United States Environmental Protection Agency

Office of Water
Washington D.C. 20460

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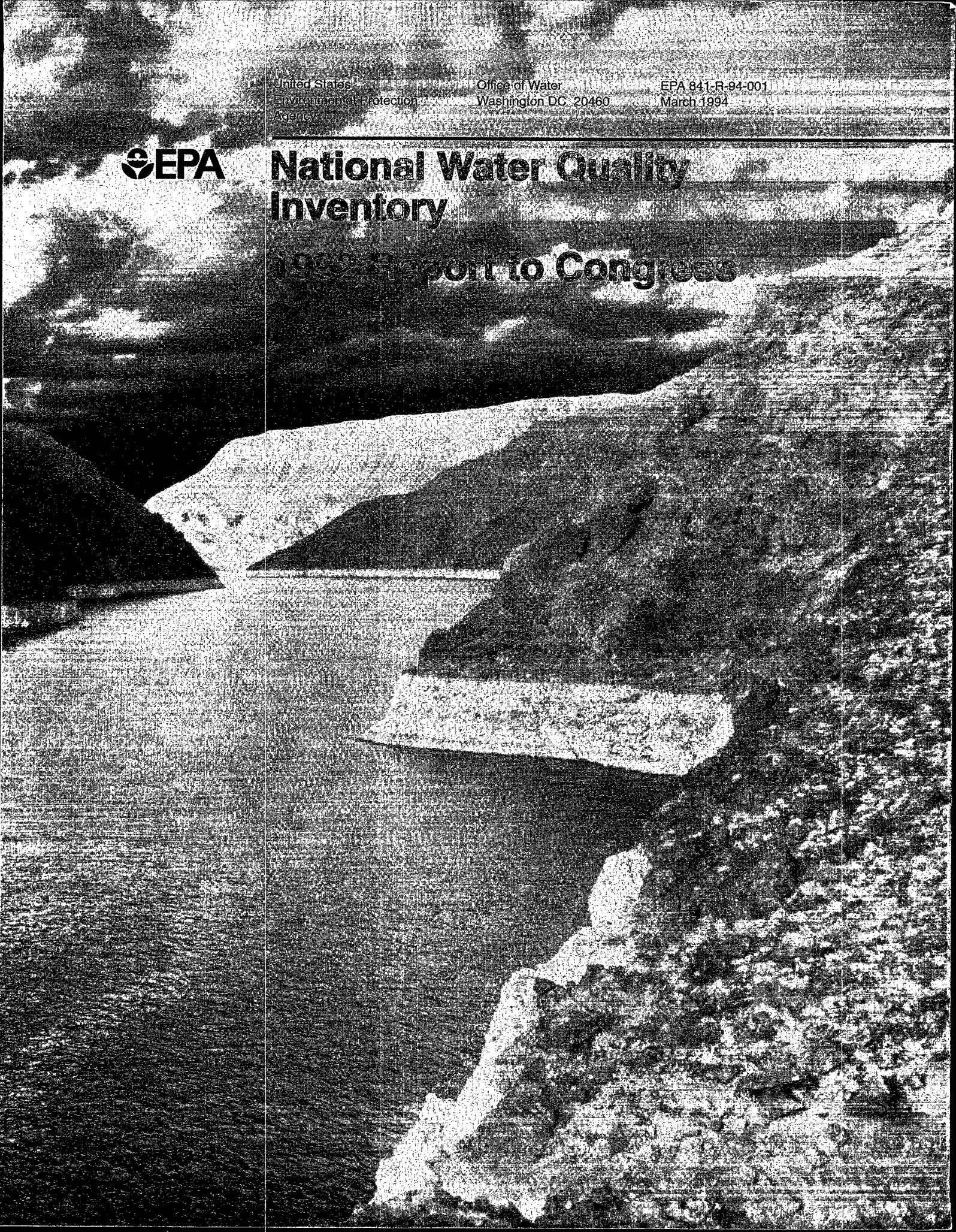
March 1994

EPA

National Water Quality Inventory

1992 Report to Congress



This report was prepared pursuant to Section 305(b) of the Clean Water Act, which states: "(b)(1) Each State shall prepare and submit to the Administrator by April 1, 1975, and shall bring up to date by April 1, 1976, and biennially thereafter, a report which shall include—

"(A) a description of the water quality of all navigable waters in such State during the preceding year, with appropriate supplemental descriptions as shall be required to take into account seasonal, tidal, and other variations, correlated with the quality of water required by the objective of this Act (as identified by the Administrator pursuant to criteria published under section 304(a) of this Act) and the water quality described in subparagraph (B) of this paragraph;

"(B) an analysis of the extent to which all navigable waters of such State provide for the protection and propagation of a balanced population of shellfish, fish, and wildlife, and allow recreational activities in and on the water;

"(C) an analysis of the extent to which the elimination of the discharge of pollutants and a level of water quality which provides for the protection and propagation of a balanced population of shellfish, fish, and wildlife and allows recreational activities in and on the water, have been or will be achieved by the requirements of this Act, together with recommendations as to additional action necessary to achieve such objectives and for what waters such additional action is necessary;

"(D) an estimate of (i) the environmental impact, (ii) the economic and social costs necessary to achieve the objective of this Act in such State, (iii) the economic and social benefits of such achievement; and (iv) an estimate of the date of such achievement; and

"(E) a description of the nature and extent of nonpoint sources of pollutants, and recommendations as to the programs which must be undertaken to control each category of such sources, including an estimate of the costs of implementing such programs.

"(2) The Administrator shall transmit such State reports, together with an analysis thereof, to Congress on or before October 1, 1975, and October 1, 1976, and biennially thereafter."

Cover photo of Lake Mead by Patricia Cunningham

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Honorable Albert Gore
President of the Senate
Washington, D.C. 20515

Dear Mr. President:

As required by Section 305(b) of the Federal Water Pollution Control Act, I am transmitting to the Congress the 1992 National Water Quality Inventory Report. This biennial report is the ninth in a series of national water quality assessments first published by the U.S. Environmental Protection Agency (EPA) in 1975 and biennially since 1976.

While this report indicates that most of the Nation's waters are of good quality, it also indicates that the remaining waters are impaired to varying degrees. Of assessed waters, a majority are reported to be supporting the beneficial uses for which they have been designated by the States, but a significant number are not. States reported that these uses, such as drinking water supply, swimming, and the propagation of aquatic life were supported in 62 percent of assessed river miles, 56 percent of assessed lake acres, and 68 percent of assessed estuarine square miles. However, States report that they consider some of these waters threatened because they could become impaired if pollution control actions are not taken.

According to the States, the most commonly reported problems in impaired waters are from nonpoint sources (such as runoff from agricultural lands). Pollutants include nutrients, siltation, pathogens, and metals. Agriculture is the leading source of pollution in rivers and lakes, and ranks in the top three sources in estuaries.

We as a Nation have made important strides toward cleaning up America's waterways, yet 40 percent of our rivers, lakes, and estuaries are still not suitable for fishing and swimming. The Administration has a proposal for fundamental changes to the Clean Water Act that will address the last remaining sources of pollution at a reduced cost to the Nation. The proposed reform would cost $30 billion less per year than the current law. In addition, it would allow more flexibility in controlling pollution in ways that work best for each locality. We look forward to working with Congress to adopt the Administration's proposal.

Sincerely,

Carol M. Browner

Carol M. Browner

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

THE ADMINISTRATOR

Honorable Thomas S. Foley
Speaker of the House of
Representatives
Washington, D.C. 20515

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Carol M. Browner

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Acknowledgments

This report is based primarily on water quality assessments submitted to the U.S. Environmental Protection Agency by the States, Territories, American Indian Tribes, the District of Columbia, and Interstate Commissions of the United States. The EPA wishes to thank the authors of these assessments for the time and effort spent in preparing these reports and reviewing the draft of this national assessment. Additional thanks go to the water quality assessment coordinators from all ten EPA Regions who work with the States.

The project manager and editor of this document was Barry Burgan of the Assessment and Watershed Protection Division, Office of Wetlands, Oceans and Watersheds. Key contributions were also made by the following individuals in other EPA program offices: Richard McDermott, Ground Water Protection Division; Rob Wood, Permits Division; Benjy Ficks, Wetlands Division; Ann Beier, Nonpoint Source Control Branch; Kevin Perry, Oceans and Coastal Protection Division; Brett Snyder, Office of Policy, Planning and Evaluation; Kevin Summers and Steve Paulsen, Environmental Monitoring and Assessment Program; Joseph Macknis, Chesapeake Bay Program; Susan MacMullin, Gulf of Mexico Program; and Alice Mayio, Assessment and Watershed Protection Division. Additional information was provided by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration.

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Executive Summary

Introduction

The 1992 Report to Congress describes the geographic extent of water pollution across the country and identifies specific pollutants and sources of pollutants contaminating our waters. This national snapshot of water quality conditions summarizes information submitted by the States, the District of Columbia, Territories, Interstate Water Basin Commissions, and one American Indian Tribe in their 1992 water quality assessment reports (required under Clean Water Act Section 305(b)). The 1992 Section 305(b) reports contain assessments of each State's water quality during 1990 and 1991.

This report displays and summarizes data provided by the States to EPA. EPA has not determined the accuracy of these data. It is important to note that these State-reported data are intended to provide a snapshot of the quality of the waters they assessed and cannot be used to determine trends in our Nation's water resources. These limitations are due to major differences from year to year in assessment methods within and between States as well as differences in the waters assessed in each 2-year period. In addition, not all States follow EPA's guidance on procedures for determining whether waters are supporting the uses designated in their water quality standards. EPA and the States are taking many steps toward transforming the 305(b) process into one that provides comparable data with known accuracy. These steps include implementing the recommendations of the National 305(b) Consistency Workgroup and the Intergovernmental Task Force on Monitoring Water Quality, as well as improving the Section 305(b) guidelines and implementing the Office of Water's Monitoring Strategy. These efforts will foster consistency and accuracy among the States and allow better sharing of data for watershed protection and across political boundaries.

Why Is It Important To Learn About Water Pollution?

The EPA encourages each citizen to become a steward of our precious natural resources. Complex environmental threats and diminishing funds for pollution control force us to jointly solve the pollution problems that foul our beaches and lakes or close our favorite fishing sites. We need to understand these problems and become a part of their solution. Once we understand these pollution problems and what is needed to combat them, we will be better able to prioritize our efforts, devise sound solutions, take appropriate action, monitor progress after solutions are implemented, and modify behavior that contributes to the problems.

This document provides fundamental water quality information needed to resolve our persistent water pollution problems. This Report to Congress

- Defines key water quality concepts
- Discusses the leading pollution problems in rivers and streams, lakes, estuaries, coastal waters, wetlands, and ground water as reported to EPA by the States
- Briefly describes major State and Federal activities to control water pollution
- Offers several water quality protection actions for every citizen to adopt.

Measuring Water Quality

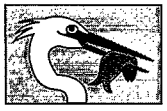
The States assess the quality of their waters by determining if their waters attain State water quality standards. Water quality standards consist of beneficial uses, numeric and narrative criteria for supporting each use, and an antidegradation statement:

- **Designated beneficial uses** are the desirable uses that water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be realized. States may designate an individual waterbody for multiple beneficial uses.
- **Numeric water quality criteria** establish the minimum physical, chemical, and biological parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters, and minimum concentrations of desirable parameters, such as dissolved oxygen. Numeric biological criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms.
- **Narrative water quality criteria** define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. Narrative biological criteria establish a positive statement about aquatic community characteristics expected to occur within a waterbody; for example, "Ambient water quality shall be sufficient to support life stages of all indigenous aquatic species." Narrative criteria may also describe conditions that are desired in a waterbody, such as, "Waters must be free of substances that are toxic to humans, aquatic life, and wildlife."
- **Antidegradation statements** protect existing designated uses and prevent high-quality waterbodies from deteriorating below the water quality necessary to maintain existing or anticipated designated beneficial uses.

The Clean Water Act provides primary authority to States to set their own standards but requires that all State beneficial uses and their criteria comply with the

"fishable and swimmable" goals of the Act. At a minimum, State beneficial uses must support aquatic life and recreational use. In effect, States cannot designate "waste assimilation" as a beneficial use, as some States did prior to 1972.

The EPA recommends that States assess support of the following individual beneficial uses:



Aquatic Life Support

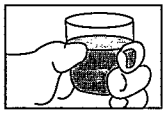
The waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms.

Fish Consumption

The waterbody supports a population of fish free from contamination that could pose a human health risk to consumers.

Shellfish Harvesting

The waterbody supports a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.

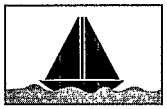


Drinking Water Supply

The waterbody can supply safe drinking water with conventional treatment.

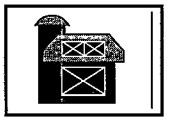
Primary Contact Recreation – Swimming

People can swim in the waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).



Secondary Contact Recreation

People can perform activities on the water (such as canoeing) without risk of adverse human health effects from occasional contact with the water.



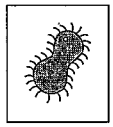
Agriculture

The water quality is suitable for irrigating fields or watering livestock.

EPA recognizes five levels of use support (Table ES-1). If possible, the States determine the level of use support by comparing monitoring data with numeric criteria for each use designated for a particular waterbody. If monitoring data are not available, the State may determine the level of use support with qualitative information. Valid qualitative information includes land use data, fish and game surveys, and predictive model results. **Monitored assessments** are based on monitoring data. **Evaluated assessments** are based on qualitative information or monitored data more than 5 years old.

After the States determine the level of use support for each individual designated use in each waterbody, the States consolidate

Table ES-1. Levels of Use Support

Symbol	Use Support Level	Water Quality Condition	Definition
	Fully Supporting	Good	Water quality meets designated use criteria.
	Threatened	Good	Water quality supports designated uses now but may not in the future unless action is taken.
	**Partially Supporting**	Fair (Impaired)	Water quality fails to meet designated use criteria at times.
	Not Supporting	Poor (Impaired)	Water quality frequently fails to meet designated use criteria.
	Not Attainable	Poor	The State has performed a use-attainability study and documented that use support is not achievable due to natural conditions or human activity that cannot be reversed without imposing widespread economic and social impacts.

NOTE

Overall use support is a general description of water quality conditions in a waterbody based on evaluation of individual use support. Overall use support determinations summarize multiple individual use determinations into a single measure of water quality conditions.

individual use support assessments to determine the level of overall use support for each waterbody.

- **Fully Supporting Overall Use** – All designated beneficial uses are fully supported.
- **Threatened Overall Use** – One or more designated beneficial uses are threatened and the remaining uses are fully supported.
- **Partially Supporting Overall Use** – One or more designated beneficial uses are partially supported and the remaining uses are fully supported.
- **Not Supporting Overall Use** – One or more designated beneficial uses are not supported.
- **Not Attainable** – The State has performed a use-attainability study and documented that use support of one or more designated beneficial uses is not achievable due to natural conditions or human activity that cannot be reversed without imposing widespread economic and social impacts.
- **Impaired Waters** – The sum of waterbodies partially supporting uses and not supporting uses.

The EPA then aggregates the State use support information into a national assessment of the Nation's water quality.

Water Quality Monitoring

Water quality monitoring consists of data collection and sample analysis performed according to quality control protocols. Monitoring also includes subsequent analysis of the body of data to support decisionmaking. Federal, Interstate, State, Territorial, Tribal, Regional, and local agencies, industry, and volunteer groups with approved quality assurance programs monitor a combination of chemical, physical, and biological water quality parameters throughout the country.

- Chemical data often measure concentrations of pollutants and other chemical conditions that influence aquatic life, such as pH (i.e., acidity) and dissolved oxygen concentrations. The chemical data may be analyzed in water samples, fish tissue samples, or sediment samples.
- Physical data include measurements of temperature, turbidity (i.e., light penetration through the water column), and solids in the water column.
- Biological data measure the health of aquatic communities. Biological data include counts of aquatic species that indicate healthy ecological conditions.

Monitoring agencies vary parameters, sampling frequency, and sampling site selection to meet program objectives and funding constraints. Sampling may occur at regular intervals (such as monthly, quarterly, or annually), irregular intervals, or during one-time intensive surveys. Sampling may be conducted at fixed sampling stations, randomly selected stations, stations near suspected water quality problems, or stations in pristine waters.

How Many of Our Waters Were Assessed for 1992?

National estimates of the total waters of our country provide the foundation for determining the percentage of waters assessed by the States and the portion impaired by pollution. In 1992, EPA calculated national estimates of total rivers and streams, lakes, estuaries, and coastal shoreline by summing State estimates of their total waters reported in their 1992 305(b) reports. Based on State-reported data, the estimate of total river and stream miles increased in 1992 in large part because the States included nonperennial streams, canals, and

ditches that were previously excluded from estimates of total stream miles.

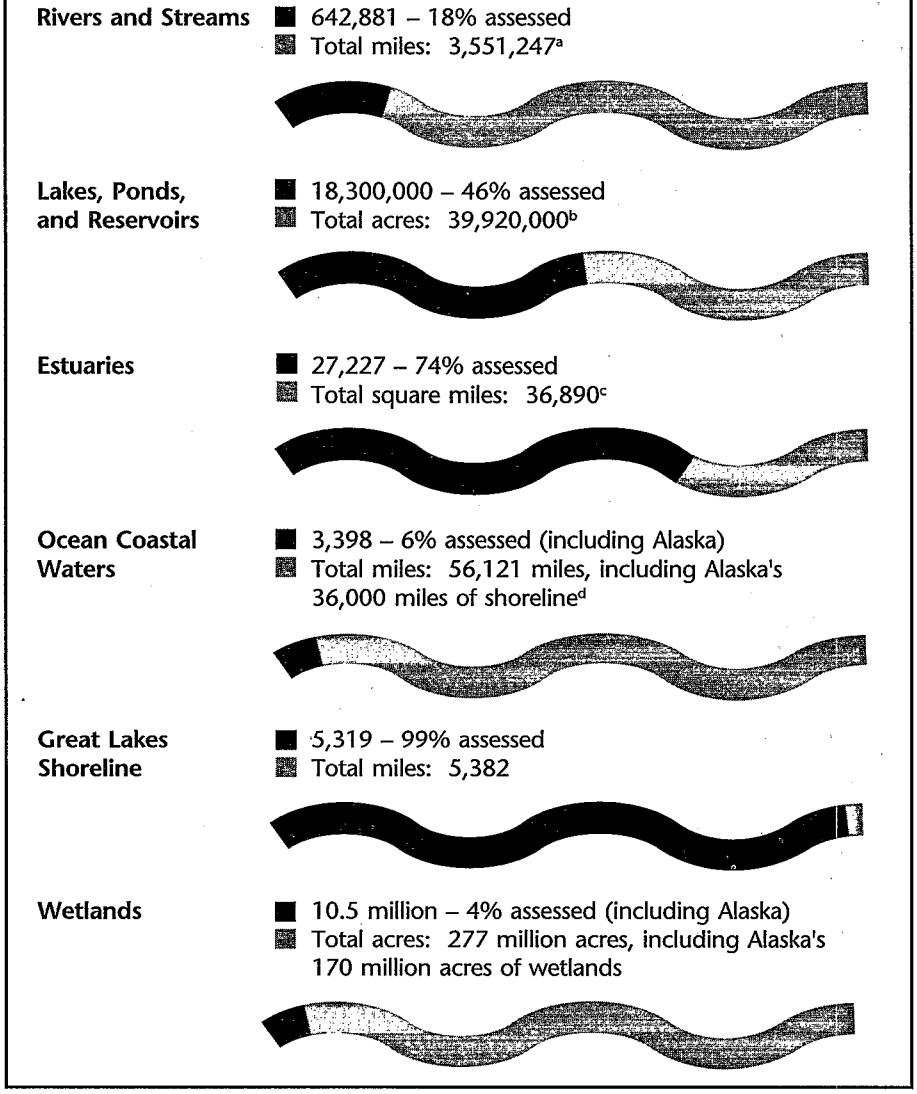
Current estimates indicate that the United States has

- More than 3.5 million miles of rivers and streams, which range in size from the Mississippi River to small streams that flow only when wet weather conditions exist (i.e., intermittent streams)
- Approximately 40 million acres of lakes, ponds, and reservoirs
- About 37,000 square miles of estuaries (excluding Alaska)
- More than 56,000 miles of ocean shoreline, including 36,000 miles in Alaska
- 5,382 miles of Great Lakes shoreline
- More than 277 million acres of wetlands such as marshes, swamps, bogs, and fens in the continental States including 170 million acres of wetlands in Alaska.

Due to factors such as funding limitations, most States assess a subset of their total water resources during each 2-year reporting cycle required under Clean Water Act Section 305(b). States are more capable of assessing all of their waters over a 5- to 10-year period. Figure ES-1 presents the percentage of total waters assessed by the States for the 1992 report. It should be noted that the percentage of perennial rivers and streams assessed is much greater than the percentage of total rivers and streams assessed.

Figure ES-1

Percent of Total Waters Assessed for the 1992 Report



Based on 1992 State Section 305(b) reports.

NOTE: These figures were reported by the States. See explanation of changes in total water estimates on page ES-4.

[a] Does not include river miles in American Samoa and Guam, which did not report total river miles.
[b] Does not include lake acreages in American Samoa, Guam, Kentucky, and the Virgin Islands, which did not report total lake acreages.
[c] Does not include estuarine areas in Alaska, American Samoa, and Guam.
[d] Does not include shoreline miles in American Samoa and Guam.

The summary information based on assessed waters may not represent overall conditions in the Nation's total waters because States often focus on monitoring and assessing major perennial rivers, estuaries, and public lakes with suspected pollution problems. Many States lack the resources to collect use support information for intermittent streams, small tributaries, and private ponds. EPA cannot predict the health of these unassessed waters.

Pollutants That Degrade Water Quality

Where possible, States identify the pollutants or processes that degrade water quality and indicators that document impacts of water quality degradation (see Table ES-2). Pollutants include sediment, nutrients, and chemical contaminants (such as dioxin and metals). Processes that degrade waters include habitat modification (such as destruction of streamside vegetation) and hydrologic modification (such as flow reduction). Indicators of water quality degradation include physical, chemical, and biological parameters. Examples of biological parameters include species diversity and abundance. Examples of physical and chemical parameters include pH, turbidity, and temperature. Following are descriptions of the effects of the pollutants and processes most commonly identified in rivers, lakes, estuaries, coastal waters, wetlands, and ground water.

Table ES-2. Five Leading Causes of Water Quality Impairment

Rank	Rivers	Lakes	Estuaries
1	Siltation	Metals	Nutrients
2	Nutrients	Nutrients	Pathogens
3	Pathogens	Organic Enrichment/ Low DO	Organic Enrichment/ Low DO
4	Pesticides	Siltation	Siltation
5	Organic Enrichment/ Low DO	Priority Organic Chemicals	Suspended Solids

Based on 1992 State Section 305(b) reports.

Nutrients include nitrates found in sewage and fertilizers and phosphates found in detergents and fertilizers. In excess levels, nutrients overstimulate the growth of aquatic plants and algae. Excessive growth of these organisms, in turn, can clog navigable waters, use up dissolved oxygen as they decompose, and block light to deeper waters. This seriously affects the respiration of fish and aquatic invertebrates, leads to a decrease in animal and plant diversity, and affects our use of the water for fishing, swimming, and boating. In ground water, fertilizers and nitrates are among the principal contaminants that can lead to drinking water well closures.

Silt and other suspended solids wash off plowed fields, construction and logging sites, urban areas, strip-mined land, and eroded stream banks when it rains. As these sediments enter rivers, lakes, coastal waters, and wetlands, fish respiration is impaired, plant productivity and water depth are

reduced, aquatic organisms and their habitats are smothered, and our aesthetic enjoyment of the water is reduced.

Pathogens (certain waterborne bacteria, viruses, and protozoans) can cause human illnesses that range from typhoid and dysentery to minor respiratory and skin diseases. These organisms can enter waterways through a number of routes, including inadequately treated sewage, storm water drains, septic systems, runoff from livestock pens, and boats that dump sewage. Because it is impossible to test water for every type of disease-causing organism, States usually measure indicator bacteria such as fecal coliforms that suggest the water may be contaminated with untreated sewage and that other, more dangerous, organisms may be present.

Organic material may enter waterways in many different forms–as sewage, as leaves and grass clippings, or as runoff from livestock feedlots and pastures. When natural bacteria and protozoa in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many types of fish and bottom-dwelling animals cannot survive when levels of dissolved oxygen drop below 2 to 5 parts per million.

Metals (such as mercury, lead, and cadmium) and **toxic organic chemicals** (such as PCBs and dioxin) may originate in industrial discharges, runoff from city streets, mining activities, leachate from landfills, and a variety of other sources. These toxic chemicals, which are generally persistent in the environment, can cause death or reproductive failure in fish, shellfish, and wildlife. In addition, they can accumulate in animal and fish tissue, be absorbed in sediments, or find their way into drinking water supplies, posing long-term health risks to humans.

Pesticides and herbicides used on croplands, lawns, and in termite control can be washed into ground and surface waters by rainfall, snowmelt, and

Fish Kills

Fish kill reporting is a voluntary process; States are not required to report on how many fish kills occur, or what might have caused them. In many cases it is the public–fishermen and hunters, recreational boaters, or hikers–who first notice fish kills and report them to game wardens or other State officials. Many fish kills go undetected or unreported, and others may be difficult to investigate, especially if they occur in remote areas. This is because dead fish may be carried quickly downstream, or may be difficult to count because of turbid conditions. It is therefore likely that the statistics presented by the States underestimate the total number of fish kills that occurred nationwide between 1990 and 1992.

Despite these problems, fish kills are an important consideration in water quality assessments, and State reporting on the number and causes of kills is improving. In 1992, 43 States reported a total of 1,620 fish kill incidents. These States attributed 930 of the fish kills to pollution, 369 to unknown causes, and 586 to natural conditions, such as low flow and high temperatures. Pollutants most often cited as the cause of kills included biochemical oxygen-demanding substances, pesticides, manure and silage, oil and gas, chlorine, and ammonia. Leading sources of fish kills include agricultural activities, industrial discharges, municipal sewage treatment plant discharges, spills, and pesticide applications.

irrigation practices. These contaminants are generally very persistent in the environment and may accumulate in fish, shellfish, and wildlife to levels that pose a risk to human health and the environment. Pesticides are among the principal contaminants causing drinking water well closures in the southern and western regions of the country.

Habitat modification results from activities such as grazing, farming, channelization, dam construction, and dredging. Typical examples of the effects of hydrologic modification include loss of streamside vegetation, siltation, smothering of bottom-dwelling organisms, and increased water temperatures.

Other pollutants include salts, acidic contaminants, and oil and grease. Fresh waters may become unfit for aquatic life and some human uses when they become contaminated by salts. Sources of salinity include irrigation runoff, brine used in oil extraction, road deicing operations, and the intrusion of sea water into ground and surface waters in coastal areas. Acidity problems are of concern in areas with many abandoned mines (acid mine drainage) and areas susceptible to acid rain. Changes in acidity (measured as pH) can alter the toxicity of other chemicals in water and can render lakes and streams unfit for aquatic life.

Other pollutants of concern include crude oil and processed petroleum products spilled during extraction, processing, or transport or leaked from underground storage tanks; noxious aquatic plants, particularly introduced species that compete against native plants; and increased water temperatures resulting from industrial cooling processes or habitat modification.

Table ES-3. Pollution Source Categories Used in This Report

Category	Examples
Industrial	Pulp and paper mills, chemical manufacturers, steel plants, textile manufacturers, food processing plants
Municipal	Publicly owned sewage treatment plants that may receive indirect discharges from industrial facilities or businesses
Combined Sewers	Single facilities that treat both stormwater and sanitary sewage, which may become overloaded during storm events and discharge untreated wastes into surface waters.
Storm Sewers/ Urban Runoff	Runoff from impervious surfaces including streets, buildings, lawns, and other paved areas that enters a sewer, pipe, or ditch before discharge into surface waters
Agricultural	Crop production, pastures, rangeland, feedlots, other animal holding areas
Silvicultural	Forest management, tree harvesting, logging road construction
Construction	Land development, road construction
Resource Extraction	Mining, petroleum drilling, runoff from mine tailing sites
Land Disposal	Leachate or discharge from septic tanks, landfills, and hazardous waste sites
Hydrologic Modification	Channelization, dredging, dam construction, streambank modification

Sources of Water Pollution

Often we associate water pollution with images of oil spills or raw sewage and toxic chemicals spewing from pipes at industrial facilities and sewage treatment plants. Although point source discharges

still produce some pollution, most are controlled with specific permit conditions that they usually meet. Currently, less visible nonpoint sources of pollution are more widespread and introduce vast quantities of pollutants into our surface and ground waters. Nonpoint sources deliver pollutants to waterbodies in a dispersed manner rather than from a discrete pipe or other conveyance. Nonpoint sources include atmospheric deposition, contaminated sediments, and land use activities that generate polluted runoff, such as construction, agriculture, logging, mining, and onsite sewage disposal.

In contrast, point sources discharge wastes into waterbodies from a discrete point that is easily identified. The most common point sources are industrial facilities, municipal treatment plants, and combined sewers. Although diffuse runoff is generally treated as a nonpoint source, runoff is a point source if it enters and is discharged from a conveyance such as those described in CWA Section 502(14) (such as pipes, ditches, and canals). Table ES-3 defines the point and nonpoint categories of pollution sources most frequently cited in this document. Table ES-4 lists the leading sources of impairment reported by States for their rivers, lakes, and estuaries.

Other sources cited less frequently include atmospheric deposition, in-place contaminants, and natural sources. Atmospheric deposition refers to contaminants entering waters from polluted air. In-place contaminants were generated by past activities, such as discontinued industrial discharges, logging, or one-time spills. In-place contaminants often reside in sediments but continue to release pollutants back into the water column. Natural sources refer to an assortment of water quality problems:

- Natural deposits of salts, gypsum, nutrients, and metals in soils that leach into surface and ground waters
- Warm weather and dry conditions that raise water temperatures, depress dissolved oxygen concentrations, and dry up shallow waterbodies
- Low-flow conditions and tannic acids from decaying leaves that lower pH and dissolved oxygen concentrations in swamps draining into streams.

With so many potential sources of pollution, it is difficult and expensive for States to identify specific sources responsible for water quality impairments. Many States lack funding for monitoring to identify all but the most apparent sources degrading waterbodies. State management priorities may focus monitoring

> ***"The term 'point source' means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm water discharges and return flows from irrigated agriculture."***
>
> Clean Water Act Section 502(14)

Table ES-4. Five Leading Sources of Water Quality Impairment

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Municipal Point Sources
2	Municipal Point Sources	Urban Runoff/ Storm Sewers	Urban Runoff/ Storm Sewers
3	Urban Runoff/ Storm Sewers	Hydrologic/Habitat Modification	Agriculture
4	Resource Extraction	Municipal Point Sources	Industrial Point Sources
5	Industrial Point Sources	Onsite Wastewater Disposal	Resource Extraction

Based on 1992 State Section 305(b) reports.

Total rivers = 3.5 million miles
Total assessed = 642,881 miles

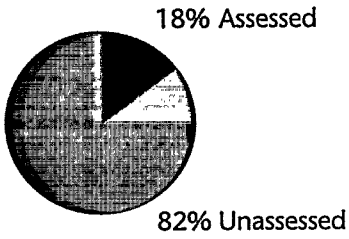


Figure ES-2

Levels of Overall Use Support – Rivers and Streams

Fully Supporting
56%

Threatened
6%

Partially Supporting
25%

Not Supporting
13%

Not Attainable
<1%

Based on data contained in Appendix A, Table A-1.

budgets on other water quality issues, such as identification of contaminated fish populations that pose a human health risk. Management priorities may also direct monitoring efforts on larger waterbodies and overlook sources impairing smaller waterbodies. As a result, the States do not associate every impacted waterbody with a source of impairment in their 305(b) reports, and the summary information presented in this report applies exclusively to a subset of the Nation's impaired waters.

Rivers and Streams

Pollutants discharged upstream often become the problem of someone who lives downstream (or of the aquatic life that exists *instream*), and all of the activities that take place in a watershed can have a water quality impact elsewhere in the watershed. The term watershed simply refers to a geographic area in which water, sediments, and dissolved materials (contaminants) drain to a common outlet such as a point on a larger river, lake, ground water aquifer, or ocean. It is therefore important to remember that rivers and streams are connected–by hydrology, ecology, geology, and social and economic considerations–to the lakes, wetlands, and coastal and ground waters we discuss later in this document.

Do Our Rivers and Streams Support Uses?

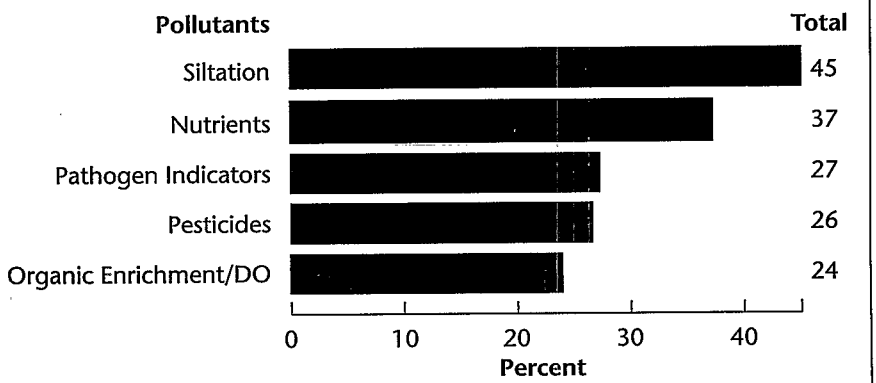
For the 1992 Report, 54 States, Territories, Tribes, Commissions, and the District of Columbia (hereafter referred to as "States") assessed 642,881 miles (18%) of the Nation's total 3.5 million miles of rivers and streams (see Appendix A, Table A-1, for individual State information).

The States assessed about 4,000 fewer river miles in 1992 than in

Figure ES-3

Percent of Assessed River Miles Impaired by Pollutants

(222,370 assessed river miles impaired)



Based on data contained in Appendix A, Table A-3.

1990. EPA expected the percentage and amount of waters assessed to decline in 1992 because EPA advised the States to no longer include waters in the assessed categories for which the State lacked specific information. The percentage of waters assessed dropped because the baseline estimate of total waters increased.

Conditions in unassessed rivers cannot be estimated with summary information based on assessed waters because unassessed rivers include an unknown combination of pristine and impaired rivers. Therefore, the following discussion applies exclusively to assessed waters and cannot be extrapolated to describe conditions in the Nation's rivers as a whole. EPA is working with the States to expand assessment coverage of the Nation's waters and expects future assessment information to cover a greater portion of the Nation's rivers and streams (see Chapter 12).

Of the Nation's 642,881 assessed river miles, the States found that 56% fully support their designated uses, and an additional 6% support uses but are threatened and may become impaired if pollution control actions are not taken. The States reported that 25% of the assessed river miles partially support uses, and 13% of the assessed river miles do not support designated uses. Only 125 miles (less than one-tenth of 1%) of the assessed waters could not attain designated uses (see Figure ES-2).

What Is Polluting Our Rivers and Streams?

The States reported that siltation and nutrients impair more miles of rivers and streams than any other pollutants, affecting 45% and 37% of impaired stream miles in the States reporting causes, respectively (see Appendix A, Table A-3, for individual State information). Other leading causes of impairment include indicators of pathogens, affecting 27%; pesticides, affecting 26%; and organic enrichment and resultant low levels of dissolved oxygen, affecting 24% of impaired stream miles (see Figure ES-3).

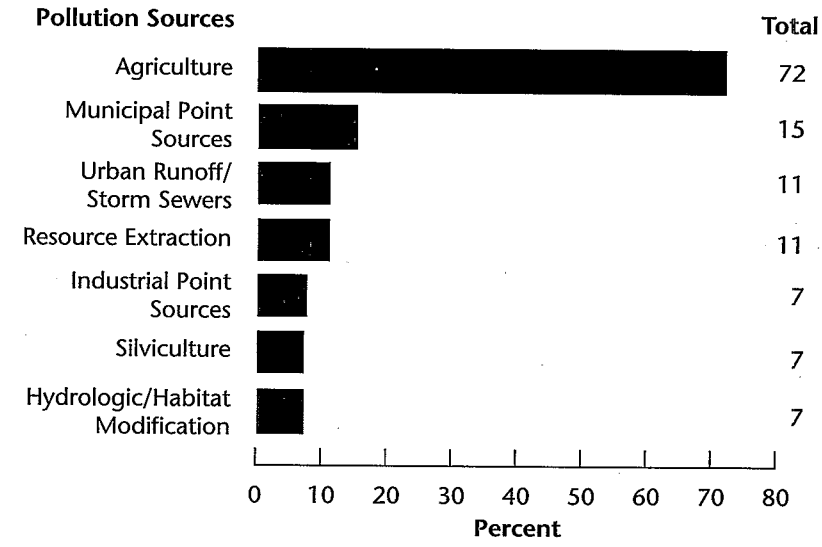
Where Does This Pollution Come From?

Forty-eight States identified sources contributing to the impairment of 221,877 miles of their rivers and streams not fully supporting designated uses (see Appendix A, Table A-4, for individual State information). These States reported that agricultural runoff is the leading source of pollutants in rivers and streams (see Figure ES-4). Forty-five States identified almost 160,000 river miles impaired by agricultural sources, including nonirrigated crop production, irrigated crop production, rangeland, and animal holding

Figure ES-4

Percent of Assessed River Miles Impaired by Sources of Pollution

(221,877 assessed river miles impaired)



Based on data contained in Appendix A, Table A-4.

areas. These States found that agricultural activities contribute to the impairment of 72% of the impaired stream miles in the 48 States reporting sources. The States identified other sources of impairment less frequently, such as municipal point sources, affecting 15%, urban runoff and storm sewers, affecting 11%, and resource extraction, affecting 11% of the impaired waters.

Although this summary provides the best picture of national impacts from sources available to EPA at this time, it has limitations. The information provided applies to only a small portion of our Nation's total rivers and streams because the States cannot assess all their waters in a 2-year period and they cannot specify the source of pollution impairing each waterbody assessed. In addition, national summary information can obscure sources with regional or State significance. For example, Oregon reports that silviculture (forestry activity) contributes to the impairment of 46% of their rivers and streams that do not fully support designated uses. Nationally, silviculture impacts only 7% of the impaired rivers and streams. Therefore, it is important to refer to the individual State data presented in Appendix A for a more specific description of sources impairing rivers and streams.

Trophic States

Oligotrophic	Clear waters with little organic matter or sediment and minimum biological activity.
Mesotrophic	Waters with more nutrients and, therefore, more biological productivity.
Eutrophic	Waters extremely rich in nutrients, with high biological productivity. Some species may be choked out.
Hypereutrophic	Murky, highly productive waters, closest to the wetlands status. Many clearwater species cannot survive.
Dystrophic	Low in nutrients, highly colored with dissolved humic organic matter. (Not necessarily a part of the natural trophic progression.)

The Eutrophication Process

Eutrophication is a natural process, but human activities can accelerate eutrophication by increasing the rate at which nutrients and organic substances enter lakes from their surrounding watersheds. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, eroded streambanks, and similar sources can enhance the flow of nutrients and organic substances into lakes. These substances can overstimulate the growth of algae and aquatic plants, creating conditions that interfere with the recreational use of lakes and the health and diversity of indigenous fish, plant, and animal populations. Enhanced eutrophication from nutrient enrichment due to human activities is one of the leading problems facing our Nation's lakes and reservoirs.

Lakes, Ponds, and Reservoirs

Lakes are sensitive to pollution inputs because lakes flush out their contents relatively slowly. Even under natural conditions, lakes undergo eutrophication, an aging process that slowly fills in the lake with sediment and organic matter (see sidebar on p. ES-12). The eutrophication process alters basic lake characteristics such as depth, biological productivity, oxygen levels, and water clarity. The eutrophication process is commonly defined by a series of trophic states as described in the sidebar.

Do Our Lakes and Reservoirs Support Uses?

Forty-nine States assessed overall use support in more than 18 million lake acres representing 46% of the approximately 40 million total acres of lakes, reservoirs, and ponds in the Nation (see Appendix B, Table B-1, for individual State information). For 1992, the States assessed about 180,000 fewer lake acres than in 1990. Overall, 43% of the assessed lake acres fully support designated uses such as swimming, fishing, and drinking water supply (see Figure ES-5). An additional 13% were identified as threatened and could soon become impaired if pollution control actions are not taken. The States reported that 35% of assessed lake acres partially support designated uses, 9% do not support uses, and less than 1% cannot attain uses.

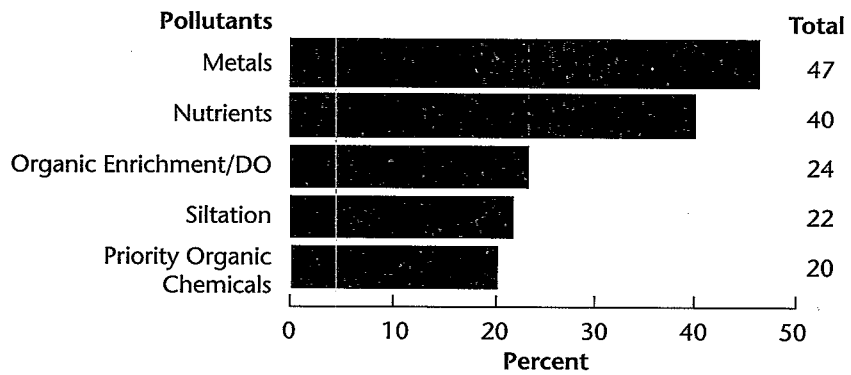
What Is Polluting Our Lakes, Reservoirs, and Ponds?

Forty-seven States reported causes of impairment in their lakes (Appendix B, Table B-3, contains individual State data). Overall, these States reported that metals and nutrients are the most common causes of nonsupport in assessed lakes, affecting 47% and 40% of impaired lake acres, respectively (see Figure ES-6). However, impairments due to metals were concentrated in several States with large numbers of lakes (primarily Minnesota), while nutrient problems were widely reported by 41 States. Other leading causes of lake impairment were organic enrichment, affecting 24% of impaired lake acres; siltation, affecting 22%; and priority organics, affecting 20% of impaired lake acres.

Figure ES-6

Percent of Assessed Lake Acres Impaired by Pollutants

(7,958,064 assessed lake acres impaired)



Based on data contained in Appendix B, Table B-3.

Total lakes = 39,920,000 acres
Total assessed = 18,300,000 acres

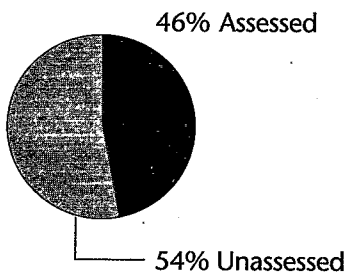
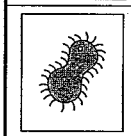


Figure ES-5

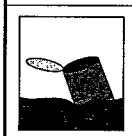
Levels of Overall Use Support – Lakes

Fully Supporting 43%

Threatened 13%


Partially Supporting 35%

Not Supporting 9%


Not Attainable <1%

Based on data contained in Appendix B, Table B-1.

Forty-one States also assessed trophic status, which is associated with nutrient enrichment, in 11,477 of their lakes. Nutrient enrichment tends to increase the proportion of lakes in the eutrophic and hypereutrophic categories. These States reported that 17% of the lakes they assessed for trophic status were oligotrophic, 35% were mesotrophic, 32% were eutrophic, 7.5% were hypereutrophic, and 8.5% were dystrophic. This information may not be representative of national lake conditions because States often assess lakes in response to a problem or public complaint or because of their easy accessibility. It is likely that more remote lakes – which are probably less impaired – are underrepresented in these assessments.

Acid Effects on Lakes

Increases in lake acidity can radically alter the community of fish and plant species in lakes and can increase the solubility of toxic substances and magnify their adverse effects. Twenty-four States reported the results of lake acidification assessments. These States assessed pH (a measure of acidity) at more than 6,800 lakes and detected a threat of acidic conditions in 1,038 lakes (15% of the assessed lakes). Most of the States that assessed acidic conditions are located in the Northeast, upper Midwest, and the South.

Only 11 States identified sources of acidic conditions. States in the Northeast attributed most of their acid lake conditions to acid deposition from acidic rain, fog, or dry deposition in conjunction with natural conditions that limit a lake's capacity to neutralize acids. Only two States, Tennessee and Alabama, reported that acid mine drainage resulted in acidic lake conditions.

Where Does This Pollution Come From?

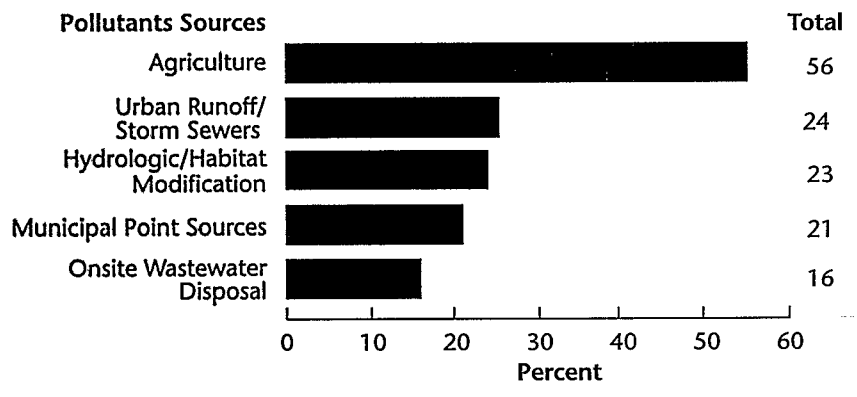
Forty-five States identified individual sources degrading some of their 5.5 million impaired lake acres (Appendix B, Table B-4, contains individual State data). These States reported that agriculture impairs more lake acres than any other source. Thirty-eight States found that agriculture contributes to the impairment of 3 million lake acres, or 56% of the impaired lake acres in the 45 States reporting sources of pollution in lakes (see Figure ES-7).

The States also reported that urban runoff and storm sewers contribute to impairments in 24% of their impaired lake acres, hydrologic modifications and habitat modifications affect 23%, municipal point sources affect 21%, and onsite wastewater disposal (such as septic systems) affect 16% of the impaired lake acres.

Figure ES-7

Percent of Assessed Lake Acres Impaired by Sources of Pollution

(5,543,987 assessed lake acres impaired)



Based on data contained in Appendix B, Table B-4.

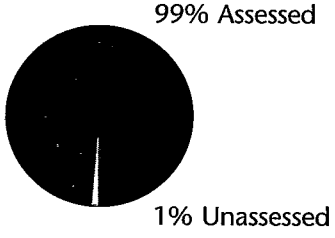
The Great Lakes

The Great Lakes contain one-fifth of the world's fresh surface water and are stressed by a wide range of pollution sources associated with the large urban centers located on their shores. Many of the pollutants that reach the Great Lakes remain in the system indefinitely because the Great Lakes are a relatively closed water system.

Do the Great Lakes Support Uses?

The States assessed 99% of the Great Lakes shoreline miles in 1992. Less than 3% of the assessed shoreline miles fully support uses due to conditions that generate fish consumption advisories issued by the Great Lakes States and the Province of Ontario for the nearshore waters of the Great Lakes (see Figure ES-8). Thirty percent of assessed shoreline miles partially support uses, and the remaining 67% do not support uses. These figures do not address water quality conditions in the deeper, cleaner, central waters of the Lakes.

Total Great Lakes = 5,382 miles
Total assessed = 5,319 miles

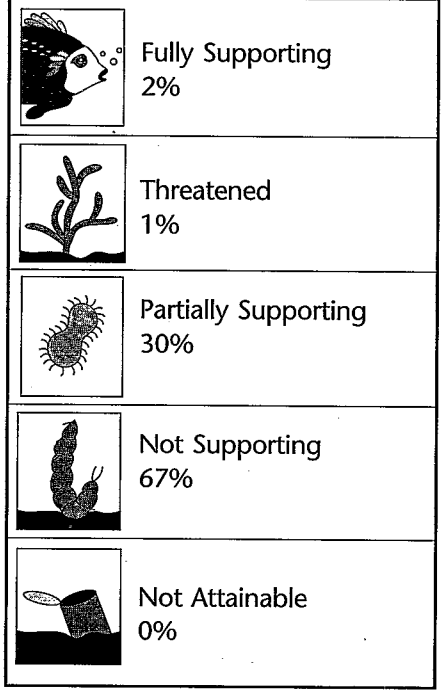


What Is Polluting the Great Lakes?

Most of the Great Lakes shoreline is polluted by toxic organic chemicals–primarily PCBs and DDT–that are often found in fish tissue samples. The Great Lakes States reported that toxic organic chemicals impact 99% of the impaired Great Lakes shoreline miles. Other leading causes of impairment include metals, affecting 11%, organic enrichment and low dissolved oxygen, affecting 7%; nutrients, affecting 5%; and siltation, affecting 3% (see Figure ES-9).

Figure ES-8

Levels of Overall Use Support – Great Lakes

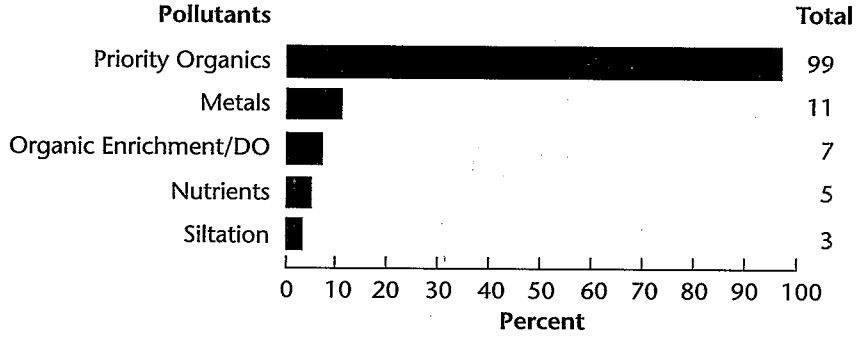


Based on data contained in Appendix F, Table F-1.

Figure ES-9

Percent of Assessed Great Lakes Shore Miles Impaired by Pollutants

(5,171 assessed Great Lakes shore miles impaired)



Based on data contained in Appendix F, Table F-3.

Where Does This Pollution Come From?

Although information on sources of pollution in the Great Lakes is sketchy, the reported information suggests that atmospheric deposition and contaminated sediments are the leading sources impairing Great Lakes waters. Sediment contamination is a major problem in nearshore waters and harbors. Other sources cited by the States include landfills, urban runoff, and combined sewer overflows (see Figure ES-10).

Estuaries

Estuaries are areas partially surrounded by land where rivers meet the sea. They are characterized by varying degrees of salinity, complex water movements affected by ocean tides and river currents, and high turbidity levels. They are also highly productive ecosystems with a range of habitats for many different species of plants, shellfish, fish, and animals.

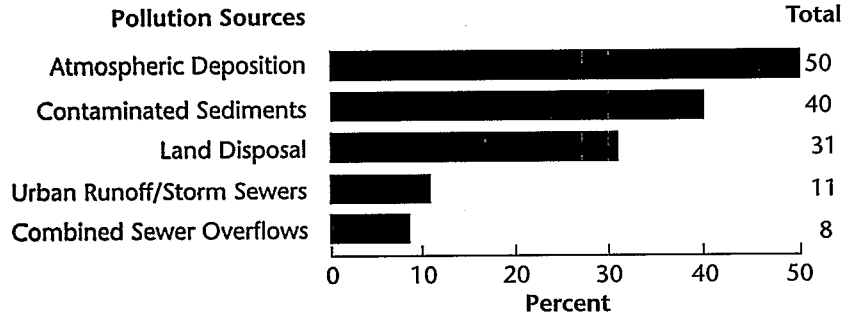
Many species permanently inhabit the estuarine ecosystem; others, such as shrimp, use the nutrient-rich estuarine waters as nurseries before traveling to the sea.

Estuaries are stressed by the particularly wide range of activities located within their watersheds. They receive pollutants carried by rivers from agricultural lands and cities; they often support marinas, harbors, and commercial fishing fleets; and their surrounding lands are highly prized for development. These stresses pose a continuing threat to the survival of these bountiful waters.

Figure ES-10

Percent of Assessed Great Lakes Shore Miles Impaired by Sources of Pollution

(1,884 assessed Great Lakes shore miles impaired)



Based on data contained in Appendix F, Table F-4.

Total estuaries = 36,890 square miles
Total assessed = 27,227 square miles

Do Our Estuaries Support Uses?

Twenty-five coastal States assessed roughly three-quarters of the Nation's total estuarine waters in 1992. Of these, 56% were found to fully support designated uses. An additional 12% are fully supporting uses but are threatened and could become impaired if pollution control actions are not taken. Twenty-three percent of assessed estuarine square miles partially support uses, and the remaining 9% do not support uses (see Figure ES-11).

What Is Polluting Our Estuaries?

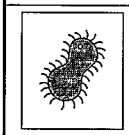
States report that the most common causes of nonsupport of designated uses in our Nation's estuaries are nutrients, affecting 55% of the 8,572 impaired square miles; followed by pathogens, affecting 42%; organic enrichment and resulting low levels of dissolved oxygen, affecting 34%; and siltation, affecting 12% (see Figure ES-12). Pathogen contamination is responsible for the closure of shellfishing beds in many areas of the country.

Figure ES-11

Levels of Overall Use Support – Estuaries

Fully Supporting
56%

Threatened
12%



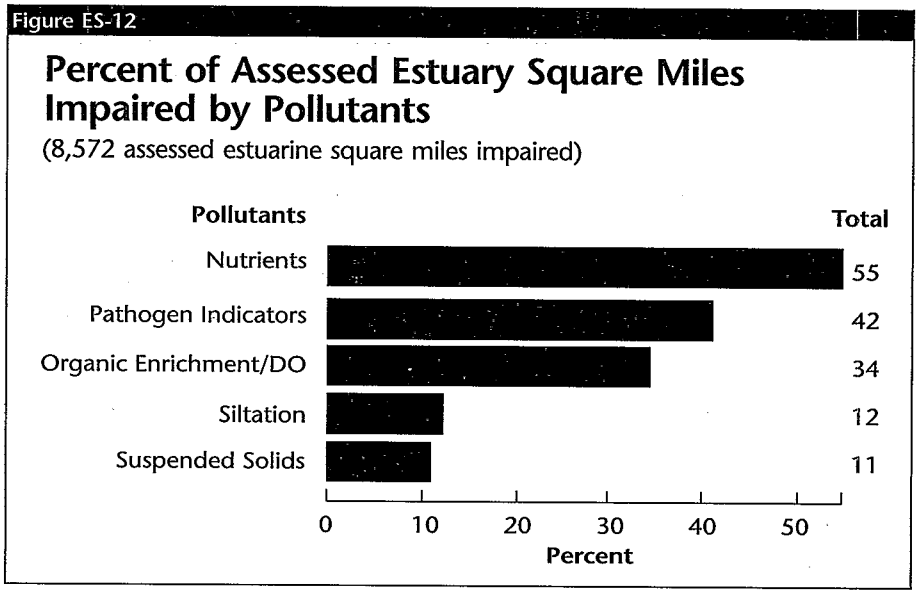
Partially Supporting
23%

Not Supporting
9%

Not Attainable
0%

Based on data contained in Appendix C, Table C-1.

Figure ES-12



Based on data contained in Appendix C, Table C-3.

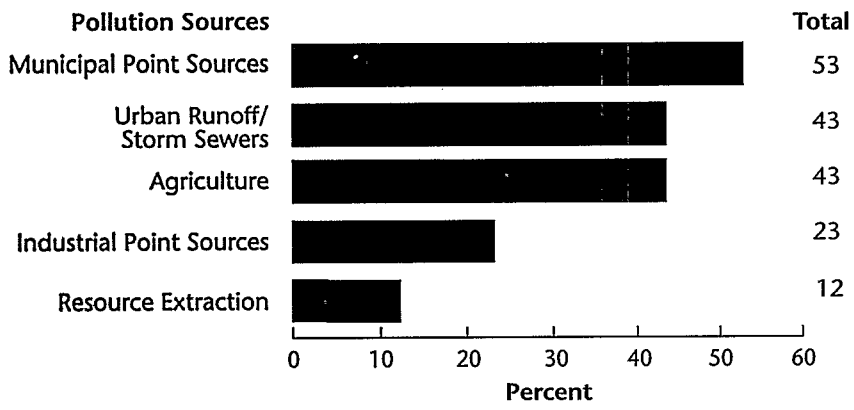
Where Does This Pollution Come From?

States report that municipal sewage treatment plants, urban runoff/storm sewers, and agriculture are the leading sources of pollution in their estuarine waters, affecting 53%, 43%, and 43% of impaired estuarine square miles, respectively (see Figure ES-13). Other leading sources cited by the States include industrial point sources, affecting 23%, and resource extraction, affecting 12%. Point sources continue to have a significant impact on estuarine water quality because concentrated population centers and industrial operations are located adjacent to major estuarine systems. In contrast, rivers and lakes are more dispersed in rural and urban areas throughout the country and tend to support more diverse land uses that generate nonpoint source pollution.

Figure ES-13

Percent of Assessed Estuary Square Miles Impaired by Sources of Pollution

(8,303 assessed estuarine square miles impaired)



Based on data contained in Appendix C, Table C-4.

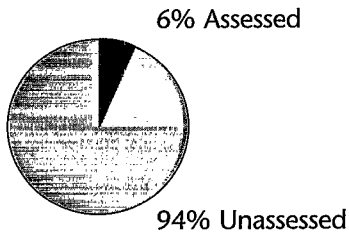
Ocean Coastal Waters

We know less about the condition of our ocean coastal waters than we do about our estuarine or inland waters. In part, this may be because we tend to think that only oil spills or similar disastrous events could possibly affect a resource as vast as an ocean.

In fact, we are seeing evidence that our ocean waters – particularly the waters near our coasts – suffer from the same pollution problems that affect our inland waters. Beach debris cleanups are cataloging tons of trash carried into the oceans by rivers, washed in from city storm sewers, thrown in by beach visitors, or dumped overboard by boaters. Beaches are closed to swimming every summer due to pathogens from inadequately treated wastes. Marine mammals are suffering from pollution-related stresses. Fragile coral reefs in Florida and Hawaii show signs of pollution impacts. Coastal development is increasing at a rapid rate. Clearly we can no longer assume that the oceans can take care of themselves.

Total ocean shore = 56,121 miles

Total assessed = 3,398 miles



Do Ocean Shores Support Uses?

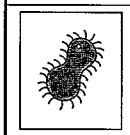
Twelve of the 29 coastal States assessed only 6% of the Nation's estimated 56,121 miles of ocean coastline. Of these, 80% were found to fully support their designated uses, and 7% are supporting uses but are threatened and likely to become impaired if pollution control actions are not taken. Nine percent of assessed ocean shore miles partially support designated uses, and 5% do not support uses (see Figure ES-14). These figures do not necessarily represent water quality conditions in the Nation's ocean coastal waters as a whole because they apply to only 6% of the Nation's coastline miles. Data on pollutants and sources of pollution are too sparse to be included in this report.

Figure ES-14

Levels of Overall Use Support – Ocean Coastal Waters

Fully Supporting
80%

Threatened
7%



Partially Supporting
9%

Not Supporting
5%

Not Attainable
0%

Based on data contained in Appendix C, Table C-5.

Wetlands

Wetlands are areas that are inundated or saturated by surface water or ground water at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Often in the past, wetlands were considered wastelands–the source of mosquitoes, flies, and unpleasant odors–to be filled or drained and put to "better use." When European settlers first arrived in America, over 200 million acres of wetlands existed in the coterminous States. Today, half of our Nation's wetlands have been destroyed by filling, draining, polluting, channelizing, grazing, clearing, and other modifications resulting from human activity.

Wetlands are now recognized as some of the most unique and important natural areas on earth. They vary in type according to differences in local and regional hydrology, vegetation, water chemistry, soils, topography, and climate. Coastal wetlands include estuarine marshes; mangrove swamps found in Puerto Rico, Hawaii, and Florida; and Great Lakes coastal wetlands. Inland wetlands, which may be adjacent to a waterbody or isolated,

Total wetlands = 277 million acres
Total assessed = 10,516,754 acres

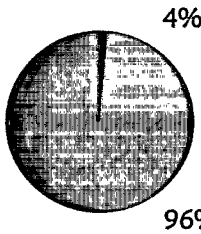
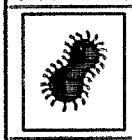


Figure ES-15

Levels of Overall Use Support – Wetlands

Fully Supporting
50%

Threatened
<1%


Partially Supporting
26%

Not Supporting
24%

Not Attainable
0%

Based on data contained in Appendix D, Table D-2.

NOTE: The information on designated use support represents data from only eight States so national trends should not be drawn from these data.

include marshes and wet meadows, bottomland hardwood forests, Great Plains prairie potholes, cypress-gum swamps, and southwestern playa lakes.

Wetlands provide food and shelter to countless animal species including many fishes, birds, reptiles, and mammals. A high percentage of federally listed threatened or endangered animals and plants depend directly or indirectly on wetlands for their survival. Wetlands also provide spawning habitat and nursery grounds for an estimated 71% of commercially valuable fish and shellfish consumed in this country. In addition, they also serve as feeding areas along migration routes for waterfowl and other wildlife.

Wetlands soil and vegetation help in flood control by acting as natural sponges that attenuate flooding water. Wetlands plants also help control erosion in two ways: their roots bind the soil and their leaves slow the movement of water. Wetlands help purify water by processing nutrients and other pollutants and filtering suspended materials. They also help regulate water quantity by absorbing water in wet seasons and releasing it through seeps, springs, and open outlets during dry seasons.

In addition, wetlands are widely enjoyed by hikers, birdwatchers, hunters, fishermen, photographers, and boaters and play an important role in our Nation's natural and cultural heritage. Millions of people spend nearly $10 billion each year observing and photographing wetlands-dependent wildlife.

Do Our Wetlands Support Uses?

In 1992, most States could not assess use support in wetlands because they were still developing wetlands water quality standards. As a result, only eight States (California, Colorado, Hawaii, Iowa, Kansas, Nevada, North Carolina, and Oklahoma) reported use support for 10.5 million acres of their wetlands. These States assessed use support in approximately 4% of the Nation's 277 million acres of wetlands. North Carolina assessed 98% of the assessed wetlands; therefore, the summary information on use support describes conditions primarily in North Carolina's wetlands rather than the Nation's wetlands as a whole (see Figure ES-15).

These States reported that 50% of the assessed wetlands fully support designated uses, less than 1% are threatened, 26% partially support uses, and 24% do not support designated uses (Appendix D, Table D-2, contains individual State data). However, this information does not accurately reflect water quality conditions in the Nation's wetlands due to the skewed distribution of the assessed wetlands. Despite limitations in the data, the summary information suggests that water quality problems exist in our remaining wetlands.

What is Polluting Our Wetlands?

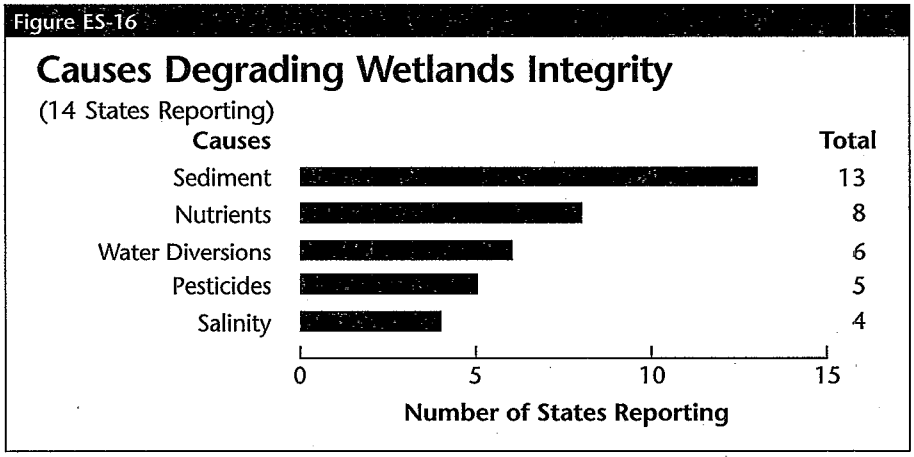
Of the eight States reporting overall use support in wetlands, only three States (Iowa, Kansas, and Nevada) quantified the wetlands acreage degraded by specific

pollutants or processes causing wetlands impairment. Although the data submitted by these States are not representative of national conditions in wetlands, these States did report that metals impair over 60,000 acres of wetlands, salinity and chlorides impair over 42,000 acres of wetlands, and siltation impairs almost 29,000 acres of wetlands. Fourteen States did not quantify the acreage affected but did identify pollutants and processes that degrade some unknown quantity of their wetlands. Most of these States cited sediment and nutrients as pollutants of concern in wetlands (Figure ES-16). Fewer States reported that water diversions, pesticides, salinity, heavy metals, ponding, weeds, low dissolved oxygen, and pH impact their wetlands.

Where Does This Pollution Come From?

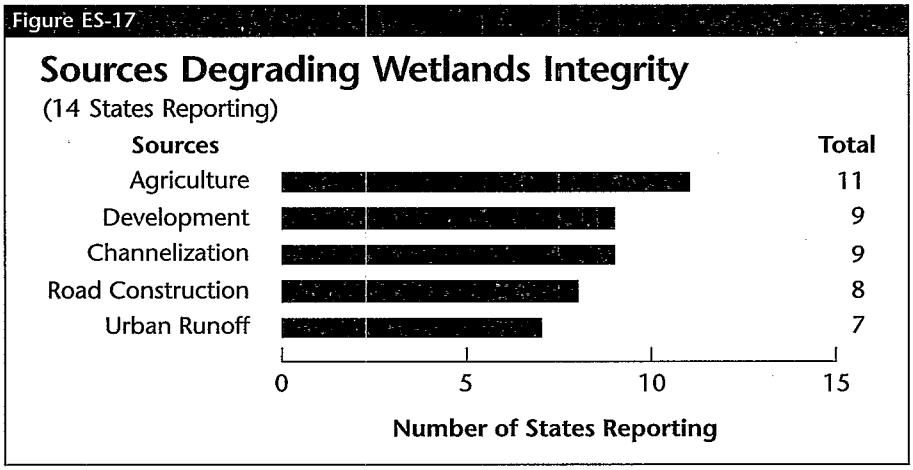
Iowa, Kansas, and Nevada also reported that agriculture impairs 76,000 acres of wetlands, hydrologic habitat modification impairs 48,000 acres, and municipal point sources impair over 11,000 acres of wetlands. Fourteen States did not quantify the acreage affected but did identify sources of pollutants that degrade some unknown quantity of wetlands. Most of these States reported that agriculture, development, channelization, and road construction degrade wetlands integrity (see Figure ES-17). These States also reported that urban runoff, resource extraction, landfills, natural conditions, industrial runoff, onsite systems, irrigation, recreation, point sources, and silviculture impact wetlands.

Figure ES-16



Based on data contained in Appendix D, Table D-3.

Figure ES-17



Based on data contained in Appendix D, Table D-4.

Wetlands Loss: A Continuing Problem

Despite what we have learned about the value of our wetlands, these national treasures continue to be threatened by a variety of human activities. A U.S. Fish and Wildlife Service study of wetlands loss found that 2.6 million acres of wetlands were lost over the 9-year study period from the mid-1970s to the mid-1980s, or 290,000 acres a year. This is an improvement from the 1950s to the 1970s when wetlands were lost at a rate of 458,000 acres per year. Serious consequences have resulted nationwide from the loss and degradation of wetlands, including species decline and extinction, water quality decline, and increased incidences of flooding.

In 1992, 27 States reported on sources of current wetlands losses. These include agriculture, commercial development, residential development, highway construction, impoundments, resource extraction, industry, and dredge disposal (see Appendix D, Table D-1, for individual State information).

Comprehensive State Ground Water Protection Programs

A Comprehensive State Ground Water Protection Program (CSGWPP) is a prevention-first approach that will enable better coordination of Federal, State, Tribal, and local ground-water-related programs. This will allow for better allocation of resources to the highest priority activities. Once the EPA endorses a CSGWPP, the Agency will seek to provide more consistent deference to State priorities.

A CSGWPP is composed of six "strategic activities," which include

- Establishing a prevention-oriented goal
- Establishing priorities, based on the characterization of the resource and identification of sources of contamination
- Defining roles, responsibilities, resources, and coordinating mechanisms
- Implementing all necessary efforts to accomplish the State's ground water protection goal
- Coordinating information collection and management to measure progress and reevaluate priorities
- Improving public education and participation.

Ground Water

Ninety-five percent of all fresh water available on earth (exclusive of icecaps) is ground water. Ground water–water found in natural underground rock formations called aquifers–is a vital natural resource with many uses. The extent of the Nation's ground water resources is enormous. At least 60% of the land area in the conterminous United States overlies aquifers. Usable ground water exists in every State.

Aquifers can range in size from thin surficial formations that yield small quantities of ground water to large systems such as the High Plains aquifer that underlies eight western States and provides water to millions. Although most of the Nation's ground water is considered to be of good quality, an increasing number of pollution events have threatened the integrity of the resource.

Ground Water Use

Nationally, 53% of the population relies to some extent on ground water as a source of drinking water. This percentage is even higher in rural areas where most

residents rely on potable or treatable ground water as an economical source of drinking water. Eighty-one percent of community water systems are dependent on ground water. Seventy-four percent of community water systems are small ground water systems serving 3,300 people or less. Ninety-five percent of the approximately 200,000 noncommunity water systems (serving schools, parks, etc.) are ground water systems.

Irrigation accounts for approximately 64% of national ground water withdrawals. Public drinking water supplies account for approximately 19% of the Nation's total ground water withdrawals. Domestic, commercial, livestock, industrial, mining, and thermoelectric withdrawals together account for approximately 17% of national ground water withdrawals.

Ground Water Quality

Although the 1992 Section 305(b) State Water Quality Reports indicate that, overall, the Nation's ground water quality is good to excellent, many local areas have experienced significant ground water contamination. Although the sources and types of ground water contamination vary depending upon the region of the country, those most frequently reported by States include:

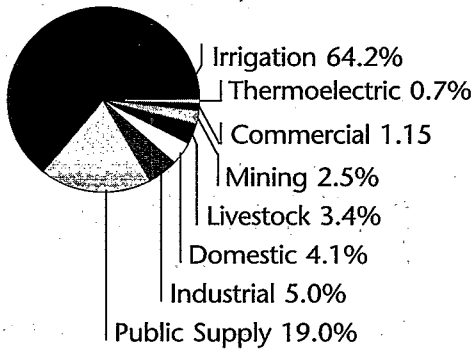
- **Leaking underground storage tanks.** About 400,000 of an estimated 5 to 6 million underground storage tanks in the United States are thought to be leaking. About 30% of all tanks store petroleum or hazardous materials.
- **Septic tanks.** Approximately 23 million domestic septic systems are in operation in the United States. About half a million new systems are installed each year.
- **Municipal landfills.** Of the quarter million solid waste disposal facilities in the United States, about 6,000 are municipal solid waste facilities. Approximately 25% of these municipal facilities have ground water monitoring capabilities.
- **Agricultural activities.** Seventy-seven percent of the 1.1 billion pounds of pesticides produced annually in the United States is applied to land in agricultural production, which often overlies aquifers.
- **Abandoned hazardous waste sites.** Approximately 33,000 sites have been identified as abandoned hazardous waste sites, of which 42% involve ground water contamination.

The most common contaminants associated with these sources include nitrates, metals, volatile organic compounds (VOCs), and pesticides.

EPA has been working with States to develop a set of ground water quality indicators. These indicators will allow the characterization of trends in ground water quality over space and time. Examples of preliminary indicators include the number of maximum contaminant level violations in public water systems, detections of VOCs in ground water, and the extent of leachable agricultural pesticide use. EPA will

IRRIGATION
accounted for more than 64% of ground water use

National Ground Water Withdrawls by Water Use Category



continue to work with the States to refine these ground water quality indicators.

Additional ground water monitoring initiatives have been undertaken in numerous States. These initiatives are aimed at characterizing the overall quality of ground water resources and typically include the establishment of ambient monitoring networks, regional monitoring networks that focus on sensitive aquifers, or site-specific monitoring efforts that focus on known or suspected contamination sources.

The Watershed Protection Approach (WPA)

Several key features characterize the WPA:

- The WPA encourages managers to examine all the factors contributing to water quality problems in a watershed and apply a coordinated, holistic approach to resolving the problems.
- The WPA advocates restoring and protecting ecological integrity in addition to protecting human health and meeting water quality standards.
- The WPA fosters a high level of interprogram coordination.

A State that is using the WPA

- Targets those watersheds where pollution poses the greatest risk to human health, ecological resources, or desirable uses of the water
- Involves all parties with a stake in the watershed in the analysis of problems and the implementation of solutions
- Draws on the full range of methods and tools available, integrating them into a coordinated, multiorganizational attack on the problems.

Water Quality Protection Programs

The EPA works in partnership with State and local governments to improve and protect water quality. Since the 1990 Report to Congress, EPA and many States have moved toward a more geographically oriented approach to water quality management. They share a growing consensus that the Nation's remaining water quality problems can be solved most effectively at the basin or watershed level.

In 1991, EPA highlighted the Watershed Protection Approach (WPA), a framework for focusing and integrating water quality monitoring and management activities in a watershed of concern. The WPA is not a new government program, but rather a means of pulling together the resources and expertise of existing programs at all levels, from Federal to State and local levels.

The EPA, other Federal agencies, State pollution control agencies, and local governments are applying the WPA to existing monitoring and assessment programs as well as water quality protection programs (see sidebar). A number of laws provide the authority to develop and implement pollution control programs. The primary statute providing for water quality protection in the Nation's rivers, lakes, wetlands, estuaries, and coastal waters is the Federal Water Pollution Control Act of 1972, commonly known as the Clean Water Act (CWA).

The Clean Water Act

The Clean Water Act of 1972 and its amendments are the driving force behind many of the water quality improvements we have witnessed in recent years. Key provisions of the Clean Water Act provide the following pollution control programs.

Water quality standards and criteria – States adopt EPA-approved standards for their waters that define water quality goals for individual waterbodies. Standards consist of designated beneficial uses to be made of the water, criteria to protect those uses, and antidegradation provisions to protect existing water quality (see page ES-2).

Effluent guidelines – The EPA develops nationally consistent guidelines limiting pollutants in discharges from industrial facilities and municipal sewage treatment plants. These guidelines are then used in permits issued to dischargers under the National Pollutant Discharge Elimination System (NPDES) program. Additional controls may be required if receiving waters are still affected by water quality problems after permit limits are met.

Total Maximum Daily Loads– The development of Total Maximum Daily Loads, or TMDLs, establishes the link between water quality standards and point/nonpoint source pollution control actions such as permits or Best Management Practices (BMPs). A TMDL calculates allowable loadings from the contributing point and nonpoint sources to a given waterbody and provides the quantitative basis for pollution reduction necessary to meet water quality standards. States develop and implement TMDLs for high-priority impaired or threatened waterbodies.

Permits and enforcement – All industrial and municipal facilities that discharge wastewater must have an NPDES permit and are responsible for monitoring and reporting levels of pollutants in their discharges. EPA issues these permits or can delegate that permitting authority to qualifying States. The States and EPA inspect facilities to determine if their discharges comply with permit limits. If dischargers are not in compliance, enforcement action is taken.

In 1990, EPA promulgated permit application requirements for municipal sewers that carry storm water separately from other wastes and serve populations of 100,000 or more and for storm water discharges associated with some industrial activities. The EPA is developing regulations to establish a comprehensive program to regulate storm sewers, including requirements for State storm water management programs.

Grants – The EPA provides States with financial assistance to help support many of their pollution control programs. These programs include the State Revolving Fund program

NOTE

Under the Watershed Protection Approach (WPA), a "watershed" is a hydrogeologic area defined for addressing water quality problems. For example, a WPA watershed may be a river basin, a county-sized watershed, or a small drinking water supply watershed.

for construction and upgrading of municipal sewage treatment plants; water quality monitoring, permitting, and enforcement; and developing and implementing nonpoint source pollution controls, combined sewer and storm water controls, ground water strategies, lake assessment, protection, and restoration activities, estuary and near coastal management programs, and wetlands protection activities.

Nonpoint source control – The EPA provides program guidance, technical support, and funding to help the States control nonpoint source pollution. The States are responsible for analyzing the extent and severity of their nonpoint source pollution problems and developing and implementing needed water quality management actions.

Control of combined sewer overflows – Under the National Combined Sewer Overflow Control Strategy of 1989, States develop and implement measures to reduce pollution discharges from combined storm and sanitary sewers. The EPA works with the States to implement the national strategy.

The CWA also established pollution control and prevention programs for specific waterbody categories, such as the Clean Lakes Program, discussed in more detail on the next page. Other statutes that also guide the development of water quality protection programs include

The Safe Drinking Water Act, under which States establish standards for drinking water quality, monitor wells and local water supply systems, implement drinking water protection programs, and implement Underground Injection Control (UIC) programs.

The Resource Conservation and Recovery Act establishes State and EPA programs for ground water and surface water protection and cleanup and emphasizes prevention of releases through management standards in addition to other waste management activities.

The Comprehensive Environmental Response, Compensation, and Liability Act (Superfund Program), which provides EPA with the authority to clean up contaminated waters during remediation at contaminated sites.

The Pollution Prevention Act of 1990 requires EPA to promote pollutant source reduction rather than focus on controlling pollutants after they enter the environment.

The Clean Lakes Program

EPA's Clean Lakes Program provides Federal funds to help States carry out diagnostic studies of lake problems, determine necessary protection and restoration measures, implement those measures, and monitor the long-term impacts and effectiveness of those measures. The Clean Lakes Program provides grants for four types of cooperative agreements:

Lake Water Quality Assessments strengthen State lake management programs and improve water quality information.

Phase I Diagnostic/Feasibility Studies investigate the causes of water quality decline in a publicly owned lake and determine the most feasible procedures for controlling pollutants and restoring the lake.

Phase II Projects implement the restoration and pollution control methods identified in a Phase I study.

Phase III Postrestoration Monitoring Projects sponsor long-term monitoring to verify the longevity and effectiveness of restoration and control measures implemented during a Phase II project.

Managing lake quality often requires a combination of in-lake restoration measures and pollution controls, including watershed management measures:

Restoration measures are implemented to reduce existing pollution problems. Examples of in-lake restoration measures include harvesting aquatic weeds, dredging sediment, and adding chemicals to precipitate nutrients out of the water column. Restoration measures focus on restoring uses of a lake and may not address the source of the pollution.

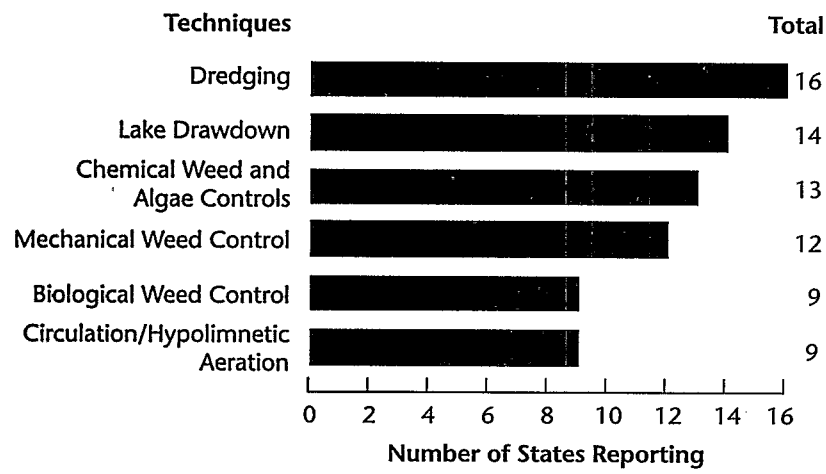
Pollution control measures deal with the sources of pollutants degrading lake water quality or threatening to impair lake water quality. Control measures include planning activities, regulatory actions, and implementation of BMPs to reduce nonpoint sources of pollutants.

During the 1980s, most States implemented chemical and mechanical in-lake restoration measures to control aquatic weeds and algae. In their 1992 Section 305(b) reports, the States report a shift toward watershed planning techniques and nonpoint source controls to reduce pollutant loads responsible for aquatic weed growth and algal blooms. Watershed management plans simultaneously address multiple sources of pollutants, such as runoff from urbanized areas, agricultural activities, and failing septic systems along the lake shore. Although the States reported that they still use in-lake treatments (Figure ES-18), the States recognize that source controls are needed in addition to in-lake treatments to restore lake water quality.

Figure ES-18

In-Lake Treatment Techniques Implemented by the States

(22 States Reporting)

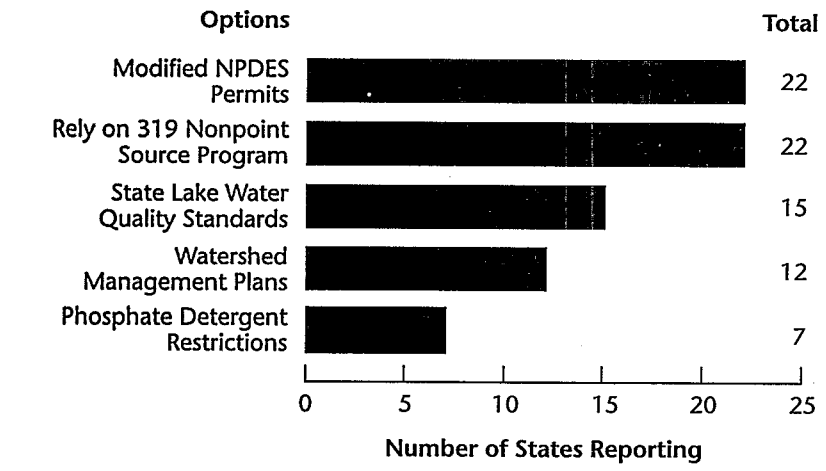


Based on 1992 State Section 305(b) reports.

Figure ES-19

Management Options for Lake Restoration and Pollution Control

(35 States Reporting)



Based on 1992 State Section 305(b) reports.

The States reported that they most frequently rely on their NPDES permit programs and their Section 319 nonpoint source (NPS) management programs to control pollutants entering lakes (Figure ES-19). Through the State NPDES permit programs, States often impose stricter nutrient limits for effluents discharged into lakes than into rivers and streams. Seven States reported that phosphorus detergent restrictions enhanced sewage treatment plant compliance with NPDES nutrient limits. Twenty-two States reported that they use their Section 319 NPS programs to implement BMPs in watersheds surrounding impaired or threatened lakes.

Successful lake programs require strong commitment from local citizens and cooperation from natural resource agencies at the local, State, and Federal levels. Forty-nine States, Puerto Rico, and 18 American Indian Tribes have established cooperative frameworks for managing lakes under the Clean Lakes Program.

The National Estuary Program

Section 320 of the Clean Water Act (as amended by the Water Quality Act of 1987) established the National Estuary Program (NEP) to protect and restore water quality and living resources in estuaries. The NEP adopts a geographic or watershed approach by planning and implementing pollution abatement activities for the estuary and its surrounding land area as a whole.

Through the NEP, States nominate estuaries of national significance that are threatened or impaired by pollution, development,

or overuse. EPA evaluates the nominations and selects those that show evidence of a committed citizenry, political support, a range of government involvement (State, Federal, regional, and local), and available scientific and technical expertise to tackle the problem. The EPA convenes management conferences with representatives from all interested groups (e.g., industry, agriculture, conservation organizations, and State agencies) to more fully characterize the problems and seek solutions.

The NEP is also a national demonstration program. There are more than 150 estuaries in the United States and only a small fraction can be targeted for action through the NEP. It is therefore important that the lessons learned through the NEP be communicated to estuarine water quality managers throughout the country. As of June 1993, 21 estuaries are included in the NEP (see Figure ES-20).

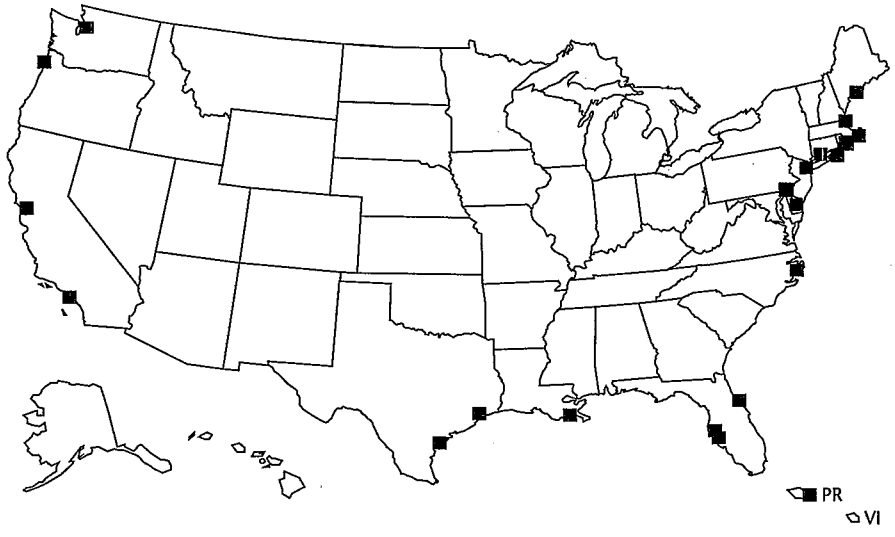
Protecting Wetlands

Section 404 of the CWA remains the primary Federal vehicle for protecting wetlands. Section 404 regulates the discharge of dredged or fill material into waters of the United States, including wetlands. EPA continues to promote other mechanisms to protect wetlands including

- Incorporating wetlands considerations into traditional water programs and other EPA programs
- Working with other Federal agencies
- Helping to build State and local government programs to protect wetlands
- Improving wetlands science
- Promoting outreach and education
- Developing voluntary partnerships with landowners
- Coordinating international wetlands protection.

Figure ES-20

Locations of National Estuary Program Sites



Source: U.S. EPA National Estuary Program.

More information on wetlands can be obtained from the EPA Wetlands Hotline at 1-800-832-7828.

In addition, EPA has awarded wetlands grants since 1990 to support the development of State and Tribal wetlands protection programs. States and Tribes have used these grants to develop water quality standards, monitor trends in wetlands loss, coordinate State and local planning agencies, and disseminate educational materials on wetlands.

Overall, States reported that they are making considerable progress in protecting the quantity and quality of their wetlands through regulatory and nonregulatory approaches. States were asked to report on several key areas, including the application of Section 401 certification authority to protect wetlands, their progress in developing water quality standards for wetlands, and efforts to incorporate wetlands considerations into other programs (see Appendix D, Table D-5). In addition, 18 States and one Territory reported on efforts to inventory the physical acreage of their wetlands.

According to State-reported information, no State is currently operating a statewide wetlands monitoring program. However, five States did describe water quality and habitat monitoring efforts for some portion of their wetlands.

EPA recognizes that the development of biological monitoring and assessment methods for wetlands is a critical need for State wetlands managers so that they can begin to monitor their wetlands. To this end, EPA is developing assessment protocols for freshwater emergent wetlands as part of its 5-year research plan. However, more research on other wetlands systems is needed on both the Federal and State levels.

State monitoring programs are critical for determining whether wetlands are meeting their designated and existing uses as well as for prioritizing restoration once impairment is identified. Wetlands monitoring information is also important for making Section 401 certification decisions, determining mitigation success for Section 404, and supporting other management decisions.

Protecting the Great Lakes

The Great Lakes are cooperatively managed by the United States and Canada under the Great Lakes Water Quality Agreement of 1978 (as amended in 1987). The International Joint Commission, established by the 1909 Boundary Waters Treaty, is responsible for identifying actions to protect the Great Lakes. Representatives from State and Federal agencies and universities work together on the Commission's two boards to identify problem areas, plan programs to reduce pollution, and publish findings and issue papers.

Since 1973, 43 Areas of Concern have been identified in the Great Lakes basin where environmental quality is substantially degraded. Most Areas of Concern are harbors, bays, and river mouths. Remedial Action Plans are being developed for each Area of Concern. These plans identify impaired uses and examine management options to restore the areas.

In 1989, the EPA launched the Great Lakes Initiative to provide a framework for Federal assistance in pursuing the goal of whole-system restoration based on an ecosystem

perspective. The Initiative emphasizes areas in which EPA can provide State governments and other stakeholders with technical support. The Initiative envisions EPA making the following technical contributions:

- Develop guidance for identifying toxic hot spots
- Develop guidance for tracking the relative contributions of toxic and acidic pollutants from surface water and atmospheric sources
- Develop guidance for determining the relative roles of point and nonpoint source contributions to conventional and toxic pollutant burdens
- Suggest innovative approaches for the protection of critical habitat areas
- Support the development of special wildlife standards.

To help implement the goals of the Great Lakes Initiative, EPA Region 5 and the EPA Great Lakes National Program Office coordinate a Steering Committee, Technical Workgroup, and Public Participation Group. The States have played an active role in the development of draft criteria and policies.

By late 1992, EPA had reviewed a draft of the Great Lakes Initiative Guidance. When issued in final form, this major guidance document will assist in updating the Great Lakes Strategy, which provides the framework for implementing the Great Lakes Water Quality Agreement. Specific policies under the Great Lakes Initiative will help integrate the development of Remedial Action Plans for designated Areas of Concern with the more holistic goals of Lakewide Management Plans and pollution prevention strategies for the Great Lakes as a whole.

The Chesapeake Bay Program

In 1975, the Chesapeake Bay became the Nation's first estuary targeted for protection and restoration when Congress directed EPA to study the causes of environmental declines in the Bay. Section 117(a) of the 1987 CWA amendments required that the EPA Administrator continue the Chesapeake Bay Program to

- Collect and distribute information about the Bay's environmental quality
- Coordinate Federal and State efforts to improve the Bay's water quality
- Determine impacts from environmental changes such as inputs of nutrients, chlorine, oxygen demanding substances, toxic pollutants, and acid precipitation.

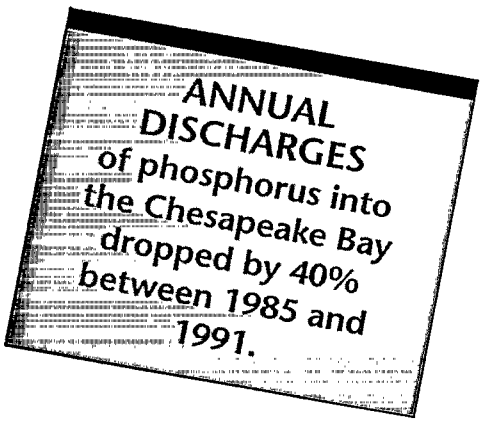
A system of committees, subcommittees, work groups, and task forces have evolved under the Chesapeake Executive Council, which consists of the Governors of Maryland, Virginia, and Pennsylvania, the Administrator of EPA, the Mayor of the District of Columbia, and the Chairman of the Chesapeake Bay Commission. The Council coordinates program implementation, establishes policy directions,

and provides oversite for the restoration and protection of the Bay and its living resources. On August 6, 1991, the Chesapeake Executive Council adopted four action steps, building on the 1987 Chesapeake Bay Agreement to reduce nitrogen and phosphorus loads entering the Bay by 40%. The four action steps commit the Council to

- Reevaluating and accelerating the nutrient reduction program
- Adopting pollution prevention
- Restoring and enhancing living resources and their habitats, such as submerged aquatic vegetation beds
- Broadening participation in the Bay Program.

The Chesapeake Bay Program has implemented programs to reduce impacts from nutrients, oxygen-demanding substances, and pathogens. To date, three elements of the Chesapeake Bay Program's point source control strategy are responsible for reductions in nutrient loadings:

- Ugrading wastewater treatment plants
- Improving compliance with discharge and pretreatment permits
- Pollution prevention actions such as prohibiting the sale of detergents containing phosphorus.



As a result of these measures, annual discharges of phosphorus into the Bay dropped by 40% (4.7 million pounds) between 1985 and 1991.

The Chesapeake Bay Program's nonpoint source program emphasizes controls for runoff generated by agricultural activities, paved surfaces, and construction in urban areas. The program includes nutrient management for applying animal wastes and fertilizers to cropland in amounts calculated to meet crop requirements without contaminating ground and surface waters.

The Chesapeake Bay Program developed a model to estimate nutrient load reductions from nonpoint sources because it is not possible to monitor every nonpoint source in the Bay's watershed. The model estimates that implementation of nonpoint source controls has resulted in a 12% and 8% reduction in controllable nonpoint source nitrogen and phosphorus, respectively.

Overall, water quality monitoring data confirm significant progress in reducing phosphorus loads into Chesapeake Bay. Total phosphorus concentrations in the Bay decreased by 16% between 1984 and 1992. However, total nitrogen concentrations have remained stable in the mainstem of the Bay and increased in some tributaries, indicating a need for additional progress in reducing nitrogen loadings.

The Gulf of Mexico Program

In 1988, the Gulf of Mexico Program (GMP) was established with EPA as the lead Federal agency to develop and help implement a strategy to protect, restore, and maintain the health and productivity of the Gulf. The GMP is a grass roots program that serves as a catalyst to promote sharing of information, pooling of resources,

and coordination of efforts to restore and reclaim wetlands and wildlife habitat, clean up existing pollution, and prevent future contamination and destruction of the Gulf. The GMP mobilizes State, Federal, and local government; business and industry; academia; and the community at large through public awareness and information dissemination programs, forum discussions, citizen committees, and technology applications.

A Policy Review Board and a newly formed Management Committee determine the scope and focus of GMP activities. The program also receives input from a Technical Advisory Committee and a Citizen's Advisory Committee. The GMP Office and 10 Issue Committees coordinate the collection, integration, and reporting of pertinent data and information. The Issue Committees are responsible for documenting environmental problems and management goals, available resources, and potential solutions for a broad range of issues, including habitat degradation, public health, freshwater inflow, marine debris, shoreline erosion, nutrients, toxic pollutants, and living aquatic resources. The Issue Committees publish their findings in Action Agendas. Two additional committees provide operational support and information transfer activities for the entire GMP.

On December 10, 1992, the Governors of Alabama, Florida, Louisiana, Mississippi, and Texas; EPA; the Chair of the Citizen's Advisory Committee; and representatives of 10 other Federal agencies signed the Gulf of Mexico Program Partnership for Action agreement for protecting, restoring, and enhancing the Gulf of Mexico and adjacent lands. The agreement commits the signatory agencies to pledge their efforts, over the next 5 years, to obtain the knowledge and resources to

- Significantly reduce the rate of loss of coastal wetlands
- Achieve an increase in Gulf Coast seagrass beds
- Enhance the sustainability of Gulf commercial and recreational fisheries
- Protect human health and food supply by reducing input of nutrients, toxic substances, and pathogens to the Gulf
- Increase Gulf shellfish beds available for safe harvesting by 10%
- Ensure that all Gulf beaches are safe for swimming and recreational uses
- Reduce by at least 10% the amount of trash on beaches
- Improve and expand coastal habitats that support migratory birds, fish, and other living resources
- Expand public education/outreach tailored for each Gulf Coast county or parish.

During 1992, the GMP also launched Take-Action Projects in each of the five Gulf States to demonstrate that program strategies and methods could achieve rapid results. The Take-Action Projects primarily address inadequate sewage treatment, pollution prevention, and habitat protection and restoration. Several projects aim to demonstrate

the effectiveness of innovative sewage treatment technologies to control pathogenic contamination of shellfish harvesting areas. Other projects aim to restore wetlands, sea grass beds, and oyster reefs. The Take-Action Projects are designed to have Gulf-wide application.

Ground Water Protection Programs

Protection of ground water resources is addressed under the Clean Water Act, the Safe Drinking Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Toxic Substances Control Act, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the Pollution Prevention Act. The Comprehensive State Ground Water Protection Programs (CSGWPP) are an approach to ground water protection that embraces all the above-mentioned ground water protection activities, with emphasis placed on preventing contamination. A CSGWPP is also intended to act as a catalyst for fundamental changes in the development and implementation of ground water protection programs at the Federal, State, and local levels.

Several principal or important ground water protection programs control pollutant sources: solid and hazardous waste treatment, storage, and disposal and underground storage tanks are regulated under RCRA; subsurface injection of fluids is regulated under SDWA; abandoned waste is regulated under CERCLA; and pesticides are controlled under FIFRA. These programs enable States to regulate and monitor pollutant sources more effectively.

Funds allotted under Sections 319(h) and (i) and 518 of the Clean Water Act are intended to assist States in implementing EPA-approved nonpoint source management programs and ground water protection activities. In addition, a number of States have developed nonpoint source control programs that focus on contamination resulting from agriculture and septic tanks.

The Toxic Substances Control Act and the Federal Insecticide, Fungicide, and Rodenticide Act control the use and disposal of commercial chemical products thereby minimizing the risks to public health and the environment. EPA's Pesticides and Ground Water Strategy emphasizes prevention and protection of the Nation's ground water resources and provides a flexible framework for tailoring programs to the needs of each State. In addition, EPA has established a Restricted Use classification for pesticides, which is intended to reduce both the risks of point source causes of ground water contamination and nonpoint source causes of contamination.

The Pollution Prevention Act of 1990 was enacted by Congress to promote pollution prevention and environmental protection goals. The Act allows for grants to be allotted to fund research projects involving education, demonstration, and training in sustainable agriculture and other agricultural practices that emphasize ground water protection and reducing the excessive use of nutrients and pesticides.

A number of mechanisms have been developed to manage the

ever-growing volume of information on the Nation's ground water resources. These include the development of a standard format for reporting ground water data called the Minimum Set of Data Elements (MSDE) for Ground Water Quality. The MSDE is intended to improve access to ground water data and to increase information sharing capabilities by standardizing the elements used in ground water databases. Additional mechanisms include the development of a geographic information system (GIS) to integrate ground water data that have been collected under different programs, the development and management of two databases concerning pesticides and ground water, and inclusion of ground water data in a modernized STORET (EPA's water database).

What You Can Do

Federal and State programs have helped clean up many waters and slow the degradation of others. But government alone cannot solve the entire problem, and water quality concerns persist. Nonpoint source pollution, in particular, is everybody's problem, and everybody needs to solve it.

Examine your everyday activities and think about how you are contributing to the pollution problem. Here are some suggestions on how you can make a difference.

Be Informed

You should learn about water quality issues that affect the communities in which you live and work. Become familiar with your local water resources. Where does your drinking water come from? What activities in your area might affect the water you drink or the rivers, lakes, beaches, or wetlands you use for recreation?

Learn about procedures for disposing of harmful household wastes so they do not end up in sewage treatment plants that cannot handle them or in landfills not designed to receive hazardous materials.

Be Responsible

In your yard, determine whether additional nutrients are needed before you apply fertilizers, and look for alternatives where fertilizers might run off into surface waters. Consider selecting plants and grasses that have low maintenance requirements. Water your lawn conservatively. Preserve existing trees and plant new trees and shrubs to help prevent erosion and promote infiltration of water into the soil. Restore bare patches in your lawn to prevent erosion. If you own or manage land through which a stream flows, you may wish to consult your local county extension office about methods of restoring stream banks in your area by planting buffer strips of native vegetation.

Around your house, keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. Use the minimum amount of water needed when you wash your car. Never dispose of any household, automotive, or gardening wastes in a storm drain. Keep your septic tank in good working order.

Within your home, fix any dripping faucets or leaky pipes and install water-saving devices in shower heads and toilets. Always follow

directions on labels for use and disposal of household chemicals. Take used motor oil, paints, and other hazardous household materials to proper disposal sites such as approved service stations or designated landfills.

Be Involved

As a citizen and a voter there is much you can do at the community level to help preserve and protect our Nation's water resources. Look around. Is soil erosion being controlled at construction sites? Is the community sewage plant being operated efficiently and correctly? Is the community trash dump in or along a stream? Is road deicing salt being stored properly?

Become involved in your community election processes. Listen and respond to candidates' views on water quality and environmental issues. Many communities have recycling programs; find out about them, learn how to recycle, and volunteer to help out if you can. One of the most important things you can do is find out how your community protects water quality, and speak out if you see problems.

Volunteer Monitoring: You Can Become Part of the Solution

In many areas of the country, citizens are becoming personally involved in monitoring the quality of our Nation's water. As a volunteer monitor, you might be involved in taking ongoing water quality measurements, tracking the progress of protection and restoration projects, or reporting special events, such as fish kills and storm damage.

Volunteer monitoring can be of great benefit to State and local governments. Some States stretch their monitoring budgets by using data collected by volunteers, particularly in remote areas that otherwise might not be monitored at all. Because you are familiar with the water resources in your own neighborhood, you are also more likely to spot unusual occurrences such as fish kills.

The benefits to you of becoming a volunteer are also great. You will learn about your local water resources and have the opportunity to become personally involved in a nationwide campaign to protect a vital, and mutually shared, resource. If you would like to find out more about organizing or joining volunteer monitoring programs in your State, contact your State department of environmental quality, or write to

Alice Mayio
U.S. EPA
Volunteer Monitoring (4503F)
401 M St. SW
Washington, DC 20460
(202) 260-7018

For further information on water quality in your State, write to your State department of environmental quality (see Chapter 8). Additional water quality information may be obtained from the following Regional offices of the U.S. EPA:

Diane Switzer
EPA Region 1 (EMS-LEX)
60 Westview Street
Lexington, MA 02173
(617) 860-4377
Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, Vermont

Xuan-Mai T. Tran
EPA Region 2 (SWQB)
26 Federal Plaza
New York, NY 10278
(212) 264-3188
New Jersey, New York, Puerto Rico, Virgin Islands

Charles A. Kanetsky
EPA Region 3 (3ES11)
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-8176
Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia

Larinda Tervelt
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For Further Reading

U.S. EPA. 1988. *America's Wetlands: Our Vital Link Between Land and Water*. Office of Water. EPA 87-016.

U.S. EPA. 1988. *Environmental Backgrounder: Wetlands*. Office of Water.

U.S. EPA. 1989. *EPA Journal: Can Our Coasts Survive More Growth?* Volume 15, Number 5.

U.S. EPA. 1991. *EPA Journal: Nonpoint Source Pollution: Runoff of Rain and Snowmelt, Our Biggest Water Quality Problem*. Volume 17, Number 5.

U.S. EPA. 1992. *National Water Quality Inventory: 1990 Report to Congress*. Office of Water. EPA 503/99-92-006.

Fish Consumption Advisories

States issue fish consumption advisories to protect the public from ingesting harmful quantities of toxic pollutants in contaminated fish and shellfish. Fish may accumulate dangerous quantities of pollutants in their tissues by ingesting many smaller organisms, each contaminated with a small quantity of pollutant. This process is called bioaccumulation or biomagnification. Pollutants also enter fish and shellfish tissues through the gills or skin.

Fish consumption advisories recommend that the public limit the quantity and frequency of fish consumption from specific waterbodies. The States tailor individual advisories to minimize health risks based on contaminant data collected in their fish tissue sampling programs. Advisories may completely ban fish consumption in severely polluted waters or limit fish consumption to several meals per month or year in cases of less severe contamination. Advisories may target a subpopulation at risk (such as children, pregnant women, and nursing mothers), specific fish species, or larger fish that may have accumulated high concentrations of a pollutant over a longer lifetime than a smaller, younger fish.

The EPA fish consumption advisory database tracks advisories issued by each State. For 1993, the database listed 1,279 fish consumption advisories in effect in 47 States. Fish consumption advisories are unevenly distributed among the States because the States use their own criteria to determine if fish tissue concentrations of toxics pose a health risk that justifies an advisory. States also vary the amount of fish tissue monitoring they conduct and the number of pollutants analyzed. States that conduct more monitoring and use strict criteria will issue more advisories than States that conduct less monitoring and use weaker criteria. For example, 66% of the advisories active in 1993 were issued by the States surrounding the Great Lakes, which support

extensive fish sampling programs and follow strict criteria for issuing advisories.

Most of the fish consumption advisories are due to mercury, polychlorinated biphenyls (PCBs), chlordane, dioxins, and DDT (with its byproducts). The States report that the leading sources of these pollutants are industrial discharges and polluted wet weather runoff from agricultural lands, urban areas, and storm sewers.

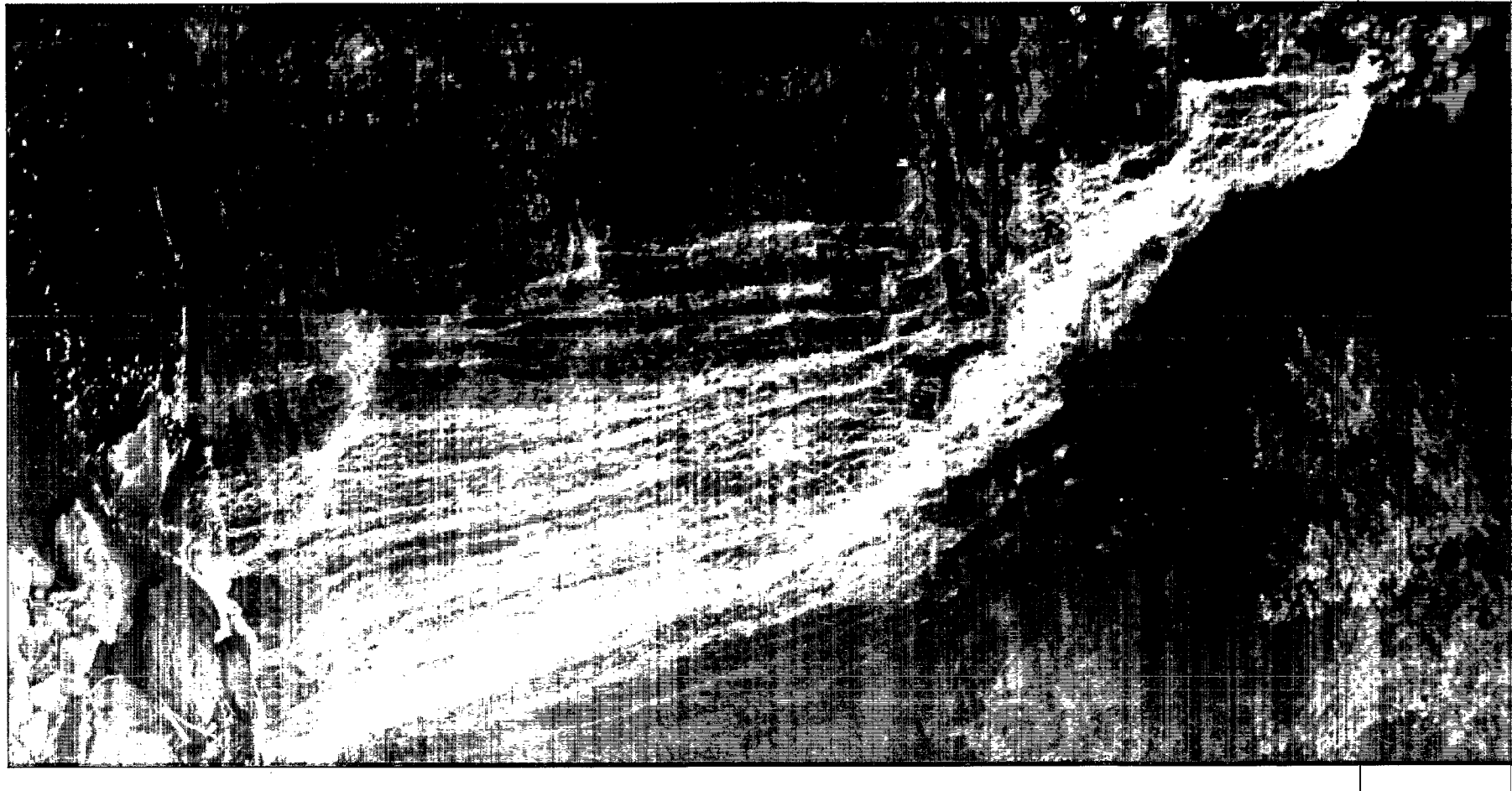
Many coastal States report restrictions on shellfish harvesting in estuarine waters. Shellfish–particularly oysters, clams, and mussels–are filter-feeders that extract their food from water. Waterborne bacteria and viruses may also accumulate on their gills and mantles and in their digestive systems. Shellfish contaminated by these microorganisms are a serious human health concern, particularly if consumed raw.

States currently sample water from shellfish harvesting areas to measure indicator bacteria, such as total coliform and fecal coliform bacteria. These bacteria serve as indicators of the presence of potentially pathogenic microorganisms associated with untreated or undertreated sewage. States restrict shellfish harvesting to areas that maintain these bacteria at concentrations in sea water below established health limits.

In 1992, 18 States reported that shellfish harvesting restrictions were in effect for more than 3,455 square miles of estuarine and coastal waters during the 1990-1992 reporting period. Nine States reported that urban runoff and storm sewers, municipal wastewater treatment facilities, marinas, and industrial discharges restricted shellfish harvesting.

Part I

Introduction



Introduction

This document describes the overall quality of our Nation's assessed surface and ground waters during 1990 and 1991. The contents discuss the geographic extent of water pollution across the country and identify specific pollutants and sources of pollutants contaminating our waters. This document also highlights programs initiated by State and local governments, the U.S. Environmental Protection Agency (EPA), and other Federal agencies to improve water quality.

To prepare this document, EPA summarized information submitted by States, Territories, Interstate Water Basin Commissions, the District of Columbia, and the Gila River Indian Community in their 1992 water quality assessment reports (the "305(b) reports" required under Clean Water Act Section 305(b)). Individual State summaries are provided in Chapter 8.

This report displays and summarizes data provided by the States to EPA. EPA has not determined the accuracy of these data. It is important to note that these State-reported data are intended to provide a snapshot of the quality of the waters they assessed and cannot be used to determine trends in our Nation's water resources. These limitations are due to major differences from year to year in assessment methods within and between States as well as differences in the waters assessed in each 2-year period. In addition, not all States follow EPA's guidance on procedures for determining whether waters are supporting the uses designated in their water quality standards. EPA and the States are taking many steps toward transforming the 305(b) process into one that provides comparable data with known accuracy. These steps include implementing the recommendations of the National 305(b) Consistency Workgroup and the Intergovernmental Task Force for Monitoring Water Quality, as well as improving the Section 305(b) guidelines and stipulating adherence to those guidelines in proposed State Section 106 grant guidelines. These efforts will foster consistency and accuracy among the States and allow better sharing of data across political boundaries for watershed protection.

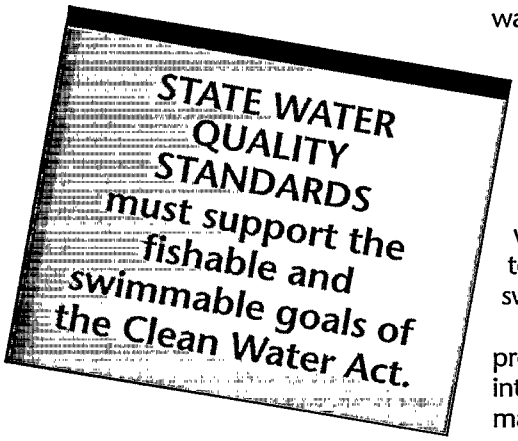
The Clean Water Act

The Clean Water Act (CWA) still guides Federal and State water pollution control programs 20 years after it was enacted by Congress. In 1972, the CWA launched a national objective to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." The Act set two goals to achieve this objective:

- Eliminate the discharge of pollutants into navigable waters by 1985, and

The Clean Water Act of 1972

. . . it is the national goal that, wherever attainable, an interim goal of water quality which provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water, be achieved by July 1, 1983 . . .



■ Achieve an interim water quality level that protects and propagates fish, shellfish, and wildlife and supports recreation in and on the water, where attainable.

As it became evident that the Nation could not eliminate pollutant discharges by 1985, Congress amended the CWA to stress achieving the interim water quality levels, which came to be known as "the fishable and swimmable goals of the Act."

The EPA measures national progress in achieving the CWA interim water quality levels by summarizing attainment of State water quality standards. Water quality standards consist of designated beneficial uses, numeric and narrative criteria sufficient to protect each use, and an antidegradation statement:

■ **Designated beneficial uses** are the desirable uses that water quality should support. Examples are drinking water supply, primary contact recreation (such as swimming), and aquatic life support. Each designated use has a unique set of water quality requirements or criteria that must be met for the use to be realized. States may designate an individual waterbody for multiple beneficial uses.

■ **Numeric water quality criteria** establish the minimum physical, chemical, and biological parameters required to support a beneficial use. Physical and chemical numeric criteria may set maximum concentrations of pollutants, acceptable ranges of physical parameters, and minimum concentrations of desirable parameters, such as dissolved oxygen. Numeric biological criteria describe the expected attainable community attributes and establish values based on measures such as species richness, presence or absence of indicator taxa, and distribution of classes of organisms.

■ **Narrative water quality criteria** define, rather than quantify, conditions and attainable goals that must be maintained to support a designated use. Narrative biological criteria establish a positive statement about aquatic community characteristics expected to occur within a waterbody. For example, "Aquatic life shall be as it naturally occurs," or "Ambient water quality shall be sufficient to support life stages of all indigenous aquatic species." Narrative criteria may also describe conditions that are desired in a waterbody, such as, "Waters must be free of substances that are toxic to humans, aquatic life, and wildlife."

■ **Antidegradation statements** protect existing designated uses and prevent high-quality waterbodies from deteriorating below the water quality necessary to maintain existing or anticipated designated beneficial uses.

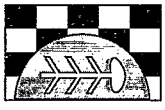
The CWA allows States to set their own standards but requires that all State beneficial uses and their criteria comply with the goals of the Act. At a minimum, State beneficial uses must provide for "the protection and propagation of fish, shellfish, and wildlife" and provide for "recreation in and on the water" (i.e., the fishable and swimmable goals of the Act), where attainable. The Act prohibits States from designating waste transport or waste assimilation as a beneficial use, as some States did prior to 1972.

Assessment Methodology

Section 305(b) of the CWA requires that the States biennially assess their water quality for attainment of the fishable and swimmable goals of the Act and report the results to EPA. The States measure attainment of the CWA goals by determining how well their waters support their designated beneficial uses. EPA encourages States to assess support of the following individual beneficial uses:

Aquatic Life Support

The waterbody provides suitable habitat for survival and reproduction of desirable fish, shellfish, and other aquatic organisms.

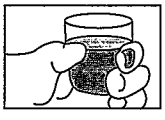


Fish Consumption

The waterbody supports a population of fish free from contamination that could pose a human health risk to consumers.

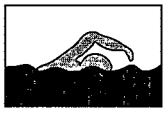
Shellfish Harvesting

The waterbody supports a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.



Drinking Water Supply

The waterbody can supply safe drinking water with conventional treatment.

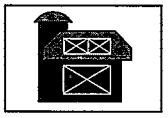


Primary Contact Recreation – Swimming

People can swim in the waterbody without risk of adverse human health effects (such as catching waterborne diseases from raw sewage contamination).

Secondary Contact Recreation

People can perform activities on the water (such as canoeing) without risk of adverse human health effects from occasional contact with the water.

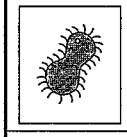
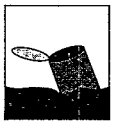


Agriculture

The water quality is suitable for irrigating fields or watering livestock.

The States assign one of five levels of use support categories to each of their waterbodies (Table 1-1). If possible, the States determine the level of use support by comparing monitoring data with numeric criteria for each use designated for a particular waterbody. If monitoring data are not available, the State may determine the level of use support with qualitative information. Valid qualitative information

Table 1-1. Levels of Use Support

Symbol	Use Support Level	Water Quality Condition	Definition
	Fully Supporting	Good	Water quality meets designated use criteria.
	Threatened	Good	Water quality supports beneficial uses now but may not in the future unless action is taken.
	**Partially Supporting**	Fair (Impaired)	Water quality fails to meet designated use criteria at times.
	Not Supporting	Poor (Impaired)	Water quality frequently fails to meet designated use criteria.
	**Not Attainable**	Poor	The State has performed a use-attainability study and documented that use support is not achievable due to a natural condition or human activity that cannot be reversed without imposing widespread economic and social impacts.

includes land use data, fish and game surveys, and predictive model results. **Monitored assessments** are based on monitoring data. **Evaluated assessments** are based on qualitative information or monitored information more than 5 years old.

