



Nonpoint Source News-Notes

*The Condition of the Water-Related Environment
The Control of Nonpoint Sources of Water Pollution
The Ecological Management & Restoration of Watersheds*

News-Notes Goes Electronic!

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Read more about the switch on page 2.

Special Focus: Onsite Wastewater Treatment

Will EPA's new Guidelines for Management of Onsite/Decentralized Wastewater Systems Affect You?



The CWAP logo denotes articles related to action items called for in the President's Clean Water Action Plan. See News-Notes #51 and #52 for more information on the plan.

If you live in a community with water pollution problems from failing septic systems, EPA's new onsite/decentralized wastewater system guidelines could help you. EPA has developed draft *Guidelines for Management of Onsite/Decentralized Wastewater Systems* to assist communities in managing wastewater from onsite systems. The guidelines can be used as a reference by communities interested in improving their onsite wastewater management programs to increase public health and environmental protection. They were structured to allow communities to pick and choose or entirely adopt sets of management criteria that will provide the necessary level of protection while balancing cost and other institutional factors.

A Growing Problem

When properly managed, onsite/decentralized wastewater systems (commonly referred to as septic systems, private sewage systems, or individual sewage systems) can be the most practical and least expensive way to treat and dispose of household wastewater in suburban and rural areas. On the other hand, it is difficult to measure the specific relationship between onsite systems and the quality of our water resources; studies show that when these systems operate improperly they can contribute significantly to water quality degradation.

States report failing septic systems as the third most common source of ground water contamination. EPA estimates that approximately 168,000 viral and 34,000 bacterial illnesses each year result from drinking water systems that rely on ground water as their source. Malfunctioning septic systems are

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News-Notes is Going Electronic — Well, Almost!

After 10 years of printing 14,000 copies per issue, *News-Notes* is finally entering the digital age! To better serve *News-Notes* subscribers and to save on printing costs, the producers of *News-Notes* are switching to electronic distribution of the newsletter.

Future issues of *News-Notes* will be available on EPA's web site at www.epa.gov/owow/info/NewsNotes in both pdf and html formats (they are currently available in only html format). An added feature will be the ability to search through back issues using an online searchable database. Users will also be able to search by keyword, date and issue, or by typing in their own search criteria.

We have set up a *News-Notes* listserver that will be used to announce the posting of each new issue on the web. It will also provide a table of contents of what articles are available as well as a short description of each article. **To sign up for this listserver, please send an e-mail directly to:**

- Listserver@unixmail.rtpnc.epa.gov
- In the body of the message type: subscribe News-Notes firstname lastname
- Leave the subject line blank

Once subscribed, you will receive a welcome message explaining how the listserver works. Unlike the widely popular NPSINFO listserver, subscribers will not be able to post messages to the *News-Notes* listserver. It will only be used to distribute information pertaining to *News-Notes*.

Still Need a Printed Copy?

For those of you who are unable to obtain *News-Notes* electronically and wish to continue receiving printed copies in the mail, we will continue to print a limited number of copies. However, to receive a hard copy, you must complete and return the form below, as we will need to develop a new subscriber database.

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identified as one potential source of this contamination. In its 1999 National Health Protection Survey of Beaches, EPA reported that septic systems were a significant pollution source for more than one-third of the water-quality impaired miles of shoreline. The discharge of partially treated sewage from malfunctioning septic systems was identified as a principal or contributing factor in 32 percent of all harvest-limited shellfish growing areas. Onsite wastewater systems have also added to the overabundance of nutrients in ponds, lakes, and coastal estuaries. As a result, algal blooms and other signs of eutrophication have occurred.

In 1997, EPA's *Response to Congress on the Use of Decentralized Wastewater Treatment Systems* recognized the lack of management as a major barrier to implementing decentralized systems and concluded 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." In 1998, EPA was directed in the Clean Water Action Plan to promote adoption and management of appropriate onsite/decentralized systems and specifically, to produce a set of voluntary national management standards. These guidelines are a result of that process.

Management Guidelines

The management guidelines present five levels of management in a progressive series of model programs, beginning with basic information collection and awareness of maintenance needed, and moving up to the highest level of management, in which onsite systems are owned and managed by a utility. Each model program profiled in the guidelines shares the common goal of protecting human health and the environment. In general, there is a direct relationship between the need to protect a sensitive resource and the level of onsite/decentralized technology required. As more complex technologies are needed, the level of management should increase. The guidelines have been written to track these concepts starting with Model 1 (low potential impacts, simple technologies, and little oversight) and ending with Model 5 (high environmental risk, complex technologies, and a high level of managerial oversight). Each model program includes a set of management objectives and associated program elements and activities targeted at the satisfactory achievement of the management objectives. Program elements include planning, siting, design, construction, operation and maintenance, residuals management, certification and licensing, education and training, inspections, monitoring, record keeping, and corrective action.

The model programs are a benchmark for a state, tribal, or local unit of government to:

- identify its management objective;
- evaluate whether its current program is adequate; and
- determine both an appropriate management program, and/or the necessary program enhancements to achieve its management objectives and public health and environmental goals.

Model Program 1 — System Inventory and Awareness of Maintenance Needs:

EPA recommends this as a minimum level of management. Model Program 1 applies where conventional onsite systems, owned and operated by individual homeowners, are sited in areas of low environmental sensitivity, i.e., no site or soil restrictions such as a high groundwater table or drinking water wells in close proximity. Model Program 1 is intended to raise the local regulatory agency's awareness of the location of systems, raise homeowners' awareness of basic system needs, and ensure homeowner compliance with basic maintenance requirements. This program also serves as a starting point for communities to have basic data to determine if higher management levels are necessary.

Did you know . . .

- Approximately 25 percent of the estimated 100 million homes occupied in the United States are served by onsite wastewater systems.
- Approximately 40 percent of new homes are served by onsite wastewater systems.
- More than half of all onsite systems are more than 30 years old and a significant number are experiencing problems.
- Septic tank systems constitute the third most commonly reported source of ground water contamination.

Model Program 2 — Management Through Maintenance Contracts: EPA recommends this program where sites with limiting conditions, such as small lot sizes, or restrictive soil conditions (i.e., slowly permeable soils, shallow soils with limited treatment capacity or high ground water table) are encountered in a small portion of a community. These limiting conditions require improved effluent dispersal to the soil or additional treatment units such as media filters or aerobic treatment units, and are typically operated through contract with equipment vendors. Model Program 2, therefore, sets higher expectations than Model Program 1 for a regulatory program and for educating homeowners.

Model Program 3 — Management Through Operating Permits: This program is recommended in situations where the receiving environment indicates a need for advanced levels of treatment, such as an unconfined aquifer used as a drinking water supply or a fish spawning area. Model Program 3, consistent with the increasing risk, recommends setting measurable performance standards and ensuring compliance by issuing renewable operating permits that indicate specific performance criteria to be achieved. The regulatory agency monitors these systems for compliance with the performance criteria.

Model Program 4 — Utility Operation and Maintenance: This program is appropriately applied where engineered designs, such as aerobic treatment units, are required to overcome site, soil, or environmental conditions that are not conducive to conventional or alternative onsite technology. Frequent monitoring and maintenance are needed in these situations. Model Program 4 recommends that a public/private utility be responsible for operation and maintenance to ensure maintenance needs are met.

Model Program 5 — Utility Ownership and Management: Model Program 5 represents the management needs of a more complex program where a very high level of control is required due to public health or environmental concerns. It includes the public/private utility as the designated management entity that both owns and operates the onsite systems in a manner analogous to a publicly owned wastewater utility. This program is similar to the utility concept in Model Program 4. Under this level of management the utility maintains total control of all aspects of management, not just operation and maintenance.

Although adopting the guidelines is completely voluntary, EPA recommends the highest levels of management be implemented in cases where there is high risk of environmental degradation or a threat to public health, particularly where onsite systems are identified as a significant source of water quality impairment. However, EPA does recognize that states, tribes, and local governments need a flexible framework and guidance to best tailor their programs to the specific needs of the community and to the institutional capacity of the regulatory authority. These guidelines are not intended to supersede existing federal, state, tribal, and local laws and regulations, but to complement them.

Onsite/Decentralized Wastewater Resources on the Web

- The Consortium of Institutes for Decentralized Wastewater Treatment
www.dal.ca/~cwrs/cdwt
- EPA's Office of Wastewater Management
www.epa.gov/owm
- National Environmental Health Association
www.neha.org
- National Onsite Demonstration Program
(a part of Small Flows Clearinghouse)
www.estd.wvu.edu/nsfc/NSFC_NODP.html
- National Onsite Wastewater Recycling Association, Inc.
www.nowra.org
- National Small Flows Clearinghouse
www.estd.wvu.edu/nsfc/nsfc_homepage.html
- National Sanitation Foundation
www.nsf.org

Spreading the Word

EPA has collected input from various sources, including federal, state and local regulators, environmentalists, engineers, trade associations, and service providers and will continue to actively seek further input on how to ensure the guidelines are useful.

A Notice of Availability of the draft guidelines was published in the *Federal Register* on October 6, 2000. Interested parties are encouraged to submit comments using the following web site:
www.epa.gov/owm/smallc/guidelines.htm. Comments can also be submitted by e-mail to decentralized@epa.gov, by mail to Joyce Hudson at the address below, or faxed to (202) 260-0116. The deadline for submitting comments is January 19, 2001.

[For more information, contact USEPA's Joyce Hudson at (202) 564-0657, e-mail: hudson.joyce@epa.gov or Steve Hogye at (202) 564-0631, e-mail: hogye.stephen@epa.gov, both located at the USEPA Office of Wastewater Management, Ariel Rios Building (4204), 1200 Pennsylvania Avenue, N.W., Washington, DC 20460.]

Onsite Wastewater Innovations from State and Local Governments



Onsite wastewater treatment systems collect, treat, and release more than *4 billion gallons* of treated effluent *per day* from an estimated 26 million homes, businesses, and recreational facilities nationwide. These systems include treatment units for both individual residences and small clusters of buildings connected to a common treatment system. Recognition of onsite system impacts on ground water and surface water quality (e.g., nitrate and bacteria contamination of wells, nutrient inputs to lakes and coastal waters) have increased interest in optimizing their performance.

Public health and environmental protection officials now acknowledge that onsite systems are not just temporary installations that will be replaced eventually by centralized sewage treatment service, but permanent approaches to treating wastewater for release and reuse in the environment. Onsite systems are recognized as viable, low-cost, long-term approaches to wastewater treatment if they are planned, designed, installed, operated, and maintained properly. To be effective, onsite system management programs should ensure that these systems provide treatment that is comparable to centralized wastewater treatment plants.

Building A Management Framework for the New Millennium

Management or oversight of onsite wastewater treatment systems in the past most often meant developing minimum site criteria (i.e., soil type and depth, setback distances, slopes), prescribing particular system types, and overseeing installation. Operation and maintenance was often left up to untrained and often uninformed homeowners, which produced mixed results and many documented instances of system failures.

During the 1980s, however, state and local government representatives began partnering with federal agency staff, design engineers, academicians, and other industry professionals to improve onsite/decentralized system management. The result has been a rapid increase in wastewater treatment research, new system technologies, and management program approaches. The following case studies, featured in publications by the Small Flows Clearinghouse, the State of Pennsylvania, the State of Massachusetts, and others, illustrate a few of the innovations helping to drive national interest in better management programs for onsite treatment systems.

Model Framework for Onsite Wastewater Management

- ✓ Performance requirements that protect human health and the environment.
- ✓ System management to maintain performance within the established performance requirements.
- ✓ Compliance monitoring and enforcement to ensure system performance is achieved and maintained.
- ✓ Technical guidelines for site evaluation, design, construction, and operation and acceptable prescriptive designs for specific site conditions and use.
- ✓ Education/training for all practitioners, planners, and owners.
- ✓ Certification/licensing for all practitioners to maintain standards of competence and conduct.
- ✓ Program reviews to identify knowledge gaps, implementation shortcomings, and necessary corrective actions.

Source: National Onsite Wastewater Recycling Association, 1999.

The District Model

Sanitation District Management of Onsite Systems in New Mexico.

Onsite systems in Peña Blanca, New Mexico, are managed by the Peña Blanca Water and Sanitation District, which is organized under state statutes requiring a petition signed by 25 percent of the registered voters and a public referendum prior to district formation. Once formed, water and sanitation districts in New Mexico are considered subdivisions of the state and have the power to levy and collect ad valorem taxes (imposed at a rate percent value) and the right to issue general obligation and revenue bonds.

