Nonpoint Source
News-Notes
May 2006, #78
The Condition of the Water-Related Environment
The Control of Nonpoint Sources of Water Pollution
The Ecological Management & Restoration of Watersheds

Notes on the National Scene

Watershed Planning Handbook Helps Protect the Nation's Water Resources

EPA recently released a draft guide to help communities, watershed organizations, and local, state, tribal, and federal environmental agencies develop and implement watershed plans to meet water quality standards and protect water resources. The *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (Handbook) offers practical tips and a robust framework to help any and all local or regional watershed planning efforts. The Handbook should be particularly useful to those working to improve and restore impaired or threatened waters. EPA intends for the Handbook to supplement the many good watershed planning guides developed by other agencies, universities, and nonprofit organizations.

Over the past several decades, more and more organizations have moved toward managing water quality by using a watershed approach, which includes stakeholder involvement and management actions supported by sound science and appropriate technology. The watershed planning process works within

Portland adapts rain gardens to control road runoff. See article on page 7.

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this framework to identify and quantify specific causes and sources of water quality problems. It also identifies water quality goals and specific actions required to solve those problems.

How Is This Handbook Different from Other Guides?

EPA believes that this Handbook presents a more scientifically defensible protocol and a more inclusive public process than most, if not all, previous planning guides. It provides instructions for selecting the appropriate set of tools to quantify existing pollutant loads, developing estimates of the load reductions designed to meet water quality standards, and identifying reductions associated with different management measures. Applying these tools to specific watershed conditions will enable organizations to select specific management practices best suited for reducing loads from targeted pollutants. The Handbook also presents tools for tracking progress once the plan is implemented to ensure that the management measures and practices are helping to improve water quality.

Developing watershed plans does not have to be an exhaustive, expensive endeavor. The Handbook shows how to effectively and efficiently collect the information needed to answer the right questions. The level of effort expended preparing a watershed plan will depend on several factors, such as the available information, the size of the watershed, and the pollutants of concern.

EPA Wants Your Input!

EPA is actively soliciting suggestions and comments by June 30, 2006 to shape a "final" release of the Handbook later this year or very early in 2007. Philosophically, EPA views the Handbook as a living, evolving document that it intends to update as necessary for maximum relevance and effectiveness. Please send suggestions and comments on the draft Handbook to watershedhandbook@epa.gov.

What's Inside?

EPA's new Handbook is divided into 13 chapters that move through the watershed planning and implementation process (see Table 1). The Handbook is structured so that users can either follow it step-by-step through the watershed planning process or go to individual sections that highlight specific technical tools for use in the watershed planning effort. Each chapter includes information that addresses the key issues for each step, along with examples that illustrate how to apply these concepts. Practical worksheets and checklists are provided throughout the Handbook to help work through the watershed planning process.

Table 1. Relationship of Handbook Chapters to the Watershed Planning Process.

Chapter		Steps in Watershed Planning and Implementation Process
1	Introduction	
2	Overview of Watershed Planning Process	
3	Build Partnerships	Build Partnerships
4	Define Scope of Watershed Planning Effort	Characterize the Watershed
5	Gather Existing Data and Create an Inventory	
6	Identify Data Gaps and Collect Additional Data if Needed	
7	Analyze Data to Characterize the Watershed and Pollutant Sources	
8	Estimate Pollutant Loads	
9	Set Goals and Identify Load Reductions	Set Goals and Identify Solutions
10	Identify Possible Management Strategies	
11	Evaluate Options and Select Final Management Strategies	
12	Design Implementation Program and Assemble Watershed Plan	Design Implementation Program
13	Implement Watershed Plan and Measure Progress	Implement Watershed Plan
		Measure Progress & Make Adjustments

Who Should Use This Handbook?

EPA designed the Handbook to be used by watershed organizations, universities, consultants, local agencies, and federal, state, and tribal environmental agencies that are developing or reviewing

Watershed Planning Handbook Helps Protect the Nation's Water Resources (continued)

watershed plans, participating as stakeholders on watershed planning committees, or providing guidance to watershed associations. It is especially suited for those working in watersheds with impaired or threatened waters. To successfully use the Handbook, readers should already have a basic level of understanding about watersheds, their processes, and the major components to be included in a watershed plan. In some cases, development of a watershed plan will need the technical support of experienced professionals such as engineers, hydrologists, statisticians, biologists, and database managers.

What if a Watershed Plan Already Exists for My Watershed?

EPA recognizes that many states and local groups already have some form of watershed plans in place or are developing them. These plans exist at varying levels of scale, scope, and specificity. The Handbook can still be very helpful in these situations. Although many different components may be included in a watershed plan, the Handbook outlines a minimum of nine elements that EPA has determined are critical for achieving water quality improvements. Organizations can use the Handbook to adapt their existing plans and strategies or use them as building blocks for developing and implementing watershed plans that contain these nine minimum elements. Organizations can accomplish this by adapting existing plans to include the omitted components, incorporating by reference existing assessments or other information in a newly developed plan, or merging existing information into an updated plan that includes all the basic components. Where existing plans and strategies have been developed for a basin-wide or other large geographic area, they will usually need to be refined for sub-basins or smaller watershed units to provide the information needed to develop a watershed plan. The assessment, monitoring, and other data collection requirements for larger basin studies typically are not as detailed as those for watershed plans or assessments generated for site-level work plans.

You can order a free paper copy of the Handbook from the National Service Center for Environmental Publications (NSCEP). Contact NSCEP at 800-490-9198 or by e-mail at ncepimal@one.net, and request EPA document number EPA 841-B-05-005. You may also download a PDF version of the Handbook for free at www.epa.gov/nps/watershed_handbook. Don't forget: EPA wants to hear your suggestions about how the Handbook might be improved to better meet the needs of your organization. Please send comments by June 30, 2006 to watershedhandbook@epa.gov.

[For more information, contact Stuart Lehman, USEPA Office of Wetlands, Oceans and Watersheds, Ariel Rios Building, 1200 Pennsylvania Avenue, N. W., Mail Code: 4503T, Washington, DC 20460. Phone: 202-566-1205; E-mail: lehman.stuart@epa.gov]

EPA Releases New Management Measures Guidance to Control Urban Runoff

In December 2005, EPA released *National Management Measures to Control Nonpoint Source Pollution from Urban Areas.* This non-regulatory document is intended to present EPA guidance to state and local program managers and other practitioners on the best available, most economically achievable means of managing urban runoff and reducing nonpoint source pollution of surface and ground waters from urban sources. The document is intended to be relevant to all urban areas in the U.S., not just those covered by National Pollutant Discharge Elimination System (NPDES) Phase II requirements or coastal nonpoint management areas established under the Coastal Zone Act Reauthorization Amendments (CZARA) and subject to management measures specified under Section 6217(g) of the Act. The new guidance describes how to develop a comprehensive runoff management program that deals with all phases of development—from predevelopment watershed planning and site design, through the construction phase of development, to the operation and maintenance of structural controls. It also provides information for other situations such as retrofitting existing development, implementing nonstructural controls, and re-evaluating an existing runoff management program.

"Our guidance is a textbook and toolkit for cooperative conservation and sustainable management of urban and suburban runoff," said Benjamin H. Grumbles, Assistant Administrator for EPA's

EPA Releases New Management Measures Guidance to Control Urban Runoff (continued)

Office of Water. "Stormwater pollution can harm surface and groundwater, but this guidebook identifies effective ways to reduce pollution and increase low impact development."

Guidance Structure

The document presents management measures that can be used to guide the development of a comprehensive runoff management program. Management measures establish performance expectations and, in many cases, specify actions that can be taken to prevent or minimize nonpoint source pollution or other negative impacts associated with uncontrolled and untreated urban runoff. Twelve management measures have been included in this guidance, grouped within the context of a runoff management program (see Figure 1). The components of the runoff management program shown are organized in a cycle that together comprises an integrated watershed-based management strategy. Although the management measures are meant to work together, each may stand alone, if necessary.

As seen in Figure 1, chapters 2 through 9 of the document consecutively focus on the eight components of the runoff management program cycle. Each chapter describes a component, introduces one or more management measures that define the performance expectation(s) for that component, and presents a range of management practices that potentially can be implemented to achieve the management measure(s). When available, information concerning effectiveness and costs of practices is included in the discussion, as are case studies that illustrate how select management practices have been implemented within communities.

Why Is the Guidance Needed?

The National Water Quality Inventory: 2000 Report to Congress identified urban runoff as one of the leading sources of water quality impairment in surface waters. Polluted runoff from the urban environment and from construction activities can flow off the landscape into surface waters. Infiltration of polluted runoff can also threaten ground water. Common sources of urban pollution include pet wastes, lawn and garden fertilizers and pesticides, improper disposal of household chemicals, automobile fluids, road deicing/anti-icing chemicals, vehicle emissions, and improperly sited, designed, and maintained onsite wastewater treatment (septic) systems. This runoff can include pollutants such as sediments, pathogens, fertilizers/nutrients, hydrocarbons, and metals.

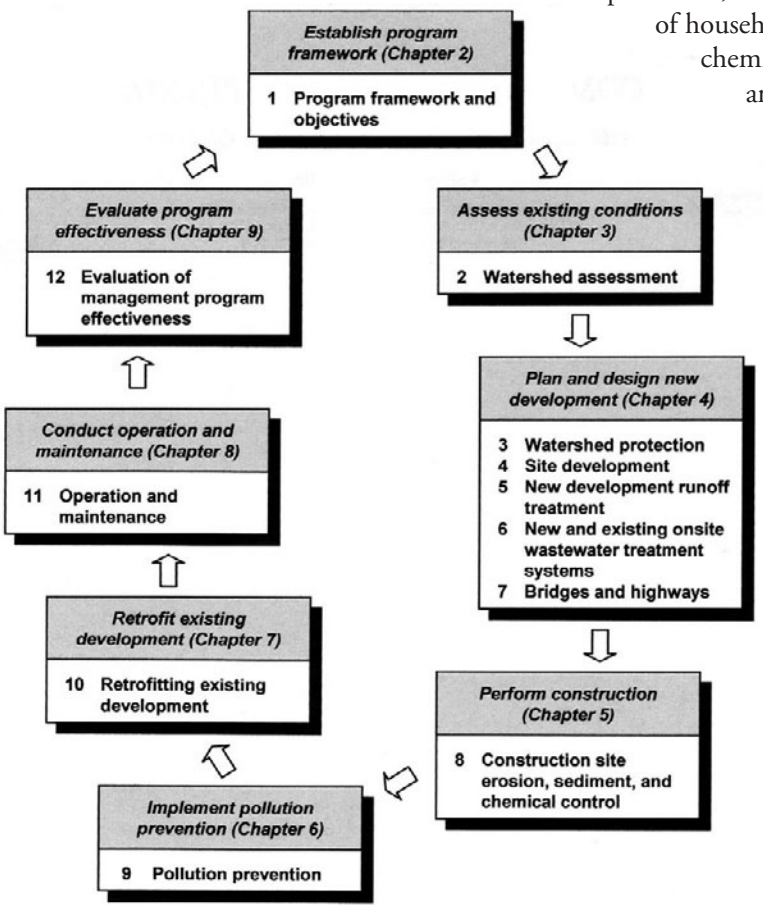

Figure 1. Twelve management measures associated with an integrated runoff management program.

