



# 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*

## **New Tools for Communities are Needed if NPS Regulation is to Succeed**

by Chester L. Arnold, Co-Director, University of Connecticut NEMO Project and Tom Schueler, Director, Center for Watershed Protection

Agencies and programs concerned with nonpoint source pollution have not, as a group, fully embraced the ramifications of the suburbanizing of America. If we are to succeed in reducing the impacts of poorly planned development on our water resources, providing educational assistance and practical tools to the nation's communities must become a major focus of NPS programs.

In recent decades, natural resource management has been moving out of agency offices and farmers' kitchens into town halls. With the dawn of the NPS era came a realization that our critical environmental issues are diffuse and incremental, making them a poor fit for traditional "command and control" regulatory solutions. However, the first wave of NPS programs had an advantage of sorts, in that it focused largely on a well-defined land use (agriculture) controlled by an easily identified group (farmers). Now, as American suburbanizes, the majority of our landscape is no longer primarily controlled by individuals owning large swaths of farm or forest land. In urban and suburban American, communities, rather than individuals, assume the role of the predominant land-use decision maker.

How do we respond to the new challenges inherent in this evolution of our landscape and understanding? Seeking new answers to the seemingly intractable problem of nonpoint source control in urban and urbanizing areas, water resource agencies are turning to regulatory approaches such as the NPDES Stormwater Phase II, Total Maximum Daily Loads (TMDLs), and Source Water Assessment programs. Bringing NPS pollution under the regulatory umbrella, however, is at



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.

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best a “back-door” approach to influencing land use, the root cause of the problem. These programs, while not directly regulating land use, will have an impact on development decisions — but will it be the intended, positive impact?

Assuming that an increase in regulatory pressure will automatically result in huge improvements is a leap of faith. It seems safe to predict that community leaders and developers under pressure will embrace any strategy out there that will satisfy their state regulators. At the moment, what’s “out there” is still dominated by structural stormwater practices, which have several inherent limitations. First, the literature tells us that the pollutant removal capability of such practices is modest, particularly when compared to preventive approaches involving watershed planning and better site design. Second, by addressing NPS pollution at only the site level, the impacts of poorly planned development on community character, long-term economic health, and overall watershed health — concerns that have made “smart growth,” “liveable communities,” and “sprawl” common terms in today’s lexicon — are not always adequately addressed.

A new focus is needed. We must put much more emphasis on providing communities with the education and technical assistance that they need to improve their overall land-use planning, and implement development design that is more protective of water resources. Comprehensive planning, watershed planning, open space planning, farmland protection, natural resource inventories, innovative subdivision design, green roofs, pervious parking, bioretention — all of these techniques and more must be made viable options to communities seeking to do a better job of growing the right way.

The Nonpoint Education for Municipal Officials (NEMO) Project and the Center for Watershed Protection (CWP) are attempting to assist communities through education and development of new tools. NEMO, with strengths in land-use planning, and CWP, with strengths in design and stormwater management practices, share many topical emphases and methods, but perhaps the most important thing they share is the commitment to directly working with community-level decision makers.

NEMO offers communities direct assistance in the form of a dozen different educational programs targeted for local land-use decision makers, delivered at the rate of about 150 presentations per year. These programs all focus on some aspect of natural resource-based community planning, an approach that considers conservation and development in tandem, and is consistent with Phase II minimum management measures. Through the judicious use of remote sensing, geographic information systems, and other technologies, NEMO programs allow local officials to step back from their site-level focus, and put development proposals in the broader context of their town or watershed. More technical planning, mapping, and design information delivered via publications, the Web, and CD serve to create a multimedia support system for communities following the NEMO approach.

CWP acts as a technical resource for local and state governments around the country, helping them develop more effective urban stormwater and watershed protection programs. CWP provides this support on many different levels, from publishing the journal *Watershed Protection Techniques*, to running training workshops for planning and design professionals (more than 275 to date), to conducting in-depth studies for individual municipalities and counties that result in stormwater master plans, watershed plans, urban stream remediation, and better site design.

Both CWP and NEMO are now confronting the challenge of disseminating information and methods beyond the ability of immediate staff to meet the escalating needs of America’s communities. The National NEMO Network, comprised of a diverse group of educational projects currently encompassing 19 states, is an attempt to magnify both the geographic scope and topical coverage of on-the-ground land-use education programs (see *The National NEMO Network Launched*, page 5). NEMO is also engaged in research partnerships with NASA and NOAA, aimed at making remotely sensed data truly useful and accessible by local officials. Using both historic data sets and new high resolution data, changes in land cover information showing the growth patterns of suburban development and the resultant increases in impervious cover in four



Northeast watersheds is being made available over the Web, so that local officials can visualize the past and potential future impacts of their plans and regulations.

CWP is working on providing growing communities with new tools, such as their new Stormwater Manager's Resource Center web site ([stormwatercenter.net](http://stormwatercenter.net)), which contains practical information for communities facing Phase II and other regulatory requirements. The site has more than 2,000 pages, including 150 articles, a reference library, fact sheets, and information on a range of topics, from diagnosing watershed problems to overall resource protection strategies.

NEMO and CWP have agreed to work together toward the long-term goal of providing quality education and practical technical tools to the thousands of communities that will be affected by the new wave of stormwater regulation — and beyond that, to the many smaller and larger communities in need of assistance. A big job, and one that will require more effort, more resources, more people and organizations willing to “get their hands dirty” at the local level.

Despite the very real gains of the past 20 years in understanding and controlling NPS pollution, the NPS community as a whole needs to admit that we have yet to evolve beyond the old “end of the pipe” mentality. It's well past time for that evolution to occur. Let's roll up our sleeves and make a real commitment to focus on land use, the “beginning of the pipe.”

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## **Notes on the National Scene**

### *New BEACH Act Strives to Protect Human Health*



Every year, many family vacations center around America's bountiful coastal recreational resources. Unfortunately, some families arrive at their favorite beach only to find that the water is unsafe for swimming because of high levels of disease-causing microorganisms that enter the water through stormwater runoff and sewage treatment plant malfunctions. Other families swim at their favorite beach, assuming the water is safe, without knowing whether that state actually has a program in place to monitor for microorganism levels. The Beaches Environmental Assessment and Coastal Health (BEACH) Act of 2000, signed into law on October 10, 2000, will address these issues by expanding the federal, state, and local partnership for beach protection and ensuring that the public is more aware of potential health risks in coastal waters.

#### *Key Provisions of the Act*

The BEACH Act requires that all coastal states and territories and the Great Lakes adopt EPA's existing water quality criteria for bacteria. If a state does not adopt standards that are “as protective of human health as EPA criteria,” EPA is required to promptly propose revised standards.

The new law also establishes a new grants program to assist state and local governments. The law authorizes up to \$30 million per year to help them establish monitoring programs for coastal waters, and develop programs to notify the public when coastal waters fail to meet standards.

To supplement state efforts, the Act requires EPA to conduct additional studies on the health risks from pathogen exposure, the types of and detection methods for pathogens and pathogen indicators, and how states should apply EPA's pathogen and pathogen indicator criteria in diverse geographic and aquatic conditions. Based on the results of this research, EPA must propose new pathogen criteria within 5 years. To ensure the public has access to information, the Act requires EPA to establish a national coastal recreation

#### **EPA's Water Quality Criteria for Bacteria**

- ◆ Fresh waters: geometric mean values of 33 enterococci bacteria per 100 ml and 126 *E. coli* bacteria per 100 ml
- ◆ Marine waters: geometric mean of 35 enterococci per 100 ml

EPA based these values on specific levels of risk of acute gastrointestinal illness.

water pollution occurrence database that contains beach data, including beach advisories, pollution sources, and other information. The Act also requires EPA to develop performance criteria to assess whether the Act is being implemented effectively and to provide a baseline for determining whether states are eligible for grants. If a state fails to implement the Act's monitoring and notification requirements, the Act directs EPA to establish and conduct a monitoring and notification program for the state's waters.

### What Initiated the Legislation?

Currently, water quality monitoring along coastlines varies greatly among states. Most coastal states have developed their own water quality standards that they enforce through state programs, but the standards themselves, how they are enforced, and the level of monitoring differ from one state to another. The states that monitor do not always inform the public when the water exceeds standards. Because legislators recognized the need to ensure protection of public health, they developed and passed the BEACH Act to establish consistent national guidelines for standards, monitoring, and public notification.

The BEACH Act provisions will be incorporated into EPA's broader BEACH program, which strives to significantly reduce the risk of disease to users of the nation's recreational waters by improving recreational water programs, communication, and science. The BEACH program works with state, tribal, and local health and environmental officials to design, develop, and implement beach monitoring and advisory programs. The BEACH program also conducts an annual national survey (see box) to better inform the public about the status of beaches around the country. The new BEACH Act authorizes funds that will allow states to expand their present efforts and participate more fully in public notification. For more information on EPA's BEACH program see [www.epa.gov/ost/beaches](http://www.epa.gov/ost/beaches). To view the final version of the BEACH bill, see <http://thomas.loc.gov> and search on HR999.

[For more information, contact Rick Hoffmann, U.S. EPA (4305), 1200 Pennsylvania Avenue, NW, Washington, DC, 20460. Phone: (202) 260-0642; e-mail: [hoffman.rick@epa.gov](mailto:hoffman.rick@epa.gov).]

### EPA's BEACH Survey Sheds Light on Need for BEACH Act

In the spring of 2000, EPA conducted the third annual National Health Protection Survey of Beaches. This voluntary survey of government agencies solicited information on local beach health activities and conditions during the 1999 swimming season. Participants (usually local governmental agencies from coastal counties, cities, or towns) were asked the following: Which beaches are being monitored? How often are they monitored? Who conducts the monitoring? Where and how often have advisories or closings been issued? What methods are used to determine beach advisories and closings? How often are water quality standards exceeded at the beaches?

For the 1999 swimming season, organizations in 32 states and territories representing all coastal and Great Lakes states reported data on 1,891 beaches. EPA's survey showed that 459 beaches (24 percent of the reported beaches) were affected by at least one advisory or closing. Survey respondents issued advisories and closings for various reasons, including

when monitoring revealed a violation of pathogen indicators (such as enterococci levels) in the water, after events like sewage spills and heavy rain, and during water conditions such as red tides, algae blooms, and the presence of seaweed and zebra mussels.

Survey results showed that 89 percent of the beaches had some type of water quality monitoring program, but the monitoring programs were inconsistent. Although some states and local governments monitored water quality at their beaches using EPA-recommended indicators (enterococci for saltwater and *E. coli* for fresh water), many continued to use older measures such as total coliforms or fecal coliforms. Currently, of the 1,692 beaches with reported monitoring programs (679 freshwater and 1,013 saltwater), only 379 freshwater beaches use *E. coli* and 261 estuarine and saltwater beaches use enterococci for issuing beach advisories or closings.

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## The National NEMO Network Launched



The National NEMO Network, a confederation of projects adapted from the University of Connecticut's *Nonpoint Education for Municipal Officials* (NEMO) program, converged on Haddam, Connecticut in October 2000 to hold the first ever network-wide conference. NEMO is an award-winning project that uses remote sensing and geographic information system (GIS) technologies to educate local land-use decision makers on the links between land use and water resource protection.

More than 40 participants representing 20 states came to the conference, dubbed "NEMO University," to discuss how to collaborate, share methodologies and research, and develop new educational strategies. Representatives of the NEMO Network also heard updates from each state, as well as the latest from the Connecticut program. "NEMO U is the first time we have all sat down together as a group to mull over successes and challenges, and map out what we wish to accomplish in the future," commented John Rozum, National NEMO Network Coordinator. "The National NEMO Network is attempting to create a truly interactive network of shared experiences among diverse state projects."



Interest in adapting the NEMO model has continued to grow since NEMO Project Directors Chet Arnold and Jim Gibbons made their first out-of-state NEMO presentation in 1995. Currently, 19 states have active NEMO programs and more are organizing and looking for funding. "In 1991 when NEMO started in Connecticut, we didn't foresee a diverse network of projects that included 40 percent of the states," remarked Arnold, a water quality educator. Network projects focus on issues ranging from impervious surface reduction to quality of life and community character to habitat protection in the face of suburbanization. All projects are educational efforts targeted at local land-use decision makers, and use technologies such as GIS and remote sensing to convey their message. Key among these technologies is the build-out scenario used by many projects to show decision makers the cumulative effect of development on natural resources. Build-out scenarios compare existing development conditions to the community's projected future development as set forth in local land-use regulations.