Residents and public agency officials in Peña Blanca sought to improve the management of systems in the community after a 1985 study found that 86 percent of existing systems required upgrades, repair, or replacement. The water and sanitation district was designated as the lead agency for managing onsite wastewater treatment systems because it already provided domestic water service to the community and had an established administrative structure. The sanitation district relies on the New Mexico Environment Department to issue permits and monitor installation, while the district provides biannual pumping services through an outside contractor for a monthly fee of \$10.64 for a 1,000-gallon tank. The program has been in operation since 1991 and serves nearly 200 homes and businesses. Sampling of private wells in the area in 1999 found nitrate nitrogen levels below

1 mg/L. Septage pooling on ground surfaces, a problem identified in the 1985 study, has been eliminated. For more information, see www.estd.wvu.edu/nodp4/products.htm.

Financing Onsite/Decentralized Management Programs

PENNVEST: Financing Onsite Wastewater Systems in the Keystone State.

The Pennsylvania Infrastructure Investment Authority (PENNVEST) provides low-cost financing for existing systems on individual lots or within entire communities. Teaming with the Pennsylvania Housing Finance Agency and the state Department of Environmental Protection, PENNVEST created a low-interest onsite system loan program for low to moderate income homeowners. The \$65 application fee is refundable if the project is approved. The program can save system owners \$3,000 to \$6,000 in interest payments on a 15-year loan of \$10,000. As of 1999, PENNVEST has approved 230 loans totaling \$1.8 million (an average loan of \$7,800). Funds for the program come from state revenue bonds, special statewide referenda, the state general fund, and the State Revolving Fund. For more information, see www.pennvest.state.pa.us.

Monitoring and Assessment

Characterizing Nitrogen Contributions from Onsite Systems in California. The San Lorenzo River Basin in California is served primarily by onsite wastewater treatment systems. Since 1985, the Santa Cruz County Environmental Health Service has been working with local stakeholders to develop a program for inspecting all onsite systems, assessing pollutant loads from those systems, and correcting identified problems. Studies conducted through this initiative included calculations of nutrient inputs to the river from onsite systems. According to the analyses performed by the county and its contractors, 55 to 60 percent of the nitrate load in the San Lorenzo River during the summer months came from onsite system effluent. Assumptions incorporated into the calculations included an average septic tank effluent total nitrogen concentration of 50 mg/L, per capita wastewater generation of 70 gallons per day, and an average house occupancy of 2.8 persons. Nitrogen removal was estimated at 15 percent for wastewater infiltration fields in sandy soils, and 25 percent in other soils.

Using GIS Tools to Characterize Septic System Water Quality Threats in Colorado.

Summit County, Colorado, developed a geographic information system (GIS) to identify potential impacts that septic system-generated nitrates might have on water quality in the upper Blue River watershed. The GIS was developed in response to concerns that increasing residential development in the basin might increase nutrient loadings into the Dillon Reservoir. Database components entered into the GIS included geologic maps, soil survey maps, topographic features, land parcel maps, domestic well sampling data, onsite system permitting data, well logs, and assessors' data.

The database can be updated with new water quality data, system maintenance records, property records, and onsite system construction permit and repair information. The database is linked to a spreadsheet-based ground water vulnerability rating system. The approach is being used to identify areas that may have excessive contamination by nitrate-nitrogen loading from onsite systems. The assessments will support onsite system placement and removal decisions and help prioritize water quality improvement projects.

Performance Standards

Onsite System Operating Permits: St. Louis County, Minnesota.

St. Louis County, Minnesota, extends from the southwestern tip of Lake Superior north to the Canadian border. The physical characteristics of the region are poorly suited for application of traditional onsite treatment systems. To allow the use of onsite treatment, the county has adopted performance requirements that may be followed in lieu of the prescriptive requirements where less than three feet of unsaturated, permeable soils are present. The system should not discharge nitrate in concentrations exceeding 10 mg/L and fecal coliforms must be removed if the underlying ground water is to be used as drinking water without disinfection. In such cases the county requires that the owner continuously demonstrate and certify that the system is meeting performance requirements. This is achieved through the issuance of renewable operating permits for higher-performance alternative treatment systems.

Onsite Wastewater Training Centers Help Citizens and Professionals Maintain Septic Systems

Maintenance is the key to preventing septic systems from leaking. Onsite wastewater training centers in 20 states throughout the country are ensuring that installers, regulators, homeowners, and others responsible for maintaining these systems have the right keys. Each training center's funding sources vary and may include federal, state, educational institution, industry (septic installers and pumpers), and fees generated by the center. Each center is unique and displays onsite wastewater treatment technologies that are typical of their region. Most centers

provide aboveground displays of typical and alternative onsite technologies (using water rather than wastewater to demonstrate). It takes the mystery out of wastewater treatment and allows students to see how the systems function and what is needed to keep them running properly. The training centers also provide valuable onsite system curricula and can provide training to prepare for licensing and certification and continuing education for states or counties that require licenses for onsite professionals. The centers are located in the following states:

STATE	CENTER	CONTACT
Alabama	AL Onsite Training Center	Allen Tritt, 205-652-3803
Arizona	Northern AZ University Onsite Wastewater Demonstration Facility	Paul Trotta, 520-523-4330
Arizona	Onsite Wastewater Association of AZ	Colin Bishop, 520-226-0607
Delaware	Environmental Training Center at Del Tech	Jerry Williams, 302-855-5900
California	CA Wastewater Training & Research Center	Tibor Banathy, 530-898-6027
Colorado	CO School of Mines/CO Environmental Health Assn.	Rober Siegrist, 303-273-3490
Florida	FL Onsite Wastewater Training Center	Kevin Sherman, 850-402-9230
Kentucky	KY Onsite Training Center	Mike Davis, 502-839-5082
Massachusetts	MA DEP Training Center	John Higgins, 508-756-7281
Michigan	MI Onsite Wastewater Training and Education Center	Ted Loudon, 517-353-3741
Minnesota	Univ. of MN, Extension Service	Dave Gustafson, 612-625-6711
Missouri	MO Small Wastewater Flows Education and Research Center	Dennis Sievers, 573-882-7855
New York	NY Onsite Wastewater Treatment Training Network	Kathy White, 315-684-6670
North Carolina	Guilford County Onsite Wastewater Training Center	Larry Smith, 336-373-4773 Brenda Morris, 336-375-5876
North Carolina	National Land-Based Technology and Watershed Protection Training Center	Mike Hoover, 919-515-7305 Joni Tanner, 919-513-1678
North Carolina	SE Regional Onsite Wastewater Training Facility	David Lindbo, 252-793-4428, x166
North Carolina	Tidewater Onsite Wastewater Research and Edu Center	David Lindbo, 252-793-4428, x166
Oregon	OR Onsite Wastewater Training Center	Joel Smith, 541-440-4683
Rhode Island	Univ. of RI Onsite Wastewater Training Center	George Loomis, 401-874-4558
Tennessee	TN Onsite Training Center (in progress)	James McClain, 615-226-9601
Texas	International Wastewater Treatment Training Center	Raymond Bader, 915-859-7725
Texas	South TX International Onsite Wastewater Treatment Training Center	John Drawe, 956-968-5585
Texas	TX Onsite Wastewater Treatment Training Center	Bruce Lesikar, 979-845-7453
Utah	UT Onsite Wastewater Treatment Training Center	Judy Sims, 435-797-3159
Vermont	Northern New England Wastewater Training Center	Dick Perez, 802-234-9279
Washington	Northwest Onsite Wastewater Training Center	Dave Lenning, 360-455-8880
West Virginia	WV Onsite Wastewater Training Center	Mike Aiton, 304-293-4191, x 5510
Wisconsin	Univ. of WI Small Scale Waste Management Project	E. Jerry Tyler, 608-262-0853

For more information about onsite wastewater training centers, contacts, activities, and other training resources, please visit these web sites: National Environmental Training Center for Small Communities (www.estd.wvu.edu/netc/netcsc_homepage.html); Consortium of Institutes for Decentralized Wastewater Treatment (www.dal.ca/~cwrs/cdwt).

The operating permit is based on evaluation of system performance rather than design. The permit is issued for a limited term, typically five years. Renewal requires that the owner document that the permit requirements have been met. The permit program is self-supporting through permit fees.

Massachusetts' Requirements for Nitrogen-sensitive Areas. Nitrogen-sensitive areas are defined in Massachusetts rules as occurring within certain wellhead protection areas, watersheds, or recharge areas for public water supplies; nitrogen-sensitive embayments; and other areas designated as nitrogen-sensitive based on evaluations of the receiving waters. Newly constructed onsite systems in these areas must limit design flow to a maximum of 440 gallons per day of aggregated flow per acre. Exceptions are permitted for treatment systems with enhanced nitrogen removal capability, where the maximum design flow can be increased. The design flow restrictions do not apply to systems that produce an effluent with no more than 10 mg/L of nitrate.

Inspection and Maintenance

Massachusetts' Inspection Program. In 1996, Massachusetts mandated inspections of onsite systems to identify and address problems posed by failing systems. The intent of the program is to ensure the proper operation and maintenance of all systems. Inspections are required at time of property transfer, system expansion, and a change in use of the building that might alter the waste stream. Systems with design flows equal to or greater than 10,000 gallons per day require annual inspections. Inspections are to be performed only by persons approved by the state. The inspection criteria include detailed descriptions of the site, system components, and inspection findings for the soil infiltration field, septic tank, and other treatment units, if any. The owner must make the appropriate upgrades to the system within two years of discovery. The owner's failure to have the system inspected as required or to make the necessary repairs constitutes a violation of the code.

Busted! Leaky Septic Tanks Caught Redhanded!

One evening while watching the popular television series *Cops*, John Church, an environmental health specialist with the Arkansas Department of Health (ADH), devised a revolutionary new way to spot failing septic tanks. Watching police officers use an infrared heat detection system to track criminals on the run at night, Church thought there must be a way to transfer this technology to water quality protection. He began working on a plan to use infrared equipment to identify leaking septic tanks contributing to high bacterial concentrations in Lake Conway, located 30 miles north of Little Rock.



Lake Conway, built and owned by the Arkansas Game and Fish Commission, is located in a rapidly growing rural residential area. Wetlands around the lake provide habitat for ducks, geese, and other migratory birds, including the bald eagle. The lake is popular for its game fish, including bass, crappie, brim, and catfish. However, recent concerns about sewage in the lake have put a damper on recreationists' enthusiasm. There have been several fish kills on the lake attributed to low dissolved oxygen levels. At least one fish kill has been blamed on a malfunction at a large sewer plant that discharges into a tributary of the lake.

In 1998, the Lake Conway Conservation Committee (LCCC), a local watershed association, compared water samples flowing into the lake with those discharged from the lake. Results indicated that the concentration of *E. coli* bacteria, which can cause rashes and stomach aches, was 15 times higher in water flowing out of the lake than that coming into the lake. Additional testing carried out by the ADH revealed 30 malfunctioning septic systems within 300 feet of the lake. But the septic systems continue to be installed—Church said he has seen around 600 septic system permits approved annually in recent years.

Although the Arkansas Game and Fish Commission owns a 20-foot buffer zone around the lake, there are no restrictions, covenants, or building codes associated with lakeside property. Most of the residences within 300 feet of the lake were built before septic permits were required by the state. Today, however, developers continue to install septic systems, even though the soil is often unsuitable. Most of the soils around Lake Conway, especially those with shallow depths to a seasonal water table or bedrock, present limitations for designing septic systems. Sometimes these limitations can be overcome by using alternate designs, however; according to the ADH, many sites are not suitable for

any kind of onsite subsurface sewage disposal system. The LCCC and the ADH knew they needed to address the problem, but were unsure how to proceed—that is, until Church started watching *Cops*.

Targeting the Leaky Systems

Knowing that sewage effluent is, on average, 20 degrees warmer than the ambient ground temperature and thus exhibits a different thermal signature than a nearby water body, Church devised a plan to use an Arkansas State Police helicopter equipped with a Forward Looking Infrared (FLIR) imaging system, as well as video equipment and a global positioning system (GPS) to locate, map, and videotape sites of malfunctioning septic tanks in the Lake Conway watershed. Infrared mapping can distinguish heat differences as small as one-tenth of a degree.

The Arkansas State Police agreed to donate the use of their helicopter if Church would foot the bill for the fuel, which came to only about \$130. In November, when the ambient ground temperature was cold enough to allow the warm septc effluent to show up well on the FLIR system, Church began his flights. When he got a hit with the infrared unit, he videotaped it and then recorded the GPS location to note on a map later.

Based on his infrared searches and ADH data, Church estimates indicated that "more than 1,000 improperly installed or seasonally failing septic systems influence the lake." Between 2,500 and 3,500 residents live within 300 feet of the lake. ADH estimates that 5 percent of these residents or about 225, may have failing systems. This finding is especially disturbing since 1,600 to 2,100 of residences in this area are served by private wells for drinking water, which could also be affected by the malfunctioning septic systems.