Overall Use Support

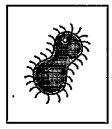
For waterbodies with more than one designated use, the States consolidate the individual use support information into a single overall use support determination:

- **Fully Supporting Overall Use** – All designated beneficial uses are fully supported.
- **Threatened Overall Use** – One or more designated beneficial uses are threatened and the remaining uses are fully supported.
- **Partially Supporting Overall Use** – One or more designated beneficial uses are partially supported and the remaining uses are fully supported.
- **Not Supporting Overall Use** – One or more designated beneficial uses are not supported.
- **Not Attainable** – The State has performed a use-attainability study and documented that use support of one or more designated beneficial uses is not achievable due to natural conditions or human activity that cannot be reversed without imposing widespread economic and social impacts.
- **Impaired Waters** – The sum of waterbodies partially supporting uses and not supporting uses.

SAMPLE

Little River

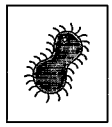
Little River is designated for aquatic life use and primary contact recreation. The State examines dissolved oxygen data and notes that 15% of the samples contained dissolved oxygen concentrations below the aquatic life use criterion of 5 parts per million (ppm). Bacterial indicators did not exceed the contact recreation criterion. Therefore, the waterbody partially supports aquatic life use and fully supports contact recreation use. The waterbody partially supports overall uses based on monitored data.



SAMPLE

Turkey Lake

Turkey Lake is also designated for aquatic life use and primary contact recreation. However, the State has never sampled chemical and physical parameters, such as dissolved oxygen, in the lake. The State did perform a biological survey of the lake and noted the presence of desirable fish species and insect larvae. The survey also revealed a probable source of sewage contamination upstream. The lake appears to fully support aquatic life use but may only partially support contact recreation use due to sewage contamination. The waterbody partially supports overall uses based on evaluated information (the suspected source of sewage contamination).



Total Assessed Waters

Most States do not assess all of their waterbodies during the 2-year reporting cycle required under Section 305(b). Thus, the assessed waters reported in Figure 1-1 are a subset of the Nation's total waters. In addition, the summary information based on assessed waters may not represent overall conditions in

the Nation's total waters because States often focus on assessing major perennial rivers, estuaries, and public lakes with suspected pollution problems in order to direct scarce resources to areas that could pose the greatest risk. Many States lack the resources to collect use support information for intermittent streams, small tributaries, and private ponds. This report does not predict the health of these unassessed waters, which include an unknown ratio of pristine waters and waters impaired by point sources and nonpoint sources.

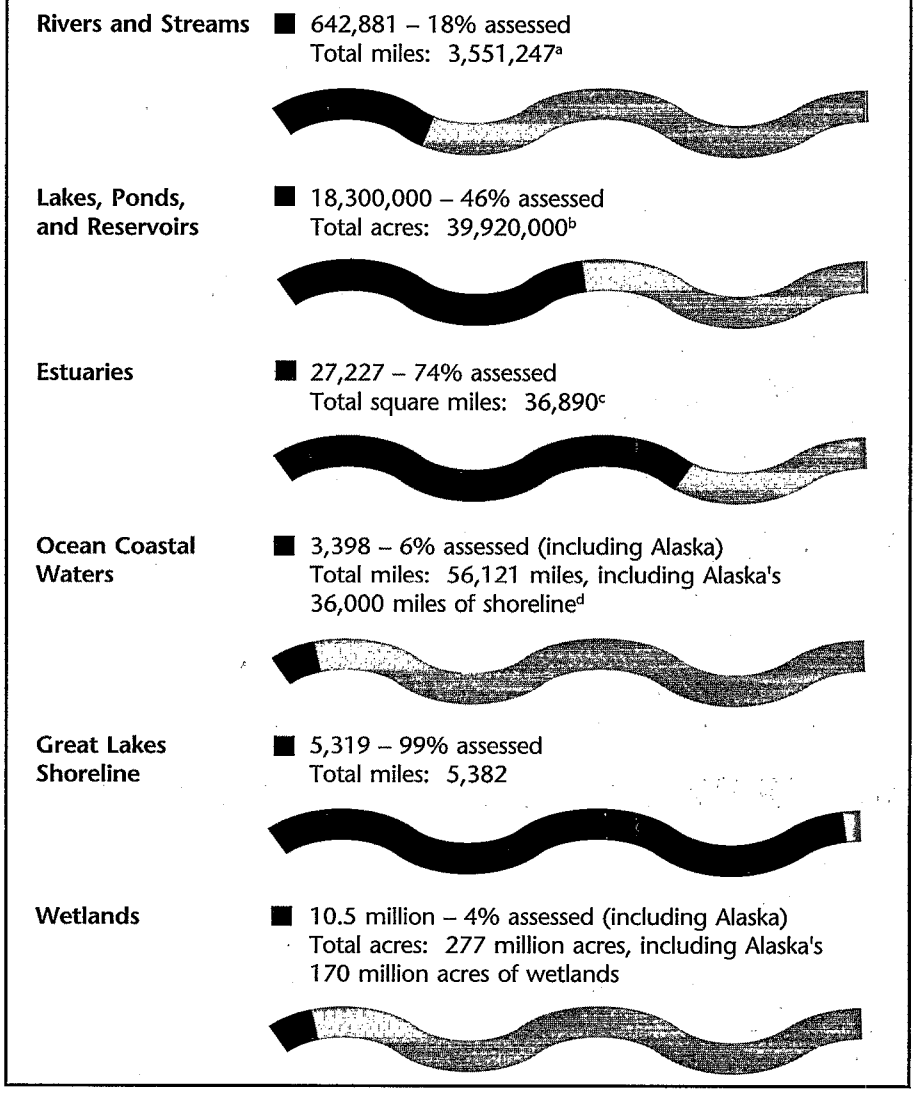
Causes and Sources of Impairment

Where possible, States identify the pollutants causing water quality impairments and the sources of pollutants degrading their waterbodies. **Causes of impairment** are pollutants or processes that violate numeric or narrative use support criteria. Causes of impairment include chemical contaminants (such as polychlorinated biphenyls [PCBs], dioxin, and metals), physical parameters (such as temperature), and biological parameters (such as aquatic weeds).

Sources of impairment generate the pollutants that violate use support criteria. Point sources discharge pollutants directly into surface waters from a conveyance. Point sources include industrial facilities, municipal sewage treatment plants, and combined sewer overflows. Nonpoint sources deliver pollutants to surface waters from diffuse origins. Nonpoint sources include urban runoff, agricultural runoff, and atmospheric deposition of contaminants in air pollution.

Figure 1-1

Percentage of Total Waters Assessed for the 1992 Report



Source: 1992 State 305(b) reports.

NOTE: These figures were reported by the States. See explanation of changes in total water estimates on page 8.

[a] Does not include river miles in American Samoa and Guam, which did not report total river miles.
[b] Does not include lake acreages in American Samoa, Guam, Kentucky, and the Virgin Islands, which did not report total lake acreages.
[c] Does not include estuarine area in Alaska, American Samoa, and Guam.
[d] Does not include shoreline miles in American Samoa and Guam.

Habitat alterations, such as hydromodification, dredging, and streambank destabilization, can also degrade water quality.

Throughout this document, EPA rates the significance of causes and sources of pollution by the percentage of waters impaired by each individual cause or source (obtained from the States 305(b) reports). Note that the cause and source rankings do not describe the condition of all waters in the United States because the States identify the causes and sources degrading a subset of their impaired waters, which are a small subset of assessed waters, which are a subset of the Nation's total waters. For example, the States identified sources degrading some of the 241,407 impaired river miles, which represent 38% of the assessed river miles and only 7% of the Nation's total stream miles.

NOTE

Several States assess a portion of their watersheds each year as part of a rotating basin planning program. These States assess all of their waters in a 5-year period. The 2-year 305(b) snapshot does not give these States full credit for their wide assessment coverage. States that will assess all of their waters over a longer time period include North Carolina, Ohio, South Carolina, and Wisconsin.

Changes in Reporting Methodology

Individual Use Support and the CWA Goals

During previous 305(b) report cycles, States reported overall use support status and CWA fishable and swimmable goal attainment for their waters. CWA goal attainment was reported separately from overall use support status. For example, in the past a State would report

- The number of river miles fully supporting, threatened, partially supporting, and not supporting designated uses
- The number of river miles attaining the fishable goal of the Act
- The number of river miles attaining the swimmable goal of the Act.

For the 1992 report cycle, the 305(b) Consistency Workgroup (composed of State and EPA Regional 305(b) coordinators as well as EPA Headquarters staff) recommended that States report individual use support status instead of CWA goal status. The Workgroup suggested that data on individual use support, such as fish consumption use and aquatic life use support, would distinguish which components of the fishable and swimmable goals of the Act are impaired. In the past, it was unclear whether waters did not attain the fishable goals of the Act because the water quality failed to support a healthy community of fish or because the fish were contaminated and unfit for human consumption, or both. Individual use support information identifies specific water quality problems contributing to lack of full attainment of the fishable and swimmable goals of the Act.

Total Waters

National estimates of total waters provide the foundation for determining the percentage of our waters assessed by the States. In 1992, EPA provided the States with national estimates of total waters derived from the EPA Reach File, a database containing traces of waterbodies adapted from 1:100,000 scale maps prepared by the U.S. Geological Survey. The States modified these total water estimates where necessary. Previously, EPA had used estimates of total rivers and stream miles and lake acres reported in *America's Clean Water: The States' Nonpoint Source*

Assessment, prepared by the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) in 1985. Based on the new Federal/State estimates of total waters, the estimate of total river and stream miles increased in 1992 because most States included intermittent streams, canals, and ditches in total water estimates for the first time. As a result, the percentage of river and stream miles assessed appears much lower than in past Reports to Congress (Table 1-2).

The estimate of total Great Lakes shoreline grew in 1992 because Wisconsin's Coastal Zone Management Division updated its measurements of Wisconsin's shoreline mileage. Wisconsin's estimate of total Great Lakes shoreline grew from 650 miles (reported in 1990) to 840 miles in 1992.

The States assessed nearly the same area of lakes and estuarine waters in 1992 and 1990, but the States assessed fewer ocean shoreline miles in 1992. EPA did not change its method for calculating total estuarine and ocean coastal waters; both the 1990 and 1992 estimates are based on State estimates of their total estuarine and ocean coastal waters. However, the national estimates of total estuarine and ocean coastal waters increased in 1992 because more States reported the information. In particular, the estimate of total ocean coastal waters more than doubled with the addition of 36,000 shoreline miles in Alaska.

Interpreting Toxic Pollutant Data

In the guidelines for preparing the 1992 State Section 305(b) reports, EPA recommended that the States implement stricter assessment methods for determining aquatic life use support with toxicant data. According to the new assessment method, one or more violations of toxic pollutant criteria in a 3-year period indicate that a waterbody does not support aquatic life use. In previous assessment cycles, States might have classified waterbodies with one toxic criteria violation as partially supporting aquatic life use. The new assessment method increases the proportion of waters not supporting designated uses even if no actual change in water quality occurred between 1990 and 1992.

Table 1-2. Comparison of Waters Assessed in 1990 and 1992

Waterbody Type	Year	Estimate of Total Waters	Assessed Waters	Percent Assessed
Rivers and Streams	1992	3,551,247 mi[a]	642,881 mi	18
	1990	1,800,000 mi	647,066 mi	36
Lakes, Ponds, and Reservoirs	1992	39,920,000 ac[b]	18,300,000 ac	46
	1990	39,400,000 ac	18,488,636 ac	44
Estuaries	1992	36,890 mi^2[c]	27,227 mi^2	74
	1990	35,624 mi^2	26,693 mi^2	75
Ocean Shoreline	1992	56,121 mi[d]	3,398 mi	6
	1990	19,200 mi[e]	4,230 mi	22
Great Lakes Shoreline	1992	5,382 mi	5,319 mi	99
	1990	5,169 mi	4,857 mi	94

Sources: *National Water Quality Inventory: 1990 Report to Congress* and the 1992 State Section 305(b) reports.

[a] Does not include river miles in American Samoa and Guam, which did not report total river miles.

[b] Does not include lake acreages in American Samoa, Guam, Kentucky, and the Virgin Islands, which did not report total lake acreages. Includes estimate of Alaska's total lake acreage reported in the 1986 Report to Congress.

[c] Does not include estuarine area in Alaska, American Samoa, and Guam.

[d] Does not include shoreline miles in American Samoa and Guam.

[e] Does not include shoreline miles in Alaska.

NOTE: These figures were reported by the States. See explanation of changes in total water estimates on page 8.

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The Waterbody System:

A Database of Water Quality Assessments

EPA designed the Waterbody System (WBS) as a State and national database for storing and analyzing water quality assessment information. The WBS tracks use support information for water units called waterbodies. States, Territories, American Indian Tribes, and River Basin Commissions define their own waterbodies to best serve their management needs. An individual waterbody may consist of a short stretch of stream, an individual lake, or the rivers and streams of an entire watershed. Usually, waterbody boundaries correspond to significant hydrologic or ecologic features, such as watershed boundaries. The WBS recognizes rivers, lakes, estuaries, tidal wetlands, freshwater wetlands, Great Lakes shorelines, and coastal shorelines as different types of waterbodies.

The WBS provides a convenient way for a State to track a wide range of assessment information for its designated waterbodies. Data fields track information on designated use support including aquatic life support, human health risks related to fish and shellfish consumption, and recreational use support. The WBS provides data fields to document causes and sources of pollution impairing full attainment of State water quality standards in each designated waterbody.

Once a State enters the data, it can use the WBS to generate a variety of summary reports and lists that simplify preparation of its 305(b) water quality assessment reports. EPA can then use all WBS data to prepare the National Water Quality Inventory Report to Congress. Summary data from each 305(b) Report and the WBS are found in the Appendices of this report. Other WBS uses include information management for the Section 314 Clean Lakes Program, the Section 319 Nonpoint Source Management Program, and the new nonpoint source management initiatives under the Coastal Zone Act Reauthorization Amendments.

EPA originally designed the WBS to facilitate analyses of water quality information. The future design for the WBS is to include geographic analyses and visualization as pictured on the next page. The WBS and related software tools can be used on a variety of computer platforms, including personal computers, the EPA National

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WBS: Design for the Future

Prototype example shown: South Carolina

WBS MAIN MENU

Edit Create Save Browse Reports Utilities System 3:57:31

OPEN WINDOW

WB Identification	1
WB Reach Indexing	2
Assessment Info	3
Assessment Codes	4
Use Support Matrix	5
Cause/Sources	7
Point Sources	7
Nonpoint Sources	8

1993

WBS INDIVIDUAL WATERBODY

System File Edit Window 11:01:03

Waterbody Identification
Waterbody Assessment Information

WBID SC - 03050108-010 R | Seg 00 Assess Date 9201 Cycle 92

Assessment category M | Toxics monitoring Y

Begin sampling (YYMM) | End sampling (YYMM)

Water quality limited | Signif publicly owned lake

New/Revised TMDI needed | Date of Latest TMDL (YYMM) 3

Size Impacted by Priority Pollutanats, Ammonia or Chlorine
Size CWA 314 Impaired | Size CWA 314 Threatened
Size CWA 319 Impaired | Size CWA 319 Threatened
Size Impaired or Threatened by Acid Deposition

Trophic Status Trend Size Comments Memo

<F1> Help; <ALT+F1> Valid Codes, <Esc> Main Menu.

WBS REPORT SUMMARIZING OVERALL USE SUPPORT STATEWIDE

System File Edit Window 11:01:03

Use Summary Report: Overall Use Support

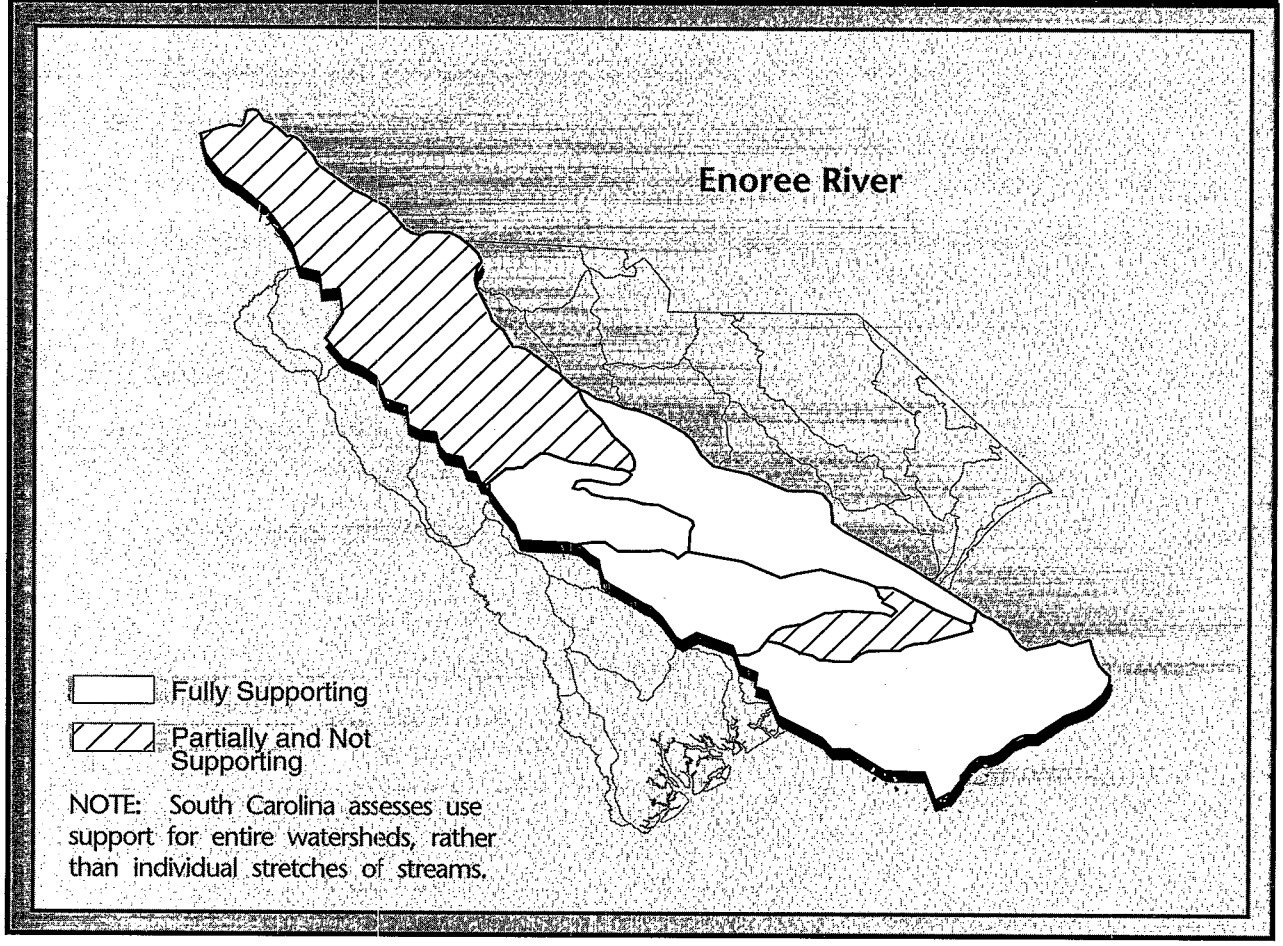
OPEN WINDOW | SOUTH CAROLINA

02 - 24 - 93

Query condition: (WBSEGNO = '00') and (USE = '01')

Waterbody type: Rivers
Total Number of Rivers in Assessment File: 181
Total Number of Monitored Rivers: 181
Total Number of Evaluated Rivers: 0

OVERALL USE SUPPORT IN SOUTH CAROLINA RIVERS

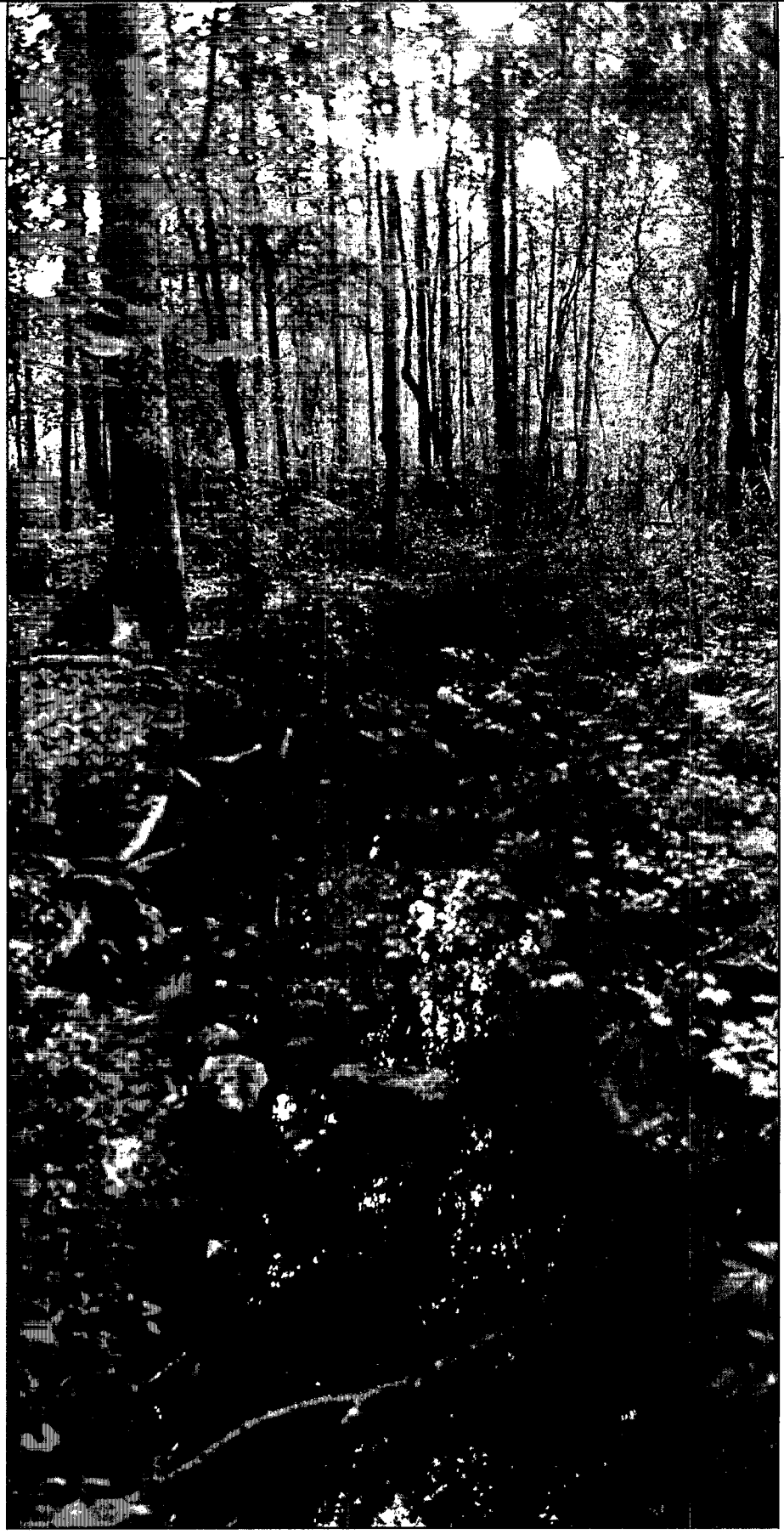


NOTE: South Carolina assesses use support for entire watersheds, rather than individual stretches of streams.

Computing Center mainframe computer, and Geographic Information System workstation environments. WBS data through the 1992 cycle are available on the EPA mainframe and from the States through the 305(b) coordinators (see Chapter 8). Those accessing the data on the mainframe must have an account and be authorized STORET users. As EPA moves to encourage geographic targeting approaches, access to databases with spatial location elements becomes critical. EPA's Watershed Protection Initiative (see Chapter 10) and the total maximum daily load (TMDL) process provide additional uses for spatially oriented water quality information stored in the WBS.

Part II

Water Quality Assessments



Rivers and Streams

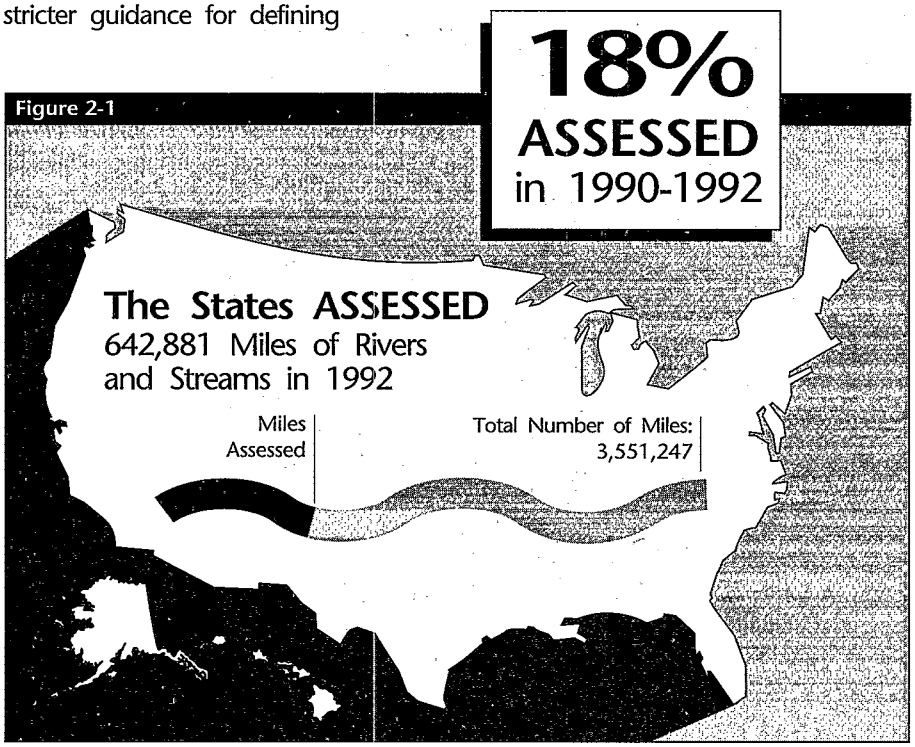
Fifty-three States, Territories, Jurisdictions, and Interstate River Commissions, the District of Columbia, and one American Indian Tribe (hereafter collectively referred to as States) rated the water quality in 642,881 miles of streams and rivers in their 1992 Section 305(b) reports. In the years 1990-1992, these States assessed 18% of the total 3,551,247 river and stream miles reported by these States (Figure 2-1). The States assessed about 4,000 fewer river miles than they assessed for 1990. EPA expected the States to assess fewer waters in 1992 because EPA issued stricter guidance for defining assessed waters in 1992. The percentage of rivers assessed in 1992 appears much smaller than the percentage assessed in 1990 because the Nation shifted its baseline to the more inclusive total waters estimates described in Chapter 1 (page 8).

Fifty States reported overall use support for rivers and streams. Overall use support is the standard measure of water quality required by the Clean Water Act. States determine overall use support by summarizing how well each waterbody supports each designated use, such as drinking water supply use,

NOTE

It appears that the States assessed a smaller percentage of the Nation's rivers in 1992 than in 1990 due to an increase in the estimate of total waters in the United States. For the first time, most States used a nationally consistent method for counting their waters. By this method, States included intermittent streams, canals, and ditches in estimates of total stream miles in 1992. As a result, the national estimate of total stream miles almost doubled from 1.8 million miles in 1990 to more than 3.5 million miles in 1992.

Figure 2-1



River Miles Assessed by the States

1992 ■ 642,881 miles = 18% assessed
▩ Total miles: 3,551,247

1990 ■ 647,066 miles = 36% assessed
▩ Total miles: 1,800,000

1988 ■ 519,413 = 29% assessed
▩ Total miles: 1,800,000

Based on data contained in Appendix A, Table A-1.

recreational use, or aquatic life use (see Chapter 1 for a complete discussion of use support). Another five States reported individual use support for rivers and streams but did not summarize overall use support. In such cases, EPA assumed that the status of aquatic life support use represented overall use support.

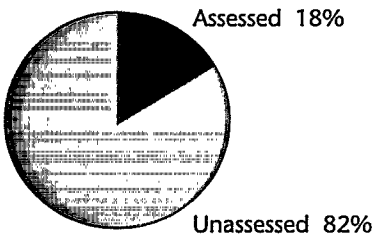
Overall Use Support

Fifty-six percent of the 642,881 river miles assessed fully support overall designated uses (Figure 2-2). The percentage of river miles fully supporting overall designated uses fell slightly in 1992 due to changes in the total river miles assessed, the number of States reporting use support, and the assessment methods employed by each State.

An additional 6% of the assessed river miles fully support overall uses but are threatened by potential sources of pollution. These rivers may not support uses in the near future if we fail to control potential sources of pollution. Twenty-five percent of the assessed river miles partially support designated uses. One or more uses may be temporarily restricted in these rivers. For example, a stream may fully support recreational use in dry weather but not support recreational use following a severe thunderstorm because heavy rainfall might overload a combined sewer system with a slug of runoff. The resulting discharge of undertreated sewage would restrict the public's use of the river for swimming until

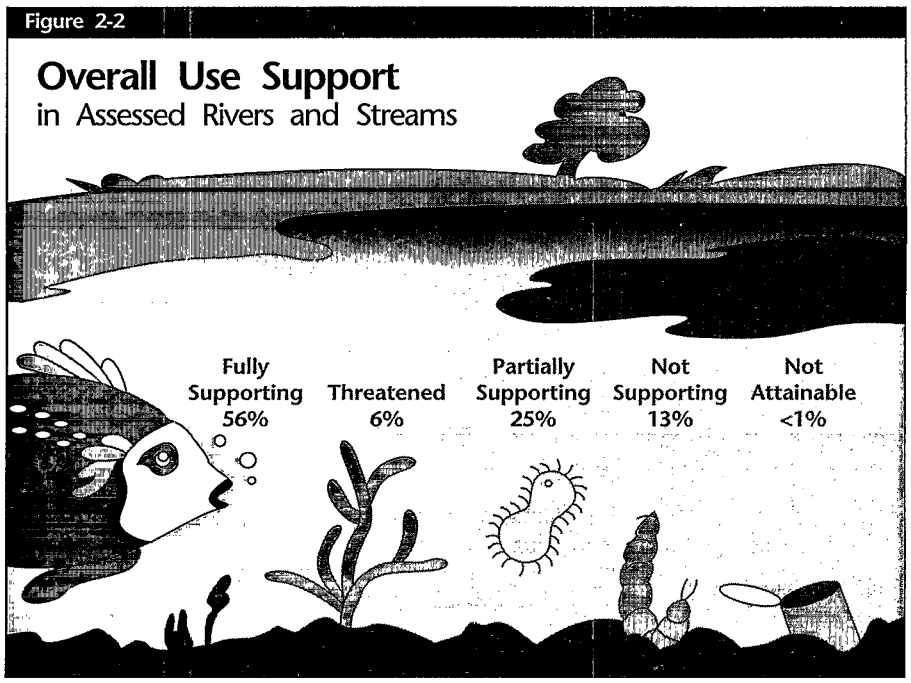
Total rivers = 3.5 million miles
Total assessed = 642,881 miles

■ 18% assessed
■ 82% unassessed



Of the assessed miles:
- 36% were monitored
- 60% were evaluated
- 4% were not specified

Figure 2-2



Based on data contained in Appendix A ,Table A-1.

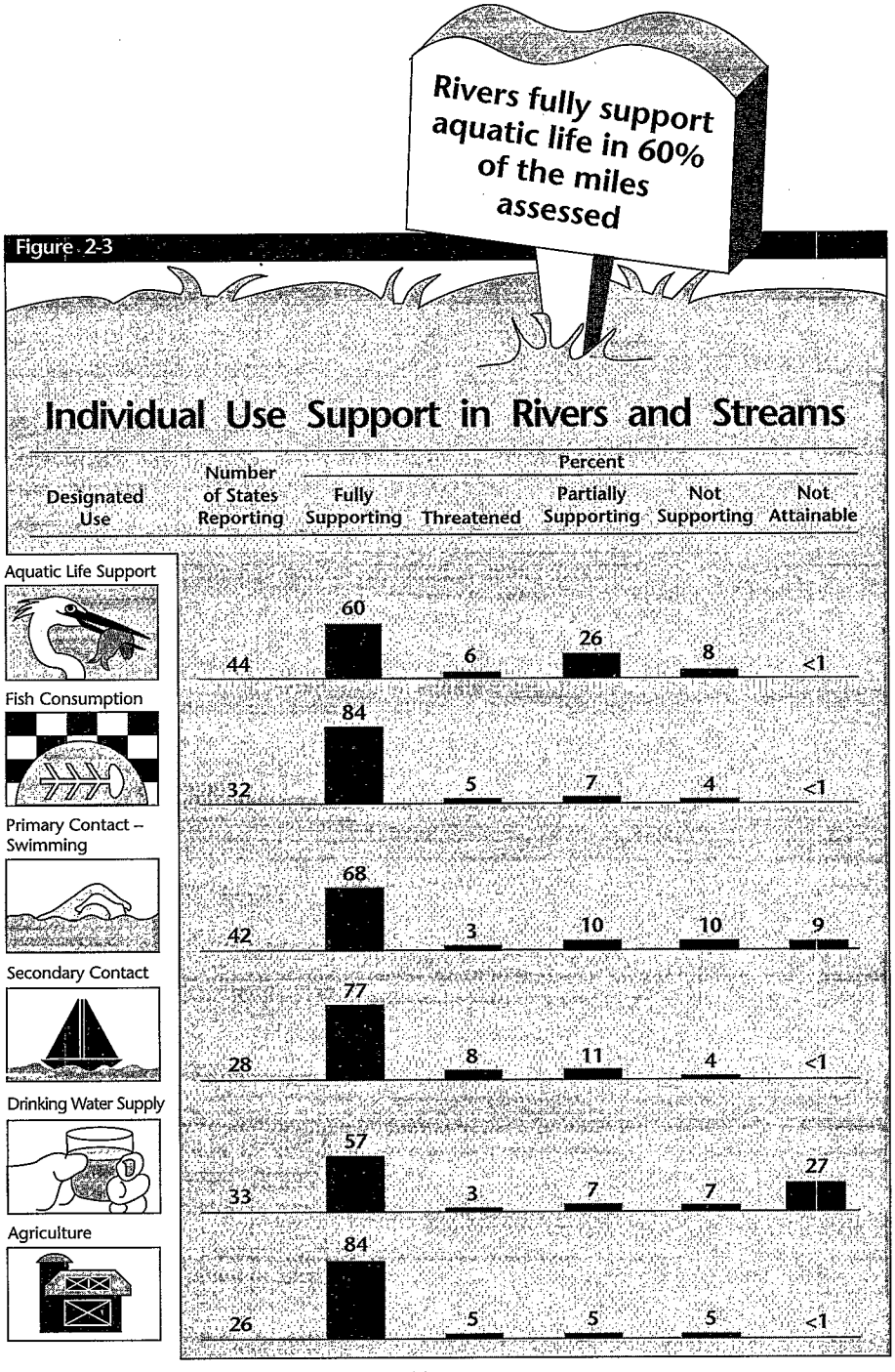
the flow of runoff into the treatment plant subsided.

Thirteen percent of the assessed river miles do not support overall designated uses and less than 1% cannot attain designated uses due to excessive degradation or natural conditions such as low flow.

Individual Use Support

The States assessed support of six individual designated uses in rivers: aquatic life support, fish consumption, primary contact recreation–swimming, secondary contact recreation, public drinking water supply, and agricultural supply (see Chapter 1, page 3, for a description of each individual use). The States reported the status of aquatic life support and swimming use support most frequently (Figure 2-3). Fifteen States failed to report individual use support (see Appendix A, Table A-2, for individual State information).

Rivers fully support aquatic life in 60% of the 547,871 miles assessed. Aquatic life support accounts for most of the river miles partially supporting their designated uses. Of the 221,352 river miles assessed for drinking water supply use, 27% cannot attain drinking water use standards. Natural physical characteristics, such as hardness and color, as well as degradation from human activities may prevent rivers from attaining drinking water standards.



Based on data contained in Appendix A, Table A-2.

Causes of Impairment

Forty-nine States identified the number of stream miles affected by individual causes of nonsupport. Causes of nonsupport are pollutants or pollutant processes that impair waterbodies, such as sediment, metals, acidity, and hydromodification. The total number of river miles affected by a particular pollutant is subdivided into whether the cause is a major or moderate/minor contributor to impairment. A major contributor is solely responsible for the impairment or predominates over other causes. A moderate contributor is one of multiple causes responsible for less than full support, of which none predominate.

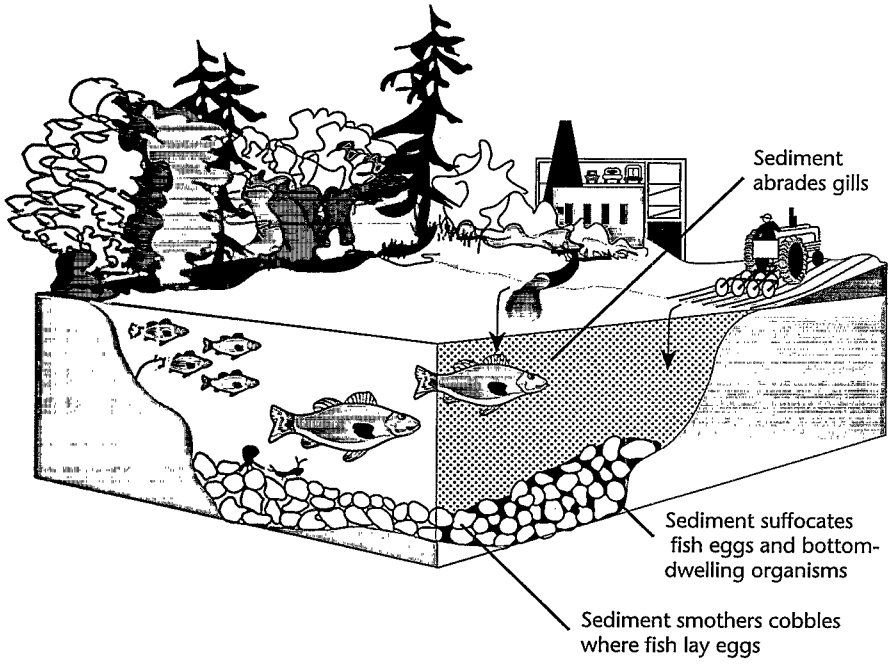
Any given stream mile can be affected by multiple causes of impairment. Therefore, States count each stream mile under each cause category contributing to its impairment. As a result, States count a single mile of river affected by multiple causes of impairment under several cause categories. The values reported are the total number of river miles affected by a particular cause of impairment according to whether the cause is a major or moderate/minor contributor to impairment.

States report that siltation is the most prevalent cause of impairment in assessed rivers and streams (Figure 2-4). Siltation affects 45% of the 222,370 impaired stream miles in the States reporting causes of pollution (Figure 2-5). Nutrients, the second most commonly reported cause, affect 37% of the impaired river miles and most often consist of nitrogen and phosphorus compounds typically found in agricultural fertilizers, phosphate detergents, and municipal sewage treatment plant discharges.

Pathogen contamination affects 27% of the impaired stream miles. Pathogens impair drinking water supply uses and contact recreation uses and commonly enter waters in inadequately treated sewage or runoff from pastures, feedlots, and urban areas.

Figure 2-4

The Effects of Siltation in Rivers and Streams



Siltation is the leading pollution problem in the Nation's rivers and streams. Over the long term, unchecked siltation can alter habitat with profound effects on aquatic life. In the short term, silt can kill fish directly, destroy spawning beds, and increase water turbidity resulting in depressed photosynthetic rates.

Forty-two States specified the degree of impact (i.e., major or moderate/minor) of the causes affecting rivers and streams. These States reported that all causes have more moderate and minor impacts than major impacts.

Sources of Impairment

Forty-eight States reported sources of some impairments in their rivers and streams. Because it is so difficult to detect and differentiate sources of pollution, most States identify sources for a subset of their impaired rivers, which are a portion of their assessed rivers, which are, in turn, a fraction of the Nation's total river miles. As a result, the ranking of sources shown in Figure 2-6 applies to only 6% of the Nation's total river miles.

As with causes of impairment, multiple sources may affect an individual river mile. Therefore, States count a single river mile under each source category contributing to its impairment. As a result, States count a single mile of river affected by multiple sources of impairment under several source categories. The values reported are the total number of river miles affected by a particular source of impairment according to whether the source is a major or moderate/minor contributor to impairment.

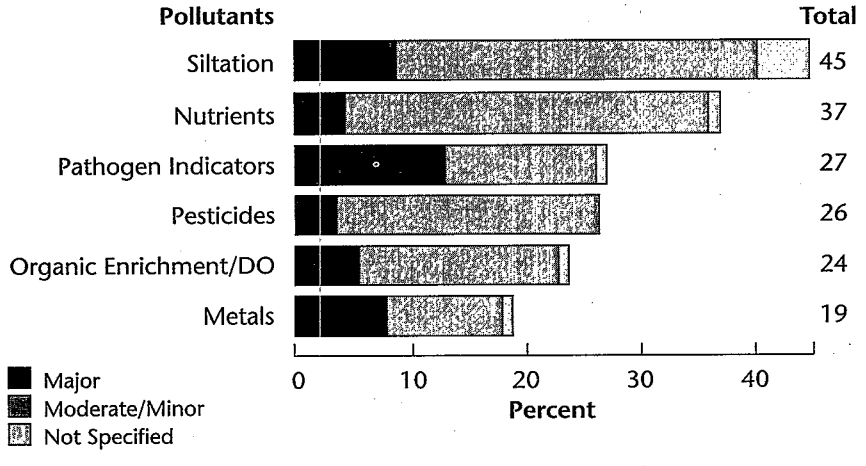
SILTATION is the leading cause of impairment in rivers and streams, affecting 45% of the impaired river miles.

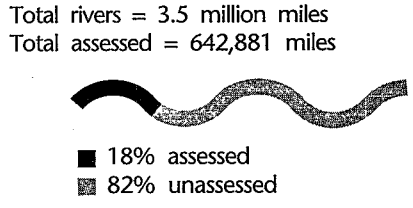
The States report that agriculture is the most extensive source of pollution in the Nation's assessed rivers. The general category of agriculture, which includes irrigated crop production, nonirrigated crop

Figure 2-5

Percent of ASSESSED River Miles Impaired by Pollutants

(222,370 assessed river miles impaired)





Based on data contained in Appendix A, Table A-3.

AGRICULTURE is the leading source of impairment in the Nation's rivers, affecting 72% of the impaired river miles.

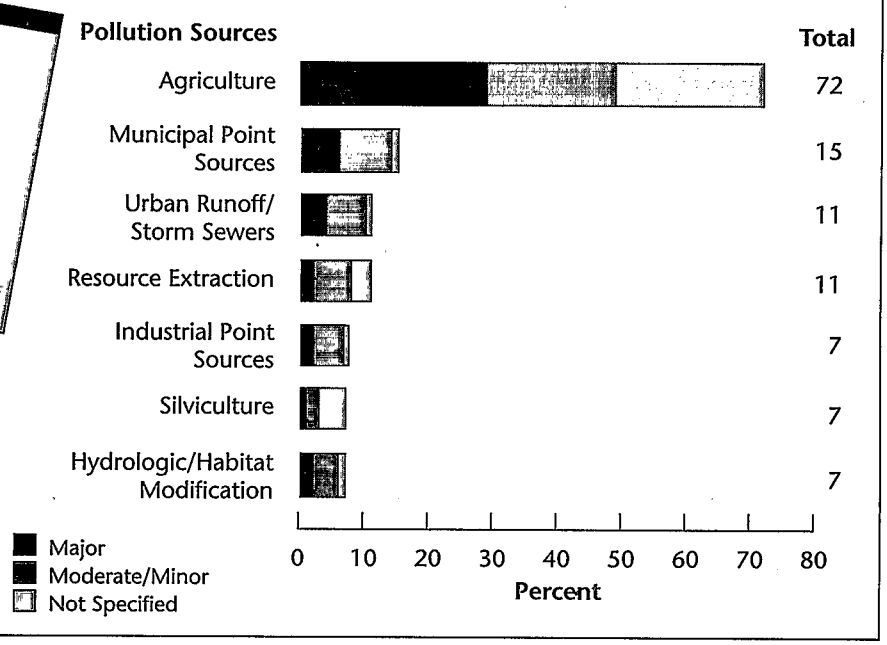
Total rivers = 3.5 million miles
Total assessed = 642,881 miles

■ 18% assessed
■ 82% unassessed

Figure 2-6

Percent of ASSESSED River Miles Impaired by Sources of Pollution

(221,877 assessed river miles impaired)



Based on data contained in Appendix A ,Table A-4.

NOTE

It is relatively easy to collect a water sample and identify pollutants causing impairments, such as fecal coliform bacteria indicating pathogen contamination. However, detecting and ranking sources of pollutants can require monitoring pollutant movement from numerous potential sources, such as failing septic systems, agricultural fields, urban runoff, municipal sewage treatment plants, and local waterfowl populations.

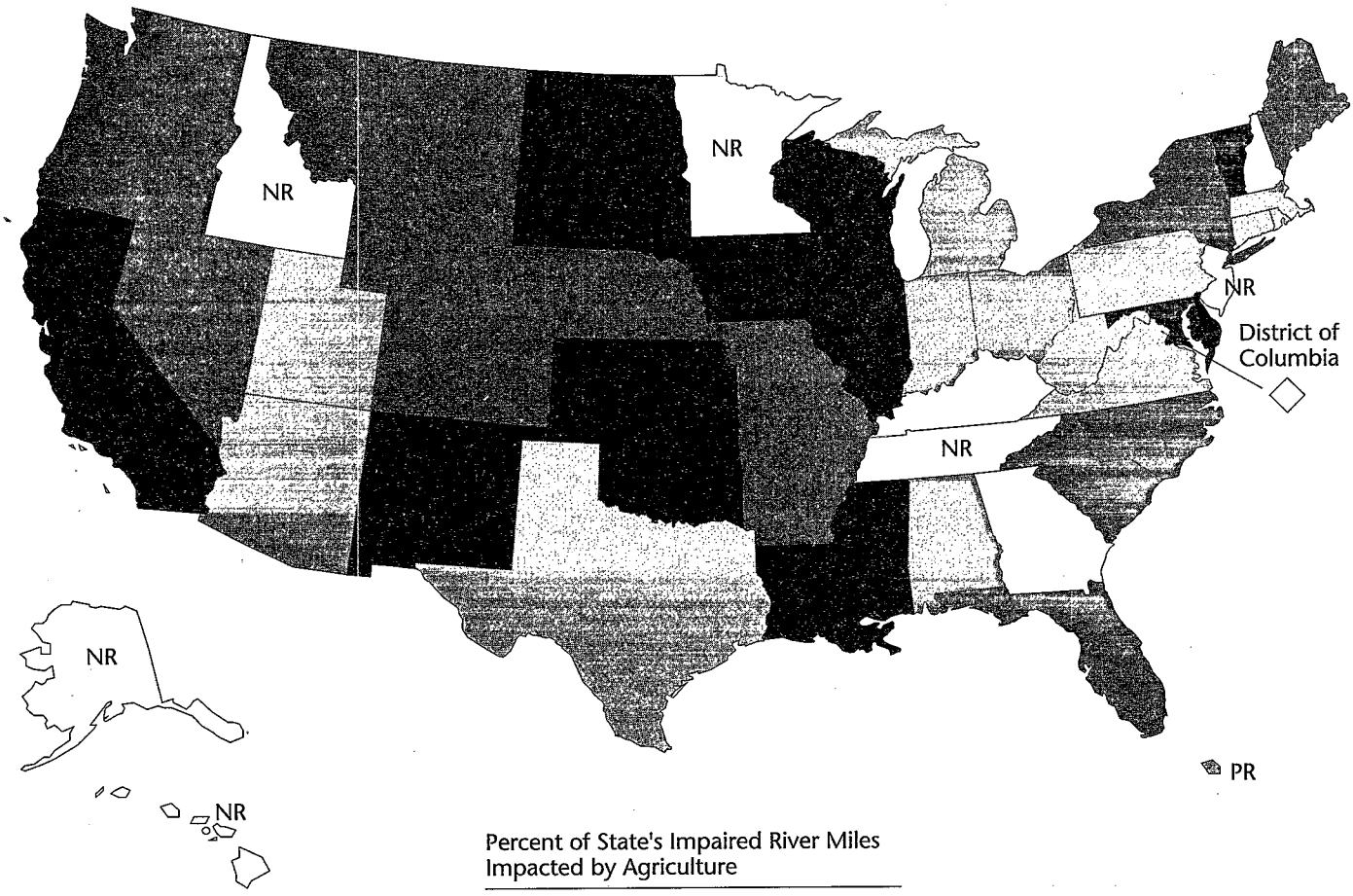
production, rangeland, and feed lots, affects 72% of the 221,877 impaired river miles in the States reporting sources of river impairments. Reporting of agricultural impacts is widespread (Figure 2-7). Agricultural sources are responsible for many pollutants such as sediment, nutrients, pesticides, pathogens, and organic enrichment.

Other specific sources of pollution that impair rivers include municipal point sources (15%), urban runoff and storm sewers (11%), resource extraction (11%), industrial point sources (7%), silviculture (7%), and hydrologic and habitat alterations (7%).

The States also report that "other" sources impair significant stretches of our rivers and streams. "Other" sources include natural sources, such as low-flow conditions, leaf litter, and glacial debris that may increase turbidity, acidity, and water temperature in the absence of human activity. For example, Oregon reported that 4,232 river miles were impaired by natural glacial debris elevating turbidity.

Figure 2-7

Distribution of Agricultural Impacts on Rivers and Streams



Based on data contained in Appendix A,Table A-4.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Nutrient Loads in Four Major River Basins*

Nutrient enrichment is one of the most pervasive water quality problems in the Nation's rivers and streams. Excessive inputs of nutrients (such as nitrogen and phosphorus) can overstimulate aquatic plant growth and algal productivity, which, in turn, destabilizes dissolved oxygen concentrations and pH (acidity) in stream ecosystems. The unstable conditions may force fish and other aquatic organisms to seek healthier habitat.

The U.S. Geological Survey (USGS) assessed total phosphorus and total nitrogen loads in four river basins under the National Water Quality Assessment (NAWQA) Program. The USGS designed the NAWQA Program to describe status and trends in the Nation's water resources and to improve understanding of the natural and human factors that affect the quality of water resources. The NAWQA program assessed point and nonpoint source nutrient loads in the Kentucky River Basin, the Upper Illinois River Basin, the Lower

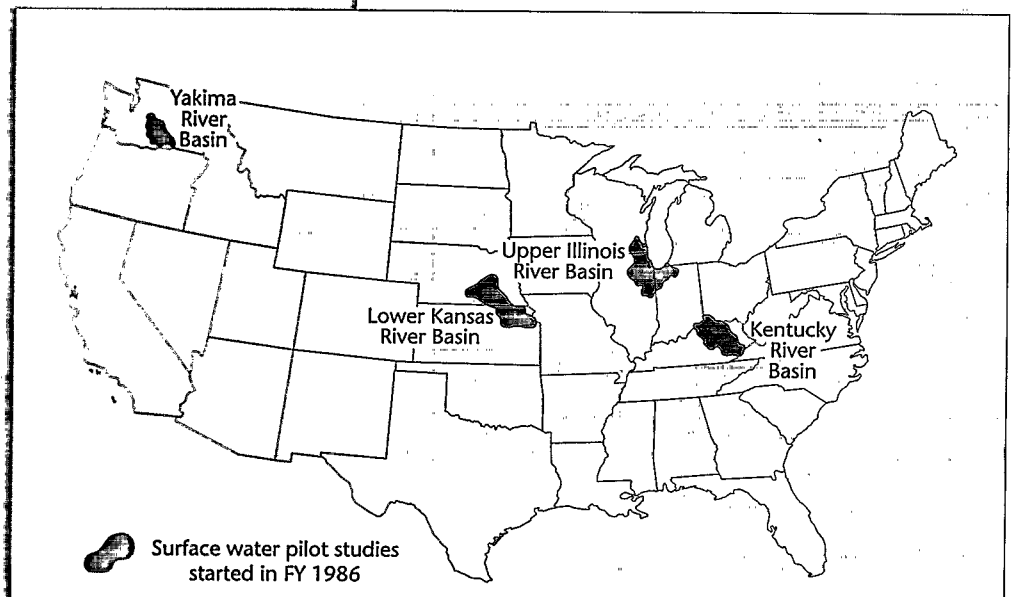


Figure 1. U.S. Geological Survey National Water Quality Assessment Program.

*The information contained in this highlight was extracted from *Preliminary Estimates of Phosphorus and Nitrogen Loads from Point and Nonpoint Sources in Four Major River Basins in the United States*, by J.V. Davis and W.G. Wilber of the U.S. Geological Survey.

Kansas River Basin, and the Yakima River Basin in Washington (Figure 1).

The USGS estimated the mean daily instream loads of total phosphorus and total nitrogen at USGS's most downstream long-term monitoring site in each river basin. The USGS used all available water quality data to develop equations relating instream flow to nutrient loads and applied the equations to daily streamflow records to estimate mean annual nutrient loads in each basin. The annual loads were divided by 365 days to estimate the mean daily instream load of nutrients entering each basin. The USGS also divided the mean daily nutrient loads by the drainage area of each basin to estimate the yield of nutrients coming off an acre of land in each basin.

The USGS calculated mean daily loads from point sources (such as sewage treatment plants and industrial dischargers) with effluent flow rate data and nutrient concentration data contained in EPA's Permit Compliance System Database and other databases managed by wastewater treatment plant operators. The USGS estimated nonpoint source nutrient loads by subtracting the total point source load in a basin from the total instream basin load at the most downstream monitoring station. The resulting estimate of nonpoint source nutrient load is conservative because it does not take into account nutrient losses due to physical, biological, and chemical processes.

Of the four basins studied, the Upper Illinois River basin had the highest estimates of instream nutrient loads and yields (Figure 2). The Upper Illinois River basin also has the largest percentage of land devoted to cultivated row crops (75%), the highest nitrogen and phosphorus fertilizer application rates, and the largest wastewater effluent loadings of nitrogen and phosphorus due to the large population in the basin (about 7.6 million people).

In contrast, nitrogen and phosphorus loads were smallest in the Yakima River basin, which has a small population and land use dominated by forests, grazing lands,

orchards, and crops that tend to be more permanent and result in less erosion.

Nonpoint sources generated most of the nutrient loads in the Lower Kansas River basin, the Kentucky River basin, and the Yakima River basin (Figure 2). Point sources played a greater role in generating nutrients in the Upper Illinois River basin than in the other basins because the Upper Illinois River basin's large population generates more sewage than do populations in the other basins. Point sources accounted for 57% of the mean annual load of total phosphorus exported from the Upper Illinois River basin compared to 39% in the Lower Kansas River basin, 27% in the Yakima River basin, and 20% in the Kentucky River basin.

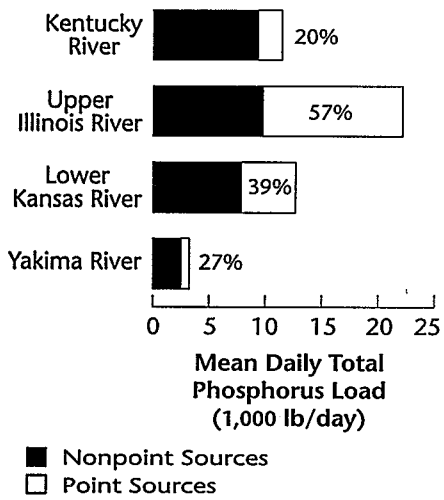
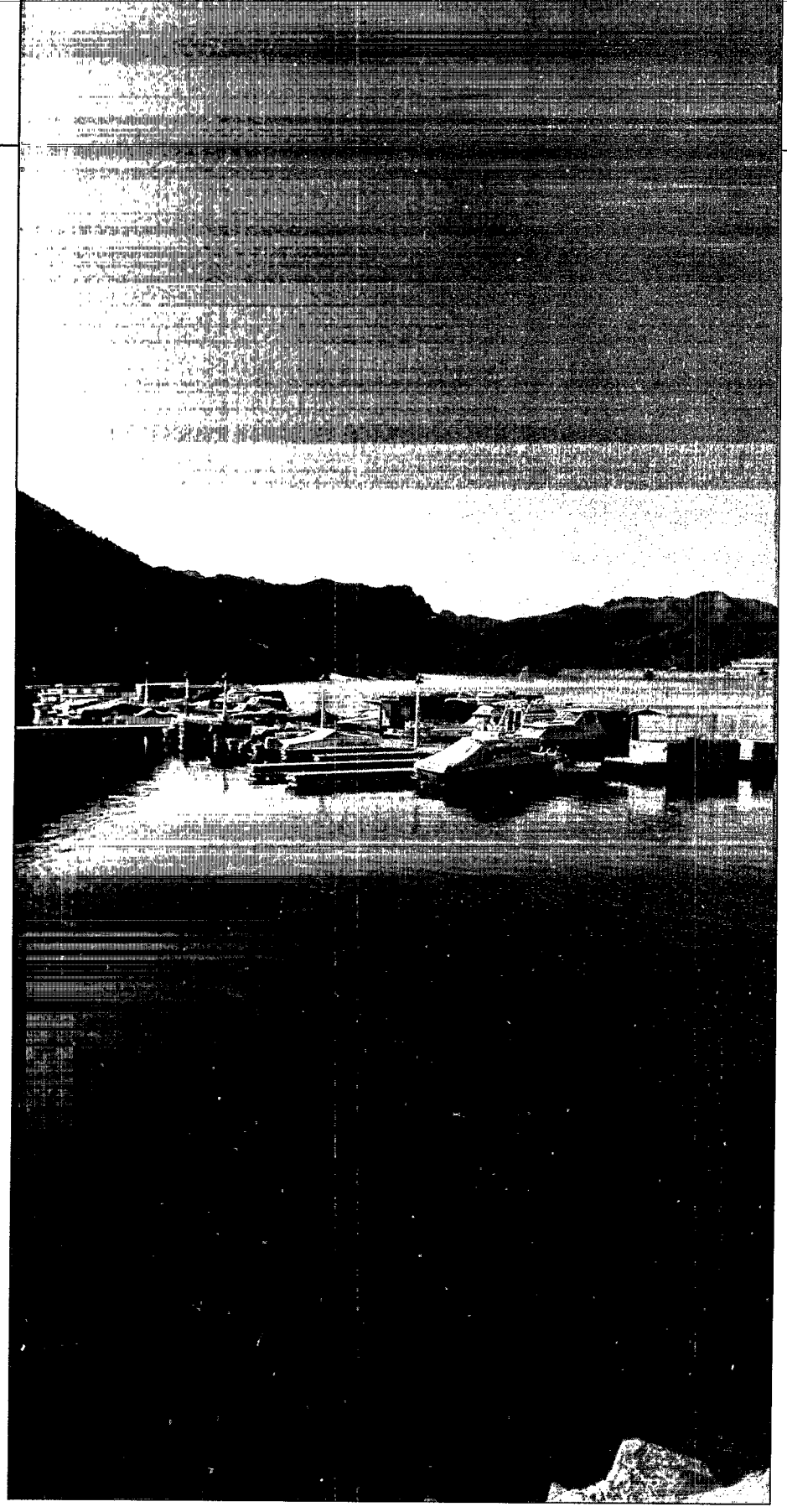


Figure 2. Mean daily total phosphorus loads.

In general, point source effluent monitoring and ambient monitoring programs still lack integration, which limits our ability to determine the relative magnitude of point versus nonpoint sources of contamination. For example, relatively few wastewater treatment facilities routinely monitor their effluent for nutrients, metals, and other constituents of interest in ambient water assessments. Estimates of point and nonpoint sources of contamination would be improved by the following:

- Sampling the same pollutants and constituents in point source discharges and ambient waterbodies
- Increasing the frequency of effluent monitoring at many locations and using flow-weighted composite samples for selected constituents
- Developing and using a quality assurance plan for effluent flow-rate estimation.



Lakes, Reservoirs, and Ponds

Overall Use Support

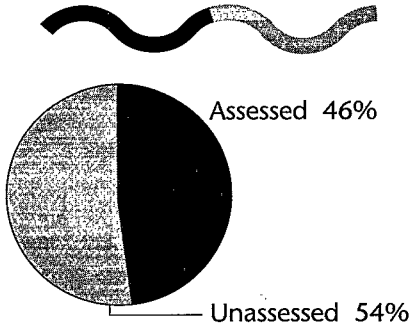
Forty-seven States and Territories, the District of Columbia, and one American Indian Tribe (hereafter referred to as States) assessed overall use support in more than 18 million acres of lakes, reservoirs, and ponds (see Appendix B, Table B-1, for individual State data). As shown in Figure 3-1, these States assessed almost half of the Nation's 40 million acres of lake waters (excluding the Great Lakes, discussed in Chapter 11). The States based 63% of their lake assessments on monitored data, 22% of their lake assessments on evaluated information, and 14% were not specified.

Forty-three percent of the assessed lake acres fully support designated beneficial uses (Figure 3-2). Another 13% of the assessed lake acres fully support uses but are threatened by potential sources of pollutants. Thirty-five percent of the assessed lake acres partially support designated uses, and 9% of the assessed lake acres do not support designated uses.

THE STATES ASSESSED more than 18 million acres of lakes in 1992.

Lake, Reservoir, and Pond Acres Assessed by the States

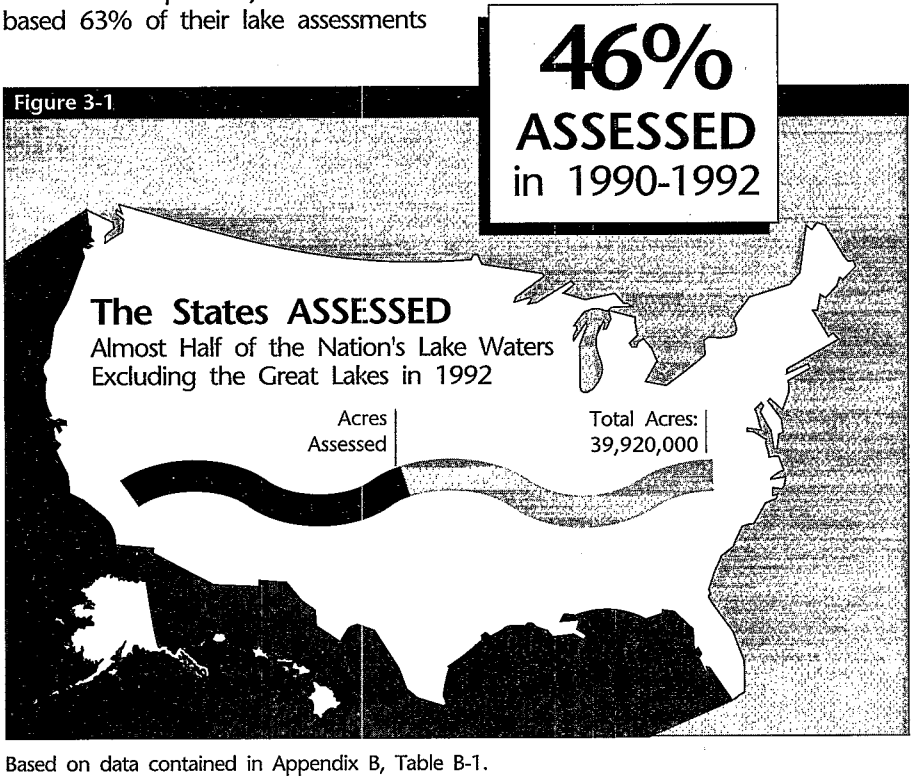
1992 ■ 18,300,000 acres = 46% assessed
▒ Total acres: 39,920,000



1990 ■ 18,489,000 acres = 47% assessed
▒ Total acres: 39,400,000

1988 ■ 16,314,000 acres = 41% assessed
▒ Total acres: 39,400,000

Figure 3-1



Based on data contained in Appendix B, Table B-1.

43% OF ASSESSED lake acres fully support designated beneficial uses and 13% currently support uses but are threatened.

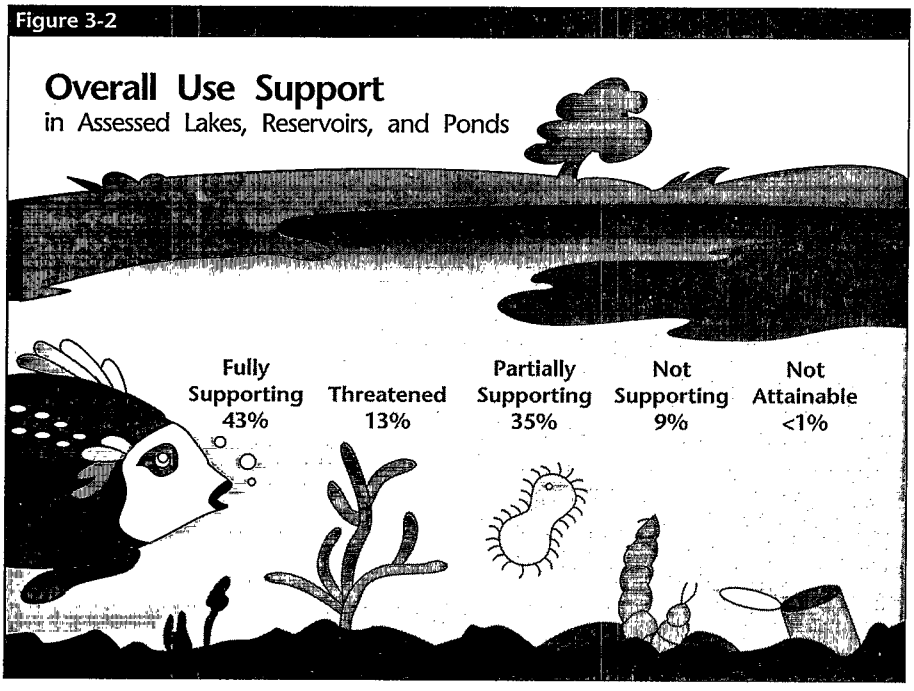
Lake data should not be compared among States, which devote varying resources to monitoring water quality chemistry, biological integrity, and toxic pollutants in fish tissues. These inconsistencies, rather than actual differences in water quality, often account for the wide range in use support reported by individual States.

Individual Use Support

The States reported individual use support for the first time in their 1992 Section 305(b) reports (Appendix B, Table B-2, contains individual State data). Forty States described the status of aquatic life use support in their lakes. The criteria for supporting aquatic life use are often more strict than the criteria for supporting other uses because aquatic organisms are sensitive to numerous water quality parameters. The States reported that 60% of the assessed lake acres fully support aquatic life and 9% are threatened (Figure 3-3). Aquatic life support use is impaired (i.e., partially supporting or not supporting designated uses) in the remaining 31% of the assessed lake acres.

Fish consumption use was also highly impaired, primarily by elevated contaminant concentrations in fish tissues that trigger States to issue fish consumption advisories. Fish consumption advisories recommend that the public restrict ingestion of contaminated fish to minimize human exposure to elevated toxic pollutants in fish tissues. Water pollution also impairs

Figure 3-2



Total lakes = 39,920,000 acres
Total assessed = 18,300,000 acres

- 46% assessed
- 54% unassessed

Of the assessed acres:

- 63% were monitored
- 22% were evaluated
- 14% were not specified

Based on data contained in Appendix B, Table B-1.

fish consumption use by degrading the habitat of desirable sport fish species.

Causes of Impairment

Forty-seven States reported the number of lake acres impaired by individual causes of nonsupport (see Appendix B, Table B-3, for individual State data). Causes of nonsupport are pollutants and processes that impair water quality, such as metals, nutrients, or sediment. Multiple pollutants may impair an individual lake acre. Therefore, States may count an individual lake acre under several cause categories although the lake acre was counted only once as an impaired waterbody. The causes are designated as either major or moderate/minor contributors to waterbody impairments.

The relative extent of each cause is determined by dividing the acreage impaired by each cause category by the total impaired acres in the States reporting causes of nonsupport. In 1992, these States reported that 7,958,064 lake acres were impaired, which represents 43% of the assessed lake acres and 20% of the 40 million total lake acres in the Nation.

The information reported by the States indicates that metals, nutrients, organic enrichment/ dissolved oxygen depletion, siltation, and priority organic chemicals are the five leading causes of lake impairment (Figure 3-4). Although metals impaired the most lake acres overall, the effect of metals is concentrated in one State: Minnesota

Lakes fully support fish consumption in 63% of the acres assessed

Figure 3-3

Individual Use Support in Lakes, Reservoirs, and Ponds

Designated Use	No. of States Reporting	Percent				
		Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Aquatic Life Support	40	60	9	22	9	<1
Fish Consumption	32	63	1	33	2	<1
Primary Contact – Swimming	39	64	13	16	6	<1
Secondary Contact	28	64	15	14	7	0
Drinking Water Supply	31	69	13	12	4	3
Agriculture	22	79	15	1	4	<1

Based on data contained in Appendix B, Table B-2.

MORE STATES reported impairments due to nutrients than any other single pollutant.

reported more than 50% of all the acres impaired by metals. The information on metals contamination may also be exaggerated by contaminated samples. The Workshop on Aquatic Life Criteria for Metals, held by EPA in January 1993, found that most metals data have not been collected using clean sampling and analysis techniques. Consequently, metal values may be unreliable due to various types of contamination.

More States reported problems from nutrients than any other single pollutant (Figure 3-5). Forty-one States reported that nutrients impair more than 3 million lake acres. Nutrients cause nuisance overgrowth of algae as well as noxious aquatic plants, which leads to oxygen depletion via plant respiration and microbial decomposition of plant matter (Figure 3-6).

Thirty States reported that siltation impairs their lakes, ponds, and reservoirs. Siltation can smother aquatic organisms and their habitats, damage gills in fish and other aquatic organisms, and gradually fill in reservoirs. As reservoirs fill, they support fewer recreational activities and cannot function as reliable sources of drinking water.

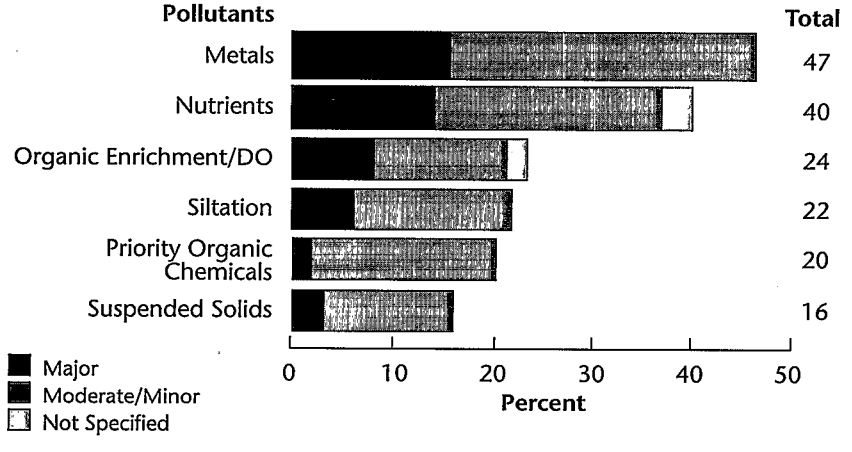
Priority organic chemicals (such as polychlorinated biphenyls–PCBs) increased in relative importance during the 1992 reporting cycle. In 1990, priority organics ranked eighth in the number of lake acres impaired. In 1992, priority organics ranked fifth, with Minnesota reporting 82% of the lake acreage impacted by priority organics.

Total lakes = 39,920,000 acres
Total assessed = 18,300,000 acres

- 46% assessed
- 54% unassessed

Figure 3-4

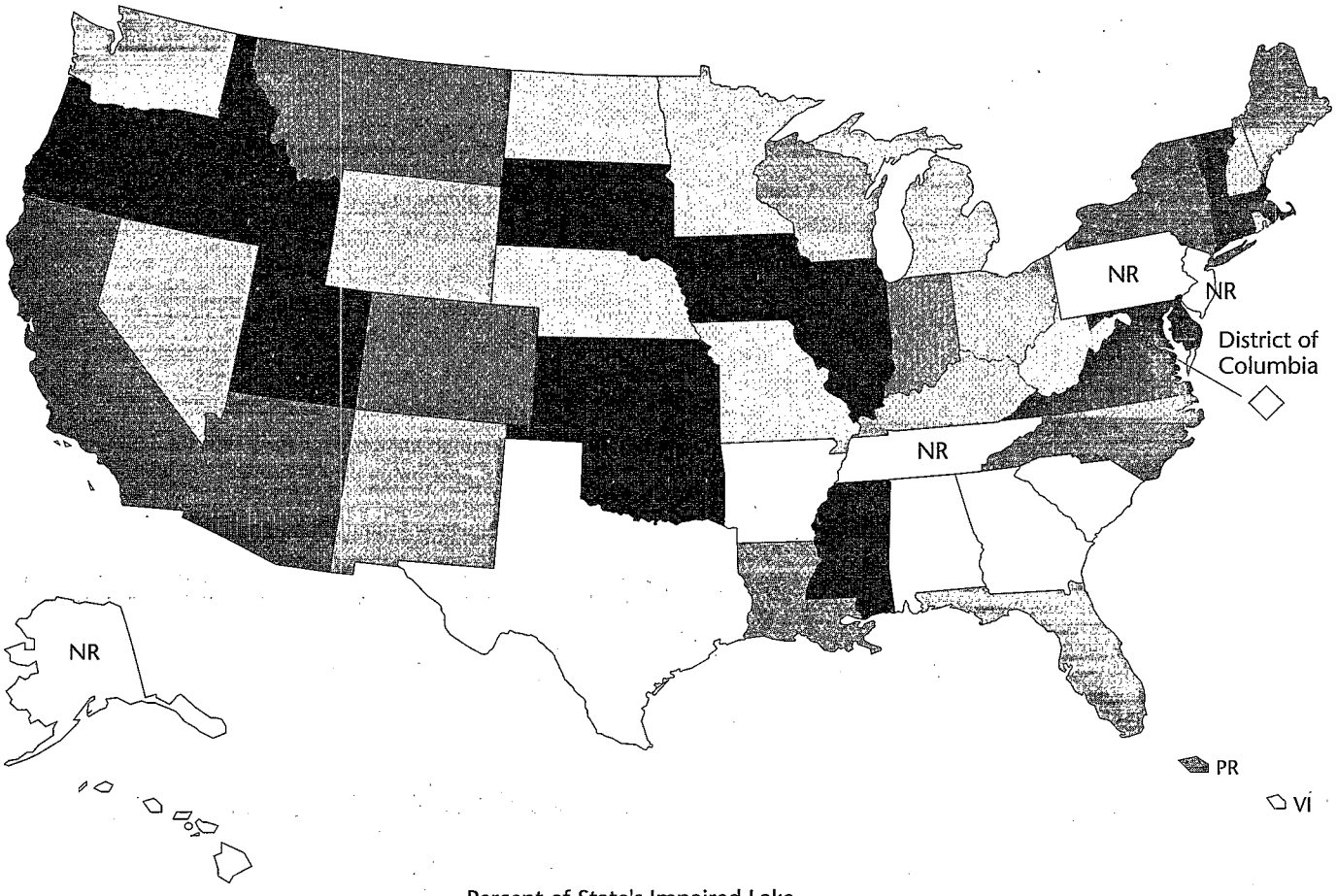
Percent of ASSESSED Lake Acres Impaired by Pollutants
(7,958,064 assessed lake acres impaired)



Based on data contained in Appendix B, Table B-3.

Figure 3-5

Distribution of Lake Acres Impaired by Nutrients



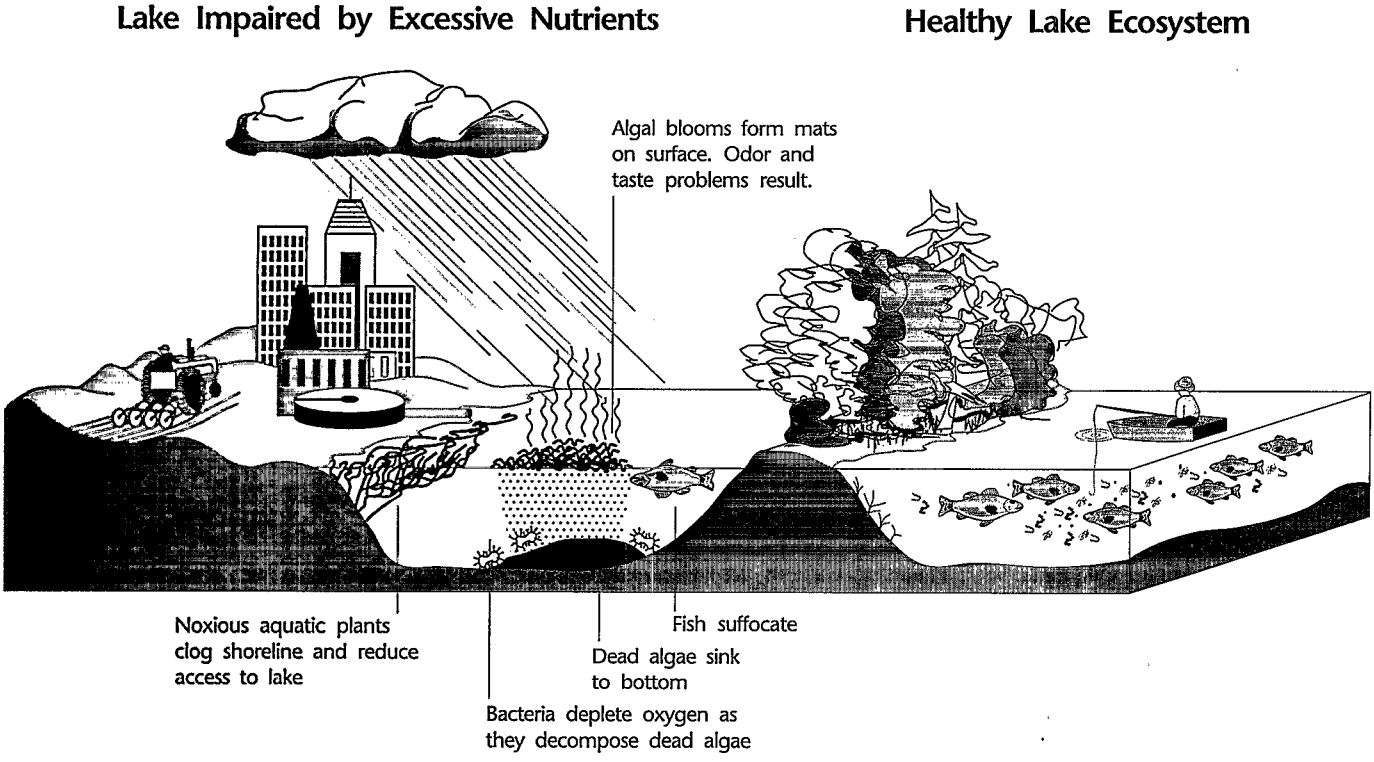
Source: 1992 State Section 305(b) reports.

Sources of Impairment

Forty-five States reported the number of lake acres impaired by individual sources of pollutants (see Appendix B, Table B-4). Multiple sources may impair an individual lake acre. In these cases, States count the impaired acre under each source category contributing to its impairment. Therefore, States may count an individual lake acre under several source categories. The sources are designated as either major or moderate/minor contributors to waterbody impairments.

As with causes, the source categories are ranked by the percentage of impaired waters attributed to each source category. The States reported sources of lake impairment for 5,543,987 impaired lake acres, which represents 30% of the lake acres assessed and 14% of the 40 million total lake acres in the United States.

Figure 3-6



Nutrients cause nuisance overgrowth of algal as well as noxious aquatic plants, which leads to oxygen depletion via plant respiration and microbial decomposition of plant matter. If not properly managed and controlled, sources such as agriculture, industrial activities, municipal sewage, and atmospheric deposition can contribute to excessive nutrients in lakes.

The State data portray agriculture as the most extensive specific source of pollution in the Nation's lakes, followed by urban runoff and storm sewers, hydrologic and habitat modification, municipal point sources, and onsite wastewater disposal (Figure 3-7). Hydrologic modification includes dredging activities and drawdown at reservoirs. Habitat modification includes activities that destroy shoreline vegetation that buffers the aquatic system from disturbances on shore. The States also reported that "other" sources, including natural sources, impair lakes, reservoirs, and ponds. Natural sources include drought conditions and natural turbidity, which may impair swimming use at a reservoir.

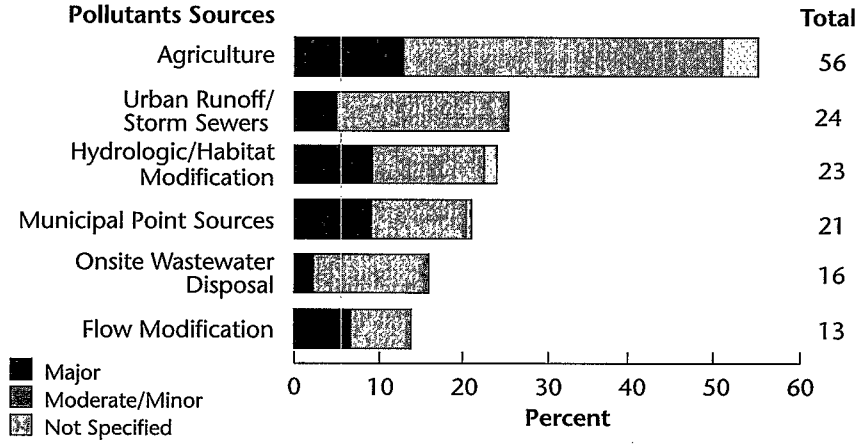
The summary information on sources of impairment in lakes should be interpreted with care. Individual States with large lake acreages can influence source rankings. For example, Florida alone reported 49% (almost half) of all the lake acres impaired by urban runoff and storm sewers and 68% of the lake acres impaired by onsite wastewater disposal. As a result, the source ratings can fluctuate dramatically depending on which States report sources of impairment.

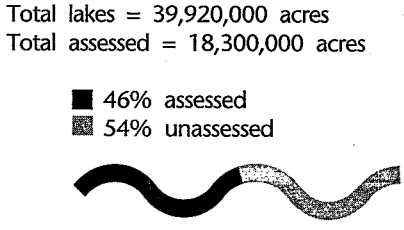
AGRICULTURE is the leading source of impairment in lakes, affecting 56% of impaired lake acres.

Figure 3-7

Percent of ASSESSED Lake Acres Impaired by Sources of Pollution

(5,543,987 assessed lake acres impaired)





Based on data contained in Appendix B, Table B-4.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

EMAP – Surface Waters: Northeast Lakes Pilot

The EPA Office of Research and Development (ORD) initiated the Environmental Monitoring and Assessment Program (EMAP) to evaluate the quantity and quality of our Nation's ecological resources. EMAP consists of seven integrated units, each dedicated to evaluating an individual ecological resource area such as forests or surface waters (lakes and streams). To address EMAP's broad goals, ORD coordinates planning and implementation with numerous EPA program offices, EPA Regions, and States, as well as other Federal agencies, including the U.S. Fish and Wildlife Service , the U.S. Geological Survey (USGS), and the National Oceanic and Atmospheric Administration.

In 1991, ORD began piloting the EMAP-Surface Waters program with a study of northeastern lakes. The EMAP-Surface Water team selected indicators of biological integrity, trophic condition, and fishability to describe the condition of the Nation's lakes. The first year of the pilot study focused on collecting data on trophic status from northeastern lakes with a surface area between 1 and 2,000 hectares (or approximately 2.5 to 5,000 acres). The pilot study also estimated the number of lakes in the northeastern United States using updated versions of the EPA Office of Water's River Reach File (which produced the estimates of total waters used in this report).

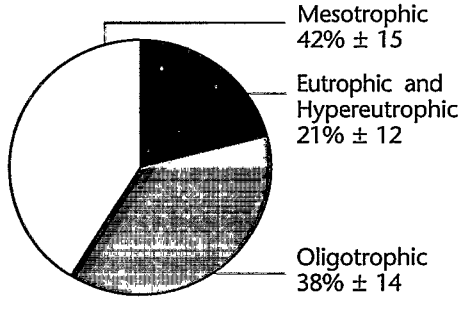


Figure 1. Lake Trophic State – 1991 EMAP data for the Northeastern United States.

Lake Water Quantity

The EPA Office of Water, using Version 3.0 of the EPA River Reach File (RF3), summarizes digitized traces of waters from the USGS 1:100,000 scale map series to estimate the number of lakes and total lake acreage in each State. RF3 was used by EMAP–Surface Waters to select a stratified, random sample of lakes across the northeastern States. This statistical sampling approach will allow EMAP, along with the States and others, to submit corrections to update the RF3 estimates of stream miles, lakes, and lake acreage.

Lake Water Quality

During the first year of the lake pilot study, EMAP–Surface Waters sampled and analyzed chlorophyll *a* and total phosphorus concentrations in northeastern lakes (New England, New York, and New Jersey). Chlorophyll *a* (a surrogate measure of algal biomass) and total phosphorus concentrations indicate the degree of nutrient enrichment in lakes. After screening over 300 lakes, EMAP teams visited 74 lakes to measure various lake quality parameters. EMAP-Surface Waters then applied criteria developed by the North American Lake Management Society

to chlorophyll *a* and total phosphorus data to classify lakes according to trophic category. Based on the distribution of sampled lakes, EMAP-Surface Waters estimated the total number of lakes (including confidence limits) in each trophic category in the Northeast (Figure 1).

To demonstrate how the EMAP approach might be used to evaluate spatial patterns in lake quality, the data were statistically aggregated into three ecoregions (Figure 2): the Adirondacks, the New England Uplands, and the Coastal/Lowland/Plateau regions. During this first year's pilot, the sample sizes within each of these regions were quite small (all <30 lakes sampled) but the statistical design still provides an estimate of lake trophic condition and a measure of the uncertainty in the estimate (Figure 3). In future years, the sample size will be larger and greater confidence can be placed in the estimates.

The results of the EMAP-Surface Waters program complement the State programs described elsewhere in this report. The EMAP-Surface Waters program applies a consistent lake definition, sampling protocols, and assessment methods across an entire region. EMAP-Surface Waters looks at all lakes rather than a subset of impacted lakes or other high-priority lakes. With data from EMAP and from the assessments of high- priority waterbodies conducted by the States, we will have a much clearer picture of water resource conditions upon which to base management decisions. In future years, EMAP-Surface Waters will report on biological integrity in lakes and will address the condition of river and stream resources.

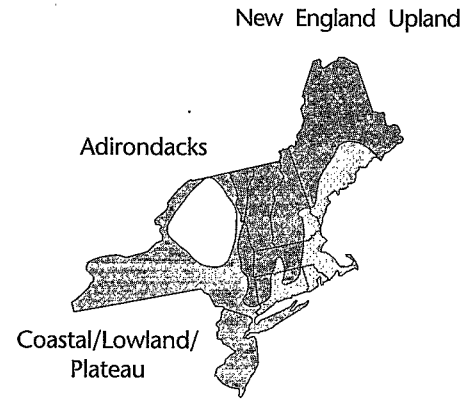


Figure 2. Three ecological regions on which statistical summaries can be based for routine reporting.

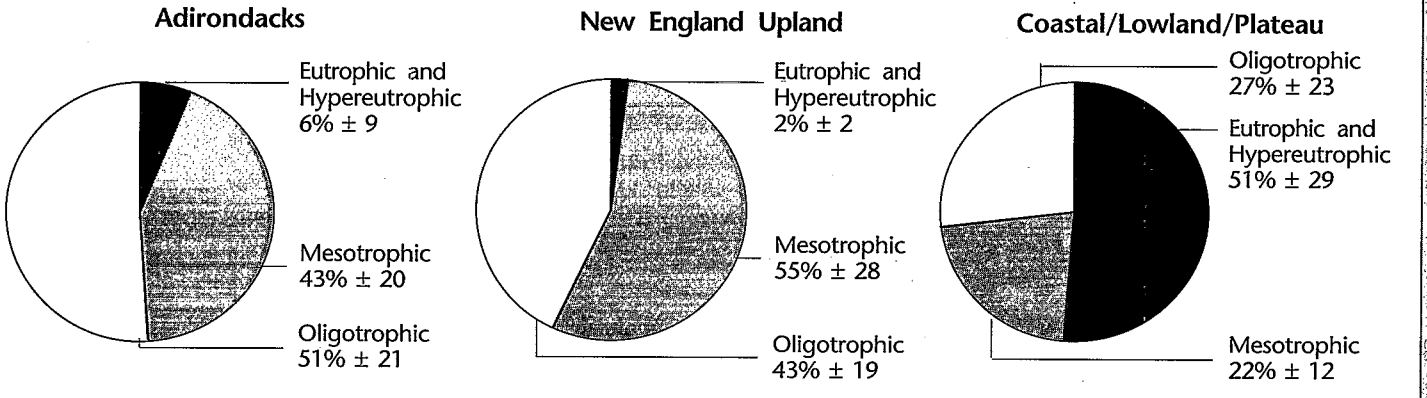
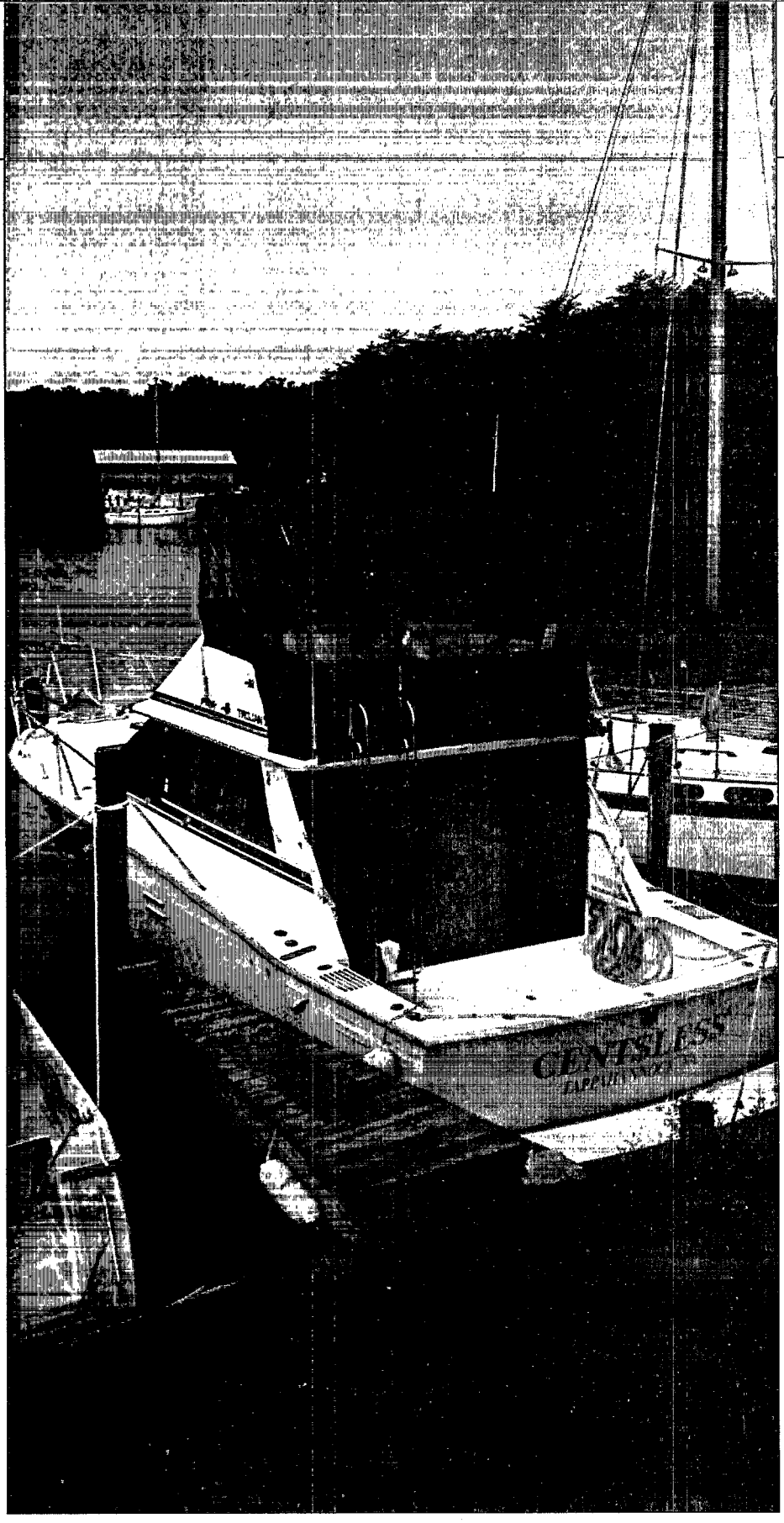


Figure 3. Lake trophic states for northeast subregions.


CENTSLESS

Estuaries and Ocean Coastal Waters

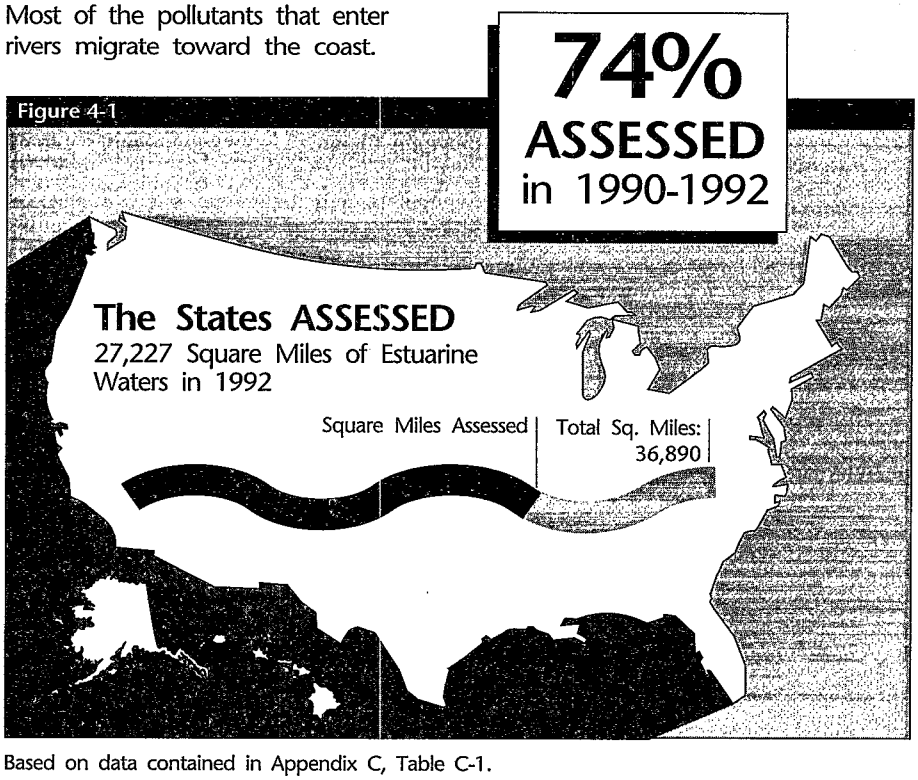
Estuaries are our richest aquatic ecosystems and also the most susceptible to cumulative contamination. Estuaries are coastal waters where tidal influence mixes oceanic salt water with riverine fresh water that carries pollutants from the entire watershed. Estuarine waters include bays and tidal rivers that serve as nursery areas for most commercial fisheries and shellfish populations. Almost all of our fish and shellfish industry relies upon productive, healthy estuarine waters and their adjacent wetlands.

Both local and distant pollution sources threaten estuarine health. Most of the pollutants that enter rivers migrate toward the coast. As rivers approach the coast, their mouths broaden and flow decreases. The low flow and fluctuating tides, characteristic of estuarine waters, reduce flushing and trap nutrients as well as pollutants within estuarine waters. The ability to trap nutrients lays the foundation for a rich estuarine ecosystem but also makes estuaries vulnerable to overloading.

Historic development patterns have amplified natural trapping functions and overloaded estuaries from Boston Harbor to San

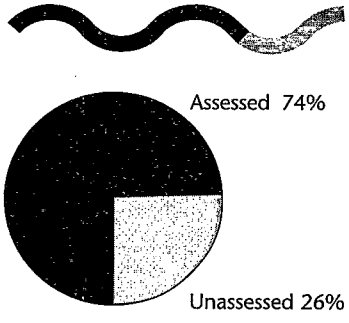
ESTUARIES are our richest aquatic ecosystems and also the most susceptible to cumulative contamination.

Figure 4-1



Estuaries Assessed by the States

1992 ■ 27,227 square miles = 74%
▒ Total square miles: 36,890



1990 ■ 26,692 square miles = 75%
▒ Total square miles: 35,624

1988 ■ 26,676 square miles = 76%
▒ Total square miles: 35,198

Based on data contained in Appendix C, Table C-1.

TWENTY-THREE STATES reported overall use support status for estuarine waters.

Francisco Bay. Historically, industrial development clustered around estuarine bays with access to shipping and an adjacent waterbody for waste disposal. Population centers grew up around the industrial sites and added sewage to estuarine waters. Now, many coastal cities must develop alternative disposal systems for their outdated combined sewer systems.

Estuaries

Overall Use Support

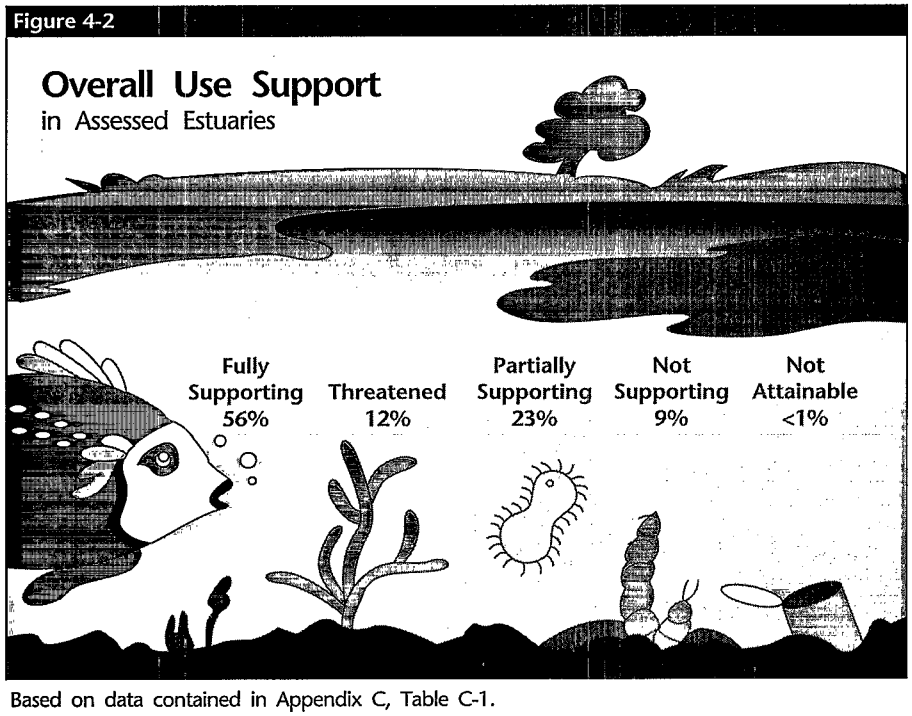
Twenty-three States (including the Delaware River Basin Commission and Territories) reported overall use support status for estuarine waters (Appendix C, Table C-1, contains individual State data). In addition, California and New Jersey reported individual use support in estuarine waters but did not summarize overall use support. The EPA assumed that aquatic life use support status represented overall use support status in these two States. Altogether, the States assessed 27,227 square miles of estuarine waters representing 74% of the total estuarine waters in the lower 48 States (Figure 4-1). Fifty-six percent of the assessed waters fully support their designated beneficial uses; an additional 12% fully support designated uses but are threatened by pollution (Figure 4-2). Impaired waters include 23% of the estuarine waters partially supporting their designated uses and 9% of the waters not supporting their designated uses.

Total estuaries = 36,890 square miles
Total assessed = 27,227 square miles

- 74% assessed
- 26% unassessed

Of the assessed estuarine waters:
- 41% were monitored
- 33% were evaluated
- 26% were not specified

Figure 4-2



Based on data contained in Appendix C, Table C-1.

Four of the 29 estuarine States and Territories did not submit designated use assessments for their estuarine waters. Four of the 25 States that did submit estuarine use support information reported that almost none of their estuarine waters fully supported designated uses (Delaware, the District of Columbia, California, and Oregon). These States may have focused assessment and monitoring efforts on estuaries with known or suspected water quality problems.

Individual Use Support

For the first time, 19 States reported individual use support status for estuarine waters (see Appendix C, Table C-2). Data suggest that shellfishing use is the most impaired individual use (Figure 4-3). Nineteen percent of the assessed waters do not support shellfish harvesting use and 11% partially support shellfish harvesting use. In addition, almost one-quarter of the assessed estuaries do not fully support aquatic life.

Causes of Impairment

Twenty-three States reported the extent of estuarine waters impaired by individual pollutants (see Appendix C, Table C-3, for individual State data). Several pollutants may prevent a waterbody from fully supporting its designated uses. Therefore, States count a square mile of an estuary impacted by multiple pollutants under several cause categories (although the estuarine area was counted only once as an impaired waterbody). The relative extent of each cause is represented by the fraction of the total impaired estuarine acreage (in the States reporting causes of impairments in

Estuaries fully support shellfishing in 67% of the waters assessed

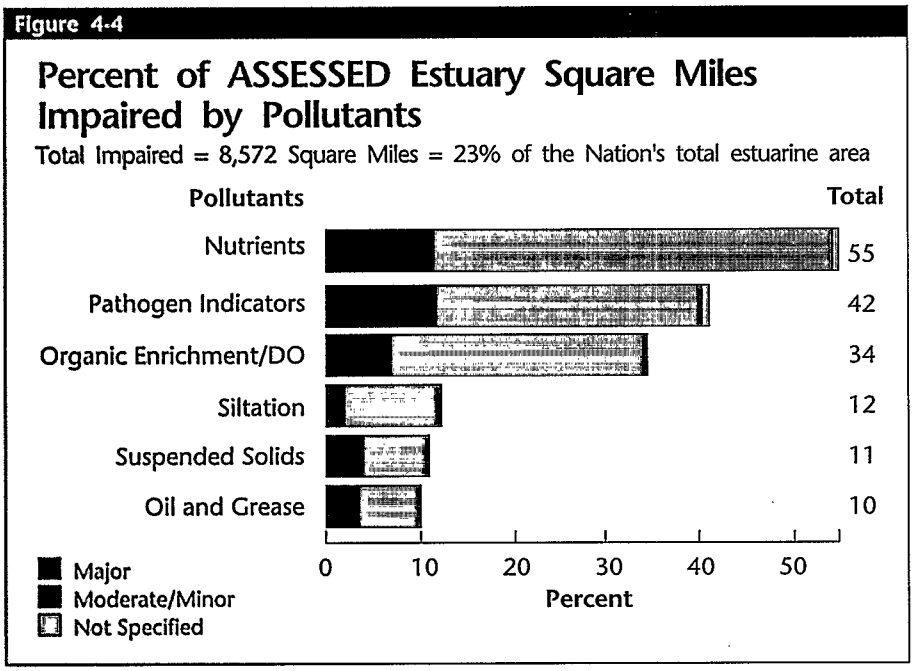
Figure 4-3

Individual Use Support in Estuaries

Designated Use	Number of States Reporting	Percent Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Aquatic Life Support	19	76	2	20	2	0
Fish Consumption	13	93	1	4	1	0
Shellfishing	17	67	2	11	19	<1
Primary Contact – Swimming	16	83	<1	12	5	0
Secondary Contact	14	85	<1	14	<1	0

Based on data contained in Appendix C, Table C-2.

Figure 4-4

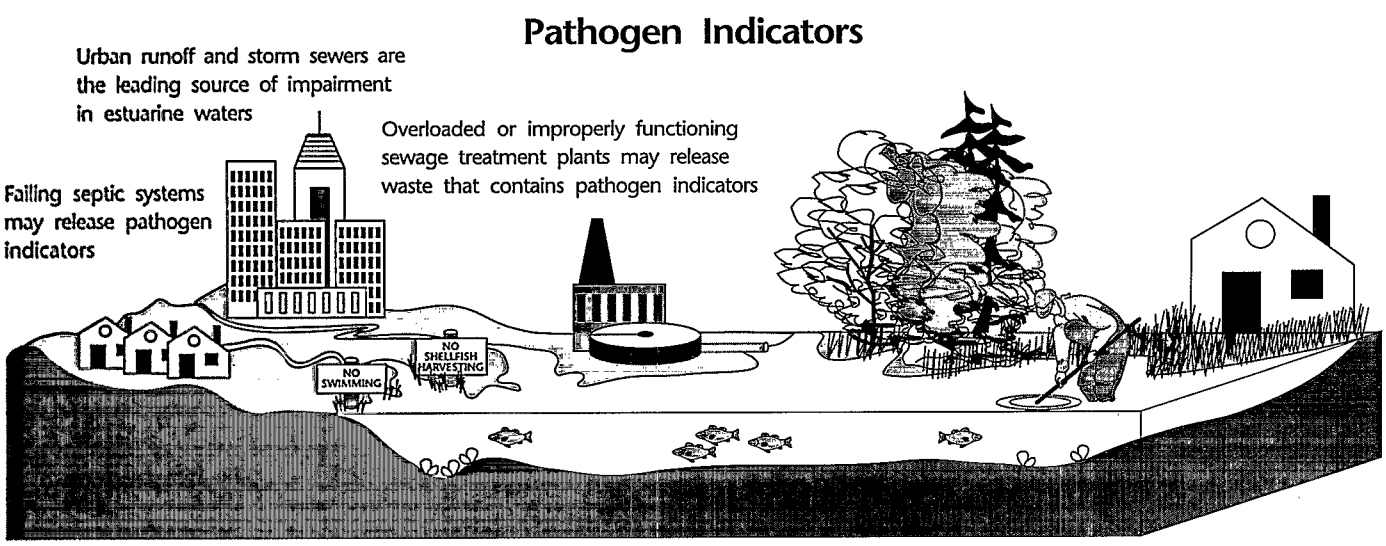


Based on data contained in Appendix C, Table C-3.

estuarine waters) attributed to each cause category.

As with rivers and lakes, nutrients, pathogen indicators, organic enrichment and low dissolved oxygen concentrations, and siltation were among the top five causes of water quality impairment (Figure 4-4). Nutrients affected 55% of the 8,572 square miles of impaired estuarine waters in the States reporting causes of estuarine impairments. Pathogen indicators (which indicate sewage contamination and cause shellfish harvesting restrictions) followed nutrients, affecting 42% of the impaired waters (Figure 4-5). Organic enrichment and low dissolved oxygen concentrations impacted 34% of the impaired estuaries, and siltation affected 12%.

Figure 4-5



Pathogen indicators, such as fecal coliform bacteria, provide evidence that an estuary is contaminated with fecal material that may contain pathogenic bacteria and viruses harmful to people. Often, the pathogenic viruses and bacteria do not adversely impact aquatic life, such as fish and shellfish. However, shellfish may accumulate bacteria and viruses that cause human diseases when ingested. Therefore, officials restrict shellfish harvesting in contaminated waters to protect public health. Pathogen indicators also impair swimming uses because some pathogenic bacteria and viruses can be transmitted by contact with contaminated water.

Sources of Impairment

Twenty-two States reported the extent of estuarine waters impaired by individual sources of pollutants (see Appendix C, Table C-4). States counted any area impacted by multiple sources under each source category, although the area was counted only once as an impaired waterbody. As with causes, the relative importance of each source was determined by dividing the area impaired by an individual source by the total impaired estuarine area in the States reporting sources of estuarine impairments.

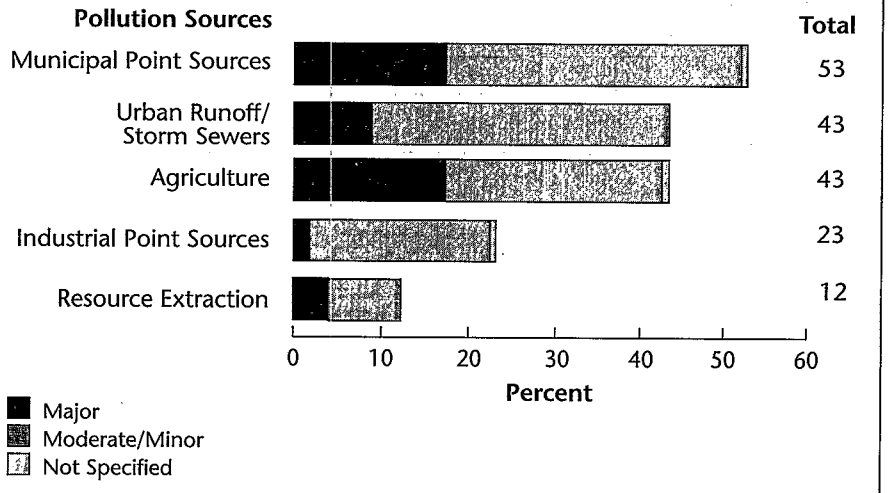
The States identified municipal wastewater treatment plants as the most pervasive source of pollution in assessed estuarine waters (Figure 4-6). Municipal point sources impaired 53% of the impaired estuarine waters in the 22 States reporting source information. Urban runoff and storm sewers impacted 43% of the impaired estuarine waters and agriculture also affected 43%. Industrial point sources affected 23% of the impaired estuarine waters and resource extraction affected 12%. In estuarine waters, point sources contribute significantly to water quality degradation because population centers and industrial centers are often located adjacent to estuarine waters.

MUNICIPAL POINT SOURCES are the leading pollution problem in the Nation's estuaries.

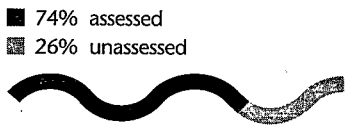
Figure 4-6

Percent of ASSESSED Estuary Square Miles Impaired by Sources of Pollution

(8,303 assessed estuarine square miles impaired)



Total estuaries = 36,890 square miles
Total assessed = 27,227 square miles



Based on data contained in Appendix C, Table C-4.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

A Regional Assessment of the Ecological Condition of Estuaries

Millions of dollars are spent on pollution control problems in the United States and more than $133 billion is spent to monitor the condition of the marine environment by Federal, State, and local agencies; public utilities; and private corporations.* Most of these programs address specific local pollution problems; however, it is difficult to assess the effectiveness of these programs for protecting the environment at national and regional scales and over extended periods of time. The EPA considers it critical to establish monitoring, research, and assessment programs to determine the effectiveness of pollution control strategies and to substantiate the science upon which these strategies are based.

To address these issues, the Environmental Monitoring and Assessment Program (EMAP) is being developed as a national program by EPA's Office of Research and Development (ORD). EMAP is an integrated Federal program examining the condition of the Nation's ecological resources. While ORD is coordinating, planning, and developing EMAP; other Federal agencies (e.g., Agricultural Research Service, U.S. Forest Service, U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration) participate in the collection and analysis of EMAP data and will use them to guide their policy decisions, as appropriate.

One component of EMAP is designed to quantitatively assess the condition of the Nation's estuarine resources using ecological indicators. During the period 1990-1993 (and continuing annually), NOAA, EPA regions, State agencies, and universities have assisted ORD in planning and implementing EMAP estuarine demonstration projects in the Virginian Province (between Cape Cod, MA, and the mouth of Chesapeake Bay), the Louisianian Province (between Tampa Bay, FL, and the Mexican border), and the Carolinian Province (between Chesapeake Bay and Indian River Lagoon, FL).

EMAP-Estuaries has been developed by EPA/ORD because an integrated monitoring and assessment program that samples estuarine resources in a probability-based manner offers considerable additional information to historical monitoring approaches. The EMAP approach provides improved definition of the extent and magnitude of pollution problems at regional and national scales. Simultaneous, probability-based sampling of pollution exposure, environmental condition, and biological resources is the important central focus of

**Managing Troubled Waters: The Role of Marine Environmental Monitoring.* National Research Council, 1990.

EMAP-Estuaries. This approach enables estimates to be made of the uncertainty associated with assessments and will improve our ability to identify ecological responses to pollution. EMAP-Estuaries (and eventually other resource groups within EMAP, e.g., surface waters, forests) will provide objective assessments of the severity and extent of environmental problems on an historical and regional scale and the degree to which degraded resources are responding to efforts to protect or restore them.

EMAP-Estuaries

In 1990-1993, EMAP-Estuaries teams annually sampled about 150 sites in the Virginian Province and about 165 sites in the Louisianian Province. Beginning in 1994 about 100 sites will be sampled annually in the Carolinian Province. The specific number of sites may vary in any year by about 5% due to the nature of the probability-based sampling design. This design is used to select sampling sites throughout the regions being assessed in proportion to the areal distribution of the estuarine resources in the region. The sampling teams measure indicators that can be directly measured in the field to represent biotic integrity, ecosystem quality, and societal values of estuarine resources. These indicators represent key aspects of the estuarine ecosystem such as benthic and fish community parameters, health condition of fish, and degree of eutrophication. In addition, several abiotic condition indicators are measured to characterize the environment associated with these estuarine ecosystems, including sediment contaminants and toxicity, water quality, dissolved oxygen, and habitat characteristics. By measuring these two types of indicators concurrently, EMAP-Estuaries can determine the degree that observed ecological degradation appears to be associated with specific types of environmental exposures.

Biotic Integrity

The presence of a healthy, diverse, and sustainable biological community reflects strong biotic integrity. The EMAP-Estuaries teams evaluated biotic integrity in the Virginian and Louisianian Provinces in 1991 by measuring species composition and abundance of bottom-dwelling organisms and the condition of fish communities. Benthic organisms are sensitive to pollution and integrate responses to pollution over a long period of time. Fish can bioaccumulate contaminants and

their health condition can deteriorate with continued exposure to environmental stresses. Preliminary data from 1991 indicate that degraded benthic communities populate 19 ± 8% of the estuarine area in the Virginian Province and 31 ± 9% of the estuarine area in the Louisianian Province (Figure 1).

Ecosystem Quality

Ecosystem quality refers to the condition of the environment in which organisms live. EMAP-Estuaries measured dissolved oxygen (DO) concentrations in the water column and toxic contaminants concentrations in sediments and tested sediment toxicity to evaluate this second component of ecological integrity in the two demonstration provinces.

The EMAP-Estuaries teams compared DO concentrations measured in bottom waters to two threshold values, 5 ppm and 2 ppm. Some fish and benthic organisms cannot tolerate DO concentrations below 5 ppm; therefore, many States set minimum DO standards at 5 ppm to support aquatic life. Many estuarine organisms are adversely affected if DO concentrations fall below 2 ppm. Dissolved oxygen concentrations fell below 5 ppm in bottom waters in approximately 35 ± 10% of the estuarine bottom waters of the Virginian Province and in 21 ± 9% of the bottom waters of the Louisianian Province (Figure 2). Bottom dissolved oxygen concentrations fell below 2 ppm in 6 ± 5% of the Virginian Province and 12 ± 6% of the Louisianian Province. However, about half of hypoxic waters in the Louisianian Province were below 2 ppm only in the early morning hours (2 a.m.-7 a.m.) representing cyclic conditions. Under these cyclic conditions, acceptable DO concentrations exist most of the time with poor conditions occurring about 20% to 30% of the time.

The EMAP teams also evaluated the potential

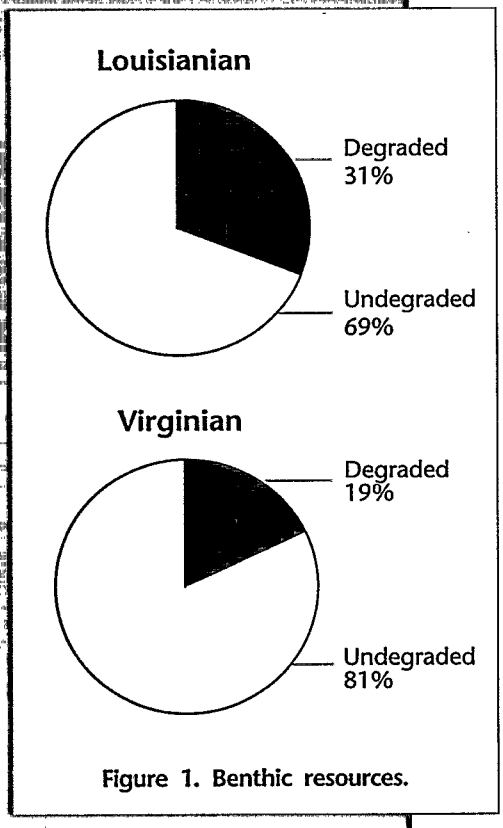


Figure 1. Benthic resources.

