SMALL FLOWS QUARTERLY

SF

Helping America's Small Communites Meet Their Wastewater Needs

PREMIER ISSUE!

Small Flows and The Small Flows Journal Unite

Small Flows

Wastewater Management

Surfaces as an Important Issue in the New Millennium

JURIED ARTICLE

Impact of Bacteria and Dosing Frequency on the Removal of Virus within Intermittently Dosed Biological Filters

NATIONAL SMALL FLOWS CLEARINGHOUSE

Winter 2000 Volume 1, Number 1

Peter Casey, NSFC Program Coordinator

On behalf of the staff at the National Small Flows Clearinghouse (NSFC), it is my pleasure to introduce you to the first edition of our new publication, the *Small Flows Quarterly*. We trust that this inaugural issue, appearing at the dawning of both a new century and a new millenium, can fulfill the promise inherent in such an auspicious beginning. You can be assured that everyone at the Clearinghouse is determined, and will work to make sure, that the momentum of such a promising start is not only maintained but increased.

As is reflected on the cover, the *Quarterly* is a consolidation of two former publications, the *Small Flows* newsletter and the *Small Flows Journal*, in a new 8 1/2 by 11-inch format, which will make reading and photocopying articles easier.

Our goal for the *Quarterly* is to continue the same type of news and feature articles that were part of the *Small Flows* newsletter, as well as one or more peer-reviewed articles per issue as appeared in the *Journal*. By combining the two publications, we are responding to many of our readers' requests for more technical content in the newsletter while at the same time providing the authors of *Journal* papers with a much wider audience on a more frequent basis. The current circulation of the *Small Flows* newsletter is approximately 43,000, while that of the *Journal* is in the vicinity of 6,000. We hope that the increased exposure for juried technical articles will attract more manuscript submissions and thus increase the depth of technological coverage.

The mission of the NSFC is to protect public health and the environment by serving as a resource center for collecting, processing, storing, and disseminating information on all aspects of wastewater in order to support the nation's small communities. The most important part of this mission is the dissemination of information. If the message doesn't get out, there isn't much point in the rest of the exercise. The most effective way to "get the message out" is through our publications–*Small Flows Quarterly* and *Pipeline*. Our fervent hope is that the *Small Flows Quarterly* will prove to be greater than the sum of its parts and be an even more effective tool in helping accomplish the NSFC's mission.

In order to be an authoritative source of information on all aspects of wastewater, we are developing a systematic set of articles on the varied and often overlapping fields involved with wastewater, from onsite to community systems. This includes collection and treatment technologies, management (which includes operation and maintenance), finance, planning, legislative and legal matters, construction, plus other topics and subsets of the aforementioned. We also will have news from the industry, articles on various wastewater topics by recognized (or possibly unrecognized) experts, columns, letters, and question and answer articles. I'm sure some readers can readily come up with other pertinent topics, and if you do, please let us know. We hope to continually shape and refine the editorial direction of the publication with input from readers.

Another concern is the title of this new publication. Most of our current readers are familiar with the term "small flows" and readily associate it with wastewater and the NSFC. Unfortunately, new audiences we would hope to reach, such as homebuilders, real estate professionals, developers, etc., do not make such a connection. In coming editions we will be asking for feedback from readers to help us choose a title that might more clearly reflect the mission of the *Quarterly*. We are sure there will be some great suggestions.

There is an old Irish proverb about starting a new venture: "making the beginning is one-third of the work." We have made the beginning, so now, with some assistance from our friends, we will get on with producing our new *Quarterly*.

From all of us at the National Small Flows Clearinghouse, please accept our best wishes for every success in the new century.

Helping America's Small Communities Meet Their Wastewater Needs

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Peter Casey, P. Eng. | NSFC Program Coordinator

Timothy Suhrer | Managing Editor

Cathleen Falvey | Associate Editor

Eric Merrill | Senior Graphic Designer
Kairi Frame | Graphic Designer

Collen Mackne | Promotions Writer/Editor

Margaret C. McKenzie | Staff Writer
Marilyn Noah | Staff Writer
Natalie Eddy | Staff Writer

Article Submissions
Small Flows Quarterly welcomes letters to the editor, articles, news items, photographs, or other materials for publication. Please address correspondence to:

Editor, *Small Flows Quarterly*
National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064
(800) 624-8301 or (304) 293-4191
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SF

JURIED ARTICLE

Impact of Bacteria and Dosing Frequency on the Removal of Virus within Intermittently Dosed Biological Filters

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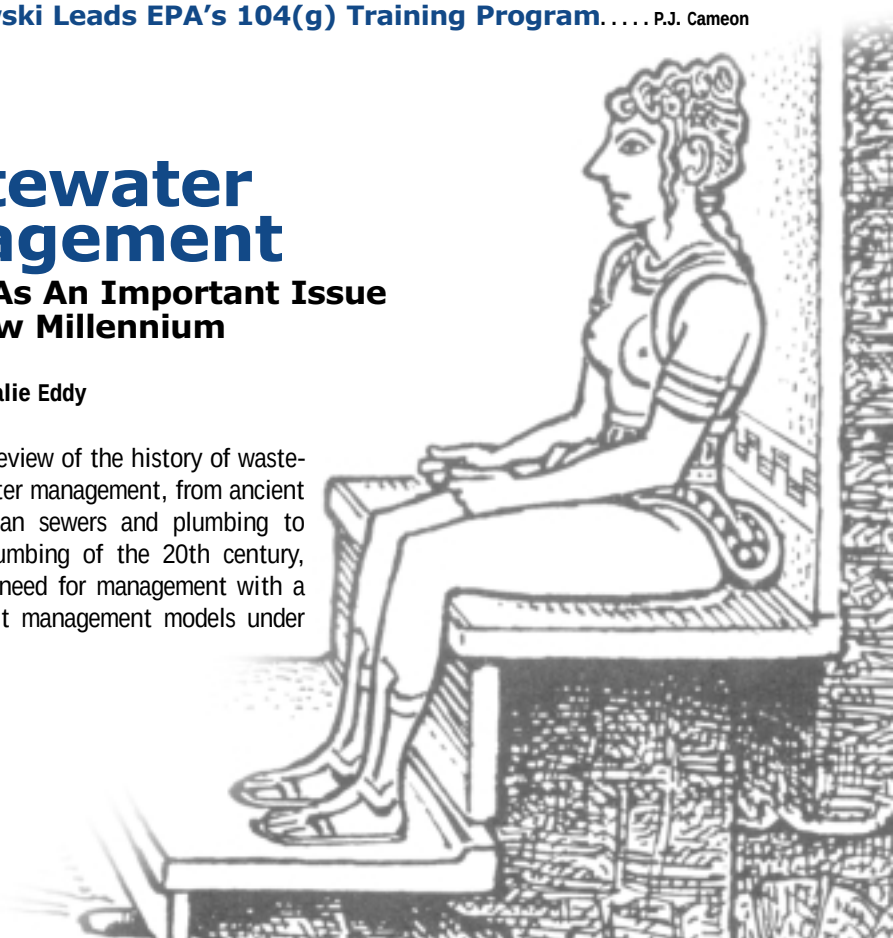
14 A review of the history of wastewater management, from ancient urban sewers and plumbing to the indoor plumbing of the 20th century, exploring the need for management with a look at current management models under development

Cover Photo: Paul Ashburn, President of Ashco-A-Corporation, Morgantown, WV, designer, manufacturer, and installer of onsite wastewater treatment systems, displays some of the tools used to manage onsite wastewater.



North Carolina Issues Flood Guidelines for Septic Tanks

Recently, in the wake of hurricane Floyd, the North Carolina Division of Environmental Health (DEH) issued the following guidelines for homeowners whose septic systems failed due to flooding:

- Avoid using the house's plumbing system if the septic tank or the drainfield is still underwater.
- Do not use the plumbing system if sewage is backing up into the house.
- Try to reduce the amount of debris entering the septic tank and plumbing systems.
- Avoid contact with the sewage from malfunctioning septic tanks—raw sewage is a public health problem and can cause disease.
- Contact your local county health department or environmental health section for information about septic system repair or construction.

Officials warned that some systems might be so damaged that repairs will be required before they will work again. Significant health problems associated with a malfunctioning septic tank are the release of untreated sewage onto the surface of the ground or in stagnant pools left behind by flooding.

While no specific rules govern the abandonment of subsurface wastewater systems, the DEH has also issued the following recommendations to ensure that sites formerly used for subsurface treatment and disposal are safe:

1. Have an approved hauler pump the sludge and scum from all tanks in the system. Remove the tanks or crush them in place. Backfill the excavation to a natural grade and establish a vegetative cover.
2. Disconnect power at the source to all electrical controls and remove all controls and panels.
3. Remove all parts of the drainfield on the ground surface (such as valves, valve boxes, and risers), backfill the area to a natural grade, and establish a vegetative cover.
4. Coat all surface areas exposed to effluent with hydrated lime and establish a vegetative cover.
5. Wait at least 18 months before using the disposal area for gardening or construction.

Photo courtesy of Patrick Schneider/The Charlotte Observer

The DEH stated that these recommendations should be included in any sewer use ordinance whenever public wastewater service is extended to facilities with existing onsite wastewater systems.

For more information about how to deal with failed septic tank systems, contact your local health department.

Utah State University Plans Formation of State Onsite Wastewater Association

The Utah Water Research Laboratory at Utah State University is considering forming a Utah onsite wastewater state association. "This association would benefit individuals involved in land development, real estate, system design, installation, inspection, regulation, percolation testing, pumping service, repair, site evaluation, education, manufacturing, and sales. It would also help municipal authorities, homeowners, elected officials, and any others with a stake in Utah onsite wastewater treatment systems," said Steve Iverson, manager of the Utah Water Research Laboratory.

Many states have such an organization and have found them to be helpful in identifying their onsite wastewater needs, Iverson said. He said that participation in this association could promote and advance the onsite wastewater efforts in Utah by

- uniting onsite wastewater treatment professionals, homeowners, municipal and elected officials, and others with a stake in onsite wastewater treatment;
- providing timely input to Utah policy makers concerning onsite wastewater regulations;
- providing a forum for open dialogue of ideas, information, and technology transfer;
- keeping members informed about advances in onsite wastewater treatment;
- promoting opportunities for professional onsite wastewater practitioners and other audiences to upgrade skills, elevate performance, and increase their knowledge and awareness of onsite wastewater issues through training, certification, and education; and
- investigating and evaluating conventional and alternative onsite wastewater systems, methods, and materials for use in Utah.

For more information, contact Iverson at (435) 797-3159 or e-mail *siverson@cc.usu.edu.*

Calendar of Events

FEBRUARY

Texas Wetlands Conference
CLE International
February 3–4
Austin, Texas
(800) 873-7130

Tools for Urban Water Resource Management & Protection
Chicago Botanic Garden; U.S. Environmental Protection Agency Office of Wastewater Management Region 5; Chicago, Illinois Northeastern Illinois Planning Commission; and Water Environment Federation
February 7–10
Chicago, Illinois

Third Southwest On-Site Wastewater Conference and Exhibit
Arizona County Directors of Environmental Health Services Association
February 16–17
Laughlin, Nevada
Dan Smith (520) 226-2713

2000 Pumper and Cleaner Environmental Expo International
COLE Inc.
February 16–19
Nashville, Tennessee
(800) 257-7222

Introductory & Advanced Hands-On Workshops on SWMM, PCSWMM, WASP, EPANET, Modeling for Stormwater & Urban Water System Impacts & Analysis
Computational Hydraulics Int.
February 21–23
Toronto, Canada
Lyn James (519) 767-0197
(519) 767-2770 (Fax)

Operation, Maintenance, and Management of Wastewater Pump & Life Stations
University of Nevada, Las Vegas, Howard R. Hughes College of Engineering & Professional Development Center Division of Continuing Education
February 23–25
Las Vegas, Nevada
(702) 895-3707
(702) 895-3394 (Fax)

Stormwater & Urban Water Systems Modeling Conference
American Society of Civil Engineers, Urban Water Resources Research Council, the American Water Resources Association (AWRA), the U.S. Environmental Protection Agency, the Ontario Ministry of Environment & Energy, the Society of Canadian Civil Engineers, and Conservation Ontario
February 24-25
Toronto, Canada
Lyn James (519) 767-0197
(519) 767-2770 (Fax)

14th Annual Residuals and Biosolids Management Conference
Water Environment Federation
February 27–March 1
Boston, Massachusetts
(800) 666-0206 or (703) 684-2452
emailconfinfo@wef.org

Texas On-Site Wastewater Treatment Research Council's Eighth Annual Conference
Texas On-Site Wastewater Treatment Research Council
February 28–March 1
Waco Convention Center,
Waco, Texas
(512) 239-6333 or (512) 239-4799

MARCH

Hawaii Water Environment Association Conference
Hawaii Water Environment Association
March 3–4
Honolulu, Hawaii
(808) 842-1133

Remodel America Exposition
National Association of Home Builders
March 16–18
Las Vegas, Nevada
(703) 312-9121

The Journal of Light Construction
The Journal of Light Construction
March 24-25
Baltimore, Maryland
Larry Rice (802) 244-9987

WasteX2000
Autodromo Hermanos Rodriguez
March 29–31
Mexico City, Mexico
(713) 735-3290

March Short Courses

PACS (Professional Analytical & Consulting Services, Inc)

COURSE/DATE	LEVEL
Mass Spectral	
March 11–13	Basic
Interpretation	
March 17–19	Advanced
ICP-Mass Spectrometry	
March 17–18	
LC-MS (2 courses)	
March 17–18	
Atomic Spectroscopy	
March 14–15	Basic
AA/GFAA/ICP	
March 15–16	Advanced
Chromatography	
(THIN LAYER)	March 12
(5 courses) HPLC:SFT	
March 10–11	
Gas Chromatography	
March 9–11	
Capillary Electrophoresis	
March 10–11	
Quality Assurance of Chemical Measurements	
March 13–14	
Statistical Process Control	
March 15–16	
ISO-9000 & ISO-14000	
March 16–17	
Quality Assurance of Environmental Measurements	
March 13–15	
Environmental Data Validation	
March 15–16	
Environmental Site Assessments	
March 16–17	
Environmental Laws & Compliance	
March 17	
Toxicology 4 Non-Toxicologist	
March 28	
OSHA Lab Safety	
March 27	

Short Courses will be held in New Orleans, Louisiana

Call: Barbara Sherman at 800-367-2587 for more information

APRIL

No Dig 2000
North American Society for Trenchless Technology
April 9–12
Anaheim, California
(800) 960-2242

National Safety Council Section Meeting
The Research,Development & Emerging Technologies Section
April 9–12
Argonne National Laboratory
Argonne, Illinois
Gerry DeFalco (800) 621-7615
ext. 2381

NWQMC National Monitoring Conference 2000
National Water Quality Monitoring Council
April 25–27
Austin, Texas
(405) 516-4972

Environmental Laws Conference
Professional Analytical & Consulting Services, Inc.
April 27–28
Pittsburgh, Pennsylvania
(724) 457-6576 or (800) 367-2587

AWRA Spring Specialty International Conference: "Water Resources in Extreme Environments"
April 30–May 4
By: AWRA
Anchorage, Alaska
Doug Kane (907) 474-7808

MAY

Regional Water Planning Conference
The National Ground Water Association
May 17–18
Austin, Texas
Bob Masters (800) 551-7379
rmaste@ngwa.org

If your organization is sponsoring an event that you would like to have promoted in this calendar, please send information to the Small Flows Quarterly, Attn. Annette Judy, National Small Flows Clearinghouse, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-6064. Or contact Ms. Judy at (800) 624-8301 or (304) 293-4191, or via e-mail at *ajudy@wvu.edu*.

ASCE Creates New Environmental and Water Resources Institute

The American Society of Civil Engineers (ASCE) has announced the creation of the semi-autonomous Environmental and Water Resources Institute (EWRI). The institute's goal is to provide an inclusive forum for all related professionals in the water and environmental field.

"Creating the EWRI enables us to have the best of both worlds," said EWRI President Conrad Keyes, Jr. "We can open the door to related professionals and organizations, and be more flexible and responsive to members' needs, plus benefit from ASCE's economy of scale and wealth of existing systems and resources."

EWRI offers individuals and organizations the opportunity to network with other professionals and to participate in technical activities, conferences, and the development of standards and manuals. Members also receive discounts on EWRI journals and other publications, conferences, and continuing education courses.

For more information about EWRI, see their Web site at *http://www.ewrinstitute.org* or call EWRI at (800) 548-2723, ext. 6380.

NPDES Permit Applications Revised

EPA issued a final rule that amends permit application requirements and application forms for publicly owned treatment works (POTW) and other treatment works treating domestic sewage. This rule consolidates POTW application requirements, including information regarding toxics monitoring, whole effluent toxicity testing, industrial user and hazardous waste contributions, and sewer collection system overflows. The most significant revisions require toxic monitoring by major POTWs (and other pretreatment POTWs) and limited pollutant monitoring by minor POTWs.

For the Federal Register notice, visit *http://www.epa.gov/fedrgstr/EPAWATER/1999/August/Day-04/w18866.htm* on the Internet.

ETV Update

For the past year, NSF International (formerly the National Sanitation Foundation) has been working in conjunction with other organizations to assist the U.S. Environmental Protection Agency (EPA) in developing their Environmental Technology Verification (ETV) Program. NSF's partners in this project include the National Small Flows Clearinghouse (NSFC), the National Onsite Wastewater Recycling Association (NOWRA), and the National Environmental Health Association (NEHA). NSF, its partners, and the EPA Urban Watershed Management Branch, Edison, New Jersey, are developing a pilot program for verifying commercially available technologies for source water protection (SWP).

The goal of the SWP pilot is to provide potential buyers and regulators with independent evaluations of commercially available technologies, designed to prevent contamination of ground and surface waters, that they may purchase or permit respectively. The technologies will be verified against technically sound protocols, following appropriate quality assurance/quality control to develop objective, reliable data.

Efforts in the decentralized wastewater area are well underway. Three technology panels have been formed, focusing on high-strength/commercial wastewater treatment, nutrient reduction technologies, and package wastewater treatment plants. A fourth technology panel, which focuses on disinfection technologies, has been finalized.

High-Strength/Commercial Wastewater Treatment Panel

The high-strength/commercial wastewater treatment panel is working with Ayres Associates of Madison, Wisconsin, to develop a test protocol. The final draft protocol is complete and will be available for review and comment by interested stakeholders. It will be posted on both the EPA/ETV and NSF Web sites. Notice will also be sent to everyone on the SWP mailing list. Anyone interested in being added to the mailing list may contact Thomas Stevens, NSF pilot manager, at (734) 769-5347 or *stevenst@nsf.org*.

Nutrient Reduction Technology Panel

NSF is working in conjunction with the Environmental Technology Evaluation Center (EvTEC), another of the 12 ETV pilots, to develop a joint protocol for nutrient reduction/denitrification. EvTEC is an innovative environmental technology center for the American Society of Civil Engineers' (ASCE) Civil Engineering Research Foundation (CERF). The Pennsylvania Department of Environmental Protection has contracted with EvTEC to develop a protocol for denitrification systems. Technology panels from the SWP pilot and the EvTEC pilot are working with Gilmore & Associates of New Britain, Pennsylvania, to develop the protocol. The first draft was recently completed.

Package Wastewater Treatment Plant Technology Panel

The package wastewater treatment plant technology panel is focusing on technologies treating domestic strength wastewater in non-residential applications. The draft protocol is currently under development.

Other ETV News

The Decentralized Wastewater Stakeholder Advisory Group met on November 2 at Jekyll Island, Georgia, prior to NOWRA's annual meeting. Members investigated other technology areas to be considered by the pilot, policy issues, and pilot procedures.

NSF will conduct meetings for the vendors of various technologies to explain how the ETV process works and to stimulate interest in the verification process. The NSFC will play an active role in identifying technology vendors as well as other experts to join the technology panels or give peer reviews of documents.

The National Drinking Water Clearinghouse, one of the NSFC's sister organizations, has been involved with the ETV Package Drinking Water Treatment System Pilot, which helps small communities more easily comply with the 1996 Safe Drinking Water Act. Emphasis is placed on performance and cost of specific vendor systems used in treating common small drinking water system problems, such as disinfection byproducts, particulates, and microbials.

Bruce Bartley, NSF project manager, says there are 18 verifications underway. Of the nine protocols covering 38 technologies, 98 percent are nearly complete. Currently, NSF is looking into what private funds may be available for protocol verification.

For more information about the ETV program, contact Stevens at NSF International at (734) 769-5347 or *stevenst@nsf.org*.

Wastewater on the Web

National Association of Sewer Service Companies (NASSCO)
http://www.nassco.org

Nassco is an organization that strives to distribute the information and tools needed to succeed in the waste collection system business. Its members—individuals and companies spanning the United States, Canada and New Zealand—are listed along with the services each provide. The site also makes it easy for someone to see which members offer certain products, such as pipeliners, pumps, or cleaning tools, in one orderly chart. There is a description of NASSCO's three publications: the *Manual of Practices for Rehabilitation Methods*, *The Specifications Guidelines*, and *The Inspectors Handbook*, along with an online order form.

Small Business Environmental Home Page
http://www.smallbiz-enviroweb.com

This Web site provides small business with access to abundant information on compliance and pollution prevention through its long list of publications and videos, as well as links to many other sources of information. There are summaries of laws, such as the Toxic Substances and Control Act, with a handy checklist and regulatory calendar to help keep any small business compliant. The many links at this site include state and federal funding agencies, national compliance assistance centers, small business assistance programs, ISO 14000, and more. The site also provides summaries of small business initiatives, policies, and laws, such as the Small Business Regulatory Enforcement Act of 1996, including recent U.S. Environmental Protection Agency fact sheets.

Massachusetts Department of Environmental Protection (MADEP)
http://www.state.ma.us/dep/

The MADEP makes it very easy to find information on a wide range of environmental issues, from waste site cleanup to the Source Water Assessment Program (SWAP). The site supplies the reader with access to enforcement policies and a long list of permit applications, such as an Approval to Conduct Pilot Study permit. There is information about the new Massachusetts enhanced emissions and safety test, including a descriptive diagram. It is also simple to locate regional offices and energy facilities anywhere in the state via site maps. Other features include an events calendar, MADEP newsletters and press releases, and employment information.

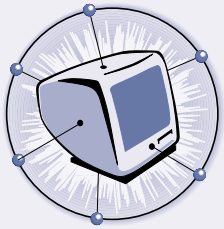
Federal Emergency Management Agency (FEMA)
http://www.fema.gov/mit/

FEMA helps people before and after disasters, such as hurricanes, floods, or fires. Although the organization is concerned with all aspects of disaster relief, the site offers many examples illustrating FEMA's capacity to solve or prevent wastewater problems. FEMA has funded many projects, such as preventing wastewater spills in the event of a disaster, and has provided assistance to damaged wastewater treatment plants all over the country.

American Water Resources Association (AWRA)
http://www.awra.org

AWRA's Web site does everything it can to keep people actively involved in its organization. Anyone interested in the water resource and management industry can easily join AWRA via the online membership application, and existing members can just as easily renew their memberships. It is easy to learn who is who from the site's extensive information on the different kinds of members, committees, board and staff members, and state and student chapter links.

The benefits of AWRA membership go beyond voting rights: certain members may receive both of the organization's publications, the *Journal of the American Water Resources Association*, and the newest publication, *Water Resources IMPACT*. Information also is provided about each of these publications. Members may add their names to the "positions wanted" page and search available positions. AWRA's site presents the minutes of recent meetings, as well as the organization's new proposed bylaws and upcoming conferences. SF



Web Sites Cover New & Innovative Environmental Technologies

EPA Information

Technology Innovation Office (TIO)
http://www.epa.gov/tio/

The TIO promotes new technologies for the treatment of contaminated waste sites, soils, and groundwater.

Government Information

Federal Laboratory Consortium for Technology Transfer
http://www.fedlabs.org/

This nationwide network of federal laboratories provides a forum to develop strategies and opportunities for linking federal technologies, research and development, and expertise with the marketplace.

International Information

Center for the Analysis and Dissemination of Demonstrated Energy Technologies (CADDET)
http://CADDET-EE.ORG/

CADDET collects, analyzes, and disseminates information on new energy-saving technologies that have been effectively used in industries, buildings, transportation, utilities and agriculture.

Business/Corporate/ Nonprofit Information

Environmental Technology Evaluation Center (EvTEC), Civil Engineering Research Foundation (CERF)
http://www.cenet.org/evtec/

EvTEC, in cooperation with the U.S. EPA, was set up to accelerate the adoption of environmental technologies into practice.

Global Network of Environment and Technology (GNET)
http://www.gnet.org/

GNET contains information resources on environmental news, innovative environmental technologies, government environmental technology programs, contracting opportunities, market assessments, market information, current events and other material of interest to the environmental technology community.

Virginia Toughens Regulations for Installing Septic Systems

Virginia has altered regulations for installing septic systems in areas that are not served by sewers, a change that supporters say will protect public health but that critics contend will increase residential development costs.

The new rules were published August 16 in the *Virginia Register of Regulations* and took effect October 1. They increase the required separation distance between drainfield trenches and the water table from as little as 2 inches to a minimum of 18 inches.

Land that cannot meet the requirement will need a pretreating system for household waste, which will increase the cost of installation, as well as add maintenance time and expense.

"The idea is to treat sewage before it's disposed of, not just dispose of it," said Dave Jordan, environmental health supervisor for the Peninsula Health District.

Most other states already require a separation of 2 feet to as much as 4 feet. Said Tricia Angoli, a technical assistant at the National Small Flows Clearinghouse, "It may seem like the state's being unfair, but what they're actually trying to do is protect people's health and to protect the environment." A shallow separation distance dumps sewage into drinking water and recreational water, she said.

When household wastewater leaves a drainfield, it works its way through the soil, which helps to cleanse it. A greater amount of soil provides more cleansing.

"It's not hard to understand that if you put raw sewage 6 inches from the water table, you don't get the separation you need," said Rick Cox, environmental health manager for the Three Rivers Health District, which includes localities in the Middle Peninsula and Northern Neck.

But Middlesex County Administrator Charles M. Culley Jr. said the change "could potentially cause many property owners to suddenly have to pay three times as much for their onsite sewage system than the current going rate for a conventional septic field." A conventional septic system costs about $3,000.

—From the Bay Journal, September 1999

New England Pollution Commission Helps Form Regional Onsite Wastewater Association

The New England Interstate Water Pollution Control Commission (NEIWPCC), in existence since 1947, is an organization devoted to improving water quality in New Hampshire, Massachusetts, Maine, Connecticut, New York, Rhode Island, and Vermont.

NEIWPCC has assisted with the formation of the Yankee Onsite Wastewater Association (YOWA), a regional affiliate of the National Onsite Wastewater Recycling Organization (NOWRA). YOWA is being formed to bring together academics, designers, inspectors, installers, pumpers, regulators, soil scientists, and suppliers in New England devoted exclusively to the onsite and decentralized wastewater industry. Information about YOWA's next meeting and bylaws are posted on the NEIWPCC Web site at *www.neiwpcc.org.*

NEIWPCC facilitates communication and cooperation among its member states through its different work groups, including the Groundwater Management Group and the On-site Sewage Disposal Group. Over the years, the organization has worked with other federal, state, and local agencies to strengthen existing water pollution control programs for the area's lakes and rivers. NEIWPCC also is involved in New England coastal waters studies and projects.

