Nonpoint Source
News-Notes
January 2007, #80

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

Special Focus Issue: Clean Water Act Section 319 Program Successes

Editor's Note

Congress amended the Clean Water Act (CWA) in 1987 to establish the section 319 Nonpoint Source Management Program. Under section 319, states, territories, and Indian tribes receive grant money which supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and monitoring to assess the success of specific nonpoint source implementation projects. This section highlights just a few of the many section 319 success stories achieved to date.

In August 2005, the U.S. Environmental Protection Agency (EPA) launched a new Section 319 Nonpoint Source Success Stories Web site to document the achievements of projects funded under section 319 of the CWA (www.epa.gov/nps/success). The Web site features projects receiving grant funds from the section 319 Nonpoint Source Program that have achieved documented water quality improvements, including the achievement of water quality standards and removal from state section 303(d) lists of impaired waters.

If you have a nonpoint source success story that has resulted in full or partial restoration of an impaired water body, EPA would like to hear from you. Please contact Andrea Matzke at matzke.andrea@epa.gov or by phone at 202-566-1150.

This floating classroom lures visitors with ice cream. See box on page 4.

Inside this Issue

Maine Cheers Cobbossee Achievement

Maine is celebrating the imminent removal of popular Lake Cobboseecontee from the state's list of impaired waters. Called Cobbosee Lake for short, the 5,238-acre lake has suffered since the 1960s from nuisance algae blooms attributed to high phosphorus levels. In 1971, the Maine legislature authorized the formation of the Cobbossee Watershed District (CWD) to work to reduce pollution from poor agricultural practices, residential development, straight pipes, and road runoff throughout the watershed. Funding came from section 319 and other sources. The clean-up effort took time, but it worked. No algae blooms have occurred in the lake for the past nine years. In June 2006, after almost 35 years, the Maine Department of Environmental Protection (DEP) declared that Cobbossee Lake's water clarity has improved enough to allow the lake to be removed from the state's list of impaired waters.

Background

Cobbossee Lake is located in south-central Maine, approximately five miles west of Augusta, the state capital. It is one of Maine's premier bass fishing lakes and serves as a secondary source of drinking water for the City of Augusta. Cobbossee Lake receives drainage from an immediate 32-square mile watershed, as well as from the upper portion of the larger 217-square mile Cobbosseecontee Stream watershed. The stream ultimately discharges to the Kennebec River.

Prior to the 1960s, the lake was well oxygenated and clear, and once supported coldwater fish species, including salmon. Annabessacook Lake, immediately upstream of Cobbossee Lake, received municipal sewage discharges from the Town of Winthrop, resulting in excessive nutrient (phosphorus in particular) loading which promoted noxious blooms of blue-green algae. By the 1960s, water quality in Cobbossee Lake began to suffer dramatically as a result of a combination of inputs from Annabessacook and other upstream lakes, and from nonpoint source (NPS) runoff from Cobbossee Lake's own direct watershed. Primary sources of NPS included stormwater runoff from residential and commercial development, soil erosion, and runoff from agricultural lands. As a result, elevated phosphorus levels led to algae blooms that formed green surface scums, reduced water clarity, and depleted oxygen in the bottom waters of the lake.

By 1971, concerns over dramatically fluctuating water levels and poor water quality prompted the Maine legislature to authorize the formation of the Cobbossee Watershed District (CWD). The CWD is tasked with protecting, improving, and managing 28 lakes, ponds, and streams within the 217-square mile Cobbossee watershed. The CWD is financially supported by eight member municipalities and is overseen by a board of trustees that represents the municipalities and a utilities district. "The CWD is unique—it is the only watershed district in Maine supported financially by its member towns for the sole purpose of protecting lake water quality," explains Christine Smith, Lakes Education Coordinator with the Maine DEP. CWD quickly became a nationally recognized model of regional and local cooperation.

A Long-Term Effort

Since its formation, CWD has facilitated extensive and diverse restoration work throughout the watershed. CWD worked with community volunteers, helped municipalities to create thoughtful land use controls, and garnered support from lakeside landowners, municipalities, and the community as a whole. Since the mid-1970s, CWD has applied for and received more than $2 million in grant funds to support diagnostic surveys, restoration, and demonstration and protection projects throughout the Cobbossee watershed.

In the mid- to late-1970s, CWD relied on EPA Clean Lakes Program (e.g., Clean Water Act section 314) funds and USDA Farm Bill program funds to help farmers reduce polluted runoff by improving manure management and storage on 31 dairy farms in the Cobbossee Lake watershed. At that time, approximately 55 percent of the annual phosphorus load to Cobbossee Lake was from Annabessacook Lake, located just upstream. By 1977, point sources of sewage into Annabessacook Lake were eliminated. Despite this advance, algae blooms persisted in Cobbossee Lake because of

Maine Cheers Cobbossee Achievement (continued)

internal phosphorus recycling from Annabessacook Lake sediments, and excessive phosphorus from nonpoint sources in the Cobbossee Lake watershed. In 1978, CWD conducted an alum treatment in Annabessacook Lake that greatly reduced the release of phosphorus from lake sediments (see box for more information about alum). Continued inputs of phosphorus from upstream areas led the CWD to intensify its work in upstream lakes; for example, in 1986, CWD conducted an alum treatment on Cochnewagon Lake and addressed nonpoint sources of phosphorus in that lake's watershed.

For the next two decades, CWD and its partners implemented diverse projects to further reduce the nonpoint source pollution entering Cobbossee Lake. The CWD has worked with five towns to help them adopt ordinances requiring that new developments be designed to meet strict phosphorus allocation standards for stormwater runoff. The CWD has helped towns and landowners to adopt erosion control best management practices (BMPs) at homes, on town roads, and on private camp roads.

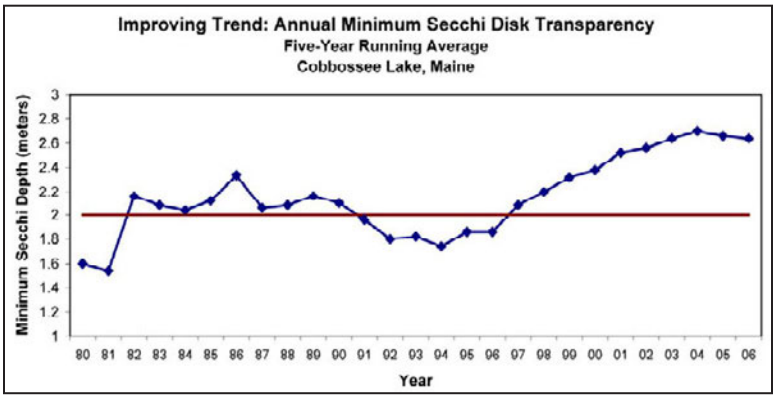
The CWD completed a total maximum daily load (TMDL) assessment for Cobbossee Lake in 1995. This assessment, combined with existing knowledge, helped the CWD to further focus its efforts. For example, from 1995 to 1998, CWD used section 319 money to support a series of demonstration projects showing practical erosion and sediment control BMPs. Then, in 2004, the CWD and its partners completed a five-year section 319-funded watershed project on Jock Stream, a large tributary of Cobbossee Lake. The project partners constructed 45 BMPs at 13 unpaved road sites to reduce erosion and sediment. Farmers implemented nutrient management plans and installed agricultural BMPs. In 2004, CWD documented that Jock stream phosphorus levels were attaining the TMDL load allocation.

What is Alum and How Does it Work?

Alum (aluminum sulfate) is commonly used in drinking water treatment plants to clarify drinking water. In lakes, alum is used to reduce the amount of phosphorus in the water column. Phosphorus enters the water either externally, from runoff or groundwater, or internally, from the nutrient-rich sediments on the bottom of the lake. Phosphorus is released from the sediments under anoxic conditions that occur when the lake stratifies into two thermal layers (a natural annual springtime phenomenon) and oxygen is depleted from the colder lower layer. Even when external sources of phosphorus have been curtailed by best management practices or other means, the internal recycling of phosphorus can continue to support explosive algal growth for many years. Alum is used primarily to control this internal recycling of phosphorus from the sediments of the lake bottom. On contact with water, alum forms a fluffy aluminum hydroxide precipitate called floc. Aluminum hydroxide (the principal ingredient in common antacids such as Maalox) binds with phosphorus to form an aluminum phosphate compound. This compound is insoluble in water under most conditions so the phosphorus in it can no longer be used as food by algae organisms. As the floc slowly settles, some phosphorus is removed from the water. On the bottom of the lake the floc forms a layer that acts as a phosphorus barrier by combining with phosphorus as it is released from the sediments. For more information, see *Alum Treatment to Control Phosphorus in Lakes*, a 2003 fact sheet developed by the Wisconsin Department of Natural Resources, at www.dnr.state.wi.us/org/water/fhp/papers/alum_brochure.pdf.

Clear Again!

This past summer, after nine consecutive years with no algae blooms, the Maine DEP declared that Cobbossee Lake's clarity has rebounded enough to satisfy the state's lake water quality standards. The DEP's functional definition of a nuisance algae bloom is an annual minimum Secchi disc transparency (SDT) of less than 2.0 meters (an algae bloom is declared if the SDT falls below 2.0 meters once during a year). From 1976 to 1996, the average of the annual minimum SDT readings was 2.0 meters—some years fell below the standard while others did not. The last nuisance algae bloom occurred in 1996, when the minimum SDT was 1.8 meters. Since 1997, the annual minimum SDT exceeded Maine's 2.0-meter criterion (see figure). Between 1997 and 2005, the average of the annual minimum SDT was 2.6 meters. Notably, in 2004, the minimum SDT reached 2.8 meters. In 2005, the minimum SDT decreased to 2.4 meters because of unusually heavy rains, but improved to 2.5 meters in 2006.



The five-year running average of the annual minimum secchi disk transparency (SDT) in Cobbossee Lake. For the past decade, note how the annual minimum SDT has consistently been above Maine's nuisance algae bloom threshold of 2.0 meters.

In June 2006, as a result of the transparency improvements, Maine's Governor Baldacci announced that Cobbossee Lake would be the first large lake in Maine

Maine Cheers Cobbossee Achievement (continued)

to be removed from the impaired lake list. The Governor then presented the Maine DEP's Outstanding Achievement Award to the CWD for their decades of hard work and commitment to the rehabilitation effort. The announcement and presentation of the special achievement award coincided with the Annual Governor's Cup Charity Bass Fishing Tournament, with both events taking place at Cobbossee Lake. The tournament pits members of the House of Representatives against members of the Maine Senate, and is popular with the press. The winner receives $1,500 donated to a charity of their choice. This venue was an appropriate setting for the award ceremony, and attracted media attention to the de-listing announcement.

Maine Governor Baldacci (left) and DEP Commissioner Dave Little announce the removal of Cobbossee Lake from the list of impaired waters. To help program attendees appreciate the changes in water quality over time—and to help them understand that the water is not yet totally clean—the Maine DEP placed three plastic columns of water representing the water quality found in Cobbossee Lake in the past, present, and future.

Maintaining Momentum

Media attention is always helpful, acknowledges Bill Monagle, CWD Director. "We have seen measurable improvements in water quality during the past decade in Cobbossee Lake as well as in Annabessacook Lake. One of our biggest challenges will be to keep the public interested and educated about why lake projects need to continue." As with watershed organizations and government agencies nationwide, obtaining adequate funding is always a limiting factor. CWD has been successful in obtaining state and federal grant funding to finance lake and watershed projects and provide added support to hire interns and part-time help during the summer monitoring season. This has allowed the full-time staff to work on project implementation, lake water level management, data analysis, planning, and multi-agency coordination. Fortunately, a nonprofit organization—the Friends of the Cobbossee Watershed—has emerged and is helping to get the

Group Uses Ice Cream to Educate

Ice cream and outreach—an unbeatable combination. The Friends of the Cobbossee Watershed have discovered that a floating ice cream store also provides a great opportunity to reach out and educate the lake-loving public about ways to protect water quality. During the summers, the Friends' 22-foot pontoon boat is a welcome sight on many of the 28 lakes within the Cobbossee Watershed. People easily pick out the OTTER II by either hearing the music playing or catching sight of the many colorful banners fluttering in the summer breezes.

At each stop, the crew sells ice cream to eager children and adults alike. While they do so, they take the opportunity to provide information and guidance to landowners and lake users about what they can do to help combat two of the key problems facing the watershed: nonpoint source pollution and invasive plants.

Each week, the OTTER II is transferred to a different lake and "hosted" by residents who provide dock space and electrical hook-up for the boat's ice cream freezers. Since the ice cream boat program was started four years ago, the OTTER (retired in 2005) and OTTER II have come in contact with tens of thousands of people, enlisted more than 1,000 members, and provided valuable information and advice to thousands more regarding what they can do to help protect the Cobbossee Watershed. For more information, see www.watershedfriends.com/otter.html.

The lure of ice cream draws people to the OTTER II—and they leave with an education about lake protection.

Maine Cheers Cobbossee Achievement (continued)

public excited about lake protection, while CWD continues its valuable watershed management and monitoring work.