NEMO U was underwritten by a grant from NOAA's National Sea Grant College Program. USDA and EPA also support the national network, and many individual state projects are funded by Clean Water Act section 319. An Interagency Work Group (IWG), formed from representatives of EPA, USDA, NOAA, NASA, USGS, and client organizations such as the American Planning Association and the National Association of County Officials, serves as an advisory committee for the network's national efforts. In 1999 the IWG approved a charter pledging to work together to promote and support the National NEMO Network. This support has come in the form of new funding opportunities for network projects, promotion of NEMO at national conferences, and wider support within the agencies.

"Over the past several years, many agencies and organizations have reached the conclusion that the key to protecting natural resources relies on better local land-use decisions," says Jim Gibbons, a land-use educator. "NEMO's focus on local land-use decision makers represents a nonregulatory way to address the diverse range of issues now encompassed in catch phrases like 'smart growth' and 'liveable communities.'" Rozum observed that a primary focus of NEMO U participants was promoting low-impact development and natural resource-based planning. Participants also agreed to continue strengthening the network by sharing information and materials, and staying in close contact with other members. "In many ways the conference really was the birthplace of the national network. We know this is a unique and ambitious idea, but we are encouraged by the enthusiasm we see across the country to shake up the status quo and start to develop differently," said Rozum.

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# Notes from the States, Tribes, and Localities

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## Ohio Lake Erie Buffer Program Takes Off



A new program in Ohio will buffer Lake Erie and its watershed from the impacts of agricultural nonpoint source runoff. In 1998 the Ohio Lake Erie Commission released *The Lake Erie Quality Index*, which identified soil erosion and sediment transport as the leading cause of water quality impairment in the Lake Erie watershed. Shortly thereafter, the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) convened a meeting of several public and private agricultural and natural resource agencies to discuss ways to improve water quality in Ohio's Lake Erie watershed, more than 75 percent of which is in cultivated cropland. The group decided that the installation of buffers, an effective method of reducing sediment loss from the land, was the best option for reducing water quality impairments.



Grass filter strips and riparian buffers protect water quality in Ohio's Lake Erie watershed.

From these discussions, the Lake Erie Buffer Program was born in 1999. A group of 19 organizations lead the program. Collectively known as the Ohio Lake Erie Buffer Team, they include the NRCS, the Ohio Lake Erie Commission, Ohio Department of Natural Resources, the Ohio Wetlands Foundation, Pheasants Forever, and others. The Buffer Team's goal is to establish 50,000 acres of new conservation buffers on agricultural cropland using available Conservation Reserve Programs (CRPs) by the end of 2005. The Lake Erie Buffer Program complements the Clean Water Action Plan's (CWAP) multi-agency National Conservation Buffer Initiative, which aims to install 2 million miles (or up to 7 million acres) of conservation buffers across the nation by the year 2002. Buffers implemented through the Lake Erie Buffer Program will count toward this national goal.

### *Types of Practices*

The Buffer Program focuses on installing several different types of buffers, including grassed waterways, filter strips, riparian forest buffers, windbreak buffers, and wetlands. The Buffer Team originally anticipated the installation of 90 percent grassed waterways and filter strips and only 10 percent of the types that require more labor and time to implement. However, "almost 20 percent of the practices we've installed have been the more permanent type like tree planting and wetland development, even though these require a longer contract agreement with the landowner," explained Steve Davis, Ohio Buffer Team Coordinator. "We've been extremely pleased with the response."

Since the program was formally launched in Summer 1999, the Lake Erie Buffer Program has made significant progress toward its 50,000-acre goal. The number of acres installed to date is not yet known because the organizations responsible for developing contracts and tracking conservation reserve sign-ups operate on different time periods. However, "just over the past seven months we have allocated \$4 million — all the CRP Enhancement money we had for two years," noted Davis.

### *Funding the Program*

The administration and outreach of the Buffer Program are funded primarily by a three-year, \$229,635 Lake Erie Protection Fund Grant from the state of Ohio. Buffer Team organizations match these funds with \$62,476 in cash and in-kind services. Buffer installation is funded primarily by state and federal cost-share funds. The largest source of funding comes from the \$201 million Ohio Lake Erie Conservation Reserve Enhancement Program (LECREP), a program jointly developed and funded by the state of Ohio (\$33.5 million) and the USDA (\$167.5 million). Over the next 10 years, participating landowners will receive payments from this fund based on the type and size of buffers they implement. Because LECREP is a stand-alone program, it has its own long-term goal of installing 67,000 acres of conservation practices over a 10-year

period. Any buffers enrolled through the Buffer Program using LECREP will count toward the LECREP goal, the Buffer Team goal, and the CWAP national buffer goals. In addition to using LECREP for buffer installation, the Buffer Team also relies on other government programs that provide technical and financial assistance, including the Northwest Windbreak Program, the Wetlands Reserve Program, the Environmental Quality Incentives Program, the Wildlife Habitat Incentives Program, and USDA's regular continuous CRP.

### Getting the Word Out

The Buffer Team has completed many activities that work toward their goals (see *Ohio Lake Erie Buffer Program Strategic Plan 2000-2004* at [www.glc.org/basin/OHbuffer/buffer\\_plan.html](http://www.glc.org/basin/OHbuffer/buffer_plan.html)) to promote the program and teach people about the potential environmental and economic benefits of buffers:

- Published a buffer education brochure for landowners
- Printed and distributed 1,300 signs to counties to display at highly visible buffer sites along roads in the watershed
- Launched a recognition program for participating landowners
- Participated in a statewide conservation award program
- Filmed a television segment on buffers for Agricountry, a well-known regional program with more than half a million viewers
- Developed a slide presentation for meetings
- Printed brochures to advertise the Lake Erie Conservation Reserve Enhancement Program
- Developed three traveling buffer displays

"Interest in the program has been widespread in all 30 counties in the watershed. Of course, we've had the most response in counties where the local county agency representatives have been more aggressive in promoting the Buffer Program and soliciting sign-ups. But we've had a solid response from all counties," noted Davis. "At the rate we are going we'll definitely meet the LECREP's 10-year goal...whether we get there by 2005 depends on whether the state legislature accelerates additional funding to meet the increased demand. If not, we will be limited by how many acres can be funded each year."

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## Land and Water Fund of the Rockies Offers a Model of Resource Conservation



A Colorado-based environmental organization is turning heads with a new landscape design around its building. But many passersby don't see the rest of the story — that the innovative landscape doubles as an effective stormwater control system for the Land and Water Fund of the Rockies' (LAW Fund) building and parking lot in the city of Boulder. The LAW Fund is a nonprofit environmental organization that uses economics, law, and policy analysis to protect and restore the Rocky Mountains and Desert Southwest. In 1992 the LAW Fund began an effort to become a model of efficiency and comprehensive sustainable landscaping in a business setting by creating the Environmental Center of the Rockies.

Leslie Kaas, Communications/Outreach Director for the LAW Fund, explains the reasons behind the effort. "When Kelley Green started the organization in 1989, she had a vision of a central meeting place for environmental activists that was a model of sustainability and efficiency. Today, the Environmental Center of the Rockies is an office building that offers an opportunity for collaboration among conservationists in our region. It is a model for the community and other businesses because we are 'walking the walk' of environmental conservation and sustainability."

Following this vision, the organization purchased a half-acre site along a busy street for their headquarters. First they reduced nonrenewable energy use by 85 percent by retrofitting the building with energy saving measures like reflective windows and solar panels. In the spring of 1999, at a cost of about \$113,000, the LAW Fund installed a water-efficient landscape system that uses swales and gardens to funnel and capture runoff from the building roof and parking lot. Following are some of the highlights of their efforts:



**Runoff flows under sidewalk into gardens around the building.**

- The parking lot was reduced in size, reconfigured with recycled asphalt, and sloped so that some water is directed to the plants and trees in the gardens in the parking lot and the front of the building. Sand and grass filters placed at the edge of the landscaped gardens capture the large solids in the runoff stream. The remainder of the water on the parking lot collects in one corner and flows through a series of swales, gardens, and ponds that wrap around two sides of the building. Soil in the bottom of the swales filters out finer pollutants. The ponds are formed by low-level check dams in the swales and are surrounded by drainage fabric, sandy loam backfill, gravel mulch, waterproof membranes, aggregate mulch, and gravel wrapped in geotextile.
- Precipitation from the rooftop is directed through a series of eight scuppers, or drainage holes, located around the building's roof. Although site constraints require two of the scuppers to empty into an alley behind the building, the remainder are directed into the swale system.
- Grasses, shrubs, and flowering plants are used liberally in the landscape to give the site a natural look. Drip irrigation was installed to help the plants become established. In the future, the irrigation lines may be removed because the plants should be able to survive on rainfall and runoff alone.

### *Results*

After the landscape project was completed, a year of monitoring data showed 70 to 80 percent of the water applied to the property infiltrated to ground water, 19 percent was evapotranspired by plants, and an estimated 1 to 10 percent was incorporated into plant biomass. The landscape system does allow overflow in cases of heavy rain, which occurred once during the monitoring year, accounting for a 1 percent loss of water off the property. Students from the University of Colorado at Boulder are continuing to monitor the site. (For more information about the water budget study, visit [www.lawfund.org/ecr/ecrstudy.htm](http://www.lawfund.org/ecr/ecrstudy.htm).)

The swale and garden system requires relatively little maintenance, said Kaas. "Right now we are providing supplemental irrigation during the driest months of the year. A landscape company also comes in to make sure the weeds don't take over the newly landscaped beds. If our staff sees trash collected in the grassy areas, they make an effort to dispose of it. The system itself was developed to be self-sustaining."



**Roof drainage pours into a garden next to the building.**



## Resource Sharing

Another aspect of the founder's original vision for the Center was for it to serve as a hub for regional environmental efforts. The LAW Fund works to support collaboration and the sharing of resources by providing office space to environmental organizations at or below market value. Some of the Center's other occupants include the National Wildlife Federation, Sierra Club, American Lands Alliance, Western Mining Action Project, the Center for Native Ecosystems, and the Wilderness Education Institute.

Honored as a pilot demonstration project by the National Forum on Nonpoint Source Pollution, the stormwater portion of the project illustrates how a conventional business or residential landscape can be attractive while capturing and treating stormwater. The project was featured in *Landscape Architecture* magazine (May 1998, pp.58-63), and was recognized by the National Geographic Society. The city of Boulder's cable television station continues to air a 15-minute video on the project entitled "Environmental Center of the Rockies: An Urban Stormwater Control Project."

The city of Boulder, a partner in the landscaping project, has written several articles about the project, leads tours for interested individuals, and gives presentations at conferences. "We want people to know that this is a feasible project. One of the selling points is that it was an existing site, and we had to work with constraints that you might find at any site. These are the types of projects that we need to replicate to ultimately make a difference in water quality," explained Paul Lander, with the city of Boulder's Office of Water Conservation. Pictures of the project and a project summary are available on the Internet at [www.lawfund.org/ecr/ecr1.htm](http://www.lawfund.org/ecr/ecr1.htm).

[For more information, contact Leslie Kaas, Communications/Outreach Director, LAW Fund, 2260 Baseline Road, Suite 200, Boulder, CO 80302. Phone: (303) 444-1188 ext. 216; e-mail: [leslie@lawfund.org](mailto:leslie@lawfund.org); web site: [www.lawfund.org](http://www.lawfund.org). For more information on the system schematics, contact Paul Lander, City of Boulder, Office of Water Conservation, P.O. Box 791, Boulder, Colorado 80306. Phone: (303) 413-7407; e-mail: [landerp@ci.boulder.co.us](mailto:landerp@ci.boulder.co.us). Copies of the video are available from Channel 8, P.O. Box 791, Boulder, CO 80306. Phone: (303) 441-4298.]

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## Innovative Seattle Project Controls Storm Water



You might think keeping your dog out of the neighbor's yard is a chore, but have you ever tried to keep your storm water out of your neighbor's yard? Well, Seattle Public Utilities (SPU) is taking that idea a step further with a project to keep storm water onsite, not shunt it offsite to affect someone downstream. Instead of building a traditional curb, gutter, and sidewalk system in Seattle's Broadview neighborhood, SPU began an innovative street and drainage design that uses a swale system to reduce impervious surfaces, increase vegetation, and detain and filter water during precipitation events.