NEIWPCC's education and training programs reach elementary school children as young as third grade with such programs as Mr. & Mrs. Fish Water Conservation and Reuse Program, which teaches children about wastewater treatment. The organization also conducts workshops to educate teachers, and, along with the New England Environment Association, forms speaker's bureaus to lecture at schools and in local communities.

In 1969, NEIWPCC established the New England Interstate Environmental Training Center (NEIETC), located on the campus of Southern Maine Technical College, to provide the region with wastewater-related training and educational opportunities. The two organizations work together on many water quality improvement efforts.

NEIWPCC produces several publications, including *L.U.S.T.Line* and *Water Connection. L.U.S.T.Line* is a national bulletin about underground storage tanks (USTs) that provides information about programs geared toward controlling leaking USTs (LUSTs). Regulators, consultants, contractors, and tank owners can stay up-to-date on state and federal UST, LUST, and state clean-up fund issues and activities, recommendations, and prevention technologies through *L.U.S.T.Line*.

The organization also addresses on-going and emerging issues related to water and its interaction with air, land, and living organisms in its newsletter, *Water Connection*. This newsletter is free for subscribers. Another free publication is the *New England Interstate Environmental Information Catalogue*, which includes all of NEIWPCC's publications, slide/tape shows, videos, and training materials.

For more information about the NEIWPCC or YOWA, call (978) 323-7929, fax (978) 323-7919, or email *mail@neiwpcc.org.*

Compliance Date Approaches for Georgia Onsite Regulations

As of February 20, 2000, single-compartment septic tanks will no longer be legal in the state of Georgia. Legislation in 1998 gave manufacturers and installers one year to prepare for compliance, after which only two-compartment septic tanks can be installed. Last year, a number of one-year variances were issued, and those will expire February 20.

On that same date in 2000, all inspection personnel, installers, and pumpers in Georgia must have passed a certification exam. Inspectors will be classed as either Level I (systems inspector) or Level II (site evaluator). Pumpers at Level I will be certified to dispose waste at approved wastewater disposal sites, and those at Level II will be certified for land application.

The state administers these examinations through the 19 health districts and also offers advanced modules in commercial contracting, drip irrigation, and mound/fill absorption fields.

The new legislation also creates the following three review boards that regulate, on a statewide level, activities that in other states are handled on a county level to create statewide uniformity:

- The Technical Review Committee, which held its organizational meeting on July 1, 1999, was formed to make recommendations to the Department of Human Resources (DHR) regarding the approval of new systems. It will also assist the DHR with developing and revising standards and guidelines for new technology. It will assist with the adoption of periodic updates to the *Manual for On-Site Sewage Management Systems*, and serve as the final authority in contested interpretation issues of the *Rules for On-Site Sewage Management Systems* and the *Manual for On-site Sewage Management Systems*.
- The Certification Review Board is responsible for certifying persons who install, inspect, and pump septic tanks and maintain or repair onsite sewage management systems.
- The Soil Classifier Certification Board is responsible for certification, oversight, performance assessment and re-certification of persons who classify soils for onsite sewage management systems. These individuals, in effect, replace the percolation test usually conducted across the country in site evaluations.

For more information about Georgia's onsite wastewater regulations, visit the DHR's Web site at *http://www.ph.dhr.state.ga.us/org/envhealth.htm* or call (404) 657-6534. SF

EPA Seeks Field Testers for New Manual

The U.S. Environmental Protection Agency (EPA) is looking for local governmental agencies of small communities (fewer than 50,000 residents) to field test a new manual and provide comments and share experiences to make the manual more useful.

Techniques for Tracking, Evaluating, and Reporting the Implementation of Nonpoint Source Control Measures is a new manual published by the EPA's Nonpoint Source Pollution Control Branch. The purpose of the manual is to assist governmental officials in designing a program to track the installation, operation, and maintenance of best management practices (BMP) in water pollution control.

This manual is designed to help communities determine whether their goals, standards, and management practices are being used as designed. It provides statistical approaches needed to properly collect and analyze data in an accurate and defensible manner. Chapters contain information about

- methods to inventory BMP implementation,
- sampling design and variable selection,
- methods for evaluating data,
- conducting an evaluation, and
- presenting results.

While this manual does not address monitoring the effectiveness of individual BMPs, it will help design a BMP implementation monitoring program for a savings in time and money. It will help establish a statistical sampling of representative BMPs to yield conclusions at a lower cost than that of a comprehensive inventory.

The EPA will provide technical guidance and other support. To download the guidance manual, visit *www.epa.gov/owow/info/PubList/publist4.html* (under the technical documents section). For further information, contact Rod Frederick, EPA, Nonpoint Source Pollution Control Branch, 401 M Street, SW, Washington, D.C. 20460, or call (202) 260-7054. You also may e-mail *Frederick.Rod@epa.gov*. SF

EPA Announces Class V Injection Well Final Rule

The U.S. Environmental Protection Agency (EPA) recently announced new requirements to protect public health and the environment by eliminating or reducing injection of wastes from large capacity cesspools and motor vehicle waste disposal wells, regulated by EPA as Class V underground injection wells. Class V injection wells are typically shallow disposal systems that are used to place a variety of fluids below the land surface. New motor vehicle waste disposal wells and new large cesspools are now prohibited nationwide as of April 2000. Existing motor vehicle waste disposal wells, which typically receive waste fluids from vehicle maintenance and repair in unsewered areas, will be phased out through January 2007. Existing cesspools will be phased out nationwide by April 2005.

For more information about the rule and underground injection wells, visit the EPA Web site at *http://www.epa.gov/safewater/uic.html*. SF

Onsite Wastewater Management at the Start of the New Millennium

CONTRIBUTING WRITER

Jim Kreissl

Editor's Note: Jim Kreissl is an environmental engineer with the U.S. Environmental Protection Agency's (EPA) National Risk Management Research Laboratory of the Center for Environmental Research Information in Cincinnati, Ohio. He has been the small community wastewater systems expert for the EPA's Office of Research and Development for nearly 30 years.

Onsite wastewater systems have been serving the rural sectors of our society for nearly the entire 20th century. Until the middle of the century, there were fewer than five million onsite systems, and these were generally located in the rural towns and villages that dotted the American landscape.

After World War II, the U.S. Public Health Service began a major research effort on onsite technology, co-funded by the Federal Security Agency (later called the Federal Housing and Home Finance Agency). It was spurred by a tremendous housing demand, a lack of consistent state and local codes, and the absence of factual information upon which federal mortgage insurance could be based (1).

This period of significant onsite wastewater research continued for approximately three decades, culminating in 1980 when the U.S. Environmental Protection Agency (EPA) published its design manual, *Onsite Wastewater Treatment and Disposal Systems* (2). The two decades since its publication have been marked by many advances in allied fields, such as source water protection, and by watershed approaches to ecosystem protection and restoration that recognize the usually dominant role nonpoint or wet weather flows play in determining water quality. These advances once again put the spotlight on onsite systems because they are an important and sometimes major source of critical pollutants (usually nutrients) within some watersheds.

Improved Databases Needed

Planners and decision makers are unable to get the technically based answers they need to ensure that local projects provide the most cost-effective service to the community. What are the shortcomings in the onsite system databases? Most advances in onsite technology have been accomplished through private sector efforts without sufficient or quantitative evaluation by properly designed third-party studies that are quality assured. Such efforts by reputable, neutral institutions are necessary to provide potential users with confidence in their application. Without them, subsequent rules for application become more political than technical and the risk of failure increases accordingly.

Centralized Management Is the Key

The concept of centralized management of decentralized systems has become the mantra of the onsite industry in the last few years as a recognition of the need to protect our ecosystems and watersheds from any negative impacts from household wastewater treated by and discharged from these systems. The level of management required is inherent to the specific technologies chosen, but it should be sufficient to replicate the homeowner-management relationship that has existed for many years in centralized wastewater systems that have served the urban areas of the country for the last century.

Effective management involves much more than merely inspecting, pumping, or repairing onsite treatment systems. It also includes monitoring the receiving environment; planning future development; overseeing design, construction, and repair activities; enforcing regulations; reporting to county and/or state oversight agencies; financial self-sufficiency; and outreach or public education programs for the affected population to ensure their involvement and support.

Our knowledge of the best ways to accomplish effective management under the myriad of local conditions where it can and should be applied is incomplete, given that the best study of centralized management initiation, planning, and implementation was performed in 1982 (3). There are several projects in the U.S., most funded through EPA, that are endeavoring to document the best attempts to provide centralized management for onsite systems. There is far less funding, however, for quality-assured, application-realistic, third-party technology

evaluations, and almost no studies of what happens to key contaminants when they are introduced to the environment at a particular place, especially soil. Without expanding our knowledge in all three areas, it is difficult to implement true performance-based standards, which generally require centralized management to be successful. Centralized management, however, does not require a complete knowledge base to be effectively employed.

Barriers to Management

Ideally, the customers served by such a management program would pay a monthly fee for services. The management program would be responsible to the overseeing governmental agency (likely the state), and would be responsible for the day-to-day compliance with state environmental laws. In many states, this type of management is not possible, owing to a lack of enabling legislation.

Another major impediment is the present makeup of state agencies responsible for wastewater systems. Most states are divided between an environmental agency that is responsible for centralized systems through the National Pollutant Discharge Elimination System (NPDES) permit program and the local health departments who are responsible for onsite systems. Until this situation is remediated, there cannot be an optimum utilization of all the wastewater management tools available for local use.

Other major impediments to full use of all alternatives are the inadequate training of wastewater professionals in onsite system capability, inflexible engineering standards of practice and fee structures, and bias built into existing grant and loan vehicles. Add to this the unflattering image among the general public created by the present system of homeowner-managed onsite wastewater systems designed in accordance with inflexible prescriptive codes (4).

Until these barriers are overcome, onsite wastewater treatment systems will not be considered capable of providing the same level of service as a centrally sewered system with a single treatment system prior to discharge to the environment. This is in spite of the fact that well-designed onsite and cluster systems with centralized management can perform at least as well in terms of environmental protection and even have many advantages in terms of aquifer recharge, energy conservation, and reuse potential.

How to Make the Changes

The final issue is how the needed changes (identified above) will be made. As with all meaningful change, the process must start with local citizens, merchants, and other stakeholders. Those who believe that change must or will come from the federal level will once again be either disappointed or a lot older when something happens.

There are local communities that are forced year after year to pay two to four times more than should be necessary for an often-unmanageable wastewater service. This scenario can be avoided by allowing communities to consider the entire mix of appropriate technologies and reuse opportunities from the outset. (Small community systems are responsible for more than 90 percent of all NPDES violations.) These communities must demand that they be allowed to use the entire range of affordable and effective alternatives. They need to join other rural communities and counties and demand that their legislative representatives do what is necessary to stop wasting scarce local funds on unnecessary and prohibitively expensive infrastructure.

Organizations such as the National Association of Counties, National Association of Towns and Townships, Council of State Community Development Agencies, International City/County Management Association, U. S. Conference of Mayors, and the National League of Cities can assist. When equally effective or superior solutions are not considered because an engineer is unschooled in the technologies, local leaders and citizens are unaware of possible solutions, and regulatory agencies are legally unable to even consider options, people need to create the momentum to change the system.

As the new millennium begins, the present paradigm for small community wastewater systems is wanting, owing to the use of inappropriate technologies that waste precious local resources and produce marginal results. A new paradigm has been identified, but there are barriers that impede its adoption. These barriers must be understood and eliminated through concerted efforts by representatives of small local governments.

The long-term prognosis is, however, very good. Small communities will eventually have the flexibility to employ the most cost-effective technological solutions with appropriate management to solve wastewater problems in a way that satisfies the citizens, improves the environment, and reduces risks to both humans and the ecosystem. SF

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Letter to the Editor

Septic Additives

Dear Editor,
I am compelled to respond to your article (Summer 1999 *Small Flows*) on North Carolina State University's research titled "The Effect of Bacterial Additives on Septic Tank Performance."

I applaud Gregory H. Clark for setting up an objective and scientific protocol to measure the effects of tested additives.

Your article describes the study as "landmark." To my knowledge this is probably accurate. If there is another study that measured as many parameters using as many septic tanks, I am unaware of it. Overall commendations are in order.

There are three things about the study, however, that your readers need to recognize. First, the title of the study leaves out one extremely important word: "three." It has been estimated that there are over 1,000 additives on the market. These products come in both liquid and powder form. Some are available at retail stores and some are only available from plumbing industry professionals. Since all the products tested were liquid, obtained at a retail store and only represent a tiny fraction of the products available to the consumer, the study would be more correctly titled "The Effect of Three Bacterial Additives on Septic Tank Performance." To draw broad-based conclusions from this study would be highly unscientific.

Second, as producers of biological products for waste treatment, we have been telling people for years that with current technology it is impossible to put all of the ingredients into a liquid product that we put into our powders. Our experience is that the ingredients left out of liquids are essential to achieving top performance. It is unfortunate that no powdered products were tested.

Third, according to your article, one of the study's conclusions was that, "This study does not demonstrate any practical value from using bacterial septic tank additives." If the words, "any of the three" were inserted between "using" and "bacterial," the statement would be 100 percent accurate. As written, however, it implies that the study results apply to additives other than the three tested. To that extent the conclusion is misleading and unscientific.

Other than the above-mentioned exceptions, the study was definitely a step in the right direction, and more research using other products should be encouraged.

Sincerely,
Richard Kinzie, Vice President
Kinzie & Payne Biochemical Corp.

NODP II at Work in the Green Mountain State

SMALL FLOWS QUARTERLY EDITOR
Timothy Suhrer

The state of Vermont has been working under a grant from the National Onsite Demonstration Project's (NODP) Phase II program in an ambitious, collaborative effort to reform the way Vermont manages its onsite wastewater treatment and disposal.

The Vermont Department of Housing and Community Affairs (DHCA) spearheaded the effort, with the support of the Onsite Sewage Committee, which was formed in 1993 by the Vermont Agency of Natural Resources (ANR) as an ad hoc committee comprised of contractors, municipal officials, regulators, and other interested parties.

Vermont is the most rural state in the U.S., according to the last census, and approximately half of the households rely on individual water supply and wastewater treatment.

"Vermont does not have minimum standards applicable to all systems being constructed," said Peg Elmer, planning coordinator for the DHCA and co-chair of the Onsite Sewage Committee. "Instead, the current exemptions to state jurisdiction and lack of consistent local oversight result in up to one half of new or replacement systems being constructed with little or no review."

The NODP II project in the town of Jericho involved a heavy emphasis on public education, including the installation of effluent filters and risers for a septic tank.

Nearly half of Vermont's towns have adopted some type of local health ordinance regulating septic systems, Elmer said, but standards and enforcement vary widely. "There has been very little training available for local officials, designers, or installers for years. There are no licensing requirements for installers—anyone can install a system.

Vermont has more difficult soils than neighboring states. Having been an ocean floor in earlier glacial ages resulted in low-lying level areas of dense clay. The more mountainous areas have shallow soil on steep slopes."

All of this results in a high rate of septic system failures. Elmer estimated that one third of the systems installed each year in Vermont are replacements of failed systems.

"In a situation having untrained installers, difficult sites, and little oversight," she said, "the probability that those replacements are a good investment is low. In areas lacking local review, since the state reviews only one third of the new systems constructed, people still install 'outlaw' systems such as straight pipes to a stream or wetland, or pipes into a buried container with holes in it."

The mission of the NODP is to help communities across the U.S. protect public and environmental health by successfully demonstrating innovative and alternative onsite wastewater treatment and management systems. In August of 1998, in response to a proposal from the state of Vermont, the NODP, as part of its Phase II program, awarded a grant of $95,000, along with technical and educational assistance, to the DHCA. This was allocated to five projects located in Addison County, Windham County, the town of Warren, the town of Jericho, and the town of Hinesburg.

The Addison County project was started two years earlier with U.S. Environmental Protection Agency (EPA) funds through the Lake Champlain Management Conference. The NODP project continued monitoring of the original project's four alternative systems, provided a "tips" handout to share lessons learned on construction and maintenance beyond the information given in the industry materials, and expanded on public distribution of the results. The project was completed in September 1999.

In Windham County, the regional planning commission designed and provided broad education on alternative systems through regional seminars and developed a pilot administrative and technical assistance program for local officials. This project also was completed in September 1999.

The projects in the towns of Warren and Jericho included creation and implementation of wastewater management districts, establishment of strong regional partnerships, and public education. These projects are both ongoing.

In the town of Hinesburg, the project involved working with the Vermont State Housing Authority in a mobile home park having a history of failed septic systems. They developed an education program on proper operation and maintenance of wastewater systems, created a wastewater management model, and constructed and monitored two alternative systems serving 10 homes. This project is also still active.

Phase I of the NODP was funded by the EPA in 1993, and in 1996, the agency funded Phase II. Based on the success of Phase I, Phase II has a narrower focus, targeting environmentally sensitive areas. It also adds increased emphasis on education and training and the task of developing a database of all known onsite demonstration projects.

For further information about the Vermont project, contact Elmer at (802) 828-5220. For information about NODP II, call Clement Solomon at (800) 624-8301 or (304) 293-4191. SF

Land Use and Zoning Laws

CONTRIBUTING WRITER
Scott Fogarty

I recently had the opportunity to talk with Steve Wert, a well-known wastewater sanitarian and soil scientist who lives and works in Oregon. I wanted to ask him about the necessary steps to take in rural Oregon concerning the siting of a wastewater system in a remote location in the western Cascade Mountains. Specifically, I needed to know what the local regulations were regarding the installation of a septic tank and wastewater drainfield in an old mining camp called Jawbone Flats.

Jawbone Flats serves as an environmental learning center in the heart of the Opal Creek Wilderness Area and is owned by the Friends of Opal Creek, a local nonprofit organization. The organization had suffered a loss of two cabins to fire the previous year and was interested in rebuilding the facilities with upgraded wastewater treatment. After Steve's initial visit to the remote location, he said I would first need to look at the land use planning laws for the state and county to see if we would be allowed to dispose of the effluent onsite. He thought this might be a problem as Oregon has very strict laws regarding land use.

Land use planning is a generic term used to describe restrictive measures such as zoning, control of real estate development and use, and environmental impact studies. Many states have land use planning laws, which are implemented by local zoning and land use ordinances. Often these ordinances govern the ability to build new structures or expand existing dwellings, thus affecting the type, size, and location of onsite wastewater treatment. It stands to reason that looking at land use laws and ordinances are among the first steps in wastewater treatment planning.

Land use laws are typically mandated at the state level in legislation designed to regulate land use planning. Each state has its own land use laws which, depending on where you live, can be very restrictive or very liberal. These laws are in place for both human health and environmental health purposes and are designed to protect citizens, wildlife, habitat, and water quality.

Oregon's land use laws prohibit using lands designated as resource lands to aid in the development of urban uses. This prevents community wastewater systems from being placed on suitable soils that occur on parcels zoned agricultural or forestry. Also, there are minimum lot sizes in various zones. If a parcel is below the minimum, it can be very difficult to obtain a building permit.

Zoning laws are primarily enforced at the county level and range from commercial, to residential, to agricultural, and vary in different geographical areas. Additionally, most states have laws that restrict the use of land for scenic, environmental, or recreational purposes. Zoning, which divides land into specific areas (zones), regulates the use and physical dimensions (e.g., setbacks from water bodies, lot boundaries, and building size) within each specific zone (e.g., residential, industrial, commercial, or parkland). It is important to consider these restrictions before moving forward with plans.

After many phone calls and much research, time, and help from Steve, we were able to get approval from county wastewater officials for the siting of a bottomless sand filter. We had the additional task of working with the State Division of Natural Resources who regulate and control activities in the designated wild and scenic Little North Santiam Watershed.

This project in particular demonstrates the importance of working with county and state officials at the outset of any projected changes in your onsite wastewater treatment system. It is imperative that planning department staff members, sanitarians, and commissioners are kept informed throughout the entire process, from design to installation. This inclusion will enable the decision makers to know every detail of proposed treatment as the project is undertaken. It will pay off in the long run in savings of time, and money.

SF
Land use laws are typically mandated at the state level in legislation designed to regulate land use planning. These laws are in place for both human health and environmental health purposes and are designed to protect citizens, wildlife, habitat, and water quality.

Scott Fogarty is an environmental attorney in Mill City, Oregon, and the executive director of the Friends of Opal Creek, a nonprofit organization that works to educate the public and maintain the natural and cultural values of the Opal Creek Wilderness and Scenic Recreation Area. He also has worked with the National Small Flows Clearinghouse and the National Onsite Demonstration Project.

Scott Fogarty, Executive Director, Friends of Opal Creek

If you would like more information about this project or the Friends of Opal Creek, contact Fogarty at (503) 897-2921, send e-mail to *scottf@wvi.com*, or visit the organization's Web site at http://*www.opalcreek.org*. SF

Wastewater Management

Surfaces as an Important Issue in the New Millennium

STAFF WRITER
Natalie Eddy

The idea of wastewater management is as old as man himself.

Simply put, man has struggled through the ages with the problem of what to do with his waste. The painstaking efforts of plumbers past is evidenced by the ancient drains, grandiose palaces, and bath houses of the Minoan civilization some 4,000 years ago.

Man knew instinctively, even in his earliest existence, the importance of allowing animal and human waste to go downstream, yielding to the natural flow of things. He may not have known all of the consequences, but he surely found the prospect of harvesting drinking water from the same area of the stream used for waste distasteful.

Now, in the dawning of a new century, wastewater management is still an issue in the forefront. As our ancestors sought to answer that eternal question, we, in a more sophisticated manner today, are still trying to figure out the best way to manage our waste.

What Is Wastewater Management?

Imagine that you are opening a new business. It is a considerable investment. You have put a lot of time and hard-earned money into it. Would you open your new store without a long-term plan, having no control over future sales or purchasing?

Although this question may seem rudimentary, in many parts of the country the onsite wastewater treatment industry has been functioning just this way, without a long-term plan or management program.

The dictionary defines management as "the act, manner, or practice of managing, supervising, or controlling." Whether you spend millions or thousands of dollars, or whether the system is part of a public works project or an individual septic tank, there should be some entity responsible for the overall consequences and direction.

Most communities already manage their onsite systems to some extent through regulation. But the term "management" as it is used today implies a broader definition.

In other words, wastewater systems, particularly onsite systems, need to be managed or controlled, not just technologically, but with a broad concept connecting individuals, communities, local officials, and regulatory agencies if failures and malfunctions are to be avoided.

Why Is Management Important?

Trends and numbers speak volumes about the need for onsite wastewater management today.

As we enter the new millennium, population growth is moving more and more homeowners into suburban areas, many relying on onsite wastewater treatment and disposal. The majority of homes in rural America already rely solely on onsite systems.

Approximately one fourth of the estimated 109 million housing units in the United

States are served with septic tanks or cesspools, according to a 1995 American Housing Survey (AHS). During that year alone, more than 2.5 million septic tanks in America were reported as malfunctioning (or as having a total breakdown of the system).

Graham Knowles of the National Small Flows Clearinghouse's (NSFC) National Onsite Demonstration Project (NODP) authored a report titled "Septic Stats, An Overview," based on the AHS data (1). In the report, he combines U.S. Department of Commerce Bureau of Census statistics with the AHS data to establish septic tank trends.

Knowles' report projects that by the year 2025 there will be 40 million housing units with septic tanks. If the current trend continues, that could mean as many as 4 million septic systems could be malfunctioning by 2025.

If this projection becomes a reality, the necessity for greater control through management programs should be self-evident.

Many people are familiar with the early 1900 image of a splintered, wooden shed, usually with one door and a hole in the floor, as the rural family's outhouse. Chamber pots were dumped outside or in the privy.

After the 1930s when electricity and gas became available in rural areas, the need for onsite treatment arose because of the increased volume of liquids in the wastewater, Casey said.

"Once farmhouses got electricity and indoor plumbing and the conveniences of the large cities, the flows became too great and caused problems," Casey added. "Suddenly, there was running water in the house, making way for baths, showers, and flush toilets.

Cesspools were the earliest form of onsite system in response to increased water use. They were usually just a large, covered hole dug in an inaccessible area.

"With the move to the suburbs in the 1940s, we saw dense housing units trying to use all this water on half-acre

As In Olden Times

Turning the clock back to study how wastewater systems evolved and how management programs have fared throughout the years can be a useful tool.

Close to 4,000 years ago, approximately 1700 B.C., the Minoan Palace of Knossos on the isle of Crete featured four separate drainage systems that emptied into great sewers constructed of stone. The palace latrine was the world's first flushing toilet with a wooden seat and a small reservoir of water (2).

From 3000 to 1500 B.C., early plumbers laid sewage and drainage systems. Archaeologists have discovered underground channels that remained virtually unchanged for centuries (3).

Ancient gravity sewers were developed in response to the density of populations living in close proximity or in cities, according to Peter Casey, program coordinator for the NSFC. These large central systems were actually analagous to sewers developed in the 1800s in London and other large cities.

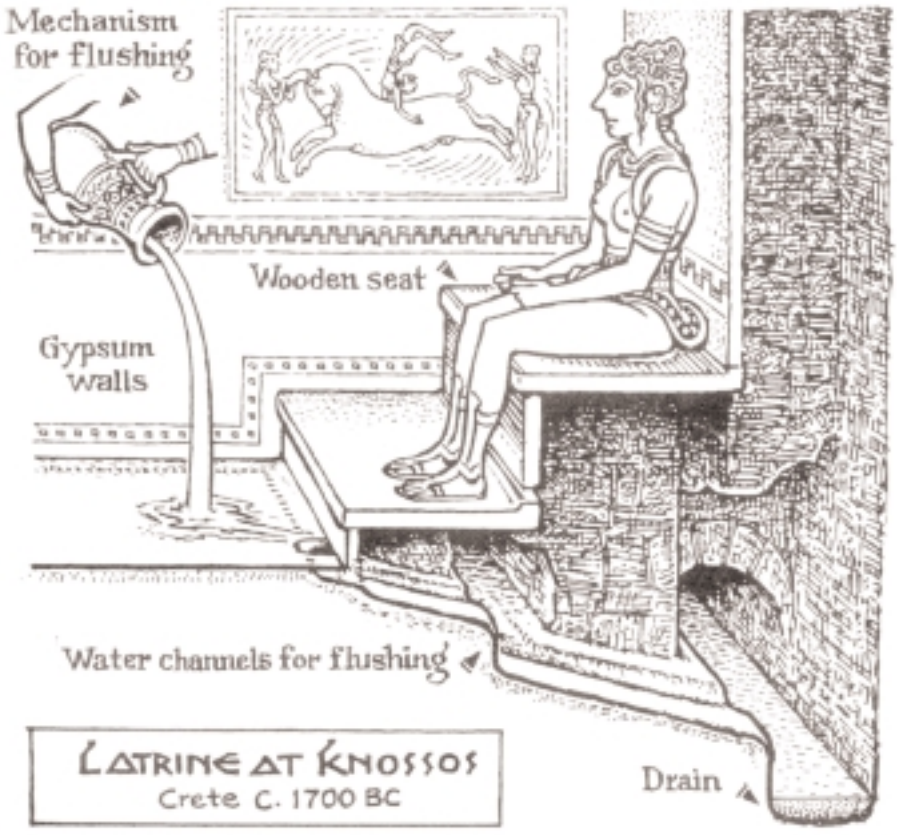
During these times, there were many outbreaks of various diseases, such as dysentery, cholera, infectious hepatitis, typhoid and paratyphoid, and various other types of diarrhea.