Pavement and compacted areas, roofs, and reduced tree canopy and open space increase runoff volumes that rapidly flow into our waters. This increase in volume and velocity of runoff often causes stream bank erosion, channel incision, and sediment deposition in stream channels. In addition, runoff from these developed areas can increase stream temperatures that, along with the increase in flow rate and pollutant loads, negatively affect water quality and aquatic life.

Management measures for urban runoff were previously addressed in Chapter 4 of a 1993 EPA manual entitled *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (required under CZARA Section 6217(g) and available at www.epa.gov/owow/nps/MMGI). However, over the past 13 years urban NPS pollution control has advanced both technologically and philosophically. Many communities have set their sights beyond the original document's NPS pollutant reduction targets and are now seeking ways to achieve balance and integration of many quality-of-life

EPA Releases New Management Measures Guidance to Control Urban Runoff (continued)

factors, including economic growth, community livability, and environmental protection. Based on these changes, EPA perceived a need to update and expand the information in Chapter 4 of the 1993 coastal nonpoint program guidance to help local officials in all regions of the U.S. remain current with state-of-the-art management measures and practices to manage urban runoff.

Obtaining a Copy

An electronic version of the guidance document is available for download at www.epa.gov/nps/urbanmm. Free paper copies of this guidance are available from the National Service Center for Environmental Publications via phone at 1-800-490-9198 or via the Web site: www.epa.gov/ncepihom (request Publication # EPA 841-B-05-004).

[For more information, contact Rod Frederick or Robert Goo, USEPA, Ariel Rios Building, 1200 Pennsylvania Avenue, NW (Mail Code 4503T), Washington, DC 20460. Phone: 202-566-1197 (Frederick) or 202-566-1201 (Goo); E-mail: frederick.rod@epa.gov or goo.robert@epa.gov]

Development Density Scenarios and their Water Resources Impacts

Is low-density development best for water quality? Not necessarily, according to a new study by EPA. The study showed that higher-density development, especially when integrated into a watershed protection strategy, might actually be a better way to protect water resources. In January 2006, EPA released a report, *Protecting Water Resources with Higher-Density Development*, that is intended to help communities better understand the impacts of high- and low-density development on water resources (a copy may be downloaded at www.epa.gov/smartgrowth/water_density.htm).

"In addition to enjoying the many benefits of growth, communities are also grappling with growth's challenges, including development's impact on water resources," notes Benjamin Grumbles, Assistant Administrator for EPA's Office of Water. "In the face of increasing challenges from nonpoint source pollution, local governments are looking for, and using, policies, tools, and information that enhance existing neighborhoods and protect water resources. This report gives communities a different perspective and set of information to address the complex interactions between development and water quality."

Is Less Better?

To test the premise that lower density development would be more protective of water quality, EPA used a simple sketch model to examine water quality impacts arising from three different levels of development density, across multiple scales, and at three different time spans of watershed buildout. EPA examined stormwater runoff impacts generated by this analysis from different development densities to determine comparative differences between scenarios. This analysis demonstrated:

- The higher-density scenarios generate less runoff per housing unit across all spatial scales (one acre, development site, and watershed) and all three temporal build-out rates (see Figure 2);
- For the same amount of development, higher-density development produces less impervious cover, and therefore less overall runoff, at the watershed level than low-density development produces; and
- For any given amount of growth, low-density development spreads water quality impacts across a greater portion of the watershed (see Figure 3).

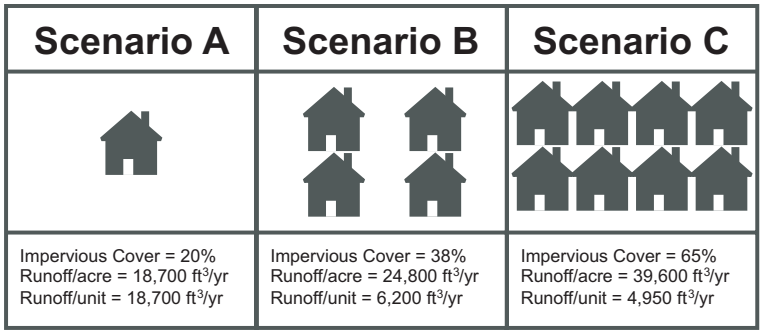

Figure 2. Although the total runoff per acre increases as density increases, the runoff generated per housing unit decreases dramatically.

Sometimes More Is Better

Taken together, EPA's findings indicate that low-density development may not always be the preferred strategy for protecting water resources. Higher densities may better protect water quality—especially at the development site and watershed levels. Why? To accommodate the same number of houses, denser developments consume less land than lower density developments. Consuming less land means creating less impervious cover in the watershed, which in turn means generating less stormwater runoff.

High Versus Low Density Development and their Watershed Impacts

When 10,000 housing units are built in a 10,000-acre watershed, the higher density Scenario C (eight houses per acre) creates significantly less overall runoff and percent watershed imperviousness than does the lower-density Scenario A (one house per acre). What happens if growth in the area continues, and another 70,000 houses are needed? In Scenario A, the growth would spread across eight watersheds (of the same size) and generate 1.496 billion ft^3/yr of stormwater runoff. In Scenario B, the growth would spread across two watersheds and generate 496 million ft^3/yr of stormwater runoff. In Scenario C, the growth would fill one watershed and generate 396 million ft^3/yr of stormwater runoff.

Scenario A	Scenario B	Scenario C
		
10,000 homes built on 10,000 acres produce 10,000 acres x 1 house x 18,700 ft^3/yr of runoff =	10,000 homes built on 2,500 acres produce 2,500 acres x 4 houses x 6,200 ft^3/yr of runoff =	10,000 homes built on 1,250 acres produce 1,250 acres x 8 houses x 4,950 ft^3/yr of runoff =
• **187 million ft^3/yr of stormwater runoff**	• **62 million ft^3/yr of stormwater runoff**	• **49.5 million ft^3/yr of stormwater runoff**
• **Site: 20% impervious cover**	• **Site: 38% impervious cover**	• **Site: 65% impervious cover**
• **Watershed: 20% impervious cover**	• **Watershed: 9.5% impervious cover**	• **Watershed: 8.1% impervious cover**

Figure 3. Low-density development (Scenario A) has the potential to impact more of the watershed.

However, while this study debunks perceptions that low-density development is automatically better for protecting water resources, it does not conclude that high-density development is necessarily always preferable. EPA believes that increasing development densities in certain areas is just one piece of a larger plan that communities can use to minimize regional water quality impacts. High-density growth should occur within the framework of a more encompassing watershed strategy that considers other factors—such as the location of other development (both existing and planned) within the watershed, preservation of critical ecological and buffer areas, and the availability and use of site-specific stormwater management strategies.

Other Considerations

This study emphasizes that minimizing total imperviousness and runoff within a region or watershed—rather than from particular sites—is important for the watershed's overall water quality. However, potential local water quality impacts from high-density development must also be considered and addressed. For example, higher-density development can create more site-level impervious cover, which will exacerbate water quality problems in nearby or adjacent waterbodies, if not mitigated. To address this, communities can employ innovative site-level techniques, such as porous pavements, green roofs, rain gardens, and bioretention areas, to prevent, store, and treat stormwater runoff. Many site-level techniques can also enhance a neighborhood's sense of place, increase community character, and, in some cases, perform better financially.

More Resources….

Many resources are available to help communities develop and implement watershed-based water quality protection strategies that incorporate high-density development. In fact, EPA recently released two comprehensive guidance documents that provide extensive information about watershed planning and stormwater runoff control—both of which are described in greater detail in the preceding articles of this newsletter:

- *Handbook for Developing Watershed Plans to Restore and Protect Our Waters* (www.epa.gov/owow/nps/watershed_handbook)
- *National Management Measures to Control Nonpoint Source Pollution from Urban Areas* (www.epa.gov/nps/urbanmm)

Development Density Scenarios and their Water Resources Impacts (continued)

Two additional EPA publications, *Using Smart Growth Techniques as Stormwater Best Management Practices* and *Protecting Water Resources with Smart Growth* draw on the experience of local governments, which has shown that regional and site-specific strategies are most effective when implemented together. Both are available at www.epa.gov/smartgrowth.

Beyond these EPA resources, the Local Government Commission and the National Association of Realtors jointly published *Creating Great Neighborhoods: Density in Your Community*, which provides information on additional community benefits of high-density development (www.epa.gov/smartgrowth/pdf/density.pdf). Lastly, Emeryville, California, has a guide for minimizing stormwater impacts from high-density development titled *Stormwater Guidelines for Green Dense Development* (www.ci.emeryville.ca.us/planning/pdf/stormwater_guidelines.pdf).

EPA and other organizations offer additional resources on smart growth tools and techniques. For a list of relevant publications and other resources, see www.epa.gov/smartgrowth. Hard copies of *Protecting Water Resources with Higher-Density Development* are available for free from the National Service Center for Environmental Publications, by e-mailing ncepimal@one.net or calling 800-490-9198 and requesting EPA publication 231-R-06-001.

[For more information, please contact Lynn Richards, USEPA, 1200 Pennsylvania Avenue, NW (Mail Code 1807T), Washington, DC 20460. Phone: 202-566-2858; E-mail: richards.lynn@epa.gov]

News from the States, Tribes, and Localities

Portland's Green Streets Protect Water Quality

In Portland, Oregon, drivers are seeing more stormwater management features popping up—although many might not recognize them for what they really are. Relying on the familiar curb and stormwater inlet method of controlling stormwater runoff from roads is, by necessity, becoming a thing of the past in Portland. Today, the attractive landscaped island along the street might also be serving as a stormwater collection and filtration feature. The asphalt under the wheels of cars might be porous—holding up to the weight of the traffic but also allowing rainwater to soak through to the soil underneath. Portland is in the midst of a tremendous push to capture, store, and infiltrate as much stormwater as possible on-site. By doing so, Portland hopes to help reduce the amount of stormwater entering the sewer system, prevent sewer backups in basements, and eliminate up to 94 percent of combined sewer overflows into local waterways.

Portland Has a History of Stormwater Challenges

Portland receives an average of 37 inches of rainfall per year, which generates approximately 10 billion gallons of stormwater runoff annually. For decades, a portion of this stormwater runoff has mixed with untreated sewage in Portland's combined sewer system and has been pouring into the Columbia Slough and Willamette River through combined sewer overflows (CSO). When Portland's first sewer system was built in the late 1800s, it carried both sewage and stormwater runoff directly to the rivers. In 1952, the sewage mix was redirected to a wastewater treatment plant. As the City grew, these original sewer lines quickly filled to capacity with each rain. Whatever volume didn't fit into the pipes—including rainwater, human and industrial waste, toxic materials, and debris—overflowed into streams and rivers. The CSO problem continues today, along with its associated environmental and human health risks.