The drainage project, which is located in the 1,835-acre Pipers Creek watershed that flows into Puget Sound, is part of SPU's Urban Creeks Legacy Program. The program supports a series of creek restoration and drainage improvement projects that seek to enhance water quality, reduce flooding and nonpoint source pollution, improve habitat for salmon and other wildlife, and encourage citizen involvement through education and outreach.

### Outdated Street Design Under Attack

Streets and drainage have not been improved in many of the Seattle neighborhoods that were annexed 40 to 50 years ago. "We have found that the streets without drainage improvements are the ones that have the greatest impacts on water quality and quantity. If there are curbs and gutters, at least the water can be contained and managed," explained SPU's John Arnesen, the project manager. "We are working with the community to build sidewalks and improve the drainage in many of these neighborhoods and to better protect creek and stream ecosystems. We needed to find a cost-effective way to balance both needs."

SPU decided that a system of swales and gardens along the length of a street was the ideal solution. "We wanted to move back to more of a natural system, with localized detention and infiltration," noted Arnesen. "The swales back up the water during storms, essentially slowing it down and allowing it to filter through the vegetation." The water can then evaporate, evapotranspire, infiltrate, or slowly release to the creek.



(Above) Broadview neighborhood before construction (wide streets and no drainage system).

(Below) Broadview neighborhood after construction (curving street bounded by drainage swales and gardens).



SPU, working with other city departments, assessed many neighborhoods in Seattle to identify good candidates for reconstruction. Once they developed a list of 30 potential blocks, they invited all the residents to a public meeting to discuss the proposed changes. They sent the residents home with petitions to sign up their neighbors. To qualify for further consideration, the neighborhood had to have signatures from at least 60 percent of the residents on the block.

Of the 30 blocks identified, six achieved the signature requirement. Seattle's Broadview neighborhood was chosen after residents submitted a petition signed by 18 of the 19 properties (94 percent). The Broadview block includes 19 homes on lots less than a quarter-acre in size.

Broadview's original street configuration included a straight 20-foot-wide street with a 20-foot shoulder right-of-way on either side where people parked their cars. The neighborhood had no sidewalks and no drainage control except for ditches at the end of the block. Runoff traveled over the pavement until it found the ditches at the end of the street.

### Project Components

SPU completely replaced the street and redesigned the 60-foot right-of-way. City design staff from SPU and the transportation department developed the site plan, based on discussions with the landowners. Following the approved design, SPU built a new 14-foot-wide meandering street to replace the 20-foot-wide straight street. They placed a sidewalk along one side of the street and parking areas on alternating sides. Overall, the project reduced impervious surface area on the block by 7 percent.

In the remaining right-of-way, SPU built a system of 12 interconnected water-retaining swales that can hold a 24-hour, two-year storm event. To increase evapotranspiration and minimize runoff, SPU planted trees and other native plants along the road and in the right-of-way. "Not only does this project help improve water quality and reduce the potential for flooding, it also gives these homeowners a much nicer looking front area. Prior to this project, there wasn't a single tree in the 60-foot right-of-way. Now there will be at least 80 trees," remarked Arnesen.

Prior to construction, SPU gathered baseline monitoring data of the overland flow off the street. Now that the project is complete, SPU will begin monitoring the project's results by measuring the quantity of stormwater that reaches the flow control structure located at the end of the swale system.

The project was funded completely by SPU, using money from drainage fees paid by the citizens of Seattle. The cost of developing this innovative street and drainage system was \$800,000, compared to between \$600,000 and \$800,000 for a traditional curb, gutter, and sidewalk system. "The specific cost of a project like this will vary because each is designed for the needs of the specific location," noted Arnesen. "However, as we become more familiar with the requirements for this type of project, we anticipate that it might actually be less expensive to implement than a traditional drainage system."

[For more information, contact John Arnesen, Seattle Public Utilities, 710 2<sup>nd</sup> Avenue, Room 640 Seattle, WA 98104. Phone: (206) 684-8921; e-mail: john.arnesen@ci.seattle.wa.us; web site: [www.cityofseattle.net/util/urbancreeks/pipers.htm](http://www.cityofseattle.net/util/urbancreeks/pipers.htm).]

# Notes on Watershed Management

## BMPs Reduce Pollution from Kansas Golf Course



Best management practices have done their job on a Kansas golf course, according to a study released by Wichita State University (WSU). In 1997, WSU researchers monitored water quality in areas affected by urban, suburban, and agricultural runoff in the Wichita area. Based on the results, the researchers selected one site, a golf course, for BMPs. Researchers hoped to measure the degree to which golf course BMPs could reduce pollution from nonpoint sources. This three-year project was funded through a \$260,000 section 319 grant from the Kansas Department of Health and Environment (KDEH).

### Site Selection

During the first year of the project, researchers collected and analyzed monthly low flow and 8 to 10 high flow water samples at each of a series of sites, including public parks, urban lawns and streets, a row crop agricultural site, and two golf courses. Of these sites, the researchers identified the Braeburn golf course as the best candidate for BMPs. The researchers selected Braeburn for several reasons, including: (1) Water samples from ponds at Braeburn showed elevated levels of fertilizer and pesticides; (2) The golf course was associated with WSU, so the superintendent was willing to cooperate on the project; and (3) The golf course was located at the highest point in the watershed so all the water flowing into the ponds originated on golf course land (allowing water quality changes to be directly attributed to changes on the golf course).

The initial year of water quality monitoring in two of Braeburn's four golf course ponds had revealed high levels of fertilizer and pesticides. Mean nitrate and total phosphorus levels in Ponds A and C (see figure) were 1.63 mg/L and 1.23 mg/L, respectively, well above KDEH's nutrient enrichment criteria limits of 1.2 mg/L nitrate and 0.1 mg/L total phosphorus. The elevated nutrient levels were blamed for severe algal blooms and resulting fish kills. Pond data also revealed several spikes of 2,4-D and simazine above the chronic exposure limits of 3 ppb and 10 ppb, respectively, after spring and early summer application periods. An initial biological assessment of the ponds showed a very low number of species, likely because of the influx of pesticides and the application of copper sulfate directly to the ponds to control algae blooms.

### Choosing BMPs

In 1998, WSU researchers worked with the golf course superintendent to develop and implement a BMP plan at the golf course. Not all of the BMPs were readily accepted. "At first, the superintendent was reluctant to reduce the amount of fertilizer applied. However, once we did soil tests to show him that he already had enough nutrients in the soil, he agreed," explained M.J. Lydy, WSU project director. The BMPs were implemented in stages to assess whether one type was more effective than the other. BMPs included:

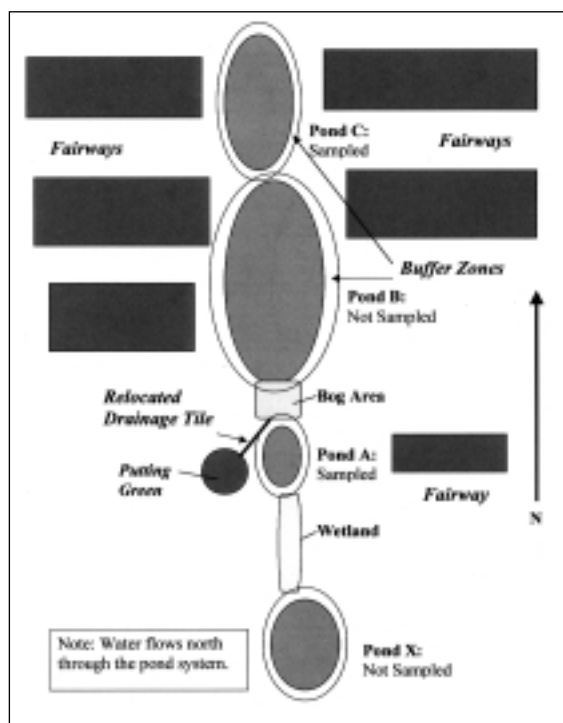
Management (implemented during summer 1998, at the start of the project's second year):

- Modified the chemical application schedule. Fertilizer was applied more frequently but at reduced amounts, which ultimately reduced the overall application amount.
- Discontinued the use of copper sulfate, which is highly toxic to aquatic macroinvertebrates.

Structural and Vegetative (implemented during summer 1999, at the start of the project's third year):

- Placed chemical-free (no application allowed) buffer zones of 20-meter-wide unmanicured grass around the pond perimeters.
- Relocated golf course greens' drainage tile discharge from Pond A into a bog area where it could be better filtered by soil and vegetation.

Braeburn golf course site plan.



- Established aquatic plants in wetlands, the bog, and the inlet and outlet of ponds.
- Dredged Pond A, which was shallow (1 to 2 feet) and eutrophic, to increase the depth to 3 to 6 feet so the pond could support aquatic vegetation and grass carp. Created a wetland in a 40-meter-long drainage ditch leading from Pond X to Pond A.

Pond water samples taken during the second year after the management BMPs were implemented showed dramatic reductions in nutrient levels, even during application periods in the spring and early summer and during rainfall events. The annual mean nitrate and total phosphorus levels declined to about 0.77 mg/L and 0.54 mg/L, respectively, down from a high of 1.63 mg/L and 1.23 mg/L, respectively. Structural BMPs installed at the beginning of the third year of monitoring resulted in further nutrient declines. At the close of the third year, researchers found that the annual mean nitrate and total phosphorus levels had declined to 0.19 mg/L and 0.39 mg/L, respectively. Nitrate levels were well below KDEH's nutrient enrichment criteria of 1.2 mg/L. Although phosphorus never fell below the criteria of 0.1 mg/L, it did decline. "Phosphorus takes a lot longer to move out of a system. These ponds have been receiving phosphorus inputs for over 100 years so it may take a while for the phosphorus levels to decline further," explained graduate student Nate Davis, a key member of the research staff.

Pesticide contamination also declined after installation of structural BMPs. No 2,4-D was detected in the water samples after July 1999, indicating that levels were at least below the detection limit of 2 ppb. Like 2,4-D, simazine declined initially after July 1999. In December 1999, however, simazine levels of more than 150 ppb were found in the pond. Researchers attributed the spike to a series of factors, including:

- The golf course staff had applied 50 pounds of simazine to four fairways in mid- to late-November, two weeks prior to a seasonally uncharacteristic 5.5-inch rainfall;
- Dormant vegetation is less effective at absorbing contaminants;
- The microbial degradation rates of pesticides decreases during colder weather; and
- The buffer zone around the contaminated pond had been severely damaged during a BMP-related dredging activity prior to fall application.

By March 2000 simazine levels had fallen below 10  $\mu\text{g/L}$  (water quality criteria), but minute levels persisted through June 2000. After the December 1999 simazine spike, researchers encouraged the golf course superintendent to consider only spot treatments in the fall instead of a broadcast application.

Data indicated that BMP implementation also helped the ponds' macroinvertebrate populations rebound. By the summer of 2000, researchers observed an increase in the number of existing macroinvertebrate families as well the appearance of several less pollution-tolerant species, including butterflies, damselflies, and dragonflies, which were previously absent because of poor water quality.

The project has been a learning experience for WSU staff and students and the local community. Over the three-year project, many students worked on the project and helped promote it. "The students and I have offered several workshops and have given 30 to 35 presentations at regional and national meetings," noted Lydy. "On a local level, we developed an educational pamphlet for the Braeburn golfers that explains the purpose of the project." The team also maintains a web site where interested individuals can find out more project information ([www.twsu.edu/~biolwww/319\\_NPS\\_Project/Background\\_of\\_Braeburn\\_Project.htm](http://www.twsu.edu/~biolwww/319_NPS_Project/Background_of_Braeburn_Project.htm)).

### *The Future*

The researchers hope to continue working on the site after the end of the grant period. However, "construction is occurring on the course, and BMPs will be affected to some extent. In the meantime, the superintendent will maintain the BMPs as best as possible," explained Lydy. "We hope to monitor the site during the construction project and in the future to see if it affected the water quality."