"The biggest health benefit of the 20th century was brought about by the purification of drinking water and treatment of wastewater," Casey added. "It increased life expectancies and had a tremendous impact on man's health and survival."

Casey said in 1870, the average person could expect to live to be 40 years old. By 1900, that age climbed to 47 with steady increases throughout the decades since. Today, the average person in a developed country can expect to live into his or her 70s or beyond.

According to a 1997 U.S. Environmental Protection Agency (EPA) document, onsite wastewater systems have been around since the mid-1800s (4).

"In rural areas during the mid-1800s to the early 1900s, sanitation was not a problem because the water supply was hand carried or pumped. No water was required for the privy," Casey said. "If it became full, they would simply cover it and dig a new privy."



The Queen's chamber (above) in the Minoan palace of Minos, at Knossos, contains the earliest known flush toilet. Fitted pipes (left), looking very much like modern ones, filled and emptied bathtubs in the palace complex.

lots. There was no place for all of the water to go," Casey said.

Septic tank systems, specifically, have been used for wastewater treatment since the turn of the century, according to a report from a 1994 University of Waterloo, Ontario, conference (5).

The report, by Richard J. Otis and Damann L. Anderson, adds that the use of septic tanks did not become widespread until after World War II when the suburban housing boom outgrew the rate of sewer construction.

Regulation Begins

The Otis and Anderson report notes that in the 1950s, states began to adopt regulations to provide a universal basis for the design and installation of septic tank systems. These early codes did not, however, provide much in the way of broad management or prevention of system failure. The programs regulating the installation and use of onsite systems could not keep up with the increasing demand (5).

The report adds, "Today, it is generally recognized that past approaches to managing onsite wastewater treatment systems use are no longer adequate . . . . The failure of these systems to gain acceptance as effective and permanent facilities is due primarily to shortcomings in management programs."

The report notes that the biggest assumption at that time was that onsite systems would ultimately be replaced by central sewerage.

Despite this, some early management programs did arise. In 1954, Fairfax County, Virginia, established an onsite wastewater management program when the board of supervisors there directed the health department to develop a program that would prevent future septic system failures (6).

The management plan focused on the planning, design, and construction review of septic tank systems through an extensive permit program.

Under this early management plan, the county was in charge of site evaluation, design review, installation supervision, monitoring, and public education while the homeowners were responsible for the operation, maintenance, and repair of the systems (6).

With the establishment of the wastewater treatment construction grant program under the Federal Water Pollution Control Act Amendments in 1956, the focus continued on construction of centralized sewers. Throughout the 1960s, the concept of septic tank systems being a temporary solution continued.

Onsite Systems Are Recognized

In the 1970s, millions of dollars were still being spent on constructing sewers and centralized wastewater treatment facilities, while at the same time, many federal and state agencies started to consider regulating and managing onsite systems as part of environmental pollution control issues. Throughout the 1970s, management programs sprang up across the country.

By 1974, many states had identified the need for better managed individual onsite systems through studies conducted under the Federal Water Pollution Control Act, Section 208. More importantly for the onsite system industry, EPA regulations required the inclusion of a cost-effectiveness analysis of alternatives by all applications initiated after April 30, 1974, under the Federal Construction Grants Program.

In fact, the 1977 Clean Water Act (CWA) Amendments required communities to examine alternatives to conventional systems. In addition, the NSFC was established by Congress as part of the amendments to provide technical information and assistance to small communities across the country.

In the 1978 "Report to the Congress," the Comptroller General of the U.S. stated that septic systems can function as effectively and permanently as central facilities and are a cost-effective alternative to sewage treatment plants, adding that "EPA and other federal agencies should increase the acceptance of septic systems by requiring established public management entities to control their design, installation, and operation (7)."

If the 1970s could be remembered as the decade septic systems became recognized as permanent wastewater treatment options, then the 1980s might be remembered as the decade of onsite exploration. During the 1980s, the field progressed significantly, and many onsite management system models were developed.

In the 1990s, the issue of management has been tweaked further, focusing on the development of adequate monitoring and comprehensive management systems.

In the 1997 "Response to Congress on Use of Decentralized Wastewater Treatment Systems," EPA stated that "adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas."

Since then, septic tank systems and other alternative systems generally have been recognized not only as environmentally and technologically sound treatment methods, but have been viewed as viable, permanent methods of treatment.

In the 1997 report, EPA noted that one of the barriers to implementing decentralized systems is a lack of management programs. To overcome this, EPA recommended development of management programs "on state, regional, or local levels, as appropriate, to ensure that decentralized wastewater systems are sited, designed, installed, operated, and maintained properly and that they continue to meet health and water quality performance standards."

As one of the responses to these 1997 recommendations, EPA launched Phase IV of the NODP in 1998.

Enter Phase IV

Phase IV of the NODP is a three-year program, focusing on establishing the necessary processes to help small communities develop a broad concept of management for onsite systems.

Knowles, program coordinator of Phase IV, has been studying management issues. He commented, "Management programs are imperative today because they will enable communities to control the effectiveness of wastewater treatment and can help ensure public health, improve water quality, and sustain the environment."

Knowles said Phase IV's mission has three components:

1. *To gather data, information, knowledge and insights concerning all aspects of onsite management systems nationwide.*

   Under this component, Knowles said objectives will be to establish a repository of information and

expertise on the topic of onsite management, forming a national database of management systems complete with case studies addressing issues of management approaches, compliance, improvement, and prevention perspectives.

2. *To create a framework, with tools and educational products for national dissemination to communities through a network of partners.*

   Knowles explained that this component seeks to "develop a framework of guiding ideas to assist communities through the process of moving from their current reality toward increasingly effective onsite wastewater management." He added, "The aim is to establish strategies for change, creating "a network of interested publics to partner with, for disseminating the onsite management idea and delivering products, tools, and services."

3. *To analyze, evaluate, review, and refine onsite management models, methods, and materials at strategically selected sites.*

   Knowles said this component of the project is designed to select suitable sites to pilot onsite management systems. It also will "provide NODP expertise, materials, mentors, management insights, tools, and techniques to communities interested in adopting an onsite management systems approach." This component will document and track management strategies, products, tools, and services to meet differing community needs.

Once these components have been met, Knowles said Phase IV ultimately will provide interested communities with practical, hands-on technological and management expertise facilitating community onsite system management programs tailor-made to meet a particular local community's needs.

To help the project succeed, NODP IV has enlisted an expert panel, made up of talented individuals in the wastewater field who have made and are continuing to make significant contributions to the evolution and development of onsite management plans.

Cranberry Lake's Success

One panel member, Jane Schautz, vice president and director of the Small Towns Environment Program at The Rensselaerville Institute in New York, is working with several communities, studying their onsite management programs. Schautz's role is that of an observer, documenting the progress and noting the plan's assets and possible defects.

She defines onsite management as "the systematic monitoring and maintenance of onsite systems to anticipate and/or correct malfunction in order to preserve the life of the system and prevent environmental degradation."

The challenging task, she said, is to make a management program work in existing communities that have onsite systems and do not automatically see the benefit of adopting a management system with all of its associated costs that the residents have not paid previously.

She cited Cranberry Lake, New Jersey, as an excellent case study of this scenario. One important lesson she has learned is that residents have to be shown there are innumerable benefits to whatever costs might be incurred.

The Cranberry Lake Septic Management System was established in 1990. It is a relatively affluent area. Most of the houses around the lake were built in the 1950s and intended for seasonal use. Because of this, some of the lots are small, approximately 50 by 50 feet.

"Year-round occupancy was not expected, but with retirement increasing, more and more people are living there year-round," she said. "With retirees you have to be sensitive to their limited incomes. One fear was that they would be thrown out of their houses if a malfunction were discovered. That made the problem more intense."

> "Management programs are imperative today because they will enable communities to control the effectiveness of wastewater treatment and can help ensure public health, improve water quality, and sustain the environment."
>
> **Graham Knowles, NODP Phase IV program coordinator**

Prior to the establishment of the management system, Cranberry Lake had a nitrate problem from failing septic systems and was overgrown by weeds. Schautz said that as a bonus, having the management system for wastewater in place helped the township to successfully secure funding for treating unwanted plants.

Schautz believes Cranberry Lake's success should be credited largely to Margaret McGarrity, the "spark plug," or local person who took the initiative to get things moving there. She added that Township Manager Ronald Gatti also played a major role in their success.

"Trying to establish a management district is going to be controversial, and people have to be willing to deal with controversy without being damaged," said Schautz. "You have to have savvy people who have the guts to stick with it. A plan is inert until somebody believes in it. You have to have a champion to give any plan a life."

McGarrity, a member of the environmental township commission, was that person for Cranberry Lake.

Schautz said McGarrity felt that sewers were inappropriate for the area. "Sewers just take wastewater from one area and move it to someplace else," said Schautz. "McGarrity felt they couldn't afford that for the wells or lake. She looked at all of the components and decided it made no sense to spend money installing septic systems and allowing them to malfunction."

Under the management plan, residents pay a

Photo by Joyce Bambach

At Cranberry Lake, New Jersey, homes built for seasonal use became year-long residences as the area evolved from a vacation spot to an established community made up primarily of retirees. As the use of onsite systems changed, so did their management requirements.

flat $15 fee that covers a three-year period, that extends from one date of pumping to another. By paying the fee, they update their permit by showing proof of pumping. Municipal officers oversee the process.

The township board of health is responsible for enforcement. "They have astonishing compliance," said Schautz.

"Starting a wastewater management district is like planting asparagus—the first rule is the ground should have been prepared three years ago."

Jane Schautz
vice president and director of the Small Towns Environment Program at The Rensselaerville Institute in New York

Schautz added that the township residents' drinking water is provided by privately owned wells. "People understand that this is all related to maintaining the purity of their lake, as well as preserving their drinking wells.

"It took awhile to convince people that this was in their best interest, but they now see that this is an improvement of their relationship with the township government," said Schautz.

In fact, Cranberry Lake's management plan has been the model for other communities in the area. She said, "To me one of the most persuasive evidences of the plan's success is that others in the area have seen the results and are taking steps to follow that model.

"In the beginning, people were saying, 'why us?' and now after the evidence, not only are they seeing many upgrades to systems made voluntarily, but people are saying, 'why not us?' and have petitioned the township board to include other areas," she added.

Schautz cautioned that management plans cannot be established overnight. She quipped, "Starting a wastewater management district is like planting asparagus—the first rule is the ground should have been prepared three years ago. Cranberry Lake did it faster, but very intensively."

Cranberry Lake's first step was education, including presentations at local meetings, seminars, articles in the local newspaper, information booths at community meetings, and insert fliers. Schautz said this process took approximately one year.

"McGarrity and Gatti said their success depended on persistence—getting the word out and allowing it to take hold, giving people time to come to their own conclusions," Schautz added. "In this case, their commitment and belief eventually became infectious."

Another helpful aspect of gaining acceptance was that the ordinance was relatively mild. "That way, there was less opposition," she said. "There's no reason to make this harder than it has to be. In fact, they went out of their way to accommodate people."

The management plan gives the township the authority to fine residents $1,000 per day or order them to do 90 days of community service for noncompliance, but Schautz said there has rarely been a need to impose those punishments.

In addition to having a spark plug, educating the public, and persistence, Schautz believes humor is an imperative component to the key to success. "McGarrity and Gatti livened up their material with graphics and energy," she said. "It really worked for the community."

In the end, Schautz said a management plan must be based on the local culture and philosophy. "Some of the purists say it isn't a management system unless you have inspectors there all the time, tearing up the soil. I'm not saying that doesn't work; but for an older established community, it seems that moving in areas of environmental sensitivity makes sense when people come to the understanding that they are at risk."

Getting Utilities Into the Plan

Another expert panel member, Bridget Chard, is a Small Communities Project coordinator and a township supervisor from Pillager, Minnesota. She works as a consultant for many townships in Minnesota, helping them implement a management model, called an "Environmental" Subordinate Service District, that can be tailored to meet differing needs.

In essence, the model allows local township boards, usually lacking the expertise, time, and experience needed, to develop and maintain a management plan by partnering with the local rural utilities. "The rural utilities are already in place and providing electric power to the rural residents. These residents are already part of the rural electric co-op. Therefore, these utilities are usually more than willing to provide this management service," she explained.

"They have the needed assets to oversee the systems. They do the billing, administrative work, and actually manage the wastewater system and therefore relieve the work that the town board would have to do. Essentially this becomes a public-private management system. It's a good set of checks and balances. The townships have the authority to levy onto the residents property taxes for any unpaid service charges."

In this model, enforcement issues are taken care of through a partnership with the township or county. "This is a choice situation," said Chard. "We continually are building new partnerships and better ways to do things. As homeowners and township board people become introduced to this new model, it's always an education process. We do a great deal of informational work up front before we create the districts."

The model allows for different methods of funding, including service charges and/or a property charge. She added, however, that a township and its residents sometimes find other alternative and equitable methods for financing their projects.

Chard, who is an independent contractor and chairman of her township board, said this model works well for old and new systems. "This model is usually used to retrofit and replace old groups of non-conforming wastewater systems as well as being used for new conservation-based designed subdivisions. It's a fluid, dynamic model that can change and adapt to the local homeowner's needs. You can come up with different ways of handling old systems versus new systems. We want everybody's environment to be protected," she added. "It also stabilizes the local economy and protects the landowners real estate investment."

Like Cranberry Lake, the area has water sources to protect. As a result, Chard said lake associations are very active in Minnesota with education programs as well as performing lake monitoring. They have been very supportive of projects that protect their lake quality and well supplies. Most of the areas where Chard works as a consultant are served by individual well systems.

Also like Cranberry Lake, many of the lots were platted years ago and originally may have been set up for seasonal homes and have very small lot sizes. These lots are

now seeing a need to replace a failing system with nowhere to place it on the property.

Chard has helped township projects, ranging from as small as eight to 200 homeowners, set up management districts. "We continually learn from the evolution of these and older districts," she said. "You should always be improving on the models."

Chard was involved with the establishment of Cass County's first management district model, which was included in EPA's 1997 "Response to Congress on Use of Decentralized Wastewater Treatment Systems."

The statute used in Minnesota for the framework of this management model is Minnesota Statute 365A for townships. This statute is used to provide many services that residents need within a township including road paving, animal control, and many other services. The statute was used to develop "Environmental" Subordinate Service Districts, which manage a water or wastewater projects or both at the same time.

Under that plan, the Rural Utilities Services, formerly the Rural Electrification Association, was a major player. Cass County sought out the local utility, Crow Wing Power and Light of Brainerd, Minnesota, and asked them to help with the management program, including monitoring, monthly inspections, pumping, record keeping, and billing administration. Chard said this type of plan is typical of the model.

She added that there are currently four known wastewater management districts operating in Cass County today with many others being implemented around the state by townships and counties. The county usually partners with the townships to do all of the enforcement, permitting, and siting of treatment sites as well as implementation of a Geographic Information System (GIS) database for the districts. "They don't want to micromanage small groupings of wastewater systems, but would rather partner with townships. This method keeps them informed about the smaller wastewater management systems. Now they have started doing planning and zoning, road work, and many other ideas have evolved from this original partnership and dialogue," she added.

"The county attends yearly audit meetings with the township boards, residents, and rural utility representatives. They physically review the system and look at the management logs to see how the wastewater system could be improved."

The keys to success, in Chard's view, are education and the ability to keep an open mind. "It all goes back to working with your neighbor, building a trust base. From there, you are challenged to find answers," she said.

"You sit down with the property owners in a meeting and say here is the problem, now what can we do. I have yet to come up against a group that can't find their own solutions."

Like Schautz, Chard recommends keeping education material and any documents homeowner friendly and humorous. "Try to make it fun. Homeowners always think of the government as being very imposing, but there is a lot of flexibility in this model that can be used to help the homeowners and town board work together and find solutions they need. When it's done, all feel that they have ownership in their project," she added.

Chard believes the definition for onsite management depends on a person's perspective. "Onsite management from the homeowner's perspective is new," she said. "It means taking care of their system, which is something they have never done before. By taking responsibility of your system, you are also protecting your neighbor. Further, we are managing and protecting a considerable investment and not wasting anyone's money to replace it sooner than is necessary."

Chard added that onsite systems will always need some type of management tool, from the simplest "tank management" tools to the more sophisticated technologies that homeowners would not understand.

"To me, it is doing it right from cradle to grave. It has gone beyond knowing that there are problems, that central piping is no longer a necessary evil because it's so costly," she added.

"The NODP IV theory is truly fourth-generation thinking regarding the evolution of wastewater management for the new millennium," Chard said. "Now we know we not only have the technology, but the tools to manage and maintain any onsite- and cluster-designed wastewater system." SF

Photo courtesy of Bridget Chard

At Little Boy Lake in Cass County, Minnesota, homeowners meet with a contractor, rural electric representatives, and town board supervisors for a pre-construction walk-through of homes whose failed septic systems will be replaced by a collection system that pumps effluent from the septic tanks of a number of homes to a common drainfield.

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Eutrophication

Phosphorus Overload or Phosphorus Recycling?

A Review of an Alternate Approach from Europe

NSFC ENGINEERING SCIENTIST
David A. Pask

A fairly recent issue of *Scope Newsletter* offers an alternate insight into shallow lake eutrophication in an article titled "Shallow Lakes, Biomanipulation and Eutrophication" by Brian Moss of the University of Liverpool, UK. This publication of the Centre European d'Etudes des Polyphosphates (CEEP) is sponsored by the European Chemical Industry Council.

Eutrophication is the process by which a rich flow of nutrients into a body of water, especially a lake or pond, causes excessive growth of aquatic plants, particularly algae. This article appears to offer a scientific explanation for the lack of success in the counteraction of eutrophication by conventional limitation of phosphorus and some success in alternate treatments.

The premise is that the theories of phosphorus as a limiting nutrient were developed from observation and analysis of deep lakes. The majority of lakes and waters of our concern are shallow, and different mechanisms of nutrient balance are in operation.

In any water body, the balance of nutrients, principally nitrogen (N) and phosphorus (P), is a function of inflow from the watershed (including lakeshore development), outflow, denitrification to the atmosphere, and settlement of P as organic or precipitated material to the lake bottom. Compared to a deep lake, there is, in a shallow lake, severe denitrification to the atmosphere (a function of area/volume) and major recycling of P between sediments, plants, and water. Thus there is a major difference in N/P ratio between the two systems.

An understanding of the difference between the two systems has come from the lack of success in attempts to restore shallow lakes modeled on methods tested on deep lakes. These attempts took place in the Netherlands and Great Britain. Studies of these failures led to the hypothesis that in a eutrophied lake (dominated by algae); reeds, pondweeds, lilies, and other large plants cannot survive. But these plants are essential for the survival of zooplankton, which graze on algae, as they serve as a refuge from zooplankton-eating fish.

Without the plants, fish will eat almost all of the zooplankton and the growth of algae is no longer kept in check. A second factor in the ecology of the shallow lake is that the activity of bottom-feeding fish and other animal life stirs up the sediment in their search for food and, in doing so, resuspend P into the water column, providing nutrients for the regrowth of algae. Boat propellers can have similar effects.

The two states of a lake, a) clear water with larger weeds and reeds, and b) algal eutrophication, are essentially stable and self-sustaining. The two states can, however, be "switched," not only by limiting one or more nutrients but also by the removal and replacement of plant and fish species, or biomanipulation.

A lake in Wales had become eutrified after replacement of brown trout by common carp and other fish in the 1950s. In the 1990s, blooms of potentially toxic blue-green algae appeared, and warning notices on this recreational lake had to be posted. A study by the University of Liverpool concluded that

the carp had acted as a "forward switch" to permanently change the state of the lake.

The lake was created by a dam and so could be drained to remove the existing fish. The lake was restocked with rudd, roach, pike, and crucian carp and replanted with lilies. (The common carp were sold to angling clubs for restocking private waters.) The lake is now recovering and is much clearer than it has been in decades.

A seven-step restoration strategy is suggested:

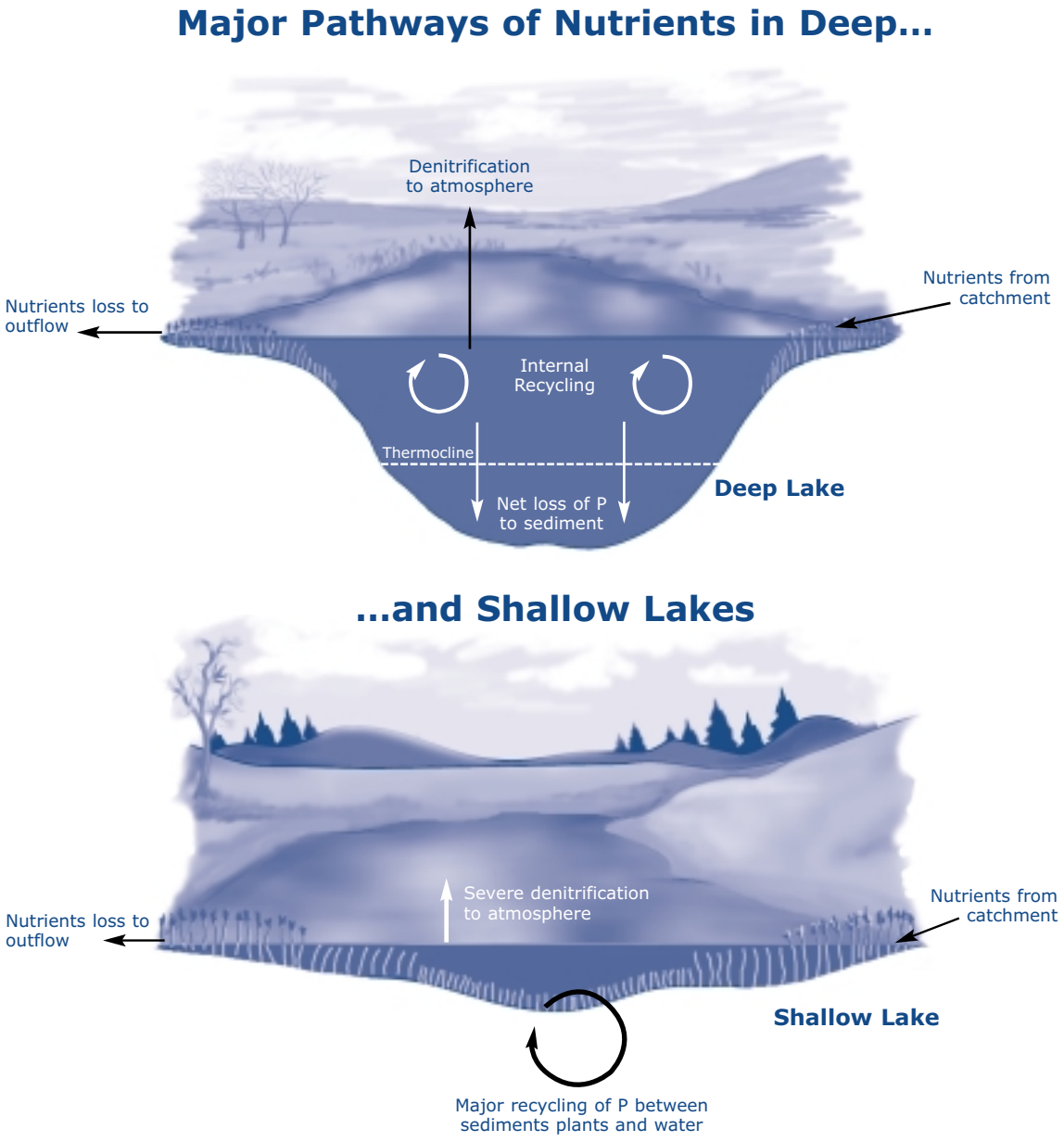
1) diagnosis of the problem and establishment of the target for restoration,
2) removal of existing or potential forward switches,
3) reduction of nutrient loading,
4) biomanipulation,
5) re-establishment of plants,
6) re-establishment of an appropriate fish community, and
7) monitoring of the results.

All of these steps are given in detail in the original text.

I cannot give an opinion as to how this science relates to conditions in North American shallow lakes, but I do recommend to those with an interest in this field that they read the original article and the referenced material.

The complete article may be seen on the Scope Web Page, listed below. The publisher may be able to provide a limited number of the original publication and has given the Clearinghouse permission to copy the material. We cannot, unfortunately, reproduce the beautifully colored graphics, but can provide photocopies for the cost of reproduction.

The original article appeared in *Scope Newsletter*, Number 29, October 1998, published by CEEP. The *Scope Newsletter* seeks to promote the sustainable use of phosphates through recovery and recycling and a better understanding of the role of phosphates in the environment. Back issues of the newsletter are available at *http://www.ceep-phosphates.org*. Articles about phosphorus recovery and recycling can be found at *http://www.nhm.ac.uk/mineralogy/phos/index.html*.



Adapted with permission from "Shallow Lakes, Biomanipulation and Eutrophication," *Scope Newsletter*, no. 29 (October 1998).

Phosphorus Overload in Receiving Waters

Some New Approaches to an Old Problem

NSFC STAFF WRITER
Marilyn Noah

A stroll along a clean white beach, a seafood dinner, a refreshing dip in a serene, reflective lake—all these pleasures can be ruined by the over-abundance of a single element—phosphorus.

Inadequate treatment of wastewater is one of the common sources of this element. Conventional septic systems can be unsuitable for effective treatment, especially near extensive bodies of water.

As development along shorelines and coastal areas becomes increasingly popular, new strategies are being investigated that specifically address the reduction of phosphorus in onsite wastewater treatment.

Reducing a limiting factor

Phosphorus, the eleventh most common mineral in the earth's crust, is an essential element to the metabolism of all living creatures. Along with sulfur, magnesium, nitrogen, calcium, and potassium, phosphorus is considered a macronutrient, an element required in comparatively large amounts. But generally, phosphorus (as orthophosphate) is considered the "limiting" nutrient in freshwater aquatic systems. In other words, if all the phosphorus is used up, plant growth will cease, no matter how many of the other nutrients are available. Identifying the limiting factors that lead to undesirable conditions, such as algal blooms, is necessary to managing nutrients in our waterways.

Excessive, nutrient-induced production of aquatic plants can have several detrimental consequences:

a) Large mats of algae form and then break down, causing odor and discoloration of the water, discouraging aesthetic and recreational use.
b) Rooted plants grow abnormally lush, interfering with navigation and aeration.
c) As the excessive levels of plants decompose, facultative bacteria create an oxygen depletion that causes the death of desirable fish species.
d) Algal blooms, such as a "red tide," can cause a poisonous condition in shellfish, which become toxic for consumers.
e) Extensive plant growth interferes with the processes used by water treatment plants (e.g., filamentous algae clogs filters).

Where does phosphorus come from?

Nonpoint sources of phosphorus range from the natural erosion of rocks to runoff from over-fertilized agricultural and urban areas. Other minor sources include failing onsite septic systems.

Residential wastewater acquires phosphorus from various sources. Typical phosphorus-releasing activities are toilet flushing, washing clothes and dishes, and bathing. Although the major brands of laundry detergent in the U.S. are non-phosphate, the element is still found in products such as toothpaste and other cleaning agents.