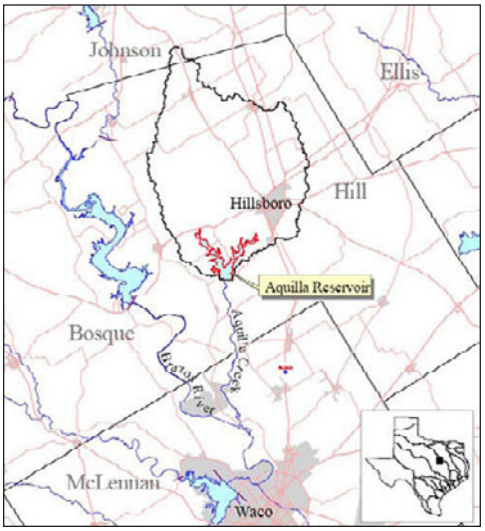
Formed in 2001, the Friends of the Cobbossee Watershed seeks to promote public awareness of water quality issues, educate the public about strategies to protect water quality, and work with students, citizens, agencies, communities, and municipalities to improve the Cobbosee watershed. The group has made headlines through innovative outreach efforts like their pontoon ice cream boat (see box), which doubles as a floating classroom. The group educates people about water quality protection and invasive species control through many outreach avenues. The group also offers restoration services, such as shoreline stabilization and erosion control, for waterfront properties within the Cobbossee Watershed. And people have noticed—membership, which stood at 71 people in 2003, has swelled to more than 5,000 people today. For more information, see www.watershedfriends.com.

Despite the many accomplishments to date, CWD and its partners realize that lake protection efforts must continue with the even more vigilance—not only to protect the investments of the last three decades, but also to address the ongoing pressures to develop and suburbanize the watershed. "We have the technical capability to solve many of the water quality problems," notes Monagle. "We just need to attract and maintain the support of local landowners and municipalities to allow us to implement solutions."

[For more information, contact Christine P. Smith, Lakes Education Coordinator, Maine Department of Environmental Protection, 17 State House Station, Augusta, ME 04333. Phone: 207-287-7734; E-mail: Christine.P.Smith@maine.gov. You may also contact Bill Monagle, Executive Director, Cobbossee Watershed District, P.O. Box 418, Winthrop, ME 04364. Phone: 207-377-2234, E-mail: cwd@fairpoint.net]

Aquilla Reservoir's Rapid Recovery

One Texas drinking water reservoir is again meeting drinking water standards, thanks to the coordinated efforts of diverse stakeholders. In 1997, water samples from Aquilla Reservoir showed high levels of the herbicide atrazine. State, local, and federal agencies quickly joined forces to implement projects that would reduce agricultural atrazine sources—and to a lesser extent, urban sources—in the watershed. As a result of technical assistance to corn and sorghum producers, using agricultural best management practices (BMPs), and educating urban residents, atrazine concentrations in Aquilla Reservoir declined by 60 percent within a couple of years. The waterbody now meets atrazine concentration standards. In 2004, the Texas Commission on Environmental Quality (TCEQ) recommended that Aquilla Reservoir be removed from the state's 303(d) list of impaired waters.



Aquilla reservoir and its watershed.

Background

The U.S. Army Corps of Engineers constructed the 3,280-acre Aquilla Reservoir in 1983 in the Brazos River Basin to provide drinking water, flood control, and recreation. Texas regulations require that water quality in Aquilla Reservoir be suitable for a number of designated uses, including swimming, wading, fishing, drinking (with treatment), and a healthy aquatic system. In 1997, water quality tests revealed that the reservoir exceeded the drinking water standard's maximum contaminant level of 3.0 micrograms per liter of atrazine.

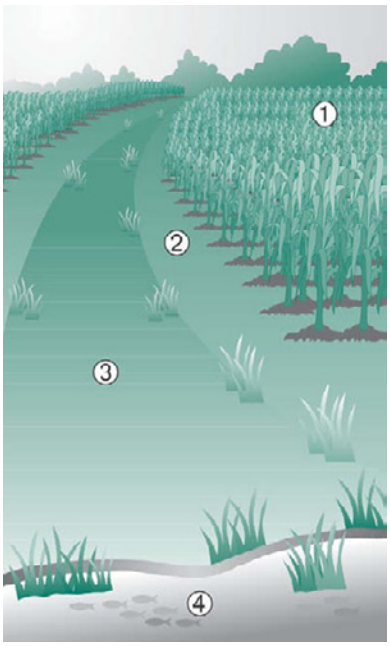
Three consecutive violations led the state to formally place the reservoir on the 303(d) list of impaired waters in 1998. The TCEQ and the Texas State Soil and Water Conservation Board (TSSWCB) initiated a total maximum daily load (TMDL) project to determine the amount (or load) of pollutant the reservoir could receive and still support its designated uses. The TMDL determined that all atrazine loading originated from nonpoint sources, some from small urban areas, but most of it from the corn and sorghum fields that covered 40 percent of the reservoir's 225-mile watershed. Atrazine is an inexpensive herbicide used to control broadleaf weeds—it is found in many residential lawn products and is typically used by many corn and sorghum producers to control weeds.

Aquilla Reservoir's Rapid Recovery (continued)

Identifying and Removing Atrazine Sources

Beginning in 1997, even before the TMDL was developed, the atrazine threat to drinking water triggered several coordinated projects within the watershed. First, the Aquilla Water Supply District installed an activated carbon treatment system to make the water safe for drinking. This end-of-pipe solution was only temporary, and the District turned to local officials, and regional, state, and federal agencies to help pinpoint and remove the sources of contamination.

State, federal, regional, and local agencies joined forces to formulate and implement plans designed to reduce pollution in the reservoir, protect against new pollution sources, and monitor progress through water quality testing. The TCEQ's Source Water Assessment and Protection team conducted assessments and inventories to determine the origin of atrazine within the watershed. The team discovered more than 600 potential contamination sources, such as fertilizer and pesticide application sites. All of this information was forwarded to the Aquilla Water Supply District and its partners. The TSSWCB then led a coordinated effort to change agricultural practices that contribute to atrazine pollution in the reservoir.



Sample best management practices used to reduce atrazine loads. A field of corn (1) is cultivated. Atrazine is tilled into the soil, rather than simply applied on top of the ground. Farmers install filter strips (2) between the field and an adjacent creek (4). A grassed waterway (3) is also used to direct runoff to the creek while filtering out pollutants at the same time.

The agency worked with area producers and other stakeholders to implement best management practices for atrazine reduction (see figure). Typical BMPs included:

- tilling atrazine into the soil rather than applying it on top of the soil,
- constructing filter strips,
- planting grass along waterways,
- stabilizing and terracing slopes,
- implementing integrated pest management (e.g., targeted herbicide application), and
- increasing education and outreach.

The corn and sorghum producers in the watershed received technical and financial assistance to implement the BMPs.

Project partners looked for other ways to reduce atrazine pollution. For example, the TSSWCB worked with other agricultural agencies to provide training on safe pesticide application. These meetings reached hundreds of agricultural producers and led to an increased awareness of water quality in general. Help also came from the Texas Watershed Protection Committee, an independent body formed to address threats to several reservoirs—including Aquilla—from atrazine contamination. The Committee was made up of diverse stakeholders from TCEQ, TSSWCB, Texas Agricultural Experiment Station's Blacklands Research Center, Texas Cooperative Extension, USDA's Natural Resources Conservation Service, Brazos River Authority, the Texas Farm Bureau, and others. The committee worked to increase pesticide dealers' awareness of the problem and gain their assistance and support in solving it. The committee members also evaluated alternatives to atrazine, facilitated nine demonstration/education products within the watershed, and surveyed usage of BMPs by agricultural producers.

Project leaders also targeted urban areas for atrazine reductions. They prepared fact sheets about atrazine and alternative lawn management. Through the Texas Master Gardener program, they delivered television public service announcements about proper application and storage of herbicides and pesticides. Finally, they distributed fact sheets and general articles to local newspapers, to feature columnists, and at local meetings.

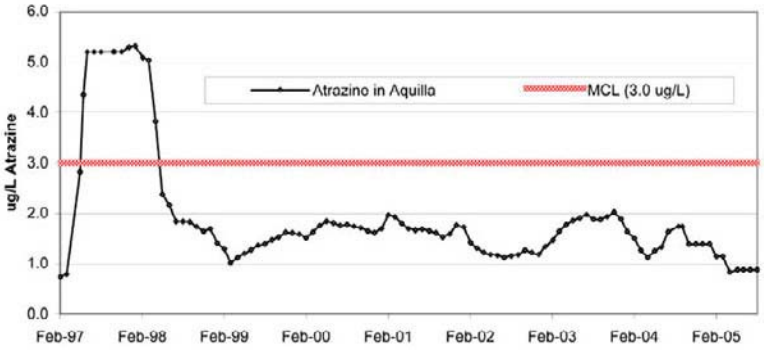
Since 1999, approximately $2.8 million in EPA Clean Water Act section 319 and nonfederal matching funds have helped to support these many restoration efforts. In addition, the USDA Natural Resources Conservation Service provided more than $1.9 million in cost-share funds between 1998 and 2003 to help producers implement BMPs in the watershed.

Aquilla Reservoir's Rapid Recovery (continued)

Success!

The TMDL required that Aquilla Reservoir maintain a running annual average atrazine concentration not to exceed the 3.0 micrograms per liter maximum contaminant level for two consecutive years. To meet the TMDL, the reservoir would need to reduce atrazine levels by 25 percent. To measure the effectiveness of reduction efforts, TCEQ conducted monthly water quality monitoring. In addition, a private corporation that markets atrazine continued its voluntary pesticide monitoring program with the area's public water suppliers.

The monitoring showed a 60 percent drop in atrazine levels within the first year (1998)—far exceeding the TMDL requirements. As presented in the graph, more than two consecutive years of monthly reservoir sampling have continually shown atrazine concentrations well below the 3.0 micrograms per liter maximum contaminant level standard. The reservoir now clearly meets atrazine concentration standards, and so the TCEQ has recommended that it be removed from the state 303(d) list. In the meantime, TCEQ will collect quarterly samples to monitor reservoir water quality. In addition, finished drinking water will continue to be monitored for compliance with Safe Drinking Water Act. Thanks to the success of the Aquilla Reservoir watershed project, similar nonpoint source pollution reduction efforts are now being implemented in several watersheds across the state to reduce threats to drinking water sources from atrazine and other chemicals. For more information, see the TCEQ Aquilla Reservoir TMDL Web site at www.tceq.state.tx.us/implementation/water/tmdl/10-aquilla.html, or the new Section 319 Success Stories Web site at www.epa.gov/nps/Success319.

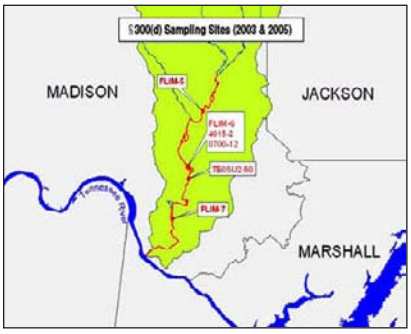


Atrazine concentrations in Aquilla Reservoir. Data represent running annual averages. Concentrations have steadily remained below the maximum contaminant level (MCL) since 1998. With the reservoir meeting the MCL requirement for more than two consecutive years, Texas has recommended that it be removed from the state's 303(d) list.

[For more information, contact Arthur Talley, Texas Commission on Environmental Quality, Mail Code 203, P.O. Box 13087, Austin, TX 78711-3087. Phone: 512-239-4546; E-mail: atalley@tceq.state.tx.us. You may also contact Aaron Wendt, Texas State Soil and Water Conservation Board, P.O. Box 658, Temple, TX 76503. Phone: 254-773-2250; E-mail: awendt@tsswcb.state.tx.us.]

Restoring Alabama's Lower Flint River through Cooperative Efforts

In 1995, biological testing by the Tennessee Valley Authority identified the Flint River in Madison County, Alabama, as impaired due to low dissolved oxygen and organic enrichment. Based on this data, in 1998, a 28-mile segment of the Flint River just south of the Tennessee border was placed on Alabama's 303(d) list of impaired waters for not meeting its designated water use classifications as a public water supply and fish and wildlife resource. Today, after numerous on-the-ground projects and extensive water quality monitoring, this stretch of river once again meets the water quality standards for its designated uses. The Alabama Department of Environmental Management (ADEM) has proposed its removal from the 2006 303(d) list of impaired waters.



Impaired portion of Alabama's lower Flint River watershed.

The Flint River is one of the largest tributaries to the Tennessee River in north central Alabama and is also one of the last free-flowing tributaries within the Tennessee Basin. More than 80 species of fish have been documented in the river. The Flint River could be considered the heart of Madison County because, other than the headwaters of the basin (which flow through southern Tennessee), the vast majority of this subwatershed flows within the county's boundaries. The river and its tributaries also branch out to cover a majority of the land area in the county, especially in north Madison County.

The river basin is a popular recreation destination. In addition to canoeing and kayaking opportunities, the Flint River Conservation Association maintains a Watershed Education Center at the 1,000-acre bottomland forest complex made up by the Hays

Landowners installed exclusion fencing to limit cattle's access to creeks, and constructed alternative watering sources at eight different locations.

Volunteers who live, work, and recreate in the area supported stream clean-up efforts throughout the watershed.

Nature Preserve and the Goldsmith-Schiffman Wildlife Sanctuary. This watershed and wetland education resource is owned and operated by the City of Huntsville.