Next Steps

To address the problem, the LCCC and the ADH considered both centralized and decentralized wastewater treatment options for the community. For a rural area, using one centralized wastewater treatment system would be more expensive, with 70 to 90 percent of the cost coming from the construction of the system. The decentralized solution uses cluster systems connecting several homes to a small onsite community treatment system. After a preliminary feasibility study earlier this year, the LCCC decided that a series of seven decentralized systems was the best solution for the region. At a cost of \$9.2 million, the decentralized systems offer

siting flexibility while allowing for a centralized management network. The LCCC also conducted a low-to-moderate income study to determine if at least 51 percent of the estimated 1,600 residents around the lake fall below certain income levels.

The positive results of the income survey, coupled with majority failure rate for existing septic systems, will virtually guarantee funding from a variety of sources for the new project. Each of the qualified residents could connect to the new systems for approximately \$20 to \$30 in monthly sewer bills.

The new systems will serve more than 1,500 homes in several areas around the 6,700-acre lake. Fifty-three percent of the cost will come directly from grant money. In the meantime, the Faulkner County Public Facilities Board, which was created under a county ordinance in 1990, has filed a draft with the legal division of the ADEQ to place a moratorium on the installation of new septic systems within a half mile of the lake's shoreline.

Each of the new cluster systems will send wastewater flows by gravity from a septic tank to a recirculation tank, which is equipped with a pump, a timing mechanism, and float valves. The wastewater is pumped to a recirculating sand filter either in timed doses or when the wastewater reaches a certain level in the tank. After being treated in the sand filter, the wastewater collects in underdrains and a portion of it is directed back to the recirculation tank, where it mixes with the septic tank effluent and is recirculated to the sand filter. The remaining sand filter effluent goes directly to further treatment or disposal.

The LCCC and the ADH chose sand filters because they are one of the best options for additional onsite treatment where septic tank/soil absorption systems have failed or are restricted because of high ground water, shallow bedrock, poor soils, or other

Infrared Technology in Michigan

Church isn't the only one who uses infrared. Scientists at the Macomb County Health Department in Michigan have been using infrared technology to spot septic leaks for several years. Infrared experts collect thermal and reflective infrared data to help pinpoint pollution sources in Lake St. Clair. Thermal data show areas of the lake that are a little warmer—such as would be expected from an area receiving wastewater from a leaking tank or an illicit sewer discharge. Reflective data are used to pinpoint areas with unusually green vegetation—an indication of standing wastewater. Lingering problems with Lake St. Clair beach closures because of high *E. coli* counts have led Macomb County and St. Clair County to form a joint task force charged with investigating ways to prevent water pollution.

[For more information contact the Macomb County Health Department, Environmental Health Services Division at (810) 469-5236.]

site conditions. They also can be a good choice in areas where centralized treatment is unavailable or too expensive. Their performance is relatively consistent and they have low operation and maintenance requirements.

Not only did the infrared scanning identify which septic tanks were malfunctioning, it also saved the ADH money. Sending agents on foot to do the same investigative study would have cost thousands more. ADH hopes to secure additional grants for further study.

[For more information, contact John Church, P.O. Box 1726, Conway, AR 72033. Phone: (501) 450-4941; fax: (501) 450-4941.]

Washington Scientists Explain How to Track Down Bacteria

Combating bacterial contamination is often an intimidating task, especially when the source is ambiguous. Scientists at the State of Washington Department of Ecology have developed a new tool to help make it a little easier. After a comprehensive literature review, the Department published *Fecal Contamination Source Identification Methods in Surface Water*.

"We work with local groups a lot with their monitoring efforts — many of them asked about ways to differentiate between sources of bacteria," explains Debby Sargeant, the document's primary author. "We realized that we didn't have all of the answers, so we decided to develop a reference document for us and others to use. In the past, bacterial contamination of water was often blamed on sewage treatment plants, but today we know that many different sources can be to blame, including runoff from livestock operations, failing septic tanks, an overabundance of geese or deer, or other nonpoint sources."

Sargeant compiled information on the available methods for identifying human versus nonhuman sources of fecal contamination in surface waters. The document describes each method, lists the advantages and disadvantages of each, and provides examples of application. The methods detailed in the document include the following:

Microbiological Methods

- **Fecal Coliform-to-Fecal Streptococci Ratios.** Different ratios indicate the presence of human or nonhuman bacteria.
- **Streptococcal Population Profiles.** Species composition is used to indicate host animals. Composition varies among types of animals and has been quantified for human, nonhuman, and dairy.
- **Species-specific Indicators.** Some bacteria strains are specific to certain animal species and can be identified as originating within that animal group. For example, *Rhodococcus coprophilus* is primarily associated with domestic farm animal fecal pollution.
- **Bacteriophages/Coliphages and Viruses.** Phages are viruses that infect bacteria—they can multiply in sewage and therefore can be used to indicate the presence of human fecal pollution.
- **Multiple Antibiotic Resistance.** Bacteria are analyzed for their resistance to various antibiotics. Bacteria from humans would be expected to show resistance to the antibiotics typically used in humans, whereas bacteria from dairy would show resistance only to antibiotics used in dairy operations.
- **DNA Ribotyping/Genetic Fingerprinting.** Ribosomal RNA (rRNA) genetic information is isolated from a pure bacteria culture grown from bacteria found in a water sample. This information is compared to a known sample of bacteria rRNA, such as one from a human. If the rRNA information for the unknown bacteria matches that for the known sample, the researcher knows the bacteria are derived from the same strain (in this example, a human source).

Chemical Methods

- **Detergents/Optical Brighteners.** These chemicals are associated with laundry discharge and might indicate human waste discharge from leaky septic tanks. The chemicals are absorbed by cotton in surface water and can be seen when viewed under ultraviolet light.

- **Caffeine.** Has been proposed as an indicator of human fecal pollution.
- **Coprostanol.** Coprostanol forms as a byproduct of the bacterial breakdown of cholesterol in the body and is proposed as an indicator of human fecal pollution.

Other Methods

- **Fluorescent Dye Tracing.** If dye is introduced into an onsite septic system that is suspected of leaking, charcoal in the receiving water body absorbs the dye, indicating that a leak is present.
- **Land-use-based Site Selection.** Land-use information can be used to select monitoring sites that can help pinpoint potential bacterial sources. For example, GIS overlays of specific sources can be used to select monitoring sites to determine relative pollutant contributions from each source.

Each method has advantages and disadvantages. "Unfortunately, we discovered that there is no sure-fire, inexpensive way to go. You have to keep track of the new methods that become available," notes Sargeant. "In fact, it is likely that new information has been published since our document was printed in October 1999." When choosing a method, Sargeant recommends researchers consider the types of sources likely to be in the water, the pollutant loading mechanisms and time frame, the type of medium being sampled (fresh water, sea water), and the budget. To date, the DNA ribotyping/genetic fingerprinting method has been used most often. Sargeant notes, however, that other promising techniques on the horizon include improved DNA techniques, multiple antibiotic resistance, bacteriophages, and method combinations.

The document, available on the Internet at www.ecy.wa.gov/biblio/99345.html, is organized by method type and includes an appendix summarizing the typical microbiological indicators used in bacterial assessments.

[For more information, contact Debby Sargeant, Washington State Department of Ecology, Environmental Assessment Program, P.O. Box 47600, Olympia, WA 98504-7600. Phone (360) 407-6684; e-mail: dsar461@ecy.wa.gov.]

Optical Brighteners to Shed Light on Sewer and Septic Tank Leaks

Do you suspect your stream is being polluted by leaking septic or sewer systems? Two Massachusetts groups, the Ipswich Coastal Pollution Control Committee and the Gloucester Shellfish Department/ Shellfish Advisory Commission, have developed a handbook explaining how to use an inexpensive detection method—optical brighteners. The two groups are using optical brightener testing as part of a larger sampling effort to help identify leaking septic systems, leaky sewage pipes, and storm drain cross connections, and differentiate human and nonhuman wastes in streams emptying into Ipswich Bay.



The two groups found the test for optical brighteners, a common dye in laundry effluent, to be a reliable indicator and volunteered to develop an Optical Brightener Handbook to serve as a reference. They cooperated with the Eight Towns and the Bay (8T&B) Committee to make the document available on the Internet at www.thecompass.org/8TB/pages/SamplingContents.html. The 8T&B Committee is a coalition of nine communities on the coast of Ipswich Bay that cooperate on initiatives to improve the environmental quality of the bay and its watershed. The Committee believes that by sharing the handbook it can assist other communities and small groups that want to conduct optical brightening sampling. "I believe that this method is one of the most exciting and effective tools available to detect wastewater in the environment for volunteers and professionals alike," notes Wayne Castonguay, coauthor of the document and a member of the Ipswich Coastal Pollution Control Committee.

Optical brighteners are fluorescent white dyes that are added to almost all laundry soaps and detergents to make cotton fabric look whiter. Some optical brightener is discharged with the laundry effluent into a household's wastewater stream. Therefore, the presence of optical brighteners in a surface water body may indicate an upstream source of wastewater.

Optical Brightener Handbook

As an introduction to the method, the handbook defines optical brighteners and reviews the historical use of dyes for tracing leaking septic systems and other uses. It then provides sampling program guidance, emphasizing the need to combine optical brightener data with other data such

as rainfall, bacteria sampling, flow data, and field observations. The handbook includes a sample data sheet, a list of necessary materials, and requirements for quality control.

After helping to establish a program, the handbook explains how to test for optical brighteners by placing cotton pad "traps" in the surface water body of concern. During seven days in the water, the pads absorb any optical brightener present in the water column. After the collection period, the pads are dried and returned to the laboratory, where an ultraviolet light is used to show whether any optical brightener is present. The handbook recommends that samples be taken only from storm drains, pipes, and small streams, because the volume of water in larger water bodies might dilute optical brightener concentrations beyond detection. It also provides a summary of the data collected from the city of Gloucester to show what a watershed group might expect if they perform similar testing.

The most challenging step is data interpretation. The handbook includes a protocol for boxing in pollution sources using bacterial loading and optical brightener sampling. For example, if data taken under dry (low-flow) conditions indicate high bacterial loading and optical brightener, the authors suggest that the bacteria are likely due to failing septic systems. In this case, successive samples for bacteria and optical brightener should be taken upstream until the source is located.

Program Costs and Benefits

The material costs (mesh, cotton pads, UV light, and other items) for the Massachusetts groups' optical brightener sampling program are low — only about \$450. However, labor costs are high because personnel must visit each site twice (placement and retrieval), complete paperwork, and care for the sampling equipment. The handbooks suggest that a two-person team can comfortably visit between 12 and 15 stations per day, so costs are determined by the hourly rate of the personnel and the number of sampling sites. "I see optical brightener sampling as a great tool for grassroots groups. It is a labor-intensive process but fairly inexpensive," explains Dave Sargent, coauthor of the document and a member of the Gloucester Shellfish Advisory Commission.

Optical brightener sampling has helped reduce the fecal pollution entering the Ipswich Bay. "It's a really good tool. But," Sargent hastens to mention, "it needs to be used with another form of bacterial sampling before you can take enforcement action." Sargent notes that the optical brightener sampling program has been ongoing for years and has uncovered numerous problems, including leaky municipal sewage systems and "many, many septic tanks that need to be upgraded. Most people understand the need to fix the failing system and are willing to work with us, although we've had to take enforcement action against some."

Other Uses for Optical Brighteners

Optical brighteners are being used frequently in urban areas to identify illicit discharges to storm drains. In 1999 the Northern Virginia Planning District Commission (NVPDC) performed optical brightener analysis on 173 samples from storm drains leading to Four Mile Run in the suburbs of Washington, D.C. The study even identified one illegal hook-up of a hotel laundry facility. The optical brightener study complemented a larger DNA genetic analysis study to identify the sources of bacteria in the watershed. For more information on the NVPDC study, see www.novaregion.org/4MileRun/bacteria.htm.

Interpreting Optical Brightener Data

Often, the presence of optical brighteners indicates a sewage leak. In one instance, the authors found a positive optical brightener test in combination with a high bacteria count at a storm drain outfall in Gloucester, an area that was completely sewerized. Additional sampling up through the drain system pinpointed a leaky sewer pipe as the culprit. The city has since repaired the pipe as part of numerous upgrades to its sewer system.

The optical brightener sampling program has continued to be a success because "it is truly a cooperative effort," explains Sargent. In Gloucester's program, many state and local agencies, including the Massachusetts Division of Marine Fisheries, the Gloucester Health Department, and the Gloucester Shellfish Department contribute personnel time for collecting and analyzing fecal coliform and optical brightener samples; much of the coordination of the optical brightener sampling program is done by volunteers who see the need to improve water quality in their communities.

