

CHAPTER 14: ADDRESSING COASTAL WATER POLLUTION

Coastal waters are subject to cumulative impacts from a variety of pollutants—from near and far, and from point, nonpoint, and airborne sources. For this reason, any solution must be founded on an ecosystem-based and watershed management approach involving a broad range of agencies, programs, and individuals. Solutions will also require a substantial financial investment and will take time. Over the last few decades, great strides have been made in controlling water pollution from point sources, although further improvements could be realized through increased funding, strengthened enforcement, and promotion of innovative approaches such as market-based incentives. However, substantial enhancement of coastal water quality will require significant reductions in nonpoint source pollution—a technical and political challenge. Establishing measurable pollution reduction goals for coastal areas is needed, as is coordination of the many related agencies and programs to effectively target the various laws, programs, funds, training, technical assistance, incentives, disincentives, and other management tools to address nonpoint source pollution of coastal waters.

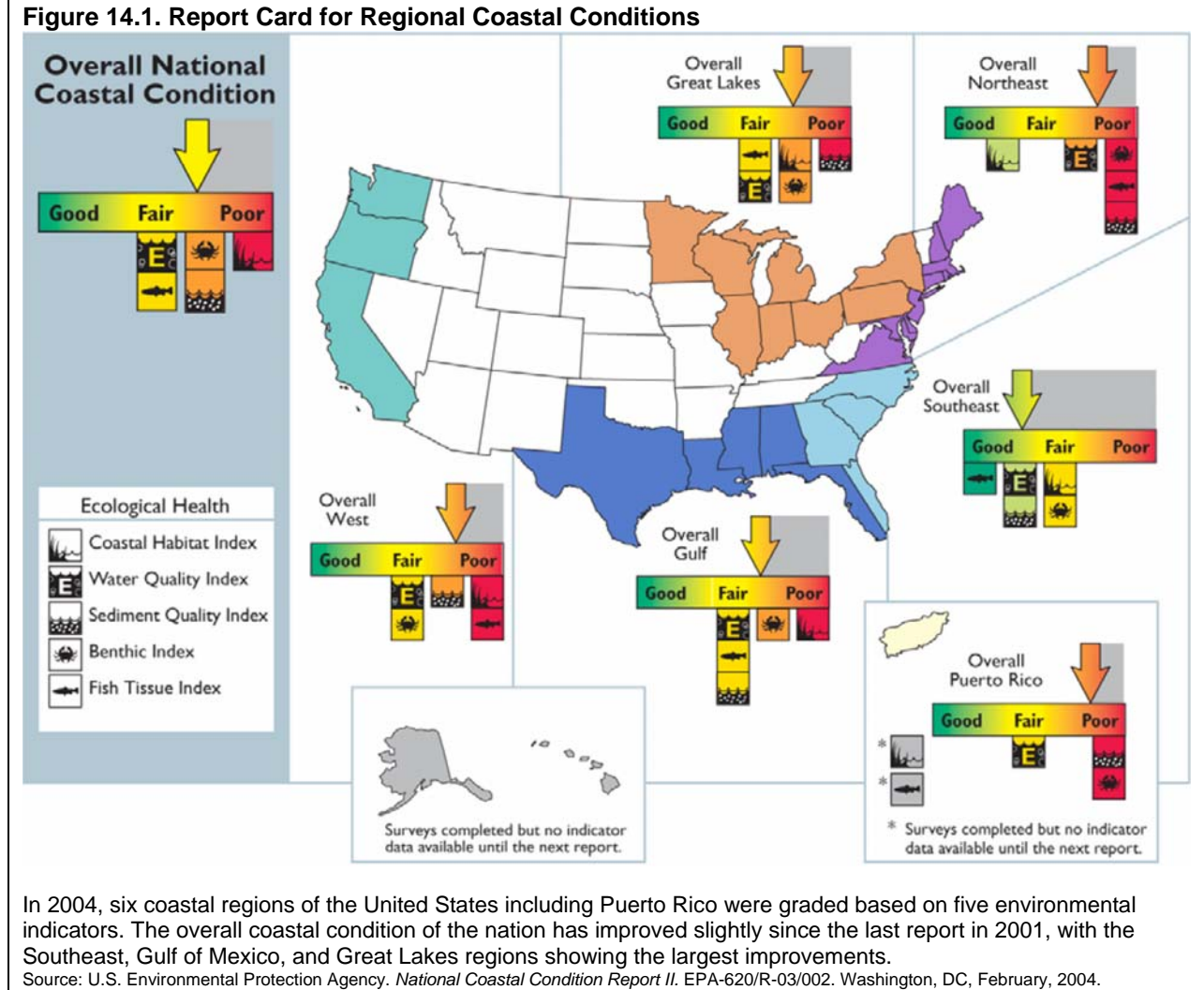
STOPPING THE DEGRADATION OF COASTAL WATERS

Coastal waters are one of the nation's greatest assets, yet they are being bombarded with pollution from all directions. The heavy concentration of activity in coastal areas, combined with pollutants flowing from streams far inland and others carried through the air great distances from their source, are the primary causes of nutrient enrichment, hypoxia, harmful algal blooms, toxic contamination, sedimentation, and other problems that plague coastal waters.

The U.S. Environmental Protection Agency's (EPA's) 2002 *National Water Quality Inventory* found that just over half of the estuarine areas assessed were polluted to the extent that their use was compromised, either for aquatic life, drinking water, swimming, boating, or fish consumption.¹ EPA's 2004 *National Coastal Condition Report II* rated coastal waters along most of the continental United States as being in fair condition, with poor conditions in the Northeast and Puerto Rico regions (Figure 14.1).

The protection of coastal waters will require managers to address a range of human activities that generate pollution in many locations and a variety of pollutants following different pathways. Management that is ecosystem-based and that considers entire watersheds will help guide this daunting task.

Figure 14.1. Report Card for Regional Coastal Conditions



The complex array of laws, agencies, and programs that address water pollution, and the number of parties involved, will require greatly enhanced coordination among federal agencies, primarily EPA, the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Agriculture (USDA), and U.S. Army Corps of Engineers (USACE). Greater coordination is also needed between the federal government and managers at the state, territorial, tribal, and local levels, watershed groups, nongovernmental organizations, private stakeholders, and the academic and research communities. The case of nutrient pollution, detailed in the following box, illustrates many of the challenges involved in improving coastal water quality.