River in Trouble

When the Flint River was placed on the list of impaired waters, local landowners joined forces with federal, state, and local agencies to restore the river. In 2000, an EPA Clean Water Act section 319 grant from the ADEM provided $250,000 to support a watershed coordinator and to implement on-the-ground best management practices. Stakeholders contributed an additional $331,000 in matching funds through gifts and in-kind services, bringing the total cost of the project to $581,000.

Between 2001 and 2003, landowners implemented many best management practices, including:

- winter cover and conservation tillage on 2,000 acres
- livestock BMPs (e.g., stream crossings, alternative watering facilities, exclusion fencing, rotational grazing plans) on 10 farms encompassing 400 acres
- cropland conversion of 10 acres
- heavy-use protection areas on 13 sites
- annual soil tests and nutrient management plans covering 300 acres

In addition, the project partners conducted education and outreach activities such as stream clean-ups, local school presentations, landowner/public meetings, and field days. The local media assisted by covering the events.

Station	Type of data	# of samples	DO < 5 mg/L
FLIM-5	Water column	17	0
FLIM-6	Water column	17	1
	Continuous	217	0
FLIM-7	Water column	17	1
	Continuous	216	0

Table 1. Project leaders measured water column dissolved oxygen concentrations at three stations during separate eight-month periods in 2003 and 2005. In addition, continuous dissolved oxygen monitoring occurred at two stations in July 2005. Only two water column samples showed concentrations below the water quality standard of 5.0 mg/L.

Scott Hughes of ADEM noted, "The commitment of time and resources of the various stakeholders, including the Madison County Soil and Water Conservation District, the USDA Natural Resources Conservation Service, the Tennessee Valley Authority, the Flint River Conservation Association, and the City of Huntsville, was crucial in making sure the project was implemented and successful."

Between March and October of both 2003 and 2005, ADEM collected dissolved oxygen data at three sites on the impaired segment of the Flint River. The agency also collected continuous dissolved oxygen data at two of the sites during July 2005. As shown in Table 1, during that time only two monthly measurements (4.60 mg/L and 4.97 mg/L) fell below the state minimum criterion of 5.00 mg/L for the public water supply and fish and wildlife designated water use classifications. Furthermore, none of the continuous dissolved oxygen measurements from July 2005 fell below the minimum criterion. Therefore, water quality data indicates

Restoring Alabama's Lower Flint River through Cooperative Efforts (continued)

that this segment of the Flint River now meets the water quality standards associated with its designated use classifications of public water supply and fish and wildlife habitat.

"We are very pleased that technology, public awareness, stakeholder involvement and hard work have combined to achieve this success on the Flint River," said ADEM Director Trey Glenn. "These improvements will restore and help maintain the integrity of this important watershed."

[For more information, please contact Scott Hughes, Alabama Department of Environmental Management, P.O. Box 301463, Montgomery, AL 36130-1463. Phone: 334-271-7955; E-mail: ash@adem.state.al.us.]

Notes on the National Scene

New Document Offers Help for Hydromodifications

Thanks to the natural processes of water erosion and sediment accretion, streambanks and shorelines have always been on the move. This rate of change, however, is often greatly accelerated and thrown out of balance by human hydromodification activities such as damming, channelization, and relocation of streams. These activities can change a waterbody's physical structure as well as its natural function, and cause problems such as changes in flow, increased sedimentation, higher water temperature, lower dissolved oxygen, degradation of aquatic habitat structure, loss of fish and other aquatic populations, and decreased water quality. Fortunately, the U.S. Environmental Protection Agency (EPA) recently released a draft guidance document designed to support hydromodification planning and implementation decisions. The EPA's draft *National Management Measures to Control Nonpoint Source Pollution from Hydromodification* provides technical assistance to states, territories, tribes, and the public to help them manage hydromodification activities and reduce associated nonpoint source (NPS) pollution of surface and ground water.

What is Hydromodification?

Hydromodification typically refers to changes in a river or stream channel that result either in an increase or decrease in the usual supply of water flowing through the channel, or in a change to the usual physical characteristics of the water or the channel. EPA defines hydromodification as the "alteration of the hydrologic characteristics of coastal and non-coastal waters, which in turn could cause degradation of water resources." For this draft document, hydromodification refers to an activity or group of activities that alter the geometry and physical characteristics of a stream or river in such a way that the flow patterns change. The document describes three main types of hydromodification, including:

- Channelization and channel modification, which includes activities such as straightening, widening, deepening, and clearing channels of debris. Channelization activities can play a critical role in NPS pollution by increasing the timing and delivery of pollutants, including sediment, that enter the water.
- Dams, which are artificial barriers on waterbodies that impound or divert water, are built for a variety of purposes, including flood control, power generation, irrigation, navigation, and to create ponds, lakes, and reservoirs for uses such as livestock watering, municipal water supply, fish farming, and recreation. They can contribute to NPS pollution by altering flows, which ultimately can cause impacts to water quality (changes to temperature or dissolved gases) and biological/habitat (disruption of spawning or altering of plant and benthic communities) above and below the dam.
- Streambank and shoreline erosion, which are the wearing away of sediment along non-tidal streams and rivers and the loss of beach material in tidal portions of coastal bays or estuaries. Streambank erosion occurs when the force of flowing water in a river or stream exceeds the ability of soil and vegetation to hold the banks in place.

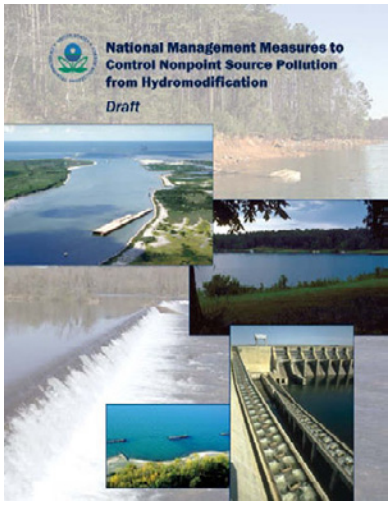
Why is the Guidance Needed?

According to the EPA's *National Water Quality Inventory: 2000 Report to Congress,* hydromodification is a leading source of water quality impairment in assessed surface waters. Of the 11 pollution source categories listed in the report, hydromodification was ranked as the second leading source of impairment in assessed rivers, second in assessed lakes, and sixth in assessed estuaries.

New Document Offers Help for Hydromodifications (continued)

Book Provides Help to Minimize and Avoid Impacts from Hydromodification

The EPA developed this free *National Management Measures to Control Nonpoint Source Pollution from Hydromodification* draft guidance document to help states, territories, tribes, and the public to understand and manage hydromodification-related water problems. The document is divided into the three main chapters: (1) Channelization and Channel Modification, (2) Dams, and (3) Streambank and Shoreline Erosion. Each chapter focuses on individual management measures that are specific to each type of hydromodification activity. Each section introduces the management measure(s) for the particular topic and presents a range of management practices that may be implemented to achieve the management measure. EPA believes that implementation of management measures can minimize and control hydromodification NPS pollution through erosion and sediment control, chemical and pollutant control, management of instream and riparian habitat restoration, and protection of surface water quality.



EPA's draft *National Management Measures to Control Nonpoint Source Pollution from Hydromodification* is available online at www.epa.gov/nps/hydromod.

For example, in the chapter about "Streambank and Shoreline Erosion," the document presents the following multi-part management measure:

1. Where streambank or shoreline erosion is a nonpoint source pollution problem, streambanks and shorelines should be stabilized. Vegetative methods are strongly preferred unless structural methods are more effective, considering the severity of stream flow discharge, wave and wind erosion, and offshore bathymetry, and the potential adverse impact on other streambanks, shorelines, and offshore areas.
2. Protect streambank and shoreline features with the potential to reduce NPS pollution.
3. Protect streambanks and shorelines from erosion due to uses of either the shorelands or adjacent surface waters.

While the management measures may be thought of as goals statements, the document proceeds to describe both nonstructural and structural practices that can be implemented to help achieve these goals. For example, the document describes nonstructural practices such as using live staking, live fascines, brush layering, coconut fiber roll, tree revetments, and other materials to stabilize streambanks and shorelines (the document also describes these terms). Because nonstructural practices do not work in all cases, the document includes information on the proper use of structural practices such as riprap, bulkheads and seawalls, breakwaters, toe protection, wing deflectors, and others. The document offers examples of activities that can be used as a single practice or in combination with other practices to achieve the desired project goals.

Case studies throughout this and other chapters highlight important concepts and provide real-life examples of how select management practices have been implemented within communities. When available, information concerning effectiveness and costs of practices is included. The document includes references and offers a resource section that includes an updated list of documents, technical guidance, journals, funding information, general hydromodification Web links, listservers, and educational materials.

Document Expands on 1993 Guidance

Management measures for hydromodification 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 by Congress under section 6217(g) of the Coastal Zone Act Reauthorization Amendments (CZARA) and available at www.epa.gov/nps/MMGI/). The current draft guidance document expands on the 1993 text and now includes updated information on the

New Document Offers Help for Hydromodifications (continued)

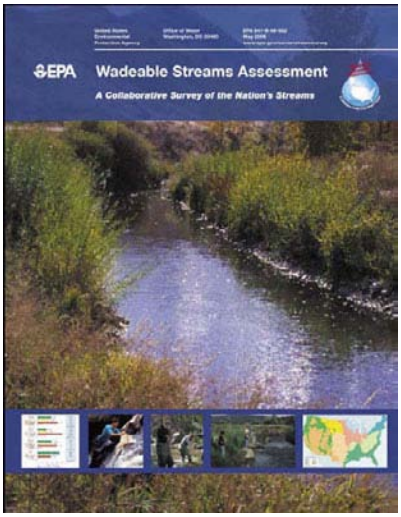
application and effectiveness of hydromodification management practices, the cost of installing the practices, watershed-scale and ecological impacts of hydromodification activities, and certification programs for personnel involved in construction and dam removal.

The new draft guidance is not regulatory; it does not set new or additional standards for either CZARA section 6217 or Clean Water Act section 319 programs. The management measures in the 1993 guidance have not been changed or replaced. The new draft guidance is a stand-alone document that addresses protecting streams and other bodies of water impacted by hydromodification for the abatement of nonpoint source pollution.

The *National Management Measures to Control Nonpoint Source Pollution from Hydromodification* draft guidance document is available online at www.epa.gov/nps/hydromod. Copies of the complete draft (document number EPA 841-D-06-001) can also be obtained by request from Chris Solloway by e-mail (solloway.chris@epa.gov), or by calling 202-566-1202.

EPA's Wadeable Streams Assessment Provides Insights

A landmark, statistically-based national stream assessment offers a new perspective on the health of U.S. waters—and it indicates a need for more work ahead. The U.S. Environmental Protection Agency's (EPA) *Wadeable Streams Assessment: A Collaborative Survey of the Nation's Streams* found that 42 percent of U.S. stream miles are in poor condition compared to the best available reference sites in their regions. Wadeable streams—those streams and rivers that are shallow enough to sample without boats—make up approximately 90 percent of all perennial stream and river miles across the continental United States. The assessment attributes many of the problems to four key stressors: nitrogen and phosphorus pollution, excess streambed sediments, and riparian disturbance. These stressors come from both point and nonpoint sources. The EPA hopes that the assessment results will help scientists better understand the current condition of the nation's waterways and allow them to develop appropriate water quality management plans and priorities. This project was a collaborative effort involving states, EPA, other federal agencies, tribes, universities, and other organizations.



The *Wadeable Streams Assessment* document is available for free download at www.epa.gov/owow/streamsurvey.

Assessment Design

The Wadeable Streams Assessment (WSA) report is the final product of a groundbreaking collaboration on stream monitoring. Diverse organizations from throughout the United States came together with the EPA to demonstrate a cost-effective approach for answering one of the most basic water quality questions: what is the condition of our nation's streams? The EPA requested help from states, universities, other federal agencies, and volunteer groups, whose past involvement in water quality monitoring of wadeable streams made them uniquely qualified to help with a nationwide monitoring project. Each participating organization attended a national meeting to discuss and formulate the data analysis approach, and attended regional meetings to evaluate and refine the results presented in this report.

To select monitoring sites, the WSA team used a random sampling technique called a probability-based sample design, in which every element in the population has a known probability of being selected for sampling. This technique led the WSA team to select and sample 1,392 random sites, which represented the condition of all streams in regions that share similar ecological characteristics. Participants used the same standardized methods at all sites, to ensure results that are comparable across the nation. A rigorous quality control program included training all field crews, auditing field crews and labs, and re-sampling 10 percent of the sites. The sampling began with pilot work in the western United States in 2000 and was completed nationwide in 2004. More information about the study design is available in the WSA report at www.epa.gov/owow/streamsurvey.

The WSA team used benthic macroinvertebrates to determine the biological condition of streams. Benthic macroinvertebrates are aquatic insects, crustaceans, worms, and snails that live in streams attached to rocks and woody debris, or burrowed into the stream bottom. These organisms are found nationwide, even in the smallest streams that cannot support fish. Since some benthic

EPA's Wadeable Streams Assessment Provides Insights (continued)

macroinvertebrates are more sensitive to pollution than others, information on the abundance of the various types of organisms reveals information about the health of a stream.

