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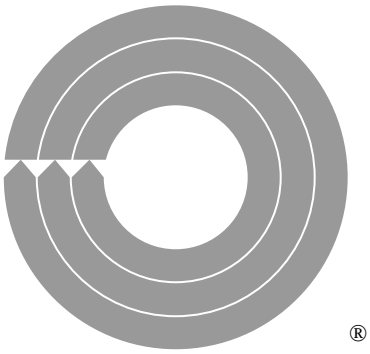

Congress on Control of Nonpoint Source Water Pollution: Options and Opportunities

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RENEWABLE RESOURCES JOURNAL

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The Department of Natural Resource Sciences and Landscape Architecture at the University of Maryland served as host and provided university and extension service personnel to serve as facilitators and working group reporters. Conduct of the meeting and the preparation of this report would not have been possible without their volunteered assistance. These volunteers are identified in the appendix.

Serving in the important capacity of working group chairs were: **Peter Black** (State University of New York, Syracuse), **Greg Brown** (Virginia Tech), **Mark Bundy** (Maryland Department of Natural Resources), **Chris Lant** (Southern Illinois University), **Larry Nielsen** (North Carolina State University), and **Patrick Reid** (University of Arizona). They presided over the working groups, and prepared and presented working group summary reports at the conclusion of the congress. Their work has been incorporated into this report.

Six distinguished plenary-session speakers provided essential background information and insightful analysis: **Donald Boesch** (University of Maryland), **Jim McElfish** (Environmental Law Institute), **Tim Miller** (U.S. Geological Survey), **Tom Schueler** (Center for Watershed Protection), **Dov Weitman** (U.S. Environmental Protection Agency), and **Lauren Wenzel** (Maryland Department of Natural Resources). And everyone appreciated the special keynote presentations by NOAA's **Margaret Davidson** and **Maryland Governor Parris Glendening**.

Tireless leadership in planning and conducting the congress was provided by program committee chair **John S. Dickey Jr.** He also served as moderator and master of ceremonies. He could not have served better.

RNRF Chairman David W. Moody provided leadership in conceptualizing the congress, gave technical assistance, and facilitated a plenary session.

Also critical to the success of the congress were the 24 volunteers who served on the program committee. Committee members are listed on page 3.

RNRF interns provided critical research and logistical support. They were: **Madeleine Bayard** (Georgetown Univ.), **Meghann Garrabrant** (American Univ.), **Todd Kuiken** (George Washington Univ.), **Kara LeBeau** (Johns Hopkins Univ.), **Nathan Matthews** (Michigan State Univ.), and **Camille McCarthy** (George Washington Univ.).

Special appreciation and thanks go to our program director **Ryan Colker**. Our freshly minted *juris doctor* tackled his first national conference with enthusiasm and determination. He assembled this report from plenary session presentations, working group reports, notes, flip chart sheets, and delegate comments.

Finally, sincere thanks are extended to the dedicated congress delegates who shared their expertise, experience, ideas, vision and passion to conserve and restore an essential renewable natural resource. They provided the essential interdisciplinary content for this report. A complete list of delegates appears in the appendix.

Robert D. Day

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Executive Summary

Water is essential to the functioning of all life forms and ecosystems, and necessary for many agricultural, industrial and human uses. It provides us with drinking water, recreational activities, and irrigation, and provides plants and wildlife with habitat, nutrients, and a food source. However, in the U.S about 40 percent of streams, 45 percent of lakes and 50 percent of estuaries are not clean enough to support uses such as fishing and swimming (EPA, 2002). A dead zone the size of New Jersey has stretched from the mouth of the Mississippi River into the Gulf of Mexico, mercury contaminated rain falls onto streams, rivers and lakes from Virginia to Maine, and the Chesapeake Bay's sea grasses are disappearing.

In recent years, progress has been made in the control of end-of-the-pipe discharges—the point sources. However, nonpoint sources have proven to be much harder to control and now contribute to the majority of water quality problems (USGS, 1999). Nonpoint source pollution is so difficult to control because of the diversity of sources and the complexities inherent in interactions between land use and hydrology. No single sector of society, land use or medium is totally responsible.

Nonpoint source pollution is the deposition and movement of contaminants from diffuse sources. Such contaminants include fertilizers and pesticides from agricultural and residential lands; nutrients from livestock and pet wastes, and septic systems; persistent bioaccumulative toxins (PBTs, see page 22) and other toxins from impervious surfaces such as parking lots; erosion and siltation of streams from land disturbances associated with development, silviculture, and agriculture; and atmospheric deposition of nitrogen and other contaminants from automobiles and trucks, power plants, and other industrial sources onto land or directly into water.

A multidisciplinary approach is necessary to address the causes, effects, and solutions. The Renewable Natural Resources Foundation (RNRF) convened a congress of delegates from diverse backgrounds to examine this difficult problem. The Congress on "Control of Nonpoint Source Water Pollution: Options and Opportunities," was held September 18–21, 2002, in Baltimore, Maryland. A case study and working group based approach was used to frame the issues and structure discussion among the delegates. (See Appendix A for a summary of the congress program and information on the process and procedures.)

This report is based upon comments and discussion that took place during the plenary and working group sessions. Findings and recommendations identified in this report are those of the congress delegates and do not necessarily represent policies of RNRF, its member organizations, or the sponsoring agencies.

Controlling Nonpoint Source Pollution

Current approaches to nonpoint source pollution control, including Best Management Practices (BMPs), have made important contributions to improving water quality. However, as the sole approach they are insufficient. Efforts must be made to implement programs that place a greater focus on the characteristics of a particular region and take into account all sources of water quality impairment, such as Total Maximum Daily Loads (TMDLs). Utilizing BMPs in conjunction with TMDLs can lead to significant improvement in water quality.

Local, state and national governments have significant roles in controlling nonpoint source pollution. Government's responsibilities include ensuring funding for essential programs like education and research; providing necessary tools such as models and technical assistance; and developing financial incentive programs. Equally important is a robust monitoring program. Data are essential to gauge progress and to understand the effects of control strategies. Unfortunately, monitoring has been chronically under-funded. This must change.

Appropriately assigning these important responsibilities among the various levels of government is essential. This is particularly so given the inter-jurisdictional flow of water. Recognizing local variations in land and water characteristics—and community needs—the control or mitigation of nonpoint source pollution ultimately will be undertaken by local authorities. Regional management structures that have the ability to address inter-jurisdictional pollution issues, particularly at the watershed level, will need to be developed.

Developing and nurturing private and public partnerships is essential to accomplishing local and regional goals. Partnerships among governments also are necessary to improve cooperation and effectiveness. A mentoring or exchange program between and among state and federal agencies could help these partnerships

develop as employees learn the challenges, goals and constraints of other agencies. Partnerships with nongovernmental organizations also can improve effectiveness of programs.

These partnerships ultimately should be responsible for developing and implementing control strategies. The Congress delegates recognized several key components of any control strategy. Education is an important tool to inform and motivate. Financial incentives can be used to encourage people to "do the right thing." Legislation, particularly in the areas of zoning and planning, needs to be properly formulated to accomplish water quality goals. Existing laws also must be linked and clarified to recognize the interconnectedness of resources, and to strengthen current control programs.

While nonpoint source pollution has become a significant problem, most people are unaware of their contribution to it. Therefore, educating the public about how changed habits can contribute to cleaner water is necessary. Regional workshops involving local stakeholders, including government, natural resource professionals, citizen groups, and schoolteachers, can create issue awareness and prompt participation among essential interests and regional leaders.

An especially important audience for educational efforts is our legislators. They are a key component of any pollution control strategy. Legislators need to understand the gravity of the problem and strategies for controlling pollution. Pilot projects and success stories can provide information about what measures work. The reasons for these successes also must be understood.

Natural resources professionals and their societies also have a key role in nonpoint source pollution control. Most natural resources decisions impact water quality. Professionals should be trained to anticipate and resolve potential impacts from nonpoint source water pollution. Professional societies can improve awareness and practice through continuing education, certification, and publications.

Better utilization of the media and schools can contribute to a more informed public. A nonpoint source marketing campaign could include an easily recognized logo, mascot and slogan. Incorporating environmental education elements into school curriculums prepare children to educate their parents.

Creating a sense of place in all sectors of society could help raise awareness and provide incentives to examine actions. The involvement of community groups such as Kiwanis and Rotary can bring community minded people into the mix. Targeting the consumers of pesticides, herbicides, and fertilizers should be accomplished through vendor licensing and instructional requirements.

Conclusion

There are many actions that we can take to control nonpoint source water pollution.

- Governments need to work together, recognizing the variability in communities and resources.
- Monitoring programs need to be funded to determine where controls are necessary and to assure that they are working.
- Future legislation needs to be evaluated for its impact on water quality, while existing laws need to be clarified and utilized to take advantage of possible control opportunities.
- Natural resources professionals have a responsibility to anticipate and resolve potential impacts from nonpoint source water pollution.
- An extensive education effort including all sectors of society—from legislators to elementary school students—is needed.

Introduction

Ryan M. Colker

Because of the multiple sources of nonpoint source pollution, the varying impacts, and the diversity of control methods required, no single discipline can adequately address the nonpoint source problem. Cooperation among the biological, physical and social sciences is required to meet the Nation's water quality goals. In recognition of the need for a multidisciplinary approach, over 100 delegates from a variety of disciplines attended the RNRF Congress on "Control of Nonpoint Source Water Pollution: Options and Opportunities." (See Appendix B for a list of delegates.)

The following report is the proceedings of the congress. It contains the findings and recommendations of the congress delegates, and important background information.

The author of this report, Ryan M. Colker, is the Director of Programs at the Renewable Natural Resources Foundation. Colker earned a Bachelor of Arts with honors in environmental policy from the University of Florida, and a Juris Doctor from The George Washington University Law School.

Summary of Presentations

The congress utilized a working group-based approach to tackle this major problem in water resource protection. Respected and knowledgeable speakers presented information necessary for the thorough discussion of nonpoint source pollution. The content of these presentations appears in the section "Summary of Presentations" which begins on page 9. Following each presentation, delegates questioned the speaker and discussed the issues.

The congress also examined the Chesapeake Bay as a case study. The Bay was selected because of the wide variety of land-uses within the watershed, its history of monitoring and modeling, and the long-standing efforts of several states to save its environmental integrity. Information from the case study also is provided in this section.