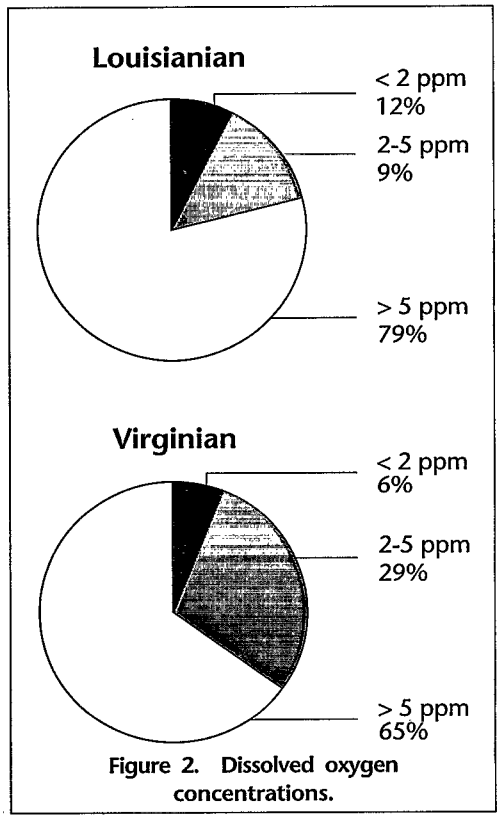


Figure 2. Dissolved oxygen concentrations.

for sublethal effects from sediment contamination in estuaries. The teams compared contaminant concentrations in sediment samples collected at all sites to ER-L values. ER-L values represent concentrations at which biological effects (both sublethal and lethal) were observed in at least 10 percent of the contaminant exposure studies reviewed in the literature.

Metals were the most prevalent contaminants found at concentrations exceeding ER-L values indicating biological concern. In the Virginian Province, 38 ± 7% of the estuarine sediments contained contaminant concentrations of biological concern. Lead, nickel, and zinc most frequently exceeded ER-L values. Sampling detected organic contaminants at concentrations of biological concern in 12 ± 7% of Virginian Province sediments (Figure 3).

In the Louisianian Province, 33 ± 9% of the estuarine sediments contained elevated concentrations of metals, primarily mercury, arsenic, and chromium. Pesticides followed metals with 31 ± 8% of the province sediments containing concentrations that exceeded ER-L values. Dieldrin, chlordane, and DDT were the most widespread pesticides observed in the Louisianian Province.

Societal Values

The EMAP teams evaluated the extent of marine debris, measured water clarity, and measured contaminant levels in selected seafood to determine how well estuarine waters attain societal values. Marine debris has multiple deleterious effects on coastal economies and public perceptions of coastal health. Marine debris decreases the market potential for fish, damages fishing gear and vessels, and can reduce tourism. The EMAP teams estimated that trash was present in 17 ± 5% of the Virginian and Louisianian Provinces (Figure 4).

Society values clear waters, which contribute to healthy, productive aquatic communities. However, clarity varies greatly in estuaries and should not necessarily be compared between estuarine water bodies. A healthy estuary may be turbid due to local geomorphology or natural inputs of detritus. In other estuaries, reduced clarity may indicate unhealthy conditions resulting from pollutant inputs of sediments and nutrients. Although EMAP cannot distinguish between reduced clarity caused by pollution or natural sources, the data collected during the pilot projects establishes a baseline against which future changes in water clarity may be assessed. The EMAP teams found that 14 ± 6% of the Virginian Province had clarity of less than 1 meter, the depth of

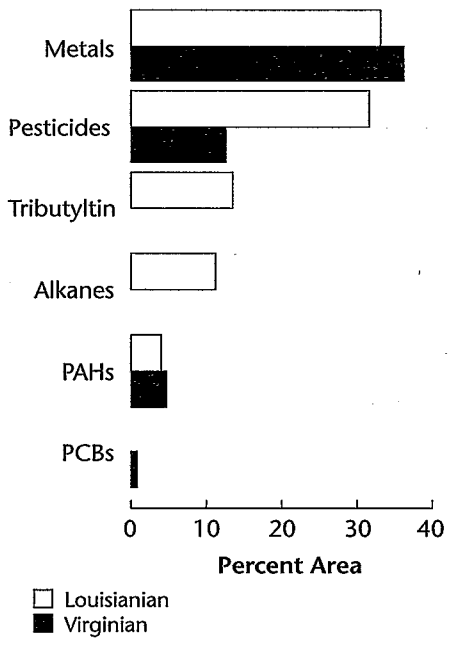


Figure 3. Sediment contamination exceeding ER-L values.

one's feet when wading in waist-deep water. Waters in the Virginian Province were characterized by a visibility of no better than 0.3 meters (approximately 1 foot) in less than 1% of its estuarine area. About 55 ± 11% of the Louisianian Province had water clarity of less than 1 meter, including 27 ± 10% of the Province's waters with clarity less than 0.3 meters deep (Figure 5).

Contaminants in the edible portions of commercially and recreationally important fish and shellfish are important social measures of acceptable estuarine condition. At present, the Food and Drug Administration (FDA) provides action limits for fish and shellfish denoting safety for consumption. While EMAP-Estuaries does not provide a comprehensive evaluation of all fish and shellfish, selected target species were examined. These target species included weakfish, flounders, white perch, and croakers in the Virginian Province and Atlantic croaker, catfish, and shrimp in the Louisianian Province. Only fillet or tailmeat materials were examined. No fish taken from Virginian waters were observed to exceed the FDA limits while only 1% of the marine catfish collected in the Louisianian

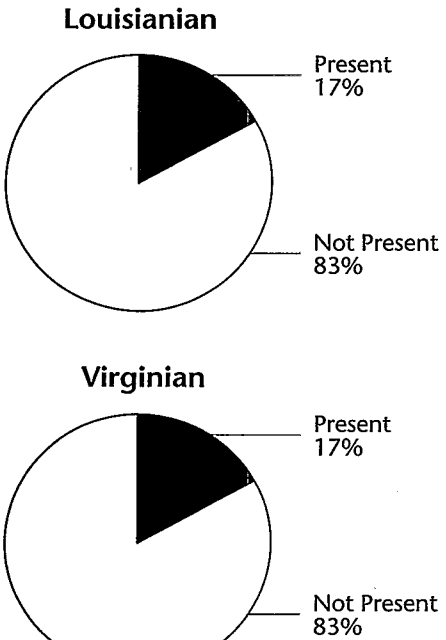


Figure 4. Presence of marine debris and trash.

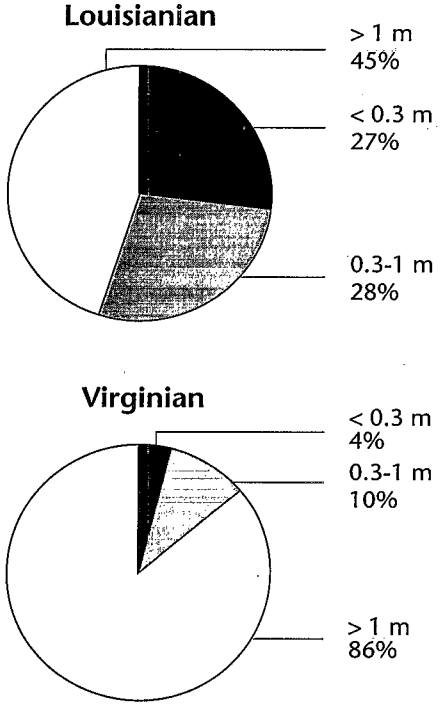


Figure 5. Water clarity.

Province exceeded the FDA limit for mercury. A more complete risk assessment associated with the contaminant levels observed in fish and shellfish from the Virginian and Louisianian Provinces is presently under way.

Overall Estuarine Condition

As the EMAP-Estuaries program reaches full implementation, a single index will be developed to summarize the overall condition of estuarine resources within each province and to accumulate province measures to create a national estimate of estuarine condition. The index may incorporate measures of fishability, swimmability, and aesthetics with measures of biotic integrity based on benthic communities and fish assemblages. For the demonstration studies, overall condition was estimated in each province by integrating biotic integrity indicators and societal value indicators. The results indicate that 42 ± 7% of the Virginian Province and 53 ± 9% of the Louisianian Province showed evidence of degraded biological resources or degraded ability to support activities valued by society (Figure 6) .

The Virginian and Louisianian Provinces represent about 40% of the estuarine resources in the United States. At present, our best estimate of estuarine condition in the United States falls somewhere between the assumption that the remaining estuarine resources (Southeast, West Coast) are in acceptable condition and the estuarine resources in these areas are in similar condition to those observed along the mid-Atlantic and Gulf coasts. These assumptions would bound the overall national estimate of estuarine condition between 23% and 47% of the resource showing evidence of degraded biological resources or degraded ability to support human activities.

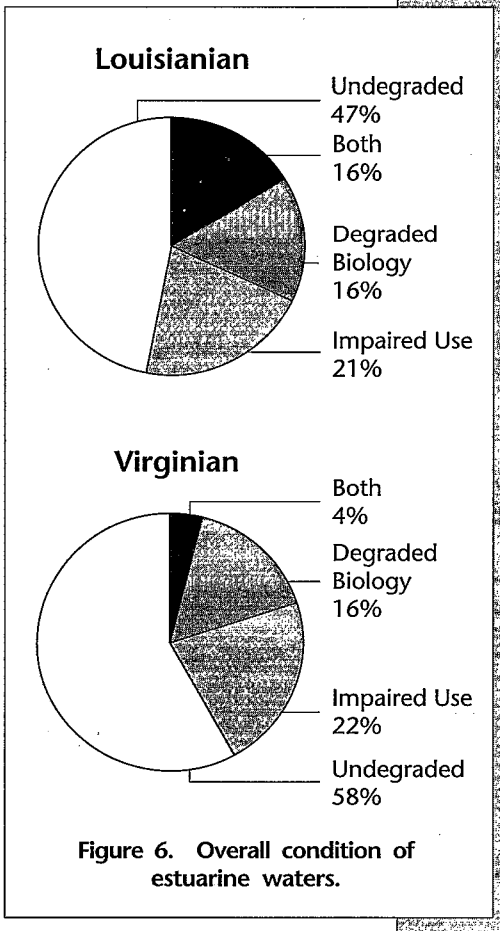


Figure 6. Overall condition of estuarine waters.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Chemical Contamination in Coastal Sediments*

Background

The National Oceanic and Atmospheric Administration (NOAA) created the National Status and Trends (NS&T) Program to monitor trends of chemical contamination in coastal waters and to determine biological responses to contamination. Since 1984, NOAA has analyzed seven trace metals and four organic contaminants (see Table 1) in sediments, bottom-feeding fish, and mussels and oysters collected from almost 300 NS&T sites around the United States.

The NS&T Program was designed to describe national distributions of contamination; the program was not designed to identify the most contaminated sites in the country. Therefore, NOAA selected monitoring sites that represent large coastal areas and avoided sites in small-scale patches of contamination, or "hot spots." In particular, the Agency avoided sites that were located near known wastewater discharge points.

The selected sites were not uniformly distributed. Almost half of the sites were located in urban estuaries within 10 miles of population centers in excess of 100,000 people. The distribution is based on the assumption that contamination is more severe, more variable, and more likely to cause biological impacts in urban coastal areas than in rural areas. The monitoring sites are also more densely situated in estuaries than in open shorelines.

Nationwide Distribution of Contaminants in Sediment

NOAA detected low concentrations of contaminants in the sediment samples collected at the vast majority of sampling sites. The Agency defined the upper 17% of observed contaminant concentrations as "high" concentrations of contaminants. On the national scale, high contaminant concentrations in sediment were associated with urbanized areas of the northeast States, San Diego, Los Angeles, and Seattle. High contaminant concentrations were relatively rare in most of the Southeast and along the Gulf of Mexico coast. This association of higher sediment contamination with

*The information contained in this highlight was extracted from *Coastal Environmental Quality in the United States, 1990 – Chemical Contamination in Sediment and Tissues*, published by the National Oceanic and Atmospheric Administration, U.S. Department of Commerce, Rockville, Maryland.

highly populated areas is not a surprising result. Nevertheless, it is important to note that these results come from sites that are considered to be "representative" of conditions throughout the U.S. coastal zone.

The high sediment contamination levels detected at NS&T sites are generally lower than those expected to cause sediment toxicity. NOAA did not find many cases of biological responses to high sediment contaminant concentrations, such as liver tumors in fish. However, the NS&T program provides an overall picture of sediment contamination in the Nation's coastal waters and does not describe conditions at individual sites. Studies of individual sites have detected higher concentrations of contaminants in sediments than were detected at any of the NS&T sites. Therefore, it is important for States, universities, and local agencies to conduct site-specific studies to complement the NS&T Program and provide the detailed information needed for local decisionmaking.

NOAA is beginning to define temporal trends in contaminant levels at NS&T sites from annual analyses of mussels and oysters. Comparing data collected over a 10-year period or longer indicates that concentrations of most contaminants measured in the NS&T Program may be decreasing. With the exception of copper, there is little evidence that contaminant concentrations are increasing.

Table 1. Chemicals Measured in NOAA's National Status and Trends Program

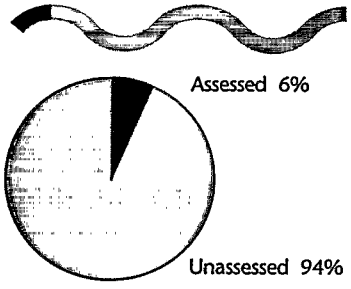
Trace Metals	Organic Compounds
Cadmium	Total DDT (DDT, DDE, and DDD)
Chromium	Total PCBs (sum of 18 types of PCBs)
Copper	Total chlordane
Lead	Total polychlorinated aromatic hydrocarbons (PAHs)
Mercury	
Silver	
Zinc	

Ocean Coastal Waters Assessed by the States

Total ocean coastal waters (including Alaska) = 56,121 miles

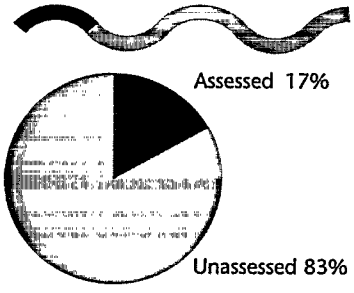
Including Alaska's Ocean Coastal Waters

■ 3,398 miles = 6%
■ Total ocean shore miles: 56,121



Excluding Alaska's Ocean Coastal Waters

1992 ■ 3,398 miles = 17%
■ Total ocean shore miles: 20,121



1990 ■ 4,230 miles = 22%
■ Total ocean shore miles: 19,200

1988 ■ 3,755 miles = 20%
■ Total ocean shore miles: 19,200

Of the assessed ocean shore miles:
- 28% were monitored
- 47% were evaluated
- 25% were not specified

Ocean Coastal Waters

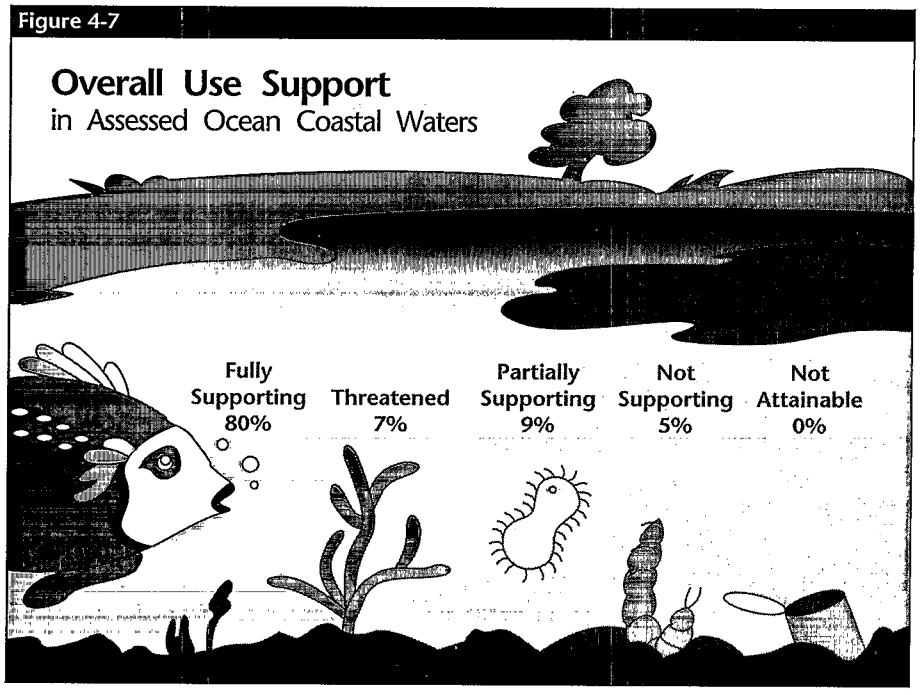
Overall Use Support

Twelve of the 29 coastal States and Territories assessed only 6% of the 56,121 miles of ocean coastline (including Alaska's 36,000 miles of ocean coastline) or 17% of the 20,121 miles of national ocean coastline (excluding Alaska) (see Appendix C, Table C-5, for individual State information). Most of the assessed waters fully support designated beneficial uses (80%) (Figure 4-7). Another 7% fully support uses but are threatened by pollution. Nine percent of the assessed shoreline miles partially support designated uses and 5% do not support designated uses. Because only 12 States submitted use support data, these figures do not represent the extent of conditions in ocean coastal waters throughout the 29 coastal States.

Individual Use Support

Ten of the 29 coastal States reported attainment of aquatic life use in ocean coastal waters (see Appendix C, Table C-6, for individual State data). Fewer States reported support of other individual uses. General conclusions cannot be drawn from information representing such a small fraction of the Nation's ocean coastal waters (Figure 4-8).

Figure 4-7



Based on data contained in Appendix C, Table C-5.

Causes and Sources of Impairment

Only 5 of the 29 coastal States identified individual pollutants responsible for less than full support of designated uses in assessed ocean coastal waters (Appendix C, Table C-7). These States reported that pathogen indicators, metals, priority organics, and unknown toxicity caused more impairments than any other contaminants (Figure 4-9). However, this information applies to only 1% of the ocean shoreline along the contiguous States, which may explain why the data portray toxic pollutants as a more pervasive problem in ocean coastal waters than in estuarine waters. States may be targeting their limited ocean coastal sampling in areas with suspected toxicity problems.

Five States also listed sources of pollutants preventing designated use support in 1% of the Nation's ocean shore miles (Appendix C, Table C-8). These States identified urban runoff and storm sewers as the leading source of contamination in ocean coastal waters, followed by land disposal (including septic tanks), municipal point sources, and contaminated sediments (Figure 4-10).

Ocean coastal waters fully support aquatic life in 92% of assessed waters in 10 coastal States.

Figure 4-8

Individual Use Support in Ocean Coastal Waters

Designated Use	Number of States Reporting	Percent Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Aquatic Life Support	10	92	2	5	1	0
Fish Consumption	7	89	0	11	0	0
Shellfishing	8	91	0	5	4	0
Primary Contact – Swimming	9	85	7	7	1	0
Secondary Contact	6	82	6	10	2	0

Based on data contained in Appendix C, Table C-6.

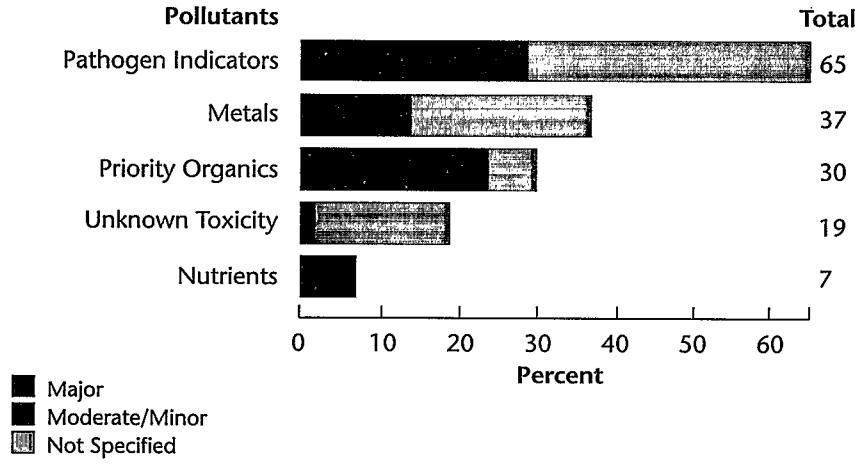
Total ocean shore miles = 20,121 miles
(excluding Alaska)
Total assessed = 3,398 miles

■ 17% assessed
■ 83% unassessed

Figure 4-9

Percent of ASSESSED Ocean Shore Miles Impaired by Pollutants

(239 assessed ocean shore miles impaired)



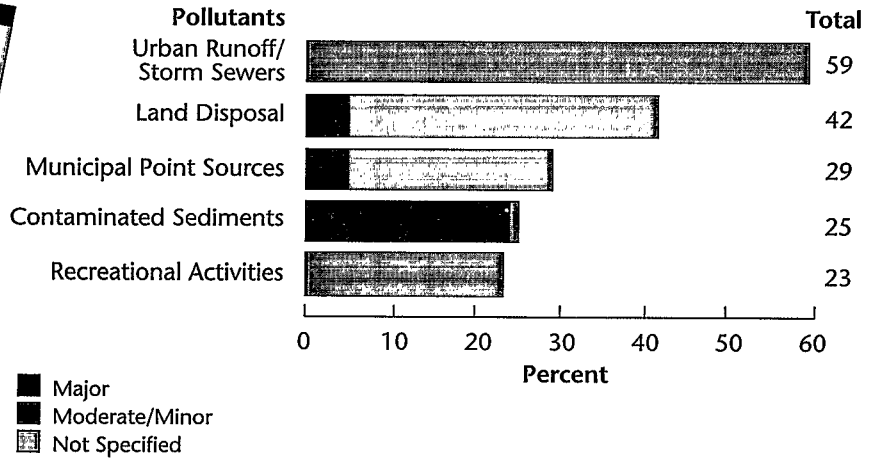
Based on data contained in Appendix C, Table C-7.

STATES IDENTIFIED causes and sources for only 1% of the Nation's impaired ocean shore miles.

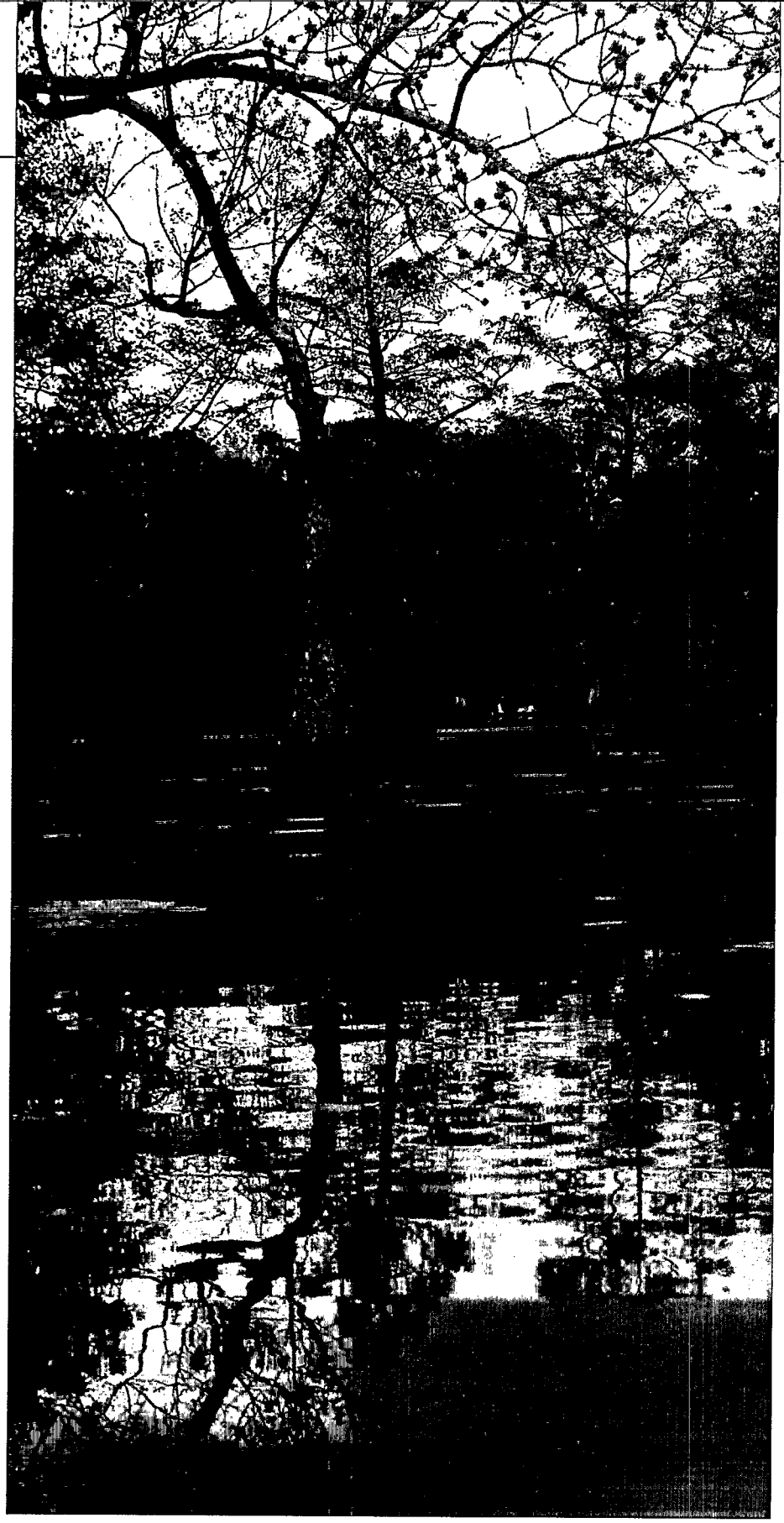
Figure 4-10

Percent of ASSESSED Ocean Shore Miles Impaired by Sources of Pollution

(239 assessed ocean shore miles impaired)



Based on data contained in Appendix C, Table C-8.



Wetlands

Introduction

Wetlands are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support (and that under normal circumstances do support) a prevalence of vegetation typically adapted for life in saturated soil conditions (Figure 5-1). Wetlands generally include swamps, marshes, bogs, and similar areas. This is the definition of wetlands as it appears in the regulations jointly issued by the Army Corps of Engineers (COE) and the U.S. EPA (33 CFR Part 328.3(b), 40 CFR Part 232.2 (r), and 40 CFR Part 230.3(t)).

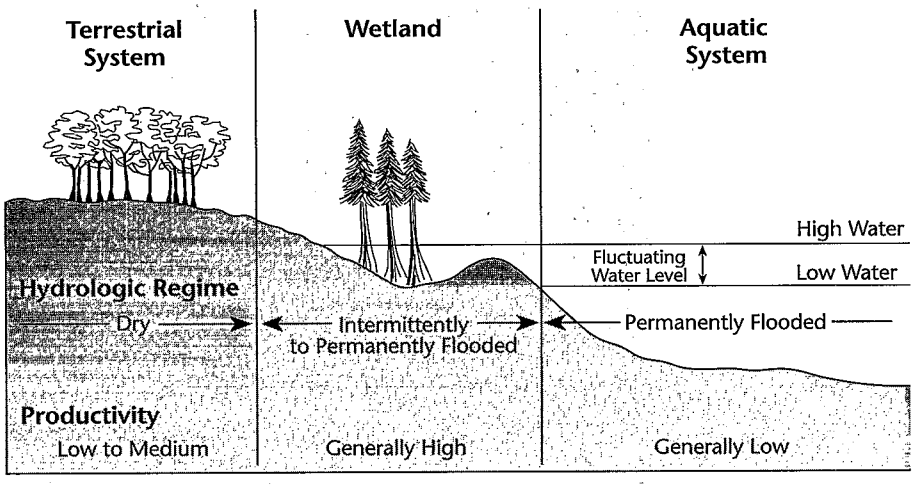
A wide variety of wetlands exist across the country as a result of regional and local differences in hydrology, vegetation, water chemistry, soils, topography, climate, and other factors. Wetlands type is determined primarily by local hydrology, the unique pattern of water flow through an area. In general, there are two broad categories of wetlands: coastal and inland wetlands.

With the exception of the Great Lakes coastal wetlands, coastal wetlands are closely linked to estuaries, where sea water mixes with fresh water to form an environment of varying salinity and fluctuating water levels due to tidal action. Coastal marshes dominated by grasses and halophytic (salt-loving) plants are particularly abundant along the Atlantic and Gulf coasts due to the gradual slope of the land. Mangrove swamps, which are dominated by halophytic shrubs and trees, are common in Hawaii, Puerto Rico, and in southern Florida.

Inland wetlands are most common on floodplains along rivers and streams, in isolated depressions surrounded by dry land, and along the margins of lakes and ponds. Inland wetlands include marshes and wet meadows dominated by grasses and herbs, shrub swamps, and wooded swamps dominated by trees, such as hardwood forests along floodplains. Some regional wetlands types include the pocosins of North

Figure 5-1

Depiction of Wetland Adjacent to Waterbody



Wetlands are often found at the interface between dry terrestrial ecosystems, such as upland forests and grasslands, and permanently wet aquatic ecosystems, such as lakes, rivers, and oceans.

Reprinted with modifications, by permission, from Mitsch/Gosselink: *Wetlands 1986*, fig. 1-4, p. 10. ©1986, Van Nostrand Reinhold.

NOTE

States assessed only 4% of their wetlands. Therefore, these use support figures should not be extrapolated to represent national trends in wetlands integrity.

Carolina, bogs and fens of the northeastern and north central States and Alaska, inland saline and alkaline marshes and riparian wetlands of the arid and semiarid West, vernal pools of California, playa lakes of the Southwest, cypress-gum swamps of the South, wet tundra of Alaska, the South Florida Everglades, and prairie potholes of Minnesota, Iowa, and the Dakotas.

Values and Functions of Wetlands

In their natural condition, wetlands provide many benefits, including food and habitat for fish and wildlife, flood protection, shoreline erosion control, natural products for human use, ground water exchange, water quality improvement, and opportunities for recreation, education, and research.

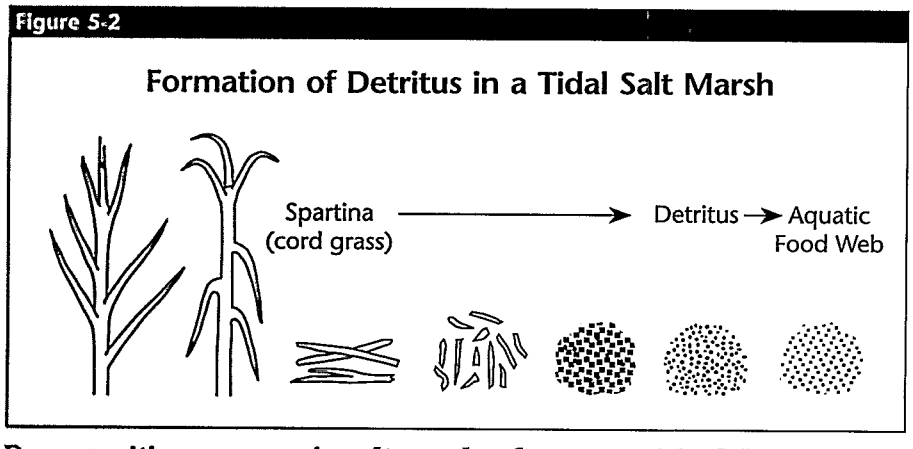
Wetlands are critical to the survival of a wide variety of animals and plants, including numerous rare and endangered species. Wetlands are also primary habitats for many species, such as the wood duck, muskrat, and swamp rose. For others, wetlands provide important seasonal habitats where food, water, and cover are plentiful.

Wetlands are among the most productive natural ecosystems in the world. They produce great volumes of food as leaves and stems break down in the water to form detritus (Figure 5-2). This enriched material is the principal food for many aquatic invertebrates, various shellfish, and forage fish that are food for larger commercial and recreational fish species such as bluefish and striped bass.

Wetlands function like natural basins, storing either floodwater that overflows riverbanks or surface water that collects in isolated depressions. By doing so, wetlands help protect adjacent and downstream property from flood damage. Trees and other wetlands vegetation help slow the speed of flood waters. This action, combined with water storage, can lower flood heights and reduce the water's erosive potential. In agricultural areas, wetlands can help reduce the likelihood of flood damage to crops. Wetlands within and upstream of urban areas are especially valuable for flood protection, since urban development increases the rate and volume of surface water runoff, thereby increasing the risk of flood damage.

Wetlands are often located between rivers and high ground and are therefore able to store flood waters and reduce channel erosion. Wetlands bind soil, dampen wave action, and reduce current velocity through friction.

Figure 5-2



Decomposition processes in salt marshes fragment original detritus (e.g., dead Spartina leaves and stems) into smaller pieces. The smaller, bacteria-rich detritus provides more nutrition for animals than live Spartina tissue. The enriched detritus is the principal food for many aquatic invertebrates, shellfish, and forage fish.

Wetlands produce a wealth of natural products, including fish and shellfish, timber, wildlife, and wild rice. Much of the Nation's fishing and shellfishing industry harvests wetlands-dependent species. For example, in the Southeast, 96% of the commercial catch and over 50% of the recreational harvest are fish and shellfish that depend on the estuary-coastal wetlands system. Waterfowl hunters spend over $300 million annually to harvest wetlands-dependent birds.

Wetlands help maintain and improve water quality by intercepting surface water runoff before it reaches open water, removing or retaining nutrients, processing chemical and organic wastes, and reducing sediment loads to receiving waters.

Wetlands provide considerable opportunities for popular recreational activities such as hiking, bird watching, fishing, and boating. An estimated 50 million people spend nearly $10 billion each year observing and photographing wetlands-dependent birds.

Consequences of Wetlands Loss and Degradation

The loss or degradation of wetlands can lead to serious consequences, including increased flooding; species decline, extinction, or deformity; and decline in water quality. The following are a few examples of the consequences of wetlands loss and degradation.

In Massachusetts, the U.S. Army Corps of Engineers estimated that over $17 million of annual flood damage would result from the destruction of 8,422 acres of wetlands in the Charles River Basin. The Corps decided to preserve the wetlands rather than construct expensive flood control facilities.

Wetlands in the Kesterson Wildlife Refuge in California were degraded after being continuously flooded with agricultural irrigation return flow waters that contained high concentrations of selenium. Largemouth bass, striped bass, and catfish disappeared from Kesterson National Wildlife Refuge in 1982. In the spring of 1983, waterfowl eggs hatched less frequently and their embryos suffered more deformities. Cost estimates for the Refuge cleanup and restoration of its wetlands now exceed $5 billion.

CONSEQUENCES OF WETLANDS LOSS AND DEGRADATION include increased flooding; decline, extinction, or deformity of animal species; and decline in water quality.

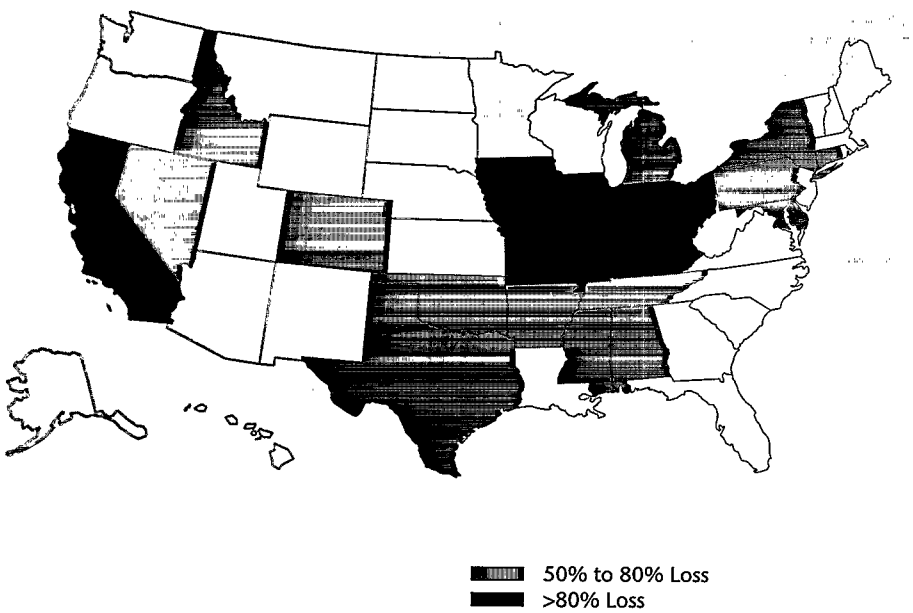
The channelization of the Kissimmee River in South Florida in the 1960s disrupted the ecological balance of the entire region. Marshlands have disappeared because channelization minimizes or prevents natural spillover of water. Habitat loss has caused wading bird populations to drop by 90% and white-tailed deer populations by 50%. Some argue that the drainage of wetlands has disrupted the normal rain cycle, creating the potential for a long-term drought in South Florida. The dechannelization of the Kissimmee River and the restoration of wetlands will cost an estimated $280 million.

Forested riparian wetlands play an important role in reducing nutrient loading into the Chesapeake Bay. In one study, a riparian forest in a predominantly agricultural watershed was shown to remove approximately 80% of the

phosphorus and 89% of the nitrogen from the water before entering a tributary of the Chesapeake Bay. Destruction of wetlands that reduce the amount of nutrients entering the Bay would lead to an increase in undesirable weed growth and algae blooms. When algae decomposes, oxygen is used up, threatening fish and other oxygen-dependent life forms.

Figure 5-3

States with More Than 50% Wetlands Loss



Twenty-two States have lost at least 50% of their original wetlands. Seven of these 22 (California, Indiana, Illinois, Iowa, Missouri, Kentucky, and Ohio) have lost more than 80% of their original wetlands.

Source: Dahl, T.E. 1990. *Wetlands Losses in the United States 1780's to 1980's.* U.S. Department of the Interior, Fish and Wildlife Service.

Extent of the Resource

Wetlands Loss in the United States

It is estimated that over 200 million acres of wetlands existed in the lower 48 States at the time of European settlement. Since then, extensive wetlands acreage has been lost, with many of the original wetlands drained and converted to farmland and urban development. Today, less than half of our original wetlands remain. The losses amount to an area equal to the size of California (see Figure 5-3). According to the U.S. Fish and Wildlife Service's *Wetlands Losses in the United States 1780's to 1980's*, the three States that have sustained the greatest percentage of wetlands loss are California (91%), Ohio (90%), and Iowa (89%).

Massachusetts reported that it continues to lose an estimated 1,000 acres per year. South Dakota reported that, since enactment of the Swampbuster provisions of the Food Security Act, annual losses of wetlands in the State due to drainage, excavation, and fill has decreased by 50%. Wisconsin tracks individual Section 404 permits, and, from 1982-1990, a total of 11,800 acres of wetlands were lost from permitted discharges of dredged or fill material. A study in southeast Wisconsin showed that when losses from impacts not related to the Section 404 program were considered, the loss total tripled.

Detailed wetlands maps and status and trends reports are used to track the quantity of wetlands nationally. Detailed maps provide site-specific information on wetlands,

and status and trend information is used to evaluate changes to the resource in 10-year intervals based on a subset of the Nation's wetlands. The U.S. Fish and Wildlife Service (FWS) has the statutory mandate to conduct these efforts and has completed inventory maps for 67% of all States except Alaska and has digitized 15% for the lower States (as of the beginning of 1993). The FWS is the primary source of inventory information for States. Additionally, some States use information from the Soil Conservation Service (SCS) or the National Oceanic and Atmospheric Administration (NOAA). In some instances, States map their own wetlands or supplement national inventories with State inventories.

According to the FWS status and trends reports, the average annual loss of wetlands has decreased over the past 40 years. The average annual loss from the mid-1950s to the mid-1970s was 458,000 acres, and from the mid-1970s to mid-1980s it was 290,000 acres. Agriculture was responsible for 87% of the loss from the mid-1950s to the mid-1970s and 54% of the loss from the mid-1970s to the mid-1980s.

Twenty-seven States listed sources of current wetlands loss in their 1992 305(b) reports (Figure 5-4). Agriculture and commercial development were cited as the leading sources of current losses (see Appendix D, Table D-1, for individual State information). Other losses were due to residential development, highway construction, impoundments, and resource extraction.

Eighteen States and one Territory reported on efforts to inventory wetlands. Some of the programs are designed to augment the FWS's National Wetlands Inventory, while others are designed to produce status and trend information. Some of the programs have already been completed and others have been authorized but not funded.

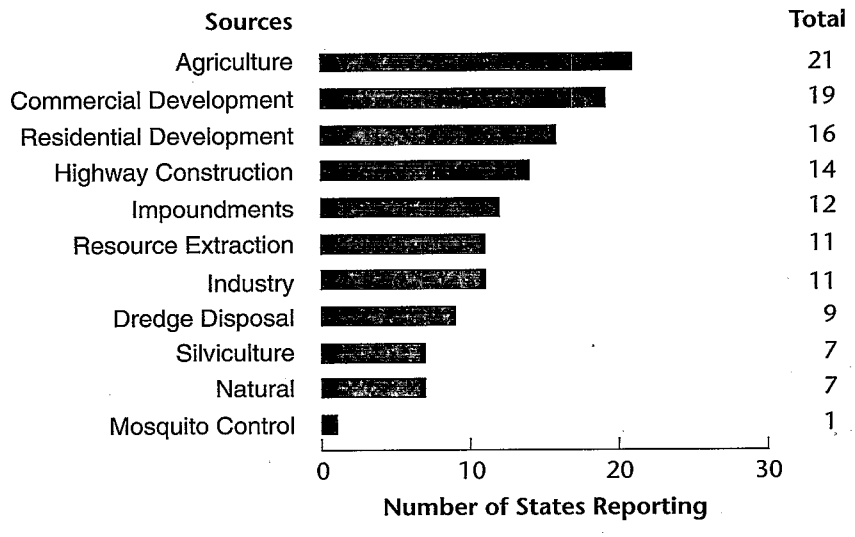
■ Massachusetts reported that the National Wetlands Inventory (NWI) maps provide a good baseline for wetlands resources, but that considerable construction activity and wetlands impacts have occurred since the maps were produced in the late 1970s. In addition, NWI maps at a 1:24,000 scale do not show many wetlands smaller than 1 acre in size. In response, the Massachusetts Division of Wetlands and Waterways, through the Wetlands

STATES REPORT agriculture and development as leading sources of current wetlands loss.

Figure 5-4

Sources of Current Wetlands Losses

(27 States Reporting)



Based on data contained in Appendix D, Table D-1.

Conservancy Program, has initiated a project to develop more detailed, larger-scale (1:5000) maps to provide a baseline of wetlands resources.

Massachusetts's inventory will be conducted over the next 5 to 10 years and the Conservancy Program will map and classify all wetlands in Massachusetts greater than or equal to 1/4 acre in size. This geographic information will be entered into the Massachusetts Geographic Information System (GIS) and will be used to compile and automate highly accurate location data for hazardous waste sites and other regulated activities. The information from the inventory will be used in conjunction with the permit tracking system to quantify wetlands losses.

■ Delaware reported that it updated the FWS maps from 1983 for its tidal waters and entered the information into a database for State and local agencies to use to make land use decisions.

■ Georgia Department of Natural Resources developed a digitized land cover/wetlands database for the entire State based on LANDSAT satellite imagery taken in 1989-1990.

■ Ohio reported that its Department of Natural Resources is conducting a statewide wetlands inventory with the U.S. Soil Conservation Service. The program reviews digital LANDSAT data and compares them with digitized soils data from the SCS. The State completed classifying the data in 1992 and is now conducting field verification.

■ Oregon Division of State Lands, the FWS, and the Portland Metropolitan Service District completed inventories and maps at a scale of 1:24,000.

■ Puerto Rico's Department of Natural Resources published an inventory of mangroves in 1989.

■ The Virgin Islands Department of Planning and Natural Resources is conducting an inventory of wetlands in their territory and, in the interim, will rely on digitized NWI data.

■ Pennsylvania reported that it has been monitoring wetlands status and trends yearly for its coastal zone since 1986. Federal and State enforcement agencies also document wetlands losses with annual helicopter overflights.

■ Arizona will inventory and classify riparian areas throughout the State. The State defines riparian areas as aquatic or terrestrial ecosystems that are associated with bodies of waters or are dependent upon the existence of surface or subsurface water drainage.

■ The Utah Division of Wildlife Resources received a grant from EPA to create a statewide wetlands inventory using a GIS and to develop a statewide classification and ranking model specific to Utah.

■ Idaho reported that the main work to determine the extent of its wetlands is being done by the FWS, which is currently mapping wetlands in Idaho. In addition, they mentioned some local efforts scattered throughout the State.

■ Washington's Department of Ecology issued grants to 16 local jurisdictions to perform field wetlands inventories. The Department developed inventory guidance, including specific inventory methods, a wetlands function and value characterization, and a four-tier rating system. It also initiated the development of a State-wide wetlands database.

■ Between 1981 and 1986, the Michigan Department of Natural Resources conducted a statewide land cover/use inventory, including wetlands. The State obtained data from infrared aerial photographs, digitized them, and entered them into the computerized Michigan Resource Inventory System. The State classified wetlands into seven categories, which do not correspond to the Cowardin classification system developed by the FWS.

■ The Texas Parks and Wildlife Department initiated a statewide habitat mapping project. The project used LANDSAT data and produced vegetation cover maps and detailed numerical inventory data for coastal marshes, swamps, bottomland hardwoods, and other forested wetlands.

■ Florida completed a comprehensive statewide wildlife habitat inventory in 1990, which included several wetlands types. However, the State reported that it has not implemented a wetlands inventory program required in the Warren S. Henderson Wetlands Protection Act passed in 1984 because of funding limitations. Florida legislation requires reporting of wetlands acreage affected by permitting activities. The State tracks wetlands conversions and mitigation efforts authorized under the dredge and fill program. Many violations are reported by the public.

■ New York requires regulatory inventories of tidal wetlands on Long Island, in New York City, and in certain counties along the Hudson River. State statutes also require inventories of freshwater wetlands protected by State law.

■ South Carolina received a fiscal year 1991 State wetlands grant to develop a statewide land use/land cover inventory using satellite imagery and Ecological Monitoring and Assessment Program (EMAP) classification. Wetlands are a component of this project.

■ Kentucky is currently digitizing all NWI maps and Tennessee has already digitized NWI maps in the western part of the State where 85 percent of the State's wetlands are located.

WETLANDS monitoring programs are still in their infancy. No State is currently operating a Statewide wetlands monitoring program.

Integrity of the Resource

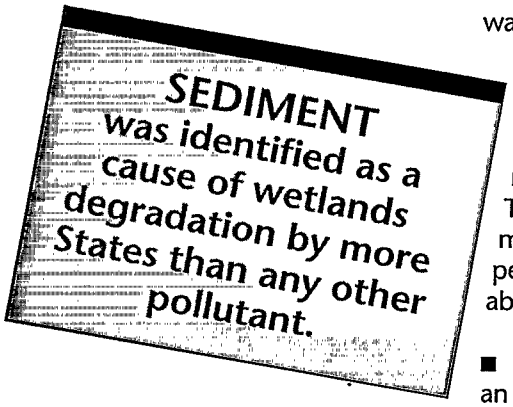
Monitoring programs should and could provide the data needed to identify integrity degradation in wetlands and sources of that degradation, but specific wetlands monitoring programs are still in their infancy. Five States described water quality and habitat monitoring efforts for wetlands. Three of these States currently monitor some wetlands and two States have proposed or are considering wetlands

monitoring programs. No State is currently operating a statewide wetlands monitoring program.

■ Massachusetts requested an EPA wetlands grant to create a standard operating procedure for collecting wetlands data. An EPA-funded project is currently under way to develop a two-tiered approach for functional assessment of wetlands. The State requires project proponents to monitor specific project elements.

■ Montana's Water Quality Bureau will monitor 20 water quality impaired wetlands and 40 minimally impaired wetlands. The data will establish baseline water quality and biological conditions needed to develop wetlands standards. The Montana Department of Transportation will also develop a monitoring program to judge the effectiveness of existing wetlands mitigation projects.

■ As part of its efforts to develop water quality standards for wetlands, the Texas Water Commission currently monitors water quality, associated biota, and beneficial uses at selected minimally impacted coastal wetlands. The program will be expanded to monitor other wetlands types as personnel and funds become available.



■ Washington State does not have an established monitoring program for assessing use support of wetlands, but it has studied plant and animal habitat diversity in addition to chemical and physical water quality parameters in wetlands.

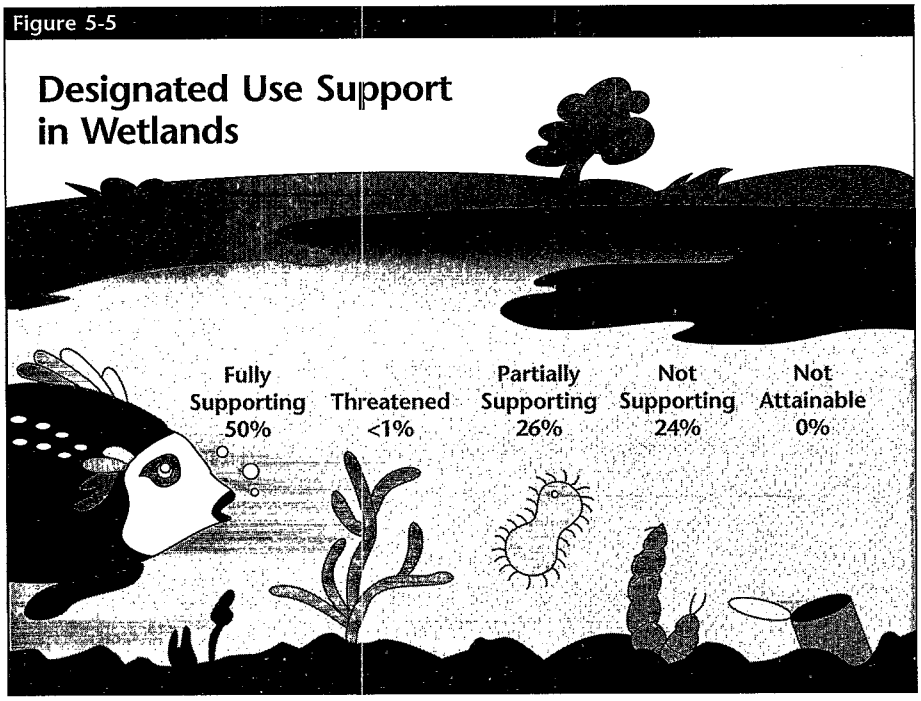
■ Wisconsin is considering wetlands initiatives that include monitoring wetlands communities and habitats.

Designated Use Support in Wetlands

Only eight States (California, Colorado, Hawaii, Iowa, Kansas, North Carolina, Nevada, and Oklahoma) provided information on overall use support in some portion of their wetlands (see Appendix D, Table D-2). Half of the 10,516,774 acres of assessed wetlands acreage fully support their designated uses (Figure 5-5), but this information pertains to less than 4 percent of the total wetlands in the United States. Of the assessed acres, 98% are in North Carolina. Therefore, the use support figures should not be extrapolated to represent national trends in wetlands integrity.

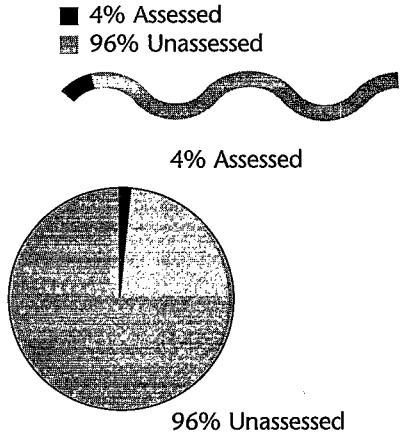
More States will assess use support in wetlands as they develop standards for wetlands. Many States are still in the process of developing wetlands water quality standards, which provide the baseline for determining beneficial use support (see Chapter 16). Improved standards will also provide a firmer foundation for assessing impairments in wetlands in those States already reporting use support in wetlands. Hawaii, for example, reports that it assessed 100% of its wetlands but also reports that it is still developing wetlands-specific use classifications and that few of their existing water quality standards can be applied to wetlands. Wetlands-specific water quality standards will help eliminate some of these apparent inconsistencies.

Figure 5-5

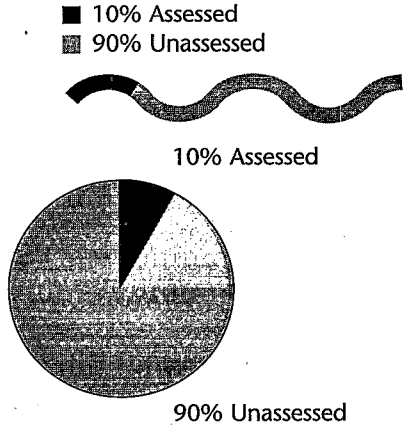


Total wetlands (including Alaska) = 277 million acres
Total assessed = 10,516,774 acres

Including Alaska's wetlands



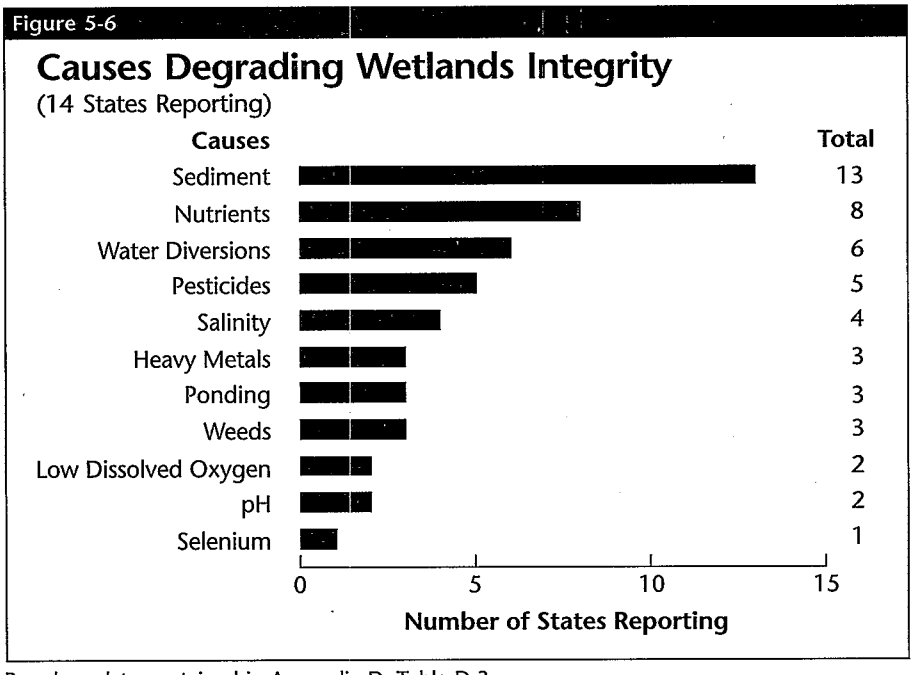
Excluding Alaska's wetlands



Based on data contained in Appendix D, Table D-2.

NOTE: This information on designated use support represents data from only eight States, some of which do not have water quality standards for wetlands. In addition, 98% of the assessed wetlands are in one State, so national trends should not be drawn from these data.

Figure 5-6

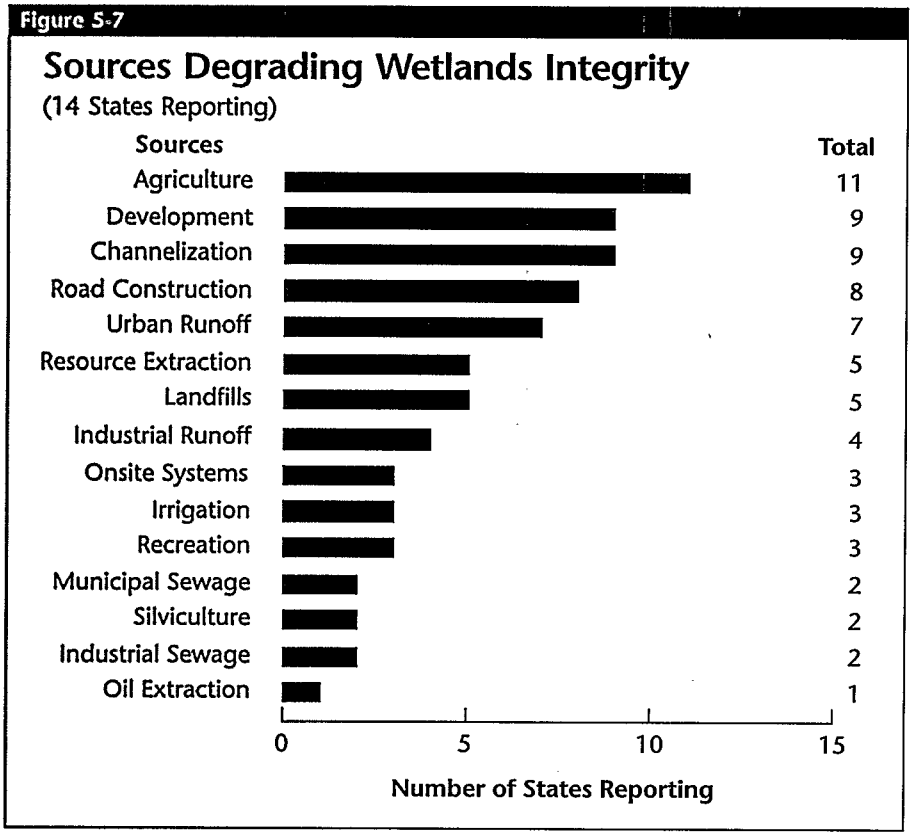


Based on data contained in Appendix D, Table D-3.

More information on wetlands can be obtained from EPA's Wetlands Hotline at 1-800-832-7828, between 9 a.m. and 5 p.m. Eastern Standard Time.

The States have even fewer data to quantify the extent of pollutants degrading wetlands and the sources of these pollutants. Although most States cannot quantify wetlands area impacted by individual pollutants and sources, 14 States identified pollutants and sources known to degrade wetlands integrity to some extent (Figures 5-6 and 5-7). These States listed sediment as the most pervasive pollutant impacting wetlands, followed by nutrients, water diversions, and pesticides. Agriculture topped the list of sources degrading wetlands, followed closely by development, channelization, road construction, and urban runoff (see Appendix D, Tables D-3 and D-4, for individual State information).

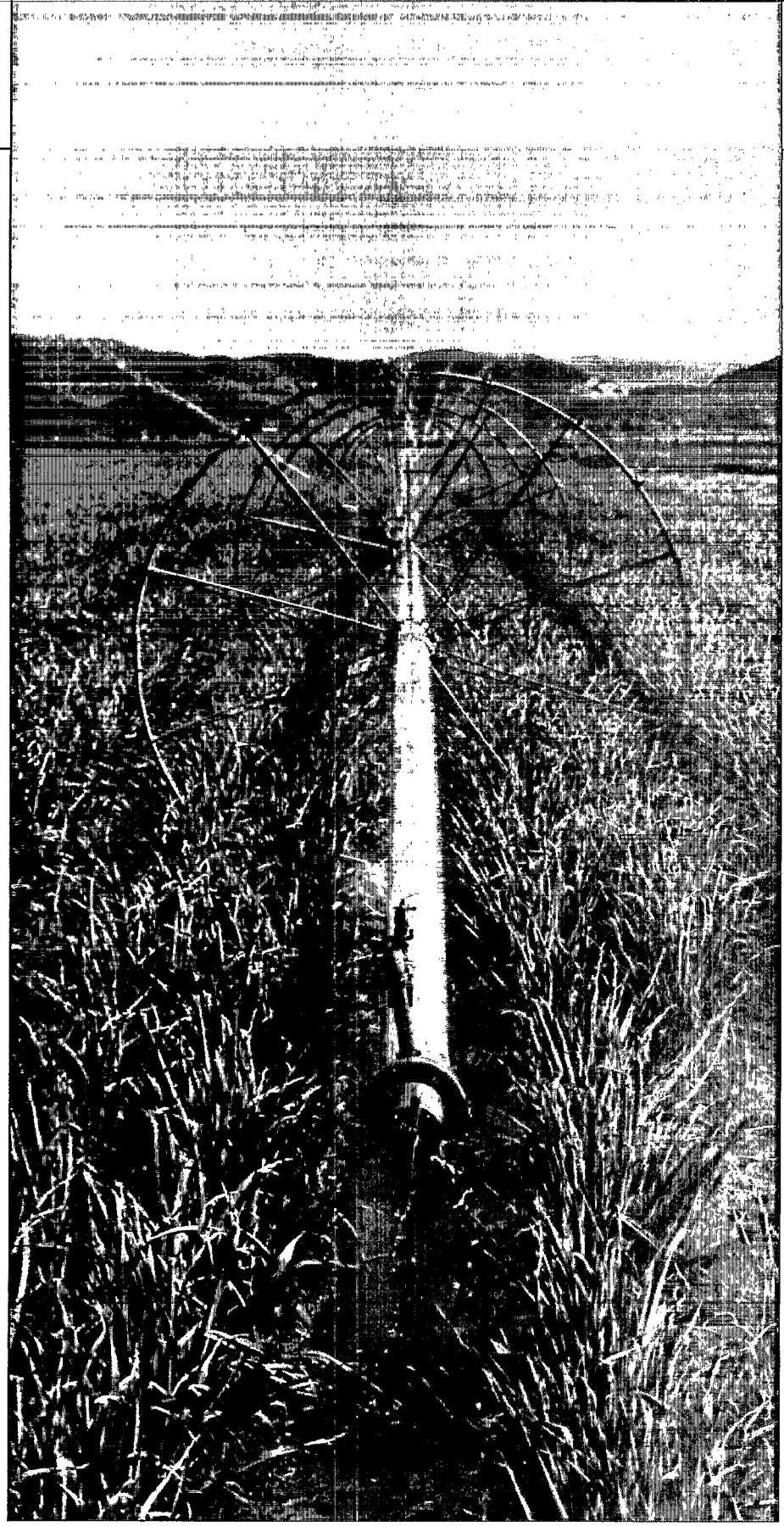
Figure 5-7



Based on data contained in Appendix D, Table D-4.

Summary

Currently, most States are not equipped to report on the integrity of their wetlands. Only eight States reported attainment of designated uses for wetlands in 1992. National trends cannot be drawn from this limited information. This is expected to change, however, as States adopt wetlands water quality standards and enhance their existing monitoring programs to more accurately assess designated use support in their wetlands. In addition, EPA's EMAP for wetlands will provide indicators and procedures that States may eventually be able to adapt to their own programs. The EMAP indicators and procedures may also provide consistent macroscale information on wetlands conditions in the future.



Ground Water Quality

Introduction

The protection of our Nation's ground water resources has received widespread attention at all levels of government. The need to protect this vital resource to sustain the life and health of citizens and the ecosystem is becoming increasingly clear. Ground water is used for domestic and municipal drinking water supplies, irrigation and livestock, and industrial processes. Ground water also supports the health of related surface water ecosystems, including lakes, rivers, streams, wetlands, and estuaries. In many parts of the Nation, ground water serves as the only reliable source of drinking or irrigation water. However, the quality of this vital resource is threatened by a number of land-use activities.

As a result of the growing public awareness of the importance of our ground water resources, EPA has issued guidance for Comprehensive State Ground Water Protection Programs. These programs will be the focal point for long-term joint commitments between the Federal Government and the States and will provide for a more coherent and comprehensive approach to ground water protection. The States have identified a broad range of ground water contaminants and contamination sources that threaten the integrity of the resource. Controlling these sources of contamination and preventing further contamination of the resource have become the focus of a number of State and Federal programs.

EPA compiled the information reported in this chapter primarily from 1992 305(b) State Water Quality Reports required under the Clean Water Act. EPA requested that each State provide information concerning its ground water quality and protection initiatives, along with information on sources of ground water contamination and the principal contaminants of concern. In addition to the data reported in the State 305(b) reports, this chapter provides information obtained from the U.S. Geological Survey Open-File Report 92-63 entitled *Preliminary Estimates of Water Use in the United States, 1990* and information reported by other Federal agencies.

This chapter consists of three sections that summarize the following ground water information: use, quality, and indicators.

GROUND WATER provides drinking water for 53% of the population.

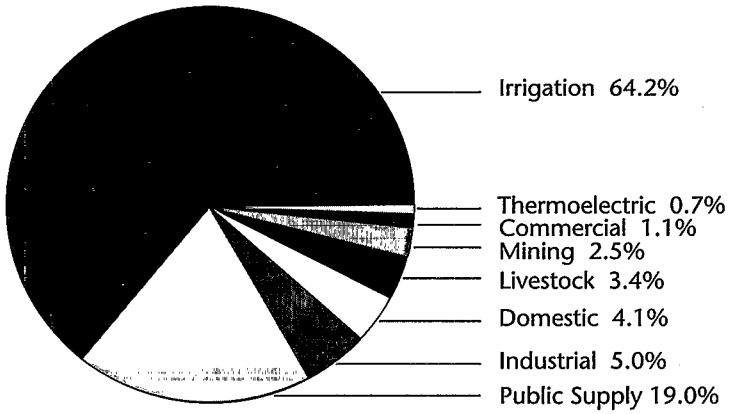
Ground Water Use

Ground water withdrawals in 1990 accounted for approximately 20% of the Nation's total water withdrawals. Ground water withdrawals increased significantly between 1950 and 1980 from 34 billion gallons/day (gal/d) to 83 billion gal/d. The 1990 estimate of total ground water withdrawals is

IRRIGATION
accounted for more than 64% of ground water use

Figure 6-1

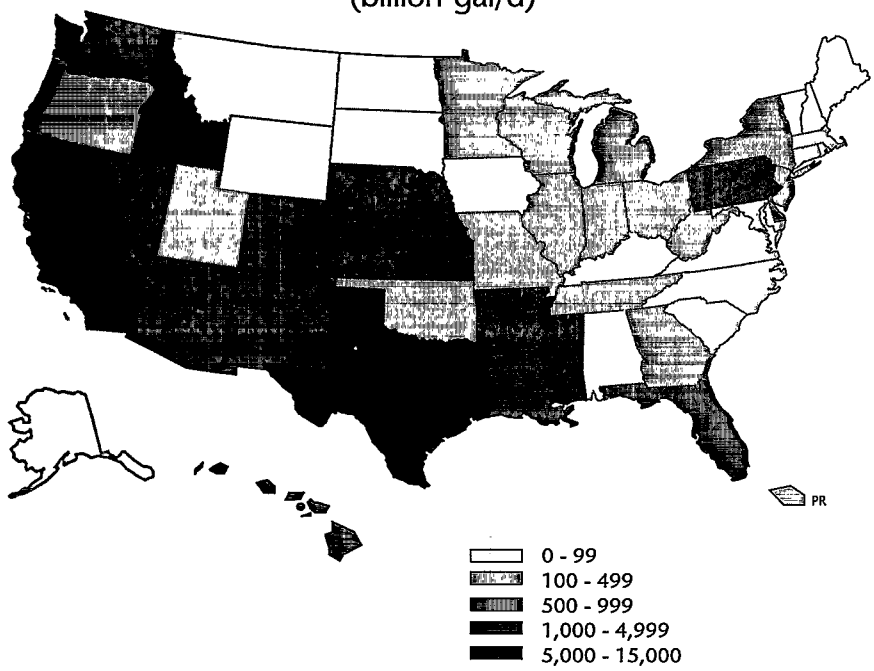
National Ground Water Withdrawals by Water Use Category



Source: Open-File Report 92-63, U.S. Geological Survey.

Figure 6-2

Total Fresh Ground Water Withdrawals by State
(billion gal/d)



Source: Open-File Report 92-63, U.S. Geological Survey.

81 billion gal/d. This is consistent with a general decrease in the rate of increase in ground water withdrawals from 1970 to 1980 and with a decrease in total ground water withdrawals from 1985 to 1990. While public, domestic, and commercial water supply withdrawals and withdrawals for mining and thermoelectric power continued to increase between 1985 and 1990, withdrawals for irrigation and industrial supply declined.

Nationally, ground water provides drinking water for 53% of the total population and nearly all of the rural population. National ground water withdrawals by water use category are shown in Figure 6-1. Irrigation accounts for the largest percentage of ground water withdrawals with approximately 51 billion gal/d or 64% of total withdrawals. Public water supplies account for approximately 19% of the total ground water withdrawals. Industrial, domestic, livestock, mining,

commercial, and thermoelectric withdrawals account for a total of 17% of withdrawals.

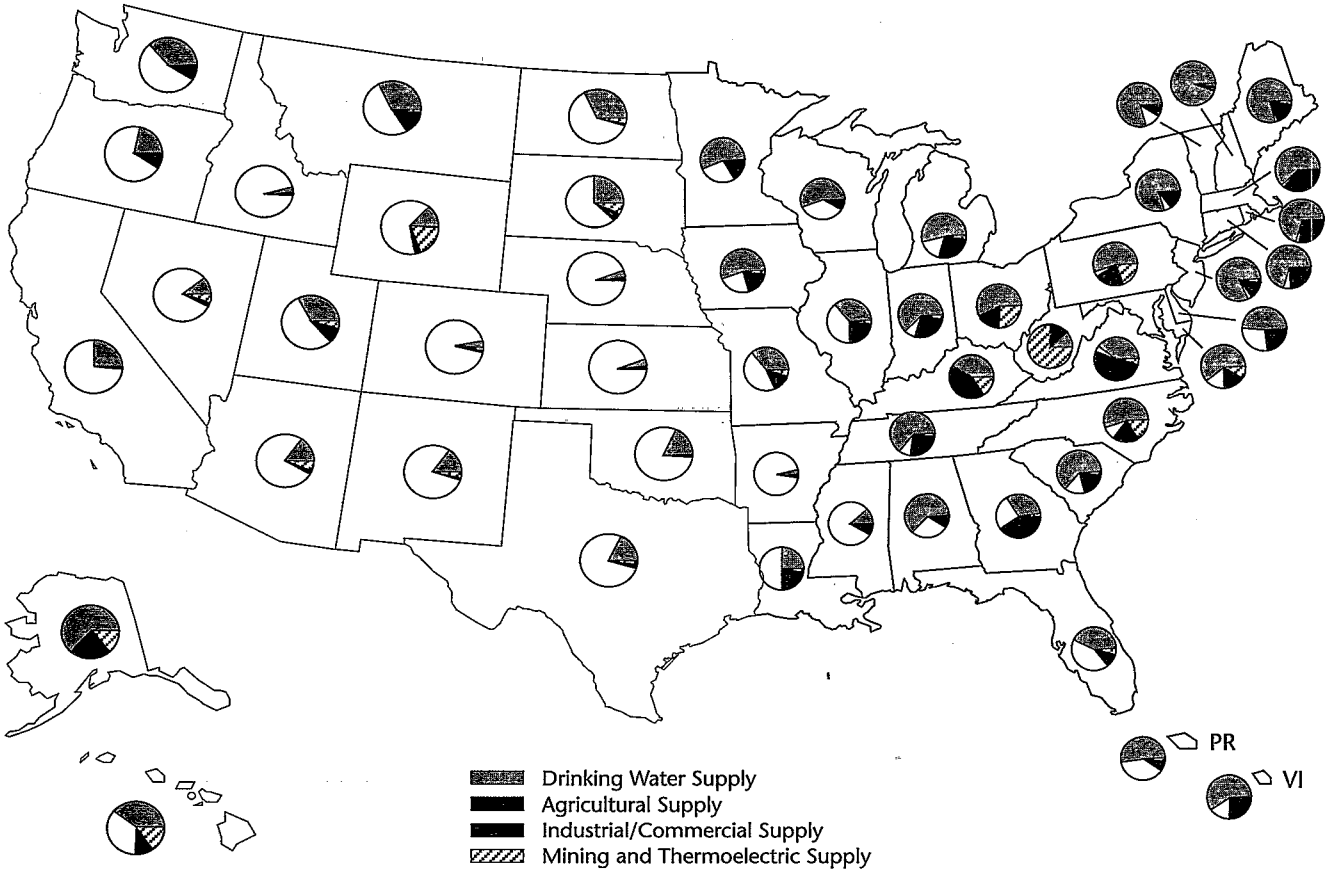
Figure 6-2 depicts the total fresh ground water withdrawals by State. Nine States accounted for 72% of the Nation's total ground water use. In 1990-1991, California withdrew a total of 14.6 billion gal/d, approximately 10.7 billion gal/d of which was used for irrigation. Idaho and Texas withdrew 7.6 and 7.4 billion gal/d, with 6.6 and 5.6 billion gal/d, respectively, used for irrigation. Ground water withdrawals from Arkansas, Colorado, Kansas, and Nebraska were used primarily for irrigation accounting for 92% of the withdrawals. The remaining two States were Florida and Arizona; 72% of Arizona's ground water was used for irrigation. Irrigation and public water supply combined account for 78% of withdrawals in Florida.

40% OF U.S. ANNUAL AVERAGE streamflow is derived from ground water.

Ground water is withdrawn for a number of purposes, which vary considerably depending on the

Figure 6-3

Fresh Ground Water Withdrawals by Water Use Category



Source: Open-File Report 92-63, U.S. Geological Survey.

region. Fresh ground water withdrawal with breakdowns of water use categories is shown in Figure 6-3. In the East and South, withdrawals are used primarily for industrial, domestic, commercial, and public water supply purposes. In the West, most ground water is withdrawn for agricultural supply.

29 STATES
judged their ground water quality to be good or excellent

Ground Water Quality

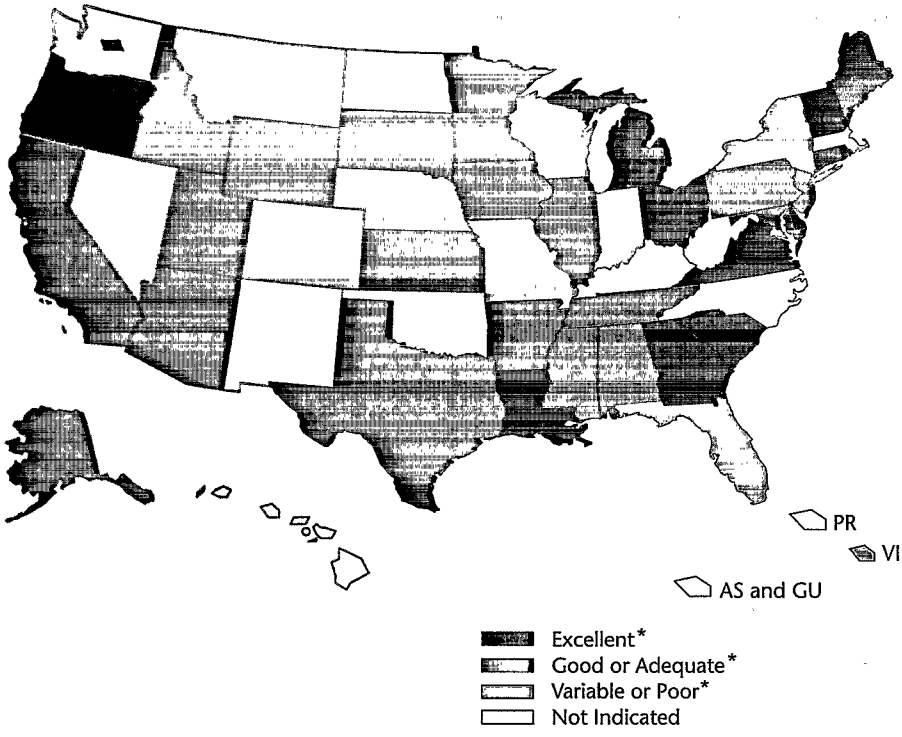
For the 1992 Section 305(b) State Water Quality Reports, EPA requested that States use best professional judgment to assess the overall quality of their ground water. Overall, the Nation's ground water quality is good to excellent (Figure 6-4). Thirty-eight States made some judgment concerning the quality of their ground water: 11 States judged their ground water quality to be excellent, 18 States judged their ground water quality to be good, and 9 States reported that their overall ground water quality was variable or poor. One problem in assessing national ground water quality trends stems from the lack of consistent and reliable ground water quality indicators. While the overall quality of the Nation's ground water resource appears to be good, local ground water contamination problems are widespread in every State.

In 1985, the National Governor's Association (NGA) began conducting biennial surveys to identify State restrictions imposed on contaminated or hazardous sites. In 1992, the NGA published a report entitled *Restrictions Imposed on Contaminated Sites: A Status of State Actions*, covering information obtained during the 1991 survey. This report cites 1,295 incidents of ground water use restrictions imposed at contaminated sites, an increase of 37% from the number reported in 1989 (948 incidents) and nearly four times the number reported in 1987 (331 incidents). The imposed use restrictions include restricted ground water use for drinking, the need for treatment or blending of contaminated ground water to meet drinking water standards, restrictions on ground water use for irrigation or food processing purposes, and the issuance of ground water use advisories.

The NGA also gathered information on State well closings in an

Figure 6-4

Overall Ground Water Quality



Source: 1992 State Section 305(b) reports.
***Based on 38 States reporting.**

effort to gain insight into ground water quality around contaminated sites. The 1992 report lists a total of 14,324 well closures and restrictions, based on State responses to a survey question concerning restrictions imposed on contaminated sites. The number of well closures and restrictions represents a very small percentage of the total number of wells supplying water for irrigation, domestic use, industrial use, and other uses across the country. The primary ground water contaminants that resulted in the reported well closures include benzene, trichloroethylene, tetrachloroethylene, other volatile organic compounds (VOCs), ethylene dibromide, fertilizers, and nitrates.

Many States are undertaking studies and programs to better understand the quality of their ground water, to identify potential contamination sources, and to determine ways to protect the resource from further contamination. Twenty-six States reported that they have conducted statewide ground water monitoring studies that focus on one or more contaminants, and an additional six States reported on statewide programs that are under development. The contaminants assessed in these large-scale monitoring efforts include pesticides, nitrates, volatile organic chemicals, radionuclides, chloride, iron, and bacteria.

Eighteen States reported on regional ground water studies conducted in sensitive ground water basins or other areas of concern. Contaminants of concern in these regional studies include pesticides, nitrates, volatile organic chemicals, bacteria, chloride, and radionuclides. Reported underground chemical storage or releases and waste disposal sites in all States require monitoring under a number of Federal statutes. In addition, 25 States reported on site-specific monitoring efforts surrounding contamination point sources such as landfills, underground fuel and chemical storage facilities, hazardous waste surface impoundments, mining sites, and spray irrigation sites. The principal contaminants of concern at these monitoring sites are petroleum hydrocarbons, volatile organic chemicals, acidic mine drainage, metals, and nutrients.

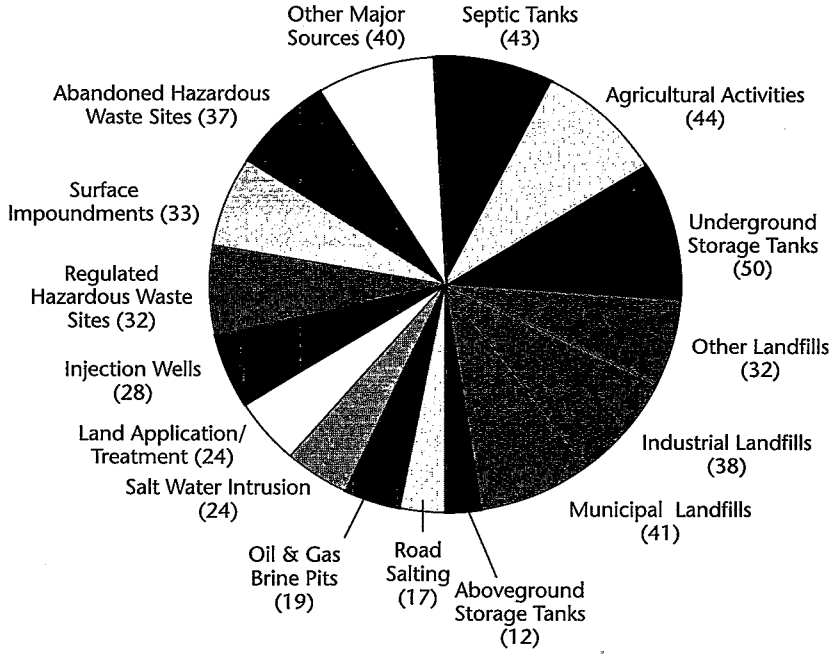
26 STATES

reported that they conducted statewide ground water monitoring studies of one or more contaminants.

Figure 6-5

Sources of Contamination

(Number of States Reporting)



Source: 1992 State Section 305(b) reports.

UNDER-GROUND STORAGE TANKS
were cited by 39 States as the most common source of ground water contamination.

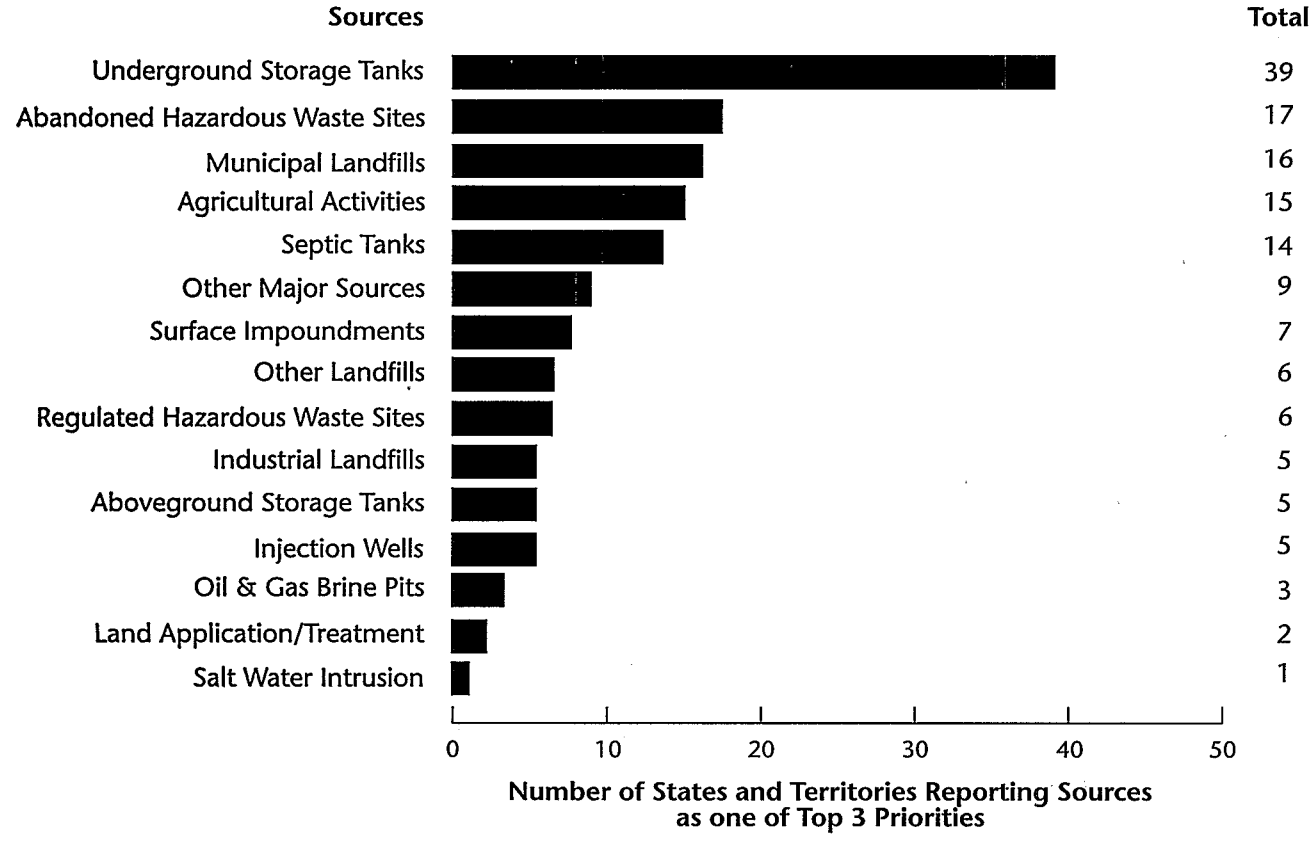
Overview of Contamination Sources

EPA requested that the States identify and rank the severity of sources of ground water contamination in their jurisdiction. The ranking was based on the best professional judgment of State ground water experts and included consideration of many factors such as: findings of the State's ground water protection strategy or related studies, evaluations of the population at risk from contaminated drinking water, the number or location of contamination sources, evaluations of the risk posed to human health or the environment, and the suitability of existing controls.

Figure 6-5 summarizes the major sources of contamination listed by the 49 States reporting. The most frequently cited sources of

Figure 6-6

Highest Priority Contamination Sources



Source: 1992 State Section 305(b) reports.

contamination were underground storage tanks, landfills, agricultural activities, and septic tanks. Approximately two-thirds of the States listed landfills, including municipal, industrial, and other types of landfills, as a significant source of ground water contamination, and more than 75 percent of the States reported that agricultural activities posed a significant threat to ground water quality. In addition to the sources highlighted in Figure 6-5, the States noted contamination from hazardous material spills, mining activities, urban and stormwater runoff, abandoned or improperly constructed water wells, and agricultural drainage wells.

Figure 6-6 depicts the highest priority contamination sources as ranked by the States. Underground storage tanks continue to be the most frequently ranked high-priority contamination source. Abandoned hazardous waste sites, municipal landfills, agricultural activities, and septic tanks were the next most frequently reported sources. These rankings were relatively unchanged from the 1990 State reports. Surface impoundments, landfills, and other chemical or waste storage facilities also continue to be sources of concern in the States.

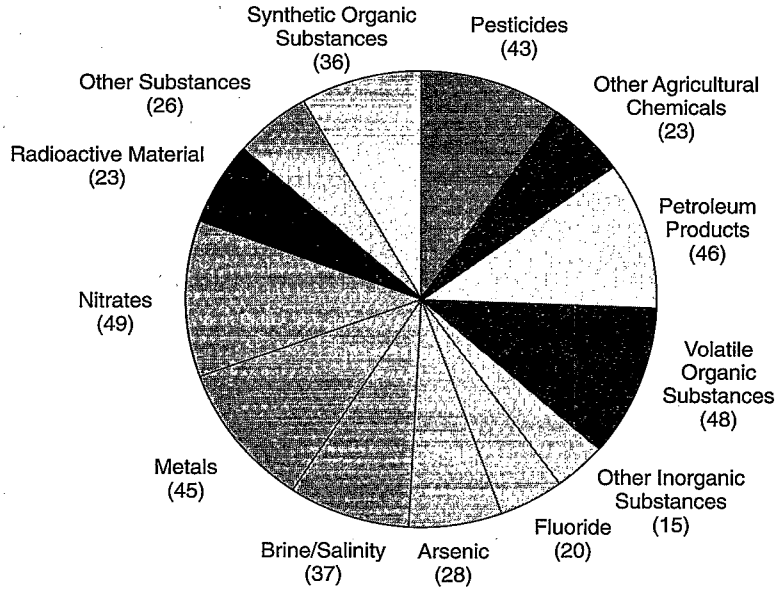
Overview of Contaminants

EPA also requested that the States identify the most prevalent contaminants observed in their ground water (see Figure 6-7). Nitrates were identified as a principal ground water contaminant by 49 States, an increase of five States from the 1990 reports. The next most frequently reported contaminants were volatile organic substances, petroleum products, metals, and pesticides. These contaminants were also reported as most frequently observed in ground water in 1990. Fluoride was reported as a principal contaminant by 21 States in 1990, but was reported by only 20 States in 1992. Among the other contaminants reported by States were bacteria, radionuclides, dissolved inorganics, septage and sewage, and acids.

49 STATES
identified nitrates as a principal ground water contaminant.

Figure 6-7

Substances Contaminating Ground Water
(Number of States Reporting)



Source: 1992 State Section 305(b) reports.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

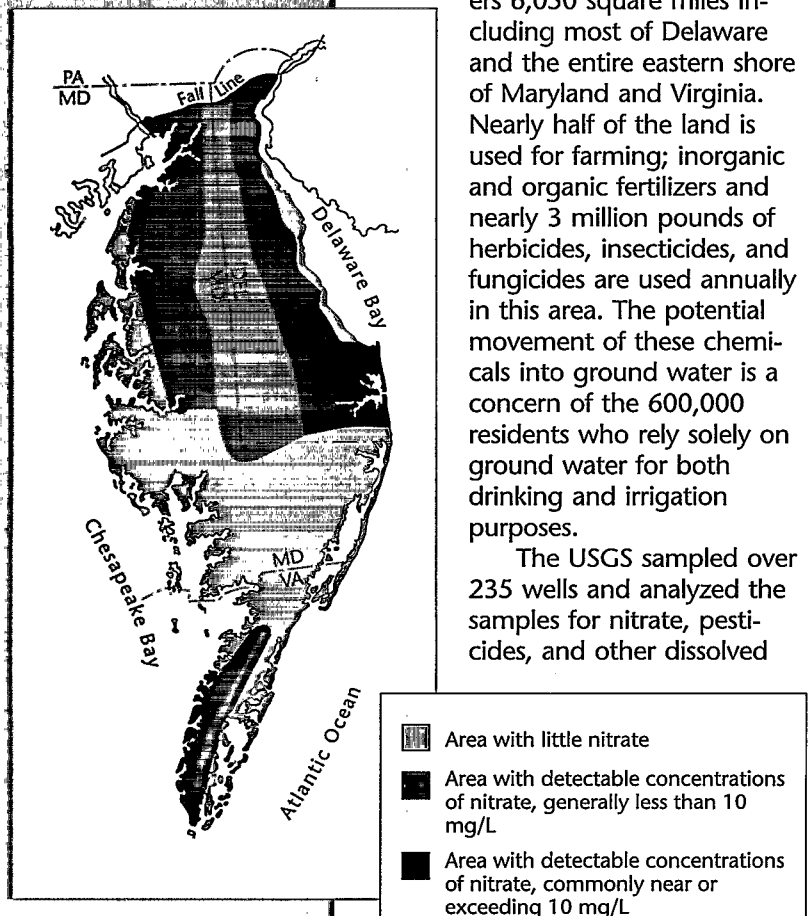
Are Pesticides Affecting Ground Water Quality?

Case Study of the Delmarva Peninsula

The USGS began a National Water Quality Assessment (NAWQA) case study of the Delmarva Peninsula in 1986. The area of study covers 6,050 square miles including most of Delaware and the entire eastern shore of Maryland and Virginia. Nearly half of the land is used for farming; inorganic and organic fertilizers and nearly 3 million pounds of herbicides, insecticides, and fungicides are used annually in this area. The potential movement of these chemicals into ground water is a concern of the 600,000 residents who rely solely on ground water for both drinking and irrigation purposes.

The USGS sampled over 235 wells and analyzed the samples for nitrate, pesticides, and other dissolved constituents. Nitrate concentrations in 15% of the wells in the water table aquifer exceeded the maximum contaminant level (MCL) of 10 milligrams/liter (mg/L) set by the EPA. Concentrations of pesticides were generally low; 94% of the samples with detectable limits of pesticides were below the MCL set by the EPA. The pattern of contamination was found to correlate with crop type, geology, soils, land use, and ground water flow. An understanding of these factors will help to identify areas where future contamination is most likely to occur. One direct result of this study is the development and implementation of management and protection strategies by local, State, and Federal agencies. These strategies center on monitoring and protecting surface and ground water from future nitrate and pesticide contamination.

For additional information, see: *Are Fertilizers and Pesticides in the Ground Water? A Case Study of the Delmarva Peninsula, Delaware, Maryland, and Virginia.* USGS Circular 1080.



Indicators of Ground Water Quality

While vast amounts of ground water quality data are being collected at the community, regional, State, and national levels, there remains a growing need to standardize the collection of data on key environmental indicators. These data will allow the characterization of trends in ground water quality over space and time. The EPA Office of Ground Water and Drinking Water continues to work with States and others in the ground water community to refine a series of indicators. Preliminary indicators that have been developed to track progress and trends in ground water protection efforts at the State and national levels are:

- Maximum contaminant level (MCL) violations in public drinking water systems supplied by ground water, and the population at risk from these violations
- Extent of ground water contamination resulting from hazardous waste sites, and the population at risk from exposure to this contamination
- Detections and levels of VOCs in ground water
- Detections and levels of nitrates in ground water
- Extent of leachable agricultural pesticide use.

In its guidelines for preparation of the 1992 State 305(b) reports, the EPA encouraged States to use one or more of these indicators, where data were available, as part of their 305(b) reporting. Further guidance on the reporting of ground water indicators will be available for the preparation of 1994 State 305(b) reports.

Thirty-five States provided information on one or more of the requested ground water indicators. Twenty-eight of the States reporting provided information on nitrates, pesticides, or VOC detections from regional or local ground water monitoring studies. Other indicator parameters reported by several States included: salinity, bacteria, inorganic constituents, and radioactivity levels. The most in-depth indication of ground water quality was provided through descriptions of State monitoring programs. Some of these programs are described in the following section.

State Ground Water Monitoring Programs

A number of States have undertaken monitoring initiatives that are aimed at characterizing the overall quality of their ground water resources. Statewide initiatives commonly include the establishment of ambient monitoring networks. Many of these networks include private domestic and agricultural wells, in addition to ground water monitoring wells maintained by USGS or the States. In addition, concern over the effects of agricultural land use on ground water resources has prompted a number of States to monitor shallow and alluvial aquifers for nitrates and pesticides. Many States also maintain regional monitoring networks that focus on sensitive areas or vulnerable aquifers. Site-specific

34 STATES provided information on indicators of ground water quality.

monitoring efforts were reported by most States. These studies typically focus on known or suspected contamination sources. The range of ground water monitoring initiatives reported by the States is demonstrated by the following approaches.

Missouri

Missouri relies on several activities to assist in forming a statewide characterization of ground water quality. Public drinking water wells serve about half the area of the State and draw from four aquifers (the confined and the unconfined Ozark bedrock aquifers of southern Missouri, and the unconsolidated alluvial aquifers of Cretaceous and Quaternary age in the Missouri Bootheel aquifer). The wells are sampled every 3 years for a large list of water quality constituents and will be tested more frequently as cities begin meeting monitoring requirements of the Safe Drinking Water Act.

For many years, the State has also provided free bacterial and nitrate testing for many private wells statewide. Since 1986, special studies by the USGS, the Missouri Department of Health, and other studies by the University of Missouri and the Department of Natural Resources have sampled several hundred private wells for pesticides and nitrates, giving an excellent profile of farm chemical levels in private wells in agricultural areas of the State.

In addition to drinking water wells, a number of monitoring wells, usually associated with the cleanup of surface or ground water contamination sites, are used to define and characterize ground water problems.

New Jersey

The prevalence of naturally occurring radionuclides in the rock formations in several areas of New Jersey has prompted a number of regional studies of well water. In 1987, 389 wells tapping crystalline rock aquifers in the Reading Prong and Newark Basin areas were monitored for radionuclides. In the Reading Prong area, radon levels in well water ranged from 36 to 24,000 picocuries per liter (pCi/L), and approximately 5% of the wells sampled were found to have radon levels that exceeded 10,000 pCi/L. In the Newark Basin area, radon levels in well water ranged from approximately 70 to 16,000 pCi/L, with the highest concentrations of radionuclides found in wells tapping a narrow uranium-rich layer of the aquifer. A 1990 study of the Kirkwood-Cohansey aquifer in the southern New Jersey Coastal Plain has also revealed the presence of radionuclides in well water. Preliminary findings indicate that 26% of the 82 wells sampled exceeded the health standards for radium.

In a study to determine whether agricultural chemicals have adversely affected ground water quality, 120 domestic, irrigation, and public water supply wells were sampled in 10 Coastal Plain counties. Residues of 22 pesticides and 3 pesticide metabolites were detected in these wells, and dissolved nitrate concentrations were found to exceed health standards in 24% of the wells sampled. In another study, the effects of heavy ground water

withdrawals from the New Jersey Coastal Plain aquifer system and a buried valley aquifer system in the Central Passaic River basin were evaluated. Investigations have revealed the increased potential for saltwater intrusion in several areas of the New Jersey Coastal Plain and the decrease in the quantity of available potable ground water supplies. A three-dimensional computer model is being used to help predict the response of the Central Passaic River aquifer system to future ground water withdrawals.

New Mexico

Ground water quality is of paramount concern in New Mexico, since approximately 88% of the population of the State relies on ground water for their drinking water supplies. The State maintains a comprehensive monitoring program for both community and noncommunity water systems that rely on ground water. The 495 noncommunity systems in New Mexico are sampled every 4 years to monitor the levels of nitrates. In addition, the 596 community ground water systems are sampled every 3 years for nitrates, fluoride, and trace elements and every 4 years for radiological parameters. Some systems located in vulnerable areas are also sampled every 3 to 5 years for a suite of 59 potential contaminants.

New Mexico also sponsors an outreach program to benefit private well owners. The State organizes water fairs where citizens may bring samples from private wells for free testing in a mobile laboratory. The State maintains a database of test results and conducts followup testing of wells that exceed levels of concern for detected contaminants. In addition, the State maintains an inventory of all known instances of ground water contamination. The inventory covers contamination incidents dating from 1927 to the present. A total of 177 public water supply wells and 1,465 private wells have been affected by the 1,745 incidents of contamination recorded through early 1992. Most of the affected public water supply wells have been removed from use, and some level of remediation has been undertaken or is planned in 149 of the other contamination incidents.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Are Pesticides Affecting Ground Water Quality?

Findings of the National Survey of Pesticides in Drinking Water Wells

The National Survey of Pesticides in Drinking Water Wells was a joint project of EPA's Office of Ground Water and Drinking Water (OGWDW) and Office of Pesticide Programs (OPP). It was the first national study of pesticides, pesticide degradates, and nitrates in drinking water wells. Information on the construction of rural domestic and community supply wells was also collected. The study was designed with two principal objectives:

- To determine the frequency of occurrence and concentration of pesticides and nitrates in drinking water wells nationally

- To relate the occurrence of pesticides and nitrates in drinking water wells to agronomic and hydrogeologic factors.

It is estimated that approximately 10,500,000 rural domestic wells (RDWs) and 94,600 community water system (CWS) wells supply drinking water in the United States. Approximately 1% of these wells may exceed a health-based limit for at least one pesticide. EPA estimates that about 10% of CWS wells contain detectable levels of one or more pesticides, and approximately 7% of these wells may exceed an established maximum contaminant level (MCL) or health advisory for the detected contaminant. In contrast, it was estimated that about 4% of RDWs may contain detectable levels of one or more pesticides, with approximately 28% of these wells exceeding a health-based limit. Approximately 150,000 people obtain water from RDWs that exceed health-based levels for at least one pesticide.

In the survey, the most frequently detected pesticide was a metabolite of dacthal, an herbicide primarily used on turf. The dacthal metabolite was generally detected at concentrations below the health-based action level. The only pesticides detected at concentrations that exceeded action levels were alachlor, atrazine, 1,2-dibromo-3-chloropropane (DBCP), ethylene dibromide (EDB), and lindane. Alachlor and atrazine are herbicides, DBCP and EDB are nematocides, and lindane is an insecticide.

EPA concluded that the overall chance that a given drinking water

well has exceeded a level of concern for a pesticide is low. However, if pesticide residues are present in individual wells, they are likely to be present at high levels that pose a health risk. In contrast, it was estimated that approximately 52% of the RDWs and 57% of CWSs contain detectable levels of nitrates, with approximately 2% of RDWs and 1% of CWSs exceeding the health-based limits for nitrates.

Among the major findings of the survey were associations between the occurrence of pesticides and nitrates in drinking water wells and individual agronomic and hydrogeologic factors. These findings include

- Detections of 1,2-dibromo-3-chloropropane (DBCP) acid metabolites were related to the rate of DCPA use by urban applicators and golf courses.

- At the county level, the concentrations of nitrates in wells was positively correlated with the amount of fertilizer sold in that county.

- Detections of nitrates were less likely in areas with high levels of precipitation.

- Shallow water wells were correlated with more frequent detections of pesticides and nitrates.

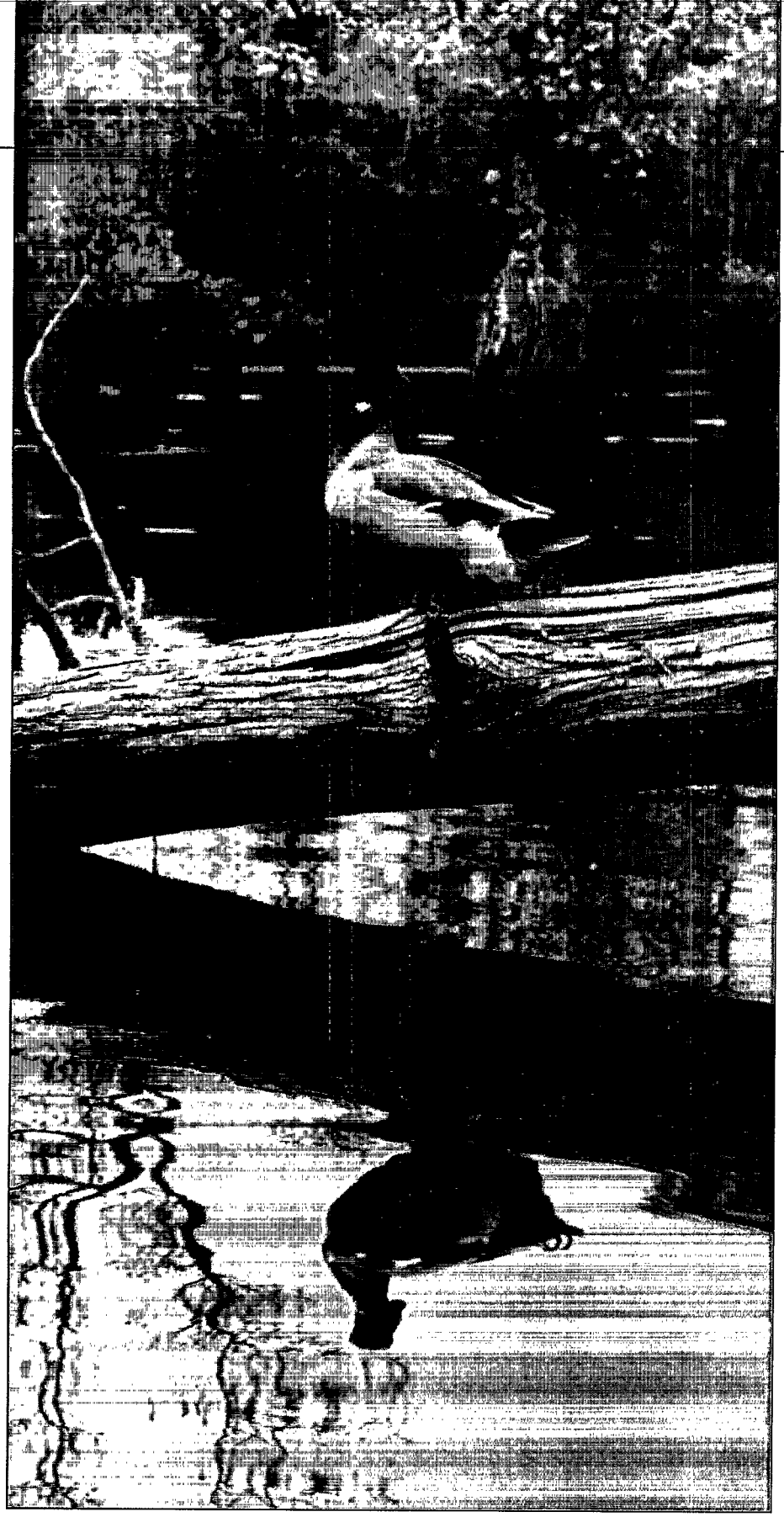
- Older wells were correlated with more frequent detections of pesticides and nitrates.

In conclusion, EPA recommends that well owners who know or suspect that their well is affected by pesticides or nitrates have the water tested. Because of the many factors that may influence the contamination of drinking water wells, EPA recommends an approach that focuses on pollution prevention. Among the steps that should be considered to protect the Nation's ground water resources are appropriate applications of pesticides and fertilizers, site-specific assessments to accurately target vulnerable ground water supplies, identification and protection of ground water recharge areas and wellhead areas, more careful use of flood irrigation, and continued efforts to identify problem pesticides.

Oklahoma

In 1983, the State established a ground water quality monitoring network covering 21 major ground water basins in Oklahoma. This network provides information on ambient ground water quality in the State. The monitoring network is being used to characterize the current status of the State's ground water resources and to identify changes in ground water quality over time. The accuracy of well location and completion information has been evaluated for all wells included in the monitoring network, and a vulnerability assessment was completed for each network well in 1989. In 1990, an additional 224 domestic, irrigation, stock, and municipal water wells were included in the network. The ground water quality monitoring network is sampled annually.

Public drinking water wells are routinely monitored for nitrates, bacteria, VOCs, and other drinking water parameters. The State maintains a database of MCL violations for these wells that includes the name and county of the water supply system, the aquifer tapped by the contaminated well, and the confirmation date for each violation. In addition, the State performs analyses of private water supplies at the request of private citizens. The State has also undertaken a 3-year sampling project to identify private drinking water wells at risk from agricultural contamination. The project is scheduled to be completed in 1994 and will address a total of 200 sites.



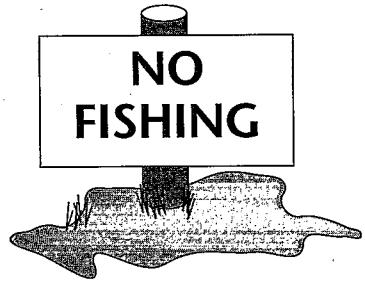
Public Health and Aquatic Life Concerns

Water pollution threatens public health by contaminating seafood, drinking water supplies, and recreational waters with toxic substances as well as pathogenic viruses and bacteria, which cause disease. Aquatic organisms tolerate most bacteria and viruses pathogenic to humans, but many aquatic organisms are more sensitive to toxic substances than humans are. Aquatic organisms also suffer if chemical and physical conditions exceed an acceptable range. Important chemical and physical conditions include acidity, dissolved oxygen concentration, and temperature.

Public Health Concerns

Toxic Pollutants

Health officials link waterborne toxic pollutants, such as mercury, dioxin, PCBs, and some pesticides with human birth defects, cancer, neurological disorders, and kidney ailments. Once discharged to surface waters, these toxicants persist in the sediments and contaminate the food chain and the overlying water. Waterborne toxicants can enter human systems via ingestion of contaminated fish, shellfish, or drinking water supplies. Swimmers may also swallow toxic substances or absorb toxic pollutants through skin exposure in contaminated recreational waters. Fish and shellfish contamination usually poses a greater human health risk than does contaminated drinking water or recreational waters because fish and shellfish concentrate many toxic substances in their tissues. As a result, the concentration of toxicants within fish and shellfish tissues may be one million times the concentration of toxicants in the surrounding waters.



Fish Consumption Advisories

States issue fish consumption advisories to protect the public from ingesting harmful quantities of toxic pollutants in contaminated fish and shellfish. In general, advisories recommend that the public limit the quantity and frequency of fish consumption from specific waterbodies. The States tailor individual advisories to minimize health risks based on contaminant data collected in their fish tissue sampling programs. Advisories may completely ban fish consumption in severely polluted waters or limit fish consumption to several meals per month or year in cases of less severe contamination. Advisories may target a subpopulation at risk (such as children, pregnant women, or

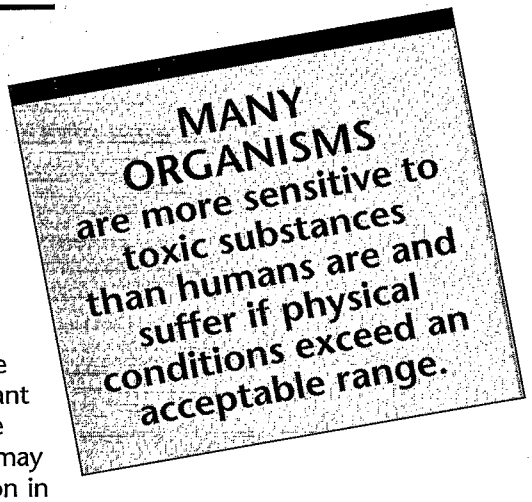
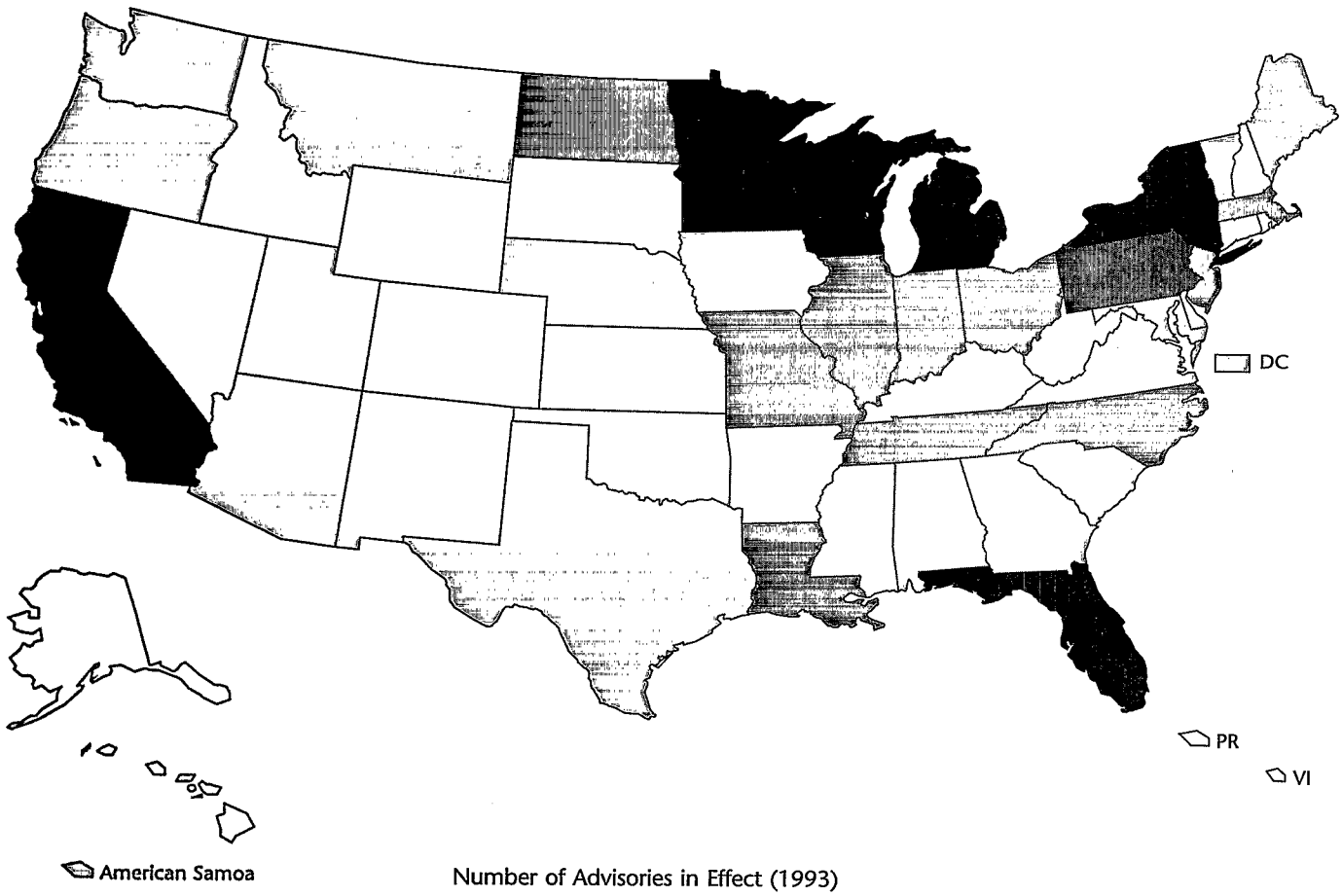


Figure 7-1

Fish Consumption Advisories in the United States



Note: States that perform routine fish tissue analysis (such as the Great Lakes States) will detect more cases of fish contamination and issue more advisories than States with less rigorous fish sampling programs.

Based on data contained in the EPA Fish Consumption Advisory Database as of September 1993 (see Appendix E, Table E-1, for individual State data).

nursing mothers), specific fish species that concentrate toxic pollutants in their flesh, or larger fish within a species that may have accumulated higher concentrations of a pollutant over a longer lifetime than a smaller (i.e., younger) fish.

EPA evaluates the national extent of toxic contamination in fish and shellfish by counting the total number of waterbodies with consumption advisories in effect. For this year's Report to Congress, EPA used information from its new Fish Consumption Advisory Database to tabulate the number of State advisories. EPA built the database to centralize fish consumption advisory information separately maintained in various State agencies and the U.S. Fish and Wildlife Service.

The 1993 EPA Fish Consumption Advisory Database listed 1,279 advisories in effect in 47 States (Figure 7-1). The database counts one advisory per waterbody, regardless of the number of species affected and the number of toxic pollutants detected at dangerous concentrations in fish sampled within a waterbody (see Appendix E, Table E-1, for individual State data).

EPA cannot identify States with a high proportion of toxic contamination based solely on the number of fish consumption advisories issued by each State. National statistics on advisories are difficult to interpret because the intensity and coverage of State monitoring programs vary widely from State to State. Simply comparing the total number of fish advisories in each State unfairly penalizes States with superior toxicants monitoring programs that often use strict criteria for issuing consumption warnings. The EPA has advocated consistent criteria and methods for issuing fish consumption advisories in several publications released from 1991 to 1993 (see sidebar, page 89).

Mercury, PCBs, chlordane, dioxins, and DDT (with its byproducts) caused more than 93% of the fish consumption advisories in 1993 (Figure 7-2). EPA and the States have banned or restricted the use of PCBs, chlordane, and DDT for over a decade, yet these organochlorine compounds persist in the sediments and still threaten public health.

Because some fish species migrate considerable distances, it is often difficult to identify sources of pollutants causing fish consumption advisories. Migratory fish may be exposed to toxic pollutants in the sediments and water column or may ingest toxic contaminants concentrated in prey miles from the sampling areas where they are collected. In this reporting period, only

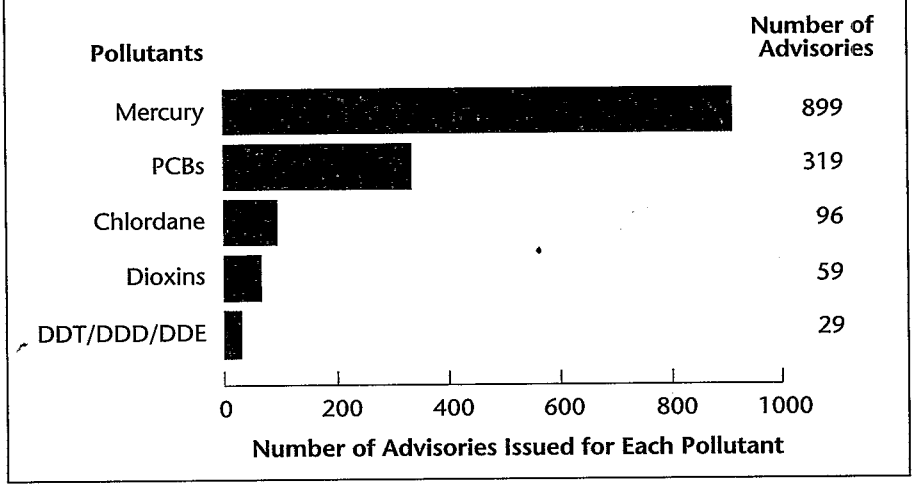
THE EXTENSIVE MIGRATION of some fish species complicates efforts to identify sources of pollutants.