Nutrient Pollution in Coastal Waters

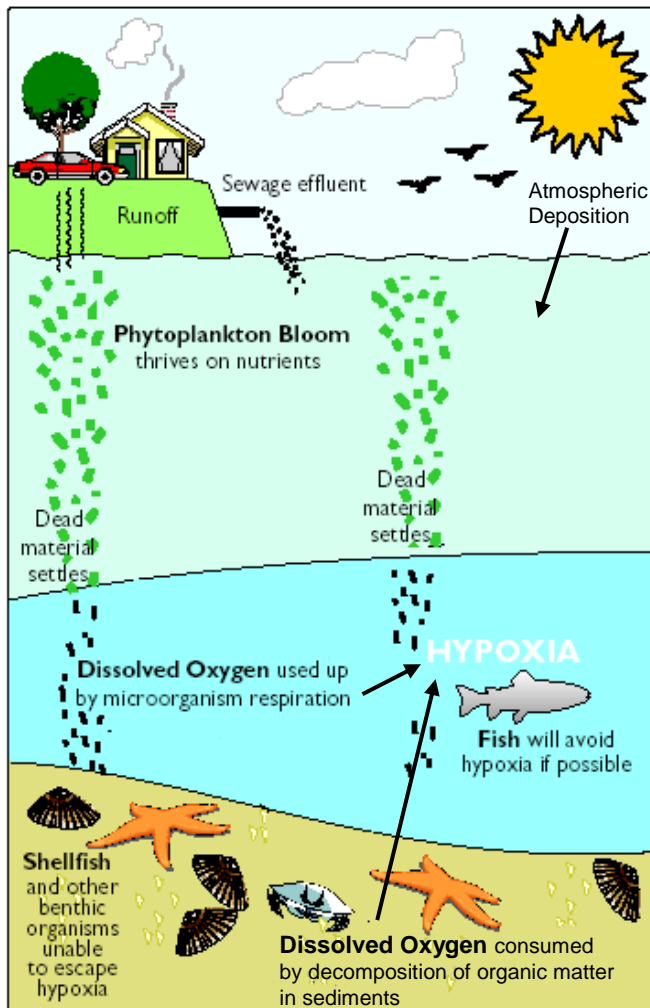
A 2000 National Research Council report called nutrient pollution the most pervasive and troubling pollution problem currently facing U.S. coastal waters.² Although nutrients such as nitrogen and phosphorus are necessary to marine ecosystems in small quantities, human activities on the coasts and inland have greatly increased the flow of nutrients—in some cases to harmful levels (Figure 14.2).

Nutrient pollution defies simple categorization and is difficult to control because it can come from point, nonpoint, and atmospheric sources, from near and far. The main sources include runoff from agricultural land, animal feeding operations, and urban areas, discharges from wastewater treatment plants, and atmospheric deposition of chemicals released during fossil fuel combustion. Human activities have approximately doubled the amount of reactive nitrogen cycling through the biosphere compared to pre-industrial conditions, with most of this increase occurring during the last thirty years.³ The largest human additions of nitrogen stem from an increased use of inorganic fertilizers.⁴

Nutrient pollution leads to a host of ecological and economic impacts including: fish kills due to oxygen depletion; loss of important and sensitive coastal habitats; excessive and sometimes toxic algal blooms; changes in marine biodiversity; increases in incidents of human illness; and reductions in tourism. The greatest impacts occur in estuaries and nearby coastal regions. Nutrient pollution has been particularly severe along the lower Atlantic Coast and in the Gulf of Mexico. The infamous “dead zone” in the Gulf of Mexico is an area of seasonal oxygen depletion caused by nutrients draining from the Mississippi River Basin.

Smaller dead zones are becoming increasingly frequent in other estuaries. The severity and extent of nutrient pollution are expected to worsen in more than half of the nation’s estuaries and coastal waters by 2020.⁵ Without concerted, coordinated, and sustained action to reduce nitrogen sources, nutrient pollution will be a continuing problem in the nation’s coastal waters.

Figure 14.2. Land-based Nutrients Can Cause Death on the Seafloor



When ocean water becomes enriched in dissolved nutrients, from sources such as agricultural runoff and sewage outflows, these nutrients stimulate the growth of phytoplankton. As the phytoplankton die and sink to the bottom, their decomposition consumes the dissolved oxygen that other benthic organisms need to survive.

Source: U.S. Environmental Protection Agency. *National Coastal Condition Report*. EPA620-R-01-005. Washington, DC, August, 2001.

REDUCING POINT SOURCES OF POLLUTION

With strong public support, government and private sector actions over the past three decades have made great strides in controlling water pollution from identifiable point sources, such as industrial facilities and wastewater treatment plants, whose discharges can be monitored as they emerge from the end of a pipe. Even so, opportunities remain to further reduce point source impacts on U.S. coastal waters and improve compliance with existing environmental requirements.

Existing Management Tools

Point source pollution is primarily addressed through the National Pollutant Discharge Elimination System and the State Revolving Loan Fund, two longstanding EPA programs.

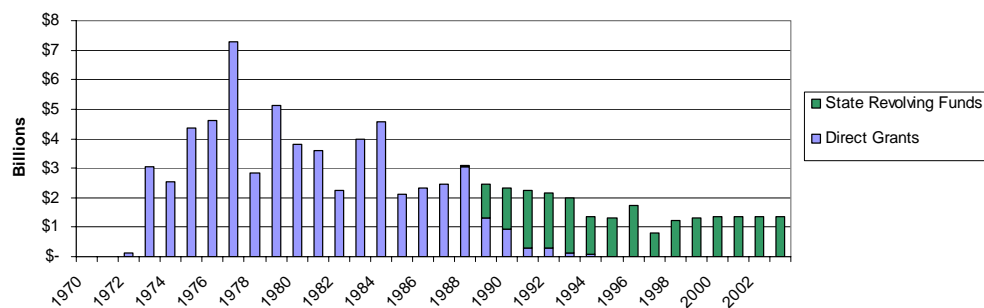
The National Pollutant Discharge Elimination System

Over the past thirty years, the Clean Water Act and its National Pollutant Discharge Elimination System have led to dramatic reductions of polluted effluents. EPA typically delegates administration of this program to the states, and the state or EPA then regulates polluters by issuing permits that reflect federal standards for discharges. If the regulatory agency determines that a particular water body is not meeting water quality standards, permittees discharging to those waters may be required to implement more stringent controls.

State Revolving Loan Funds

Under the Clean Water Act, the federal government has provided significant financial support for water quality infrastructure improvement. From 1970 to 1995, funding was provided under the Federal Construction Grants Program to build publicly owned treatment works and collection systems, without any requirement for repayment. In 1987, in a major shift in policy, Congress established and began to fund the State Revolving Fund Program, in which the federal government provides capitalization grants for a more self-sustaining, state-administered revolving loan fund (Figure 14.3). States decide which projects are the highest priorities for funding, the borrowers repay the loans, and the program loans the money again to other borrowers. States provide below-market interest rates and other financial incentives to towns, counties, nonprofit organizations, farmers, and homeowners for water quality improvement projects. The funds finance capital construction costs—not operations and maintenance—and are mostly used to build wastewater treatment plants.