Findings and Recommendations

To utilize the delegates' previous knowledge and that gained from the plenary sessions and case study, working groups were formed to discuss the major outstanding issues in nonpoint source pollution control. (For an in-depth explanation, see "Working Groups" in Appendix A). Findings and recommendations developed in these working groups and the plenary session discussions are presented in this section. The recommendations include both short- and long-term actions that need to be taken.

Appendices

RNRF congresses provide a unique format for exploration of critical issues in natural resources. The elements and history of this special forum are included in Appendix A.

The success of this and previous congresses can be attributable to the high caliber of invited delegates. Delegates to the fifth national congress are listed in Appendix B.

The Internet has become a major source of information. Appendix C features Internet resources on nonpoint source pollution identified by delegates. The list is by no means exhaustive—many high-quality resources are not listed.

Summary of Presentations

Defining Nonpoint Source Pollution, Its Extent and Effects

Timothy L. Miller, chief of the National Water Quality Assessment (NAWQA) program for the U.S. Geological Survey (USGS), began the congress with a description of nonpoint source pollution and how NAWQA data are used to assess the current impact of nonpoint source pollution on our water resources.

Miller recognized the importance of the problem and the complications of trying to control it. Over 70 percent of impaired rivers' water quality problems are associated with diffuse nonpoint sources of pollution from agricultural land, urban development, forest harvesting, and the atmosphere. The Clean Water Act was reauthorized in 1987 to include provisions to address nonpoint source pollution. However, difficulties in controlling nonpoint source pollution remain—its origins are diffuse and widespread and its magnitude varies hour-to-hour and season-to-season.

At about the same time, Congress began appropriating funds to USGS to support an assessment of the nation's streams and groundwater resources. Over the past decade, more than 50 NAWQA studies have documented significant nonpoint source contaminant patterns in some of the nation's more important river basins and aquifers. NAWQA studies are not limited to nonpoint source pollution; their goal is to describe the general health of water resources, as well as current and emerging water issues.

In the last decade, NAWQA studies described water quality conditions in nearly 120 agricultural watersheds and 35 urban watersheds. The findings generally showed that nonpoint chemical contamination is an issue for both types of watersheds.

Nitrogen and phosphorus in these watersheds commonly exceeded levels that lead to excessive algae growth. Nearly 80 percent of sampled agricultural streams and over 70 percent of urban streams exceeded the Environmental Protection Agency (EPA) phosphorus goal for preventing nuisance aquatic plant growth. Such growth can lead to low dissolved oxygen, causing harm to fish and other aquatic life. The EPA, along with states and tribes, are developing criteria for phosphorus and nitrogen runoff. Because such runoff depends on factors such as hydrology and climate, the criteria are being developed on a regional basis.

Nitrate levels in shallow ground water underlying farmland often are above background levels. This raises concern in rural areas, particularly where the shallow ground water is used for domestic supply. The wells may not be regulated and owners often do not know if the water is contaminated. Nitrate levels are highest where soils and karst structure enables rapid infiltration and downward movement of water and contaminants. Locations such as the Central Valley of California, parts of the Pacific Northwest, the Great Plains, and the Mid-Atlantic regions are most vulnerable.

Pesticides also are widespread and prevalent in streams and groundwater. Almost all stream samples (97 percent) and half the groundwater samples contained at least one pesticide. Almost every fish sample also contained pesticides, but that does not necessarily translate to human health risks.

Finding low levels of pesticides allows scientists to detect and evaluate emerging issues and track contaminant levels over time. The pesticides commonly occurred in complex mixtures with over 70 percent of all stream samples containing five or more pesticides, and nearly a quarter containing more than ten. Chemical breakdown products, which may have similar or greater toxicities than their parent compounds, are often as widespread as their parents, and at higher concentrations.

While the concentrations of pesticides are generally low and within drinking water standards, the possible risks to humans, aquatic life, and wildlife remain unclear. Drinking water standards or guidelines do not include many contaminants and their breakdown products. Current standards also do not address the presence of multiple compounds or the impacts of brief pulses of higher concentrations due to seasonal variations.

These seasonal variations were detected in every basin, but the characteristics varied. In general, brief seasonal pulses of much higher concentrations followed lengthy periods of low concentration. In many streams that drain agricultural areas, the highest levels of nutrients and pesticides occurred during spring and summer

when recently applied chemicals were washed away by spring rains, snowmelt, and irrigation. Other agricultural areas may have had different patterns due to crop type and climate. In urban areas, the seasonal spikes were typically less pronounced. Pesticides used mostly in urban areas, such as prometon and diazinon, usually were applied in late summer and higher concentrations were detected at this time in many urban streams.

Patterns of contamination provide insight for tracking the origins of nonpoint source pollution. The types and concentrations of compounds found in certain bodies of water are closely linked to their use and land use in the surrounding area. Thus, water in urban settings typically has a characteristic chemical makeup or signature that differs from that found in agricultural or other settings.

For example, some of the highest concentrations of nitrogen and herbicides, particularly four of the top five herbicides used in agriculture, were detected in streams in agricultural areas. In urban areas, four compounds accounted for most of the insecticides detected. These compounds occur at higher frequencies and higher concentrations in urban streams than in agricultural ones. Insecticide concentrations were usually within EPA drinking water standards, but insecticide concentrations in every urban stream sample exceeded at least one guideline established to protect aquatic life.

In addition to water samples, NAWQA scientists have looked at toxins in urban stream and lake sediments. Concentrations of trace elements such as cadmium, lead, zinc, and mercury were elevated in populated urban settings, most likely due to emissions from industrial and municipal activities, and the widespread use of motor vehicles. These toxic compounds inevitably appear in fish. Because of bioaccumulation, concentrations of some toxic contaminants in fish tissue often are higher than concentrations in the sediment. Nationwide, one or more organochlorine compounds were detected in 97 percent of urban whole fish samples and PCBs were detected in more than 80 percent of whole fish samples. (See PBTs and NPS, page 22.)

Nonpoint source pollution also degrades biological communities. Pollution tolerant algae and aquatic invertebrates and omnivorous fish communities often dominate degraded areas. Three factors have been found to contribute to this degradation: nonpoint chemical contamination, accumulation of toxics in sediment, and habitat disturbance. Habitat disturbances can occur through channelization, deforestation, and increased impervious surfaces (parking lots, roads, etc.) and storm drainage. The latter causes dramatic fluxes in streamflow, often resulting in increased sediment erosion, organism removal, and removal of banks and instream habitat.

Natural factors (such as geology, hydrology, and soils) and land practices (such as tile drainage and irrigation) affect the vulnerability to contamination because they affect the transport of chemicals over land and into aquifers or surface waters. Even in areas with similar sources of contamination and land management strategies, differences in the natural environment can result in varying degrees of vulnerability.

NAWQA is now entering its second decade of studies. Forty-two study areas will be reassessed in the next ten years. NAWQA will increase its focus on understanding the links among sources of contaminants, the transport of contaminants, and the potential effects that contaminants have on humans and aquatic ecosystems.[1]

Current Approaches to Nonpoint Source Pollution Control

Next, Dov Weitman, chief of the Nonpoint Source Control Branch for the U.S. Environmental Protection Agency (EPA), reported on federal government programs and their success in addressing nonpoint source issues.

Federal Programs

Weitman began with the observation that in order to control nonpoint source pollution effectively, it is important to understand its elements and mechanisms. The most significant pollutant for rivers and streams is sediment. Nutrients and pathogens also are major pollutants. When sediments enter rivers and streams, they degrade or destroy habitats. Our radical transformation of the landscape is the root of our water quality problems. People have modified forests, grasslands, and prairies from their natural state to use them for timber, grazing, farming, and urban development.

The federal government became involved in nonpoint source pollution control when Section 319 of the Clean Water Act was enacted in 1987. This section was added because the original act only addressed point sources. Greater federal leadership also was necessary to focus state and local nonpoint source control efforts. While there are no federal regulations associated with the §319 program, EPA provides funds to states to deal with nonpoint source pollution issues. Much of the decision-making process is left to the individual states. However, current funding is inadequate. With the 50 states, tribes, and territories vying for $238 million, many necessary and worthwhile programs are unfunded.

In addition to funding, debate has arisen about the models currently being used to assess the success or potential success of controls. There are four areas of particular tension: 1) a technology based vs. water quality based approach; 2) a national, state or watershed scale for management and/or regulation; 3) a regulatory approach or voluntary mechanisms; and 4) focusing on prevention or remediation.

In the technology vs. water quality debate, the U.S. Department of Agriculture has traditionally favored a technological approach. This approach relies on the use of best management practices (BMPs) that should, and usually do, result in reductions of nonpoint source pollution. This approach, by itself, does not assure that the cumulative effects from multiple landowners and land uses within a watershed will achieve the water quality desired.

The water quality approach has its beginnings in the 1965 water pollution law. However, in 1972 Congress enacted a strong technology-based point source permit program in the Federal Water Pollution Control Act. The water quality approach lost favor when it became too cumbersome to effectively deal with point sources. With a new focus on controlling nonpoint sources, particularly at the watershed level, the water quality based approach has been revitalized.

Developing a national nonpoint source control program has been a daunting task. A program that focuses on a state or watershed, such as Total Maximum Daily Loads (TMDLs), is more likely to attain specific water quality standards. The primary problems with the TMDL program are: 1) knowing that specific prescribed measures taken by landowners will actually result in water that meets the set standard; 2) assuring that measures are implemented; and 3) providing the essential funding. (See TMDL sidebar, at right)

Much of the effort in controlling nonpoint source pollution has focused on providing incentives and fostering voluntary programs. These programs have resulted in significant reductions of nonpoint source pollution. However, completing the clean up of our waters is going to require that voluntary actions and BMPs be supplemented with measures that establish and assure progress towards attaining water quality standards. Establishing TMDLs,

TMDLs: Integrating Point Sources and Nonpoint Sources

In the past, U.S. water quality management has depended upon effluent-based water quality standards and the control of point sources of pollution. Using these standards, water quality improved but these controls did not achieve the national water quality goal of fishable and swimmable waters. This shortfall was due largely to unregulated nonpoint sources. Meeting the water quality goal required a shift from effluent-based to ambient-based water quality standards.

The total maximum daily load (TMDL) program is designed to meet these ambient water quality goals through the control of both point and nonpoint sources of pollution. A TMDL specifies the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and allocates the allowable pollutant load among point and nonpoint pollutant sources. States must develop TMDLs for all assessed waters determined to be impaired—about 40 percent of streams, 45 percent of lakes and 50 percent of estuaries (EPA, 2002).