93%

of advisories were caused by mercury, PCBs, chlordane, dioxins, and DDT and its byproducts.

Figure 7-2

Pollutants Causing Fish Consumption Advisories



Based on data contained in Appendix E, Table E-2.

The National Study of Chemical Residues in Fish (NSCRF)

This study, formerly called the National Bioaccumulation Study, was a one-time screening study undertaken by EPA to determine the prevalence of selected bioaccumulative pollutants in fish and identify sources of these pollutants. The NSCRF study began in 1986 as an outgrowth of the EPA's National Dioxin Study, a nationwide investigation of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) contamination in soil, water, sediment, air, and fish. Some of the highest concentrations of 2,3,7,8-TCDD detected in the National Dioxin Study were found in fish tissue. EPA's concern that there may be other toxic pollutants bioaccumulating in fish that may pose a risk to human health was the primary reason for conducting the NSCRF. Additionally, this study was conducted in response to a petition from the Environmental Defense Fund and the National Wildlife Federation in which EPA committed to conducting a fish contaminant monitoring survey of the occurrence of chlorinated dibenzodioxins and dibenzofurans. Fish and other aquatic biota serve as sentinels that indicate whether substances are bioaccumulating and that signal acutely toxic conditions and stresses, such as sublethal toxicity, particularly due to interactions among chemicals.

Toxic pollutants were selected for analysis in the NSCRF based on their

- potential to bioaccumulate in fish
- potential for causing human health effects
- persistence in the environment
- detectability in fish tissue.

An initial list of 403 pollutants was screened, resulting in a final list of 60 compounds. These compounds included 15 dioxins and furans, 10 polychlorinated biphenyls (PCBs), 21 pesticides/herbicides, mercury, biphenyl, and 12 other organic compounds.

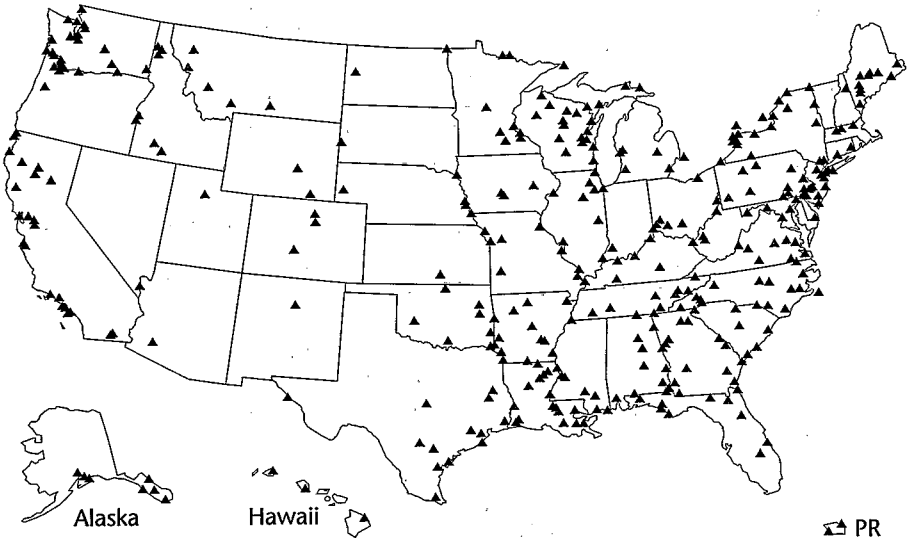
Three to five adult fish of the same species and of similar size were collected at each site. At most locations, both a composite sample of a bottom-feeding fish species (e.g., carp, channel catfish, white sucker) and a composite sample of a predatory gamefish (e.g., walleye, largemouth bass, smallmouth bass) were collected. Although 119

different finfish species were collected, most of the fish belonged to only 14 different species.

Fish were collected at a total of 388 unique sites throughout the United States selected by EPA Regional and State staff. The types of sites sampled included 315 targeted sites near potential point or nonpoint sources of pollution where contamination of fish was suspected, 34 background sites where chemical contamination was not anticipated, and 39 sites that were a subset of sites from the United States Geologic Survey NASQAN network (see map).

Target sites were selected based on proximity to potential sources. Fish and other aquatic biota were sampled near industrial discharges, urban areas, or areas receiving agricultural runoff. The number of sites was not allocated equally among types of sources. Some of the targeted sites were selected based on potential chlorinated dioxin and furan contamination. These sites included areas near pulp and paper mills using chlorine to bleach pulp, wood preservative facilities, users of polychlorinated phenols and phenoxides, PCB dischargers, organic chemical and pesticide manufacturers, and combustion sources (sewage sludge and municipal refuse

Location of Bioaccumulation Study Sampling Sites



incinerators). More sites with potential dioxin/furan contamination were selected than any other chemical groups to follow up on results of the National Dioxin Study.

Fish samples were analyzed at the EPA Environmental Research Laboratory (ERL) in Duluth, Minnesota. In general, the bottom-feeding species were analyzed as whole-body samples to determine the occurrence of the study chemicals and the gamefish were analyzed as fillets to indicate the potential risks to human health from fish consumption.

The study revealed that seven dioxins/furans/congeners were detected in samples from more than 50% of the sites surveyed.* Pulp and paper mills using a chlorine-bleaching process were identified as the dominant source of 2,3,7,8-TCDD and 2,3,7,8,-tetrachloro-dibenzofuran (2,3,7,8-TCDF). Statistical correlation analyses were less definitive for the other dioxins/furans in that results showed no dominant source for any of these chemicals.

The study also showed that six pesticides, PCBs, three other industrial organic chemicals, and mercury were detected at more than 50% of the sites surveyed. Results for the other 45 chemicals studied showed no single dominant source for any of these chemicals. Although these compounds showed no dominant source, a number of observations can be made from review of the data. Two such observations involve pesticides and PCBs. A comparison of 15 agricultural and 20 background sites for 10 of the pesticides evaluated showed no significant differences between these categories. This same comparison for four other pesticides (DDE, nonachlor, chlordane, and lindane) showed that fish contamination levels were significantly higher at sites near agricultural sources. The median PCB concentration for the 20 background sites was below detection (1.25 to 6.25 parts per billion depending on the degree of chlorination) compared with values of 213 to 525 parts per billion for industrial/urban sites, paper mills using chlorine, refinery/other industry sites, nonchlorine paper mills, and Superfund sites.

*The presence of pollutants alone does not mean that risk does or does not exist at the site. EPA is currently reassessing the health effects associated with dioxins and furans and, as a consequence, has not yet evaluated the relative health and environmental risks associated with these pollutants.

23 States identified specific sources of toxicants causing less than 11% of the reported fish consumption advisories (Figure 7-3). These States attributed fishing restrictions to industrial discharges, agriculture, urban runoff, storm sewers, resource extraction, natural conditions, and atmospheric deposition (see Appendix E, Table E-3, for individual State data).

At this time, EPA cannot detect trends in toxic contamination of fish and shellfish because the States have not established a baseline inventory of advisories and the contaminant levels that trigger advisories may vary from State to State. The States inevitably issue new advisories as they sample more sites and identify toxic contamination that previously went undetected.

Drinking Water Restrictions

Four States reported cases of surface drinking water supply closures and advisories due to priority pollutant chemicals, oil, and cyanide (see Appendix E, Table E-4, for individual State data). Chemical plant spills, an oil spill at a power plant, and priority pollutants from hazardous waste disposal sites caused the closures.

Recreational Restrictions

Three States listed contact recreation restrictions (such as beach closures) due to toxics. Tennessee closed two sites where toxicants were detected in the sediment and water column. Ohio restricted access to seven recreational sites with elevated concentrations of PCBs, dioxin,

EPA Publications About Fish Consumption Advisories

Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories. Volume 1: Fish Sampling and Analysis. 1993. EPA 823/R-93-002. Office of Water, Office of Science and Technology, Washington, DC.

Proceedings from National Workshop on PCBs in Fish Tissue, May 11-12, 1993. In preparation. Office of Water, Washington, DC.

National Study of Chemical Residues in Fish. Volume 1. 1992. EPA 823/R-92-008a. Office of Water, Office of Science and Technology, Washington, DC.

National Study of Chemical Residues in Fish. Volume 2. 1992. EPA 823/R-92-008b. Office of Water, Office of Science and Technology, Washington, DC.

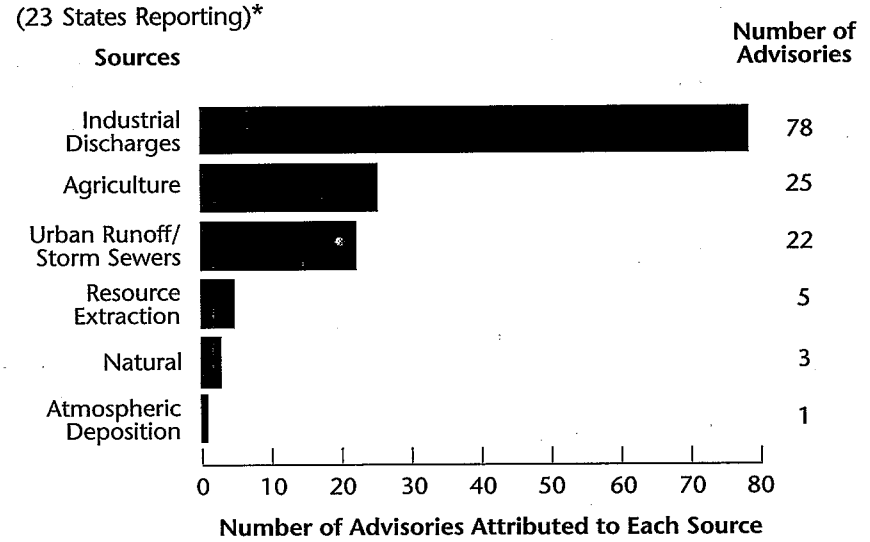
Consumption Surveys for Fish and Shellfish: A Review and Analysis of Survey Methods. EPA 822/R-92-004. Office of Water, Washington, DC.

Environmental Monitoring and Assessment Program (EMAP) Near Coastal Program Laboratory Methods for Filleting and Compositing Fish for Organic and Inorganic Contaminant Analyses. 1991. Draft. Office of Research and Development, Environmental Research Laboratory, Narragansett, RI.

Figure 7-3

Sources of Contaminants Causing Fishing Advisories

(23 States Reporting)*



Based on data contained in Appendix E, Table E-3.

*Only 23 States reported sources of contaminants causing less than 11% of the 1,279 fish consumption advisories reported nationwide.

mirex, chlordane, and polynuclear aromatic hydrocarbons (PAHs). Louisiana reported that abandoned hazardous waste sites impacted recreational waters (see Appendix E, Table E-5, for individual State data).

Bacterial and Viral Contamination

Waterborne viral and bacterial pollutants may also cause serious human illness and death. People can contract infectious hepatitis, gastroenteritis, dysentery, and cholera from waters receiving inadequately treated sewage. Bacteria and viruses may enter human systems through contact with contaminated swimming and bathing waters or through ingestion of contaminated drinking water or shellfish.

Table 7-1. Shellfish Harvesting Restrictions Reported by the States

State	Number of Waterbodies with Restrictions	Area Affected (sq. miles)
Alabama	4	373
Alaska	0	0
California	—	—
Connecticut	17	122
Delaware	17	—
Delaware River Basin	2	42
District of Columbia	1	6
Florida	—	—
Georgia	6	86
Hawaii	—	—
Louisiana[a]	—	297
Maine	258	—
Maryland	33	188
Massachusetts	—	—
Mississippi	—	605
New Hampshire	11	19
New Jersey	—	—
New York	67	306
North Carolina	—	59
Oregon	8	56
Rhode Island	48	53
South Carolina	86	304
Texas	25	663
Virginia	69	276
Virgin Islands	—	—
Washington	—	—
Totals	652	3,455

[a] Louisiana reports three permanent closures due to potential pollution from industry, but does not report the number of waterbodies periodically closed by other sources.

Source: 1992 State Section 305(b) reports.

— Not reported.

Shellfish Contamination

Contaminated shellfish pose a public health risk particularly to those who consume raw shellfish. Shellfish, such as oysters, clams, and mussels, extract their food (plankton) by filtering water over their gills. In contaminated waters, shellfish accumulate bacteria and viruses on their gills and mantle and within their digestive systems. If shellfish grown in contaminated waters are not cooked properly, consumers may ingest live bacteria and viruses.

To protect public health, coastal States routinely monitor shellfish harvesting areas for bacterial contamination and restrict shellfish harvests in contaminated waters. Most often, States measure concentrations of fecal coliform bacteria such as *Enterococcus or Escherichia coli*, which are nonpathogenic bacteria that populate human digestive systems and waste products. Their presence in water samples is an indicator of sewage contamination that may pose a human health risk from pathogenic viruses and bacteria. Fecal coliforms, however, may exceed criteria even when no human sewage is present because birds and nonhuman mammals also excrete them.

States issue several types of shellfish harvesting restrictions:

- **Prohibited Waters** violate criteria consistently; therefore, shellfish cannot be harvested at any time.

- **Restricted Waters** may be harvested if the shellfish are transferred to clean waters to reduce concentrations of bacteria.

- **Conditionally Approved Waters** temporarily exceed bacteriological criteria following predictable events (such as a storm). Shellfish from these waters may be harvested when criteria are met.

Nineteen of the 29 coastal States and Territories provided information on shellfish harvesting restrictions in their 1992 Section 305(b) reports (Table 7-1). Eighteen of these States prohibit, restrict, or conditionally approve shellfish harvesting in more than 3,455 square miles of estuarine waters. Maine and Delaware reported 275 harvesting restrictions but did not report the size of their estuaries affected by the restrictions.

Only nine States identified specific sources contaminating shellfish waters with pathogens (Figure 7-4). These States cited urban runoff and storm sewers as the source of 143 shellfish harvesting restrictions (see Appendix E, Table E-6, for individual State information). Municipal discharges caused bacterial contamination at 60 sites, marinas impacted 51 sites, and industrial discharges affected 40 sites.

The EPA cannot draw firm national conclusions from shellfish restriction data because the States issue shellfish harvesting restrictions based on varying bacteriological criteria. The quality of State shellfish monitoring programs also varies. Therefore, States with strict bacteriological criteria and progressive monitoring programs appear to have more polluted estuarine waters than other States that may monitor less vigorously or use less stringent criteria.

Drinking Water Restrictions

Pathogens seldom cause complete closures of drinking water supplies because disinfection procedures (such as chlorination or boiling) usually eliminate pathogenic contamination. In most cases of bacterial contamination, water officials temporarily advise consumers to boil or chemically treat their drinking water rather than to stop consumption.

Only six States and Puerto Rico reported drinking water restrictions

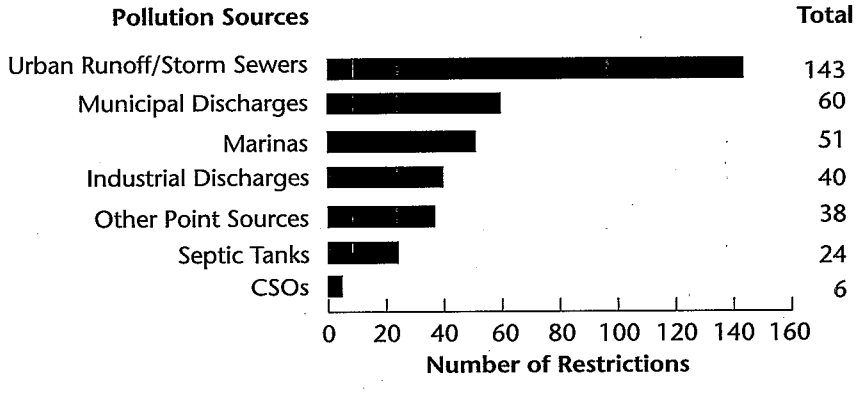
States

cited urban runoff and storm sewers as the leading source of shellfish restrictions

Figure 7-4

Sources Associated with Shellfish Harvesting Restrictions

(9 States Reporting)



Based on data contained in Appendix E, Table E-6.

caused by pathogens (see Appendix E, Table E-4, for individual State information). These States and Puerto Rico blamed drinking water treatment plant malfunctions and raw sewage discharges for elevating bacterial concentrations above safe drinking water standards.

Recreational Restrictions

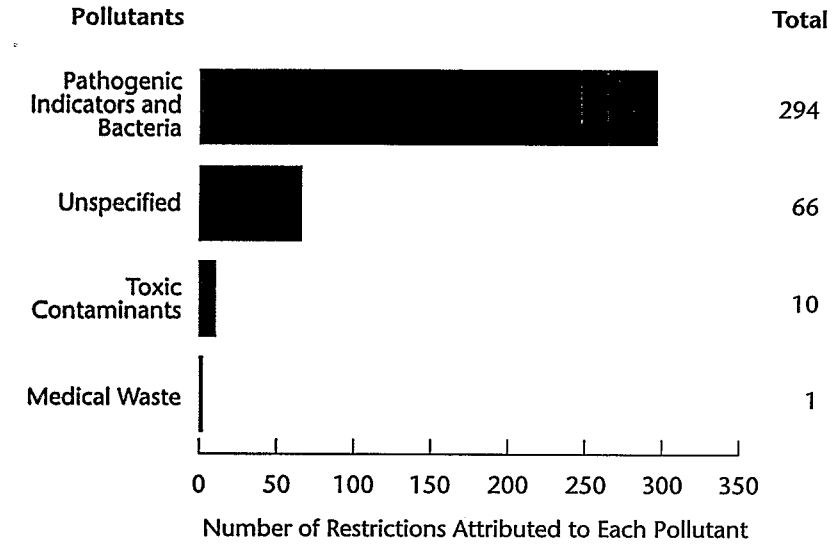
Pathogenic indicators cause most contact recreation restrictions, such as beach closures (Figure 7-5). Thirty-six States provided information on 371 recreation restrictions (see Appendix E, Table E-5, for individual State data). Twenty-five of these States restricted recreational activities in 294 cases because bacteria concentrations exceeded public health criteria. Only three States reported recreational restrictions due to toxics and only one State (New Mexico) reported a recreational closure due to medical waste on the shores of a reservoir. Six States reported that they did not restrict activities at any recreational sites during the 1991-1992 reporting cycle.

36 States
provided information on recreation restrictions.

Figure 7-5

Pollutants Causing Recreational Restrictions

(36 States Reporting)



Based on data contained in Appendix E, Table E-5.

Aquatic Ecosystem Concerns

Toxic Pollutants

Many indigenous aquatic organisms are more sensitive than humans to toxic pollutants. In severe cases of contamination, toxicants destroy the aquatic ecosystem; in less severe cases, toxicants alter the species composition in aquatic ecosystems. The aquatic system deteriorates as toxic contaminants poison aquatic organisms (including fish, shellfish, benthic bottom-dwelling organisms, and plants), increase their susceptiblility to disease, interfere with their reproduction, or reduce the viability of their young. Toxic pollutants also disrupt the chemical and physical balance in an aquatic ecosystem and indirectly cause mortality.

Aquatic toxicants fall into four broad categories:

- Metals (such as copper, cadmium, and mercury)
- Priority organic chemicals, including pesticides and numerous solvents (such as toluene and benzene)

- Other petrochemical hydrocarbons (such as oil and grease)
- Nonconventional toxics (such as ammonia and chlorine).

Physical and Chemical Conditions

Mortality of aquatic life from depleted oxygen concentrations, excessive temperatures, or high acidity can exceed the impact of toxic pollutants in aquatic habitats. Organic pollutants impose a biological oxygen demand (BOD) on receiving waters because bacteria consume oxygen as they decompose organic wastes. Nutrients also may indirectly deplete oxygen concentrations by feeding algal blooms.

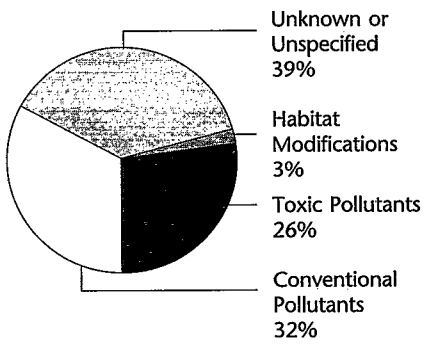
Acidity (the concentration of hydrogen ions) drives many chemical reactions in living organisms. The standard measure of acidity is pH, and a pH value of 7 represents a neutral condition. A low pH value (less than 5) indicates acidic conditions; a high pH value (greater than 9) indicates alkaline conditions. Many biological processes (such as reproduction) cannot function in either acidic or alkaline waters. High acidity also aggravates toxic contamination problems because sediments release toxicants in acidic waters. Common sources of acidity include mine drainage, runoff from mine tailings, and atmospheric deposition.

Fish Kills Caused by Pollution

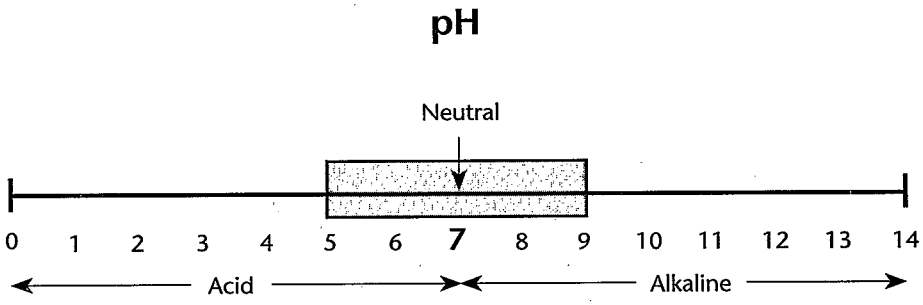
The number of fish kills provides a limited picture of pollutant impacts on aquatic life. In general, fish kill data track sporadic pollution events (such as chemical spills) rather than chronic pollution problems. Data collection methods also bias the data toward identifying kills in populated areas because most States acquire leads on fish kills from the public (such as anglers, hikers, and boaters). Fish kills in remote areas may go undetected and unreported.

Forty-three States reported that pollution caused 930 fish kills during 1990 and 1991 (Figure 7-6). More than 5 million fish died during these events (see Appendix E, Table E-7,

Causes of Pollution-Related Fish Kills
(43 States Reporting)



Based on data contained in Appendix E, Table E-7.



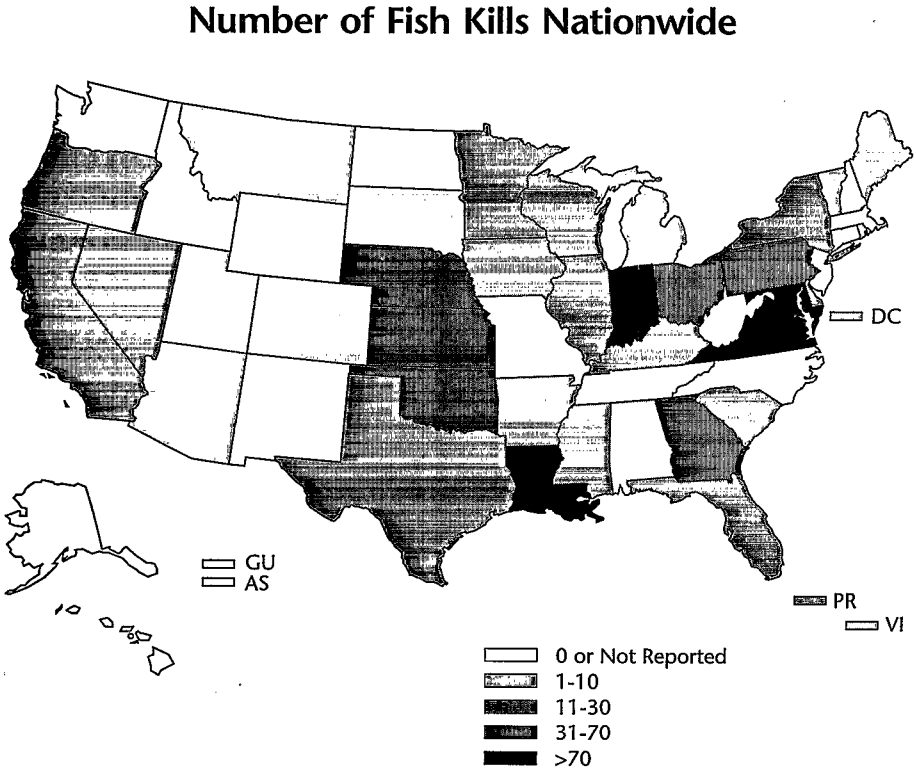
Most aquatic organisms cannot live outside a pH range of 5-9.

for individual State data). Toxic pollutants (including ammonia and chlorine) caused 26% of these fish kills. Conventional pollutants (including BOD, pH, suspended solids, temperature, and oil and grease) caused 32% of the reported fish kills, and habitat modification caused 3% of the reported fish kills. The States could not determine the cause of 39% of the fish kills. Fish kill investigations often fail to identify causes and sources because currents can carry dead fish downstream from the pollutant source before the kill is observed.

In some cases, toxicants trigger conventional pollutant impacts. For example, Florida reported that herbicide applications, in conjunction with high temperatures and heavy rainfall, depressed oxygen concentrations and suffocated over 45,000 fish in Lake Rousseau. The toxic herbicide caused heavy die-off of aquatic weeds, and bacteria depleted oxygen concentrations as they decomposed the dead weeds.

Thirty-nine States identified specific pollutants causing fish kills. These States attributed most fish kills to BOD and depressed oxygen

Figure 7-6



Based on data contained in Appendix E, Table E-7.

concentrations, pesticides, and a combination of manure and silage (Figure 7-7 and Appendix E, Table E-8). Manure and silage contain ammonia, which is lethal to fish, and organic substances, which increase biological oxygen demand.

Thirty-seven States listed sources of pollutants causing fish kills (Figure 7-8). Natural sources (such as high temperatures) caused the greatest number of fish kills, followed by agriculture, industrial discharges, municipal discharges, other spills (such as trucks), and pesticide applications (Appendix E, Table E-9). Pesticide applications include intentional algicide and herbicide applications on lakes to control algae and weeds.

Sediment Contamination

Most waterborne toxic pollutants settle to the bottom and bind to sediments or organic material or remain in solution in the interstitial water between the sediment particles. Bacteria degrade some toxicants in sediments, but many toxic contaminants (such as metals) persist in sediments for many years after the original toxic source has been eliminated. Contaminated sediments may reintroduce toxicants into the water column for decades.

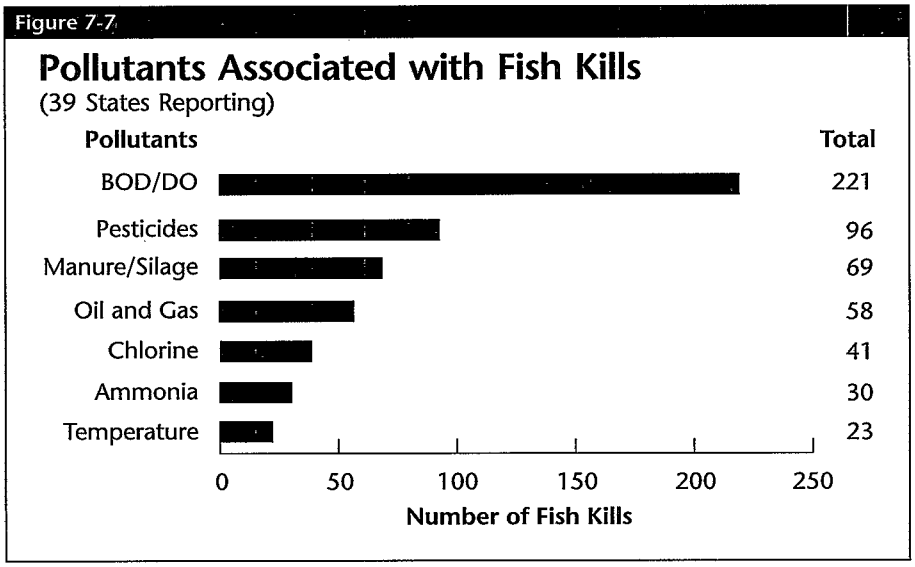
Dredging contaminated sediments may also reintroduce toxicants into the water column and food web. Due to these impacts, sediment contamination can obstruct maintenance dredging of harbors and navigation channels. Dredge spoil disposal methods (such as open water dumping, spreading on "reclaimed" lands, and diked containment areas) may also create new aquatic life threats.

Currently, no national criteria are in effect that define harmful concentrations of pollutants in sediment. However, EPA released draft sediment criteria for five pollutants (endrin, dieldrin, phenanthrene, fluoranthene, and acenaphthene) in January 1994 for public comment and plans to publish final criteria for the five toxicants in 1995 after responding to final comments. EPA also intends to publish additional sediment criteria for two or three pollutants each year beginning in 1994 and propose methods for deriving sediment quality criteria for metals in 1994.

In 1992, 27 States reported incidents of sediment contamination in their 305(b) reports (see Appendix E, Table E-10, for individual State data). Several States preferred not to list contaminated sites until EPA publishes national criteria for screening sediment data. Other

39 States
identified specific pollutants causing fish kills

Figure 7-7



Based on data contained in Appendix E, Table E-8.

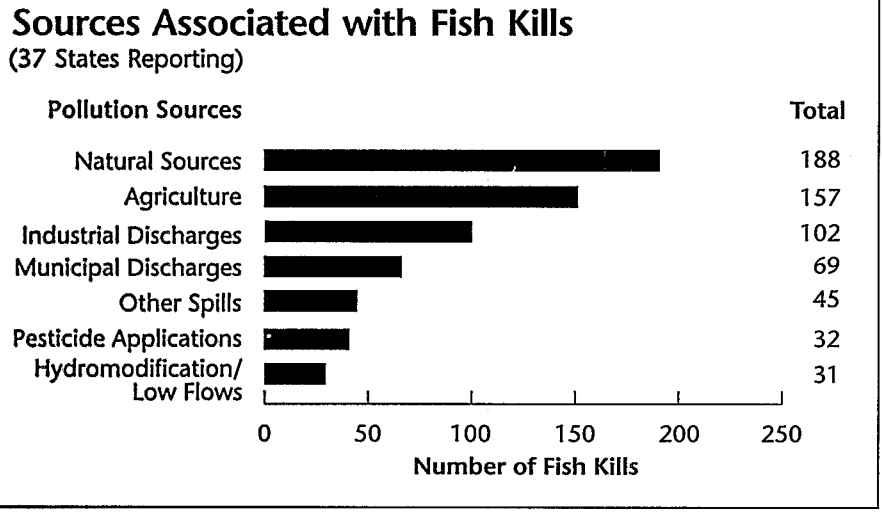
States lack the analytical tools and resources to conduct extensive sediment sampling and analysis. Therefore, the following discussion probably understates the extent of sediment contamination in the Nation's surface waters.

Twenty-seven States listed 770 separate sites with contaminated sediments and identified pollutants detected in sediments. These States most frequently listed metals (e.g., mercury, cadmium, and zinc), PCBs, DDT (and its byproducts), chlordane, and priority organics. These States also identified industrial and municipal discharges (past and present), landfills, resource extraction, abandoned hazardous waste disposal sites, and combined sewer overflows as the primary sources of sediment contamination.

EPA is developing the following guidance and information sources to provide States with better tools for assessing and managing sediment contamination:

- A compendium of sediment assessment methods (Fall 1992)
- Sediment criteria for toxicants (beginning in 1993)
- National Inventory of Sediment Contaminant Sources (Spring 1993)
- Sediment Remediation Methods (Spring 1993)
- EPA's Sediment Management Strategy will focus the Agency's resources on preventing, remediating, and managing disposal of dredged contaminated sediments (Spring 1993)
- A testing manual for evaluating sediment disposal in inland waters under Section 404 of the Clean Water Act (Fall 1993)
- Guidance documents describing methods for conducting acute toxicity tests, chronic toxicity tests, and bioaccumulation tests for sediments (Fall 1993)
- A national database of contaminated sediment sites (late 1993)

Figure 7-8



Based on data contained in Appendix E, Table E-9.

A 1989 National Academy of Sciences Report on contaminated marine sediments concluded that the effects of sediment contamination are potentially far-reaching. This report found that contamination of marine sediments poses a potential threat to marine resources and human health (through consumption of seafood) in numerous sites around the country – particularly near metropolitan areas.

Source: *Contaminated Marine Sediments – Assessment and Remediation*, Committee on Contaminated Marine Sediments, Marine Board, Commission on Engineering and Technical Systems, National Research Council, National Academy Press, 1989.

■ Methods for deriving sediment quality criteria for heavy metals (late 1993).

Total Waters Affected by Toxic Pollutants

Responding to public concern about toxic pollutants, EPA requested that States track the overall extent of toxic contamination in their surface waters. Forty-eight States reported the size of waters monitored for toxicants (either in the water column, sediments, or aquatic organisms) and the total waters found to contain elevated concentrations of toxic pollutants (see Figure 7-9 and Appendix E, Table E-11, for individual State data).

Forty-six States reported that they monitored toxicants (primarily in the water column) in almost 600,000 miles of rivers and streams. These States monitored 17% of the Nation's 3.5 million river miles for toxic contamination. The States detected elevated concentrations of toxicants in only 8% of the monitored rivers and streams (Figure 7-10).

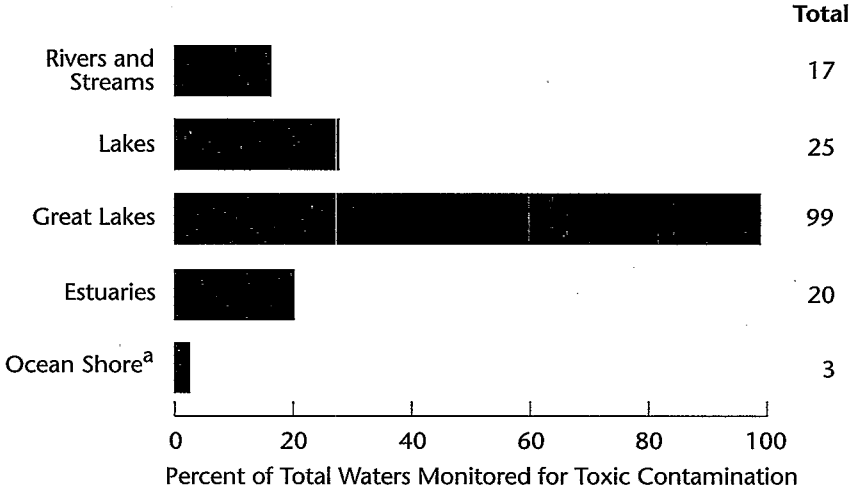
Forty-two States reported that they sampled toxicants in almost 10 million acres of lakes, reservoirs, and ponds. The monitored acres represent 25% of the Nation's 40 million lake acres. The States found elevated concentrations of toxicants in 43% of the sampled lake acres.

Eighteen coastal States sampled toxicants in 20% of the Nation's estuarine waters. These States detected elevated toxic concentrations

The results do not describe the extent of toxic contamination in all waters across the Nation because most toxic pollutants are found in the sediment and food chain, not in the water column.

Figure 7-9

Waters Monitored for Toxic Contamination



Based on data contained in Appendix E, Table E-11.

[a]Excluding the Alaska shoreline.

- River miles monitered: 600,000
- Total river miles: 3.5 million

- Lake acres monitored: 10 million
- Total lake acres: 39,950,000

- Estuarine waters monitored: 7,307 square miles
- Total estuarine waters: 36,000 square miles

- Great Lakes miles monitored: 5,319
- Total Great Lakes shore miles: 5,382

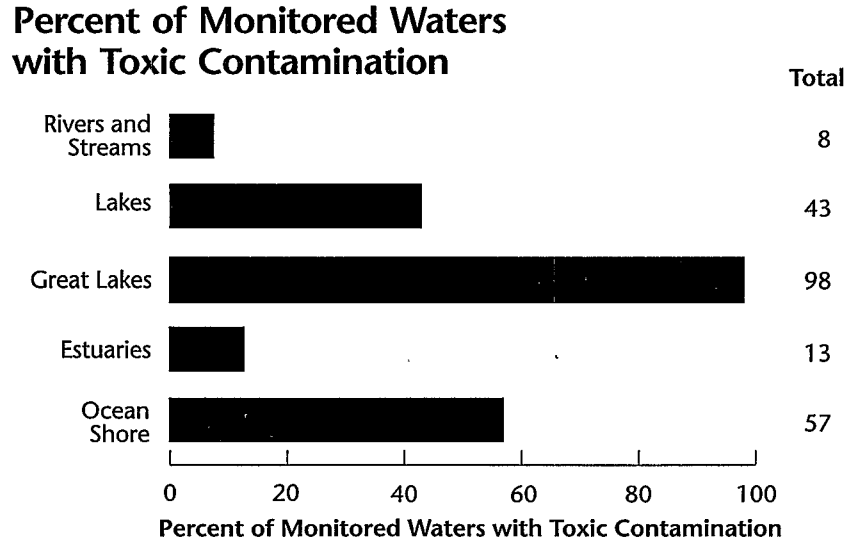
- Ocean shore miles monitored: 506
- Total ocean shore miles: 20,121 (excluding Alaska)

in 13% of the 7,307 square miles of estuarine waters that they sampled.

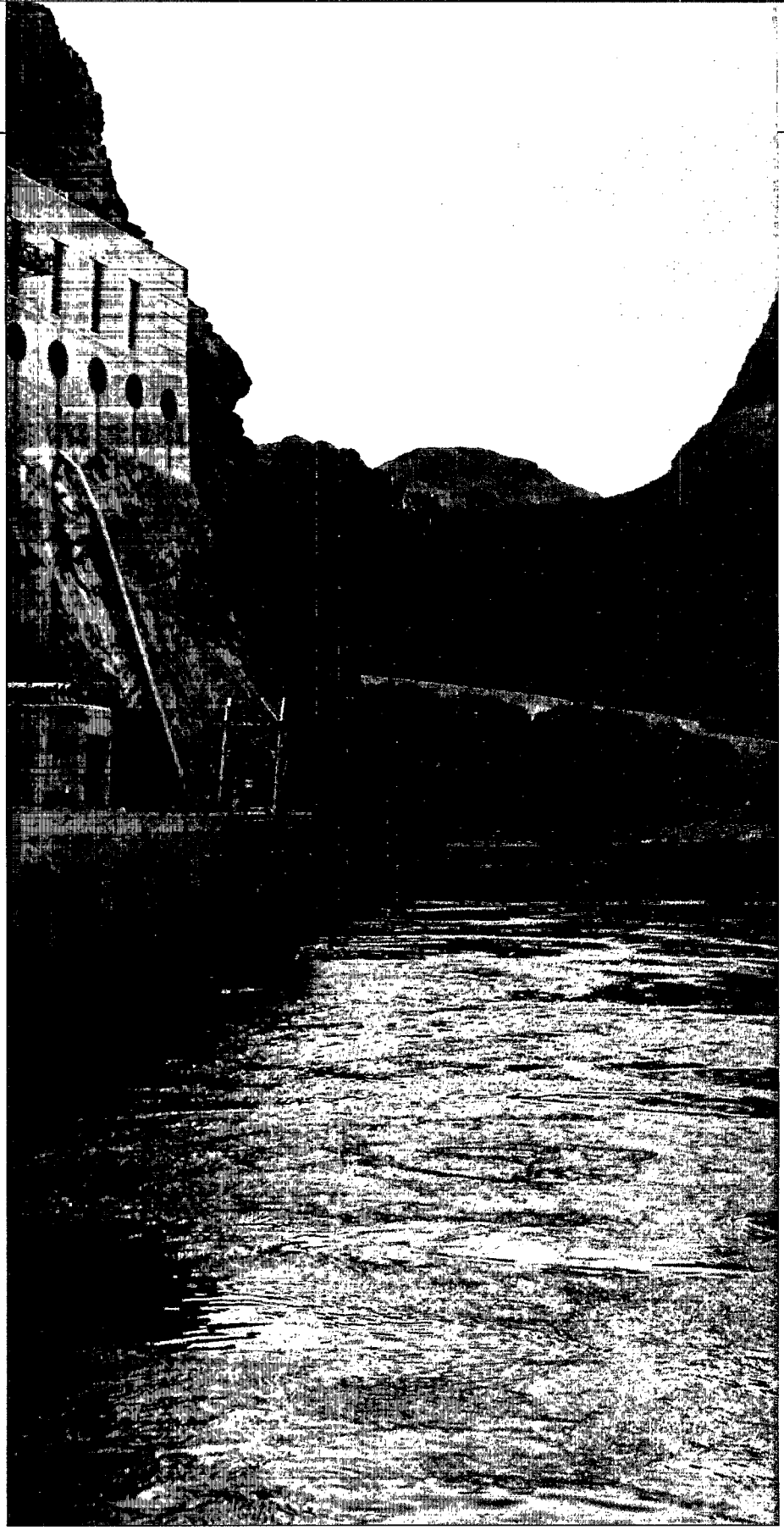
Only six States reportedly monitored toxicants in coastal waters. These States found elevated concentrations of toxicants in 57% of the sampled coastline, but this information cannot be applied nationally because the States monitored less than 3% of the Nation's coastal waters (excluding the Alaska shoreline).

Seven States reported that they monitored all of their Great Lakes' shoreline for toxicants (primarily in fish tissue samples) and detected elevated toxicants in 98% of the shoreline. Three States reported that they monitored toxicants in 167,178 acres of wetlands (less than one-tenth of 1%) of the Nation's wetlands. The States identified elevated concentrations of toxicants in 63% of the monitored wetlands.

Figure 7-10



Based on data contained in Appendix E, Table E-11.



Individual State Summaries

This section provides individual summaries of the data reported by the States, Territories, Interstate Water Basin Commissions, District of Columbia, and Gila River Indian Community in their 1992 Section 305(b) water quality assessments.

Variation among States in how these data are generated result from differences in pollution problems, monitoring priorities, and water quality criteria. Each State does not use the same method to measure use support and, in many instances, the standards against which use support is measured are different. Regional patterns of pollution also affect the data generated. In addition, some States have the funds for more sophisticated monitoring techniques while other States must rely on more conventional methods to identify pollutants of concern.

However, progress is being made in introducing consistency in assessment approaches to the 305(b) reporting process. In addition, statistically valid information on water quality status and trends in the Nation's waters will be collected in coming years by scientifically designed, broad-scale monitoring programs such as EMAP (see Chapter 10).

Alabama

For a copy of the Alabama 1992 305(b) report, contact:

Michael J. Rief
Alabama Department of Environmental Management
Water Quality Branch
1751 Congressman W. L. Dickinson Drive
Montgomery, AL 36130
(205) 271-7829

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	12,292 mi	72%	2%	18%	8%
Lakes	392,474 ac	49%	30%	20%	1%
Estuaries	343 mi^2	77%	—	22%	1%
Oceans	50 mi	100%	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 16% of river miles, 84% of lake acres, 56% of estuary square miles, and 100% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Agricultural runoff, municipal point sources, industrial point sources, and resource extraction impair rivers and streams with nutrients, siltation, organic materials, pathogen indicators, ammonia, pesticides, and metals. Industrial point sources impair more lake acres than any other source with priority organics and pathogen indicators. Pathogen indicators, primarily from storm sewers, urban runoff, and septic tanks, cause all of the use support violations in estuarine waters.

Programs to Correct Impairments

Alabama reduced toxic loadings into surface waters by 57 percent between 1989 and 1990. Additional reductions should result since Alabama's Department of Environmental Management (ADEM) adopted numeric standards for a broad range of toxic pollutants in 1991. All National Pollutant Discharge Elimination System (NPDES) permits issued since adoption of the numeric standards limit toxicant concentrations in wastewater discharges. (Prior to 1991, NPDES permits primarily regulated conventional pollutants, such as pH, fecal coliforms, and oxygen-demanding substances.)

ADEM is also initiating watershed projects that simultaneously address pollutants from multiple sources. The Bayview Lake Watershed Project, for example, employs artificial wetlands treatment technology to address urban runoff, acid mine drainage from coal mine tailings, and pollution from an industrial landfill.

Programs to Assess Water Quality and Program Effectiveness

ADEM is assessing habitats and resident biota at several candidate streams in order to establish reference sites for future biological monitoring.

Alaska

For a copy of the Alaska 1992 305(b) report, contact:

Earl Hubbard
Alaska Department of Environmental Conservation
410 Willoughby Street - Suite 105
Juneau, AK 99801-1795
(907) 465-2653

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	4,054 mi	29%	—	32%	39%
Lakes	—	—	—	—	—
Estuaries	—	—	—	—	—
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 1% of river miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Urban runoff is the major source of impaired rivers and streams, followed by placer mining, petroleum products, and sources of sewage. Urban development is also the major source of pollution in 26 impaired lakes, followed by fuel and chemical leaks and spills, septic system failures, erosion, and agricultural sources of pesticides, fertilizers, and animal wastes. The State attributes impairments at 34 estuaries to harbor activities, urban development, oil and gas development, transportation, industrial sources, municipal sewage treatment plants, and silvicultural activities. Gas and oil development on the Kenai Peninsula and the North Slope have also impaired wetlands.

Programs to Correct Impairments

Alaska's Total Maximum Daily Load (TMDL) program will address pulp mills, the seafood processing industry, placer mining, timber harvesting, and urban runoff sources. The Alaska Department of Environmental Conservation (ADEC) received $120,000 in FY92 to assess and monitor activities in support of the TMDL program. The State also intends to revise its water quality standards to include criteria for numerous toxic pollutants.

Programs to Assess Water Quality and Program Effectiveness

The State operates intensive monitoring programs to evaluate water quality at sites on the State's list of impaired waters (which includes waters suspected of degradation). The State also initiated intensive monitoring programs to study the effects of placer mining, the Exxon Valdez oil spill, the Ketchikan Pulp Mill, and heavy metal contamination in Skagway Harbor. In 1991, ADEC established the Alaska Volunteer Water Watch program, and the new State Forest Practices program includes intensive monitoring of the effectiveness of best management practices implemented to control runoff from timber activities.

American Samoa

For a copy of the American Samoa 1992 305(b) report, contact:

Pat Young
Project Officer for American Samoa
U.S. EPA Region 9 MC E-4
75 Hawthorne Street
San Francisco, CA 94105
(415) 744-1591

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	—	—	—	—	—
Lakes	—	—	—	—	—
Estuaries	—	—	—	—	—
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

— None or not reported.

Causes and Sources of Water Quality Impairments

The waters of this Territory suffer from numerous manmade sources of pollution including discharges from tuna canneries, erosion and surface runoff, discharges of domestic wastewater, direct discharges from ocean-going vessels, and careless disposal of solid wastes. Visiting vessels and local inhabitants frequently dispose of solid wastes directly into the harbor where tides transport the wastes upstream. Many villages withdraw water for domestic use from these streams, which frequently do not meet safe drinking water standards. The government water system relies primarily on ground water, which is also at risk of contamination from failing sewage disposal systems and animal wastes.

Programs to Correct Impairments

In FY90, the Territory entered into a consent agreement with the two canneries discharging 95 percent of the nutrient load into Pago Pago Harbor. As a result of the agreement, the canneries implemented high-strength waste segregation and began discharging high nutrient wastes and sludge at an ocean dump site instead of into the Harbor. Since initiation of these changes, monthly measurements of total nitrogen and total phosphorus in the Harbor have decreased by as much as 50 percent. The Territory also initiated the Nonpoint Source Management Program that sponsors demonstrations of best management practices, a Well Head Protection Program, and public education projects. Specific projects demonstrate soil stabilization techniques, swine production practices that prevent manure from contaminating waters, and ground water protection controls.

Programs to Assess Water Quality and Program Effectiveness

The Territory samples water quality monthly at 12 of the Territories' 163 streams. Shortages of trained personnel, supplies, and equipment limit monitoring and analysis.

Arizona

For a copy of the Arizona 1992 305(b) report, contact:

Diana Marsh
Arizona Department of Environmental Quality
3033 North Central Avenue
Phoenix, AZ 85012
(602) 207-4545

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	4,461 mi	18%	7%	36%	38%
Lakes	121,058 ac	4%	23%	72%	1%
Wetlands	—	—	—	—	—

[a]Totals represent 3% of river miles and 94% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Agriculture is the predominant source of turbidity, sediment, and nutrients in rivers and streams. Habitat and hydrologic modification (including channelization, dredging, and dam construction) is also widespread in Arizona and impacts all types of waterbodies. Ground water pollution from inorganic compounds (i.e., nitrates, sulfates, and total dissolved solids), pesticides, and radiochemicals results from agricultural and mining activities, while volatile organic chemicals, petroleum, and microorganism contamination result from leaking underground storage tanks, landfills, and poor well construction.

Programs to Correct Impairments

Arizona's Nonpoint Source Water Quality Management Plan integrates regulatory and voluntary program components. Regulatory programs include general permits for nitrogen fertilizer applications and concentrated animal feeding operations, a Pesticide Contamination Prevention Program, draft Best Management Practices (BMPs) for grazing activities, and the Aquifer Protection Permit system. The Aquifer Protection Permit system requires permits for most activities that may impact ground water from point and nonpoint sources, including landfills, storage ponds, injection wells, mine leaching practices, septic tanks, recharge projects, and point source discharges to rivers. Monitoring is required by dischargers to show no violation of Aquifer Water Quality Standards. In addition, BMPs are required for nitrogen fertilizer applications.

Programs to Assess Water Quality and Program Effectiveness

Arizona's Department of Environmental Quality (ADEQ) and the U.S. Geological Survey (USGS) monitored ambient water quality at 62 sites in 1990-1991. Baseline biological, chemical, and physical monitoring will be conducted at over 100 less impacted, perennial stream sites for use in developing biocriteria for future assessments.

Arkansas

For a copy of the Arkansas 1992 305(b) report, contact:

Bill Keith
Arkansas Department of Pollution Control and Ecology
P.O. Box 8913
Little Rock, AR 72219-8913
(501) 562-7444

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	7,462 mi	49%	—	29%	22%
Lakes	355,063 ac	100%	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 8% of river miles and 67% of lake acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

Siltation and turbidity primarily from agricultural sources cause the majority of impairments in rivers and streams. Contamination of shallow domestic wells and springs by human and animal wastes is the most predominant ground water problem in the State.

Programs to Correct Impairments

The Arkansas Department of Pollution Control and Ecology listed impacts from the expansion of confined animal production as a special State concern in their 1992 305(b) report. The Arkansas National Pollutant Discharge Elimination System (NPDES) permit program regulates liquid wastes from the confined animal industry in addition to industrial point sources and municipal treatment plants. Farms with liquid waste handling and storage systems must obtain a State Water Permit. This rule applies to most swine and poultry layer operations and some dairy production facilities.

The Arkansas Nonpoint Source Pollution Management Plan also educates poultry, swine, and dairy producers about best management practices (BMPs) to prevent manure from entering streams and ground water. Under the program, the University of Arkansas Agricultural Extension Service provides soil testing and analyzes proper land application rates for animal wastes. The U.S. Department of Agriculture Soil Conservation Service prepares a waste management plan for individual facilities, and the Arkansas Soil and Water Conservation Commission and Districts provide financial assistance for animal producers to voluntarily implement the waste management plans.

Programs to Assess Water Quality and Program Effectiveness

Arkansas categorizes its waters into geographically defined ecoregions. Waterbodies within an ecoregion share similar physical, chemical, and biological features as well as major pollution problems arising from land use practices common throughout an ecoregion. The ecoregion approach enables the State to identify the predominant land use in each ecoregion that threatens water quality.

California

For a copy of the California 1992 305(b) report, contact:

Nancy Richard
California State Water Resources Control Board, M&A
Division of Water Quality
P.O. Box 944213
Sacramento, CA 94244-2130
(916) 657-0642

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	5,679 mi	13%	5%	77%	5%
Lakes	307,981 ac	7%	1%	92%	—
Estuaries	89 mi^2	—	4%	96%	—
Oceans	700 mi	90%	—	9%	1%
Wetlands	60,858 ac	1%	—	99%	—

[a]Totals represent 3% of river miles, 26% of lake acres, 12% of estuary square miles, 38% of ocean miles, and 26% of wetlands acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Pesticides and metals are the leading major cause of impairment in rivers, lakes, estuaries, bays, and harbors. Other causes of impairment in lakes are nutrients, siltation, suspended solids, and low dissolved oxygen. Pathogens are a moderate problem in many estuaries, and salinity and dissolved solids cause most ground water impairments. Agriculture dominates the list of major sources impairing rivers, estuaries, bays and harbors, and ground water, and land development, urban runoff, and habitat modifications are the leading sources of lake degradation.

Programs to Correct Impairments

As a result of toxicity test results, rice growers cooperated with the California Department of Food and Agriculture and modified rice cultivation practices. Improved pesticide management practices developed by the California Department of Pesticide Regulation and overseen by the Central Valley Regional Water Board decreased rice pesticide concentrations in the City of Sacramento's water supply by 99.5 percent.

Programs to Assess Water Quality and Program Effectiveness

Toxicity testing plays a central role in California's three Water Quality Control Plans, which establish standards for all surface waters in the State. The toxicity standards set minimum survival rates for test species exposed to test waters for acute (short-term) and chronic (long-term) periods. Currently, the State and Regional Water Boards are investigating toxicity testing protocols for nonpoint sources of water pollution in three major agricultural regions: the Sacramento Valley, the San Joaquin Valley, and the Imperial Valley. The Sacramento Valley study identified rice field pesticides as a source of toxicity in agricultural discharges to the Sacramento River and Delta.

Colorado

For a copy of the Colorado 1992 305(b) report, contact:

John Farrow
Colorado Department of Health
Water Quality Control Division
4300 Cherry Creek Drive, South
Denver, CO 80222-1530
(303) 692-3575

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	27,195 mi	84%	3%	4%	8%
Lakes	143,140 ac	85%	8%	7%	<1%
Wetlands	60 ac	100%	—	—	—

Causes and Sources of Water Quality Impairments

Metals are the most common pollutant identified in Colorado rivers not supporting designated uses. Agriculture and resource extraction are the leading sources impacting rivers. In lakes, nutrients and metals cause most impairments and major sources are agriculture, construction runoff, industrial discharges, and municipal discharges. Many of Colorado's shallow, unconfined aquifers are contaminated with nitrates and salts resulting from agricultural activities.

Programs to Correct Impairments

Water quality management in Colorado has evolved from a technology-based program into a program that relates specific control actions to water quality problems. Program goals focus on measurable improvements or maintenance of existing water quality. The State is giving more attention to nonpoint source pollution controls where it can be shown that stream standards will not be attained by additional point source controls at reasonable cost levels. Colorado's nonpoint source program provides education and supports watershed programs to restore water quality and demonstrate nonpoint source treatment techniques.

In 1990, the Colorado Legislature passed an agricultural chemicals ground water protection act (Senate Bill 126). The Act will be implemented by the Colorado Department of Agriculture with fees collected on fertilizer and agricultural chemical sales. The Department of Health will monitor ground water and the Colorado Extension Service will conduct education programs. If monitoring reveals ground water contamination, the Commissioner of Agriculture may designate an agricultural management area and initiate a tiered approach to solving the problem. The first tier consists of voluntary implementation of best management practices (BMPs). If BMP implementation fails to correct the ground water problem, mandatory rules and regulations may be developed.

Programs to Assess Water Quality and Program Effectiveness

In Colorado, 9,315 stream miles have been, or are being, routinely monitored. At least seven lakes have long-term monitoring programs that sample nutrients and other trophic state indicators.

Currently, Colorado lacks comprehensive data on ground water contamination. The Ground Water Unit is addressing the problem by developing a comprehensive ground water quality database that will contain data on organic and inorganic chemical concentrations, radionuclides, and agricultural chemicals. The State is collecting additional data on agricultural chemicals in ground water under several programs. In 1992, the State sampled 100 wells in the South Platte River Valley. Permanent wells will be established where ground water problems are identified, forming a statewide network. A Section 319 nonpoint source (NPS) grant supports additional ground water monitoring in agricultural areas. The program will provide background data and identify aquifers vulnerable to contamination by agricultural chemicals.

Connecticut

For a copy of the Connecticut 1992 305(b) report, contact:

Donald Gonyea
Bureau of Water Management PERD
Connecticut Department of
Environmental Protection
79 Elm Street
Hartford, CT 06106-5127
(203) 566-2588

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	893 mi	41%	20%	31%	8%
Lakes	43,407 ac	76%	11%	13%	—
Estuaries	600 mi^2	60%	<1%	39%	1%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 11% of river miles, 52% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Estuarine waters are primarily impacted by nutrients and indicator bacteria, with lesser impacts from conventional organic pollutants. The dominant sources of pollutants are: municipal sewage treatment plants, urban runoff, CSOs, in-place contaminants and agricultural activities. Rivers and streams are impacted by a combination of conventional organic and inorganic pollutants, toxics, indicator bacteria, nutrients, and associated dissolved oxygen problems. The dominant sources of pollutants are: municipal and industrial point sources, CSOs, in-place contaminants, and a variety of nonpoint sources. Lake water quality is primarily impacted by excessive nutrient loads associated with noxious plant growth and priority organics. The dominant sources of pollutants are: nonpoint sources, in-place contaminants, and municipal sewage treatment plants.

Programs to Correct Impairments

The State Clean Water Fund was created to address the costs of municipal sewage treatment plant upgrading and CSO abatement. The State NPDES program is streamlining and addressing discharge toxicity issues in accordance with revisions to State water quality standards. The State is designating significant resources to and has expanded the Clean Water Fund to include nonpoint source pollution control strategies.

Programs to Assess Water Quality and Program Effectiveness

Physical/chemical monitoring is conducted both in cooperation with the USGS ambient monitoring program and with specific State programs including: intensive surveys, ambient toxicity monitoring, and specific water quality surveys as needed. Ambient biological monitoring is conducted to assess biological community viability, and bioaccumulation monitoring is conducted for a variety of pollutants. The State participates in the Long Island Sound Study monitoring water quality trends and finfish population. In addition, the State compiles water quality data from other State agencies, local authorities, and water supply utilities.

Delaware

For a copy of the Delaware 1992 305(b) report, contact:

Sergio Huerta
Delaware Department of Natural Resources and Environmental Control
P.O. Box 1401
Dover, DE 19903
(302) 739-4590

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	802 mi	11%	1%	6%	82%
Lakes	2,805 ac	22%	8%	32%	38%
Estuaries	29 mi^2	—	—	—	100%
Oceans	25 mi	100%	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 25% of river miles, 73% of lake acres, 35% of estuary square miles, and 100% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Bacteria, nutrients, and toxics impact surface water quality in Delaware. Bacteria concentrations exceed swimming criteria at 93% of assessed rivers, 63% of assessed lake waters, and 70% of estuarine waters (excluding the Delaware River and Bay). Inadequately treated sewage from onsite systems and municipal treatment plants are of most concern. Industrial point sources are the major source of elevated zinc and copper concentrations. Nutrient contamination impairs 77% of rivers, 67% of lake waters, and 100% of estuarine waters (excluding the Delaware River and Bay). Primary sources of nutrients include agricultural runoff, municipal wastewater treatment plants, food processing plant discharges, and urban runoff.

Programs to Correct Impairments

The Delaware Department of Natural Resources and Environmental Control (DNREC) adopted a watershed approach for assessing and managing water quality. The watershed approach enables the DNREC to evaluate all pollutant sources impacting a waterbody and to determine the most effective and efficient methods for protecting water quality or abating existing problems. In 1991, DNERC also initiated the Sediment Control and Stormwater Management Program to prevent existing flooding and water quality problems from worsening. The four components of the program are:
(1) sediment control and stormwater management plan approval;
(2) inspections during construction;
(3) post-construction inspection of permanent stormwater facilities; and
(4) education and training.

Programs to Assess Water Quality and Program Effectiveness

The DNREC will conduct intensive surveys in the priority watersheds targeted for initial implementation of the watershed approach. The surveys integrate water quality sampling with hydrodynamic and hydrologic studies to determine pollutant mass loadings and transport.

Delaware River Basin Commission

For a copy of the Delaware River Basin Commission 1992 305(b) report, contact:

Warren Huff
Delaware River Basin Commission
P.O. Box 7360
West Trenton, NJ 08628-0360
(609) 883-9500

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	206 mi	—	100%	—	—
Lakes	NA	NA	NA	NA	NA
Estuaries	216 mi^2	—	100%	—	—
Oceans	NA	NA	NA	NA	NA
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles and 28% of estuary square miles.

NA = Not applicable.
— None or not reported.

Causes and Sources of Water Quality Impairments

Fish consumption use is not supported on 5.6 miles of the Delaware River and 22 square miles of the Delaware Estuary due to a fish advisory restricting consumption of fish contaminated with chlordane and PCBs. Forty-two square miles of Delaware Bay do not support shellfishing use because elevated concentrations of pathogen indicators restrict harvests. An area of acute toxicity also extends from the Bucks/Philadelphia County boundary downstream to the mouth of the Schuylkill River.

Programs to Correct Impairments

In 1991, the Commission initiated a special study to develop a comprehensive combined sewer overflow (CSO) assessment and control strategy for the Delaware Estuary. Combined sewers remain one of the last largely uncontrolled sources of water pollutants in the estuary. The 2-year study will determine critical flows, loadings, and impacts from the four CSOs discharging into the estuary. The study will also evaluate and model CSO functional designs and real-time operations. Surrounding land use patterns will be determined to estimate nonpoint source wasteloads. The study will estimate conventional and nonconventional pollutant impacts with several hydraulic and surface water quality models. Upon completion of the model studies, the Commission will evaluate alternative control strategies.

Programs to Assess Water Quality and Program Effectiveness

The Commission and the cooperating States initiated the Delaware Estuary Toxics Management Program in 1989 to control toxic substances discharged from point sources. During 1990, the cooperators established a toxics database to track the occurrence and magnitude of toxic pollutants in wastewater discharges, ambient waters, and sediments. The cooperators will use the database to establish water quality criteria for toxics.

District of Columbia

For a copy of the District of Columbia 1992 305(b) report, contact:

Dr. Hamid Karimi
Water Quality Monitoring Branch
Department of Consumer
and Regulatory Affairs
2100 Martin Luther King Jr.
Avenue, SW
Washington, DC 20032
(202) 404-1120

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	39 mi	—	—	9%	91%
Lakes	238 ac	—	—	—	100%
Estuaries	6 mi^2	—	—	—	100%
Wetlands	—	—	—	—	—

[a]Totals represent 21% of river miles, 100% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Elevated fecal coliform bacteria concentrations impair contact recreation uses in most district waters. Metals are a concern, especially in the District's smaller streams. Low dissolved oxygen concentrations resulting from organic enrichment impair most of the Anacostia River. Oil and grease, high pH, and priority organics also degrade District waters. The principal source of pollutants is urban runoff from storm sewers, combined sewer overflows, and surface runoff. Wastewater treatment plant effluent discharges are a major source of nutrients in the Potomac Estuary.

Programs to Correct Impairments

The District contracted the Metropolitan Washington Council of Governments (MWCOG) to study the feasibility of charging a fee when developers obtain a stormwater management waiver. Current stormwater regulations require all new development projects to control stormwater runoff with best management practices (BMPs). However, the District finds it difficult to apply traditional BMPs to sites undergoing development or redevelopment in the central city. Most traditional BMPs require more land than is available in the City. As a result, the District waives stormwater regulations at many sites under development. The study will investigate fees and recommend stormwater retrofit projects the District might implement with fees collected in lieu of stormwater management plans.

Programs to Assess Water Quality and Program Effectiveness

During the 1990-1992 reporting period, the District performed a small-scale rapid bioassessment of its tributaries and a land use monitoring project to assess nonpoint source pollutant loadings. The District also performed field sampling of toxics in sediments and planned to monitor effects of urban best management practices in 1992.

Florida

For a copy of the Florida 1992 305(b) report, contact:

Joe Hand
Florida Department of
Environmental Protection
Twin Towers Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400
(904) 921-9926

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	7,933 mi	64%	3%	23%	10%
Lakes	957,120 ac	31%	1%	56%	12%
Estuaries	2,730 mi^2	62%	1%	32%	6%
Oceans	902 mi	95%	—	4%	1%
Wetlands	—	—	—	—	—

[a]Totals represent 15% of river miles, 46% of lake acres, 64% of estuary square miles, and 11% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Many of the problems in Florida's surface waters can be attributed to industrial discharges and sources associated with residential development. Other important sources include agricultural runoff, domestic wastewater, and hydrologic modifications (including dam construction, channelization, dredging, and draining). Major sources of ground water contamination are underground storage tanks, agricultural activities, landfills, and septic tanks. Three agricultural chemicals (aldicarb, alachlor, and ethylene dibromide) have caused local and regional contamination problems. Other pollutants of concern include nitrates, petroleum products, and hazardous wastes.

Programs to Correct Impairments

In addition to controlling discharges with standard permit programs, Florida is pursuing reuse of wastewater discharges, primarily for irrigation use, and the use of wetlands for advanced treatment of wastewater plant discharges. Florida's Stormwater rule is the core of Florida's nonpoint source program. Regulations require all new developments to retain the first inch of runoff water in ponds to remove, theoretically, 80% to 90% of the sediment carried in the runoff. However, these rules are difficult to monitor and enforce.

Programs to Assess Water Quality and Program Effectiveness

During the reporting period, Florida planned to revise its biocriteria and initiated projects to develop freshwater macroinvertebrate sampling protocols and to refine the delineation of ecoregions in Florida. The State will conduct biological and chemical sampling at proposed ecoregion reference sites during wet and dry periods to determine the best quality invertebrate community present for the representative habitat and water chemistry.

Georgia

For a copy of the Georgia 1992 305(b) report, contact:

W. M. Winn, III
Georgia Environmental Protection Division
Water Quality Management Program
205 Butler Street, S.E.
Floyd Towers, East
Atlanta, GA 30334
(404) 656-4905

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	4,054 mi	29%	—	32%	39%
Lakes	394,802 ac	90%	—	7%	2%
Estuaries	854 mi^2	53%	—	—	47%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 6% of river miles, 94% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Pathogens and metals are major causes of impairments in rivers, lakes, and estuaries. Pesticides and pH also affect many lakes, and low concentrations of dissolved oxygen persist in estuarine waters. Industrial and municipal point sources, urban runoff, storm sewers, and industrial nonpoint sources generate most pollutants.

Programs to Correct Impairments

The Georgia Environmental Protection Division (EPD) pays significant attention to compliance and enforcement activities. During the reporting period, EPD issued 139 orders to municipalities for violations of NPDES permit requirements, collected $456,744 in related civil penalties, and imposed sewer connection bans on 42 municipalities. During the same period, DER issued 65 legal orders to industries for improperly treated discharges and collected $412,440 in related penalties. EPD issued 17 additional orders to private discharges and assessed their fines at $28,050. In addition, EPD issued 12 orders to resolve erosion and sedimentation problems and fined violators $41,000. Another 12 orders and fines of $65,000 resulted from investigations of hazardous spills.

Programs to Assess Water Quality and Program Effectiveness

During the reporting period, EPD added 16 sampling stations to the fixed station trend monitoring network, raising the number of sites to 145 stations. EPD conducted 26 intensive surveys of rivers, lakes, and estuaries and performed more than 600 compliance inspections of wastewater plant discharges. The State also performs aquatic toxicity testing to identify discharges that may require additional controls to eliminate toxic effects.

Gila River Indian Community

For a copy of the Gila River Indian Community 1992 305(b) report, contact:

Errol Blackwater
Gila River Indian Community
Water Quality Planning Office
Corner of Main and Pima Streets
Sacaton, AZ 85247
(602) 562-3203

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	196 mi	—	—	31%	69%
Lakes	153 ac	—	—	18%	82%
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles and 100% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

The Water Quality Planning Office suspects that rangeland management, agriculture, and upstream mining are the source of turbidity and siltation, salinity, and metals loading in the Gila River. Pathogens from onsite sewage disposal were detected in ground water and are the primary public health concern in the community. Other concerns include salinity and pesticides from large-scale agriculture and the limited potential for fuel and solvent leaks.

Programs to Correct Impairments

The Community's Water Quality Planning Office initiated a water quality control program by applying for Federal funding of a Wellhead Protection Strategy study. The proposed Wellhead Protection Strategy would identify the Community's most vulnerable water supplies and define a point source control program for wellhead protection areas. Point source controls will eliminate discharges that could reach ground water or provide incentives for rapid mitigation in cases where ground water is contaminated. The community needs funding to address existing pollution and potential degradation resulting from growth in the adjacent Phoenix metropolitan area and a planned large-scale expansion of agricultural activity on Community lands.

Programs to Assess Water Quality and Program Effectiveness

The Gila River Indian Community currently participates in a small-scale joint surface water monitoring effort with the Arizona Department of Environmental Quality (ADEQ). The program collects grab samples during runoff events in the Gila River to assess potential sulfate impacts from upstream mining operations. To assess overall water quality, the Community needs to establish quarterly sampling at sites on the Gila River, Thawnc Lake, and other ponds and ephemeral streams. The Community's Water Quality Planning Office has developed a ground water monitoring program consisting of 35 wells. Sampling from this program will establish the first comprehensive and reliable data set on ground water quality for the Community.

Hawaii

For a copy of the Hawaii 1992 305(b) report, contact:

Eugene Akazawa, Monitoring Supervisor
Hawaii Department of Health
Clean Water Branch
P.O. Box 3378
Honolulu, HI 96801
(808) 586-4309

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	105 mi	52%	48%	—	—
Lakes	—	—	—	—	—
Estuaries	874 mi^2	86%	12%	<1%	2%
Oceans	773 mi	81%	5%	3%	10%
Wetlands	51,802 ac	70%	30%	—	—

[a]Totals represent 42% of river miles, 100% of estuary square miles, 99% of ocean miles, and 100% of wetlands acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Degradation of Hawaii's waters occurs mainly in urban, populated areas. Nonpoint sources such as agricultural, industrial and urban runoff generate the largest amount of damage to the water quality of streams, rivers, estuaries and coastal waters. Impacts from nonpoint sources are especially high during the wet seasons when runoff increases significantly. Pesticide percolation is considered to be the most important source of ground water contamination.

Programs to Correct Impairments

In order to control soil erosion and sediment, county governments are required to enact ordinances which set erosion control standards for various types of soil and land uses. These ordinances also include criteria, techniques, and methods for control of erosion and sediment problems caused by land-disturbing activities. The State would like to enact ordinances that require the rating of pesticides on their potential to migrate through soil and into ground water. The use of pesticides that pose a threat to ground water quality would be prohibited. Until more stringent ordinances can be enacted, the State recommends using alternatives to pesticides, such as natural predators of pests or other biological controls. Also encouraged is the use of low-toxicity, degradable, nonpersistent chemicals for home gardens, landscaping, and golf courses.

Programs to Assess Water Quality and Program Effectiveness

The State and EPA jointly monitor priority pollutants in water, sediment, fish, and shellfish samples collected at sites with a high potential for toxic contamination as well as at recreationally important areas. The State is also concerned about the uncertainty associated with bacterial indicators of human fecal contamination.

Idaho

For a copy of the Idaho 1992 305(b) report, contact:

Don Zaroban
Idaho Department of Health and Welfare
Division of Environmental Quality
1410 North Hilton
Statehouse Mall
Boise, ID 83720
(208) 334-5860

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	12,987 mi	5%	3%	66%	26%
Lakes	418,529 ac	—	57%	9%	34%
Wetlands	—	—	—	—	—

[a]Totals represent 11% of river miles and 81% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Point sources impact only 7% of Idaho's surface waters, but nonpoint sources impair 57% of the State's surface waters. Agriculture, including grazing, has the greatest impact on rivers and streams, followed by road construction and maintenance, forest practices, and mining. The extent of impacts by these activities varies by region. Urban runoff, land disposal, and hydrologic modification also impact lakes.

Fine sediments, channel alteration, nutrients, elevated temperatures, acid mine drainage, vegetation removal, streambank destabilization, low dissolved oxygen concentrations, and organic loading impair aquatic life in Idaho's waters. Recreational uses are impaired by bacteria and hydrologic modification. Bacteria, radionuclides, inorganic compounds, volatile organic compounds, and turbidity impair drinking water supply uses.

Programs to Correct Impairments

The Idaho Forest Practices Act contains approved best management practices (BMPs) for controlling water quality impacts from forest practices. These mandatory BMPs are approved in the State Water Quality Standards. New staff positions recently increased forestry BMP inspection, education, and enforcement activities.

Programs to Assess Water Quality and Program Effectiveness

The BMP Feedback Loop features onsite and in-stream monitoring to evaluate the effectiveness of implemented agricultural BMPs. The BMPs are modified through a public participation process if monitoring indicates that BMPs are not protecting beneficial uses. The Forest Practices Water Quality Management Plan also sponsors monitoring to determine the effectiveness of forestry BMPs.

Illinois

For a copy of the Illinois 1992 305(b) report, contact:

Mike Branham
Illinois Environmental Protection Agency
Division of Water Pollution Control
2200 Churchill Road
Springfield, IL 62704
(217) 782-3362

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	13,980 mi	42%	2%	54%	1%
Lakes	206,081 ac	1%	8%	50%	41%
Great Lakes	63 mi	—	100%	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 40% of river miles, 67% of lake acres, and 100% of Great Lakes shore miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Nutrients, siltation, organic enrichment and dissolved oxygen deficiencies, habitat/flow alteration, ammonia, metals, and suspended solids cause most impairments in Illinois. The sources of pollution most impacting Illinois waters include agriculture (primarily row crop production), in-place contaminants deposited on sediments, hydrologic/habitat modification, resource extraction, urban runoff, atmospheric depositions, and municipal point sources.

Programs to Correct Impairments

Illinois Environmental Protection Agency (IEPA) documents such as *Surface Water Monitoring Strategy*, *Water Pollution Control Program Plan – FY92*, and the *Illinois Water Quality Management Plan* (WQMP) detail the numerous surface water pollution control and monitoring programs of the agency for both point and nonpoint source control programs. Point source control program activities include Monitoring, Planning, Permitting, Financial Assistance Administration, Compliance Assurance, and Program Management. Current nonpoint source programs are built on the original recommendations of the WQMP, which includes, but is not limited to, the *State Nonpoint Source Management Program Report* and the *State Nonpoint Source Assessment Report.*

Programs to Assess Water Quality and Program Effectiveness

The IEPA conducts a wide variety of surface water monitoring programs that are designed to assess water quality and program effectiveness. Surface water monitoring programs include a Toxicity Testing Program, Ambient Water Quality Monitoring Network (streams), Pesticide Monitoring Subnetwork, Industrial Solvents Subnetwork, Facility-Related Stream Survey Program, Intensive River Basin Surveys Program, Ambient Lake Monitoring Program, Volunteer Lake Monitoring Program, Lake Water Quality Assessment Grant Program, Lake Michigan Survey Program, and the Fish Contaminant Monitoring Program.

Indiana

For a copy of the Indiana 1992 305(b) report, contact:

Dennis Clark
Indiana Department of Environmental Management
Office of Water Management
5500 W. Bradbury Avenue
Indianapolis, IN 46241
(317) 243-5037

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	6,849 mi	70%	6%	5%	19%
Lakes	102,096 ac	100%	—	<1%	<1%
Great Lakes	43 mi	—	—	100%	—
Wetlands	—	—	—	—	—

[a]Totals represent 19% of river miles, 71% of lake acres, and 100% of Great Lakes shore miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

The major causes of use impairment are bacteria, organic enrichment, pesticides, priority organic compounds, and ammonia. The sources of substances most often contributing to nonsupport of uses are industrial and municipal point sources, combined sewer overflows, and agricultural nonpoint sources. Impacts due to nonpoint sources are considered major. Nitrates, volatile organic chemicals, and heavy metals are most commonly detected in drinking water wells. The most commonly reported sources of ground water contaminants include hazardous material spills, underground storage tanks, and waste disposal activities.

Programs to Correct Impairments

Indiana's T-by-2000 program is a State-funded initiative aimed at reducing erosion on each acre of land to its tolerable (T) limit (at which crop productivity is not impaired) and controlling all offsite sedimentation using best practical technology. The program sponsors soil conservation education, agricultural and urban erosion control technical assistance, cropland erosion control cost-sharing, and lake enhancement projects.

Programs to Assess Water Quality and Program Effectiveness

Until EPA issues sediment criteria, Indiana will continue to identify areas of toxic concern by comparing sediment data with maximum background concentrations of toxic pollutants. The State derived background concentrations of toxicants from sediment samples collected at 86 background sites located upstream of known point source discharges. Toxicant concentrations exceeding 100 times the background concentrations merit high concern. A contaminant concentration of 10 to 100 times the background concentration merits medium concern. During the 1990-1992 reporting cycle, pesticides, PCBs, and metals in fish and sediment were detected at medium to high levels of concern in 35% of the monitored stream miles. Only 3% of the monitored inland lakes exhibited toxic levels of concern in sediments.

Iowa

For a copy of the Iowa 1992 305(b) report, contact:

John Olson
Iowa Department of Natural Resources
Water Quality Section
900 East Grand Avenue
Wallace State Office Building
Des Moines, IA 50319
(515) 281-8905

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	9,983 mi	—	5%	91%	4%
Lakes	48,730 ac	3%	48%	47%	2%
Wetlands	26,489 ac	4%	31%	52%	14%

[a]Totals represent 12% of river miles, 60% of lake acres, and 72% of wetlands acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

The failure of assessed waterbodies of all types to fully support their designated uses is attributed primarily to sediment and nutrients from nonpoint sources of pollution. Point sources, however, impact approximately 5% of the stream miles assessed and toxics impair the Red Rock Reservoir.

Programs to Correct Impairments

Iowa's Resources Enhancement and Protection (REAP) Program represents a major new initiative to protect and enhance Iowa's natural resources. The REAP fund supports various conservation activities, including soil and water enhancements. The Iowa Division of Soil Conservation (DSC) and the County Soil and Conservation Districts implement the Water Protection Program and the Water Protection Practices Program with REAP funding. In 1991, the REAP Act provided almost $2 million for Water Protection Program projects and Water Protection Practices. The DSC adopted rules for administering the Water Protection Practices Program in 1990, which include the following provisions:

- Districts must designate high-priority watersheds or water quality problems targeted for funding and the State Soil Conservation Committee must approve the priority designations

- Cost-share (up to 75%) will be available for best management practices ignored by previous programs, such as planting critical areas, grass strips, field borders, filter strips, and pasture and hay lands.

The Prairie Pothole Joint Venture program is reversing the previous trend of wetlands destruction in Iowa. The program purchases and restores wetlands with funds provided by State agencies, Federal agencies, and county and private organizations. During 1990 and 1991, the program purchased almost 5,000 acres of wetlands and surrounding uplands and restored almost 1,300 acres of wetlands in 288 basins.

Programs to Assess Water Quality and Program Effectiveness

Since the 1970s, Iowa's Department of Natural Resources (DNR) has collected data from fixed-station water quality monitoring sites (sampled monthly or quarterly), from DNR-sponsored special studies, and from monitoring programs conducted by other agencies. The State's surface water monitoring strategy was revised in 1990, but no major changes were made in DNR's monitoring network.

Kansas

For a copy of the Kansas 1992 305(b) report, contact:

Mike Butler
Kansas Department of Health and Environment
Bureau of Water Protection
Forbes Field, Building 740
Topeka, KS 66620
(913) 296-5575

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Rivers	17,103 mi	3%	—	2%	45%	50%
Lakes	172,129 ac	<1%	2%	92%	5%	—
Wetlands	34,256 ac	—	—	100%	—	—

[a]Totals represent 13% of river miles, 100% of lake acres, and 100% of wetlands acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

Pathogens, metals, salinity, and suspended solids are the major causes of use impairment in Kansas streams. These contaminants enter streams via agricultural runoff, sewage treatment plant discharges, and other point sources. Agricultural activities generate most of the pesticides and nutrients degrading lake water quality. Flow alterations resulting from agricultural activities and hydromodifications are responsible for impairments in assessed wetlands. The most significant sources of ground water contamination are underground storage tanks and oil and gas operations (excluding injection wells).

Programs to Correct Impairments

Kansas' Nonpoint Source Pollution Control Program assumes that nonpoint source (NPS) pollution threatens all of Kansas' water resources and that NPS controls must be implemented to reverse existing damage and prevent future water quality degradation. The program consists of four components. The **Certification Unit** reviews and certifies local NPS Pollution Management Plans and Project Plans and reviews Federal, State, and local projects for consistency with State water quality standards and the NPS Pollution Control Program. The **Local Environmental Protection Unit** provides funding to local governments to prepare and implement Local Environmental Protection Plans, which include a subdivision and wastewater management plan, public water supply plan, and an NPS control plan. The **Technical Assistance Unit** develops and administers demonstration projects, helps local health departments and conservation districts prepare plans, and maintains a Catalog of NPS Control Practices. **The Information and Education Unit** produces several newsletters, fact sheets, and displays.

Programs to Assess Water Quality and Program Effectiveness

In 1990, the Kansas Department of Health and Environment added NPS assessment sites to the ambient stream chemistry network. NPS monitoring sites now constitute 58% of the 277 sampling stations in the network.

Kentucky

For a copy of the Kentucky 1992 305(b) report, contact:

Tom VanArsdall
Department for Environmental Protection
Division of Water
14 Reilly Road
Frankfort Office Park
Frankfort, KY 40601
(502) 564-3410

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	9,737 mi	67%	1%	10%	22%
Lakes	214,962 ac	47%	44%	6%	3%
Wetlands	—	—	—	—	—

[a]Totals represent 11% of river miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Fecal coliforms cause most impairments of swimming use in rivers, while siltation and organic enrichment impair aquatic life use in rivers. The sources impairing the largest number of stream miles include municipal wastewater treatment plants, agricultural activities, and resource extraction. Nutrients, primarily from agricultural runoff and municipal discharges, were the greatest cause of impairment in lakes. Iron and manganese also impaired domestic water supply use in many lakes. The Commonwealth considers underground storage tanks, septic tanks, abandoned hazardous waste sites, agricultural activities, and landfills to be the leading sources of ground water contamination.

Programs to Correct Impairments

In 1988, the Commonwealth of Kentucky integrated whole-effluent toxicity (WET) limits with traditional chemical limits in discharge permits issued to industrial facilities and municipal wastewater treatment plants. The Commonwealth set WET limits for both acute and chronic toxicity based on case-by-case evaluations of the discharge type and volume, and the characteristics of the receiving waterbody. By the end of 1991, 77 municipal and 35 industrial discharge permits required WET monitoring. Initially, these facilities submit monthly WET test results for 1 year after which tests are performed quarterly. A facility must undertake a toxicity reduction evaluation following two consecutive failures of a single concentration "screen" test. As a result of the program, five dischargers are changing plant operations, five dischargers are making plant improvements, and four dischargers are constructing new treatment plants to reduce effluent toxicity.

Programs to Assess Water Quality and Program Effectiveness

Kentucky implemented several long-term studies to determine nonpoint source impacts and demonstrate water quality improvements from best management practices, including a joint project with the State of Tennessee to correct mine drainage problems in the Bear Creek watershed.

Louisiana

For a copy of the Louisiana 1992 305(b) report, contact:

Emelise S. Cormier, Acting Program Manager
Louisiana Department of Environmental Quality
Office of Water Resources
Water Quality Division
P.O. Box 82215
Baton Rouge, LA 70884-2215
(504) 765-0511

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Rivers	9,089 mi	26%	21%	37%	16%	—
Lakes	612,288 ac	42%	7%	51%	<1%	<1%
Estuaries	4,943 mi^2	29%	53%	17%	<1%	—
Oceans	—	—	—	—	—	—
Wetlands	—	—	—	—	—	

[a]Totals represent 14% of river miles, 57% of lake acres, and 65% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

The most frequently cited pollutants causing impairments are pathogen indicators, nutrients, organic enrichment and low dissolved oxygen concentrations, and oil and grease. Most estuaries are impaired by high bacterial counts that force the State to close oyster harvesting areas. The most commonly cited sources of pollutants impacting the assessed waterbodies are agricultural runoff, discharges and spills from petroleum activities, urban runoff, industrial point sources, and inadequately treated sewage discharges from municipalities. Although the quality of the State's major ground water aquifer remains excellent, the State is concerned about threats to shallow aquifers and the water-bearing zones that contribute significantly to the deeper aquifers.

Programs to Correct Impairments

In 1989, the Louisiana State Legislature created the Lake Pontchartrain Basin Foundation, a nonprofit organization that brings together scientists, citizens, and politicians to reverse the shoreline erosion, loss of marshes, and reduction in fisheries accelerated by urban runoff and shell dredging. To date, the Foundation has sponsored educational projects with funding from the Greater New Orleans Expressway Commission and private donations.

Programs to Assess Water Quality and Program Effectiveness

The State's water pollution control program relies heavily on strong water quality standards. During 1989 and 1991, the State adopted numerical criteria for toxic substances including several priority organics and metals. Currently, the State is revising its bacteriological criteria and is considering biological criteria for all waters.

Maine

For a copy of the Maine 1992 305(b) report, contact:

Phil Garwood
Maine Department of Environmental Protection
Bureau of Water Quality Control
State House Station 17
Augusta, ME 04333
(207) 287-7695

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	31,672 mi	98%	—	1%	1%
Lakes	958,389 ac	73%	6%	21%	—
Estuaries	1,633 mi^2	90%	—	2%	8%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles, 97% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

In Maine, priority pollutants (most notably dioxin) cause the most significant nonattainment in major rivers. In other riverine waters, oxygen deficits due to organic enrichment and bacteria are the most significant causes of impairment. Nonpoint sources generate most of the organic enrichment while municipal point sources, onsite wastewater treatment, and untreated discharges are the primary sources of pathogenic indicators. The most significant cause of nonattainment in Maine lakes is organic enrichment from nonpoint sources of pollution, such as urban runoff, agriculture, and silviculture. Pathogenic indicators from municipal point sources are the most significant cause of nonattainment in estuarine and coastal waters. The greatest threat to Maine's ground water is leaking underground storage tanks.

Programs to Correct Impairments

The State issued fish consumption advisories for major rivers due to elevated concentrations of dioxin detected in fish tissue samples. Maine is working with the Kraft pulp and paper mills to reduce dioxin concentrations in their discharges. As a result, Maine restored the fully supporting status of 20 river miles that were previously contaminated by dioxin.

Programs to Assess Water Quality and Program Effectiveness

The Maine Department of Environmental Protection (DEP) is concerned about possible mercury contamination from nonpoint sources. Occasionally, samples of older lake trout caught in inland waters lacking point sources exceed FDA standards for mercury. The DEP plans additional ambient fish tissue sampling during the next 2 years.

Maryland

For a copy of the Maryland 1992 305(b) report, contact:

Shermer Garrison
Maryland Department of the Environment
Chesapeake Bay and Special Projects Program
2500 Broening Highway
Baltimore, MD 21224
(410) 631-3580

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	17,000 mi	92%	—	7%	<1%
Lakes	21,001 ac	77%	4%	19%	<1%
Estuaries	2,522 mi^2	—	4%	93%	3%
Oceans	—	99%	1%	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles, 27% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Overall, Maryland's surface waters are in good condition, but recreational bathing, shellfish harvesting, and consumption of certain fish species are restricted or prohibited in some areas. The most serious water quality problem in Maryland is the continuing accumulation of nutrients in estuaries and lakes. Excess nutrients from agricultural, urban, and natural runoff, as well as point sources, result in algal blooms and low dissolved oxygen concentrations in lakes and tidal embayments. The impacts affect water supplies, recreational activities, and limit habitat for aquatic plants and animals.

Locally high sediment levels affect all of the State's surface waters. Sources of sediment include agricultural and urban runoff, construction activities, natural erosion, dredging, forestry, and mining operations. Other State concerns include high bacteria levels found in all water types, toxic contaminants in sediments and fish tissues in selected urban areas, and acidic waters from acid mine drainage in western Maryland.

Programs to Correct Impairments

In 1989, the State issued a fish consumption advisory in a portion of the Potomac River in western Maryland due to elevated concentrations of dioxin identified in several fish species. The Kraft-process paper mill identified as the source of the dioxin changed its treatment process, reductions in dioxin levels in fish tissue samples were observed, and this advisory was modified to address only two fish species. A Targeted Watershed Program was implemented at several sites to demonstrate how an interagency approach can be used to identify and solve water pollution problems. Nonpoint source pollution control programs affect most of the State's citizens to some degree and range from shoreline protection and development regulations to implementation of agricultural and construction BMPs to educational efforts. Efforts to improve wastewater treatment plant performance through capital improvements and enhanced operator training have resulted in very high levels of compliance (greater than 95%) at major wastewater facilities in Maryland during the past 2 years.

Programs to Assess Water Quality and Program Effectiveness

Maryland's diverse and extensive water quality and aquatic resource monitoring programs are reviewed periodically and revised to incorporate newer technologies and sampling strategies. The Chesapeake Bay Monitoring Program monitors water quality, sediment, and aquatic resources intensively to document nutrient trends in the Bay and calculate pollutant loads from significant river systems. In 1990, the State initiated a biological assessment program using EPA-sanctioned rapid bioassessment protocols at almost 400 stream sites throughout the State. The State also modified its fish tissue and shellfish monitoring programs to enhance efficiency and respond to the analytical needs of each program.

Massachusetts

For a copy of the Massachusetts 1992 305(b) report, contact:

Warren Kimball
Massachusetts Department of Environmental Protection
Division of Water Pollution Control
Technical Services Branch
1 Winter Street - 8th Floor
Boston, MA 02108
(617) 292-5968

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	1,571 mi	39%	—	17%	44%
Lakes[b]	21,247 ac	38%	—	55%	7%
Estuaries	223 mi^2	30%	—	10%	60%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 18% of river miles, 14% of lake acres, and 100% of estuary square miles.
[b]Excludes Quabbin Reservoir which covers 53% of the State's lake surface area. The entire Quabbin Reservoir does not support its designated uses because of a fish consumption advisory based on elevated mercury levels in fish tissues.

— None or not reported.

Causes and Sources of Water Quality Impairments

Pathogens impair the most miles of rivers and streams, followed by priority organics, and nutrients. Urban runoff/storm sewers are the predominant source of contamination in rivers and streams, followed by septic systems and in-place contaminants. Major causes of nonattainment in lakes include excessive aquatic plant growth, nutrients, organic enrichment, and exotic species. The major sources of lake water quality impairments are unknown. Stormwater runoff and combined sewer overflows generate the pathogenic contamination that impairs most estuarine waters. Estuaries also suffer from unionized ammonia and low dissolved oxygen concentrations. Organic pollutants appear most often in contaminated public ground water supplies.

Programs to Correct Impairments

Recent State legislation will provide funds for a revolving loan program to cities and towns for the correction of combined sewer overflows and the construction of wastewater treatment facilities. Local sources of funding to repay the loans and to finance nonfundable projects will be increased through higher use fees and other financial arrangements. DEP has established a Nonpoint Source Program. Currently, 14 demonstration projects are being funded with Section 319 funds in the State. DEP is developing a watershed based planning approach for regulation and monitoring of water quality.

Programs to Assess Water Quality and Program Effectiveness

DEP has ongoing surface water quality and assessment programs including wastewater discharge evaluations, river monitoring, lake monitoring, and coastal monitoring. In addition to water chemistry, there is a biomonitoring program including macroinvertebrate analysis, bioaccumulation studies, and toxicity testing. DEP has a joint surface water discharge permit program with EPA. The permits contain effluent limits for various parameters and monitoring requirements necessary to achieve compliance with water quality standards.

Michigan

For a copy of the Michigan 1992 305(b) report, contact:

Greg Goudy
Michigan Department of Natural Resources
Surface Water Quality Division
P.O. Box 30028
Lansing, MI 48909
(517) 335-3310

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened[b]	Partially Supporting[b]	Not Supporting
Rivers	22,590 mi	94%	—	—	6%
Lakes	490,455 ac	95%	—	—	5%
Great Lakes	3,288 mi	—	—	—	100%
Wetlands	—	—	—	—	—

[a]Totals represent 40% of river miles, 51% of lake acres, and 100% of Great Lakes shore miles.
[b]Michigan assesses its waters as either fully supporting their designated uses or not supporting their designated uses. Michigan does not recognize threatened and partially supporting categories of use support.

— None or not reported.

Causes and Sources of Water Quality Impairments

Priority organics caused impairments in more river miles than any other cause, followed by heavy metals and siltation/sedimentation. The State identified agriculture-related nonpoint sources as the most common source of river impairments. Heavy metals, priority organics, and dissolved oxygen depletion had the greatest impact on inland lakes. Point sources were the leading source of impairment in lakes. All Michigan waters in the Great Lakes failed to support designated uses because of elevated PCB concentrations in water and fish tissue samples. Sources of contamination include atmospheric deposition and in-place contamination (e.g., sediments contaminated by discontinued industrial discharges). The largest number of ground water contamination incidents are associated with underground storage tanks, surface discharges, and landfills.

Programs to Correct Impairments

The Watershed Demonstration Program is the major focus of nonpoint source control efforts in Michigan. The program facilitates interagency cooperation to improve water quality in specific watersheds and ensures that limited resources are directed to the highest priority areas. Most of the funded watershed projects combine streambank stabilization techniques with soil erosion controls and animal waste best management practices to reduce sedimentation and nutrient loading in waterbodies.

Programs to Assess Water Quality and Program Effectiveness

Michigan is pursuing a sediment assessment protocol that combines biological field surveys with chemical and physical analysis of sediments and sediment toxicity testing. The State will not incorporate sediment bioassay tests into an assessment program until further work validates toxicity test results in the field and defines the relationship between laboratory test results and instream responses.

Minnesota

For a copy of the Minnesota 1992 305(b) report, contact:

Catherine Malave
MPCA, Division of Water Quality
520 Lafayette Road
St. Paul, MN 55155
(612) 296-8861

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	4,634 mi	23%	—	25%	52%
Lakes	2,882,818 ac	11%	6%	76%	7%
Great Lakes	272 mi	—	—	—	100%
Wetlands	—	—	—	—	—

[a]Totals represent 5% of river miles, 88% of lake acres, and 100% of Great Lakes shore miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Minnesota most frequently cites metals, nutrients, and fecal material from nonpoint sources as the causes of impairment in rivers. Pollution in lakes is primarily due to nutrients from agricultural runoff and mercury from atmospheric deposition. Portions of Lake Superior suffer from persistent toxic substances. Data indicate that human activities have introduced volatile organic compounds, pesticides, and nitrate into several important ground water aquifers.

Programs to Correct Impairments

The Minnesota Pollution Control Agency (MPCA) is moving toward integrating surface water monitoring, planning, and management on a watershed basis. Such an approach will focus on interconnections throughout the whole watershed and deal with water pollution problems in a comprehensive manner. Minnesota also intends to strengthen wetland preservation through local implementation of the Wetland Conservation Act of 1991. The Act advocates "no net loss" in the quantity, quality, and biological diversity of Minnesota's existing wetlands. The Act requires developers to avoid impacts where it is prudent and feasible, or replace wetland values where impacts cannot be avoided. The Act also creates a compensation program for permanent easements on high-quality wetlands and provides property tax incentives to landowners enrolling wetlands in preservation banks for 8 years. The State also plans to establish a cost-share program to create and restore wetlands.

Programs to Assess Water Quality and Program Effectiveness

The State tries to locate the source of fish tissue contamination by monitoring sediments in areas where fish tissue samples reveal elevated toxic concentrations. The State would like to pair sediment sampling with routine monitoring performed by dischargers where a toxicity problem is detected. Currently, several municipal wastewater dischargers monitor sediments for pollutants that tend to bioaccumulate.

Mississippi

For a copy of the Mississippi 1992 305(b) report, contact:

Randy Reed
Mississippi Department of Environmental Quality
Office of Pollution Control
P.O. Box 10385
Jackson, MS 39289-0385
(601) 961-5158

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	35,854 mi	6%	4%	88%	2%
Lakes	326,844 ac	47%	18%	35%	<1%
Estuaries	18 mi^2	5%	68%	26%	—
Oceans	81 mi	—	12%	88%	—
Wetlands	—	—	—	—	—

[a]Totals represent 43% of river miles, 65% of lake acres, 14% of estuary square miles, and 100% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Nutrients, pathogens, pesticides, and solids cause major impacts to rivers and streams; pesticides and nutrients cause major impacts on assessed lakes; and metals cause the only significant major impact on estuaries. Agriculture impacts the majority of impaired river miles, followed by industrial and municipal point sources. Major impacts on lakes are also due to agricultural nonpoint sources. Septic tanks contribute to moderate impairments on lakes. Industrial point sources cause major impairments in estuaries. Municipal point sources, urban runoff, and septic tanks cause moderate impairments in estuarine waters and coastal waters.

Programs to Correct Impairments

Currently, Mississippi is implementing 10 nonpoint source (NPS) control projects with funds from Section 319 of the Clean Water Act. The projects provide technical assistance, public education, and agrichemical monitoring and demonstrate the effectiveness of slotted board risers, animal waste spray irrigation systems, constructed wetlands, and other best management practices.

Programs to Assess Water Quality and Program Effectiveness

The Mississippi Office of Pollution Control (OPC) implements an ambient biological integrity program that features annual ambient fish tissue sampling and macroinvertebrate sampling in freshwater and periphyton sampling in estuarine waters. The OPC collects three fish species at selected primary stations and analyzes composite samples for the presence of 27 organic compounds and 7 heavy metals. The OPC protocols include habitat assessment and sampling of every habitat that could be a home for macroinvertebrates. Staff count the number of individuals of each macroinvertebrate species collected to rate species richness and trophic community structure at each site.

Missouri

For a copy of the Missouri 1992 305(b) report, contact:

John Ford
Missouri Department of Natural Resources
Water Pollution Control Program
P.O. Box 176
Jefferson City, MO 65102
(314) 751-7024

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	21,015 mi	53%	—	46%	1%
Lakes	287,543 ac	53%	35%	2%	10%
Wetlands	—	—	—	—	—

[a]Totals represent 18% of river miles and 100% of lake acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

Siltation, habitat alteration, and water loss cause most impairments in rivers and streams. Channelization has degraded aquatic life habitat in 17 percent of Missouri's streams and the State does not have a program to prevent additional projects to straighten streams. Agriculture is the predominant source of river impairments. Pesticides from agricultural activities cause most lake impairments in the State. Urban runoff and hydrologic/habitat alterations also impair lakes.

Programs to Correct Impairments

The Nonpoint Source (NPS) program staff were very active during 1990 and 1991. The NPS staff generated four new pieces of legislation, participated in 11 public information and education projects, 11 watershed implementation projects, and 8 technical assistance programs. The NPS program focus areas include animal waste management, dead bird composting, inventory and water quality monitoring of NPSs, and fertilizer and pesticide management. The most successful nonpoint source program to date reclaims abandoned coal mine lands. Reclamation projects reduced the number of stream miles seriously impaired by coal mine drainage from 100 miles to 42 miles by October 1991.

Programs to Assess Water Quality and Program Effectiveness

The Missouri Department of Natural Resources (DNR) discontinued ambient chemical monitoring primarily for financial reasons. As a result, some important streams with long historical records are no longer monitored. In contrast, the ambient fish tissue monitoring network grew in recent years. At present, the EPA and Missouri DNR sample fish from 25 sites for a wide variety of toxicants. The Missouri Department of Conservation also analyzes a smaller number of toxicants in approximately 170 fish collected at 60 sites. The expansion of the ambient fish sampling program enables the Missouri Department of Health to specify individual species and waterbody segments affected by fish consumption advisories. Currently, the State recommends limiting consumption of fish caught in 19 waterbodies.

Montana

For a copy of the Montana 1992 305(b) report, contact:

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Montana Department of Health and Environmental Science
Water Quality Bureau
Cogswell Building, Room A206
1400 Broadway
Helena, MT 59620
(406) 444-5342

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	64,677 mi	74%	5%	19%	2%
Lakes	979,433 ac	38%	14%	46%	2%
Wetlands	—	—	—	—	—

[a]Totals represent 36% of river miles and 100% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Flow alteration, suspended solids, and siltation cause most impairments in rivers and streams. Agricultural sources (crop production and rangeland), streambank destabilization, silviculture, flow modification, and construction impact the most stream miles. Metals, flow alteration, nutrients, suspended solids, noxious aquatic plants, and organic enrichment impair the most lake acres. Agricultural activities and flow regulation are the leading sources of lake impairments. Natural arsenic contamination in much of the State's water remains a concern, and the State is concerned about elevated concentrations of selenium, salts, and other trace elements and pesticides entering wetlands from agricultural and irrigation practices.

Programs to Correct Impairments

The Montana Department of Health and Environmental Sciences, Water Quality Bureau, received an EPA grant for more than $433,000 to fund a Statewide interagency wetlands program. The program's six components will (1) collect existing interagency data and establish a database; (2) monitor 20 water-quality-limited wetlands and 40 least-impacted wetlands and develop wetland biocriteria; (3) develop wetland education programs; (4) implement river corridor management projects; (5) revise the Department of Transportation's wetland protection and mitigation program, develop a system to track wetlands losses and mitigation banking, and monitor mitigation projects to determine effectiveness; and (6) print a Statewide classification and management document for riparian and wetland sites.

Programs to Assess Water Quality and Program Effectiveness

Successful long-term trend analysis has been limited to the Clark Fork River Basin and Flathead Lake. The Clark Fork River has shown improvement during the last several years. Copper concentrations have declined in the headwater reaches and phosphorus concentrations have declined in the lower reaches of the river. Unfortunately, water quality in Flathead Lake has declined as evidenced by increased algal growth.

The State is implementing studies under the Clean Lakes Program that will develop a nutrient balance and determine primary productivity status for Flathead Lake and Swan Lake. A third study will investigate methylmercury and PCBs in fish tissue and sediments as well as trophic status in 20 of the most heavily fished lakes in Montana.

Nebraska

For a copy of the Nebraska 1992 305(b) report, contact:

Steven Walker, Section Supervisor
Nebraska Department of
Environmental Quality
Water Quality Division
P.O. Box 98922
Lincoln, NE 68509-8922
(402) 471-2875

Causes and Sources of Water Quality Impairments

Nebraska identified fecal bacteria, pesticides, and flow alteration as major causes of river impairments. Organic enrichment, ammonia, and metals cause moderate or minor impairments. Agriculture, natural sources, and point sources affected the most river miles. Metals, pathogens, suspended solids, and nutrients were the leading cause of impairment in lakes. Municipal point sources and agriculture were the leading sources of lake impairments. Major sources of ground water contamination included agricultural activities, leaking underground storage tanks, septic systems, waste disposal, and industrial facilities. Nitrate contamination, primarily from overfertilization of irrigated land, is the most widespread ground water concern in the State.

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	8,061 mi	26%	2%	49%	23%
Lakes	132,948 ac	26%	2%	43%	29%
Wetlands	—	—	—	—	—

[a]Totals represent 10% of river miles and 87% of lake acres.

— None or not reported.

Programs to Correct Impairments

The Special Protection Area (SPA) Program authorizes local Natural Resource Districts (NRDs) to regulate activities that may generate nonpoint source contamination in designated ground waters. Designated SPA areas suffer from documented nonpoint source contamination or face a threat from nonpoint sources of pollution. The Nebraska Department of Environmental Conservation (NDEC) conducts detailed studies of proposed SPA sites. The predesignation studies usually include ground water sampling, coring of the vadose zone, and collection of existing data on geology, soils, and land use. At the close of 1991, NDEC had examined eight proposed SPA sites and designated two SPA sites encompassing 482 square miles.

Programs to Assess Water Quality and Program Effectiveness

The Nebraska Department of Health annually monitors nitrate concentrations in samples representing all 1,426 public ground water supplies in the State.

Nevada

For a copy of the Nevada 1992 305(b) report, contact:

Glen Gentry
Bureau of Water Quality Planning
Division of Environmental Protection
123 West Nye Lane
Carson City, NV 89710
(702) 687-4670

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Rivers	1,427 mi	23%	—	23%	50%	3%
Lakes	213,257 ac	62%	—	12%	26%	
Wetlands	36,169 ac	—	—	33%	67%	

[a]Totals represent 1% of river miles, 38% of lake acres, and 26% of wetlands acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

Agricultural practices (specifically irrigation, grazing, and flow regulation) generate the large sediment and nutrient loads impacting the waters of Nevada. Urban drainage systems add nutrients, heavy metals, and organic substances to the load. The State is eliminating point sources where possible and their adverse effects on water quality have been greatly reduced. However, the Las Vegas wastewater treatment plant and low flows resulting from natural drought conditions also impair waters in the State.

Programs to Correct Impairments

The Nevada Nonpoint Source (NPS) Base Program (initiated in 1991) enhances the Nevada NPS Program with new activities that address technical transfer and technical outreach. The new Base Program utilizes existing staff and one new hire to administer new projects.

In 1990, DEP issued two stormwater discharge permits to control runoff from two major urban areas in the State. The first permit was issued jointly to the Cities of Reno and Sparks, Washoe County, and the Nevada Department of Transportation (NDOT). The second permit was issued to the cities of Las Vegas, North Las Vegas, and Henderson, the NDOT, and the Clark County Regional Flood Control District. The permits require monitoring, land use planning, and zoning to address upstream stormwater issues. Wet weather sampling began in 1991.

Programs to Assess Water Quality and Program Effectiveness

As a long-term goal, DEP recommends increased staffing and funding to develop a ground water monitoring network and database. Current activities are fragmented, sporadic, and site-specific. The State would use the monitoring data to assess existing water quality in Nevada's aquifers and inventory sources of known or potential threats to ground water quality.

New Hampshire

For a copy of the New Hampshire 1992 305(b) report, contact:

Greg Comstock
Water Quality Section
New Hampshire WSPCD/DES
P.O. Box 95
Concord, NH 03301-6528
(603) 271-2457

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	10,841 mi	98%	—	1%	1%
Lakes	153,580 ac	85%	6%	6%	3%
Estuaries	28 mi^2	34%	—	—	66%
Oceans	18 mi	100%	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles, 100% of lake acres, 100% of estuary square miles, and 100% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Elevated bacteria levels, organic enrichment and depressed oxygen concentrations, nutrients, and siltation cause occasional problems in rivers and streams. The sources of these contaminants are primarily "unknown." Excessive noxious aquatic plants and nutrients from industrial and municipal discharges and "unknown" sources are the main cause of nonattainment of designated uses in reservoirs. Elevated bacteria levels from small point sources and nonpoint sources restrict shellfishing in the coastal bays and estuaries. The major sources of ground water contamination are leaky underground storage tanks, uncontrolled hazardous waste sites, and municipal landfills.

Programs to Correct Impairments

The State drafted a Clean Water Strategy to address the remaining water quality standard violations. The plan proposes to confirm the presence of violations with additional sampling and detect causes and sources with field investigations. The State will take compliance actions to eliminate the sources on a priority basis. Plan implementation relies on EPA funding.

Programs to Assess Water Quality and Program Effectiveness

All point source discharge permits require (or will require) effluent testing for acute toxicity. Some permits will also require chronic toxicity testing depending on the flow limitations of the receiving waters. Some dischargers must also sample surface water toxicity at upstream sites. Approximately 80 percent of the industrial dischargers and 90 percent of the municipal dischargers have been screened for acute toxicity. The State has not detected evidence of in-stream acute toxicity.

New Jersey

For a copy of the New Jersey 1992 305(b) report, contact:

Kevin Berry
New Jersey DEPE
Office of Land and Water Planning
401 East State Street, 4th Floor
Trenton, NJ 08625
(609) 633-1179

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	1,515 mi	—	73%	15%	12%
Lakes	—	—	—	—	—
Estuaries	614 mi^2	72%	—	20%	8%
Oceans	146 mi	73%	—	—	27%
Wetlands	—	—	—	—	—

[a]Totals represent 23% of river miles, 100% of estuary square miles, and 100% of ocean miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Fecal coliform bacteria, nutrients, depressed dissolved oxygen concentrations, siltation, road salts, and oil and grease cause most water quality impairments in rivers and streams. The most common pollution problems in lakes include nutrients, siltation, depressed dissolved oxygen concentrations, and excess primary productivity. The State cites nonpoint sources (such as stormwater outfalls, construction, urban and agricultural runoff) as the principal source of contaminants in surface waters. However, very little monitoring data exist to quantify the effect of individual nonpoint sources. The most common pollutants detected during ground water pollution investigations include volatile organic compounds, metals, base neutrals, acid extractables, PCBs, and pesticides. Underground storage tanks are most often cited as the source of ground water contamination, followed by landfills, surface spills, and industrial/commercial septic systems.

Programs to Correct Impairments

The New Jersey Department of Environmental Protection and Energy (NJDEPE) developed the Sewage Infrastructure Improvement Act (SIIA) program to address stormwater drainage and combined sewer overflows in the coastal zone. The program provides funds to municipalities to inventory and map their sewer lines, stormwater systems, cross-connections, and interconnections. The municipalities will use the data to develop municipal nonpoint source abatement measures and plans.

Programs to Assess Water Quality and Program Effectiveness

The New Jersey Cooperative Coastal Monitoring Program concluded that 70% of New Jersey's 62 ocean beach closures between 1987 and 1991 could be prevented through implementation of the SIIA program.

New Mexico

For a copy of the New Mexico 1992 305(b) report, contact:

Erik Galloway
Surface Water Quality Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, NM 87502-6110
(505) 827-2923

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	3,589 mi	9%	1%	82%	8%
Lakes	143,718 ac	<1%	9%	91%	<1%
Wetlands	—	—	—	—	—

[a]Totals represent 3% of river miles and 95% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Siltation, metals, and habitat alterations in the riparian zone cause most impairments in rivers and streams. Agricultural sources impair more stream miles and lake acres than any other identified source. Hydrologic modification and recreation impair rivers to a lesser extent. Recreation, spills and silviculture impair significant areas of lakes. The leading causes of impairment in lakes are mercury contamination in fish tissues, siltation, metals, and habitat alterations along shorelines.

Programs to Correct Impairments

New Mexico's ground water protection regulations consist of (1) ground water quality standards and (2) requirements for ground water discharge plans. The ground water discharge plans establish baseline concentrations of contaminants that cannot be exceeded after the discharger begins disposal practices. The dischargers prepare the plans, which must be approved by the New Mexico Environment Department or the Oil Conservation Division. The State approves most plans for a 5-year period, after which the discharger must renew the plan. With enforceable numeric standards, the State ground water discharge plans function like a discharge permit. As of 1991, New Mexico had adopted numeric ground water quality standards for 47 contaminants and narrative criteria for 87 toxic pollutants in ground waters that could serve a beneficial use. The ground water rules apply to wastewater discharges on the surface of the ground as well as subsurface discharges. In addition to municipal sewage plants and industrial facilities, ground water discharge plans regulate dairies, mineral extraction operations, sludge and septage disposal sites, hydrocarbon cleanup operations, and large private sewage treatment systems for trailer parks.

Programs to Assess Water Quality and Program Effectiveness

The ground water discharge plans also specify monitoring schedules to detect standard violations or document compliance with standards.

New York

For a copy of the New York 1992 305(b) report, contact:

George K. Hansen, P.E.
New York State Department of Environmental Conservation
Bureau of Monitoring and Assessment
50 Wolf Road
Albany, NY 12233
(518) 457-8819

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	51,729 mi	93%	3%	6%	<1%
Lakes	730,387 ac	44%	3%	53%	3%
Great Lakes	577 mi	15%	—	85%	—
Estuaries	1,530 mi^2	72%	<1%	11%	17%
Oceans	120 mi	50%	—	48%	2%
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles, 100% of lake acres, 100% of Great Lakes shore miles, 100% of estuary square miles, and 100% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Agriculture and hydrologic/habitat modifications are major sources of water quality impairment in New York's rivers, lakes, and reservoirs. Agricultural sources contribute nutrients and silt, which cause turbidity and excessive weed and algae growth. Hydrologic/habitat modifications include activities that alter stream beds or shorelines, such as dredging, filling, and impoundments. Urban runoff is the major nonpoint source of impairment in New York's bays and estuaries. Urban runoff is a source of silt, pathogen indicators, bacteria, petroleum products, heavy metals, and oxygen-demanding substances. Pathogen indicators from urban runoff, point sources, boats, water fowl, and onsite disposal systems caused the State to close 200,000 acres (16 percent) of the shellfish beds in the New York City-Long Island region.

Programs to Correct Impairments

In 1991, New York revised its surface water quality standards and adopted methodologies for developing toxic standards for human health and aquatic life. To date, the State has adopted standards and/or guidance values for nearly 250 toxic substances or groups of toxic substances. These standards and guidance values are the basis for setting effluent limits for discharge permits.

Programs to Assess Water Quality and Program Effectiveness

In 1990 and 1988, the NY State Division of Environmental Conservation (NYSDEC) sampled PCB and aroclor in Hudson River striped bass. The data indicated a spatial decline in average PCB concentrations with increasing distance from the Albany-Troy area. The study also found an overall decline in fish tissue concentrations of total PCB, Aroclor 1254, and Aroclor 1016 between 1980 and 1990.

North Carolina

For a copy of the North Carolina 1992 305(b) report, contact:

Carol Metz
North Carolina Division of Environmental Management
P.O. Box 29535
Raleigh, NC 27626-0535
(919) 733-5083

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	35,060 mi	37%	34%	24%	5%
Lakes	304,542 ac	70%	21%	9%	<1%
Estuaries	3,122 mi^2	87%	4%	9%	<1%
Oceans	—	—	—	—	—
Wetlands	10,307,000 ac	51%	—	25%	24%

[a]Totals represent 93% of river miles, 100% of lake acres, 100% of estuary square miles, and 100% of wetlands acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Siltation causes most use impairment in rivers and streams. Agriculture is the leading source of water quality degradation in rivers and streams, followed by urban runoff/storm sewers, and point sources. Excessive nutrient enrichment is the major cause of use impairment in North Carolina lakes. Municipal wastewater treatment plants are the leading source of nutrients in lakes. Gasoline and diesel fuel from leaking underground tanks is the primary cause of ground water contamination.

Programs to Correct Impairments

North Carolina has a number of strong programs to not only correct, but also to prevent, water quality impairments. Several of these include

- A newly initiated Basinwide Management Program that addresses both point and nonpoint source pollution on a watershed basis. This program will cover every basin in the State on a 5-year cycle.
- A Water Supply Protection Program requiring development within water supply watersheds to control stormwater quantity and quality through density restrictions or stormwater treatment devices.
- A substantial Agricultural Cost Share Program ($8 million per year) to reduce sediment, nutrients, pesticides, etc., which contribute to impairment of State waters.
- Recently enacted Animal Waste Management Rules, which mandate Best Management Practices for new and existing confined animal feeding operations.
- An innovative nutrient management strategy involving nutrient trading between point and nonpoint sources in the nutrient-sensitive waters of the Tar-Pamlico River Basin. This strategy provides point sources with the option of meeting nutrient reduction goals either through in-plant reductions or through the funding of agricultural BMPs within the basin.

Programs to Assess Water Quality and Program Effectiveness

North Carolina integrates a wide variety of information to address multiple needs of the water quality program. Data collected from a statewide fixed station chemical/physical monitoring network (AMS) provides baseline long-term information. Intensive water quality characterization studies augment baseline data in predictive modeling for assimilative capacity and wasteload allocation. These surveys include time of travel work, physical/chemical collections, long-term BOD analysis, and in situ sediment oxygen demand measurements. Numerous assessment tools are used in evaluating existing conditions of water quality and biological integrity in-stream. These include macroinvertebrate surveys, fish community structure analyses, phytoplankton analyses, fish tissue analyses, aquatic toxicity tests, and limnological review of lakes and watersheds incorporating many of these tools.

North Dakota

For a copy of the North Dakota 1992 305(b) report, contact:

Mike Ell
North Dakota Department of Health
Division of Water Supply and Pollution Control
P.O. Box 5520
Bismarck, ND 58502-5520
(701) 221-5210

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	9,172 mi	2%	73%	25%	0%
Lakes	611,074 ac	2%	36%	26%	36%
Wetlands	—	—	—	—	—

[a]Totals represent 77% of river miles and 99% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

Nutrients and siltation, primarily from agricultural runoff, caused most impairments in the State's surface waters. Loss of streamside vegetation, wetlands drainage, and flow regulation also impaired streams. The recent drought, compounded by water management policies for the two mainstem Missouri River reservoirs in the State, Lake Sakakawea and Lake Oahe, impaired approximately 36 percent of the assessed lake acres. The policy implemented during the drought required the State to maintain downstream Missouri River uses (such as municipal water supply and navigation uses) by releasing reservoir waters at the expense of lake uses (such as fishing, recreation, and wildlife habitat). Five percent of the assessed lake acres partially supported designated uses due to periodic fish kills resulting from low dissolved oxygen concentrations caused by the decomposition of organic matter. Major sources of pollution to the State's lakes are agricultural runoff and internal nutrient cycling from sediments. Drainage continued to be the greatest threat to wetlands in the State. However, nonpoint source pollution problems, such as siltation and pesticide contamination are a growing concern as significant threats to wetlands in the State. Chemical spills from petroleum storage facilities and agricultural chemical storage facilities are the primary sources of ground water contamination.