Figure 14.3. Clean Water Relies on Recycled Money



In the last thirty years, there has been a fundamental shift in the way the federal government funds the infrastructure for water pollution control in local communities. From 1970 to 1995, EPA provided \$61.1 billion in direct grants to help build or upgrade publicly owned wastewater treatment facilities. However, since 1988 the EPA has increasingly supported these types of projects through state revolving loan funds, which provide low interest loans that are paid back into the account to fund future projects.

Source: U.S. Environmental Protection Agency. *Progress in Water Quality: An Evaluation of the National Investment in Municipal Wastewater Treatment*. EPA-832-R-00-008. Washington, DC, June, 2000.

This program is widely considered a cost-effective, long-term mechanism for meeting infrastructure demands. From 1998 to 2002, the funds provided an average of \$3.8 billion per year for water quality improvement. Since the program's inception, a total of \$38.7 billion has been disbursed.⁶ State revolving loan funds are crucial to restoring, maintaining, and improving the nation's water quality.

Major Point Sources

The major point sources of pollution to the nation's waterways include wastewater treatment plants, sewer system overflows, septic systems, industrial facilities, and animal feeding operations.

Wastewater Treatment Plants

Municipal wastewater consists primarily of wastewater from individual households and from manufacturing and commercial activities. Wastewater entering a treatment plant may contain organic pollutants, metals, nutrients, sediment, bacteria, viruses, and toxic substances. Wastewater treatment plants have met their original goal of removing most pathogens, organic materials, and suspended solids; however, nutrients and many chemicals are not effectively removed with existing treatment processes. The effluent from treatment plants can be discharged into fresh water or directly into estuaries, coastal waters, and oceans. Even discharges into waters far upstream can have serious impacts on coastal waters.

Although nutrient pollution has had a major impact on coastal waters, both primary and secondary wastewater treatment have been effective in adequately removing nitrogen and phosphorus. In many heavily developed areas, existing wastewater treatment is unlikely to achieve nutrient-related standards; additional controls will be needed to meet water quality goals.

Advanced—or tertiary—treatment technologies, which can remove most nitrogen and phosphorus from wastewater treatment plant discharges, cost approximately 25 percent more than secondary treatment.⁷ These advanced technologies are being implemented in regions where wastewater discharges are significant sources of nutrient pollution, such as Tampa Bay and Chesapeake Bay. One recent success in developing and applying advanced treatment was at a Stamford, Connecticut wastewater treatment plant where a novel biological nutrient process removed much of the nitrogen at very little cost.⁸

Conventional treatment plants have been generally ineffective in removing many of the household and industrial chemicals present in wastewater. These chemicals—including pharmaceuticals, antibiotics, hormones, insecticides, and fire retardants—are then discharged to surface waters. Although many of these compounds may break down in the environment, their cumulative loading is substantial. Significant concentrations of many commonly used chemicals, including over-the-counter pharmaceuticals, have been detected in some coastal and ocean waters.⁹ These compounds, designed to produce biological effects in humans, may have unforeseen impacts on aquatic life. For example, the effluent from wastewater treatment plants has been shown to disrupt endocrine functions in some aquatic organisms.¹⁰

Recommendation 14–1. The U.S. Environmental Protection Agency (EPA) and states should require advanced nutrient removal for wastewater treatment plant discharges into nutrient-impaired waters. Additionally, EPA should support a vigorous effort to characterize the extent of the impact of household and industrial chemicals in wastewater.

In particular, EPA should:

- *support research and demonstration projects for biological nutrient removal and other innovative advanced treatment processes to eliminate nitrogen and phosphorus from wastewater discharges.*
- *ensure that information about innovative advanced treatment processes and technologies is widely disseminated.*

- *support development of technologies to reduce concentrations of pharmaceuticals, personal care product ingredients, and other biologically active contaminants in wastewater treatment plant discharges.*

Sewer System Overflows

Combined sewer systems were designed to collect domestic sewage, industrial wastewater, and rainwater runoff or snowmelt in the same pipes. While these systems provided human health benefits at the time they were constructed, they have a major drawback: when total water volumes exceed the system's capacity, the overflow enters receiving waters without treatment. Sanitary sewer systems, which are designed to transport only domestic sewage and industrial wastewater, can also under some circumstances overflow, discharging untreated wastewater.

EPA estimates that at least 40,000 sewers overflow every year, discharging wastewater directly into rivers, estuaries, and oceans. In addition to causing human health problems and closures of beaches and shellfishing areas, human sewage may be a contributing factor in the decline of coral reefs.¹¹

Septic Systems

About 25 percent of the U.S. population is served by residential septic systems and about 33 percent of new homes use these systems.¹² If not properly managed, septic systems can become a significant source of coastal pollution, particularly pathogens and nutrients. Septic systems can contaminate aquifers and coastal waters either by direct overflow from improperly operating systems or by migration of pollutants through groundwater to surface waters. The threat can be severe in places like Florida where the ground is highly permeable and the water table close to the surface. Government policies and subtle socioeconomic factors may be encouraging new development that relies on septic systems rather than centralized wastewater treatment, even in locations where population density would support centralization. To protect coastal waters, it is important to ensure that existing and new septic systems are properly designed, located, constructed, and maintained.

Recommendation 14–2. The U.S. Environmental Protection Agency (EPA) and states should increase technical and financial assistance to help communities improve the permitting, design, installation, operation, and maintenance of septic systems and other on-site treatment facilities. State and local governments, with assistance from EPA, should adopt more effective building codes and zoning ordinances for septic systems and should improve public education about the benefits of regular maintenance.

Industrial Facilities

While some industrial plants are connected to wastewater treatment plants, others discharge directly into receiving waters. Discharges to wastewater treatment plants must comply with certain pretreatment requirements established by the facility operator. Direct discharges must have a National Pollutant Discharge Elimination System permit which establishes limits on pollutants in the effluent. Initially, permits are based on the use of best available technology. However, in cases where the use of best available technology is insufficient to meet water quality standards, further action may be required.

Although the National Pollutant Discharge Elimination System and pretreatment requirements have made significant progress in abating industrial sources of pollution, these sources remain a significant cause of environmental degradation in some areas. Industrial discharges can contain nutrients, mercury, lead, sulfur, oils, corrosives, and other toxic chemicals. Another group of contaminants entering coastal waters from industrial sources is polychlorinated biphenyls (PCBs). Although these compounds are no longer

manufactured and new uses are severely restricted, improper disposal and continued use of older PCB-containing products persist. In many cases, discharges from factories and power plants are also warmer than surrounding waters, resulting in thermal pollution that can disrupt local ecosystems.

Animal Feeding Operations

Many animal feeding operations are located in coastal areas or in upstream areas that flow into coastal waters; these businesses have become major contributors to coastal water pollution. For example, along the East Coast, many feeding operations are concentrated in the coastal plain, which is home to an economically important and ecologically sensitive network of wetlands, rivers, estuaries, and coastline.