TMDLs do not specify how to reduce pollutant loads, only how much should be controlled from point sources and how much from nonpoint sources. Thus, the current TMDL program is consistent with the findings and recommendations of the RNRF Congress delegates.

Although most TMDL determinations are required to meet an eight- to 13-year deadline (from 1992, i.e., 2000 to 2005), states have completed only a minute amount of the required determinations. States have claimed that they do not have the personnel or financial resources to assess the condition of their waters and to develop TMDLs. A 2000 Government Accounting Office (GAO) report found a pervasive lack of data available at the state level to establish water quality standards, to determine waters that are impaired, and to develop TMDLs. GAO's findings are in concert with the findings of the RNRF Congress that financial support for monitoring is woefully deficient.

Following the GAO report, the National Research Council (NRC) was asked by the U.S. Congress to assess the scientific basis of the TMDL program. NRC's recommendations were targeted at those issues where science can and should make a significant contribution, and at barriers to the use of science in the TMDL program. NRC found that the best available scientific information could be used through the adoption and use of adequate monitoring and assessment approaches, sound selection of appropriate models, and adaptive implementation.

The success of these approaches also is highly dependant upon the allocation of adequate personnel and financial resources for data collection, management, and interpretation and for the development of sufficiently detailed and stratified water quality standards.

Source:
Assessing the TMDL Approach to Water Quality Management, National Research Council, 2001 (http://books.nap.edu/html/tmdl/) and *The Twenty Needs Report: How Research Can Improve the TMDL Program*, U.S. EPA, 2002 (http://www.epa.gov/owow/tmdl/techsupp.html).

particularly in conjunction with well-tailored voluntary BMPs, can lead to the achievement of desired water quality.

The necessary direction provided by the §319 funds is critical for the program's success. Weitman discussed the need to focus on impaired waters. Of the $238 million available, EPA guidelines provide that $100 million be used on problem areas. EPA also has been promoting the increased use of §319 funds for the development of watershed-based plans to guide implementation in watersheds containing impaired waters.

New directions from the Office of Management and Budget (OMB) demand that agencies quantify the success of their programs. EPA needs to show that money spent on control programs is yielding results. Thus, numerical goals must be developed. They will help the agency respond to this requirement. However, to establish and meet these goals requires sufficient monitoring to assure that the results are attainable and progress is being made.

The new farm bill will provide the U.S. Department of Agriculture (USDA) with $700 million for the Environmental Quality Incentives Program (EQIP) and $1 billion in 2004 for EQIP and Conservation Reserve Programs. (See page 19) The question remains, however, whether this influx of money will be focused effectively on water quality problems and thus have a positive effect on water quality.

In closing, Weitman emphasized that the primary ways to affect water quality are through education, and the proper appropriation and use of funds.

State Programs

Jim McElfish, senior attorney and director of the Sustainable Use of Land Program of the Environmental Law Institute, presented an update on methods that states are employing to control nonpoint source pollution. He reiterated the lack of federal enforcement or regulatory authority associated with the nonpoint source provisions of the Clean Water Act. He also reported the resulting need for states to take necessary actions beyond planning and technical assistance. Traditional methods of planning, technical assistance, voluntary BMPs, cost sharing for BMPs, and publicly-funded stream buffers have been largely insufficient. States need to develop enforceable mechanisms that can be used to protect their waters.

These mechanisms are of two types, prescriptive and after-the-fact. Prescriptive mechanisms include pollution abatement orders, required operating practices and regulations (or mandatory BMPs), discharge prohibitions, and direct enforcement of water quality standards. After-the-fact mechanisms include nuisance and misdemeanor prosecutions for impacts on public health.

The federal government also has provided some influences on the mechanisms employed by states. The Coastal Zone Act of 1990 requires coastal states to develop "enforceable policies" in order to receive coastal zone and §319 funding. EPA's stormwater program requires bringing stormwater discharges previously classified as nonpoint sources, into the point source scheme. TMDLs require states to assess impaired waters, determine the sources of pollutants, allocate these to nonpoint and point sources, and address the revealed problems through state mechanisms. Finally, concentrated animal feedlot operations (CAFOs) regulations are being developed by EPA for implementation by the states.

The Environmental Law Institute conducted a series of studies on state nonpoint source enforcement authorities and programs considering the variety of mechanisms available to control nonpoint source pollution. (The studies are available at http://www.eli.org under "Research"). One incidental but significant finding of the study is "How little monitoring data exist to assess the effect of any nonpoint source programs on water quality. Indeed, even where water quality data exist for a particular place and time—demonstrating nutrient impairment for example—there is rarely comparable data from an earlier and later time that can show trends. Thus, program effectiveness is expressed in this study in terms of compliance with standards, norms, or BMPs that are believed to protect water quality."

The study also found that enforceable mechanisms are already at least a small part of most states' nonpoint source programs. Mechanisms related to sediment and erosion control regimes associated with land-clearing activities were common. Forest BMPs have been implemented in all states according to the National Association of State Foresters. However, in 23 states that reported on implementation and compliance, a compliance rate of only 86 percent was cited.

Animal feeding operations are a major contributor to nonpoint source pollution. Voluntary measures have proven insufficient because of the costliness of many of the remedies, even with available cost-sharing provisions. States also must recognize that some nonpoint dischargers will not respond to voluntary measures even if cost sharing is available. Thus, back-up mechanisms, including, "bad actor" provisions (as a last resort), should be available.

Many states already have embraced the watershed approach and geographically targeted their programs with varying degrees of success. Maryland and Virginia have focused on the Chesapeake Bay; Wisconsin has had priority watersheds since 1978 but currently is phasing them out in favor of a statewide approach; and Georgia has a river corridor protection program that is mandatory by statute but has become voluntary in practice.

Technical assistance and cost sharing have become extremely significant in nonpoint source control. Many states depend upon §319 or farm bill program funds. A significant number of states, including Maryland and Wisconsin, provide their own investments in cost-sharing programs. However, the relationship between cost-sharing dollars and enforcement varies. In some cases, there is no explicit link, while in others, there is an informal understanding. Some programs, such as Maryland's mandatory nutrient planning, provide cost-sharing money to support a specific regulatory program. In Ohio, nonpoint source abatement orders are prohibited unless cost-share funds are provided.

McElfish concluded with the example of Maryland's nonpoint source program, calling it one of the most comprehensive and integrated programs using enforceable mechanisms and cost-share arrangements. Program elements include "no discharge" authority, mandatory nutrient planning for agricultural operations, grading and clearing permits for land clearing greater than 5000 square feet, a forest conservation law, a Chesapeake Bay Critical Areas Law, and substantial cost-share funding including up to 87.5 percent for agricultural cost-sharing, and up to 50 percent local property tax credit for agricultural land with soil and water quality plans and nutrient management plans.

Case Study: *Chesapeake Bay*

As McElfish reported, Maryland has taken great steps to control nonpoint source pollution. The impetus and primary beneficiary of these measures is the Chesapeake Bay. The Bay is North America's largest estuary and provides an excellent example of what can be done and what still needs to be done to control nonpoint source pollution. The case study provided delegates with a brief course on the Bay Region with a particular focus on nonpoint source pollution.

Overview

Donald Boesch, president, University of Maryland Center for Environmental Science, provided delegates with an overview of the Bay including the nature of the problem, the progress made and likely future challenges.

The region has come to be seen as a leader in the use of a watershed approach to protect a natural resource. Even with such a concerted focus, there seem to be few clear indications of progress. New and greater efforts are necessary to halt and reverse environmental degradation.

The Bay is a large rather shallow coastal plain estuary with a relatively large watershed in relation to its volume. The watershed includes portions of six states: Maryland, Virginia, Delaware, Pennsylvania, West Virginia, New York; and the District of Columbia. A mix of land-use types throughout the watershed leads to a diverse array of inputs to the Bay. For example, rapid metropolitan growth is occurring in parts of Maryland, Pennsylvania and around Washington, D.C. Significant areas of agricultural land also exist throughout the watershed, and a large atmospheric catchment area is vulnerable to atmospheric deposition of pollutants (see page 23).

The greatest challenge in the Bay and across the country is nutrient pollution. Nutrient over-enrichment leads to increased primary aquatic plant/algae production, resulting in increased oxygen demand and anoxia.[2] This promotes a shift in the biological community structure, reflected in harmful algal blooms and the replacement of sea grasses by macroalgae.

The Chesapeake Bay has seen a substantial decline in submerged sea grasses. In the 1970s, researchers showed that excess nutrient pollution stimulated the growth of small algae that grow on the surface of the sea grass leaves. These "epiphytes" can become so dense that they effectively shade the sea grasses and prevent them from conducting photosynthesis. The result has been a serious disappearance of sea grasses from nearly 90 percent of the 600,000 acres it can potentially inhabit.

Anoxia and hypoxia[3] also have occurred in the Bay with a three-fold increase in volume since 1950 (3 billion m^3 in 1950s to 10 billion m^3 in 1990s). Coastal eutrophication[4] also has increased across the country during this period. A NOAA study of 138 coastal estuaries found that 44 had high levels of eutrophication, and an additional 40 had moderate symptoms.

The Gulf of Mexico's "Dead Zone" is probably the most famous hypoxic area in the United States. It has been as large as 12,000 square miles, but varies seasonally and from year-to-year. Excess nutrient runoff, landscape alterations and river channelization have been found to be the leading causes. About 90 percent of the nitrate load comes from nonpoint sources, particularly agricultural lands along the upper Mississippi and Ohio Rivers, nearly 1,000 miles upstream from the river's mouth.

The Chesapeake Bay Program undertook the development of models to gauge the problem more accurately and to determine the role various changes in the region would have. Three models simulating interconnected regional elements were developed: an air-shed model, a watershed model, and an estuary model. Based on these models, we have seen a decrease in both total nitrogen load and total phosphorus load (largely due to reductions in point sources of pollution), but still have not met the goal established in 1987 of a 40 percent reduction by 2000. In fact, inputs from the nonpoint sources have not decreased.

To meet current goals for the Chesapeake Bay, key changes must be made. These changes include increased fer-

tilizer efficiency and reduced application, more effective manure management, waste management to reduce nitrogen loss, and a greater emphasis on perennial cropping. In addition, restoration of wetlands and riparian zones must be part of the solution, along with the significant reduction in NO_X air emissions.

Implementation

Lauren Wenzel, deputy director, Education, Bay Policy and Growth Management, Maryland Department of Natural Resources, concluded the case study with a look at the resources and methods that have been used to protect the Bay.