The WSA team supplemented information on the biological condition of streams with measurements of key chemical and physical indicators that reveal stress or degradation of streams. The WSA assessed four chemical indicators (phosphorus, nitrogen, salinity, and acidity) and four physical condition indicators (streambed sediments, in-stream fish habitat, riparian vegetative cover, and riparian disturbance).

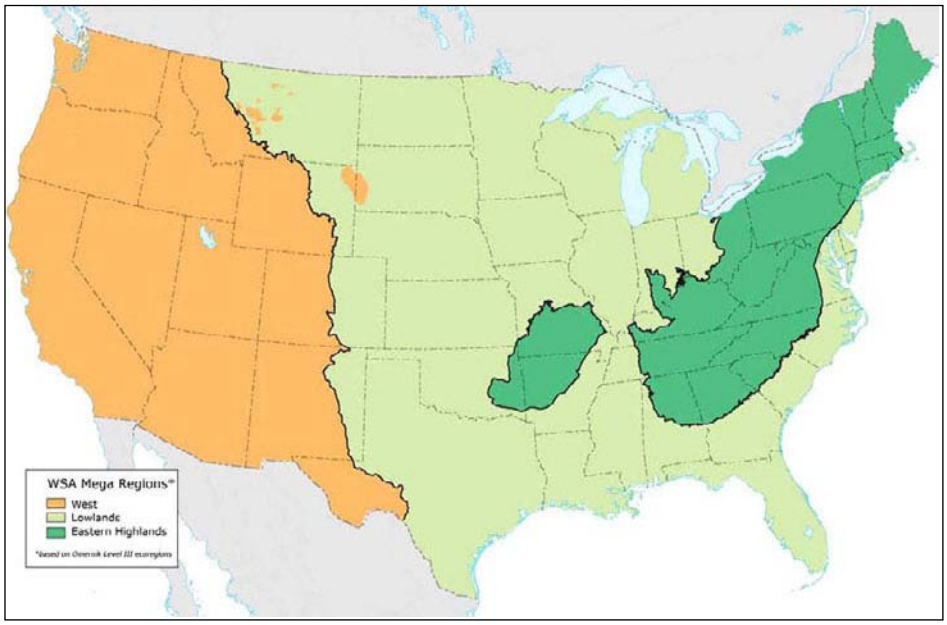
Assessment Findings

The WSA was designed to provide regional and national assessments of stream quality. Findings are presented at three levels of detail. First, the WSA discussed overall water quality of the conterminous United States; Alaska and Hawaii were not included in this assessment, but pilot projects are underway in those states. Second, the WSA summarizes the assessment data by the nation's three major climate and landform regions: the Eastern Highlands, Plains and Lowlands, and West (see figure). Finally, the report explains the results from each of nine ecological regions that further divide the three major climate and landform regions. The Eastern Highlands, for example, are divided into the Northern and Southern Appalachians. The report does not discuss water quality at the state level because there were not enough sites in the survey to allow statistically-valid assessments for all states.

The WSA found that 28 percent of assessed U.S. stream miles are in good condition when compared to the best available reference sites in their regions, 25 percent are in fair condition, and 42 percent are in poor condition. Another five percent were not assessed because New England states opted to exclude assessment of first order streams in their region. Stream quality varies widely across the diverse ecological regions of the United States. Of the three large climate and landform regions, the West is in the best condition, with 45 percent of the length of wadeable streams and rivers in good condition. In the Eastern Highlands region, 18 percent of stream length is in good condition, and more than half is in poor condition. The quality of streams in the Plains and Lowlands region falls between the other two regions, with almost 30 percent of stream length in good condition and 40 percent in poor condition.

Nationwide Lake Assessment Underway

EPA is leading a partnership with states, tribes, and others to routinely assess the waters of the U.S. using statistically-valid approaches. Together, the partners are currently implementing a survey of the nation's lakes, ponds, and reservoirs. Lake field data will be collected in 2007 and a report is planned for 2009 (see www.epa.gov/owow/lakes/lakessurvey). They will also be conducting nationwide assessments of rivers and wetlands in future years, and have already conducted two assessments of the nation's coastal waters (see www.epa.gov/owow/oceans/nccr).



The *Wadeable Streams Assessment* groups data by the nation's three major climate and landform regions: the Eastern Highlands, Plains and Lowlands, and West.

EPA's Wadeable Streams Assessment Provides Insights (continued)

The most widespread stressors observed across the country and in each of the three major regions are nitrogen, phosphorus, streambed sediments, and riparian disturbance. These stressors can degrade stream conditions for fish and other aquatic life. Nitrogen and phosphorus are nutrients that can increase the growth of algae, decrease levels of dissolved oxygen and water clarity, and degrade stream habitat. Excess streambed sediments can smother habitat for aquatic organisms. Riparian disturbance includes evidence of human activity alongside streams, such as pipes, pavement, and pastures. The WSA finds that between 25 and 30 percent of stream miles rate poor due to high levels of nutrients and excess streambed sedimentation. These streams are two times more likely to score poor for biological condition than streams with low levels of these parameters.

Data Available to Public

Sampling data from the Wadeable Streams Assessment are available to the public in the EPA's national STORET data warehouse (see http://iaspub.epa.gov/storpubl/DW_home).

Understanding the current condition of the nation's wadeable streams and rivers is critical in order to support the development of water quality management plans and priorities that help maintain and restore the ecological condition of these resources. Further, the WSA has established a national baseline assessment that managers can use to track water quality status and trends. The results of this WSA, and others like it in the future, will inform the public, water quality managers, and elected officials of the effectiveness of efforts to protect and restore water quality and the potential need to refocus these efforts.

[For more information, contact Susan Holdsworth, USEPA Headquarters, 1200 Pennsylvania Avenue, N. W. (Mail Code 4503T), Washington, DC 20460. Phone: 202-566-1187; E-mail: holdsworth.susan@epa.gov; Web: www.epa.gov/owow/streamsurvey.]

Can states use the WSA statistical survey approach to meet their needs?

Every two years the Clean Water Act requires states to provide an assessment of the quality of all their waters (section 305(b)) and a list of those that are impaired (section 303(d)). EPA believes that a monitoring and assessment approach that includes statistical surveys *as well as* targeted monitoring is the best approach to understanding and managing waters to meet both EPA and state needs. Each of these approaches has specific advantages.

Statistical surveys using a probability-based sample design generate an unbiased picture of water quality conditions statewide, present the condition of the entire resource being studied (e.g., all wadeable streams or lakes), and provide a cost-effective benchmark of state water quality program effectiveness. The results of statistical surveys can also help a state prioritize stressors for further assessment and management of waters. Currently, about 20 states are using probability-based designs to complement their site-specific monitoring.

Site-specific monitoring characterizes the conditions at specific locations within a waterbody by generating detailed data on concentrations and loadings of specific pollutants from specific sources. These data are important for developing local water quality management actions, including total maximum daily loads (TMDLs) and NPDES permits. Many states have long-standing fixed monitoring networks for collecting site-specific data, particularly around potential sources of pollution. These results are used to identify and manage impaired waters. They have long been assembled in state 305(b) reports to describe the condition of the subset of waters that are monitored within the state (e.g., 20 percent of stream and river miles). This information cannot be extrapolated to represent the remaining waters within a state.

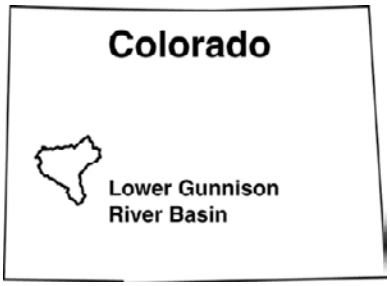
The WSA approach has the advantage of using consistent methods for a specific set of core indicators. This allows the results to be aggregated into regional and national scale assessments and to establish baselines for trend analysis. The current 305(b) report is based on data collected using a variety of state methods, standards, and many parameters that change over time and between states. Because of variations in state approaches, the current 305(b) report is not particularly useful for tracking national trends.

Many states are incorporating statistical surveys into their monitoring and assessment programs, and EPA plans to report on the results of those state-level surveys in future national 305(b) reports to Congress. However, it is important to note that states must also continue monitoring and reporting on targeted waters of importance to meet specific needs such as identifying and tracking impaired waters, and protecting public health at bathing beaches, etc. Statistically-valid approaches do not provide the waterbody-specific information needed for these management purposes.

Notes on Watershed Management

Gunnison Basin: A Selenium Success Story in the Making

Selenium—not your typical nonpoint source pollutant. In the American west, where arid conditions are the norm, irrigation water is causing naturally-occurring selenium to leach out of soil and rocks and into the groundwater. Some of this groundwater finds its way into surface waters—whether by seepage or by being pumped out and used for irrigation. This leaching process eventually caused selenium concentrations to exceed the 4.6 parts per billion (ppb) state water quality standards for aquatic life in Colorado's lower Gunnison River. Ongoing restoration projects have included lining ponds, replacing irrigation canals with pipes, and other methods to reduce the amount of water percolating into the ground in the first place. Project partners declare the restoration effort a 'success' because restoration methods have been demonstrated to work. However, they also emphasize that it is still 'in progress' because the task is so large that it will take years to complete.



Selenium on the Move

In the lower Gunnison River Basin, scientists know that deep percolation from on-farm irrigation and canal seepage mobilizes selenium from soils derived from the Mancos shale. The selenium is then transported by groundwater into the rivers. The selenium and salts found in the Mancos shale formations were deposited eons ago when the area was an inland sea. Until the beginning of irrigation in the area, little selenium or salts were washed out of the ground because this is a semi-arid region with little rainfall. But in sections of the Uncompahgre and Gunnison Rivers that drain irrigated land, selenium levels have spiked to unacceptable levels.

Selig Canal, an earthen canal system proposed for lining in 2007 is located in a high selenium and salinity loading area of the Uncompahgre Valley. *Photo by Sonja Chavez de Baca, Gunnison Basin Selenium Task Force.*

Selenium is a naturally-occurring, necessary trace element required by all animals. Unfortunately, selenium becomes poisonous as slightly higher concentrations are ingested, either through food or water. In the aquatic environment, selenium enters the food chain through plants, which then become the food base for higher organisms such as insects, fish, and birds. With each level of the food chain, more selenium is concentrated. Eventually, the selenium in an organism can reach toxic levels. High concentration of selenium has been shown to cause mortality, deformities, and decreased reproduction in fish and aquatic birds. Additionally, some plants that grow in the area—such as locoweed or milk vetch—take up selenium and are dangerous for animals that may eat them. For example, if cattle ingest the plants in sufficient quantities, their vision can become impaired and they can lose control of their muscles. Although selenium poisoning can potentially occur in humans, the Gunnison Basin problems remain limited to fish and wildlife impacts.

The Department of the Interior National Irrigation Water Quality Program (NIWQP) began investigating potential irrigation-related problems in the late 1980s. In 1988, following the listing of several stream segments on the 303(d) list, the Colorado Department of Public Health and Environment's Water Quality Control Division assembled the Gunnison Basin Selenium Task Force, made up of members from local governments, organizations, and citizens. The Task Force worked closely with the NIWQP (now inactive) to resolve selenium contamination problems while maintaining the economic viability and lifestyle of the lower Gunnison River Basin communities.

Developing a Remediation Plan

The Task Force continues to work to implement remedial actions and flesh out a comprehensive remediation plan to bring the Gunnison, Uncompahgre, and Colorado rivers into compliance with Colorado water quality standards. Scientists have estimated that this may require reductions of 5,700 pounds of selenium loading each year, or almost 30 percent of the total existing selenium

load. Sections of all three rivers are on Colorado's 303(d) list of impaired waters for having selenium concentrations above the state standard of 4.6 ppb.

The preliminary remediation plan includes piping irrigation laterals (ditches), lining canals and ponds, improving on-farm irrigation practices, implementing best management practices in non-agricultural settings, and public education and outreach. Some form of water treatment may eventually be required to meet the water-quality improvement goal in 303(d) listed tributaries.

Lateral/Ditch Piping in the Uncompahgre Valley benefits both salinity and selenium reduction. *Photo by Mike Baker, Bureau of Reclamation.*

Most of these practices have been shown to be effective. For example, the Uncompahgre Valley Water Users Association implemented the Montrose Arroyo Demonstration Project, which showed that piping 8.5 miles of irrigation laterals (replacing unlined ditches with pipes) reduced selenium loading by 27 percent. The project was funded by NIWQP and the Colorado River Basin Salinity Control Program (CRBSCP). Selenium and salt loading occur by similar means, so joint projects are common. The U.S. Geological Survey collected selenium and salinity data to document the effects of the project.

Supported by positive results from the test site, Task Force members have successfully obtained more than $1.7 million in Congressional funding for the piping of additional irrigation system laterals. This is being matched with additional CRBSCP funding. In addition to the original Montrose Arroyo project, more than 30 miles of laterals will be piped between 2004 and 2008. Task Force members have raised a large amount of money from different sources, but replacing the large number of ditches with pipe is expensive and will take time. Additionally, pivot sprinklers have proved to use less water than furrow irrigation and send little or no excess water into the shale. Interest in sprinkler installation is growing because of a successful CRBSCP demonstration project.

Since some vegetation takes up selenium, another demonstration project was undertaken to plant trees and other crops that would remove selenium from groundwater. Project leaders planted 4,000 poplar trees, which need little irrigation once they are established. The trees send their roots into the groundwater and are able to take selenium from possibly both the soil and groundwater. Project planners hope that mature trees could eventually be sold for particleboard.