Programs to Correct Impairments

During the past 3 years, the State directed a majority of its Section 319 funds to local projects addressing NPS pollution from agriculture lands, the dominant land use in North Dakota. Given the complexity of the agricultural industry, the Division of Water Quality has to work closely with the U.S. Department of Agriculture (USDA), as well as with local project sponsors to secure sufficient funds to adequately address agriculture-related pollution at specific project watersheds. Funded projects demonstrate the effectiveness of reduced cropland tillage, proper grazing use, livestock waste management, low energy precision application (LEPA) irrigation, as well as nutrient and pesticide management as effective strategies for NPS pollution control and abatement. Several projects also provide funds to demonstrate proper procedures for sealing abandoned wells.

Programs to Assess Water Quality and Program Effectiveness

North Dakota's Division of Water Quality administers a diverse program to assess water quality. Program monitoring and assessment activities include the State's ambient stream water quality monitoring network, which includes 61 monitoring sites on 31 rivers and streams, the lake water quality assessment project, the ground water monitoring program, monitoring in support of Section 319, NPS pollution projects, and biological monitoring including instream bioassay and fish flesh analysis. In March 1991, the State issued its first fish consumption advisory for sections of the Missouri River, the Red River, and 10 lakes. The advisory affects 509 miles of rivers and 339,370 acres of lakes where fish sampling revealed elevated concentrations of mercury in fish tissues.

Ohio

For a copy of the Ohio 1992 305(b) report, contact:

Ed Rankin
Ohio Environmental Protection Agency
Division of Surface Water
1685 Westbelt Drive
Columbus, OH 43228
(614) 777-6264

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	7,903 mi	33%	7%	21%	39%
Lakes	78,527 ac	<1%	8%	85%	7%
Great Lakes	236 mi	—	—	100%	—
Wetlands	—	—	—	—	—

[a]Totals represent 27% of river miles, 66% of lake acres, and 100% of Great Lakes shore miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Organic enrichment affects 30 percent of the assessed river miles, followed by sediment (affecting 9 percent), and habitat modification (affecting 8 percent). Point sources are the leading source of pollutants impairing rivers, followed by habitat modification, agriculture, and mining. Agricultural runoff, discharges from wastewater treatment plants and industries, failing septic systems, stormwater runoff, and habitat modifications are the leading sources depleting oxygen, elevating nutrients, and causing siltation in Ohio's lakes. The Great Lakes shoreline is impaired by a fish consumption advisory and exceedences of copper and cadmium criteria in the water column.

Programs to Correct Impairments

Ohio EPA is shifting from a regulatory approach that controls individual pollutants to an ecosystem approach that tackles habitat degradation on shore as well as in the water. Long-term solutions include land use setbacks and preservation of stream hydrology.

Programs to Assess Water Quality and Program Effectiveness

Ohio EPA adopted biocriteria (direct measures of fish and macroinvertebrate population and community characteristics) in February 1990. The State measures biological community health by comparing observed ecological characteristics with the characteristics at least-impacted reference sites for a given ecoregion and stream type. Biological monitoring enables the State to detect aquatic life effects that would not be revealed by measuring chemical and physical parameters alone. Trend analysis of comprehensive data collected over the past 12 years indicates substantial improvements in river quality, especially in rivers where organic enrichment loadings have declined and dissolved oxygen levels have increased. The State attributes much of the water quality improvements to wastewater treatment plant upgrades performed since 1972.

Ohio River Valley Water Sanitation Commission (ORSANCO)

For a copy of the ORSANCO 1992 305(b) report, contact:

Jason Heath
ORSANCO
5735 Kellogg Avenue
Cincinnati, OH 45230
(513) 231-7719

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	981 mi	0%	0%	51%	49%
Lakes	NA	NA	NA	NA	NA
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles.

— None or not reported.
NA = Not applicable.

Causes and Sources of Water Quality Impairments

Priority organics, metals, pesticides, siltation, and pathogens impair the mainstem of the Ohio River. Priority organics, such as benzene and chloroform, exceed the 10-6 Cancer Risk Criteria Level in 10 to 90 percent of the daily samples. Urban runoff, storm sewers, combined sewer overflows, unknown sources, agriculture, and industrial point sources impair large stretches of the river, and the relative contribution of nonpoint sources appears to be increasing.

Programs to Correct Impairments

The Ohio River Valley Sanitation Commission (ORSANCO) relies on its member States (Illinois, Indiana, Kentucky, Ohio, Pennsylvania, and West Virginia) to administer point source permit programs. However, the Commission reviews point source permits drafted by the States to ensure that Commission standards will not be violated. The Commission's Pollution Control Standards (adopted in 1990) include criteria for human health pollutants and industrial waste treatment requirements. The Commission recently began to define its role in controlling nonpoint source pollution. The Commission went on record advocating a technology-based approach for controlling nonpoint sources. The Commission will prioritize the control of pollution resulting from resource extraction activities, followed by urban runoff. However, the Commission's role in managing nonpoint source pollution remains undefined.

Programs to Assess Water Quality and Program Effectiveness

ORSANCO's monitoring program includes ambient sampling, daily organics monitoring, fish tissue analysis, fish population studies, bacterial monitoring, and intensive surveys. Following detections of copper in samples collected from intakes, the Monitoring Strategy Subcommittee undertook a complete review and assessment of the ambient monitoring system. The Subcommittee will review field operations, sample handling and analysis, data review and validation, data uses, and reporting procedures. The review should ensure that valid data are generated and distributed to decision makers.

Oklahoma

For a copy of the Oklahoma 1992 305(b) report, contact:

John Dyer
Oklahoma Department of Environmental Quality
Water Quality Division
1000 Tenth Street
Oklahoma City, OK 73117-1212
(405) 271-5205

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	7,045 mi	8%	50%	31%	11%
Lakes	605,892 ac	16%	38%	40%	6%
Wetlands	120 ac	—	100%	—	—

[a]Totals represent 8% of river miles, 58% of lake acres, and <1% of wetlands acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

Turbidity, siltation, pesticides, and nutrients, primarily from agricultural sources, cause the most widespread impairments in rivers, streams, and lakes. Other significant sources include domestic and industrial wastewater discharges, construction runoff, urban runoff, and oil field activities.

Programs to Correct Impairments

In 1990, the Oklahoma Conservation Commission (OCC) received an EPA 319 grant to implement a 3-year demonstration project for "Control of Erosion Related Pollution from Mixed Agricultural Activities." The OCC will implement the demonstration project at three watersheds in western Oklahoma. Two of the watersheds suffer from excessive nutrient and sediment loads; the third watershed is impaired by bacteria, followed by sediment and nutrients. Local conservation districts and the OCC will select best management practices (BMPs) to remedy the problems in each watershed and recruit agricultural operators to implement the BMPs. The OCC set a project goal at 70 percent participation by local landowners. The project also includes background monitoring and post-implementation monitoring to assess BMP effectiveness.

Programs to Assess Water Quality and Program Effectiveness

In 1991, the State initiated a 3-year sampling program to identify ground water wells potentially at risk from agricultural impacts. The State conducted background surveys to identify areas most likely to be contaminated by agricultural impacts, such as animal waste, fertilizer, and pesticides. In 1991, the State sampled 67 wells and analyzed the samples for nitrate-nitrogen and specific pesticides used in the vicinity of each well. Four of the samples contained nitrate-nitrogen above the recommended limit of 20 mg/L for noncommunity water supplies. None of the samples contained significant concentrations of pesticides. Ultimately, the State will sample 200 wells under the program.

Oregon

For a copy of the Oregon 1992 305(b) report, contact:

Elizabeth Thomson
Oregon Department of Environmental Quality
Water Quality Division
811 SW Sixth Avenue
Portland, OR 97204
(503) 229-5358

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	29,109 mi	43%	—	30%	27%
Lakes	504,928 ac	74%	—	12%	14%
Estuaries	60 mi^2	7%	—	63%	31%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 32% of river miles, 82% of lake acres, and 30% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Habitat alterations, flow alterations, elevated temperatures, and siltation affect the largest number of stream miles. Rangeland, agriculture, forestry, and recreational activities impair the most stream miles. Nutrients and pH affect lakes, and pathogens and toxics impair estuarine waters.

Programs to Correct Impairments

The Groundwater Protection Act requires statewide ground water monitoring, domestic well testing, public education activities, and implementation of Best Management Practices (BMPs). The Oregon Department of Environmental Quality (DEQ) implements the Groundwater Quality Protection Rules through existing programs such as the National Pollutant Discharge Elimination System (NPDES) permit program for point sources and the Environmental Cleanup Program. The ground water rules minimize wastewater discharges by requiring facilities to adopt "highest and best methods" that prevent pollutants from entering ground water. The rules also require that facilities develop ground water management plans and monitor ground water quality. In addition, the DEQ reviews new facility plans to ensure that facility design, construction, and operation will not degrade ground water.

Programs to Assess Water Quality and Program Effectiveness

In 1991, the State adopted new narrative biocriteria and focused on using biological monitoring to detect the effects of nonpoint sources. In 1991, the State monitored macroinvertebrates at 45 sites to determine the effects of grazing and forest management practices on water quality. The biological monitoring program includes macroinvertebrate assessments, fish enzyme studies, fish tissue analysis for toxic chemicals, fish health observations, periphyton growth studies, and toxicity testing.

Pennsylvania

For a copy of the Pennsylvania 1992 305(b) report, contact:

Robert Frey
Pennsylvania Department of Environmental Resources
Bureau of Water Quality Management
Division of Assessment and Standards
P.O. Box 8465, 10th Floor
Harrisburg, PA 17105-8465
(717) 783-2959

1992 Water Quality Assessment[a]

Waterbody Type	Waters Assessed[b]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	24,751 mi	81%	—	8%	11%
Lakes	—	—	—	—	—
Great Lakes	—	—	—	—	—
Wetlands	—	—	—	—	—

[a] Source: 1993 305(b) Update.
[b] Totals represent 45% of river miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Abandoned mine drainage is the leading source of surface water quality degradation. The pollutants responsible for degradation due to mining are low pH, metals, and turbidity. Other sources of surface water degradation include agriculture and municipal and industrial point sources. These sources generate nutrients, turbidity, and metals. The major source of ground water contamination is leaking underground storage tanks. Other sources of ground water contamination include coal mining, bulk storage tanks, chemical plants, and oil and gas exploration. Contamination is from both organic and inorganic chemicals.

Programs to Correct Impairments

Current efforts to address mining-related problems include: requiring abatement or load reduction when sites are remined, reconstruction of abandoned mines that are a threat to public health, and research programs. The Department of Environmental Resources is also pursuing legislative changes to provide incentives for remining and reclamation. Agriculture problems are addressed primarily through individual conservation plans using Best Management Practices (BMPs) and education programs. Several of the State's agencies are jointly developing a single, integrated document that encompasses all the planning issues related to agriculture — such as erosion/sediment control, manure management, and integrated pest management. A permitting program modifies land disposal problems, and stormwater rules require every county to prepare a stormwater management plan that identifies problems and suggests BMPs to address the problems.

Programs to Assess Water Quality and Program Effectiveness

Currently there are 168 fixed-monitoring stations on rivers, streams, and Lake Erie scheduled to be visited monthly for stream discharge and physical/chemical analysis and annually for biological evaluation of stream bottom life.

Puerto Rico

For a copy of the Puerto Rico 1992 305(b) report, contact:

Eric H. Morales
Puerto Rico Environmental Quality Board
Water Quality Area
P.O. Box 11488
Santurce, PR 00910
(809) 751-5548

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	5,375 mi	5%	11%	18%	66%
Lakes	10,587 ac	15%	22%	29%	33%
Estuaries[b]	184 mi	5%	8%	18%	69%
Oceans	428 mi	44%	42%	8%	5%
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles, 100% of lake acres, 100% of estuary square miles, and 100% of ocean miles.
[b]Puerto Rico reports linear miles of estuaries supporting designated uses rather than square milesof estuaries supporting designated uses.
— None or not reported.

Causes and Sources of Water Quality Impairments

The principal causes of impairment in rivers are pathogen indicators, nutrients, dissolved oxygen, and metals primarily from land disposal activities, agriculture, and urban runoff. Impairment in lakes and lagoons is caused by pathogen indicators, nutrients, dissolved oxygen, and other inorganics, the sources of which include land disposal, urban runoff, and agriculture. In estuaries, urban runoff, storm sewer discharges, and land disposal are primary sources of impairment caused by unknown toxicity, metals, organic enrichment, and pathogen indicators. Pathogen indicators are the primary cause of impairment in oceans with metals, chlorine, and unknown toxicity also contributing. Sources of ocean impairment include land disposal and municipal point sources.

Programs to Correct Impairments

In addition to traditional point source controls, Puerto Rico promotes water quality through various nonpoint source programs. Two of the more prominent programs attempt to control contamination from livestock enterprises and erosion from construction and mining operations. Livestock enterprises are required to implement animal fecal waste management systems and other Best Management Practices (BMPs). Construction or extraction activities that meet certain requirements are required to file a sediment and erosion control plan that establishes the control measures necessary to minimize erosion.

Programs to Assess Water Quality and Program Effectiveness

Monitoring of both surface and ground waters was performed in five priority watersheds to evaluate the effectiveness of BMPs. Inspections of 200 livestock enterprises were performed in five priority watersheds. Inspections will also be performed on cropland and agricultural activities within the priority watersheds to evaluate implementation of BMPs.

Rhode Island

For a copy of the Rhode Island 1992 305(b) report, contact:

Connie Carey
Rhode Island Department of Environmental Management
Division of Water Resources
291 Promenade Street
Providence, RI 02908-5767
(401) 277-6519

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	664 mi	31%	42%	5%	22%
Lakes	16,749 ac	8%	71%	18%	3%
Estuaries	193 mi^2	73%	7%	11%	9%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 86% of river miles, 100% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Metals, especially copper and lead, are the most significant causes of nonsupport in rivers and streams, followed by priority organics, pathogen indicators, low dissolved oxygen concentrations, and nutrients. Nutrients, metals, eutrophication-related low dissolved oxygen concentrations, and pH impair lakes. In estuaries and coastal waters, the major causes of impairment include pathogen indicators, heavy metals, nutrients, and eutrophication-related low dissolved oxygen concentrations. Major sources of pollutants in rivers and estuaries include industrial discharges, municipal discharges, combined sewer overflows, urban runoff, highway runoff, septic systems, and contaminated sediments. In lakes, septic systems and runoff are the leading sources of impairment.

Programs to Correct Impairments

Since 1990, the NPS management program has documented freshwater wetland water quality problems, evaluated the State's freshwater wetland regulations, and proposed revisions to the regulations. The NPS program also reviewed the existing regulatory framework for stormwater runoff and developed Best Management Practice (BMP) performance standards and applicability criteria for a guidance manual issued to State and municipal staff. The NPS program also oversaw creation of the Site Plan Review Program by the Rhode Island Conservation Districts. The program assists municipalities reviewing site plans for compliance with soil erosion and sediment controls.

Programs to Assess Water Quality and Program Effectiveness

The Rhode Island Department of Environmental Management and the Narragansett Bay Project developed the Citizen's Volunteer Monitoring Program Coordination Project to promote and coordinate all volunteer monitoring groups at the State level. The project supports a Statewide Coordinator to educate volunteers and ensure data quality.

South Carolina

For a copy of the South Carolina 1992 305(b) report, contact:

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Columbia, SC 29201
(803) 734-5300

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	3,954 mi	72%	—	16%	12%
Lakes	382,028 ac	80%	—	14%	6%
Estuaries	427 mi^2	73%	—	24%	3%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 40% of river miles, 73% of lake acres, and 20% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Organic enrichment, pathogens, and pH cause most stream impairments in South Carolina. Agriculture, unknown sources, municipal point sources, and urban runoff/storm sewers are the leading sources of impairments in rivers and streams. Organic enrichment and low dissolved oxygen concentrations are the leading source of impairment in lakes and estuaries. Unknown sources generate most lake impairments, followed by agriculture and industrial point sources. Unknown sources also generate most estuarine impairments, followed by urban runoff/storm sewers and industrial point sources. Leaking underground storage tanks account for most ground water contamination incidents in the State.

Programs to Correct Impairments

The South Carolina Department of Health and Environmental Control (DHEC) initiated the Watershed Water Quality Management Strategy to integrate protection activities on a basin and watershed scale. The Strategy integrates monitoring, assessment, problem identification and prioritization, water quality modeling, permitting, and planning activities to develop management plans and implementation strategies for entire watersheds. On a 5-year rotation, DHEC will develop or revise a water quality management strategy for one of five delineated hydrologic basins per year. Each year, DHEC staff can focus monitoring efforts on the targeted basin rather than randomly selecting monitoring sites throughout the State. The watershed approach encourages DHEC to evaluate both point and nonpoint source impacts and consolidate management solutions.

Programs to Assess Water Quality and Program Effectiveness

Biological monitoring includes identification and enumeration of phytoplankton, aquatic macroinvertebrates, and fish. Biological sampling stations are located in headwater reaches of selected impoundments, in major waterbodies subject to possible pollution, and critical waters used for water supplies, recreation, and fish and wildlife propagation.

South Dakota

For a copy of the South Dakota 1992 305(b) report, contact:

Andrew Repsys
South Dakota Department of the Environment and Natural Resources
Division of Water Resource Management
523 East Capitol, Joe Foss Building, Room 425
Pierre, SD 57501-3181
(605) 773-3696

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	3,604 mi	17%	—	26%	57%
Lakes	683,458 ac	—	81%	5%	14%
Wetlands	—	—	—	—	—

[a]Totals represent 36% of river miles and 98% of lake acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

Agricultural nonpoint sources and livestock operations are the primary sources of suspended solids and pathogens causing impairments in rivers and streams. River impairments also result from natural pollutant sources, such as the erosive soils naturally occurring in western South Dakota. Elevated stream pH is another important cause of impairment, but the source could not be identified. Runoff from agricultural lands, carrying sediment and nutrients, remains the major source of lake pollution. Petroleum products, fertilizers, and pesticides are the most frequently identified contaminants in ground water.

Programs to Correct Impairments

The land treatment phase of the Oakwoods-Poinsett Rural Clean Water Program (RCWP) implemented best management practices (BMPs) to reduce total nitrogen, pesticides, animal wastes, and water- and sediment-borne contaminants entering ground water and surface waters. The project identified and prioritized three critical areas for BMP implementation based on aquifer vulnerability and sediment delivery. The RCWP contracted with landowners to implement BMPs (conservation tillage, fertilizer management, pesticide management, and animal waste management) on 81 percent of the critical area with highest priority and 60 percent of all three critical areas. The RCWP provided 75 percent cost share assistance through the Agricultural Stabilization and Conservation Service.

Programs to Assess Water Quality and Program Effectiveness

The Comprehensive Monitoring and Evaluation (CM&E) phase of the Oakwoods-Poinsett RCWP monitored the effects of BMP implementation on ground water and surface water quality. The CM&E phase included three monitoring studies: (1) ground water monitoring, (2) the Oakwood Lakes System Study, and (3) the Agricultural Chemical Leaching Study in the vadose zone. Ground water monitoring was conducted at five farmed fields with BMPs, one farmed field without BMPs, and one unfarmed site. Event-based sampling techniques were developed for monitoring ground water and the vadose zone.

Tennessee

For a copy of the Tennessee 1992 305(b) report, contact:

Greg Denton
Tennessee Department of
Environment and Conservation
Division of Water Pollution Control
401 Church St., L&C Annex,
6th Floor
Nashville, TN 37243-1534
(615) 532-0699

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	10,823 mi	47%	16%	27%	9%
Lakes	539,326 ac	78%	1%	9%	12%
Wetlands	—	—	—	—	—

[a]Totals represent 57% of river miles and 100% of lake acres.

— None or not reported.

Causes and Sources of Water Quality Impairments

No single cause or source of water quality impairment is dominant, but siltation, organic enrichment/dissolved oxygen, and suspended solids affect many river miles. Principal sources of river impairment are agriculture, hydromodification, and land development/construction. Although agriculture impacts approximately 25 percent of the State's river miles, it is not necessarily dominant. Impairment of Tennessee's lakes is from organic enrichment/dissolved oxygen, priority organics, flow alteration, and siltation. Sources of lake impairment include in-place contaminants, upstream impoundments, land development/construction, and agriculture. The largest single source of lake impacts is in-place contaminants, which has resulted in the majority of the State's fish consumption advisories.

Programs to Correct Impairments

New regulatory and planning tools such as Total Maximum Daily Loading studies, updated water quality standards, and the Stormwater Program are being used to adress pollution sources. Tennessee has been very progressive in its use of the Federal 401 Certification and the State Aquatic Resource Alteration Permit (ARAP) program to protect wetlands, regulate construction runoff, and oversee activities such as gravel dredging and channelization of streams. Future tools envisioned include watershed planning for NPDES permitting activities, biocriteria, sediment criteria, and increased ability to require BMPs for nonpoint sources not currently being regulated. Tennessee's ground water criteria, wellhead protection program, and an aquifer mapping program are currently under development.

Programs to Assess Water Quality and Program Effectiveness

Overall program effectiveness will ultimately be gaged by streams and lakes that are not currently fully supporting designated uses being brought into compliance with water quality standards. The recent updating of the STORET system and the newest Waterbody System (WBS) will be used to track support of designated uses and improved water quality.

Texas

For a copy of the Texas 1992 305(b) report, contact:

Steve Twidwell
Texas Natural Resource
Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087
(512) 908-1000

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable
Rivers	14,107 mi	74%	—	10%	17%	—
Lakes	1,504,539 ac	89%	—	<1%	11%	—
Estuaries	1,991 m^2	66%	—	8%	23%	3%
Oceans	—	—	—	—	—	—
Wetlands	—	—	—	—	—	—

[a]Totals represent 7% of river miles, 49% of lake acres, and 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Use impairments in Texas streams and rivers result primarily from treated domestic wastewater discharges that reduce dissolved oxygen concentrations and elevate fecal coliform densities. Use impairments in reservoirs stem from natural sources and municipal wastewater treatment plant discharges resulting in elevated salinity, total dissolved solids, and fecal coliform densities. Industrial and municipal point sources generate most of the fecal coliform bacteria and toxic contaminants causing use impairments in bays. Most ground water contamination incidents are related to point source activities, such as petroleum storage tanks and industrial waste disposal.

Programs to Correct Impairments

The Texas Water Commission (TWC) wrote new rules that created the Program for Assessment of Water Quality by Watershed and River Basin. The rules realign water quality programs by regional river authorities and require the TWC to move toward simultaneously issuing all wastewater discharge permits in a basin. The watershed program encourages public participation in the development of regional assessments.

Programs to Assess Water Quality and Program Effectiveness

The TWC, Texas Parks and Wildlife Department, and EPA Region 6 are cooperatively conducting the Texas Ecoregion Project. The project will evaluate regional variability of physical, chemical, and biological characteristics of Texas streams. The project will determine the potential for developing regional water quality standards and biological criteria, verify Texas ecoregions, and refine use assessment procedures.

Utah

For a copy of the Utah 1992 305(b) report, contact:

Thomas W. Toole
Utah Department of Environmental Quality
Division of Water Quality
P.O. Box 144870
Salt Lake City, UT 84114-4870
(801) 538-6146

Causes and Sources of Water Quality Impairments

Metals impair aquatic life support use and total dissolved solids impair agricultural uses of streams and rivers. The primary source of these pollutants is nonpoint source runoff. Agricultural practices such as grazing and irrigation increase sediment and nutrient loading in streams. Nutrient concentrations, especially phosphorus, exceed State indicator levels in most rivers, streams, lakes, and reservoirs sampled. However, the State does not consider nutrient levels when determining use support in rivers and streams because the effects of nutrients are difficult to assess without concurrent biological sampling or visual evaluations of aquatic plant growth. The State does consider nutrients the leading cause of impairment in lakes, followed by low dissolved oxygen and suspended solids. The major sources of lake pollutants are nonpoint sources, agricultural practices, industrial and municipal point sources, drawdown of reservoirs, and natural background level sources. Irrigation, urbanization, and infiltration of leachate from landfills, mine tailings, and mill tailings degrade ground water.

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	7,557 mi	57%	—	16%	27%
Lakes	450,078 ac	61%	—	32%	7%
Wetlands	—	—	—	—	—

[a]Totals represent 64% of river miles and 93% of lake acres.

— None or not reported.

Programs to Correct Impairments

Utah's Watershed Program is implementing NPS controls in five priority watersheds, restoring stream channels and wetlands, and identifying sources of salts and sediments entering the Colorado River. The priority watershed projects will demonstrate the water quality benefits derived from NPS controls. The State routinely relies on the Soil Conservation Service to provide technical expertise to cooperators in priority watersheds. The Jordan River Wetland Project will demonstrate river restoration techniques in an urban area. The Colorado River project will focus on rangelands loading salts and sediment into the River.

Programs to Assess Water Quality and Program Effectiveness

Utah's interagency monitoring program will undertake additional habitat monitoring in addition to chemical sampling to document water quality improvements resulting from nonpoint source management. Sampling will focus on watersheds implementing best management practices.

Vermont

For a copy of the Vermont 1992 305(b) report, contact:

Jerome J. McArdle
Vermont Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division
103 South Main Street
Building 10 North
Waterbury, VT 05671-0408
(802) 244-6951

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	5,264 mi	59%	22%	15%	4%
Lakes/Ponds	52,851 ac	37%	33%	20%	10%
Lake Champlain	174,175 ac	—	—	46%	54%
Wetlands	—	—	—	—	—

[a]Totals represent 100% of river miles and 99% of lake/pond acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

As in 1990, agriculture impairs the greatest number of river miles, primarily via nutrient runoff from nonirrigated crop production, animal management areas, and pasture land. Siltation, nutrients, thermal modification, and organic enrichment cause the most extensive impairments in rivers and streams. Unspecified sources generate flow alterations, nutrients, and algae, the leading causes of impairments in lakes and ponds (excluding Lake Champlain). Flow regulation, streambank destabilization, and agriculture are the most significant identified nonpoint sources of pollution in lakes. All of Vermont's portion of Lake Champlain is impaired by phosphorus concentrations that exceed the State's lake-specific criteria. Fish consumption advisories for priority organics, PCBs, and mercury also threaten the entire lake. Leading sources of ground water contamination include leaking underground storage tanks and leachate from landfills and hazardous waste sites.

Programs to Correct Impairments

In 1991, Vermont received EPA Section 319 funding to implement erosion controls in targeted watersheds, demonstrate agricultural milkhouse waste treatment BMPs, enforce domestic discharge rules, and coordinate NPS projects with other States.

Programs to Assess Water Quality and Program Effectiveness

Diagnostic studies on three lakes suggested that watershed monitoring programs are the only reliable method for identifying nonpoint sources impairing lakes. The diagnostic studies identified sources that contradicted professional evaluations made prior to watershed monitoring. For example, monitoring revealed that internal phosphorus loading was the major source of pollution in Lake Morey. Prior to monitoring, the State suspected that poorly sited septic systems were the primary source of nutrients in the lake. Vermont will expand lake monitoring with an EPA Clean Lakes grant.

Virginia

For a copy of the Virginia 1992 305(b) report, contact:

Carrie Gorsuch
Department of Environmental Quality – Water Division
Office of Water Resources Management
P.O. Box 11143
Richmond, VA 23230-1143
(804) 762-4290

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	17,958 mi	80%	—	14%	6%
Lakes	90,762 ac	93%	—	7%	<1%
Estuaries	3,080 mi^2	78%	—	20%	2%
Oceans	120 mi	100%	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 33% of river miles, 56% of lake acres, 100% of estuary square miles, and 100% of ocean miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Elevated densities of fecal coliform bacteria, primarily from agricultural runoff, are the most common cause of impairment in Virginia's rivers and streams, followed by metals. Nutrients and pH are the most common causes of nonsupport in lakes. The most prevalent sources of lake impairments are agriculture, silviculture, and urban runoff/storm sewers. Nutrients are the dominant cause of impairment in estuaries, followed by Kepone and suspended solids. Municipal and industrial point sources, in-place contamination, agriculture, runoff/storm sewers, and atmospheric deposition affect the most estuarine waters in Virginia.

Programs to Correct Impairments

The Virginia Water Control Board (now the Department of Environmental Quality) encourages wastewater treatment plants to implement biological nutrient removal (BNR), a new cost-effective technology. The Hampton Roads Sanitation District (HRSD)-York River Sewage Treatment Plant conducted a full-scale demonstration of the BNR process during 1988 and 1989, with a grant from the Water Control Board. The HRSD was granted a public domain patent for the BNR process, ensuring that it will be freely available to other municipalities and industrial dischargers.

Programs to Assess Water Quality and Program Effectiveness

Virginia contracts the U.S. Geological Survey (USGS) and two universities to monitor the Chesapeake Bay and its tributaries. The USGS samples nutrients at the fall lines of five tributaries. The USGS increases sampling frequency during storm events to capture increased nutrient and sediment loadings into the tidal portion of the watershed. Virginia will estimate nutrient loads to the Bay with the nutrient data collected by the USGS. The universities sample chemical and biological parameters at 27 stations in the mainstem of the Chesapeake Bay. The State will characterize spatial and temporal patterns of nutrients, organic materials, and plant pigments in the Bay and its tributaries.

Virgin Islands

For a copy of the Virgin Islands 1992 305(b) report, contact:

Anne Hanley
U.S. Virgin Islands Department of Planning and Natural Resources
Division of Environmental Protection
P.O. Box 4340
St. Thomas, VI 00801
(809) 773-0565

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	—	—	—	—	—
Lakes	—	—	—	—	—
Estuaries	6 mi^2	50%	17%	17%	16%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 100% of estuary square miles.
— None or not reported.

Causes and Sources of Water Quality Impairments

Conventional pollutants pose the greatest threat to marine and estuarine environments. Sewage discharges are frequent and result from both mechanical breakdowns and unpermitted discharges. Nonpoint source contamination is primarily from construction projects and urban runoff from roads and landfills. This runoff leads to increased turbidity and nutrient levels. Wastes from marine vessels is another significant source of impaired water quality. Water quality standards for fecal coliform are often exceeded and low dissolved oxygen levels are found where there are large numbers of live-aboard vessels and low flushing rates of waters.

Programs to Correct Impairments

Discharge permits are the principal regulatory tool for reducing pollutant release into territorial waters. Currently, a bill is pending that would disallow any marine vessel from discharging pollutants into the territorial waters. Effective nonpoint source control is, for all purposes, nonexistent, but the Territory is developing programs to combat soil erosion and urban runoff. For example, new development projects must provide for vegetated buffers, wetlands, catch basins, porous pavements, and similar systems for the detention, retention, treatment, and percolation of runoff. The Coastal Zone Management Act also requires that the Territory develop management plans for 18 of the most sensitive areas in the Territory. Unfortunately many delays have prevented development of these plans.

Programs to Assess Water Quality and Program Effectiveness

Toxicity testing, stormwater limits, and biological monitoring are required by some permits. All point sources must self-monitor and submit results to DPNR and EPA. DPNR conducts compliance inspection on all permittees and compliance monitoring on all major permittees.

Washington

For a copy of the Washington 1992 305(b) report, contact:

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Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
(206) 407-6482

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	5,639 mi	29%	7%	19%	46%
Lakes	80,696 ac	46%	5%	22%	27%
Estuaries	1,093 mi^2	24%	13%	9%	54%
Oceans	—	—	—	—	—
Wetlands	—	—	—	—	—

[a]Totals represent 14% of river miles, 13% of lake acres, and 37% of estuary square miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Low levels of dissolved oxygen, often naturally occurring, are the major cause of impairment of designated uses in estuaries. Bacterial contamination, primarily from agricultural runoff, onsite wastewater disposal, and municipal wastewater treatment plants also causes impairments in estuaries. Major causes of impairment in lakes include nutrients, pesticides, siltation, flow alteration, and low dissolved oxygen. Agricultural production is the predominant source of impairment in lakes. Other sources include urban runoff, land disposal, septic tanks, and natural sources. In rivers and streams agriculture is the major source of water quality degradation, followed by industrial point sources and hydro-habitat modification. Causes of water quality impairment from these sources include thermal modification, pathogen indicators, metals, and priority organics.

Programs to Correct Impairments

Washington provides financial incentives to encourage compliance with permit requirements, the principal vehicle for regulating point source discharges. The State also has extensive experience developing, funding, and implementing nonpoint source pollution prevention and control programs since the early 1970s. The State has developed nonpoint source control plans with Best Management Practices (BMPs) for forest practices, dairy waste, irrigated agriculture, dryland agriculture, and urban stormwater. The State is now focusing attention is watershed planning. Efforts are currently geared toward prioritizing watersheds and developing comprehensive plans for the priority watersheds.

Programs to Assess Water Quality and Program Effectiveness

Washington implements an aggressive program to monitor the quality of lakes, estuaries, and rivers and streams. The program makes use of fixed-station monitoring to track spatial and temporal water quality changes so as to ascertain the effectiveness of various water quality programs and be able to identify desirable adjustments to the programs.

West Virginia

For a copy of the West Virginia 1992 305(b) report, contact:

Michael A. Arcuri
West Virginia Division of
Environmental Protection
Office of Water Resources
1201 Greenbrier Street
Charleston, WV 25311
(304) 558-2108

Causes and Sources of Water Quality Impairments

Metals, siltation, and pH are the leading causes of impairment in rivers and lakes. Coal mining impairs the most stream and river miles, followed by pasture land and road construction and maintenance. Coal mining is the dominant source of impairment in lakes, followed by industrial point sources and agriculture.

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	5,287 mi	14%	7%	63%	16%
Lakes	21,522 ac	27%	8%	57%	8%
Wetlands	—	—	—	—	—

[a]Totals represent 16% of river miles and 100% of lake acres.

— None or not reported.

Wisconsin

For a copy of the Wisconsin 1992 305(b) report, contact:

Meg Turville-Heitz
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921
(608) 266-0152

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	11,336 mi	82%	1%	12%	5%
Lakes	211,734 ac	21%	21%	25%	33%
Great Lakes	840 mi	—	—	100%	—
Wetlands	—	—	—	—	—

[a]Totals represent 20% of river miles, 22% of lake acres, and 100% of Great Lakes shore miles.

— None or not reported.

Causes and Sources of Water Quality Impairments

Siltation, habitat alterations, and nutrients cause most impairments in Wisconsin's rivers and streams. Unspecified nonpoint sources, agriculture, and habitat modification are the leading sources of river impairments. Most lake impairments are due to aquatic weeds, metals, and nutrients. Fish contamination impairs all 840 miles of Wisconsin's Great Lakes shoreline. The Wisconsin Department of Natural Resources blames historical point source discharges for introducing most of the priority organics, pesticides, and metals currently detected in fish samples. Other significant sources include atmospheric deposition and contaminated sediments.

Programs to Correct Impairments

The WDNR is currently developing a strategic plan, Water 2010, to guide the State's water-related activities for the next 20 years. River basin water quality management plans lay the foundation for the Water 2010 strategic plan. The basin plans, updated every 5 years, identify planning goals, summarize the condition of the waters in each river basin, identify water quality improvements and persistent pollution problems, and recommend remedial or preventive actions needed to protect water quality. The river basin plans also contain watershed rankings used to select priority watershed projects for funding under the Wisconsin Nonpoint Source Water Pollution Abatement Program. The nonpoint source program provides funds to individual landowners and communities to implement priority watershed projects.

Programs to Assess Water Quality and Program Effectiveness

Under the Great Lakes Coastal Sediment Study, WDNR is evaluating procedures for assessing sediment toxicity. The staff established reference concentrations for toxics measured in samples collected from coastal streams and harbors above contaminated areas. The study will evaluate contaminant bioacummulative potential of coastal sediments by placing caged fathead minnows over sediments previously sampled for laboratory tests. Sediment samples will be collected from the cage sites for bulk chemistry analysis.

Wyoming

For a copy of the Wyoming 1992 305(b) report, contact:

Robert Gumtow
Wyoming Department of Environmental Quality
Water Quality Division
Herschler Building - 4th Floor
122 West 25th Street
Cheyenne, WY 82002
(307) 777-7098

1992 Water Quality Assessment

Waterbody Type	Waters Assessed[a]	Fully Supporting	Threatened	Partially Supporting	Not Supporting
Rivers	6,013 mi	13%	20%	59%	8%
Lakes	125,422 ac	26%	1%	50%	23%
Wetlands	—	—	—	—	—

[a]Totals represent 26% of river miles and 43% of lake acres.
— None or not reported.

Causes and Sources of Water Quality Impairments

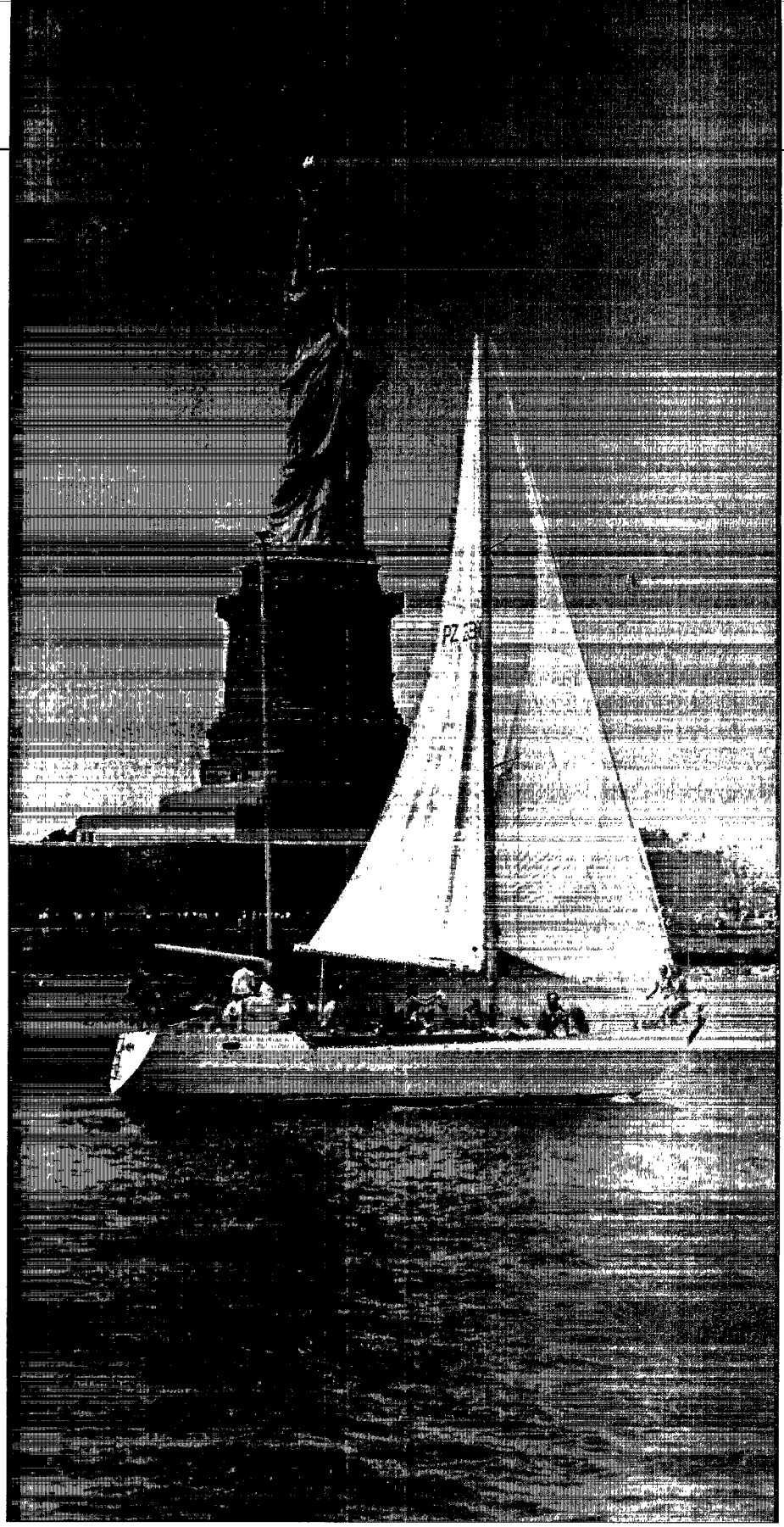
Sediment and siltation, nutrients, total dissolved solids and salinity, flow alteration, and low dissolved oxygen concentrations are the top five causes of water quality impairment in Wyoming streams. The top five sources, based on the number of miles impacted, are rangeland, natural sources, irrigated cropland, pasture land, and highway, bridge, and road construction. In lakes, low dissolved oxygen concentrations, nutrients, sediment and silt, other inorganics, and metals cause the most extensive impairments. The top five sources of impairment in lakes include natural sources, rangeland, irrigated cropland, flow regulation, and municipal discharges.

Programs to Correct Impairments

In 1991, the Governor appointed a citizen-based Nonpoint Source Task Force to modify the Wyoming Nonpoint Source Plan and oversee nonpoint source project funding and implementation. Since its formation, all project proposals undergo Task Force review. Currently funded projects will demonstrate best management practices for cropland production and road construction, riparian restoration, and education programs.

Programs to Assess Water Quality and Program Effectiveness

Nonpoint source assessment is a high priority in Wyoming due to the complexities of accounting for natural background levels of sedimentation. The State intends to incorporate volunteer monitoring and biological assessment in the routine monitoring program to gather additional data needed to distinguish natural sedimentation and nonpoint source inputs. Currently, the State is designating reference stream sites representative of relatively undisturbed sites in specific ecoregions. Biological parameters such as species composition, species abundance, and relative habitat condition will be examined at these candidate streams.


PZ 23

State Recommendations

In their 1992 reports, 30 States and Territories discussed recommended program actions needed to make additional progress toward the Clean Water Act's goal of fishable and swimmable waters. These recommendations encompass a range of actions at the congressional, Federal, State, and local levels and are often expressed in terms of State objectives or continuing needs. It should be emphasized that the recommendations discussed here were reported by the States themselves in 1992; this discussion does not attempt to assess their merits. Nor should this discussion be construed as an EPA or Administration endorsement of any State recommendations. Many of the State recommendations for action do, however, coincide with current EPA program concerns and priorities.

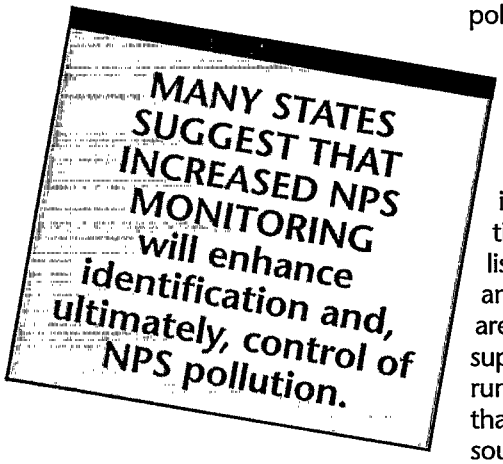
A recurring theme in almost all State recommendations is the need for continued, and in many cases additional, funding to implement ever-expanding State water quality protection responsibilities. For example, Mississippi's 305(b) report includes the following:

> Additional resources are needed to evaluate and regulate the environmental risk from the release of toxic chemicals, to develop the storm water permitting and regulatory program, to implement a statewide nonpoint control program, to expand and strengthen our wetlands protection efforts, to implement and manage the State's Wellhead Protection Program, to expand the Ambient Surface Water Monitoring Program, to develop narrative and numeric biological criteria, to expand our laboratory's analytical capability, to develop Total Maximum Daily Loads, and to develop and implement a citizen volunteer monitoring program. Without additional funding and staffing, most of these concerns cannot be adequately addressed, if at all.

In general, the most frequently reported State recommendations fall into eight major categories. These areas of concern are nonpoint source abatement, toxic identification and control, water quality monitoring, ground water conservation, wetlands protection, pollutant source discharge permitting, municipal facilities, and water quality criteria and standards. Other concerns less frequently reported include data management/coordination, sewer overflow treatment, and education to increase public awareness.

RECURRING THEMES ARE nonpoint source abatement, toxic identification and control, water quality monitoring, ground water conservation, wetlands protection, pollutant source discharge permitting, municipal facilities, and water quality criteria and standards.

Nonpoint Source Abatement



Recommendations most often cited by the States concern the identification, prevention, and control of nonpoint sources (NPSs) of pollution. Most commonly, States cite the need for additional funding for development of better monitoring and assessment methods to detect nonpoint sources, assess their impacts, and determine the effectiveness of NPS controls. States listed regulation of urban runoff and increased monitoring as NPS areas needing additional financial support. (Note that much of urban runoff is discharged in a conveyance that is legally considered a point source and is subject to National Pollutant Discharge Elimination System [NPDES] stormwater requirements.) Many States indicate that increased monitoring will enhance the ability to identify and eventually control nonpoint sources of pollution. Montana's 305(b) states:

> To adequately measure the effectiveness of the state's nonpoint source control program and other water pollution control programs would require a greatly expanded monitoring and assessment effort.

A number of States cite increased public education on the nature of NPS pollution and NPS controls as a mechanism for encouraging BMP implementation and NPS program funding. Several States suggest EPA should take specific actions with respect to NPS programs ranging from issuing total maximum daily loading limits for NPS pollutants and recommending adoption of more stringent nutrient standards to developing numeric criteria for NPS pollutants.

Identification and Control of Toxic Substances

The States strongly recommend expanding efforts to gather data on toxic pollutants and to develop or implement State toxic control programs. Specific recommendations for data collection on toxics emphasize two areas: bioaccumulation of toxics in fish and shellfish tissue and sediment contamination. The States cite a need for the Federal government to provide national guidance on bioaccumulation of toxics in fish tissue. Several States requested funding to initiate or expand their current fish tissue monitoring programs. With respect to sediment contamination, there were recommendations for the EPA to actively pursue development of a nationwide in-place pollutant program designed to provide both technical guidance and dedicated Federal financial support for expansion of sediment monitoring programs and remediation efforts. In addition, States cite the need for EPA to refine and/or develop national sediment criteria for toxics, particularly heavy metals.

Water Quality Monitoring

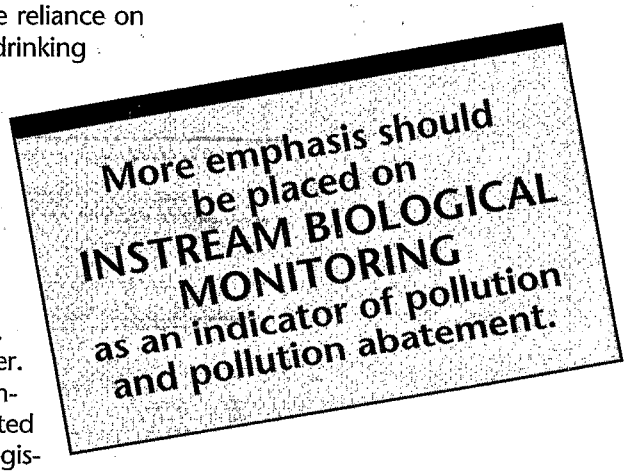
Beyond expressing a general need to expand water quality monitoring activities and evaluate them to be certain they are providing needed data, a prominent theme of State monitoring recommendations is to increase the emphasis on instream biological monitoring as an indicator of pollution and pollution abatement. Specifically, several States recommend the expanded use of volunteer monitoring programs in which volunteers are trained to make observations of aquatic and terrestrial conditions and perform water quality sampling and analysis. Other monitoring recommendations include seeking increased EPA and State support to expand fish tissue and sediment toxics monitoring programs as well as lake and NPS monitoring efforts.

Future Ground Water Concerns

A number of special or future ground water concerns were mentioned by 33 States in their Section 305(b) reports. The most prevalent issues were

- Agricultural nonpoint source discharges, including nitrate and pesticide contamination and soil erosion problems (17 States)
- Funding and staff resources (15 States)
- Data management (12 States)
- Development and implementation of State and Federal regulations, including enforcement and legislative support for State ground water protection programs (12 States)
- Development and maintenance of State monitoring systems (11 States).

Nitrate and pesticide contamination of ground water are of particular concern in many States because of the extensive reliance on ground water for rural drinking water supplies. Potential adverse health effects associated with the consumption of nitrate- or pesticide-tainted water include methemoglobinemia (blue baby syndrome), cardiovascular disorders, hypertension, and cancer. In response to these concerns, one State suggested that Federal pesticide registration criteria should be developed to rate pesticides on their potential to migrate through soils and into ground water.



A number of States expressed concerns with regard to the continued ability to fund State and Federal ground water research and protection programs. The lack of a stable long-term source of funding for these programs and the Federal emphasis on expanding the role of State governments in ground water protection programs were of concern to many States. These States applauded the Federal focus on prevention of ground water contamination as a more effective

and economical approach than a focus solely on remediation programs. However, they also expressed that, without adequate Federal funding, the development and implementation of these programs cannot be accomplished. Two States suggested better utilization of volunteers in reaching program goals. Also mentioned was the establishment of a cleanup fund financed by penalties or other enforcement actions and fees.

Data management concerns for many States included the lack of computerized databases to accommodate the growing body of ground water quality data. Monitoring produces large volumes of data, much of which remains on manual files in various State and local agencies where it is not readily accessible. Incompatibility between computer systems and lack of coordination between agencies was also cited as a problem. Many of the States recognized that they must continue to expand their monitoring efforts to include potential sources of contamination and to evaluate the relationship between surface water and ground water quality.

Although ground water has traditionally been considered a safe source of drinking water, research and monitoring have revealed problems in a number of States that may threaten the integrity of their ground water resources. Population growth and residential development compound the need for clean, safe ground water supplies. Many States see that the promotion of public awareness campaigns and improved ground water monitoring have placed ground water protection in the forefront of their environmental agenda.

Wetlands Protection

Several States called for increased Federal efforts in protecting valuable wetlands resources. Specific recommendations include the need for additional Federal appropriations to identify and quantify wetlands acreage and to strengthen existing State protection efforts. In addition, a number of States cited the need for additional Federal guidance in developing water quality standards and designated use classification for wetlands or, in lieu of that, the need for establishing national minimum water quality standards for wetlands to be incorporated into State regulations.

Pollutant Source Discharge Permitting

Federal financial assistance has been requested by the States for increases in planning/review functions necessary to enact a more forceful and stricter NPDES permit program as stipulated by the Federal Government. Because new mandates require sludge management, toxicity biomonitoring, and storm water management to be implemented through the NPDES program, a heavier burden has been placed on State programs to comply with these revisions. Several States indicated the need to incorporate NPS into the NPDES permit program. The State of Oklahoma is currently developing a Total Maximum Daily Load process to be used in issuing NPS permits. Another recommendation made was to amend the Atomic Energy Act, which exempts certain pollutants, such as plutonium and enriched uranium, from regulation under the NPDES program. The EPA was specifically asked to change its NPDES enforcement policy from focusing on permit classification (dischargers are currently graded on volume of discharge) to uniform enforcement, regardless of discharge volume. It was suggested that enforcement efforts be based on compliance records, designated stream uses, water quality standards violations, and potential risk to environment or public health.

Municipal Facilities

Continued funding for the maintenance, upgrade, and construction of municipal sewage treatment facilities remains a leading recommendation of the States. Several States expressed concerns about the State Revolving Fund Program, which replaces the Construction Grants Program terminated in 1990. The State Revolving Fund Program transfers funding responsibility for wastewater treatment construction from the Federal Government to the States. Several States voiced concerns that adequate money is not available to provide a smooth transition from the Construction Grants Program to the State Revolving Fund Program. Several States expressed concerns about acquiring the matching funds required to initiate State Revolving Fund Programs in their States.

Two other municipal concerns that were cited by many States involved pretreatment and combined sewer overflow (CSO) mitigation problems. States feel EPA should put more pressure on municipalities to implement and enforce their approved pretreatment programs. Federal funding is urged to support inspections, audits of industrial uses, enforcement, and more research on the effectiveness of pretreatment in reducing toxics in effluent. Special appropriations are also suggested for CSO mitigation projects, and, because of excessive costs, States recommend Federal assistance be provided to implement the projects expeditiously.

States' water quality standards consist of:

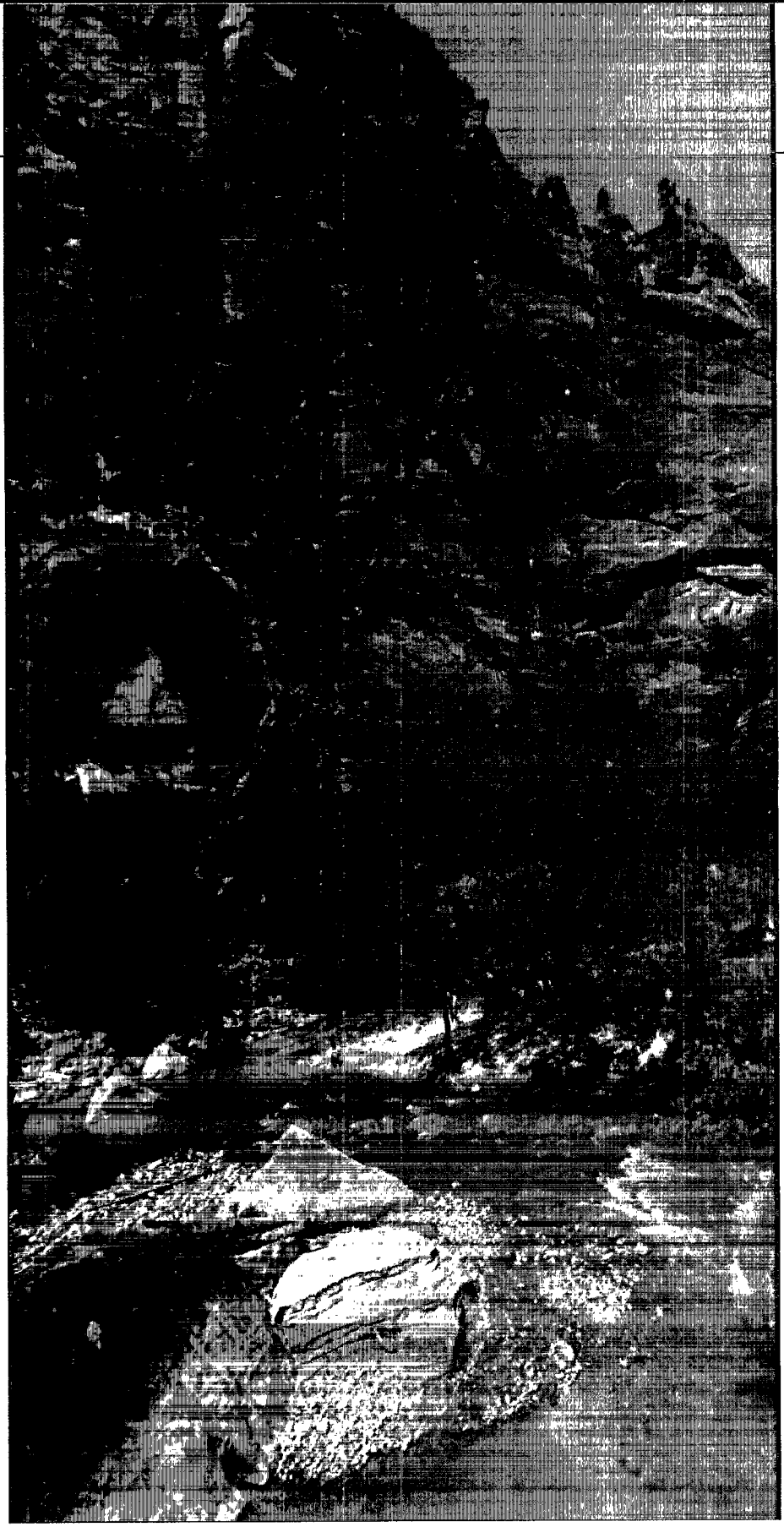
- *Criteria for specific pollutants established by the States and approved by EPA*
- *Designated uses*
- *Antidegradation policy*

Water Quality Criteria and Standards

The States' ability to assess water quality conditions depends heavily on criteria for specific pollutants established by the States and approved by the EPA. When these criteria are violated, designated uses may not be met. Together with an antidegradation policy, the criteria and the uses they protect form the State's water quality standards. A number of States recommend updating their standards by taking such actions as strengthening numerical criteria for toxics (particularly priority organics and heavy metals), adopting new standards for NPS pollutants and wetlands protection, or developing more specific classifications such as nutrient-sensitive or high-quality waters. Federal leadership is urged in finalizing criteria for sediment contamination and continuing to refine and develop criteria for substances causing risks to human health with specific emphasis on fish and shellfish consumption advisories. EPA is also encouraged to promote greater interstate consistency in all water quality standards.

Part III

Water Quality Management Programs



The Watershed Protection Approach

Background

Since the 1990 Report to Congress, EPA and many States have moved toward a more geographically oriented approach to water quality management. They share a growing consensus that the Nation's nonpoint source and habitat degradation problems can be solved best at the basin or watershed level.

In 1991, EPA highlighted the Watershed Protection Approach (WPA), a framework for focusing efforts on carefully chosen watersheds. The WPA is not a new government program, but rather a means of pulling together the resources and expertise of existing local, State, and Federal programs. A State that is using the WPA

- Targets those watersheds where pollution poses the greatest risk to human health, ecological resources, or desirable uses of the water, and where a successful outcome is likely

- Involves all parties with a stake in the watershed in the analysis of problems and the implementation of solutions

- Draws on the full range of methods and tools available, integrating them into a coordinated, multi-organizational attack on the problems.

The WPA draws on existing EPA authorities, as well as State and local requirements, and voluntary actions to resolve all significant water quality problems in a watershed. The WPA emphasizes the goal of monitoring or restoring ecological integrity in watersheds in addition to the more traditional goals of protecting human health and meeting water quality standards. Restoring ecological integrity means more than controlling chemical pollutants in the water column; other factors–flow, temperature, bank and riparian buffer condition, sedimentation, existence of riffles and pools in the stream–must be considered.

THE WATERSHED PROTECTION APPROACH moves beyond the traditional goals of protecting human health and meeting water quality standards; it seeks to protect and restore ecological integrity.

The Total Maximum Daily Load (TMDL) process, as established by Section 303(d) of the Clean Water Act, is a key element of the Watershed Protection Approach. TMDLs provide a flexible tool to address any stressor that precludes the attainment of water quality standards. A TMDL calculates allowable loadings from the contributing point and nonpoint sources to a given waterbody and provides a quantitative target for the pollution reduction necessary to meet water quality standards. States develop and implement TMDLs for impaired or threatened waterbodies.

NOTE

Under the WPA, a "watershed" is a hydrogeologic area defined for best management purposes. A watershed can be a river basin, a county-sized watershed, or a small supply watershed.

EPA's recent efforts to fully implement Section 303(d) revolve around tackling more challenging problems and moving toward integrated water-quality-based controls on point and nonpoint sources, geographic targeting, and watershed-scale assessments and protection.

The WPA fosters a high level of interprogram coordination within a State. Historically, each individual program deals with a particular problem, and each sets its own priorities. In a typical State, the National Pollutant Discharge Elimination System (NPDES) program issues discharge permits for point sources, the Section 319 program deals with nonpoint source controls, the ground water program protects wellheads and aquifers, and the fisheries program monitors fish populations and contamination by toxics. The WPA seeks to establish common priorities so that all available resources and talent can be brought to bear on targeted areas.

Implementation

WPA projects are being implemented at three levels–State, local, and regional. Some States, such as North Carolina and South Carolina, have incorporated elements of the WPA by shifting program activities to a basinwide planning approach. These States concurrently conduct most major program activities such as NPDES permitting, nonpoint source management, TMDL development, and monitoring within a basin (Figure 10-1). A management plan is developed for each basin every 5 years. Both of these States made the switch to basinwide planning without major organizational changes or increased resources.

Wisconsin's Priority Watershed Program focuses on watersheds rather than large basins. Wisconsin targets several of the State's 330

watersheds each year and begins nonpoint source planning, monitoring, and other efforts; full implementation of a watershed plan takes about 10 years.

On the local level, the U.S. Department of Agriculture and other agencies have sponsored watershed projects for many years. In other cases, a local government agency provides the impetus for a project and a special management agency may be formed. Successful projects involve a high degree of local participation through advisory committees, volunteer monitoring, and other activities. The Anacostia River Restoration Program is an example of a progressive urban watershed project (see highlight). The State of Washington also provides technical expertise to local committees for preparation of watershed action plans (see Puget Sound highlight).

At the regional level, large watershed projects often involve multiple States and Federal jurisdictions. The Great Lakes and National Estuary Programs (described in Chapter 11) are examples of WPA-type projects at the regional level. In addition, the EPA Regions are implementing a series of WPA projects in their States.

Figure 10-1

Neuse River Basin

The Neuse River Basin, North Carolina, featuring the upper Contentnea Creek watershed. The State will update the Neuse River Basin Plan, conduct monitoring, and revise NPDES permits concurrently throughout the basin every 5 years.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

The Anacostia River Restoration Project

This project illustrates many of the principles being encouraged under EPA's Watershed Protection Approach.

Background

The Anacostia River is a tributary to the Potomac River and has a watershed of about 150 square miles. The watershed has a variety of pollution and habitat modification problems. Starting in the 1930s, construction projects along the Capitol Mall and Washington's central business district transferred much of the surface drainage of the Tiber River to the Anacostia. This creates a substantial combined sewer overflow (CSO) problem on the lower, tidal portions of the River. In addition, approximately 75% of the Anacostia watershed's forest cover has been removed for urban development and agriculture, resulting in high stormwater flows and pollutant loadings.

From an early date, the Anacostia was targeted by Maryland as a Critical Area under the Chesapeake Bay program. With impetus from this program, the Anacostia Restoration Agreement was signed in 1987. The four principal signatories are the State of Maryland, Maryland's Montgomery and Prince George's Counties, and the District of Columbia.

Stakeholders

The Anacostia River Restoration Committee consists of representatives from the signatory agencies:

- District of Columbia Department of Public Works
- District of Columbia Department of Consumer and Regulatory Affairs
- Prince George's County Department of Environmental Regulation
- Montgomery County Department of Environmental Programs
- Maryland Department of Natural Resources
- Maryland Department of the Environment.

Other stakeholders and participants include

- U.S. Army Corps of Engineers
- Washington Suburban Sanitary Commission
- National Park Service
- Interstate Commission on the Potomac River Basin
- Metropolitan Council of Governments
- U.S. Department of Agriculture
- U.S. Environmental Protection Agency
- Izaac Walton League
- Anacostia Watershed Society
- Alliance for Chesapeake Bay.

Subwatershed Action Plans

With more than 60 groups and government programs involved, the key to restoring the Anacostia River is the creation of detailed Subwatershed Plans (SWAPs). SWAPs are blueprints for restoration activities within a portion of the Anacostia Basin. SWAPs address high-priority needs in each subwatershed while targeting attention on goals that will benefit the entire basin.

Each SWAP consists of eight elements:

- an analysis of existing water quality information
- specific goals to guide restoration efforts
- an inventory of stormwater retrofit and stream restoration opportunities
- a priority ranking of restoration projects based on feasibility, cost, and ability to meet goals
- long-term agreements to implement and monitor priority restoration projects
- plans to increase wetlands and forest cover
- lists of additional actions that could protect the subwatershed
- a long-term monitoring program to assess progress in achieving water quality and habitat improvements.

SWAPs have been defined for nine subwatersheds and three more SWAPs are under development.

Implementation of Controls

Implementation measures in the Anacostia Basin generally fall into two categories: stormwater retrofits and stream restoration projects. Stormwater retrofits usually control storm surges with wet or dry detention structures. Promising restoration measures include the establishment of stream buffer zones, streambank stabilization, wetlands reclamation, riparian reforestation, and modification of fish barriers. Coordination with open space agencies, such as the National Park Service and city parks, helps target restoration efforts to streamsides with the most potential to restore aquatic resources and enhance natural processes that trap pollutants.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Puget Sound Watershed Planning*

Developing an Action Plan

Local watershed management committees form the backbone of efforts to protect the State of Washington's Puget Sound from nonpoint sources. Local committees seeking funding for watershed projects in the Puget Sound basin are required to prepare action plans for control of nonpoint sources. The Puget Sound Water Quality Authority's Nonpoint Rule requires watershed management committees to include, at a minimum, the following elements in their action plans:

- A watershed characterization, including information such as watershed maps, geographic and biological information, and sources of data on the watershed

- A water quality assessment identifying nonpoint sources of pollution and evaluating water quality, beneficial uses, and the biological "health" of the watershed

- A problem definition indicating the extent of existing and potential water quality problems and effects on beneficial uses from nonpoint sources in the watershed

- Goals and objectives for prevention and correction of these nonpoint pollution concerns

- Specific source control programs to address the problems identified and justification for the management actions proposed in each of these programs. Source control programs can apply to stormwater, erosion, agriculture, onsite sewage disposal systems, forest practices, boats and marinas, and other nonpoint sources.

*Source: Puget Sound Water Quality Authority, 1989.

■ An implementation strategy identifying specific actions required, the responsibilities of each implementing agency or entity, and project milestones, costs, and funding sources.

Interagency Technical Assistance Teams

The Washington Department of Ecology (DOE) formed the Interagency Technical Assistance Team to support local watershed committees. The Interagency Technical Assistance Team provides a central pool of experts that local committees can utilize. The team consists of representatives from over 20 State agencies with expertise in

■ Forestry best management practices
■ Technical transfer to the agricultural community
■ Surface water quality monitoring and assessment
■ Ground water protection
■ Stormwater management
■ Shellfish protection
■ Public involvement strategies
■ Wildlife management
■ Habitat protection.

In addition, a Puget Sound Cooperative River Basin Study Team was formed with representatives from the Soil Conservation Service, the Forest Service, the Washington Department of Fisheries, and DOE. This team helps evaluate land use water quality problems within watersheds through field and literature investigations, provides management alternatives, and produces reports and maps based on watershed information.

Helpful Publications About Watershed Protection

Metropolitan Washington Council of Governments. 1990. *The State of Anacostia: 1989 Status Report.* Washington, DC.

Metropolitan Washington Council of Governments. 1992. *Watershed Restoration Sourcebook.* Washington, DC.

National Research Council. 1992. *Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy.* National Academy Press, Washington, DC.

Puget Sound Water Quality Authority. 1989. *Managing Nonpoint Pollution: An Action Plan Handbook for Puget Sound Watersheds.* Seattle, Washington.

USEPA. 1993. *Geographic Targeting: Selected State Examples.* EPA 841/B-93-001. Office of Water, Washington, DC.

USEPA. 1993. *The Watershed Protection Approach: Basinwide Water Quality Management.* Draft. Office of Water, Washington, DC.

USEPA. 1992. *Watershed Events: An EPA Bulletin on Integrated Aquatic Ecosystems Protection.* Office of Water, Washington, DC.

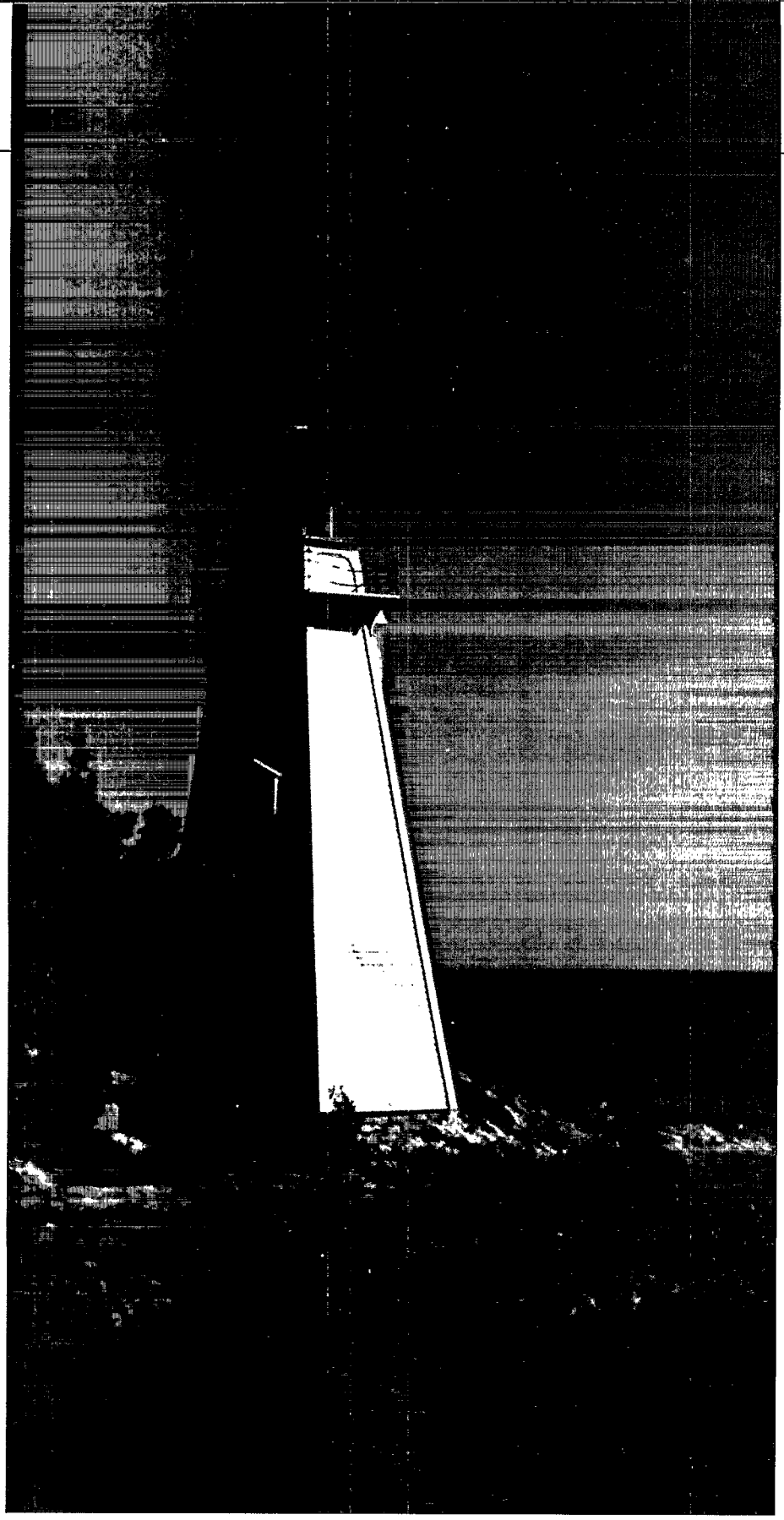
USEPA. 1991. *The Watershed Protection Approach: An Overview.* EPA 503/9-92-001. Office of Water, Washington, DC.

USEPA. 1991. *Final Watershed Protection Framework Document.* Office of Water, Washington, DC.

USEPA. 1991. *Guidance for Water Quality-Based Decisions: The TMDL Process.* EPA 440/4-91-001. Office of Water, Washington, DC.

USEPA. 1991. A Review of Methods for Assessing Nonpoint Source Contaminated Ground-Water Discharge to Surface Water. EPA 570/9-91-010. Office of Ground Water, Washington, DC.

Wisconsin Department of Natural Resources and Dane County Land Conservation Department. 1989. *A Plan for the Control of Nonpoint Sources and Related Resource Management in the Black Earth Creek Priority Watershed Plan.* Madison, Wisconsin.



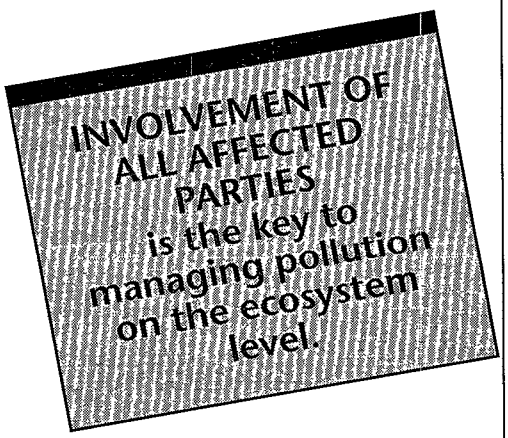
Geographically Targeted Programs

Introduction

The programs described in this chapter (the Great Waterbodies Program, the Great Waters Program, and the National Estuary Program) embody a watershed protection approach at different scales. The Great Waterbodies Program and the Great Waters Program target entire drainage basins, such as the Gulf of Mexico, which drains two-thirds of the continental United States and a large portion of Mexico. The National Estuary Program (NEP) targets clusters of watersheds that drain into a specific estuary, such as Galveston Bay. NEP sites may be nested within a larger basin targeted by the Great Waterbodies or Great Waters Programs, such as the Gulf of Mexico.

Although scales differ, these programs share a common ecosystem approach to solving water quality problems. The ecosystem approach recognizes that all components of the environment are interconnected and that pollution released in one area can cause problems in another. This concept requires all responsible parties to recognize and reduce impacts. Therefore, managing pollution on the ecosystem level requires building institutional frameworks that involve all affected parties, such as agricultural interests, environmental advocacy organizations, industry, government agencies, and private citizens. Consensus is a key to managing pollution on the ecosystem level.

The ecosystem approach also encourages pollution prevention and efforts to avoid actions that can even indirectly lead to contamination of the waterbody. Although such ecosystem perspectives are hardly new, they are more often applied to much smaller units such as watersheds.



The Great Waterbodies Program

Background

The Great Waterbodies Program manages water quality protection in the three largest watersheds targeted by EPA: the Gulf of Mexico, the Great Lakes, and the Chesapeake Bay.

The Gulf of Mexico

Background

The Gulf of Mexico is fed by rivers draining a vast area in five countries. The Gulf's watershed, which covers almost 2 million square miles, is far larger than the Chesapeake Bay or Great Lakes

watersheds. It includes two-thirds of the continental United States, one-half of Mexico, and parts of Canada, Guatemala, and Cuba. Over 1.1 million square miles of the Gulf's watershed are in the Mississippi River drainage system, making the Mississippi the single largest freshwater riverine influence on the Gulf.

The Gulf of Mexico is enormously productive and diverse. Covering 600,000 square miles, the Gulf provides habitat for over 75% of U.S. migratory waterfowl. Its commercial fisheries annually produce nearly 2 billion pounds of fish, oysters, shrimp, and crabs, and almost 90% of U.S. offshore oil and gas comes from Gulf waters. Four of our Nation's busiest ports border its shores, and many nations of the world fish its waters. As a recreational resource, the Gulf and adjacent estuaries provide a playground for sport fishing, diving, water skiing, sailing, swimming, sunbathing, beachcombing, or just plain relaxing.

However, the health and vitality of the Gulf have been declining in recent years, caused in part by increasing populations along its coast and the growing demand upon its resources and in part by the accumulation of years of careless depletion, abuse, and neglect of its environment. These problems in the Gulf have reduced its ability to regenerate naturally. The result has been alarming damage and destruction of the Gulf's ecosystem and habitats, particularly wetlands and seagrasses. These losses stem from: marine debris, toxic substances and pesticides, coastal and shoreline erosion, nutrient enrichment, freshwater inflow, nonpoint source runoff, and contaminants from inefficient or nonexistent septic systems. The effects are seen in decreasing populations of waterfowl and marine wildlife, increasing degradation and loss of wetlands and other habitat, and growing threats to human health from environmental pollution.

The Gulf of Mexico Program

In response to signs of serious long-term environmental damage throughout the Gulf's coastal and marine ecosystem, the Gulf of Mexico Program (GMP) was established in August 1988 with EPA as the lead Federal agency. The Program Office is located at Stennis Space Center in Mississippi. Its main purpose is to develop and help implement a strategy to protect, restore, and maintain the health and productivity of the Gulf. The GMP is a grass roots program that serves as a catalyst to promote sharing of information, pooling of resources, and coordination of efforts to restore and reclaim wetlands and wildlife habitat, clean up existing pollution, and prevent future contamination and destruction of Gulf resources.

In addition to providing funds, the GMP mobilizes Federal, State, and local government; business and industry; academia; and the community at large through programs of public awareness, information dissemination, forum discussions, citizen committees, and technology application. A Policy Review Board and a newly formed Management Committee determine the scope and focus of GMP activities. The

program also receives input from a Technical Advisory Committee and a Citizen's Advisory Committee. The GMP Office and 10 technical Issue Committees coordinate the collection, integration, and reporting of pertinent data and information.

The Issue Committees are responsible for documenting environmental problems and management goals, available government and private resources, and potential solutions relating to specific issue areas. The Issue Committees are composed of individuals from Federal, State, and local agencies and from industry, science, education, business, citizen groups, and private organizations. These committees cover a broad range of issues, including habitat degradation, public health, freshwater inflow, marine debris, coastal and shoreline erosion, nutrient enrichment, toxics and pesticides, and living aquatic resources. They develop and present their findings in GMP documents called Action Agendas, which describe strategies to build upon programs already under way and to develop new cooperative mechanisms with other public and private organizations. The Action Agendas also provide strategies to monitor and assess the effectiveness of ongoing efforts and to communicate information to individuals and agencies that can best use it. Two additional committees provide operational support for public education and outreach and data and information transfer activities for the entire GMP.

Partnership for Action

On December 10, 1992, EPA; the Governors of Alabama, Florida, Louisiana, Mississippi, and Texas; the Chair of the Citizens Advisory Committee; and representatives of 10 other Federal agencies signed a Gulf of Mexico Program Partnership for Action agreement for protecting, restoring, and enhancing the Gulf of Mexico and adjacent lands. The partnership document includes vision and goal statements and nine 5-year challenges for the GMP. The goals established for the Gulf of Mexico Program are to protect, restore, and enhance the coastal and marine waters of the Gulf of Mexico and its natural coastal habitats, to sustain living resources, to protect human health and the food supply, and to ensure the recreational use of Gulf shores, beaches, and waters in ways consistent with the economic well-being of the region.

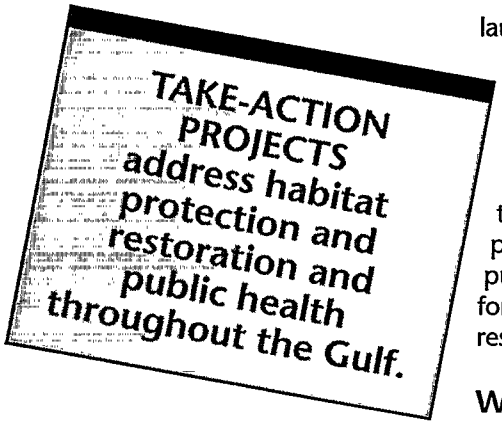
The nine environmental challenges commit the signatory agencies to pledge their efforts, over the next 5 years, to obtain the knowledge and resources to

- Significantly reduce the rate of loss of coastal wetlands
- Achieve an increase in Gulf Coast seagrass beds
- Enhance the sustainability of Gulf commercial and recreational fisheries
- Protect human health and the food supply by reducing inputs of nutrients, toxic substances, and pathogens to the Gulf
- Increase Gulf shellfish beds available for safe harvesting by 10%
- Ensure that all Gulf beaches are safe for swimming and recreational uses
- Reduce by at least 10% the amount of trash on beaches

■ Improve and expand coastal habitats that support migratory birds, fish, and other living resources
■ Expand public education/outreach tailored for each Gulf Coast county or parish.

The GMP structure has been streamlined to better meet the needs of the new 5-year environmental challenges. In addition, EPA is restructuring its management scheme for the GMP to increase Regional involvement in the program as it moves to implement environmental protection and restoration activities.

Take-Action Projects



During 1992, the GMP launched important environmental projects in each of the five Gulf States to demonstrate that GMP strategies and methods could achieve positive results quickly. Called "Take-Action Projects," they primarily address habitat protection and restoration and public health. They are designed for Gulf-wide application to help restore the environment.

Water Quality

In Louisiana, Florida, and Alabama, several Take-Action Projects deal with pollution and contaminants from inadequate treatment of human waste–a main cause of damage to Gulf coastal ecosystems and a major concern to public health officials and to the tourism and seafood industries.

■ An innovative wastewater treatment system is being monitored in a pilot project near the Port Fourchon/Bay Marchand area of Lafourche Parish, Louisiana. The *upwelling injection* system filters human wastewater through a sand/soil bed to remove fecal coliforms and enteric viruses–the primary pollutants and contaminants in human waste. The system uses inexpensive, easy to install equipment that has potential use throughout the Gulf's system of rivers and bayous. Monitoring and mathematical modeling will be used to evaluate the improvement of environmental conditions in nearby oyster beds.

■ A Take-Action Project is under way in Florida's Suwannee Sound and Appalachicola National Estuarine Research Reserve to upgrade existing septic systems that pollute coastal waters. Contamination from fecal coliforms has required suspension of oyster harvesting and threatened to close beaches. Health officials are monitoring improvements to oyster habitat and recreational uses of coastal waters.

■ The use of peat moss as a medium for filtration and biological treatment of household wastewater is being demonstrated in Weeks Bay, Alabama. Use of this raw material and renewable resource as a sewage treatment medium is intended to reduce fecal coliforms in nearby oyster-producing waters.

Pollution Prevention

The State of Mississippi has developed a common sense publication entitled *The Gulf of Mexico Citizens Pollution Prevention Handbook*. Written in nontechnical language, the handbook describes the Gulf of Mexico and explains why it is a valuable resource to our Nation's economy and quality of

life. This take-action guide provides a detailed listing of contacts for more information, and it explains specific ways that everyone in the Gulf region can be actively involved in restoring and preserving the environmental quality of the Gulf.

Habitat Protection

Based on a Texas program called Coastal Preserves, a GMP Take-Action Project called Eco-reserves strives to protect coastal tracts that have been identified as important to the Gulf ecosystem. In some cases, areas may be preserved as wilderness. In others, they would be conserved–that is, carefully monitored and managed to maintain their vitality as wildlife and marine life habitat while being used for hunting, fishing, resource extraction, recreation, or other development. Ideally, these tracts would be under the management and protection of a government agency or established environmental organization.

To promote the concept Gulf-wide, the GMP sponsored an Eco-reserves Workshop in New Orleans to share information about the need to protect such areas; to discuss the resources available to help manage, preserve, or conserve them; and to develop a strategy for generating Gulf-wide support and funding for protecting the most valuable of these tracts.

■ Adopting this concept, Mississippi set aside a donated portion of the Graveline Bayou Estuary and placed it under the protection and management of the State's Bureau of Marine Resources.

■ Protection of oyster habitat is the goal of a Take-Action Project in Alabama. Oyster beds and reef systems in the shallow waters of Mobile Bay, often harmed unintentionally by boaters and fishermen, have been marked with buoys and signs to help boaters and fishermen avoid damaging them in the future.

Habitat Restoration

The degradation (and in many cases, complete disappearance) of wildlife and marine life habitats is one of the most serious environmental problems of the Gulf ecosystem. Restoration of these habitats is the focus of numerous GMP Take-Action Projects throughout the Gulf Region. Wetlands, reefs, seagrasses, and the quality of the water in these habitats are among the most significant concerns receiving immediate attention.

Seagrass Beds

One of several Take-Action Projects in Alabama's Mobile Bay is an innovative program to restore damaged or destroyed seagrass beds – a major habitat for fish, shrimp, and crabs. A new approach being developed is less costly and labor intensive than current methods of transplanting from existing seagrass beds. Seagrasses are germinated from the seeds of wild plants, grown in the natural environment within protected mesh-covered trays, then planted in designated areas where seagrass beds are in decline or are known to have once existed. Low in cost and requiring very little equipment or technical knowledge, this program lends itself extremely well to hands-on participation by concerned citizens and can be easily implemented Gulf-wide.

Salt Marsh Wetland

Another Take-Action Project in Alabama's Mobile Bay is the restoration of a salt marsh wetland on an abandoned site near the Dauphin Island Sea Lab. A wildlife habitat before the Civil War, this marsh wetland was filled in and used for a number of land uses including grave sites and large septic tank reservoirs. The objective of this project is to accelerate the natural reclamation process of tidal action and provide a model for future manmade marsh and wetlands areas. A team of scientists is carefully monitoring the marsh reconstruction (from initial sloping of the land and planting of marsh and wetlands flora, to rebuilding of the adjacent dune system) and will conduct a long-term evaluation of the habitat's health and development. This "living marsh" will also serve as an outdoor exhibit for the nearby *Estuarium* – a marine sciences museum intended to educate the public about the marine flora and fauna found in the surrounding area.

Oyster Bed

In Louisiana, Florida, and Alabama, the number of oyster reefs that have been closed to harvesting operations has steadily increased in recent years due to bacterial contamination from inadequately treated human waste. The solution is a series of Take-Action Projects to install upgraded septic systems or innovative sewage treatment systems in areas affecting the oyster beds. In a few short years, these low-cost, easy-to-install systems are expected to revitalize oyster habitats and help rebuild associated commercial operations.

■ In Louisiana, the Nation's number one producer of oysters, a take-action project in cooperation with the National Estuary Program targets 240,000 acres of the Barataria-Terrebonne Estuary that contains 68% of the State's private oyster leases–an area increasingly closed to harvesting. Likewise, the oyster-producing areas near Suwannee Sound and Appalachicola Bay (Florida) and Weeks Bay (Alabama) will benefit from similar projects to improve sewage treatment systems.

■ Another Take-Action Project in Alabama's Mobile Bay aims to restore and create oyster habitat with a certain type of Mexican coral taken from dead reef deposits found inland and used to form new living reefs for young oysters to grow on. This first-of-its-kind application of such coral will shorten the time it takes for oyster reefs to form. If successful, it could have far-reaching impacts in reef restoration Gulf-wide.

The Great Lakes Basin

Background: Water Quality in the Great Lakes

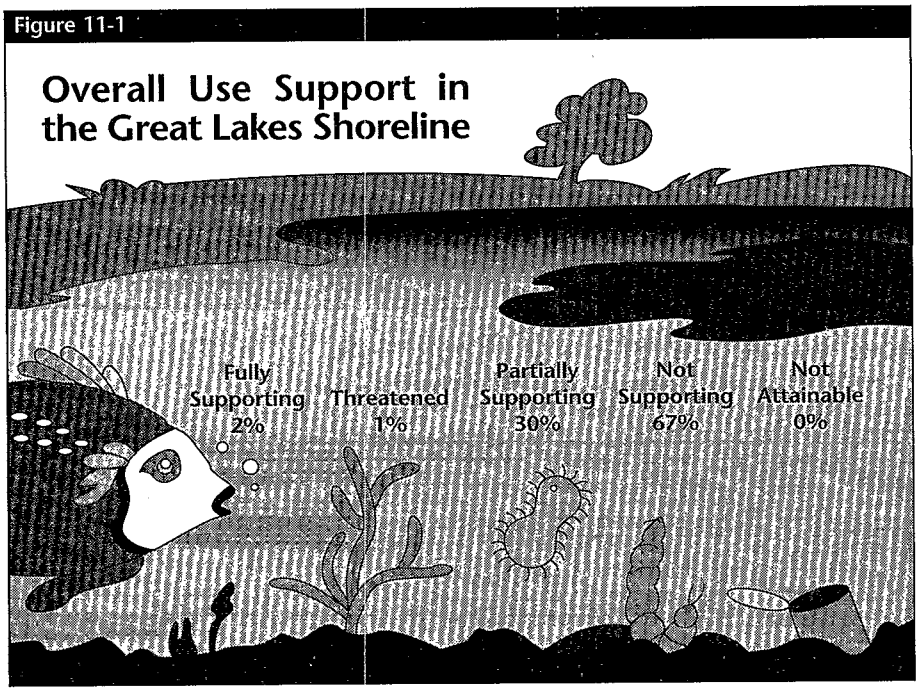
During the past two decades, the United States and Canada have corrected many of the nutrient enrichment problems in the Great Lakes region that attracted national attention in the 1960s. Since 1970, phosphorus detergent restrictions, municipal sewage treatment plant construction and upgrades, and agricultural practices that reduce runoff have cut the annual phosphorus load into the Great Lakes in half. The decline in phosphorus loadings is most evident in Lake Erie, which receives more effluent from sewage

treatment plants and sediment from agricultural lands than the other Great Lakes. Lake Erie also experienced a concurrent decline in phytoplankton biomass, an indicator of trophic condition and nutrient enrichment. The decline in phytoplankton biomass provides evidence that the phosphorus controls implemented in the early 1970s have reversed Lake Erie's severe nutrient enrichment problems of the 1960s.

Despite dramatic declines in the occurrence of algal blooms, fish kills, and "dead" zones depleted of oxygen, less visible problems continue to degrade water quality in the Great Lakes. The States report that toxic contamination is the most prevalent and persistent water pollution problem in the Great Lakes. The eight States bordering the Lakes have issued advisories to restrict consumption of fish caught along their entire shorelines because concentrations of mercury, PCBs, pesticides, and dioxins in fish tissues exceed standards set to protect human health. As a result, virtually all of the waters along the Great Lakes shoreline fail to fully support fish consumption use, and therefore fail to fully support overall designated uses (Figure 11-1).

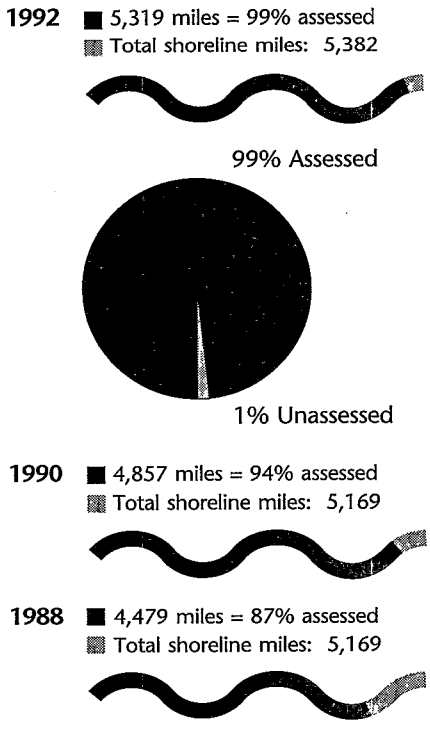
Although fish consumption use is impaired throughout the Lakes, more than 96% of the Great Lakes shoreline fully supports recreational uses, drinking water supply use, and agricultural use (Figure 11-2). The individual use support data submitted by the States indicate that the remaining problems on the Lakes have the greatest impact on fishing activities and aquatic life. Aquatic life impacts include depleted fish

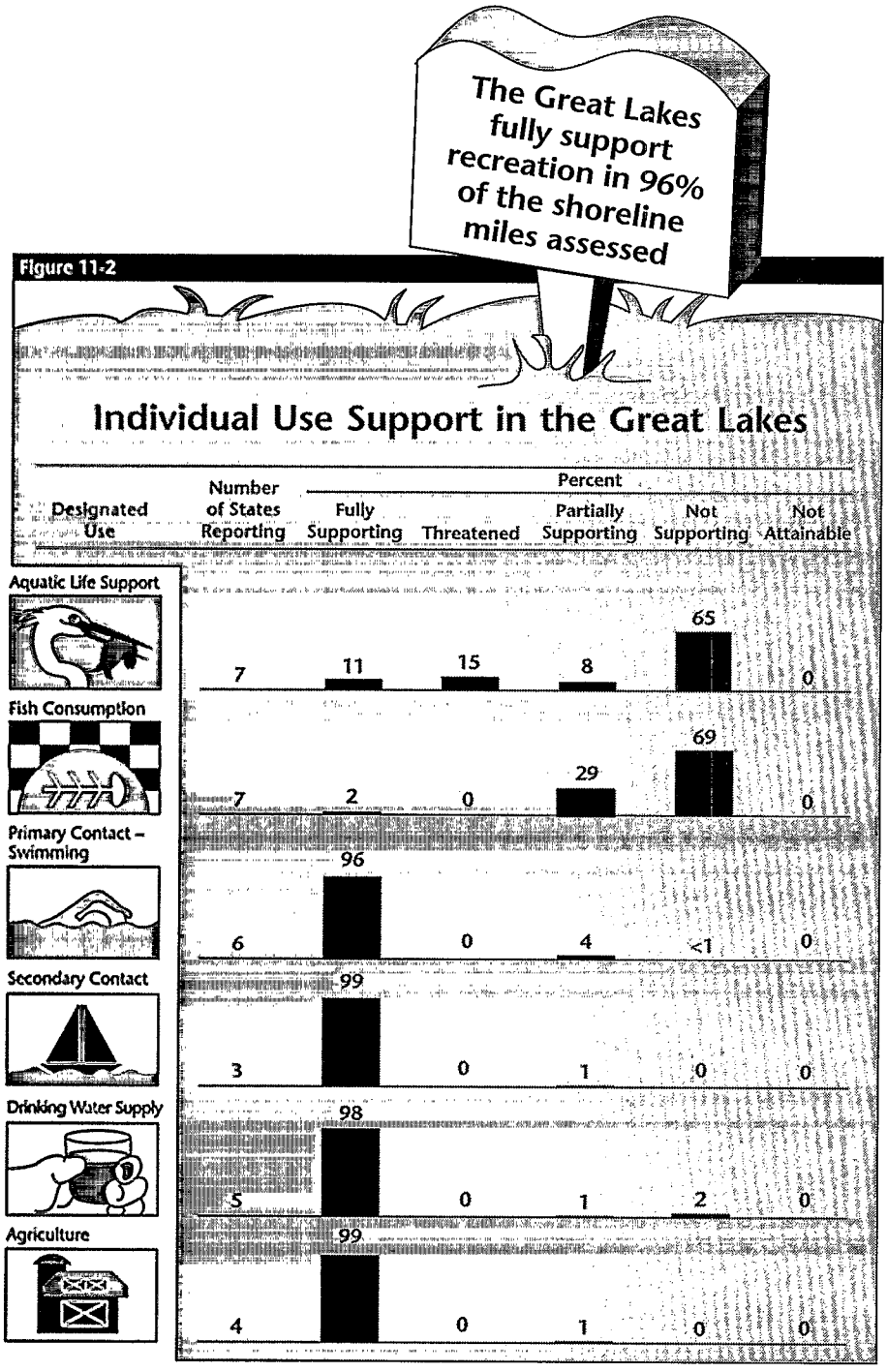
Figure 11-1



Based on data contained in Appendix F, Table F-1.

Great Lakes Shoreline Miles Assessed by the States





Based on data contained in Appendix F, Table F-2.

populations and reproduction problems in birds (Table 11-1 and box). Aquatic life impacts result from persistent toxic pollutant burdens in birds, habitat degradation and destruction, and competition and predation by nonnative species, such as the zebra mussel and the sea lamprey.

The States reported that priority organic chemicals, such as PCBs and dioxins, are the most prevalent cause of impairment in their Great Lakes waters (Figure 11-3). These toxic chemicals persist in fish tissues, wildlife tissues, and sediment. The States reported much lower incidences of metal contamination, depressed oxygen conditions, nutrient pollution, and siltation.

The States did not report extensively on sources of contamination in the Great Lakes (Figure 11-4). Therefore, the information on sources applies to only one-third of the Great Lakes shoreline. The States reported that atmospheric deposition contributes to the impairment of 50% of the impaired shoreline, followed by contaminated sediments (affecting 40%), land disposal (affecting 30%), and urban runoff and storm sewers (affecting 10%).

Building Institutional Frameworks for the Great Lakes

Rehabilitating the Great Lakes requires cooperation from numerous organizations because pollutants originate in both Canada and the United States and pollutants enter the Lakes via multiple media (i.e., air, ground water, and surface water). The International Joint

Trends in PCB Contamination in the Great Lakes

Research conducted by the United States and Canada in the Great Lakes indicates that PCB concentrations in wildlife have declined dramatically since the EPA banned most uses of PCBs in 1976. However, the PCB concentrations in fish persist well above concentrations set to protect public health, and the persistent PCB burdens in some fish, mammals, and birds still may impair reproductive success. For example, concentrations of PCBs in Lake Michigan lake trout declined by about 90% since 1970, but remain at about 180 times the target goal of 0.014 parts per million. Similarly, body burdens of PCBs in a colony of Forster's terns near Green Bay, Wisconsin, declined by 66% while hatching success tripled between 1983 and 1988. However, the tern's offspring continued to suffer "wasting" and other fatal health problems, which may have resulted from the contaminant burdens in the adult birds.

Table 11-1. Effects of Toxic Contamination on Fish and Wildlife in the Great Lakes

Species	Population Decrease	Effects on Reproduction	Eggshell Thinning	Birth Defects	Behavioral Changes	Biochemical Changes	Mortality
Mink	X	X	NA	NE	NE	NE	X
Otter	X		NA	NE	NE	NE	?
Double-crested Cormorant	X	X	X	X		X	?
Black-crowned Night Heron	X	X	X	X		X	?
Bald Eagle	X	X	X	NE		NE	NE
Herring Gull		X	X	X	X	X	X
Ring-billed Gull				X		NE	X
Caspian Tern		X		X	NE	NE	
Common Tern		X	X	X		X	
Forster's Tern		X		X	X	X	
Snapping Turtle	NE	X	NA	X	NE	NE	NE
Lake Trout		X	NA			X	
Brown Bullhead			NA NA			X X	
White Sucker			NA	X		X	

X = Effects documented.

NA = Not applicable.

NE = Not examined.

? = Suspected because population declined.

NOTE: Unpublished records of gross birth defects exist for the double-crested cormorant, great blue heron, and the Virginia rail.

Commission (IJC), established by the 1909 Boundary Waters Treaty, lays the foundation of the institutional framework for managing the Great Lakes. Representatives from the Governments of the United States and Canada, the Province of Ontario, and the eight States bordering the Lakes sit on the IJC. The IJC is responsible for identifying actions needed to maintain the integrity of the Great Lakes ecosystem.

The EPA Great Lakes National Program Office (GLNPO) serves as a liaison and provides information to the Canadian members of the IJC and the Canadian counterparts to the EPA. The GLNPO also coordinates activities in the United States aimed at protecting and restoring the Lakes.

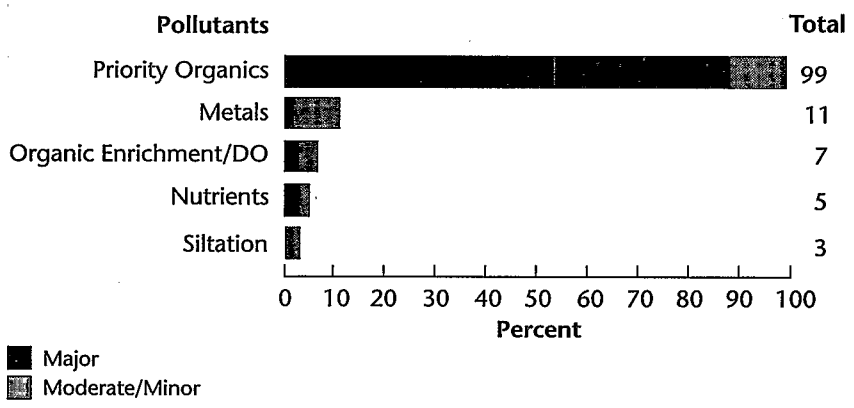
The Great Lakes Protection Fund was formed by the Great Lakes Governors in 1989. The mission of the Fund is to identify, demonstrate, and promote regional action to enhance the health of the Great Lakes ecosystem. It is the Nation's first multi-State environmental endowment. The Great Lakes States have pledged $100 million to its permanent endowment.

Public-private partnerships support the institutional framework for managing the Great Lakes water quality. Special boards, commissions, and committees composed of representatives from universities, environmental organizations, agricultural interests, industry, shipping interests, and government play vital roles in coordinating policy and management decisions. Some of these groups focus on local areas and issues, while others represent national organizations. To better coordinate their activities on the

Figure 11-3

Percent of Great Lakes Shore Miles Impaired by Pollutants

Total Impaired = 5,171 Miles = 97% of the total Great Lakes shoreline



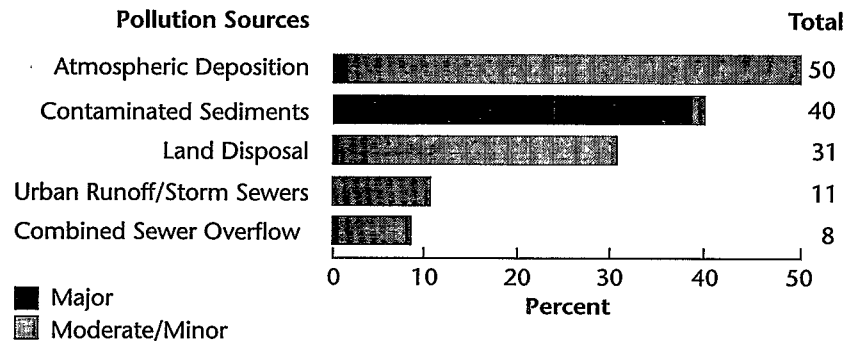
Based on data contained in Appendix F, Table F-3.

Information on sources applies to ONLY 35% of the Great Lakes Shoreline.

Figure 11-4

Percent of Great Lakes Shore Miles Impaired by Sources of Pollution

Total Impaired = 1,884 Miles = 35% of the total Great Lakes shoreline



Based on data contained in Appendix F, Table F-4.

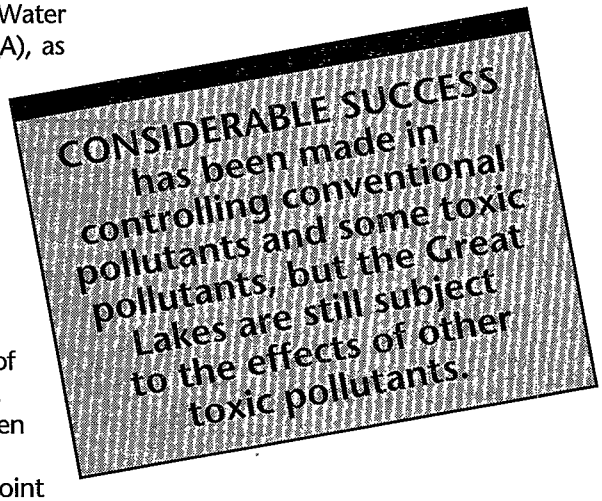
Great Lakes Basin, groups have begun to support umbrella organizations, such as Great Lakes United. Great Lakes United, started in 1982, represents more than 180 affiliated groups in the United States and Canada. One of its goals is to facilitate citizen involvement in decision-making processes.

The Great Lakes Commission is an independent organization binationally chartered that integrates environmental concerns with economic development concerns. The Commission's members are appointed by the States, Canadian Provinces, and Federal governments. The members issue reports on subjects such as the environmental impacts of transportation options in the Great Lakes Region. The reports provide data for decisionmaking by the government bodies with authority to manage the Lakes.

Private conservation groups are also working with government agencies to protect natural areas in the Great Lakes Basin. The GLNPO is funding 19 restoration and protection projects based, in part, on findings of the Great Legacy Project. The Great Legacy Project includes efforts by the Nature Conservancy of Canada and the United States and other conservation groups to pool natural heritage data from several public agencies and land trusts and to apply geographic targeting approaches to identify particularly high-quality resource areas.

The Great Lakes Water Quality Agreement

The 1978 Great Lakes Water Quality Agreement (GLWQA), as amended in 1987, established a commitment by the United States and Canada to restore and protect the Great Lakes. The Amendments to the Agreement stress two central concepts: (1) the ecosystem approach, and (2) the virtual elimination of persistent toxic substances.



Although there has been considerable progress in addressing impacts from point and nonpoint loadings of conventional pollutants under the GLWQA, the Great Lakes are still highly vulnerable to toxic pollutants. The IJC released a set of recommendations identifying 11 "critical pollutants" for which management scrutiny is warranted throughout the Basin. These chemicals and possible sources are presented in Table 11-2.

The Great Lakes Water Quality Initiative

In June of 1989, EPA launched the Great Lakes Water Quality Initiative to provide a framework for Federal assistance in pursuing the goal of whole-system restoration based on an ecosystem perspective. The Initiative emphasizes areas in which EPA can provide State governments and other stakeholders with technical support. The Initiative envisions EPA making the following technical contributions:

Table 11-2. Toxic Chemicals of Concern in the Great Lakes Basin: 11 Critical Pollutants Identified by the IJC's Water Quality Board

Chemical	Production and Release	Source
2,3,7,8-TCDD (dioxin) and 2,3,7,8-TCDF (furan)	Unintentional	Contaminant in herbicides used in agriculture, range, and forest management. Also produced as a byproduct of combustion of fossil fuels and waste incineration, and through production of pentachlorophenol (PCP) and pulp and paper production processes. 2,3,7,8-TCDD is the most toxic of 75 congeners (forms) of dioxin, and 2,3,7,8-TCDF is the most toxic of 135 congeners of furan.
Benzo[*a*]pyrene (b[*a*]p)	Unintentional	Product of incomplete combustion of fossil fuels and wood, including forest fires, grills (charcoal broiling), auto exhaust, and waste incineration. One of a large family of polynuclear aromatic hydrocarbons (PAHs).
DDT[a] and its breakdown products (including DDE)	Intentional	Insecticide; used heavily for mosquito control in tropical areas. Banned for use in the U.S. and Canada with some exceptions for gypsy moth control. Once used extensively in North America and worldwide.
Dieldrin[a]	Intentional	Insecticide used extensively at one time, especially on fruit.
Hexachlorobenzene (HCB)	Unintentional	Byproduct of combustion of fuels and waste incineration, and of manufacturing processes using chlorine. Found as a contaminant in chlorinated pesticides.
Alkylated lead	Intentional	Used as a fuel additive and in solder, pipes, and paint.
	Unintentional	Released through combustion of fuel, waste, and cigarettes, and from pipes, cans, and paint chips.
Mirex[b]	Intentional	Fire retardant; pesticide used to control fire ants. Breaks down to more toxic form, photomirex, in presence of sunlight. Present sources are residuals from manufacturing sites, spills, and land disposal.
Mercury	Intentional	Used in metallurgy, batteries, thermometers, electrical switches, and disinfectants.
	Unintentional	Byproduct of chlor-alkali, gold mining, paint, and electrical equipment manufacturing processes. Also occurs naturally in soils and sediments. Releases into the aquatic environment may be accelerated by sulfate deposition (i.e., acid rain) and leaching from landfills.
Polychlorinated biphenyls (PCB)[c]	Intentional	Insulating fluids used in electrical capacitors and transformers and in the production of hydraulic fluids, lubricants, and inks. Was previously used as a vehicle for pesticide dispersal. PCBs comprise a family of 209 congeners of varying toxicity.
	Unintentional	Primarily released to the environment through leakage, spills, and waste storage and disposal. Leaches from soil and sediment deposits.
Toxaphene[a]	Intentional	Insecticide used on cotton. Substitute for DDT. Use in Great Lakes Basin not documented, but the presence of toxaphene in the Great Lakes raised the issue of long-range transport, or atmospheric deposition.

[a] Use restricted in the United States and Canada.

[b] Banned for use in the United States and Canada.

[c] Manufacture and new uses prohibited in the United States and Canada.

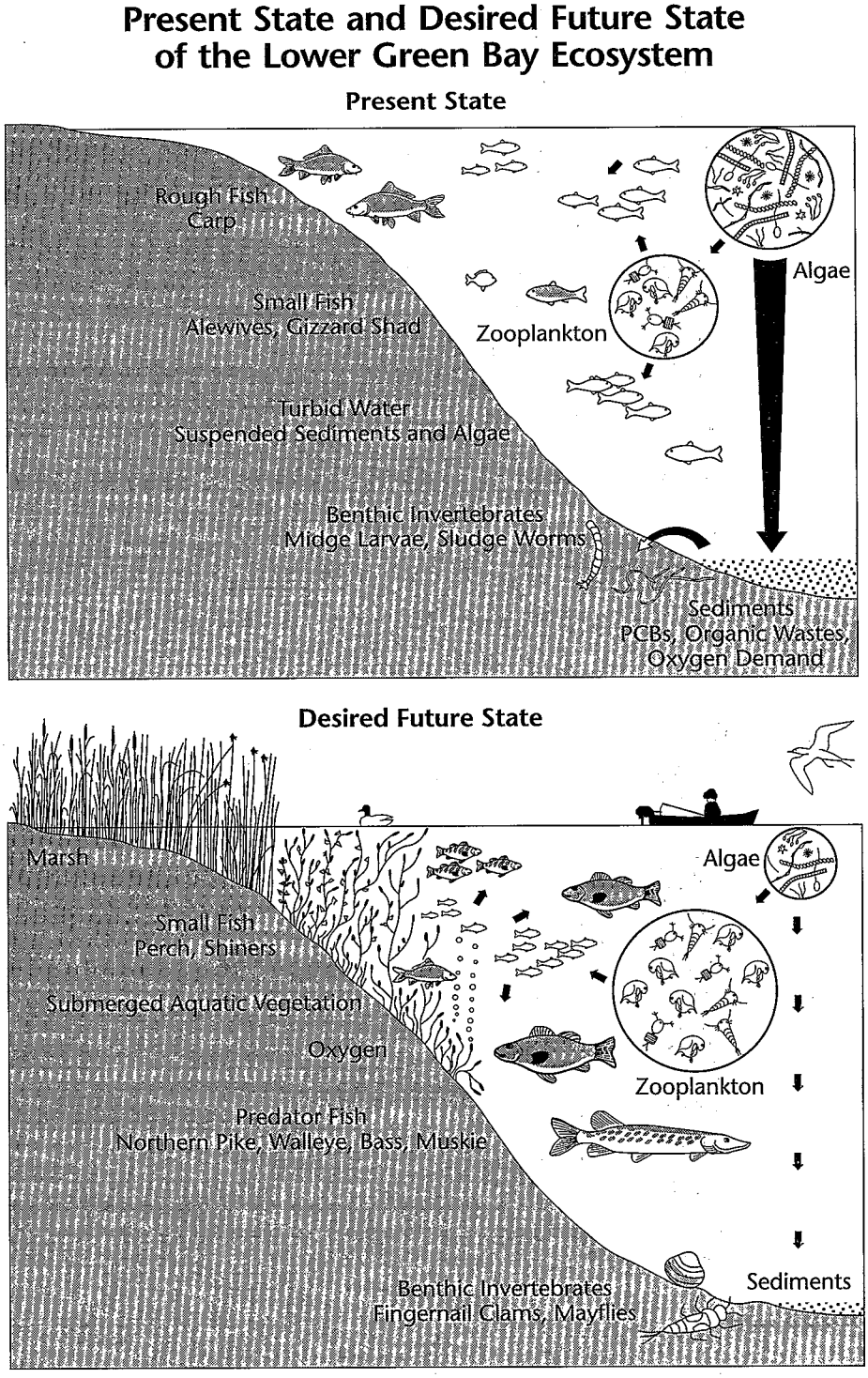
- Develop guidance for identifying areas affected by toxics
- Develop guidance for tracking the relative contributions of toxic and acidic pollutants from surface water and atmospheric sources
- Develop guidance for determining the relative roles of point and nonpoint source contributions to conventional and toxic pollutant burdens
- Suggest innovative approaches for the protection of critical habitat areas
- Support the development of special wildlife standards.

To help implement the goals of the Great Lakes Initiative, EPA Region 5 and the EPA GLNPO coordinate a Steering Committee, Technical Workgroup, and Public Participation Group. The States have played an active role in the development of draft criteria and policies. For example, Wisconsin took the lead in developing water quality standards criteria and wildlife criteria. This is clearly one of the most challenging aspects of the Great Lakes Initiative, since it involves attention to a variety of mammals, waterfowl, and raptors that use aquatic or wetlands habitats and are especially vulnerable to toxicants in their aquatic food supplies. Figure 11-5 illustrates the current status of an impaired Great Lakes watershed (the Lower Green Bay Ecosystem) and the desired future status of the ecosystem, which is the ultimate goal of the Great Lakes Initiative.

By August 1993, EPA had held public hearings on the Great Lakes

Figure 11-5

Present State and Desired Future State of the Lower Green Bay Ecosystem



Initiative Guidance published in the *Federal Register* in the Spring of 1993. When issued in final form, the GLNPO will use this major guidance document to update the Great Lakes Five Year Strategy. The Strategy translates the general goals of the Great Lakes Water Quality Agreement into practical steps.

Remedial Action Plans for Areas of Concern

Implementing control measures for pollutants usually begins in smaller drainages and waterbodies. At the smallest geographic scale, the IJC identified 43 Areas of Concerns (AOCs), located primarily along river mouths or harbors. The United States and Canada designated all 43 AOCs, which face major toxics concerns. Thirty-five of the 43 AOCs report toxics concerns in ambient water, 41 of 43 report toxics in sediments, and 38 of 43 AOCs restrict consumption of fish harvested from local waters because of elevated toxic concentrations in fish tissues.

In 1985, the Great Lakes States and the Canadian Provinces agreed to develop and implement a Remedial Action Plan (RAP) for each AOC. A complete RAP encompasses the following stages and has a planning document associated with each milestone:

STAGE 1 – Summarizes available information and specifies the nature of the problem(s).

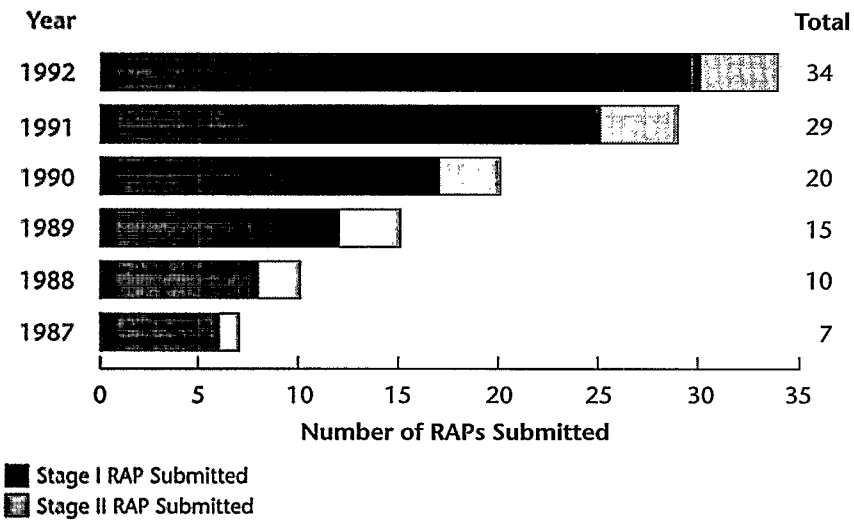
STAGE 2 – Specifies remedial and regulatory measures needed to restore beneficial uses.

STAGE 3 – Summarizes results as progress is achieved in implementing management plans.

Figure 11-6 summarizes the status of Stage 1 and Stage 2 RAP submittals through 1992.

Figure 11-6

Status of Remedial Action Plan (RAP) Development for Areas of Concern in the Great Lakes



Lakewide Management Plans

Lakewide Management Plans (LaMPs) are the next level of geographic integration envisioned in the Great Lakes Water Quality Agreement. The United States is preparing the LaMP for the Lake Michigan Basin, which is contained entirely in this country. Although impacts from nutrients and unionized ammonia toxicity persist, most of the problems in Lake Michigan stem from toxic contaminants

already in the Lake system and ongoing toxic loadings from point and nonpoint sources.

Building on work in progress at the various AOCs, the Lake Michigan LaMP will look at the lake ecosystem as a whole and identify a set of critical pollutants. In some cases, this would be a subset of the range of pollutants being addressed at smaller geographic units such as the AOCs. In other cases, pollutants that are not of the highest concern in localized areas but are deemed critical to the entire Lake Michigan ecosystem may warrant scrutiny. As the set of critical pollutants is refined, the LaMP will propose a tiered concept for developing management actions.

The LaMPs for each Great Lake will also encourage pollution prevention approaches. Lake Superior provides perhaps the best opportunity to implement pollution prevention because it is the least impacted of the Great Lakes. Lake Superior has been spared much of the extreme ecological disruptions associated with industrial and municipal discharges, introduction of exotic species, and overharvesting of the fisheries that have had devastating impacts on the lower Great Lakes, especially Lakes Ontario and Erie.