As Boesch observed, the Chesapeake Bay is a regional resource that requires regional cooperation to solve its problems. The Chesapeake Bay Agreement, signed in 1983, is the framework for regional cooperation. This agreement has brought the governors of Maryland, Virginia and Pennsylvania, the mayor of Washington, D.C., the U.S. EPA administrator, and the Chesapeake Bay Commission together in an effort to protect the Bay.

The concept of tributary strategies was introduced in 1992 to help meet the nutrient reduction goal. Strategies were to be developed by the states for each major river basin and would thus reflect the land use and nutrient sources within each basin. Additionally, all major sewage treatment plants within the watershed were to install nutrient removal systems. The strategies had five primary criteria. They needed to be cost effective, efficient, applicable, fair, and achieve the 40 percent input reduction goal. In implementing these strategies, key practices for reducing nutrients were identified along with efficiencies and implementation targets. The cumulative result of these practices was to be the 40 percent load reduction target.

Maryland brought local governments into the process through partnership agreements. These agreements provided tools for implementing tributary strategies. Maryland and Virginia also established tributary teams, comprised of stakeholder groups, to help implement the strategies.

Although significant progress was made in implementing the strategies, the 40 percent reduction goal was not met. There was a need for a renewed commitment to the Bay. It came in the signing of the Chesapeake 2000 Agreement. This agreement looks to five missions for further progress: living resource protection and restoration, vital habitat protection and restoration, water quality protection and restoration, sound land use, and stewardship and community engagement.

The agreement set goals of removing all nutrient and sediment impairments to tidal waters by 2010, mandating zero release of chemical contaminants from point sources, implementing watershed plans for two-thirds of the Bay watershed by 2010, and continuing efforts to reach and maintain the 40 percent input reduction.

These new water quality goals are to be met using new tributary strategies that are cooperative, watershed-based, comprehensive and strategic. The new strategies are necessary to meet the more stringent nutrient goals and the new goals for sediments, habitat and land-use. They will focus on implementation, funding and coordination with the establishment of TMDLs.

Maryland has taken the lead in the implementation of these strategies and has focused on five nodes.

- **Urban Land:** To deal with stormwater, a new stormwater manual has been developed along with a greater focus on the use of nonstructural solutions such as rain gardens. However, providing continued funding for maintenance is a major challenge. Septic systems also have proven to pose significant problems in some watersheds. Use of nitrogen removal systems is being evaluated.
- **Agriculture:** Cost-sharing programs have been a major component of the control strategies. The programs fund up to 87.5 percent of costs. Use of cover crops, particularly in fall, helps remove nitrogen from the groundwater and reduces soil erosion. Nutrient management plans now are required. In the management of animal waste, phytase is required in feed to reduce phosphate, and focus has been placed on the proper storage and application of manure and ammonia management. A manure matching service and cost-share funds for manure transport also have been used.
- **Resource Protection:** Over 350 marine pump-out stations have been installed using cost-share funds and the Clean Vessel Act. "No discharge" zones have been established in sensitive areas. More than 600 miles of streamside buffers have been planted. A critical areas law limits development within 1,000 feet of tidal waters, and limits density and impervious surfaces. Shoreline protection also has been an important focus, particularly through the establishment of "living shorelines."
- **Habitat Goals:** Restoration and protection goals have been established in each tributary basin for wetlands, forests and streams.
- **Public Involvement and Education:** Community "wade-ins," newspaper supplements, mass media campaigns and youth summits have been implemented to raise public awareness.

Several key challenges still exist in the Chesapeake Bay watershed. These challenges include implementing major new pollutant reductions, maintaining a cap on pollutants—particularly in the face of continued growth, developing new technologies, changing environmental behavior, getting simple messages to the public, and reversing

Eight Tools For Watershed Planning

1 Watershed Planning: Watershed planning applies land use planning techniques, such as watershed-based zoning, performance zoning, impervious overlay zoning, urban growth boundaries, large lot zoning, infill/community redevelopment, and transfer of development rights to redirect development, preserve sensitive areas, and maintain or reduce the impervious cover within a given watershed.

2 Land Conservation: Watershed managers must decide which natural resources must be conserved. Typically, lands to be conserved in a sub-watershed can be categorized as critical habitats, aquatic corridors, hydrologic reserve areas, water hazards, and cultural areas. Depending upon the categorization, different conservation techniques such as land sale to a land trust, land alteration regulation, hazard regulations, and open space development can be used to safeguard the land. These techniques range from absolute to very limited protection.

3 Aquatic Buffers: Aquatic buffers physically protect and separate a stream, lake, or wetland from future disturbance or encroachment. These buffers can regulate light and temperature conditions, remove bacteria, nutrients, and sediment from ground and stormwater, and stabilize and protect the streambed. Due to the importance of buffers, careful consideration about which kinds of buffers and their width is important.

4 Better Site Design: Better site design attempts to reduce the impact of site development through improved plans dealing with residential streets and parking lots, lot development, and conservation of natural areas. These plans utilize techniques such as vegetated islands that provide stormwater filtration, shorter driveways, narrow streets, and alternative pavement for overflow parking in order to reduce impervious cover. The better site design tool appears to function the greatest in sub-watersheds that are approaching their maximum impervious cover limit.

5 Erosion and Sediment Control: Erosion and sediment controls help mitigate the impact of development. During the clearing and grading stage, vegetation is removed exposing the topsoil to erosion. This alters the topography and drainage patterns leaving the receiving waters more vulnerable. By using erosion and sediment control measures, sediment loss during construction is reduced and conservation areas, buffers, and forests are not cleared.

6 Stormwater Management Practices: Stormwater management practices (SMPs) are techniques of building ponds, wetlands, infiltration surfaces, filtering systems, and open channels to maintain groundwater recharge and quality, reduce stormwater pollutant loads, protect stream channels, prevent increased overbank flooding, and safely convey extreme floods. Determining the primary stormwater objectives for a sub-watershed will govern the selection, design, and location of stormwater management practices at individual sites.

7 Non-Stormwater Discharges: Non-stormwater discharges such as septic systems, sanitary sewers, industrial National Pollution Discharge Elimination System (NPDES) discharges, urban "return flow" water diversions, and runoff from confined animal feeding lots can contribute significant pollutant loads to receiving waters. A number of strategies can be used to minimize these discharges: inspections of private septic systems, repairing or replacing failing systems, utilizing more advanced on-site septic controls, identifying and eliminating illicit connections from municipal stormwater systems, and implementing spill prevention techniques.

8 Watershed Stewardship Programs: Watershed stewardship strives to increase public awareness about watershed management efforts and to get participation in the process to ensure stewardship on private property and homes through watershed advocacy, watershed education, pollution prevention, watershed maintenance, watershed indicator monitoring, and watershed restoration. Within the context of watershed education, the four main focuses are watershed awareness, personal stewardship, professional training, and watershed engagement.

Source:
Tom Schueler, http://www.stormwatercenter.net/Slideshows/8tools%20for%20smrc/sld001.htm

(despite significant efforts) the lack of progress "in the water" in many areas.

Urban Development's Impact on Water Quality

Urban development and the increase in associated impervious surfaces have had a significant impact on water quality. Tom Schueler, executive director of the Center for Watershed Protection, provided delegates with information on the extent of the impact and steps that can be taken to lessen it.

The increasing effort and commitment to combating urban nonpoint source pollution has been a response to the increased severity of the problem. Conversion of land is the principal culprit. Over 2.5 million acres of land have been developed resulting in 50,000 to 100,000 miles of streams with degraded habitat, diversity and water quality. This loss of stream quality intensifies the impact of nonpoint source pollution on other water resources such as beaches, estuaries, rivers and lakes.

The amount of impervious cover associated with development is a good indicator of the quality of surrounding streams. Such impervious cover includes parking lots, roadways, buildings, roofs, driveways, and sidewalks. At less than 10 percent impervious cover, good water and stream quality can be maintained. Between 10 and 25 percent impervious cover, suburban streams exhibit a loss of biodiversity, higher pollutant loads and unstable stream channels. Once impervious cover exceeds 25 percent, the streams are largely non-supporting of aquatic life due to increased bacteria, pollutants and poor water quality. At 60 percent, the streams have become little more than urban drainage systems.

When impervious cover is maintained at less than 10 percent, other factors provide better indications of the stream's quality. Such factors include the proportion of the watershed with forest cover, the percentage of cultivated lands, and the percentage of riparian continuity (the proportion of drainage network that has stable streamside forest).

Over 300 studies have evaluated the relationship between impervious cover and hydrologic indicators. The studies show that as impervious cover increases, so does run-off, flooding and channel enlargement. This leads to a decrease in stream quality—degraded pool and riffle structure, changes in velocity, an increase in temperature, and a loss of "large woody" debris. Water quality also decreases due to the collection of pollutants, including metals, pesticides, and chloride, from the impervious surfaces. Diversity also is affected with a decrease in insect, fish and amphibian species.

Eight basic tools have been developed for watershed planning. (See page 15.) Little research has been performed to evaluate the effect of these practices. In the few watersheds where these practices have been implemented, research has shown a decrease in nitrogen, phosphorus and bacteria. Aquatic biodiversity, however, has seen little change.

Concentrating on small watershed provides the best opportunity for reductions in urban nonpoint source pollution. These small watersheds typically are two to 10 square miles and allow easy organization of resources and implementation of the eight tools for watershed protection.

Streams can be classified in a number of ways. One system relates stream and watershed characteristics to future potential water quality characteristics. In sensitive streams, even low intensity residential development will degrade quality because one- to two-acre lots can result in 10 to 15 percent impervious cover. Impacted streams will decline in quality. However, through application of the eight tools and goals for retaining forest cover and riparian continuity, much of the quality can be maintained. Non-supporting streams are not likely to ever support a full range of designated uses. They constitute most of the key TMDLs and regulatory problems.

If non-supporting streams are in areas with 25 to 45 percent impervious cover, restoration is possible. Above 45 percent imperviousness, a surface stream likely cannot be restored. However, smart growth principles applied in these non-supporting watersheds can provide protection for more sensitive areas. An urban drainage classification for streams with high impervious cover should be developed.

Communities have excellent opportunities to care for their streams but municipal resources have not been organized. Therefore, implementing a "Smart Watershed Program" can help organize municipal efforts to achieve watershed protection.

Four essential points need to be examined for effective watershed protection.