Portland began a comprehensive program to address its CSO problem in 1991, in response to a lawsuit-driven mandate by the Oregon Department of Environmental Quality (DEQ). The DEQ required that Portland address its CSO problem within 20 years, by 2011. In response, Portland's Bureau of Environmental Services (BES) launched a group of projects in 1991 to remove and/or temporarily store a significant amount of the runoff that enters the combined system. Some of the projects require new infrastructure, including constructing big tunnels to capture and store stormwater and CSO until treatment capacity is available, separating combined sewers, and installing new pump stations to redirect CSO to different treatment systems with more capacity (see www.portlandonline.com/bes/index.cfm?c=31030 for more information). Collectively, implemen-

tation of these projects has already reduced CSO volume by more than 50 percent.

Portland's Downspout Disconnection program was featured in Nonpoint Source News-Notes Issue #74. See www.epa.gov/newsnotes for a copy of the article.

Hoping for Big Results from Small Projects

The large infrastructure projects are supplemented by a series of small-scale projects that attempt to control stormwater a little bit at a time, at the source. These projects include installing vegetated "ecoroofs," disconnecting downspouts from the combined sewer system (see box), and adding swales, rain gardens, and vegetated planters on properties to capture, store, and infiltrate runoff from roofs, walkways, and parking lots before the water drains into the combined sewer system. In a number of locations, the City has installed stormwater control features adjacent to public roads—or, in the case of porous pavement—as a feature of the road itself. These "Green Street" features—many of them very visible to the passing motorist—include landscaped curb extensions, stormwater street planters, and porous pavement.

Figure 4. The landscaped curb extensions on Siskiyou Street improve aesthetics, calm traffic, and capture and infiltrate runoff from the street.

Figure 5. Water flows into the Siskiyou Street curb extension during a rainstorm.

Figure 6. This landscaped curb extension demonstration project, located on at the intersection of 131st and Freemont Streets, shows how these features can be easily adapted to allow for pedestrian traffic.

Landscaped Curb Extensions

One type of Green Street feature, known as a landscaped curb extension, is a special rain garden designed to capture and treat stormwater runoff. Curb extensions are typically placed in the parking zones of streets, just uphill from intersections (see Figure 4). These relatively simple retrofits are designed to intercept the stormwater flowing down the street just before it would have entered the storm drain. The stormwater is redirected through a vegetated area where it has a chance to infiltrate into the soil. During very heavy storms, any stormwater overflowing from the curb extension will drain into the existing storm drain located just beyond the lower end of the feature.

Installation of a landscaped curb extension is fairly simple. The existing curb remains intact and no modifications to the storm drains or stormwater collection system are necessary. First, BES removes the asphalt from the parking areas along the existing curb and pours an additional curb—complete with multiple openings to allow stormwater to enter and exit—along the edge of the travel lane. City workers excavate the feature, backfill with a controlled mixture of sand, topsoil and compost, and install landscaping (mostly consisting of native plants with some bulbs and perennials added for accent). Each curb extension has three check dams, with four separate compartments for ponding runoff and slowing its passage through the feature (see Figure 5). The City is responsible for weeding and replacing plants as needed; however, the local neighborhood residents typically help with weeding and any watering that might be necessary.

BES installed the first project of this type on NE Siskiyou, a residential street. Completed at a cost of $15,000, the two Siskiyou curb extensions converted about 590 square feet of pavement to landscape, and capture runoff from approximately 9,300 square feet of paved surfaces. Monitoring of the Siskiyou project shows that the features capture and infiltrate a large proportion of the runoff. More project information, including monitoring data, is available at www.portlandonline.com/bes/index.cfm?c=37592. BES was so pleased with the effectiveness of these landscaped curb extensions that they have completed two similar projects—and more are planned. Fortunately, the curb extensions can be easily modified for different street configurations (see Figure 6).

"These projects have been very successful," explains Emily Hauth, of the BES Sustainable Stormwater Program. "The residents like both the look of the extensions and the way the narrowing of the street has calmed traffic. The general public is also taking notice. In fact, residents from more than 30 other city neighborhoods have asked for landscaped extensions on their streets." Ms. Hauth adds that the city will try to accommodate these requests as project planning and funding allow.

Figure 7. These stormwater planters at a shopping area use all available space between the sidewalk and the street for stormwater control.

Figure 8. Another of the City's stormwater planter systems, installed next to a parking lane, includes a path of pervious block pavers for pedestrian access.

Stormwater Planters

In other demonstration projects, BES chose to create highly visible stormwater control features directly next to city streets—without affecting traffic flow or parking. For example, at a redeveloped shopping area, BES partnered with the store owners to help design and install a chain of four stormwater planters within a six-foot planting strip between the sidewalk and street to capture the street's runoff. Like the curb extensions, stormwater planters act like small rain gardens. They are installed slightly below grade within the confines of concrete (see Figure 7). To create this feature, BES replaced a portion of the existing curb with an inlet that allows water to enter the planter. The planting area was excavated, backfilled with soil, and landscaped. If the fourth and final planter in the chain fills up with stormwater, any overflow returns to the street and is conveyed into existing storm drains. This demonstration project also included installation of interconnected stormwater swales that ring the shopping area and receive stormwater runoff from the building's rooftop, outdoor plaza, and parking lot. Once the vegetation is established, this retrofit design should remove about one million gallons of stormwater runoff from the combined sewer system annually. This was a major improvement over a preliminary design that was much less attentive to stormwater and removed only about 1,000 gallons. BES has included similar stormwater planters in other demonstration projects throughout the city (see Figure 8). Maps showing the locations of all demonstration projects are available at www.portlandonline.com/bes/index.cfm?c=34604.

Porous Pavement Projects

BES is also relying on the soil underneath some roads to help manage stormwater. BES, working with Portland's Office of Transportation, recently completed installation of the city's first major porous pavement demonstration pilot project on a public street. In fall 2004, the City paved about 1,000 feet of street surface with interlocking high-strength concrete block pavers. The configuration of the pavers leaves open spaces that are backfilled with fine rock—this allows water to percolate through to the soil underneath. One street was paved curb-to-curb with concrete pavers. Two other streets were paved with a center strip of standard asphalt and interlocking concrete pavers in both curb lanes (see Figure 9). A fourth area of the same size—a control—was paved curb-to-curb with standard asphalt.

In fall 2005, the City finished a second porous pavement pilot project, which installed porous asphalt and pervious concrete on four different residential streets. The project will assess the success of four different pavement combinations: (1) pervious concrete curb-to-curb; (2) pervious concrete in both curb lanes and standard concrete in the middle travel lanes; (3) pervious asphalt curb-to-curb; and (4) pervious asphalt in the curb lanes and standard asphalt in the middle lanes.

Success will be determined by monitoring all pavement types over the long term for infiltration performance, the quality of the water draining through the pavement, the durability of the pavement surfaces, the pavements' structural integrity, maintenance needs, and public perception. Initial tests using flow from a water truck showed rapid infiltration (see Figure 10). Steve Fancher, a Civil Engineer with BES, estimates that the two pervious pavement pilot projects remove an estimated

2.2 million gallons of runoff from the combined sewer annually. BES had planned to collect monitoring data, but has run into difficulty doing so, explains Fancher. "We had intended to collect grab samples of the stormwater moving through the pavement, but we've found that the water infiltrates so quickly—even in the biggest storms—that none backs up into the underdrains." Fancher expects to have some monitoring data to report by 2007. In the meantime, monitoring information for most of the other sustainable stormwater projects is already posted on the BES Web site.

Figure 9. The curb lanes of Westmoreland Street were retrofitted with interlocking concrete block pavers. Excess stormwater not captured by the permeable pavement will overflow into existing stormdrain inlets, such as the one pictured here.

Figure 10. Water sprayed from a truck quickly infiltrates through the new curb-to-curb pervious asphalt section of North Gay Avenue.

The previous pavement pilot project cost more than a conventional paving project, but the city expected that, explains Bob Cynkar, BES Community Outreach Representative. "Pilot projects typically cost more because of initial design costs and the use of less-common materials." Paving four blocks of North Gay Avenue with porous asphalt and concrete cost about $240,000, while the same project using conventional materials would cost about $156,000. "However, we see porous pavement as having a large potential for future use," he adds. "One advantage of using porous pavement as part of a stormwater management plan is that additional real estate is not needed—you just use the road itself." In the long term, Portland expects that the small sustainable stormwater projects like the porous pavement, stormwater planters, curb extensions, and others will ultimately significantly reduce the cost of collecting and treating stormwater runoff. Additional information about this and other projects is available at www.portlandonline.com/bes/index.cfm?c=34598.

Funding

Portland is relying on many sources of funding for its stormwater management and CSO-reduction programs. Residents' combined water and sewer bills help finance most of the costs of managing stormwater system-wide. The City will soon offer residents and multi-family, commercial, and industrial property owners a discount off their bills if they install private on-site stormwater management features such as rain gardens or water collection systems to capture roof runoff. In addition, Portland has applied for and received a number of water quality improvement grants. Since 2002, the City has received almost $3 million in grants from the U.S. EPA to support a series of projects demonstrating innovative stormwater control techniques, including those described above.

Given the success of the projects and the positive public reaction, Portland plans to continue expanding its decentralized, watershed-based stormwater control efforts across the city. Many of Portland's private developers are now also incorporating these types of innovative stormwater control techniques into their projects. Portland is making great progress toward its 2011 CSO deadline to protect clean water, and, at the same time, is improving neighborhood health and aesthetics.

[For more information, visit www.portlandonline.com/bes, or contact Bob Cynkar, Community Outreach Representative, City of Portland, Bureau of Environmental Services, 1120 SW 5th Ave., Rm. 1000, Portland, OR 97204. Phone: 503-823-7898; E-mail: robertcy@bes.ci.portland.or.us. You may also contact Emily Hauth (503-823-7378 or emilyh@.bes.ci.portland.or.us) or Steve Fancher (503-823-7125 or stevef@bes.ci.portland.or.us)]

Environmental Greenskeeping Becoming Par for the Course in Michigan

Big expanses of turfgrass might look pretty, but can be contributing sources of nonpoint source runoff pollution if improperly managed. For the past eight years, an innovative, voluntary Michigan program—the Michigan Turfgrass Environmental Stewardship Program (MTESP)—has been working to improve management practices to help golf courses be environmental leaders within their community. The program is dedicated to protecting groundwater and surface water resources by advancing turfgrass management practices, preventing pollution, and increasing regulatory compliance within the golf industry.