In the United States, approximately 238,000 animal feedlots produce an estimated 500 million tons of manure every year—more than three times the amount of sewage produced by humans.¹³ The animal manure generates discharges of solids and liquid effluent to groundwater and surface waters. Ammonia and other gases also volatilize from manure in storage facilities or on fields, resulting in atmospheric transport and deposition of pollutants. Pollutants originating at animal feeding operations include nutrients, ammonia, pathogens, hydrogen sulfide, methane, pesticides, and antibiotics.

Although discharges from animal feeding operations resemble nonpoint sources of pollution, they are regulated as point sources under the National Pollutant Discharge Elimination System program. In particular, facilities designated as concentrated animal feeding operations are subject to specific regulations. By 2006, all concentrated animal feeding operations (about 15,500 nationwide) will be required to obtain National Pollutant Discharge Elimination System permits. This requirement is expected to greatly reduce the amount of nutrients and sediments entering coastal waters.^{14,15} States may impose additional requirements such as regulating operations that are not large enough to be regulated by EPA, increased monitoring and reporting standards, and requiring animal processors to be co-permittees along with the contractors raising the animals.

Recommendation 14–3. Where necessary to meet water quality standards, states should issue regulatory controls on concentrated animal feeding operations in addition to those required by the federal government. The U.S. Environmental Protection Agency and the U.S. Department of Agriculture should fund research on removal of nutrients from animal wastes and should develop improved best management practices that retain animal waste-derived nutrients and pathogens on agricultural lands.

Improving the Control of Point Sources

To control point source pollution effectively, the nation will need to maintain a long-term commitment to investments in infrastructure, improve the enforcement of water pollution standards, and promote market-based incentives and other innovative approaches.

The Need for Long-term Infrastructure Investments

The gap between existing and needed funding for wastewater and drinking water improvements is large, and serious adverse human health and environmental effects are likely if the challenges presented by an aging public infrastructure are not addressed. Capital spending for wastewater treatment infrastructure is currently about \$13 billion per year, and annual operations and maintenance costs are around \$17 billion. EPA estimates that over the next twenty years, the total U.S. need for investment in wastewater treatment infrastructure will exceed \$270 billion, and the need for drinking water infrastructure will reach almost \$265 billion. Sewer system overflows will be particularly costly to correct.¹⁶ In addition, the gap between the

funding states currently have and the funding they will need to fully implement Clean Water Act programs is substantial—about \$700 million to \$1 billion a year—and will most likely increase.¹⁷

Given expected shortfalls in funding for wastewater-related construction, state revolving loan funds will become even more important. Improving coastal water quality will require long-term financial investments.

Recommendation 14–4. The U.S. Environmental Protection Agency, working with state and local governments, should develop a prioritized, comprehensive plan for long-term funding of the nation’s current aging and inadequate wastewater and drinking water infrastructure, anticipating demands for increased capacity and more stringent treatment in the coming decades. To implement this plan, Congress should fund the State Revolving Fund Program at or above historic levels.

Promoting Market-based Incentives

One powerful incentive-based approach to reducing water pollution in many watersheds is EPA’s water pollutant trading policy. Under this policy, a source can be reduced beyond required levels, creating a credit that can then be sold to another source discharging the same pollutant to the same body of water. EPA has had a water pollutant trading policy in place since the 1990s, primarily for use between wastewater treatment plants. (EPA’s trading policy does not authorize trading of toxic substances in effluent.)

Recommendation 14–5. The U.S. Environmental Protection Agency and states should experiment with tradable credits for nutrients and sediments as a water pollution management tool and evaluate the ongoing effectiveness of such programs in reducing water pollution.

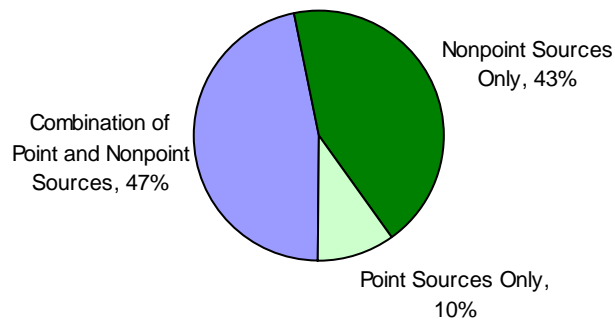
Improving Enforcement

Many major point source facilities are exceeding water pollution permit limits. A significant number of the serious offenders are exceeding pollution limits for toxic substances and many violators have been subject to only light penalties or no enforcement at all. In view of this, there is a strong need for improved oversight of states’ permitting and enforcement programs and for more funds and personnel at the state level to properly implement and enforce the National Pollutant Discharge Elimination System program.

Recommendation 14–6. The U.S. Environmental Protection Agency and states should modernize the National Pollutant Discharge Elimination System’s information management system and strengthen the program’s enforcement to achieve greater compliance with permits and develop an effective ongoing monitoring program.

INCREASING THE FOCUS ON NONPOINT SOURCES OF POLLUTION

While considerable progress has been made in reducing point sources of pollution, further progress toward improving coastal water quality will require significant reductions in nonpoint sources as well. This pollution occurs when rainfall and snowmelt carry pollutants over land, into streams and groundwater, and down to coastal waters. Nonpoint source pollutants include: fertilizers and pesticides from rural farms and urban lawns; bacteria and viruses from livestock and pet waste; sediments from improperly managed construction sites and timber harvesting; oil and chemicals flowing over streets, parking lots, and industrial facilities; and a variety of pollutants being blown along airborne pathways. Ninety percent of impaired water bodies do not meet water quality standards at least in part because of nonpoint source pollution (Figure 14.4).

Figure 14.4. Controlling Nonpoint Source Pollution is Key to Cleaner Waters

Nonpoint source pollution contributes to 90 percent of all water pollution incidences where water quality is determined to be below the standards set for specific activities such as recreation, water supply, aquatic life, or agriculture. Source: U.S. Environmental Protection Agency. *Clean Water Act Section 303(d) Lists: Overview of TMDL Program*. Washington, DC, 1998.

Existing Management Tools

Decreasing polluted runoff from agriculture, urban development, and construction will be a significant challenge. Numerous federal agency programs address nonpoint sources of pollution, and some of the most important programs are discussed briefly here. (Appendix D includes additional program information.)

The Total Maximum Daily Load Program

Many efforts to control nonpoint source pollution are driven by the Total Maximum Daily Load (TMDL) program, administered by EPA as part of the Clean Water Act. A TMDL is the maximum amount of a pollutant, from point and nonpoint sources, that can be present in a water body while still meeting water quality standards. States must develop a TMDL for each pollutant of concern and then implement plans to achieve and maintain those TMDLs by allocating reductions among all sources. To include a margin of safety, states must also take seasonal variations into account.