Spreading the Word

The Massachusetts groups' success with the optical brightener approach has not gone unnoticed. Recently they have worked with organizations and communities throughout the state and the nation. "We get a lot of phone calls from people wanting more information. We've offered free training in optical brightener sampling for Massachusetts shellfish officers, have worked closely with local board of health agents, and are providing free technical

support for a sampling program in Chattanooga, Tennessee," notes Sargent. "We've even been contacted by an agency in Spokane, Washington."

[For more information, contact Dave Sargent, Gloucester Shellfish Advisory Commission, 637 Essex Avenue, Gloucester, MA 01930, Phone: (978) 281-3981, e-mail: gsgt@massed.net, or Wayne Castonguay, Ipswich Coastal Pollution Control Committee, 47 Clark Road, Ipswich, MA 01938. Phone: (978) 412-2569.

Protecting Ground Water on the Garden Peninsula



The beautiful but environmentally fragile Garden Peninsula juts out into northwestern Lake Michigan in eastern Delta County, Michigan. Problems with leaky septic systems and nonpoint source runoff in this rural area of sinkholes, fractures, a high water table, and shallow soil prompted the Delta-Menominee District Health Department (DMDHD) to take action. As John Petrasky, MD, MPH, Medical Director/Health Officer of the DMDHD graphically states, "People shouldn't be drinking their own sewage." By targeting failing septic systems for upgrade and educating the community, the DMDHD has made great progress toward protecting the region's ground water quality.

Geology and Water Quality

The region's geology leaves ground water supplies vulnerable to contamination. The Garden Peninsula is underlain by an aquifer composed of a limestone and dolomite bedrock formation typically located less than five feet below the surface of the ground. In many areas, the rock is at the ground surface. The bedrock is marked with fractures and sinkholes, allowing nonpoint source runoff and poorly treated wastewater from onsite systems to enter the ground water. In some cases, perennial or seasonal streams flow into the openings in the bedrock and disappear. To compound the problem, a high water table further reduces the depth of the unsaturated zone of soil that would otherwise help filter contaminated water.

This vulnerable bedrock aquifer is the primary drinking water source for the region's 1,000 residents and 70,000 yearly visitors. Unfortunately, the wastewater disposal needs of the people are served by septic systems perched above the same aquifer. When the region's geological limitations cause a septic system to function poorly, everyone's water supply is at risk. Luckily, the DMDHD recognized the potential human health threat and secured a section 319 grant to identify and alleviate sources of pollutants. The DMDHD's project, known as the Garden Peninsula Aquifer Protection Project (GPAPP), includes development of an aquifer protection plan; identification of sinkholes, disappearing streams, and fractures throughout the peninsula; an inventory of potential contamination threats; and efforts to target priority problems with cost-share funds.

Project Activities

To help residents understand the importance of the project, the DMDHD sampled the well water of 141 residents. The findings were startling from a public health perspective: 16 percent of samples tested positive for *Escherichia coli*, indicating that human or animal sewage is making its way into the ground water. An additional 49 percent of samples tested positive for general coliform bacteria, indicating that other disease-causing bacteria, viruses, protozoans, or organisms might also be present. The DMDHD believes that the coliform results indicate a source of surface water input. Only 35 percent of the samples analyzed did not indicate the presence of coliform bacteria. The high number of positive tests showed that the DMDHD was correct to be concerned about the potential risk for residents to contract a waterborne disease.

Although they don't expect their project to solve the contamination problems, the DMDHD hopes it will help. "There are many sources, including natural ones, that as a health department, we won't be able to address," explains the DMDHD's Lori Schultz. "We are focusing our pollution reduction activities on the human sources that release waterborne diseases into the environment. We've raised people's awareness of the issue, which is very important. Many people had no idea of the quality of their water."

Once the community was informed and involved, the DMDHD began to target priority pollution problems. To date the DMDHD has focused on repairing or replacing failed septic systems, using alternative and emerging technology where appropriate. In most cases where the soil was too shallow to support a conventional system, the DMDHD encouraged the use of a pressurized mound, a system known for its success in the area. In a couple of cases the DMDHD installed other types of

alternative systems as deemed appropriate for the site. Using section 319 cost-share funds, the DMDHD has funded 75 percent of the cost of repairing or replacing 11 failed septic systems.

All replacement septic systems funded by GPAPP—whether conventional, mound, or other alternative systems—have effluent filters. The filters are installed at the outlet of the septic tank and stop solids from exiting with the effluent. These units should extend the life of all systems because the drainfields will not become clogged by solids that degrade slowly or are not biodegradable. The filters should last the life of the system because although they will clog, they can be rinsed off and reused. The effluent filters are another innovation that will promote the proper functioning and long life of these septic systems.

The DMDHD has also focused its efforts on educating residents so they can make informed decisions regarding their own practices and the safety of their water supply. GPAPP has held three well-attended public meetings at which speakers discussed ground water conditions on the peninsula. At the public meetings and through the biannual GPAPP newsletters, the DMDHD encourages individuals to take action to help reduce bacterial contamination, including raising buried wellheads, sealing abandoned wells, diverting surface water from sinkholes and fractures, and modifying agricultural management practices to reduce the input of bacteria and other pollutants into the ground water.

The educational efforts have paid off. Some residents who had been drinking their tap water have chosen to obtain alternative supplies or to treat their drinking water to minimize their risk of waterborne disease. After attending one of the public meetings, one resident replaced a straight pipe that had been discharging directly into a fracture with a new septic system. These successes are only a start. Many residents now understand the natural conditions that make the peninsula susceptible to ground water contamination and how their actions can affect drinking water quality.

Community Support

This project would not be as successful as it is without the participation and support of a diverse community steering committee. The committee members represent the Garden Peninsula professionally and geographically. "This community is incredibly close-knit," remarks Schultz.

"The steering committee members work hard to spread the word about the project in the community. They are willing to talk to people who have pollution problems to encourage them to participate." Like many rural communities, residents on the Garden Peninsula are wary of regulatory agents. Without the backing of the steering committee, few residents would have participated, dooming the project to failure.

The project also has improved DMDHD's relationship with the community, notes Schultz. "On the Garden Peninsula, many viewed us negatively as a regulatory agency. Through this project we've gained a much better working relationship. We can now work cooperatively to plan for the future, including exchanging ideas about zoning and other planning tools to protect their ground water."

[For more information, contact Lori Schultz, Delta-Menominee District Health Department, 2920 College Ave, Escanaba, MI 49829. Phone: (906) 789-8138; e-mail: lschultz@dmdhd.localhealth.net.]

Septic Systems for Dogs?

"Picking up after your pooch" became much easier after the town of Clifton Park, New York, established a dog park with its own waste treatment system. Owners may allow their dogs to roam freely in the fenced enclosure, but they must place the dogs' waste into the on-site treatment system to prevent it from accumulating and running off when it rains.

Thought to be the first of its kind in the state, the Mary Jane Roe Dog Park has become increasingly popular since it was established in October 1999. "The town requires that pet owners obtain a permit to use the dog park. We have already issued 182 permits, and the number is growing every day," notes Jason Kemper, the town's environmental specialist.

Along with popularity comes a pile of pet waste. Foreseeing the potential environmental and aesthetic problems, the town incorporated a treatment system into the dog park plan. "The park has several low-lying areas with hydric soils. Surface water runs off the park area through a small wetland and into a nearby stream," explained Kemper. "We were concerned about surface runoff

from the site, as well as the mess and odors associated with the large quantities of waste that would be generated."

The Treatment System

When the park first opened, the town installed an in-ground stool digester designed to break down the pet waste by using enzymes and a bacteria additive. The cold New York winter inhibited the degradation processes, however, causing the waste (and dog owner complaints) to accumulate. The growing popularity of the park also placed added pressure on the already insufficient system.

By late winter the town realized that the digester would not meet the park's annual treatment needs. The town voted to install a 500-gallon sealed underground septic tank that could be pumped out once a year or on an as-needed basis. Although no money was set aside in fiscal year 2000 to support the installation of the new \$700 system, the town proceeded with the project this summer, using contingency funds. Eventually, the cost of the tank will be offset by the annual \$20 permit fees paid by each dog park user. The fees are directed into the town's general fund, out of which \$700 is set aside annually to support the dog park's maintenance needs such as fence repair and new poop scoopers.

Environmental Concerns

Although the soils in the park are frequently wet, the tank shouldn't pose any risk of leaching pet waste into the ground water. "The tank is constructed of concrete and was placed below the frost line, so it will not leak or crack," explains Kemper. It is 96 inches long, 62 inches wide, and 38 inches high and was buried a foot below the ground surface. A covered chute, 10 inches wide and 2 feet deep, allows pet owners to deposit their pet's waste directly into the tank.

As the town of Clifton Park strives to meet the recreational and waste treatment needs of all its two-legged and four-legged citizens, the challenges the town has overcome serve as a model for other growing areas struggling to meet similar needs. Thanks to Clifton Park, other municipalities might see the major benefits of providing dogs with a place of their own. Not only will the dogs and owners be happy, but the town can also consolidate and treat pet waste, rather than see it scattered throughout the residential areas waiting for the next storm to wash it away.

[For more information, contact Jason Kemper, Environmental Specialist, One Town Hall Plaza, Clifton Park, NY 12065. Phone (518) 371-6651 x229; fax (518) 371-1136; e-mail: kempjay@hotmail.com.]

New York Onsite Wastewater Treatment Training Network Underway!

In New York state, professionals in all aspects of onsite wastewater treatment systems are getting training that presents current, advanced, technologically correct information that is consistent with state regulations.

The New York State Onsite Wastewater Treatment Training Network currently offers courses including: Foundations of Onsite Wastewater Treatment, Site Evaluation for Onsite Wastewater Treatment Systems, and Regulatory Plan Review of Onsite Wastewater Treatment Systems. More courses are being developed to reach audiences from homeowners to municipal code enforcement officials, in topics ranging from evaluating existing systems to setting up management districts.



Training is currently given at the Morrisville campus of the State University of New York, which has also had a technology demonstration site. Training will soon be offered at other locations across the state as well.

Funding for developing and implementing the training program has been a collaborative effort of industry and governmental agencies. The National Onsite Demonstration Project provided funds to develop the demonstration site, as did industry sponsors. The state Department of Environmental Conservation is applying CWA section 319 monies to support staff and provide a tuition stipend to local officials. The Finger Lakes-Lake Ontario Watershed Protection Association contributed to signs at the facility.

[For more information, contact Douglas Nelson (Nelsondj@morrisville.edu), or Larry Kinne (Kinnelw@morrisville.edu), NYS Onsite Wastewater Treatment Training Network, SUNY Morrisville, Shannon Hall, Morrisville, NY 13408, Phone: 315-684-6673.]

Notes on the National Scene

New Nonpoint Source Management Partnership Kicked Off

The Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) and EPA have joined to form the new State/EPA Nonpoint Source Management Partnership. The Partnership provides an excellent framework for states and EPA to work together cooperatively to identify, prioritize, and solve nonpoint source problems.

The states and EPA initiated the new partnership at a national nonpoint source meeting sponsored jointly by ASIWPCA and EPA in April 2000, when the two came together to identify high-priority nonpoint source issues on which they want to work together through their Clean Water Act Section 319 Nonpoint Source Management Programs. Over the past several years, states have been working hard to upgrade and improve their section 319 programs. The new partnership should help the states identify and satisfy their technical and programmatic needs as they implement their newly enhanced NPS programs.

The partnership has established seven work groups to focus on nonpoint source needs, including watershed planning and implementation, rural nonpoint sources, urban nonpoint sources, nonpoint source grants management, nonpoint source capacity building and funding, information transfer and outreach, and nonpoint source results. Each work group is composed of a chair and cochair (one EPA and one state), as well as other EPA and state representatives. A steering committee, consisting of the chairpersons of each individual work group, has also been established to oversee the new partnership. Roberta Savage, Executive Director of ASIWPCA, and the Director of the Assessment and Watershed Protection Division at EPA, cochair the steering committee.