Launched in 1998, MTESP's focus is to improve stewardship of golf course properties. With approximately 860 golf courses, Michigan ranks first in the number of courses per capita and number of public golf facilities. Improperly managed golf courses can contaminate groundwater and surface water through a number of routes, such as the runoff of pesticides and fertilizers, leaks from poorly maintained motorized equipment, and leaks from improperly stored and handled chemicals.

Unique Origins

Michigan State University (MSU) initiated the program at the request of the Michigan Turfgrass Foundation (MTF), a non-profit organization whose mission includes promoting the practice of environmental stewardship for turf managers. MSU worked with the Michigan Department of Agriculture (MDA) and Michigan Department of Environmental Quality (MDEQ) to develop the program's curriculum. The program's origins can seem surprising to the uninitiated. MTESP Coordinator Debbie Swartz explains, "It's an industry-driven program. Industry came to the state and said they wanted to be proactive and to learn how to be in compliance."

Currently, the program is primarily funded through a grant from the MDA Groundwater Stewardship Program and annual membership fees. Additional support comes from MTF, MSU, and MDEQ. Four regional golf course superintendents associations, along with the Golf Course Owners Association and the Golf Association of Michigan, support the program by promoting it in their member outreach materials and by inviting MTESP staff to participate in events and conferences. Golf courses pay a fee of $200 to receive the initial training and $350 for each required follow-up visit—money that helps supplement the grant funds for the program.

Program Components

Currently, the MTESP consists of three parts: educational workshops, self-assessment exercises, and implementation of environmental action plans. During the training, MTESP staff members introduce golf course superintendents and other participants to ten modules that highlight topics including:

- Evaluation of a golf course's current environmental status (module 1),
- Protection of wellheads and sensitive waterways (module 2),
- Fuel storage practices (module 3),
- Pesticides and fertilizers: proper mixing, storage, loading, and application practices (modules 4,5, and 6),
- Equipment washing (module 7),
- Emergency response planning (module 8),
- The importance of buffer zones around water resources (module 9), and
- Purchase and use of environmentally-friendly products (module 10).

Next, superintendents conduct self-assessments of their courses based on the MTESP's ten modules to help identify sites on their property that are sensitive for wildlife habitat or susceptible to water pollution. This assessment also prioritizes areas where management practices could be improved to

help meet applicable state environmental standards, such as those found within Michigan's Public Act 451—the Natural Resources and Environmental Protection Act.

Based on the self-assessments, MTESP staff members help superintendents develop three-year environmental action plans that lay out policies, procedures, goals, and practices for environmentally sound management. Action plans also enhance communication among course stakeholders about long-term management needs. A golf course earns its formal MTESP certification as a "Certified Environmental Steward" once MTESP staff members confirms that the course has addressed all required items in its action plan, such as posting signs, upgrading fuel storage tanks, plugging floor drains in chemical storage areas, and implementing turfgrass management changes. A MTESP staff member must re-evaluate a golf course's action plan every three years for the facility to retain its certification. Currently, 61 golf courses are MTESP-certified, and more than 165 other courses are working toward achieving certification. MTESP enjoys equal participation by golf courses owned and operated by municipalities and those owned and operated privately.

Participating courses can be active in the program without being certified as long as they pay membership fees and continue to work toward implementing action plan items. Obtaining certification can be rather simple and inexpensive for some courses—and a challenge for others. The majority of golf courses have achieved certification by spending less than $2,000, Swartz explains. There are, however, other courses that currently lack the funds to carry out portions of their environmental action plan. In these cases, she hopes that the availability of new financial incentives in the future will help increase the motivation of some of the golf courses. For example, the MTESP staff members are currently working to connect golf courses with insurance companies that will offer lower premiums for MTESP-certified courses.

Because the MTESP is voluntary, the program encourages—but does not require—participants to collect water quality data. However, all participating golf courses are required to regularly complete checklists and detailed reports on the management improvements and other actions that were implemented. Many of these actions—such as sealing old wells, installing riparian buffers, moving equipment washing locations away from sensitive areas, and upgrading chemical storage/mixing facilities—all reduce the risk of pollution entering the surface and groundwater supplies.

Incentives and Rewards

The MTESP offers benefits to participants, as well as to the environment. MTESP staff members interpret and prioritize important laws and regulations impacting golf courses, and they help participating courses determine if they are in compliance. The program is confidential and does not report non-compliant courses; rather, MTESP staff members continue to work with courses individually as needed to make improvements until they achieve compliance. MTESP staff members identify and map the natural resources on each golf course, and identify protective measures that can be applied to environmentally sensitive areas. The MTESP staff also keeps its members informed about the latest environmental issues, innovative management practices, and news involving the turfgrass industry. The MTESP hosts a workshop series every year to introduce representatives from newly participating golf courses and to provide information to previously uninvolved employees of participating golf courses.

The MTESP also provides publicity and marketing opportunities. For example, the MTESP highlights environmental achievements of participating golf courses at high-profile community events such as golf tournaments. Local celebrities or elected officials sometimes present golf course owners with their formal program certificates, thereby helping to raise the visibility of the program and its participants.

Many courses use their "Certified Environmental Steward" status as part of their marketing package (see Figure 11). For example, the 900+ acre Grand Traverse Resort and Spa, in Acme, Michigan, plans to highlight its certification in newsletters, in correspondence to the resort's private condominium owners, and at

Figure 11. Michigan Turfgrass Environmental Stewardship Program (MTESP) participants display the MTESP logo at their golf courses and on promotional materials.

golf trade shows. Paul Galligan is the resort's golf course superintendent. He has participated in the MTESP for eight years, and achieved certification for the resort's three courses in January 2006. "Being involved in this program is the best day of work you can provide your employer; it makes golf course superintendents know how they impact the environment and how they can lessen those impacts. For me, just knowing I've done the right thing is worth it."

Applying the Program Elsewhere

For other states interested in replicating this program, Swartz recommends working with turfgrass industry associations, the Golf Course Superintendents Association of America (GCSAA), the pollution prevention branches of state environmental agencies, and educational institutions. The GCSAA offers an Environmental Management Program to help golf course superintendents strengthen their natural resources stewardship. Program information is available at www.gcsaa.org/education/emp. In 2005, the GCSAA sponsored a nationwide webcast on the fundamentals of golf course stewardship based on the principles of the MTSEP's training course. Information on ordering this webcast is available at www.gcsaa.org/education/webcast/archivedwebcast.asp. Hardcopies of the MTESP training modules are available for $200. The information within the modules can be adapted and applied in other regions.

[For more information, contact Debbie Swartz, Michigan State University, Michigan Turfgrass Environmental Stewardship Program, Department of Crop and Soil Sciences, E. Lansing, MI 48824. Phone: 517-355-0271 ext. 145; E-mail: swartzd@msu.edu; Web: www.mtesp.org]

Notes on Education

New Environmental Literacy Report Offers Lessons for NPS Outreach

> "What passes for environmental education in America is usually environmental information. One might compare it to the difference between a full-course meal and a quick snack. True education nourishes a deeper understanding and an all-important ability to skillfully apply that knowledge; information simply makes one aware of a topic and goes no farther."
> - *Environmental Literacy in America, 2005*

People typically think they know more about the environment than they really do, finds a report recently released by The National Environmental Education & Training Foundation (NEETF), a private nonprofit organization chartered by Congress in 1990 to advance environmental education. The 152-page report, *Environmental Literacy in America*, examines the results of more than a decade's worth of environmental literacy research. On the positive side, the research has found that most people believe environmental education (EE) is valuable. The report also finds that many people are aware of environmental topics that are relatively simple to understand. However, far fewer people truly comprehend more complex environmental subjects. The average American adult, regardless of age, income, or level of education, generally fails to grasp essential aspects of environmental science, important cause-and-effect relationships, or certain basic concepts such as nonpoint source runoff pollution, power generation and fuel use, or water's natural drainage patterns. The report examines reasons for the environmental knowledge gap and explores recommendations for improving environmental education and outreach.

Nonpoint Source Pollution—Still Unknown or Insignificant to Most Americans

Environmental Literacy in America found evidence that many people are either unaware of or misinformed about many environmental issues, including air, water, solid waste, and energy. For example, the report shows that few Americans understand the meaning, dynamics, and impact of nonpoint pollution. In fact, the report indicates that 86 percent of the U.S. public is not even familiar with the term "nonpoint source pollution." When provided with a multiple-choice list, 60 percent of surveyed Americans cannot pick out the correct definition of a watershed. A full 78 percent of the U.S. public does not understand that runoff from agricultural land, roads, and lawns is now the most common source of water pollution; nearly half of Americans (47 percent) believes industry still accounts for most water pollution.

New Environmental Literacy Report Offers Lessons for NPS Outreach (continued)

People also don't understand the extent and potential ramifications of point and nonpoint water pollution. A survey of people in the U.S. and abroad showed that only 9 percent know that polluted/contaminated water is responsible for more childhood deaths worldwide than any other single reason. Most people surveyed (55 percent) incorrectly believe that famine is the leading cause of childhood death worldwide.

Why this large knowledge gap? Subjects such as nonpoint source pollution can be difficult for many people to understand because they involve a "causal disconnect." Environmental education is about understanding important causal relationships—what factors and sources might contribute to air and water pollution, what factors contribute to species loss, how different parts of a moving system affect one another—and about an individual's ability to sort out those connections. The report identifies this understanding of causal connection as the single biggest problem in the environmental knowledge gap. The studies show that most people grasp simple one-step causes of problems easily enough. The majority can, for example, understand that a car pollutes the atmosphere or that a factory can pollute a stream. But add a couple of complicating steps to the process (a car deposits small amounts of oil on the road and rain washes it into a drain that goes to a stream), and understanding drops off steeply. A relatively small portion of people seem to grasp multi-step causal relationships even when they involve such critical concerns as water pollution caused by runoff from the land.

The report explores the factors that seem to have some influence on people's general awareness and understanding of environmental issues, including their education level (people with higher education levels score significantly better on environmental awareness tests than those with less education); their gender (men typically scored better than women); and their geographic location (people in western states scored slightly better). The report also discusses other factors thought to contribute to a lack of awareness, including the media's inconsistent use of terminology (e.g., using "watershed," "basin," or "drainage" interchangeably), and a lack of in-depth environmental information in the media.

Environmental Literacy in America: What's Inside

Environmental Literacy in America begins by exploring the status of American environmental knowledge and ends with a plan for obtaining environmental literacy. The plan is based on research from many disciplines and looks at environmental education as a lifelong ("pre-K to gray") undertaking. The basis for this report rests on primary research conducted over a ten-year period through The National Environmental Education & Training Foundation's (NEETF) partnership with Roper Public Affairs, a major international survey research firm. Over the last decade, NEETF has been issuing reports based on survey data collected by Roper on Americans' environmental knowledge, attitudes, and behavior. ***Environmental Literacy in America*** summarizes what NEETF and Roper have learned in the process.