- Use of the correct unit of production (small watershed).
- Increase demand for nonpoint source pollution control, and for mechanisms such as land trusts and smart growth.
- Set standards of performance.
- Require a multidisciplinary approach for watershed protection.

Endnotes

[1] To access data, publications, findings and maps from the NAWQA program see http://water.usgs.gov/nawqa.

[2] Anoxia is the complete absence of oxygen in the water.

[3] Hypoxia is a condition where dissolved oxygen levels drop below 2 mg/L.

[4] Eutrophication is the long-term increase in the biological productivity of an ecosystem—often as a result of excess nutrients.

Controlling Nonpoint Source Pollution

Just as nonpoint source pollution is caused by multiple sources and land-uses, controlling it requires a multi-faceted approach involving education, legislation, research, and monitoring. Some components may take longer to achieve noticeable results, but this is no reflection on their importance. Raising public awareness and changing habits are key components of any control strategy, but they will likely require a long-term sustained education effort. There are steps that can be taken, particularly by government, resulting in immediate and lasting effects.

Delegates to the RNRF congress recognized that government has an important role in controlling nonpoint source water pollution. Responsibilities should be divided among the levels of government in recognition of their capabilities. Many of the programs advocated by the delegates rely on the knowledge and experience gained from current programs focused on controlling nonpoint source water pollution.

Programs such as Best Management Practices (BMPs) and Total Maximum Daily Loads (TMDLs) provide valuable lessons for formulating a multi-faceted and integrated approach to nonpoint source pollution control. While BMPs have made important contributions to improving water quality, as the sole approach they are insufficient. (See page 18 for more information on BMPs).

TMDLs place a greater focus on the characteristics of a particular region, and take into account all sources of water quality impairment. (See page 11 for more information on TMDLs). Utilizing BMPs in conjunction with TMDLs can lead to significant improvement in water quality.

In addition to taking the lead through further development and integration of these control programs, government must recognize the need for leadership and support of essential components of a nonpoint source pollution control strategy.

The Role of Government

One clearly recognized role of government is providing the tools necessary for evaluating and implementing control strategies.

Monitoring

Monitoring data[1] are essential for gauging progress and understanding the effects of control strategies. The government cannot set standards of performance, determine controls, and establish goals unless it has data upon which to base those decisions. Currently data are limited and come from multiple sources in forms that are not easily integrated.

EPA charges states and tribes with most of the responsibility for monitoring in compliance with EPA programs. The quality and quantity of monitoring data vary by state and depend largely on the states' financial resources, commitment, and political interest.

USGS conducts extensive chemical monitoring through its National Stream Quality Accounting Network (NASQAN) at fixed locations on large rivers across the country.

The NAWQA program uses a regional focus to study status and trends in water, sediment, and biota. The U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, and Tennessee Valley Authority conduct their own water-quality monitoring to support their programs and activities. As Jim McElfish noted, despite this collective effort, there is little monitoring data available to assess the effect of any nonpoint source control program on water quality.

Water quality monitoring is an essential element of any program to control nonpoint source pollution. Despite its importance, monitoring is chronically under-funded and usually the victim of budget constraints. Such underfunding is likely due to the mindset that funding activities and programs is more desirable than collecting data.

One highly important program laid victim to funding reductions is NAWQA. Congress established NAWQA in 1991 to assess 59 study units that covered 65 percent of drinking and irrigation water in the U.S. Budget cuts in 2001 led to the elimination of 13 study units and the combining of eight units into four. Further proposed cuts would eliminate six more units, leaving only 36 study units. These cuts would cripple NAWQA's ability to fulfill its original design to assess our nation's water quality.

An adequate water-gage network, particularly in streams and lakes requir-

ing the development of TMDLs, is essential. Without the proper tools to identify, and then allocate, waste loads on a scientific basis, progress in establishing TMDLs will be hindered and subject to challenges. Water resource professionals at the RNRF congress estimated that adequate monitoring data would require at least twice the current funding, and that the long-term benefits would far outweigh the costs.

Research

Government also should fund research into some of the most pressing questions in nonpoint source pollution control. Research needs include: 1) developing the highly efficient modeling and monitoring tools necessary to evaluate control potential and progress, 2) assessing alternative agricultural methods and application methods that produce less pollution, 3) reducing the uncertainty in the effects of pesticides and other contaminants, 4) studying human beliefs, behaviors, awareness and preferences related to nonpoint source pollution including household waste and yard management practices, and 5) improving tracking of chemical use to attribute specific pollutants to sources to support management decisions.

Other Tools

Other tools that government should develop and improve are models and templates. These tools must be appropriate for a particular ecosystem, watershed, issue, or locale. One size does not fit all. Appropriate monitoring is important to the proper functioning of these tools—they depend on data for validation or verification.

Technical assistance is another important tool but it must be tailored to fit the needs and abilities of the community. Existing programs such as Cooperative Extension—administered through land-grant colleges and universities—and Natural Resources Conservation Service (NRCS) programs already provide high quality technical assistance. However, Cooperative Extension recently has suffered significant funding cuts. This on-the-ground program needs to be expanded to reach both rural areas and those currently underserved in urban/suburban areas (e.g., homeowners, gardeners).

BMPs and the American Agricultural System

While nonpoint source pollution cannot be attributed to one land-use type, agriculture has a key role in its control. Agricultural land constitutes over 50 percent of the continental U.S., while urban areas comprise less than five percent. The EPA's *National Water Quality Inventory* reports that agriculture is the leading source of impairments to surveyed streams, rivers and lakes. (EPA, 2002).

The Case of Cropland

In the 1950s, fossil fuel based agricultural production systems were introduced and American agriculture shifted from a nutrient cycling system to an input/output system. Such systems almost exclusively derive necessary nutrients from outside inputs. Reliance on these outside inputs has caused farm operations to specialize, standardize and simplify. This specialization and the current system of subsidies has led to decreased crop diversity and dependence on fossil fuel inputs for fertility and pest control. Agricultural price supports have led farmers to increase inputs of fertilizers, pesticides and irrigation water in the hope of maximizing yield. This shift in farming operations also has led to soil degradation, nutrient pollution and imperiled water systems.

The current farming system relies on best management practices (BMPs) to reduce impacts on surrounding water resources. BMPs are a combination of management, cultural, and structural practices that agricultural scientists, the government, or some other planning agency decides upon to be the most effective and economical way of controlling problems. They constitute a technological approach to controlling nonpoint source pollution. The goal is to make impacts on water quality acceptable. However, it must be recognized that BMPs are not universally effective; they have varying degrees of success depending upon soils, hydrology, weather and location in the watershed. A comprehensive assessment of current BMPs and their success in different environments should be conducted.

Present day economics of farming leave little margin to implement the necessary BMPs. Consumers expect cheap food while farmers incur high costs for fuel, fertilizers, pesticides and equipment. Measures to control nonpoint source pollution only add to these costs. In fact, many farmers lease farmland from large corporations at rates that do not provide for soil and water conservation measures in the overall cost of production. Farmers look to the government to provide the financial assistance necessary to implement BMPs. Such financial assistance could come in the form of subsidies or through §319 cost-sharing programs. The reinvigoration and reauthorization of conservation programs associated with the farm bill may provide the needed impetus and resources. Sustainable farming methods must be advanced—and powerful farm interests must be overcome.

Financial Incentives

Financial incentive programs are important but require funding or the forgoing of revenue. Financial incentives can take the form of subsidies or tax credits to support prevention and restoration projects, or foregone revenues in recognition of nonpoint source reduction activities.

The recently passed Farm Bill provides and continues these types of incentives in agriculture through the creation or enhancement of programs like the Conservation Reserve Program (CRP), Wetlands Reserve Program (WRP), and Environmental Quality Incentives Program (EQIP).[2] However, sustaining funding and farmer participation are key.

Very few programs of this type exist for nonpoint source pollution associated with urban or suburban areas. They should be developed and implemented. Individual landowners, whether they are developers, farmers, ranchers, mine or commercial forest operators, or suburban residents, make land use decisions with little direct legal or financial incentive to consider the effect on hydrological processes and water quality. They rarely consider how adding impervious surface or applying extra fertilizer contributes to nonpoint source pollution.

Providing tax credits for good practices, and providing cost-share funds for projects can help motivate people to "do the right thing." Another incentive could be the granting of impervious surface credits and the establishment of credit banks that would encourage reductions in impervious surfaces. When providing incentives, government must be sensitive to the balance between private property rights and the need for behavior modification.

Education

Education is a crucial component of any control strategy. The government's role in education includes ensuring that there is adequate funding for necessary materials and instruction. One means of securing this funding is through taxes on consumer products that contribute to the nonpoint source pollution problem. These products include fertilizers, pesticides, and herbicides.

While such a tax will not likely alter the public's purchasing habits immediately, it will raise awareness ("What is this extra five cents for?") and provide funds for a much needed education effort. Requiring a water education component in secondary schools also is essential. Government also is responsible for the proper education of its employees. For more recommendations regarding the nonpoint source education need, see page 20.

Legislation

Legislation must be properly framed to accomplish nonpoint source pollution control goals. Zoning and planning laws in particular can be utilized to encourage environmentally sensitive development patterns and on-site mitigation techniques. For example, Baltimore County, Maryland required broad riparian buffers and stormwater containment areas in the newly developed Owings Mills New Town.

Many existing laws do not recognize the interconnectedness of resources. Linking and clarifying relevant existing laws to provide nonpoint source pollution control can strengthen current control programs. For example, instances of breast cancer on Long Island prompted New York to pass the Neighbor Notification Act for pesticides. The act focused on the transport of pesticides through the air but did not recognize the significant impact pesticide application has on water resources. Such a law could have provided an opportunity to recognize the role pesticides play in nonpoint source pollution—and do something about it.

Exemptions from nonpoint source regulations must be drastically curtailed or eliminated. Nonpoint source pollution will not be controlled if large numbers of polluters are exempted from regulations. For example, some states have laws that limit the discharge of any substance without a permit, but statutory or regulatory exemptions may be given for forestry or agricultural activities.

When framing regulations, it is important to include the eight tools for watershed planning introduced by Tom Schueler. These tools are: watershed planning, conservation, aquatic buffers, better site design, erosion and sediment control, stormwater management practices, non-stormwater discharges, and watershed stewardship programs. See page 15.