In the Spring of 1992, the United States, Canada, and the States of Minnesota, Wisconsin, and Michigan formally agreed on a new regional agreement to protect Lake Superior from toxic pollution. The Binational Agreement seeks to expand authorities (where appropriate) to implement a goal of zero pollutant discharge of persistent toxic substances. As a first step, both the U.S. and the Canadian governments will work to freeze loadings of toxic discharges. The United States and Canada plan to issue a draft LaMP for Lake Superior by the end of October 1993.

Pollution Prevention Initiatives

The EPA GLNPO is working with EPA Regions 2, 3, and 5, the States, and their Canadian counterparts to promote pollution prevention as the most effective approach to achieve the GLWQA goal of virtually eliminating discharges of persistent toxic substances in the Great Lakes. In 1991, EPA and the States developed the Great Lakes Pollution Prevention Action Plan to highlight how EPA and the States will minimize the use, production, and release of toxic substances at the source. The Action Plan targets persistent bioaccumulative toxic substances for reduction or elimination.

RAPs AND LAMPs are the major tools for coordinating actions to eliminate environmental problems in the Great Lakes Basin.

At this time, the EPA is implementing the National 35/50 Program in the Great Lakes Basin. Under this program, EPA has received voluntary commitments from industry to reduce the emission of 17 priority pollutants by 50% by the end of 1995. The EPA is also working with utilities located within the Great Lakes Basin to accelerate the phaseout of transformers containing PCBs.

The Chesapeake Bay Program

In 1975, the Chesapeake Bay became the Nation's first estuary to be targeted for protection and restoration when Congress, through the appropriations bill, directed EPA's Office of Research and Development to launch a study investigating the causes of the environmental declines experienced in the Bay. Section 117(a) of the Clean Water Act amendments of 1987 required the EPA Administrator to continue the ongoing Chesapeake Bay Program and maintain a Chesapeake Bay Program Office. This program would continue to collect and make available information about the Bay's environmental quality; coordinate Federal and State efforts to improve the Bay's water quality; and determine the impact of sediment deposition and natural and man-induced environmental changes in the Bay, especially nutrients, chlorine, acid precipitation, dissolved oxygen, and toxic pollutants, with particular attention to the impact on striped bass.

Building Institutional Frameworks

A system of committees, subcommittees, work groups, and task forces have evolved under the Chesapeake Executive Council, which acts as the coordinating body for implementation, establishes the policy direction, and provides oversight for the restoration and protection of the Bay and its living resources. On August 6, 1991, the Chesapeake Executive Council adopted four action steps, building on the original 1987 agreement, which defined the future priorities and direction of the Chesapeake Bay Program. These steps are: (1) to reevaluate and accelerate the nutrient reduction program; (2) to adopt pollution prevention; (3) to restore and enhance living resources and their habitat; and (4) to broaden participation in the Bay Program.

Baywide Nutrient Reduction Strategy

In 1987, the parties to the original Chesapeake Bay Agreement of 1983 signed a new Chesapeake Bay Agreement. The 1987 agreement set a specific goal–to achieve at least a 40% reduction of nitrogen and phosphorus entering the mainstem Chesapeake Bay by the year 2000. The agreement also included a provision that the goal be reevaluated in 1991 to determine whether it is, indeed, the reduction needed.

The Problem

Studies completed in the 1970s substantiated that increases in agricultural development, population growth, and sewage treatment plant flows were causing the Bay to become nutrient enriched. High levels of nutrients (primarily phosphorus and nitrogen) flow into the Bay causing excessive algae growth (see Figure 11-7). This condition involves a chain reaction and has two effects:

- In shallow areas, the excess algae shade underwater bay grasses, blocking the light the grasses need

to grow. This degrades the habitat and causes the eventual loss of grass beds.

■ In deeper areas, when the algae die and sink to the bottom, their decomposition uses up available oxygen in the water. During the warm summer months, oxygen in the bottom waters can only be replenished slowly because little mixing with the high oxygen surface water occurs. Many bottom-living animals such as oysters, clams, and worms, which provide food for fish and crabs, cannot survive this prolonged period of low oxygen.

The Sources

Nutrients that enter the Chesapeake Bay originate from point sources (e.g., municipal and industrial wastewater), nonpoint sources (e.g., cropland, animal wastes, urban and suburban runoff), and atmospheric deposition (airborne contaminants). These sources span

Figure 11-7

Effects of Pollutants in the Chesapeake Bay

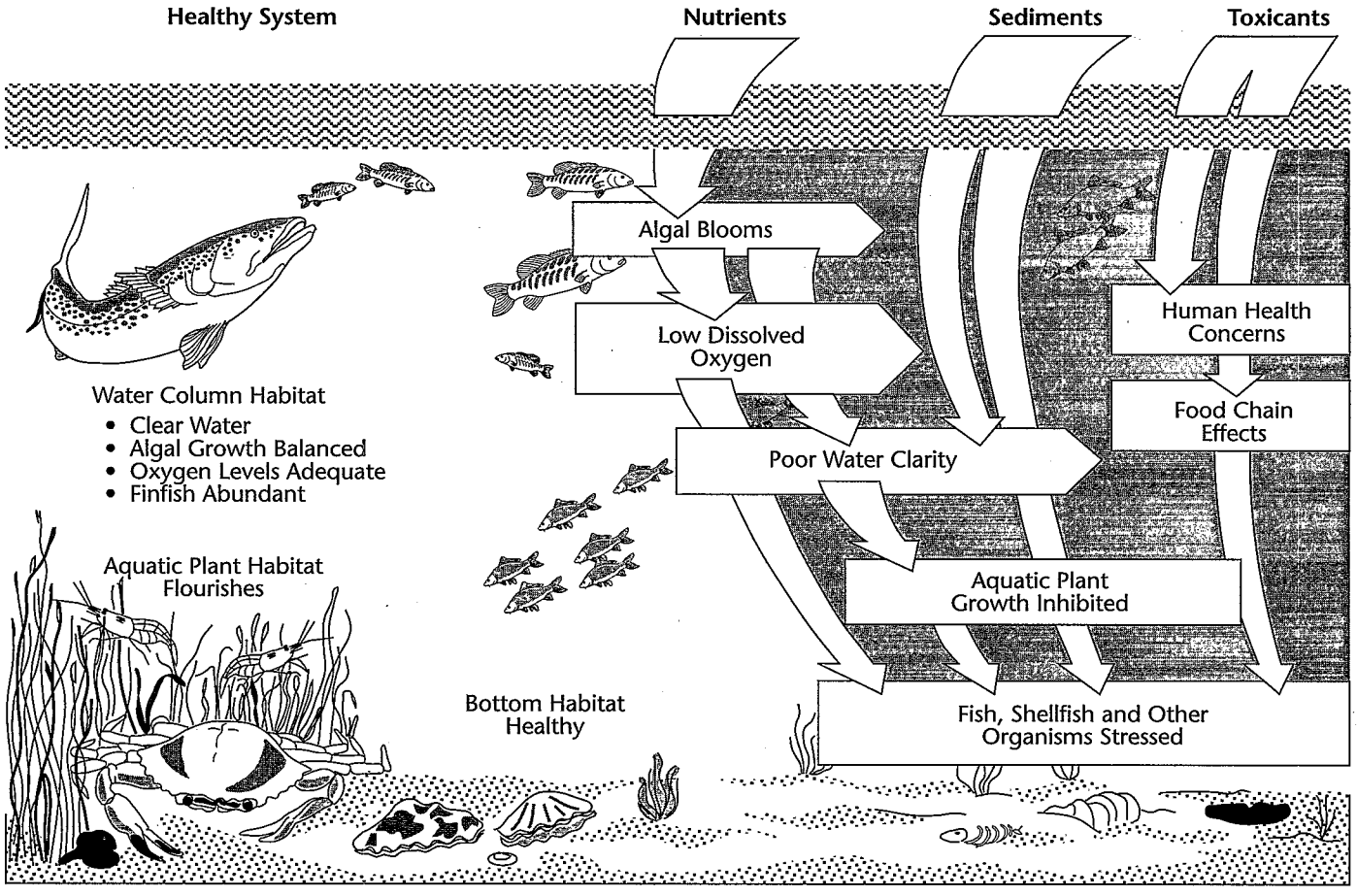
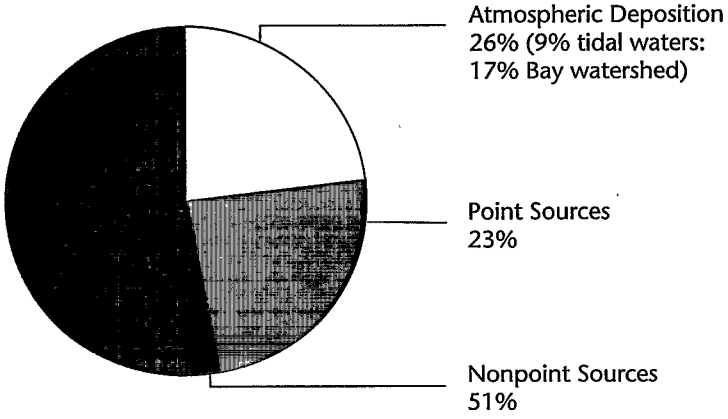


Figure 11-8

1985 Total Nitrogen Base Load Distribution in Chesapeake Bay

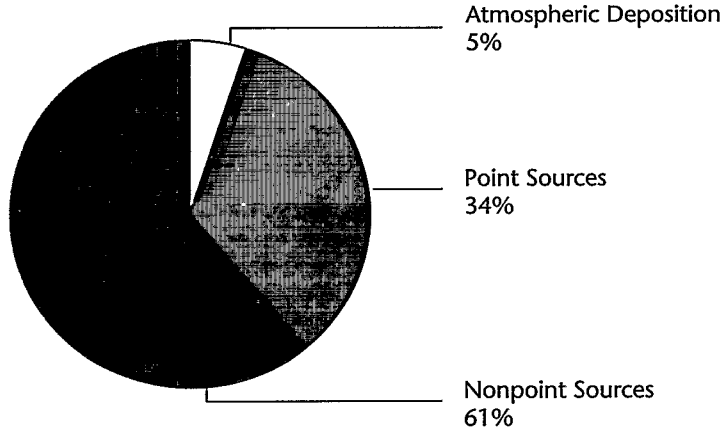


Total Load = 376 Million Pounds

Source: 1991 Watershed Model, September 30, 1992.

Figure 11-9

1985 Total Phosphorus Base Load Distribution in Chesapeake Bay



Total Load = 27 Million Pounds

Source: 1991 Watershed Model, September 30, 1992.

so vast an area that it is difficult to collect comprehensive data throughout the watershed. Therefore, a computer simulation of sources was used as the common mechanism for estimating both the 1985 base load and the load reductions that are necessary to improve dissolved oxygen conditions in the deep trench of the Bay.

To approximate long-term average conditions, the 1985 base load was calculated as a 4-year average to take into account the natural variations in runoff and river flow. Figure 11-8 shows that nonpoint sources contribute 51% to the total *nitrogen* load followed by atmospheric deposition (26%), and point sources (23%). Atmospheric loads of total nitrogen include nitrogen loads deposited on the tidal waters of the Bay (9%) and total nitrogen loads deposited on the watershed lands surrounding the Bay that wash into the Bay waters (17%). Figure 11-9 shows the same breakdown but for *phosphorus*. The percentage of contributions are 61% for nonpoint sources, 34% for point sources, and 5% for atmospheric deposition.

To calculate the controllable loads of nutrients to the Bay, the Program estimated the expected load if there were 100% forest cover and subtracted that from the 1985 base load (see Tables 11-3 and 11-4). The controllable fraction of nutrient loads is approximately 49% for nitrogen and 77% for phosphorus.

Point Source Nutrient Reduction

Municipal and industrial discharges are major sources of nutrient loads to the Bay system. Three elements of the Chesapeake Bay

Program's point source control strategy are responsible for reductions in the nutrient loading:

- Upgrading wastewater treatment plants
- Improving compliance with permit requirements
- Pollution prevention actions such as prohibiting the sale of detergents containing phosphorus.

Phosphorus detergent restrictions sharply reduced the quantity of phosphorus entering municipal sewage treatment plants at the same time that population growth increased the total volume of water entering treatment facilities (Table 11-5). Plant operators also use fewer chemicals to remove phosphorus from their effluent and produce less sludge as a result of the phosphorus detergent restrictions.

Phosphorus load reduction has occurred at a faster pace than predicted. Annual discharges have dropped about 4.7 million pounds from 1985 to 1991, a reduction of 40% since 1985 (Figure 11-10). Wastewater treatment plant upgrades have also begun to have an effect on nitrogen loads.

The Chesapeake Bay Program has conducted pilot projects to assess the cost and effectiveness of an emerging technology known as biological nutrient removal. That technology is now used to reduce nitrogen and phosphorus loads from point sources in the Bay.

Furthermore, compliance has improved with permitted discharge limits. Since 1989 when the Chesapeake Executive Council made compliance a priority, the rate of

Table 11-3. Nitrogen Loading to Chesapeake Bay – 1985 Base Load and Controllable Fraction (million lb/yr)

Nutrient Source[a]	1985 Base Load[b]	Forest Background Load[c]	Controllable Load[d]	Reduction (40% Controllable)
Nonpoint	254.6	153.9	100.7	40.3
Point	87.3	2.8	84.5	33.8
Atmospheric Deposition[e]	34.6	—	0	0
Total	376.5	156.7	185.2	74.1

[a] Nonpoint source loads include atmospheric deposition to the land (17%). Point source loads are reported as delivered to tidal waters.

[b] The 1985 Base Load is 1984-1987 output from the Watershed Model plus point source load discharged below the fall line.

[c] Forest Background Load simulated all land uses converted to forest. Includes atmospheric deposition on the land, rivers, and lakes that may be possible to control.

[d] Controllable Load equals Base Load minus Forest Background Load.

[e] Deposition to tidal waters only (9%). Deposition to land is included in nonpoint source load. Technical studies indicate that a large majority of this load is attributable to human activities, but that fraction is not estimated here.

Source: 1991 Watershed Model, September 30, 1992.

Table 11-4. Phosphorus Loading to Chesapeake Bay – 1985 Base Load and Controllable Fraction (million lb/yr)

Nutrient Source[a]	1985 Base Load[b]	Forest Background Load[c]	Controllable Load[d]	Reduction (40% Controllable)
Nonpoint	16.50	4.35	12.15	4.86
Point	9.25	0.33	8.92	3.57
Atmospheric Deposition[e]	1.47	—	0	0
Total	27.22	4.68	21.07	8.43

[a] Nonpoint source loads include atmospheric deposition to the land. Point source loads are reported as delivered to tidal waters.

[b] The 1985 Base Load is 1984-1987 output from the Watershed Model plus point source load discharged below the fall line.

[c] Forest Background Load simulated all land uses converted to forest. Includes atmospheric deposition on the land, rivers, and lakes that may be possible to control.

[d] Controllable Load equals Base Load minus Forest Background Load.

[e] Deposition to tidal waters only. Technical studies indicate that a large majority of this load is attributable to human activities, but that fraction is not estimated here.

Source: 1991 Watershed Model, September 30, 1992.

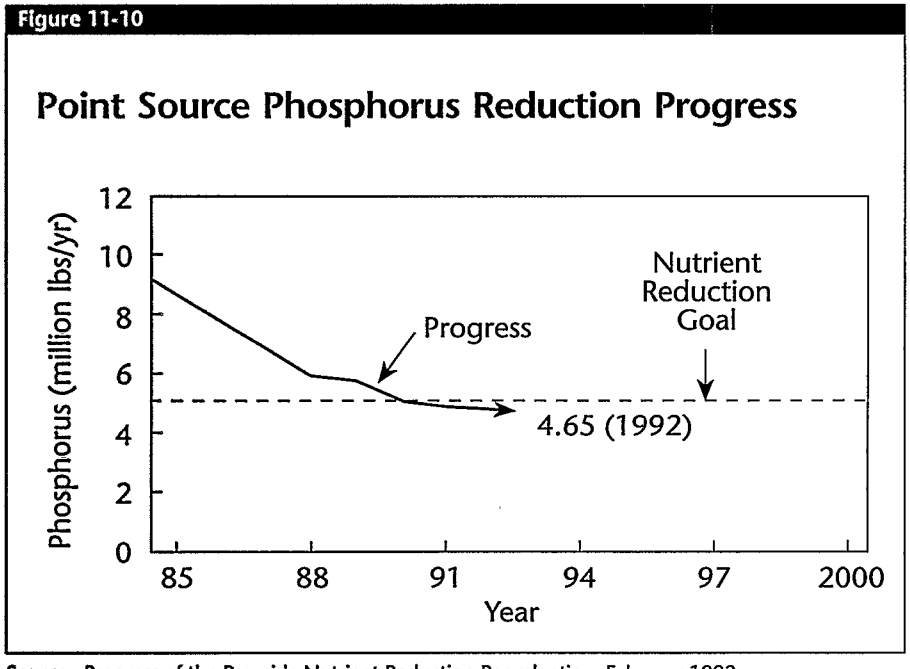
significant noncompliance has declined from a high of about 7% in 1989 to less than 4% in 1992. The percentage of significant noncompliance nationally has decreased from approximately 10% in 1989 to 9% in 1992.

Table 11-5. Results of Phosphorus Detergent Bans in the Chesapeake Bay System

State	Date Implemented	Reduction in Influent Phosphorus	Reduction in Effluent Phosphorus	Reduction in Sludge Production
Maryland	1985	30%	16%	28 dry tons/day
District of Columbia	1986	26%	—	14%
Virginia	1988	34%	50%	—
Pennsylvania (Susquehanna River Basin)	1990	25-33%	—	—

— Not reported.

Figure 11-10



Source: Progress of the Baywide Nutrient Reduction Reevaluation, February 1992.

Nonpoint Source Nutrient Reduction

The Chesapeake Bay Program's nonpoint source control program emphasizes controls on agriculture, paved surfaces, and construction in urban areas. The most important additional control measure is the practice of nutrient management in which animal wastes and fertilizers are applied to farmland in amounts carefully calculated to meet the needs of the crops. This practice reduces the runoff and leaching of nutrients that result from overuse of fertilizers.

Because it is not possible to monitor every nonpoint source, a model was developed to estimate the reduction of nutrient loadings. Implementation of nonpoint source control programs has resulted in a 12% and 8% reduction in controllable nonpoint source nitrogen and phosphorus, respectively. Portions of these decreases are reductions in nitrogen loads to ground water. Because nitrogen in ground water is released very slowly, the benefits to Bay water quality may not be seen for years.

Water Quality Trends and Characterization

Bay water quality monitoring data confirm the significant progress made in reducing phosphorus from nonpoint source and municipal point source loads, as well as the need for further progress toward reducing nitrogen loadings. These trends are as follows:

Phosphorus Trends

- Total phosphorus levels in the Chesapeake Bay decreased by 16% between 1984 and 1992.

■ Significant downward trends in phosphorus concentrations were observed in the upper middle mainstem (from the Susquehanna Flats to the Bay Bridge) and the lower mainstem (from the Rappahannock River south to the mouth of the Bay).

■ Phosphorus concentrations declined in two upper tributaries (Patuxent and James) and increased in three tributaries (Gunpowder, Nanticoke, and Choptank).

Nitrogen Trends

■ Total nitrogen levels in the mainstem of the Chesapeake Bay are essentially unchanged.

■ Nitrogen concentrations increased in the upper reaches of several tributaries (Potomac, Rappahannock, York, James, Gunpowder, Northeast, Sassafras, Chester, and Choptank).

■ Nitrogen concentrations increased significantly in Mobjack Bay, located between the Rappahannock and York Rivers).

Dissolved Oxygen Trends

■ The volume of anoxic/hypoxic water in the mainstem has fluctuated widely over the last four decades, often reflecting patterns of freshwater inflow.

■ The volume of anoxic waters has increased since 1950, based on available data.

Water Quality Characterization

■ Numerous areas in the Bay's tributaries, as well as previously identified areas in the mainstem Bay, are impacted by low dissolved oxygen. These tributaries include the Patapsco, Magothy, Severn, South, West, Rhode, Patuxent, Potomac, Anacostia, Rappahannock, Your, Chester, and Little Choptank rivers, as well as Easter Bay.

■ Submerged aquatic vegetation (SAV) is the best single indicator of the health of the Bay. Although water quality conditions in many tributaries are not currently suitable for survival and growth of SAV, the amount of SAV in the Bay has doubled during the past decade.

■ There is no one single limiting nutrient in the Bay. Phosphorus tends to stimulate algae growth in freshwater areas of the Bay while nitrogen stimulates phytoplankton development in salt water areas. Reduced phosphorus loads will decrease algae growth in the tributaries and upper portions of the Bay, allowing for increased light penetration to underwater grasses. Reduced nitrogen loads will improve dissolved oxygen conditions in the upper and lower Bay by reducing the amount of decomposing algae available to settle to the saltier and denser bottom water that circulates back up the Bay.

Water Quality and Living Resource Objectives

The Bay Program's highest priority is to restore the Bay's living resources. One of the ways to do this is to improve water quality through nutrient reductions. These reductions will increase dissolved oxygen and improve water clarity. Submerged aquatic vegetation

provides critical habitat for many of the Bay's organisms, but requires relatively clear water to grow and photosynthesize. The Chesapeake Bay Executive Council, which consists of the Governors of Maryland, Virginia, and Pennsylvania, the Administrator of the EPA, the Mayor of the District of Columbia, and the Chairman of the Chesapeake Bay Commission, set a goal to increase the amount of SAV from 70,000 acres to 114,000 acres. At the current rate of recovery, this acreage will be achieved by the year 2005. The Council also pledged to open hundreds of miles of Bay tributaries to spawning fish by removing some dams and creating fish passages.

The Great Waters Program

Section 112(m) of the Clean Air Act Amendments of 1990 requires that the EPA and the National Oceanic and Atmospheric Administration (NOAA) jointly conduct a program to identify the extent of atmospheric deposition of hazardous air pollutants (HAPs) into the Great Lakes, Chesapeake Bay, Lake Champlain, and selected coastal waters. EPA developed the Great Waters Program to comply with Section 112(m).

THE GREAT WATERS Program will identify the extent of atmospheric deposition of hazardous air pollutants into the Great Lakes, Chesapeake Bay, Lake Champlain, and selected coastal waters.

The Great Waters Program requires four monitoring networks:

- A Great Lakes monitoring network established one wet/dry collection facility for each of the five Great Lakes. The facilities will collect data to help identify and track movement of HAPs into the Great Lakes ecosystem and determine overall HAP loadings from atmospheric deposition. EPA will ensure that the data collected are compatible with related databases. The information will support development of Remedial Action Plans (RAPs) for the 43 Areas of Concern designated by the United States and Canada and development of LaMPs.

- A Chesapeake Bay monitoring network has deposition monitoring stations within the Bay watershed, which extends into Virginia, Maryland, West Virginia, Delaware, and Pennsylvania. The monitoring program will help determine the relative contribution of atmospheric HAP loadings to total pollutant loadings into the Bay, investigate sources of HAPs, and evaluate the environmental effects of deposited HAPs on the Bay ecosystem based on biological sampling within individual watersheds.

- A Lake Champlain monitoring network should establish deposition monitoring stations in the Lake Champlain watershed straddling Vermont and New York. The Lake Champlain network will also investigate the contribution air deposition makes to overall pollutant loadings, the sources of deposited HAPs, and the environmental effects of atmospheric deposition in the Lake Champlain watershed.

- A coastal waters monitoring network should determine relative loadings of HAPs into National Estuary Program waters designated by EPA and National Estuarine Research Reserves designated by NOAA. The first step in this network is a screening study targeted for Galveston Bay in 1993-94.

Beginning in 1993, Section 112 of the Clean Air Act Amendments also requires EPA to report program results to Congress biennially. The Great Waters Report to Congress should describe the relative contribution of deposited HAPs to total pollutant loadings, the environmental and human health effects of HAPs, the sources of HAPs, and water quality standards violations due to HAP deposition in designated Great Waters. Recommendations should also be proposed for additional regulatory revisions under any Federal laws needed to protect the Great Waters from hazardous pollutants, and EPA should promulgate any needed revisions under Section 112 of the Clean Air Act.

EPA assembled three teams to author scientific documents that will support preparation of the Great Waters Report to Congress. Each team analyzed available information on one of the following issues:

- Loading of toxicants from air relative to total loading from all routes
- Human and ecological exposure and effects
- Source identification.

Each team distributed a draft of its support document, and EPA's Office of Air Quality Planning and Standards (OAQPS) held a workshop to critique, discuss, and supplement their documents. Attendees included invited experts and the Great Waters Core Group, composed of representatives from EPA program offices, EPA laboratories, NOAA, and States. The teams recently incorporated workshop comments into the final drafts of their support documents.

Currently, EPA is synthesizing the supporting information into the Great Waters Report to Congress. The Report will describe the extent of our knowledge, the data needed to fill gaps, and conclusions based upon available information. EPA will develop a long-term strategy for future Great Waters work based on the research needs described in the support documents and policy needs identified by program participants.

The National Estuary Program

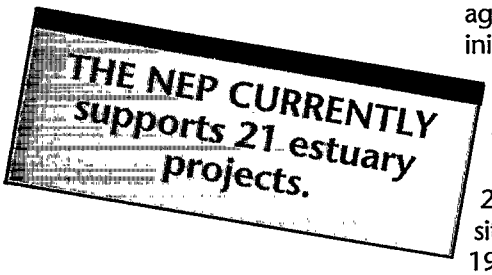
The National Estuary Program embodies the ecosystem approach by building coalitions, addressing multiple sources of contamination, pursuing habitat protection as a pollution control mechanism, and investigating cross-media transfer of pollutants from air and soil into estuarine waters.

Congress recognizes that estuaries are unique and endangered ecosystems and that traditional water pollution control programs alone cannot address the more complex issues associated with estuaries. These issues include protecting living resources and their habitats, controlling diffuse sources of pollutants, and managing estuaries as watershed ecosystems. Responding to the unmet needs of estuarine ecosystems, Congress established the National Estuary Program in 1987 under Section 320 of the Clean Water Act.

The NEP adopts a geographic, basin-wide approach to environmental management. A State governor nominates an estuary in the

governor's State for participation in the program. The State must demonstrate a likelihood for success in protecting candidate estuaries and provide evidence of institutional, financial, and political commitment to solving estuarine problems.

If an estuary meets the NEP guidelines, the EPA Administrator convenes a management conference of representatives from interested Federal, Regional, State, and local governments; affected industries; scientific and academic institutions; and citizen organizations. The management conference defines program goals and objectives, identifies problems, and designs strategies to prevent and control pollution and manage natural resources in the estuarine basin. Each management conference develops and initiates implementation of a Comprehensive Conservation and Management Plan (CCMP) to restore and protect its estuary.



The NEP currently supports 21 estuary projects, including four sites added to the program in 1992:

- Albemarle-Pamlico Sounds in North Carolina
- Buzzards Bay in Massachusetts
- Long Island Sound in Connecticut and New York
- Narragansett Bay in Rhode Island
- Puget Sound in Washington State
- San Francisco Bay Estuary in California
- Santa Monica Bay in California
- Delaware Estuary in New Jersey, Pennsylvania, and Delaware
- Delaware Inland Bays in Delaware
- Galveston Bay in Texas
- New York-New Jersey Harbor in New York and New Jersey
- Sarasota Bay in Florida
- Indian River Lagoon in Florida
- Tampa Bay in Florida
- Barataria-Terrebonne Estuarine Complex in Louisiana
- Casco Bay in Maine
- Massachusetts Bay in Massachusetts
- Corpus Christi Bay in Texas
- Peconic Bay in New York
- San Juan Bay in Puerto Rico
- Tillamook Bay in Oregon.

These 21 estuaries are nationally significant in their economic value as well as in their ability to support living resources. The project sites also represent a broad range of environmental conditions in estuaries throughout the United States and its Territories.

The NEP integrates science and decisionmaking for the protection, restoration, and maintenance of estuaries. Through a characterization process, scientists from Federal, State, and local government agencies, academic institutions, and the private sector analyze an estuary's problems and their causes and work with estuary managers to suggest remedies. Because the NEP is not a research program, it relies heavily on past and current research of other agencies and institutions to support its work.

Appendix F, Table F-5, lists physical and economic characteristics of 17 NEP estuarine basins. The table also describes each estuary's susceptibility to pollution in terms of its ability to flush out and dilute pollutants. This information is being evaluated as part of a national survey of nutrient enrichment in estuaries, sponsored jointly by EPA and NOAA.

Estuarine Problems

Each of the 21 estuaries in the NEP is unique, yet the estuaries share common threats and stressors. Each estuary faces expanding human activity near its shores that may degrade water quality and habitat. Eutrophication, toxic substances (including metals), pathogens, and changes to living resources and habitats top the list of problems being addressed by the NEP Management Conferences. Tables F-6, F-7, and F-8 in Appendix F, list the problems stressing 17 NEP sites.

Eutrophication

Nutrients enter waterways through sewage treatment plant discharges, stormwater runoff from lawns and agricultural lands, faulty septic tanks, and even ground water discharges. (For example, nitrates are believed to leach into ground water and discharge into the Delaware Inland Bays.) Algae and bacteria respond to elevated inputs of nutrients by rapidly reproducing. Decomposition of the algae consumes oxygen and causes hypoxia–low concentrations of dissolved oxygen.

■ The Long Island Sound Study Management Conference (which includes representatives from NOAA, State and County agencies in Connecticut and New York, and New York City) is focusing on sources of hypoxia in the basin surrounding the Sound. During recent summers, poor water circulation exacerbated hypoxia problems in parts of the Sound. The Long Island Sound Study identified nitrogen as the primary nutrient linked to hypoxia in the Sound and concluded that discharges from sewage treatment plants and runoff are the leading controllable sources of nitrogen loadings to the estuary.

NATIONAL ESTUARY Programs are addressing eutrophication, toxic contamination, pathogen contamination, and habitat modification in their estuaries.

■ The Delaware Inland Bays Management Conference is focusing on the Inland Bays' capacity to assimilate nutrients. First, the study identified critical information gaps and planned research projects to fill the gaps. Ongoing research projects target four goals: (1) determine ground water contributions of nutrients, (2) develop a mass balance model of nutrient cycling between ground water and the Inland Bays, (3) define nutrient transport processes in the Inland Bays' basin, and (4) develop a strategy for using living resources as indicators of water quality. The project coordinates public input and research conducted by Federal, State, academic, and private scientists in an attempt to characterize the estuary and develop a Comprehensive Conservation and Management Plan.

Toxic Substances

■ Metals in Massachusetts Bay illustrate the impact from sewage treatment plants, atmospheric deposition, and polluted tributaries. The Bay receives high metal loading from the Merrimack River. The Comprehensive Conservation and Management Plan for the Bay will have to address sources of metals contaminating the Merrimack River as well as sources discharging metals directly into the Bay.

■ Sediment core samples collected at Narragansett Bay revealed that most metal concentrations peaked during the 1950s and have declined by an average of 60% since the 1950s. The study attributes declines in metal concentrations to improvements in sewage treatment.

■ The Casco Bay Estuary Project focuses on the extent of toxic contamination in Bay sediments. Heavy metal concentrations in Casco Bay sediments exceed concentrations in most NEP estuaries. The Casco Bay study detected heavy metals, PCBs, PAHs, pesticides, dioxins, and other organic compounds in the Casco Bay sediments. NOAA's flounder liver survey revealed heavy concentrations of lead, copper, zinc, silver, and PCBs in fish captured in Casco Bay.

Pathogens

Pathogens are bacteria and viruses that cause diseases. To protect public health, State agencies prohibit the harvest of shellfish in waters contaminated with pathogens or pathogen indicators, such as fecal coliforms. Waters contaminated with pathogens also pose a health risk to swimmers, surfers, and divers.

■ A growing network of shellfish farms on the Indian River Lagoon serves as a monitoring system to alert scientists and managers to water quality problems in the Lagoon, including the presence of pathogens.

■ Elevated counts of bacterial and viral indicators in two Santa Monica storm drains raised concern about the safety of swimming near storm drain outfalls. Additional sampling confirmed elevated bacterial indicator counts in the surf zone and in storm drain runoff. However, the data were inadequate to calculate health risks. The study recommended additional research to determine the source of fecal organisms and viruses in the storm drains and the dispersion of runoff along the shoreline.

Living Resources and Their Habitat

Overharvesting and loss of habitats have led to a decline of valuable species, an increase in populations of less desirable species, and a decrease in the diversity of living resources in estuaries. Land development in upland areas increases sedimentation in waterways; construction in wetlands destroys this valuable filter system and habitat for juvenile fish; bulkheading interferes with natural plant and animal shoreline interactions; and dredge and fill activities create turbid waters, destroy habitat, and interfere with circulation patterns. In Florida, ongoing estuary projects study the effects of habitat changes, rapid growth and development, and sewage treatment plant expansion on living resources.

■ The Florida Marine Research Institute is conducting cooperative studies of fish-habitat relationships in Tampa Bay with NOAA funding channeled through the Florida Department of Environmental Regulation. These studies examine fish community structure along the salinity gradient, fish density in seagrass beds and unvegetated habitats, and the use of microhabitats by economically valuable

fish species. The State will enter the results of this research into a database for predicting the effects of future habitat modifications.

■ In Sarasota Bay, water quality trends indicate that nutrient and salinity levels and the alkalinity/acidity ratio have decreased over time. The decrease reflects a shift from agrarian to urban land use. On the eastern shore, submerged aquatic vegetation has declined, particularly in an area within transport range of a seawater treatment plant outfall. Although the total concentration of suspended solids is elevated, researchers cannot link increased biomass to decreased light resulting from the sewage plant discharges. Further studies are investigating another possible cause of the vegetation losses: the formation of insoluble calcium carbonate from the soluble bicarbonate present in the sewage plant effluent.

■ The Bay Study Group of the City of Tampa has conducted extensive monitoring in Tampa Bay. Monitoring at middle Tampa Bay and Hillsborough Bay indicate wastewater plant upgrades implemented in 1979 reduced nitrogen and chlorophyll concentrations and blue-green algae levels in Hillsborough Bay. Dissolved oxygen concentrations and water transparency also increased. At the same time, sea grasses colonized shallow areas around Hillsborough Bay, which had been barren of attached vegetation for several decades preceding the sewage plant upgrades. The Bay Study Group has documented a fourfold increase in the quantity of sea grasses since they began monitoring sea grass in 1986.

Although historical information and current investigations have expanded our understanding of estuarine problems, cooperative scientific studies must continue to evaluate management options for correcting estuarine impairments. Knowledge of estuarine systems lays the foundation for successful management plans.

Looking to the Future: Trends and Needs

As we approach the end of this century, it is encouraging to consider the advances in pollution control achieved during the past two decades. Under the Clean Water Act, many regulatory controls evolved to minimize point source discharges (see Chapter 13 for a discussion of point source controls). New technologies have also improved the effectiveness of wastewater treatment processes. These pollution controls have led to some improvements in estuarine water quality, particularly with respect to reduced toxic discharges.

In spite of these advances, some problems persist and challenge all of us: pollution from the air, waste sites, and ground water; runoff from agricultural land and urban streets; and the loss of wetlands and other vital habitats. Alliances of Federal, State, and local agencies with the scientific community and the public will accelerate our pursuit of these challenges.

Closer Integration with EPA Programs

There is growing concern about impacts on estuaries from air deposition, solid and hazardous waste sites, and contaminated ground water. Several NEP projects are investigating cross-media pollutant sources. The Long Island Sound Study is investigating the role that vehicle emissions play in polluting the Sound. Work at Superfund sites in Puget Sound and Buzzards Bay has been coordinated with NEP projects, but even closer ties between remediation activities at waste sites and estuary projects are needed. Although the New York-New Jersey Harbor estuarine program addresses the problems caused by solid waste, few projects deal directly with trash by encouraging household recycling and waste reduction. With cooperation from the Rhode Island business community, the Narragansett Bay Project is performing hazardous waste audits and encouraging source reduction, recycling, and safer chemical substitution.

Though much interaction among EPA's base programs is under way, more integration is needed at EPA Regional Offices and Headquarters.

IT IS IMPERATIVE that scientific findings be widely communicated and form the basis for public education efforts.

A Scientific/Management/ Public Partnership

Using the scientific knowledge gathered and interpreted during the characterization phase ensures that the public, elected officials, and special interest groups–all part of the Management Conference–understand the problems of the estuary and are prepared to support the measures needed to correct the problems.

This process is simple in theory but complex in practice. Scientists do not always agree on the causes of a problem or the solutions. Furthermore, scientists and managers do not always communicate well with each other. In the NEP, managers operate on a 5-year plan; scientists rarely operate on a fixed 5-year plan. Under the auspices of the Management Conferences, however, scientists are focusing their research and applying their results to project managers' needs and time constraints. Managers are challenging scientists to direct their studies to meet Management Conference needs for short-term answers. The Management Conference enhances communication between scientists and managers and results in better solutions to management issues.

Members of the public often express concerns about highly visible problems, yet these issues may not be the most important problems for the Management Conference to consider. In fact, spending resources on a highly visible but relatively insignificant problem could divert attention from a crucial matter. It is imperative, therefore, that scientific findings be widely communicated and form the basis for public education efforts.

■ Faced with diverse constituencies, each with a different idea of what constitutes a monitoring program appropriate for Santa Monica Bay, the Santa Monica Bay Restoration Program held a 2-day consensus-building conference for scientists, managers, dischargers, regulators, and public interest group

representatives. The conference goal was to outline monitoring objectives that would guide the development of detailed hypotheses and sampling and analysis plans. Conference participants were led through a set of structured exercises that focused on the overall concerns driving the regulatory/monitoring system, agreement on a monitoring philosophy for the Bay, and determination of which Bay resources were the most highly valued. These exercises were followed by a decisionmaking process through which specific monitoring objectives were developed. The selected objectives reflected management goals, scientific knowledge, and public concerns.

Every estuary program in the NEP has a public participation and education component. Solutions to pollution problems are grounded in scientific information, but protection of habitats and commitment to action are dependent upon public education. Through education and participation, the public gains an understanding of the estuary and its problems, the will to act to solve immediate problems, and the desire to be stewards of the ecosystem for the future.

Priority Concerns

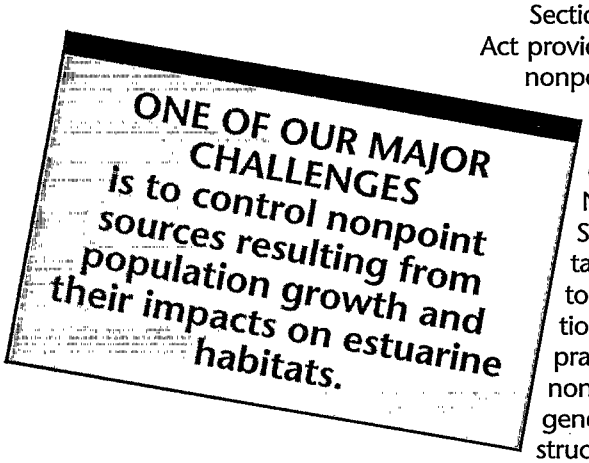
The public, in partnership with scientists and government managers, faces enormous challenges compounded by the population growth projected to continue in the coastal zone well into the 21st century. We will need to manage this growth more effectively to protect our coastal resources. Critical management areas that must be addressed include general growth and development, nonpoint sources, and natural habitat destruction.

Growth and Development

Coastal population growth and development patterns disrupt natural processes in coastal ecosystems and threaten both the ecologic and economic values of estuaries. As we approach the year 2000, we must improve conventional pollution controls and accelerate enforcement actions. However, new strategies are required to solve the more complex problems brought about by increasing pressure to develop rural areas and sensitive pristine areas.

Shoreline development often strips vegetation and eliminates wetlands, which exposes the land to erosion. Increased sedimentation in shallow waters chokes underwater grasses and threatens fish and shellfish habitats. Development near shorelines also damages life-sustaining habitats for shore birds and animals.

As development replaces vegetation with less pervious surfaces (such as buildings, parking lots, and roads), rainwater cannot seep slowly into the soil and replenish ground water. Instead, storm water runs off the impervious surfaces, collecting pollutants deposited from the air, and delivers the pollutants directly into surface waters. Without wetlands and other vegetated areas, the land cannot filter pollutants from storm water runoff before it enters estuarine waters. Looking ahead, our major challenge is controlling nonpoint sources resulting from population growth and their impacts on estuarine habitats.



Nonpoint Source Control

Section 319 of the Clean Water Act provides funding for some nonpoint source control projects in estuarine waters (see Chapter 14 for a full discussion of the Section 319 Nonpoint Source Program). States employ both voluntary and regulatory controls to encourage implementation of best management practices to minimize nonpoint source pollution generated by agriculture, construction, silviculture, marinas, and urbanization.

The 1990 amendments to the Coastal Zone Management Act (CZMA) require States with federally approved coastal zone management programs to develop nonpoint source pollution control programs in coastal areas. Each State's program will consist of selected management measures for source categories, such as construction, marinas, and agriculture. The States will develop and implement the coastal nonpoint source programs through existing State coastal zone management programs administered by NOAA under Section 306 of the CZMA and State nonpoint source programs administered by EPA under Section 319 of the Clean Water Act.

In May 1991, EPA, in consultation with NOAA, proposed management measures to control nonpoint sources in coastal waters. In October 1991, EPA and NOAA proposed guidelines to help States develop their coastal nonpoint source pollution control programs. EPA issued final guidelines in 1992.

EPA also issued new stormwater regulations in 1992 that will require National Pollutant Discharge Elimination System (NPDES) permits for urban storm drainage systems and runoff discharges from various industrial and commercial sites (see Chapter 12 for a complete discussion of storm water controls). The rule applies to 173 cities, 47 urbanized counties with populations exceeding 100,000 people, and several smaller communities using storm sewers in covered jurisdictions. The rule applies to industries that discharge into municipal storm sewers or directly discharge storm water into surface waters. The rule stops illegal connections to storm drains.

Habitat Protection

NEP projects are looking beyond traditional pollution control approaches toward strategies that address total estuarine ecosystem health. These strategies base habitat protection plans on a scientific understanding of how ecosystems function. These long-term strategies require further coordination of research and monitoring activities performed by EPA, NOAA, individual NEP projects, marine academic institutions, and other Federal and State agencies.

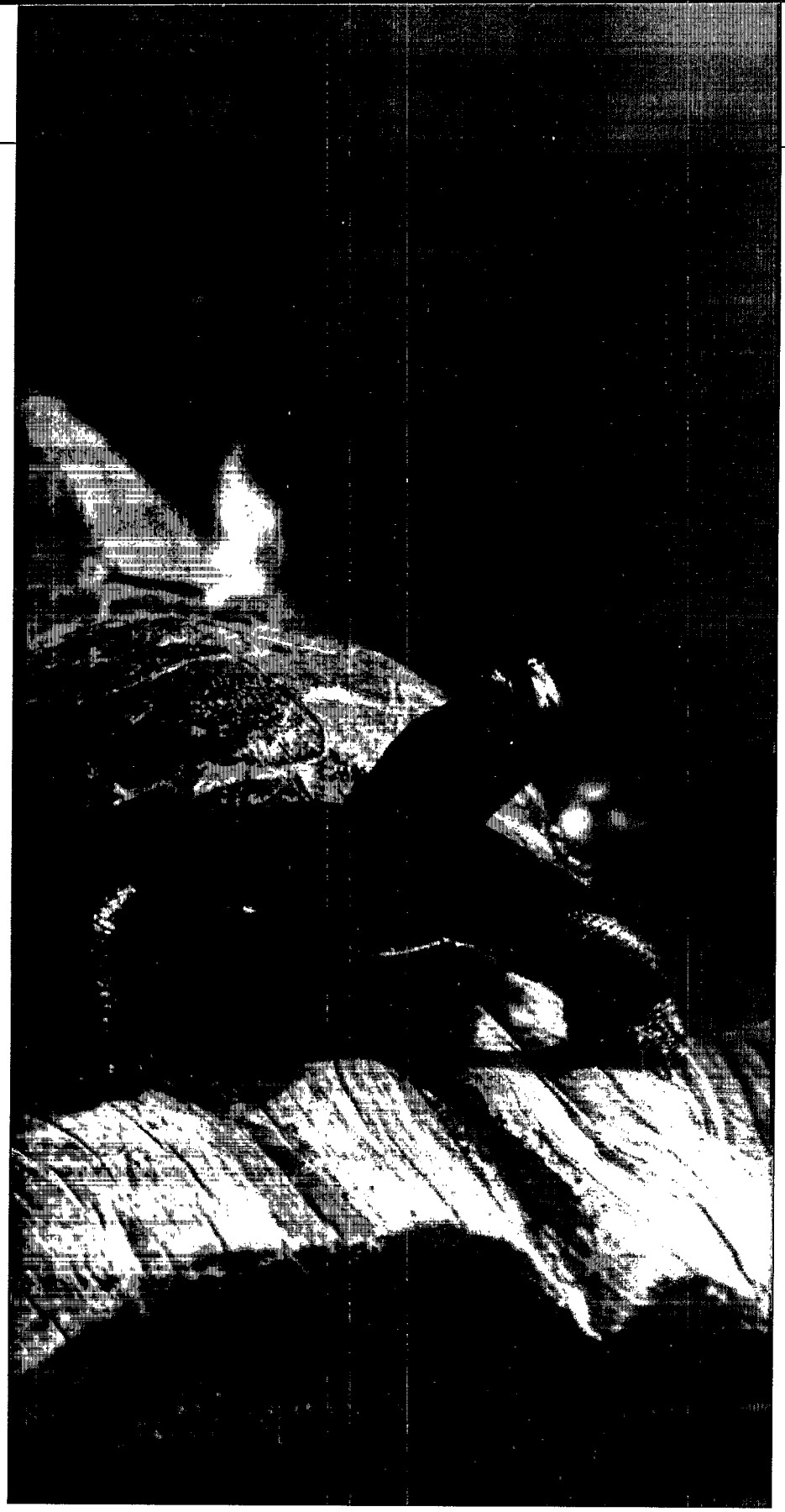
While long-term strategies are being developed, management conferences act locally to address immediate threats to estuarine habitats. For example, management conferences limit fish harvesting, replant seagrass beds, seek building restrictions such as setback requirements, create land conservation areas, and curb harmful uses of waterways. Such efforts are not implemented in all NEP sites but will

likely be more widespread in the future.

Management conferences will need to work even more closely with agencies such as the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers to improve our understanding of habitat problems and develop new technologies to mitigate adverse impacts. Examples of new technologies include stabilizing shorelines with vegetation instead of bulkheads and techniques for creating wetlands. EPA is working with Management Conferences to increase habitat mitigation activities, such as removing dams blocking fish migrations and eliminating freshwater diversions.

Steps in the Right Direction

The NEP recognizes that it may take decades to fulfull Congress' directive to restore and protect estuaries of national significance. In the short term, however, progress continues. Each estuary project in the NEP is focusing on the key environmental problems in its estuary and integrating protection efforts conducted by Federal, State, and local agencies. NEP projects are considering air and land pollution sources in addition to controls for traditional point source polluters. Finally, NEP projects are developing restoration and protection strategies based upon an understanding of estuarine ecosystem functions and encouraging the public to care for estuarine ecosystems.



Surface Water Monitoring and Assessment Programs

Introduction

Water quality monitoring is essential for an understanding of the condition of water resources and to provide a basis for effective policies that promote wise use and management of those resources. A large number of Federal, State, and local agencies and private sector organizations currently collect water quality information for a wide range of purposes that can generally be divided into five categories: (1) status and trends, (2) detection of existing and emerging problems and setting priorities among them, (3) designing and implementing programs, (4) evaluating program or project success, and (5) emergency response monitoring.

Numerous public and private groups conduct many and varied monitoring programs to fulfill one or more of these purposes. This chapter discusses current conditions of water resource quality monitoring in the United States and efforts to establish an integrated nationwide monitoring strategy.

Overview of National Monitoring Activity

Water resource quality monitoring is conducted by Federal, interstate, State, local, and Tribal agencies, as well as public, private, and volunteer organizations. A recent survey undertaken by the Intergovernmental Task Force on Monitoring Water Quality indicates that 18 Federal agencies conduct approximately 141 separate monitoring programs across the country, as do all States and Territories, local governments, and an increasing number of American Indian Tribes.

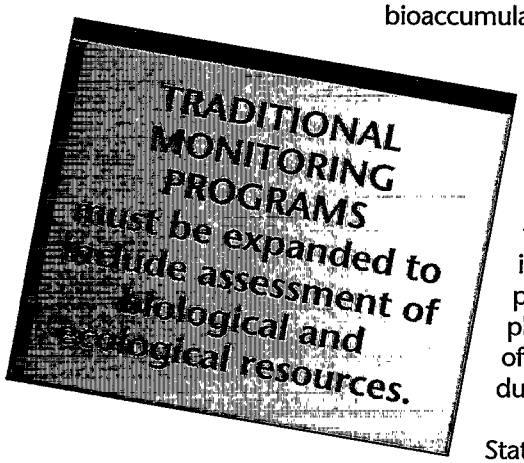
18 FEDERAL AGENCIES
conduct 141 monitoring programs across the country

MONITORING DATA are needed to characterize water quality and assess the effectiveness of water management and regulatory programs.

At the Federal level, ambient water quality data are collected by the U.S. Geological Survey (USGS), the U.S. Fish and Wildlife Service (FWS), the U.S. Forest Service, the Bureau of Reclamation, the National Park Service, EPA, National Oceanic and Atmospheric Administration (NOAA), the Tennessee Valley Authority (TVA), the Bonneville Power Administration, the U.S. Army Corps of Engineers (COE), the Bureau of Land Management (BLM), and various other organizations within the Departments of Agriculture, Energy, Defense, and Interior. Of this group, the USGS, FWS, EPA, NOAA, and TVA have either long-term regional or both regional and national programs for water quality monitoring. The other agencies and organizations monitor ambient water quality primarily at site-specific or

project scales, usually for limited periods of time.

Results from Federal monitoring programs have provided important information at the national and regional scales. For example, USGS data indicate that fecal bacteria counts and total phosphorus concentrations have decreased at a considerable number of stations across the United States from the late 1970s to the late 1980s. The FWS and NOAA data show that bioaccumulation of trace elements, pesticides, and trace industrial compounds has occurred at many locations in our rivers, estuaries, and near-coastal areas. And data from EPA monitoring indicate substantial improvement in the phosphorous concentrations of the Chesapeake Bay during the past 6 years.



Similarly, within each State, both State and local monitoring programs have provided the data to characterize State water resource quality and assess the effectiveness of water management and regulatory programs. Contributing to the picture are the monitoring programs run by industrial and municipal dischargers, by private groups, and by volunteer monitoring organizations.

This wealth of information from individual agencies, however, cannot be easily aggregated to provide an overview of national water quality conditions. Individual reports, such as this 305(b) report, aggregate State information. Individual agency reports, such as that of USGS, give nationwide information on particular constituents. Because of inconsistencies among the various agencies in monitoring purpose and design as well as data collection methods and assessment procedures, data from the various sources cannot be easily combined to give an overall national water quality picture. In addition, data are often stored without accompanying descriptors, thus other data users cannot determine if they can use the data for their own purposes.

Effects of Changes in Water Programs

In addition to this multiplicity of effort, water programs themselves are changing, necessitating similar changes in water monitoring activities. The country is moving beyond single-media command-and-control programs into more holistic management programs based on risk assessment and reduction. New emphases include watershed, ecoregion, and geographically based programs; a focus on biological, ecological, and habitat integrity and diversity; wet weather runoff control programs such as those for nonpoint sources, stormwater, and combined sewer overflows; and wetlands and sediment contamination programs. Traditional monitoring programs must be expanded to include assessment of biological and ecological resources and new methods must be developed to identify and control pollution from hard-to-trace, diffuse sources of pollution such as wet weather runoff and sediment contamination.

Intergovernmental Task Force on Monitoring Water Quality

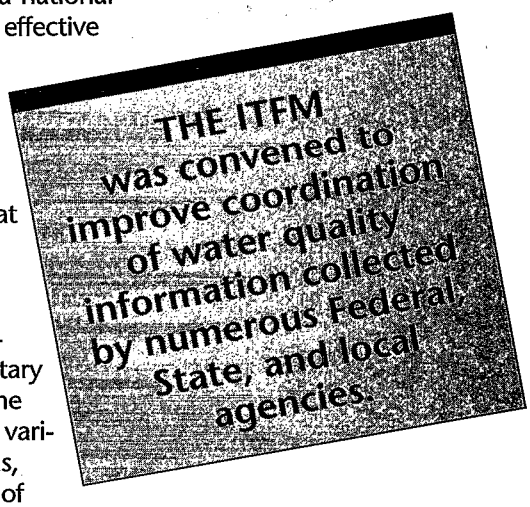
In January of 1992, representatives from EPA, USGS, NOAA, FWS, COE, USDA, DOE, OMB, and seven State agencies and one interstate agency formed a 3-year Intergovernmental Task Force on Monitoring Water Quality (ITFM) to prepare a strategy for improving water quality monitoring nationwide. The Tennessee Valley Authority, National Park Service, one State, and one American Indian Tribe, have since been added. The ITFM is part of the implementation of Office of Management and Budget (OMB) memorandum 92-01 to strengthen coordination of water information across the country. The USGS has lead responsibility for this and has designed its Water Information Coordination Program for this purpose.

The ITFM is chaired by the EPA with the USGS as vice chair and Executive Secretariat. To date, over 100 additional Federal, State, and interstate agency representatives have been involved in the deliberations of the ITFM and its seven task groups:

- Institutional Framework
- Environmental Indicators
- Methods
- Data Management Sharing
- Assessment and Reporting
- Financial Survey
- Ground Water.

The ITFM is considering the full range of nationwide water resources, including surface and ground waters, near-coastal waters, associated aquatic communities and habitat, wetlands, and sediment. Water resource protection factors include human and ecological health and the uses designated for the Nation's waters through State water quality standards. Monitoring activities include gathering data on physical, chemical/toxicological, and biological/ecological/habitat parameters.

The mission of the ITFM is to develop and implement a national strategic plan to achieve effective collection, interpretation, and presentation of water quality data and to improve the availability of existing information for decisionmaking at all levels of government. To accomplish this, the ITFM has recommended and will develop an integrated nationwide voluntary strategy that will meet the nationwide objectives of various monitoring programs, make more efficient use of available resources, distribute information more effectively, and provide comparable data and consistent reporting of water quality status and trends.



A standing national monitoring committee is envisioned to provide guidelines and support for comparable field and laboratory methods, quality assurance/quality control,

environmental indicators, data management and sharing, ancillary data, interpretation techniques, and training. Regional data collection under the national guidelines would provide the needed information for nationwide assessment of water resource quality.

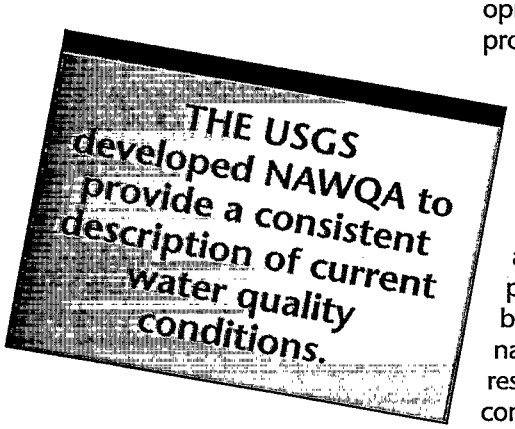
The ITFM is also producing products that can be used by monitoring programs nationwide, such as an outline for a recommended monitoring program, environmental indicator selection criteria, and a matrix of indicators to support assessment of State designated uses.

The ITFM will disband in favor of full implementation overseen by a permanent committee in January 1995.

Major Nationwide Monitoring Programs

■ Environmental Monitoring and Assessment Program (EMAP)

EPA's Office of Research and Development initiated EMAP in 1990 to provide information on the current status and long-term trends in the condition of the ecological resources of the United States. EMAP develops indicators to measure ecological condition, monitors for those indicators, and presents analyses of data in periodic reports. Site selection is based on a random design within natural resource areas so individual results can be interpolated with confidence to the condition of the Nation as a whole. EMAP, in cooperation with NOAA and the FWS, monitors seven resource groups: Near Coastal Waters, Surface Waters, Wetlands, Forests, Arid Lands, Agroecosystems, and Great Lakes.



■ National Acid Precipitation Assessment Program (NAPAP)

During the 1970s, the effects of acid rain on the environment and human health became a major concern for many scientists, public policy officials, public interest groups, the media, and the general population. Reports were published linking emissions from industry, electric power plants, and automobiles with acid rain. Many believed that acid rain damages crops, forests, buildings, animals, fish, and human health. Congress established NAPAP under the Acid Precipitation Act of 1980 to provide the information needed for policy and regulatory decisions on acidic deposition. The areas of investigation addressed by NAPAP Task Groups are Emissions and Controls, Atmospheric Processes, Atmospheric Transport and Modeling, Atmospheric Deposition and Air Quality Monitoring, Terrestrial Effects, Aquatic Effects, and Effects on Materials and Cultural Resources. NAPAP has also developed Assessment Work Groups in the areas of Atmospheric Visibility, Human Health Effects, and Economic Valuation.

■ U.S. Geological Survey, National Water Quality Assessment Program (NAWQA)

The USGS developed NAWQA to provide a nationally consistent description of current water quality conditions for a large part of the Nation's water resources; to define long-term trends (or lack thereof) in water quality; and to identify, describe, and explain, to the extent possible, the major factors that affect observed water quality conditions and trends. This program is

concerned with both ground and surface water quality; ultimately, 60 drainage basins will be monitored under this program.

■ U.S. Geological Survey, National Stream Quality Accounting Network (NASQAN)

This network is composed of 420 stations on large rivers, located at the outlets of major drainage basins to collectively measure a large fraction of total runoff in the United States. The stations reflect general water quality conditions in the country. Measurements at NASQAN sites include inorganic constituents, radionuclides, and bacteria, but exclude routine analyses for organic chemicals.

■ U.S. Geological Survey, the Hydrologic Benchmark Network (HBN)

Composed of 55 stations located in relatively pristine headwater basins, this network is designed to define baseline water quality conditions and the effects of atmospheric deposition on water quality. The Network measures inorganic constituents, radionuclides, and bacterial contamination, among other parameters.

Both NASQAN and HBN achieve their objectives but neither is designed to provide a statistically representative sample of basins throughout the Nation, nor are stations in NASQAN purposefully located downstream from industry, municipal, and urban runoff outfalls to isolate and measure maximum impacts. These network design considerations are a component of the NAWQA program.

■ U.S. Geological Survey, the National Atmospheric Deposition Program/National Trends Network

Composed of 200 sampling sites within the interagency NAPAP, this network is designed to determine spatial patterns and temporal trends in chemical wet-only deposition. It supports research into impacts on aquatic and terrestrial ecosystems. Measurements are limited to inorganic constituents only.

■ U.S. Fish and Wildlife Service, National Contaminant Biomonitoring Program (NCBP)

This program, now being revised, determines tissue residue levels in fish and birds nationwide. The fish tissue part of the program consists of 110 stations at nonrandomly selected points along the Nation's major rivers and in the Great Lakes. Fish tissues are analyzed for organic contaminants (pesticides and industrial chemicals) and seven elements. Sampling has been conducted on a 2- to 4-year basis since the mid-1960s.

■ U.S. Fish and Wildlife Service, Biomonitoring of Environmental Status and Trends (BEST) Program

This program, now under development, has three major goals: (1) to determine the status and trends of contaminants and their effect on natural resources; (2) to identify and assess the major factors affecting resources and provide current and predictive information to alleviate impacts; and (3) to provide summary information in a timely manner to decisionmakers and the public. The BEST Program has two major components: FWS lands and

The National Biological Survey

Secretary of the Interior, Bruce Babbitt, has proposed the creation of an independent, non-advocacy biological science bureau within the Department of the Interior. The National Biological Survey (NBS) will provide information and technical assistance. The NBS will be created by incorporating elements from eight bureaus within the Department. The NBS will have three major functions:

- *biological and ecological research*
- *inventory and monitoring of the Nation's biological resources*
- *information transfer activities.*

The NBS became operational on November 11, 1993.

FWS trust species and their habitats. Activities include collection and evaluation of existing data for site characterization and bioassessment data from four general categories–ecological surveys, tissue residue, organism health or biomarkers, and toxicity tests/bioassays.

■ U.S. Fish and Wildlife Service, National Wetlands Inventory (NWI) Program

This program determines status and trends of U.S. wetlands to produce comprehensive, statistically valid acreage estimates of the Nation's wetlands. This information is widely distributed and mandated by the Emergency Wetland Resource Act of 1986. To date, more than 32,000 detailed wetlands maps have been completed covering 72% of the coterminous United States, 22% of Alaska, and all of Hawaii and Puerto Rico.

■ National Oceanic and Atmospheric Administration (NOAA), National Status and Trends Program (NS&T)

NOAA conducts the NS&T, which includes the Benthic Surveillance Program and the Mussel Watch Program. Indicators for determining the effects on marine biotas of contaminated sediments are currently under development. Parameters that are sampled for NS&T include accumulated compounds in the tissues and conditions of physical features of selected biota as well as sediment chemistry.

■ National Oceanic and Atmospheric Administration (NOAA), National Estuarine Research Reserves

The National Estuarine Research Reserve System was created to protect representative areas of the estuarine environment and to provide a system of protected sites for long-term monitoring and research. It is a State-Federal partnership managed by NOAA under the Coastal Zone Management Act. The Act requires nomination of a reserve site by the Governor of a State and designation by the Secretary of Commerce. Since 1972, NOAA has kept this partnership, and the evolving statutory mission of the program, by providing resources and guidance to the States, by developing national programs, and by shaping the legislation into an operating program. Twenty-one reserves have been designated including sites in Hawaii, Puerto Rico, the Great Lakes, the Gulf of Mexico, the Atlantic Coast, and the West Coast.

■ Tennessee Valley Authority (TVA), Water Resource Monitoring

TVA conducts a regional water resource monitoring program to evaluate ecological health and suitability for body-contact recreation of reservoirs and major streams in the Tennessee Valley and to evaluate the suitability for human consumption of fish in those waters. The program includes systematic measurement of physical, chemical, and biological variables at strategic locations. Results are used to draw attention to pollution problems, to set cleanup goals, and to measure the effectiveness of water quality improvement efforts over time. TVA also monitors aquatic plant and

mosquito populations around TVA lakes to help target management efforts. Monitoring of conditions in tailwaters below several dams focuses on prioritizing facilities for reaeration of reservoir releases and providing data to evaluate the effectiveness of those efforts.

■ U.S. Department of Agriculture, Resource Conservation Act of 1977 (RCA)

Mandated by the Resource Conservation Act (RCA) of 1977, the U.S. Department of Agriculture (USDA) is "to provide for furthering the conservation, protection, and enhancement of the Nation's soil, water, and related resources for sustained use." In recognition of the importance of, and need for, obtaining and maintaining information on the current status of soil, water, and related resources, USDA makes a continuing appraisal of the soil, water, and related resources of the Nation. The objective of the appraisal currently under way is to present information to assist policy decisionmakers and program managers to form better policies and programs to address soil, water, and other environmental concerns for the next 2 decades.

RCA appraisals include data on: the quality and quantity of soil, water, and related resources, including fish and wildlife habitats; the capability and limitations of those resources for meeting current and projected demands on the resource base; the changes that have occurred in the status and condition of those resources resulting from various past uses, including the impact of farming technologies, techniques, and practices; and the current Federal and State laws, policies, programs, rights, regulations, ownerships, and their trends and other considerations relating to the use, development, and conservation of soil, water, and related resources.

Developed by the Interagency Work Group on Water Quality, the *Guide to Federal Water Quality Programs and Information* is an attempt to inventory all significant Federal water quality programs and information of national scope or interest. The guide contains information on (1) factors affecting water quality including underlying demographic pressures, use of the land, water, and resources, and pollutant loading; (2) ambient water quality information, including biological, chemical, and physical/ecological conditions; (3) other effects of water pollution including waterborne disease outbreaks; and (4) a listing of programs established to preserve, protect, and restore water quality. For a copy of the Guide, contact EPA's Public Information Clearinghouse (PIC) at (202) 260-7751.

For a description of other Federal water quality programs, see the Guide to Federal Water Quality Programs and Information, *available from EPA's Public Information Clearinghouse at (202) 260-7751.*

Office of Water Programs to Support Monitoring

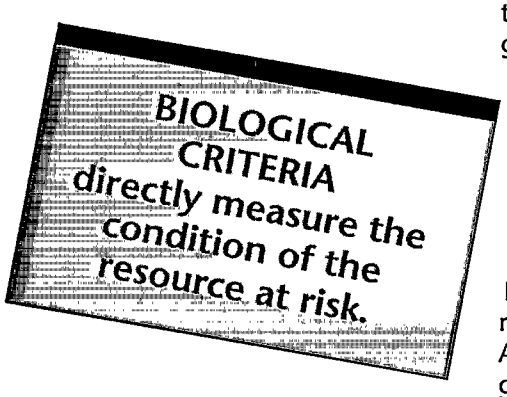
Environmental Indicators

EPA'S OFFICE OF WATER is developing indicators to characterize the health of national water resources.

The EPA Office of Water (OW) is developing a strategic plan that outlines its future directions and articulates its goals. To measure success toward these goals, OW is establishing indicators to accurately characterize the health of national water resources

and measure how well the waters meet their designated uses. This effort has identified data sources to track the indicators. Future indicator development activities include developing comparable monitoring and reporting mechanisms by working with other agencies and national trends programs, such as EPA's EMAP and USGS' NAWQA, through the ITFM.

Monitoring Program Grant Guidance



EPA gives grants to States to assist them in administering pollution prevention and control programs, including monitoring activities. In fact, the law states EPA shall not give such grants unless the State adequately monitors surface and ground waters, compiles and analyzes the data, and reports them in 305(b) reports. EPA, working with States and the ITFM, is developing an outline for a recommended monitoring program. A comprehensive monitoring program would include both ambient monitoring and monitoring to determine the effectiveness of individual projects and individual programs designed to protect waterbodies or control sources of pollution. Recommended elements of a monitoring program include monitoring program objectives; a monitoring design description; written protocols; analytical laboratory support; quality assurance and quality control procedures; data storage, management, and sharing; water resource assessment and reporting; training; and volunteer monitoring support.

305(b) Consistency Workgroup

The 305(b) Consistency Workgroup, convened in 1990, was expanded in 1992 to address issues of consistency in water quality reporting and to improve accuracy and coverage of State assessments. The 1994 305(b) Consistency Workgroup consists of representatives of 21 States, 6 Federal agencies, the 10 EPA Regions, and EPA Headquarters. This standing workgroup, which will develop future 305(b) guidance, makes recommendations to improve each iteration of guidance to the States. Recent recommendations have included refining total State waters estimates and providing more detailed guidance for aquatic life use support assessments, including appropriate methods for using biological data along with physical and chemical data.

Water Monitor Newsletter

Since the early 1980s, EPA has issued a regular status report on monitoring activities at EPA and among the States. Now known as the *Water Monitor*, this report provides monthly updates on State, EPA Regional, and EPA Headquarter activities in areas such as biological monitoring, total maximum daily load development, biological criteria and protocol development, volunteer monitoring, and the watershed approach. New documents and upcoming meetings are highlighted. To obtain a copy or be placed on the mailing list for the *Water Monitor*, write to Editor, *Water Monitor*, AWPD (WH-553), 401 M St. SW, Washington, DC 20460.

Biological Monitoring

The Biological Criteria Program

Priorities established in 1991 by EPA call for States to adopt biological criteria (biocriteria) into their water quality standards. To support this priority, the Agency has provided guidance for development and implementation of biocriteria. Several future guidance documents will provide additional technical information to facilitate activities directed toward that implementation. When implemented, biocriteria will expand and improve water quality standards programs, help to quantify impairment of beneficial uses, and aid in setting program priorities. These criteria will be useful because they provide for direct measurement of the condition of the resource at risk, detect problems that other methods may miss or underestimate, and provide a systematic process for measuring progress resulting from the implementation of water resource quality programs. Biocriteria are intended to supplement, rather than replace, chemical and toxicological methods.

Rapid Bioassessment Protocols

In 1989, EPA's Office of Water issued rapid bioassessment protocols (RBPs) for streams as a tool intended to provide States with biological monitoring methods to supplement traditional instream chemical analyses. The key concept underlying these protocols is the comparison of the structure and function of the aquatic community in the context of habitat quality at a given stream study site to that of an ecological reference site. On the basis of this comparison, a water resource quality assessment can be made. EPA has provided technical support and training to States to encourage the implementation of the RBPs. Currently (1993), 24 States have active RBP-based water resource monitoring programs for streams and another eight have RBP programs under development.

Additional guidance is being developed to aid States in adapting the protocol framework to fit a variety of ecological regions in the United States (lakes/reservoirs, estuaries, and others). Work is also under way to evaluate the effectiveness of RBPs for assessing combined sewer overflows.

Quality Assurance/Quality Control for Biological Monitoring and Biological Assessment

The U.S. EPA Office of Water and Office of Research and Development are assembling generic guidance documents for production of quality assurance project plans for biological monitoring and assessment. This work is currently under way and involves review and input from State and EPA regional monitoring personnel.

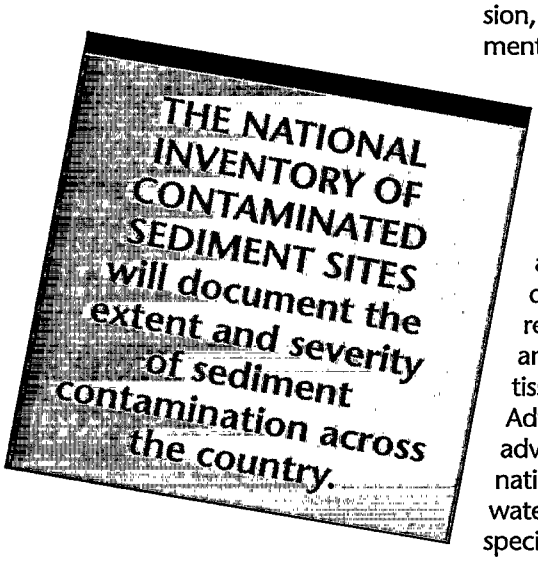
EPA Habitat Cluster

In ranking habitat degradation and loss as one of the highest environmental risk problems facing EPA and other governmental agencies today, the EPA's Science Advisory Board (SAB) recommended in 1990 that EPA attach as much importance to reducing ecological risks as to reducing human health risk. EPA

has since progressed toward a more comprehensive approach to environmental problems and their remedies, and habitat is an integral part of this perspective. In 1992, EPA established the Habitat Cluster, cochaired by OW and EPA's Office of Policy, Planning and Evaluation, which is developing a strategy for the agency to deal comprehensively with habitat issues.

Fish Advisory Guidance and Information

In response to interest on the part of States to have nationally consistent methods for issuing fish consumption advisories, EPA's Office of Science and Technology (OST), Standards and Applied Science Division, is developing guidance documents for sampling and analysis of contaminated fish tissues for the purposes of issuing consumption advisories. This guidance became available in October, 1993.



In addition to this guidance, OST has developed two databases, one for States to report fish advisory information and another that contains fish tissue contaminant data. The Fish Advisory Database contains fish advisory information reported nationwide by States including the waterbody affected, the type of fish species, the type of advisory, and a contact person. It is updated regularly and can be accessed through the Fish Advisory Special Interest Group on the Nonpoint Source Bulletin Board. The National Fish Tissue Contaminants Database can be accessed through the Ocean Data Evaluation System (ODES).

National Study of Chemical Residues in Fish

In late 1992, EPA issued a report on results of the EPA National Study of Chemical Residues in Fish (NSCRF), formerly called the National Bioaccumulation Study. This study is a followup to the EPA National Dioxin Study and substantially broadens that work with regard to both the number of chemicals analyzed and the number of sites examined. The NSCRF was a screening study designed to determine the extent to which water pollutants are bioaccumulating in fish and to identify correlations with sources of the contamination within a watershed/drainage basin (see the highlight in Chapter 7 for further information about the NSCRF).

Specific Water Program Monitoring

National Estuary Program Monitoring Guidance

EPA is developing guidance on the design, implementation, and evaluation of estuary monitoring programs required under Section 320 of the Clean Water Act. The guidance document identifies the major steps involved in developing and implementing estuary monitoring programs, documents existing monitoring methods, and describes their use in monitoring the effectiveness of estuarine management actions. Case studies of existing programs are included.

Nonpoint Source National Monitoring Program

EPA is developing a national monitoring database designed to provide information on the success of nonpoint source pollution control activities. To be included in the database, projects must have ambient monitoring of chemical, physical, and/or biological/habitat conditions, and the monitoring must be part of a rigorous nonpoint source abatement program with well-defined goals and objectives. Each of the 10 EPA Regions is to allocate a portion of the Section 319 grant funds for these projects. Data provided through this program will document the effects of well-developed nonpoint source pollution control efforts, provide better understanding of management programs and results, and provide a model for adjusting best management practices, where necessary, to achieve better results.

Wetlands Monitoring

National estimates of wetlands acreage have been available since 1975 from the FWS National Wetlands Inventory (see Chapter 16). EPA's Wetlands Division is now working closely with FWS and EPA's EMAP–Wetlands Program to characterize the ecological status and trends of existing wetlands. Standardized protocols are being developed for measuring wetlands conditions. See Chapter 16 for further information about EPA and State wetlands monitoring and protection programs.

Contaminated Sediment Strategy

In early 1993, EPA issued its Contaminated Sediment Management Strategy: A Proposal for Discussion. One of its main objectives is to describe EPA's current understanding of the extent and severity of sediment contamination. A major principle outlined in the Strategy describes EPA's commitment to continue to develop and improve methods for identifying contaminated sediments, to provide a basis for assessment of sediment contamination, to outline steps to reduce risk supported by sound science, and to outline a strategy for assessing the extent and severity of sediment contamination.

One of the initial steps to implement not only this strategy but to meet mandated statutory requirements to address and resolve contaminated sediment problems is to develop a national inventory of contaminated sediment sites for which a detailed monitoring database will be developed entitled the National Inventory of Contaminated Sediment Sites. Based on existing data, the site inventory will provide a near-term screening assessment of the national extent and severity of sediment contamination across the country and will contain sampling locational data, site characteristic data, quality assurance and quality control information, and sampling parameters. It is expected to be completed by December 1994.

Ground Water Monitoring

EPA's support for State Ground Water Protection Programs has expanded in line with the Ground Water Task Force's recommendations in the report *Protecting the Nation's Ground Water: EPA's Strategy for the 1990's*. This document addresses the development of consistent data collection protocols to improve accessibility, quality, and the usefulness of ground water quality data. To that end, the Ground Water Minimum Set of Data Elements for Ground Water Quality was finalized requiring their use for EPA ground water monitoring.

Volunteer Monitoring Programs

In recognition of the value of volunteer water monitoring efforts and to encourage the development of carefully planned volunteer programs that work in conjunction with State water quality agencies, EPA, in 1990, developed a volunteer water monitoring guide for State managers (see sidebar). This guide provides specific steps for planning, implementing, and maintaining a volunteer water monitoring program, and includes sections on quality assurance and quality control, data management and presentation, and funding.

EPA also developed a variety of other documents in support of volunteer monitoring, including a lake monitoring methods manual for volunteers, which provides step-by-step instructions for common volunteer monitoring techniques of lakes, a directory of volunteer monitoring programs nationwide, and the proceedings of the third national conference on volunteer monitoring.

EPA will continue to provide technical support in the area of volunteer monitoring by developing additional methods manuals (one for streams and one for estuaries are under way) and guidance on preparation of quality assurance project plans for volunteers. To help facilitate technical transfer and information exchange, EPA is sponsoring regular national and regional volunteer monitoring conferences, working to strengthen its own network of volunteer monitoring coordinators in the 10 EPA Regions, and sponsoring technical transfer tools such as the *Volunteer Monitoring* newsletter and an electronic bulletin board for volunteers. In addition, many of the EPA Regions issue Clean Water Act grants to the States under the Nonpoint Source and Clean Lakes programs that include volunteer monitoring components.

EPA Publications About Volunteer Monitoring

Citizen Volunteers in Environmental Monitoring: Summary Proceedings of the Second National Workshop. New Orleans, Louisiana. EPA 503/9-90-009. Office of Water, Washington, DC.

National Directory of Citizen Volunteer Environmental Monitoring Programs, Third Edition. EPA 503/9-90-004. Office of Water, Washington, DC.

Proceedings of Third National Citizen's Volunteer Water Monitoring Conference – Building Partnerships in the Year of Clean Water. March 29-April 2, 1992. EPA 841/R-92-004. Office of Water, Washington, DC.

Volunteer Lake Monitoring: A Methods Manual. December 1991. EPA 440/4-91-002. Office of Water, Washington, DC.

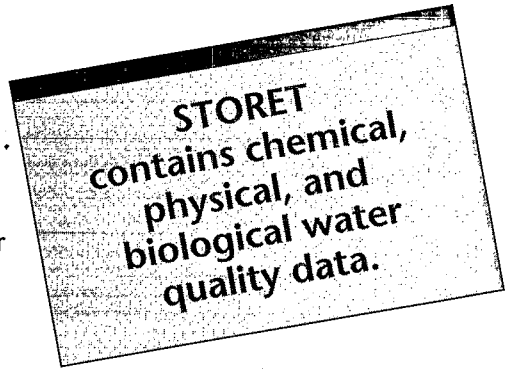
Volunteer Water Monitoring: A Guide for State Managers. August 1990. EPA 440/4-90-010. Office of Water, Washington, DC.

EPA Data and Information Systems

Storet Modernization

The STORET (STOrage and RETrieval) Database of ambient water quality data, first developed in 1964, is one of the oldest and largest water information systems currently in use. It has been jointly maintained by EPA's Office of Information Resources Management and the Office of Wetlands, Oceans, and Watersheds. STORET stores information on ambient, intensive survey, effluent, and biological water quality monitoring and provides users with an array of analytical tools and linkages to other data systems. STORET primarily contains chemical and physical water quality monitoring data in the water quality system, with biological sampling and site information stored in the BIOS (Biological System) Database, another major component. ODES (Ocean Data Evaluation System) is a separately maintained and linked information system specifically for water quality and biological data for marine, estuarine, and freshwater environments. ODES users can access STORET information for further manipulation using ODES graphical and modeling tools.

EPA information systems are being called upon to respond to new program needs, including geographically oriented management approaches, storage of ground water quality and associated geologic data and biological and habitat assessment information, and to enhance sharing of data (across EPA, other Federal, State, and local programs). STORET, BIOS, and ODES are undergoing a major modernization scheduled to be complete in 1997 with interim products throughout, including a prototype in late 1993. This effort will result in a more flexible, efficient, and usable state-of-the-art information system, which, in turn, will provide improved tools for ground and surface water quality decisionmaking.



The Waterbody System

The Waterbody System (WBS) is a data management tool used by States to record assessments of ambient water quality for surface waters. Although originally designed to facilitate the reporting under Section 305(b), the WBS is used by many States to track results of all their ambient water quality assessments. During the 1992 reporting cycle, 30 States, Territories, and Interstate Water Commissions submitted WBS data files. Approximately 10 additional States used the WBS in some capacity but did not submit files compatible with the 1992 version of the WBS.

The Waterbody System contains information that program managers can access quickly on the water quality status of a particular waterbody. Data elements include waterbody identification, water quality status, assessment information, designated use evaluations, causes of impairment (nutrients, pesticides, siltation, etc.), and sources of impairment (municipal treatment plants, agricultural runoff, etc.).

Enhanced twice since it was originally developed in 1988, system users communicate regularly with each other and can receive user information and support from the Monitoring Branch at EPA Headquarters.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Volunteer Monitoring

Across the country, people are learning about water quality issues and helping to assess and protect our Nation's water resources by monitoring waters in their communities. Volunteers commonly measure physical and chemical water quality parameters, including dissolved oxygen concentrations, acidity (pH), nutrient concentrations, and temperature. Some volunteers also evaluate the health of stream habitats and aquatic biological communities, inventory stream-side conditions, and assess land uses that may affect water quality. Other volunteers collect and catalog beach debris and restore degraded habitats.

State and local agencies may use volunteer data to screen for water quality problems, establish trends in waters that would otherwise be unmonitored, or make planning decisions. Volunteers benefit by learning more about their local water resources, identifying conditions and activities that might be contributing to pollution problems, and working with clubs, environmental groups, and government agencies to address problem areas.

What is EPA's Role in Volunteer Monitoring?

The EPA supports volunteer monitoring by providing technical guidance, establishing formats for information exchange, and offering limited funding. EPA sponsors national and regional conferences to encourage information exchange among volunteer groups, government agencies, businesses, and educators. EPA publishes sampling method manuals for volunteers and provides technical assistance (primarily on quality control and laboratory methods) through the 10 EPA regional offices. The EPA Regions also manage grants to States to support volunteer monitoring in lakes and waters impacted by nonpoint sources.

What is the State's Role in Volunteer Monitoring?

Every year, citizens initiate new volunteer monitoring programs. Many of these volunteer monitoring groups work with State agencies. In 1988, only 14 State agencies provided technical and/or organizational assistance to volunteer

monitoring groups. In 1992, 32 States supported volunteer monitoring programs and 6 additional States were planning volunteer monitoring programs.

Over 24,000 volunteers monitor more than 985 streams, 4 major estuaries, and 2,800 lakes, ponds, and wetlands in State-supported programs. Without volunteers, the States could not monitor many of these waterbodies.

Who Pays for Volunteer Monitoring?

Volunteer monitoring programs are funded through a variety of private and public sources. In some cases, public agencies sponsor volunteer programs by providing staff to train and organize volunteers, equipment, and services, such as data analysis. City, county, and Tribal governments, State agencies, and Federal agencies (such as the U.S. Park Service, the U.S. Forest Service, and the EPA) support volunteer monitoring programs financially or with guidance and training.

Many volunteer programs also receive private support from foundations, corporate sponsors, universities, and other research centers. This support may include funding for full- or part-time organizers, equipment, training workshops, and data analysis. Many volunteers contribute by purchasing their equipment and hosting training sessions.

How Do Volunteer Monitoring Programs Improve Our Environment?

The following examples demonstrate the important contributions volunteers have made to improving the environment.

Snohomish County's Adopt-a-Stream Program: Improving Fish Resources in Washington State

Over 20 school groups and 16 parent groups currently maintain and monitor adopted streams and tributaries in Snohomish County, Washington. The groups look for evidence of pollution, erosion, and activities that might disrupt fish spawning in their adopted streams.

Volunteers and county employees, working together, completed over 105 stream restoration projects and opened 30 miles of previously restricted spawning and rearing habitat for salmon and steelhead trout.

Neighborhoods United: Protecting the Cold Stream in Cedar Rapids, Iowa

With only 13 members, Neighborhoods United began protecting the Cold Stream in Cedar Rapids, Iowa, 3 years ago. The volunteers accomplished the following tasks:

- Identified a sewer overflow and convinced the City to repair it by presenting a video tape of the overflow to city officials.
- Organized city-wide cleanup days that dramatically reduced the stream's solid waste content by several commercial truckloads of garbage.
- Involved children and adults in regular biological monitoring of the stream.

Vermont Lay Monitoring Program: Lake Champlain's Steward

Hundreds of volunteers measure Secchi disk transparency (a measure of the water turbidity) and collect water samples from 30 monitoring stations on Lake Champlain. The State analyzes chlorophyll and total phosphorus concentrations in the water samples collected by the volunteers. Volunteers also conduct user perception surveys. Volunteer data helped the State establish phosphorous standards for Lake Champlain and obtain a Federal grant to study phosphorus in Lake Champlain. The volunteer data also enabled the State to include information on Lake Champlain in the State's 305(b) report.

Volunteer Lake Monitoring Program: Benefits in Illinois

Every year, 270 volunteers donate 2,400 hours of their time to monitor over 150 lakes in Illinois. Volunteers collect data on water transparency, nutrients, and suspended solids. State agencies and local lake associations perform the following tasks with the data:

- Plan and implement over 30 lake and watershed management projects, such as a cost-sharing project with farmers to implement safe and effective use of agricultural chemicals.
- Determine water quality trends and the effectiveness of lake and watershed management projects.
- Prepare the State's 305(b) report.

Trout Unlimited: Restoring and Protecting Fish Habitat

Trout Unlimited is a nonprofit cold water fisheries conservation organization with 66,000 members in 400 local chapters. Trout Unlimited offers technical assistance to its members who participate in dozens of water monitoring and river restoration projects each year. Trout Unlimited members recently completed the following projects:

■ Constructed a barbed-wire fence along California's Trout Creek in the Shasta-Trinity National Forest to prevent cows from damaging fish habitat. Chevron Corporation assisted.

■ Restored fish habitat on Spring Creek in Missouri's Mark Twain National Forest. Trout Unlimited members planted 20,000 trees along a 6-mile segment of the creek, restored the creek banks, and reclaimed the natural Ozark vegetation.

The GREEN Project: Empowering People to Improve Water Quality Around the World

The Global Rivers Environmental Network (GREEN) is affiliated with the School of Natural Resources at the University of Michigan in Ann Arbor. GREEN provides a clearinghouse of scientific information and ideas for people with an interest in studying and improving local water quality through hands-on monitoring and problemsolving. Several examples of student actions arising from GREEN's water monitoring programs include:

■ In Swaziland on the African continent, students reduced the cases of schistosomiasis (a tropical disease caused by parasitic worms) by locating an alternative river site for washing clothes and providing basins and water pumps at the new site.

■ In Australia, students and teachers identified partially treated sewage near public beaches and appeared on national television to advise the public of the health risks.

■ In Detroit, Michigan, students identified a malfunctioning municipal sewage treatment station emptying raw sewage into the Rouge River. The city immediately repaired the station's equipment.

For More Information

To learn more about volunteer monitoring and how to participate, contact:

Alice Mayio
Volunteer Monitoring Coordinator
U.S. Environmental Protection Agency (4503)
401 M Street, SW
Washington, DC 20460
(202) 260-7018

For further information about databases and information systems, see the Office of Water Environmental and Program Information Systems Compendium available from the EPA Office of Water at (202) 260-5684.

The Permit Compliance System

The Permit Compliance System (PCS) is an information management system maintained by the Office of Wastewater Enforcement and Compliance (OWEC) to track the permit, compliance, and enforcement status of facilities regulated by the National Pollutant Discharge Elimination System (NPDES) program under the Clean Water Act. PCS tracks information about wastewater treatment and industrial and Federal facilities discharging into navigable rivers. Tracked items include facility and discharge characteristics, permit conditions, inspections, enforcement actions, and compliance schedules. PCS distinguishes between major and minor facilities based on the potential threat to human health or the environment. Only major facilities must provide complete records to PCS, currently numbered at around 7,100; however, States and Regions do submit information for approximately 56,300 minor facilities. PCS users are able to use graphical and statistical tools to analyze PCS data and can use a PCS/STORET interface to link the systems and support additional analyses.

Nonpoint Source Information Exchange

The Nonpoint Source Information Exchange, housed at the Assessment and Watershed Protection Division of EPA's Office of Water, is designed to serve as a national center for the exchange of information concerning (1) the nature of nonpoint source (NPS) pollution, (2) NPS management techniques and methods, and (3) institutional arrangements for the planning and implementation of NPS management including financial arrangements.

The Exchange contains two major activities: a technical bulletin, the *NPS News-Notes*, published approximately eight times per year, and the NPS Electronic Bulletin Board System (NPS BBS). The target audience for the *News-Notes* is State and local water quality managers although, with a circulation of over 10,000, other interested parties including public officials, environmental groups, private industry, citizens, and academics receive *News-Notes* regularly.

The NPS BBS, first opened in 1991, provides timely and relevant NPS and other information to a similar audience. There are more than 1,200 users of the NPS BBS who, through the system, can access several special interest areas: Agricultural Issues, Fish Consumption Advisories and Bans, Waterbody System Users Group, NPS Research, Watershed Restoration Network, Total Maximum Daily Loads, and Volunteer Monitoring. Also available are on-line searchable databases such as the Clean Lakes Clearinghouse, *NPS News-Notes* database, the Fish Consumption Bans and Advisories database, and the National Registry of Watershed Projects.

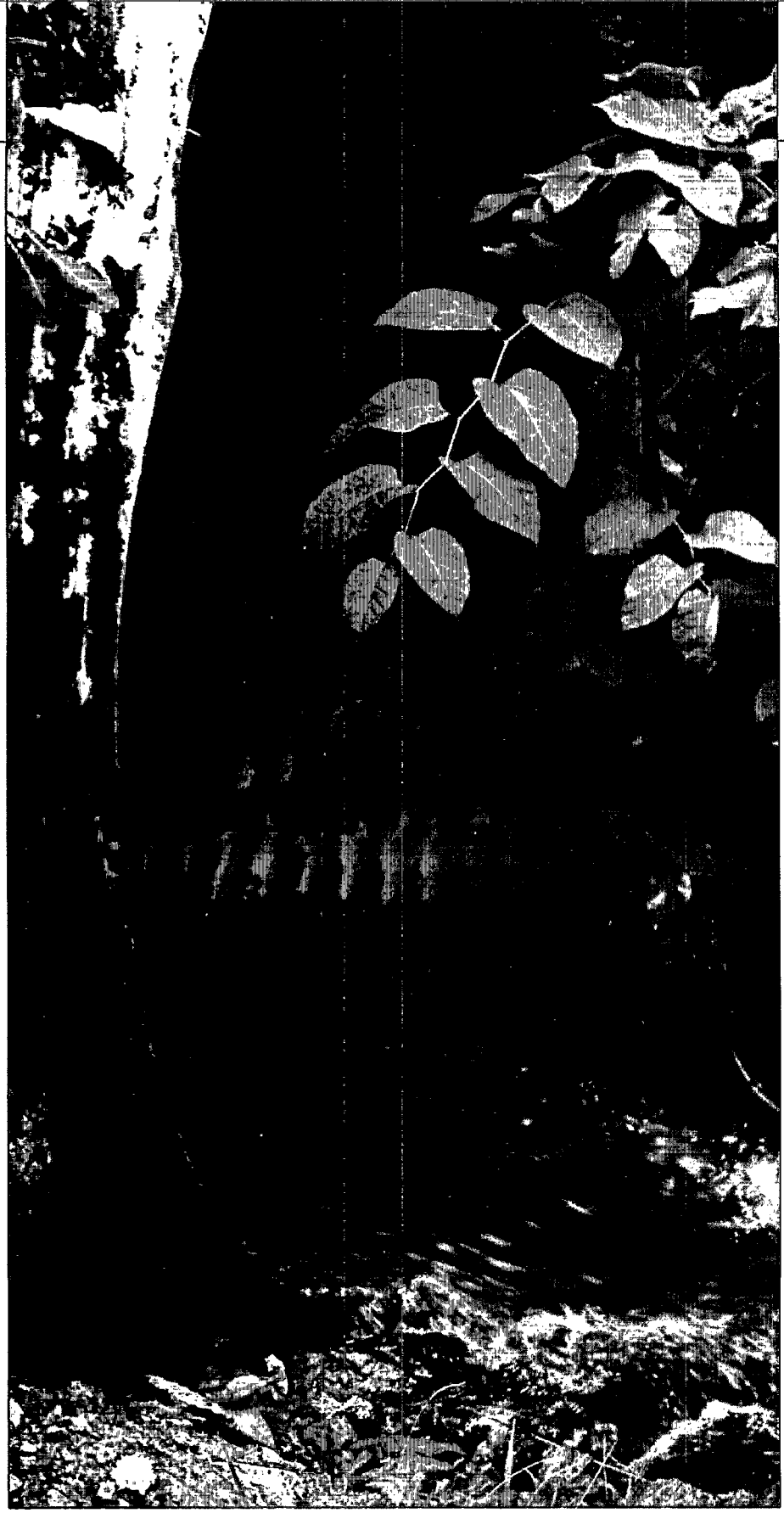
Great Lakes Envirofacts

The Great Lakes National Program Office (GLNPO) is initiating a computer system development pilot effort called *Great Lakes Envirofacts* (GLEF) to assist managers and technical staff in developing strategies to reduce toxic chemical loadings. The keystone goal of GLNPO's data integration program is developing a system to enable technical staff to access, display, analyze, and present Great Lakes multimedia and geographic information from their desk top, providing environmental decisionmaking support for Great Lakes Program managers. The GLEF pilot project will explore both the system requirements of Great Lakes Program staff and the technical means (hardware, software, and telecommunications) to begin realizing its keystone goal.

The GLEF will build upon the Envirofacts/Gateway system developed by EPA's Office of Information Resources Management (OIRM) Program Systems Division (PSD). The *Envirofacts* database stores environmental monitoring and program (e.g., PCS, TRIS, FINDS) information in a relational structure. *Gateway* is a graphical user interface that provides spatially referenced access to the Envirofacts database. The Great Lakes Envirofacts project will be the first implementation of the Gateway/Envirofacts concept, testing its capability and utility for the Great Lakes Program.

Other Information Clearinghouses & Electronic Bulletin Boards

Several other clearinghouses, electronic bulletin boards, newsletters, and information updates on water quality activities have been developed by EPA for use by State and local governments, Federal agencies, and the public. These include COASTNET bulletin board for coastal waters and estuary protection activities, the Clean Lakes Clearinghouse, the *Contaminated Sediment News* bulletin, the Water Monitor (described on page 218), and the Office of Science and Technology's Resource Center.



Point Source Control Program

Treating Municipal Wastewater

Municipal treatment facilities receive wastewater from residential sources as well as from industry, ground water infiltration, and storm water runoff. The array of pollutants that may be associated with these sources includes suspended solids, organics, pesticides, heavy metals, nutrients, acids, viruses, and bacteria.

Adequate treatment of municipal wastewater is important for the protection of the Nation's water resources and public health. Without adequate treatment, this pollution poses a potentially serious threat to aquatic life, commercial and recreational opportunities, surface water drinking supplies, ground water drinking supplies, and the general health and stability of many of the Nation's stream, river, lake, estuarine, and coastal ecosystems.

The Clean Water Act requires municipalities to achieve treatment levels based on technology performance. The 1981 CWA amendments extended the deadline for eligible treatment plants to achieve "secondary treatment" to July 1, 1988. Secondary treatment removes at least 85% of several key conventional pollutants. If secondary treatment is not enough to meet water quality standards, the Clean Water Act mandates additional treatment as necessary.

Historically, under the Clean Water Act, EPA has been authorized to help municipalities solve their wastewater treatment problems by providing grants for construction. For this purpose, $18 billion was originally appropriated to the construction grants program. Funding has continued since the initial appropriation in 1972, and the Federal investment in municipal wastewater treatment was $56 billion through fiscal year 1992.

THE STATE REVOLVING FUND PROGRAM provides grants to States to establish loan programs that finance wastewater treatment.

Through the 1987 amendments to the Clean Water Act, the State Revolving Fund (SRF) Program was established to follow the phaseout of the Construction Grants Program. Under this program, the Agency provides grants to States to fund the establishment of State-run loan programs. This is a major step in restoring the responsibility for financing wastewater treatment to States and municipalities. Congress appropriated more than $9 billion through fiscal year 1994 for State Revolving Funds. States must provide a 20% match as part of their commitment toward establishing their SRFs. In addition to providing loans for construction of wastewater treatment facilities, SRFs allow funding for activities not previously eligible under the Construction Grants Program. The amendments

STATES may finance nonpoint source projects, as well as treatment plant construction, with State Revolving Funds.

of 1987 expanded eligibilities and also led to the promulgation of new rules related to new enforceable requirements. The major categories of new eligibilities are nonpoint source control and programs for the protection of ground water and estuaries. The primary programs with new enforceable requirements are those dealing with storm water, toxic discharges, and sludge use and disposal. The SRF loan program provides States with more discretion than ever before in selecting projects for funding. States are now able to finance projects they may consider to be of higher priority, such as nonpoint source, estuarine, combined sewer overflow, or storm water control projects. All States and Puerto Rico had approved SRF programs in place as of September 1990.

The States provided some examples of water quality improvements due to municipal construction and upgrading in their 1992 305(b) reports (see sidebar).

Funding Needs for Wastewater Treatment

The Needs Survey, a biennial report to Congress, is the primary mechanism for assessing municipal wastewater treatment needs nationwide. The 1992 Needs Survey focuses on the expanded CWA funding eligibilities under the SRF in the 1987 Amendments to the Clean Water Act. Models were used to supplement documented needs estimates for combined sewer overflows (CSOs). Models were also used to develop preliminary urban storm water and agricultural and silvicultural nonpoint source (NPS) pollution control implementation costs since very little documentation of specific projects or costs was available from the States.

EPA's needs estimates include those facilities and activities for which a water quality or public health problem could be documented using specific criteria established by EPA. The capital investment necessary to satisfy all categories of need is presented in Table 13-1. Additional nonconstruction estimates are included for program development costs associated with storm water and NPS control. The

Table 13-1. Needs for Publicly Owned Wastewater Treatment Facilities and Other Eligibilities (January 1992 Dollars in Billions)

Needs Category	Total Needs
Title II Eligibilities	
I Secondary Treatment	31.3
II Advanced Treatment	15.5
IIIA Infiltration/Inflow Correction	2.8
IIIB Replacement/Rehabilitation	3.6
IVA New Collector Sewers	17.9
IVB New Interceptor Sewers	14.7
V Combined Sewer Overflows	41.2 [a]
VI Storm Water (institutional source controls only)[b]	0.1 [a]
Total Categories I-VI	**127.1**
Other Eligibilities (Sections 319 and 320)	
Nonpoint Source (agriculture and silviculture only)	8.8 [a]
Ground Water, Estuaries, Wetlands	1.2
GRAND TOTAL	**137.1**

[a] Modeled needs.

[b] Includes SRF-eligible costs to develop and implement storm water plans but not eligible structural and construction costs.

NOTE: Costs for operation and maintenance are not eligible for SRF funding and therefore are not included.

1992 total documented and modeled needs are $137.1 billion to satisfy all categories of needs eligible for SRF funding for the design year (2012) population.

This amount included $50.1 billion in modeled needs for CSO, storm water, and NPS pollution control. For storm water and NPS, the estimates exclude operation and maintenance costs (O&M) since O&M costs are ineligible for SRF funding. However, O&M costs are the major costs associated with storm water and NPS program implementation. Only agriculture and silviculture NPS pollution control costs were estimated. Many types of NPS pollution were not addressed: abandoned mines, urban areas, septic systems, contaminated sediments, hydromodification, and atmospheric deposition.

The needs estimate for the Nation rose in constant dollars by $53.4 billion (39%) from 1990 to 1992. The increase was due to a variety of factors, primarily improved documentation of SRF eligibilities and the use of models to capture full CSO, as well as partial urban storm water and NPS costs.

Water Quality Improvements from Treatment Plant Upgrades

- Wisconsin reported that construction of new municipal treatment plants restored large segments of the Fox and Wisconsin Rivers. These segments now fully support fishing use and aquatic life use. As a result, sport and commercial fisheries have returned to some river segments.
- Vermont reported that a secondary treatment facility constructed in Troy addressed untreated municipal discharges and corrected long-term stream use impairments.
- The Ohio River Valley Water Sanitation Commission (ORSANCO) detected statistically significant declines in total suspended solids and total nitrogen in the Ohio River mainstem between 1977 and 1987. These pollutants commonly occur in municipal wastewater discharges and their decline suggests that treatment plant upgrades are reducing pollution in the Ohio River.
- New Mexico attributed a sharp decline in the total loading of oxygen demanding wastes (BOD) into the State's surface waters between 1977 and 1991 to sewage treatment plant construction. During the same period, population growth spurred an increase in the total volume of wastewater treated. However, the construction of more efficient treatment plants outpaced the increase in wastewater load.

Treating Industrial Wastewater

The Clean Water Act required EPA to establish uniform, nationally consistent effluent limitation guidelines for industrial discharges. At this time, EPA has established Best Available Technology Economically Achievable (BATEA) and Best Conventional Pollutant Control Technology (BCT) guidelines for about 28 industrial categories. EPA has also promulgated technology-based guidelines for approximately 15 additional secondary industries that represent Best Practicable Control Technology Currently Available (BPT) levels. EPA is studying an additional dozen industries for future guidelines development.

In addition to these technology-based requirements, EPA, in 1984, issued a policy on the water-quality-based control of toxic pollutants discharged by point sources. In 1985, EPA issued the *Technical Support Document for Water Quality-Based Toxics Control* to support the national policy. EPA updated and enhanced this document in 1991. Both the policy and guidance

recommend using overall toxicity as a measure of adverse water quality impact and as a regulatory parameter. In 1989, EPA amended its NPDES regulations to require the use of effluent discharge limitations for whole-effluent toxicity in addition to specific toxic chemicals. The use of whole-effluent toxicity as a regulatory tool coupled with controls for specific chemicals provides a powerful means of detecting and controlling toxic problems.

Table 13-2. Status of Permit Issuance

	Major Permits	Minor Permits
Total Facilities	7,105	57,143
EPA-Issued Permits		
Total	2,070	7,243
Expired	217	4,055
Percent	10.5%	56%
State-Issued Permits		
Total	5,035	49,900
Expired	1,119	18,518
Percent	22.2%	37.1%

Source: Permit Compliance System, February 1993.

Permitting, Compliance, and Enforcement

EPA and the States use rigorous permit conditions to control point source discharges from industrial and municipal wastewater treatment facilities. During the early 1980s, the rate of permit issuance fell behind the rate of permit expiration, and large backlogs of unissued permits developed. Efforts to remedy these backlogs have been largely successful. Table 13-2 illustrates the status of permit issuance as of February 1993.

Once the permit is established, compliance with these conditions is essential for achieving water quality improvements. Despite examples of water quality improvements associated with upgrading municipal facilities, 10% of major municipal treatment plants are in significant noncompliance with applicable permit conditions. Industrial permittees have historically achieved a higher rate of compliance; 7% of industrial facilities are in significant noncompliance with their permit conditions.

EPA and States with approved NPDES programs are responsible for ensuring that municipal and industrial facilities comply with the terms of their discharge permits. Currently, 39 States have approval from EPA to administer their own NPDES programs. This responsibility includes issuing permits, conducting compliance inspections and other compliance monitoring activities, and enforcing compliance. EPA has the lead implementation responsibility in the remaining States. EPA and the States evaluate compliance by screening self-monitoring reports submitted by the permitted facility. Facilities that are determined to be in noncompliance are subject to Federal as well as State enforcement action.

Figure 13-1 illustrates rates of significant noncompliance based on statistics maintained by EPA from December 1983 through June 1992. Significant noncompliance rates for municipal and industrial facilities jumped in FY90 primarily because, for the first time, EPA calculated noncompliance directly from its automated database. Therefore, if data are not entered into the Permit Compliance System in a timely manner (e.g., failure to enter the receipt of a required report within 30 days), the system will automatically determine that the facility is not in compliance. EPA is continuing to refine its tracking of compliance with permit conditions to better reflect instances of noncompliance by the regulated community.

National Municipal Policy

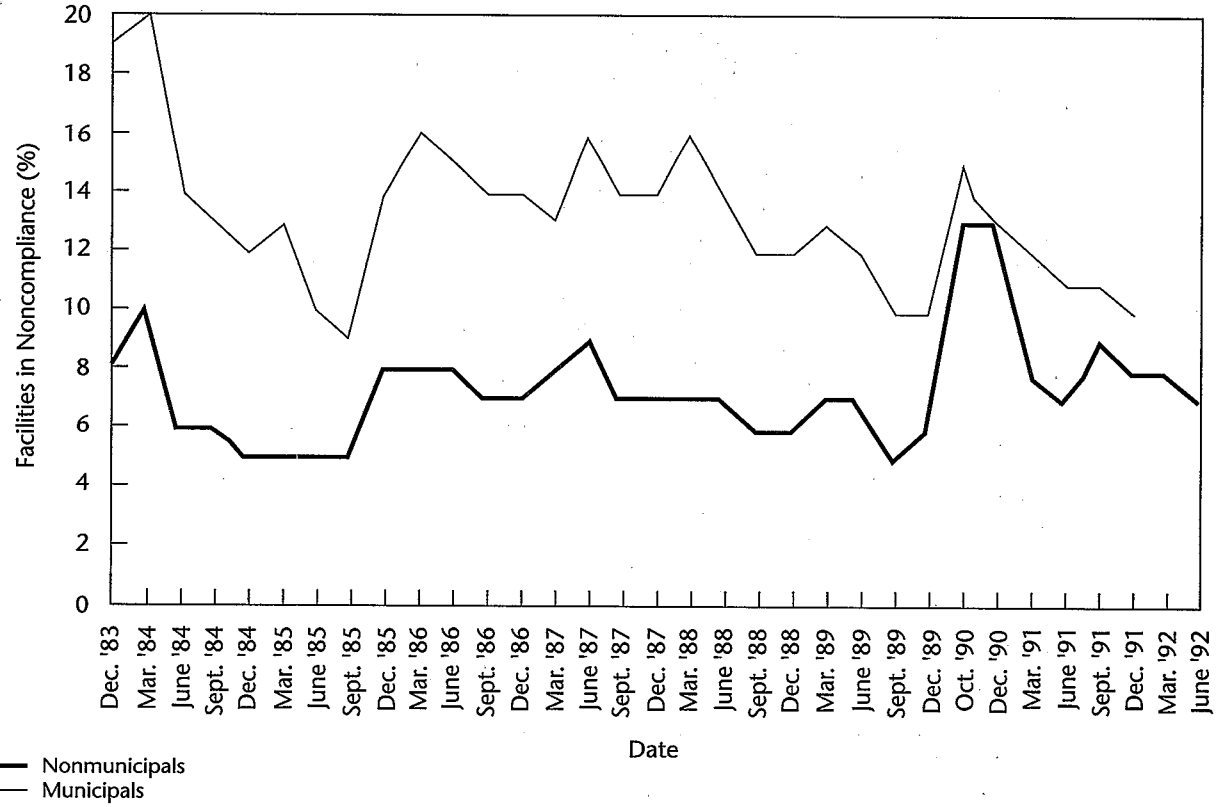
Due to the generally poor municipal compliance record, and because of congressional concern over the performance of treatment works built primarily with Federal funds, EPA developed the National Municipal Policy (NMP) to address the failure of publicly owned treatment works (POTWs) to meet treatment levels required for compliance with the CWA. On January 23, 1984, the EPA Administrator signed the NMP into effect. The NMP clarified and emphasized EPA's resolve to ensure that municipalities comply with the Clean Water Act as quickly as possible, regardless of whether Federal grant assistance was available for treatment plant construction.

The deadline established for full compliance with the Clean Water Act was July 1, 1988. By this date, all municipal treatment facilities were to be in compliance with the secondary treatment requirement of

INDUSTRIAL FACILITIES
have a higher rate of compliance with discharge permits than do municipal facilities.

Figure 13-1

Percent of Facilities in Significant Noncompliance with NPDES Permit Requirements



Source: USEPA Permit Compliance System, June 1992.

SECTION 304(l) of the CWA focused attention on known water quality problems resulting from point source discharges of toxic pollutants.

Section 301(b)(1)(B) of the CWA or with more stringent limitations established to meet State water quality standards. Of the total universe of 3,731 major municipal facilities, 1,478 facilities were identified as requiring construction to meet the 1988 deadline. By July 1, 1988, all but 423 municipal facilities achieved compliance with the requirements. Since the 1988 deadline, 188 facilities have come into compliance, and, of the remaining 235 facilities, all but 50 have been placed on enforceable compliance schedules. EPA is continuing to track the progress of these facilities in meeting the requirements of the CWA.

In the 1987 Water Quality Act amendments to the CWA, EPA was given authority to seek administrative penalties from permittees in noncompliance with the Act's requirements. EPA issued guidance and delegated the authority for issuing these orders to the regional level in August 1987. The first Administrative Penalty Order (APO) was issued in September 1987. Through October 1990, 396 APOs have been issued assessing a total of $7.5 million in penalties. These orders have been an effective tool in expeditiously addressing violations of the CWA and represent an integral component of EPA's overall enforcement strategy.

Controlling Toxicants

The 1987 amendments to the Clean Water Act reinforced both the water-quality-based and technology-based approaches to point source control, requiring EPA to develop and update technology-based standards and adding specific direction as to how water-quality-based limits should be used to achieve additional improvements. One of the Act's primary emphases lay in strengthening the Nation's toxics control program.

Identifying Waters Impaired by Toxicants

Section 304(l) of the CWA required States to develop lists of impaired waters, identify point sources and the amounts of pollutants they discharge that cause toxic impacts, and develop an individual control strategy (ICS) for each such point source. These ICSs are NPDES permits with new or more stringent limits on the toxic pollutants of concern. The individual control strategies must be accompanied by supporting documentation to show that the permit limits are sufficient to meet water quality standards as soon as possible but no later than 3 years after establishment of the ICS. The general effect of Section 304(l) was to immediately focus national surface water quality protection programs on addressing known water quality problems due entirely or substantially to point source discharges of Section 307(a) toxic pollutants. Under Section 304(l), EPA and States identified 68 facilities in the United States that were required to have individual control strategies. ICSs have been established for 58 of these facilities.

EPA implements control measures for all toxic pollutants as part of its ongoing surface water program. Section 304(l) emphasized implementing point source controls to protect particularly impaired

surface waters for priority toxic pollutants. EPA will continue identifying impaired waters and controlling the discharge of toxic and other pollutants through existing reporting, standards setting, and permitting programs.

In developing lists of impaired waters under Section 304(l), States used a variety of available data sources (including State Section 305(b) reports). At a minimum, dilution analyses were conducted based on existing or readily available data. EPA asked States to assemble data quickly to report preliminary lists of waters, point sources, and amounts of discharged pollutants by April 1, 1988, in their Section 305(b) reports. These lists were then to be refined and expanded by the statutory deadline of February 4, 1989.

Section 304(l) encourages the States and EPA to address problems identified through review of existing and readily available data. The States and EPA Regions will continue to collect new water quality data to fill existing data gaps and ensure that changes in water quality are identified.

Status of 304(l) Implementation (as of August 1993)

As of August 1993, 529 waterbodies had been identified as being impaired entirely or substantially by point source discharges of Section 307(a) toxic pollutants. In addition, 687 point sources were listed as being responsible for impairing the quality of those waters. There are also 18,770 waters on the "long" list that includes all waters impaired by any pollutant from either point sources or nonpoint sources. The long list will be used for long-term planning and setting of priorities for monitoring, total maximum daily load development, nonpoint source controls, and permit revisions.

In a September 1990 decision in NRDC v. EPA, the U.S. Court of Appeals, Ninth Circuit, remanded portions of EPA's regulations interpreting Section 304(l) of the Clean Water Act. The Court said that EPA erred when it required States to identify only those point sources discharging to waters listed by States as impaired entirely or substantially due to the point source discharge of toxic pollutants; there are 529 such waters. Instead, the Court said that EPA must require States to identify point sources discharging toxic pollutants to any water identified under Section 304(l) as impaired for any reason; there are 18,770 such waters. The States are currently listing the additional point sources and EPA expects the new listings to be finalized by November 1993.

THE STATES identified 529 waterbodies impaired primarily by point source discharges of toxic pollutants.

In its 1990 decision in NRDC v. EPA, the U.S. Court of Appeals, Ninth Circuit, recognized it might be significantly changing the list of point sources under Section 304(l). So the Court required EPA to reconsider whether all point sources under Section 304(l) should be required to have individual control strategies (EPA's regulations at issue had required control strategies for all point sources listed under Section 304(l)). EPA is currently considering this question and has invited public comment (see 57 FR 33051, July 24, 1992).

EPA Regions and the States continue to work on implementing 304(l) requirements. Approximately 80% of the ICSs required are in place as EPA-approved draft or final NPDES permits.

Toxicity Testing

On March 9, 1984, EPA issued a policy designed to reduce or eliminate toxics discharge and help achieve the objectives of the Act. The "Policy for the Development of Water Quality-Based Permit Limitations for Toxic Pollutants" (49 FR 9016) described EPA's integrated toxics control program. The integrated program consisted of the application of both chemical-specific and biological methods to address the discharge of toxic pollutants. To support this policy, EPA issued the *Technical Support Document for Water Quality-Based Toxics Control (TSD)* guidance. EPA continued the development of the toxics control program by revising the TSD in 1991 and by including some aspects of the policy in NPDES regulations at 40 CFR 122.44(d)(1) in June 1989.

49 STATES AND THE DISTRICT OF COLUMBIA include whole effluent toxicity limits or monitoring requirements in their toxics control programs.

Toxicity reduction evaluations (TREs) identify and implement whatever actions are needed to reduce effluent toxicity to the levels specified in the permit. TREs combine toxicity testing, chemical analyses, source investigations, and treatability studies to determine either the actual causative agents of effluent toxicity or the control methods that will reduce effluent toxicity. EPA is currently documenting successful TREs conducted by permittees, States, and EPA researchers. Methods and procedures for conducting TREs are described in several EPA guidance documents and referenced in the TSD.

In October 1992, EPA conducted a survey of the 50 States and the District of Columbia to determine the extent of implementation of whole effluent toxicity (WET) controls for industrial and municipal point sources. The District of Columbia and 49 States are using the whole effluent approach in permitting as part of their water-quality-based toxics control program. Thirty-five States and the District required numeric WET limits in NPDES permits for industrial and municipal dischargers, while 14 States required monitoring. Forty States and the District required both acute and chronic testing.

The National Pretreatment Program

The primary goal of the National Pretreatment Program is to protect POTWs and the environment from the adverse impact that may occur when toxic, hazardous, and concentrated conventional wastes are discharged into sewer systems from industrial sources. To achieve this goal, the EPA has promulgated national pretreatment standards for pollutants that: (1) interfere with the operation of a POTW, including interference with its use or disposal of municipal sludge; or (2) pass through the POTW and contaminate the receiving stream or are otherwise incompatible with the operation of the treatment works. In addition, the program is intended to improve opportunities to recycle and reclaim

municipal and industrial wastewaters and sludges. The prevention of interference, the prevention of pass-through, and the improvement of opportunities to recycle wastewater and sludge are the three regulatory objectives of the National Pretreatment Program. These objectives are accomplished through a pollution control strategy with two elements:

■ **National Categorical Standards:** National technology-based standards developed by EPA Headquarters reflecting best available technology (BAT) in establishing effluent limits for the 126 "priority pollutants" as well as for conventional and nonconventional pollutants for specific industrial categories.

■ **Prohibited Discharge Standards:**

General Prohibitions: National regulatory prohibitions established by EPA against pollutant discharges from any nondomestic user that cause pass-through or interference at the POTW.

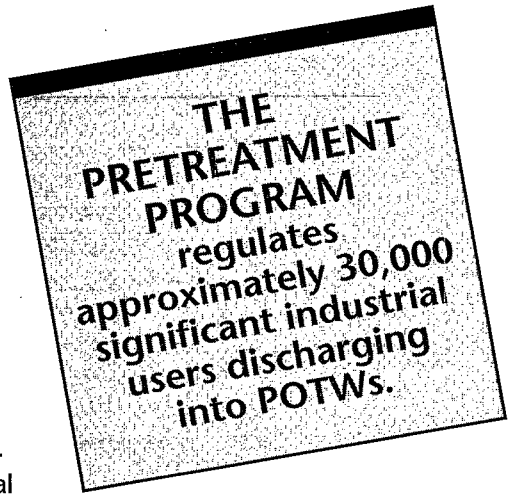
Specific Prohibitions: National regulatory prohibitions established by EPA against pollutant discharges from any nondomestic user that cause: (1) fire or explosive hazard, (2) corrosive structural damage, (3) interference due to obstruction, (4) interference due to flow rate or concentration, (5) interference due to heat, (6) interference from petroleum-based oil, and (7) acute worker health and safety problems from toxic gases.

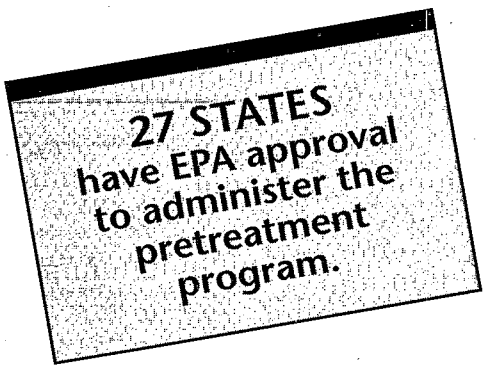
Local Limits: Enforceable local effluent limitations developed by POTWs on a case-by-case basis to reflect site-specific concerns and implement the Federal general and specific prohibited discharge standards as well as State and local regulations.