- Chapter 1 summarizes the current state of environmental knowledge in America, explores where adults acquire environmental information, and examines the disparity between what Americans know about the environment and what they think they know.
- Chapter 2 examines the environmental "myths" that people hold, and explores how the media may contribute to the durability of these myths in the public's mind.
- Chapter 3 explores American attitudes toward the environment and environmental education, and their activities on behalf of the environment ("environmental stewardship").
- Chapter 4 examines the role of the media in environmental education, and the potential for targeting different segments of the population with higher levels of environmental literacy.
- Chapter 5 examines what constitutes environmental education and environmental literacy.
- Chapter 6 discusses support for environmental education in the U.S., including parental expectations, and summarizes research on the effects of environmental education on student performance in academic subjects, character development, and overall learning skills.
- Chapter 7 discusses the long-term value of environmental literacy, and examines community leadership, cultural diversity, health care advances, and other societal goals.
- Chapter 8 contains recommendations for a bold but feasible plan of action that would dramatically improve the state of environmental literacy in America. Although a considerable amount of research is now available on environmental education, significant gaps still remain. This report points out areas for further study that, if addressed, would help take environmental education to a higher level and fulfill its ultimate promise.

New Environmental Literacy Report Offers Lessons for NPS Outreach (continued)

What Can Be Done?

The report indicates little difference in environmental knowledge levels between the average American and those who sit on governing bodies, town councils, and in corporate boardrooms, and whose decisions often have wider ramifications on the environment. However, NEETF sees encouraging evidence that the public can learn more about the environment and complex ecological relationships. NEETF concludes that we are far from succeeding in making this a reality because of the absence of a comprehensive coordinated approach to environmental education. The report details recommendations for how to bring EE up to its fullest potential, including:

- Achieving a wider and stronger base of environmental knowledge;
- Organizing delivery of EE content into a logical progression;
- Expanding EE training to K-12 teachers, doctors and nurses, community leaders, business managers, and weathercasters;
- Conducting more EE at nature-rich community places, including zoos, aquariums, museums, parks, and more; and
- Maximizing use of information technology for EE delivery.

Environmental Literacy in America is available as a free download from NEETF's Web site at www.neetf.org.

[For more information, contact The National Environmental Education & Training Foundation, 1707 H Street, NW Suite 900, Washington, DC 20006. Phone: 202-833-2933; E-mail: neetf@neetf.org; Web: www.neetf.org. This article includes text excerpted from Environmental Literacy in America *and adapted with permission from NEETF.]*

Stormwater Awareness: North Carolina and Beyond

A recent study by the North Carolina Department of Environment and Natural Resources (NC DENR) explored North Carolinians' awareness, perceptions, and behaviors related to polluted stormwater runoff. DENR also reviewed the results of surveys conducted in other states, counties, towns, and watersheds. DENR hopes that by compiling information about surveys and outreach efforts in other places, North Carolina can heed lessons learned and avoid financial pitfalls, capitalize on others' success and, it is hoped, create the most effective and efficient stormwater outreach campaign possible for its regulated municipalities and state residents. DENR's findings are published in a new report by Chrystal Bartlett, *Stormwater Knowledge, Attitude and Behaviors: A 2005 Survey of North Carolina Residents*, available online at www.ncstormwater.org/pdfs/stormwater_survey_12506.pdf.

North Carolina's Survey

To determine North Carolina residents' stormwater knowledge, DENR administered a 31-item phone survey in early fall 2005. Findings indicate a slight majority perceive overall water quality in local streams, lakes, and rivers as good and the greatest perceived water pollution threats are trash dumped into lakes and rivers by recreational users and the wastewater from manufacturing and sewage treatment plants. Most respondents did not know that stormwater flows untreated to the closest stream, lake, or river. Behaviors affecting stormwater pollution were also explored. Although slightly less than half of respondents fertilize their yards, most of those who fertilize fail to use a soil test to determine soil needs. Most North Carolina residents leave grass clippings on their lawns, wash their own cars, and have their oil changed at commercial facilities. However, the majority of pet walkers do not dispose of pet waste properly, and small groups report dumping used oil into storm drains or onto grassy areas as well as over-applying fertilizer to their lawns.

Stormwater Knowledge around the Nation

To learn from the efforts of other states and localities, Bartlett reviewed stormwater-related survey results from around the country. No statistical comparisons could be made between surveys because

they all differed in methods. However, anecdotal and empirical data have value—not just in the findings themselves, but in the comparisons those findings make possible.

The majority of surveys were "snapshots" because they were designed to be administered a single time. For this reason, trend analysis data were not widely available. All surveys gathered invaluable data, however, because they captured different audiences' knowledge, perceptions, and behaviors regarding water quality and stormwater runoff. This holds true despite the varying degrees of outreach done on polluted stormwater runoff in the communities that received surveys. North Carolina's residents have also been exposed to varying levels of stormwater outreach. By gathering background knowledge on different states' outreach efforts, DENR hopes to estimate the impact of specific outreach efforts and integrate these findings into future outreach plans.

Overall, the behavioral findings revealed wide national disparities with regard to activities that impact stormwater. Many factors, including educational inputs, could be a factor in these results. The literature reviewed shows rural or urban resident status appears to play a role in oil changing and pet walking behavior. Rural residents are less likely to walk dogs, wash vehicles on hardened surfaces, and fertilize their yards, but some surveys found they are more likely to change their own oil. Urban dwellers have access to yard waste pickup, but few live with ditches in their yards. Urbanites are, however, more inclined to wash vehicles on driveways. Gender also appears to play a role. More women than men pick up pet waste for proper disposal. Some surveys show women are also more likely to use a soil test before applying fertilizer. More detailed comparisons of each state and locality's survey results and outreach efforts are included in the report.

Next Steps

Based on the survey results and literature review, DENR developed a series of recommendations for stormwater outreach and social marketing methods in North Carolina. Since less than 50 percent of the population is aware that stormwater is not treated before entering local water bodies, DENR concluded that any outreach must focus on increasing awareness of this fact before, or in conjunction with, messages requesting behavior change. Residents must first understand the link between their behaviors and water quality before they can reasonably be expected to make voluntary changes in their daily activities.

A number of DENR's key recommendations are included below. For the complete list and explanations for each, please refer to the report.

- Target basic stormwater information messages toward women. Survey results show that women know less about stormwater's destination and treatment status than their male counterparts.
- Target messages by age group. Survey results show that awareness of stormwater's untreated status varies greatly from age group to age group.
- Mass media messages should be used to educate about lawn care. The majority of North Carolina residents take care of their own yards, so point of purchase, broadcast, and direct mail would reach this group most effectively.
- Target vehicle care behavior change messages to urban and suburban dwellers. Surveys show they are most likely to wash cars on impervious surfaces.

What is Social Marketing?

In a nutshell, social marketers find out what attracts people's attention, and then tailor their environmental message to match it.

Applying Lessons Learned

DENR is planning to conduct two follow-up surveys during 2006 and 2007. These surveys will gather trend data on the questions asked in the 2005 survey. They will also gather data on awareness and retention of social marketing efforts conducted in the interims between surveys. These data will allow North Carolina's stormwater outreach professionals to refine their outreach efforts in two major ways. First, the marketers can concentrate efforts where and to whom they are most

Stormwater Awareness: North Carolina and Beyond (continued)

needed. Second, they can see where campaigns have produced positive changes and adopt the programs used in those areas. DENR hopes that by applying informed social marketing techniques, their efforts will not only increase people's awareness about stormwater, but also help to change behavior where necessary. DENR views its outreach program as an essential component of its overall efforts to address stormwater in North Carolina. By itself, social marketing cannot solve the problem. But it will not be effectively approached without it.

[For more information, contact Chrystal Bartlett, Stormwater Awareness & Outreach Coordinator, N.C. Dept. of Environment & Natural Resources, 1601 Mail Service Center, Raleigh, NC 27699-1601. Phone: 919-715-4116; E-mail: chrystal.bartlett@ncmail.net; Web: www.ncstormwater.org]

Technical Notes

EPA Provides Faster Water Quality Tests for Safe Beach Swimming

EPA researchers developed a new rapid method for testing beach water quality that will protect Americans' health by reducing the time it takes to detect bacterial contamination from 24 hours to just two hours. In tests done at two Great Lakes beaches, researchers verified that the more rapid method accurately predicts health threats from bacterial contamination. The results of the study will help support new federal criteria and limits for water quality indicators in recreational waters.

The paper, published in the January 2006 issue of *Environmental Health Perspectives*, presents some of the first findings of the National Epidemiological and Environmental Assessment of Recreational (NEEAR) Water Study (see www.ehponline.org/members/2005/8273/8273.pdf for a copy of the paper). NEEAR is a multi-year research project being conducted by EPA and the Centers for Disease Control and Prevention (CDC). The first phase of the project assessed the new method in the Great Lakes. The next phase will collect and analyze similar data at ocean beaches.

"This research provides a new DNA-based tool that can be used by Great Lakes beach managers to test the water quality in the morning and make same-day decisions on beach warnings or closing—often before people even go into the water to swim," said George Gray, assistant administrator for the Office of Research and Development. "This tool is an excellent real-world example of how EPA is working to protect the health of people. We can provide them with useful, practical information with which to make decisions that affect their lives and health."

Approximately 89 million Americans enjoy swimming in recreational waters each year. If the water is contaminated with bacteria or other pathogens from sewage, it can lead to unwanted health effects, causing gastrointestinal, respiratory, eye, and ear illnesses. This study shows a strong link between the health of swimmers and sewage-derived bacteria that was identified using the new technology.

The research used DNA analysis to quantify two types of bacteria, enterococci and bacteroides, in the water at two beaches on Lake Michigan and Lake Erie. The results of the water quality tests were then correlated to targeted health surveys by interviewing swimmers as they left the beach, and again by telephone 10 to 12 days after their beach visit. For more information on the study, visit the NEEAR Web site at www.epa.gov/NEEAR.

Study Shows Parking-Lot Sealcoat to be a Major Source of PAHs

Coal-tar based sealcoat—the black, shiny emulsion painted or sprayed on asphalt pavement such as parking lots—has extremely elevated concentrations of polycyclic aromatic hydrocarbons (PAHs) and can affect the quality of downstream water resources, according to a recent joint study in Texas by the U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program and the City of Austin. PAHs are an environmental concern because they are toxic to aquatic life and because several are suspected human carcinogens. Small particles of PAH-filled sealcoat flake off as the asphalt is subjected to the friction of moving vehicle tires—these particles can wash into urban streams with rain and runoff.

Study Shows Parking-Lot Sealcoat to be a Major Source of PAHs (continued)

The study found that particles in runoff from coal-tar based sealcoated parking lots have PAH concentrations that are about 65 times higher than in particles washed off parking lots that have not been sealcoated. Particles in runoff from parking lots sealed with asphalt-based sealcoat, the other major product on the market, have PAH concentrations about 10 times higher than those from unsealed lots. These large PAH concentrations suggest that small particles of either type of sealcoat can be a potentially dominant (and heretofore unrecognized) source of PAHs in urban and suburban water bodies. PAH concentrations have been increasing over the past three decades in many urban and suburban lakes across the United States.