Selenium bench-scale bioreactors funded by the U.S. Bureau of Reclamation are being tested to determine their ability to reduce selenium concentrations in 303(d) listed tributaries of the Grand Valley and Gunnison Basin. *Photo by Dr. Russ Walker, Mesa State College, Colorado.*

To complicate matters, land use in the area is changing rapidly. The population is expected to double in the next 35 years. Homes, commercial development, ballparks, and golf courses may replace agricultural land, but the impact of land use change looms as a big question—will development increase or decrease percolation? Other work is underway in an effort to understand the potential impact.

The Task Force, in conjunction with a recently formed Wise Water Use Council, has also launched a program of education for urban and suburban dwellers to help them understand the problems and to improve water use efficiency. Members of the Task Force are consulting with local governments to explore what regulations might be put in place to keep selenium from this source to a minimum.

Not a Quick Fix

According to current estimates, piping 202 miles of irrigation laterals and small canals on the east side of the Uncompahgre Valley may eliminate up to 2,900 pounds of selenium per year of the 5,700 pounds of the load reduction needed, but construction is only 11 percent complete (as of Summer 2006). Piggybacking on federal salinity-control programs will accomplish much of the needed piping, but the overall effort will still take 15 to 20 more years.

Gunnison Basin: A Selenium Success Story in the Making (continued)

Dan Beley, Coordinator of the Lower Colorado Watershed for the Colorado Department of Public Health and Environment, commented, "The Gunnison Basin Selenium Task Force has invested a significant amount of time and money into characterizing and planning to mitigate the selenium problem in the Gunnison Basin. They continue to move forward and most are optimistic that these efforts will be rewarded by reduced levels of selenium in the area's waters, realizing though that change will take time and money, and many challenges such as land use changes still lie ahead."

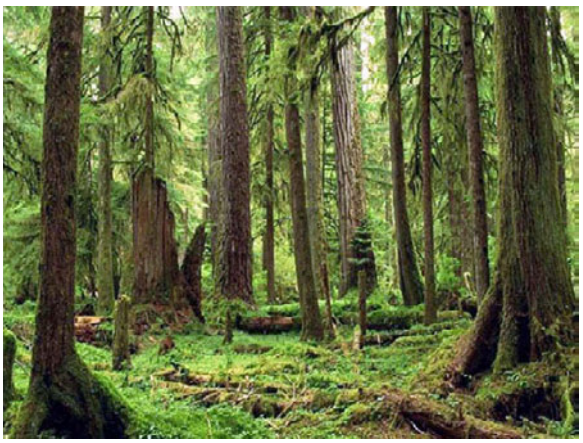
[For more information, please contact Dan Beley, Coordinator, Lower Colorado Watershed, Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver, CO 80246-1530. Phone: 303-692-3606; E-mail: daniel.beley@state.co.us. You may also contact Sonja Chavez de Baca, Coordinator of the Gunnison Basin Selenium Task Force, 114 Sandpiper Trail, Gunnison, CO 81230. Phone: 970-641-8927; E-mail: gbstf@adelphia.net.]

Northwest Forest Plan Improves Watershed Health

Watersheds in some federally-owned forested areas of the Pacific Northwest are growing healthier, thanks to a large-scale forest plan now in place. In 1994, the federal government adopted the Northwest Forest Plan (NFWP) as the overlying forest plan for nearly 25 million acres of federal land in Washington, Oregon, and Northern California. The NFWP represents the efforts of various federal agencies—with diverse missions and agendas—to agree on a common management approach that strives to balance the need for forest habitat with the need for forest products. One of the NWFP's most innovative aspects was the decision to manage terrestrial and aquatic ecosystems at a regional, as opposed to forest-by-forest, scale. This decision paid off. Monitoring results for the past 10 years indicate that watershed conditions have improved over a wide area.

How did the NFWP Come to Be?

In the early 1990s, federal forests in the Pacific Northwest were being managed primarily for timber production. Management priority was not given to the wildlife that depended on the forests and the streams; as a result, the number and diversity of species were on the decline. One species in particular, the northern spotted owl, had declined to the point that it was designated as protected under the Endangered Species Act in 1990. Moreover, the harvest of trees from riparian areas allowed streams to be exposed to sunlight, resulting in water too warm to support salmon and other native cold-water fish. Sediment that eroded from timber harvest activities and poor road maintenance clogged streams, reducing available spawning habitat. The situation came to a breaking point in 1992 when timber harvests on federal lands halted because of litigation related to the northern spotted owl. Anger, controversy, and frustration abounded in both the public and private sectors.



NFWP-managed forest area.

To resolve this issue, President Clinton directed a team of scientists and managers to construct a forest plan that would be "scientifically-sound, ecologically-credible, and legally-responsible." In addition, the plan was to be crafted to protect the long-term health of "our forests, our wildlife, and our waterways," and to "produce a predictable and sustainable level of timber sales and non-timber resources that will not degrade or destroy the environment."

The plan that emerged was the NWFP. Adopted in 1994, the NWFP was a groundbreaking land management strategy. Covering nearly 25 million acres of federal land, it was the largest ecosystem management plan in the United States at that time. It was also one of the first management plans to take a large-scale, regional landscape approach to restore and maintain the health of terrestrial and aquatic ecosystems.

How Does the NWFP Work?

The 25 million acres under the NWFP are managed primarily by the Forest Service, Bureau of Land Management (BLM), and National Park Service. These acres generally fall into one of several land use allocations, including:

The NWFP applies to nearly 25 million acres of federal lands in three states—an area that approximates the natural range of the northern spotted owl.

- Congressionally Reserved Areas—wilderness areas, etc. (7.3 million acres);
- Late Successional Reserves—designated to protect late successional and old-growth forest ecosystems (7.4 million acres);
- Administratively Withdrawn Areas—where recreation or other management emphasis precludes timber harvesting (1.5 million acres);
- Adaptive Management Areas—where new management approaches can be tested (1.5 million acres);
- Riparian Reserves—sets aside areas next to waterbodies (2.6 million acres); and
- Matrix Areas—designated for active timber harvest (3.98 million acres).

The NWFP's 25 million acres are not only assigned to particular land use allocation categories, but are also subject to additional management depending on the watershed in which the acres occur. Scientists assessed the NFWP watersheds and assigned them into one of three watershed priority categories:

- Tier 1 Key Watersheds, which include those directly contributing to conservation of habitat for at-risk fish species (33 percent of total acreage);
- Tier 2 Key Watersheds, which include those serving as important sources of high quality water (four percent of total acreage); or
- Non-key Watersheds, which include all other watersheds (63 percent of total acreage).

Table 2 shows the number of acres in each land use allocation area, and how these acres are assigned to a watershed priority category. The NWFP Record of Decision and Standards and Guidelines documents (www.reo.gov/library) contain specific management direction regarding how each of these areas are to be managed, including actions that are prohibited and descriptions of the conditions that should occur there.

Table 2. The number of acres in each NFWP land use allocation area, broken down by watershed priority category.

	Watershed Priority Category			
NWFP Designated Areas	Tier 1	Tier 2	Non-key	Total Acres
Congressionally reserved	2,728,000	311,200	4,281,400	7,320,600
Late-successional reserves	3,151,700	279,100	4,000,000	7,460,800
Adaptive management areas	228,100	60,600	1,233,100	1,521,800
Managed late-successional	55,100	0	47,100	102,200
Administratively withdrawn	407,900	54,700	1,014,500	1,477,100
Riparian reserves	631,000	113,700	1,882,800	2,627,500
NWFP Matrix	917,600	182,400	2,875,300	3,975,300
Total acres	8,119,400	1,001,700	15,334,200	24,455,300

The key water protection element of the NFWP is known as the Aquatic Conservation Strategy (ACS). The goal of the ACS is to maintain and restore ecological health of watersheds and aquatic ecosystems. The ACS consists of a system of the aforementioned Riparian Reserves and Key Watersheds, a series of watershed analyses, and a program of watershed restoration. For more information about the ACS, see www.reo.gov/library/acs.

Evaluating Results

The NWFP includes a multi-pronged monitoring program element that tracks the status and trends of key resources at the regional scale. Monitoring priorities include northern spotted owl and marbled murrelet (an endangered seabird nesting in the same forest range) populations, late successional and old growth forests, socio-economic factors, federal-tribal relations, and the health

of aquatic and riparian ecosystems. A separate monitoring program is in place for each priority (see www.reo.gov/monitoring for more information).

The monitoring component of the ACS is called the Aquatic Riparian Effectiveness Monitoring Program (AREMP). It assesses aquatic and riparian ecosystem conditions and tracks trends in watersheds subject to the NWFP. Although most assessment data are collected annually, meaningful trends may not be detected for several decades because watershed processes operate over the course of decades or longer. However, after ten years of implementation, AREMP made several key findings:

- An estimated 97 percent of the watersheds assessed showed a stable or improving trend. The three percent of the watersheds that showed a declining trend were in watersheds that experienced significant fire events.
- 74 percent of the ACS-designated "key" watersheds that were targeted for restoration showed improvement.
- The decommissioning of roads was determined to be a significant factor in the watershed improvements. The miles of roads decommissioned was nine times greater than the amount built between 1995 and 2002, the reverse of the trend before the NWFP went into effect.
- The amount of timber harvest in riparian areas decreased substantially, and many of the activities that could have had negative effects on aquatic ecosystems have declined under the NWFP.
- Watersheds with more non-federal ownership had the lowest changes in watershed condition scores, indicating that conditions are improving more rapidly on federally-owned land.

ACS, TMDLs, and the Clean Water Act

When a stream segment is designated as impaired, the Clean Water Act (CWA) section 303(d) requires that states develop a Total Maximum Daily Load (TMDL) for that segment. Many streams in the Pacific Northwest are impaired because of elevated temperatures—the result of the harvest of shade-producing trees in riparian areas. As the sun warms the water, cold-water fishes such as trout or salmon become subject to metabolic stresses and are left vulnerable to disease and predation. Fortunately, states with lands administered under the NWFP are finding that the ACS sometimes can be used to complement or replace the need for TMDL development.

For example, after completing several water quality restoration plans for watersheds within the NWFP area, the Forest Service and BLM discovered that management of designated streamside zones (e.g., the ACS Riparian Reserves) can provide sufficient stream shade to protect or recover stream temperature in waters listed as "impaired" on states' TMDL lists. Subsequently, in September 2005, the Forest Service and BLM developed a document entitled *Northwest Forest Plan Temperature TMDL Implementation Strategies*, which outlines how management of Riparian Reserves contributes to the long-term protection and restoration of water quality.

The TMDL implementation strategy outlined in the new document was recently recognized by the Oregon Department of Environmental Quality (ODEQ) as the temperature TMDL implementation mechanism pursuant to the CWA for lands administered under the NWFP in Oregon. ODEQ sees the TMDL implementation strategy as an opportunity to streamline temperature TMDLs, reduce duplicative effort, and, where needed, support development of finer-scale water quality restoration plans.

The ACS is also supporting CWA compliance in the state of Washington. The Washington Department of Ecology has determined that ACS-based pollution control plans can be

Riparian Protection Expanded Under Aquatic Conservation Strategy

The Riparian Reserve network, established by the Aquatic Conservation Strategy (ACS), was a significant change from previous forest plans. Before the ACS, the riparian ecosystem was generally defined as 100 feet on either side of fish-bearing streams or some areas with high landslide risk. The ACS Riparian Reserve network is based on an "ecological function" approach that identifies zones of influence rather than set distances and includes the entire stream network, not just fish-bearing streams. Consequently, implementation of the ACS led to expansion of the protected riparian zone along fish-bearing streams to 300 feet along fish-bearing streams or 150 feet along permanently flowing and intermittent non-fish-bearing streams.

Northwest Forest Plan Improves Watershed Health (continued)

designed to improve and attain water quality in a manner comparable to a TMDL implementation plan. The Gifford Pinchot National Forest, the Washington Department of Ecology, and the U.S. Environmental Protection Agency's (EPA) Region 10 office worked together to develop a water quality restoration plan, based on the ACS, for several temperature-impaired waterbodies within the Gifford Pinchot National Forest. This plan, known as the Yellowjacket Water Quality Restoration Plan, has been found adequate to move these waterbodies toward meeting water quality standards, thereby eliminating the need to develop a temperature TMDL.

More Work Ahead

Despite the improvements in watershed health, many of the NWFP's goals are still not being met. The northern spotted owl population has not increased; rather, it has decreased more than three percent during the past 10 years. Although the NWFP has improved the habitat available on federal land, the northern spotted owl is facing a number of additional stressors, including the arrival of the barred owl, a native of the eastern U.S. that has recently made its way to the Pacific Northwest. An interdisciplinary recovery team, led by the U.S. Fish and Wildlife Service, is currently working to better understand the population decline and to identify ways to reverse the trend. A draft recovery plan will be available for public review in earl 2007. For more information, see www.fws.gov/pacific/ecoservices/endangered/recovery/NSORecoveryPlanning.htm.

What is a TMDL?

A TMDL, or Total Maximum Daily Load, is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. A TMDL also allocates pollutant loadings among point and nonpoint pollutant sources. For more information, see www.epa.gov/owow/tmdl.