To ensure the success of the pretreatment program, EPA also issues guidance documents and has conducted scores of training seminars to assist POTWs in developing, implementing, and enforcing effective pretreatment programs.

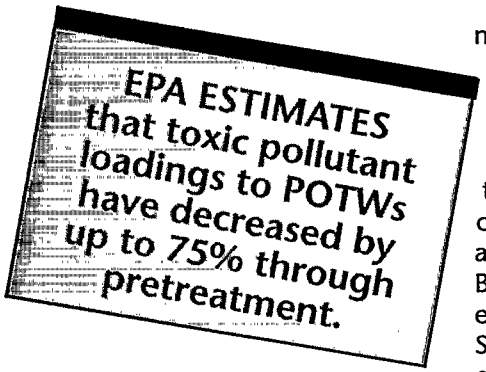
The primary focus for pretreatment implementation is at the local level since the POTW is in the best position to regulate its industrial users. States may become involved in pretreatment implementation through a formal approval process in which the Federal Government transfers its oversight responsibilities to the State. The Federal Government, through the EPA, is involved in pretreatment through standard setting, policy development, and oversight of program implementation by approved States and POTWs in States without approved pretreatment programs. At present, 27 States have received approval from EPA to administer the pretreatment program, including five States that have chosen to directly regulate the industrial community in their States in lieu of local program approval and implementation. In addition, 1,442 local programs have been approved by either EPA or approved States, and another 100 programs are under development. The pretreatment program currently regulates approximately 30,000 significant industrial users (SIUs).

On July 24, 1990, the EPA promulgated the Domestic Sewage





Study (DSS) final rule, which implements the recommendations made in the DSS. Specifically, the rule is designed to improve the control of hazardous wastes discharged to POTWs as well as strengthen the enforcement of pretreatment program requirements. In addition, the rule requires that POTWs conduct toxicity testing of their effluents. A continuing task will be to integrate the implementation of these requirements into the normal operations of the POTWs' pretreatment programs.



The environmental accomplishments of the National Pretreatment Program have been significant. Nationwide, EPA estimates that toxic pollutant loadings to POTWs have decreased by up to 75% through pretreatment. In many cases, the effects on surface water and sludge have been dramatic. Between 1975 and 1985, for example, 15 POTWs discharging to San Francisco Bay decreased their overall metals loadings by 80%, despite a 15% increase in POTW flows. In Wisconsin, 14 of 24 POTWs reported marked decreases in average total metals concentrations in their sludge after approval of their local pretreatment programs.

The compliance status of industrial users and POTWs is an indicator of the programmatic success of pretreatment implementation. Based on data reported by POTWs or States, approximately 54% of significant industrial users of sewage treatment plants are in significant noncompliance with discharge standards and/or reporting and self-monitoring requirements. This compares with a rate of 7% significant noncompliance for the major industries in the NPDES program, which discharge directly to waterbodies. According to data in EPA's national database, 39% of POTWs are failing to implement at least one significant component of their approved pretreatment programs.

EPA has focused its oversight and enforcement resources on ensuring that local municipalities properly implement their approved programs. Toward that end, on October 4, 1989, EPA announced the National Pretreatment Enforcement Initiative against cities for failure to adequately implement their approved pretreatment programs. In this action, EPA joined with several States in bringing civil judicial suits or administrative penalties against 61 cities. This effort was designed to alert cities as to their requirements under the pretreatment program and to ensure adequate implementation of the program. A followup announcement was made on May 1, 1991, containing 755 additional actions against both POTWs and significant industrial users.

In July 1991, EPA issued a report to Congress on the effectiveness of the pretreatment program as required under Section 519 of the CWA. This report analyzed the major strengths and weaknesses of the program and has provided direction for improving the program.

Managing Sewage Sludge

The need for effective sewage sludge management is continuous and growing. In the United States, the quantity of municipal sewage sludge produced annually has

almost doubled since 1972. Municipalities currently generate approximately 5.3 million dry metric tons of wastewater sludge per year, or approximately 47 pounds per person per year (dry weight basis). Improper sewage sludge management could lead to significant environmental degradation of water, land, and air, as well as adverse human health conditions.

Prior to the 1987 amendments to the Clean Water Act, the authorities and regulations related to the use and disposal of sewage sludge were fragmented and did not provide States and municipalities with adequate guidelines on which to base sludge management decisions. There was no single legislative approach or framework for integrating the various Federal laws to ensure that sludge would be used or disposed of in a consistent or environmentally acceptable manner. Although the Clean Water Act, the Clean Air Act, the Resource Conservation and Recovery Act, the Marine Protection, Research and Sanctuaries Act, and the Toxic Substances Control Act all regulate some aspect of sludge management, coverage is uneven, and the requirements are based on different methodologies and approaches.

Section 406 of the Water Quality Act of 1987, which amends Section 405 of the Clean Water Act, for the first time sets forth a comprehensive program for reducing the environmental risks and maximizing the beneficial uses of sludge. The program is based on the development of technical requirements for sludge use and disposal and the implementation of such requirements directly through the rule and through permits.

In May 1989, EPA promulgated regulations for including sewage sludge conditions in NPDES permits and for issuing sludge-only permits. These rules also outline the requirements for States to seek EPA approval to implement the new statutory requirements.

EPA will be the permitting authority for sewage sludge since there are currently no approved State programs. Initially, EPA will rely strongly on the self-implementing nature of the technical regulations. EPA will focus its initial permitting efforts on

- Sewage sludge incinerators (which require site-specific pollutant limits)
- Facilities posing a threat to human health and the environment
- Facilities needing a permit to promote beneficial use
- Facilities with NPDES permits up for renewal.

In implementing the new sewage sludge requirements, EPA will also focus on approving State programs and educating the general public and the regulated community.

In addition, regulations that address sewage sludge disposal in municipal solid waste landfills were proposed in August 1988 and are scheduled to be promulgated on October 9, 1993.

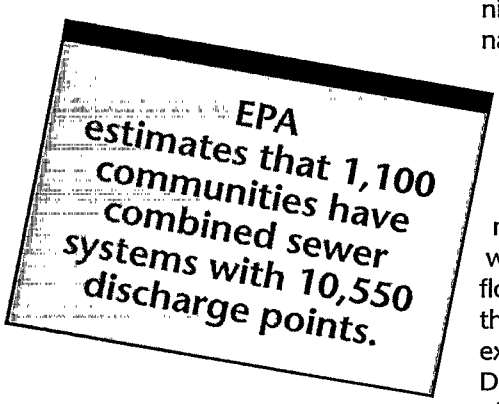
Pursuant to Section 405, EPA has developed regulations for each of the major use and disposal options for sewage sludge. These options include land application, incineration, landfilling, and surface

disposal. The standards for each end use and disposal practice consist of general requirements, numerical limits on the pollutant concentrations in sewage sludge, management practices, and, in some cases, operational requirements. The final rule also includes monitoring, recordkeeping, and reporting requirements.

Standards apply to publicly and privately owned treatment works that generate or treat domestic sewage sludge, as well as to any person who uses or disposes of sewage sludge from such treatment works. The rule requires compliance with these standards as expeditiously as possible but not later than 12 months after the date the rule is published, or within 24 months of publication if construction of new pollution control facilities is required to comply with the regulations.

New Initiatives in Point Source Control

Combined Sewer Overflow Control



Currently about 1,100 communities served by 1,303 CSO facilities nationwide use combined sewer systems, which are designed to carry sanitary and industrial wastewater and storm water. These facilities are mainly located in older cities in the Northeast, the midcentral States, and along the west coast. Combined sewer overflows occur when the capacity of the combined sewer system is exceeded during a storm event. During these storm events, part of the combined flow in the collection system is discharged untreated into receiving waters. The overflows may contain high levels of suspended solids, floatables, heavy metals, nutrients, bacteria, and other pollutants. Pollution from CSOs can pose health risks, degrade the ecology of receiving waters, and impair the beneficial use of water resources.

EPA published the National Combined Sewer Overflow Control Strategy in the *Federal Register* on September 8, 1989, at 54 FR 37370. Although implementation of the 1989 strategy has resulted in some progress toward controlling CSOs, significant public health and water quality risks remain.

In August 1991, EPA determined that implementation of the 1989 strategy was not proceeding rapidly enough. EPA's Office of Water (OW) initiated an Expedited Plan to accelerate the implementation of the 1989 National CSO Control Strategy. At the recommendation of OW's Management Advisory Group, a negotiated policy dialogue with key stakeholders was also initiated. The negotiations occurred during the summer of 1992.

Based on the negotiated policy dialogue and subsequent negotiations between municipal and environmental groups and States, a *CSO Framework Document – Recommended Guidance to NPDES Permit Writers,* dated November 2, 1992, was submitted to EPA's Office of Water for consideration as part of the development of a draft CSO policy. Although the framework was not the result of consensus among the negotiating parties, significant agreement was reached, allowing OW to use the framework as the basis to develop a draft CSO policy.

On December 22, 1992, the Assistant Administrator for Water and the Assistant Administrator for Enforcement issued a draft CSO Control Policy (dated December 18, 1992) for comment. A notice of availability was placed in the *Federal Register* on January 19, 1993, establishing a public comment period until March 22, 1993, on the draft policy (58 FR 4994).

The main purposes of the Policy are to elaborate on the 1989 National CSO Control Strategy and to expedite compliance with the requirements of the Clean Water Act.

The Policy is being developed to provide guidance to permittees with CSOs, NPDES authorities, and State water quality standards authorities on coordinating the planning, selection, sizing, and construction of CSO controls that meet the requirements of the CWA and to allow for public involvement during the decisionmaking process.

Contained in the Policy are provisions for developing appropriate, site-specific NPDES permit requirements for all combined sewer systems that overflow as a result of wet weather events and enforcement initiatives to require the immediate elimination of overflows that occur during dry weather and to ensure that the remaining CWA requirements are complied with as soon as practicable. The 1992 Needs Survey modeled the cost of compliance with the draft 1992 CSO Policy. The Needs Survey estimated that the national cost of CSO corrections will be $41.2 billion. The modeled estimate compares to the State-documented costs of $22.4 billion for 375 of the approximately 1,300 CSOs needing correction.

EPA will finalize this policy in the fall of 1993. As it finalizes the draft policy, EPA is preparing a number of guidance documents to assist in the implementation of the final policy when it is issued. Specific programmatic areas that this guidance will address are implementing minimum CSO control measures by all communities with CSOs; monitoring and modeling of combined sewer systems, CSO discharges, and receiving water impacts; preparation of long-term CSO control plans by CSO communities; and drafting NPDES permit requirements for CSO discharges by EPA and State NPDES permit writers.

NPDES Storm Water Controls

Since 1972, State and EPA efforts under the NPDES program have traditionally focused on controlling pollutant discharges from POTWs and industrial process wastewaters. As these sources of pollution came increasingly under control, the need for controlling pollutants in storm water point source discharges became more critical to efforts to achieve the goals of the CWA. As reflected in this report, storm water discharges from a variety of sources, including storm sewers discharging urban runoff, construction site runoff, runoff from resource extraction activities, and runoff from land disposal sites, are major sources of use impairment.

IN 1990, EPA initiated permitting activities for storm water discharges from manufacturing facilities, mining sites, oil and gas facilities, and land disposal sites receiving hazardous or industrial wastes.

Section 402(p) of the CWA amendments of 1987 established a timetable and framework for EPA to address storm water discharges

under the NPDES program. Section 402(p) required EPA to develop a two-phase program to control point source discharges of storm water. On November 16, 1990, EPA promulgated permit application requirements for the first phase for discharges from municipal separate storm sewer systems serving populations of 100,000 or more and for storm water discharges associated with 11 industrial categories:

- Manufacturing facilities
- Construction operations or activities disturbing 5 or more acres
- Hazardous waste treatment, storage, and disposal facilities
- Landfills
- POTWs with approved pretreatment programs and/or discharging over 1 million gallons per day
- Recycling facilities
- Power plants
- Mining operations
- Some oil and gas operations
- Airport facilities
- Certain transportation facilities (such as vehicle maintenance areas).

Permits are required to be issued for these sources, for the most part, by October 1, 1993.

For the second phase, EPA is required to develop two storm water reports to Congress. The first will identify storm water discharges and determine, to the maximum extent practicable, the nature and extent of pollutants in such discharges. The second study will establish procedures and methods to control storm water discharges to the extent necessary to mitigate impacts on water quality. Based on these two studies and recommendations from experts, as well as public input, Congress will direct EPA to control additional sources under Phase II.

Control of Bioconcentratable Contaminants

Bioconcentratable contaminants can damage both human health and aquatic life. In response, EPA has developed draft guidance to identify and, where necessary, control bioconcentratable organic compounds that may be present in effluents, nonpoint source runoff, receiving waters, sediments, dredged material, and the tissues of aquatic organisms.

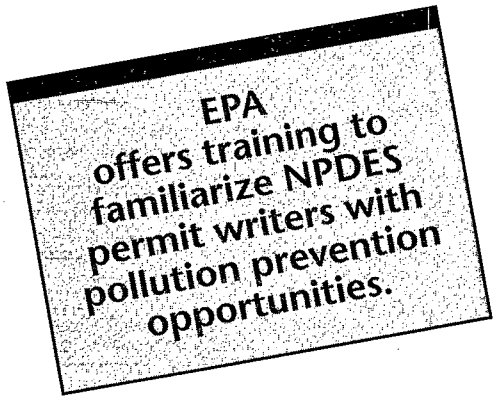
The approach outlined in EPA's draft guidance is designed to assist

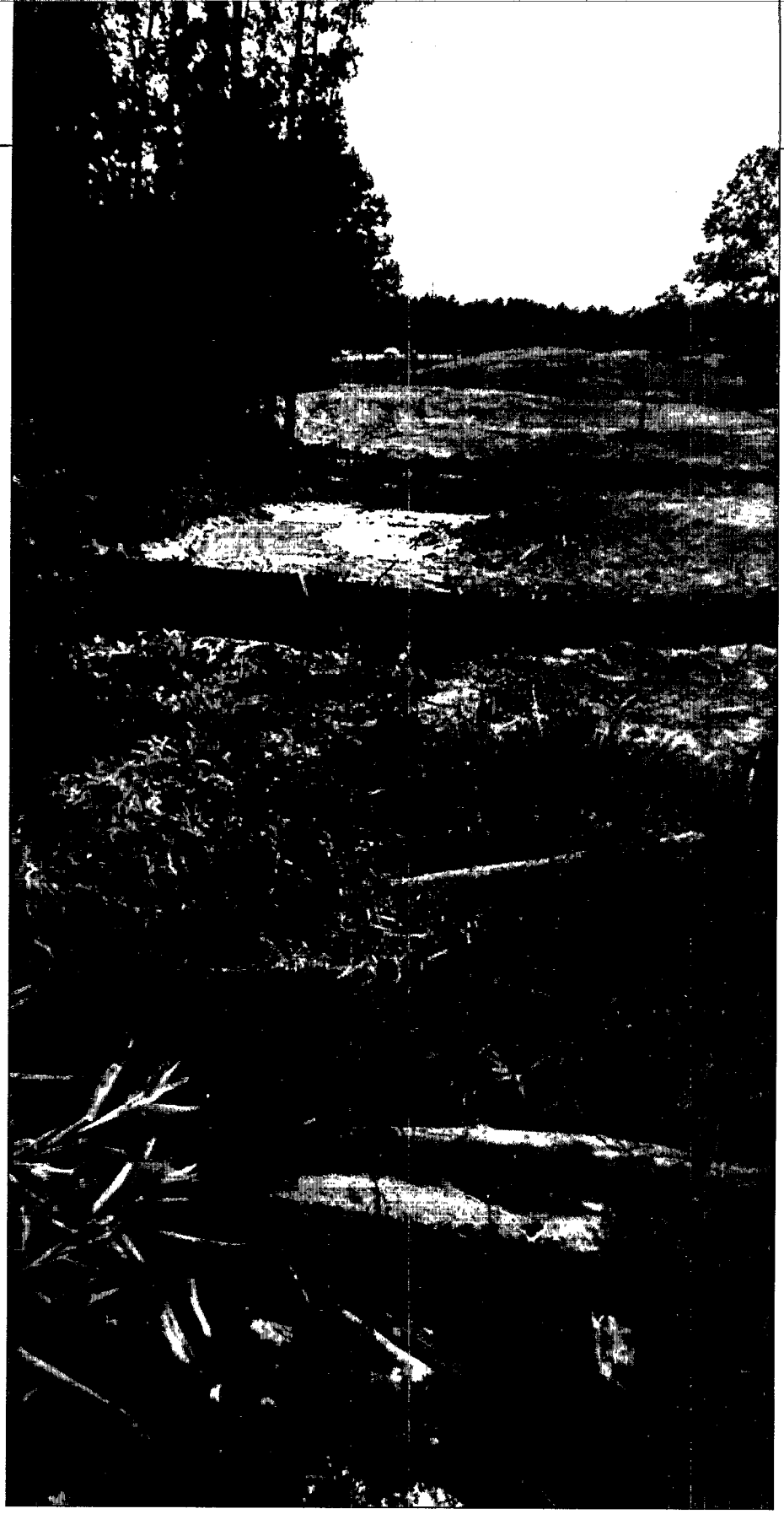
regulatory authorities in identifying and determining the concentration of specific organic compounds in complex mixtures and to make more informed decisions concerning control of these substances. EPA's approach provides: a comprehensive screen for organic chemicals that are likely to bioconcentrate, procedures for assessing and controlling complex mixtures, a standardized assessment methodology, and triggers for regulatory action and control development. EPA's draft guidance focuses principally on the development and implementation of point source limitations on bioconcentratable organic compounds.

Pollution Prevention

EPA has established an Office of Pollution Prevention that works with other program offices to improve pollution prevention activities within the Agency. For example, an Agency pollution prevention policy has been developed, and a strategy to address pollution prevention in manufacturing and chemical use has been drafted. Future strategies will focus on the municipal water and wastewater, agricultural, energy, and transportation sectors. A subcommittee comprising representatives from EPA Headquarters and Regions has been formed to develop an Agency-wide training strategy to ensure that pollution prevention concepts are integrated into all Agency activities.

In terms of the point source control program, the Agency's draft pollution prevention strategy recognizes the importance of permitting and enforcement activities and will continue support for a strong program in these areas. Training is being provided to familiarize NPDES permit writers with pollution prevention opportunities, how their permit decisions can affect other media, and how to effectively communicate the concept of pollution prevention to industrial managers.





Nonpoint Source Control Program

Background

Nonpoint source (NPS) pollution generally results from land runoff, atmospheric deposition, drainage, or seepage of contaminants. Major sources of nonpoint pollution include agricultural runoff, runoff from urban areas, and runoff from silvicultural operations. Siltation and nutrients are the pollutants responsible for most of the nonpoint source impacts to the Nation's surface waters. These diffuse sources are often harder to identify, isolate, and control than traditional point sources. As a result, from 1972 to 1987, EPA and the States placed primary focus on addressing the obvious problems due to municipal and industrial discharges: issuing permits for point source discharges, then inspecting, monitoring, and enforcing those permits to ensure that point sources met the Clean Water Act requirements.

Sections 208 and 303(e) of the Clean Water Act of 1972 established the initial framework for addressing nonpoint sources of pollution. States and local planning agencies analyzed the extent of NPS pollution and developed water quality management programs to control it with funds provided by EPA under Section 208. Best management practices were evaluated, assessment models and methods were developed, and other types of technical assistance were made available to State and local water quality managers.

The National Section 319 Program

In 1987, Congress enacted Section 319 of the Clean Water Act, which established a national program to control nonpoint sources of water pollution. Section 319 created a three-stage national program to be implemented by the States with Federal approval and assistance. States were to address nonpoint source pollution by (1) developing nonpoint source assessment reports, (2) adopting nonpoint source management programs, and (3) implementing the management programs over a multiyear timeframe.

SILTATION AND NUTRIENTS are the pollutants responsible for most of the nonpoint source impacts to the Nation's surface waters.

All States and Territories now have EPA-approved nonpoint source assessments. EPA has also fully approved 51 State nonpoint source management programs and has approved the high-priority portions of all remaining State management programs.

Section 319 also authorizes EPA to issue annual grants to States to assist them in implementing their

EPA-approved programs. From FY90 through FY93, Congress appropriated more than $191 million for Section 319 assistance. EPA issued final guidance on the award and management of Section 319 funds in February 1991 following extensive public comment. The guidance encourages States to focus Section 319 funds on high-priority activities including:

- Addressing nationally significant, high-risk nonpoint source problems and focusing implementation activities in priority watershed or ground water areas
- Comprehensively integrating existing programs to control nonpoint source pollution
- Providing for monitoring and evaluation of program effectiveness including using water quality monitoring protocols
- Emphasizing pollution prevention mechanisms
- Protecting particularly sensitive and ecologically significant waters (wetlands, estuaries, wild and scenic rivers)
- Promoting comprehensive watershed management.

THE NPS GRANTS GUIDANCE establishes a monitoring program to assess results of NPS controls implemented in representative watersheds across the country.

Roughly half of each State's annual award supports Statewide program activity (staffing, public education and outreach, technical assistance) and half supports specific projects to prevent or reduce nonpoint source pollution at the watershed level.

Funding under Section 319 is also available to American Indian Tribes with approved nonpoint source assessments and management programs. To date, EPA has awarded grants to the Poarch Band Tribe (Alabama) and the Colville Tribe (Washington). In addition, in FY91, one-time funds were made available by EPA for tribal development of nonpoint source assessments and management programs.

In the summer of 1993, EPA will update the 319 grant guidance, incorporating lessons learned during 3 years of awarding and managing 319 grants and consulting with the States.

Section 319 National Monitoring Program

To improve technical understanding of nonpoint pollution and the effectiveness of various nonpoint source control technologies, the Section 319 grants guidance establishes requirements for a standardized water quality monitoring program for representative watersheds across the country. The guidance requires each of EPA's 10 Regional offices to award a portion of each year's funds to support more intensive water quality monitoring of selected watershed projects. To date, EPA headquarters has approved three projects: Long Creek, North Carolina, Sny Magill, Iowa, and Elm Creek, Nebraska. A total of approximately $1.4 million had been obligated for these projects as of July 1992. This national set-aside totalled approximately $2.1 million in FY91 and $2.3 million in FY92.

The Sny Magill watershed involves an interagency effort to monitor and assess improvements in water quality resulting from the implementation of nonpoint source controls. The entire watershed is agricultural with no industrial or urban areas. Land use consists predominantly of cropland (corn, oats, and alfalfa), pasture, and forest. Sediment is the major pollutant but nutrients, pesticides, and animal waste are also of concern. The U.S. Department of Agriculture (USDA) will provide technical assistance, cost sharing, and educational programs to assist agricultural producers in implementing nonpoint source control measures such as sediment control, stream corridor management improvements, and animal waste management systems. Land treatment application will be coordinated with water quality monitoring.

The Bloody Run watershed (a neighboring watershed of approximately the same size) serves as the paired comparison watershed. Primary monitoring sites were established on both watersheds to measure discharge and suspended sediment. Other sites on both creeks will be sampled for chemical and physical water quality variables on a weekly to monthly basis. A habitat assessment will be conducted along stretches of both stream corridors annually, fishing surveys will be conducted annually, and biomonitoring of macroinvertebrates will be performed bimonthly.

The Long Creek project is located in south-central North Carolina. The watershed contains mixed agricultural and urban/industrial land use. Long Creek serves as the primary water supply for Bessemer City (population 5,000). Sediment from eroding cropland is the major problem in the upper third of the watershed (above the water supply intake). Long Creek is impaired mainly by bacteria and nutrients from urban areas and animal holding facilities below the intake. Proposed nonpoint controls involve implementing the land use restrictions of the State watershed protection law for areas above the water supply intake and a comprehensive nutrient management system for a farm below the intake. Water quality monitoring will include a station before and after the land treatment design near the water intake, an upstream/downstream design on the Creek above and below the dairy farm, and a paired watershed design at a cropland runoff site on the dairy. Continuous and grab samples will be collected at various sites to provide the data needed to assess the effectiveness of the nonpoint controls.

THE EPA has approved 3 NPS watershed monitoring projects in Iowa, Nebraska, and North Carolina.

Reports on Section 319 Activities

The 1990 Report to Congress on Section 319 of the Clean Water Act, "Managing Nonpoint Source Pollution," provides the most current (as of October 1, 1990) and comprehensive information on nonpoint source programs at the national, State, and local levels. Included are findings of State nonpoint source assessments; related activities of EPA, other Federal agencies, and other entities; State

achievements to date in controlling NPS pollution; and summaries of the activities and views of other private and public organizations active in the NPS arena. EPA is currently preparing an update to the 1990 report that will include activities carried out with the FY91 and FY92 grant awards. This update will be available in the fall of 1993.

National NPS Strategic Plan

In January 1989, EPA developed the *Nonpoint Source Agenda for the Future*. This Agenda was designed to assist EPA in defining the goals of the national NPS program and the means to achieve those goals.

The stated goal of the Agenda was to protect and restore the quality of U.S. waters through strong national leadership and by helping State and local governments overcome barriers to the successful implementation of NPS measures. Among identified barriers were (1) inadequate public awareness of the nonpoint source problem, (2) inadequate knowledge or inadequate transfer of knowledge about successful solutions to nonpoint source problems, and (3) inadequate incentives to correct nonpoint source pollution.

EPA organized the goals of the Agenda under five themes:

Five Themes for NPS Action

- *Public Awareness*
- *Practical Solutions*
- *Financial Incentives*
- *Regulatory Capabilities*
- *Tools*

■ Raise public awareness of nonpoint source pollution

■ Provide States and local governments with information on practical nonpoint source solutions

■ Provide financial incentives that encourage the public to install pollution controls and change land management practices.

■ Help States and localities improve their regulatory capabilities (e.g., by developing water quality criteria and monitoring protocols specifically designed to evaluate control activities)

■ Develop tools needed by States and localities to establish sound water-quality-based nonpoint source control programs.

EPA has made progress in all of the theme areas. For example, EPA (with assistance from the States and other Federal agencies) developed the first comprehensive nationally recognized technical guidance on nonpoint source management techniques during 1991 and 1992. EPA also initiated the first phase of its public awareness program: a nonpoint source brochure and poster were distributed in early 1990, and EPA's *Nonpoint Source Newsnotes* now serves as the primary vehicle for sharing State and local success stories on nonpoint control. EPA also began operating an electronic bulletin board to support transfer of nonpoint pollution information.

EPA believes that much of the Agenda continues to be sound and relevant. At the same time, 4 years of Federal funding for State nonpoint source implementation and the experiences that has provided, initiation of a new coastal nonpoint source program, and significant increases in State's commitment to address nonpoint source pollution create new opportunities.

Therefore, EPA, with the involvement of all parties who have a role to play in preventing and reducing nonpoint source pollution, will conduct, during 1993 and 1994, a broad and inclusive effort to develop an updated strategic plan for the national nonpoint source program.

Nonpoint Source Management Programs and Implementation

The States, local governments, community groups, and EPA Regions have initiated many innovative projects across the Nation to manage nonpoint source pollution problems. The projects described in this section exemplify the diversity of approaches that have been applied to NPS pollution prevention and control. In some cases, prevention or control is only beginning. In other situations, prevention and/or control measures have been in place long enough to show significant results.

Lake Whitney Reservoir, Connecticut

The Lake Whitney Reservoir in Hamden, Connecticut, has been a public water supply for the city of New Haven since 1862. The reservoir's watershed area (36.4 square miles) is primarily impervious due to residential, commercial, and industrial development. More than 60 storm water outlets discharge near or directly into Lake Whitney or the nearby Mill River without treatment. Main water quality problems are: sedimentation, accelerated eutrophication, and anoxia, which is largely the result of urban storm water runoff.

In an effort to restore Lake Whitney, a plan was developed to capture and treat storm water prior to discharge into Lake Whitney or its tributaries as well as to work with local townships to adopt storm water regulations. The 2-year project will demonstrate how the construction of a storm water treatment system can reduce the input of contaminants associated with urban runoff. Postconstruction monitoring of inflow and outflow from the storm water treatment basin will characterize the quality of urban runoff and the average pollutant removal efficiency. The results of the project will be applied to other subwatersheds that contribute to Lake Whitney.

THE STATES, LOCAL GOVERNMENTS, COMMUNITY GROUPS, AND EPA REGIONS have initiated numerous innovative projects to prevent and control NPS pollution.

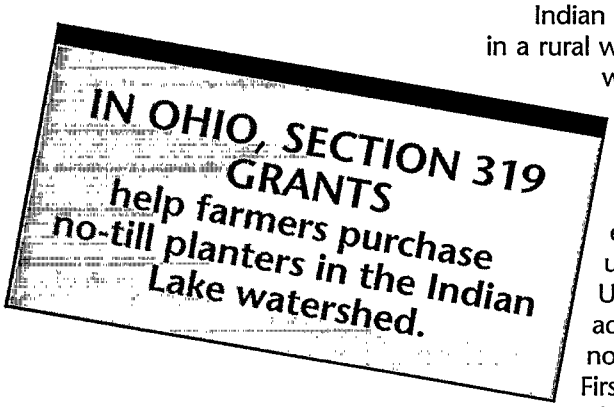
Middle Fork River, West Virginia

In 1990, the American Fisheries Society (AFS) initiated a meeting with EPA and the Department of Interior's (DOI) Office of Surface Mining to discuss deteriorating water quality conditions and dwindling fisheries resources in eastern streams caused by acid mine drainage from abandoned coal mines. In response, the participants signed a Memorandum of Understanding agreeing to commit technical and financial support to a project in the Middle Fork River watershed.

The Middle Fork watershed encompasses 151 square miles in

north central West Virginia. Acid mine drainage has eradicated fish from the lower 24 miles of the river. The effort to date has focused on inventorying all coal mine sites in the watershed, developing baseline water quality data, and designing and installing abatement techniques to remedy or reduce acid mine impacts. Along with contributions from the West Virginia Division of Environmental Protection and Division of Natural Resources, the West Virginia State Soil Conservation Committee, USDA's Soil Conservation Service (SCS), and DOI's Office of Surface Mining, EPA has provided Section 319 funds to establish a Geographic Information System to analyze the resource data provided by other agencies, to install an anoxic limestone trench and engineered wetlands to assimilate acid mine drainage and prevent entrance of acid waters into the river, and to evaluate and implement abatement technologies.

Indian Lake, Ohio



Indian Lake is a eutrophic lake in a rural watershed. The primary water quality problems are sedimentation and, to a lesser degree, nutrient enrichment. The project provides an excellent example of the use of a mix of EPA and USDA programs to address agricultural nonpoint source problems. First, EPA allocated Clean Lakes Phase I funds for evaluation of the lake's water quality problems.

Currently, Phase II Clean Lakes grants are funding implementation efforts such as construction of shoreline erosion controls and spot dredging so that the lake can be used for recreational purposes until sediment source control is accomplished in the watershed. Section 319 money provides assistance to farmers purchasing no-till planters and supports technical assistance and education costs throughout the watershed. USDA's SCS provides additional education and technical assistance to farmers through the Hydrologic Unit Program. Extra USDA cost-share funds are also being targeted to the watershed through its designation as an Agricultural Stabilization and Conservation Service's ACP Special Water Quality Project Area.

West Lake Reservoir, Iowa

West Lake is a reservoir owned and operated by the City of Osceola, which serves as a public drinking supply for the cities of Osceola, Woodburn, and several hundred rural users. In a watershed dominated by agricultural land use, runoff from cropland impacts the lake's water quality. Sediment, pesticides, and nutrients are major pollutants. Pesticides, such as atrazine, are of particular concern. Samples of treated drinking water often exceed EPA's maximum contaminant level of 3 parts per billion of atrazine (determined on an annual basis by averaging results of quarterly tests of treated drinking water).

To protect the reservoir, a comprehensive nonpoint pollution control project has been developed. The project emphasizes education and voluntary adoption of best management practices by farmers. Section 319 funds have been

awarded to promote better farm management including the use of conservation tillage or no-till methods and integrated crop management (nutrient and pesticide management). To address the atrazine problem, more than 90% of the watershed's farmers voluntarily agreed to reduce or eliminate atrazine use during the 1992 cropping season. Initial monitoring results after the voluntary reductions found only one sample with atrazine levels greater than 3 ppb. Monitoring over a longer period will be necessary to determine if atrazine levels will remain below the maximum contaminant level.

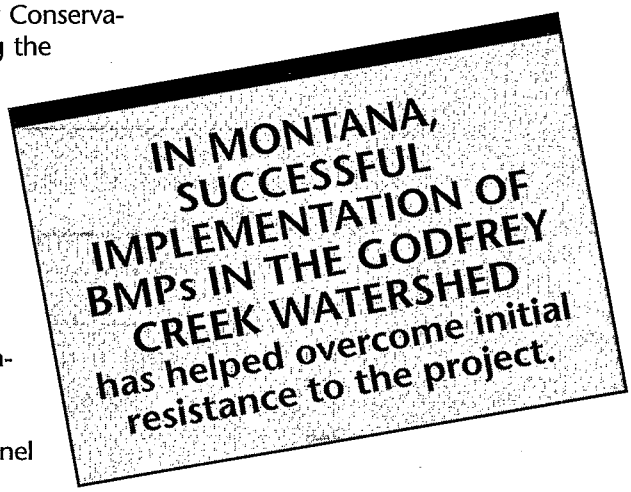
Maskenthine Lake, Nebraska

In 1989, the Nebraska Department of Environmental Quality began one of its first Clean Lakes Program projects monitoring Maskenthine Lake in northeastern Nebraska with a Phase I grant. Project implementation began with funding from the Clean Lakes Program (Phase II), Section 319, the Lower Elkhorn Natural Resources District, and the USDA. In addition, EPA's TMDL "Swat Team" is assisting the State in calculating a TMDL for the lake with funding from a TMDL mini-grant. The project will determine the assimilative capacity of the lake for targeted pollutants (atrazine, nutrients, and sediment) and loading targets for the lake inflow. The TMDL process will evaluate various watershed management scenarios that include load allocations for subwatersheds, uplands, and stream channels. The State will use the TMDL to refine and implement the watershed management plan.

Godfrey Creek, Montana

The Godfrey Creek project combines a Section 319 nonpoint source pollution management project with a USDA Hydrologic Unit Area project. It addresses severe dairy/animal waste related water quality problems (i.e., high nutrient and bacteria levels and physical channel degradation) in the creek and the surrounding 8,000-acre watershed. The project strives to reduce nutrient and bacteria levels in the creek by 80% and to restore fisheries through on-farm implementation of best management practices over a 10-year period (1991-2000).

The Gallatin County Conservation District is managing the Godfrey Creek project with assistance from the SCS, the Extension Service, and the Montana Water Quality Bureau. Best management practices (BMPs), such as renovated and expanded dairy waste handling facilities, relocation of animal confinement areas, off-stream livestock watering, channel shaping, revegetation, improved grazing systems, and improved irrigation management are being implemented. Education, peer pressure, and observation of the successes of BMP implementation by the initial cooperating landowners have helped overcome initial resistance to the project. Although BMP implementation will take several years to complete, great progress has been made in securing the cooperation of the watershed's landowners.



Morro Bay, California

The State of California established a cooperative agreement between the State Water Resources Control Board and the California Coastal Commission in response to the nonpoint source requirements of Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990. The agreement provides resources for a nonpoint source control project in the Morro Bay watershed. Morro Bay is located in San Luis Obispo County within the central California coastal area. The watershed supports a $16 million agricultural industry. Limited grazing and the presence of several abandoned mines on public lands contribute sediment and heavy metals to the Bay. Major impairments are sediment, increased temperature, and agricultural pollutants such as nutrients. Cost-share funds are being provided for implementation of selected erosion control practices. California, with support from EPA Region 9, will support a long-term monitoring effort in the watershed and the project is being considered for inclusion in the Section 319 national monitoring program.

Malheur Experiment Station Best Management Practices Research and Development Program

Oregon has used Section 319 funds to support multiple, interrelated ground water protection projects in the Malheur Basin, an irrigated area in the eastern part of the State. Heavy fertilizer and chemical applications have contaminated the shallow aquifer underlying the Malheur Plains. Nitrate concentrations exceed EPA's maximum contaminant level in many private wells. Oregon's Department of Environmental Quality has designated the Malheur Basin as a ground water management area under the State's Groundwater Management Act. This designation enables State agencies to focus resources on nonpoint source problems contributing to ground water contamination.

Oregon State University's Agriculture Experiment Station is leading the research efforts to develop modified fertilizer applications (rate and timing) and new irrigation practices that reduce nitrate contamination of the ground water. The Experiment Station shares its results with local growers through widely attended annual field days, during which they take growers on tours of various experiment sites and explain the objectives and results of each project.

Upper North Bosque Watershed, Texas

The Upper North Bosque Watershed demonstration project, west of Fort Worth, supports technical assistance, water quality monitoring, and technology transfer activities. The Texas State Soil and Water Conservation Board (TSWCB) provides an onsite coordinator to integrate animal waste management activities in the basin. The coordinator assists area dairy operators in understanding the technical requirements of the Texas Water Commission's animal waste rules. The project also supports water quality monitoring by the Texas Agriculture Extension Services (TAEX) at the edge of fields on two dairies that land-apply their waste. Both farms have established filter strips (of varying size and grass species) that are instrumented with automatic samplers to measure nitrogen, phosphorus and bacteria in the runoff water.

Monitoring for sediment, nutrients, dissolved oxygen, bacteria, and oxygen-demanding waste will be conducted to assess best management practices at selected sites. Biological monitoring of benthic organisms will be performed on the three tributaries and on the main stem of the Bosque River to evaluate the effectiveness of the project. The USDA also has begun a Hydrologic Unit Area project in the watershed that will determine the cost of shared lagoon installation and provide increased technical assistance to dairy farmers.

The demonstration project, working through the Tarleton Institute for Applied Environmental Research (TIAER) at Tarleton State University, coordinates the actions and policies of private citizens, dairy farmers, city and county governments and State agency personnel to promote changes in waste handling practices. Each member is to transfer the technology and program information back to his/her respective group or agency and work to implement the changes agreed upon. Demonstration of new technology on six sites will be part of the TIAER education/outreach program.

Bluewater Creek, New Mexico

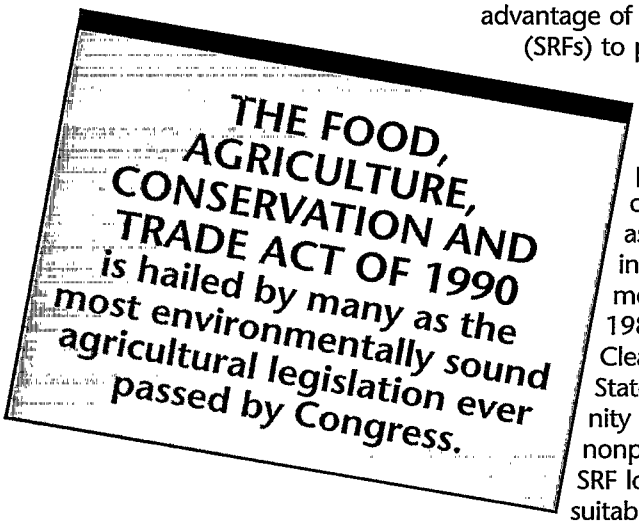
The Bluewater Creek watershed is located 60 miles west of Grants, New Mexico, in the Cibola National Forest. In this project, the USDA Forest Service and the USDA Soil Conservation Service are implementing best management practices (BMPs) on Federal lands to prevent further overgrazing in the watershed. Newer and innovative BMPs include riparian fencing to exclude cattle, people, and elk; rerouting of roads and road closures; and rechannelizing a stream away from sloughing stream banks too steep and unstable to repair. The Forest Service also added improved livestock management requirements to new grazing leases, such as rest/rotation grazing systems.

These agencies and New Mexico's Environment Department are also monitoring BMP effectiveness with instream grab samples above and below each BMP site during all seasons. The agencies monitor physical, chemical, and biological parameters, as well as physical habitat. The data gathered by New Mexico's Environment Department on this project suggest

that some BMPs are truly more effective than others and other BMPs would be effective if their design and installation location were modified. The Forest Service has used this information to modify their BMP handbook and design specifications.

Funding for Nonpoint Source Control

In addition to Section 319 funds, several States have taken advantage of State revolving funds (SRFs) to provide loans to finance nonpoint source and other water pollution control programs. SRFs were originally established to assist States in upgrading their sewage treatment systems, but the 1987 amendments to the Clean Water Act provide States with the opportunity to use these funds for nonpoint source control. SRF loans are particularly suitable for funding structural BMP construction, such as storm water detention ponds and manure storage structures.



At present, four States – Washington, California, Delaware, and Wyoming – are using SRF loans to fund a wide variety of nonpoint programs. Approved projects will retrofit failed septic tanks, construct storm water management structures, remediate leaking underground storage tanks, and build poultry composting facilities. As States meet sewage treatment system upgrade requirements, SRF funds will become increasingly available to address nonpoint source problems.

New Initiatives in NPS Control

The 1990 Farm Bill

The Food, Agriculture, Conservation and Trade Act of 1990 (1990 Farm Bill), enacted by Congress on October 25, 1990, contains strong water quality provisions and offers new opportunities to link USDA and EPA water quality programs in the States. The bill, hailed by many as the most environmentally sound agricultural legislation ever passed by Congress, builds on existing USDA and EPA efforts, broadens the applicability of the Conservation Reserve Program (CRP) to environmentally sensitive areas and establishes a new Wetland Reserve Program (WRP) and Water Quality Incentives Program (WQIP).

The CRP, created by the 1985 Farm Bill, has paid producers to remove highly erodible cropland from production for a 10-year period to protect and improve soil and water resources. The 1990 Farm Bill expands the land eligibility requirements to include not only highly erodible land, but also other cropland areas that are potential threats to surface water quality and ground water quality in wellhead protection areas. The bid evaluation process also provides higher priority for producers who provide filter-strips, sod waterways, shelterbelts, and contour grass strips on their property, which increase water quality benefits under the CRP.

The Act also established a Wetland Reserve Program with an enrollment goal of up to 1 million acres. Land accepted into the WRP would be removed from production through easements.

The WQIP allows the USDA to provide technical assistance and up to $3,500 in incentive payments to individual producers to develop and implement farm-level water quality plans. An additional $1,500 in cost-share payments is available to individual farmers to implement some practices. Lands identified by States under the Wellhead Protection Provisions (Section 1428) of the Safe Drinking Water Act and Section 319 of the Clean Water Act are explicitly targeted under the WQIP. Other areas targeted are endangered or threatened species habitat areas and areas of karst topography, which are particularly vulnerable to seepage of contaminants.

In addition to the WQIP and CRP, the Farm Bill contains provisions for greater flexibility to allow crop rotations, sustainable agriculture research and education programs, pesticide recordkeeping for certified applicators, and an organic food certification program.

29 STATES AND TERRITORIES WITH APPROVED COASTAL ZONE MANAGEMENT PROGRAMS must implement coastal nonpoint pollution control programs.

The Coastal Zone Management Reauthorization Amendments of 1990

Congress also enacted the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990, which established under Section 6217 a new coastal nonpoint source pollution control program that integrates State Section 319 (CWA) programs with State Coastal Zone Management Act (CZMA) programs. NOAA administers the

CZMA and EPA administers Section 319, and the two agencies have worked cooperatively toward implementing Section 6217.

Section 6217 requires that States with federally approved coastal zone management programs develop and implement Coastal Nonpoint Pollution Control Programs to ensure protection and restoration of coastal waters. Twenty-nine States and Territories, including several Great Lakes States, currently have approved coastal zone management programs.

Under CZARA, State Coastal Nonpoint Pollution Control Programs must provide for implementation of (1) management measures specified by EPA in the national technical guidance, and (2) additional, more stringent measures developed by each State as necessary to attain and maintain water quality standards where the baseline measures do not accomplish this objective. The CZARA further provides that States' Coastal Zone Management Programs must contain enforceable policies and mechanisms to ensure implementation of the baseline and additional management measures.

EPA issued final technical guidance in January 1993. This guidance specifies management measures for five major categories of nonpoint pollution: agricultural runoff, urban runoff, silvicultural runoff, hydromodification, and marinas and recreational boating. The guidance also describes specific practices that may be used to achieve the level of prevention or control specified in the management measures.

EPA and NOAA have also issued joint program guidance to assist the States in developing coastal nonpoint pollution control programs. Final program guidance was issued in January 1993. The program guidance addresses issues related to development by the States of coastal nonpoint programs for joint approval by NOAA and EPA. The States must submit coastal nonpoint control programs to NOAA and EPA within 30 months of issuance of the management measures guidelines (July 1995).

The Section 314 Clean Lakes Program

Introduction

Background and New Themes Since the 1987 CWA Reauthorization

The principal Federal program dealing with restoration of degraded lakes is EPA's Clean Lakes Program (CLP), established by the Clean Water Act (CWA) of 1972. Activities under the CLP began in 1975 as congressional appropriations were used to develop a national program to clean up publicly owned freshwater lakes. From 1975 to 1978, research and development grants were issued to identify restoration techniques and conduct demonstration projects to restore specific lakes. By 1980, formal regulations were finalized governing the award of Federal funds for Clean Lakes grants. These regulations (40 CFR Part 35, Appendix H) still provide the framework for use of the Federal grants and for States seeking to create their own programs.

The CLP has always stressed the need for skillful coordination with other State or Federal programs. During the 1970s and early 1980s, a major goal of CLP grants was to rehabilitate lakes that had experienced excessive nutrient inputs from point and nonpoint sources of pollution. The CLP requires that all point sources be treated or have treatment planned under Sections 201 and 402 of the CWA before a grant is awarded for in-lake restoration activities.

In the course of the 1980s, and especially with the 1987 CWA reauthorization, States were encouraged to consider control measures for nonpoint source impacts and even for multimedia issues such as acid rain. Programs that integrated support from CLP with assistance from other Federal, State, or local initiatives were encouraged. In particular, States were encouraged to coordinate their CLP activities with their Section 319 Nonpoint Source Management Programs. The CLP helped pioneer a holistic watershed approach to identifying lake pollution control and restoration needs. This watershed perspective is prominent in Section 319 programs and is a major organizing principle for the Section 303(d) TMDL process and for such efforts as EPA's new Watershed Protection Approach (WPA). These integrated management concepts are important for projects carried out wholly within the scope of a Federal CLP grant. Such concepts become essential when projects are designed to address concerns that could easily exceed the levels of support from a conventional Section 314 project.

THE CLEAN LAKES PROGRAM pioneered a holistic watershed approach to identifying lake pollution control needs.

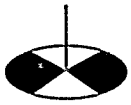
Especially for larger lakes, or where watershed control measures are vital to successful lake protection or restoration, the Clean Lakes Program becomes just one component in a larger institutional framework.

Figure 15-1

Activities Conducted with Clean Lakes Program Grants

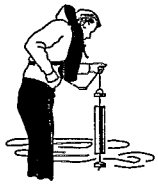
Lake Water Quality Assessments

- Statewide screening level assessments of lake quality
- Public information/education
- Priority setting



Phase I. Diagnostic/ Feasibility Studies

- Water quality sampling
- Data analysis
- Recommend control and restoration measures to address water quality problems

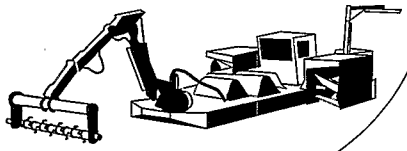


Phase III. Postrestoration Monitoring

- Water quality sampling
- Data analysis
- Determine longevity and effectiveness of control and restoration measures

Phase II. Implementation

- In-lake treatments
  - Mechanical weed control
  - Artificial aeration
  - Phosphorus precipitation
- Watershed treatments
  - Best management practices
  - Zoning and planning ordinances
  - Public education



Program Goals and Objectives

The CLP encourages States to develop active, ongoing monitoring and assessment programs and has supported these efforts with Lake Water Quality Assessment Grants. These activities should be sufficiently broad to cover all important publicly owned lakes in a State, with general monitoring procedures geared to those lakes with high-priority protection or restoration needs. For as many lakes as possible, and certainly for lakes with serious water quality concerns, more detailed investigations should be conducted to outline the major pollution problems (or threats) and identify appropriate restoration or control techniques. Where this sort of background information is available, and where stakeholders can be identified who are willing to assume management or stewardship responsibilities, the stage is set for actual lake projects.

The first step is to carry out an appropriate limnological study to document baseline conditions and to make a careful determination of the most appropriate techniques for pollution controls and in-lake or watershed restoration measures. The next step is to implement the recommended management measures, making use of available CLP grants but also leveraging support from other local, State, and Federal resources. The final step is to document the success of the lake project, gathering technically sound evidence that water quality conditions have improved.

The three steps described coincide with CLP Phase I, Phase II, and

Phase III grants (Figure 15-1). One of the most difficult parts of the Clean Lakes Program lies in putting together enough information to initiate a Phase I grant. After adoption of the formal rules and regulations in 1980, EPA provided funds for States to carry out classification surveys. These classification survey grants provided States an opportunity to evaluate existing information, and collect new data where needed, to provide an ample candidate pool of publicly owned lakes. A typical State would be able to assemble good background information on approximately 100 lakes. From the classification information, a ranking system could be developed to highlight lakes with the more pressing management concerns for award of CLP project grants.

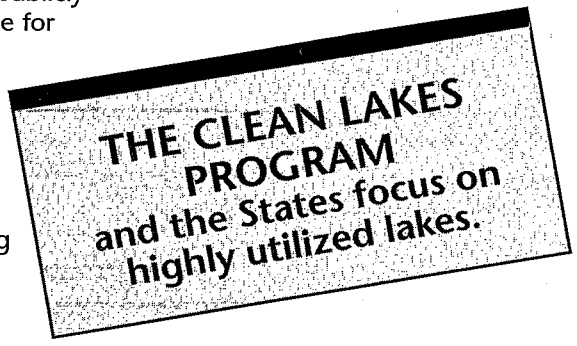
By the 1987 CWA reauthorization, many States were using classification and priority lists that did not always reflect current conditions. In addition, the original classification surveys had focused almost exclusively on adverse impacts from excessive nutrient loadings, excessive sedimentation, or other signs of significant cultural eutrophication.

The 1987 reauthorization encouraged States to adopt an even broader water-quality-based perspective. Although there was still a need for evaluating lakes according to their trophic condition, States were also asked to consider any other major pollution problems. In addition to conventional pollutants (e.g., nutrients or sediment), States were to pay attention to impacts from toxics and acidity problems resulting from acid mine drainage or acid deposition.

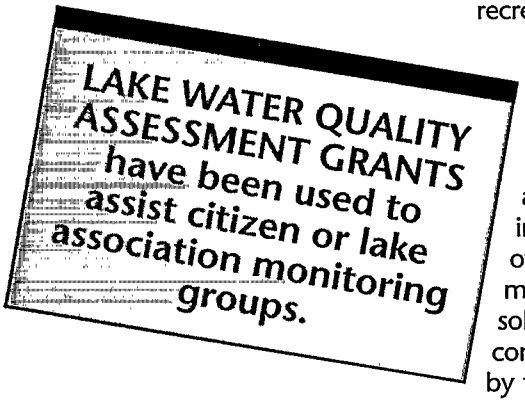
Instead of a one-time classification survey, lake monitoring and assessment were to become part of each State's continuing planning process. Available information was to be summarized biennially and submitted as part of the biennial 305(b) reports. To help States institutionalize these enhanced lake monitoring and assessment expectations, EPA has made available special Lake Water Quality Assessment grants. Most States, and other groups such as American Indian Tribes, have taken advantage of these grants, and, with the 1992 National Inventory Report, many States have completed the transition from their older classification surveys to more current information generated over the past 2 to 4 years.

Publicly Owned Lakes

The CLP requires participating States to define "significant publicly owned lakes" that are eligible for CLP assistance. The CLP and the States focus on highly utilized lakes because local citizens and governments are more likely to assist in control and restoration projects and assume ongoing stewardship for these lakes and their watersheds. High-value lakes attract a diverse group of local stakeholders to anchor the activities associated with a Section 314 project.



States define significant publicly owned lakes with varied physical and legal criteria, but most States include minimum size criteria and recreational use caveats in their definitions. For example, New Hampshire's definition of significant publicly owned lakes is "any freshwater lake or pond that has a



surface area of 10 or more acres, is not private, and does not prohibit recreational activity."

Some States further refine their definition of significant publicly owned lakes with quantitative criteria that describe recreational use. In another example, Iowa's screening criteria for significant publicly owned lakes exclude shallow marsh-like lakes, reservoirs used solely for water supply, and flood control impoundments constructed by the U.S. Army Corps of Engineers.

As a general rule of thumb, most States settle on a set of significant lakes ranging in number from less than a hundred (for a smaller State like Rhode Island) to a few hundred lakes in larger western or midwestern States.

Clean Lake Program Implementation Grants

Based on the most current monitoring and assessment information for significant publicly owned lakes, States prepare a classification list and a ranking and prioritization system to help target the lakes most in need of restoration or pollution control attention. High-priority candidate lakes can be considered for three types of cooperative agreements under the Clean Lakes Program:

■ Cooperative Agreements for Phase I:

Diagnostic/Feasibility Studies: These studies investigate the causes of the decline in quality of a publicly owned lake and determine the most feasible procedure for protecting and restoring the lake. The maximum Federal contribution is $100,000 with a 30% non-Federal match required.

■ Cooperative Agreements for Phase II Projects:

These projects implement the recommended methods and procedures for controlling pollution entering a lake and for restoring or protecting a lake. Phase II agreements follow Phase I studies or equivalent investigations. There is a 50% non-Federal match for Phase II awards. There is no absolute cap on the size of the Federal share.

■ Cooperative Agreements for Phase III Studies:

Postrestoration monitoring cooperative agreements offer selected projects the opportunity to conduct long-term, postrestoration monitoring studies to verify the longevity and effectiveness of various restoration techniques. The non-Federal share is 30% with the maximum Federal share set at $125,000.

In addition to these lake-specific cooperative agreements, States can be eligible for cooperative agreements for Lake Water Quality Assessments.

■ Cooperative Agreements for Lake Water Quality Assessments:

These awards are intended to help States compile a comprehensive Statewide assessment of lake water quality, to enhance overall State lake management programs, and to increase public awareness and commitment to protecting lakes.

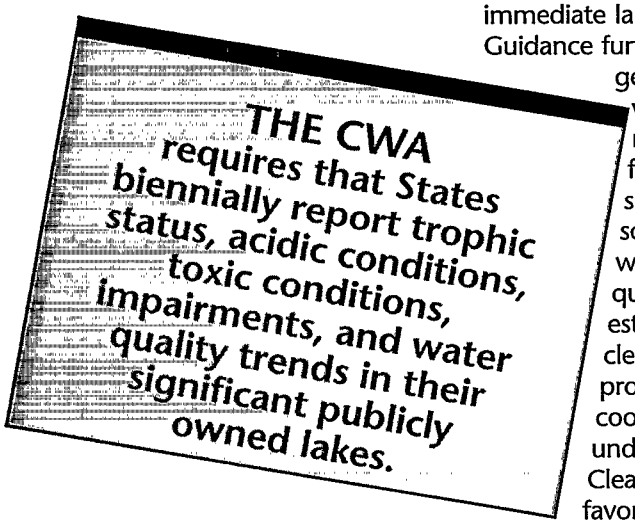
The Clean Lakes regulations require that any lake project must be consistent with the State Water Quality Management Plan (40 CFR Part 35). This is to ensure that EPA and the States coordinate a variety of programs under the Clean Water Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act, and other laws administered by EPA. The Clean Lakes Program is conducive to integration with other water quality management programs because of the natural linkages between lake management and other environmental efforts.

EPA has provided support to help States develop ongoing lake assessment efforts through special Lake Water Quality Assessment (LWQA) grants. In addition to detailed monitoring work carried out through State water quality agencies, LWQA grants have been used to provide technical assistance to citizen or lake association monitoring groups. These local volunteer groups typically use Secchi depth measurements to monitor lake transparency. Although many States feel that additional measurements are needed to provide an adequate characterization of lake trophic status, time series data collected by volunteers can be valuable to document trends in lake water quality. This information can also be used to develop relative ranking systems based on an important aspect of a lake's recreational appeal. Grass roots involvement starting with volunteer monitoring activities can also help build the institutional frameworks vital to undertaking a successful lake restoration project. These grants have very successfully created and fostered strong working relationships among EPA, States, local governments, and citizens.

In addition to its work with the States and such political entities as the District of Columbia and Puerto Rico, the Clean Lakes Program has made substantial progress in expanding its work with American Indian Tribes. The 1987 CWA reauthorization stressed enhanced partnerships in all programs in which American Indian Tribes could assume management or stewardship responsibilities. In addition to activities such as the National Pollutant Discharge Elimination System (NPDES) permitting program, American Indian Tribes are also encouraged to develop monitoring and assessment programs and to use this information to address both point and nonpoint source pollution control efforts. Many American Indian Tribes are interested in developing watershed-based approaches to improve the management of lakes and streams on tribal lands. The CLP has proved a very attractive vehicle for American Indian Tribes to develop monitoring and resource stewardship capabilities. To become eligible for CLP grants, Tribes must meet several requirements in CWA Section 518 that enable EPA to treat Tribes as States. Since 1989, 18 American Indian Tribes in seven EPA Regions have participated in LWQA grants, and several American Indian Tribes have proceeded with Phase I or Phase II implementation grants.

SINCE 1989, 18 American Indian Tribes in seven EPA Regions have participated in LWQA grants.

As specified in the Clean Lakes Program Guidance, Clean Lakes projects must be developed and implemented on a watershed basis. This ensures that restoration



activities funded by EPA are long term and address symptoms of water quality impairments as well as immediate lake restoration. The Guidance further states that this geographic approach to water quality management has been identified as a key element of success in nonpoint source control, ground water protection, water-quality-based permitting, estuarine protection and cleanup, and wetlands protection. In awarding cooperative agreements under the competitive Clean Lakes Program, EPA favors projects with a watershed-based approach to water quality management.

Starting with grant awards for fiscal year 1990, the Clean Lakes Program has recommended that EPA Regional offices (which have been delegated authority to enter into Clean Lakes cooperative agreements with the States) encourage States to integrate their Clean Lakes projects with other State and Federal programs. This memorandum also encourages States to consider technical and financial assistance that may be available through Section 319 State nonpoint source programs for targeted watershed demonstration projects. The memo also mentions that USDA P.L. 83-566 projects (for small watershed conservation assistance) promote land treatment activities in watersheds significantly affected by agricultural nonpoint source pollution.

Section 314 Reporting Requirements

Biennial Lake Assessment

Under the 1987 CWA reauthorization, several new provisions were added to the original provisions encouraging States to identify their publicly owned lakes and classify them according to their eutrophic condition. Lake assessment information was to be updated in a fashion analogous to other State water quality assessments and reported biennially following the same time lines as the Section 305(b) reports. Most States now include their Section 314 lake assessments in their 305(b) reports. Recent procedural changes to the regulations governing the Water Quality Planning and Management Program (FRL-3979-8, *Federal Register*, Vol. 57, No. 143, Friday, July 24, 1992) now clearly specify that lake assessment materials should be part of the 305(b) report submittals.

Continued Importance of Trophic Status Classifications

Reporting on trophic conditions is still a central feature under the 1987 CWA reauthorization, and most States still use ranking systems based primarily on this trophic status information as the foundation for their selection of candidates for the Federal Clean Lakes Program grants.

Pollution Control and Restoration Techniques

The Clean Water Act encourages reporting on in-lake restoration techniques to improve lake water quality and control techniques for reducing pollutant loadings from the surrounding watershed. Lake pollution controls may include provisions in point source permitting or other regulatory programs. States can describe lake quality standards and monitoring programs related to standards enforcement as a means of controlling lake pollution. States should also describe the relation of their CLP to other State programs, especially their Section 319 nonpoint source management programs. Approaches working with other State or Federal programs can also be included.

States should also provide materials on their lake restoration techniques. For example, States may provide specific restoration techniques from which they will draw to develop lake-specific management plans. Where possible, States are encouraged to document specific techniques recommended for individual publicly owned lakes. This information could be drawn from CLP projects completed or under way as well as techniques anticipated to be promoted for specific lakes.

Toxics and Acidity Impacts or Threats

During the 1980s, considerable national attention was focused on how pollution factors can lower the pH of receiving waters, especially lakes. Acidity can pose a direct threat to aquatic life and lake recreational amenities. Major potential sources would be atmospheric deposition or acid mine drainage. In addition to impacts from acidity per se, low pH conditions can accentuate impacts from a variety of toxicants. For instance, many metals show increased availability as the pH drops and, where acid mine drainage is involved, the pollutant source for the acidity may also be a source of toxicants. Acidity may also accentuate the impacts on aquatic organisms of a variety of toxics and may often increase bioaccumulation or biomagnification processes that move toxicants into the tissues of fish and thus into the food chain. Toxic accumulations in sediment also complicate the use of lake restoration techniques such as dredging.

ACIDITY can enhance bioaccumulation or biomagnification of pollutants up through the food chain.

In light of these concerns, Congress added provisions for State lake assessment reporting to document known instances of acidity or toxics impact to public lakes. If such issues are related to actual impairments or pose real degradation threats, States are encouraged to document methods and procedures that could mitigate the harmful effects of high acidity or toxic metals and other toxic substances. These activities are funded with LWQA grants.

The Red Lake Chippewa Lake Assessment Grant

The 1987 Clean Water Act reauthorization encouraged States, and other groups with lake stewardship responsibilities, to develop ongoing monitoring and assessment programs. To help institutionalize these assessment activities, the national Clean Lakes Program created special Lake Water Quality Assessment (LWQA) Grants, which became available starting in fiscal year 1989. By the end of the 1992 305(b) reporting cycle, most States had availed themselves of these "modified" Clean Lakes Phase I cooperative agreements. Section 518(e) of the CWA also encouraged EPA to work with those American Indian groups interested in assuming responsibilities for programs or grants. In addition to activities such as the National Pollutant Discharge Elimination System (NPDES) permitting program, Tribes may apply for a variety of water quality management grants. Since 1989, the EPA Clean Lakes program has awarded Lake Water Quality Assessment grants to 18 American Indian Tribes in seven EPA Regions. These LWQA grants can help equip American Indian groups to organize their own Clean Lakes programs.

There has been considerable interest in these LWQA grants in Region 5. States such as Wisconsin and Minnesota are dotted with natural lakes and have numerous large tracts of American Indian lands. A good example of an LWQA grant is work being completed by the Red Lake Chippewa Tribe. The Chippewa, also known as the Ojibway, are part of the Sioux Indian Group that inhabitated an area from the forests of the upper Midwest out into the prairies. By 1919, the Chippewa people in Minnesota had been assigned to a number of scattered holdings and two large reservations. The Red Lake Chippewa have set up a so-called "closed" reservation–they direct their tribal government, have control over their resource base and livelihoods, and have preserved their native language and customs.

The reservation covers an area the size of Rhode Island and is the home for around 4,000 people. The tribal lands surround the 230,000 acres of the Upper and Lower Red Lakes. These waterbodies represent remnants of the mammoth Lake Agassiz that covered most of the

present drainage of the Red River of the North during the Ice Ages. The Red Lakes are perched above several ancient shoreline terraces in a scenic wooded landscape completely different from the flat prairies on the Red River's course along Minnesota's border with the Dakotas. The Red Lakes are famous for their walleye pike, perch, and whitefish. Since 1929, the Tribe has operated a cooperative that harvests and packages fish for commercial markets as far away as Minneapolis and Chicago. The Tribe grows much of its own food. There are commercial timber operations as well as a sawmill, a factory for cedar fencing materials, and shops producing other finished wood products. The Tribe operates its own schools, general stores, and other commercial and social services.

These diversified economic enterprises and land use activities can pose threats to the integrity of water resources on the reservation. An LWQA Grant awarded with FY 1989 funds has enabled the Red Lake Chippewa to gather baseline data on the trophic condition of the Upper and Lower Red Lakes and inventory possible pollutant sources in the lakeshore area and along small tributaries.

The Tribe is especially eager to identify critical erosion areas and activities that could increase nutrient loadings. Traditionally, the oligotrophic Red Lakes contain few nutrients, but considerable natural inputs of humic materials from marshes and wetlands give the water a brownish appearance. The natural coloration of the water prevents the Chippewa from detecting trophic status with simple measurements such as Secchi disk depth. Therefore, they must perform detailed site evaluations and chemical analyses to detect nutrient and sediment hotspots. To date, sampling performed with the LQWA Grant has documented nutrient inputs from a malfunctioning lift station in a community sewerage system. When complete, the findings of this assessment grant will help the Tribe pursue an integrated approach to implementing lake restoration or watershed control measures.

Lake Beneficial Use Impairments and Trends

The 1987 CWA reauthorization contained many provisions encouraging a water-quality-based approach to pollution assessment, planning, and management activities. Biennial lake assessments are now expected to make use of available information to document publicly owned lakes where uses are known to be impaired as well as lakes where there is evidence of water quality deterioration. Most States use EPA's Waterbody System to produce summary tables that categorize lake acreages by use attainment (e.g., fully supporting, threatened, partially supporting, or not supporting). Summary tables are also generally provided that categorize the major causes and sources of pollution. However, many States still lack water quality standards for lakes. Without standards, States cannot assess beneficial use support and lake impairments in a consistent manner.

Under the 305(b) reporting process, States are encouraged to provide waterbody-specific summaries of various public health and aquatic life concerns. This can include information on fishing advisories, fish kills, sites with sediment contamination, restrictions on surface water drinking supplies, bathing area restrictions, and incidents of waterborne diseases. This information is reported for all waterbody types, including lakes. Perhaps the most common concern reported is the contamination of fish tissue by toxicants, leading to fish consumption warnings or advisories. Although valuable, many States have difficulty relating this information clearly to provisions in their own water quality standards. For instance, a public health agency may declare a fish consumption advisory for a lake based on trigger values for some toxicant (for instance, mercury) that are not tied to numeric standards criteria for any particular beneficial use. States are making progress in achieving consistency in their reporting of concerns such as fish consumption advisories in relation to their reporting State beneficial use attainment status. However, results for these two types of assessment information may require careful scrutiny to avoid misinterpretation.

A final provision in the 1987 CWA reauthorization encourages States to make use of available information to identify apparent trends in water quality for public lakes. Where possible, such determinations should look not only at shifts in trophic status but at all forms of point and nonpoint source pollution. Attention to trends involving toxics is particularly recommended.

Trophic Status

Trophic condition is a characterization of a lake's biological productivity based on the availability of plant nutrients. Commonly accepted systems for describing trophic status recognize a range of conditions, with oligotrophic indicating the least biologically productive lakes and eutrophic indicating significantly higher levels. For national reporting purposes, the following categories are recommended: oligotrophic, mesotrophic, eutrophic,

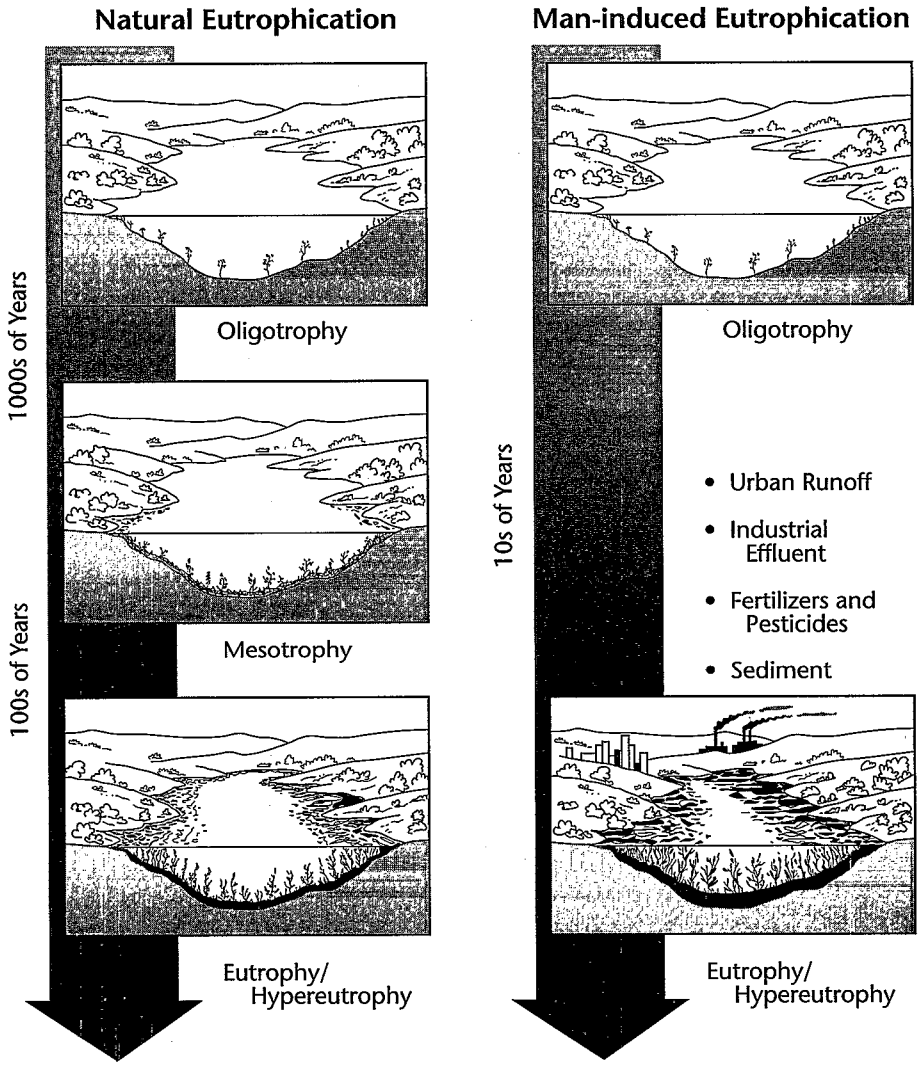
and hypereutrophic. For those lakes showing exceptionally high levels of organic materials and associated reduced pH levels, humic substances, and natural color, the term dystrophic is used.

Both natural lakes and manmade reservoirs will usually show shifts in their trophic condition over time (Figure 15-2). As natural lakes fill in, a process that ordinarily may take centuries, they may naturally shift from an oligotrophic to a more eutrophic status. Reservoirs have design lives ranging from a few decades to perhaps a few hundred years. Sedimentation processes will eventually lead to trophic shifts in manmade impoundments, generally in a much shorter time period than for natural lakes. Similarly, newly impounded reservoirs may initially be characterized as eutrophic because of the decay of woody debris but may shift to a less eutrophic status for most of the impoundment's useful life.

Because there is an inherent dynamic aspect to the trophic balances in lakes, caution must be exercised in characterizing anything other than an oligotrophic condition as undesirable. On the other hand, many types of anthropogenic stresses may result in rapid trophic status shifts. If a lake shows rapid progression toward a state exhibiting excessive algae growth (i.e., algal blooms), rapid organic and inorganic sedimentation and shallowing, and seasonal or diurnal dissolved oxygen deficiencies leading to obnoxious odors, fish kills, or a shift in the composition of aquatic life forms to less desirable forms, then cultural eutrophication is very likely. Most commonly, large inputs

Figure 15-2

The Progression of Eutrophication



(left column) The progression of natural lake aging or eutrophication through nutrient-poor (oligotrophy) to nutrient-rich (eutrophy) sites. Hypereutrophy represents extreme productivity characterized by algal blooms or dense macrophyte populations (or both) plus a high level of sedimentation. The diagram depicts the natural process of gradual nutrient enrichment and basin filling over a long period of time (e.g., thousands of years).
(right column) Man-induced or cultural eutrophication in which lake aging is greatly accelerated (e.g., tens of years) by increased inputs of nutrients and sediments into a lake, as a result of watershed disturbance by humans.

Source: *NC Lake Assessment Report.* NCDEHNR, DEM. Report No. 92-02. June 1992.

TROPHIC STATUS ASSESSMENTS are the backbone of the lake classification systems used in most States to rank and prioritize publicly owned lakes.

of nutrients or nutrient-laden sediments associated with point or nonpoint source pollution will lead to cultural eutrophication. Restoring a lake to a more desirable trophic condition will then require implementation of control techniques to reduce the nutrient loadings and possibly in-lake restoration activities to mitigate the impacts of previous pollution inputs.

Trophic classification begins with an assessment of conditions in a lake at a given time. There are many aspects of reservoirs that make it difficult to categorize them by traditional trophic status assessments. When evidence suggests that pollution factors are driving the lake to a more eutrophic state, a State's Clean Lakes Program will likely rate that waterbody as a relatively higher priority candidate for management attention. Other types of information are helpful in prioritizing a public lake's management needs (e.g., documentation of trends and consideration of factors such as acidity or toxics), but trophic status assessments are the backbone of the classification systems used in most States.

At least half the States make use of a trophic classification methodology developed by R.E. Carlson in the 1970s. Carlson worked primarily with natural lakes in the Midwest. He developed a series of indices involving simple logarithmic transforms of monitoring records based on total phosphorus, chlorophyll *a*, and Secchi depth. For many lakes, these parameters provide a measure of a principal cause of cultural eutrophication (the nutrient phosphorus), a reasonable indicator of the standing crop of algae associated with nutrients (chlorophyll *a* is the major photosynthetic pigment in algal phytoplankton), and a measure of unwanted reduction in water transparency due to elevated levels of algal biomass.

The formulas for these trophic status indexes (TSIs) were calibrated to conditions in the Midwest so that an increase of 10 index units would match a change in lake eutrophic condition to the next highest status (e.g., from oligotrophic to mesotrophic). For many lakes studied by Carlson, there was a strong correlation among the predictions provided by the TSIs. Because it is generally much less expensive to gather total phosphorus data than chlorophyll *a* data and much easier to measure a light transparency from a Secchi disk than to develop actual water chemistry data, there has been a tendency to rely heavily on Secchi disk measurements when using a Carlson TSI to characterize trophic state.

Well over half the States use one or more of the Carlson TSIs or indices very similar to Carlson's. For the 1992 305(b) reporting cycle, there is a noticeable tendency on the part of the States to use greater discretion when the only measurement for a TSI comes from Secchi disk readings. Without other information about a lake, and especially reservoirs where reductions in transparency may be due more to suspended inorganic particles than to blooms of algae or due to location of the sampling site or other factors, a Secchi measurement may give false signals as to the degree of biological productivity.

States are increasingly giving greater precedence to TSIs using phosphorus or, where possible, chlorophyll *a* measurements.

However, light transparency data may still be useful, especially when correlated with visual observations of color. Even if loss of transparency is due more to turbidity and suspended solids than to algae, it may indicate unwanted sedimentation problems affecting trophic balances and a lake's recreation value. When available, long time series of Secchi depth readings are often a good tool for trend analysis. Secchi readings, often collected by volunteer monitoring groups, can therefore still play an important role in a State's lake monitoring programs; but, for the highest quality characterization of lake trophic status, measurements more closely related to biological process and food chain dynamics are preferred.

With support from EPA Lake Water Quality Assessment grants, many States are evaluating different ways to supplement methods such as Carlson TSIs to make cost-effective characterizations of trophic status. For instance, using a broader range of parameters, there are other standard indexes that may prove helpful, many of these originally developed in the 1970s as part of EPA's pioneering National Eutrophication Survey. Whatever the general form in a TSI formula, it is highly desirable to regionalize the system to conditions found in a specific State or ecoregion. States such as North Carolina have developed regional indices, and Oregon, Minnesota, and Arkansas have applied ecoregion concepts in interpreting their lake monitoring data. Oklahoma and Texas are evaluating different methods to assess trophic status in reservoirs.

Because a TSI is a simplified analysis tool with a strong correlation to basic aspects of the biological structure for lakes in a region, many States are exploring ways to develop bioassessment techniques. For instance, the presence or absence of certain types of zooplankton is often strongly correlated with a well-balanced biological community. Diverse and healthy populations of algae-consuming zooplanktons such as *Daphnia pulex* can help prevent the buildup of objectionable algal biomass even in lakes showing appreciable nutrient inputs. Shifts in the populations of game fish or plankton-eating forage fish can sometimes lead to a decimation of the zooplankton, allowing algae to flourish. Biomanipulation techniques aimed at increasing the populations of top predator fishes or reducing the populations of forage fishes can often correct the trophic imbalances. Bioassessments of the plankton communities or the fish populations can therefore indicate overall trophic status. Other techniques being explored look at benthos or macrophytes in lake littoral areas. These techniques can be valuable supplements to the more traditional Carlson TSIs that focus on algal standing crop, nutrients, or transparency parameters.

In 1992, 41 States reported that 17% of the 11,477 lakes they assessed for trophic status were oligotrophic, 35% were mesotrophic, 32% were eutrophic, 8% were hypereutrophic, and 8% were dystrophic. This information may be somewhat biased, as States often assess lakes in response to a problem or public complaint or because of their easy accessibility. It is likely that more remote lakes–which are probably less impaired–are underrepresented in these assessments.

Acid Effects on Lakes

Acidic lakes are generally found in areas where watershed soils have limited buffering capabilities. Acid rain or acid mine drainage can then depress a lake's pH levels to a point at which many forms of aquatic life are stressed or eliminated. Table 15-1 summarizes some of the common biological effects at progressively lower pH ranges.

Acid conditions can also aggravate toxics impacts, especially for heavy metals. During the 1980s there was major public concern over the impacts of lowered pHs to lakes, primarily from atmospheric deposition. EPA coordinated a major multi-agency study called the National Acid Precipitation Assessment Program (NAPAP). NAPAP led to actual data collection efforts on many lakes and stream systems. It also provided insights into promising monitoring designs to document receiving waters with actual acidity problems or sensitivities to potential acid impacts.

NAPAP's conclusion was that the incidence of serious acidification problems was far more limited than originally feared, and this Federal hypothesis seems to be reflected in evidence reported by the States in their lake water quality assessments. At least for significant publicly owned lakes, the Adirondacks area of New York emerges as the only region showing appreciable numbers of public lakes with significant acidification damage. States have documented areas where local geological and soil factors may render lakes deficient in natural buffering capacity and therefore vulnerable to acidity stress. Such sensitive areas seem quite prevalent in high-altitude glacial lakes in mountainous areas in the Rockies and several western States. A major concern here is low pH water introduced from snowpack meltwater. Many of these high-altitude lakes may show a seasonal pulse of low pH inflows, usually during the Spring. The ecological consequences are not entirely clear, and States such as Colorado and Washington will continue to study this episodic phenomenon.

In the eastern United States, such areas as southern New Jersey have been shown to have limited natural buffering capacity, making many lakes potentially vulnerable to acid deposition impacts. In addition to lakes, some States are concerned about acidity impacts on high-gradient trout streams. Where the acidity concerns affect whole watersheds, this encourages a search for mitigation techniques that could benefit both lakes and streams. New York has undertaken some innovative demonstration projects aimed at liming whole watershed areas instead of the more traditional strategy of liming just the lakes.

Serious impacts from acid mine drainage also seem relatively rare. No State has found clear documentation of acidity impacts related to active mining activities. However, there is some concern about abandoned mine workings. At least one

Table 15-1. Effects of pH on Aquatic Life

pH Range	General Biological Effects
6.5 to 6.0	Some adverse effects for highly acid-sensitive species
6.0 to 5.5	Loss of sensitive minnows and forage fish; decreased reproductive success for trout and walleye
5.5 to 5.0	Loss of many common sports fish and additional nongame species
5.0 to 4.5	Loss of most sports fish; very few fishes able to survive and reproduce where pH levels commonly below 4.5

State, Oklahoma, is undertaking a CLP Phase I study on a portion of the Eufaula Reservoir that lies in a region with a long history of surface and hard rock coal mining activities.

Toxic Effects on Lakes

In the 1987 CWA reauthorization, there was an expectation that if toxics concerns were encountered in lakes, they might be tied to an anticipated widespread incidence of acidity problems. From evidence submitted by the States and from the Federal NAPAP investigations, lake acidity problems are much rarer than anticipated. Toxics concerns States have submitted, therefore, will generally not be related to depressed pH levels.

Many States do report serious toxic concerns, with the most common centering on fish consumption advisories. Most States maintain programs to sample fish tissues from their major public lakes. These collections also generally involve sampling of ambient water and sediments. Rarely do ambient water levels exceed detection limits for heavy metals or common pesticides. For sediments and fish flesh, however, virtually all States have at least one public lake at which elevated levels of some toxicant have been documented. Any exceedances of FDA alert levels or other Federal or State threshold levels will be noted in the 305(b) reporting process. Especially for contaminants in fish flesh, State health authorities will issue consumption advisories so that the public can make appropriate fish consumption decisions.

If a State has established provisions in its water quality standards regarding these public health issues, lakes may be reported as showing beneficial use impairments. Where such standards are not well-defined, the information may show up only in the 305(b) sections dealing with public health/aquatic life concerns. If it is carried over into the use attainment portion of the 305(b) documents, States may choose to characterize the concern as a 305(b) "assessment" issue. This is a rapidly evolving field, with many States attempting to add public health features to their water quality standards or expanded standards' provisions for wildlife protection.

STATES report that fish consumption advisories reflect the most common toxic concerns in lakes.

Because many of the toxicants in question are persistent substances (e.g., chlordane or PCBs), it is often likely that there are no active pollutant sources; rather the problems are related to in-place contaminants. This situation is compounded by the fact that many of the organic or heavy metal toxicants are multimedia problems, with any ongoing pollutant loading coming from atmospheric deposition. The sources for such "air pollution" inputs are generally not well known; in some cases the ultimate sources may even lie outside the United States, reflecting pollution processes on a hemispheric or global scale. Faced with these uncertainties, most States are continuing to gather monitoring data and are adopting risk management strategies.

IN-PLACE CONTAMINANTS from past activities, rather than active pollutant sources, generate many toxic problems.

Trends in Significant Public Lakes

EVERY STATE reported a need for additional data to detect water quality trends.

Lakes are dynamic systems, which means that they may naturally display shifts in trophic status over time. The only exception might be bog-like dystrophic lakes that constitute a special case in terms of the ordinary evolution for lake waterbodies. Without some time series records of lake conditions, it can be hard to interpret the management implications of a eutrophic classification based solely on current conditions.

Trend analysis can be extremely valuable in documenting rapid shifts toward more eutrophic features. Waterbodies in which changes can be related to ongoing pollution inputs are generally considered to warrant higher priority in management attention. Although the desirability of trend assessments is widely recognized, States still face challenges in gathering adequate information to document a trend signal, especially when they try to apply sophisticated statistical methods to document the significance of an apparently empirical change.

The majority of States do attempt some sort of trend determination when they have at least a recent set of trophic classifications in conjunction with other data, usually from their original classification survey in the early 1980s. Determinations made based on data from only two points in time must rely heavily on best professional judgment (BPJ). Virtually every State that presents such BPJ trends assessments notes that confidence limits or other measures of reliability or precision are not available.

At least three States–Illinois, Wisconsin, and Minnesota–did apply statistical analysis techniques to select lakes for which approximately 5 to 10 years of time series data were available. Illinois used least squares regressions (using a "parametric" statistical approach) combined with examination of scatter plots of the raw data and residuals. From 212 lakes, about 50 results suggested either alinear improvement or a degradation trend. Nearly 60 percent of the lakes had extremely complicated fluctuating patterns suggesting cyclical or nonlinear patterns, perhaps related to weather variability. Illinois therefore felt that additional data and further analysis would be worthwhile.

Wisconsin and Minnesota used the Kendall tau test available with the WQSTAT computer program developed at Colorado State University. This is a nonparametric test considered by many to be

preferable to parametric techniques for use with water quality data. Minnesota applied the test to 161 lakes; trends were suggested in 32. Wisconsin looked at 49 lakes, with the test suggesting trends for 25. Wisconsin, in particular, expressed some reservations. They felt the main patterns in the raw data reflected normal, short-term, cyclical changes rather than genuine long-term trends in water quality.

Although States continue to explore ways to detect empirically significant trends, virtually every State expressed the need to acquire additional data, a common estimate being that at least 10 years of observations would be needed to apply rigorous statistical methods. Another common theme is that the patterns displayed in many lakes do not seem linear. Most available statistical tests are geared to spotting simple, linear trends. Where the underlying physical patterns are nonlinear or cyclical, more complex analysis systems may be needed.

Lake Restoration and Pollution Control Measures

Managing lake quality often requires a combination of in-lake restoration measures and pollution controls, including watershed management measures:

Restoration measures are implemented to reduce existing pollution problems. Examples of in-lake restoration measures include harvesting aquatic weeds, dredging sediment, and adding chemicals to precipitate nutrients out of the water column. Restoration measures may not address the source of the pollution.

Pollution controls deal with the sources of pollutants degrading lake water quality or threatening to impair lake water quality. Control measures include planning activities, regulatory actions, and implementation of best management practices to reduce nonpoint sources of pollutants. Regulatory measures include point source discharge prohibitions and phosphate detergent bans. Watershed management plans and lake management plans are examples of planning measures. Watershed management plans simultaneously address multiple sources of pollutants, such as runoff from urbanized areas, agricultural activities, and failing septic systems along the lake shore.

During the 1980s, most States implemented chemical and mechanical in-lake restoration measures to control aquatic weeds and algae. In their 1992 Section 305(b) reports, the States report a shift toward watershed planning

techniques and nonpoint source (NPS) controls to reduce pollutant loads responsible for aquatic weed growth and algal blooms. Although the States reported that they still use in-lake treatments (Table 15-2), the States recognize that source controls are needed in addition to in-lake treatments to restore lake water quality.

The States reported that they most frequently rely on their NPDES permit programs and their Section 319 NPS management programs to control pollutants entering lakes (Table 15-3). Through the State NPDES permit programs, States often impose stricter nutrient limits for effluents discharged into lakes than into rivers and streams. Seven States reported that they enhanced sewage treatment plant compliance with NPDES nutrient limits for lakes by imposing phosphorus detergent restrictions.

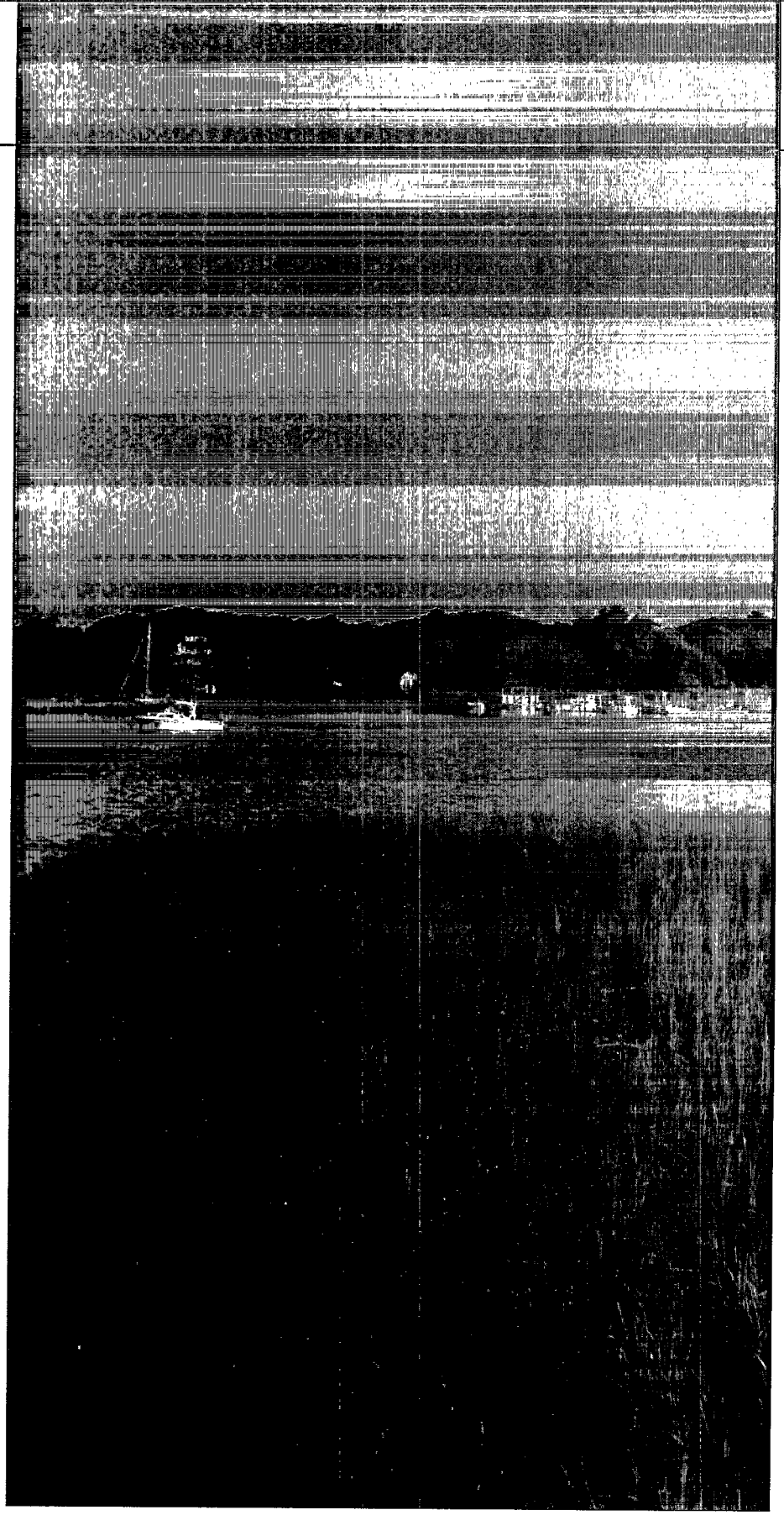
Twenty-two States reported that they use their Section 319 NPS programs to implement BMPs in watersheds surrounding impaired or threatened lakes. The States reported that they implemented agricultural practices to reduce soil erosion, constructed retention and detention basins to cleanse urban storm water, revegetated shorelines, and constructed or restored wetlands to remove pollutants before they entered lake waters.

Table 15-2. Number of States Reporting Use of In-Lake Restoration Measures

Control Measures	Number of States Reporting
Dredging	16
Lake Drawdown	14
Chemical Weed and Algae Control	13
Mechanical Weed Harvesting	12
Biological Weed Control	9
Artificial Circulation/Hypolimnetic Aeration	9
Chemical Nutrient Inactivation	7
In-Flow Diversion	6
Hypolimnetic Withdrawal	5

Table 15-3. Number of States Reporting Control Measures

Control Measures	Number of States Reporting
Section 319 NPS Program	22
NPDES Permit Program	22
State Lake Water Quality Standards	15
Watershed Management Planning	12
Restrict Phosphate Detergents	7
Restrict Point Source Discharges	6
Regulate Shoreline Activities	5
Lake Management Planning	4



Wetlands Protection Programs

A variety of public and private programs protect wetlands. The Conservation Foundation organized the National Wetlands Policy Forum in 1987 to coordinate these disparate efforts and develop a national, coordinated vision for wetlands protection. The forum included three State governors and representatives from State and local governments; the oil, gas, agriculture, and forestry industries; academic institutions; environmental/conservation groups; and EPA and other Federal agencies. The group issued a report in November 1988 containing over 100 recommended actions for all levels of government and the private sector.

The Forum established an interim goal to achieve no overall net loss of the Nation's wetlands base and a long-term goal to increase the quantity and quality of the Nation's wetlands resource base. The Clinton Administration has adopted these goals and plans to issue a Presidential Executive Order to implement them. In addition, the Administration has recommended that Congress amend the Clean Water Act to include them.

Section 404

The major Federal program for regulating activities in wetlands is Section 404 of the Clean Water Act. Section 404 establishes a permit program for regulating discharges of dredged and fill material to wetlands and other U.S. waters. The EPA and the U.S. Army Corps of Engineers (COE) jointly implement the Section 404 program. The COE is responsible for administering the permit program day-to-day, reviewing permit applications, and issuing or denying permits. The EPA is responsible for reviewing COE permit decisions, determining geographic jurisdiction, overseeing State programs, and enforcing with the COE the Section 404 program.

The COE processes permit applications under Section 404. EPA reviews and evaluates applications using its Section 404(b)(1) guidelines, which contain the environmental criteria for Section 404 permit decisions. The U.S. Fish and Wildlife Service and the National Marine Fisheries Service also influence the Section 404 permitting process through their review of applications. After receiving comments from these agencies, the States, and other interested parties, the COE makes a permit decision.

Under Section 404(c), EPA has the authority to veto a COE decision to issue a permit or to otherwise prohibit or restrict the discharge of dredged or fill material to wetlands or other waters of the United States. EPA has the ultimate authority to determine the geographic scope of the CWA (i.e., whether an area is a wetland or other U.S. water). Similarly, EPA has the final word on the applicability of Section 404(f), which exempts certain discharges from regulation. EPA and the COE share authority for enforcing the requirements of Section 404. Also, EPA

The Administration's goals are to

- *Achieve no overall net loss of the Nation's remaining wetlands base*
- *Increase the quality and quantity of the Nation's wetlands resource base*

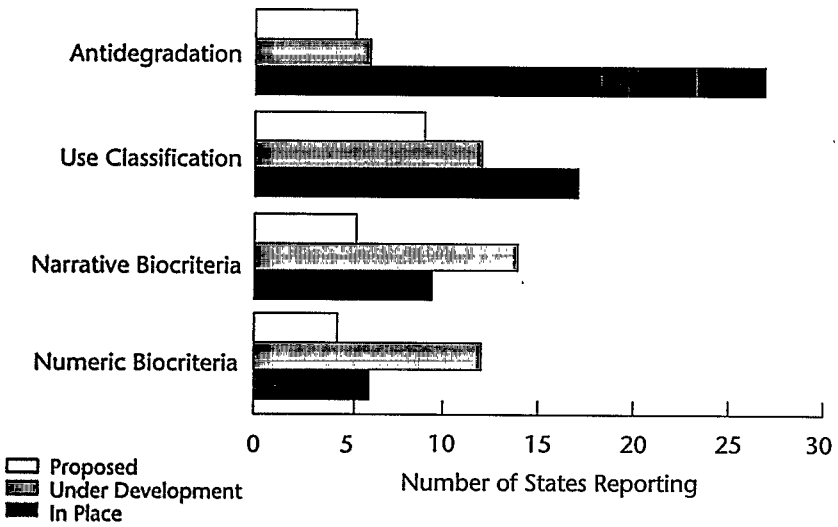
approves and oversees State assumption of the Section 404 program. To date, Michigan and New Jersey are the only States to have assumed this responsibility.

Wetlands Water Quality Standards

Water quality standards for wetlands ensure that the provisions of CWA Section 303 that apply to other surface waters are also applied to wetlands. In July 1990, EPA issued guidance to States for the development of wetlands water quality standards. Figure 16-1 indicates the State's progress in developing these standards (see Appendix D, Table D-5, for individual State data).

Figure 16-1

Development of State Water Quality Standards for Wetlands



Based on data contained in Appendix D, Table D-5.

Water quality standards have three major components: designated uses, criteria to protect those uses, and an antidegradation policy. States designate uses that must, at a minimum, meet the goals of the CWA by providing for the protection and propagation of fish, shellfish, and wildlife and for recreation in and on the water. States may choose to designate additional uses for their wetlands, such as flood water attenuation or ground water recharge. Once uses are designated, States are required to adopt criteria sufficient to protect their designated uses. Criteria are general narrative statements or specific numerical values such as concentrations of contaminants and water quality characteristics (e.g., dissolved oxygen concentration = 5.0 mg/L). Narrative criteria are particularly appropriate to wetlands. An example of a narrative criteria is "natural hydrological conditions necessary to support the biological and physical characteristics naturally present in wetlands shall be protected."

Standards provide the foundation for a broad range of water quality management activities under the CWA including, but not limited to, monitoring for the Section 305(b) report, permitting under Section 402 and 404, water quality certification under Section 401, and the control of nonpoint source pollution under Section 319.

Water Quality Certification of Federal Permits and Licenses

Section 401 of the CWA gives States and eligible American Indian Tribes the authority to grant, condition, or deny certification of federally permitted or licensed activities that may result in a discharge to U.S. waters, including wetlands. Such activities include discharge of dredged or fill material permits under Section 404 of the Clean Water Act, point source discharge permits under Section 402 of the Clean Water Act, and Federal Energy Regulatory Commission's hydropower licenses. States review these permits to ensure that they meet State water quality standards. In 1989, EPA issued guidance to States and American Indian Tribes on how to use 401 certification authority to protect wetlands. Ideally, 401 certification should be used to augment State programs because it applies only to projects requiring Federal permits or licenses. Activities that do not require permits, such as draining of wetlands, are not covered.

State Wetlands Conservation Plans

A new tool that States are using to protect wetlands are State Wetlands Conservation Plans (SWCPs). Essentially, these plans are strategies for States to achieve their wetlands management goals, such as no net loss of wetlands, by integrating both regulatory and cooperative approaches to protecting wetlands.

Wetlands are impacted by a large number of land- and water-based activities not addressed by a single Federal, State, or local agency program. In addition, many public and private programs and activities exist to protect wetlands, but often each program is limited in scope and is not well coordinated with the others. Also, these programs often do not address all of the problems affecting wetlands.

An SWCP can help to integrate programs; avoid duplication of effort; identify problems that need to be addressed; maximize efficient use of budgets, staff, and expertise; and tap or combine unused resources. Twenty States are currently involved in different stages of developing an SWCP; 19 of these States have received financial assistance from EPA. Michigan's SWCP will focus on nonregulatory aspects of wetlands management. New York will work toward a no net loss/net gain goal under its SWCP. California plans to inventory its wetlands, identify crucial wetlands, develop a statewide strategy to plan wetlands protection and restoration, and take a crucial role in overall wetlands regulation through its SWCP. Missouri, Tennessee, Delaware, New Jersey, North Dakota, Ohio, Oklahoma, Oregon, Texas, Louisiana, Alabama, Arkansas, Illinois, Montana, Nebraska, Vermont, and Massachusetts are also pursuing SWCPs.

STATE WETLANDS CONSERVATION PLANS integrate regulatory and cooperative approaches to protect wetlands.

State Wetlands Protection Grants

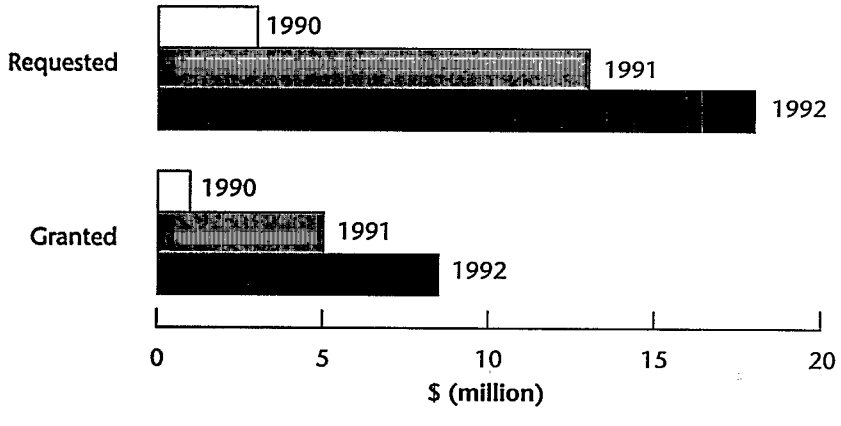
In FY90, Congress first appropriated funds to establish a grant program specifically aimed at supporting State wetlands protection programs. This grant program has provided and continues to provide financial support to States and federally recognized American Indian Tribes to enhance existing State wetlands programs or develop new ones.

Grant funds are available to State agencies administering or developing wetlands protection programs or to State agencies with wetlands-related programs. Since the program began in 1990, these grants have been instrumental in enhancing State expertise in the following areas: Section 404 assumption, Section 401 water quality certification, State Wetland Conservation Plans, watershed approach demonstration projects, improved coordination, and wetlands water quality standards development.

Each year, more States and American Indian Tribes participate in the EPA Wetlands Protection Grants Program and each year funding for the program has grown (Figure 16-2).

Figure 16-2

Funding for Wetlands Protection Projects



Environmental Monitoring and Assessment Program

The wetlands component of EPA's Environmental Monitoring and Assessment Program (EMAP) aims to assess and report the status and trends of ecological conditions in wetlands on regional and national scales. In the short term, the EMAP-Wetlands program will provide standardized protocols measuring and describing wetlands conditions, provide estimates of wetlands conditions in several regions, and develop formats for reporting program results.

Nonpoint Source Pollution and Wetlands

Section 319 of the 1987 CWA amendments created a comprehensive program to integrate Federal and State programs aimed at controlling nonpoint source (NPS) water pollution. The physical location of wetlands between water and land links wetlands protection with abatement of NPS runoff and water quality improvements in adjacent waters. In 1990, EPA published

guidance on the coordination of State and Federal NPS control programs and wetlands protection programs. The guidance discusses the implementation of activities that benefit both NPS and wetlands programs.

Under the NPS control program, Section 319(h) authorizes Federal grants to States with approved assessment reports and management programs. These grants assist the States in implementing the NPS controls identified in their management programs. Thirty-two States received 319(h) funds in fiscal years 1990 and 1991 for NPS control projects with a wetlands or riparian area component. Nineteen of the projects involved protection or restoration of wetlands or riparian areas. Other projects involved program development, education and training materials development, or wetlands construction.

Swampbuster

The swampbuster provisions of the 1985 and 1990 Food Security Acts ("Farm Bills") deny crop subsidy payments and other agricultural benefits to farm operators who convert wetlands to cropland after December 23, 1985—the date the 1985 Farm Bill was signed into law. The U.S. Department of Agriculture's Soil Conservation Service (SCS) is responsible for determining compliance with swampbuster provisions and for determining whether agricultural wetlands sites fall under the jurisdiction of the swampbuster provisions. EPA and the COE have sole authority to determine Section 404 jurisdiction.

State Programs to Protect Wetlands

States protect their wetlands with a variety of approaches, including use of CWA authorities (such as Section 401 and 303), permitting programs, coastal management programs, wetlands acquisition programs, natural heritage programs, and integration with other programs. For this report, States described particularly innovative or effective approaches they use to protect wetlands.

State-Reported Information

The following trends emerged from individual State reporting:

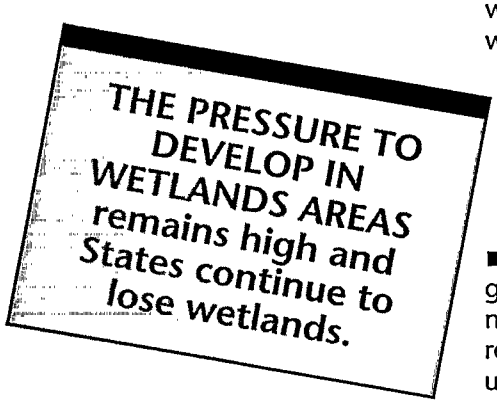
- States are making progress in developing wetlands water quality standards.

- States are beginning to incorporate wetlands considerations into other programs.

- States are working with the Army Corps of Engineers and other State and Federal agencies to coordinate Section 404 permit reviews and Section 401 certifications.

- A large number of States reported that they denied Section 401 certification of Section 404 nationwide permits.

- The pressure to develop in wetlands areas remains high based on the number of Section 404 permit applications States are receiving.



■ States continue to lose wetlands.

Some highlights from individual State reports are as follow:

■ Alaska reported that it integrates wetlands protection into existing water quality programs such as nonpoint source pollution control, ground water protection, and wetlands monitoring through land use planning and local controls.

■ Arizona reported that it has integrated wetlands protection into the nonpoint source program. Arizona reported an incident in which it used Section 401 certification to require changes to an original plan to reduce wetlands loss from 20 to 3 acres.

■ Florida reported that it has in place a joint Federal/State application form for dredge and fill projects. In addition to direct dredging and filling, the quantity and quality of water delivered to wetlands is extremely important to wetlands integrity in Florida. The most notable example is the Everglades in southern Florida. Florida also mentioned that degraded wetlands are used primarily for treatment of storm water; in these cases, restoration of the hydroperiod is an important goal and extensive monitoring is sometimes required.

■ Wisconsin, which recently had its wetlands water quality standards approved by EPA, reported that wetlands water quality standards appear to be the most effective mechanism for protecting wetlands. Wisconsin's Department of Natural Resources reported that it will be making use of its 401 certification authority now that standards are in place. The State is also considering implementing a wetlands monitoring program.

Wisconsin also reported that standards may influence Federal Energy Regulatory Commission (FERC) dam relicensing, Wisconsin Pollution Discharge Elimination System permits to discharge treated wastewater, landfill siting and Superfund cleanup activities, fish and wildlife management decisions, construction and operation of cranberry marshes, park acquisitions, selection of best management practices in priority watersheds, and chemical applications for controlling aquatic weeds.

■ Louisiana reported that 401 certification in coastal areas is more effective when done in conjunction with coastal use permits. Louisiana is sponsoring wetlands research to find out how wetlands respond to municipal wastewater and processing wastewater. The State developed numeric biocriteria in the Thibodaux swamp.

■ Rhode Island denied 401 certification for most nationwide permits, feeling that these projects should be reviewed individually. It also reported that the Department of Environmental Management's Division of Forest Environment and the Freshwater Wetlands Division coordinate on forest management plans.

■ South Dakota reported that it is developing a comprehensive, interagency, statewide wetlands protection program.

■ Idaho reported that it used its 401 certification authority to prevent the draining of significant wetlands as part of a residential development. Idaho is currently in the process of developing 401 certification regulations; one objective of these regulations is to include wetlands impacts in the 401 certification process.

■ Indiana reported that largely through placing conditions on 401 certification of permits, the State is obtaining approximately 3 acres of wetlands as mitigation for every acre lost.

■ South Carolina denied certification for nationwide permit 26 because it believes that protection of isolated and headwater wetlands is imperative for South Carolina to achieve the goals of the CWA.

■ North Carolina has a State General Permits Program for 404 permits and has developed a State wetlands rating method currently used in 401 certification evaluations.

■ The Pennsylvania Department of Environmental Resources (DER) reported that it has adopted a joint permit application with the COE that enables applicants to enter both State and Federal permit review processes with one application. An Environmental Review Committee, consisting of representatives from the U.S. Fish and Wildlife Service, Pennsylvania Game Commission, Pennsylvania Fish and Boat Commission, EPA, COE, and DER, meets monthly to review selected applications submitted under Section 404. The DER receives 1,500 applications each year for water obstruction permits under the Dam Safety and Encroachments Act of 1978, which establishes DER's jurisdiction for the protection of wetlands. The DER reported that there are 3,000 violations of the Act each year, 75% of which involve wetlands resources.

■ Hawaii reported that it denied 401 certification for all nationwide permits.

■ Virginia reported that it uses a joint permitting process that allows applicants to submit one application to the Commission, which coordinates review with appropriate agencies whose comments are considered in development of or denial of 401 certification. Virginia denied certification of nationwide permit 26 for areas greater than 1 acre. It also denied three other nationwide permits because associated impacts would not be addressed adequately through other regulatory processes (e.g., FERC licensing procedures and storm water management pond construction).

WISCONSIN REPORTED THAT WETLANDS WATER QUALITY STANDARDS appear to be the most effective mechanism for protecting wetlands.

■ Texas reported that it received a wetlands protection grant to improve its 401 certification program.

■ Minnesota reported that it is undertaking a permit simplification program. It wants to produce a combined permit application that may serve as an application for a 404 permit and as notification to Minnesota's Department of Natural

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Louisiana Coastal Wetlands Program

Coastal Louisiana is losing marshes and swamps at a rate of 25 square miles per year. Yet, Louisiana's remaining 10,160 square miles of coastal marshes account for 40% of the Nation's marsh resource, support 25% of the Nation's fishing industry, support the largest furbearing trade in North America, and provide habitat for more than two-thirds of the wintering waterfowl on the Mississippi flyway.

Historically, the Mississippi River carried extremely large quantities of sediment that formed most of Louisiana. Under natural conditions, water would overflow onto surrounding land via overbank deposition. This water would be dispersed through an extensive network of delta tributaries, depositing large volumes of sediment in the surrounding marshes and wetlands. Through these deltaic building processes, wetlands generation kept pace with natural subsidence and sea level rise.

In modern times, levees built along the Mississippi River prevent fresh water and sediment from overflowing into coastal wetlands during floods. Without this replenishment of sediment, wetlands and marshes are gradually deteriorating to open water. Exacerbating this problem are the numerous navigation and oil and gas pipelines and flood control levees that speed the river's flow, which prevents sediments from settling out over the marshes. As a result, sediments are not captured and enter the deep waters of the Gulf of Mexico. It is estimated that Louisiana's land loss is directly attributable to the marshes not being able to capture sediment and provide subsequent accretion. For example, between 1954 and 1963, subsidence rates were 1.32 centimeters per year, while backmarsh accretion rates were approximately 0.72 centimeters per year. Coupled with subsidence, sea level rise is estimated to be 0.3 meters per century, further endangering wetlands resources.

To address this national resource crisis, the U.S. Congress passed the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) (P.L. 106-646) in 1990. The CWPPRA authorizes appropriations for up to approximately $70 million dollars a year, depending on small gasoline tax revenue collections, to develop priority restoration projects. Under the Act, a list of priority projects is sent to Congress each year for projects

to be funded and implemented during the coming fiscal year.

In addition, the CWPPRA mandates a plan to restore coastal Louisiana. Possible options will be presented in the Comprehensive Coastal Restoration Plan for decreasing wetlands loss and restoring the Mississippi Delta. The Plan, currently under development, divides the delta into nine distinct hydrologic units or basins. The overall plan selects alternatives to aggressively approach the rebuilding and maintenance of the coast by initiating growth of a new delta through enhancement of natural processes, except in areas where erosion is severe. Other strategies include enforcing the barrier island chain as a primary defense to protect inland wetlands, decrease the advance of saltwater intrusion, and decrease the wave energy of the Gulf in the marshes and estuaries. The major objectives of this plan will be to determine the maximum use of the flow of sediment of the Mississippi River; to create and sustain wetlands; to possibly curtail wetlands loss; and to restore the first line of defense–the barrier island chain.

In addition to the restoration efforts in Louisiana, resource protection of wetlands may benefit across the country through information gained from this large-scale restoration effort:

- New restoration strategies and techniques, as well as coastal erosion prevention techniques that are being developed and demonstrated through this effort, may provide viable restoration options for other areas of the country.

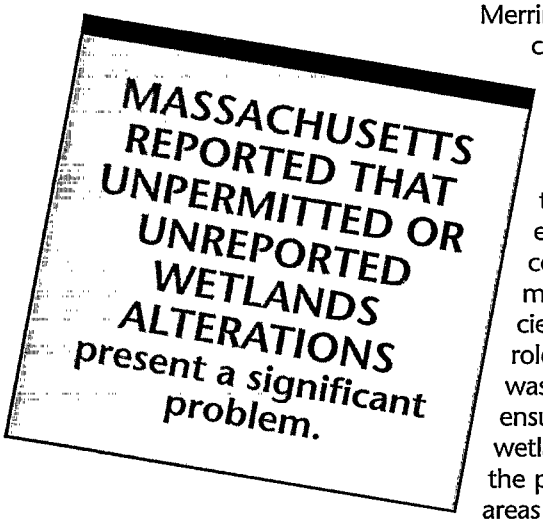
- Methodologies will be developed to evaluate the relative benefits of these environmental projects.

- Intensive monitoring will allow detailed analysis to determine the success of individual restoration project techniques and document these techniques as successful in a summary Report to Congress.

- The intensive planning process will be documented and planning techniques may be transferred to other areas of the country where dramatic wetlands loss is occurring or where intensive resources are targeted to address wetlands loss and degradation.

Resources (DNR), SCS, and local governments. The Governor of Minnesota issued an Executive Order in January 1990 directing all State departments and agencies to follow "no net loss" of wetlands policy and requiring them to protect, enhance, and restore the State's wetlands to the full extent of their authority. Minnesota reported that it will be expanding its antidegradation policy to include a sequencing review process, requiring avoidance/minimization of impacts before considering a project for approval.

■ The Massachusetts Department of Environmental Protection (MDEP) reported that unreported or unpermitted wetlands alterations continue to present a highly significant problem. In response, it is undertaking a pilot project in Merrimack River Watershed that combines legal assistance to municipalities with an increased focus on enforcement actions with multiple resource interests. MDEP also reported that it has spent considerable effort in coordinating wetlands considerations within its department and with other State agencies. One area mentioned is its role in revising the hazardous waste site cleanup program to ensure maximum protection of wetlands. Massachusetts said that the pressure to develop in wetlands areas and buffer zones remains high throughout Massachusetts with an estimated 5,300 applications expected to be received during FY92.



■ Ohio reported that it applies its antidegradation policy to wetlands, which are classified as State resource waters. Ohio EPA has denied 401 certification for fill projects and reduced the scope of proposed activities in wetlands by issuing conditional certification. Two examples of the types of conditions it is requiring are: an unmaintained buffer area around mitigation wetlands and existing wetlands and extensive monitoring of water quality, sediment, vegetation establishment, and hydroperiod for 5 years.

■ Wyoming reported that the only mechanism it has at present to require preservation of any particular wetland is to show that the destruction of that wetland will result in an exceedence of an ambient water quality standard.

Opportunities and Recommendations from States

Several States identified challenges and opportunities for the future and came up with specific recommendations on how to improve wetlands protection.

■ Hawaii recommended that wetlands protection would improve if "wetlands planning" and "regulatory administration" functions were consolidated into a single State agency.

■ Oregon reported that it lacks the capability for assessing and monitoring ecological and water quality functions of wetlands. This inhibits its ability to establish definitive wetlands-specific beneficial uses and criteria to protect those uses.

■ Alabama recommended that activities that impact wetlands such as draining and logging operations be regulated in addition to discharges.

■ Arizona recommended that the Army Corp of Engineers' area of interest be expanded to include the 100-year floodplain. In addition, the State recommended that the COE definition of wetlands be revised to better accommodate arid climates.

■ Rhode Island suggested that jurisdiction extend to some activities adjacent to wetlands. To illustrate the need for such protection, it offered as an example the clearing of natural vegetation adjacent to wetlands. This can result in decreases in the natural filtering capacities of wetlands and in concomitant increases in runoff velocities and pollutant loads.

■ Florida said that the quantity and quality of water delivered to wetlands is an issue and cited as the most notable example the Florida Everglades in southern Florida.

■ Louisiana called for a permitting system in which requests are considered on the basis of the whole landscape.

■ Wisconsin reported that the all or nothing delegation of the Section 404 permit program to the States is inflexible. Wisconsin expressed concern that it will become swamped by the 404 permit process due to its denial of nationwide permits. Specifically, the State feels that changes in the COE's approach to permitting is resulting in case-by-case calls under 401.

FLORIDA REPORTED THAT THE QUANTITY AND QUALITY OF WATER DELIVERED TO WETLANDS is an issue, especially in the Florida Everglades.

■ Pennsylvania reported that it will not change criteria for wetlands until EPA comes out with aquatic life criteria specifically for wetlands.

■ Massachusetts reported that more attention and effort must be provided for long-term project monitoring, especially for wetlands replication projects.