More information is available at http://water.usgs.gov/nawqa/asphalt_sealers.html. Project information and data are available at http://pubs.usgs.gov/of/2004/1208. An article by Mahler, B.J. and others, "Parking lot sealcoat: an unrecognized source of urban PAHs," was published in the August 1, 2005 issue of Environmental Science & Technology (ES&T). This article describes the project and its potential nationwide ramifications. The abstract of the ES&T article is available on-line at http://pubs.acs.org/cgi-bin/abstract.cgi/esthag/asap/abs/es0501565.html.

Software Spotlight

CADDIS: Helping Scientists Identify the Causes of Biological Impairments

EPA recently released CADDIS, the Causal Analysis/Diagnosis Decision Information System. This online system (www.epa.gov/caddis) uses a step-by-step guide with worksheets and examples to help scientists and engineers find, organize, share, and use environmental information to evaluate causes of biological effects observed in aquatic systems such as streams, lakes, and estuaries.

Caddisflies are aquatic insects that are used by biologists to monitor the environmental quality of streams. This image of a caddisfly larva in its case was chosen as the logo for CADDIS.

Why Was the Program Needed?

More than 1,000 waterbodies in the United States are listed by states as biologically impaired. For many of these, the cause of the impairment is reported as "unknown." Before scientists can develop an appropriate management action, they must determine the cause of the biological impairment (see box). Defensible causal analyses require knowledge of the mechanisms, symptoms, and stressor-response relationships for various specific stressors, as well as the ability to use that knowledge to draw appropriate

Stressors that Can Potentially Cause Biological Impairment

- Dissolved oxygen (DO) regime alteration
- Hydrologic regime alteration (includes flow or depth conditions; timing, duration, frequency, etc.)
- Nutrient regime alteration
- Organic-matter regime alteration
- pH regime alteration
- Salinity regime alteration
- Bed sediment load changes, including siltation
- Suspended solids and/or turbidity alteration
- Water temperature regime alteration
- Habitat destruction
- Habitat fragmentation (e.g., barriers to movement, exclusion from habitat)
- Physical crushing and trampling
- Toxic substances
- Interspecies competition
- Complications due to small, isolated populations (e.g., inbreeding, increased vulnerability to environmental changes)
- Genetic alteration (e.g., hybridization)
- Overharvesting or legal, intentional collecting or killing
- Parasitism
- Predation
- Poaching, vandalism, harassment, or indiscriminate killing
- Unintentional capture or killing (e.g., artillery explosions, roadway casualties)
- Vertebrate animal damage control (includes trapping, shooting, poisoning)
- Radiation exposure increase (e.g., increased UV radiation)

conclusions. CADDIS provides a standardized and easily accessible system to help scientists determine the causes of aquatic impairment.

Program Structure

CADDIS is based on EPA's 2000 Stressor Identification (SI) Guidance document (available at www.epa.gov/ost/biocriteria/stressors/stressorid.html), which provides (1) a formal and rigorous process to identify stressors causing biological impairments in aquatic ecosystems, and (2) a structure for organizing the scientific evidence supporting the conclusions. Susan Cormier, with EPA's Office of Research and Development, explained that EPA created CADDIS to fill a growing need in the community. "States used the SI Guidance document a lot, and began to ask for an easier, more accessible version that incorporated the latest information available. Our online CADDIS platform allows us to provide that and more." The online application incorporates updates, clarifications, and additional material developed since the document was published in 2000.

Current features of CADDIS include:

- A step-by-step guide to conducting a causal analysis (see Figure 12);
- Worksheets and example case studies available for download;
- A library of conceptual models; and
- Information sources, including related links, a reference section, glossary, and an acronym list.

Lee Dunbar, of Connecticut's Department of Environmental Protection, is enthusiastic about CADDIS. "I see this as a place for scientists involved in the SI process to continue to learn from one another and share ideas as we move forward with this relatively young science. In particular, the tools provided by CADDIS, such as generic conceptual models and a database of case studies, will facilitate information exchange."

In the future, EPA plans to update CADDIS to include modules on deriving empirical stressor-response relationships; stressor-specific tolerance values; and databases and syntheses of relevant literature on sediments and toxic metals. Future versions will be developed incrementally and iteratively. EPA invites the public's input on the system, as this feedback will be essential to the system's success.

Figure 12. Each step of CADDIS guides users through three tabs: an "overview," an "in-depth look," and "results and next steps." Examples of the first two tabs are featured here.

CADDIS: Helping Scientists Identify the Causes of Biological Impairments (continued)

[For more information, contact the CADDIS team at caddis@epa.gov. Alternatively, you may contact the Technical Information Staff of the National Center for Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency, 1200 Pennsylvania Ave NW, Washington, DC 20460. Phone: 202-564-3217 during normal work hours and they will direct your call. CADDIS can be accessed at www.epa.gov/caddis]

Looking for StreamStats?

Streamflow statistics, such as the 100-year flood and the 7-day, 10-year low flow, are needed for water resources planning and management; for design of bridges, culverts, and flood-control structures; and for many other purposes. In addition, researchers, planners, regulators, and others often need to know the physical and climatic characteristics of the drainage basins upstream from locations of interest to help them understand the mechanisms that control water availability and water quality at these locations. Now, a tool is available from the U.S. Geological Survey (USGS) that makes this information much more accessible for some. StreamStats is a map-based Web application (http://water.usgs.gov/osw/streamstats) that makes it easy for the public to obtain streamflow statistics, basin characteristics, and other information for user-selected USGS data-collection stations and ungauged sites of interest (see Figure 13).

If a user selects the location of a data-collection station, StreamStats will provide previously published information for the station from a database. If a user selects a location where no data are available (an ungauged site), StreamStats will run a Geographic Information System (GIS) program to measure basin characteristics and estimate streamflow statistics for the site. These estimates assume that natural flow conditions exist at the ungauged site. In the past, it could take an experienced person with access to USGS data more than a day to determine the estimates. StreamStats reduces the effort to only a few minutes.

StreamStats was developed cooperatively by the USGS and the Environmental Systems Research Institute, Inc., and was designed for national implementation over the long-term. Interactive maps of four states are currently available: Washington, Idaho, Vermont, and Pennsylvania. Implementation is underway in a number of other states. Please see http://water.usgs.gov/osw/streamstats/ssonline.html for an updated list. To access the available interactive maps, select the state of your choice under "State Applications."

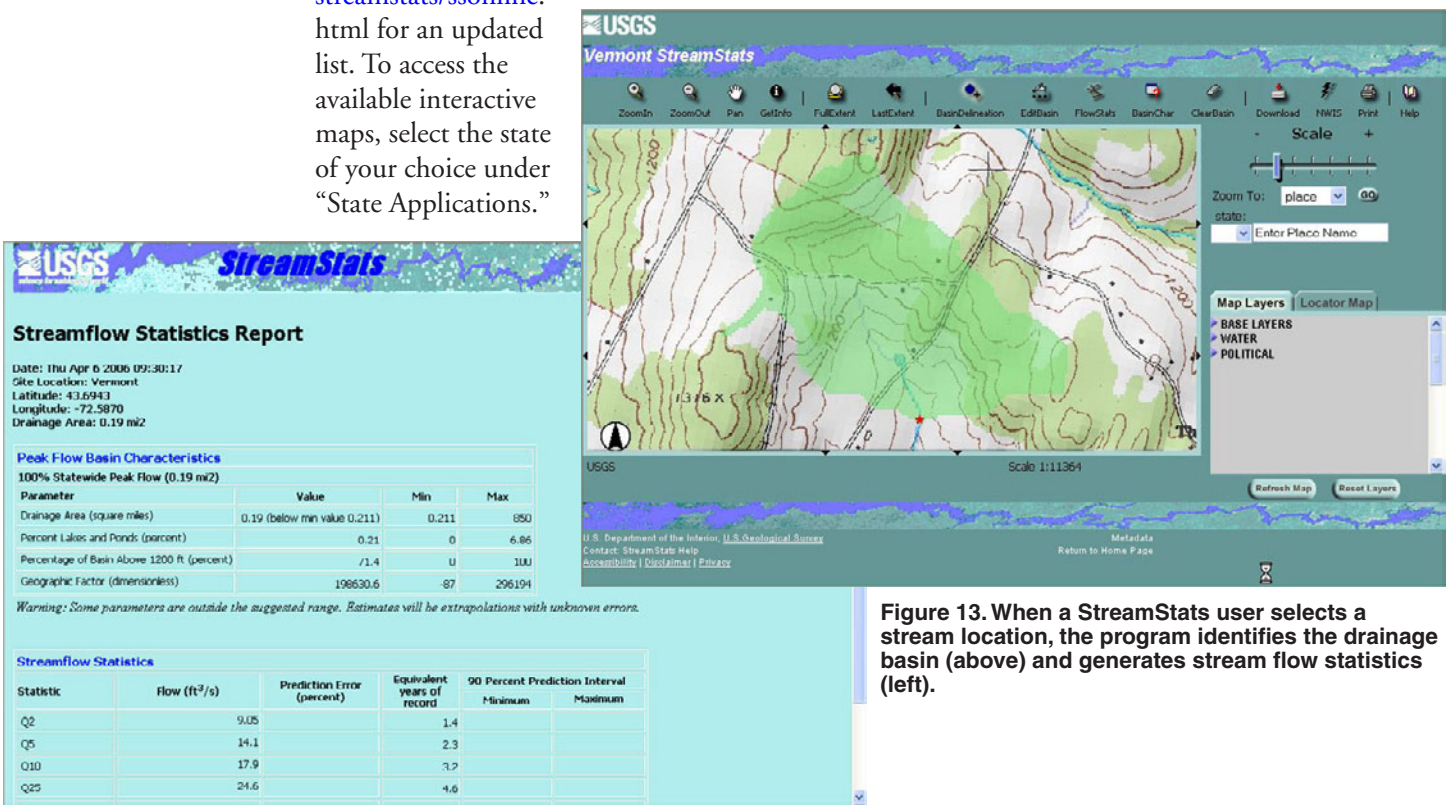

Figure 13. When a StreamStats user selects a stream location, the program identifies the drainage basin (above) and generates stream flow statistics (left).

Looking for StreamStats? (continued)

The application consists of five major components: (1) a user interface that displays maps and allows users to select stream locations where they want streamflow statistics information, (2) a database that contains previously published streamflow statistics and descriptive information for USGS data-collection stations, (3) an automated GIS process that determines drainage boundaries for user-selected ungauged sites and measures the basin characteristics for those sites, (4) a GIS database that stores base-map data needed for users to locate sites of interest and other map data needed for measuring basin characteristics, and (5) an automated process that takes the measured basin characteristics for ungauged sites as input, solves regression equations to estimate various streamflow statistics, and outputs the estimates for display to the user in a Web browser window.