Each work group has identified its needs and priorities and has developed individual action plans to address those needs over the next several years. Highlights of the work groups' priorities include the following:

- *Watershed Planning and Implementation Workgroup.* Strengthening the links between nonpoint source assessment and implementation activities by sharing examples of nonpoint source TMDLs/watershed management approaches and related useful tools; facilitating flexible approaches to watershed problemsolving across EPA and other federal/state agencies and programs.
- *Rural Nonpoint Sources Workgroup.* Providing technical guidance to states in developing and implementing Comprehensive Nutrient Management Plans; surveying and facilitating the distribution of educational materials relating to Animal Feeding Operations and Confined Animal Feeding Operations; sharing information on rural BMP effectiveness and research gaps.
- *Urban Nonpoint Sources Workgroup.* Identifying effective BMPs; providing support for municipal storm water program activities.
- *Nonpoint Source Grants Management Workgroup.* Exploring options to streamline and simplify the section 319 grant awards process; developing or sharing examples of ways to enhance the involvement of local communities in nonpoint source activities with federal and state financial support.
- *Nonpoint Source Capacity Building and Funding Workgroup.* Researching successful state financial and program capacity-building programs; identifying measures of success; collecting good examples of effective state marketing tools.
- *Information Transfer and Outreach Workgroup.* Researching existing nonpoint source-related education materials and developing a good model for integrating such materials into school curricula; and conducting a media campaign to educate the general public about nonpoint source problems.
- *Nonpoint Source Results Workgroup.* Enhancing state and national systems to enable EPA to report more accurately and comprehensively to both Congress and the general public about what is being accomplished through implementation of the nonpoint source program.

(continued)

The Partnership plans to communicate workgroup activities and accomplishments through *Nonpoint Source News-Notes*, nonpoint source listservers, future EPA web site updates, and other means, in addition to interaction at scheduled stakeholder meetings.

EPA and ASIWPCA are excited about the new partnership, believing that this effort will capitalize on, benefit from, and support the newly enhanced and upgraded nonpoint source management programs. "By anticipating program needs and using our collective resources and expertise to address them in a coordinated manner, states and EPA will be able to greatly enhance nonpoint source management programs," states Savage.

[For more information, contact Stacie Craddock, Office of Wetlands, Oceans, and Watersheds, USEPA, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. Phone: (202) 260-3788; fax: (202) 260-1977; e-mail: craddock.stacie@epa.gov; or Linda Eichmiller, Association of State and Interstate Water Pollution Control Administrators, 750 First Street, NE, Suite 910, Washington, DC 20002. Phone: (202) 898-0905; fax: (202) 898-0929; e-mail: l.eichmiller@asiwPCA.org.]

Exploring the Realm of Enforceable Nonpoint Source Controls



Nonpoint source pollution control is difficult to enforce. The sources and responsible parties are just too diffuse to get a handle on. But some states are finding ways to do it. In June the Environmental Law Institute (ELI) in Washington, DC, released a report that examines the efforts of eight states to use enforceable mechanisms as part of their programs for the control of nonpoint source pollution. ELI's report, *Putting the Pieces Together: State Nonpoint Source Enforceable Mechanisms in Context*, builds on several of ELI's prior studies addressing available nonpoint source enforcement mechanisms.

ELI's watershed-based study details the enforcement methods used by Georgia, Maine, Maryland, Ohio, Oregon, Texas, Virginia, and Wisconsin. "States are increasingly adopting new provisions to deal with water pollution issues," explains James McElfish, one of the document's authors. "States divide technical assistance and enforcement responsibilities for nonpoint source pollution control in many different ways." In its analysis, ELI focused on (1) the tools used by each state's nonpoint source control program; (2) how the state's enforcement programs tied into its cost-share, technical, and voluntary assistance programs; and (3) how the methods tried successfully in each state could be applied in other states.

Common Enforcement Issues

Using the eight case study states, ELI identified five major enforcement-related findings that local, state, and federal officials should consider when developing or modifying a nonpoint source pollution control program.

1. Enforcement is already a small part of the strategic mix to control nonpoint sources.

"Although enforcement wasn't the primary control mechanism in any state, all the states we looked at have some enforcement capabilities built into their programs," notes McElfish. Each state has enforceable mechanisms in place for some nonpoint source pollution problems, such as timber harvesting or land clearing activities that are not subject to NPDES permitting. "State program managers realize that voluntary requirements do not always prevent the pollution from occurring and sometimes enforceable mechanisms are required."

2. Enforcement authority can be linked to operating requirements or standards and can be integrated into a watershed plan.

States have two kinds of enforcement mechanisms in their programs: (1) those that are activated after the pollution occurs, such as after water quality standards are exceeded because of a discharge; or (2) those that prevent pollution from occurring, such as erosion control requirements. ELI noted that programs that emphasize pollution prevention are more successful than those that rely on punishment after pollution has occurred. For example, Oregon requires farmers to comply with water quality management plans that are designed to prevent pollution. State law provides enforcement authority when compliance is not achieved. ELI also noted that many states have

linked their programs to watershed assessment and planning, which provides them greater accountability and measures of program effectiveness.

3. Cost-share mechanisms continue to play a substantial role, particularly for agricultural sources .

All eight states rely primarily on cost-share and technical assistance to control nonpoint source pollution from agricultural lands. Several states in the study (Maryland, Virginia, and Wisconsin) supplement federal cost-share funds with substantial state-funded cost-share programs. Some states also provide tax breaks to encourage BMP implementation. The ELI report explains that states have found it difficult to combine supportive agricultural programs with enforcement measures in the same agency. Often, the agency that administers cost-share and technical assistance programs for the agricultural sector seeks to distance itself from any association with enforcement.

"Unfortunately, unless enforcement is well coordinated, this separation can be inefficient," explains McElfish. "In some cases, when the support agency has exhausted its efforts to convince a person to fix a problem, the referral to the enforcement agency leads to the initiation of the cajoling process all over again prior to issuing an order or penalties, which simply defers compliance."

Sample Enforcement Mechanisms in Maryland

For the agricultural sector, Maryland focuses its water quality improvement efforts on cost-share, technical assistance, and voluntary programs, using enforcement tools primarily as a backup measure. Land development and forestry activities, on the other hand, must comply with enforceable requirements adopted by counties under state legislation. The spectrum of enforcement mechanisms used in Maryland includes:

- ✓ **No Discharge.** State law prohibits discharges of any pollutant to waters of the state. The Maryland Department of the Environment (MDE) can enforce this law with hefty fines.
- ✓ **Soil or Sediment Discharges.** State law prevents discharge of soil or sediment to waters of the state except as authorized. MDE can impose fines or imprisonment for violators.
- ✓ **Maryland's Water Quality Improvement Act.** This 1998 law requires farmers to prepare and implement nutrient management plans. If a farmer fails to implement a plan under the appropriate schedule, the Maryland Department of Agriculture can impose fines. People hired to apply commercial fertilizer to nonagricultural land are also subject to fines if they apply fertilizer improperly.
- ✓ **Grading and Land Clearing Permits.** MDE and county/local government conduct an enforceable permitting process for forestry activities and land clearing and development. Enforcement includes stop work orders, corrective action orders, injunctions, fines, and imprisonment.
- ✓ **Forest Conservation Requirements.** State law requires that a developer comply with the local forest conservation program to obtain a grading/land clearing permit. If a development violates the local program, the local authority or state can impose stop work orders, injunctions, and fines.

4. Geographically targeted enforceable protections are significant features of state nonpoint source programs.

Many states have begun developing enforceable nonpoint source pollution control laws for particular geographical areas. For example, the Edwards Aquifer Protection Program in Texas places special emphasis on reducing pollution in sensitive aquifer recharge areas. Georgia's River Corridor Protection Program requires local governments to develop plans to protect rivers from the impact of human activities on land adjacent to the rivers.

5. Enforcement procedures are more effective when simple to use and prompt in their effect.

In all states, nonpoint source pollution controls begin with emphasis on voluntary efforts. These efforts can take time. Therefore, to be most effective, state enforcement programs should allow quick action when necessary. Wisconsin, for example, can issue "abatement orders" at the state level for most nonpoint source problems, but the process is complicated and can require up to a year to complete. Instead, Wisconsin relies heavily on counties to handle violations through enforcement of local ordinances for control of erosion, control of stormwater runoff, and livestock and manure management. Locally enforceable mechanisms like these are visible tools that are both timely and effective.

Enforcement Mechanisms on the Rise

Through its research, ELI discovered that increasing numbers of states are supplementing traditional nonpoint source controls with enforceable mechanisms. "Based on our research, we are confident that most states will continue to integrate more enforcement capabilities into their programs. However, not all states will do so, or do so for all sectors, without some incentive from the federal government," adds McElfish. ELI believes that continued improvement in state nonpoint source programs will require accountability for water quality, adequate state and federal funding, and the use of enforcement measures.

[ELI's report, as well as the previous reports in the series, are available on the Internet at www.elix.org. For more information, contact James McElfish, Environmental Law Institute, 1616 P Street., NW, Suite 200, Washington, DC 20036. Phone: (202) 939-3800; e-mail: mcelfish@eli.org.]

Notes from the States, Tribes, and Localities

Northeast Heronry Suffers the Effects of Development

Fort Delaware, located on Pea Patch Island in the upper Delaware Estuary, was once used by Union soldiers to protect the ports of Wilmington and Philadelphia. Today it is the island's inhabitants themselves who need protection.

According to the Delaware Coastal Management Program (DCMP), the 310-acre island is home to the second largest heron rookery (heronry) on the Atlantic Coast. These wading birds nest on the island and forage in quiet seclusion in the surrounding coastal wetlands that line the coasts of Delaware and New Jersey. In 1989 Pea Patch Island's heron population peaked at 12,000 nesting pairs, but recently the number of nesting pairs has plummeted to only 3,000. Why? Among other factors, these fragile birds are losing ground to suburban sprawl and the nonpoint source pollution that comes along with it.

In 1996 the DCMP, under the authority of the federal Coastal Zone Management Act of 1972, began to develop a Special Area Management Plan (SAMP) for the Pea Patch Island heronry with the goal of detailing how to preserve and protect this natural resource. Representatives from local, state, and federal government agencies, nonprofit organizations, businesses, and industries formed the Pea Patch Island Core Group to identify problems and to develop management strategies to address them. Implemented initially in February 1998, the Pea Patch Island Heronry Region SAMP focuses on seven priority issues—habitat change and development, pesticides, contaminants, oil spills and industrial accidents, habitat improvement and protection, human disturbance, and outreach and education. An Implementation Team staffed by relevant resource management agencies and key stakeholder groups is responsible for overseeing the progress of strategies and achievement of goals.

Habitat Change and Development

As is true in many regions of the country, the area surrounding Pea Patch Island is experiencing a suburban population explosion and a subsequent demand for more housing. In fact, in New Castle County, Delaware, the population of the area is expected to double over the next 20 years. Rapid suburban growth associated with cities like Bear, Christiana, and Middletown, swallows up agricultural lands and wetlands that were once foraging and nesting grounds for the birds. In addition to the direct loss of habitat, the area is slowly being covered with impervious surfaces like parking lots, rooftops, and roadways. These surfaces funnel storm water filled with sediment, nutrients, and other contaminants directly to the low-lying wetlands and eventually to the Delaware River.

Species Found in the Pea Patch Island Heronry

- ◆ Great Blue Heron
- ◆ Great Egret
- ◆ Snowy Egret
- ◆ Cattle Egret
- ◆ Glossy Ibis
- ◆ Tri-colored Heron
- ◆ Little Blue Heron
- ◆ Black-crowned Night Heron
- ◆ Yellow-crowned Night Heron

In the SAMP, the Core Group identifies several strategies to address the impacts of growth and development. The strategies include developing a land preservation tool box, establishing an awards program to recognize program owners and developers who preserve natural areas, and developing criteria for determining riparian buffer design standards. The DCMP worked with New Castle County to ensure the inclusion of riparian buffers. To complement this effort, at Delaware's October 1999 Coast Day, DCMP unveiled a new GIS application that will enable planners, landowners, farmers, and resource managers to increase the use and effectiveness of riparian buffers and target urban and agricultural areas. The application will help create new buffer design criteria that will specify width, vegetation type and distribution, and local conditions in Delaware's watersheds.

Pesticides

Pesticides from area golf courses, lawns, and other landscaped areas pose a severe threat to the health of the birds of Pea Patch Island. Pesticide exposure can result in acute and chronic toxicity at sufficient exposure levels. Tests have shown that some species on the island currently have lowered levels of cholinesterase, an enzyme used in nerve-to-nerve transmissions. Lowered levels often indicate exposure to certain types of pesticides (like organophosphate and carbamate pesticides) and result in

behavioral changes such as lethargy or inattentiveness to nests, which can affect the survival of the young. The SAMP Implementation Team plans to expand pest management education and conduct additional studies of pesticide use within the study area and its effects on the birds.

Contaminants

Along with a population explosion and increased demand for housing comes an increase in industrial activity, specifically waste disposal activities. Sediment contaminated by industrial effluent and runoff from landfills, underground storage tanks, and other disposal sites is ingested by macroinvertebrates, which are then eaten by bottom-feeding fish. Many of the Pea Patch Island birds forage on these bottom-feeding fish along the Delaware River wetlands. Because these foraging birds are near the top of the food chain, they tend to bioaccumulate the contaminants, which can eventually kill them or decrease their reproduction. The Implementation Team is evaluating and assessing the impacts of dredging and disposal sites in the study area, establishing water quality criteria that will protect the birds' habitat, and studying specific contaminants of concern.