Because control of point sources has already received so much attention, the TMDL program is shifting its focus to controlling nonpoint sources. As a first step, the program requires states to identify water bodies that are not meeting water quality standards even after all point sources have installed their required pollution control technologies.

Although the TMDL program has been criticized as lacking effective compliance mechanisms for nonpoint source pollution, the program does provide valuable quantitative information on pollution amounts and impacts within a watershed. This information can be used to generate greater public awareness and support for water quality initiatives and to identify the most effective use of funds, such as those available through agricultural conservation programs, to address nonpoint sources within a particular watershed. While TMDLs specify limits for individual pollutants, EPA has been working with states and watershed managers to consider the impacts of multiple pollutants in a larger watershed management context, consistent with comprehensive ecosystem-based management initiatives.

National Nonpoint Source Pollution Program

Under the National Nonpoint Source Pollution Program, established under Section 319 of the Clean Water Act, EPA provides matching grants to states to develop and implement statewide programs for managing nonpoint sources. Grants may be used for a wide range of activities, including technical and financial

assistance, education and training, monitoring, watershed planning, technology transfer, demonstration projects, and state and local regulatory programs. States must prepare an assessment of waters where the control of nonpoint source pollution is necessary to meet water quality standards, identify the significant sources, and specify control measures. States must also develop a program that sets forth the best management practices necessary to remedy the problems.

Coastal Zone Management Act

One of the hallmarks of the Coastal Zone Management Act (CZMA) is that it requires each participating coastal state to incorporate the requirements of the Clean Water Act as the water quality portion of the enforceable policies that comprise the state's coastal management program. This provision has proved to be very useful in coordinating these separate federal programs at the state level and should be continued.

In addition, the 1990 amendments to the CZMA created a program specifically to address nonpoint sources of coastal pollution. Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) requires that all states with a federally approved coastal management program to develop a plan that includes enforceable management measures to control nonpoint sources affecting coastal waters. Administration of this program is assigned to both EPA and NOAA to combine their experiences with the Clean Water Act and Coastal Zone Management Act programs. The nonpoint source pollution control program created by Section 6217 relies on implementation of best management practices, compiled by EPA. While modest federal funding has been provided for states to prepare and implement their plans, it has been insufficient to achieve the goals of the CZARA.

U.S. Department of Agriculture Conservation Programs

Agricultural conservation programs have been growing in importance, scope, and funding. In 2002, Congress dramatically increased funding for these programs, dwarfing the resources of the EPA and NOAA nonpoint programs. The agricultural conservation programs generally involve cash payments to farmers to implement conservation and best management practices on productive farm and ranch lands, retirement of land through permanent or long-term easements, and conservation and restoration of wetlands and grasslands. These programs present an opportunity to decrease nonpoint pollution and improve aquatic habitats and natural resources—the challenge will be to ensure that the programs are targeted to maximize their benefits.

The Environmental Quality Incentives Program—the largest agricultural conservation program—will receive approximately \$5.6 billion in funding through fiscal year 2007. In recent amendments to this program, USDA was directed to reduce nonpoint source pollution in impaired watersheds as one of the nation's most important environmental needs that could be addressed with the help of agricultural producers. The other priorities established for the program—reducing air emissions and soil erosion and promoting habitat conservation—will also have benefits for coastal water quality.

Another important USDA program is the Conservation Security Program, which provides financial and technical assistance to implement stewardship measures. This program is open to any farmer or rancher who wishes to participate, including small operations in coastal areas. It has the potential to improve water quality by encouraging conservation on land in active production and rewarding farmers who have been good stewards but are not able to participate in other conservation programs.

Major Nonpoint Sources

The majority of the nonpoint source pollution entering rivers, estuaries, coastal waters, and ultimately the oceans is from agricultural and stormwater runoff. Stormwater discharges were previously discussed with

respect to municipal wastewater pollution, and they are often classified as point sources. However, they are not as consistent or predictable as industrial or urban wastewater flows and, like other nonpoint pollution sources, are driven primarily by precipitation. Thus, they are discussed here in conjunction with other nonpoint sources.

Agricultural Sources

There are more than 300 million acres of agricultural land in the United States.¹⁸ Agricultural activities can be a significant source of nonpoint pollution in rivers, lakes, and estuaries and a major contributor to groundwater contamination and wetlands degradation. Soil disturbance, irrigation, and application of herbicides, pesticides, fertilizers, and animal wastes to fields all lead to excess sediments, nutrients, pathogens, and salts in coastal waters.

Excessive sedimentation decreases water clarity, smothers fish spawning areas and coral reefs, and carries pollutants into water bodies. (A more complete discussion of sediment management is provided in Chapter 12.) But arguably the most significant impact from agricultural activities is the transport of nutrients, primarily nitrogen and phosphorous, into coastal waters.

USDA is a very important participant in the nonpoint source management process because of the funding it can provide to address agricultural sources. The state conservationist in each state, an employee of USDA's Natural Resources Conservation Service, is a key player in allocating these funds. State- and county-level committees make recommendations to the state conservationist about best management practices to be rewarded and the appropriate level of cost sharing. There are concerns that funds may still go to farmers and ranchers who follow harmful practices, and many deserving recipients do not receive adequate technical assistance. USDA, the Land Grant Extension Service, Farm Service Agency, and farmers themselves also need to be more closely involved in broader watershed and coastal ecosystem-based management efforts so their actions can be coordinated with the many others that affect coastal water quality.

Recommendation 14–7. The U.S. Department of Agriculture (USDA) should align its conservation programs and funding with other programs aimed at reducing nonpoint source pollution, such as those of the U.S. Environmental Protection Agency and the National Oceanic and Atmospheric Administration.

In particular, USDA's Natural Resources Conservation Service should:

- *require that its state conservationists coordinate with representatives of federal and state water quality agencies and state coastal management agencies, and participate in watershed and coastal management planning processes, to ensure that funding for agricultural conservation programs complements and advances other federal and state plans.*
- *provide enhanced technical assistance in the field to meet the demands of growing agricultural conservation programs.*

The Impact of Farm Nutrients on the Marine Environment

Every year, an area covering up to 12,000 square miles in the Gulf of Mexico becomes a dead zone.¹⁹ Nitrogen fertilizers from farms far inland wash into streams and other water bodies and ultimately flow into the Gulf. These nutrients cause excess algal growth, depleting oxygen in the Gulf's bottom waters to levels too low to support fish, crustaceans, and many other forms of marine life.