The implementation of the NWFP has also not produced the volume of timber that was anticipated. This is largely due to budget constraints and continued litigation. The federal agencies working to implement the NWFP continue to seek ways to improve implementation and fully achieve the fundamental objectives of the Plan. For more information on these efforts, see www.reo.gov/riec/.

Fortunately, watershed conditions in the NWFP area are trending positive. If the ACS continues to be implemented in its current form, NWFP managers expect this trend to continue. As threats beyond the control of the federal agencies continue to mount against species such as the northern spotted owl, watersheds that are healthy and functional will be ever more critical to species recovery. Managers will continue to gauge the success of the ACS and all of the components of the NWFP as they strive to achieve the restoration, economic, and social goals of the NWFP.

[For more information, contact Teresa Kubo, EPA Region 10, Oregon Operations Office, 811 S.W. 6th Avenue, 3rd Floor, Portland, OR 97204. Phone: 503-326-5874; E-mail: kubo.teresa@epa.gov.]

Notes on Education

Minnesota Offers New Snow and Ice Removal Resources

Have you ever gone outside after an ice storm and slipped—on leftover salt? Just in time for the winter season, the Minnesota Pollution Control Agency (MPCA) is promoting a new program to help minimize the amount of unnecessary salt and other de-icing chemicals applied by private entities to parking lots, walkways, and roads. Although the public agencies responsible for snow and ice removal have had access to training for years, the private sector did not. Now, a new training program and a series of helpful resources are available to everyone responsible for snow removal—from the church groundskeeper to the private snow removal company.

Why the Effort?

Chloride is being increasingly recognized as a source of water quality impairment in snowy regions of the United States. In arid regions, elevated chloride levels in water are often traced to evaporative sediments. In snowy regions like Minnesota, most of the chloride found in water bodies is derived from cold season application of salt (sodium chloride) and other de-icers. Heavy use of road salts damages nearby vegetation; salty runoff can harm aquatic life, birds, plants, and animals. The salt applied to roads and parking lots eventually dissolves, resulting in excess chloride being carried off

in solution by runoff into storm drain systems that discharge into lakes and rivers. A sizable portion also infiltrates through the soil and into the groundwater. Suburban stream segments in Minnesota are now starting to appear on the impaired waters list due to high chloride concentrations.

While developing a total maximum daily load for one impaired stream—Shingle Creek—the Shingle Creek Watershed District reported to the MPCA that approximately 7.5 percent of road salt load could be traced to private applicators who cleared parking lots, access roads, and sidewalks. MPCA surveys and staff members' general observations indicated that private operators, who had little information about the environmental consequences of over-application of salt, tended to believe that "more is better." Most private operators were also unaware of alternative methods of snow and ice removal.

Meeting the Need

For the past five years, the Minnesota Department of Transportation and the Circuit Training and Assistance Program (co-sponsored by the University of Minnesota's Center for Transportation Studies and the Minnesota Local Road Research Board) have contracted with Fortin Consulting to work with their Winter Snow and Ice Control trainers. This group conducts statewide training for the people responsible for the majority of snow removal across Minnesota—state and local government operators of snow removal equipment for public roads and highways. Connie Fortin and Carolyn Dindorf of Fortin Consulting saw an opportunity to expand the reach of the training to the private sector and submitted a proposal to MPCA. "We brought the vision of a training program to reduce the impacts of winter parking lot and sidewalk maintenance to the MPCA. The speed at which MPCA accepted the idea, found the funding, improved upon our ideas, and made that vision a reality was remarkable."

Too much salt was applied to this sidewalk in the City of Plymouth, Minnesota.

In February 2005, the MPCA awarded a $25,000 Pollution Prevention grant to Fortin Consulting to develop a training program for private applicators of road salt and de-icers. The firm was tasked with developing best management practices for application of road salt to parking lots and sidewalks, conducting three pilot training sessions, and following up with past training session participants to learn if they were implementing best management practices.

Pilot Program Elements

Beginning in the fall of 2005, the firm launched what is thought to be the first private operator snow removal training program in the nation. Private operators participated in a free four-hour class where they learned the basic do's and don'ts of de-icing. The participants learned about appropriate best management practices and how to use them. The training was designed to be interactive and easy to understand, notes Fortin. "For example, instead of talking about the chronic level of chlorides being 230 mg/l, we use the example that one teaspoon of salt in a five gallon bucket of water will put that water on the U.S. list of impaired waters." Overall, Fortin conducted six classes—three in various watershed areas around Minneapolis (47 attendees), and one each at a Maintenance Expo (110 attendees), the MPCA (six attendees), and a Road Salt Symposium (60 attendees).

During the training, the attendees calculated how much de-icer they typically applied. They then calculated how much how much they should have been using based on what they just learned. Most participants discovered that they should have been applying approximately 90 percent less, although the values ranged between 25 and 100 percent less.

To help the participants implement what they had learned in the class, MPCA provided them with a laminated clipboard to use while on the road. The clipboard, which has information on both sides, offers a synthesis of the latest knowledge and practices on winter highway operations (see www.pca.state.mn.us/publications/roadsalt-clipboardpages.pdf for a copy of the information provided on the clipboards). The operator of de-icing or snow removal equipment can quickly consult

tables written on the clipboard to identify the recommended application of de-icer or sand on rain, snow, or ice, and at different road surface temperatures. Each training course participant also received a *Winter Parking Lot and Sidewalk Maintenance Manual* that offers detailed explanations of the topics discussed during the training (see box).

MPCA also plans to release a second, complementary manual next year. *Guidelines for the Selection of Snow and Ice Controls to Mitigate Environmental Impacts* will supplement the *Winter Parking Lot and Sidewalk Maintenance Manual* by providing information on the performance of snow and ice removal materials and their impact on the environment, infrastructure, and vehicles.

Certification Provides Incentive

To entice private operators to spend four hours in a training session, the MPCA and Fortin Consulting devised a voluntary certification program. Individuals who participated in the training, passed a voluntary certification test, and agreed to apply best management practices to reduce chloride impacts were highlighted on MPCA's Web site at www.pca.state.mn.us/publications/roadsalt-certificateholders.pdf. In the training evaluations, many participants noted that option for the voluntary certification was very important to them. As of September 2006, 34 individuals had received certification.

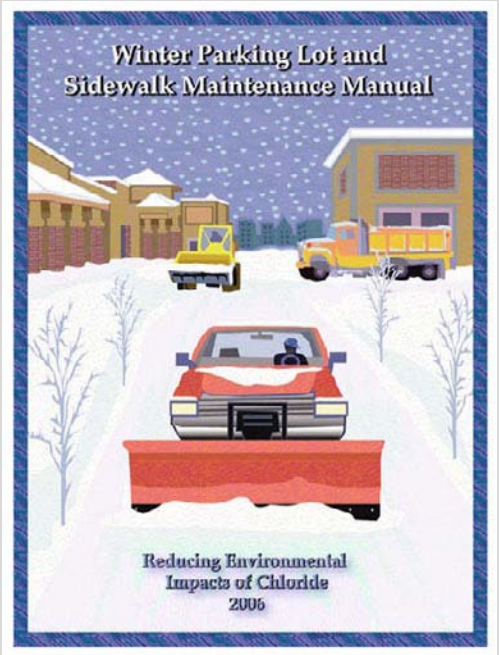
Manual Describes Best Management Practices for Removal of Snow and Ice

The *Winter Parking Lot and Sidewalk Maintenance Manual*, developed by MPCA, Fortin Consulting, and a technical expert team offers detailed information on how to minimize the application and accidental release of salt and other de-icers into the environment. The manual discusses how to store de-icers and sand, how to prepare for winter, and the best practices that can be used when winter weather hits. For example, the manual offers a variety of suggestions for ways operators can prepare for winter, including:

- Calculate the area of parking lots, service roads, and sidewalks.
- Understand the properties of the various de-icers, and then select the most appropriate type(s) to use.
- Estimate the amount of material needed using the application rate charts. Order quantities based on the estimate.
- Understand the environmental problems caused by snow, salt, and sand storage. Then determine where and how to best store each item (e.g., to prevent snowmelt from running through salt or de-icer storage areas).
- Train crews on proper application rates.

The manual also discusses strategies for snow and ice control. Some suggestions include:

- Consider anti-icing. This new proactive approach should be first in a series of strategies for each winter storm. By applying a small and strategic amount of liquid or pre-wet deicer before a storm, you can prevent snow and ice from bonding to the pavement.
- Check the weather. Know if temperatures are rising or falling.
- If traditional de-icers are planned, focus on aggressive mechanical removal of snow. The less snow on the pavement, the less de-icer required.
- Understand the melting properties of your deicers. Do not use them unless you understand how they work.
- Use a pavement temperature sensor. Pavement temperature will typically be different from the air temperature. Use the application rate chart to determine which de-icer would be most effective based on the current pavement temperature.
- Use wet salt. This reduces bounce and scatter and speeds up the melting process. A liquid salt can be added to the salt pile or sprayed on dry salt as it is applied. Both methods can reduce the amount of salt required by up to 30 percent.
- Limit use of salt and sand during the storm; use only to reduce bonding.



For the complete details, see www.pca.state.mn.us/publications/parkinglotmanual-june06.pdf.

Implementation?

Within two months after the training, Fortin Consulting conducted a follow up survey of the 47 participants in the three watershed area training classes. Eighty percent of participants responded to the survey—all of these individuals reported using less salt and sand than they had been using before the training. The reduction rates ranged from 30 to 65 percent less, with the most participants reporting that they were applying approximately 50 percent less.

In a letter to Fortin, operator Chuck Cadwell explained how the training had changed his practices. He had been applying approximately 12 to 14 tons of salt per one-day snow event to a parking lot. Immediately after training, he made changes that reduced application rates to between five and six tons of salt per one-day snow event. "Based on the lectures provided in the training, we no longer apply salt chemical during a storm," he said. "Salt is applied after the snow has been mechanically removed." He reduced the rate at which salt was applied, and also performed maintenance on his equipment that prevented spills. Like Cadwell, all the other survey responders said they had implemented some of the BMPs taught during the training course, and planned to try the new practices again.

The Minnesota Pollution Control Agency awarded this certificate to private snow removal operators who participated in a training session, passed a voluntary certification test, and committed to apply best management practices.

Andrew Ronchak, who coordinated this project for the MPCA, said, "This grant has been so effective because there is no other training targeting this group. This low hanging fruit easily resulted in significant environmental improvements." Because of the initial success of the pilot project, MPCA awarded Fortin Consulting a Clean Water Act section 319 grant to conduct more than 25 additional training sessions across Minnesota starting in the fall of 2006. Fortin Consulting will use its experience with the pilot project to identify ways to raise the visibility of and participation in the training and voluntary certification program.

Connie Fortin is pleased with the program's success and sees its value on a greater scale. "I am convinced that all of the cold weather states should take what has been developed here and implement it in their state," she notes. "The certification process is the key to increased participation. Either each state should set up its own certification process, or EPA should set up a national certification program that each state could administer. I am proud to be a part of such an innovative program."

[For more information, contact Andrew Ronchak, 520 Lafayette Road, St. Paul, MN 55155-4194. Phone: 651-296-3107; E-mail: andrew.ronchak@pca.state.mn.us. You may also contact Connie Fortin, Fortin Consulting, Inc., 215 Hamel Road, Hamel, MN 55340. Phone: 763-478-3606; fci@fortinconsulting.com.]

Discover Nonpoint Source Pollution Online

Are you looking for a comprehensive introduction to nonpoint source pollution and its impacts? The National Oceanic and Atmospheric Administration (NOAA) recently released a new online nonpoint source educational resource. The Communication and Education Division of NOAA's National Ocean Service (NOS-CED) has created an online Education Discovery Center, which offers a wide variety of free educational resources, including Discovery Kits, Discovery Stories, and Discovery Classroom. The Center's *Nonpoint Source Pollution Discovery Kit* explores the history of pollution, explains the differences between point and nonpoint source pollution, reviews the types of pollutants, and discusses how scientists monitor, assess, and control nonpoint source pollution. Many of the Center's other educational resources address environmental issues with nonpoint source elements.

The *Nonpoint Source Pollution Discovery Kit* is one of five Web-based Discovery Kits offered by the Center. The other four Discovery Kits address corals, tides and water levels, estuaries, and geodesy (the science of measuring and monitoring the size and shape of the Earth and the location of points on its surface). Discovery Kits describe the basic scientific principles underlying the applied science

and activities of NOS. "We hope the kits will help teachers bring NOAA science to the classroom and spark student interest in our oceans and marine environments," explains Bruce Moravchik, education specialist with the National Ocean Service.

What's Inside?

Each of the Center's Discovery Kits contains:

- A Tutorial that introduces a scientific subject related to the National Ocean Service's mission. Each tutorial is organized into chapters that can be read in sequence or individually. The tutorials incorporate photographs, videos, animations, and illustrations to enhance the text and bring understanding to concepts that might otherwise be difficult to visualize. The nine-chapter *Nonpoint Source Discovery Kit's* tutorial provides an overview of the history and types of nonpoint source pollution, discusses methods used to detect pollutants, and explains ways to assess and reduce their damaging effects on the environment.
- A Roadmap to Resources that guides educators and students to online data offerings related to the material presented in the tutorials. The Roadmap is a collection of annotated links that describe how each link might be useful. The *Nonpoint Source Discovery Kit's* roadmap directs you to online data and other pollution-related information from NOAA, the U.S. Environmental Protection Agency, and other reliable sources.
- A series of Lesson Plans. Developed for students at the high school level, each lesson brings together the information presented in the tutorials with data offerings from the Roadmaps. All lesson plans contain detailed background information and resource materials to facilitate their use by educators in formal classroom settings. The *Nonpoint Source Discovery Kit's* lesson plans focus on how scientists identify and measure nonpoint pollutants and determine their effects on living organisms using bioassays and chemical analyses.