Performing the Roles

Natural resources—including water and air—do not recognize political boundaries but must be protected and managed by entities that do. Thus, an effective division of labor among governments must be determined. All delegates recognized the importance of considering local land and water characteristics, and the needs of local communities. Ultimately, whatever is done to control or mitigate nonpoint source water pollution will be done locally. An approach that was popular among delegates was to recognize the leadership of the federal government in establishing a framework and goals, and in providing knowledge and skills, while looking to state and local governments to develop strategies for implementation and advance communication and educational opportunities.

Regional management structures with authority to address inter-jurisdictional pollution issues, particularly at a watershed level, need to be developed. In designing these structures, we need to study current models, such as Soil and Water Conservation Districts, Florida's Water Management Districts, and Nebraska's Natural Resource Districts. These models for regional cooperation can work effectively within

states. However, management of watersheds that extend beyond state boundaries presents a much greater challenge. There are no regional government structures in the United States that have the authority necessary to deal effectively with nonpoint source water pollution. Only the federal government, through its constitutional interstate commerce powers, could enforce a regulatory regime to protect a multi-state watershed. River basin commissions are a good example of scope and cooperation, but they lack the necessary authority. There is no consensus in the United States Congress (or among the public) that such federal action is warranted at this time.

Developing Partnerships

Developing partnerships is essential to accomplishing local and regional goals. Partnerships among governments also are necessary to improve cooperation and effectiveness. The use of memoranda of understanding (MOUs)[3] between and among agencies can solidify these partnerships. MOUs can benefit particularly from directions provided by the relevant congressional committees. In 1992, the EPA and USGS signed an MOU to provide the framework for cooperation in the conduct of water quality monitoring and assessment activities.

Partnerships such as the Chesapeake Bay Program[4] can provide the framework for other regional and intergovernmental cooperatives. These interagency partnerships would likely require executive or legislative orders to integrate activities or programs.

A mentoring or exchange program between and among state and federal agencies could build cooperation and understanding as employees learn the challenges, goals and constraints of other agencies. For example, an NRCS or USDA Forest Service employee with responsibility for implementing BMPs could be assigned to the EPA Nonpoint Source Control Branch for six months, or an EPA employee could be assigned to work in the North Carolina Department of Environment and Natural Resources' Nonpoint Source Office.

Partnerships between government and nongovernmental organizations (NGOs) also can improve program effectiveness. Section 319 of the Clean Water Act could fund NGOs to organize river basin facilitation, bringing all interested parties in the watershed together to develop strategies to solve local nonpoint source problems.

However, an NGO must remain independent and have the freedom to advocate a position that may be contrary to the supporting agency. NGOs also may be ideal for forming clearinghouses of watershed and nonpoint source information.

Education

While significant progress can be made through the actions of government, education for all segments of society is critical for long-term success. The Clean Water Act and other environmental efforts of the past thirty years have given society a good understanding of point source pollution from factories and sewage treatment plants.

Nonpoint source pollution has not received the same attention. Thus, most people are unaware of nonpoint source pollution and how their behavior contributes to the problem. Nearly nine in 10 Americans (86 percent) are unfamiliar with the term nonpoint source pollution (National Geographic Society, 2001). This situation presents an obvious question. How can people be made aware of their role and thus change their habits?

Regional workshops and meetings should be conducted to foster issue awareness and participation among essential interests and regional leaders. Such workshops would feature opportunities for natural resource professionals to come together to discuss issues specific to that region. These workshops also should include participation by schoolteachers and community volunteers. These influential people can amplify the message by bringing it to their classrooms and community.

Legislators

Educating legislators must be a prominent part of the strategy to combat nonpoint source water pollution. Legislators are key decision-makers who must understand the problem and the best control strategies.

Many political decisions have impacts on water quality. Particularly at the local level, land-use decisions require consideration of many complex community issues, including natural resource management and use. Through watershed management classes or programs such as Nonpoint Education for Municipal Officers (NEMO)[5], officials can learn about the issues and make better decisions in the future.

Showcasing pilot projects and success stories can provide legislators with information about measures that work.[6] However, the reasons behind a project's success must be understood. Did a particular area's demographics, geography or political climate contribute to the success? Can a "repeatable recipe" be developed? Many of the reported success stories are in narrative form, but legislators typically desire results reported with numbers and statistics to fully understand the impact of the successes and to communicate them to others. More importantly, legislators need statistics on the cost of nonpoint source pollution to society. What impact has it had on the economy, jobs, and human health?

Communication with legislators can be enhanced by showing how issues are affecting their constituents. Pointing out the causes of decreases in underwater grasses in the Chesapeake Bay or oyster disease in North Carolina, can bring urgency to a problem.

In addition to using local examples,

the message can be more effective if delivered by local citizens. Regional workshops can be an excellent means of educating people and stimulating action. The issue should be presented in an easily understood manner. The building of coalitions, particularly among organizations not typically linked, can be especially effective in raising awareness and building credibility with legislators.

Resource Professionals

Natural resources professionals have varied backgrounds and responsibilities, but many of their actions impact water quality. Assuring that these impacts are understood and anticipated is essential. Professional societies can improve awareness and practice through continuing education, certification and publications.

Some congress delegates thought that a certification program for nonpoint source professionals would be ideal. Certification could be awarded through an umbrella organization that brings together all relevant professional societies. Certification would require a training base in elements of biology, chemistry, hydrology, soils, forestry, statistics, geography, GIS, geology, economics, social sciences, engineering, public policy, and communications.

Some delegates believed establishing a new nonpoint source professional society was warranted. It could raise awareness of both the public and natural resources professionals. Another suggestion was that the State Water Resources Research Institutes (WRRI)[7] be revitalized as coordinators of these activities. Finally, some delegates believed that existing professional societies already are making good efforts in addressing various facets of the nonpoint source problem. They thought that existing support from government, academia and private industry should be consolidated in support of these continuing efforts.

The Public

Americans generally lack basic knowledge about their water resources. They fail to appreciate that they are part of a larger interrelated system in which their actions have negative effects, and they are unaware of the extent to which waters are in danger. Only 17 percent identified human actions in the watershed—agricultural run-off and urban sprawl—as the major threats to rivers (National Geographic Society, 2001). The complexities of nonpoint source pollution make public understanding an even greater challenge. Yet, the public is key to success.

Using the Media

Creating a nonpoint source marketing campaign would be a valuable first step in raising awareness. Successful programs from other natural resource sectors, like Smokey the Bear or Woodsy the Owl, can be models. An easily recognized nonpoint source logo, mascot, and slogan should be developed. One popular suggestion in developing a marketing campaign was to change the name of "nonpoint source pollution." Another term might be more descriptive and easily understood by non-scientists. Although there was no consensus on the new name, some suggestions include: watershed pollution, runoff pollution, polluted runoff, pointless pollution, phantom pollution, and personal pollution.[13]

Better utilization of existing resources in the media could contribute to a more informed public. For example, weather forecasters could teach television viewers about nonpoint source pollution. They already are adept at explaining technical information about the weather in terms that are easily understood.

Weather forecasters could introduce the concept of watersheds and give current hydrologic and water quality conditions. A nonpoint source university for weatherpeople, reporters and other important media personalities could improve reporting on water quality issues.

Targeted public service announcements can raise awareness at opportune times. For example, Memorial Day weekend would be an ideal time to explain how to properly apply fertilizer on lawns. Integrating nonpoint source pollution education concepts into relevant television shows, such as on HGTV (Home and Garden Television), also will convey the message to an important audience.

Create a Sense of Place

It is important to instill in people a sense of place. When people feel that they are part of a community, they are more sensitive and concerned about how their actions affect their environment. Creating a sense of place requires making people aware of their ecological "address" and knowing their local watershed (e.g., Bethesda, Maryland, Middle Potomac Watershed).

One way of bringing the local watershed into people's consciousness is through an introduction to their local stream, and how their activities impact that stream. One suggestion was to have an "Adopt a Stream" campaign, just as groups "Adopt a Highway" to keep communities litter-free. Some communities already have begun to provide signs letting people know that they are crossing into a particular watershed, but the practice needs to be expanded across the country.

Community groups such as Kiwanis and Rotary clubs could be effective in raising awareness about nonpoint source pollution. These groups are dedicated to serving their communities and helping people all over the world. Volunteers usually are active in their communities and could be effective in teaching others. Volunteer monitoring programs have begun across the country and have been effective in educating people about the environmental dynamics within their local watershed.

Other community resources can be

used to raise awareness. When the local health department issues polluted river warnings or fish advisories, it should take the opportunity to explain the causes of those warnings and how everyday activities contribute.

Cooperative extension agents can meet with local homeowners to discuss proper lawn care and other household activities. Locally tailored information on nonpoint source pollution, watersheds and water quality could be included in water and sewer bills.

Requiring all sellers of pesticides, herbicides, and fertilizers to be licensed and provide extensive instructions for consumers before they purchase such products can help educate a critical group.[9] Requiring more stringent labeling on these products regarding nonpoint source pollution and its impacts on local waterways and human health may act as a deterrent or provide an educational opportunity. Stricter neighbor notification requirements for consumer use, including providing the necessary flags as an attachment to the container, also could raise awareness and limit product use.

It has long been said that the best way to educate is "to lead by example." Providing education and assuring proper practices among visible profes-

The Role of PBTs in NPS

Persistent bioaccumulative toxins (PBTs) are damaging or fatal chemicals that linger in the environment and build-up in the food chain. They result in toxic levels, even if released in small, legally allowable quantities. PBTs include common toxins such as DDT, lead, arsenic, cyanide, dioxins, mercury and polychlorinated biphenyls (PCBs). These contaminants adversely affect human health including effects on the nervous system, reproductive and developmental problems, cancer, and genetic impacts. The U.S. fish supply continues to contain significant levels of PBTs, even after some of their uses have been banned or curtailed. From 1993 to 1997, the total number of fish advisories in the U.S. increased by 80 percent, and the number of waterbodies under advisory nearly doubled from 1,278 to 2,299. All of the substances causing the advisories are PBTs.

PBTs enter the environment through emissions from industrial facilities and through the use and disposal of consumer products that utilize them in their manufacture. Industrial processes that emit PBTs include coal-fired power plants, steel works and the chemical industry. These emissions inevitably result in the atmospheric deposition of PBTs miles away from their initial sources.

Most consumers are unaware that everyday products contain PBTs and the hazards associated with them. The growing use of cellular phones, computers and other electronic products has contributed to the PBT problem. Such products contain printed wiring boards, LCDs and batteries that contain contaminants such as lead, mercury, arsenic, cadmium, zinc and a host of other hazardous substances. Printed wiring boards contained in all electronic products are the second largest source of lead in the U.S. municipal waste stream. Other PBT-containing products include paints and printing inks with heavy metals, and toys containing toxic plasticizers. When these products are disposed of or used, the PBTs enter the water supply through atmospheric deposition due to incineration, runoff from applied surfaces, leaching from landfills, or improper disposal.