Over the last half of the 20th century, the use of nitrogen fertilizers within the Mississippi River Basin watershed increased exponentially. The main contributors to the Gulf's dead zone are located along the Mississippi and Ohio rivers, in southern Minnesota, Iowa, Illinois, Indiana, and Ohio (Figure 14.5). On average, streams draining from Iowa and Illinois contribute about 35 percent of the nitrogen discharged from the Mississippi River to the Gulf of Mexico.²⁰

Figure 14.5. Pollution Drains from the Midwest to the Louisiana Coast



The Mississippi–Atchafalaya River Basin (the shaded area in the figure) is the largest river basin in North America, draining an area of 1.24 million square miles or about 41 percent of the continental United States. Polluted waters from the basin flow into the Gulf of Mexico affecting coastal areas. Increased nutrients have resulted in a low oxygen zone along the Louisiana coast.

Source: Committee on Environment and Natural Resources. *Integrated Assessment of Hypoxia in the Northern Gulf of Mexico*. Washington, DC: National Science and Technology Council, 2000.

Urban and Suburban Stormwater Runoff

Stormwater runoff poses another serious threat to U.S. coastal waters. Housing developments, shopping centers, and roads have been built in areas once covered by natural vegetation and wetlands. These developments have increased impervious surfaces, decreased the land available to absorb rain and snow, accelerated runoff into streams, and altered the hydrology of coastal watersheds. Many areas have lost billions of gallons of drinking water due to reductions in groundwater recharge.²¹

Stormwater picks up a variety of substances on its way to coastal waters, including oil, chemicals, heavy metals, pesticides, trash, and pet waste. These pollutants alter the water chemistry and can harm ecosystems. As water runs across impervious surfaces, its temperature also becomes elevated, accelerating the growth of algae and harming fish and other aquatic life that have specific water temperature tolerance limits. Larger volumes of water rushing into streams also erode streambanks, streambeds, and the surrounding land, transporting excess sediments that can damage coastal habitat, harm aquatic life, and reduce light penetration into the water column.

It is estimated that aquatic ecosystem health becomes seriously impaired when more than 10 percent of the watershed is covered by impervious surfaces.²² Impervious surfaces cover 25–60 percent of the area in medium-density residential areas, and can exceed 90 percent at strip malls or other commercial sites.²³

Stormwater-related problems impose measurable economic costs. Drinking water sources can become polluted and excess sediment can increase dredging costs for navigational purposes. Poor stormwater management may increase flooding, causing property damage from flash floods and leading to higher insurance rates. Stormwater is also a source of bacterial contamination, leading to increased disease incidence, thousands of beach closures in the United States each year, and loss of revenues from coastal tourism and sport fishing.²⁴ Millions of dollars are spent on treating the symptoms of stormwater pollution but much less is spent on efforts to control its causes.

Improving the Control of Nonpoint Sources

The nation has a number of opportunities to reduce the impacts of nonpoint sources of pollution on coastal waters. These include coordination of federal nonpoint programs so they are mutually supportive, more targeted and aggressive use of state revolving loan funds, broader implementation of incentives and disincentives, and improved monitoring to assess compliance and overall progress. State and local governments also have important roles to play in land use planning and stormwater management decisions.

Aligning Federal Nonpoint Programs and Goals

The management of nonpoint source pollution in coastal areas includes a mix of planning requirements, state actions, direct funding incentives, and grant programs to encourage standard setting and implementation. Some programs are directed by EPA; one is jointly directed by NOAA and EPA; USDA and USACE both have programs with substantial impacts; and state and local governments play major roles. Currently, there is no mechanism to ensure that the diverse programs are effective, are being adequately coordinated, and are working toward common goals. Addressing nonpoint source pollution will require mechanisms at both the national and regional levels to develop goals and coordinate efforts to meet those goals.

Recommendation 14–8. The National Ocean Council (NOC) should establish significant reduction of nonpoint source pollution in all impaired coastal watersheds as a national goal, and set specific, measurable objectives focused on meeting human health- and ecosystem-based water quality standards. The NOC should ensure that all federal nonpoint source pollution programs are coordinated to meet those objectives.

Coordination among the many agencies, however, will not be enough. States must have enforceable policies, similar to those called for in the CZARA Section 6217 nonpoint source pollution control program, but with greater funding and incentives to reward states that adopt proactive nonpoint source control programs, such as are provided under the Clean Water Act Section 319 program. These programs both have positive attributes that, if combined, could more effectively address nonpoint source pollution. A combination of incentives and enforcement techniques will be needed to ensure progress.

Recommendation 14–9. To improve and strengthen federal efforts to address nonpoint source pollution, Congress should amend the Clean Water Act to merge the National Oceanic and Atmospheric Administration’s enforceable nonpoint source pollution program, created under Section 6217 of the Coastal Zone Act Reauthorization Amendments, into the U.S. Environmental Protection Agency’s incentive-based program, created under Section 319 of the Clean Water Act. To support these efforts, Congress should provide adequate federal resources to enable states to implement best management practices.

Expanding Uses of State Revolving Loan Funds

Currently, the State Revolving Loan Funds are primarily used for addressing municipal point source pollution, but they have also been tapped to address nonpoint sources by funding watershed-based activities, including control of agricultural and urban runoff. Because of the large funding gap in wastewater infrastructure needs, loan funds will need to be supplemented to meet these new demands (see Recommendation 14-4.)

Creating Incentives to Reduce Agricultural Runoff

Because of the many individuals involved, and their geographic and socioeconomic diversity, an incentive-based strategy may be a good approach for reducing pollution from agricultural sources. A number of agricultural conservation programs (some of which are described above) provide incentives to farmers and ranchers to set aside areas of land, purchase better equipment, and employ best management practices.

Several additional forms of incentives could encourage farmers and ranchers to follow practices that would reduce nonpoint source pollution. Some examples include the following:

- Congress and USDA could develop incentives to reward farmers and ranchers by providing special services or technology for good performers.
- Congress could enact tax incentives for farmers and ranchers who implement best management practices that reduce nutrient and soil runoff.
- Congress and USDA could establish insurance programs for agricultural producers who apply fertilizer at or below the agronomic rates recommended by the local Land Grant University to compensate the producers if crop yields decrease as a result.
- Federal farm aid could be tied to implementation of best management practices to reduce nonpoint source pollution.

Efforts to reduce nonpoint source pollution through incentives are already underway. For example, the Sand County Foundation launched a pilot program to test market-based incentives for reducing nitrogen discharges from agricultural lands in targeted watersheds in the Upper Midwest and to gauge farmers’ receptiveness to such incentives.

Other kinds of market-based programs would allow farmers to create nutrient credits by changing cropping practices or implementing best management practices. These credits could then be sold to a wastewater

treatment plant or other nutrient source discharging to the same water body to offset some of its own nutrient outflow and help meet water quality limits.

Authorizing Federal Agencies to Impose Disincentives

While the use of incentives has many benefits, the federal government must take action when a state is failing to protect water quality. Existing nonpoint source programs do not include the necessary federal authority to do so. For example, the Clean Water Act does not authorize EPA to develop and implement management plans, best management practices, or other nonpoint source control measures if state efforts are failing. As a result, EPA's only recourse is to withhold grant funds, depriving a struggling state of critical funding that is already too limited to successfully address nonpoint source problems.