*[For more information contact Dr. M.J. Lydy, Associate Professor, Wichita State University, Biological Sciences, 1845 N. Fairmount, Wichita, KS 67260-0026. Phone: (316) 978-3111.]*

## BMP Maintenance Guidance Helps Homeowners Associations



What good is a best management practice if it fails? The Northern Virginia Regional Commission (NVRC) decided to meet that issue head-on in its new guidance manual, *Maintaining Your BMP: A Guidebook for Private Owners and Operators in Northern Virginia*. The NVRC hopes that by offering guidance on stormwater BMP maintenance, associated costs, and availability of technical resources, it can curb the rate of failing, ineffective BMPs.

The NVRC is a regional planning agency that represents 13 Northern Virginia local governments just west of Washington, DC, including Loudoun, Fairfax, Prince William, and Arlington counties. All four counties are already or are rapidly becoming largely suburban and are covered with subdivisions and shopping malls. Under local ordinances, developments meeting certain size and density criteria are required to implement stormwater BMPs to slow and in some cases treat runoff from precipitation events. However, BMPs fail prematurely if not properly maintained.

“About 10 percent of our publicly maintained detention pond embankments have failed due to piping at an average age of failure between 8 and 9 years,” estimates Steve Aitchison of Fairfax County’s Maintenance and Stormwater Management Division. “Although failure rate data are somewhat limited for privately owned facilities, the current trends indicate that failure rates exceed those of publicly maintained facilities. Reduced levels of maintenance by some private owners and the higher percentage of privately owned wet ponds appear to contribute to these trends.” Wet detention ponds should last 20 to 50 years.

NVRC’s 21-page guide, developed under a state grant, offers information to help individual property owners, homeowners association representatives, and residential/commercial property managers ensure their BMPs continue to function properly. The guide introduces the types of stormwater BMPs typically used in the region — dry ponds, wet ponds, infiltration trenches, sand filtration systems, rain gardens, and grassed swales. It also explains who is most likely responsible for BMP maintenance, such as a community or business that is subject to a BMP maintenance agreement.

“Often, when a development is put in, the developer signs a BMP maintenance agreement on behalf of the not-yet-formed homeowners’ association. As a result, many homeowners’ associations don’t realize that they are responsible for BMP maintenance,” explains David Bulova, NVRC’s Director of Environmental Services. “We are working with local governments to distribute the guidebook to homeowners associations to help educate them.”

The guide outlines the maintenance usually required to keep a BMP functioning properly. At the end of the guide, a supplemental “quick guide” details the routine and nonroutine maintenance likely to be required for each of the region’s typical BMPs (see box).

After explaining the types of maintenance needed, the guide outlines who should conduct each maintenance activity. For example, although the responsible party can perform certain landscaping duties (e.g., community education, litter and debris removal, and some other routine maintenance), a qualified inspector should be brought in regularly to ensure early detection of problems. (The frequency varies according to BMP maintenance agreement requirements.) To supplement the regular professional inspection schedule, the responsible party should conduct self-inspections to look for problems such as unexpected ponding, obstructions of inlets or outlets, excessive erosion or sedimentation, sinkholes, and general condition of the area and the BMP components. The guide includes a sample self-inspection checklist.

Finally, the guide explains how to plan for BMP maintenance costs. As a general rule of thumb, annual routine maintenance costs \$100 per acre for minimal maintenance (mowing), while more comprehensive routine maintenance (mowing, weed control, fertilization, debris control, and other activities) can cost up to \$500

### BMP Maintenance Needs

#### Routine Maintenance

- Regular Inspections
- Vegetation Management
  - ✓ Mowing
  - ✓ Pest and weed control
  - ✓ Sediment removal (covering turf)
  - ✓ Unwanted vegetation removal
  - ✓ Maintaining no-mow zones
- Embankment and Outlet Stabilization
- Debris and Litter Control
- Mechanical Components Maintenance
- Insect Control
- Access Maintenance
- Pond Maintenance (as applicable)

#### Nonroutine Maintenance

- Sediment/Pollutant Removal
- BMP Component Replacement

per acre. Nonroutine maintenance costs are much higher. The primary nonroutine costs are for sediment/pollutant removal and BMP renovation or reconstruction, and they vary with the type of BMP and with the amount of runoff received annually. Consequently, the guide recommends that the responsible party establish a BMP maintenance fund that includes annual contributions to pay for these inevitable costs. (See table for estimated frequency of sediment removal and BMP replacement.) A dry pond, for example, needs to have sediment removed every 2 to 10 years at a cost ranging from \$3,600 to \$15,000 for a 0.25-acre pond and from \$166,000 to \$550,000 for a 10-acre pond. To be prepared, the responsible party should collect 10 to 50 percent of the expected costs annually. The responsible party should also establish a separate fund to pay for BMP replacement. The average dry pond has a life expectancy of 20 to 50 years, so the responsible party should set aside 2 to 5 percent of the estimated replacement cost annually.

Although the guidance manual was developed specifically for the Northern Virginia region, the information is applicable to any area where stormwater BMP maintenance is the responsibility of property owners, homeowners associations, and property managers. A limited number of guides are available from NVRC for \$3, including shipping and handling. The manual is also available for download on the NVRC web site ([www.novaregion.org](http://www.novaregion.org)) on the Environmental Services page.

[For more information, contact David Bulova, Director of Environmental Services, 7535 Little River Turnpike, Suite 100, Annandale, VA 22003. Phone: (703) 642-0700; fax: (703) 642-5077; e-mail: [dbulova@novaregion.org](mailto:dbulova@novaregion.org).]

<b>Recurrence of Nonroutine BMP Maintenance Costs</b>		
<b>BMP</b>	<b>SEDIMENT REMOVAL FREQUENCY</b>	<b>FACILITY LIFE SPAN</b>
<b>Wet Pond</b>	5 to 15 years	20 to 50 years
<b>Dry Pond</b>	2 to 10 years	20 to 50 years
<b>Infiltration Trench</b>	As needed	10 years
<b>Rain Garden</b>	5 or more years	Indefinite
<b>Grassed Swale</b>	As needed	Indefinite
<b>Sand Filter</b>	Every 6 months or as required	20 to 50 years

## *Coast\*A\*Syst Reaches Out to Coastal Landowners*

South Carolina has created a new coastal protection program called the Coastal Home Assessment System, or Coast\*A\*Syst, to help coastal landowners protect water quality. Adapted from Home\*A\*Syst and Farm\*A\*Syst, Clemson Extension Service and South Carolina Sea Grant Extension under a section 319 grant, Coast-A-Syst teaches coastal watershed residents and waterbody users responsible practices for protecting water quality, with the ultimate goal being to reduce fecal and nutrient nonpoint source runoff from urban and suburban activities and land development. Although participation is voluntary, the program encourages individuals to take responsibility for and to correct water quality impairments caused by their own activities.

To drive the program, the extension agencies published a 122-page document entitled *South Carolina Coast\*A\*Syst: An Environmental Risk-Assessment Guide for Protecting Coastal Water Quality*. The document explains how to protect water quality around the home; manage stormwater; keep well water clean; care for a septic system; handle hazardous household products; garden and landscape in an environmentally friendly manner; and care for boats and docks. Each chapter includes information about how coastal hazards, such as flooding and hurricanes, can affect the issue detailed in that chapter. The document also includes checklists that allow people to perform a confidential environmental self-assessment to see whether their activities might affect water quality.

Clemson Extension has implemented the program in five of South Carolina's eight coastal counties and is expanding the program to serve the remaining three counties. They have recently conducted two successful Coast\*A\*Syst training programs for master gardeners and coastal extension agents,

preparing them to administer the program in their geographic areas. In January Clemson Extension began offering a series of educational Coast\*A\*Syst workshops for the general public. Once the 319 grant ends, the ongoing administration and expansion of the program will be supported by the Clemson Extension Service and the South Carolina Department of Health and Environmental Control.

[To order a free copy of the document, visit the South Carolina Sea Grant Extension's web site at [www.scseagrant.org](http://www.scseagrant.org) (click on publications). An interactive Coast\*a\*Syst web site based on the document is also available on-line at [www.clemson.edu/sccoastasyst](http://www.clemson.edu/sccoastasyst). For more information, contact Cal Sawyer, Coastal Environmental Quality Specialist, South Carolina Sea Grant Extension Program, 259 Meeting Street, Charleston, SC 29401. Phone: (843) 722-5940; e-mail: [calvins@clemson.edu](mailto:calvins@clemson.edu).]

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## Agricultural Notes

### *Citrus Growers Take the Lead in Cleaning up Water*



The fertilization, pest control, and irrigation required in Florida's citrus groves, like in any other agricultural sector, have negative impacts on water quality if not managed properly. The Indian River Citrus League is hoping to reduce potential effects in their area by educating growers about nonpoint source pollution and available best management practices. With a new manual, *Water Quality/Quantity BMPs for Indian River Area Citrus Groves*, the Citrus League describes a series of BMPs and their environmental and economic benefits.

In a June 1998 letter to the Florida Department of Agriculture and Consumer Services (FDACS), the South Florida Water Management District expressed concerns about the quality, quantity, and timing of water draining into the St. Lucie Estuary (SLE) and ultimately into the Indian River Lagoon on Florida's east coast. Realizing that citrus groves, which comprise 120,000 of the 288,000 acres in the SLE watershed, contribute significantly to the problems, the FDACS decided to work with the Citrus League and the University of Florida's Institute of Food and Agricultural Sciences Department to develop appropriate BMPs. "Our objective," explained Doug Bournique of the Citrus League, "is to develop practices that can be adopted and implemented by citrus producers to reduce the adverse effects of their operations on the lagoon and the St. Lucie Estuary." Using this newly developed BMP information, along with existing BMPs, the Citrus League led the initiative to develop a citrus grove BMP manual to distribute to growers.

The Citrus League worked closely with many organizations to develop the 150-page manual, including the FDACS, the Florida Department of Environmental Protection (FDEP), the South Florida and St. Johns River water management districts, and others. These partners secured section 319 funding from FDEP to support the manual's development. Published in May 2000, the manual gives citrus growers detailed descriptions of BMPs and their potential economic and environmental benefits. The authors designed the manual to allow updates as researchers identify and develop new, science-based BMPs.

The authors organized the manual into the categories of water quality/quantity impact that they deemed to most threaten the health of the estuary and lagoon — water volume, sediment transport, pesticides, nutrients, and aquatic weeds. The table on page 16 lists examples of the types of BMPs detailed for each category of concern.

Many of the BMPs listed in the manual are already being used to varying degrees in the watershed. For example, about 85 percent of the citrus groves in the Indian River area have been retrofitted or designed with microirrigation (drip irrigation) systems, rather than the traditional flood irrigation. The reduced soil saturation has enhanced overall citrus production and the reduced water use has provided conservation benefits for other agricultural and nonagricultural water users in the region. In addition, all of the Indian River area groves planted in the last decade have been developed with on-site retention that limits sediment transport off-site and reduces the rate and volume of surface water discharged.

<b>CATEGORY OF CONCERN</b>	<b>OBJECTIVE OF BMP IMPLEMENTATION</b>	<b>EXAMPLE CITRUS GROVE BMP DESCRIPTIONS</b>
<b>Water volume</b>	Minimize off-site discharges after rainfall	Using drip irrigation Monitoring water table position Drainage controls/on-site retention Measuring soil moisture
<b>Sediment transport</b>	Minimize transport of sediment off-site	Using riser-board water control structures Using settling basins/sediment traps Using cautions for ditch construction and maintenance Stabilizing soils
<b>Pesticides</b>	Minimize transport of pesticides and metals off-site	Reducing spray drift and over-spray Calibrating and maintaining equipment Using integrated pest management Accounting for mixing and loading risks
<b>Nutrients</b>	Minimize transport of nutrients off-site	Using nutrient management Performing tissue and soil analysis Accounting for storage and loading risks Protecting wells
<b>Aquatic weeds</b>	Minimize the proliferation of aquatic plants in waterways	Using barriers Removing aquatic weeds mechanically Using biological controls Applying herbicides with caution

Some of the listed BMPs will be undergoing continued research to determine their effectiveness for multiple parameters. For example, researchers are trying to determine whether water furrow sediment traps, in addition to reducing sediment transport, can reduce levels of phosphorus and copper in runoff water. This type of information will help the Citrus League and its partners better assess the expected impact of the recommended practices on water quality.