[For more information, contact the StreamStats Team at GS-W_Streamstats@usgs.gov, or Kernell Ries, Project Manager, by phone at 410-238-4317 or by e-mail at kries@usgs.gov.]

Reviews and Announcements

Book Explores Balancing Economic Gains and Environmental Quality in Agriculture

The Soil and Water Conservation Society recently released *The Farmer's Decision: Balancing Economic Successful Agriculture Production with Environmental Quality*, to help agricultural producers or landowners who desire to balance economic gain and environmental quality. The discussions represent an international view and are a blend of field- and watershed-scale observations and research. The book is available for $46 ($35 plus $11 shipping/handling). For more information, see http://swcs.org/en/publications/books/the_farmers_decision.cfm.

Booklets Allow Kids to Discover Stormwater

A group of stormwater managers, educators, and experts collaborated to develop *KIDS: Discover Stormwater*, a 16-page Kids In Discovery Series (KIDS) booklet produced by Project Wet. Developed for students in grades three through seven, the booklet is used by stormwater and NPS pollution managers, teachers, urban educators, nature centers, and more. Using the information in the booklet, students try to imagine what their town would be like without storm drains. They can calculate runoff on permeable and impermeable surfaces, follow the maze of point and nonpoint source pollution, and apply best management practices. Booklets are sold in packs of 30 for $30. For more information on this and others in this series, see http://store.projectwet.org.

Edens Lost & Found—Coming to a PBS Station Near You

A new four-hour PBS documentary series titled "Edens Lost & Found" is scheduled to go on the air this spring. The series highlights practical solutions and models for urban transformation that go beyond pollution prevention to tackle the challenge of improving the quality of life in cities now and in the future. For example, the series showcases strategies that contribute to a sustainable ecosystem, including open space and public parks, urban forestry, watershed management, public art, integrated waste management (disposal and recycling), green architecture, environmental justice, neighborhood development, and mass transit alternatives. Focusing on Chicago, Los Angeles, Philadelphia and Seattle, the series shows how integrated resource planning, combined with local community support, can yield innovative ideas. The first show, airing on May 18th at 10 pm, will highlight "Chicago: The City of Big Shoulders." The series continues the following week with "Philadelphia: The Holy Experiment" on May 25th (check local listings for time). The series will resume in fall 2006 with programs that feature Los Angeles and Seattle. A second season is planned to highlight cities in China, Europe, and/or Latin America, and other U.S. cities, including New Orleans and the Gulf Coast. For more information, see www.edenslostandfound.org.

ERS Reviews Flexible Conservation Measures on Working Land

In the 2002 Farm Bill, Congress sharply increased conservation funding and allotted most of the increase to working-land payment programs. A new USDA Economic Research Service (ERS) report,

Flexible Conservation Measures on Working Land (ERR-5), explores the implications of program design on the extent to which environmental goals are cost-effectively achieved. To illustrate tradeoffs that policymakers may face in selecting one design over another, the authors used simulation analysis to estimate potential environmental gains and adjustments in agricultural production, price, and income for various working land payment program designs. Results suggest that allowing farmers to bid for financial assistance and selecting participants based on a ranking of farmers' bids using benefit-cost criteria can substantially increase the level of environmental gain achieved from a given program budget. Payments that reward producers who are already good stewards may divert funds from achieving new environmental benefits, but may also encourage stronger maintenance of conservation effort and yield long-term benefits. The document is available at www.ers.usda.gov/publications/err5.

Free Land Conservation/Water Protection CD-ROM Available

The International City/County Management Association and the Trust for Public Land, in cooperation with the U.S. EPA, hosted a webcast in June 2005 called *Protecting Water Resources through Land Conservation: Funding Options for Local Governments*. The webcast provided context for the role of conservation finance in land conservation, described critical components for creating a successful funding effort, and showcased local government success stories. Attendees gained an understanding of current conservation finance trends; revenue sources being used by local governments; voter opinions on water protection; and the importance of good measure design in funding campaigns. The Local Government Environmental Assistance Network (LGEAN) is now offering a free CD-ROM that contains the webcast materials. The CD-ROM includes a Windows Media audio/video recording of the original webcast, each individual PowerPoint presentation, several fact sheets on various land conservation and water protection topics, and Web links outlining the benefits of these efforts. To order a copy of the CD-ROM, contact LGEAN at 877/TO-LGEAN or lgean@icma.org. For more information, see www.lgean.org/html/whatsnew.cfm?id=961.

Groundswell: Stories of Saving Places, Finding Community

This 208-page book by Alix Hopkin celebrates the role of land conservation in preserving community character and connecting people to the land and to each other. The book profiles six conservation efforts, including a Bronx River restoration project, a community-supported agriculture project in Wisconsin, a countywide coastal economic development initiative in rural North Carolina, Portland Trails in Maine, Canyon Lake Creek Community Forest in Washington State, and the Montana-based Rocky Mountain Front Advisory Committee. Groundswell is available from Chelsea Green publishing for $20. For more information, see www.chelseagreen.com/2005/items/groundswell.

IFC Releases Instream Flows for Riverine Resource Stewardship

The Instream Flow Council (IFC) recently released the revised edition of *Instream Flows for Riverine Resource Stewardship*. The IFC is an organization comprised of instream flow professionals from state and provincial fish and wildlife agencies, working to improve the effectiveness of instream flow programs for conserving aquatic resources. Authored by 16 instream flow specialists from these agencies in the United States and Canada, this book provides a detailed description of riverine ecosystem management concepts and strategies for aquatic resource managers and others involved in the determination of instream flow needs and water management. The 268-page book may be purchased via the IFC Web site (www.instreamflowcouncil.org) or by calling 800-247-2553 (Cost: $85 + $8.75 shipping and handling).

Michigan Stormwater Study Offers Insight

A new study by American Rivers and the Public Interest Research Group in Michigan (PIRGIM) found that one quarter of Michigan's watersheds are at risk due to contaminated stormwater runoff. The dominant cause of this runoff is Michigan's burgeoning urban sprawl. The report, *Waterways at Risk: How Low-Impact Development Can Reduce Runoff Pollution in Michigan*, combines new land

use data (impervious surface area) and sprawl data (new building permits), and makes a statewide assessment of the health of watersheds. The trends are staggering: Michigan is predicted to add over 4 million acres of new development by 2040, nearly tripling the amount of developed land. More developed land means poorer water quality because of the increase in polluted stormwater runoff that paving natural areas brings. PIRGIM and American Rivers recommend that all municipalities struggling with polluted stormwater runoff consider establishing low-impact development and smart growth policies, including 'no net runoff' standards for new development. The report is available at www.pirgim.org/reports/waterwaysatrisk.pdf.

Microbial Source Tracking Guide Now Available

USEPA recently released the draft *Microbial Source Tracking Guide* (EPA/600-R-05-064, June 2005) to provide insight into various tools and approaches currently used to track sources of fecal contamination impacting water quality in streams, rivers, lakes, and marine beaches. The document includes a comprehensive review of the literature and, in some cases, provides a critical view of the state of the science and current research gaps in microbial source tracking. A copy of the draft guide is available online at www.epa.gov/ORD/NRMRL/pubs/600r05064/600r05064.htm. For more information, contact Jorge W. Santo Domingo, USEPA, 26 W. Martin Luther King Dr., MS 387, Cincinnati, OH 45268. Phone: 513-569-7085; E-mail: santodomingo.jorge@epa.gov.

Porous Pavement Reference Book Released

The 600-page book *Porous Pavements (Integrative Studies in Water Management and Land Development Series),* by University of Georgia professor Bruce K. Ferguson, provides practical expertise and a theoretical basis for site-specific selection and application of porous pavements. The book addresses all nine families of porous pavement materials in a single reference: porous aggregate, porous turf, plastic geocells, open-jointed blocks, open-celled grids, porous concrete, porous asphalt, "soft" pavement materials, and decks. The book complements basic training in site design, site drainage, construction materials, and horticulture with the special concepts involved in using porous pavement materials. The book (February 2005—ISBN: 0849326702) is available for $159 from the publisher, CRC Press (www.crcpress.com; type "porous pavements" into the site's search window), and through many other online booksellers.

Report Examines Biodiversity Values of the Nation's Geographically Isolated Wetlands

NatureServe, a non-profit conservation organization, recently released a report titled *Biodiversity Values of Geographically Isolated Wetlands in the United States* (available at www.natureserve.org/publications/isolatedwetlands.jsp). The report explains the results of an EPA-funded study that assessed the potential biological diversity impacts of a 2001 Supreme Court decision to remove some "geographically isolated" wetlands from under the protection of the Clean Water Act. The study found that isolated wetland ecological systems support high levels of biodiversity, including significant numbers of at-risk species and communities. The information and analyses contained in this study are designed to help federal, state, and local policy-makers and land managers better understand the biodiversity value of isolated wetlands and to plan for their conservation.

Rivertrek: Teaching Rural Students about their Local Rivers

The Chattanooga Star riverboat offers rural students from Pennsylvania to Florida a unique opportunity—an educational ride on a historic paddlewheel boat. RiverTrek, Inc., a non-profit educational organization, uses the riverboat as a floating classroom, teaching students and the public about water resources, sustainable economic and environmental management of our waterways, and the importance of the American Inland Waterway System. The boat travels on the Mississippi River, Ohio River, Tennessee River, Tennessee-Tombigbee Waterway, the Apalachicola/Chattahoochee/Flint River System, and the Escambia River, visiting mostly rural areas that have rarely or never had a riverboat visit. "Rivertrek is a continuing, remarkable journey and, to our knowledge, unique," explains Captain Pete Hosemann. "In 200 years of riverboat history in our

country, no other passenger boat has ever taken a continuing journey with the primary purpose of educational tours." For more information, see www.rivertrek.org.

Rocky Mountain Ranchers Have New Conservation Guide

The American Farmland Trust and Coleman Natural Foods recently released the *Rocky Mountain Agricultural Landowners Guide*, designed to help ranchers and farmers in seven states in the western United States (Arizona, Colorado, Idaho, Montana, New Mexico, Utah and Wyoming) augment both the productivity and stewardship of their land. The guide provides an overview of the variety of private options and public programs that are available to landowners who want to conserve their land and use innovative and sustainable practices to support the long-term environmental health and the economic viability of ranches. The document is available for download at www.farmlandinfo.org/documents/30427/FINAL_Rocky_Mountain_Guide.pdf. Print copies are available by calling 800-370-4879 (a nominal fee might be charged for shipping).

Should Water Law Control Land Use?

The Environmental Law Institute (ELI) recently released a new book, *Wet Growth: Should Water Law Control Land Use?*, as a means to disseminate new ideas about the land/water interface in law and policy. The authors provide an overview of the relevant issues, current trends toward integrating land and water controls, and prospects for further progress. The book describes the nature and costs of our currently fragmented management of land and water resources, explains how this results in unsustainable practices, and suggests principles to help guide and direct our response to these problems. The book can be ordered directly from the ELI Web site at www.elistore.org/books.asp at a cost of $38.25 for members and $44.95 for non-members.