Some efforts have been made to reduce PBT use and/or exposure. Federal and state governments have implemented purchasing systems encouraging PBT-free alternatives. Industry partnerships with EPA also seek to reduce PBT use in manufacture. PBTs should be considered in all future nonpoint source control strategies.

Source: U.S. EPA PBT factsheet (http://www.epa.gov/pbt/fact.htm) and Inform, Inc. (http://www.informinc.org).

Representative Worldwide PBT Emissions to the Atmosphere, 1850-1990 *(yearly average in tons)*

Period	Cadmium	Copper	Lead	Nickel	Zinc
1850-1900	380	1,800	22,000	240	17,000
1901-1910	900	5,300	47,000	800	39,000
1911-1920	1,100	8,000	49,000	2,100	49,000
1921-1930	1,400	9,600	110,000	2,100	62,000
1931-1940	1,700	12,000	170,000	4,900	75,000
1941-1950	2,200	17,000	170,000	8,000	96,000
1951-1960	3,400	23,000	270,000	14,000	150,000
1961-1970	5,400	44,000	370,000	26,000	240,000
1971-1980	7,400	59,000	430,000	42,000	330,000
1981-1990	5,900	47,000	340,000	33,000	260,000

Source: McNeill, J.R., Something New Under the Sun: An Environmental History of the Twentieth Century World. *New York: Norton, 2000.*

sionals such as park maintenance personnel, landscapers, lawn treatment companies, and golf course managers can give the public models for their own activities.

Children are a Key Population

Another effective means of increasing nonpoint source knowledge is by educating children and teachers. As evidenced by recycling programs, once children become excited about a program, they will teach others, including their parents.

First, however, the teachers need to be reached and recruited. Special workshops could give them teaching materials, resources, and activities. An educational materials clearinghouse should be developed to collect and distill current information. An environmental education element should be incorporated into the curriculum of every school. This element can revolve around field trips that "follow a raindrop" through the ecosystem and introduce children to their local watershed. The students would see first-hand the effects of nonpoint source pollution, including the impacts their own activities have on the watershed. Creating special children's events, like the Groundwater Festival in Nebraska, and involving groups such as 4-H and scouts also could be effective in educating children.

Air Pollution's Impact on Nonpoint Source Pollution

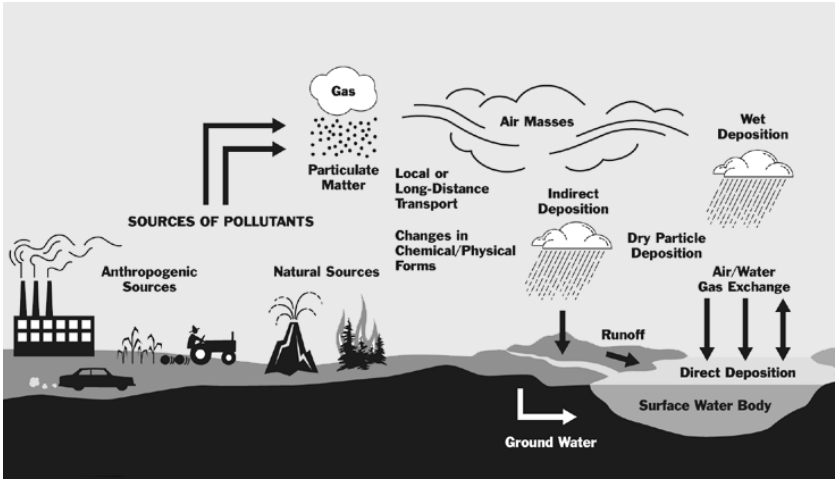
Pollutants reach surface waters through a variety of mechanisms but the most under-recognized is atmospheric deposition. Atmospheric deposition is the transport of pollutants through the air with an eventual deposit on surface waters directly or through runoff from land surfaces. These pollutants enter the atmosphere through a variety of sources and travel great distances before finally being deposited.

Soot, NO_X, and SO_2, are released into the atmosphere through human activities (burning fossil fuels) and from natural sources (forests, volcanoes and wildfires). Many other atmospheric pollutants such as PCBs and chlorofluorocarbons (CFCs) are only derived from human activity. Specific sources of atmospheric pollutants typically are divided into three categories: stationary (power plants, refineries and incinerators), mobile (cars, aircraft, trains, and ships), and area (volatilization of ammonia from manure).

Atmospheric deposition is a significant source of nonpoint source pollution. The geographic region in which the introduction of atmospheric pollutants may affect a particular land area—the airshed—associated with a particular watershed can extend hundreds of miles beyond the watershed's boundary. The airshed for the Chesapeake Bay, for example, includes all of Maryland, Delaware, Virginia, Pennsylvania, West Virginia, and Ohio and extends to portions of Vermont, Michigan, Indiana, Kentucky, Tennessee, South Carolina, North Carolina, New Jersey, and New York.

Generally, forest streams in the eastern U.S. have higher nitrogen levels than in the western U.S., partially due to atmospheric deposition. However, Lake Tahoe in California and Utah has shifted from a nitrogen-limited system to phosphorus limited (for algae growth) due to atmospheric deposition of nitrogen. The global reservoir of atmospheric mercury, for example, has increased by a factor of two to five since the beginning of industrialization and is dominated by human sources. Over 80 percent of this mercury is due to combustion processes such as coal burning and medical and municipal waste incineration.

Source:
Marine Pollution in the United States, Boesch, D.F., et. al., Pew Oceans Commission, 2001. http://www.pewoceans.org/oceanfacts/2002/01/11/fact_22987.asp.



© Pew Oceans Commission

Challenges to Control

Many challenges need to be overcome before nonpoint source pollution controls can succeed. One challenge is assuring that adequate funding is available for the necessary programs including education, cost-sharing, monitoring, infrastructure, and local initiatives. Also, more attention must be given to atmospheric deposition and rural residential issues such as septic systems and package water treatment systems.[10] See left for information on atmospheric deposition. Other suggestions include improving practices on tribal lands, engaging soil and water conservation districts as more active participants, protecting all streams instead of just funding programs for impaired ones (it is cheaper to maintain than to restore), and giving localities within states more control of programs.

Literature Cited

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National Geographic Society, 2001. National Geographic Society River Poll. Conducted June 2001. Penn, Schoen & Berland Associates, Washington, DC.

United States Geological Survey, 1999. *The Quality of Our Nation's Waters: Nutrients and Pesticides*, Circular 1225, http://water.usgs.gov/nawqa.

Endnotes

1 Monitoring is the collection of data used to determine the qualities of a particular resource.

2 See http://www.nrcs.usda.gov/programs/crp/, http://www.nrcs.usda.gov/programs/wrp/, and http://www.nrcs.usda.gov/programs/eqip/, respectively.

3 An MOU is a formal document that outlines goals, concerns, and the nature of cooperative efforts between two or more agencies.

4 The Chesapeake Bay Program is a unique regional partnership that has led and directed the restoration of the Chesapeake Bay since 1983. Partners include the states of Maryland, Pennsylvania and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the Environmental Protection Agency; and participating citizen advisory groups. See http://www.chesapeakebay.net for more information.

5 NEMO is a program developed by Connecticut Cooperative Extension that educates local land-use officials about the links between land-use planning and natural resource protection. For more information, visit http://nemo.uconn.edu/.

6 Previous compilations of success stories that can be built on upon or modified for use by legislators include: *Watershed Success Stories: Applying the Principles and Spirit of the Clean Water Action Plan*, http://www.cleanwater.gov/success/ and Stream Corridor Restoration Demonstration Projects/National Showcase Watersheds, http://www.epa.gov/owow/showcase/.

7 This program, authorized by §104 of the Water Resources Research Act of 1984, is a Federal-State partnership which:

- Plans, facilitates, and conducts research to aid in the resolution of State and regional water problems
- Promotes technology transfer and the dissemination and application of research results
- Provides for the training of scientists and engineers through their participation in research
- Provides for competitive grants to be awarded under the Water Resources Research Act

Individual state water resource research institutes have been established, typically at land grant universities, to fulfill the states' role in this program. Federal funding for this program has been threatened. See http://water.usgs.gov/wrri/ for more information.

8 The State of Florida, for example, uses "pointless personal pollution" in their nonpoint source education campaign, http://www.dep.state.fl.us/water/stormwater/docs/nonpoint/ppp.pdf.

9 New York State's Neighbor Notification Law was passed in 2000. The law requires retail establishments that sell general use lawn pesticides to post signs that:

1. Warn people to follow the information on the label,
2. Inform homeowners that they must post signs along their property boundaries when using such products, and
3. Encourage consumers to notify neighbors that they are using pesticides.

See http://www.dec.state.ny.us/website/dshm/pesticid/neighbor.htm for more information.

10 Package water treatment systems are pre-designed for use in rural communities or areas where cost or time make an extensive planning and design process impractical. The systems rarely take into account the needs of a specific community and its resources.

Appendix A: RNRF Congresses History & Procedures

Sustaining the Earth's resources is a complicated challenge and demands diverse perspectives and expertise. Recognizing the need for an interdisciplinary approach, RNRF brings together representatives from its member organizations, federal and state agencies, academic institutions, and other professional and scientific organizations. The congresses examine timely issues affecting the environment and natural resources and amplify the voice of the scientific community. These diverse gatherings have helped define issues and suggest promising solutions.

Delegates are nominated by RNRF's member organizations. They include geographically diverse representatives of the natural, physical and social sciences.

Congress History

In 1992, RNRF convened its first congress, "Critical Issues and Concepts for the 21st Century," to outline priorities for sustainability. Congress delegates explored overpopulation, economic development, management of healthy ecosystems, maintaining renewable resources, and methods to cope with climate-induced environmental change. Delegates met in working groups and identified over 120 major issues and recommended specific actions to address them.

The second congress in 1996 focused on the emerging technology of geographic information systems (GIS) and its application to the sustainability of renewable natural resources. GIS is a software system that provides and integrates multifaceted information for a given place. Delegates discussed how GIS could empower citizens and communities to participate more effectively in land-use planning to sustain their natural resources.