Oil Spills and Industrial Accidents

Oil spills and industrial accidents often have immediate impacts on the birds and their habitat. In addition to the impacts of the spilled material itself, materials and methods used to respond to and clean up a spill might also cause problems. The SAMP Implementation Team members have assisted with an effort to place boom anchoring buoys around half of the island to contain oil spills. They will soon host a workshop that will focus on developing better plans for emergency response during spills. These emergency plans will include protocols on handling and caring for birds caught up in spills. These actions will dramatically increase accident response efficiency and decrease heron injuries and losses.

Habitat Improvement and Protection

To ensure the longevity and stability of the Pea Patch Island heronry, it is essential that suitable foraging and nesting habitats be protected, restored, created, and managed for wading birds, as well as other species. The Implementation Team plans to increase the number of wetland restoration projects carried out in the study area, restore nesting habitat, and develop specific heronry criteria for use in land acquisition and protection. These criteria are needed to help target and prioritize lands for acquisition and/or protection that meet the foraging and nesting habitat requirement of long-legged wading birds with the heronry. After one SAMP study showed the importance of the marsh grass species *phragmites*—usually considered a nuisance—to the birds' nesting habitat on the island, plans to eradicate the species with herbicide were halted.

Human Disturbance

Although Fort Delaware attracts 30,000 visitors each year, the heronry area itself is not accessible without a special permit. However, other types of human disturbance such as deer hunting, research efforts, low-flying aircraft, muskrat trapping, oil boom location and maintenance, and pollution and wake from jet skis, can threaten the birds' habitat. The Implementation Team hopes to lessen the efforts of human disturbance through several strategies, such as installing better signage in the water and on the land surrounding the heronry nature preserve, maintaining a vegetative buffer between Fort Delaware and the heronry, and restricting flights over the heronry. DCMP also works to ensure that activities at Fort Delaware, such as cannon fire, do not harm the birds directly or degrade their habitat.

Getting the Public Involved

Because the health of the heronry is directly linked to the quality of the surrounding habitat, Susan Love, a natural resource planner and Implementation Team member with the Delaware Coastal Management Program, stresses that "the public can play a large role in protecting these areas by following simple measures to reduce nonpoint source pollution, such as reducing the amount of lawn fertilizers and pesticides they use or planting trees, grasses, or other vegetation in bare patches to prevent soil erosion." She adds, "Contributions to local land conservation groups and educating local decision-makers such as county council members, planners, and state legislators on the value of this important resource are other ways the citizens of Delaware and New Jersey can help protect the heron rookery."

The SAMP is based on an adaptive management approach and will be revised periodically to reflect changes in land use, local priorities, and the bird population. By March 2001 DCMP and the SAMP Implementation Team will release a status report on the activities carried out thus far under the SAMP and suggestions on how the strategies spelled out in the plan could be modified to best protect the birds and their fragile habitat.

[For more information, contact Susan Love, Delaware Coastal Management Program, Delaware Department of Natural Resources and Environmental Control, 89 Kings Highway, Dover, DE 19901. Phone: (302) 739-3451; fax: (302) 739-2048; e-mail: slove@state.de.us.]

The Bosque Watershed Doesn't Waste Manure



Whoever said that manure was just animal *waste*? A team of legislators, state agencies, and a local stakeholder group in Texas has found a way to combat nonpoint source pollution linked to excess cow manure by turning what was once considered waste into a valuable resource. Texas Representatives Kip Averitt and David Lengefeld and Senator David Sibley have worked with the Texas State Soil and Water Conservation Board (TSSWCB), Texas Natural Resource Conservation Commission (TNRCC), Texas Department of Transportation (TxDOT), the General Service Commission (GSC), and the Bosque River Advisory Committee to develop an innovative Composted Manure Incentive Program in the Bosque River watershed.

The Problem

The Bosque River headwaters are located in the Stephenville, Texas, area, about an hour's drive southwest of Fort Worth. The river meanders through rural Erath County and runs by the towns of Hico, Iredell, Meridian, and Clifton before seeping back into the ground at Valley Mills.

Extensive water quality monitoring on the river has revealed that phosphorus is the limiting nutrient. A TMDL for the river is almost complete and TNRCC plans to submit the final TMDL report to EPA for approval by the end of the year. Approximately 40,000 dairy cattle in the watershed produce a huge quantity of phosphorus-laden manure every day. Most producers use the manure to fertilize their fields, but many just pile it next to their barns. Rainwater carries nutrients from the manure to local streams, causing excessive algal growth.

The Solution

Linda Brookins, supervisor of TNRCC's Watershed Management Team; team members Carol Whittington and Bill Carter; and Scott McCoy of TNRCC's Small Business and Industry Assistance Section formed a project team that drafted a preliminary section 319 grant proposal to EPA last year, outlining incentive payments to compost users. TNRCC's project team then met with Representatives Averitt and Lengefeld, Senator Sibley, TSSWCB, TxDOT, and the Bosque River Advisory Committee, whose membership included local politicians from towns and districts within the watershed, environmental groups, dairy producers, composter associations, and other concerned citizens, to put together a program to reduce phosphorus in the Bosque River.

The TNRCC project team's goal was to remove manure from the watershed. They realized that there was a need for both manure disposal alternatives for producers in Erath County and good quality compost outside the county. Since the county is rural, the cost of hauling the raw manure to a compost facility and then hauling the finished compost to a buyer created a significant challenge to operating a composting business in the area.

The TNRCC project team set out to enlist state and local agencies to buy compost and create a large, reliable initial market for the finished product. TNRCC has been awarded a section 319 grant from EPA to provide an incentive to these buyers. TNRCC will provide a flat incentive payment of \$5 per cubic yard of compost beneficially used by a participating agency. The incentive payment is below the actual total cost of purchasing, transporting, and applying a cubic yard of compost, but in some cases it will be more than the cost of just hauling the manure. TNRCC is also developing a certification program for composting facilities used in the program. Currently, the watershed has one proposed and three existing composting facilities.

TNRCC has teamed with TxDOT to provide the \$5 incentive. "We plan," said TNRCC's McCoy, "to remove 50 percent of the collectible dairy manure, which is about 260,000 cubic yards, from the Bosque River watershed over the next three years." After submitting inquiries to seven TxDOT districts near Stephenville, TNRCC has learned that the Fort Worth TxDOT District can use 60,000 cubic yards of finished compost per year. That is more than half the yearly goal. The Fort Worth TxDOT District plans to use the compost to fertilize sediment and erosion control plantings and to aid final stabilization on construction sites.

TSSWBC joined the effort with a proposal to offset transportation costs by applying for section 319 grant funds to finance hauling the raw manure from dairies to the compost facility. Erath and the surrounding counties have more than 100 dairies, and TSSWCB has already received letters of intent from 42. "This project," explained TSSWCB TMDL/319 Program Coordinator Donna Long, "is a multi-agency and bipartisan effort from state legislation." According to Lee Munz, TSSWCB 319 Project Manager, the agency expects to receive the section 319 grant soon. These funds will be used to reimburse producers for the cost of hauling the raw manure from the dairy to the compost facility. After extensive research involving local haulers, the planning group established a reimbursement rate of \$0.85 for the first mile and \$0.125 for every additional mile to haul one cubic yard of raw manure. The first mile is weighted to include the cost of loading the manure on to the truck. Producers will be free to use any hauler. The Cross-Timbers Conservation District, one of the project partners, will appoint a coordinator to manage tasks to be accomplished within the watershed, such as issuing hauling cost reimbursements; conducting educational workshops; and coordinating the interests and concerns expressed by the producers, composters, haulers, and other interested citizens.

"The Big Spring project showed us that the compost-seed mixture for normal roadside maintenance, erosion control, or repairs saves about 20 percent of the cost of a traditional seed-soil erosion blanket," said TNRCC Commissioner John Baker. "For new construction, the savings jump to about 60 percent."

Promoting compost use in May 1999, TNRCC and TxDOT held a demonstration at a highway overpass in Big Spring to showcase the application of compost on steep slopes, which can be a challenging task. The compost was mixed with grass seed and mulch and was applied at a depth of three inches on the slope. "We thought the compost would retain soil moisture, and help conserve water when applied to highway rights-of-way," explained McCoy. By mid-June, the barren slope was transformed into an area of lush grass. To promote the benefits of using the compost-grass mixture, the two agencies have conducted other demonstration projects at highway sites and are planning more projects in the coming months. "The Big Spring project showed us that the compost-seed mixture for normal roadside maintenance, erosion control, or repairs saves about 20 percent of the cost of a traditional seed-soil erosion blanket," said TNRCC Commissioner John Baker. "For new construction, the savings jump to about 60 percent."

The Benefits of Manure

The Composted Manure Incentive Program is a win-win solution for all stakeholders upstream, downstream, and along the Bosque River. "This is a water quality solution, not an industry solution," said Averitt. "It has been rewarding to see all parties come together to address a problem that has festered for years." The dairy industry will benefit by having another means of waste disposal without increased costs. More importantly, all residents in the Bosque River watershed will benefit from better water quality.

[For more information, contact Representative Kip Averitt, Phone: (254) 772-6225, e-mail: kip.averitt@house.state.tx.us; Donna Long, Texas State Soil and Water Conservation Board, Phone: (254) 773-2250, e-mail: long@brc.tamus.edu; or Scott McCoy, Texas Natural Resource Conservation Commission, Phone: (512) 239-6774.]

Notes on Watershed Management

Ski Resorts Pledge to Protect the Environment

The environment is a ski resort's most significant asset. But skiing, snowboarding, and countless other summer recreational activities often come at the cost of the environment. This past summer the National Ski Areas Association (NSAA) and its partner organizations launched *Sustainable Slopes: The Environmental Charter for Ski Areas* to help protect the very environment upon which ski resorts depend. The Charter proposed ways that participating ski resorts can manage issues like wastewater treatment facilities, stormwater runoff, and erosion and sedimentation, while "demonstrating their commitment to good environmental stewardship," says Michael Berry, National Ski Areas Association President.

The partner organizations include a host of federal, state, and local agencies such as EPA, USDA Forest Service, the Conservation Law Foundation, National Fish and Wildlife Foundation, Leave No Trace Inc., The Mountain Institute, and the U.S. Department of Energy. EPA supported the development of the Environmental Charter and continues to support the initiative by providing technical assistance from existing voluntary partnership programs such as the Water Alliance for Voluntary Efficiency, the Waste Wise program dealing with solid waste, the Energy Star program that promotes energy efficiency, and the agency's smart growth and development efforts.

Charter Overview

The *Environmental Charter for Ski Areas* is a voluntary initiative that holds participating ski areas (winter and summer resort operations) to a broad set of principles that provide a framework for implementing best management practices, assessing environmental performance, and setting goals for future improvement. More than 160 ski areas, representing 31 states that host 70 percent of the country's skiers/snowboarders, have already endorsed the Charter. To recognize the resorts' participation, NSAA issues a "Sustainable Slopes" endorsement logo to each resort to display at their facility and on their marketing materials.

NSAA and the partner organizations are hoping that all resorts in the country will endorse and adopt the principles. Most of the resorts who have yet to endorse the Charter are small resorts without the staffing and financial or technical ability to implement the principles. To address this problem, the partner organizations will continue to develop tools and education programs that will make it easier for all resorts to eventually endorse the principles.

The voluntary principles are meant to provide overall guidance to help ski resorts practice good environmental stewardship. They are not a list of legal requirements that must be applied in every situation. Since each ski resort operates in a unique local environment or ecosystem, each resort reflects regional differences; therefore, each resort must make its own decision about how to achieve sustainable use of natural resources. In other words, while individual resorts have the same overall goal of implementing the Charter, they will need to choose different paths to get there.

The Principles

The principles in the Charter were developed through a collaborative effort by NSAA and the partner organizations, and are intended to be updated periodically as needed. They focus on three areas:

■ *Planning, Design, and Construction.* The principles include: (1) engaging stakeholders in dialogue on development plans and implementation; (2) planning and siting facilities to avoid negative impacts on natural resources and to avoid sprawl; (3) designing new facilities to conserve water, energy and materials; and (4) meeting or exceeding all regulatory requirements.

■ *Operations.* The principles include: (1) optimizing efficiency and effectiveness of water uses ski resort-wide; (2) protecting and minimizing wildlife and habitat impacts; (3) maintaining minimum stream flows; (4) conserving water, energy and fuel; (5) managing wastewater responsibly; (6) reducing all waste generated at the ski resorts; (7) reusing and recycling where

possible; (8) minimizing air quality impacts; (9) designing resorts to compliment the natural environment, and (10) contributing to solutions to decrease transportation issues. Several suggestions are offered for each resource. For example, to protect water quality, the Charter suggests that ski resorts participate in watershed planning and management efforts, maintain vegetative buffers along streams to improve natural filtration and protect habitat, and apply appropriate stormwater management techniques and erosion and sediment control practices.