Discover More

The Discovery Kits are one of three types of resources offered by the National Ocean Service's online Education Discovery Center (see http://oceanservice.noaa.gov/education). The Center also offers "Discovery Stories" and "Discovery Classroom." The Discovery Stories are case studies in coastal and ocean science drawn from current research being conducted by scientists at NOAA's National Ocean Service. They are opportunities to learn through inquiry and are accompanied by supporting resources, including student and teacher guides, interactive quizzes, exercises with real data, and interviews with National Ocean Service scientists that explore how scientists think. Two Discovery Stories are currently available: (1) "Prince William's Oily Mess: A Tale of Recovery," which discusses the recovery of the ecosystem in Alaska's Prince William Sound since a large oil spill occurred there in 1989; and (2) "The Lionfish Invasion," which teaches about the invasive non-native lionfish and its rapid spread into new coastal areas along the eastern United States.

The third type of resource, Discovery Classroom, is a collection of formal lesson plans based on the major thematic areas of the National Ocean Service Web site. Many of these include nonpoint source elements. All of the lessons emphasize hands-on activities using online data resources. The lesson plans that are currently available include:

- Coral Reef Conservation
- International Collaboration
- Marine Protected Areas
- National Marine Sanctuaries
- Ocean Exploration
- Coastal Decision-making Tools
- Coastal Ecosystem Science
- Coastal Management
- Ecological Forecasting
- Harmful Algal Blooms
- Estuarine Research Reserves
- Natural Hazard Assessment
- Natural Resource Restoration
- Aerial Photography and Shoreline Mapping
- Global Positioning
- Hydrographic Surveying

Discover Nonpoint Source Pollution Online (continued)

- Coastal Monitoring and Observation
- Contaminants in the Environment
- Marine Navigation
- Tides and Currents

Each inquiry-based activity includes: Focus Questions, Learning Objectives, Teaching Time, Audio/Visual Materials Needed, Background Information, Learning Procedures, a "Me" Connection, Evaluations, Extensions, as well as Resources and Student Handouts. Lesson plans may be downloaded for free.

Teacher Approved

NOAA emphasizes the quality of the information contained within the Discovery Center's resource sections and its applicability to classroom teaching. "All of the materials on the Discovery Center Web site have been reviewed and approved by Master Teachers," emphasizes Moravchik. Moreover, the National Science Teachers Association (NSTA) has included Discovery Center's resources in its SciLinks database (www.scilinks.org)—this database is limited to resources that undergo a rigorous review to ensure that the content is accurate and especially useful to teachers and students. Finally, to help teachers easily incorporate the Discovery Center's information into their classroom, all of the lesson plans are correlated to National Science Education Standards and the American Association for the Advancement of Science Benchmarks for Science Literacy. The resources are designed for students at the high school level, but can be easily adapted for middle school and even college undergraduate levels.

[For more information, contact Bruce Moravchik, NOAA's National Ocean Service, 1305 East-West Hwy Silver Spring, Maryland 20910. Phone: 301-713-3060; E-mail: bruce.moravchik@noaa.gov.]

NOAA and NSTA Collaborate on Coral Ecosystem SciGuide

In October 2006, the National Oceanic and Atmospheric Administration and the National Science Teachers Association (NSTA) unveiled another Web-based resource—the *Coral Ecosystem SciGuide.* This guide serves as a "science toolbox" for teachers and other educators of high school students. Offered by the NSTA for $6, the *Coral Ecosystem SciGuide* pulls together the best of the Internet's resources on coral science, and organizes these resources according to three major theme areas for the classroom: coral reef biology, coral ecosystems, and coral conservation. In addition to these Web-based resources, the SciGuide also provides access to field-tested lesson plans, classroom activities, computer simulations and teaching aids, including samples of student work and lessons learned from pilot teachers. Many of NOAA's online coral reef educational resources are included within the SciGuide. For more information, see http://sciguides.nsta.org.

The Coral Ecosystems SciGuide is the first in a series of ocean- and atmospheric-themed SciGuides to be developed by NSTA in collaboration with NOAA. Future topics include "Estuary Ecosystems" and "The Ocean Effect of Weather on Climate." For a NOAA article about the SciGuide project, see www.noaanews.noaa.gov/stories2006/s2715.htm.

Postcards Educate North Carolinians about Pet Waste

Pick up after your pooch and protect water quality. This is the message the North Carolina Department of Environment and Natural Resources' Office of Environmental Education (OEE) is trying to share through a pet waste postcard, first released in early summer 2006. The postcards describe how pet waste gets into water and why it poses a risk to water quality and human health. The postcards have proven very popular.

OEE originally planned to rely mostly on veterinarians across the state to distribute the cards. "Pet owners look to their family vet as the expert when it comes to all things pet-related," explained

Postcards Educate North Carolinians about Pet Waste (continued)

Rachel Golden, OEE's Adult Environmental Education Program Manager. "We thought vets could most easily get the information to our target audience," To get started, Golden mailed an introductory letter and sample postcard to approximately 800 veterinarians across North Carolina, inviting them to order postcards for distribution. This effort was successful; in fact, since May 2006, veterinarians have requested more than 14,000 cards.

As word of the postcards spread, OEE was pleasantly surprised by the interest shown from other organizations as well, including homeowner associations, parks, soil and water conservation districts, community colleges, pet waste removal companies, and nature centers. These other organizations have requested more than 30,000 cards for distribution. "We are pleased that the postcard has been so well received by so many different groups," adds Golden. The postcards can be viewed and ordered online at www.eenorthcarolina.org/consumer/petcard.htm. The postcard can be easily adapted and used for outreach purposes in other states.

The North Carolina Department of Environment and Natural Resources looked to veterinarians and other stakeholders to distribute this postcard throughout the state. The front of the postcard, pictured here, highlights the problem of pet waste in water. The back of the postcard includes information about North Carolina's environmental education resources.

The pet waste postcard is the first in a series of postcards to be developed and distributed through OEE's "Informed Consumer Initiative" (www.eenorthcarolina.org/consumer.htm). This program highlights key environmental issues and explains the costs and benefits associated with a variety of consumer choices. OEE hopes that informed citizens will make choices that are compatible with environmental protection.

[For more information, contact Rachel Golden, Adult Environmental Education Program Manager, Office of Environmental Education, NC Department of Environment and Natural Resources, 1609 Mail Service Center, Raleigh, NC 27699-1609. Phone: 919-733-0711; E-mail: rachel.golden@ncmail.net.]

Reviews and Announcements

Book Features Wetland Heroes

The Trust for Public Land recently released a book titled *Rescuing Wetlands Close to Home: Ten Stories of New England Landowners.* The book explores the role of private property owners in preserving natural landscapes and describes how their efforts connect people to the land and to each other. *Rescuing Wetlands* is the first book from author Anne Schwartz, a journalist who has covered environmental issues for more than 20 years. Stories range in size, complexity, and geography—from one woman's effort to restore a salt marsh behind her house on Rhode Island's Narrangansett Bay to a retired executive's purchase and preservation of land along the river in New Hampshire where he fished as a child. To order copies of *Rescuing Wetlands* online, visit www.tpl.org and click on "Publications" on the left side of the page. For a limited time, the book will be available for $10, with deeper discounts for bulk orders.

Connecting Economic Development and Smart Growth

The International Economic Development Council recently released *Economic Development and Smart Growth*, a document that highlights the connections between smart growth and economic outcomes such as job growth, occupancy rates, tax base, and private investment. The report, supported with funding from the EPA, uses detailed case studies to illustrate economic outcomes in places that have incorporated smart growth development strategies. The case studies profile diverse projects in Lakewood, Colorado; Pittsburgh, Pennsylvania; Paducah, Kentucky; Indianapolis, Indiana; Portland, Oregon; Burlington, Iowa; Silver Spring, Maryland; and Columbus, Ohio. Download the PDF of this report for free at www.iedconline.org/downloads/smart_growth.pdf.

Document Provides Status of Environmental Education at the State Level

What is the status of state-level environmental education (EE)? This new online resource includes state-by-state data, a slide show and accompanying notes, and recommendations and resources for building comprehensive EE programs. Information is based on the results from the National Environmental Education Advancement Project study (2004-2005), which tracked the development of comprehensive state-level EE programs across the 50 states. For more information, see www.naaee.org/50statesurvey.

Induced Meandering Field Guide Released

A new illustrated field guide is now available for participants of riparian restoration educational workshops and field tours. *An Introduction to Induced Meandering: A Method for Restoring Stability to Incised Stream Channels,* is a joint publication from Earth Works Institute, The Quivira Coalition, and Zeedyk Ecological Consulting. The document describes riparian restoration techniques, and includes real examples, such as those used for several demonstration sites in the Galisteo Watershed Restoration Project in New Mexico. The document highlights the use of induced meandering as promoted by Bill Zeedyk. To receive a free copy, visit www.earthworksinstitute.org and click on "publications."

Lights, Camera, e-Life: EPA Takes Message to TV and Web

In Texas, environmental awareness has gone multimedia. In October 2006, the EPA, the Texas State Soil and Water Conservation Board, North Central Texas Council of Governments, and KTVT-TV CBS 11 launched "e-Life," a new environmental education program that combines a Web site and television news spots. The e-Life Web site focuses on living in Texas' Upper Trinity River Watershed, with its network of lakes, creeks, and rivers that supplies North Texas with fresh water. The Web site provides environmental news and pollution prevention tips that can help visitors learn how to take an active role in protecting their environment. More than 115 short video segments addressing topics ranging from pet waste to toxic algae blooms may be downloaded at http://ktvt.iewatershed.com. CBS 11 adds its team of meteorologists and reporters to the e-Life mix to provide on-air news stories and related features.

Natural Resources Image Gallery Available Online

The Natural Resources Conservation Service (NRCS) maintains a free online photo gallery that contains natural resource and conservation-related photos from across the U.S. (see http://photogallery.nrcs.usda.gov). The gallery is a joint project between NRCS Conservation Communications and the NRCS Information Technology Center in Ft. Collins, Colorado. Although the images are free, NRCS requests that credit be given to NRCS when photos are used in a publication, on a Web site, or as part of any other project.

New Guide Highlights Incentives for Agriculture Water Quality Trading

By selling the amounts of nutrients or sediment reduced by conservation practices, agricultural producers are finding opportunities to get paid for stewardship activities through water quality trading. A new manual, *Getting Paid for Stewardship: An Agricultural Community Water Quality Trading Guide*, helps interested partners get started. The guide has information for producers who want to develop a trading program in their watershed, provides a basic understanding of trading, and includes contact information. Produced under an EPA cooperative agreement with the Conservation Technology Information Center, the guide is intended for agriculture advisers and/or technical service providers. The document can be downloaded at www.epa.gov/OWOW/watershed/trading.htm.

New Weed Killer May Soon Be in a Field Near You

Researchers at the University of Illinois are currently testing a solar powered, weed-killing robot. The robot uses GPS for navigation, and has two small cameras mounted on top to give it depth perception. An on-board computer offers access to information that provides the morphological features of plants to help the robot determine just what is and isn't a weed. Once a weed is identified, a robotic arm attached to the front of the machine engages a two–part device: one cuts the weed, while the second applies herbicide to the cut weed. Currently the robot is only designed to combat weed infestation; in the future, the researchers hope to install different sensors and cameras on the robotic arm that could be used to judge soil properties or plant conditions. For more information, see www.engr.uiuc.edu/news/?xId=068909120770.

Publication Illustrates Smart Growth Techniques

Environmentally sensitive development is improving quality of life, according to the new publication *This Is Smart Growth*, released by the EPA, the International City/County Management Association (ICMA), and 30 other organizations. Featuring 40 localities around the country, *This Is Smart Growth* illustrates how communities can use smart growth techniques that improve the quality of development. It shows how communities have made tax dollars go farther by reducing the cost of services and infrastructure and offering people more transportation choices. It also shows how communities have protected natural lands, farms, and ranches; created safe, convenient neighborhoods with homes people can afford; and boosted public health by reducing pollution and increasing opportunities for walking, biking, and other forms of physical activity. Download a free copy of the report at www.smartgrowth.org.

Report Reviews Riparian Buffer Information

A 2005 EPA report, *Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness: A review of current science and regulations*, summarizes existing scientific literature on the effectiveness of riparian buffers to improve water quality by removing nitrogen from surface and ground waters. The report reveals that no consensus exists for what constitutes optimal riparian buffer design or proper buffer width to achieve maximum nitrogen removal effectiveness. The report does not attempt to provide a one-size-fits-all recommendation for such a design or width; rather, it attempts to identify generalizations and trends extracted from published literature that will help managers make decisions about establishing, maintaining, or restoring riparian buffers in watersheds of concern. Download a free copy of the report at www.epa.gov/ada/download/reports/600R05118/600R05118.pdf.