A similar problem exists in the CZARA Section 6217 nonpoint source pollution control program, where the emphasis has been on crafting programs, with less focus on implementation. If a state fails to implement the management measures in its plan, the only recourse for EPA and NOAA is to withhold Clean Water Act and Coastal Zone Management Act grant funds. The potential loss of Clean Water Act funds could more than offset potential gains from CZARA funding, creating a disincentive to participate in the CZARA process at all. To avoid this result and encourage states to participate, EPA and NOAA have postponed deadlines and relaxed oversight, introducing uncertainties that hinder good long-term planning.

In the end, if a state continues to fail in controlling nonpoint source pollution, the federal government should step in to protect the public resource. In addition to invoking regulatory authority, the federal government may have to apply financial disincentives. Reasonable disincentives might include withholding federal funds for programs that contribute to degradation of water quality, such as federal highway construction, agricultural subsidy programs, or USACE development projects in watersheds that are impaired. Funding for federal programs that *promote* water quality should be maintained to encourage continued progress.

Federal regulatory action and financial disincentives to protect water quality should only be invoked if a state chronically fails to make meaningful progress toward controlling nonpoint sources, similar to the precedent established for similar situations under the Clean Air Act. In other words, the federal government should take the lead when all else fails. Federal regulatory authority and financial disincentives should be phased in over time and should be predictable and clearly communicated. Additionally, the standards for triggering federal financial disincentives or regulatory involvement should be designed with care and should consider mitigating circumstances such as whether the failure to attain water quality standards in a state is due to water quality problems that originate in upstream states.

Recommendation 14–10. Congress should provide authority under the Clean Water Act and other applicable laws for federal agencies to impose financial disincentives and establish enforceable management measures to ensure action if a state does not make meaningful progress toward meeting water quality standards on its own.

Monitoring to Assess Compliance

After best management practices are employed and incentive programs are underway, ongoing monitoring will be essential to determine whether these efforts have been effective. A detailed discussion of water quality monitoring is provided in Chapter 15.

Thinking about Land Use

Land use decisions dramatically affect the health of coastal waters. The siting and design of new development must consider such potential impacts and balance them with socioeconomic factors. Many local zoning

ordinances and building codes actually pose significant barriers to low-impact development approaches. For example, ordinances that control the design of curbs, gutters, and streets can reduce or exacerbate the need for stormwater management measures. In addition to its positive impacts on water quality, low-impact development can bring economic advantages. For example, developers are often able to realize additional profits and quicker sales on units that are adjacent to a landscaped stormwater control structure such as a constructed wetland.

Greater public awareness of the connection between land use and water quality will help move decision makers in the right direction. One program that provides education on the effects of planning, zoning, and land use decisions on water quality is Project NEMO—Nonpoint Education for Municipal Officials. Project NEMO is a University of Connecticut program supported by many different partners including EPA, NOAA, USDA, the National Aeronautics and Space Administration, and the U.S. Fish and Wildlife Service. While this program has had successes, it only reaches a small fraction of the tens of thousands of relevant decision makers across the nation.

Recommendation 14–11. State and local governments should revise their codes and ordinances to require land use planning and decision-making to carefully consider the individual and cumulative impacts of development on water quality, including effects on stormwater runoff. The U.S. Environmental Protection Agency and other appropriate entities should increase outreach programs that provide local land use decision makers with the knowledge and tools needed to make sound land use decisions that protect coastal water quality.

Managing Stormwater Runoff

The primary method for controlling stormwater runoff is the application of best management practices. Structural best management practices are measures—such as constructing detention basins, wet ponds, or wetlands—that help control the quantity and quality of stormwater. Nonstructural best management practices are generally preventive actions that rely on behavioral changes, such as modifying the use of fertilizers, sweeping streets, and educating the public. EPA and the American Society of Civil Engineers have jointly developed a national database of stormwater best management practices as a tool for local stormwater designers and planners.

While best management practices can be effective, these tools may not be sufficient on their own. In urban areas, construction activities still contribute significantly to sediment loadings and, where impervious surfaces are prevalent, stormwater flows directly into surface waters and sewer systems. A comprehensive approach will be required to minimize disturbance to the natural hydrology, minimize water flow over surfaces, and maintain water quality. Rigorous monitoring will also be needed to determine whether water quality standards are being achieved and to allow management approaches to be modified as needed to reach desired water quality goals.

Recommendation 14–12. The U.S. Environmental Protection Agency, working with state and local governments, should ensure that stormwater management programs are based on a comprehensive approach that includes: codes or ordinances requiring best management practices; increased enforcement of legal requirements; monitoring to determine whether goals and state water quality standards are being met and to identify ongoing problems; an adaptive management approach to ensure that efforts are effective and that best management practices are modified as needed; improved public education; and funding and personnel sufficient to implement and enforce stormwater management programs.

Collaboration at the Watershed Scale

As discussed in Chapter 9, watersheds are often the appropriate geographic unit for addressing water-related problems because they acknowledge upstream and downstream connections and consider the cumulative impacts of activities taking place in the watershed. These features are particularly important in addressing nonpoint source pollution.

Collaborative watershed groups have had significant successes in addressing nonpoint source pollution. These groups bring together stakeholders reflecting the diverse interests that may be represented in a watershed: agriculture, timber, and industry; sport and commercial fishing interests; recreational users and tourism-related businesses; environmental and citizen groups; and local, state, tribal, and federal governments. While such public/private sector collaborations can complement more traditional water pollution control strategies, they are often hampered by limited financial resources, institutional instability, and lack of technical expertise.

Addressing nonpoint source pollution on a watershed basis makes good sense for environmental, financial, social, and administrative reasons. In addition, regional ocean councils can play an important role in helping to support the collaborative efforts of watershed groups. Collaborative watershed approaches can build a sense of community, reduce conflicts, increase commitment to the actions necessary to meet common goals and, ultimately, improve the likelihood of sustaining long-term water quality improvements.

Recommendation 14-13. The National Ocean Council and regional ocean councils should strengthen the ability of collaborative watershed groups to address problems associated with nonpoint source pollution by developing and implementing strategies to provide them with adequate technical, institutional, and financial support.

International Efforts

Nonpoint source pollution is an important, and increasingly visible, international issue. The health, well-being and, in some cases, the very survival of coastal populations around the world depend upon the viability of coastal and marine systems. Nonpoint source pollution threatens these areas and the important economic activities, such as fishing and tourism that they support. Public health is also adversely affected through contamination of seafood, direct contact, such as through bathing, and the use of seawater in desalination and food-processing plants.