### *BMP Implementation*

The BMPs outlined in the manual are voluntary. However, the Citrus League requests that all growers maintain records and provide documentation regarding BMP use. By proving that a successful voluntary effort is underway, the Citrus League hopes to keep the program nonregulatory and incentive-based. “This manual provides citrus growers with a comprehensive set of BMPs to employ in reducing the amount of freshwater, sediments, pesticides, and nutrients discharging from their operations to the lagoon system,” explained Troy Rice, Director of the Indian River Lagoon National Estuary Program. “I hope that the growers apply these BMPs to help protect the resources of the Indian River Lagoon and its tributary, the St. Lucie Estuary, while simultaneously reducing their costs to produce the world-famous Indian River oranges and grapefruit.”

*[The manual is available on-line at [www.fcprac.ifas.ufl.edu/BMP/default.htm](http://www.fcprac.ifas.ufl.edu/BMP/default.htm). Hard copies are free from the Institute of Food and Agricultural Sciences, ATTN: Velma Spencer, 2199 South Rock Road, Fort Pierce, FL 34945-3138; Phone: (561) 468-3922. For more information, contact Troy Rice, Director, Indian River Lagoon National Estuary Program, 525 Community College Parkway SE, Palm Bay, FL 32909. Phone: (321) 984-4940; fax: (321) 984-4937; e-mail: [Troy\\_Rice@district.sjrwmd.state.fl.us](mailto:Troy_Rice@district.sjrwmd.state.fl.us).]*





Jim Crosswhite believes a healthy environment is the key to economic prosperity in ranching — and he is working to prove it. In 1996, he purchased a 300-acre ranch in Arizona's White Mountains. Known as the EC Bar Ranch, the land had been plowed, planted, and grazed since it was settled in the 1880s. However, beginning about 1970, farming declined for many reasons — including increasing numbers of elk that competed for forage, low livestock prices, a reduction in public grazing allotments, and declining pasture quality caused by overgrazing and encroachment of the invasive rabbitbrush plant. Many ranchers in the area no longer found ranching profitable and sold their land. Jim Crosswhite saw an opportunity to reverse this trend by implementing more economical and environmentally friendly ranching techniques.

Soon after he purchased the ranch in 1996, Crosswhite sought a professional evaluation of the riparian corridor along the 1.5-mile segment of Nutrioso Creek running through his land. Using the Bureau of Land Management's Functional Rating System, a consultant concluded that the riparian zone was "nonfunctional" in places and "functional-at-risk in a downward trend" in others. The streambanks appeared unstable and severely impacted from long-time overuse by livestock grazing. Erosion accelerated with each new storm. The stream supported little aquatic vegetation, ground water recharge was minimal, and water quality was poor. There was work to be done!

### *The Steps to Recovery*

Crosswhite turned to Brian Sorenson, a conservationist for the Natural Resources Conservation Service (NRCS) in Springerville, Arizona, to prepare a conservation plan for the ranch. "The conservation plan serves as a road map to follow while we pursue funding and implement practices," explained Crosswhite. The plan includes several measures to manage livestock, including

- fencing to keep the livestock out of the riparian corridor,
- alternative watering systems to remove the need for cattle to drink at the creek,
- cross-fencing pastures to allow livestock rotation, and
- better livestock management through rotational and dormant season grazing.

Other plan components include

- replacing earth irrigation ditches with pipe to improve irrigation efficiency and reduce the amount of creek water removed,
- installing stream grade stabilization structures to slow water flows,
- controlling and eradicating rabbitbrush, and
- overseeding pastures with cool-season grasses to improve forage and reduce erosion.

Crosswhite took advantage of several funding programs to help with implementing the plan. Through the Arizona State Land Department's Stewardship Incentive Program (SIP), Crosswhite received almost 75 percent, or \$6,750, of the total cost to place a five-wire fence around approximately 60 acres of the riparian corridor. The fence was designed both to manage livestock and to control wildlife. The bottom wire was smooth (no barbs) and non-electrified to allow antelope and small animals to pass under it without harm. The top wire was electrified to control livestock and discourage elk from jumping the fence. Because elk act similarly to livestock, they can damage stream banks, prevent newly planted grasses from taking root, and defeat other conservation practices.

When first installed, the riparian fencing incorporated several temporary water gaps to allow livestock and wildlife easy access to drinking water. With a \$19,800 grant he received in December 1998 from the Arizona Water Protection Fund (AWPF), Crosswhite installed alternative watering systems (wells and cattle waterers) that give both livestock and wildlife a reliable water source and allowed closure of the water gaps in the riparian fencing. As part of the matching funds required

**"A fully functioning riparian zone is a unique treasure that inspires anyone who sees it," notes Crosswhite.**

for the grant, Crosswhite contributed \$5,000 for the electric power and piping. The following year, the AWPf provided another \$30,000 to extend the number of alternative watering systems along elk migration routes on Crosswhite's property to reduce the elk's impact on the creek's riparian corridor. As part of the AWPf project, a range consultant will study the elk, inventory the wildlife and vegetation, and assess the success of the livestock management plan over time.



Crosswhite uses large tires for alternative watering troughs.

Crosswhite also implemented other strategies. He received 75 percent matching funds through NRCS' Environmental Quality Improvement Program (EQIP) to install about 3,000 feet of cross-fencing on his pastures and seven stream grade stabilization structures along Nutrioso Creek. He also tackled the rabbitbrush problem by combining mowing, plowing, and overseeding with grass seed in his pastures. The establishment of new grass was hampered by foraging elk herds, so Crosswhite and the Arizona Game and Fish Department (AGFD) entered into a cooperative agreement to make the losses more manageable. AGFD supplied \$7,300 worth of seed and fertilizer, and Crosswhite agreed to apply it annually for three years.

### *Has the Work Paid Off?*

By 1999 several improvements had been noted on Crosswhite's Nutrioso Creek segment. A wetter-than-normal growing season in 1999 resulted in above average creek water levels that raised the water table and deposited sediment at the stream grade stabilization structures, creating large pools. In response to the improving health of the stream and riparian corridor, vegetation and wildlife diversity began to rebound. A second Riparian Functional Evaluation, performed in July 2000, indicated that the segment's rating had improved to "functional-at risk with an upward trend." Over the next few years, as the riparian corridor continues to improve, the rating is expected to improve to the highest rating of "proper functioning condition." During monitoring required for the development of the Nutrioso Creek total maximum daily load (TMDL) for turbidity, the Arizona Department of Environmental Quality (ADEQ) found that turbidity was lower in Crosswhite's fenced-off portions of the riparian zone than in other parts of the creek. In fact, ADEQ was so impressed by Crosswhite's results that the final TMDL (*Nutrioso Creek TMDL for Turbidity*, July 2000) recommended that all of the practices currently in place on the EC Bar Ranch be expanded along the seven miles of creek where water quality is impaired.

### *No One Can Stop Him!*

In 2000, Crosswhite decided to purchase an additional mile of the creek, bringing 2.5-miles of Nutrioso Creek under his control and his conservation plan. In August 2000, he was awarded section 319 funding through the ADEQ Water Quality Grant Improvement Program to implement all the practices recommended in the TMDL report. The ADEQ reimbursed up to 60 percent of his expenses. Crosswhite estimates that by 2003, ADEQ will have contributed about \$150,000 or 50 percent of the total cost of all practices implemented. "The ADEQ and I are working together in hopes that within a few years Nutrioso Creek will meet and maintain the water quality standards for turbidity, and be removed from the state's list of impaired waters."

### *Hope for the Future*

Pleased by this positive beginning, Crosswhite is convinced that conservation practices can help increase ranching profits. In fact, he is planning even more improvements in the future. Before the next irrigation season in 2001, he plans to convert the open-ditch irrigation system to a pressurized sprinkler system that targets water on crops to better improve forage. Sprinklers will also be used to grow grass on exposed streambanks to restore the riparian zone and improve water quality. "We lose approximately 100 million gallons, or 307 acre-feet, of water from evaporation and seepage in open earth ditches during the 150-day irrigation season. Using the value of water rights in New Mexico as a guide, the value of this lost water is \$307,000. But when you consider the loss of crop production due to lack of available water, the actual cost is significant, although hard to put into annual losses," he said. The goal will be to remove less water and to improve water quality and riparian habitat.

Crosswhite enthusiastically shares his ideas with others. He is active in local watershed organizations and works closely with public agency staff. Even though he has contributed a lot of time and considerable personal funds toward the projects, he notes that the projects could never have been implemented without public funding and technical support, especially from the ADEQ and EPA. He plans to share some of his experiences by offering workshops beginning next year. Interested persons can join monthly group tours of his ranch.

[Details of the projects, grant applications, photos, and progress reports are available on-line at [www.ECBarRanch.com](http://www.ECBarRanch.com). For more information contact Jim Crosswhite by e-mail at [jim@ecbarranch.com](mailto:jim@ecbarranch.com). For more information on the Nutrioso Creek TMDL, contact Shad Bowman, ADEQ, 500 North Third Street, Phoenix, AZ 85004, Phone: (602) 207-7664; e-mail: [shadb@earthlink.net](mailto:shadb@earthlink.net).]

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## Notes on Education

### Shoreland Restoration — Empowering Citizens to Help Themselves and Others



Do you have too many shoreland erosion problems and not enough trained people to help fix them? The University of Minnesota Extension Service (UMES) has developed a series of shoreland workshops across the state to train local individuals, including master gardeners, soil and water conservation district and other natural resource professionals, and local government staff to design, plan, and implement local shoreland restoration projects.

In 2000 the UMES worked with local partners at seven different locations to develop two workshops. Although designed as a series, the workshops can also be taken individually. “We target people who aren’t just interested in restoring their own land but who are willing to help others carry out shoreland revegetation projects and promote shoreland restoration in general,” explained Mary Blickenderfer, Extension Shoreland Specialist with UMES. The first workshop, which focuses on shoreland design, explores using native plant materials and other biotechniques to establish a buffer area that will minimize erosion, reduce nutrient and sediment runoff, create fish and wildlife habitat, and provide a visual screen for privacy and aesthetic concerns. The workshop was designed to help individuals evaluate and identify goals for their site, select appropriate plant material, address erosion through bioengineering techniques, select appropriate site preparation methods, and learn how to develop and implement a master site design.

The second workshop focuses on shoreland revegetation techniques and offers a hands-on opportunity to prepare a site, identify the shoreland planting zones, plant suitable plant materials for each zone, and install temporary wave breaks and biomaterials to control erosion. Participants also learn how to acquire necessary permits for projects and how to maintain and monitor projects once they are in place.

#### *Applying What They’ve Learned*

Workshop coordinators request that each participant spend at least 10 hours per year applying their new skills to help local landowners with shoreland projects. As a result of the overwhelming popularity of the workshops (160 people attended one or both workshops during 2000), the number of locally led projects is on the rise. “Whereas I used to be the point person for shoreland restoration projects in my 17-county region,” notes Blickenderfer, “we have begun to refer shoreland landowners to the trained workshop participants. These people have been very effective in assisting with buffer design, plant selection, and project maintenance on sites having minor erosion problems that can be remedied with plants and bioengineering. I continue to work with the county and state natural resource agencies on ways to integrate native plants and bioengineering with ‘hard armor’ techniques (e.g., rock riprap) on the more severe shoreland erosion sites.”

Based on the success of the previous workshops, in 2001 UMES will conduct two design and planning workshops that will be followed by a third hands-on planting project. Each workshop will build on the previous. The second workshop series will be given at several new locations around the state.

### *Planning the Workshops*

The workshops are conducted on a local basis — with technical and funding assistance from local entities such as the County Extension, County Ecological Services, Soil and Water Conservation Districts, master gardeners, Department of Natural Resources, Natural Resources Conservation Service, watershed districts, and lake associations. “By conducting the workshops at the local level, coordinated by local people, we ensure each workshop is tailored to local needs and resources,” explained Blickenderfer.

Nominal workshop fees paid by participants, in addition to money contributed by local organizations (from grants and other sources) and in-kind labor and materials, offset workshop costs. “The workshops operate on a fairly low budget. The total cost for all 14 workshops conducted in 2000 was \$27,000, most of which covered plant and material purchases for the hands-on planting workshops,” added Blickenderfer. “The cost of shoreland restoration projects ranges from \$1 to \$2 per square foot for plant and mulch materials to more than double that amount if heavy machinery is required to recontour the shoreline before planting.” The budget also included the cost of the instructors. To plan ahead for workshops, many communities write an educational component into grant applications. Adjacent counties that are interested in hosting a workshop are coordinating their efforts and coming up with their own creative funding ideas.