Resource Guide Available for Organic Farmers

Cornell University recently released a new book called the *Resource Guide for Organic Insect and Disease Management*. An online version with links to printable PDF files is available at www.nysaes.cornell.edu/pp/resourceguide. The 169-page soft-cover book is divided into three sections. The first section gives detailed crop management practices for five of the most common vegetable groups: lettuce, sweet corn, brassicas (cabbages and related crops), cucurbits (squash and its relatives), and solanaceous (tomatoes, potatoes, peppers and eggplant). The focus is on what are called "preventative pest management" practices that lessen the likelihood of pest attack. Dozens of useful color pictures help growers identify insect and disease problems in these crops. The second section provides a comprehensive assessment of 13 of the most commonly used pesticides in organic production, with descriptions based on their origin and how they work, the types of pests they control, and their effects on the environment and human health. The last section describes options that growers can use for preventive management, including growing plants that are pest-resistant or planting crops in ways that reduce the risk of pest attack.

Waterborne Disease Research Summaries Published

The EPA Office of Research and Development and the EPA Office of Water have published a series of papers summarizing the research conducted on waterborne disease in the last 10 years. The work includes research supported by EPA and others and is limited to gastrointestinal illness as the health effect of concern. The 1996 Safe Drinking Water Act Amendments mandated that EPA and the Centers for Disease Control (CDC) and Prevention conduct five waterborne disease studies and develop a national estimate of waterborne disease. In response, EPA, CDC, and other authors produced a series of papers that reviews the state of the science, methods to make a national estimate of waterborne disease, models that estimate waterborne illness, and recommendations to fill existing data gaps. The papers represent the most comprehensive review conducted in the last 25 years and the first publication of modeling information that estimates waterborne illness on a national level. The papers have been published in the July/August 2006 supplement of *Journal of Water and Health*. The publications are available for free at www.epa.gov/nheerl/articles/2006/waterborne_disease.html.

Water Quality Credit Trading Agreement Signed

In October 2006, USDA Natural Resources and Environment Under Secretary Mark Rey and Benjamin Grumbles, Assistant Administrator of the EPA's Office of Water, signed a partnership agreement to establish and promote water quality credit trading markets through cooperative conservation. The agreement features a pilot project within the Chesapeake Bay basin to showcase the effectiveness of environmental markets. Water quality credit trading uses a market-based approach that offers incentives to farmers and ranchers who implement conservation practices that improve water quality. While reducing pollution, they can earn credits for trading with industrial or municipal facilities that are required by the Clean Water Act and other laws to reduce the amounts of pollution in wastewater. For more information, see www.epa.gov/owow/watershed/trading.htm.

Weather and Watersheds Course Available

A new online course, *Watersheds: Connecting Weather to the Environment*, is now available for free at www.meted.ucar.edu/broadcastmet/watershed. This course provides broadcast meteorologists with knowledge and instructional materials to help them understand and relay to their viewers the relationship between the weather and the health and protection of the environment. The course consists of six online units—each of which takes approximately 15 to 30 minutes to complete. The units include: watersheds, watershed systems, water sources, water quality, drought, and storms and floods.

The online course, while intended for meteorologists, is also highly useful for land use managers, teachers, community leaders, and others interested in learning more about watersheds. The course also contains a collection of professional quality graphics, both static and animated, that make it easy for meteorologists to explain watersheds visually to their viewers. This course was produced by The Cooperative Program for Operational Meteorology, Education, and Training (COMET) in collaboration with the National Environmental Education and Training Foundation (NEETF), and the EPA Office of Wetlands, Oceans, and Watersheds.

USGS Study Shows Benefits of Stream Fencing

The U.S. Geological Survey recently published "Effects of Streambank Fencing of Near-Stream Pasture Land on a Small Watershed in Lancaster County, Pennsylvania," which outlines the findings of a study conducted from 1993 to 2001. The study indicated that a small buffer width along a stream in pasture land can have a positive influence on surface water quality, benthic macroinvertebrates, and near-stream shallow groundwater quality. The vegetative buffer also controlled (or reduced) overland runoff processes that move suspended sediment to the stream. For more information, see http://pubs.usgs.gov/fs/2006/3112.

Recent and Relevant Periodical Articles

Comparison Study: Horizontal and Vertical Transparency Tubes

By Robert E. Carlson (www.epa.gov/owow/monitoring/volunteer/newsletter/volmon18no2.pdf). This article, published in the Fall 2006 issue of EPA's *Volunteer Monitor,* explores the difference between two types of transparency tubes used for assessing water clarity and makes recommendations about which type is the most practical for a given situation.

Construction Site Monitoring

By Wendy Steffensen (www.epa.gov/owow/monitoring/volunteer/newsletter/volmon18no2.pdf). This article, published in the Fall 2006 issue of EPA's *Volunteer Monitor*, discusses the efforts of a citizen "Stormwater Team" program in Whatcom County in northwestern Washington State. The program sends trained citizens to construction sites to spot and report stormwater problems.

F+RNA Coliphage Typing for Microbial Source Tracking in Surface Waters

By J. Stewart-Pullaro, J.W. Daugomah, D.E. Chestnut, D.A. Graves, M.D. Sobsey, and G.I. Scott (www.blackwell-synergy.com/toc/jam/101/5). This article, printed in the November 2006 issue of the Journal of Applied Microbiology, presented results from a study that used subtyping of viruses (i.e., coliphages, the viruses that infect E. Coli) to help distinguish human from animal sources of water pollution and identify the source of contamination. The results suggest that fecal contamination in surface waters can be detected and source identifications aided by coliphage analyses.

Land Conservation: A Permanent Solution for Drinking Water Source Protection

By Caryn Ernst (www.nesc.wvu.edu/ndwc/articles/OT/SP06/OT_SP06_LAND.pdf). This article, published by the National Environmental Services Center in its Spring 2006 issue of *On Tap*, offers compelling reasons for protecting the sources of drinking water. The article also provides source water protection guidelines.

Sediment and Erosion Control on Construction Sites: A discussion of current practices

By Carol Brzozowski (www.erosioncontrol.com/ecm_0609_sediment.html). This article, published in the October 2006 issue of *Stormwater*, explores the types of sediment and erosion control techniques typically used at construction sites.

Web Sites Worth a Bookmark

Cooperative Conservation America (www.cooperativeconservationamerica.org)

Cooperative Conservation America (CCA) was created to support the development of *Faces and Places of Cooperation Conservation*, a publication of the 2005 White House Conference on Cooperative Conservation (available on this site). Today, the Web site continues to serve as an online public forum for collecting and sharing cooperative conservation stories, lessons, models, and achievements. More than 800 stories are available.

Erosion and Sediment Control News (www.escn.tv)

ESCN-TV provides short (less than 10 minutes long) video segments exploring erosion and sediment control industry news and programming. The site also offers "Dirt Time," a series of half-hour segments introducing various best management practices.

Hubbard Brook Ecosystem Study (www.hubbardbrook.org)

Hubbard Brook Ecosystem Study (HBES) is a long-term ecological research project (since 1963) located at the Hubbard Brook Experimental Forest, a 3,160-hectare reserve located in the White Mountain National Forest, near North Woodstock, New Hampshire. The project Web site offers comprehensive data and information about watersheds, including sampling data, research publications, images, and educational resources for both teachers and students.

Michigan DOT Stormwater Management (www.michigan.gov/stormwatermgt)

The Michigan Department of Transportation (MDOT) has posted a variety of new stormwater education and outreach materials on its stormwater Web site. Play MDOT's Jeopardy-style stormwater game, participate in an illicit discharge interactive demonstration, and look through a variety of education posters and publications.

Sustainable Woods Network (http://sustainablewoods.net)

This new online tool highlights sellers of wood products from responsibly managed forests, allowing buyers to easily find them. The site also offers resources to help landowners better manage their woodlands. More than 4,000 landowners with 900,000 combined acres are represented on the network.

Calendar

January 2007

18-20	*Fresh Eyes on the Land: Innovation and the Next Generation*, Albuquerque, NM. For more information, see http://quiviracoalition.org/Annual_Conference/.
21-24	*Composting Council—15th Annual Conference*, Orlando, FL. For more information, see www.compostingcouncil.org.
22-24	*Delaware Estuary Science Conference and Delaware Estuary Environmental Summit*, Cape May, NJ. For more information, see www.delawareestuary.org.
22-23	*AWRA 2007 Spring Specialty Conference—3rd National Water Resources Policy Dialogue*, Arlington, VA. For more information, see www.awra.org/meetings/DC2007/index.html.
22-25	*Fourth International Conference on Remediation of Contaminated Sediments*, Savannah, GA. For more information, see www.battelle.org/environment/er/conferences/sedimentscon/.
Jan 28-Feb 1	*USDA-CSREE's National Water Conference: Research, Extension, and Education for Water Quality and Quantity*, Savannah, GA. For more information, see www.soil.ncsu.edu/swetc/waterconf/2007/home07.htm.

February 2007

1-2	*Integrating Environment & Human Health*, Washington, DC. For more information, see www.ncseonline.org/04conference/2007.
5-8	*Sixth Annual International Stream Restoration Design Symposium*, Stevenson, Washington. For more information, see http://rrnw.org/skamania2007/program.htm.
6-8	*Understanding Agriculture's Effects on Amphibians and Reptiles in a Changing World*, St. Louis, MO. For more information, see www.umesc.usgs.gov/ag_effects_workshop/registration_info.html.
12-13	*42nd Central Canadian Symposium on Water Quality Research*, Burlington, Ontario. For more information, see www.cawq.ca.
12-16	*International Erosion Control Association: Environmental Connection (EC'07)*, Reno, NV. For more information, visit www.ieca.org.
27-28	*4th Conference on Hydrogeology, Ecology, Monitoring, and Management of Ground Water in Karst Terrains*, Safety Harbor, FL. For more information, see www.ngwa.org/e/conf/0702275018.cfm.
Feb 28-Mar 1	*River Terrace & Floodplain Hydrology*, Las Cruces, NM. For more information, see http://spectre.nmsu.edu:16080/water/.

March 2007

6-8	*2007 Managing Roadsides Naturally*, Austin, TX. For more information, see www.wildflower.org.
11-13	*4th Conference on Watershed Management to Meet Water Quality and TMDL (Total Maximum Daily Load) Issues: Solutions and Impediments to Watershed Management and TMDLs*, San Antonio, TX. For more information, see www.asabe.org/meetings/tmdl2007.
12-14	*2nd National Low Impact Development Conference*, Wilmington, NC. For more information, see www.soil.ncsu.edu/swetc/lid/home.htm.
19-22	*17th Annual AEHS Meeting and West Coast Conference on Soils, Sediments and Water*, San Diego, CA. For more information, see www.aehs.com/conferences/westcoast/.

April 2007

1-4	*10th International Symposium on Wetland Biogeochemistry*, Annapolis, MD. For more information, see www.serc.si.edu/conference/index.jsp.
1-5	*20th Annual Symposium on the Application of Geophysics to Engineering and Environmental Problems*, Denver, CO. For more information, see www.eegs.org/sageep/.
9	*Sustainable Waters in a Changing World: Research to Practice*, Amherst, MA. For more information, see www.wrrcconference.com.
22-27	*2nd National Conference on Ecosystem Restoration*, Kansas City, MO. For more information, see www.conference.ifas.ufl.edu/NCER2007.
24-26	*7th Passive Sampling Workshop and Symposium*, Reston, VA. For more information, see www.cerc.usgs.gov/Research/Passive_Conference/psws.htm.
Apr 29-May 1	*Fifth Annual Greening Rooftops for Sustainable Communities Conference*, Minneapolis, MN. For more information, see www.greenroofs.org/minneapolis/.
Apr 29-May 3	*2007 Ground Water Summit*, Albuquerque, NM. For more information, see www.ngwa.org/e/conf/0704295095.cfm.

May 2007

15-19	*World Environmental and Water Resources Congress*, Tampa, FL. For more information, see http://content.asce.org/conferences/ewri2007.
18-22	*River Rally 2007*, Stevenson, WA. For more information, see www2.rivernetwork.org/rally/.
21-23	*New England Interstate Water Pollution Control Commission's 18th Annual Nonpoint Source Pollution Conference*, Newport, RI. For more information, see www.neiwpcc.org.
20-23	*2nd National Forum on Socioeconomic Research in Coastal Systems: Challenges of Natural Resource Economics and Policy*, New Orleans, LA. For more information, see www.cnrep.lsu.edu/pdfs/CNREP_abstracts07.pdf.
20-25	*International Conference on Ecology and Transportation 2007*, Little Rock, AR. For more information, see www.icoet.net.

June 2007

3-8	*Charting the Course: New Perspectives in Floodplain Management*, Norfolk, VA. For more information, see www.floods.org/norfolk.
10-15	*Society of Wetland Scientists International Conference: Water, Wetlands, and Wildlife—Resolving Conflicts and Restoring Habitat,* Sacramento, CA. For more information, see www.sws.org/sacramento2007.
20-23	*Tenth National Watershed Conference*, La Crosse, WI. For more information, see www.watershedcoalition.org.
24-27	*TMDL 2007*, Bellevue, WA. For more information, see www.wef.org/ConferencesTraining/Conferences/SpecialtyConference/TMDL2007.htm.

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