In 1998, delegates explored the impact of human population growth on the ability to sustain renewable natural resources. Important steps in moving toward a sustainable society included stopping population growth, limiting sprawl and the extravagant use of land, preserving critical elements of the natural environment, controlling pollution, moderating consumption of natural resources, and using natural resources more efficiently.

Findings and recommendations from the two congresses on sustainability suggested that current government structures are not facilitating movement towards sustainable land use. These concerns were the catalyst for RNRF's fourth congress, "Promoting Sustainability in the 21st Century," convened in 2000.

Recognizing that there is no consensus in the United States Congress (or among the public) to institute a national program of sustainable land use, and actions by communities are insufficient in geographic scope, RNRF's fourth congress examined regional tools and strategies.

Upon examination of regional planning efforts in South Florida, southern California, and the Pacific Northwest, delegates concluded that regional approaches continue to be hampered by the lack of institutions with cross-jurisdictional authority. A second focus of the congress was on the evolving roles of resource professionals and the education and training they will need to be successful in fulfilling their new responsibilities.

Congress reports are available at http://www.rnrf.org.

The Fifth National Congress

Recognizing the complex, multidisciplinary nature and inherent difficulty in nonpoint source pollution control, RNRF convened its fifth national congress, "Control of Nonpoint Source Water Pollution: Options and Opportunities." Delegates from 27 states representing a wide spectrum of disciplines came together in Baltimore, Maryland, September 18–21, 2002 (see Appendix B for complete listing of delegates). Among the delegates were prominent natural resources professionals from universities, nongovernmental organizations, industry, and government.

Prior to the congress, delegates were asked to complete a survey to assess current issues related to the control of nonpoint source pollution. Nearly 40 percent of the delegates participated, and the results were used to determine and address the highest priority issues. A summary of the congress survey results is available from RNRF's website at http://www.rnrf.org/2002congress.

A pre-congress field trip through Baltimore County, Maryland, provided delegates with first-hand knowledge about current conditions and management programs. Donald Outen, Natural Resource Manager, Baltimore County Department of Environmental Protection and Resource Management, served as the guide. Delegates toured two stream restoration and stormwater retrofit projects (Long Quarter Branch and Spring Branch) located in watersheds developed prior to stormwater and stream protection regulations. Next, delegates visited one of the largest farming operations in the area to discuss agricultural Best Management

Practices (BMPs) and nutrient management plans. Finally, delegates toured Owings Mills New Town, a new development within the county's growth boundary that incorporates mandatory stream buffers, stormwater management systems and reduced impervious surfaces to minimize its impact on the surrounding resources.

Two keynote speakers provided focus and perspective for congress delegates. Margaret A. Davidson, Director, National Ocean Service and Acting Assistant Administrator for Ocean Services and Coastal Zone Management, National Oceanic and Atmospheric Administration, described NOAA's programs to control nonpoint source pollution, particularly along our coasts. Maryland Governor Parris Glendening discussed challenges associated with instituting Smart Growth programs and protecting the Chesapeake Bay.

Each congress begins with plenary sessions during which issues are framed and up-to-date information is presented.

Working Groups

Following a day of plenary sessions, delegates met for most of the second day in working groups. A diverse mix of delegates in each working group engaged in discussions to define the issues and suggest solutions and options.

Four topics provided the basis for the working groups' deliberations:

- Methods and Strategies of Control and Overcoming Legislative Barriers;
- Educating the Public and Defining Their Role;
- Roles and Responsibilities of Local, State and Federal Government and Opportunities for Partnership; and
- The Education of Resource Professionals in Nonpoint Source Prevention and Control.

On September 20, delegates met in working groups for more than an hour on each of the four topics. Delegates were assigned to working groups to ensure geographic and disciplinary diversity. The composition of the working groups was changed with each session.

A chair, a facilitator, and a recorder administered each working group session. The chairs were selected from among the delegates. The congress host, the Department of Natural Resource Sciences and Landscape Architecture at the University of Maryland, provided facilitators and recorders. Facilitators were professors or extension specialists and recorders were graduate students or extension assistants.

Although working groups did not formally vote on findings and recommendations, consensus was informally noted and recorded by the chairs. Chairs presented a summary of their working group's findings, recommendations, and conclusions at a wrap-up session on September 21. This session provided delegates with an early opportunity to react to and comment on the findings. Delegates also had the opportunity to comment on the draft report.

Appendix B: List of Delegates

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Appendix C: Existing Internet Resources

Many outstanding resources exist on all aspects of nonpoint source pollution. Following are a few representative Internet sites. Many more sites, including short descriptions of the content offered, are available at the special congress website: http://www.rnrf.org/2002congress. Additional categories include: Chesapeake Bay, Erosion Control, Forums and Roundtables, Journals and Periodicals, Marine and Ocean Impacts, and Watershed/River Groups.

ASSESMENT, PLANNING AND MODELING

Agricultural Nutrient Management Program
http://www.agnr.umd.edu/users/agron/nutrient
Watershed Characterization and Modeling System
http://www.nrac.wvu.edu/wcms/
Agricultural Nonpoint Source Pollution Model
http://www.sedlab.olemiss.edu/agnps.html

CLEARINGHOUSES AND INFORMATION CENTERS

National Small Flows Clearinghouse
http://www.nesc.wvu.edu/nsfc/
National BMP Case Study Database
http://www.bmpdatabase.org
Pollution Prevention Regional Information Center
http://p2.ces.fau.edu/index.html

EDUCATIONAL TRAINING AND TOOLS

EPA's Watershed Academy
http://www.epa.gov/watertrain/
National Environmental Training Center for Small Communities
http://www.netc.wvu.edu
NEMO (Nonpoint Education for Municipal Officials) Training
http://www.nemo.uconn.edu
Adopt a Watershed
http://www.adopt-a-watershed.org/
Best Education Practices Project
http://www.uwex.edu/erc/bepsummary.html
Community Based Environmental Education (CBEE)
http://www.uwex.edu/erc/pdf/EPA4.pdf
Educating Young People About Water
http://www.uwex.edu/erc/eypaw/planeval.html
Environmental Education Link
http://eelink.net/ee-linkintroduction.html

GOVERNMENT PROGRAMS

Wetlands Reserve Program | NRCS
http://www.nrcs.usda.gov/programs/wrp/
Environmental Protection Agency Nonpoint Source Control Branch
http://www.epa.gov/owow/nps
EPA 2000 National Water Quality Inventory
http://www.epa.gov/ow/national/
Conservation Reserve Program
http://www.fsa.usda.gov/dafp/cepd/crpinfo.htm

INTERESTED ORGANIZATIONS AND AGENCIES

National Association of Conservation Districts
http://www.nacdnet.org
Water Environment Federation
http://www.wef.org
American Public Works Association
http://www.pubworks.org
Soil and Water Conservation Society
http://www.swcs.org
American Water Resources Association
http://www.awra.org
Lower Platte South Natural Resources District
http://www.lpsnrd.org
Universities Council on Water Resources
http://www.ucowr.siu.edu

MONITORING

Coastal Remote Sensing (CRS) Program
http://www.csc.noaa.gov/crs/
National Water-Quality Assessment (NAWQA) Program
http://water.usgs.gov/nawqa
USGS Real-Time Data
http://water.usgs.gov/realtime.html
USGS Streamflow Maps and Data
http://water.usgs.gov/waterwatch/

REPORTS AND STUDIES

Environmental Law Institute—State Laws
http://www.eli.org/research/waterpollution.htm
The National Academies—TMDLs
http://www4.nas.edu/news.nsf/isbn/0309075793?OpenDocument

TECHNICAL ASSISTANCE & SPECIFIC CONTROLS

Onsite Management of Residential Wastewater (Septic Systems)
http://www.soil.ncsu.edu/programs/on-site.htm
Farm*A*Syst
http://www.uwex.edu/farmasyst/
Home*A*Syst
http://www.uwex.edu/homeasyst/

About RNRF

Purposes

The Renewable Natural Resources Foundation (RNRF) was incorporated in Washington, D.C., in 1972, as a nonprofit, public, tax-exempt, operating foundation. It was established to:

- Advance sciences and public education in renewable natural resources;
- Promote the application of sound scientific practices in managing and conserving renewable natural resources;
- Foster coordination and cooperation among professional, scientific and educational organizations having leadership responsibilities for renewable natural resources; and
- Develop a Renewable Natural Resources Center.

The foundation represents a unique, united endeavor by outdoor scientists to cooperate in assessing our renewable resources requirements and formulating public policy alternatives.

Membership

RNRF's members are professional, scientific and educational organizations interested in sustaining the world's renewable natural resources. The foundation is governed by a board of directors comprised of a representative from each member organization. The directors also may elect "public interest members" of the board. Board members are listed on the back cover of the journal. Individuals may become Associates for an annual contribution of $50 or more.

MEMBER ORGANIZATIONS

American Fisheries Society

American Geophysical Union

American Meteorological Society

American Society for Photogrammetry and Remote Sensing

American Society of Agronomy

American Society of Civil Engineers

American Society of Landscape Architects

American Water Resources Association

Association of American Geographers

The Humane Society of the United States

Society for Range Management

Society of Environmental Toxicology and Chemistry

Society of Wood Science and Technology

Soil and Water Conservation Society

Universities Council on Water Resources

The Wildlife Society

Programs

RNRF conducts national meetings, public-policy round tables, policy briefings and leadership summits. It also conducts an annual awards program to recognize outstanding personal, project and journalistic achievements. These activities are supplemented by international outreach activities and internships. More information about RNRF's programs is available at www.rnrf.org.

Renewable Resources Journal, first published in 1982, promotes communication among RNRF's represented disciplines. The journal is provided to the governing bodies of RNRF member organizations, members of the U.S. Congress and committee staffs with jurisdiction over natural resources, federal agencies, and universities. Tables of contents of all volumes of the journal are available at RNRF's web site.

Center Development

The Renewable Natural Resources Center is being developed as an office and environmental center for RNRF's members and organizations with related interests. The Center is located on a 35-acre site in Bethesda, Maryland, where lawns and forested buffers provide an exceptional work environment. The site is the former family estate of Dr. Gilbert H. Grosvenor, of the National Geographic Society.

The master site plan for the Center contemplates the construction of approximately 283,000 square feet of office space—including a 16,500 square foot conference and common-services facility. The Center currently has approximately 52,500 square feet of office space.

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AUTHORS

SUBJECTS

Renewable Resources Journal also is independentely indexed in Environmental Periodicals Bibliography. A complete list of tables of contents can be found at http://www.rnrf.org.

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