### *Evolving to Meet the Needs of the Landowners*

Workshop participants aren't the only ones who have learned from the workshops, admitted Blickenderfer. “After working with so many landowners who have concerns about the ‘weedy’ appearance of the native vegetation in shoreland buffers, we’ve learned to make some compromises. Where we used to encourage ‘native only’ buffers, we now offer an alternative — that the landowner plant a visual screen of showy, noninvasive cultivars in high-visibility upland areas and use the native plant buffer along the shore as a backdrop. By broadening our vision, we are opening up restoration options to more people.”

*[For more information contact Mary Blickenderfer, Extension Educator, Shoreland Vegetation and Landscape, University of Minnesota Extension, 1861 E. Hwy 169, Grand Rapids, MN 55744. Phone: (218) 327-4616.]*

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## *Virginia Youth Work to Restore Wetlands*



With the help of area kids, the Alexandria Seaport Foundation is addressing historical and anticipated wetland losses in one tributary of the Chesapeake Bay. Grants from several public and private sources totaling \$110,000 have enabled the Seaport Foundation to restore 30 acres of wetlands, and plans are underway to restore an additional 110 acres along Cameron Run/Hunting Creek, Four Mile Run, and eventually on the lower Potomac River shoreline in Maryland. The Seaport Foundation relies on mutually beneficial partnerships with Boy and Girl Scout troops, schools, and at-risk urban youth programs for much of the labor. These diverse groups of youths learn about nature and responsibility while they help the Seaport Foundation realize its goals.

“We need to prove we’re making a difference in the Potomac,” remarked MariLou Livingood of the Seaport Foundation. She noted that the project began partly in response to impending construction of a replacement for Washington, DC’s aging Woodrow Wilson bridge, which spans the Potomac River near the Alexandria waterfront. “About 70 acres of wetlands are going to be destroyed by the bridge. Although officials are required to replace the wetlands, we are not taking any chances,” she explained. “We’re not going to wait around.”

Arlington County Department of Environmental Services’ Jeff Harn lauded the group’s efforts, noting that the loss of wetlands is an unfortunate side effect of development. “There’s a lot of development pressure.” Harn said, “In Arlington, the unfortunate situation is that we don’t have many wetlands left. There was a lot of filling of wetland areas around Crystal City, National Airport, and Four Mile Run. We’re very happy to see the Seaport Foundation project getting underway.”

### *Getting Down and Dirty*

Wetland work began in the summer of 1999 and, with adequate funding, will continue indefinitely. The Seaport Foundation staff, community volunteers, and youths fulfilling

court-directed community service spent many days in wetlands cleaning trash, removing invasive plants, and collecting native plant seeds. After the first summer in the wetlands, "participants were getting tired of attacking invasive vines, so we decided to expand the project to include planting," explained Livingood.

The Seaport Foundation and Arlingtonians for a Clean Environment, a nonprofit organization dedicated to educating the citizens of Arlington, Virginia, about their local environment, joined forces in July 2000 to develop a wetland plant nursery at the National Park Service Nursery on Daingerfield Island. The goal of the nursery is to support propagation of native wetland plants, such as the common three square and pickerel weed, and riparian buffer plants, such as black willow and white pine. The nursery will also provide plant materials for future local wetland and streambank

restoration projects. "Beginning next growing season we hope to establish a self-sustaining source of wetland plants. The beauty of wetland plants is that they absorb nutrients and provide habitat for animals and insects," noted Livingood. "They also trap sediment, which is the number one source of pollution in the Potomac River. The nonnative vines, such as porcelainberry, honeysuckle, and bittersweet, are causing problems by wrapping themselves around the trees on the stream banks. These invasive plants will now be replaced by native plants," she said.

The Foundation is also cooperating with a local high school to grow wetland plants in the school's greenhouse. "A number of high schools built greenhouses in the 1970s that have since fallen into disuse. We see this as a great opportunity to cooperate with high school ecology clubs to use these facilities and educate students about the benefits of wetlands," explained Livingood. A second high school might be joining the program this spring. Once the students raise the plants beyond the tender stage, the plants will be moved into the Daingerfield Island outdoor nursery ponds to become better established and accustomed to the outdoors. The students will then be able to transplant the plants they raised to a natural wetland.

To monitor the success of the restoration project, the Seaport Foundation and its volunteers plan to test the water quality in local streams and rivers and assess habitat and wildlife diversity before and after restoring a particular area. The many facets of this project will offer youths from all walks of life the opportunity to be a part of something environmentally significant for years to come.

### Helping Each Other . . .

The Seaport Foundation has worked with a community service program, known as the YES Program, for many years. A number of youths who end up in the court system are assigned to help the Foundation each week for a few hours to fulfill their community service requirements. As many as 80 percent of individuals participating in this program have gone on to college, served in the military, or found jobs relative to their skills. During the winter, the youth work with the Foundation to build boats. (For more information about the Seaport Foundation's boat-building effort, see *NPS News-Notes Issue #48*, April/May 1997.) During the past two summers, the youth worked on wetland restoration projects.

[For more information, contact MariLou Livingood, Alexandria Seaport Foundation, c/o Nannie J. Lee Recreation Center, 1108 Jefferson Street, Alexandria, VA 22314. Phone: (703) 549-7078; fax: (703) 594-6715; e-mail: [asoffice@aol.com](mailto:asoffice@aol.com); web site: [www.capaccess.org/asf](http://www.capaccess.org/asf).]

## Huron River Watershed Residents Bombarded with NPS Information



For the past three years, the Huron River Watershed Council has been conducting a massive media campaign to blanket the Huron River watershed's residents with information on nonpoint source pollution prevention. In addition to the 125-mile-long Huron River, the 900-square-mile watershed has 370 miles of creeks and tributaries, 300 lakes, and seven counties with a total of 500,000 residents. The Huron River's greatest challenge is phosphorous-laden runoff. The Council felt it was high time to show the public that they are the key to watershed health.

The project teaches homeowners proper lawn care practices, household toxicants disposal, septic system maintenance, water conservation, and storm drain awareness. In a recent study using GIS data and analysis, Andrew Brenner, a former Middle Huron Initiative Coordinator, found that an estimated 75 percent of the NPS pollutants in the Huron River Watershed result from improper disposal of toxic materials, poor septic system maintenance, using too much water, putting pollutants into storm sewers, and especially, overfertilization of lawns.

A variety of partners work with Council on this information/education campaign and are key to its success. Nine municipalities, utility providers, the Southeastern Oakland County Resource Recovery Authority, Michigan State University extension agents, Home Toxicants Drop-Off

facilities in Washtenaw County, and related agencies helped print and disseminate environmental tip cards.

The tip cards list things homeowners can do to prevent NPS pollution around their homes and in their neighborhoods. Six tip cards were designed:

- Put household hazardous waste where it belongs
- Save time and money: Simple lawn care practices
- Saving water saves you money
- The Huron River begins in your neighborhood
- Keep your septic system safe
- Save time and money: Fertilize your yard right

Each card is packed with information like phone numbers to call to find out where to dispose of toxic waste. They also include bright orange stickers to mark containers of fertilizers. One card explains how to dispose of latex paint: "Normal trash pick-up: Open the can and dry it out with cat litter. Keep it separated from your other trash." Suggestions for nontoxic cleaning supplies were also given, including using denture tablets as toilet bowl cleaner.

The lawn care tip card advises mowing grass at three inches. A small plastic ruler is included to measure height of grass. Longer blades promote stronger root growth. The card also suggests using a test plot to see if watering is really necessary. If it is, the lawn should be given one inch of water once a week. An empty tuna can placed on the lawn signals an inch when it is full. Leaving clippings on the lawn is also advised as the best way to return nitrogen to the soil.

The tip card on saving water includes stickers to place on bathroom mirrors to remind people to turn off the water and tells them how to inspect the toilet for a leak: Place a few drops of food coloring in the tank — a leak is indicated if the color appears in the bowl in a few minutes.

### New Rules for Old Septic Systems

Washtenaw County, Michigan, a rural low-density area of the Huron River watershed populated by many elderly residents, is gradually being swallowed up by surrounding cities. The area contains some abandoned septic systems and others so old that they have broken tanks or tiles that cause sewage to back up into the yard or even into the house. To alleviate these problems, local regulations require that, when an area is annexed, the homes must be connected to the sewer system within six months, if one exists. The county also requires that each septic system be inspected and found to be in good working order when a home is sold. The county has hired, trained, and certified 43 inspectors to conduct the inspections. Homeowners are being offered cost-share money from a section 319 grant to repair their systems or convert to alternative systems.

*[For more information, contact Steve Manville of the Washtenaw County Environmental Health Department, e-mail:manvills@co.washtenaw.mi.us.]*

Storm drains are explained as being built to prevent flooding of the streets and neighborhoods after heavy rainstorms by quickly diverting rainwater to the river system. But in dry weather they also carry water from activities like car washing and lawn watering. "Whatever enters the storm drains ends up in the water we call our playground: the local creeks, lakes, and the Huron River." Several suggestions are given to avoid spills, overwatering, and dumping.

A chart for keeping a record of septic system maintenance is printed on the back of the septic system tip card. It also gives several suggestions for taking care of the system. The last tip card is also about lawn care.

So far more than 210,000 tip cards have been mailed to 70,000 households. An independent survey of people who received tip cards revealed that 43 percent recalled the mailing, 38 percent read the cards, and 31 percent kept them for future use. Soil test submissions increased 500 percent in the first year. Home substances drop-offs at Washtenaw County receiving stations increased by 75 percent the first year, with increases as high as 250 percent following tip card mailings. Surveys on drop-off days supported by print advertising revealed that 75 percent of participants came because of the ads seen in the newspaper.

In addition to tip card mailing, announcements were made via radio and newspaper. The following catchy ads were placed in 14 newspapers watershed-wide:

- A septic system ad pictured an athlete flexing his biceps, and the caption read "pump it out."
- A lawn care ad showed two cute kids lying in a pile of leaves with the caption "Rake it . . . or leave it!" The message was to mulch the leaves or make a compost pile.

- A zany character with an exaggerated mohawk hairdo and a lawnmower is shown in another ad saying, “Got grass? Mow high!”
- A child looking at a plant erupting from the sidewalk is captioned, “How does your sidewalk grow?” The message is not to water the sidewalk, but to keep it clean by sweeping.
- A baby sitting in the grass with a fistful of grass has the caption, “Got grass? Feed it right!” The message being that your lawn gets hungry and grass clippings are the ideal food source.
- “Take the Super Bowl challenge. . . will your toilet pass the test?” shows bottles of colored water on the tank of a toilet. The message is that a silent toilet leak can waste as much as 200 gallons of water per day.
- Another ad shows two people visiting over a fence. The caption says, “Don’t just ask your neighbor. Bring us your dirt. Don’t guess. . . Soil test.” It then gives instructions on taking a soil sample, and lists places to have it tested.
- A hazardous waste ad says, “Reduce your wasteline,” and shows the torso of a very muscular man.

In addition to radio public service announcements, newspaper ads, and mailings, the Council produced a general brochure and a colorful map poster of the watershed to raise watershed awareness and to increase membership in the Council. A display was also created for use at events, and an Enviroscope® 3-D interactive nonpoint source pollution prevention model was purchased for use by the Council and other agencies.

Michigan Groundwater Stewardship and 10 retailers coordinated a spring soil testing promotion. Michigan Department of Environmental Quality’s stormwater staff also attended information/education trainings, coordinated additional workshops, and worked with the campaign organizers to coordinate statewide messages. In addition, 10 municipal offices distribute the map posters.

Local matching funds in combination with a 319 Clean Water Action grant administered through the Michigan Department of Environmental Quality funded the campaign. The project budget totaled \$298,000 in the first three years, with an additional \$210,000 accrued in local matching funds. Starting April 1, 2000, the project began its fourth year with a budget total of \$131,400.