Demonstration projects serve as testing grounds for phosphorus removal technologies. Shown here are biofilter baskets and the distribution system of a site at the Benzie County, Michigan NODP project (above) and a continuous feed cyclic reactor at the Florida Keys Onsite Wastewater Nutrient Reduction Systems Demonstration Project in the lower Florida Keys (right). Benzie County photo courtesy of Bill Crawford

Roadblocks to Treatment

Most treatment systems include combinations of physical, chemical, and biological processes to reduce contaminant levels. The adequate treatment of wastewater by conventional onsite septic tank and drainfield is affected by soil type. Finer textured soils such as clay provide higher levels of reduction than sandy soils, which exhibit a low phosphorus adsorption capacity. As a geologic rule, soils adjacent to large bodies of water are predominantly sand. Another prohibitive condition often encountered at waterside locations is the typically high water tables that interfere with proper operation of the conventional system. Other factors that limit the use of conventional wastewater treatment systems in shoreline communities are small lots and seasonal occupancy. In fact, conventional systems have been so unsuccessful in the past that many waterside communities have simply resorted to using holding tanks or storage pits for homes fronting sensitive bodies of water.

Across the country, researchers are striving to address the problem of excess phosphorus being released into neighboring waters from improperly functioning wastewater systems. Hoping to land upon the correct combination, they are applying a wide variety of techniques and technologies in onsite demonstration projects.

Florida Keys—The Monroe County Project

The clear, sparkling waters surrounding the Florida Keys are in danger. Among the many threats are excess nutrient loads resulting from soils inadequate for conventional onsite wastewater treatment and a dense population increased by tourism. The combined efforts of the U.S. Environmental Protection Agency (EPA), the State of Florida, the National Oceanic and Atmospheric Administration (NOAA), and the engineering firm of Ayres Associates are being concentrated on addressing this problem.

In 1995, the Florida Keys Onsite Wastewater Nutrient Reduction System (OWNRS) demonstration project was planned to demonstrate the use and capability of alternative onsite wastewater treatment system technologies. These innovative treatment systems are being tested to evaluate their potential to reduce nutrient loading to the local waters. The quantitative goal of this ongoing project is an effluent with only 1 milligram per liter (1mg/L) of total phosphorus and 3 mg/L of total nitrogen. (For more detailed information about this research, see the *Small Flows* Summer 1999 issue.)

Consisting of five different combinations of treatment processes using a shared wastewater source, the demo project revealed a varied set of results. The system involving the most passive technology was the most successful in reducing phosphorus levels. This system involved a septic tank with the effluent discharging to a lined drip irrigation field. A subsurface drip irrigation system was used to ensure even distribution to the root zone. The employment of a porous media consisting of crushed brick planted with St. Augustine grass achieved phosphorus reduction of up to 93 percent. Unfortunately, it was noted that the media adsorption sites become saturated rather quickly, reducing their effectiveness in reducing phosphorus levels.

Benzie County, Michigan

A rural county near the top of the "mitten," Benzie County, Michigan more than doubles in population during the summer months due to an influx of seasonal residents. Most of the seasonal and lakeside residences have various types of onsite sewage treatment or pump-and-haul holding tank systems. The combination of sandy soils, small lots, and high groundwater produces a threat of phosphate loading to ground and surface water.

In 1995, the Benzie County Health Department (now the Benzie-Leelanau District Health Department) joined forces with faculty from Michigan State University to investigate some alternative technologies for onsite treatment. Selecting several lakefront homes where installation of conventional sewage systems was deemed unsafe, they became part of the National Onsite Demonstration Project Phase I funded by the EPA. (See the Fall 1999 issue of *Small Flows* for a detailed report of this project.)

The technologies used in the seven sites were chosen specifically to reduce the levels of phosphorus.

David Pask, engineering scientist with the National Small Flows Clearinghouse (NSFC), who assisted with the evaluation of these projects, commented, "As far as I know, the Benzie County project has the only system using essentially a chemical process for onsite removal of phosphorus. The Benzie project attempted to use naturally occurring iron-rich sand as the chemical binding agent. The system was designed as a barrier through which the septic tank effluent would pass on its way to groundwater. Unfortunately the design did not fully anticipate the effects of the high groundwater table, with the result that the effluent bypassed the sand barrier." Later modifications to this design resulted in reducing total phosphorus between 60 and 80 percent.

Due to the observation that at high groundwater levels, the effluent plume may be carried sideways by the groundwater flow and will not contact the iron-rich sand layer, other systems in the Benzie project were modified. Recirculating sand filter units were installed as phosphorus removal units prior to final treatment and disposal to ensure the effluent came in contact with the iron-rich sand.

One system involved a septic tank followed by a recirculating sand filter and then a phosphate removal chamber (an upflow filter of iron-rich sand). Phosphorus removal exceeded 99 percent at this site.

At some sites, however, this success could not be sustained. Initial success for phosphorus removal dropped the second year when the natural iron-rich sand became hydraulically clogged.

"These systems were moderately successful for phosphorus but only the imported high-iron content sand was effective for more than one season. The native sands quickly became exhausted," Pask said.

The goal of improving the water quality of nearshore waters through a long-term strategy that is focused on reducing the nutrient load from wastewater is a worthy one. Pask maintains that, "Joint projects such as these hold the key to solving the phosphorus overload problem."

For additional information about the Ayres Associates work in the Florida Keys, contact Damann Anderson at (813) 978-8688. The National Onsite Demonstration Project Summary Report: Phase I can be ordered from the NSFC at (800) 624-8301 or (304) 293-4191. SF

Remote Monitoring Use Is on the Rise

CONTRIBUTING WRITER
Kathy Jesperson

Editor's Note: This is the second article in a two-part series about remote monitoring. The first article appeared in the Spring 1999 issue of *Small Flows*.

Telemetry units, programmable logic controllers (PLCs), and supervisory control and data acquisition (SCADA) are all common remote monitoring tools used in the municipal wastewater industry. While remote monitoring is not a new invention, it has recently found its way into the onsite market, making onsite wastewater treatment a true competitor with centralized sewering. But whether it is used for a municipality or an onsite system, this type of technology makes it possible to monitor numerous facilities or systems from one central location.

"This is a really proactive kind of service," said Bob Mayer, president of American Manufacturing, Gainesville, Virginia. "Typically, we put in dialers that call up a series of people who can then call the system back and see what the problem is. Then you can tell what class of individual you need to send out. Is it someone who needs to turn a switch, or is there some kind of troubleshooting that needs to be done?

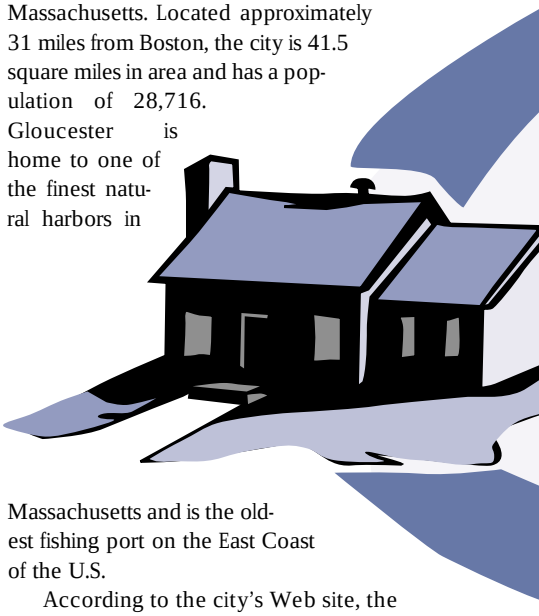
"This service is something we do for onsite systems as well," Mayer said. "The big advantage of this technology is that you [the homeowner] have an engineer who can troubleshoot the problem for you. Usually you [the system operator] would have to send for a mechanic, who may not be trained for all components—there might be a glitch in the software or hardware. And mechanics are usually familiar with things that you fix with a wrench. Remote monitoring is much more efficient and saves money over the long run."

Mayer recalled an incident where an onsite drip system at the National Onsite Demonstration Project site in Anne Arundel County, Maryland, notified American Manufacturing of a flow variance.

"There was too much flow through the system and it shut itself down," he explained. "What happened was that a cable company was installing an underground cable, which they brought through the drip system, trashing it. We sent a serviceman to the site the next day and made the necessary repairs. When we told the homeowner that we had fixed the problem, he wasn't even aware that anything had gone wrong."

Gloucester Monitors STEP System

Remote monitoring is becoming more widely used. However, when you think about remote monitoring, the first thing that comes to mind probably isn't Gloucester, Massachusetts. Located approximately 31 miles from Boston, the city is 41.5 square miles in area and has a population of 28,716. Gloucester is home to one of the finest natural harbors in Massachusetts and is the oldest fishing port on the East Coast of the U.S.



According to the city's Web site, the area is "a mosaic of small communities that each have their own unique character—from the tiny Annisquam peninsula to the

quaint neighborhood of Magnolia. Indeed, the city's natural beauty and historical character have attracted a sizable resident artist population. In summertime, Gloucester swells with visitors attracted to its beaches, fresh seafood, and the lure of whale watching."

Within the city, there are 1,500 onsite septic tank effluent pump (STEP) and grinder pump systems. All of these systems are monitored remotely.

"We wanted a system where the homeowner isn't bothered," said Aaron Cilluffo, assistant city engineer, Gloucester, Massachusetts. "They don't have to go outside and press a button to silence an alarm or even make a phone call; the system makes the call for them."

Cilluffo said that the system was created from scratch. "I'm overseeing the implementation of the system," he explained. "We're under a federal decree to get the area sewered so we're going from testing directly to implementation. We do have some bugs to get out, but overall the system is working well."

The three-float pump system handles approximately 300 to 500 gallons of wastewater per day. So when something goes wrong, it's crucial to get the system up and running again. The remote monitoring feature alleviates many concerns because it will alert technicians immediately, indicating exactly what the problem is.

"We're not struggling to figure out what the problem is," said Cilluffo. "We know what's wrong before we go to the site. And the homeowners are not involved, so they like it much better."

The systems call in on a monthly basis so that Cilluffo knows everything is working as it should. "If a system doesn't call in, I get a 'failure to communicate' notification. Then I send someone to the site to investigate the problem. All in all, we're very satisfied with this system."

EMP Monitors Pumps

Gloucester worked with OES-IBEX Environmental Technologies, Norcross, Georgia, to develop this system. "This system includes electronic monitoring panels (EMP) that monitor all functions of a STEP system, grinder pump systems, pressure sewer systems, and sewer lift stations," said Larry Bradford of OES-IBEX Environmental Technologies.

"The EMP is well suited for new installation or can be retrofitted to any existing system," said Bradford. "Features of the EMP include pump failure alarms, float failure alarms, alarm condition indicator, high float alarm, 24-hour paging of on-call technician, ability to troubleshoot operational conditions, and printed reports of any conditions.

"The purpose of the electronic monitoring panel is to incorporate all management responsibility to one central site," he explained. "Managing all systems in the field from one central location saves time and money. It also eliminates the uncertainty of which systems are working properly and which ones are not. In many instances, this removes the responsibility from the homeowners of responding to annoying lights and alarms. Because data is sent instantly and is specific in detail, it enables the technicians to react to failures quickly and efficiently."

During normal operation, the EMP will sense the pump activation signal that will be used to monitor the pump, pump run time, and pump activation number. The EMP will have an LED showing that the unit is powered.

Alarm signals are sent to the central computer station. The EMP directly senses this signal.

If the pump run time exceeds 20 minutes or another predetermined time, the EMP will report the event to the central computer station. The EMP will count and retain the number of times the pump was activated since the last report sent to the central computer station as well as report the total pump run time and retain these readings even if a power failure occurs.

The EMP will also keep track of date and time and will initiate a communication call at an interval predetermined by the central computer station. After the communication link is established, the EMP

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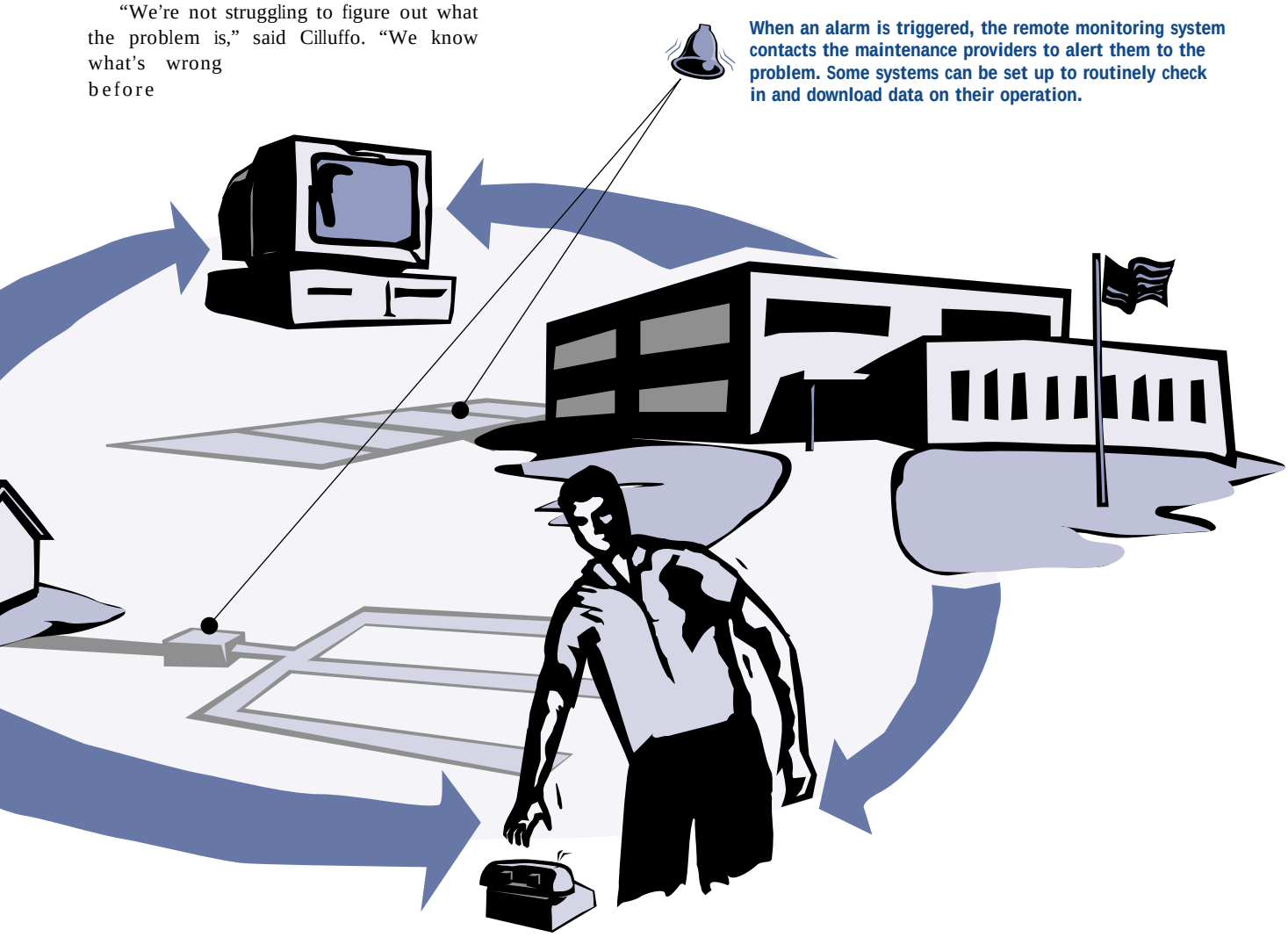

When an alarm is triggered, the remote monitoring system contacts the maintenance providers to alert them to the problem. Some systems can be set up to routinely check in and download data on their operation.

Mandated Certification of Onsite Professionals

State Legislatures Scramble To Keep Up with Technology

NSFC STAFF WRITER
Marilyn Noah

As new onsite wastewater treatment technologies are developed, the proper operation and installation of residential wastewater treatment systems has become recognized as being critical to their success. State-mandated certification of inspectors, installers, designers and other associated professionals is becoming the rule rather than the exception.

To reduce sanitary hazards, prevent degradation of groundwater, and protect public health, many states are looking to ensure that onsite systems are both installed properly and perform satisfactorily. Mandating the certification of onsite professionals is one way that states are addressing these issues.

A comparison of current legislation from certain selected states reveals the complexity of this undertaking. Not only do the laws vary from state to state, but in some cases, the laws are inconsistent within a state, varying between counties.

Range of Certifications Recognized

Across the country, a broad spectrum of professionals associated with onsite wastewater systems are required to be certified. (See table on page 27.) The following are but a few examples:

Washington: Effective July 25, 1999, designers of onsite wastewater treatment systems in the state of Washington must be properly licensed. By July 1, 2000, employees who inspect or approve the design or construction of onsite wastewater treatment systems will be required to have a certificate of competency.

Pennsylvania: Pennsylvania requires the certification of inspectors and personnel who issue the permits.

Rhode Island: The laws on the state of Rhode Island's books relating to onsite wastewater professionals are vague at best, but certification of inspectors is required by local communities.

Missouri: The state of Missouri requires that onsite installers and inspectors both receive certification.

Criteria for Certification

Criteria for certification varies from simply taking a certain number of hours of continuing education units (CEUs) to state-level licensing earned by attending classes and passing a written exam. Some states require a certain number of hours of class time, an exam, plus a certain number of years of field experience. In some states, the recommendation of an already-certified professional to vouch for a person's qualifications is a requirement. The following list of states is a good example of the range of criteria:

Florida: Florida law requires prospective onsite personnel to meet minimum eligibility requirements in order to take the qualifying examination, including an age requirement and three years of active experience.

Pennsylvania: In Pennsylvania, inspectors earn their certification after completing course requirements, which include classroom and field training.

Missouri: Installers in Missouri must attend classes and pass a written examination in order to be certified.

Rhode Island: In Rhode Island, onsite inspectors are required to participate in a two-day class and pass a written examination. The class includes classroom training and exposure to at least three actual home systems. Certification classes are designed to follow the *State of Rhode Island's Wastewater Inspectors' Manual.*

Washington: Effective July 25, 1999, designers of onsite

wastewater treatment systems in the state of Washington must be properly licensed. All applicants must pass a written examination, possess a high school diploma or equivalent, and have a minimum of four years of experience in areas such as soil assessment, hydraulics, topographic delineations, use of specialized treatment processes and devices, microbiology, and construction practices.

Implementation and Training Responsibilities Vary

The implementation of these new mandates falls on a diverse group of administrators. The organizations responsible for the training and testing are also varied. In some states the extension service affiliated with the land grant university takes a major role in the administration, while other states give the administrative role to the state health departments.

Under the auspices of the Pennsylvania Septage Management Association (PSMA), along with professionals at Pennsylvania State University, courses are offered at locations across that state that include both classroom and field training for onsite inspector certification. In contrast, to qualify for certification to become an officer allowed to permit onsite systems, the State Board for the Certification of Sewage Enforcement Officers is involved. To qualify for this certification no training is required but a passing score on the exam must be obtained. The Department offers an optional six-day training course to prepare the participants for the exam.

The University of Rhode Island's On-Site Wastewater Training Center, which houses a demonstration and field training center and is one of eight Northeast regional centers for alternative septic system technologies, is responsible for the certification of inspectors in Rhode Island. "To date, the demand for certified inspectors is coming from the communities. The homeowners at the local level are driving us," said George Loomis, soil scientist and director of the training center. "No one at the state level oversees the certification process."

As for any certification requirements enacted by the legislature in the future, Loomis comments, "The local communities are doing such a good job of policing themselves; there's really no reason for the lawmakers to become involved. As it stands now, the communities are much stricter and are exhibiting much more comprehensive control than the current state laws." He is pleased with the way the local communities are taking control of their own resources.

The responsibility for the state of Missouri's onsite wastewater training program is currently being reassigned. Until recently, the training site maintained by the University of Missouri had been the location for installer and inspector training since the law requiring their certification was enacted in 1996. However, the responsibility for installer training has been recently taken over by the State Health Department. The University of Missouri site continues to provide the full day of training required for onsite inspection certification.

The state- and university-funded training facility (located at Columbia, Missouri) will continue to offer special classes in advanced installation techniques and conduct open houses held to promote and educate the public about some of the new systems. "With the town of Columbia undergoing major growth and expansion, public interest in new wastewater treatment technology is high." commented Dennis Sievers, professor at the University of Missouri.

SF

Current state onsite certification or licensing programs

	Contractors	Installers	Inspectors	Pumpers	Designers	Engineers	Geologists	Operators
AL	Y	Y	Y	Y	N	Y	Y	Y
AK	Y	Y	NA	NA	NA	Y	NA	NA
AZ	Y	Y	NA	Y	NA	Y	Y	NA
AR	N	Y	N	Y	Y	N	N	N
CA	N	N	N	N	N	N	N	N
CO	N	N	N	N	N	Y	N	Y
CT	NA	Y	Y	Y	NA	Y	NA	NA
DE	Y	Y	N	Y	Y	Y	N	Y
FL	Y	Y	Y	Y	Y	Y	Y	Y
GA	Y	Y	Y	Y	N	N	N	N
HI	N	N	N	N	N	Y	N	Y
ID	N	Y	Y	Y	N	N	N	N
IL	Y	Y	NA	Y	NA	NA	NA	NA
IN	N	N	N	N	N	N	N	N
IA	N	N	N	Y	N	N	N	N
KS	NA	NA	NA	NA	NA	Y	Y	Y
KY	Y	Y	Y	Y	N	N	N	N
LA	NA	Y	NA	NA	NA	NA	NA	NA
ME	N	Y	Y	N	Y	Y	Y	N
MD	N	Y	Y	N	N	N	N	N
MA	Y	Y	Y	Y	Y	Y	N	Y
MI	N	N	N	N	N	N	N	N
MN	NA	Y	Y	Y	Y	NA	NA	Y
MS	NA	Y	Y	Y	NA	NA	NA	NA
MO	Y	N	N	Y	N	Y	N	N
MT	N	N	N	N	N	N	N	N
NE	N	N	N	N	N	N	N	N
NV	NA	NA	NA	NA	NA	NA	NA	NA
NH	N	Y	N	N	Y	Y	N	Y
NJ	N	N	N	N	N	N	N	N
NM	Y	Y	N	N	N	N	N	N
NY	N	N	N	Y	N	N	N	N
NC	N	N	Y	N	N	N	N	N
ND	Y	Y	Y	N	N	N	N	N
OH	N	N	N	N	N	N	N	N
OK	Y	Y	N	Y	Y	N	N	Y
OR	Y	Y	Y	Y	Y	Y	Y	Y
PA	N	N	Y	N	N	Y	Y	N
RI	Y	Y	Y	N	Y	Y	N	Y
SC	Y	Y	NA	Y	NA	NA	NA	NA
SD	N	Y	N	N	N	N	N	N
TN	N	Y	N	Y	N	Y	Y	Y
TY	N	Y	Y	Y	N	N	N	Y
UT	N	N	N	N	N	N	N	N
VT	N	N	N	N	Y	N	N	Y
VA	N	N	N	N	N	Y	Y	Y
WA	N	N	Y	N	Y	N	N	N
WV	N	Y	N	Y	N	N	N	N
WI	N	Y	Y	Y	Y	Y	Y	N
WY	N	N	N	N	Y	Y	Y	N

NA = not available

David Lenning of the Northwest Onsite Wastewater Training Center in Washington comments, "Currently, certification of designers is handled by each of the local health jurisdictions that have such programs, which are over half of the jurisdictions in the state. Regulatory personnel do not currently have to be certified to work in the onsite sewage program, though some counties require a registered sanitarian for such positions. This will change with legislation passed during our last legislative session. Our state department of licensing will be administering that certification."

He went on to explain that, "Other certifications, such as installers and pumpers, are handled currently by local health jurisdictions. Other types of certifications such as for maintenance specialists, monitoring specialists, or O&M specialists, depending on the county, are also handled at the local level, although currently, only a handful of local jurisdictions have such a certification. Such individuals can do functional monitoring inspections of systems. They typically are not involved in the initial inspection leading to initial approval of an installation. Their work could also be accepted by lending institutions for checks of systems being sold, but that is up to the lending institution.

"Presently, the cost and testing process differs from county to county, but the state will be having a consistent fee for the two classes of onsite sewage professionals when they start licensing and certifying. At our training center we do offer classes that pertain to inspections.

"We provide a specific class on monitoring inspections that consists of two days with a follow-up, two-day class for troubleshooting and an additional class to be offered this year on sampling–an important part of a monitoring inspection. Most local jurisdictions depend on our training center's classes to do the educating. Last year, we offered 25 courses and classes. As we get closer to the state legislation taking effect, I am sure we will be offering classes specifically for local health personnel who will be conducting inspections as part of their responsibilities."

Programs in Transition

With new technologies being developed rapidly, the programs needed to address the issues are struggling to keep up. As this article was being researched, new laws and mandates were being enacted and old policies were being updated.

"We're waiting for the dust to settle," commented Sievers. "Missouri's onsite wastewater professionals certification program is in transition. The laws are currently being revised and new requirements are being designed as we speak."

Professional organizations help develop standards

Several professional organizations have assisted their state lawmakers with the development of appropriate standards and certifications. The PSMA is one such group that considers their push for appropriate legislation part of their agenda of sound management of onsite sewage treatment and disposal systems. The PSMA has worked with Pennsylvania State University to develop inspection checklists and guidelines to be used statewide and has assisted in the design of the training course currently offered to inspectors. The Florida Septic Tank Association, representing approximately 50 percent of the septic tank contracting companies in that state, has been a key player in efforts to encourage state lawmakers to standardize the licensing of septic tank contractors. The professionalism and improved public image that results from having their field personnel officially state certified is considered invaluable by these organizations.

Is national accreditation the way to go?

The standardization and certification of the onsite wastewater industry and regulatory personnel is a new concept; lawmakers and other involved officials are struggling to make the appropriate decisions. The wide variability of requirements that exists between the states mirrors the variability exhibited by these same laws in just a few years time. Seivers notes, "We're in flux. Everyone is sort of scrambling around trying to figure out the best way to handle things." The time may be right for a national standardization of certification.

The National Sanitation Foundation International (NSF), long respected for its certification of products, has become interested in addressing the need for a standardized accreditation program for onsite water and wastewater inspectors. Working with many stakeholders (for example, the National Small Flows Clearinghouse, National Association of Waste Transporters, and the National Association of Home Inspectors), the NSF intends to develop a means for demonstrating the skills and knowledge of those who evaluate onsite drinking water supplies and wastewater treatment systems.

Tom Bruursema, General manager of NSF's Environmental and Research Services, explains, "To-date, we have focused more heavily on the wastewater program. Once we have this complete, we will change gears and proceed with the drinking water component. We will, however, launch the wastewater program as soon as it is complete.

"Things we have completed include the administrative policies, a program outline addressing the complete wastewater program, an inspection check-list, written and practical examination structure, program reference materials, and requirements for practical examination proctors. We are working now to finalize the two examinations, and to complete the networking for qualified proctors."