■ ***Education and Outreach.*** The principles include: (1) promoting environmental education and awareness and (2) enhancing the relationship between the ski area and stakeholders so that it benefits the environment. Ski resorts are expected to promote the Environmental Code of the slopes, a list designed to heighten the public's awareness about ways they can make sustainable use of natural resources while participating in outdoor recreational activities. The code suggests that the public practice energy conservation, participate in educational events and cleanup days sponsored by the ski resort, and practice outdoor ethics like respecting wildlife and not littering.

Based on information collected each year from the resorts, NSAA will issue an annual report card to assess how well the participating resorts are meeting the goals outlined in the principles. To assist with data collection, NSAA and the partner organizations plan to work together over the next few

years to set and achieve measurable goals for all the principles. "We don't know what the goals will be yet," explained Geraldine Hughes, NSAA's Director of Public Policy. "But, for example, to assess whether they are following the energy conservation principle, we might ask them to note whether they've achieved a certain percent reduction in energy use." NSAA expects the annual report to become more quantitative as the program develops and grows. The report will be issued each year in May and will be available on the NSAA website (www.nsaa.org).

Ski Resorts Respond

Several ski resorts have developed management plans based on the Charter, including:

Crystal Mountain, Washington: Their Master Development Plan includes several measures to address the protection of water resources, including water reclamation and conservation. Under this master plan, they have also developed management plans for roads, trails, stormwater, and stream restoration. The management plans are implemented to offset temporary and permanent watershed impacts and monitoring is used to verify their implementation, determine the effectiveness of the restoration, and validate the maintenance or improvement of the watershed functions.

Snoqualmie Pass, Washington: The Summit at Snoqualmie's Master Development Plan will be similar to that of Crystal Lake. However, the Summit must address key wildlife corridors that represent the very heart of the Northern Spotted Owl controversy. Any proposed expansion of facilities at the Summit must include sufficient revegetation or preservation of previously cleared forest to be determined neutral or beneficial to old growth forest. The proposed development will be required to include up to 400 acres to be dedicated for old growth forest preservation. In addition, several areas within the ski terrain will be revegetated to improve the aesthetics. This preservation/revegetation approach will benefit skiers, wildlife, and watershed functions.

Westwood, California: Dyer Mountain is the only undeveloped resort to endorse the environmental charter. In 1998, Dyer Mountain Associates was formed and plans to develop a resort community began to unfold. In 1999 several groups of consultants researched existing data and conducted field investigations to locate key habitats in environmentally sensitive areas, and any other constraints to developing ski, golf, residential, and base-area facilities. Based upon the vision for the recreational community and the environment, the consultants determined that four elements would drive the planning for the project, all targeted toward keeping the sense of place that currently dominates the site. These elements include emphasizing general environmental protection and using innovative planning and design to avoid environmental impact, while also offering the technology and recreational amenities desired by the community.

Compliance Incentives

A series of incentives encourage ski resorts to adopt and follow the Charter. First, by doing so, ski resorts demonstrate their environmental stewardship to customers and partner organizations. Second, adopting and implementing the principles results in a reduction of waste and energy use, which benefits the environment and resort profits. Third, partner organizations will provide technical and/or financial assistance to make improvements and share data across the industry. Resorts can also win an award, sponsored by the Skiing Company (a Times Mirror company), for environmental excellence based on the principles. And finally, by following the Charter, ski resorts can ensure their livelihood is sustainable for the future through customer satisfaction and environmental protection.

[For more information, contact Geraldine Hughes, Director of Public Policy, National Ski Areas Association, 133 South Van Gordon Street, Lakewood, CO 80228. Phone: (303) 987-1111; e-mail: nsaa@nsaa.org.]

Golf Courses are Getting Greener

Is your golf course environmentally friendly enough? What about the golf industry as a whole? The Golf & the Environment Initiative is developing tools to help answer those questions. Formed in 1995, Golf & the Environment is a partnership of environmental leaders, golf industry executives, and other interested organizations dedicated to expanding the environmental sustainability and benefits of golf by communicating and collaborating with the golf industry, environmental groups, developers, government organizations, media, and other relevant stakeholders.

In 1995, led by the Center for Resource Management, Golf & the Environment participants met to discuss golf's environmental responsibilities and to help set environmental performance goals for the golf industry. Their discussions led to the development of a 1996 document titled

Environmental Principles for Golf Courses in the United States, which provides a framework for environmental responsibility on existing and new golf courses. Since the document was published, 23 organizations have endorsed it, including golf associations, environmental groups, the federal government (EPA), and others (see box). A copy of the environmental principles can be found at http://www.usga.org/green/download/current_issues/print/environmental-principles.html.

The following organizations endorse the *Environmental Principles for Golf Courses* document:

American Society of Golf Course Architects
Arizona Golf Association
Audubon International
Center for Resource Management
Club Managers Association of America
Friends of the Earth
Golf Course Builders Association of America
Golf Course Superintendents Association of America
Ladies Professional Golf Association
National Association of Counties
National Club Association
National Coalition Against the Misuse of Pesticides
National Golf Course Owners Association
National Golf Foundation
National Wildlife Federation
North Carolina Coastal Federation
Pamlico-Tar River Foundation
Physicians for Social Responsibility
Save the Bay
Shivas Irons Society
Southern Environmental Law Center
United States Environmental Protection Agency
United States Golf Association

New and existing golf courses are expected to adopt and integrate the principles on their own. "The principles were intended to be voluntary," notes Paul Parker, Executive Vice President of the Center for Resource Management and member of Golf & the Environment steering committee. "To support this voluntary effort, we are developing a self-assessment checklist to allow groups to determine how well their golf course is adhering to the principles."

To provide an overall picture of how much the golf industry has improved by adopting the principles, the Golf & the Environment Initiative is developing a national golf course environmental performance measurement program. "We hope to track industry performance by looking at indicators of environmental performance like water use and water quality," explains Parker. "The Golf Course Superintendents Association is supporting this effort by asking its members to supply the data." Both the checklist and the performance measurement programs are planned for release at the Golf Course Superintendents Association annual meeting in February 2001.

[For more information contact, Paul Parker, Executive Vice President, Center for Resource Management, 1104 East Ashton Avenue, Suite 210, Salt Lake City, UT 84106. Phone: (801) 466-3600.]

Notes on Education

Trivia Campaign Reaches Average Citizen

Drop by Drop: You Make a Difference, a trivia campaign that educates about water pollution prevention, has been piloted in Illinois and Virginia by EPA Region 5 in partnership with Philip Morris Companies, and in Chicago, with Dominick's grocery stores.

The Girl Scout Council of South Cook County hosted two events at Dominick's stores in Oak Lawn and Matteson, Illinois. The Girl Scouts set up tables at each store, using EnviroScape® models to demonstrate water pollution prevention and offering shoppers the opportunity to participate in a quick trivia quiz on water issues. Those who took the quiz received *Drop by Drop* refrigerator magnets.

Participation was entirely voluntary, based on the principle that "Learning is much more fun when you choose to participate, when you can enjoy it, and when you know it's balanced and accurate information," observes Judy Taggart of the Terrene Institute, which developed *Drop by Drop*.

Philip Morris introduced *Drop by Drop: You Make a Difference* to Virginia at a press conference in Richmond. The conglomerate also announced the donation of 23 EnviroScapes to the Richmond City Schools and the state of Virginia. "Supporting such programs as the *Drop by Drop* campaign helps to increase our awareness of water stewardship and the importance of protecting the natural resources of our communities," said Charles E. Agee, Manager, Community Relations Programs of Philip Morris USA.

To develop *Drop by Drop*, Terrene and EPA Region 5 conducted focus groups to ascertain how to reach the average citizen who doesn't actively seek information about the environment. Focus group participants agreed that they wanted balanced, accurate information that wasn't trying to sell them a point of view. They also preferred receiving information in an attractive form, such as the trivia quiz developed by *Drop by Drop*.

Shoppers at the Chicago pilot events responded enthusiastically to the EnviroScape® demonstration and the trivia quiz. Although answers to the quizzes were to be posted in the stores later, most shoppers wanted to know the answers immediately, and many discussed the information with the Girl Scouts.

Terrene provided *Drop by Drop: You Make a Difference* kits containing all the information and materials the Girl Scouts needed to prepare for the events. The Scouts organized and presented the events. A Terrene representative, Erin Foster, assisted.

Although a national campaign, *Drop by Drop: You Make a Difference* will be conducted by community groups as local events. "Our goal is to help communities reach people in everyday places, such as grocery stores, malls, and markets," Taggart says of the campaign.

[For more information, contact Judy Taggart, Terrene Institute, 4 Herbert Street, Alexandria, VA. Phone: (703)548-5473; e-mail: terrinst@aol.com; web: www.terrene.org.]

Students Learn from Wastewater

Darrow School, a private residential high school in upstate New York, has turned its septic system nightmare into a curriculum booster. Until 1998 the school's 100 students were served by several aging and potentially leaking septic systems scattered around the campus. The school was built in the late 1920s on the original Mount Lebanon Shaker Village site, and many of the septic systems predated the school. To address this septic time bomb, the school administration decided to replace the septic systems with an innovative wastewater treatment system called the Living Machine®. In addition to solving a nonpoint source pollution problem, the new \$248,000 system is now an integral part of the learning process at Darrow School.

The school decided to build a Living Machine after much research. Not only were they impressed with the success of the treatment process (see box), but they also recognized the potential for using the system as a teaching tool. "We've developed an environmental emphasis in our curriculum that complements the system," explains Lisa Riker, Director of Environmental Studies at Darrow School.

Serving the Curriculum

The system began helping students to learn even before it was installed. To size the new system and the corresponding state discharge permit for the system effluent, the school had to determine how much water it used per day. A math class was charged with finding out. "The students forced us all to keep track of how long we were in the shower, how many times we flushed the toilet and so forth. They measured the water flow with buckets in the showers and measured the water in the toilet tanks. They kept track of how much water was used in the dining hall. We were all pleased when the state determined that the students' research was acceptable for issuing the school's discharge permit," says Riker.



A student from the Darrow school samples the effluent of the Living Machine.

Since the system's installation in October 1998, teachers have been finding more and more ways to incorporate it onto their curriculum. Science classes make an obvious connection. In the microbiology unit in biology class, the students can observe various microbes from the system under the microscope. The aerated reactors in the greenhouse also provide tropical plants for study year-round. "This is a great botany resource when it is cold and dreary outside during our New York winters," notes Riker. Students select a plant and study it in detail under the microscope and in its environment.

One botany class is developing an in-depth study guide that details all the plants in the greenhouse. The guides will be given to visitors during tours of the facility.

Students in stream ecology have also used the system. Although most of this classwork is out in the field monitoring streams, students also monitor the system's water quality. This can be an eye-opener, explains Riker. "Students were horrified to find that the effluent from the treatment system was actually cleaner than the water in local streams."

Other less obvious school subjects draw from the system. The watercolor class finds the greenhouse the perfect place to capture color and beauty during the middle of winter. The Living Machine has

led the school to look at the entire curriculum through the lens of sustainability. As a result, economics classes discuss natural resource economics and history classes look at historical events with a critical eye toward land use. English classes focus on the idea of a sense of place when analyzing literature and writing.

Living Machine Treatment Process

1. A collection system delivers wastewater to a passive anaerobic reactor buried outside the greenhouse. This provides the first stage of wastewater treatment. The anaerobic reactor provides the initial removal of solids and organic material.
2. From there, wastewater is pumped into the greenhouse and enters a closed, aerated reactor. Gasses are vented through a carbon filter to remove odors. The closed aerobic reactor further reduces organics and solids.
3. Next, the wastewater flows through a series of five open, aerated reactors. These reactors are filled with a diverse community of organisms including aquatic plants, zooplankton, and snail. In this oxygenated environment, the communities of macro and microorganisms break down the waste.
4. Following the open aerobic reactors, the wastewater enters a clarifier. Excess biosolids settle to the bottom and are pumped from the clarifier back to the anaerobic reactor for further digestion and volume reduction.
5. From the clarifier, the wastewater flows into two Ecological Fluidized Beds (EFBs) for final polishing. The beds have granular media filters, made of lava rock, surrounded by an outer ring of plants and water. These reactors remove the remaining organics and suspended solids.
6. The final clean effluent is dispersed into the ground using a mound disposal system.



Wastewater from the school passes through aerated reactors that are filled with tropical plants. The plants are also studied during botany lessons.