*[For more information, contact Jennifer Wolfe, The Huron River Watershed Council, 1100 North Main Street, Suite 210, Ann Arbor, MI 48104. Phone: (734) 769-5123; e-mail: [jwolf@hrwc.org](mailto:jwolf@hrwc.org); web: [www.hrwc.org](http://www.hrwc.org).]*

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## Technical Notes

### *New Technique Helps Streams Restore Themselves*



Retired biologist Bill Zeedyk’s new stream restoration technique hands much of the hard work back to the stream. The technique modifies the shape and dimensions of incised stream channels by installing in-stream structures that encourage storm flows to selectively remove streambank soils, thereby creating meanders and the room needed for a new floodplain to develop within the channel.

According to Zeedyk, this induced meandering technique is best suited for streams that fall into the Rosgen F or G classification scheme (streams that are deeply incised with grades of less than 4 percent), such as many of those found in the arid Southwest. “These streams might eventually stabilize themselves — but induced meandering accelerates the process,” states Zeedyk.

Zeedyk developed the induced meandering technique while working on watershed restoration projects in Mexico. “We needed an inexpensive, low-tech solution to gulleys that would allow us to use local materials and labor. I have worked in watershed management much of my life and was familiar with many different restoration methods. This technique seemed like a viable

alternative to a full-blown stream reconstruction requiring heavy machinery or check dams that create unnatural step pools that usually fail. A number of people have mentioned that they like this technique because there isn't any heavy equipment to impact the site and no unnatural or unsightly materials are used in construction."

### How Does it Work?

The induced meandering technique initially increases bank erosion because it requires placing baffles in the stream to direct the erosive force of the water during storm flows into the opposite stream bank. Any vegetation located on the streambank at the intended point of erosion is removed. As water erodes the streambank, some of the eroded sediment is deposited behind the next downstream baffle as a point bar. This erosion/deposition cycle accelerates as meanders form and vegetation colonizes the new deposits. A new floodplain develops in what was originally a fairly straight incised channel. Riffle-weirs are constructed to help control stream bed elevation, channel slope, and pool depth, just as naturally occurring riffles would do.

"Initially you produce more sediment than you store in the point bars and on your developing floodplain. However, in time sediment deposition exceeds ongoing erosion," explains Zeedyk. "The question is whether you are willing to wait for this to happen. This technique takes time, which adds some uncertainty to the restoration process."

### It's Cheaper, But it Takes Longer

According to Zeedyk, the induced meandering method is only about 20 percent of the cost of a full channel reconstruction (using heavy machinery, rootwads, logs, etc.). Costs are lower because the project relies on the power of running water to shape the channel. Local labor removes unwanted vegetation and constructs and maintains in-stream structures. All materials used are local and freely available, including rocks and stakes. The actual development of the meanders and floodplain is left to the forces of nature. Induced meandering might be the ideal solution in cases where the existing stream type meets Rosgen F or G channel type classification and restoration money is limited. "But people must remember that results are uncertain and it can take several years to achieve stability," explains Zeedyk.

Included in the overall cost is the labor required for maintaining the in-stream baffles and riffle-weirs. Maintenance is high initially because the first couple of storms can damage new structures which then need to be repaired. But, maintenance requirements decrease once vegetation begins to stabilize evolving point bars, the floodplain develops, and storm flows have less impact on structures. Also, as the opposite bank erodes, baffles are extended to "chase" the receding bank until design dimensions are reached.

### Real-world Application

Zeedyk and his partners are applying the new technique to a half-mile-long reach of the Pueblo Colorado Wash in Ganado, Arizona, at Hubbell Trading Post, a National Historic Site operated by the National Park Service within the Navajo Nation. Partner organizations include the National Park Service, several Navajo Nation agencies, the Arizona Water Protection Fund Commission (major project funder), and the Ganado Unified School District, among others. Since the project began in 1997, monitoring indicates that restoration increased sinuosity in the stream by 20 percent, adding approximately 500 feet of stream length to the original 2,600 feet, and consequently decreasing the channel slope. The stream now supports 19 permanent pools, instead of the initial three. Although a large destructive storm event in 1999 set their efforts back, lesser storms since then have recovered what was lost and continue to build meanders and

## Key Components of the Induced Meandering Technique

**Channel Design.** Three baffles and two riffle-weirs are needed to create an induced meander. Structures are installed at the appropriate intervals to generate a channel with a meander pattern and channel dimensions similar to a stable reference reach with similar geologic characteristics. The project reach should include at least two meander lengths.

- ✓ Baffles redirect flow and help create meanders. They occupy 40 to 70 percent of the channel width and are constructed by driving a grid of stakes into the stream bed and infilling with rocks.
- ✓ **Riffle-weirs** are also constructed with stakes and rocks and are placed in the streambed halfway between baffles, at the angle of anticipated future flow, to help control stream bed elevation, channel slope, and pool depth.

**Channel Characteristics.** Response to baffle and riffle-weir installation varies with the variability in discharge events; water depth and velocity; resistance of the stream bed and banks to shear stress; and the type, dimensions, competence, and roughness of the baffles and riffle-weirs. Low flow periods encourage establishment of native vegetation on point bars and floodplain, which increases stability.



widen the floodplain. The recovering stream is developing stable banks, a rising water table, and more plant and wildlife species diversity.

Zeedyk has been keeping a photographic record of the project's progress every six months since 1997. "Sometimes I am amazed by the difference when I look back through the pictures. But it is definitely working. Our measurements have shown that certain areas of the project reach are beginning to evolve into the Rosgen E channel type, which is the climax channel type," notes Zeedyk proudly. To help spread the word of the project's success, Zeedyk has given presentations at meetings and conducted several workshops on induced meandering concepts and practices.

Zeedyk knows their efforts are small compared to the overall problem. "We are only working on a very small percentage of the watershed. Right now the sediment being transported from unrestored areas upstream of the project site is helping the restored reach evolve more quickly. In the long term I don't know if it could overwhelm us. We are using native wetland plants, like American threesquare, that have the ability to grow up through successive layers of sediment deposits, so I hope we can keep up."

### *Future Research*

Zeedyk and his partners have recently received additional grant monies from the state of Arizona to continue monitoring and measurement of the Pueblo Colorado Wash site. "We hope the data will demonstrate that this technique really works over time." A number of people have been impressed enough by the ongoing success of the current project that they have asked Zeedyk to help initiate his technique on several sites on public and private ranch lands throughout the region.

[For more information contact Bill Zeedyk, P.O. Box 582, Sandia Park, NM. Phone: (505) 281-9066; e-mail: billz-genez@att.net.]

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## *Safe Winter Flying Versus Clean Water*



Winter air travelers often see expanses of beautiful snow-covered landscapes, but it's what they don't see that can be a problem. Airport runoff containing anti-icing and deicing chemicals often finds its way into nearby surface waters. In fact, in *Aviation and the Environment*, a report published in August 2000, the General Accounting Office ranked water quality second after noise as the most important environmental issue facing managers at the 50 busiest airports in the United States. Since 45 of the nation's 50 busiest airports are located within three miles of a waterbody, the water pollution potential from airport runoff is quite significant.

To ensure safety of winter aircraft flight, anti-icing and deicing fluids (ADFs) are applied to aircraft and runways. Anti-icing fluids adhere to aircraft surfaces and prevent ice and snow buildup for set periods of time, known as 'holdover' times. The aircraft remains safe from ice if it takes off within the holdover time. Deicing fluids are typically used on aircraft immediately preceding departure from the hangar or gate, or during snow or ice accumulation. To keep ice off the runways, airports use combinations of ADFs to depress the freezing point on the pavement. When used before freezing conditions set in, these chemicals prevent strong bonds from forming between the pavement surface and ice molecules, enabling snow and ice to be removed easily using sweepers and plows. Although some airports use non-chemical methods to prevent ice and snow accumulation, most airports use ADFs because they ensure aircraft and passenger safety, are easy to use and economical, and don't require physical infrastructure such as heated hangars.

### *A Chemical Cocktail*

Four types of aircraft ADFs are available. They vary according to the concentrations of either propylene or ethylene glycol (commonly known as antifreeze). Historically, ADFs for pavement included urea, ethylene glycol, or a combination of the two. Today's pavement ADFs contain additives like potassium acetate, sodium acetate, sodium formate, potassium formate, or calcium magnesium acetate to lower freezing points.

### *So What's the Problem?*

Ethylene and propylene glycol can wreak havoc on our waterways by depleting the water of oxygen as they biodegrade. A 1998 TMDL study conducted by the Kentucky State Division of Water

indicated that deicing one large passenger jet could generate a BOD<sub>5</sub> equivalent to the daily domestic wastewater generated by 5,000 people. In addition, when glycols are released into anaerobic conditions their biodegradation can release byproducts such as acetaldehyde, ethanol, acetate, and methane that are highly toxic to many aquatic organisms. Urea used on runways also biodegrades and releases ammonia and nitrogen, resulting in algal growth and decay that depletes the water of oxygen.

### Water Quality Regulation at Airports

Some regulations control ADFs. All airports discharging more than 100,000 gallons per year of glycol-based fluids or 100 tons of urea into navigable waterways must obtain a National Pollutant Discharge Elimination System (NPDES) permit. The NPDES permit requires airports to develop a storm water pollution prevention plan (SWPPP), which identifies the sources and types of pollution, delineates drainage basins in the facility, defines structural controls on storm water runoff, and describes BMPs to minimize and prevent pollution from entering the storm water drainage system. The SWPPP is the legal document holding the airport facility accountable for all discharges if and when the airport is inspected by regulators for compliance with their stated BMPs.

In a January 2000 report, *Preliminary Data Summary Airport Deicing Operations*, EPA estimated a current annual national ADF usage volume of 35 million gallons at 212 facilities in the United States. Typically, airlines apply 150 gallons of deicing fluid to a commercial jet, but may need to apply as much as 2,000 gallons during a severe storm. Airlines apply anti-icing fluids in much smaller volumes — only about 35 gallons for a commercial jet.

Because no federal effluent limits exist for ADFs, standards across airports vary greatly, if they exist at all. The establishment of standards is influenced by whether the receiving waterbody is designated as impaired, whether a total maximum daily load (TMDL) has been developed for the water, and whether the state considers the effluent to be degrading the waters and not complying with state standards. Some airports may only have to comply with their NPDES permit and may not need to meet an established standard. Instead, an airport might have to merely report concentrations of each effluent type (e.g., ammonia, total suspended solids) at a specified frequency (e.g., once a month).

The airport facility has little or no control over how, when, or what type of ADFs are administered and is often limited only to specifying where deicing can take place in its jurisdiction. The deicing decisions depend on the specifications of aircrafts and the judgment of the operators. To account for this uncertainty, many airports require individual airline operators to be co-permittees, sharing information and responsibility for BMPs.

### What BMPs Are Available?

Many BMPs can lessen the effect of ADF runoff on water quality, including:

- **Aircraft deicing pads.** These pads consist of a concrete or asphalt platform, drainage collection system, storm water pipes and drains, and wastewater storage facilities to contain the runoff.
- **Parking ramp/passenger terminal gate deicing collection.** Airports can collect ADFs from impervious surfaces using a modified storm water drainage system, where runoff is captured in a diversion box that can be opened to different outflows (separate underground storage tanks or mobile storage tanks) depending on the quality of the runoff.
- **Storm drain inserts.** Economical storm drain inserts modify existing storm water drains between seasons. A system at the Minneapolis/St. Paul Airport places compression plugs into storm drains when there is ADF-treated water, allowing the fluids to drain into temporary collection facilities. The contaminated storm water is pumped out periodically and taken by trucks to detention ponds, where glycol can be recovered.
- **Glycol vacuum vehicles.** Glycol vacuum vehicles cost less than other structural BMPs, allow high concentrations of ADFs to be directly collected for storage or recovery, and give flexible, versatile, and mobile wastewater collection. When used in conjunction with storm drain inserts or valves, they are very effective in removing ADFs from general wastewater discharge. Dulles Airport in Northern Virginia uses a mobile computer-controlled pumping unit that discharges to different storage tanks based on measured concentrations of the ADFs.

- **Volume reduction on paved areas.** Airports can reduce the amount of ADFs applied by using mechanical methods such as plows and snow trenches and by applying ADFs at recommended rates and maintaining calibration equipment. Using pavement sensors instead of air temperature measurements can help focus and time chemical application.