Ongoing efforts to reduce nonpoint source pollution internationally include the United Nations Environment Program's (UNEP's) establishment of fourteen regional seas programs worldwide as part of the 1995 Global Program of Action for the Protection of the Marine Environment from Land-Based Sources (GPA). Many nations, including the United States, are moving forward with initiatives to implement the GPA. However, broader application of GPA measures will depend on increased foreign technical assistance and funding. The U.S. Agency for International Development, NOAA, and EPA provide limited technical and training assistance through UNEP for nations where sewage treatment, monitoring, research, and law enforcement capacity are insufficient.

As part of the GPA, UNEP launched the Hilltops to Oceans initiative (H2O) at the 2002 World Summit on Sustainable Development. Overall objectives of H2O include facilitating international recognition of the links between freshwater and marine environments and assisting in the implementation of actions needed to reduce, remediate, and prevent pollution and degradation of the coastal and marine environment.

The United States is particularly involved in the coordination, integration, and management of marine pollution programs in the wider Caribbean region, including programs for addressing upstream sources and protecting wetlands, mangrove swamps, coral reefs, and offshore areas. At the 2002 Summit, the United

States launched the White Water to Blue Water initiative with a coalition of partners that includes the United Kingdom, France, Canada, the Netherlands, Caribbean island governments, nongovernmental organizations, and the private sector. The ultimate goal of the initiative is to improve the capabilities of all coastal nations to manage watershed and coastal ecosystems for sustainable development. Participants hope that success in implementing the pilot phase in the Caribbean will encourage other regions in Africa and the South Pacific to follow suit.

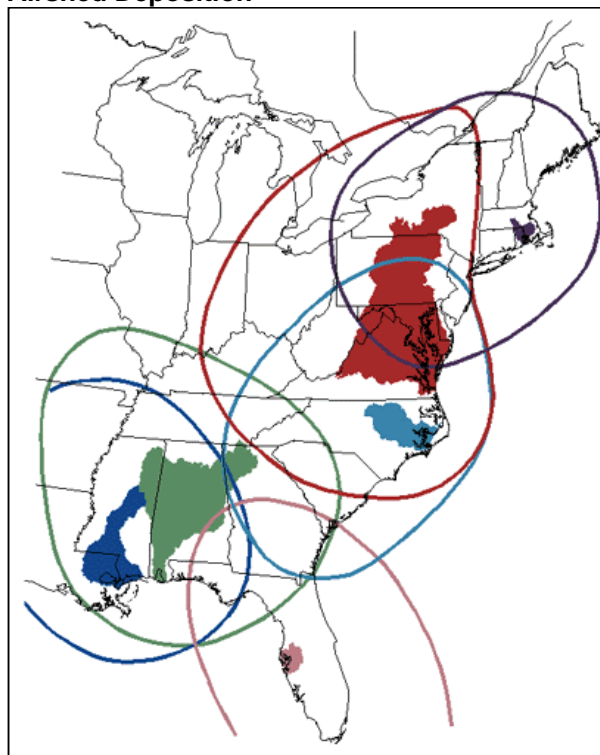
ADDRESSING ATMOSPHERIC SOURCES OF POLLUTION

Atmospheric deposition of pollutants can also harm water quality, aquatic resources, and human health. Atmospheric deposition accounts for between 10 and 50 percent of the nitrogen entering estuaries along the U.S. East Coast and the Gulf of Mexico.^{25, 26} Major atmospheric pollutants include nutrients, metals such as lead and mercury, pesticides, polycyclic aromatic hydrocarbons, dioxins, furans, and persistent toxic substances. Certain persistent toxins, such as DDT and PCB, have even been measured in remote locations, such as the Arctic and Antarctic, demonstrating the extent of dispersal of pollutants by the atmosphere. Atmospheric deposition is also a significant source of pollution in the Great Lakes; as much as 90 percent of some toxic chemicals entering the Great Lakes are believed to be the result of atmospheric deposition.²⁷ Sources of atmospheric deposition are quite varied and include agriculture, incineration, coal-fired power plants, industrial facilities, and motor vehicles, as well as natural sources such as forest fires, lightning, and volcanoes.

Improving Control of Atmospheric Sources

Addressing atmospheric deposition requires controlling multiple sources within a particular waterbody's airshed, defined as the geographic area responsible for 75 percent of the air pollutants that reach that body of water (Figure 14.6). The airshed can be ten, twenty, or even several hundred times larger than the area of the watershed.

Figure 14.6. Looking Skyward: Accounting for Airshed Deposition



The atmospheric area affecting water quality within a watershed may be ten to several hundred times larger than the watershed itself. As shown here for oxidized nitrogen contributions along the East Coast, the extent of the calculated airsheds illustrate the states, regions, and nations that must coordinate in order to effectively manage atmospheric contributions to water quality.

Source: U.S. Environmental Protection Agency.
<<http://www.epa.gov/owow/oceans/airdep/air1.html>> (Accessed January, 2004).

To add to the complexity, different pollutants exhibit different physical and chemical behaviors in the atmosphere, so the airshed of a particular body of water may vary depending on the pollutant of interest. The federal government is taking some positive steps to address atmospheric deposition. For example, in 2001

EPA developed the Air-Water Interface Work Plan, detailing actions that the agency can take based on authorities in the Clean Air and Clean Water Acts.

Recommendation 14–14. The U.S. Environmental Protection Agency, states, and watershed groups should explore regional approaches for managing atmospheric deposition, particularly when it affects water bodies in states far from the source.

Control of atmospheric deposition is currently hampered by relatively poor data on sources, atmospheric transport routes, and the sites where pollutants are ultimately deposited. While several monitoring programs exist, relatively few are in coastal areas. Reducing atmospheric deposition would be greatly aided by better data, analysis, and information on emission sources, fate and transport, and related environmental and human health consequences. (A further discussion of monitoring needs is provided in Chapter 15.)

Because of the potential range of atmospheric dispersion, international cooperation will also be needed. One example of an issue requiring urgent international action is mercury contamination in fish, a human health concern because of potential neurotoxic effects, particularly for pregnant women and children. International action to control persistent organic pollutants and other toxic substances is carried out under UNEP programs implementing the Stockholm Convention on Persistent Organic Pollutants.

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¹⁰ Harries, J.E., et al. "A Survey of Estrogenic Activity in United Kingdom Inland Waters." *Environmental Toxicology and Chemistry* 15 (1996): 1993–2002.

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¹³ U.S. Environmental Protection Agency. "National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations (CAFOs): Final Rule." *Federal Register* 68 (February 12, 2003): 7175 et seq.

¹⁴ *Ibid.*, 7176, 7239.

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¹⁶ U.S. Environmental Protection Agency. *The Clean Water and Drinking Water Infrastructure Gap Analysis*. EPA 816-R-02-020. Washington, DC, September 2002.

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