The increased complexity of onsite wastewater treatment systems, including changes in treatment technology and the need to protect groundwater and watershed areas, makes it essential that qualified professionals are involved with these systems. The criteria for determining who is qualified is still a highly contested issue. SF

Sources of Further Information

University of Rhode Island On-site Wastewater Training Center–George Loomis (401) 874-4558 or *gloomis@uri.edu*.
University of Missouri Small Wastewater Flows Education and Research Center–Dennis Sievers at (573) 882-7855 or *sieversd@missouri.edu*.
NSF–Tom Bruursema, 734-769-5575 (direct) or 800-NSF-MARK, ext. 5575. You can also e-mail *bruursema@nsf.org*.
The Pennsylvania Septage Management Association–(717) 763-PSMA or *paseos@aol.com*.
The Northwest Onsite Wastewater Training Center–David Lenning at 360-455-8880 or *dlen@forward.cwix.com*.

Performance Management

Redefining Roles and Responsibilities for Onsite Wastewater Treatment System Management in the New Millennium

CONTRIBUTING WRITER
Richard J. Otis, P.E.

In the last two decades, the perception of onsite wastewater treatment and the role it will play in the future has dramatically changed. For much of the Twentieth Century, onsite treatment was thought to be appropriate only for remote, rural homes. In more urbanized areas beyond the reach of existing sewers, onsite systems were assumed only to be interim methods of treatment that would be quickly abandoned as sewers were extended. It is now widely recognized in the United States that conventional sewerage will not be able to meet the demand for wastewater treatment because of both monetary and non-monetary costs. It will be onsite systems that will provide the necessary treatment needed for unsewered areas but only if they are accepted as effective, reliable treatment systems.

In the Response to Congress on Use of Decentralized Wastewater Treatment Systems, several barriers were identified that could prevent onsite treatment systems from fulfilling their potential as a solution to wastewater treatment in unsewered areas. The most significant barriers identified were

- lack of knowledge of onsite systems by the public, planners, engineers, and regulators resulting in the misperception that onsite systems are unable to meet water quality goals;
- regulatory programs that are prescriptive, bifurcated between or within agencies, and lacking statutory authority to implement management programs; and
- lack of continuous and reliable operation and maintenance of onsite systems (1).

The technology exists to meet human health and environmental protection requirements. Demonstration projects throughout the country have shown that onsite treatment systems can be designed to meet most water quality goals. But the paradigm of private ownership of prescriptive designs, resulting in the lack of effective management has prevented onsite wastewater treatment from being accepted as a permanent option that can be integrated with conventional sewerage. To achieve the full potential of onsite wastewater treatment as a cost-effective solution to wastewater treatment in rural areas, small communities, and urban fringe developments, effective management must be provided. To realize effective management, there must be clear lines of authorities and responsibilities between the regulatory agencies, public and private service sectors, and property owners.

Management Objectives and Needs

The objective of any wastewater program is sustainable residential and commercial development through protection of human health, environment quality, and quality of life. The future of onsite treatment lies in its integration with conventional sewerage. To achieve this status, it must be perceived to be just as effective and reliable [Otis (2)]. This requires the following:

- **Systems designed to meet specific performance requirements based on risk assessment at the receiving site must be permitted.** Under prescriptive codes, we must find sites that fit the permitted technology, but suitable sites are not always the sites that are most appropriate to develop. Performance-based codes allow technologies that fit the

Editor's Note: Richard Otis is vice president of applied technologies for Ayres Associates in Madison, Wisconsin.

given sites and, therefore, are necessary for sustainable development.

- **Oversight of planning, siting, design, and construction must be provided to ensure appropriate treatment systems are implemented.** This aspect of management is the usual focus of current management programs; however, it is not always done well. The emphasis is on conformance to the code rather than performance to meet requirements.
- **Continuous operation and maintenance must be provided to ensure that performance to requirements is maintained.** Traditionally, operation and maintenance has been neglected. The property owner is usually left to maintain the system as the untrained owner may see fit. The "bury and forget it" syndrome is common.
- **Owners must be continuously accountable for performance of their systems.** Regulatory agencies typically relinquish control of systems after the system is constructed. They only become involved when obvious hydraulic failures occur or there are complaints filed. This allows potentially preventable problems to occur.

To satisfy these needs, a performance management program is needed. Performance management is a comprehensive management program involving the regulatory agency and its delegated local unit of government, private services sector, and system owners. The objective of the program is to manage the performance of all the actors as well as the system. Each group of actors has specific authorities, responsibilities, and roles to play in onsite system management. A performance management program coordinates the responsibilities of these various actors with their appropriate authorities to act.

Traditional Management Programs

Effective management involves three entities; the regulatory agency, the service sector, and the owner or permit holder, each with its own set of responsibilities. It is the responsibility of the regulatory agency to establish and enforce the rules by which onsite treatment systems will be applied and implemented. The agency sets the minimum permissible requirements within which the owner must apply and operate the system (figure 1). Also, it is responsible for establishing the appropriate qualifications and experience of service providers through a licensing or certification program. The owner is responsible for the system. This includes siting, designing, constructing and operating the system in a manner that meets the requirements of the regulatory agency. The owner hires the appropriate services from qualified service providers who act as the owner's agents in complying with the requirements. The service providers are responsible for demonstrating and maintaining their competence to practice in accordance with all applicable rules and regulations, and to perform their services competently for the owner.

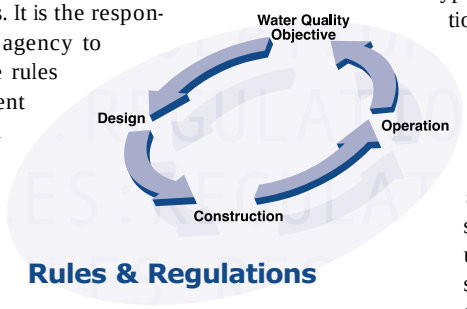

Figure 1

Rules and regulations establish the minimum requirements within which the onsite wastewater treatment system must perform

This model should also apply to traditional programs, but most often, the regulatory agency assumes many of the responsibilities of the owner and service provider. Though such regulatory involvement generally has served its purpose, it severely blurs the lines between roles and responsibilities of the actors, weakening the management program.

Traditional regulatory programs usually are administered by sanitarians. In addition to the typical regulatory functions of design review, permitting, and construction inspection, sanitarians often perform the site evaluations and specify the type of system design to be used. While their statutory obligation is to the public in enforcement of the administrative rules, many sanitarians feel they are service providers that play an important consumer protection role to protect the property owner from unscrupulous or expensive service providers. This is not their role! By accepting such roles and responsibilities outside of their regulatory functions, conflicts of interest and increased liabilities arise.

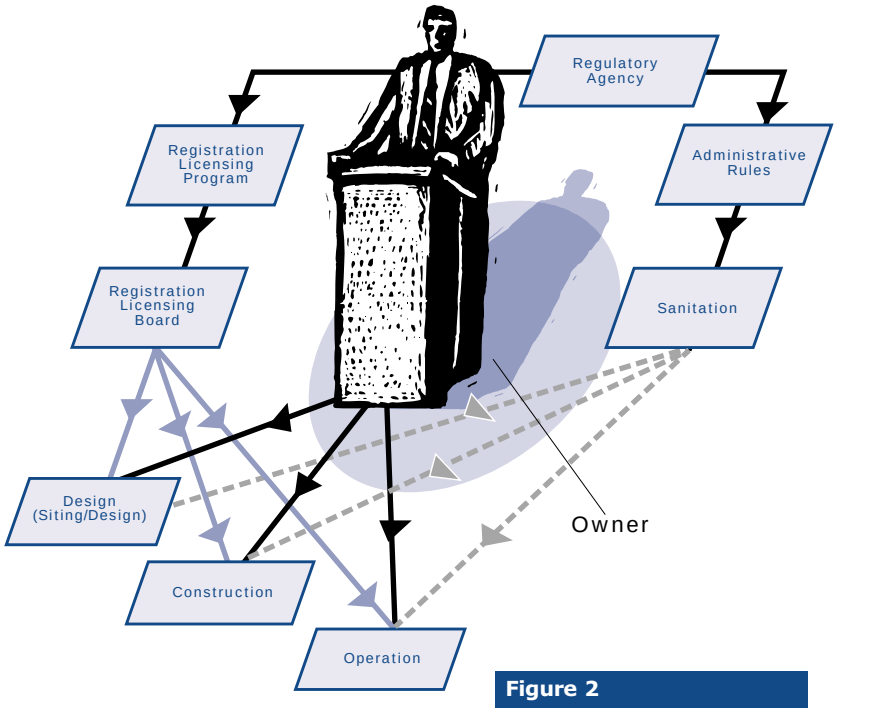

Figure 2

Traditional regulatory-based management program illustrating the assumed responsibilities of the actors

The permit holder, usually the property owner, is the individual who is responsible for performance of the treatment system. The owner is responsible for hiring qualified professionals to site, design, and construct the system. When a sanitarian performs the site evaluation and/or specifies the design, however, the sanitarian assumes the position of being both an agent of the regulatory agency and an agent of the property owner (figure 2). This is not in the best interest of the owner because the interests of the regulatory agency will take precedence over the owner's. The sanitarian usurps the owner's authority for the siting and design of the system but leaves the owner responsible for the system's performance. The sanitarian may also assume responsibility for directing the contractor in construction of the system, yet the sanitarian has no authority to spend the owner's money. These are serious conflicts of interest. If there is a problem with the system, the owner may be left with little recourse in pursuing the service providers since the system was sited, designed, and constructed according to the direction of the sanitarian. Further, effective enforcement is difficult because the sanitarian is faced with writing orders against a system sited and designed by

the sanitarian. In effect, the owner is left out of the loop and this is expressed in the management program by the lack of attention to the owner in the form of information and training regarding the function, operation, and maintenance of the system.

If management programs are to work, the actions of the actors (regulatory staff, service providers, and owners) should be limited to those for which the responsibility and authority is given. A performance management program rather than a regulatory-based management program is needed.

Performance Management

Under performance management, the objective is to control the performance of the service providers and owners so that the systems perform as required. Clear lines between the functions and responsibilities of the actors are maintained to avoid conflicts of interest and exposure to undeserved liability. Note that the transactions between the service providers and owner are not controlled in this model because these are the jurisdiction of the civil courts.

The responsibilities of each group of actors should be assigned to the actor with the appropriate authority.

Regulatory Agency

Role: To enforce the administrative rules for the good of the public.

Responsibilities:

- establishes fair and reasonable performance requirements based on risk assessment procedures (3);
- provides technical guidelines for acceptable procedures and practices to meet the performance requirements (which may include prescriptive designs for specific site characteristics);
- regulates onsite treatment systems through design review, permitting, compliance monitoring, and enforcement activities; and
- regulates service providers through licensing/certification programs.

Owner (permit holder)

Role: To own and operate the system.

Responsibilities:

- sites, designs, and constructs a system capable of complying with the performance requirements (typically by hiring qualified service providers); and
- provides perpetual operation, maintenance, and monitoring of the system such that it performs within the established requirements.

Service Sector

Role: To provide competent services to the owner.

Responsibilities:

- maintains demonstrated competence under the licensing/certification program;
- performs services in accordance with all applicable rules and regulations;
- provides siting, design and construction of systems in accordance with the established rules and regulations; and
- provides operation, maintenance, and repairs of systems.

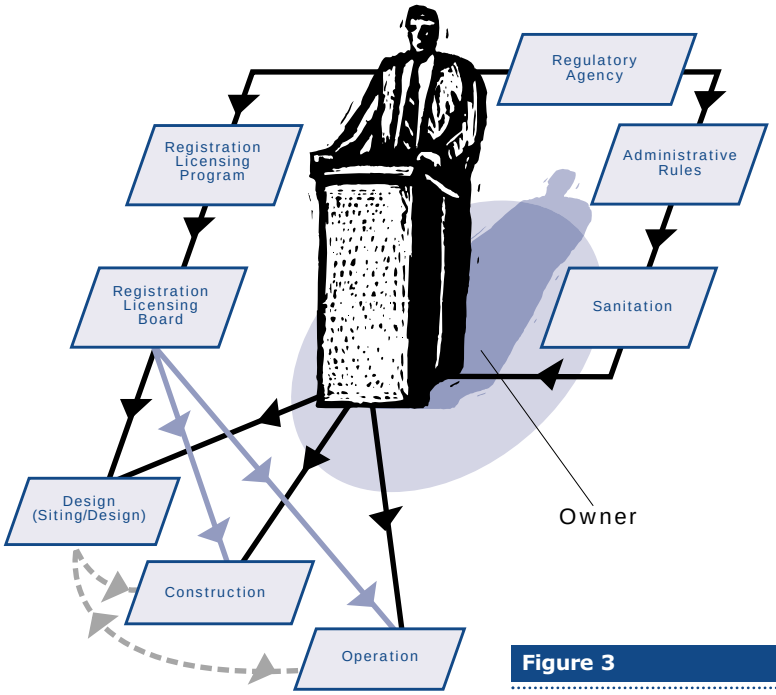

Figure 3

Comprehensive management program illustrating the lines of responsibility of the actors

The success of this model depends on the coordination of roles of each actor to maintain clear and separate responsibilities. The regulatory agency controls the performance of the system through issuance of construction and operating permits to the owner (figure 3). If an owner fails to comply with the permit requirements, the operating permit may be revoked or fines and penalties assessed until compliance is achieved. If the service provider fails to comply with the licensing/certification program requirements, the board may revoke the service provider's license to practice. This is all the control the agency needs to achieve its goal of human health and environmental protection.

This leaves the relationships between the owner and service providers outside the jurisdiction of the agency. The sanitarian's responsibility is to the general public in protecting human health and the environment. It is not to the property owner or service provider. If problems occur between the owner and a service provider, it is for those parties to settle on their own or with help from the civil courts. Thus, responsibility for system performance is solely the owner's based on specific and measurable performance requirements.

Summary

A comprehensive model is necessary for performance management if onsite wastewater treatment is to be integrated with conventional sewerage. This model mirrors the management model traditionally used in municipal wastewater treatment, allowing a smooth integration process. It is necessary because it assigns the roles and responsibilities to those actors who have the authority to act. It differs from the traditional regulatory-based programs by limiting the role of the regulatory agency to establishing and enforcing the rules. The property owner is responsible for the system siting, design, construction, and performance of the system. Regulatory oversight of performance is achieved through renewable operation permits issued to the owner after demonstrating compliance.

This model can be used for either prescriptive- or performance-based regulatory programs. But, without specific and measurable water quality standards that are part of performance-based rules, innovative designs are difficult to implement and perpetual operation and maintenance is not assured. Therefore, performance-based regulatory programs will be necessary for integration with conventional sewerage. SF

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2. Otis, R.J. "Decentralized Wastewater Treatment: A Misnomer," in *On-Site Wastewater Treatment, Proceedings of the Eighth National Symposium on Individual and Small Community Sewage Systems.* American Society of Agricultural Engineers, St. Joseph, Michigan, 1998.
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Wastewater Control in the NYC Watersheds

CONTRIBUTING WRITER
Ted Simroe

Editor's Note: This article is reprinted with permission from the September, Vol. 1, No. 5, 1999 issue of *Water Resources IMPACT*, a publication of the American Water Resources Association. Ted Simroe is the Assistant Chief of the Engineering Section, Bureau of Water Supply, Quality, and Protection of the New York City Department of Environmental Protection. He was a contributor to the development of the Watershed Rules and Regulations and was a participant in the watershed memorandum of agreement negotiations.

The watersheds of the New York City water supply system cover approximately 2000 square miles in portions of eight counties. The watersheds are divided into three separate areas or systems, the Croton, the Catskill, and the Delaware. These three systems regularly supply 1.3 billion gallons of water per day to nearly nine million people in New York City and four upstate counties, more than half the population of the state of New York. The development of the reservoirs and the aqueduct systems that transport this tremendous amount of water is truly one of the engineering marvels of the world, and the quality of the water delivered has rarely been equaled.

It must be realized that these watersheds are not isolated wilderness regions, but are populated by nearly a quarter million people who live, work, and play within the 73 towns and villages located in these areas. The need to protect the waters in these areas is a paramount consideration to the City of New York, but the protection must be accomplished without jeopardizing the livelihood or quality of life of the people living within the watershed boundaries. To this end, the City, U.S. Environmental Protection Agency (EPA), New York State Departments of Environmental Conservation, State and Health (NYSDEC, NYSDOS, NYSDOH), environmental groups and watershed towns developed a watershed memorandum of agreement (MOA) designed to protect the quality of the water and to provide the population within the watersheds the opportunity to develop a series of environmentally sensitive and economically viable patterns for growth and diversity.

The MOA has three basic components: a land acquisition program, a series of protection and partnership programs, and a revised set of watershed rules and regulations (WR&R), promulgated by the City for the protection of the water supply and its sources. The WR&R incorporate certain existing federal and state regulations and recommendations, and are unique within New York State in that both wastewater and stormwater treatment are subject to comprehensive regulations. Much of the funding for the various programs outlined in the MOA will be provided by the City. Of interest in this discussion will be the portions of both the MOA and the WR&R that provide the City with the increased opportunity to preserve and protect the quality of its water supply by controlling the wastewater generated within the watersheds.

With almost 250,000 people living in a 2000 square mile area, overall population density is less than one person per five acres, which is not much higher than the population density figures for some sections of our western states. Yet the amount of wastewater generated within the watersheds has been estimated at nearly 50 million gallons per day. There are currently 91 privately owned, decentralized wastewater treatment plants incorporating both surface and subsurface discharges, and 16 municipal wastewater treatment plants in the watersheds. These treatment plants process approximately10.8 million gallons per day. Of the 16 municipal plants, eight are owned and operated by the City. Under the MOA, each wastewater treatment plant in the watersheds will be upgraded by the year 2002 to provide phosphorus removal; sand filtration; microfiltration or equivalent technology; and back-up power, sand filter, and disinfection capabilities.

The design and construction of any new or expanded wastewater treatment plant must be approved by the New York City Department of Environmental Protection (DEP), and such systems must be operated and maintained in a manner that prevents pollution or degradation of either surface or ground waters. Any existing, new, or expanded wastewater treatment plant with a surface water discharge must be capable of 99.9 percent removal or inactivation of *Giardia* cysts and enteric viruses. In addition, each facility must be capable of providing phosphorus removal to a limit of 1.0 mg/L for facilities with flows less than 50,000 gallons per day; to .05 mg/L for flows up to 500,000 gallons per day; or to .02 mg/L for flows greater than 500,000 gallons per day. Inspections and sampling of these facilities are conducted by both NYSDEC and DEP to ensure SPDES compliance, as well as proper operation and maintenance. The results of these inspections, and the corrective actions taken in cases where there may be a compliance violation, are made available to U.S. EPA, NYSDEC and NYSDOH at the joint Watershed Enforcement Compliance Conferences (WECC) conducted quarterly throughout the year.

The remaining wastewater generated within the watersheds is handled by approximately 130,000 septic systems, which treat nearly 40 million gallons per day. Of these, roughly 19,500 systems are commercial or institutional systems now regulated by DEP under the WR&R, which incorporate NYSDEC's "Recommended Standards for Intermediate Sized Sewage Facilities (1988)." The remaining 110,500 systems are individual household systems regulated by DEP under the WR&R, which incorporate NYSDOH Regulations, Appendix 75-A.

Several requirements or limitations on the design of septic systems that are incorporated into the WR&R are more stringent than state regulations. These include increased setback distances from reservoirs and reservoir stems, limits on fast percolation rates, restrictions on the "raised system" as described in Appendix 75-A, requirements for a 100 percent reserve area for leach field replacement, and the exclusion of mounds, sand filters, and evaporation-transpiration systems.

The siting and design of all septic systems must be approved by both DEP and any established local health department. The WR&R also allows for the witnessing of soils testing and final installation of the system by DEP personnel, a provision DEP finds absolutely necessary if septic systems are to be sited and installed properly within the watershed. In certain instances, DEP has delegated some of its approval authority to the local health departments on a trial basis, under the condition that the requirements outlined in the WR&R for the review and approval of septic systems be followed.

In addition, there is within the WR&R a requirement for the proper operation and maintenance of installed systems. In other words, it is a violation of the WR&R, and since the City's WR&R were also adopted as state regulations, a violation of state law, to improperly operate or fail to maintain a septic system within the watersheds. A septic system that is in failure thus places the owner or operator at the risk of legal action in court. DEP has, however, adopted a policy of first working with the owners or operators in the development of a plan for the prompt remediation of a system in failure, believing that time spent to ensure properly functioning septic systems is more valuable to the overall water supply than time spent in a courtroom.

This brings up another unique feature incorporated into the WR&R pertaining to the remediation, replacement, modification, or expansion of any septic system. There are no state standards for the repair of failed septic systems, or for any modifications to systems already installed (NYSDOH Appendix 75-A only applies to the installation of new individual septic systems). DEP felt that no such actions should be accomplished without regulatory review. Although neither NYSDEC nor NYSDOH require any plans for the remediation or repair of failing systems, DEP, by incorporating the necessary language into the WR&R, now requires complete plans for such septic system projects, except for certain routine maintenance, and requires that these plans must be reviewed and approved by DEP. Where possible, DEP also requires that the plans must incorporate the current standards spelled out in the WR&R. If complete compliance with the current regulations is not possible, the design that complies to the best extent possible will be considered.

These special requirements are critical for water supply protection, as they provide DEP with the opportunity of ensuring that all new septic systems and remediations and repairs of failing systems will be installed properly. DEP is extremely diligent when it comes to the review and approval of septic system plans, and is confident that the siting of new and replacement systems complies with the appropriate standards. In some ways, DEP personnel are able to perform many of the functions of the certified septic system inspectors who are utilized by other states to ensure the proper installation and maintenance of septic systems. However, there are no provisions within the watersheds, or even in the state, for required routine septic system inspection and certification by licensed inspectors. Consequently, systems that could be failing within the City watersheds may not be discovered and remediated unless they are reported directly to DEP, or surfaced effluent is observed by DEP personnel. The discovery of a failing septic system, therefore, really depends on the owner or operator being aware of the situation and reporting the condition to DEP. While this is frequently done, more often then not, it is a neighbor's complaint that brings the necessary action. Extensive outreach efforts that have targeted the installation of low-flow fixtures and the operation and maintenance of septic systems, especially the need for routine pump-outs of septic tanks and the need to prevent harmful chemicals from entering the system, have been helpful in preventing failures. But it is the problem of identifying existing failures that presents the greatest challenge.

At one time it was thought that wastewater management districts could be formed within the watersheds to solve the inherent siting and maintenance problems associated with septic systems, and that these districts could be aligned with the City-owned treatment plants and proposed new or expanded plants to provide both septic and sewer operation and maintenance. This concept would have necessitated public acceptance of the potential threat posed by failing septic systems, and would require

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There are no state standards for the repair of failed septic systems, or for any modifications to systems already installed.

Monument

Oregon's First Self-Help Project

CONTRIBUTING WRITER
Jolene Lawton

There is an old ordinance in Monument that says, "All sewers shall discharge into the John Day River or into a reservoir or cistern (cesspool)." Today the residents of this east Oregon community are doing everything they can to keep their wastewater out of the river.

The onsite wastewater systems serving Monument's 160 residents were never identified as a problem until a few years ago. Approximately 65 percent of the town's septic systems are failing, and the lot sizes are too small for the required upgrades. Public health is on the line; the John Day and Pendelton rivers bordering the town are in danger of being contaminated.

The local economy is another challenge facing the town. Monument originally was a saw mill town, but the number of residents and jobs declined with the lumber industry. Town leaders wanted to inject new life into the community by attracting new businesses, but without a functioning wastewater infrastructure in place, they knew they were at a disadvantage.

The town clearly needed to find a practical, cost-effective solution to its wastewater problems—not only to address the immediate threat to public health, but also to protect the long-term environmental and economic future of the community. In response, Monument's residents have literally taken the project into their own hands, working side by side to overcome one predicament after another.

Taking the First Steps

"By the time it gets so bad that sewage is coming to the surface, the community is well aware they have a problem," said Alan Bogner of the Oregon Department of Environmental Quality (ORDEQ). "People usually come to us first."

Jackie Oakley, Monument's city manager, and involved citizen Joan Silver took this first step in 1993. At this point, there was sewage in yards and ditches. One individual who thought she had a freshwater spring in her backyard did not realize that her children were actually playing in sewage.

Bogner explained that state onsite system laws have become more stringent over the years. For example, drainfields need to be larger than in the past. The size is determined by such variables as how many bedrooms are in the occupant's house. Bogner said that roughly 90 percent of rural community lots must double the size of their current drainfields and double them again to set aside room for a backup drainfield in order to meet the required size.

"You can fix these problems with expensive technology, or some people 'Band-Aid' their systems along for several years," Bogner said.

The community originally planned to solve its dilemma the traditional way, by using a contractor and hired crew to build sewers and a community treatment facility. The estimated cost of the first project proposed was more than $2 million.

"All the retired people were shaking in their boots about how much it was going to cost," said Jack Sweek, Monument resident and member of the wastewater committee. With the lack of new business and employment, young families are continually moving out. Therefore, retired people make up a good portion of the town's remaining population.

Another threat the stagnant economy and declining population presents is the possibility that the town's school might close. Currently, the school is the only large employer in Monument, aside from an electric power co-op, and many consider it to be the heart of the community. The school was forced to lay people off for the first time this year. Enrollment is lower than it has ever been and is dangerously close to falling below the 40-student minimum state requirement.

Going Through the Process

Town officials initially applied for a Block Grant from the Oregon Community Economic Development Department (OCEDD) to help fund the project. Before this money would be accessible, the OCEDD required the community to identify the specific problems and decide in advance exactly how they would get the job done.

Monument applied for and received a small $20,000 technical assistance grant from the OCEDD to allow the community to develop a pre-plan, hire an engineer, and find out how much the entire project would cost. The engineer they hired agreed with the town's original assessment that a conventional gravity sewer system leading to a small central treatment facility would be the best choice for the community given its layout and topography.

The treatment facility, which is designed for the town, consists of three lagoons operated in series. The first lagoon will serve as a settling pond, and the second and third lagoons will provide treatment. Designed to minimize odors as much as possible, the treatment lagoons will be relatively deep and will be equipped with manifold systems to allow the wastewater levels to be adjusted.

"There is a lot of flexibility designed in this system," explains Andy Holland of Loomis and Moore, one of the engineers currently working on the project. "The manifold system also allows the wastewater to be recirculated for additional treatment."

Photo courtesy Alan Bogner.

Monument, Oregon Mayor Ron Ford with the ceremonial outhouse that was moved to the site of the town's wastewater treatment project for the ground breaking ceremony.

Once the wastewater is treated in the lagoons, it will be land-applied through spray irrigation. Due to the almost desert-like climate in this part of Oregon, most of the effluent applied by the spray system is expected to evaporate.

When the facilities plan was completed, Oakley attended a "one-stop meeting" in Salem, Oregon, sponsored by the OCEDD. All state funding agencies are invited to these meetings and any community in Oregon can attend once it has a facilities plan to see what financial backing may be available. Oakley presented Monument's plan at the meeting, and then the OCEDD asked if the town systems had ever officially been found to be noncompliant. Since the answer was no, despite the many failing onsite systems and several lingering cesspools in town, Monument could not receive funding.

Distressed by the outcome of the meeting, Oakley went back to the city council, which suggested conducting a survey of the community's onsite systems. Monument received approximately $21,000 as a Sanitary Survey Grant from the OCEDD in 1996. The engineer the town employed at the time did several dye tests and some paperwork, but the OCEDD still said they had no project.