Maintenance and Costs

Unlike their old septic systems, Darrow School's new wastewater system requires daily maintenance. Instead of being deterred from installing the system, Darrow embraced this new responsibility as a teaching tool. Lisa Riker and her students spend about an hour a day on average keeping the system operational. Maintenance needs include documenting monitoring data and just "checking to see that everything looks and smells all right." Aside from some initial microbial imbalances, which were quickly solved, the system has not suffered from operational problems.

A cost comparison between the Living Machine and other wastewater treatment systems is difficult. "Our systems are often compared in price to ones that treat wastewater to a lesser degree, which is obviously not a fair comparison," explains Erik Alm, Director of Marketing for Living Machines, Inc. "Also, less tangible benefits such as educational benefits, quality of life benefits, and co-production benefits are almost always glossed over." Darrow School had the foresight to recognize these benefits and is now reaping the educational rewards.

[For more information about Darrow School's efforts, contact Lisa Riker, Darrow School, 110 Darrow Road, New Lebanon, NY 12125. Phone: (518) 794-6011; e-mail: sec@darrowschool.org. For more information on the Living Machine system, contact Eric Alm, Living Machines, Inc., 8018 NDCBU, 125 La Posta, Taos, NM 87571. Phone: (505) 758-5090; e-mail: erik@goodwater.com.]

Educational Resources Column

Video



New Video Examines Polluted Urban Runoff. Is the water that flows from my tap safe to drink? Are the fish I buy or catch safe to eat? Can I swim in nearby rivers, lakes, or streams without facing serious health hazards? Residents of towns and cities across America are asking these questions with greater frequency as growing populations, sprawling development, and pollution threaten the purity of our freshwater supplies. To help communities deal with these issues, the Oregon State University Extension Service has produced a new video entitled *After the Rain: Urban Runoff*. "This program explores the importance of water, the pressures our towns and cities are placing on this precious resource, and ways that individuals can protect local drinking water supplies," says Ron Miner, OSU Extension Service water quality specialist. "The video should prove useful to anyone who is concerned about drinking water safety and improving the natural world around us."

After the Rain: Urban Runoff (VTP 029) costs \$19.95 (including shipping) per copy. Send your request and check or money order payable to Oregon State University to: Publication Orders, Extension & Experiment Station Communications, Oregon State University, 422 Kerr Administration Building, Corvallis, OR 97331-2119. Information about the video and other water-related educational materials is available on the Internet at <http://eesc.orst.edu>. For more information, contact Anne Gilliam, River Network, Eastern Office. Phone: 202-364-2550; e-mail: agilliam@rivernetwork.org.

Video Explains Riparian Functions. Whether it's along a coastal or a desert stream, the riparian area plays a pivotal role in the health of our watersheds. *Life on the Edge: Improving Riparian Function*, a new 12-minute video from the Oregon State University Extension Service, shows viewers:

- How this transition zone between the water's edge and the uplands provides food and cover for fish and wildlife, controls erosion, filters runoff, and produces the ingredients for fish habitat and stream channel stability.
- What land-use practices can adversely affect riparian areas.
- The techniques landowners, volunteers, and professional resource managers use to improve and protect riparian function.

Life on the Edge: Improving Riparian Function (VTP 033) costs \$19.95 (including shipping) per copy. Order by e-mailing puborders@orst.edu or send your request and check or money order payable to Oregon State University to Publication Orders, Extension & Station Communications, Oregon State University, 422 Kerr Administration Building, Corvallis, OR 97331-2119.

For Our Future. Narrated by TV personality and native Kansan Bill Kurtis, *For Our Future* beautifully summarizes Kansas' Governor's Forum on Water Quality Protection (see the Commentary in *News-Notes* No. 59). The 11-minute video is free from the Kansas Water Office by calling (785) 296-0866.

Models



Watershed Kit. The new *Make Your Own Watershed Kit* makes learning about watersheds fun — even exciting — as you create your own plaster watershed (with buildings and bridges) using the kit's molds and paints. Then, you can learn how to prevent water pollution through activities suggested by the kit's instructions (in English and Spanish). "EnviroScape Jr." in size and cost, the kit takes the successful hands-on educational approach of its popular parent into the homes and projects of students. The 12-inch-square watershed mold can be reused. EnviroScape's *Make Your Own Watershed Kit* sells for \$29.95, plus \$5.50 shipping and handling; volume discounts are available. Send your order with payment (check or credit card) to EnviroScape, c/o JT&A, 14524-F Lee Road, Chantilly, VA 20151; fax (703)631-6558. For more information, call (703) 631-8810, ext. 10; website: www.watershedkit.com.

Reviews and Announcements

Comments Period Open on National Agricultural Management Measures Guidance

National Management Measures to Control Nonpoint Source Pollution from Agriculture is a draft technical guidance and reference document for use by state, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on the best available, economically achievable means of reducing pollution of surface and ground water from agriculture. EPA is soliciting comments on this draft guidance. Comments must be postmarked by January 16, 2001 and mailed to Sharon Buck, U.S. Environmental Protection Agency (4503-F), 1200 Pennsylvania Avenue, NW, Washington, DC 20460; or electronically mailed to buck.sharon@epa.gov. For more information visit the web site at www.epa.gov/owow/nps/agmm/index.html.

Call for Papers/Posters

9th National Nonpoint Source Monitoring Workshop

August 27-30, 2001

Hyatt Regency, Indianapolis, IN

This workshop will bring together land managers and water quality specialists to share information on the effectiveness of best management practices in improving water quality, effective monitoring techniques, and statistical analysis of watershed data. The workshop will focus on the successes of Section 319 National Monitoring Program projects and other innovative projects from throughout the United States.

The agenda will include three days of workshop sessions/presentations and a one-day field trip. Two half-day workshops will focus on monitoring program evaluation and GIS. Presentations will be 20 minutes, followed by 10 minutes for discussion. Poster presentations are also encouraged. Presenters will submit a paper due the date of the conference for publication by U.S. EPA ORD.

The deadline for submission of abstracts is March 1, 2001. Presentations should focus on one of the following session topics:

- Detecting change in water quality from agricultural BMP implementation
- Modeling application of NPS pollution
- Agricultural nonpoint source pollution TMDLs
- Volunteer monitoring in section 319 projects
- Innovative monitoring in agricultural landscape
- Programs and approaches for animal operations and nutrient management

[Abstracts are limited to one page, single spaced (or 300 words). Submit abstracts by e-mail to ctic@ctic.purdue.edu or on disk by mail to Nonpoint Source Workshop, 1220 Potter Drive, Suite 170, West Lafayette, IN 47906. Phone (765) 494-9555; fax (765) 494-5969. For more information, contact Tammy Taylor at taylor@ctic.purdue.edu or visit www.citic.purdue.edu/CTIC/NPSCall.html.]

Web Sites Worth a Bookmark

www.wa.gov/ecology/wq-wow/index.html

Watch Over Washington supports volunteer monitors of all ages in learning how to collect reliable, consistent environmental information. It features a searchable roster of projects and coordinators; announcements of events, resources, and opportunities; status reports on natural resources; and more.

www.ci.knoxville.tn.us/reports/bmp_manual/index.htm

The city of Knoxville, Tennessee's BMP Manual will assist developers, contractors, engineers, inspectors, and property owners in the selection and installation of BMPs. The main text and 28 of

www.lgean.org

the BMPs, which represent approximately half of the BMP Manual, were posted in August 2000. The remainder of the BMPs are still being edited and will be released in a few months. Each section of the manual can be downloaded in Adobe Acrobat format.

The Local Government Environmental Network (LGEAN) is a "first-stop shop" that provides environmental management, planning, and regulatory information for local government elected and appointed officials, managers and staff.

Datebook

Meetings and Events

January 2001

7-9

DATEBOOK is prepared with the cooperation of our readers. If you would like a meeting or event placed in the DATEBOOK, contact the NPS News-Notes editors. Notices should be in our hands at least two months in advance to ensure timely publication.

International Symposium on Integrated Decision-Making for Watershed Management. Chevy Chase, MD. Contact Dr. Mary Leigh Wolfe, Department of Biological Systems Engineering, Virginia Tech. Phone: (540) 231-6092; e-mail: mlwolfe@vt.edu; web site: www.conted.vt.edu/watershed.htm.

22-26

Working at a Watershed Level, Fresno, CA. Contact the California State University, Fresno Geology Department. Phone: (559) 278-3086; e-mail: watershed@listserve.csufresno.edu; web: www.dpla.water.ca.gov/sjd/sjrmr/workshop/index.html.

February 2001

5-9

International Erosion Control Association's 32nd Annual Conference and Expo, Las Vegas, NV. Contact IECA at (970) 879-3010; fax: (970) 879-8563; e-mail: ecinfo@ieca.org; web site: www.ieca.org.

March 2001

21-23

10th Annual Southeastern Lakes Management Conference, Knoxville, TN. Contact Sue Robertson, Tennessee Valley Authority, (423) 751-3747; e-mail: ssrobertson@tva.gov; web: www.don-anderson.com/senalms2001.

April 2001

17-20

Enhancing the State's Lake Management Programs—Integrating Nonpoint Source Watershed Management with Lake Management and Protection, Chicago, IL. Contact Bob Kirschner, Chicago Botanic Garden, 1000 Lake Cook Road, Glencoe, IL 60022. Phone: (847) 835-6837; fax: (847) 835-1635; e-mail: bkirschn@chicagobotanic.org.

18-20

4th National Mitigation Banking Conference, Fort Lauderdale, FL. Contact Terrene Institute. Phone: (800) 726-4853; e-mail: terrinst@aol.com; web site: www.terrene.org.

30-May 2

Water Quality, Monitoring, & Modeling, San Antonio, TX. Contact Michael J. Kowalski, American Water Resources Association, 4 West Federal Street, P.O. Box 1626, Middleburg, VA 20118-1626. Phone: (540) 687-8390; fax: (540) 687-8395; e-mail: mike@awra.org; web site: www.awra.org.

May 2001

16-18

2001 Communities Working for Wetlands. Orlando, FL. Headed by The Izaak Walton League of America. For more information contact Save Our Streams. Phone: (800) 965-5004; e-mail: awm@iwla.org; web site: www.iwla.org/SOS/awm/awmconf.html.

June 2001

10-15

5th International Conference on Diffuse Pollution. Milwaukee, WI. Sponsored by the International Water Association, Specialist Group on Diffuse Pollution. Contact Vladimir Novotny, Institute for Urban Environmental Risk Management, Marquette University, Milwaukee, WI 53201-1881. Phone: (414) 288-3524; fax: (414) 288-7521; e-mail: environment@marquette.edu; web: www.mu.edu/environment/iwa-page.htm.

27-July 1

National Watershed Forum, Arlington, VA. Contact Todd Barker, Meridian Institute, (802) 899-2625; e-mail: tbarker@merid.org; web: www.merid.org.

August 2001

27-30

9th National Nonpoint Source Monitoring Workshop: Monitoring and Modeling Nonpoint Source Pollution in the Agricultural Landscape, Indianapolis, IN. Contact the Tammy Taylor, Conservation Technology Information Center, 1220 Potter Drive, Suite 170, West Lafayette, IN 47906. Phone: (765) 494-9555; fax (765) 494-5969; e-mail: taylor@ctic.purdue.edu.

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Nonpoint Source NEWS-NOTES is an oc ca sional bul le tin deal ing with the con di tion of the wa ter-related en vi ron ment, the con trol of nonpoint sources of wa ter pol lu tion and the eco sys tem-driven man age ment and re sto ration of wa ter-sheds. NPS pol lu tion co mes from many sources and is caused by rain fall or snowmelt mov ing over and through the ground. As the run off moves, it picks up and car ries away nat u ral pol lut ants and pol lut ants re sult ing from human ac tiv ity, fi nally de pos it ing them into lakes, rivers, wetlands, coastal wa ters, and ground wa ter. NPS pollu tion is as so ciated with land man age ment prac tices in volv ing agri cul ture, silvi cul ture, min ing, and ur ban run off. Hydro logic mod i fi ca tion is a form of NPS pol lu tion which of ten ad versely af fects the bio log i cal integ ri ty of sur face wa ters.

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Nonpoint Source NEWS-NOTES is produced by the Terrene Institute under an EPA Cooperative Agreement (# 820957-01) from the As sess ment and Wa ter shed Pro tec tion Di vision, Of ice of Wet lands, Oceans and Water, U.S. En vi ron men tal Pro tec tion Agency. It is dis trib uted free of cost. Views ex pressed do not nec es sar ily re flect those of EPA or the Terrene In sti tute. Men tion of com mer cial prod ucts or pub li ca tions does not con sti tut e en dor sement, or rec om men da tion for use, by EPA or the Terrene In sti tute.

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News-Notes
c/o Terrene Institute
4 Her bert Street
Alexandria, VA 22305

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