Some airlines try to reduce the amount of deicing fluids that are used on aircraft, while still ensuring safety. Some reduction methods include the following:

- **Preventive anti-icing.** Airlines sometimes treat the aircraft with a glycol based anti-icing fluid prior to the start of icing conditions, or overnight during such conditions, to limit ice and snow buildup. Correctly treated aircraft require substantially less deicing fluid than untreated aircraft.
- **Accurate forecasting of weather conditions.** The National Center for Atmospheric Research recently developed the Weather Support to Deicing Decision Making System to help manage airfield snow removal and aircraft deicing and anti-icing operations. Delta Airways currently uses a commercial version at New York's La Guardia airport.
- **Infrared heating systems for deicing.** Some airlines use infrared heating systems in hangars to warm aircraft surfaces. Buffalo-Niagara International Airport in New York has a installed a commercial system, called InfraTek, that deices four to five aircraft in one hour.
- **Forced hot air blowers.** Several airlines, including American and Midwest Express, are testing a forced hot air system that delivers a fine spray of deicing fluid at 72 miles per hour under pressure. The system drastically reduces the amount of deicing fluid used during each application.
- **Heated pavements.** Electrical current in coiled wires laid underneath paved surfaces generates heat that keeps temperature slightly above freezing and prevents ice.

### The Big Picture

Airports balance the need to ensure aircraft safety with the need to reduce environmental impacts of ADFs. Some airlines use BMPs to contain ADFs and recycle them, treat them on-site, or channel them to an off-site treatment facility. Many airlines also try to limit their use of ADFs by relying on good winter maintenance practices. Unless required by regulation, an airline's willingness to install or modify practices is influenced by cost and the education of personnel involved in deicing. When regulations are in place, enforcement remains a challenge because airports serve as umbrellas for different airline operators who are responding to engineering requirements of the aircraft, passenger volume, the best judgment of professionals, and the weather.

[For more information on the use of ADFs, contact Bonnie Wilson, Airports Council International of North America, 1775 K Street, NW, Suite 500, Washington, DC 20006. Phone: (202) 293-8500; fax: (202) 331-1362; web site: [www.aci-na.org](http://www.aci-na.org).]

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## Reviews and Announcements

### 2001 National Urban Conference • September 5–8, 2001 • Washington, DC



The 2001 National Urban Forest Conference, September 5-8, 2001, at the Omni Shoreham Hotel in Washington, DC, will center on the theme "Investing Natural Capital in Urban Places: A Green Revenue Stream for Metro America." Conference attendees will learn about new techniques to measure green infrastructure and to calculate the benefits it provides using the latest computer technology. The conference will also highlight public policies designed to increase natural capital and action programs that engage communities in rebuilding the green infrastructure. Conference participants can use these strategies to turn their communities' gray infrastructure into shades of green.

Registration and exhibitor materials are available on [www.americanforests.org](http://www.americanforests.org) — click on Trees, Cities, and Sprawl, then on 2001 conference. One-day and half-day tours and workshops will be offered on September 5. The main conference program will be September 6-8. For logistics and program information, e-mail Cheryl Kollin at [ckollin@amfor.org](mailto:ckollin@amfor.org). For registration information, e-mail Kasey Russell at [kaseyrussell@citynet.net](mailto:kaseyrussell@citynet.net).

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## Congress Passes Estuaries and Clean Water Act of 2000



On October 25, 2000, Congress passed the Estuaries and Clean Waters Act of 2000, establishing a national goal of restoring one million acres of estuary habitat by 2010 and authorizing \$275 million over the next five years for matching funds for local estuary habitat restoration projects. The Act reauthorizes the National Estuary Program, the Chesapeake Bay Program, the Long Island Sound Program, and the Clean Lakes Program, and authorizes pilot programs on alternative water sources, a Lake Ponchartrain restoration program, and funding for the cleanup of the Tijuana river near San Diego. The legislation also establishes an Estuary Habitat Restoration Council that is responsible for developing a National Habitat Restoration Strategy within one year and for reviewing and establishing funding priorities among restoration projects. EPA serves on the Council, which is chaired by the Army. To view the Act, visit EPA's web site at [www.epa.gov/owow/estuaries](http://www.epa.gov/owow/estuaries).

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## New LID Publications Available



EPA and the Low Impact Development Center, a nonprofit organization dedicated to research, development, and training for water resource and natural resource protection issues, conducted a literature review of low impact development (LID) studies to assess the state of knowledge about LID practices. *Low Impact Development: A Literature Review* contains a summary of the current monitoring and effectiveness data on LID practices and a brief overview of LID principles and programmatic issues such as application, ownership, and cost. The report and four fact sheets describing local LID case studies are available on EPA's web site at [www.epa.gov/owow/nps/lidlit.html](http://www.epa.gov/owow/nps/lidlit.html).

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## Ecologically Based Municipal Land Use Planning



The solution to urban sprawl rests in the communities themselves and in the way they construct municipal master plans. William Honachefsky's new book, *Ecologically Based Municipal Land Use Planning*, will revolutionize the way American communities plan their land use. Drawing upon more than 30 years of experience, including the investigation of thousands of cases of environmental abuse, Honchefsky presents a combination of strategies that:

1. Help restore the Municipal Master Plan to its rightful place of dominance over zoning;
2. Incorporate 30 years of scientific research and a host of new and unique "ecological indicators" with which a community can finally assess the health of the natural resources that help sustain it;
3. Apply geographic information systems to its problem solving;
4. Make preservation of the community's "ecological infrastructure" the paramount priority of the Municipal Plan.

This book is about the empowerment of regular citizens and the crafting of scientifically based local land use master plans that will withstand judicial scrutiny. For copies, contact CRC Press/Lewis Publishers, Boca Raton, FL at (800) 272-7737.

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## Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management



The Unified Federal Policy for a Watershed Approach to Federal Land and Resource Management was published in the *Federal Register* on Wednesday, October 18, 2000. It was prepared by an interagency team composed of representatives from EPA, the Tennessee Valley Authority, the Army Corps of Engineers, and the U.S. Departments of Agriculture, Interior, Commerce, Defense, and Energy.

Signatories of the policy believe that the watershed-based approach outlined in this policy will help to protect and accelerate the restoration of watersheds on federal lands. The new policy calls for the development of a science-based approach to watershed assessment for federal lands, use of a watershed management approach when protecting and restoring watersheds, improved compliance with water quality requirements under the Clean Water Act, and enhanced interagency collaboration. Implementation of the policy could significantly change some of the participating agencies' watershed management procedures. The policy and additional background can be found on the Internet at [www.cleanwater.gov/ufp](http://www.cleanwater.gov/ufp).

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## 14<sup>th</sup> Annual National Conference

### **Enhancing the States' Lake Management Programs: Integrating Nonpoint Source Watershed Management with Lake Management and Protection**

April 17-20, 2001 • Congress Plaza Hotel • Chicago, Illinois

This year's conference, sponsored by the Chicago Botanic Garden, EPA's Office of Wetlands, Oceans, and Watersheds, and EPA Region 5, will mark the 14th consecutive year that state lake program managers have gathered in Chicago to discuss successes, evaluate obstacles, and explore new approaches for improving state lake management programs. Recognizing the critical link between effective lake management and nonpoint source pollution control, the 2001 conference will focus on innovative approaches for connecting these two complementary programs.

EPA is encouraging each of its own regional Nonpoint Source Coordinators and Clean Lakes Coordinators to attend, as well as the nonpoint source program and lakes program managers from each state and tribal environmental agency. In fact, this conference will be the first formal national gathering of federal and state program staff representing both the lake and nonpoint source management disciplines.

The cost for attending the conference is \$145 (after March 30 — \$170), which includes two breakfasts, two lunches, breaks, and a special evening reception at the Chicago Botanic Garden. For more information, 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](mailto:bkirschn@chicagobotanic.org).

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## **Web Sites Worth a Bookmark**

[www.bmpdatabase.org](http://www.bmpdatabase.org): This database provides access to BMP performance data in a standard format for more than 90 BMP studies conducted over the past 15 years. It was developed by the Urban Water Resources Research Council of American Society of Civil Engineers under a cooperative agreement with EPA.

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[www.usda.gov/oc/photo/opcphsea.htm](http://www.usda.gov/oc/photo/opcphsea.htm): The USDA Online Photo Center provides high-quality digital photos of various agricultural activities and conservation issues.

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[www.ars.usda.gov/is/graphics/photos/index.html](http://www.ars.usda.gov/is/graphics/photos/index.html): USDA's Agricultural Research Service Image Gallery provides high-resolution digital photos of plants, animals, crops, insects, field and lab research, and more.

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[www.smartgrowth.org/index2.html](http://www.smartgrowth.org/index2.html): The mission of the Smart Growth Network is to encourage development that better serves the economic, environmental, and social needs of communities. It provides a forum for information-sharing, education, tool development and application, and collaboration on smart growth.

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## Datebook

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.

### Meetings and Events

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#### March 2001

20–22

*Dairy Manure Systems: Equipment and Technology*, Rochester, NY. Contact the Natural Resource, Agriculture, and Engineering Service Cooperative Extension, 152 Riley-Robb Hall, Ithaca, NY 14853-5701. Phone: (607) 255-7654; fax: (607) 254-8770; e-mail: nraes@cornell.edu; web: www.nraes.org.

21–23

*10<sup>th</sup> 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.

28

*Alternative Water and Wastewater Technologies for Small Communities Conference*, Omaha, NE. Contact M.J. Rose, Nebraska Environmental Partnerships at (402)-471-3193.

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#### April 2001

4–6

*11th Tennessee Water Resources Symposium*, Burns, TN. Contact Jack Gordon at (931) 372-3257; fax (931) 372-6352; e-mail: jgordon@tntech.edu.

17–20

*Enhancing the States' 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; web: www.nalms.org/symposia/chicago/index.htm

18–20

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

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#### May 2001

1–3

*Urban Wildlife Management Conference*, Nebraska City, NE. Contact the National Arbor Day Foundation, P.O. Box 81415, Lincoln, NE 68501-1415. Phone: (402) 474-5655; e-mail: conferences@arborday.org; web: www.arborday.org/programs/conferencereg21.html.

3–4

*Negotiating Effective Environmental Agreements*, Berkeley, CA. Contact CONCUR at (510) 649-8008 or on the web at www.concurinc.com/training.html.

14–17

*2nd National Conference: Nonpoint Source Pollution Information & Education Programs*, Glencoe, IL. Contact Bob Kirschner, Chicago Botanic Garden, 1000 Lake Cook Rd., Glencoe, IL, 60022. Phone: (847) 835-6837, fax: (847) 835-1635, e-mail: bkirschn@chicagobotanic.org.

16–18

*2001 Communities Working for Wetlands*, Orlando, FL. Contact Save Our Streams at (800) 965-5004 or on the web at www.iwla.org/sos/awm/awmconf.html.

20–24

*World Water and Environmental Resources Congress 2001*, Orlando, FL. Contact: ASCE - World Headquarters, 1801 Alexander Bell Drive, Reston, VA 20191-4400; Phone: (800) 548-2723 or (703) 295-6300; fax: (703) 295-6144; e-mail: conf@asce.org.

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#### June 2001

10–15

*5th International Conference on Diffuse Pollution*, Milwaukee, WI. 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.

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#### July 2001

30–Aug 2

*Managing River Flows for Biodiversity*, Fort Collins, CO. Contact Nicole Rousmaniere via e-mail at nrousmaniere@tnc.org; web: www.freshwaters.org/conference.

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#### August 2001

19–24

*Linking Stormwater BMP Designs and Performance to Receiving Water Impacts Mitigation*, Snowmass, CO. Contact Ben Urbonas, Urban Drainage and Flood Control District, Denver, CO. Phone: (303) 455-6277; fax: (303) 455-7880; e-mail: burbonas@udfcd.org.

27–30

*9th National Nonpoint Source Monitoring Workshop: Monitoring and Modeling Nonpoint Source Pollution in the Agricultural Landscape*, Indianapolis, IN. Contact 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.



Nonpoint Source NEWS-NOTES is an occasional bulletin dealing with the condition of the water-related environment, the control of nonpoint sources of water pollution and the ecosystem-driven management and restoration of watersheds. NPS pollution comes from many sources and is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural pollutants and pollutants resulting from human activity, finally depositing them into lakes, rivers, wetlands, coastal waters, and groundwater. NPS pollution is associated with land management practices involving agriculture, silviculture, mining, and urban runoff. Hydrologic modification is a form of NPS pollution which often adversely affects the biological integrity of surface waters.

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NONPOINT SOURCE

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