With only $300 of the grant remaining, Oakley, Silver, and Bogner bought more dye and personally flushed fluorescent green dye down every community member's toilet.

"Everyone was cooperative, and all it took was some dye and a roll of film," said Oakley. "We're telling other towns who want to save a lot of money to do it themselves!"

The dye tests the community conducted not only showed that an alleged spring next to the city hall was actually shooting out wastewater, but also that untreated wastewater was showing up only 50 feet away from the river. One house a block from city hall had the telltale dye all over its basement walls and floor.

Finding a Cost-Effective Solution

In some states, the next step is to simply collect grant money to implement the project, but this is not the case in Oregon.

"Oregon is an extremely difficult place to deal with public funding," said Silver.

Oakley then attended another one-stop meeting. Someone at the meeting mentioned the Small Town Environmental Program (STEP), which is sponsored by the Rensselaerville Institute in New York. STEP offers a self-help approach to solving wastewater problems in small, low-income communities. Oakley mentioned STEP to the engineer who was working on the town's project. He discouraged the idea.

A short time later, Jane Schautz of the Rensselaerville Institute presented a workshop on the STEP program in Oregon. The Monument council members at the STEP workshop became very excited by the possibilities of this self-help approach. They wanted to give it a try, and they also began looking for a new engineer.

The success of the self-help approach depends on the support of the town's residents. The council held town meetings and went door-to-door, and overall the response was positive. Once local support was certain, Monument became STEP's first self-help project in Oregon.

Getting the Project Underway

In the fall of 1997, the state finally gave Monument a $244,000 final engineering design grant for their project. What Monument needed to do next (as part of the self-help approach) was round up all their local resources. STEP explained how the town could save approximately $1 million through volunteer labor and the use of privately owned equipment. In a self-help project, the town also gets to exercise more decision-making power in determining such things as where to lay the pipes.

One community member, Klaus Hoehna, an Air Force reserve colonel, donated an idea. He knew that the Air Force digs trenches as part of their training. Instead of digging just anywhere, he thought, why can't they excavate the lagoons where the wastewater will be treated once the system is finished? On May 2, 1999, the local reserve unit began to do just that.

Then the Oregon Aeronautics complained that the lagoons would be too close to the nearby airstrip. They claimed any water had to be at least five miles away from the airstrip because it might attract birds. The mayor decided he would close the airstrip if that were the case. The pilots had a sudden change of heart.

The Air Force reserve unit dug one trench and cleared off most of the sloping land when yet another problem brought the project to a halt. Just two days after they started, a council member read in a neighboring community's paper that one of the funding agencies would be withholding funds. No one knew the reason.

After many letters and phone calls to local politicians, the town found out that they would receive their money, but not for several more months. Many people were disappointed that so much valuable time in the summer would be wasted.

"The engineer says a project like this takes nine to 24 months usually. We're hoping to stay between 12 and 15," said Silver. "It's going to be an interesting challenge in a town this small and remote to get it done in a timely fashion."

The good news is that the project is once again underway. The town recently hired a full-time construction supervisor. Monument also has a variety of expertise within the community, and several residents own equipment, including tractors, backhoes, and bulldozers. The town will bid for other supplies.

"The state has been sending people to talk with us," said Council Member Betty Richards. "I think that they [the state] would like to see the project be successful because there are a lot of other towns like us, especially in eastern Oregon."

The volunteers soon will be digging trenches, laying sand, and connecting pipes, which is familiar work to many of Monument's residents. Local businesses will also donate food for lunch, and some volunteers will see to it that everyone gets to eat. Unfortunately, one nearby restaurant is unable to donate the use of their restroom facilities because of their own malfunctioning onsite system.

"A lot goes into a project like this—you can't just slop it in," said Sweek, who attended a workshop on sewer systems about a year and a half ago in Portland. "I learned this is not simple like putting in a sprinkler system. The main thing now is to keep people involved. It's been dragged out because of the financing problems."

Once the system is in, the town hopes that new businesses will open. Oakley has plans for a motel on the edge of town, and there are hopes of building a dormitory to increase enrollment in the town's school.

"The benefits of a self-help project go far beyond cost savings," said Bogner. "There's a strong feeling of accomplishment, civic pride, heritage and community cohesiveness. There are always dozens of supervisors in self-help to make sure everything gets done as good as possible. People just take more pride in the improvements because they're doing it themselves."

If you would like to learn more about Monument's self-help project, contact Oakley at (541) 934-2025, or Holland at (888) 323-1180. To learn more about STEP and the self-help approach, contact Schautz at 63 Huyck Road, Rensselaerville, NY 12147; call (518) 79-3783, or visit the institute's Web site at http://*www.tricampus.org*. SF

Impact of Bacteria and Dosing Frequency on the Removal of Virus within Intermittently Dosed Biological Filters

CONTRIBUTING WRITERS

Robert W. Emerick, Ph.D.
JaRue Manning, Ph.D.
George Tchobanoglous, Ph.D.
Jeannie L. Darby, Ph.D.

ABSTRACT: Six dosing frequencies (1, 2, 3, 12, 24, and 48 times/day) were investigated for their impact on the removal of MS2 virus from primary effluent in laboratory-scale sintered-glass filter columns. The filters were operated both with and without the presence of bacteria on the sintered glass. The hydraulic application rate was 0.064 m/day [1]. The effective size of the medium was 1.5 mm with a uniformity coefficient of 1.0. The internal surface area was 87,050 m^2/m^3. Filter depth was 152 mm. At the constant hydraulic application rate, increasing the dosing frequency from 1 to 48 times/day resulted in an increase in the viral removal from 0.3 to 2.3 log in the absence of bacteria, and from 0.8 to 4.6 log in the presence of bacteria. At a dosing frequency of 48 times/day, removing the top 25 mm of the medium resulted in virus removal performance similar to that of the bacteria-free system. Filter depth also appeared to influence virus removal, with a greater depth resulting in higher virus removal.

KEYWORDS: small systems, virus, reclamation, wastewater

The passage of the Clean Water Act in 1972 prompted speculation that all residences served with onsite systems would eventually be connected to central wastewater collection/treatment/disposal systems. However, the ratio of the number of people discharging to large, centralized collection and treatment systems to those discharging to individual onsite systems has not changed significantly in the past 20 years (Crites and Tchobanoglous, 1998). This occurrence is in spite of the widespread availability in the 1970s and 1980s of federal grants to encourage construction of central treatment systems.

Thus, it is reasonable to suggest that individual onsite or small community treatment systems will make up an increasing proportion of all treatment systems in the future, given the current lack of financial incentives for building centralized wastewater treatment facilities and recent land development practices of building rural residential homes in areas not ideally suited for the placement of gravity flow sewers.

The most common small or onsite treatment system is the septic tank and soil absorption system. However, local site conditions may preclude the use of conventional septic tank and soil absorption systems due to low soil permeability, shallow soil over impervious layers, shallow soil over fractured bedrock, high or slow soil permeability, and high groundwater. If onsite systems fail due to site conditions, one of the greatest concerns is the occurrence and movement of viruses, which have been found to survive septic tanks and move with the percolating wastewater through the disposal field and the soil to reach groundwater (Hain and O'Brien, 1979; Anderson et al., 1991). Viruses are also one of the primary contaminants of concern in wastewater reclamation.

Of the available biological processes used for treating wastewater, fixed film processes are ideally suited to the small treatment system because oxygen can be provided from the atmosphere (i.e., minimizing energy requirements). Also, system cleaning normally is required infrequently (i.e., intervals of decades), the process can be automated, and the combination of septic tank storage and effluent recirculation can compensate to some degree for transient loading. The intermittently dosed sand filter is a fixed-film treatment process that has been used successfully as supplemental pretreatment for the soil absorption system at individual residences, small clusters of homes, business establishments, and rural communities for the removal of organic material and nutrients (Grantham et al., 1949; Furman et al., 1955; Schwartz and Bendixen,

1967; Marshall and Middlebrooks, 1974; U.S. EPA, 1980; Siegrist and Boyle, 1981; Anderson et al., 1985; Andreadakis, 1987; Pell and Nyberg, 1989a,b,c; Pell et al., 1990; Peeples et al., 1991; Darby et al., 1996). Use of a biological treatment step specifically for virus removal has not been reported for individual onsite systems.

Modern intermittently dosed biological filters (IDBFs) are typically 0.5 to 1 meter deep and are operated at hydraulic loading rates (HLR) varying from 0.016 to 0.070 m/day. The design has evolved in response to the use of sand as a medium due to its low cost. An effective size of 0.25 to 0.5 mm is used to provide sufficient surface area (i.e., around 20,000 m^2/m^3 for densely packed sand) for bacterial ecology development. However, to prevent system failure arising from clogging, typical dosing frequencies of 3 to 6 doses/day are used to allow some drying of the filter and thus death of bacterial cells by desiccation (Crites and Tchobanoglous, 1998). Although the strategy works well for the removal of organic wastes and total suspended solids, resulting in effluent quality that often rivals that of wastewater reclamation facilities, no support is available in the literature to suggest that the same design is optimal for the removal of virus from wastewater.

The literature supports the proposition that an intermittently dosed biological filter can be constructed to remove virus in addition to BOD_5 or TSS. Emerick et al. (1997) observed that the removal of naturally occurring phage in 0.38 m-deep pilot-scale ISFs was dependent on hydraulic loading rate in the range of 0.040 to 0.163 m/day when coupled with a dosing frequency of 24 doses/day. Maximum observed removal was 2.8 log at a hydraulic loading rate of 0.04 m/day and a dosing frequency of 24 doses/day. Gross and Mitchell (1990) described a study whereby biological filters retained all virus whenever the virus loading was less than $3.3x10^4$ PFU/mL (plaque forming unit/mL). Because of the large number of viruses held in the biologically active upper layer of the filter, it was concluded that the biological action of the filter was an important mechanism in virus removal. To date, no study has been completed in which the influences of medium type, medium depth, and biological activity on virus removal within intermittently dosed biological filters have been separated.

The specific objectives of this research were (1) to investigate the impacts of improved design (e.g., medium type, medium depth) and operation (e.g., dosing frequency) on virus removal within intermittently dosed biological filters, and (2) to investigate the role of bacteria in removing virus within intermittently dosed biological filters.

MATERIALS AND METHODS

To investigate the role of bacteria in removing virus within intermittently dosed biological filters, both bacteria-laden and bacteria-free primary effluent from the University of California, Davis (UC Davis) wastewater treatment plant was passed through laboratory scale filters. MS2 phage was added to the wastewater as the viral indicator. The wastewater quality varied considerably, with an average BOD_5 of 90.7 mg/L, and a range of ± 41.4 mg/L (95 percent confidence interval). In all experiments, the wastewater was applied to the filters in a dark constant temperature room at 22˚C. Details of the experimental design follow.

Experimental Design

Hydraulic loading rate remained constant at 400 mL/day (0.064 m/day) over the course of the study. The hydraulic loading rate was chosen because it was slightly less than the field capacity of the filter medium used. Six different dosing frequencies were investigated: 1, 2, 3, 12, 24, and 48 doses/day. A dosing frequency of one time/day thus resulted in 400 mL of primary effluent being applied once every 24 hours, whereas a dosing frequency of 12 times/day resulted in 33.3 mL being applied once every two hours. Dosing frequencies were investigated randomly. For measurement of bacteria-laden performance, filters were operated for 45 days prior to sampling with bacteria-laden water to ensure steady-state performance. One sample per day was collected over the course of five days to replicate viral removal performance.

Filter Construction

Three identical filters were used as part of this study. A single glass reservoir supplied feed water to all three filters. Influent virus concentrations were enumerated from the glass reservoir. Feed water was drawn through glass piping into 4.75 mm ID Tygon tubing using a peristaltic pump (Cole-Parmer Masterflex, Model 7017-20, Chicago, Illinois) controlled by digital programmable controllers (Crouzet, Model TOP 948). After passage through the tubing, the feed water passed through 0.3 m of stainless steel tubing (4.75 mm OD) fitted with a Vari-Jet 360˚ mister (Pepco, Fresno, CA). The stainless steel tubing permitted rigid vertical placement of the mister for uniform feed water application. Mister placement 100 mm above the surface of the filter medium resulted in uniform application measured by placing test tubes inside the filter housing and measuring the amount of water captured in each test tube. No detectable reduction in virus titer was observed through the inlet system.

Each filter was constructed of plexiglass with an inside diameter of 0.089 m. A 30-mesh stainless steel screen supported the filter medium. Effluent from the filters was collected in a funnel shaped filter chamber and drained into 1,000 mL beakers. The beakers were cleaned and autoclaved on a daily basis. Effluent virus concentrations were enumerated daily. From separate tests, it was found that no statistically significant amounts of virus were inactivated in any of the beakers prior to analysis.

Filter Medium

SIRAN carriers (Jaegar Biotech Engineering, Inc., Costa Mesa, California) were used as the medium throughout the course of this study. Each filter was filled with 465 g of medium, resulting in a medium depth of 152 mm. The field capacity of each filter was 430 mL. The SIRAN carriers were composed of sintered glass with a sphere diameter (i.e., effective size) of about 1.5 mm. The surface area of the medium was 87,050 m^2/m^3, approximately four times that of a densely packed sand. The sintered glass medium was chosen because its

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The specific objectives of this research were (1) to investigate the impacts of improved design (e.g., medium type, medium depth) and operation (e.g., dosing frequency) on virus removal within intermittently dosed biological filters, and (2) to investigate the role of bacteria in removing virus within intermittently dosed biological filters.

surface characteristics are similar to the sand used in conventional intermittently dosed sand filters, yet the extremely high internal surface area is conducive to the development of the high bacterial populations (hence its use in the pharmaceutical industry as a bacterial growth medium). The relatively large medium effective size minimizes the need for filter drying to prevent clogging while simultaneously encourages aerobic conditions throughout the filter.

Filter Influent

In the experiments requiring the use of bacteria-free wastewater, the primary effluent was autoclaved for 20 minutes, centrifuged at 3,000 G for 30 minutes, and the supernatant passed through a 0.45 µm membrane filter (Millipore Corporation, Cat. No. HAWP 047 00) to remove suspended solid material. The suspended solid material was removed from the bacteria-free wastewater because without an active filter microbiology, no degradation of the solid material could occur, most likely leading to accumulation of solid material within the filter. At minimum the experimental observations could be impacted with the added potential of filter clogging. However, the removal of the solid material in the bacteria-free wastewater necessarily resulted in different quality wastewater being applied between bacteria-free and bacteria-laden experiments, which itself could affect the experimental observations should adsorption of virus to particles and subsequent removal of those particles within the filters be important.

As a check, virus reduction in bacteria-free (and thus particle-free) filters were compared to the reduction that resulted immediately upon dosing with bacteria-laden (and thus particle-laden) primary effluent but prior to the development of a biologically active layer (i.e., filter start-up with particles present). There was never a statistically significant difference in virus removal between primary effluent with particles and primary effluent without particles prior to the development of a bacterial ecology. Thus, any difference in virus removal observed during the study was attributed to factors other than those relating to wastewater particles.

MS2 phage was added to both the bacteria-free and bacteria-laden wastewaters for use as a viral indicator. It was chosen because its size and physical characteristics resemble those associated with human enteric viruses and the virus is quite resistant to inactivation. Thus, the removal of MS2 phage may indicate corresponding removal of human viruses. Additionally, MS2 phage may be a more suitable indicator for testing biological filters than poliovirus because phages appear to be more sensitive to changes in HLR (Emerick et al., 1997).

MS2 virus were propagated in UC Davis laboratories (original source BioVir Laboratories, Benicia, California) and added to the filter feed water to result in a feedwater titer of approximately $2x10^8$ PFU/mL. The MS2 virus concentrations were enumerated using a modified form of the Coliphage Detection Method (Method 9211D) outlined in Eaten et al. (1995). The method was modified by using *Escherichia coli* (ATCC No. 15597) as the host bacterium. Three replicate measurements were made as part of the enumeration procedure. The dilution enumerated was the one that exhibited 20 to 200 plaques per plate. The median values of the replicates were used for data analysis/presentation.

RESULTS AND DISCUSSION

Analysis of variance (ANOVA) was used to assess the impact of dosing frequency and bacterial presence on virus removal within intermittently dosed biological filters. The ANOVA results are provided in table 1.

Two important points are evident from the analysis. First, both dosing frequency and bacterial presence were observed to be very significant parameters impacting virus removal (i.e., in both cases the p-value was less than 0.01). Second, and perhaps more important, there was also a very significant interaction between dosing frequency and bacterial presence (i.e., p-value also less than 0.01).

Impact of Dosing Frequency on Virus Removal in the Absence of Bacteria

The observed removal of virus within the sintered glass filter columns as a function of dosing frequency is illustrated in figure 1. The lower curve in figure 1 illustrates the observed removal of MS2 phage through the sintered glass filter columns in the absence of bacteria (at the constant hydraulic loading rate of 0.064 m/day).

In the system studied, a minimum of 0.3 log of virus at a dosing frequency of 1 dose/day and a maximum of 2 log of virus at all dosing frequencies greater than 12 doses/day were observed to be removed in the system composed solely of medium (i.e., free of any bacteria). Virus removals in the bacteria-free system were not statistically different at dosing frequencies greater than 12 doses/day. Virus removal due to the medium likely results from the type of fluid flow through the filter. At a high dosing frequency (e.g., greater than 12 doses/day), very little wastewater is applied to the filter at any one dose resulting in unsaturated film-like flow with low internal fluid velocities arising from wall effects due to the medium (Boller et al., 1994). Such hydraulic behavior encourages viral movement into medium pore spaces by diffusion where pore velocity is absent resulting in virus entrapment and eventual natural die-off. If, by chance, a viral particle is released from a pore space, ample opportunity exists for re-entrapment lower in the filter.

However, at a lower dosing frequency such as 3 doses/day, one-third of the filter's field capacity was applied with each dose. Low dosing frequencies result in saturated or near saturated flow conditions within the filter at each dosing episode (Boller et al., 1994). The resulting saturated or near saturated flow conditions encourage virus movement deep within the filter reducing the number of opportunities for pore space entrapment. Virus movement through the filter is also

Table 1

Analysis of Variance Used to Assess the Impact of Dosing Frequency and Bacterial Presence on Virus Removal Within Intermittently Dosed Biological Filters

source of variation	sum of squares	degrees of freedom	mean square	F-value	p-value
dosing frequency	84.89	5	16.98	339.6	<0.001
bacterial presence	21.36	1	21.36	427.4	<0.001
interaction of dosing frequency with bacterial presence	7.75	5	1.6	31.0	<0.001
error	3.00	60			

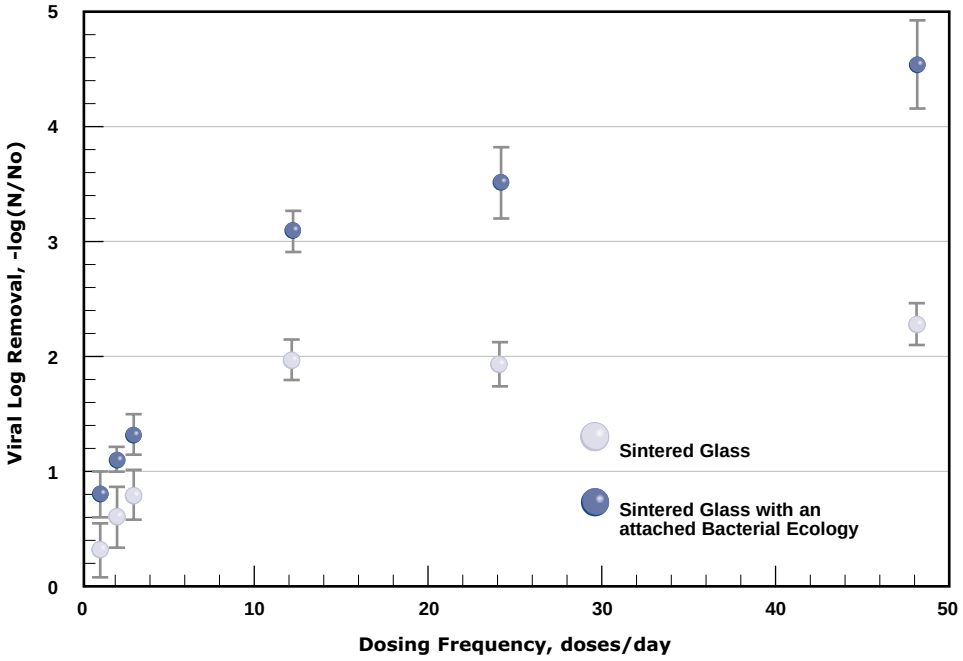

Figure 1

Impact of Bacterial Ecology Development on Intermittently Dosed Sintered Glass Filters (HLR = 0.064 m/d)

encouraged because it has been observed that decreasing the dosing frequency also encourages deviations from plug flow conditions and thus decreases the hydraulic detention time of some fluid elements (Boller et al., 1994).

Additionally, the high pore velocities associated with saturated or near saturated flow encourages the washing out of previously entrapped virus. In theory there exists a critical dosing frequency, a function of the hydraulic loading rate, that would result in unsaturated flow conditions and sufficiently low pore velocities to both encourage virus association with the medium and prevent virus shear. Dosing frequencies greater than that critical theoretical dosing frequency would not improve virus removal performance.

Impact of the Interaction Between Bacterial Presence and Dosing Frequency on Virus Removal

The observed removal of MS2 phage through the sintered glass filter columns as a function of dosing frequency with the presence of bacteria (at the constant hydraulic loading rate of 0.064 m/day) is illustrated in the upper curve in figure 1. At all dosing frequencies investigated, an established bacterial ecology increased the removal of virus from that observed by the medium alone. However, conventional dosing strategies used for BOD_5 and/or TSS removal (i.e., 3 to 6 doses/day) are not optimal for removing virus.

For example, at a dosing frequency of 3 doses/day, only 1.3 log of virus were removed in the biological system; whereas at a dosing frequency of 48 doses/day, 4.6 log of virus were removed. Virus removal occurring in the biologically active system dosed at 48 doses/day is characteristic of virus removal associated with reclamation treatment systems (e.g., oxidation, coagulation, filtration, chlorination). Additionally, from the trend illustrated in figure 1 it appears that even greater virus reduction is possible with even more frequent dosing strategies.

The two curves together in figure 1 illustrate the interactive relationship between dosing frequency and bacterial presence. At a dosing frequency of 1 time/day, the difference in virus removal between the bacteria-free and bacteria-laden system was 0.5 log. However, the difference increased with a corresponding increase in dosing frequency until at a dosing frequency of 48 doses/day, the difference between the bacteria-free and the bacteria-laden systems was 2.3 log.

In the system investigated, the hydraulic loading rate was about equal to the field capacity of the filter being dosed over the course of one day. Thus, at a dosing frequency of 48 times/day, each dose of wastewater was applied throughout only the top 1/48 of the filter (i.e., top 3 mm of filter depth). Thus, a high dosing frequency provides a regular supply of nutrients to a very narrow range within the filter, while simultaneously minimizing filter drying.

Given that bacterial presence increases the amount of virus removed, it would be expected that increasing the number of bacteria in a particular range and ensuring some residence time of all fluid elements in that range would maximize virus removal. In contrast, with a low dosing frequency (e.g., 3 times/day), nutrients are applied throughout one-third of the filter on an infrequent basis. Nutrient application throughout the filter depth would encourage moderate growth throughout a broad range within the filter. Additionally, the infrequency of application would promote drying and thus bacterial desiccation leading to a decrease in virus removal.

Mechanism of Virus Inactivation

It is not known definitively at this time how bacteria influences virus reduction within intermittently dosed biological filters. One possible explanation is that bacterial presence increases the surface area of the medium and provides additional viral adsorption sites. However, such adsorption is not likely to be the dominant mechanism because adsorption occurs, in part, due to the interaction between different chemical groups on the virus protein coat and groups on the adsorbing surface. It is unlikely that bacterial receptor sites were present for adsorption because the receptor site for MS2 phage occurs on the sex pilus of *Escherichia coli* and is only present at temperatures above about 35˚C (Davis and Sinsheimer, 1963). The operating temperature of the filters, 22˚C, was insufficient for expression of the MS2 binding sites.

There is some evidence that bacterial enzymatic attack could inactivate virus within intermittently dosed biological filters. Cliver and Herrmann (1972) reported that coxsackievirus A9 was susceptible to proteolytic enzymes, and Herrmann and Cliver (1973) demonstrated digestion of the viral coat protein of coxsackievirus A9 by bacterial proteinase. Ward et al. (1986) also demonstrated that proteolytic bacterial enzymes inactivate echovirus particles in freshwater by cleavage of virus proteins, thus exposing the viral nucleic acid to nuclease digestion. Deng and Cliver (1992) demonstrated anti-viral effects of several bacterial cultures isolated from swine slurry as did Ward (1982) from activated sludge mixed liquor.

Virus Removal Within Localized Regions Within Intermittently Dosed Filters

To determine the importance of the locally dosed region within the filter in removing virus, the top 25 mm of medium were removed from

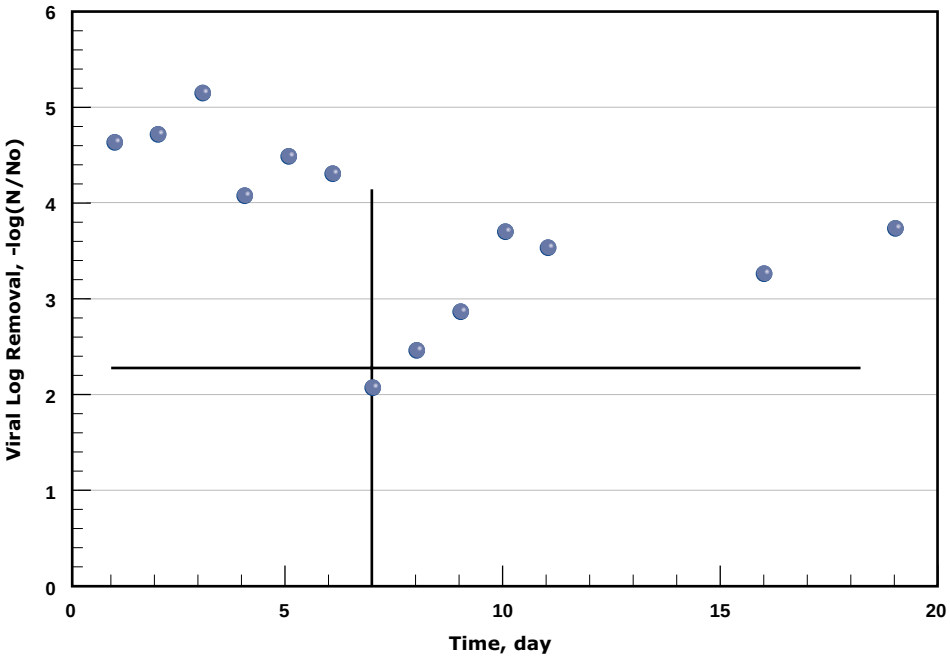

Figure 2

Impact of the Removal of the Upper Layer in an Intermittently Dosed Sintered Glass Filter (Dosing Frequency = 24 doses/d)

the filter being dosed at a frequency of 48 times/day. The resulting log removal data are presented in figure 2.