Stormwater Webcasts

EPA is launching a new series of webcast training sessions for municipal stormwater managers. Designed for those unable to attend out-of-town or multi-day workshops, this series will provide a mix of basic and advanced topics in two-hour blocks. These webcasts will allow participants to listen to lectures and see presentations through their computers. Webcasts will be scheduled approximately every other month from now until September. Future webcast topics include: Construction 101 (early May), Stormwater Utilities (mid-July), and Illicit Discharge Detection and Elimination 101: Program Development (mid-September). For more information, or to register for a webcast, see www.epa.gov/npdes/training. If you need assistance with registration, please call Adrianna Berk, Tetra Tech, Inc., at adrianna.berk@tetratech-ffx.com or 703-385-6000.

Updated Practical Guide to Environmental Management Available

The Environmental Law Institute recently released the 10th edition of the *Practical Guide to Environmental Management* (PGEM), by Frank Friedman. The latest edition of PGEM offers new material on social responsibility, the Sarbanes-Oxley Act, risk management, and sustainability. For more information, and to order a copy (retail $59.95), see www.elistore.org/books_detail.asp?ID=11123.

Wetland Webcasts

The Izaak Walton League recently launched a series of educational webcasts. The first of two series, Backyard Wetland Conservation, focuses on identifying and protecting wetlands in your backyard (series one webcasts were held on March 28 and April 25). The second series, Alternative Practices for Highway Stormwater Management, includes four parts that will outline the latest techniques available to help transportation agencies save money, comply with water quality and water supply regulations, and improve water quality with context-sensitive stormwater management practices, including low-impact development techniques. Series two webcasts are scheduled to air between May and October. For more information, see www.iwla.org/index.php?id=169.

WhAEM2000 Software Aids in Source Water Protection

EPA recently released a report describing how a free software package was used to help protect groundwater supplies. The report, *Working with WhAEM2000 - Capture Zone Delineation for a City Wellfield in a Valley Fill Glacial Outwash Aquifer Supporting Wellhead Protection*, introduces the use of the groundwater geohydrology computer program WhAEM2000. WhAEM2000 is a public domain, groundwater flow model designed to facilitate capture zone delineation and protection area mapping in support of states' and tribes' Wellhead Protection Programs (WHPP) and Source Water Assessment Planning (SWAP) for public water well supplies in the United States. For a copy of the 85-page report, see www.epa.gov/athens/publications (select "2005 publications," scroll down to "Kramer," and click on highlighted link to the report). The EPA Center for Exposure Assessment Modeling provides a free download of the WHAEM2000 software and offers free support for the program in the form of online help, tutorials, install scripts, and base maps on its Web site at www.epa.gov/athens/software/whaem.

Recent and Relevant Periodical Articles

Environmental Credit Trading: Can Farming Benefit?

By Marc Ribaudo, Robert Johansson, and Carol Jones (www.ers.usda.gov/AmberWaves/February06/Features). This article, printed in the February 2006 issue of the USDA Economic Research Service's newsletter *Amber Waves*, explores the use of environmental credit trading as an alternative to command-and-control regulations. Environmental credit trading allows regulated firms to meet their obligations by purchasing pollution abatement services (credits) from lower-cost providers, such as farmers. The article describes the benefits and challenges associated with environmental credit trading by farmers, and explores the steps underway by the USDA to encourage farmer participation in trading programs.

Eradicating Straight Pipes and Failed Systems in Kentucky

By Caigan McKenzie (www.nesc.wvu.edu/nsfc/Articles/SFQ/SFQ_su05/Straight%20Pipes_s05.pdf). This article, printed in the Summer 2005 edition of the National Small Flow Clearinghouse's *Small Flows Quarterly* newsletter, describes a Clean Water Act Section 319 project undertaken to reduce sewage-related water pollution in southeastern Kentucky's Estill County. The article explores local partners' efforts to obtain funding, educate homeowners, install septic systems, and perform water quality monitoring. The success of this project has led to similar projects being funded and implemented in other nearby Kentucky counties.

Pollutant Trading to Improve Riparian Habitats

By Curtis J. Sparks and Scott D. Wallace (www.stormh2o.com/sw_0601_pollutant.html). This article, printed in the January/February 2006 issue of *Stormwater*, describes a cooperative effort by Rahr Malting Company, the Minnesota Pollution Control Agency, local environmental groups, and other stakeholders to establish a program that resulted in one of the first watershed pollutant trading permits in the nation. The multi-pollutant Rahr permit was extremely successful—it resulted in the completion of four riparian restoration projects that yielded 30 percent more trading credits than the permit required. According to the article, pollutant trading, as carried out under the Rahr permit, demonstrated that reduction of nonpoint sources of pollutants was highly cost-effective when compared to control of conventional point sources.

Today's TMDLs: An update on the total maximum daily load program after years of debate and changes.

By Bill Tice (www.stormh2o.com/sw_0511_today.html). This article, printed in the November/December 2005 issue of *Stormwater*, provides historical and background information about the

total maximum daily load (TMDL) program and describes the challenges and successes faced by those applying the program across the country.

Web Sites Worth a Bookmark

CWP Wetlands Web Site (www.cwp.org/wetlands/index.htm)

This Web site, developed by The Center for Watershed Protection (CWP), offers a variety of tools to help protect wetlands. Features include the "Wetlands & Watersheds Article Series" (co-developed with the USEPA), wetland slideshows, wetland Web resources, a wetland research bibliography, calendar of upcoming wetland-related events, and a wetlands primer.

Nonpoint Source Kids Page (www.epa.gov/kids)

The U.S. EPA Office of Water maintains a Web site with a variety of nonpoint source-related educational activities and interactive games geared towards children of many ages.

Southeast Watershed Assistance Network (www.watershed-assistance.net)

The Southeast Watershed Forum's Southeast Watershed Assistance Network (SWAN) is a Web-based resource for transferring innovative technical tools for watershed protection, restoration, and management throughout the southeastern United States. The site offers information about and examples of model watershed programs, land use codes and ordinances, and watershed training tools.

Watershed Funding (www.epa.gov/owow/funding.html)

EPA's Sustainable Finance Team within the Office of Wetlands, Oceans and Watersheds just launched a new "Watershed Funding" Web site. The pages contain links to tools, databases, and resources about grants, funding, and fundraising. The Web site is designed to help nonprofit watershed organizations, state and local governments, and funders (e.g., foundations) home in on the most appropriate financial resources for improving watershed health.

Watershed Webcasts (www.epa.gov/watershedwebcasts)

EPA's Watershed Academy sponsors a series of free, online webcast seminars addressing issues related to nonpoint source pollution and watershed protection. Interested individuals may either register for an upcoming live webcast or download audio, PDF, or PowerPoint versions of past webcasts.

Calendar

May 2006

14-17	*5th Natural Resource Extension Professionals Conference*, Park City, UT. For more information, see www.anrep2006.org.
15-19	*Essential Elements for Successful Watershed Planning*, Fayetteville, Arkansas. For more information, see www.watershedconservation.org/mswtp.htm.
16-18	*EPA Science Forum 2006: Your Health, Your Environment, Your Future*, Washington, D.C. For more information, see www.epa.gov/scienceforum.
18	*Webcast: Introduction to Alternative Practices to Manage Highway Runoff*. For more information, see www.iwla.org/index.php?id=169 (Scroll down to the detailed information about this series to register for these free programs.)
21-24	*Challenges in Coastal Hydrology and Water Quality*, Baton Rouge, LA. For more information, see www.aihydro.org/conference.htm.
21-25	*World Environmental and Water Resources Congress*, Omaha, NE. For more information, see www.asce.org/conferences/ewri2006.

22-24 *New England Interstate Water Pollution Control Commission's 17th Annual Nonpoint Source Pollution Conference*, Burlington, Vermont. For more information, see www.neiwpcc.org/npsconference.

22-25 *2nd National Water Quality Trading Conference: Implementation at the Watershed Scale*, Pittsburgh, PA. May 22 is a one-day, pre-conference workshop called "Trading Basics." For more information, see www.epa.gov/npdes/training.

June 2006

6-8 *The Ecology and Management of Atlantic White Cedar Ecosystems*, Atlantic City, NJ. For more information, see www.wetlandsworkgroup.org.

9-11 *2006 Northeast Land Trust Conference: Farms, Fields & Forests: Building Community Conservation*, Saratoga Springs, NY. For more information, see www.lta.org/training/lct_ne.htm#neconference.

11-15 *American Water Works Association 2006 Annual Conference and Exposition*, San Antonio, TX. For more information, see http://awwa.org/ace06/.

11-16 *Floodplain Management Crossroads: Where Route 66 Meets the Rio Grande*, Albuquerque, NM. For more information, see www.floods.org.

14-16 *Stream Restoration and Protection in the Mid-Atlantic Region*, Branchville, NJ. For more information, see www.awra.org/state/new_jersey/mac2006.

15 *Webcast: Planning Highway Projects Using Alternative Practices for Stormwater Management*. For more information, see http://www.iwla.org/index.php?id=169 (Scroll down to the detailed information about this series to register for these free programs.)

25-28 *International Conference on Rivers and Civilization: Multidisciplinary Perspectives on Major River Basins*, La Crosse, WI. For more information, see www.rivers2006.org.

25-30 *Biogeomon 2006 -5th International Symposium on Ecosystem Behavior,* Santa Cruz, CA. For information, see www3.villanova.edu/conferences/biogeomon2006/.

26-28 *Adaptive Management of Water Resources*, Missoula, Montana. For information, see www.awra.org/meetings/Montana2006.

July 2006

9-15 *8th World Congress of Soil Science*, Philadelphia, Pennsylvania. For more information, see www.colostate.edu/programs/IUSS/18wcss/.

22-26 *Soil and Water Conservation Society Annual Conference*, Keystone, CO. For more information, see www.swcs.org.

23-26 *8th International Conference on Precision Agriculture*, Minneapolis, MN. For more information, see http://www.precision.agri.umn.edu/Conference/.

August 2006

2-4 *2006 Annual Southeast Watershed Roundtable and North Carolina Statewide Roundtable*, Asheville, NC. For more information, see www.bae.ncsu.edu/programs/extension/wqg/roundtable/.

6-9 *International Conference on the Future of Agriculture: Science, Stewardship, and Sustainability*, Sacramento, CA. For more information, see www.dce.ksu.edu/dce/conf/ag&environment/.

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Do you have an article or idea to share? Want to ask a question or need more information? Please contact NPS News-Notes, c/o Carol Forshee, by mail at U.S. EPA, Mail Code 4503-T, 1200 Pennsylvania Ave., NW, Washington, DC 20460, by phone at 202-566-1208, or by e-mail at forshee.carol@epa.gov.

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