Virus removal immediately and markedly decreased following removal of the top 25 mm of medium, resulting in a virus removal reduction from an average of 4.6 log to 2.1 log. Note that an average of 2.3 log removal was observed without any bacterial presence in the filter (figure 1). Thus, it appears that the entire increase in virus removal due to the established bacterial ecology occurred in the uppermost portion of the filter most impacted by the frequent dosing strategy.

The medium also appears to impact virus removal in relation to its depth within the filter. Upon development of a new bacterially active layer following the removal of 25 mm of medium, virus removal attained a steady state value roughly 1.0-log less than that observed with a 152 mm deep filter. If it was assumed that log removal of virus by the medium alone occurred uniformly throughout the depth of the filter, it would be expected that removal of 25 mm would cause a decrease in removal by 0.4 log. At a 95 percent confidence interval, however, the 0.4-log theoretical mean difference is not statistically different from the observed mean difference of 1.0 log.

CONCLUSIONS AND RAMIFICATIONS

Three specific conclusions can be made as a result of this research:

1. An established bacterial ecology is an important parameter for the removal of virus within intermittently dosed biological filters.
2. In the absence of bacteria, the medium can remove virus when combined with unsaturated flow conditions, and thus an increase in unsaturated medium depth will increase the amount of virus removed from wastewater.
3. Increasing the dosing frequency results in an increase in the removal of virus both for bacteria-free and bacteria-laden systems.

Two practical ramifications arise from this research:

First, the technique used for applying wastewater to an intermittently dosed filter is important for the removal of virus. Conventional dosing techniques used in full-scale filters apply water at discrete locations across the top of the filter rather than spraying it uniformly across the filter surface and thus rely on capillary action to distribute the wastewater over the entire cross-section. Such a dosing strategy is both an inefficient use of filter volume and would produce localized saturated flow conditions known to promote virus transport. The use of an inefficient dosing technique can thus counteract any potential gains in virus removal resulting from use of a high dosing frequency. Virus movement, particle shearing, and distributed bacterial growth are hypothesized to impair virus reduction within intermittently dosed biological filters.

Second, it may be possible to specify different mediums for different layers within intermittently dosed filters to optimize virus removal while simultaneously minimizing cost. Sintered glass is currently very expensive (i.e., $120/L), but with more demand it may decrease in cost resulting from economies of scale in its production. Additionally, other less expensive mediums (e.g., granular activated carbon) may provide the same benefits as sintered glass (e.g., by providing higher surface area for bacterial development while simultaneously providing large inter-sphere passageways to resist clogging brought upon by use of a high dosing frequency).

Additionally, it has been demonstrated that virus removal equal to that of reclamation treatment systems can occur with a medium depth of 150 mm, with only the top 25 mm contributing any biological influences. This depth is much shorter than the 0.5 m now commonly used with intermittently dosed sand filters. Thus, it may be possible to use high surface area medium for the top biologically active layer that is most likely to clog over time and less expensive sand (i.e., about $23/m^3) for additional virus adsorption necessary to meet virus removal standards.

ACKNOWLEDGEMENTS

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Notes

1. 1 m/d is equivalent to 24.54 gal/ft2(d

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Call for Papers

Papers are now being accepted for the juried article section of the new *Small Flows Quarterly*. The technical and research papers included in this portion of the magazine will be devoted specifically to small community wastewater topics.

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6. Manuscripts (and diskettes) not accepted for publication will be returned, if requested, to the principal author.
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Robert W. Emerick, Ph.D.

Robert Emerick currently works at ECO:LOGIC Engineering (Roseville, CA). He is a registered professional engineer with a bachelor of science degree, a master of science degree, and a Ph.D. in civil engineering from the University of California at Davis. He was a doctoral candidate in the Department of Civil Engineering at the University of California, Davis and a STAR fellow with the United States Environmental Protection Agency during the conduct of this research.

JaRue Manning, Ph.D.

JaRue Manning is a processor in the Section of Microbiology, Division of Biological Sciences at the University of California at Davis. He received a bachelor of science degree in physics from California State University, San Francisco, and a Ph.D. in biophysics from the University of California at Berkeley.

George Tchobanoglous, Ph.D.

George Tchobanologous is a professor emeritis in the Department of Civil and Environmental Engineering at the University of California, Davis. He has a bachelor of science degree in civil engineering from the University of the Pacific (Stockton, CA), a master of science degree in sanitary engineering from the University of California at Berkeley, and a Ph.D. in civil engineering from Stanford University. He is a registered professional engineer.

Jeannie Darby, Ph.D.

Jeannie Darby is a professor in the Department of Civil and Environmental Engineering at the University of California at Davis. She has a bachelor of science degree in civil engineering from Rice University, a master of science degree in civil engineering from Tufts University, and a Ph.D. in civil engineering from the University of Texas at Austin. She is a registered professional engineer.

For more information about this article, contact Robert Emerick at ECO:LOGIC Engineering, 3005 Douglas Blvd., Ste. 200, Roseville, CA 95661, (916) 773-8100, or via e-mail at *ecologic@foothill.net*.

The Use of Peat Filters in Domestic Wastewater Treatment

CONTRIBUTING WRITER
Clement Solomon

Editor's Note: This column is based on calls received over the National Small Flows Clearinghouse (NSFC) technical assistance hotline. If you have further questions concerning peat filters, call (800) 624-8301 or (304) 293-4191 and ask to speak with a technical assistant.

What are peat filters and how is this alternative technology used for domestic wastewater treatment?

Introduction

In rural and suburban areas where central sewer systems are not available, domestic wastewater is treated and disposed of onsite. The use of onsite systems has increased over the years, often due to the high costs associated with central sewers and the advent of innovative and alternative (I/A) systems that can be used where conventional septic systems are not feasible.

There are several I/A technologies available today using a wide variety of techniques to effectively treat and dispose of domestic wastewater onsite. Filters using different types of media are being developed to enhance the efficiency of the system by removing a large amount of pollutants before disposal. One such technology currently being evaluated as an alternative for onsite wastewater treatment is the peat filter.

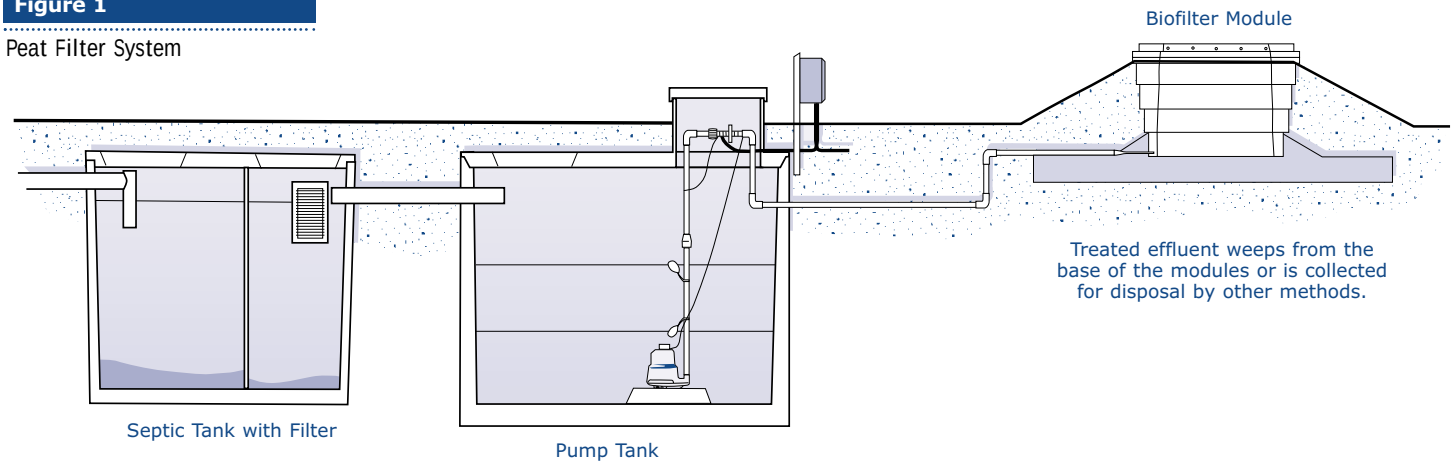
Principle of Operation and System Description

Peat is a fibrous mass of organic matter composed mainly of plant remains at various stages of decomposition that occurs in wet or supersaturated areas under anaerobic conditions. Peat is a complex material with a very high capacity to retain or bind water, as demonstrated by its widespread use in horticultural applications.

A peat filter is a biological system usually used to provide secondary level treatment of effluent from a septic tank or other primary treatment process. These filters can be constructed onsite or delivered as preconstructed modules. Treatment within the filter is achieved by a combination of physical (filtration and absorption), chemical (adsorption and ion exchange), and biological interactions (microbial assimilation) between the wastewater and the peat media.

A typical peat filter system would consist of a septic tank, a pump (dosing) tank, peat filter, and a disposal area as shown in figure 1. The septic tank is where settleable and floatable solids and scum are removed to provide primary treatment. Partially clarified effluent then flows by gravity to a pump tank where it is stored until it reaches the level of the upper float control, which activates the pump.

Figure 1
Peat Filter System



Effluent is pumped to a manifold and then evenly distributed over the peat filter. The effluent percolates through the peat media and is collected at the bottom of the filter. The treated effluent from the peat filter is disposed into a gravel bed directly under it or collected and disposed by gravity or pressure to a disposal field. The drainfield required to dispose of the treated effluent is considerably less than that required for a conventional septic system. This is due to the fact that there is considerable treatment in the peat filter before disposal.

Microbiology

Biological treatment and assimilation in a peat filter is achieved by a diverse microflora that are present on the surface of the media. Commonly found bacterial genera include *Pseudomonas*, *Micrococcus*, *Aeromonas*, *Flavobacteria*, and *Bacillus*. Bacterial populations are very large and similar numbers of fungal organisms have also been found. A wide range of higher forms of life, from protozoans, rotifers, and algae to nematodes, annelid worms, and insects have also been recorded in the media.

Advantages

- high effluent quality (BOD, TSS, fecal coliform reduction) produced when compared to conventional septic system,
- significant reduction in drainfield area requirement,
- less land area is required due to compact design,
- easy to install if its a pre-assembled unit,
- treatment capacity can be expanded through modular design,
- easily accessible for monitoring and does not require a lot of skill to maintain,
- no chemicals required, and
- low operating and maintenance costs.

Disadvantages

- limited to treating domestic strength wastewater—not suitable for industrial waste or graywater,
- treatment media has a limited useful life and has to be replaced with new media depending on the type of peat used (estimated 15 years), and
- cost of the system is higher than a conventional septic tank soil absorption system.

Case Study

In July 1997, the Department of Civil and Environmental Engineering, Old Dominion University, monitored 12 single-pass peat filter systems installed in four different soil types and operating under various climatic conditions. The monitoring was done in accordance with the guidelines recommended by the Virginia Department of Health.

Table 1

Treatment Performance of the Peat Filters Studied

Parameter	Septic Tank Effluent	Peat Filter Effluent	Percent Change
BOD (mg/L)	290	6	- 97.9
TSS (mg/L)	1190	16	- 98.7
NH_3-N(mg/L)	44	0.9	- 98.0
NO_3N(mg/L)	0.8	28	+ 97.0
Total Nitrogen (mg/L)	51	30	- 41.0
Fecal Coliform (Colonies/ml)	1.05 E6	2.0 E3	- 99.8

Source: Reasor, J. A., Erten-Urnal, M., et.al., "The Evaluation of the Performance of a Peat Biofilter for Onsite Wastewater Treatment in Virginia," Department of Civil and Environmental Engineering, Old Dominion University.

The objectives of this study were to determine quantitatively the reduction in biological oxygen demand (BOD_5), total suspended solids (TSS), ammonia nitrogen (NH_3-N), and fecal coliforms; investigate the performance of the system in a variety of soil types and climatic conditions; and demonstrate the effect of the system on groundwater quality.

There was significant reduction in the BOD_5, TSS, NH_3-N, and fecal coliform levels. A reduction of at least 95 percent was observed in all the parameters studied during a short period of monitoring. Table 1 shows the treatment performance (average values) of 12 peat filters sampled from July 1997 to January 1998.

Conclusions

On sites where conventional soil absorption systems are not feasible, peat filter systems and other media filters can be used as an alternative. A peat filter system, designed and installed properly could provide a high-quality effluent with minimal maintenance. It can be used to advantage on adverse sites where fecal coliform, nitrates and other pollutants are of major concern.

Alternative and innovative wastewater technologies are a viable option in addressing the needs and solving the wastewater problems of single-family residences and small communities since they can be used to effectively treat and dispose of domestic wastewater.

A number of states in the U.S have started issuing experimental permits for the use of alternative technologies to study the efficacy of these systems for onsite wastewater treatment or disposal. The systems are installed and monitored in different soil types, operating under varying climatic conditions.

Testing and evaluation of the new generation of systems is vital because it will provide alternatives to the conventional system. The wider use of alternative technologies will also reduce the cost per unit as more and more states approve their use for wastewater treatment and disposal. SF

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NODP to Develop National Database

A database of all demonstration projects in the U.S. is currently being developed as part of the National Onsite Demonstration Project—Phase 2. This database is designed to house a wide variety of information on as many domestic wastewater demonstration projects as can be located.

For more information concerning the database please contact Eric S. Menear at the following address:

National Demonstration Projects
Database NODP II
National Small Flows Clearinghouse
West Virginia University
PO Box 6064
Morgantown, WV 26506-9900

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Baranowski Leads EPA's 104(g) Training Program

CONTRIBUTING WRITER

P.J. Cameon

Editor's Note: This interview also appears in the Fall 1999 issue of *E-train*, a quarterly newsletter published by the National Environmental Training Center for Small Communities.

Just over a year ago, Curt Baranowski took over as project officer for a U.S. Environmental Protection Agency (EPA) program that provides onsite assistance to operators of small wastewater treatment plants. While the program receives relatively little funding, Baranowski feels it is making a positive impact on the nation's water quality.

Officially named the Wastewater Treatment Operator Training Program, the program is commonly referred to as the 104(g) program after the section of the Clean Water Act that authorized its existence.

"The 104(g) program was started to help municipally owned wastewater treatment plants in small communities maintain or achieve compliance," Baranowski explained. "Specifically, the program is available to systems that discharge fewer than five million gallons of effluent a day. Many systems that get assistance discharge fewer than one million gallons per day."

The program disperses its congressional allocation in the form of EPA grants to state training centers, environmental agencies, and nonprofit groups that provide assistance onsite at wastewater treatment plants. These groups help system personnel solve compliance issues and provide direct onsite assistance and other operation and maintenance, technical, or financial guidance necessary for the systems to operate at optimum performance.

During their onsite visits, trainers might discuss treatment plant capacity, preventive maintenance, administrative management, or laboratory operations. If there is a need for new or expanded facilities, the trainers might guide town officials on ways to finance the project, how to select consultants, and how to conduct a design review.

"There is absolutely no cost to the systems that get assistance from the program. We provide all the assistance and specific recommendations for free," Baranowski said, adding that the only requirement is the community's willingness to work cooperatively with a trainer to correct any problems.

Program's Benefits Hard To Calculate

The 104(g) program assisted 999 systems during fiscal year 1998. "We were able to help 890 of those systems get back into compliance, maintain compliance, or, at a minimum, improve their performance," said Baranowski.

He estimated that a similar number of systems were assisted during fiscal year 1999, based on data collected at mid-year. Some of those systems are carryovers from the previous year, he explained, because of their continuing need for assistance.

Curt Baranowski, Wastewater Treatment Operator Training Program project officer

The true benefit of the program, according to Baranowski, is the improvement in surface water quality as well as the number of enforcement actions that were not taken due to the efforts of the 104(g) program.

"It's really hard for us to pull together actual numbers of what enforcement costs would have been without the assistance provided under the 104(g) program and its partners," he said. "There's no way for us to estimate what the actual penalties would have been if these systems had fallen out of compliance."

When discussing the 104(g) program's impact, Baranowski does like to mention one statistic: during fiscal year 1998, federal and state environmental agencies took some form of enforcement actions against 1,000 to 1,500 small systems with discharges of fewer than five million gallons per day.

"There's no accurate information on the amount of fines levied against those facilities," Baranowski stressed. "But what I found interesting is that there was almost an even number of facilities that we were assisting and keeping in compliance—therefore enforcement actions are not being taken—as there were facilities against which enforcement actions were taken."

It could be suggested that the efforts taken under the 104(g) program have helped cut enforcement action against smaller wastewater treatment facilities significantly. "That's really excellent," Baranowski said.

The Maryland Center for Environmental Training recently conducted a survey of 45 training centers across the country. A report based on the survey results should help both quantify and qualify the 104(g) program's effectiveness with a combination of statistics and case studies. The report is expected to be released by the end of March.

Evolving Role of Regulators

Historically, regulatory agency employees have been funded to conduct enforcement activities, Baranowski said. They generally did not provide any technical assistance.

That's changing, he said, adding that both state and federal regulators are becoming more involved in helping systems, especially small systems, remain compliant or achieve compliance.

As an example, when Baranowski first started working with the New Jersey Department of Environmental Protection (DEP), the division he worked in was named Water Enforcement. By the time he left the New Jersey DEP to join EPA, the division was renamed Water Compliance Assistance and Enforcement to reflect its increased focus on assistance activities.

Regulators are increasingly taking the approach that precious funds that small communities could be forced to surrender in the form of penalties could, in many cases, be redirected to solving the systems' problems, according to Baranowski.

Tribal presence, distance training are priorities

As 104(g) coordinator, Baranowski has plenty of short-term and long-term goals. He said his top priority is to remain focused on quality training and maybe even increase the number of systems served. "Time and time again, I see training centers and trainers being very creative with what they can do with the level of funding we provide them."

Baranowski is also eager to see a Tribal training center emerge, modeled on the 104(g) program, to provide the same sort of assistance to Tribal communities. He said officials in other EPA programs also are interested.

"We'll be trying to establish a center at a Tribal college or organization that will be located in a concentrated area of Tribal communities," he said. "We've sent requests for proposals to about 30 organizations. It's very much in the development stage, but I think it's going to be a real positive program, which will supplement the existing one, once we get it up and running."

Baranowski also sees the 104(g) program partnering with various organizations to provide "distance" training where the trainer and trainee need not be in the same place at the same time. "Certainly there are a lot of operators out there who just cannot reach a training center. If they could take a training course via the Internet or television, that would be fantastic."

Using the Internet

Baranowski also has a lot of ideas for using the Internet to help get the word out about the 104(g) program. Among those plans are expanded content on the program's Web page located at *http://www.epa.gov/OWM/tomm.htm*. A message board where trainers and wastewater treatment plant operators can share ideas and an e-mail group Baranowski could keep informed through periodic broadcasts also are being considered.

"The Internet plays an important role in communications at EPA. And the more ways I can help improve communications among EPA officials and training center personnel, the more it benefits the program," Baranowski explained. "Currently there's an annual National Wastewater Operator Trainers' Conference and that's about the operators' only chance to communicate with each other.

"Certainly the Internet is a great way to get out information that EPA needs to get to state agencies and the training centers. They all have access and can get to the information," he added.

Despite his emphasis on Internet-based communications, Baranowski is well aware of the so-called "digital divide" that blocks many small, disadvantaged communities from accessing Internet-based resources.

"A lot of the communities that we assist just don't have Internet access," Baranowski conceded. "As time goes on, a lot more communities will have access regardless of their size and financial situation. But for now we have to go through more traditional means of getting the word out about the program to them."

For instance, EPA is working on a small communities fact sheet that will be distributed to local officials.

Training Is the Key

Baranowski said one of the biggest problems facing wastewater treatment plant operators in many small communities is an unfortunate lack of knowledge about how their plants work.

"They need to be trained on how to operate the systems. It's not as easy as putting wastewater in and getting clean effluent out. That's what is so good about us going out there to supply the training," he said, adding that the 104(g) program can help.

System officials who could benefit from the assistance provided by the program should be referred to the 104(g) organization in their state. To find out which group is providing 104(g) assistance in a particular state, visit EPA's Web site at *http://www.epa.gov/OWM/sstc.htm* or call the National Environmental Training Center for Small Communities at (800) 642-8301 or (304) 293-4191.

Baranowski can be contacted at EPA headquarters in Washington, D.C., at (202) 260-5806 or via e-mail at *baranowski.curt@epa.gov.* SF

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MCET Receives $40,000 Grant to Renew Program

The Maryland Center for Environmental Training (MCET), located at Charles County Community College's La Plata campus, recently received a $40,000 grant from the U.S. Environmental Protection Agency. The grant provides funding for onsite operator training and technical assistance for wastewater plants with actual or potential discharge violations. The grant allows MCET to provide no-cost technical assistance to municipal wastewater plants having a daily discharge of less than 5 million gallons per day.

For more information, call (800) 933-9177, ext. 7765.

NUCA Releases Revised Trenchless Manual

The National Utility Contractors Association (NUCA) has released the 3rd edition of its *Trenchless Construction Methods Manual and Soil Compatibility Manual* for utility contractors, engineers, and owners interested in trenchless technology, its application, characteristics, and innovation.

The revised manual includes new information on geotechnical considerations and soil compatibility, a new glossary of trenchless terms, and expanded discussions of each trenchless installation method, including auger earth boring, compaction, pipe ramming, slurry boring, directional drilling, microtunneling, pipe jacking and utility tunneling. Each chapter examines the characteristics, equipment requirements, procedures, advantages, and disadvantages of each application.

The price of the manual is $20 for NUCA members and $40 for non-members, plus shipping and handling. To order, contact NUCA at (703) 358-9300 or visit their Web site at *http://www.nuca.com*.

Troubleshooting and Optimizing Wastewater Treatment Systems

This training curriculum from the National Environmental Training Center for Small Communities (NETCSC) contains four modules—Activated Sludge, Nutrient Removal, Attached Growth, and Lagoons— developed to help operators develop skills to troubleshoot or optimize their wastewater treatment processes. The modules were designed to cover basic troubleshooting skills and knowledge, but they do not specifically focus on equipment, maintenance, and sludge processing and disposal. Each module contains an instructor guide with overheads, a participant workbook, and reference text.

For price and ordering information on this curriculum or on other available training materials, call (800) 624-8301 or (304) 293-4191 and ask to speak with a training specialist. The specialist can provide further information on the training materials in the NETCSC collection.

Septic Education Made Simple

Anyone who has considered offering a septic education program will want to check out the *Septic Education Kit* now being distributed by the Department of Commerce.

The kit was originally developed at the Padilla Bay National Estuarine Research Reserve in Washington State in 1997 by Padilla Bay and the Washington Department of Ecology. It was the result of a grant by the National Oceanic and Atmospheric Administration to develop a curriculum for adults that addressed non-point source pollution.

The kit functions as a toolbox that contains everything an educator needs to set up and publicize a septic education program. There are user-friendly fact sheets that can be customized for any area, an entertaining slide show starring Henry Homeowner, comprehensive workshop outlines, two attention-grabbing publicity photos, marketing ideas, and tips on how to partner with other agencies. There are also article templates for quick submissions to local newspapers, a humorous color poster reminding homeowners to pump their tanks, compelling radio announcement scripts, and creative newspaper ad and flyer samples.

One of the publicity photos included in the *Septic Education Kit*.

Last spring, the Department of Commerce agreed to produce and distribute the *Septic Education Kit* so that it would be available nationally. The price is $99 and the order number is AVA20666KKOO. To obtain an order form, please email *orders@ntis.fedworld.gov* or call (800) 553-6847.

Revised Environmental Statutes Available in Softcover and CD-ROM

Important changes in the environmental laws have come about under the 105th Congress. The new *Environmental Statutes*, 1999 Edition, published by Government Institutes Division, ABS Group Inc., contains the complete and up-to-date text of each statute as currently amended by Congress.

Available as both a softcover book and as a CD-ROM, this 1999 edition contains all changes made to the statutes, including those changes made to the Clean Air Act's air quality ozone and particulate matter standards.

Other statutes covered include the Emergency Planning and Community Right-to-Know Act (EPCRA); the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA); the National Environmental Policy Act (NEPA); the Pollution Prevention Act; the Federal Water Pollution Control Act; the Safe Drinking Water Act; the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund; the Toxic Substances Control Act (TSCA); and the Occupational Safety and Health Act.

The 1,308-page softcover book (ISBN 0-86587-652-5) contains a 26-page table of contents and a 13-page index of sections by statute for quick access to specific information. The CD-ROM offers a new, user-friendlier interface, faster and easier installation, and a Folio Search Engine. In addition, the CD-ROM version allows users to hyperlink from the table of contents to a section of a law, query the entire volume by typing in a word, phrase, or section number, export sections to word processing documents, and print directly from the disk.

The cost of the softcover book is $69, plus shipping and handling. The cost of the CD-ROM (Windows 95/NT only) is $139 single user, $417 network license, plus shipping and handling. For further information or to order, call (301) 921-2323 or fax (301) 921-0373 or e-mail *giinfo@govinst.com*. Their Web site is at *http://www.govinst.com*.

NETCSC Newsletter Offers Training News

The National Environmental Training Center for Small Communities' (NETCSC) quarterly newsletter, *E-train*, presents profiles of exemplary training programs, feature articles relevant to environmental training, and practical tips and techniques for successful environmental training.

Upcoming issues will provide information about NETCSC's new drinking water course, training and technical assistance efforts being made in capacity development for small drinking water and wastewater systems, and distance learning courses for a basic drinking water and wastewater program along with an Internet training course. One article will show how the Minnesota Association of Townships and NETCSC, the National Small Flows Clearinghouse (NSFC), and the National Drinking Water Clearinghouse (NDWC) worked together to provide training for 9,000 local officials.

Also highlighted are the annual events held by the National Environmental Training Association, American Water Works Association, National Environmental Health Association, 104(g) Operator Training Conference, National Association of Environmental Professionals, and other organizations. Information is provided about the new NETCSC *Distance Learning Resource Guide*, NETCSC's *On-line Curriculum*, a products insert listing of all the environmental training resources available from NETCSC, and NETCSC's new *Products Catalog*.

Subscriptions to E-train are free. For a subscription please send your name, address, and phone number to the E-train editor at NETCSC, West Virginia University, PO Box 6064, Morgantown, WV 26506-6064. You also may fax the information to (304) 293-3161. SF

Newsletter Explores Funding Options for Small Systems

Water Sense, a quarterly publication of the National Drinking Water Clearinghouse (NDWC), offers financial and management information for small communities and those who work with them to provide safe drinking water. This free publication includes information about funding sources, management options, and other educational resources for both drinking water and wastewater.

The most recent edition (Fall 1999, Item #WSENSE20) features articles about a variety of topics including: an update on the Clinton Administration's Water 2000 project, how to collect past due accounts, methods for assessing a community's financial health, and the affordability of membrane filtration for small systems.

For a free copy of the Fall issue of *Water Sense*, or to get a free subscription to the publication, call the NDWC at (800) 624-8301 or (304) 293-4191. To order by e-mail, send name, address, items, quantities you wish to order, and your phone number to *ndwc_orders@mail.estd.wvu.edu.*

Water Sense may also be downloaded from the NDWC Web site at *http://www.ndwc.wvu.edu*. SF

Free Poster on Onsite Technologies Available

The National Small Flows Clearinghouse (NSFC) is now offering a free poster from the U.S. Environmental Protection Agency Office of Water Program Operations that provides descriptions of various alternative wastewater systems available to small and rural communities.

Titled "Small Wastewater Systems: Alternative Systems for Small Communities and Rural Areas," (Item #WWPSPE02) this foldout poster includes information about both onsite and centralized wastewater systems, such as small-diameter gravity sewers, septic tank/soil absorption systems, aerobic treatment units, vacuum sewers, sand filters, chamber system mounds, composting toilets, low-pressure pipe systems, and graywater and blackwater systems. Schematic diagrams are included along with descriptions of how the technologies work.

This eight-page foldout can serve as a great educational tool for those wanting an overview of alternative wastewater treatment and disposal technologies. It may be particularly helpful to local and state officials, managers, planners, public health officials, engineers, regulators, and individual homeowners in selecting the most suitable treatment option for their situation.

To take advantage of this free offer, call (800) 624-8301 or (304) 293-4191. Orders also may be faxed to (304) 293-3161 or sent via e-mail to *nsfc_orders@mail.estd.wvu.edu*. Shipping and handling costs apply. SF

NDWC Catalog, Resource Guide Available

Two new information resources are now available from the National Drinking Water Clearinghouse (NDWC), a "sister" organization of the National Small Flows Clearinghouse.

The *Drinking Water Products Catalog* lists more than 240 educational products to assist small communities with their drinking water system needs. It includes resources covering financial topics, management issues, regulations, research, technologies, and other subjects.

The 1999 *Outreach Resource Guide* lists information about nearly 90 federal, national, professional, and trade organizations that have drinking water-related interests. It includes each organization's mission, water-related activities, publications, address, Web site, and phone and fax numbers.

For free copies of these publications, call the NDWC at (800) 624-8301 or (304) 293-4191 and request the *Drinking Water Products Catalog*, item #DWBLPR01, or the 1999 *Outreach Resource Guide*, item #DWBKGN36. Orders may be e-mailed to *ndwc_orders@mail.estd.wvu.edu*.

Many New Products Are Available from NSFC

The Onsite Assistance Program: Helping Small Wastewater Treatment Plants Achieve Permit Compliance

This booklet outlines the U.S. Environmental Protection Agency's (EPA's) Onsite Assistance Program, implemented in 1982 to address the problem of non-compliance at small wastewater treatment plants through onsite operator training and other operation and maintenance (O&M) assistance. The booklet discusses how the program operates through a network of operator training personnel in states and EPA regional offices. The personnel serve as troubleshooters and trainers. Also included is information on the benefits of onsite assistance, how a community can obtain this free assistance, what roles an onsite trainer plays, the success rates of treatment plants that have returned to compliance, and contact information to find out more about the program. This six-page booklet may be useful to state regulatory agencies, local and state officials, managers, planners, operators, and the general public.

This booklet is free. Ask for Item #WWBLOM35.

The Clean Water State Revolving Fund: How to Fund Nonpoint Source and Estuary Enhancement Projects

This booklet describes the Clean Water State Revolving Fund (CWSRF) program, a widely available financing source for water quality improvement projects. While the CWSRF has most commonly been used to finance municipal wastewater treatment projects, this booklet answers the most frequently asked questions about the program's ability to fund nonpoint source and estuary projects, key components to watershed-based water quality management. The EPA encourages the full use of the CWSRF to implement a broad range of watershed-based activities. Examples of eligible or actual projects are provided throughout the brochure to illustrate the CWSRF program's potential for funding water quality activities. This 18-page booklet can serve as a resource for finance officers, local and state officials, managers, planners, and the general public.

This booklet is free. Ask for Item #WWBLFN01.

Quality Development and Stormwater Runoff

This fact sheet by the Watershed Committee of the Ozarks outlines affordable ways to reduce harmful stormwater runoff to make your home or working environment more pleasant and enhance property values. It discusses why states and individual communities need to regulate stormwater runoff in order to reduce both pollution and flooding problems. The fact sheet highlights several residential, commercial, and industrial best management practices that can help reduce flooding, erosion, and pollution. Common runoff pollutants identified are heavy metals, pesticides, fertilizers, bacteria, and soil sediments. Methods of properly managing stormwater runoff are graphically illustrated. This four-page fact sheet can be helpful to contractors/developers, managers, planners, local and state officials, and the general public.

The cost for this fact sheet is 35 cents. Ask for Item #GNFSPE07.

Outreach and Technical Assistance Programs

This EPA report highlights accomplishments of the assistance programs managed by the EPA Small Underserved Communities Team. It describes team programs and outreach initiatives, resources provided, and major 1997 accomplishments that helped small communities comply with Clean Water Act requirements and improve their quality of life. Some of the programs highlighted in this document provide direct financial assistance for building wastewater facilities, while most of the programs take the form of information development and technical expertise initiatives that can help communities solve their own problems. This 14-page booklet may be useful to engineers, local and public health officials, planners, managers, and the general public.

This booklet is free. Ask for Item #WWBLGN126.

Clean Water Tribal Resource Directory for Wastewater Treatment Assistance

This book is intended for use by Native American tribes and tribal environmental organizations to help identify financial and technical assistance programs targeted for tribes. It also can be explored by federal representatives as a reference document in answering questions about sources of funding and technical support for tribal wastewater infrastructure. The book is divided into two sections; the first gives an overview of those federal agencies, national tribal organizations, technical assistance organizations, and resource centers that provide financial, technical, and informational support for wastewater treatment. The second section is organized according to the 10 EPA regional offices. For each EPA region, a detailed listing of each federal agency is included along with technical assistance organizations that have field offices within the regional office boundary. Telephone numbers and other contact information are also provided. This 78-page book may be helpful to state, local, and public health officials; planners; managers; and the general public.

This book is free. Ask for Item #WWBKGN127.

Wastewater Disposal Options for Small Communities

Aimed at local decision-makers and leaders in Louisiana, Alabama, and Mississippi, these easy-to-read books review ways to solve a community's wastewater problems in a particular state. Commonly used wastewater terms are defined. Chapter 2 explains the "Facility Development Process," a long-term process of identifying the problem, and planning, financing, and constructing a wastewater facility. Chapter 3 highlights the regulatory process, identifying state and federal roles. Although this chapter is about a specific state, other states can use this as a guide for determining their states' roles. Wastewater collection, treatment, and disposal options are illustrated in Chapter 4. O&M requirements, advantages, and disadvantages for each system are included as well. Chapter 5 lists federal and state financing sources available to communities for water and wastewater projects. These three books are approximately 100 pages each and may be useful to local officials, managers, finance officers, planners, and the general public. The cost for each book is $3.65.

Wastewater Disposal Options for Small Communities in Mississippi–Item #WWBKGN128

Wastewater Disposal Options for Small Communities in Alabama–Item #WWBKGN129

Wastewater Disposal Options for Small Communities in Louisiana–Item #WWBKGN130

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Item Number Breakdown

First two characters of item number: (Major Product Category)
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FM Finance and Mangement
GN General Information
SF Small Flows

Second two characters of Item number: (Document Type)
BK Book, greater than 50 pages
BL Booklet, less than 50 pages
BR Brochure
FS Fact Sheet
JR Journal
NL Newsletter
PL Pipeline
PK Packet
PS Poster
SW Software
VT Video Tape

Third two characters of item number: (Content Type)
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CS Case Study
DM Design
FN Finance
NL Newsletter
OM Operation and Maintenance
PE Public Education
PP Public-Private Partnerships (P3)
RE Research
RG Regulations
TR Training

Last two characters of item number:
Uniquely identifies product within major category

you wish to order. Shipping and handling charges apply to all orders.

Abstracts of many products are provided in the NSFC's new 1998-1999 Products Guide. The guide may be downloaded via the NSFC's Web site at *http://www.nsfc.wvu.edu*.

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CONTINUED FROM PAGE 33

the establishment of separate supplemental districts by the local governments. It was a concept that may have been a bit too advanced for the time, but the idea was extensively modified during the process of negotiating and developing the MOA, and it was decided that in the Delaware and Catskill Systems, the New Sewage Treatment Infrastructure Program, the Sewer Extension Program and the Septic System Rehabilitation and Replacement Program would become part of the watershed protection and partnership provisions of the MOA. Under these three programs, up to 22 new municipal wastewater treatment plants, decentralized treatment facilities, or septic maintenance districts would be built or formed subject to certain funding limitations, and sewer extensions to the collection systems serving the City-owned wastewater treatment plants would be constructed. In addition, a formalized septic inspection program followed by a rehabilitation or replacement of failing or likely to fail septic systems would be undertaken. All of these programs are currently underway.

The New Sewage Treatment Infrastructure Program has a prioritized listing of the communities able to participate in the program, and preliminary studies concerning flows and service areas have been completed for the first seven communities on the list. The Sewer Extension Program has delineated the proposed new areas to be served, and design studies are being conducted. The Septic System Rehabilitation and Replacement Program has identified 1227 systems that were failing or about to fail, or were substandard systems. As of this date, 1039 of these systems have received plan approval, and 479 systems have been rehabilitated or replaced. The program is continuing, and the ultimate number of systems that will need attention is at this point simply a matter of speculation.

The three programs outlined above are applicable only to the Delaware and Catskill Systems. In the Croton System, the two counties of Westchester and Putnam have been allocated special funds under three separate programs. One fund is for a diversion feasibility study that will detail the possibilities of diverting wastewater from treatment plants within the watershed to other facilities discharging outside the watershed. A second fund is for the development of a comprehensive Croton Water Quality Protection Plan, which is to focus on determining significant sources of pollution, recommending measures to improve water quality, and to protect the character and needs of the communities within the Croton System. The third fund is for the East of Hudson Water Quality Investment Program, which is to be used for the implementation of certain portions of the Diversion Study; the rehabilitation or replacement of failing septic systems; the establishment of community septic systems to address water quality problems in areas where there is existing development; the creation of new sewer collection systems or the expansion of existing systems in areas where failing or soon to fail septic systems were constructed on inappropriate sites; the construction of new treatment plants to accommodate the additional flows from such sewering; and other measures that are designed to protect and improve water quality within the Croton System. The Water Quality Investment Program thus mirrors the objectives of those portions of the Watershed Protection and Partnership Program relating to the control of wastewater in the Catskill and Delaware Systems. Responsibility for the development of these programs and plans and their implementation within the Croton System has been entrusted to the counties involved. DEP has ongoing oversight concerning the expenditure of allocated funds, which must be ultimately utilized for protection from contamination, degradation and pollution of the water supply and its sources.

After many years of deliberation and debate, the regulatory framework as well as the necessary programs that ensure the economic viability and way of life of those living within the watersheds became a reality with the signing of the MOA and the adoption of the WR&R. New York City is now confident it can adequately protect one of the state's most vital resources without causing undue hardship to those living on the land. To some, the WR&R may seem to limit their right to use their land as they see fit, while others feel that the City has not gone far enough. But in reality, the WR&R, in conjunction with the other portions of the MOA, represent a balanced approach, and function as a road map detailing how wastewater should be handled and how watersheds must be protected if drinking water is to remain safe and plentiful. SF

For more information, write to Simroe at the Engineering Section, Bureau of Water Supply, Quality and Protection, NYC DEP, 465 Columbus Ave., Suite #350, Valhalla, NY 10595 or phone (914) 742-2057, fax (914) 742-2027, or e-mail *tsimroe@valgis.dep.nyc.ny.us.*

CONTINUED FROM PAGE 25 will send data such as its identification number, date and time when the event occurred, total pump run time, and pump activation count. If there are no system-related problems to report, the EMP will request a new interval to initiate the next communication session with the central computer station.

Based on data provided by the community where the EMP is installed, some assumptions can be made to calculate average pump run time in seconds, shortest run time, longest run time, average flow rate, shortest flow rate, and fastest flow rate.

The EMP also has two optional features: the ability to monitor pump power draw to determine if the pump is functioning properly and a total functioning system battery backup.

A hand-held diagnostic terminal will program the initial operating parameters retained by the EMP or reprogram the EMP with a new ID number. After initial setup of the EMP, the central computer station can do all reprogramming.

Central Computer Station

The central computer station will respond to a call initiated by the onsite EMP and receive its status, update the database, print out a report of the event, and reprogram the onsite EMP to get new operational parameters such as a revised call-in schedule. It will also page any on-call technician when it is programmed to do so.

The system also will provide a user-friendly interface to retrieve the customer-related information, report time schedule information, and list events previously reported and stored in the database.

It will also provide an automatic scheduling of the report time for all the EMP in the database. A start date, start time, and interval between calls will be user selectable. It will be possible to manually modify or add additional reports.

The central computer will keep track of the systems that have failed to report at a scheduled time and print out a report for the technician.

The central computer can also be remotely accessed by the manufacturer to provide after-sale support, upgrade software, etc.

The cost of the EMP is $250 per unit. And the cost of the controller, which activates the pump, is approximately $390 per unit.

Fairfield, Ohio, Uses Autodialer

Fairfield, Ohio, is located approximately 35 miles north of Cincinnati and has 410 miles of sanitary sewers and 16 lift stations. Approximately 50 to 1,500 gallons per minute of sewage run through the city's various lift stations, and whenever the unmanned stations have a problem, the Antx, Inc., Dialog alarm system calls into a central plant location. The operator then contacts the appropriate people to take corrective action. The dialer calls a list of five different locations, including the wastewater and water plants, with the last dial-out being to the police station.

"Some of the city's lift stations have four-alarm systems and some have eight-alarm systems," said Jay Wright, collection systems foreman for Fairfield, Ohio. The city's wastewater crew can all program the alarm system easily. Fairfield normally keeps an extra dialer as a spare in case one goes down because of a lightening strike.

"The city has used some dialers for up to 18 years with very little maintenance except a battery change," said Wright. "The dialer system has been in place since 1967, and all 16 lift stations are equipped. The signal goes over a phone line and is dedicated for each station. We always know which station is calling. They [the dialers] are hooked up with mercury float switches that turn the pumps on and off.

Wright explained that there are alarms for:

- high wet well,
- emergency high wet well,
- intrusion alarm—if somebody breaks in it will call,
- pump seal failure, and
- power fault, which is so sensitive, it will automatically call with any power failure.

"If a pipe breaks or a leaking pump happens in the motor-control center, the dialer will call immediately so the lift station does not get flooded out," said Wright.

"The total sewage system handles approximately 10 million gallons per day of wastewater," he continued. "And it serves approximately 45,000 to 50,000 people.

"All of the lift stations are not manned," Wright explained. "They're also spread out all over the city. It's much more economical to run the system remotely than to man each station. We also have the benefit of knowing what the problem is beforehand.

"We physically check the stations three times a week—Monday, Wednesday, and Friday," he said. "If something goes wrong, the dialer calls the plant operator. The call identifies the station and the problem. It's a very reliable system, and we've had very few problems."

The dialers installed at the Fairfield stations start at a list price of $1,600. Adding options to them will increase the price with the most expensive version costing approximately $3,000.

Remote Monitoring Becomes Standard

"Remote monitoring and control have become a standard for the centralized municipal wastewater treatment industry to accomplish two major goals: efficiency and consistency," said Bill Cagle, technical sales manager, Orenco Systems, Inc., Sutherlin, Oregon. "With this technology, efficiency and consistency can be increased dramatically in areas such as process treatment, preventative maintenance, and reduced man hours. And the same thing can be so for the onsite industry as well.

"Here's what I've found in the wastewater treatment industry," he continued. "Engineers talk about SCADA when they refer to remote monitoring. But it's way too complicated and expensive for onsite systems. However, the technology is improving so much that it's becoming more and more affordable.

"You can compare remote monitoring to the computer revolution," he explained. "SCADA systems are analogous to the mainframe computer, and onsite monitoring is comparable to PCs. Prices are falling, too. Think of what you may have paid for a personal computer 10 years ago compared to what you may today.

"Now municipalities are saving money and are far more efficient for using remote monitoring," Cagle stated. "We're heading in the same direction in the onsite market. This technology has the ability to hold the entire onsite industry accountable for what we do. And accountability leads to credibility.

"Onsite systems were once viewed as a temporary arrangement until central sewering could be installed," he said. "Since they were considered disposable, there were a lot of failures followed by the notion that they don't work. But that's not true.

"Remote monitoring can make onsite service the equivalent of centralized wastewater treatment," Cagle explained. "It can make service invisible to the homeowner as well as hassle free. The homeowner need never know anything has gone wrong with the system. Someone just shows up in a service truck every once in while, just like the water company or other utility company does as part of their job.

"The advantage of this technology is that you have a full-time operator hanging on your wall, 24 hours a day, recording data, reporting data, reacting to alarms and alerts," he continued. "It also has the advantage of moving the industry from a reactive approach to a preventative approach."

For more information about remote monitoring, contact:

- Bob Mayer with American Manufacturing at (800) 345-3132,
- Bill Cagle with Orenco Systems, Inc., at (541) 459-4449,
- Steve Allen with Antx, Inc., at (877)

1999—Another Successful Year for NSFC!

The National Small Flows Clearinghouse (NSFC) recently completed its 20th year of operation in fiscal year 1999 (FY99), finding new ways to serve small communities through the World Wide Web, new products, and enhanced customer service. (FY99 is the period from October 1, 1998, to September 30, 1999.)

The NSFC's Web site, located at *http://www.nsfc.wvu.edu*, was accessed an average of 2,000 times per month, an increase from last year. The site was recently updated with information about U.S. Environmental Protection Agency (EPA) stormwater regulations, EPA's proposed TMDL [total maximum daily load] regulations, new products offered by the NSFC, a listing of wastewater-related conferences being held through June 2000, new links to Internet sites with regulatory information about onsite systems, and more.

NSFC's databases have been updated as well. The Bibliographic Database houses more than 5,500 research articles, and the Manufacturers and Consultants Database now includes information from more than 1,200 manufacturers and consultants who offer wastewater treatment products and services. The Facilities Database contains information about more than 1,200 wastewater treatment facilities.

NSFC Information Assistants Kim Kerns and Dolly Moran direct calls to the appropriate department. In FY99, the NSFC received approximately 21,000 calls on its toll-free assistance hotline.

Another FY99 accomplishment was the NSFC hosting the first-ever National Onsite Wastewater Regulators Conference in Saint Louis, Missouri. This was the first time an attempt has been made to bring together the regulators of onsite wastewater systems from all 50 states.

In FY99, NSFC added 60 new informational products to its inventory. Nearly 4,500 orders were processed by the NSFC Products Distribution Unit, which distributed close to 135,000 products to customers. In addition, technical assistance staff received approximately 21,000 calls on the NSFC's toll-free assistance hotline.

Another way the NSFC serves its customers is through outreach activities and by staying up-to-date with the latest improvements in the field. NSFC staff attended more than 20 national, regional, and local conferences in FY99 and distributed information at nearly 40 conferences.

The NSFC also reached small communities through its mailing list, which now contains nearly 48,000 names.

The NSFC continued to publish its quarterly newsletters. In FY99, the *Small Flows* newsletter circulation was approximately 43,000, and *Pipeline*, a newsletter for local officials, was sent to 22,500. *The Small Flows Journal*, a peer-reviewed annual research publication, reached approximately 7,200.

Also this year, the NSFC decided to combine the *Small Flows* newsletter and *The Small Flows Journal* into this new magazine-style publication, *Small Flows Quarterly*.

In FY99 the NSFC contacted nearly 3,200 local health departments and permitting agencies nationwide to collect information about onsite wastewater treatment systems. This data is being compiled into a report that will provide information about alternative and conventional onsite systems in the U.S. for the year 1998.

The NSFC conducted a Customer Service Feedback Survey, which showed that 90 percent of respondents were satisfied with the NSFC's service in FY99. Sixty-eight percent were very satisfied with the overall level of service.

For a free information packet that describes all of the NSFC's products and services, call (800) 624-8301 or (304) 293-4191 or send e-mail to *nsfc_orders@mail.estd.wvu.edu*. SF

Remote Monitoring Use Is on the Rise

continued

686-ANTX (2689) or e-mail the sales office at *sales@antx.com*,

- Larry Bradford with OES-IBEX Environmental Technologies at (770) 447-6253 or e-mail him at *ljbradf@ibm.net*,
- Jay Wright for the city of Fairfield, Ohio, at (513) 867-5369, or
- Aaron Cilluffo for the city of Gloucester, Massachusetts, at (978) 281-9773. SF

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NSFC Public Listserv Now Available

Readers who wish to be notified electronically of Small Flows Quarterly or Pipeline Web postings may now subscribe to a public electronic mailing list. This service is for notification only, and cannot be used for posting messages. To subscribe, send e-mail to *macjordomo@mail.estd.wvu.edu*. In the body of the e-mail, type the following message with your first and last names and spaces where indicated: subscribe estdnews Firstname Lastname.

Notifications will be sent out and the publication posted to the Web while it is being printed. Readers may then download their favorite articles weeks ahead of the publication's postal delivery

Funding of Small Community Needs Through the Clean Water State Revolving Fund

CONTRIBUTING WRITERS

Sylvia Bell
Stephanie Von Feck

Editor's Note: Both Sylvia Bell and Stephanie Von Feck are environmental protection specialists with the U.S. Environmental Protection Agency's (EPA) Office of Wastewater Management. What follows is adapted from an EPA fact sheet of the same title.

Program Overview: How SRF Works

The Clean Water State Revolving Fund (SRF) program was authorized by Title VI of the Clean Water Act (CWA) Amendments of 1987. The SRF program replaced the long-running Federal Construction Grants program in providing independent and permanent sources of low-cost assistance for water quality infrastructure projects. The Environmental Protection Agency (EPA) provides "seed money" to all 50 states and Puerto Rico to capitalize state-administered loan funds to provide financial assistance to local communities.

Low interest loans are the primary form of SRF financial assistance, which can also include purchasing insurance or guaranteeing loans. The "revolving" nature of the SRF is such that as loan payments are made, funds are recycled to support additional water quality projects.

SRF funding allows states to address their highest-priority water quality needs and is commonly used to support wastewater treatment systems (including decentralized systems), nonpoint source controls, and estuary protection.

Funding Trends

Total SRF program assets exceeded $27 billion in 1998. According to information compiled from EPA's SRF database, since 1988 the SRF has loaned $22.9 billion to communities nationwide. Of the total, small communities (10,000 or fewer people) account for $5.2 billion. Very small communities (3,500 or fewer people) have received 44 percent of that $5.2 billion.

Small communities receive an average 23 percent of total SRF funding. Since 1993 small communities have annually received from 18 to 29 percent of the total. SRF funding to small communities has nearly doubled from $456 million in 1993 to $866 million in 1998.

SRF assistance to small communities also may be evaluated in terms of the number of assistance agreements (loans). Only two states had capitalization grants in SRF's inaugural year (1988) and only three agreements were awarded that year. In 1998, 1,139 SRF assistance agreements were awarded, with 701 of those going to small communities. A total of 3,897 of 6,816 SRF assistance agreements have been awarded to small communities since 1988.

While small communities receive approximately 23 percent of all SRF dollars, they account for 57 percent of all SRF agreements awarded between 1988 and 1998. Small communities have never received less than 50 percent of the total number of loans.

Although SRF funds a portion of wastewater treatment needs of small communities, the needs of these communities are relatively large. EPA's 1996 Clean Water Needs Survey (CWNS) sets the total need for wastewater treatment and collection systems for small communities at $13.8 billion.

The 1990 U.S. Census Bureau data indicate that more than 80 percent of homes without access to wastewater treatment are located in small communities. Survey data reveal that small communities clearly have the greatest need for new collector sewers and secondary treatment. Each of these needs will require approximately $4 billion of small community funding nationwide.

The CWNS states that small communities with limited financial, technical, administrative, and legal resources encounter difficulties qualifying for and repaying SRF loans. Small financial bases limit the ability of small and rural communities to finance wastewater projects. Many of these communities also lack access to private credit markets. Consequently, these communities may delay addressing their needs.

Future SRF Direction for Small Communities

Despite their comparatively weak economic status, small communities still must comply with the CWA requirements for wastewater collection and treatment and must continue to address human health risks. Recognizing the financial constraints on small communities, President Clinton's 1994 Clean Water Initiative proposed that special subsidies be established to make loans more affordable for small communities (as part of the reauthorization of the CWA). Potential subsidies include zero or negative (down to negative two percent) interest rates on loans, extension of the loan repayment period from 20 to 30 years, or loan forgiveness.

Copies of this fact sheet may be obtained by contacting the EPA Office of Water Resource Center at (202) 260-7786 and requesting # EPA 832-F-99-057. You may also visit EPA's Web site (*http://www.epa.gov/OWM/smallc.htm*) to obtain other summaries of this information.

"One-Stop-Shop"

Environmental Services and Training Division

The Environmental Services and Training Division is part of the National Research Center for Coal and Energy at West Virginia University. The division's four federally funded programs provide a "one-stop-shop" of information to protect the environmental health of America's small communities.

National Small Flows Clearinghouse

Offers free and low-cost technical assistance, products, and information services regarding small community and onsite wastewater treatment and pollution prevention issues

National Drinking Water Clearinghouse

Provides free and low-cost technical assistance, products, and information services about small community drinking water systems and related issues

National Onsite Demonstration Program:

Phase IV Promotes and develops management strategies for onsite wastewater treatment in our nation's small communities

National Environmental Training Center for Small Communities

Offers toll-free training assistance and referral information, along with training curricula and related low-cost products, in the areas of drinking water, wastewater, and solid waste

(800) 624-8301

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http://www.estd.wvu.edu

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IN COMING ISSUES...

Got an Opinion?

Who wants your opinion? The editor of the *SF Quarterly* does, and not just as a "letter to the editor," either. Our "Forum" column is a place where readers can share informed, well-thought-out ideas that they feel will be of value to people involved in the treatment of wastewater, both onsite and small centralized systems.

We are open to all aspects of small-flow wastewater treatment, such as technology, management, regulation, operation, and maintenance. Please send your opinions (for the Forum column, 750 to 1000 words) to the *SF Quarterly* editor at the address on the staff box on page 2

America's Information Source on Small Community and Onsite Sewage Systems

Looking for information about wastewater collection, treatment, and disposal? The National Small Flows Clearinghouse (NSFC) can help.

Funded by the U.S. Environmental Protection Agency, the NSFC is a non-profit organization that assists small communities (those serving populations with fewer than 10,000) with their wastewater-related needs. We offer a wide variety of resources about such topics as:

- septic systems and alternative onsite and community wastewater treatment technologies,
- regulations,
- operation and maintenance,
- design and monitoring,
- strategies for managing small wastewater systems, and
- public education.

The NSFC helps homeowners, local and state government officials, renters, bankers, citizens' groups, regulators, research scientists, educators, consultants, manufacturers, operators, contractors, and other professionals. We produce two quarterly publications, *Small Flows Quarterly* and *Pipeline*, which are free by request to U.S. residents. Our Web site hosts discussion groups on wastewater issues and provides information about conferences and events across the country.

In addition, the NSFC operates a toll-free technical assistance hotline available Monday through Friday from 8:00 a.m. - 5:00 p.m., Eastern Time. The NSFC provides outreach services through workshops, seminars, and conference participation. We have an inventory of more than 300 free and low-cost educational wastewater products. Contact us today for a free information packet!

National Small Flows Clearinghouse
WestVirginiaUniversity
P.O. Box 6064
Morgantown, WV 26506-6064

(800) 624-8301/(304) 293-4191
www.nsfc.wvu.edu

National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064

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