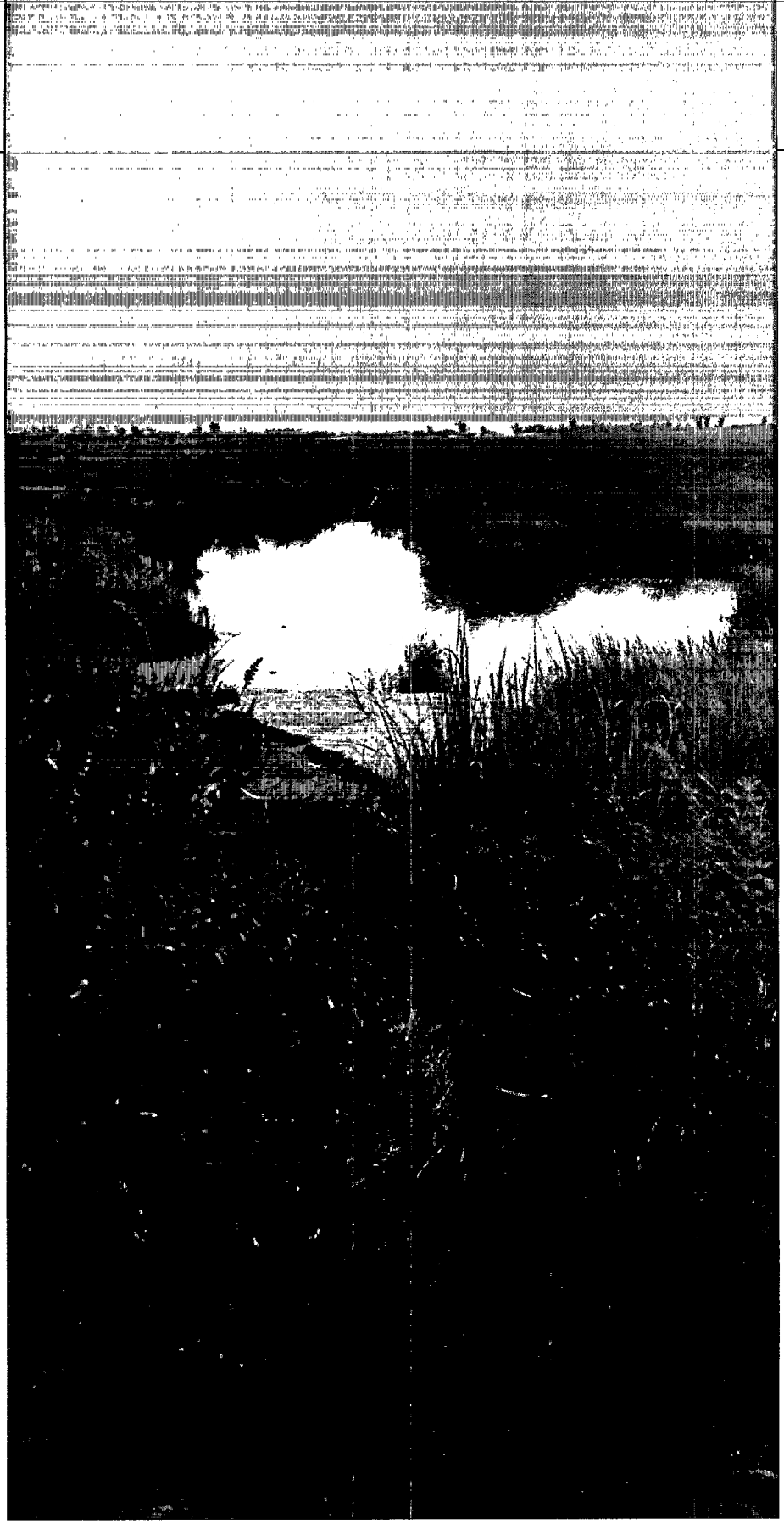
■ Delaware reported that certain activities allowed in wetlands through nationwide permits have an adverse cumulative impact. It gave as an example a house built on pilings in wetlands that must then be connected to underground utilities.

Summary

There are a variety of public and private programs to protect wetlands. A forum was held in 1987 to coordinate these and provide national direction in the area of wetlands. Section 404 of the Clean Water Act is the major Federal program for regulating activities in wetlands. Other important tools to protect wetlands include wetlands water quality standards, State water quality certification, State wetlands conservation plans, swampbuster provisions of the Farm bills, as well as incorporating wetlands considerations into other programs.

States reported that they are making progress in developing their programs to protect wetlands, especially in the areas of application of 401 certification, development of water quality standards for wetlands, and formation of more efficient joint application procedures for permits. Despite these efforts, States reported that they continue to lose wetlands and the pressure to develop in wetlands remains high. In addition, there is little known about the quality of the remaining wetlands. States put forward a variety of recommendations on how to improve protection of wetlands, including consideration of wetlands on a landscape or ecosystem basis, development of scientific tools for States to assess and monitor ecological and water quality functions of wetlands, greater sensitivity for arid climates, and regulation of additional activities that impact wetlands.

More information on wetlands can be obtained from EPA's Wetlands Hotline at 1-800-832-7828 (9 a.m. to 5 p.m., eastern standard time).



Ground Water Protection Programs

The EPA is responsible for 20 programs related to ground water protection. EPA has issued National Guidance to assist States in developing Comprehensive State Ground Water Protection Programs (CSGWPPs), which are a key component of the Agency's Ground Water Protection Strategy. Several concepts are fundamental to this new approach to ground water protection:

1. States have the primary responsibility for ground water protection

2. The CSGWPP approach is resource-oriented, using resource protection needs to guide priorities across programs, focusing on the highest priorities first

3. In partnership with States, EPA will organize coordinated Federal interagency approaches

4. In organizing a coordinated Federal approach, EPA will stress development of consistent Federal policies and regulations.

Comprehensive State programs will be the focal point for long-term joint commitments between the Federal government and the States. These programs promote a more coherent and comprehensive approach to protecting the Nation's ground water resources, with emphasis placed on preventing contamination. State activities will center on

- Ground water protection goals
- Resource characterization and priority setting
- Coordination mechanisms
- Roles and responsibilities
- Implementation programs
- Data management
- Public participation.

Federal programs will support CSGWPPs by offering programmatic and funding flexibility and by targeting Federal efforts to better address the unique needs and priorities of each State. Highlights of a number of Federal and State ground water protection programs are presented according to the following protection categories: resource protection, pollutant source control, nonpoint source control, and chemical product control.

STATES have the primary responsibility for ground water protection.

Resource Protection

Ground water protection activities are addressed under the Clean Water Act (CWA), the Safe Drinking

Water Act (SDWA), the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the Toxic Substances Control Act (TSCA), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the Pollution Prevention Act (PPA).

Comprehensive State Ground Water Protection Program

The CSGWPP approach embraces all the above-mentioned ground water protection activities. As an integral part of the CSGWPP approach, EPA is committed to identifying or developing new opportunities for State flexibility within the Agency's various ground-water-related programs. For instance, under EPA's regulations on municipal landfills under Subtitle D of the Resource Conservation and Recovery Act, States may make site-specific decisions on landfill design or monitoring requirements based, in part, on the relative vulnerability of the ground water. Decisions related to corrective action at municipal landfills may be based on the underlying ground water's use, value, and vulnerability.

EPA expects that the Agency's endorsement of States' CSGWPPs will be key to eliciting the involvement and support of other Federal agencies, as well as EPA programs, in the CSGWPP process. The U.S. Geological Survey, for example, could target mapping of aquifer recharge areas, studies of ground and surface water interactions, and other similar activities to areas of high-priority ground water as identified by the State. Other Federal agency programs, such as the Department of Agriculture's Soil Conservation Service, Extension Service, and Cooperative State Research Service, could similarly focus technical assistance, education, and research activities related to ground water on State priorities.

EPA intends the CSGWPP approach to be the catalyst for fundamental changes in the development and implementation of ground water protection programs at the Federal, State, and local levels. These changes will lead to increased integration of all ground water protection efforts, linked by a comprehensive resource-based perspective and State-directed priorities. As a result, EPA anticipates that coordination will be significantly enhanced and ground water resources will be protected more effectively.

Clean Water Act

In the CWA (Public Law 92-500) of 1972 and in the CWA Amendments of 1977 (Public Law 95-217), Congress provided for the regulation of discharges into all navigable waters of the United States. Ground water protection is addressed indirectly by several components of this Act, specifically with respect to areas where surface water and ground water are hydraulically connected. Funds allotted under Section 106 of the CWA are intended to assist States in the prevention and abatement of surface and ground water pollution. Section 104(b)(3) allows grants to support State programs

that focus on pollution prevention, reduction, and elimination. Grants to facilitate the development of water quality management plans by States and regional comprehensive planning agencies are allotted under Section 604(b).

Safe Drinking Water Act

The SDWA (Public Act 93-523) was passed by Congress in 1974 and amended in 1986 in response to accumulating evidence that unsafe levels of contaminants in public drinking water supplies, including ground water, were posing a threat to the public health. There are several major provisions to the Act that impact ground water quality. The Act provides protection to ground water through the establishment of drinking water standards, sole source aquifer designation, and the establishment of the Wellhead Protection Program and the Underground Injection Control Program. Standards known as maximum contaminant levels (MCLs) were developed under the SDWA and also may be used for enforcement in ground water monitoring programs.

Drinking Water Standards

EPA, under the SDWA, seeks to ensure that public water supplies are free of contaminants that may cause health risks and to protect ground water resources by preventing the endangerment of underground sources of drinking water. EPA has pursued a twofold approach, protecting drinking water at the tap and preventing contamination of ground water sources of drinking water supplies. The 1986 Amendments provided for an expanded Federal role in protecting drinking water, mandating sweeping changes in nationwide safeguards, and new responsibilities to enforce them in the event of State inaction.

EPA's strategy has been to usher in a comprehensive level of drinking water protection by maximizing voluntary compliance through a balance of enhanced enforcement presence, pollution prevention, State capacity building, mobilization of local government support and innovative partnerships. EPA has established its implementation priorities according to the degree of human health risk, focusing on four classes of contaminants with the highest health risks nationwide: microbiological pathogens, lead, radionuclides and disinfection byproducts. Similarly, enforcement priorities, embodied in the definition of Significant Non-Compliance (SNC) of Public Water Systems (PWSs), have been risk based.

EPA has also focused on the prevention of contamination of vulnerable ground water resources by assisting States in the development and implementation of comprehensive ground water protection strategies. These strategies address both the full range of actual and potential sources of ground water contamination and provide for wellhead protection activities in the areas around public water systems. In addition, EPA has targeted specific activities to protect drinking water sources from the harmful effects of injection of wastes and other fluids. In particular, EPA is increasing emphasis on the vast number of diverse shallow (Class V) injection

wells by developing new regulations, and reviewing the permitting of Class I hazardous waste wells.

Wellhead Protection Program

The 1986 Amendments to the Safe Drinking Water Act established the Wellhead Protection (WHP) Program. Under SDWA Section 1428, each State must prepare a WHP Program and submit it to EPA for approval. The objective of this program is to protect ground water quality by identifying the areas around public water supply wells that contribute ground water to the well and managing the potential sources of contamination to reduce threats to the resource in that area.

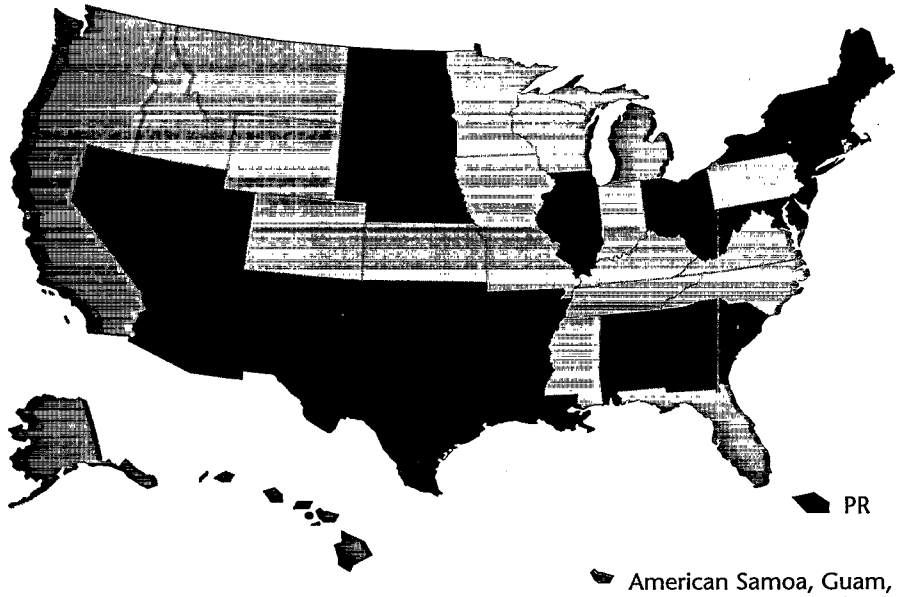
27 States
had EPA-approved WHP Programs in place by the end of 1992.

By the end of December 1992, a total of 27 States and Territories had EPA-approved WHP Programs in place (Figure 17-1). EPA is currently working with the remaining States and Territories to help them develop WHP Programs. EPA's Office of Ground Water and Drinking Water is supporting the development and implementation of WHP Programs with Wellhead Protection Demonstration grants and a cooperative agreement with the League of Women Voters (LWV). An additional form of EPA-funded support is provided through the National Rural Water Association (NRWA) Wellhead Protection programs as depicted in Figure 17-2.

In fiscal years 1990-1992, EPA awarded $3,400,000 in WHP demonstration grants for a total of 116 projects. Through these projects, municipalities and American Indian Tribes design and test ground water protection approaches that may be applied statewide in developing and implementing effective WHP programs. In 1991, EPA funded a 2-year cooperative agreement with NRWA to promote ground water protection. At the conclusion of the first 18 months of the NRWA program, over 550 communities in 14 States were actively involved in developing their own WHP programs. Also in 1991, EPA funded the first year of a 3-year cooperative agreement with the LWV. One objective of the LWV program is to develop and test models of community outreach in

Figure 17-1

States with EPA-Approved Wellhead Protection Programs



18 communities, which are designed to stimulate development of WHP programs or similar ground water protection programs.

According to the States' 305(b) reports, WHP programs have taken varying forms in different States. Among the stages of WHP program development reported by States are

- Grants to communities to explore and tailor WHP approaches
- Mapping of sensitive ground water protection areas
- Establishment of mandatory WHP programs to protect public water-supply wells
- Establishment of public education and outreach programs
- Establishment of specific protection criteria for wells tapping confined aquifers and more stringent protection criteria for wells tapping unconfined aquifers.

Sole Source Aquifer Program

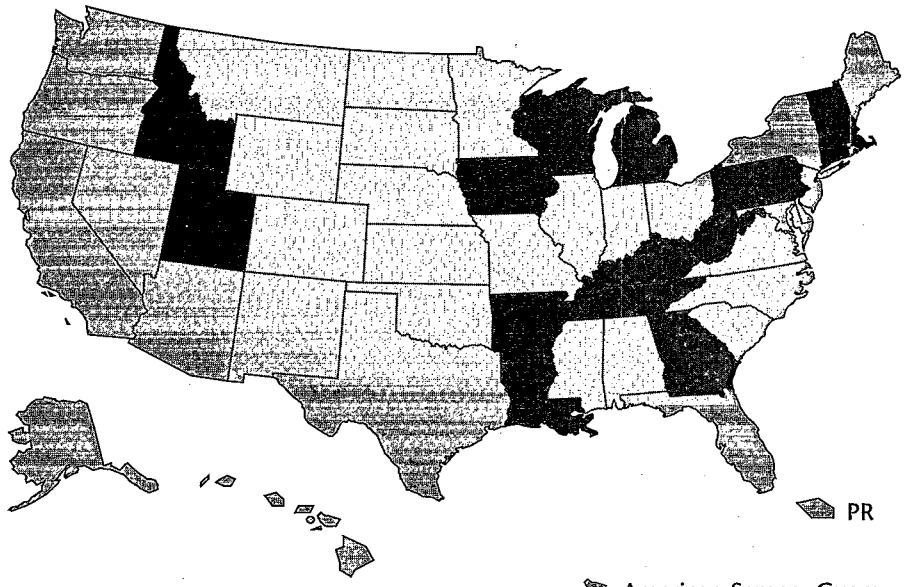
The Sole Source Aquifer (SSA) program was established under Section 1424(e) of the SDWA of 1974. The program allows individuals and organizations to petition the EPA to designate aquifers as the "sole or principal" source of drinking water for an area. EPA has approved 58 SSA designations nationwide and 12 petitions are currently being evaluated for possible designation. An SSA designation authorizes EPA to review plans for Federal financially assisted projects in the subject area to determine the potential for aquifer contamination that would create significant hazards to public health.

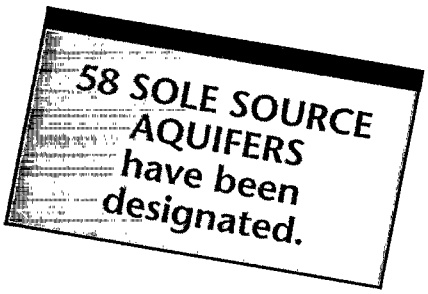
After designation, no commitment of Federal financial assistance may be made to a project that is found through EPA review to have the potential to contaminate the aquifer and create hazards to public health. Federal financially assisted projects eligible for review under the SSA program may include highway construction projects, animal waste disposal plans, airport construction approved by the Federal Aviation Administration, deep water dredging projects proposed by the Army

15 States
had established NRWA Programs by the end of 1992.

Figure 17-2

States with National Rural Water Association Wellhead Protection Programs





Corps of Engineers, and subway construction projects.

Between fiscal year 1991 and fiscal year 1992, the number of Federal financially assisted projects reviewed for potential impacts on designated sole source aquifers grew while the number of projects found to have potential impacts declined (Table 17-1). This decline could be attributed to an increased awareness of potential ground water impacts. Petitioners for and agencies offering Federal financial assistance are designing projects to minimize potential adverse effects on ground water.

In fiscal year 1991, EPA required modifications to 25 projects and denied approval to four projects because of their potential to contaminate the sole source aquifer over which they were planned. In contrast, EPA required modifications in only six projects and denied approval of only one project during fiscal year 1992.

Project modifications due to SSA concerns include

- Highway storm water drainage system construction
- Installation of clay/synthetic liners for wastewater ponds and lagoons
- Rehabilitation of water wells
- Alteration of highway bridge construction design
- Installation of pollution abatement equipment.

EPA denied approval to projects, based on SSA concerns, that submitted insufficient information regarding ground water protection or insufficient project plans to ensure ground water protection.

Table 17-1. Status of Federal Financially Assisted Projects Reviewed by EPA Under the Sole Source Aquifer Program

Fiscal Year	Number of Projects Reviewed	Number of Projects Modified to Prevent Potential Contamination of a Sole Source Aquifer	Number of Projects Not Recommended Due to Potential Contamination of a Sole Source Aquifer
1990	159	20	0
1991	152	25	4
1992	214	6	1

State Ground Water Protection Programs

States are currently working in conjunction with Federal and local agencies to provide the necessary educational, financial, and technical assistance required to restore impaired water resources, to prevent future impairment, and to evaluate the effects of these activities on ground and surface water resources. Many States have reported on a variety of activities intended to address ground water contamination and the sources of these contaminants. These activities include adopting and implementing best management practices and ground water protection strategies, enacting legislation aimed at the development of ground water protection programs and coordinating the efforts of local, State, and Federal agencies in meeting the goals of ground water protection.

The ground water protection activities reported in State 305(b) reports provide only a partial picture of State efforts to protect ground water. As an initial step in implementing CSGWPPs, EPA and States are developing individual State

assessments during fiscal year 1993. These assessments will better document the full range of State ground water protection activities.

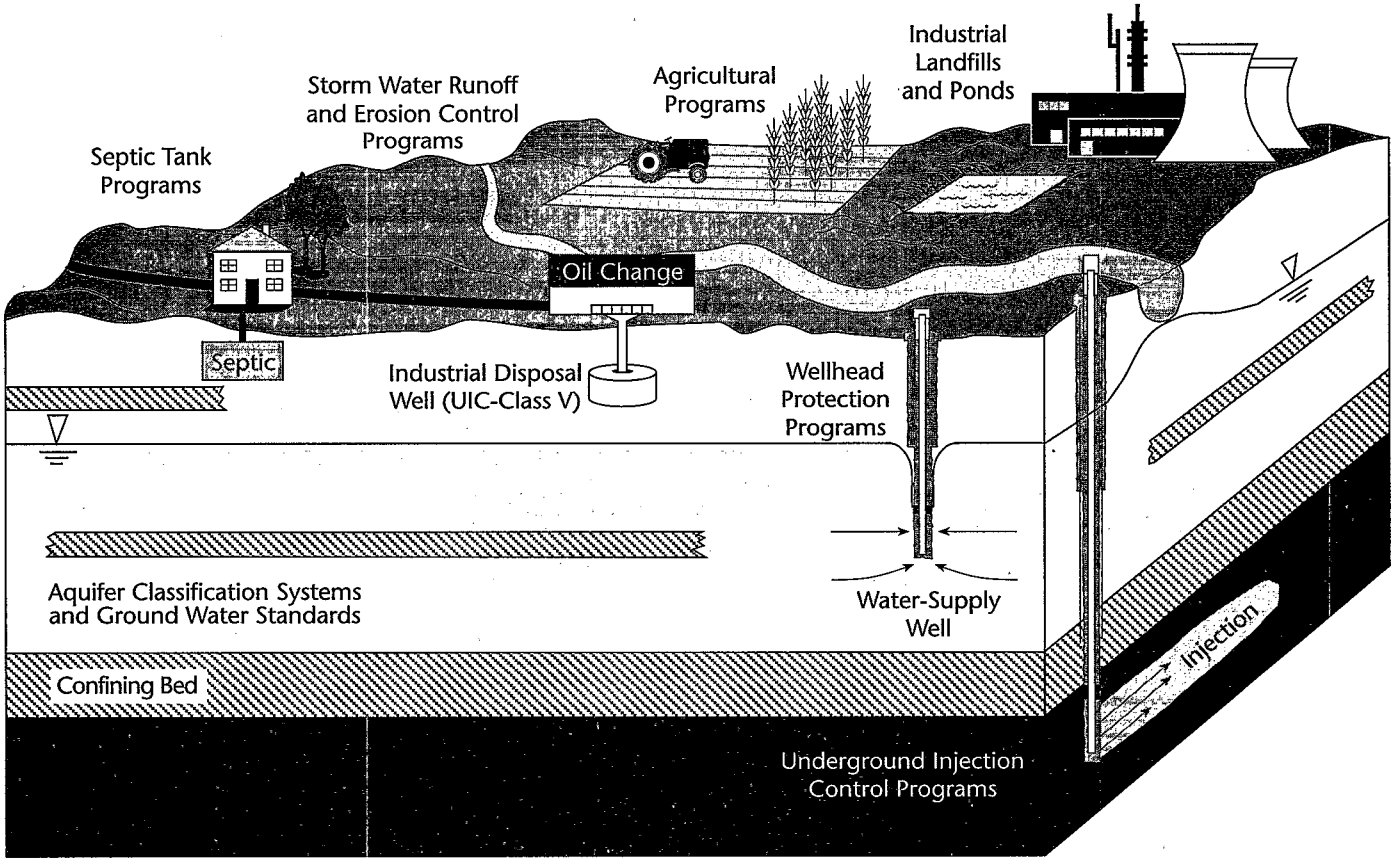
The principal State programs and strategies that address ground water protection are depicted in Figure 17-3. These include agricultural programs, septic tank programs, certification programs for well drillers or pesticide applicators, storm water runoff and erosion control programs, underground injection control programs, aquifer classification systems, ground water standards, and strategies aimed at controlling contamination from industrial landfills and ponds.

Figure 17-4 shows ongoing State ground water protection programs reported in 1992. Components of State ground water protection programs are summarized in Table 17-2. The table identifies

- Ground water protection legislation that has been adopted or is under development by State governing bodies.

Figure 17-3

Types of State Ground Water Protection Programs



- Wellhead Protection Programs that have been submitted, reviewed, or approved by EPA

- Ground water strategies or Comprehensive State Ground Water Protection Program initiatives that have been adopted or are under development

- State-specific ground water protection standards

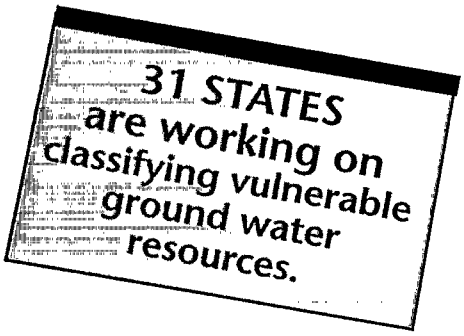
- Statewide ground water monitoring programs or initiatives that consist of a statewide network of wells periodically sampled and analyzed for specific ground water quality parameters

- Aquifer classification or mapping programs to characterize ground water resource regions

- Special programs or methods that address the control or remediation of specific contamination sources

- The existence of a plan, advisory committee, or task force established to facilitate or coordinate interagency ground water protection programs

- Controls or measures established to address nonpoint source contamination.



State Ground Water Standards

Although many States have used Federal drinking water standards to direct their ground water protection activities, a number of States have tailored standards to their specific conditions. State ground water protection standards can be either narrative or numeric. Numeric standards set health-based maximum contaminant levels. Narrative standards are adopted for pollutants for which no numeric standards have been adopted.

Minnesota updated their standards in 1990, adding 53 toxic pollutants and a detailed set of procedures to establish criteria for adding toxic pollutants. That State has also set Recommended Allowable Limits (RALs) that may be enforced at a later time. Arizona has drafted Health-Based Guidance Levels for 230 chemicals, including pesticides, organics, metals, and other inorganics in drinking water. A total of 35 States reported the development or implementation of State ground water protection standards.

State Aquifer Classification Systems

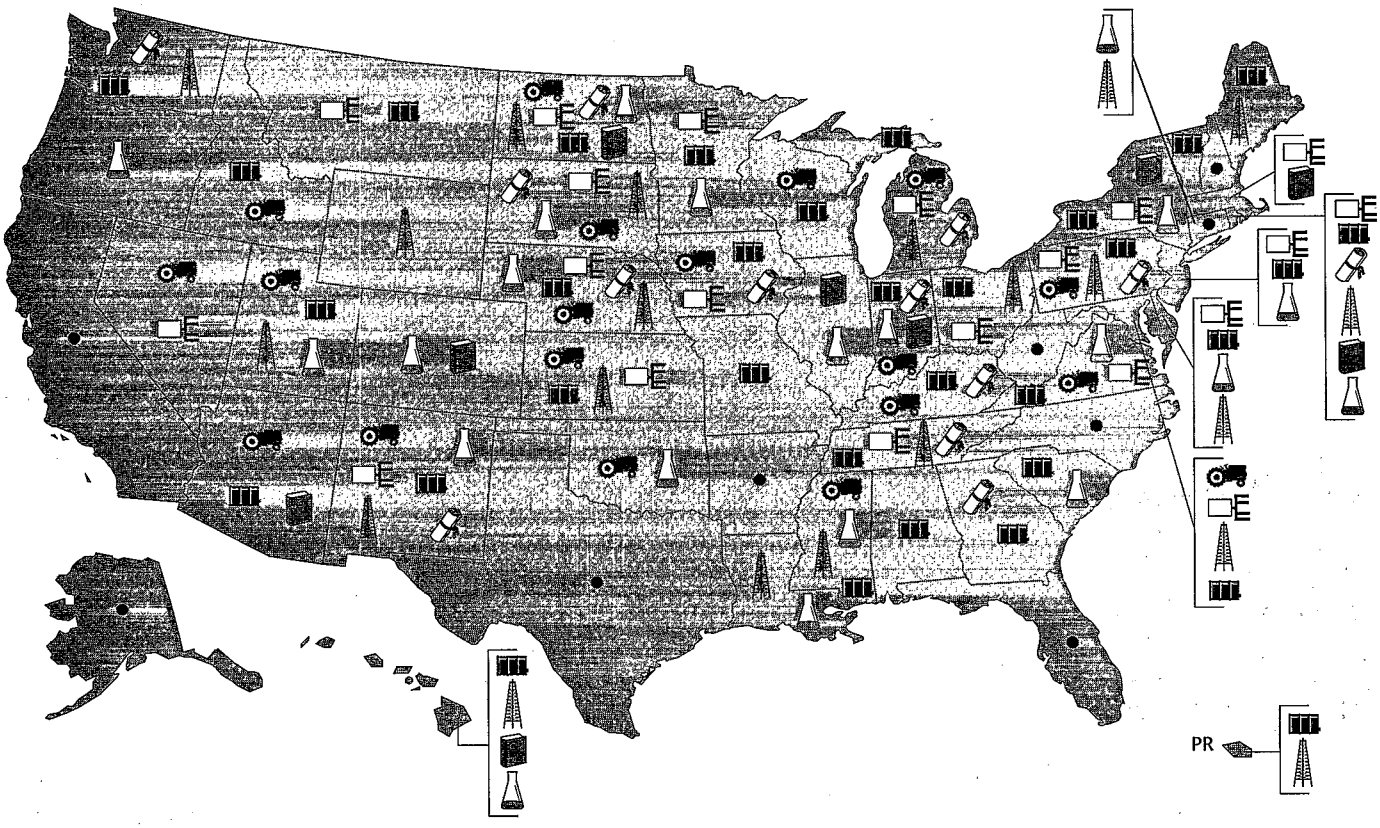
Thirty-one States report the existence or development of programs to classify or map vulnerable ground water supplies. State programs are combining elements of Federal guidelines along with elements aimed at meeting the individual State's needs and problems. Ground water is classified by factors such as the intended ground water use, current ground water quality, and hydrology.

Massachusetts currently classifies its ground water according to its most sensitive use. The three ground water classes in Massachusetts are

- Class I: fresh ground water designated as a source of potable water supply

Figure 17-4

Ongoing Ground Water Protection Programs of States and Territories Reporting



Note: This map excludes Wellhead Protection Programs. Not shown are American Samoa, Guam, and the Virgin Islands. Programs in those Territories either were not reported or are under development.

Source: 1992 State Section 305(b) reports.

Table 17-2. Summary of State Ground Water Protection Programs

State	Ground Water Legislation[a]	Wellhead Protection Program	Ground Water Strategy[a]	Ground Water Protection Standards[a]	Statewide Ground Water Monitoring Systems[a]	Aquifer Classification/ Mapping Program[a]	Special Source Controls	Interagency Coordination[a]	Nonpoint Source Controls[a]
Alabama	—	●	●	●	●	○	●	●	●
Alaska	—	□	●	—	●	—	●	●	—
Arizona	●	●	●	●	□	●	●	●	●
Arkansas	—	●	●	□	●	□	●	●	□
California	—	—	●	—	—	—	●	●	□
Colorado	●	○	●	●	□	●	●	●	●
Connecticut	●	●	●	●	—	—	●	●	—
Delaware	—	●	●	●	●	—	●	●	□
District of Columbia	—	—	●	—	□	—	●	●	●
Florida	●	—	●	—	●	●	●	●	●
Georgia	●	●	●	—	●	●	●	●	—
Hawaii	—	—	●	●	●	●	●	●	□
Idaho	●	□	●	○	●	●	●	●	□
Illinois	●	●	●	●	●	●	●	●	□
Indiana	●	□	●	□	□	●	●	●	●
Iowa	●	—	●	—	—	●	●	●	●
Kansas	●	□	●	—	●	—	●	●	●
Kentucky	□	□	●	□	—	—	●	●	●
Louisiana	—	●	●	●	●	—	●	●	●
Maine	●	●	●	●	●	●	●	●	□
Maryland	—	●	●	—	●	●	●	●	●
Massachusetts	—	●	●	●	—	●	●	●	●
Michigan	●	○	●	—	●	●	●	●	●
Minnesota	●	□	●	●	●	●	●	●	□
Mississippi	●	□	●	●	●	—	●	●	●
Missouri	—	—	●	—	●	—	●	●	□
Montana	●	○	●	—	●	—	●	●	●
Nebraska	●	●	●	●	—	—	●	●	●
Nevada	●	○	●	—	□	●	●	●	●
New Hampshire	●	●	●	□	—	□	●	●	□

Table 17-2. Summary of State Ground Water Protection Programs (continued)

State	Ground Water Legislation[a]	Wellhead Protection Program	Ground Water Strategy[a]	Ground Water Protection Standards[a]	Statewide Ground Water Monitoring Systems[a]	Aquifer Classification/ Mapping Program[a]	Special Source Controls	Interagency Coordination[a]	Nonpoint Source Controls[a]
New Jersey	●	●	●	●	●	□	●	●	□
New Mexico	●	●	●	●	●	□	●	●	●
New York	●	●	●	●	—	●	●	●	□
North Carolina	—	—	●	—	—	—	●	●	—
North Dakota	●	●	●	●	□	□	●	●	●
Ohio	●	●	●	□	●	●	●	●	—
Oklahoma	—	●	●	●	●	●	●	●	●
Oregon	●	□	●	□	□	□	●	●	□
Pennsylvania	●	□	●	—	●	—	●	●	●
Rhode Island	●	●	●	●	●	●	●	●	—
South Carolina	—	●	●	●	—	—	●	●	—
South Dakota	●	●	●	●	●	—	●	●	●
Tennessee	—	□	●	—	—	□	●	●	—
Texas	●	●	●	□	●	□	●	●	□
Utah	—	●	●	●	—	—	●	●	●
Vermont	●	●	●	—	□	□	●	●	●
Virginia	●	□	●	●	○	—	●	●	—
Washington	●	○	●	●	—	—	●	●	□
West Virginia	—	●	●	—	—	—	●	●	—
Wisconsin	●	—	●	●	●	●	●	●	●
Wyoming	—	□	●	—	—	□	●	●	□
American Samoa	●	□	●	●	—	—	●	●	●
Guam	—	●	●	—	—	—	●	●	—
Puerto Rico	●	●	●	●	●	—	●	●	□
Virgin Islands	—	—	●	—	●	—	●	●	—
Total[b]	35	46	55	35	38	31	55	55	42

● Program in place.
○ Program under revision or review.
□ Program under development.
— Not reported.

[a] Information derived from 1992 State 305(b) reports.
[b] Total number of programs in place, under development, or under revision or review.

■ Class II: saline ground water designated as a source of potable mineral waters or as a raw material for the manufacture of such products as sodium chloride

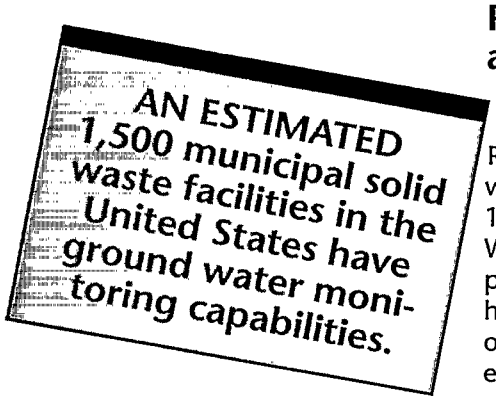
■ Class III: fresh and saline ground water designated for uses other than potable water supply.

People may request by petition a specific use for a local ground water resource. Ground water for which no petition is received is automatically designated as Class I. Ground water quality standards and protection guidelines are strictest for water classified as Class I.

Pollutant Source Control

Four principal programs control pollutant sources under four different laws: solid and hazardous waste treatment, storage, and disposal and underground storage tanks are regulated under RCRA; underground injection of waste fluids is regulated under SDWA; abandoned waste is regulated under CERCLA; and nonpoint sources are regulated under CWA.

Resource Conservation and Recovery Act



The Resource Conservation and Recovery Act (Public Law 94-580) was passed by Congress in October 1976, amending the 1965 Solid Waste Disposal Act to address the problem of safe disposal of the huge volumes of solid and hazardous waste generated nationwide each year. This Act authorizes a regulatory program to identify and manage wastes that pose a substantial hazard to human health or the environment. RCRA is a part of EPA's comprehensive program to protect ground water resources. Protection is achieved through the development of regulations and methods for handling, storing, and disposing of hazardous material and through the regulation of underground storage tanks.

Poorly managed or poorly located municipal landfills rank high among State ground water contamination concerns. Of the quarter million solid waste disposal facilities in the United States, about 6,000 are municipal solid waste facilities. Approximately 25% of these municipal facilities have ground water monitoring capabilities.

Solid and Hazardous Waste

RCRA has evolved from a relatively limited program dealing with nonhazardous solid waste to a far-reaching program that also encompasses the handling, storage, and disposal of hazardous waste. Hazardous waste generators, transporters, and owner/operators of treatment, storage, and disposal facilities (TSDFs) constitute the RCRA-regulated community. On November 8, 1984, Congress passed the Hazardous and Solid Waste Amendments (HSWA) to RCRA, thereby greatly expanding the nature and complexity of activities covered under RCRA.

The goals of RCRA, as set forth by Congress, are

■ To protect human health and the environment

- To reduce waste and conserve energy and natural resources

- To reduce or eliminate the generation of hazardous waste as expeditiously as possible.

RCRA also requires the promulgation of standards related to underground storage tank systems for both chemicals and petroleum products.

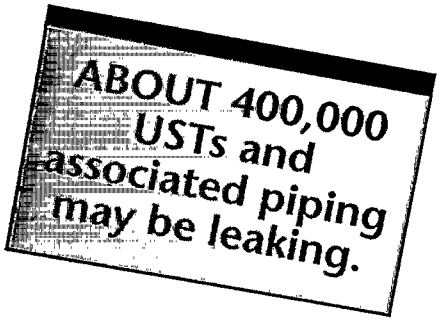
In 1990 and 1991, RCRA programs continued to emphasize the preparation of risk assessment documents and development and evaluation of tests and procedures for conducting risk assessments. Health and Environmental Effects Documents, Reference Doses, and technical evaluations are provided to support the RCRA waste listing, permitting, and land disposal restriction programs. The 1990 program emphasized the development of health and environmental effects documents for the listing/delisting programs and reference doses for the land disposal restriction program. In addition, techniques for determining soil gas concentrations and constituents and for determining ground water contamination potential were evaluated under field and laboratory conditions. Guidelines for monitoring ground water around RCRA Subtitle D landfill facilities are being developed.

Underground Storage Tanks (UST) Program

The EPA is working with State and local governments to develop support for, and improve the effective management of, USTs. To facilitate compliance with UST regulations, EPA is developing standard test procedures for leak detection equipment. These standards will allow tank owners to choose equipment that meets EPA requirements. In addition, a nationwide marketing campaign is being conducted to promote resource-efficient methods for State monitoring of owner/operator compliance. The EPA continues to support the development of State UST regulations and encourages States to apply for UST program approval. The Agency also provides technical advice and assistance in the development and implementation of State UST data management systems.

Under the UST Program, EPA also assists municipalities by providing guarantees to local owner/operators and by encouraging the development of State assurance programs and loan funds. Loan programs may be used by tank owners to upgrade or replace tanks, thereby preventing many leaks from ever occurring. These guarantees and assurance programs help owner/operators to meet their financial responsibility requirements.

In 1990 and 1991, EPA issued final regulations on corrective action, leak detection, and technical performance standards for new and existing tanks that contain petroleum products and hazardous substances. Final regulations concerning financial responsibility requirements were also issued. EPA also negotiated UST grants with all States and provided technical assistance and guidance for implementation and enforcement of UST regulations.



State Underground Storage Tank Programs

About 400,000 of an estimated 5 to 6 million USTs and associated piping are thought to be leaking. About 30% of all tanks store petroleum or hazardous materials. Each State, under RCRA requirements, has designated a State agency that registers new and existing USTs. Thirty-three States have reported that they have UST regulations in place or under development that are no less stringent than Federal regulations. State agencies involved with UST regulations vary, including fire, environmental, public health, or labor departments.

State-reported strategies include annual registration, strict installation requirements, and monitoring standards. They also include oversight of owner and operator compliance with Federal UST technical and financial responsibility requirements. Several States require permitting for USTs. Pennsylvania requires all USTs with a capacity greater than 110 gallons to be permitted. Permits are given only to tank owners who comply with State and Federal siting, design, leak detection, and operation requirements. They also provide a guidance document for tank owners and operators.

Several States, including Virginia and Minnesota, maintain a UST database. Minnesota's database of USTs contains known and potential sources of ground water contamination. Virginia's database tracks upgrades, repairs, and closures of USTs.

Safe Drinking Water Act

Pollutant source control is addressed under the SDWA through the Underground Injection Control (UIC) program.

UIC Regulations

EPA's UIC program was developed to regulate underground injection wells and fluids and thereby ensure that underground sources of drinking water are protected. Injection wells are classified as follows:

- Class I: Wells used to inject hazardous substances or industrial and municipal waste beneath the lowermost formation containing a source of drinking water. There are approximately 80 hazardous waste wells at 175 facilities controlled by stringent design, construction, and operating requirements.

- Class II: Wells used to inject fluids in the process of oil or natural gas production. These more than 170,000 disposal and enhanced recovery wells return brines back down to deep formations.

- Class III: Wells used to inject fluids for the purpose of in situ mineral extraction.

- Class IV: Wells used to dispose of hazardous or radioactive waste into or above an underground drinking water source. These wells are banned.

- Class V: Injection wells not included in the above classifications. These wells include more than 100,000 shallow injection wells such

as those used to dispose of waste from automotive service bays.

Grants allotted under Sections 1443(b) and 1451 of the SDWA may be used to support UIC activities to protect ground water resources. State and Federal UIC programs include permitting and review of permits to ensure that wells meet requirements for well construction, operation, monitoring, plugging and abandonment, and financial responsibility to ensure underground sources of drinking water are not endangered. Section 1422 provides EPA with authority to grant primary enforcement authority (primacy) to States to administer a UIC program in their States. Section 1425 allows an alternative test for EPA to use to approve of a State's UIC program for oil and brine (Class II) wells.

UIC Programs

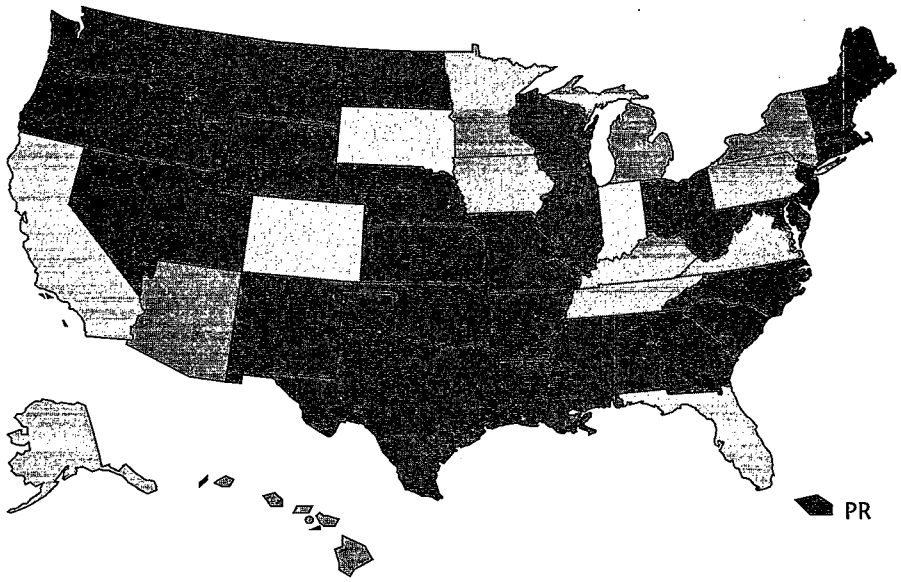
EPA and the States currently administer 57 UIC programs to maintain regulatory coverage of the more than half million underground injection wells. The majority of these programs are State-administered, as depicted in Figure 17-5. State agencies with primary enforcement authority respond to UIC violations. If a response cannot be made in a timely manner, EPA takes enforcement action.

In 1990 and 1991, EPA continued to review "no-migration" petitions for hazardous waste injection wells to ensure conformance with RCRA and UIC provisions. EPA has targeted specific enforcement, outreach, and regulatory activities to protect drinking water sources from the harmful effects of injections of wastes and other fluids through the vast number of diverse Class V injection wells. EPA Regional offices administering UIC programs in nonprimacy States continue to review permit applications for injection wells, and continue oversight of State primacy programs to ensure that UIC permits issued meet program requirements. Regional offices also continue to review petitions from operators of hazardous waste injection wells seeking exemptions from the injection ban under Part 148.

EPA AND STATES regulate more than 500,000 underground injection wells.

Figure 17-5

Underground Injection Control (UIC) Programs



Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act, more popularly known as "Superfund," was passed by Congress in December 1980 to deal with threats posed to the public by abandoned waste sites. Approximately 33,000 sites have been identified as abandoned hazardous waste sites, of which 42% involve ground water contamination. With the Superfund Amendments and Reauthorization Act (SARA) of 1986, CERCLA has assumed a larger role in the cleanup of hazardous waste sites. The main objectives of CERCLA, as established by Congress are

- To develop a comprehensive program to set priorities for cleaning up the worst existing hazardous waste sites
- To make responsible parties pay for those cleanups whenever possible
- To set up a Hazardous Waste Trust Fund for the twofold purpose of performing remedial cleanups in cases where responsible parties could not be held accountable and responding to emergency situations involving hazardous substances
- To advance scientific and technical capabilities in all aspects of hazardous waste management, treatment, and disposal.

MORE THAN 800 million pounds of pesticides are applied to U.S. land in agricultural production.

Grants to States are allotted under Section 104(b) of CERCLA. These funds are intended to support implementation, coordination, enforcement, training, community relations, site inventory and assessment, administration of remedial activities, and legal assistance relating to CERCLA implementation.

Nonpoint Source Control

Funds allotted under Sections 319(h) and (i) and 518 of the CWA are intended to assist States in implementing EPA-approved nonpoint source management programs and ground water protection activities. At least 10% of each State's annual work under these programs should be devoted to priority ground water protection activities. These activities include assessing and characterizing ground water resources, delineating wellhead protection areas, aquifer recharge areas, and zones of significant ground water surface water interactions, establishing a basis for priority protection needs, and addressing ground water protection priorities.

State Nonpoint Source Control/Agricultural Programs

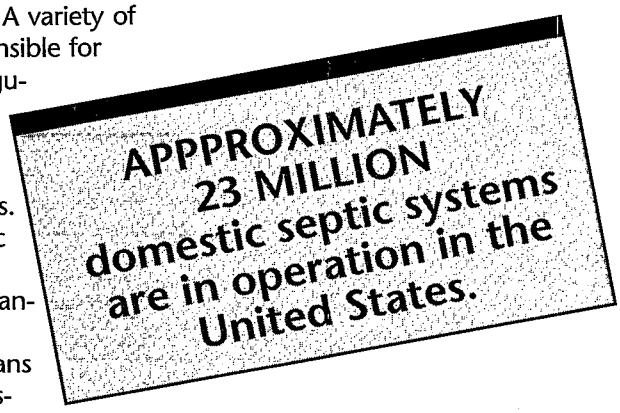
As the need for American farmers to increase their productivity rises so does concern about agricultural nonpoint source pollution. Of the 1.1 billion pounds of pesticides produced annually in the United States, 77% is applied to land in agricultural production. Twenty-seven States have reported that they have either full-scale agricultural

programs or best management strategies in place. Most of these programs focus on controls for nitrate and pesticides.

Arizona, along with several other States, regulates concentrated feeding operations, nitrogen fertilizer application, and agricultural applications of sludge. They also review registered pesticides to determine if their applications have an unreasonable adverse effect on the environment. When pesticide residues are detected in drinking water supplies in Hawaii, the Chairperson of the Board of Agriculture and the Director of Health must suspend, cancel, or restrict the use of that pesticide. Numerous States reported current monitoring of ground water near agricultural regions conducted to determine the need for future programs and strategies.

Educating the public on how farming operations and other land activities may cause pollution is a key component of most State ground water protection initiatives. Kentucky implemented a program that includes instructing farmers on use of agricultural best management practices. The program also affords water-well users an opportunity to have their water tested for nonpoint source contaminants. New York incorporates water quality in farm-level planning, provides technical assistance to farmers, and develops educational programs that heighten awareness of water quality problems that can result from improper land management.

Approximately 23 million domestic septic systems are in operation in the United States. About half a million new systems are installed each year. State septic tank programs incorporate strategies to protect ground water from contamination. Strategies include certification of septic tank installers, construction, siting, operation, and maintenance guidelines. A variety of State agencies are responsible for enforcing septic tank regulations including fire marshals, planning boards, and local and State health departments.



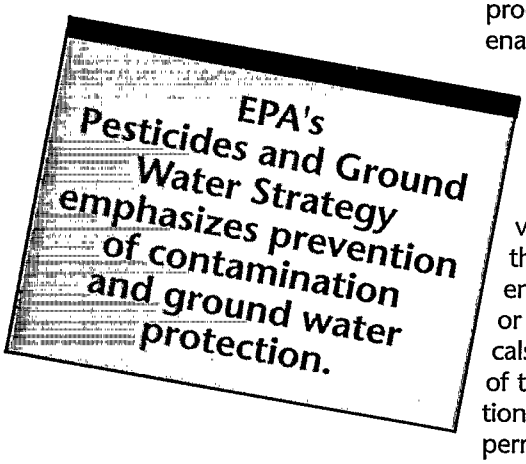
In New Jersey, septic tank regulations are enforced by the Local Planning Board. They must approve construction plans for individual sewage disposal systems and regulate multiple connections to a single septic system. The Ohio Department of Health (ODH) regulates the siting, design, operation, and maintenance of septic tanks. New Mexico requires that each system include a treatment unit and be situated in conformance with local and State siting standards. When necessary, New Mexico officials modify the State's standards on a case-by-case basis.

Chemical Product Controls

The Toxic Substances Control Act and the Federal Insecticide, Fungicide, and Rodenticide Act control the use and disposal of commercial products thereby minimizing the risks to public health and the environment.

Toxic Substances Control Act

The Toxic Substances Control Act (Public Law 94-469), enacted by Congress in 1976, brought significant changes in the day-to-day operation of the U.S. chemical industry. With TSCA, EPA was given the authority to identify and control chemical products that pose an unreasonable risk to human health or the environment through their manufacture, chemical distribution, processing, use, or disposal. To enable EPA to monitor the marketing of new chemicals, TSCA requires manufacturers to submit premanufacture notices on new chemical substances.



EPA is authorized to take a variety of steps to protect against threats to human health or the environment by the introduction or unrestricted use of new chemicals. Such steps include publication of the chemical inventory, information-gathering authority, and permitting access to manufacturing data that could assist in the development of source inventories for ground water protection planning and investigation.

The Federal Insecticide, Fungicide and Rodenticide Act

Under FIFRA, the EPA may deny registration for a pesticide if its normal use will result in unreasonable adverse effects on ground water quality. A number of ground water protection initiatives have been undertaken in support of FIFRA. In 1991, EPA put forth a Pesticides and Ground Water Strategy that establishes the policy framework for using the regulatory authorities available under FIFRA to implement ground water protection principles. The practical objective of this Strategy is the prevention of ground water contamination by regulating the normal use of certain pesticides.

Grants to States are available under Section 23(a)(1) of FIFRA. These funds are intended to promote the enforcement of pesticide compliance and ground water protection programs.

Pesticides and Ground Water Strategy

EPA's Pesticides and Ground Water Strategy describes the national policy framework for addressing the risks of ground water contamination by pesticides. The Strategy discusses EPA's authority under a number of statutes, but focuses on the use of FIFRA authority to achieve the Agency's goals for the protection of ground water from pesticide contamination.

This Strategy emphasizes prevention and protection of the Nation's ground water resources and provides a flexible framework for tailoring programs to the conditions in different geographic areas. The centerpiece of the Strategy is the development of State Management Plans for pesticides that may pose environmental concerns. The management plan approach affords States the opportunity to manage the use of pesticides so as to protect the ground water resource.

EPA has worked with States to develop a framework for the development of comprehensive State Management Plans that will focus on the protection of ground water resources. The management plan approach will allow States the

flexibility to tailor pesticide use and ground water protection programs to local conditions. States have been encouraged to develop this management framework in the form of "generic" management plans. In 1993, EPA plans to release a list of chemicals for which pesticide-specific management plans will be required. The Pesticide State Management Plans may subsequently be integrated with State Comprehensive Ground Water Protection Programs.

Prevention of Ground Water Contamination by Restricting Pesticide Use

Classifying a pesticide for Restricted Use limits its use to certified applicators or supervision by certified applicators. Certification depends upon completion of required training concerning the proper handling and application of pesticides with the potential to contaminate ground water. Restricting use to certified applicators has three practical results for the reduction of ground water contamination:

- Reduction in the population of pesticide users
- Education of the certified users to reduce the ground water contamination risks
- Training and experience in proper mixing and loading of pesticides to reduce the chances of spills or other potential ground water contamination hazards.

Therefore, Restricted Use classification is intended to reduce both the risks of some "point source" causes of ground water contamination as well as nonpoint source causes of contamination.

Pollution Prevention

The Pollution Prevention Act of 1990 was enacted by Congress to promote pollution prevention and environmental protection goals. Under this Act, the EPA Office of Pollution Prevention and Toxics and the USDA Cooperative State Research Service have worked cooperatively to lead the Nation in the development of environmentally sound agricultural policies. The Agriculture in Concert with the Environment Program promotes the use of sustainable agriculture and the integrated management of nutrients, pesticides, resources, and wastes to reduce the risks of environmental pollution. Grants allotted under this Act may be used to fund outreach projects involving education, demonstration, and training in sustainable agriculture and other agricultural practices that emphasize ground water protection and reducing the excessive use of nutrients and pesticides.

Grants are also available under this Act to support State and local pollution prevention programs that address the reduction of pollutants across all environmental media: air, land, surface water, ground water, and wetlands. These grants may be used to promote and coordinate existing State pollution prevention activities that focus on specific media, to develop new multimedia pollution prevention programs, to develop mechanisms to measure progress in multimedia pollution prevention, and to conduct education and outreach programs.

EPA Management of Ground Water Data

A number of mechanisms have been developed to manage the ever-growing volume of information on the Nation's ground water resources. These include the development of a standard nomenclature for reporting ground water data, the development of geographic information systems (GISs) to integrate ground water data that have been collected under different programs, and the development and management of two databases concerning pesticides and ground water.

Minimum Set of Data Elements

In keeping with EPA's Ground Water Protection Strategy for the 1990s, the Agency has identified the need to improve the collection, accessibility, transfer, and use of information on the Nation's ground water resources. Therefore, the Agency has established a Minimum Set of Data Elements (MSDE) for Ground Water Quality. The MSDE are intended to improve access to ground water data and to increase information sharing capabilities by standardizing the elements used in ground water database development. The MSDE is implemented when States, Federal agencies, or other officials are creating or updating ground water quality databases. The 21 data elements in the minimum set are divided into four categories:

- General descriptors pertaining to where the well information is maintained
- Geographic descriptors pertaining to the location of the well in relation to the earth's surface
- Well descriptors pertaining to construction details and other features of the well
- Sample descriptors pertaining to aspects of sample collection, analysis, and recording of the results of ground water sampling.

These elements represent the *minimum* data elements that States and Federal agencies should include during ground water information collection and reporting activities. In addition, formats and conventions for reported data are presented as examples to guide the development of standardized databases and facilitate data sharing.

Cross-Program Integration Approach Using GIS

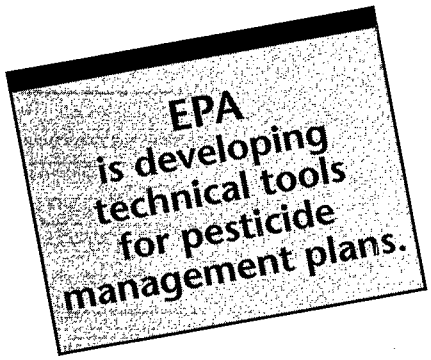
EPA recognizes that it is critical for the Agency to integrate its ground water protection programs and provide assistance to the States as they seek to build State and local capacity. States have the responsibility to implement a number of Federal programs that may impact the quality of surface-water and ground-water resources. For this reason, a project has been undertaken in the EPA's Office of Ground Water and Drinking Water to integrate the information obtained in a number of Federal programs (Public Water Supply, Underground Injection Control, Wellhead Protection, and Comprehensive State Ground Water Protection Program) and to

demonstrate how these programs complement and support each other in protecting ground water and drinking water.

The specific goals of the project are to use GIS to investigate the types of ground water data needed to facilitate State, Regional, and national programs and support the development of Comprehensive State Ground Water Protection Programs and to assess the application of existing data to characterize the contamination threats to the Nation's water supplies. Information on ground water and surface water contaminants will also be used to investigate perceived threats to drinking water supplies and to target critical geographic areas for ground water protection activities. The multiyear project will involve the analysis of data from six study sites that characterize a number of potential ground water contamination threats and various hydrogeologic regimes. It is further hoped that the project will demonstrate an approach for linkage to the USGS NAWQA program and selected State monitoring programs.

Pesticides in Ground Water Database

The Pesticides in Ground Water Database was created by the EPA's Office of Pesticide Programs to provide a more complete picture of ground water monitoring for pesticides in the Nation. It is a collection of ground water monitoring studies conducted by Federal, State, and local governments, universities, and private institutions. The focus of these studies must include the analysis of samples for pesticide residues. The Pesticides in Ground Water Database consists of monitoring data and auxiliary information in both computerized and hard copy form. The computerized portion of the database consists of files describing the study, each monitoring well, and information on ground water samples. This portion of the database is a part of the Pesticide Information Network (PIN), a computerized collection of files that contain pesticide monitoring and regulatory information in an electronic bulletin-board format. The EPA's Office of Pesticide Programs is planning to publish a summary report of the data in the Pesticides in Ground Water Database on approximately a yearly basis.



Prevention of Ground Water Contamination from Pesticides: Information Systems for State Use

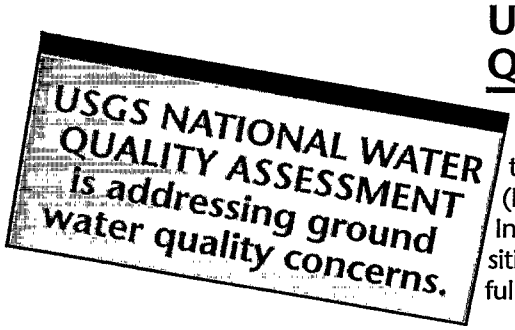
The development of State Management Plans to implement the Pesticides and Ground Water Strategy will require technical information and tools to predict vulnerability of ground water to pesticide use. Some information and tools are available, and others can be developed, to locate problem areas and develop strategies for management of pesticides on a State or local level. These tools include models to predict the leaching of pesticides to ground water, data on soil properties and other relevant environmental factors, GISs for integrating information spatially, and monitoring strategies for detecting and tracking pesticide movement in the

subsurface. The EPA's Office of Research and Development has undertaken a set of projects to provide the technical tools that States may use to develop and implement locally meaningful pesticide management plans. These projects include:

- Development of a user-friendly model or screening system for locating vulnerable soils within a State
- Identification of, and guidance to, the access of useful national databases
- Development of guidance on using GIS for pesticide management
- Development of guidance on monitoring strategies considering temporal, spatial, and environmental factors affecting pesticide occurrence and transport
- Enhancement of the PIN to include additional databases and sources of information useful to States.

This work is based on the best available knowledge and is being coordinated with related projects and research on the effects of agricultural chemicals on water quality at EPA and other Federal and State agencies.

USGS Ground Water Quality Investigations



The USGS initiated the National Water Quality Assessment (NAWQA) pilot program in 1986. In 1991, the USGS began the transition from the pilot program to a full-scale program. The NAWQA program is designed to address national and regional water quality concerns through comparative studies in a variety of hydrologic systems. Study-unit investigations of 60 areas that include most major river basins and aquifer systems have been initiated. Goals include providing nationally consistent water quality information to define long-term water quality trends and describing the primary factors affecting the Nation's surface and ground water quality. An ongoing goal of the NAWQA program is to facilitate data exchange, communication, and coordination among the USGS, water resource managers in agencies at Federal, State, and local levels, as well as other interested scientists.

National issues being addressed by the NAWQA Program focus on the degradation of water quality from nonpoint sources of pollution. Specific issues being addressed in many of the study-units focus on pesticides, nutrients, and sediment. Several specific questions related to pesticides that will be addressed by the program include:

- What are the occurrences and concentrations of pesticides in selected river basins and aquifer systems nationwide?
- What is the relation of pesticide concentrations in surface and ground water to natural factors, changes in hydrologic conditions, pesticide use, chemical properties, and land management practices?
- What significance do key findings have on current water quality monitoring, management, and regulatory practices?

EPA Publications About Ground Water Protection

USEPA. 1993. *Guide for Cost-effectiveness and Cost-Benefit Analysis of State and Local Ground Water Protection Programs.* EPA 813R/93-001. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1992. *Case Studies in Wellhead Protection: Ten Examples of Innovative Wellhead Protection Programs.* EPA 813R/92-002. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1992. *Final Comprehensive State Ground Water Protection Program Guidance.* EPA 100R/93-001. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1991. *Best Management Practices for Protecting Ground Water: Facilities Using Storm Water Drainage Wells, Improved Sinkholes, and Industrial Drainage Wells.* EPA 570/9-91-036M. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1991. *Best Management Practices for Protecting Ground Water: Facilities Using Special Drainage Wells.* EPA 570/9-91-036N. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1991. *Managing Ground Water Contamination Sources in Wellhead Protection Areas: A Priority Setting Approach.* EPA 570/9-91-023. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1991. *Protecting Local Ground Water Supplies Through Wellhead Protection.* EPA 570/9-91-007. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1991. *Protecting the Nation's Ground Water; EPA's Strategy for the 1990's: The Final Report of the EPA Ground Water Task Force.* EPA 21Z-1020. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1990. *Citizen's Guide to Ground Water Protection.* EPA 440/6-90-004. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1990. *Guide to Ground Water Supply Contingency Planning for Local and State Governments.* EPA 440/9-90-003. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1990. *Progress in Ground Water Protection and Restoration.* EPA 440/6-90-001. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1989. *Wellhead Protection Programs: Tools for Local Governments.* EPA 440/6-89-002. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1988. *Developing a State Wellhead Protection Program: A User's Guide to Assist State Agencies Under the Safe Drinking Water Act.* EPA 440/6-88-003. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1987. *Guidelines for Delineation of Wellhead Protection Areas.* EPA 440/6-87-010. Office of Ground Water and Drinking Water, Washington, DC.

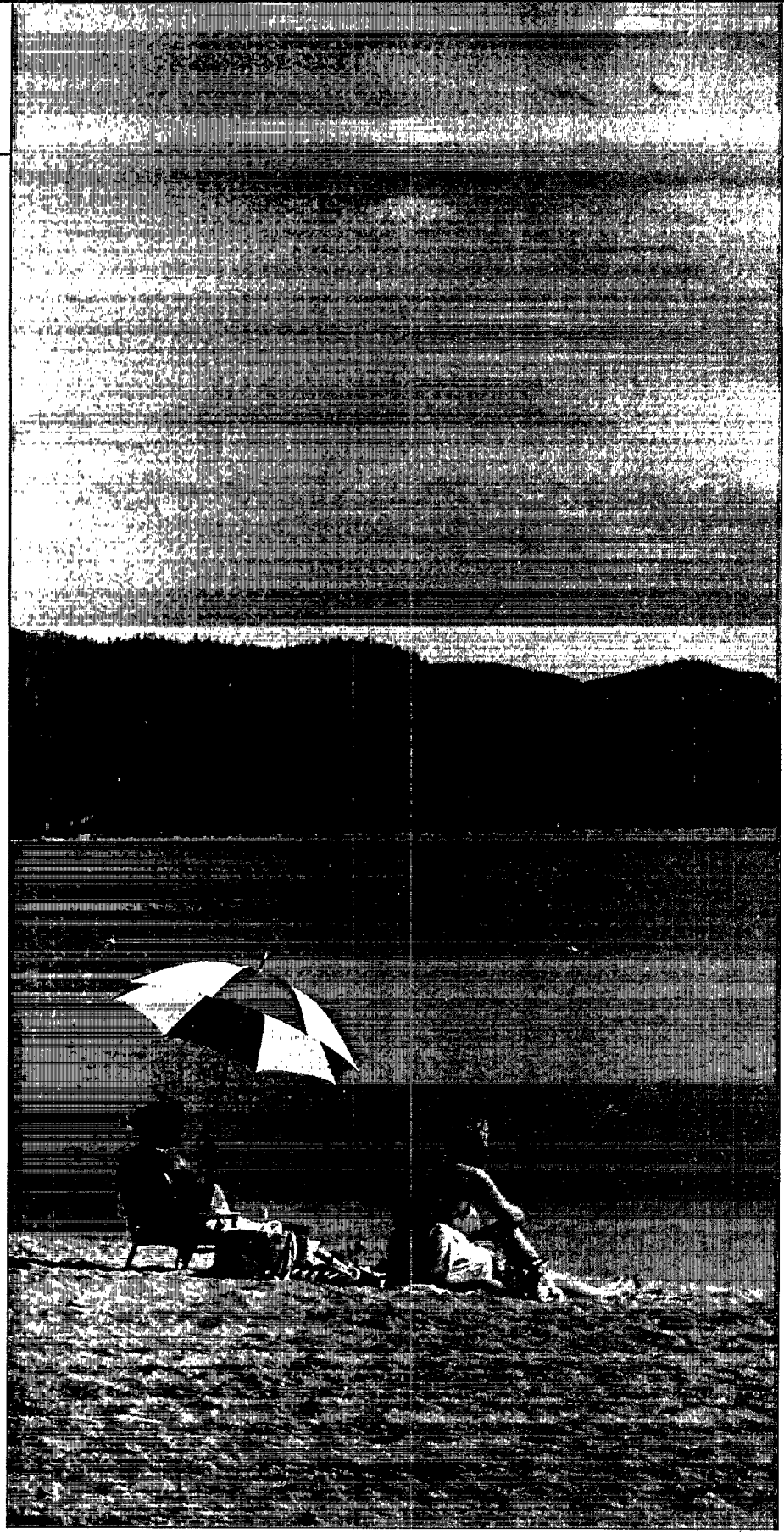
USEPA. 1985. *Protecting Our Ground Water.* EPA 440/6-85-006. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1984. *Protecting Ground Water: The Hidden Resource.* EPA 440/6-84-001. Office of Ground Water and Drinking Water, Washington, DC.

USEPA. 1975. *Manual of Water Well Construction Practices.* EPA 570/9-75-001. Office of Ground Water and Drinking Water, Washington, DC.

Part IV

Costs and Benefits of Water Pollution Control



Costs and Benefits of Water Pollution Control

Introduction

Section 305(b) of the Clean Water Act calls for States to prepare estimates of the economic and social costs necessary to achieve the objectives of the Act. States are also requested to report on the economic and social benefits of these achievements. This section draws upon the information submitted by States and developed by EPA and other Federal agencies concerning the benefits and costs of water pollution control.

None of the States and Territories reporting on their water quality programs attempted to describe the full extent of economic benefits and costs associated with progress made in improving and protecting water quality conditions.

Instead, studies have been undertaken on either a State, local, or regional scale to generate benefit and/or cost information for more specific water quality issues. Most studies of this type analyze a limited number of beneficial outcomes associated with water quality changes occurring within a given watershed, lake, or estuary. The results of these studies are used to assess implementation options or to provide a means of evaluating the effectiveness of water quality control programs. EPA and the States and Territories have had to rely upon such studies in order to provide information on the economic benefits and costs of water quality controls.

This chapter presents information both prepared by EPA and reported by the States in their 305(b) reports that pertains to the economic costs and benefits of water quality protection programs. This information does not present a comprehensive view of conditions throughout the Nation but illustrates the types and magnitude of benefits and costs that result from water quality control programs in specific situations.

EPA and the States are taking many steps toward transforming the 305(b) process into one that provides comparable data with known accuracy. These steps include implementing the recommendations of the National 305(b) Consistency Workgroup and the Intergovernmental Task Force on Monitoring Water Quality, as well as improving the Section 305(b) guidelines and implementing the Office of Water's Monitoring Strategy. These efforts will foster consistency and accuracy among the States and allow for better sharing of data for watershed protection.

Costs

Estimates of the economic costs of water quality programs include public and private expenditures for

personnel and equipment used to reduce and treat discharges to waterbodies and governmental expenditures for developing, implementing, and enforcing water quality regulations. Previous 305(b) reports have included tables showing national cost estimates prepared by the EPA and the U.S. Department of Commerce. These tables are reproduced here with some minor modifications to reflect additional information and changes in methodologies followed in cost calculations conducted by the U.S. Department of Commerce.

Table 18-1. Total Annualized Costs of Water Pollution Control for the United States (millions of 1986 dollars)

Program	1972	1980	1987	1990	1995	2000
Point Source	8,543	20,726	27,546	36,075	44,162	52,537
Nonpoint Source	567	647	779	823	893	959
Drinking Water	802	1,982	2,765	3,591	5,350	6,563
Total	9,912	23,355	31,090	40,489	50,405	60,059

Source: U.S. EPA, *Environmental Investments: The Cost of a Clean Environment – A Summary*, Office of Policy, Planning, and Evaluation, December 1990, Table 3-3, page 3-3. Updated and revised based on U.S. Department of Commerce, Pollution abatement and expenditures: 1972-1990, in *Survey of Current Business*, June 1992.

Table 18-2. Total Annualized Costs of Environmental Protection in the United States (millions of 1986 dollars)

Program	1972	1980	1987	1990	1995	2000
Water	9,912	23,355	31,090	40,489	50,405	60,056
Land	8,412	13,449	15,716	31,159	40,973	51,535
Air and Radiation	7,826	17,218	22,562	26,755	35,187	42,390
Multimedia[a]	107	868	687	1,580	2,122	2,299
Chemicals	92	889	773	1,608	2,466	2,886
Total	26,349	55,779	70,828	101,591	131,153	159,166
Percent of GNP[b]	0.87	1.52	1.70	2.13	2.53	2.80

[a] Includes costs not attributable to individual media programs (e.g., EPA management and support, Emergency Planning and Community Right to Know Act, and undesignated non-EPA Federal costs.

[b] GNP = Gross National Product using the GNP implicit price index.

Source: U.S. EPA, *Environmental Investments: The Cost of a Clean Environment – A Summary*, Office of Policy, Planning, and Evaluation, December 1990, Table 3-3, page 3-3. Updated and revised based on U.S. Department of Commerce, Pollution abatement and expenditures: 1972-1990, in *Survey of Current Business*, June 1992.

As displayed in Table 18-1, the costs for water quality controls (both point source programs and nonpoint source programs) continue to constitute the largest portion of water pollution control expenditures (91% as of 1987). Water quality costs are those associated with actions taken to meet the Marine Protection, Sanctuaries, and Research Act of 1972 and the Clean Water Act as amended in 1987.

Nonpoint source expenditures are those incurred to control pollution from sources such as land runoff, precipitation, drainage, and seepage, including agricultural storm drainage and irrigation return flows. As shown in the table, expenditures for point source controls account for the lion's share of the expenditures for improving water quality. Although the table includes estimates of expenditures for nonpoint source controls, there is much uncertainty associated with this estimate. Estimates of expenditures for point source controls, on the other hand, are much more reliable.

Total annual water pollution costs (including drinking water protection expenditures) have increased steadily over time, from about $9.9 billion in 1972 to $40.5 billion in 1990 (in constant 1986 dollars). The majority of historical point source control costs are for sewerage services and wastewater treatment and for control of industrial effluents and the pretreatment of wastewater discharges to

municipal treatment facilities. Future costs are projected to reach $60 billion by the year 2000. Much of the projected increase is attributable to additional drinking water regulations and the need to construct backlogged municipal wastewater treatment facilities. Future cost increases to control nonpoint sources are also anticipated, but the magnitude of this increase is highly uncertain. Therefore, the forecasted increase in nonpoint source controls is based on increases associated with recent trends for changes in nonpoint source expenditures.

Several other environmental statutes expressly recognize that pollution sources regulated under their protection programs can contribute to changes in water quality conditions. For example, the 1990 amendments to the Clean Air Act contain sections that call for air quality controls that will reduce the effects of acidic deposition and the delivery of other toxic materials to affected waterbodies. Measures taken to reduce runoff and leakage from landfills and underground storage facilities under the Resource Conservation and Recovery Act can prevent the contamination of surface and ground water supplies. The regulation of toxic chemicals and pesticides under the Federal Insecticide, Fungicide, and Rodenticide Act and the Toxic Substances Control Act can prevent the deterioration of natural ecosystems and enhance recreational and commercial fisheries. Table 18-2, which describes the costs of all pollution control programs, gives some perspective on the magnitude of pollution control expenditures in the United States. The relevant proportion of these costs that can be directly or otherwise related to water quality improvements has not been computed. But, as the estimates in Table 18-2 indicate, water

Table 18-3. State and Federal Expenditures for Water Pollution Control in Pennsylvania, 1987-1991 (thousands of dollars)

Year	EPA New Grants	EPA Grant Exp. Expds.	FHA Grant Expds.	Federal Dept. of Comm. Expds.	PA DER Act 443 Expds.	PA DER Act 339 Expds.	PA DER Act 537 Expds.	PA ARC*	PA Dept. of Comm. Expds.	PENN VEST Loan and Grant Obligat.
1987	78,083	109,973	3,861	1,000	49	18,920	1,868	0	4,314	—
1988	107,261	135,225	4,615	600	637	19,865	1,961	200	6,558	162,508
1989	41,398	69,691	4,565	1,180	249	20,934	1,037	0	0	152,525
1990	34,116	83,987	5,533	950	8	23,778	2,097	0	5,146	110,251
1991	32,137	51,473	13,554	0	5	27,211	1,103	0	935	128,243
Total	292,995	450,349	32,128	3,730	948	110,708	8,066	200	16,953	553,527

Source: 1992 Pennsylvania 305(b) report, Table 23, page 128.

*Appalachian Regional Development Act.

Note: EPA new grants column refers to EPA's delivery of grants to the State in that year. EPA grants expenditures column refers to the State's actual use of grant funds during that period and prior years. Thus, the grants and expenditures in any one year will not necessarily be equal.

Table 18-4. Washington State Expenditures for Water Pollution Control (millions of dollars)

Year	Manufacturing Industries Water Pollution Control Costs			State and Local Government	State and Federal Financial Assistance Grants and Loans			WA State Department of Ecology
	Capital Expenditures	Operating Costs	Payments for Public Sewage Services	Sewerage Expenses	Centennial Clean Water Fund	CWA Construction Grants	State Revolving Fund	Annual Funding
1986	16.4	90.3	13.0	286.6	—	10.9	—	No data
1987	No data	No data	No data	441.5	—	17.5	—	No data
1988	21.7	113.8	15.7	433.4	10.6	51.9	—	3.4
1989	45.4	112.2	21.9	346.0	22.6	22.2	—	5.5
1990	No data	No data	No data	369.4	60.0	18.7	16.0	6.3
1991	No data	No data	No data	No data	80.0	48.8	20.0	7.0
1992	No data	No data	No data	No data	41.5	—	41.5	9.0 (est.)
1993	No data	No data	No data	No data	No data	—	No data	9.0 (est.)

Source: 1992 Washington State 305(b) report, Tables V-5 to V-8, pp. 183-186.

Table 18-5. Wastewater Treatment System Expenditures and Ohio River Water Quality Improvements

Ohio River Mile Point	Wastewater Treatment Plant	State	Dollars Spent	Monitoring Station Mile Point	Water Quality Trend	Biological Indicator
138.2	Sisterville	WV	2,221,000			
142.6	Friendly	WV	2,859,598			
155.1	St. Mary's	WV	787,668	161.8	Improving	NA
171.0	Marietta	OH	7,114,580			
172.2	Williamstown	WV	2,523,700			
175.7	Central Boaz	WV	3,131,600			
183.3	Ohio County	WV	4,928,806			
183.3	Parkersburg	WV	19,951,500			
183.3	Vienna	WV	960,867			
185.7	Belpre	OH	2,069,974	203.9	Improving	No trend

NA = Not available (insufficient data).

Source: Adapted from Table 20, pages 40-41, 1992 Ohio Section 305(b) report, Ohio EPA, 1992.

quality programs alone make up a significant portion (35% to 40%) of the total estimated expenditures for all environmental programs in the United States.

Given the scarcity of State information, it is not possible to develop comprehensive estimates of environmental expenditures for all States. However, several States produced information on the costs of water quality control programs. Two of the more comprehensive presentations were supplied by Pennsylvania's Department of Environmental Resources and Washington's Department of Environmental Conservation (Tables 18-3 and 18-4). The costs demonstrated in these two tables are not necessarily representative of expenditures in other States, but illustrate the variety of Federal, State, local, and privately funded and administered activities aimed at protecting water quality.

Benefits

Like previous State Section 305(b) reports, the 1992 submissions do not fully describe the economic and environmental benefits associated with water quality improvements in the States. States continue to focus their reports on measurable physical, chemical, and biological changes in water quality and estimated changes in physical loadings from point and nonpoint sources of pollution. Few States have used this information in their 305(b) reports to estimate the effects of changes in water quality conditions on economic activities, and fewer still attach values to these economic activities in a manner that allows for a comparison between the economic costs and benefits. Additional information on costs and benefits related to the Clean Water Act may be found in President Clinton's *Water Initiative: Analysis of Benefits and Costs* (EPA800-R-94-002, March 1994).

Following are three examples that demonstrate how States have responded to requests for information on the economic benefits of their programs. They show the spectrum in the use of information and economic theory in the preparation of State benefit analyses.

■ The Ohio River Commission examined long-term trends in monitoring data for total suspended solids (TSS) and total Kjeldahl nitrogen (TKN) and their relationship with wastewater treatment dollars spent through the Construction Grants Program. In Table 18-5, the category of dollars spent refers to monies allocated from 1977 through 1991 for publicly owned treatment works discharging directly into the Ohio River. The dollar amount may include additional State and local funds as well as monies spent for project planning, collection system improvements, and other areas not directly resulting in improved effluent quality. Further, some monies allocated during this period may not have been spent, while monies allocated prior to 1977 are not reported but may have been spent during the report period. The trend data refer to median decreases in TSS and TKN concentrations measured using the Commission's monitoring program. These data illustrate the relationship between construction expenditures for wastewater treatment and water quality improvements in the Ohio River.

■ Arizona described a specific water quality action for which the benefits and costs of the decision were not calculated in dollars but were described in qualitative terms. This action demonstrates some of the issues that relate to the weighing of benefits and costs associated with water quality programs. In this particular case, the circumstances revolved around the reclassification of a waterbody as a Unique Water with the adoption of the new State Surface Water Standards in January 1992. The Arizona report indicates that the costs of the actions include, but are not necessarily limited to, the following:

- public acquisition of private land for the preserve
- limitation of land use options on adjoining properties to the preserve
- request to eliminate grazing permits along the waterbody
- cleanup of petroleum-tainted soils in a railroad right-of-way
- development of a maintenance and emergency response plan by the railroad
- restoration of a contaminated well
- plans to develop and implement potential roadway spill runoff from an adjacent highway
- chemical and biological monitoring of surface and ground water quality and flow levels
- State resources to develop site-specific water quality standards
- revegetation of areas damaged by construction, mining, utility corridors, and transportation rights-of-way.

The potential benefits to consider measuring from this action include, but are not necessarily limited to, the following:

- protection of one of two remaining perennial streams in the Tucson area
- maintenance of an area used for geological, ornithological, and botanical research and education
- land management cost savings afforded by consolidation of land holdings
- reduced costs of flood protection insurance
- protection of a rare ecological system and habitat for local and migratory species
- protection of high-quality drinking water sources
- provision of suitable habitat for future reintroduction of endangered native species.

The Arizona report notes that some of the costs were inevitable. In such cases, the benefits should not be solely attributed to the process. In such instances, some means must be developed to correctly attribute both benefits and costs to policy decisions, or the information must be caveated in such a way as to make this known to policymakers and the public.

■ Pennsylvania described the economic value of fishing and boating using information on the number of fishing and boating permits and studies performed by the Pennsylvania State Data Center. In this study an estimated 3,333,000 persons participated in recreational fishing with expenditures totaling $1.35 billion on equipment, supplies,

food, lodging, fuel, and other goods. In addition, some 2,981,000 State residents participated in boating activities and spent $2.878 billion in this activity.

While these expenditures provide significant revenues and income to the State economy, it would be incorrect to argue that the economic benefits of these activities have been achieved only by improving particular waterbodies. In the absence of these local recreational and boating opportunities, most of these individuals would probably be engaged in some alternative activity or choose to recreate elsewhere, which would also generate expenditures on their part. However, the fact that people choose local waterbodies when they are available reveals that such waterbodies are valued by the citizens.

The Greater Benefits of Water Quality Programs

As the preceding discussion makes clear, information on benefits is rather sparse. Nevertheless, it is also clear that protection of the Nation's waters is important to individual citizens and the economy as a whole. This section provides some perspectives on particular economic sectors dependent on water pollution control efforts to maintain their vitality.*

Recreational Fishing

An estimated 46 million Americans participate in recreational fishing. In 1985, they spent 976 million days on the water. Most of these days (84%) were spent freshwater fishing, with saltwater fishing accounting for 16%. Recreational fishers spend about $32 billion annually on tackle, gear, boats, lodging, transportation, and related expenses.

Clean water is essential to preserving recreational fisheries and local communities that depend on them. An example is the Great Lakes fishery. Sport fishing contributes about $4 billion annually to the economies of the Great Lakes States. However, fishing bans and advisories have adversely affected fishing along 4,808 of the 5,382 miles of Great Lakes shoreline.

Boating

In 1989, one out of three Americans participated in boating, and approximately 16 million boats are registered in the United States. Expenditures on boating were approximately $13.7 billion in 1990. The recreational boating industry employs about 600,000 workers, including 242,000 manufacturing workers, 184,000 workers in marine wholesaling and retailing operations, and about 174,000 workers employed by marine service businesses.

*Information in this section is drawn from *Clean Water and the Economy: An Overview*, Office of Water, EPA, August 1992.

Although high levels of water quality are not absolutely necessary for safe boating, poor water quality may restrict access. Even where poor water quality does not deter boating, there is little doubt that water pollution such as floatables, odor, and algae growths detract from the pleasures of boating.

Commercial Fishing

Approximately 274,000 Americans are commercial fishers and 90,000 workers are employed in seafood processing and related activities. In 1990, the U.S. catch was valued at $3.6 billion, and this sector's total contribution to GNP was approximately $16.5 billion.

Pollution of the Nation's rivers, lakes, bays, and estuaries has direct and indirect impacts on the commercial fisheries. Short-term effects include fish kills and advisories or bans that limit access. Long-term impacts include adverse impacts on spawning grounds and nurseries. Shellfish are extremely vulnerable to water pollution, which has severely affected much of the country's prime shellfishing grounds. Of the 17 million acres of estuarine waters monitored in 1990, 25% were prohibited for shellfishing and another 12% were in restricted or conditional status.

Appendix A

Individual State Data
Rivers and Streams

Table A-1. Overall Designated Use Support in Rivers and Streams (miles)

State	Fully Supporting				Threatened				Partially Supporting			
	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
Alabama	7,478	1,323	—	8,801	122	89	—	211	923	1,320	—	2,243
Alaska	—	1,165	—	1,165	—	—	—	—	251	1,040	—	1,291
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	467	349	—	816	182	138	—	320	1,061	569	—	1,630
Arkansas	2,322	1,315	—	3,637	—	—	—	—	1,366	826	—	2,192
California[a]	—	—	713	713	—	—	316	316	—	—	4,367	4,367
Colorado	15,725	7,984	—	23,709	—	—	—	—	1,173	193	—	1,366
Connecticut	215	172	—	387	90	82	—	172	30	238	—	268
Delaware	44	43	—	87	3	6	—	9	2	46	—	48
Delaware River Basin	—	—	—	—	—	206	—	206	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—	—	3	—	3
Florida	2,168	2,880	—	5,048	5	247	—	252	669	1,152	—	1,821
Georgia	—	1,165	—	1,165	—	—	—	—	251	1,040	—	1,291
Gila River Ind. Comm.	—	—	—	—	—	—	—	—	—	—	61	61
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	42	13	—	55	48	2	—	50	—	—	—	—
Idaho	352	282	—	634	179	175	—	354	7,066	1,570	—	8,636
Illinois	2,370	3,568	—	5,938	—	273	—	273	2,400	5,173	—	7,573
Indiana[a]	1,153	3,595	—	4,748	281	96	—	377	154	189	—	343
Iowa	—	—	—	—	108	386	—	494	8,609	443	—	9,052
Kansas	228	670	—	898	—	—	—	—	62	644	—	706
Kentucky	3,916	2,572	—	6,488	—	69	—	69	226	762	—	988
Louisiana	1,979	408	—	2,387	1,885	—	—	1,885	116	3,260	—	3,376
Maine	20,620	10,580	—	31,200	—	—	—	—	58	153	—	211
Maryland	14,372	1,317	—	15,689	—	—	—	—	349	911	—	1,260
Massachusetts	200	188	—	388	113	120	—	233	80	183	—	263
Michigan	—	21,299	—	21,299	—	—	—	—	—	—	—	—
Minnesota	99	989	—	1,088	—	—	—	—	476	679	—	1,155
Mississippi	1,958	191	—	2,149	1,021	550	—	1,571	30,002	1,573	—	31,575
Missouri	7,398	3,642	—	11,040	—	—	—	—	5,930	3,705	—	9,635
Montana	46,732	804	—	47,536	2,620	615	—	3,235	9,144	3,397	—	12,541
Nebraska	458	1,660	—	2,118	40	104	—	144	590	3,375	—	3,965
Nevada	128	204	—	332	—	—	—	—	—	334	—	334
New Hampshire	2,073	8,541	—	10,614	—	—	—	—	—	80	—	80
New Jersey[a]	—	—	—	—	—	—	1,022	1,022	—	—	329	329
New Mexico	35	278	—	313	—	50	—	50	556	2,400	—	2,956
New York	43,978	3,094	—	47,072	1,304	92	—	1,396	2,759	194	—	2,953
North Carolina	8,682	4,242	—	12,924	9,866	1,967	—	11,833	6,392	2,215	—	8,607
North Dakota	—	180	—	180	4,783	1,926	—	6,709	210	2,074	—	2,284
Ohio[a]	1,368	1,244	—	2,612	108	411	—	519	794	901	—	1,695
Ohio River Valley	—	—	—	—	—	—	—	—	79	420	—	499
Oklahoma	537	37	—	574	3,136	386	—	3,522	—	2,175	—	2,175
Oregon	12,330	322	—	12,652	—	—	—	—	7,381	1,321	—	8,702
Pennsylvania	12,790	7,351	—	20,141	—	—	—	—	364	1,573	—	1,937
Puerto Rico	285	3	—	288	577	13	—	590	862	98	—	960
Rhode Island	—	—	206	206	—	—	282	282	—	—	32	32
South Carolina	—	—	2,842	2,842	—	—	—	—	—	—	648	648
South Dakota	66	548	—	614	—	—	—	—	275	672	—	947
Tennessee	3,432	1,666	—	5,098	921	854	—	1,775	1,408	1,559	—	2,967
Texas	—	—	10,381	10,381	—	—	—	—	—	—	1,356	1,356
Utah	2,582	1,711	—	4,293	—	—	—	—	915	265	—	1,180
Vermont	2,808	305	—	3,113	975	172	—	1,147	687	103	—	790
Virginia	2,266	12,155	—	14,421	—	—	—	—	94	2,357	—	2,451
Virgin Islands	—	—	—	—	—	—	—	—	—	—	—	—
Washington	605	1,016	—	1,621	369	—	—	369	535	525	—	1,060
West Virginia	126	587	—	713	44	324	—	368	248	3,100	—	3,348
Wisconsin	7,818	1,516	—	9,334	92	7	—	99	1,141	185	—	1,326
Wyoming	15	747	—	762	826	388	—	1,214	2,285	1,264	—	3,549
Totals	232,220	113,921	14,142	360,283	29,698	9,748	1,620	41,066	97,973	56,259	6,793	161,025
% of Assessed Waters	64%	32%	4%	56%	72%	24%	4%	6%	61%	35%	4%	25%

[a]Entered aquatic life use support data in lieu of overall use support data.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-1. (continued)

Not Supporting				Not Attainable				Total Assessed			
Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
384	653	—	1,037	—	—	—		8,907	3,385	—	12,292
168	1,430	—	1,598	—	—	—		419	3,635	—	4,054
—	—	—		—	—	—		—	—	—	
1,070	625	—	1,695	—	—	—		2,780	1,681	—	4,461
971	662	—	1,633	—	—	—		4,659	2,803	—	7,462
—	—	283	283	—	—	—		—	—	5,679	5,679
1,703	417	—	2,120	—	—	—		18,601	8,594	—	27,195
5	58	—	63	1	2	—	3	341	552	—	893
236	423	—	659	—	—	—		285	518	—	803
—	—	—		—	—	—		—	206	—	206
—	35	—	35	—	—	—		—	38	—	38
248	564	—	812	—	—	—		3,090	4,843	—	7,933
168	1,430	—	1,598	—	—	—		419	3,635	—	4,054
—	—	135	135	—	—	—		137	59	—	196
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		90	15	—	105
2,698	666	—	3,364	—	—	—		10,295	2,693	—	12,988
73	123	—	196	—	—	—		4,843	9,137	—	13,980
60	1,244	—	1,304	—	—	77	77	1,648	5,124	77	6,849
22	414	—	436	—	—	—		8,739	1,243	—	9,982
7	15,492	—	15,499	—	—	—		297	16,806	—	17,103
319	1,874	—	2,193	—	—	—		4,461	5,277	—	9,738
755	686	—	1,441	—	—	—		4,735	4,354	—	9,089
11	250	—	261	—	—	—		20,689	10,983	—	31,672
21	31	—	52	—	—	—		14,742	2,259	—	17,001
270	418	—	688	—	—	—		663	909	—	1,572
152	1,139	—	1,291	—	—	—		152	22,438	—	22,590
396	1,994	—	2,390	—	—	—		971	3,662	—	4,633
125	434	—	559	—	—	—		33,106	2,748	—	35,854
25	315	—	340	—	—	—		13,353	7,662	—	21,015
1,004	361	—	1,365	—	—	—		59,500	5,177	—	64,677
108	1,726	—	1,834	—	—	—		1,196	6,865	—	8,061
87	629	—	716	—	45	—	45	215	1,212	—	1,427
5	142	—	147	—	—	—		2,078	8,763	—	10,841
—	—	164	164	—	—	—		—	—	1,515	1,515
5	265	—	270	—	—	—		596	2,993	—	3,589
288	20	—	308	—	—	—		48,329	3,400	—	51,729
1,032	664	—	1,696	—	—	—		25,972	9,088	—	35,060
—	—	—		—	—	—		4,993	4,180	—	9,173
1,910	1,167	—	3,077	—	—	—		4,180	3,723	—	7,903
40	442	—	482	—	—	—		119	862	—	981
7	768	—	775	—	—	—		3,680	3,366	—	7,046
4,926	2,829	—	7,755	—	—	—		24,637	4,472	—	29,109
173	2,500	—	2,673	—	—	—		13,327	11,424	—	24,751
2,605	932	—	3,537	—	—	—		4,329	1,046	—	5,375
—	—	145	145	—	—	—		376	289	—	665
—	—	464	464	—	—	—		—	—	3,954	3,954
110	1,932	—	2,042	—	—	—		451	3,152	—	3,603
342	643	—	985	—	—	—		6,103	4,722	—	10,825
—	—	2,370	2,370	—	—	—		—	—	14,107	14,107
891	1,193	—	2,084	—	—	—		4,388	3,169	—	7,557
173	42	—	215	—	—	—		4,643	622	—	5,265
21	1,065	—	1,086	—	—	—		2,381	15,577	—	17,958
—	—	—		—	—	—		—	—	—	
551	2,036	—	2,587	—	—	—		2,060	3,577	—	5,637
280	577	—	857	—	—	—		698	4,588	—	5,286
391	187	—	578	—	—	—		9,442	1,895	—	11,337
—	488	—	488	—	—	—		3,126	2,887	—	6,013
24,836	51,985	3,561	80,382	1	47	77	125	385,241	232,308	25,332	642,881
31%	65%	4%	13%	1%	38%	62%	<1%	60%	36%	4%	18%

Table A-2a. Aquatic Life Use Support in Rivers and Streams (miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	8,631	221	2,024	939	—	11,815
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	802	793	1,178	1,584	—	4,357
Arkansas	4,019	—	2,119	764	—	6,902
California	713	316	4,367	283	—	5,679
Colorado	22,243	—	1,366	2,166	710	26,485
Connecticut	616	56	182	38	3	895
Delaware	580	3	81	138	—	802
Delaware River Basin	206	—	—	—	—	206
District of Columbia	12	—	3	23	—	38
Florida	5,048	252	1,822	811	—	7,933
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	61	135	82	278
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	490	277	1,761	147	—	2,675
Illinois	5,938	273	7,573	196	—	13,980
Indiana	4,748	377	343	1,304	77	6,849
Iowa	—	508	9,323	141	8	9,980
Kansas	2,829	—	2,152	12,122	—	17,103
Kentucky	7,208	72	1,121	780	—	9,181
Louisiana	—	—	—	—	—	—
Maine	31,514	—	—	158	—	31,672
Maryland	15,698	—	1,141	161	—	17,000
Massachusetts	894	280	146	209	—	1,529
Michigan	21,412	—	—	1,178	—	22,590
Minnesota	1,918	—	430	1,160	—	3,508
Mississippi	2,196	1,003	31,501	435	116	35,251
Missouri	11,037	—	9,638	340	—	21,015
Montana	42,350	3,121	36,058	3,377	—	84,906
Nebraska	1,479	527	3,888	317	—	6,211
Nevada	731	—	354	357	45	1,487
New Hampshire	10,768	—	73	—	—	10,841
New Jersey	—	1,039	216	164	—	1,419
New Mexico	4,022	—	—	251	—	4,273
New York	49,254	809	1,502	164	—	51,729
North Carolina	12,924	11,833	8,607	1,696	—	35,060
North Dakota	238	6,983	1,983	—	—	9,204
Ohio	2,612	518	1,694	3,077	—	7,901
Ohio River Valley	—	—	608	373	—	981
Oklahoma	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Pennsylvania	19,859	282	1,937	2,673	—	24,751
Puerto Rico	751	688	1,577	2,359	—	5,375
Rhode Island	298	227	12	128	—	665
South Carolina	3,347	—	334	309	—	3,990
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	12,941	—	554	579	—	14,074
Utah	4,634	—	1,162	1,761	—	7,557
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	2,298	—	451	276	—	3,025
West Virginia	1,007	368	3,323	592	—	5,290
Wisconsin	9,302	69	1,150	875	13	11,409
Wyoming	—	—	—	—	—	—
Totals	327,567	30,895	143,815	44,540	1,054	547,871
Percent of Assessed Waters	60%	6%	26%	8%	<1%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-2b. Fish Consumption Use Support in Rivers and Streams (miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	8,624	221	2,024	952	—	11,821
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	—	—	—	—	—	—
Arkansas	6,716	—	39	147	—	6,902
California	3,154	230	1,880	68	—	5,332
Colorado	22,243	—	1,366	2,166	710	26,485
Connecticut	9	59	66	2	—	136
Delaware	778	—	—	24	—	802
Delaware River Basin	200	—	—	6	—	206
District of Columbia	—	—	28	—	—	28
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	—	—	—	—	—
Illinois	1,350	—	—	467	—	1,817
Indiana	4,417	—	—	331	—	4,748
Iowa	515	121	—	77	8	721
Kansas	278	—	—	20	—	298
Kentucky	9,057	—	—	125	—	9,182
Louisiana	5,207	—	1,503	2,380	—	9,090
Maine	31,436	—	236	—	—	31,672
Maryland	16,940	—	60	—	—	17,000
Massachusetts	418	9	—	300	—	727
Michigan	21,884	—	—	706	—	22,590
Minnesota	182	—	1,194	485	—	1,861
Mississippi	—	—	—	—	—	—
Missouri	19,959	—	745	312	—	21,016
Montana	—	—	—	—	—	—
Nebraska	95	439	28	—	—	562
Nevada	—	—	—	—	—	—
New Hampshire	10,827	—	13	—	—	10,840
New Jersey	—	—	—	—	—	—
New Mexico	—	—	93	—	—	93
New York	51,457	—	137	135	—	51,729
North Carolina	12,924	11,833	8,607	1,696	—	35,060
North Dakota	—	—	509	—	—	509
Ohio	1,471	332	321	—	—	2,124
Ohio River Valley	—	—	981	—	—	981
Oklahoma	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	14,144	—	—	231	—	14,375
Utah	—	—	—	—	—	—
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	23	—	—	894	—	917
West Virginia	155	—	110	389	—	654
Wisconsin	966	—	122	68	—	1,156
Wyoming	—	—	—	—	—	—
Totals	245,429	13,244	20,062	11,981	718	291,434
Percent of Assessed Waters	84%	5%	7%	4%	<1%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-2c. Swimming Use Support in Rivers and Streams (miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	8,674	140	2,047	943	—	11,804
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	1,295	224	434	399	—	2,352
Arkansas	5,375	—	—	783	—	6,158
California	2,576	8	296	60	—	2,940
Colorado	9,422	—	—	—	—	9,422
Connecticut	557	79	204	50	3	893
Delaware	61	—	37	615	51	764
Delaware River Basin	206	—	—	—	—	206
District of Columbia	—	—	3	35	—	38
Florida	5,048	252	1,822	811	—	7,933
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	61	135	135	331
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	1,131	524	574	89	—	2,318
Illinois	1,617	—	1,478	560	—	3,655
Indiana	937	—	127	3,246	—	4,310
Iowa	—	415	1,761	293	8,173	10,642
Kansas	1,960	—	3,540	11,306	—	16,806
Kentucky	1,543	—	265	1,697	—	3,505
Louisiana	3,408	—	2,409	3,273	—	9,090
Maine	31,544	—	—	128	—	31,672
Maryland	16,999	—	—	2	—	17,001
Massachusetts	649	166	337	365	—	1,517
Michigan	22,188	—	—	402	—	22,590
Minnesota	1,696	—	488	1,324	—	3,508
Mississippi	595	214	1,472	126	—	2,407
Missouri	5,370	—	—	—	15,645	21,015
Montana	68,251	504	14,272	1,773	—	84,800
Nebraska	546	—	479	1,338	13,073	15,436
Nevada	870	—	220	331	45	1,466
New Hampshire	10,694	—	—	147	—	10,841
New Jersey	—	80	40	405	—	525
New Mexico	316	—	6	—	—	322
New York	51,343	82	295	9	—	51,729
North Carolina	800	340	200	30	—	1,370
North Dakota	252	6,645	2,307	—	—	9,204
Ohio	1,247	—	159	2,145	—	3,551
Ohio River Valley	—	—	—	—	—	—
Oklahoma	843	2,141	1,053	587	—	4,624
Oregon	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Puerto Rico	1,094	469	1,316	2,496	—	5,375
Rhode Island	—	—	—	—	—	—
South Carolina	2,000	—	166	120	—	2,286
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	11,221	—	1,141	1,668	—	14,030
Utah	2,022	—	—	12	—	2,034
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	1,230	—	189	624	—	2,043
West Virginia	3,387	124	1,163	463	—	5,137
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	278,967	12,407	40,361	38,790	37,125	407,650
Percent of Assessed Waters	68%	3%	10%	10%	9%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-2d. Secondary Contact Recreational Use Support in Rivers and Streams (miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	8,681	140	2,024	939	—	11,784
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	289	131	389	639	—	1,448
Arkansas	6,902	—	—	—	—	6,902
California	5,112	—	1	—	—	5,113
Colorado	21,743	—	56	—	—	21,799
Connecticut	846	—	38	3	3	890
Delaware	781	—	—	13	—	794
Delaware River Basin	—	—	—	—	—	—
District of Columbia	1	—	—	27	—	28
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Gila River Indian Community	61	—	—	—	—	61
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	1,466	649	225	24	—	2,364
Illinois	24	—	—	—	—	24
Indiana	—	—	—	—	—	—
Iowa	—	—	—	—	—	—
Kansas	9,476	—	5,538	1,791	—	16,805
Kentucky	—	—	—	—	—	—
Louisiana	5,328	—	2,550	1,212	—	9,090
Maine	31,544	—	—	128	—	31,672
Maryland	—	—	—	—	—	—
Massachusetts	1,240	60	116	107	—	1,523
Michigan	22,188	—	—	402	—	22,590
Minnesota	—	—	—	—	—	—
Mississippi	25,115	418	8,827	870	116	35,346
Missouri	—	—	—	—	—	—
Montana	—	—	—	—	—	—
Nebraska	—	—	—	—	—	—
Nevada	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New Mexico	3,768	—	70	14	—	3,852
New York	50,587	343	799	—	—	51,729
North Carolina	12,924	11,833	8,607	1,696	—	35,060
North Dakota	252	8,952	—	—	—	9,204
Ohio	—	—	—	—	—	—
Ohio River Valley	—	—	—	—	—	—
Oklahoma	—	25	—	—	669	694
Oregon	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Puerto Rico	1,548	454	1,578	1,796	—	5,376
Rhode Island	—	—	—	—	—	—
South Carolina	3,545	—	279	109	—	3,933
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	51	—	6	—	—	57
Utah	2,022	—	—	12	—	2,034
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	1,416	—	358	315	—	2,089
West Virginia	4	—	38	—	—	42
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	216,914	23,005	31,499	10,097	788	282,303
Percent of Assessed Waters	77%	8%	11%	4%	<1%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-2e. Drinking Water Supply Use Support in Rivers and Streams (miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	818	—	—	—	—	818
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	211	64	799	139	—	1,213
Arkansas	6,037	—	33	832	—	6,902
California	2,287	12	239	—	—	2,538
Colorado	16,213	—	—	—	15,353	31,566
Connecticut	90	7	—	1	—	98
Delaware	62	13	—	2	—	77
Delaware River Basin	206	—	—	—	—	206
District of Columbia	—	—	—	—	—	—
Florida	244	—	77	4	—	325
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	—	196	196	392
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	—	—	—	—	—
Illinois	665	—	109	—	—	774
Indiana	—	—	—	—	—	—
Iowa	1	5	1	2	10,684	10,693
Kansas	6,192	—	559	10,054	—	16,805
Kentucky	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	—	—	—	—	—	—
Massachusetts	47	15	—	12	—	74
Michigan	22,551	—	—	39	—	22,590
Minnesota	—	—	—	—	—	—
Mississippi	—	83	—	—	—	83
Missouri	3,160	—	—	—	17,855	21,015
Montana	8,770	1,313	6,261	742	—	17,086
Nebraska	339	—	—	—	15,417	15,756
Nevada	11	—	—	33	—	44
New Hampshire	785	—	2	2	—	789
New Jersey	—	—	—	—	—	—
New Mexico	1,026	9	180	13	—	1,228
New York	—	155	221	—	—	376
North Carolina	2,731	2,085	1,233	159	—	6,208
North Dakota	594	1,683	1,867	—	—	4,144
Ohio	—	—	—	—	—	—
Ohio River Valley	257	—	557	167	—	981
Oklahoma	427	51	61	53	—	592
Oregon	29,109	—	—	—	—	29,109
Pennsylvania	—	—	—	—	—	—
Puerto Rico	1,138	504	2,246	1,486	—	5,374
Rhode Island	—	—	—	—	—	—
South Carolina	8,598	—	—	—	—	8,598
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	8,303	—	138	237	—	8,678
Utah	3,800	—	—	11	—	3,811
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
West Virginia	1,842	—	330	237	—	2,409
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	126,514	5,999	14,913	14,421	59,505	221,352
Percent of Assessed Waters	57%	3%	7%	7%	27%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-2f. Agriculture Use Support in Rivers and Streams (miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	79	—	146	133	15	373
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	1,624	717	557	723	—	3,621
Arkansas	6,742	—	—	160	—	6,902
California	3,443	—	40	—	—	3,483
Colorado	31,225	—	—	—	710	31,935
Connecticut	828	5	2	—	1	836
Delaware	702	—	—	—	—	702
Delaware River Basin	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—
Florida	—	—	6	—	—	6
Georgia	—	—	—	—	—	—
Gila River Indian Community	196	—	—	—	—	196
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	2,717	306	35	8	—	3,066
Illinois	—	—	—	—	—	—
Indiana	21,094	—	—	—	—	21,094
Iowa	—	—	—	—	—	—
Kansas	2,141	—	1,900	12,765	—	16,806
Kentucky	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	31,672	—	—	—	—	31,672
Maryland	17,000	—	—	—	—	17,000
Massachusetts	—	—	—	—	—	—
Michigan	22,590	—	—	—	—	22,590
Minnesota	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—
Missouri	—	—	—	—	—	—
Montana	11,598	351	4,729	448	—	17,126
Nebraska	2,103	—	—	56	—	2,159
Nevada	11	—	—	33	—	44
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New Mexico	3,515	—	538	47	—	4,100
New York	51,729	—	—	—	—	51,729
North Carolina	12,924	11,833	8,607	1,696	—	35,060
North Dakota	4,933	3,592	679	—	—	9,204
Ohio		—	—	—	—	—
Ohio River Valley	—	—	—	—	—	—
Oklahoma	462	89	73	9	—	633
Oregon	29,109	—	—	—	—	29,109
Pennsylvania	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	8,598	—	—	—	—	8,598
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	—	—	—	—	—	—
Utah	5,936	—	114	1,284	—	7,334
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	272,971	16,893	17,426	17,362	726	325,378
Percent of Assessed Waters	84%	5%	5%	5%	<1%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table A-3. Leading Causes of Pollution in Assessed Rivers and Streams (miles)

State	Total Impaired Miles		Siltation (1)				Nutrients (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	3,280	382	1,036	—	1,418	497	1,446	—	1,943
Alaska	2,889	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—
Arizona	—	3,325	—	—	—	—	—	402	—	402
Arkansas	—	3,825	2,277	117	—	2,394	141	649	—	790
California	—	4,650	327	1,671	—	1,998	312	375	—	687
Colorado	—	3,486	—	—	—	—	—	—	—	—
Connecticut	—	331	—	35	—	35	10	47	—	57
Delaware	—	707	—	1	—	1	410	208	—	618
Delaware River Basin	—	—	—	—	—	—	—	—	—	—
District of Columbia	—	38	—	—	—	—	—	—	—	—
Florida	—	2,633	—	—	—	—	279	408	—	687
Georgia	—	2,889	—	—	—	—	—	—	—	—
Gila River Indian Community	196	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—
Idaho	12,000	—	—	—	—	—	—	—	—	—
Illinois	—	7,769	181	6,598	—	6,779	982	6,584	—	7,566
Indiana	—	1,647	—	40	—	40	—	—	—	—
Iowa	—	9,488	8,364	1,121	—	9,485	31	9,034	—	9,065
Kansas	—	16,205	—	—	—	—	208	—	—	208
Kentucky	—	3,181	810	109	—	919	270	92	—	362
Louisiana	—	4,817	97	771	—	868	828	2,008	—	2,836
Maine	—	472	—	—	—	—	—	—	—	—
Maryland	—	1,312	139	831	—	970	374	878	—	1,252
Massachusetts	—	951	8	22	—	30	12	243	—	255
Michigan	—	1,291	169	37	—	206	10	42	—	52
Minnesota	—	3,545	—	—	—	—	—	1,653	—	1,653
Mississippi	—	32,134	340	29,085	—	29,425	834	29,077	—	29,911
Missouri	—	9,975	4	7,225	—	7,229	—	—	—	—
Montana	—	13,906	303	6,497	—	6,800	104	5,628	—	5,732
Nebraska	—	5,799	—	—	—	—	—	—	—	—
Nevada	—	1,050	—	66	—	66	89	161	—	250
New Hampshire	—	227	—	—	—	—	—	—	—	—
New Jersey	—	493	—	—	—	—	81	—	—	81
New Mexico	—	3,226	810	1,322	—	2,132	9	614	—	623
New York	—	3,261	2,302	1,225	—	3,527	553	2,230	—	2,783
North Carolina	—	10,303	—	—	3,941	3,941	—	—	518	518
North Dakota	—	2,284	691	1,129	—	1,820	759	1,118	—	1,877
Ohio	—	4,772	720	1,040	—	1,760	44	97	—	141
Ohio River Valley	—	981	—	1,142	—	1,142	—	—	—	—
Oklahoma	—	2,950	725	2,575	—	3,300	147	2,530	—	2,677
Oregon	—	16,457	—	—	1,260	1,260	—	—	745	745
Pennsylvania	—	4,610	—	—	—	—	—	—	582	582
Puerto Rico	—	4,497	—	—	—	—	695	592	—	1,287
Rhode Island	—	177	—	—	—	—	12	20	—	32
South Carolina	—	1,112	—	—	—	—	—	—	—	—
South Dakota	—	2,989	110	275	—	385	—	—	—	—
Tennessee	3,952	—	—	—	—	—	—	—	—	—
Texas	—	3,726	—	—	—	—	137	236	—	373
Utah	—	3,264	—	—	—	—	—	—	—	—
Vermont	—	1,005	463	367	—	830	220	264	—	484
Virginia	—	3,537	—	90	—	90	163	97	—	260
Virgin Islands	—	—	—	—	—	—	—	—	—	—
Washington	—	3,647	37	435	—	472	—	269	—	269
West Virginia	—	4,205	543	2,880	—	3,423	302	494	—	796
Wisconsin	—	1,904	493	2,662	—	3,155	514	2,395	—	2,909
Wyoming	—	4,037	—	—	3,225	3,225	—	—	877	877
Total River Miles Impaired	19,037	222,370	20,295	70,404	8,426	99,125	9,027	69,891	2,722	81,640
% of Impaired River Miles[a] Affected by Each Cause			9%	32%	4%	45%	4%	31%	1%	37%
% of Assessed River Miles Affected by Each Cause			3%	11%	1%	15%	1%	11%	<1%	13%
% of Total River Miles Affected by Each Cause			1%	2%	<1%	3%	<1%	2%	<1%	2%

[a]Includes only impaired river miles in States reporting causes affecting rivers and streams.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired River Miles in States Reporting Causes:	222,370 miles
Total Assessed River Miles:	642,881 miles
Estimate of Total River Miles in the Nation:	3,551,247 miles

Table A-3. (continued)

Pathogen Indicators (3)				Pesticides (4)				Organic Enrich./ Low Dissolved Oxygen (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
298	377	—	675	128	243	—	371	522	796	—	1,318
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
5	219	—	224	—	145	—	145	—	382	—	382
175	157	—	332	—	—	—	—	46	66	—	112
173	1,529	—	1,702	2,040	124	—	2,164	76	82	—	158
30	25	—	55	—	—	—	—	3	10	—	13
94	32	—	126	—	—	—	—	45	52	—	97
669	37	—	706	—	11	—	11	69	80	—	149
—	—	—	—	—	—	—	—	—	—	—	—
18	6	—	24	—	—	—	—	5	14	—	19
32	249	—	281	—	—	—	—	338	557	—	895
1,086	723	—	1,809	78	7	—	85	72	110	—	182
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
157	183	—	340	—	66	—	66	149	1,430	—	1,579
2,644	648	—	3,292	245	116	—	361	653	45	—	698
392	—	—	392	161	8,292	—	8,453	16	59	—	75
11,520	1	—	11,521	2,808	—	—	2,808	2,981	124	—	3,105
1,702	49	—	1,751	—	—	—	—	588	56	—	644
926	2,374	—	3,300	172	1,785	—	1,957	530	2,216	—	2,746
62	64	—	126	—	—	—	—	117	106	—	223
66	956	—	1,022	—	—	—	—	—	106	—	106
334	370	—	704	—	—	—	—	36	225	—	261
62	26	—	88	2	—	—	2	84	25	—	109
166	1,819	—	1,985	—	—	—	—	81	1,231	—	1,312
490	8,880	—	9,370	472	32,479	—	32,951	157	23,774	—	23,931
—	—	—	—	101	572	—	673	22	37	—	59
8	1,600	—	1,608	—	—	—	—	47	932	—	979
1,029	—	—	1,029	606	—	—	606	—	790	—	790
—	—	—	—	—	—	—	—	45	86	—	131
67	78	—	145	—	—	—	—	8	34	—	42
81	—	—	81	—	3	—	3	11	—	—	11
49	240	—	289	3	132	—	135	27	80	—	107
231	1,082	—	1,313	36	811	—	847	131	888	—	1,019
—	—	656	656	—	—	—	—	—	—	507	507
—	608	—	608	—	65	—	65	10	219	—	229
—	—	—	—	37	66	—	103	2,374	781	—	3,155
249	218	—	467	418	492	—	910	—	—	—	—
151	200	—	351	271	2,614	—	2,885	128	915	—	1,043
—	—	885	885	—	—	52	52	—	—	603	603
—	—	155	155	—	—	161	161	—	—	184	184
2,346	1,359	—	3,705	368	380	—	748	611	485	—	1,096
56	27	—	83	—	—	—	—	17	10	—	27
472	243	—	715	—	—	—	—	639	16	—	655
795	796	—	1,591	—	—	—	—	—	679	—	679
—	—	—	—	—	—	—	—	—	—	—	—
1,563	790	—	2,353	71	63	—	134	300	361	—	661
12	—	—	12	—	—	—	—	—	345	—	345
54	345	—	399	—	5	—	5	125	319	—	444
811	1,325	—	2,136	366	56	—	422	119	196	—	315
—	—	—	—	—	—	—	—	—	—	—	—
309	1,395	—	1,704	10	130	—	140	14	589	—	603
—	70	—	70	277	—	—	277	149	399	—	548
93	405	—	498	99	169	—	268	458	1,158	—	1,616
—	—	126	126	—	—	273	273	—	—	516	516
29,477	29,505	1,822	60,804	8,769	48,826	486	58,081	11,803	40,865	1,810	54,478
13%	13%	1%	27%	4%	22%	<1%	26%	5%	18%	1%	24%
5%	5%	<1%	9%	1%	8%	<1%	9%	2%	6%	<1%	8%
1%	1%	<1%	2%	<1%	1%	—	2%	<1%	1%	<1%	2%

(continued)

Table A-3. (continued)

State	Metals (6)				Suspended Solids (7)				Salinity/TDS/Chlorides (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	37	382	—	419	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	241	950	—	1,191	113	529	—	642	18	563	—	581
Arkansas	—	24	—	24	—	—	—	—	—	—	—	—
California	396	460	—	856	—	74	—	74	34	87	—	121
Colorado	873	706	—	1,579	—	—	—	—	—	—	—	—
Connecticut	70	47	—	117	—	22	—	22	—	23	—	23
Delaware	34	28	—	62	—	—	—	—	—	14	—	14
Delaware River Basin	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	3	16	—	19	—	28	—	28	—	—	—	—
Florida	—	—	—	—	77	195	—	272	—	—	—	—
Georgia	838	92	—	930	—	—	—	—	—	—	—	—
Gila River Indian Comm.	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Idaho	—	—	—	—	—	—	—	—	—	—	—	—
Illinois	14	1,187	—	1,201	66	715	—	781	—	106	—	106
Indiana	440	130	—	570	53	180	—	233	13	—	—	13
Iowa	165	—	—	165	—	—	—	—	—	—	—	—
Kansas	9,683	—	—	9,683	8,025	124	—	8,149	8,619	—	—	8,619
Kentucky	225	18	—	243	32	4	—	36	178	20	—	198
Louisiana	102	132	—	234	609	2,084	—	2,693	301	1,585	—	1,886
Maine	3	3	—	6	—	—	—	—	—	—	—	—
Maryland	—	—	—	—	—	—	—	—	—	—	—	—
Massachusetts	54	155	—	209	—	80	—	80	—	15	—	15
Michigan	175	7	—	182	—	7	—	7	1	6	—	7
Minnesota	250	1,801	—	2,051	—	949	—	949	10	653	—	663
Mississippi	204	1,085	—	1,289	331	273	—	604	13	1,324	—	1,337
Missouri	13	45	—	58	—	—	—	—	—	—	—	—
Montana	565	3,979	—	4,544	338	6,747	—	7,085	431	5,449	—	5,880
Nebraska	—	474	—	474	—	48	—	48	—	31	—	31
Nevada	134	—	—	134	60	315	—	375	135	106	—	241
New Hampshire	1	5	—	6	—	—	—	—	—	—	—	—
New Jersey	—	1	—	1	—	—	—	—	—	—	—	—
New Mexico	501	1,199	—	1,700	182	611	—	793	98	250	—	348
New York	41	217	—	258	194	660	—	854	26	429	—	455
North Carolina	—	—	324	324	—	—	11	11	—	—	—	—
North Dakota	—	857	—	857	—	—	—	—	176	495	—	671
Ohio	501	655	—	1,156	1	2	—	3	22	13	—	35
Ohio River Valley	—	1,505	—	1,505	—	—	—	—	—	—	—	—
Oklahoma	73	812	—	885	703	1,651	—	2,354	418	880	—	1,298
Oregon	—	—	—	—	—	—	—	—	—	—	—	—
Pennsylvania	—	—	2,061	2,061	—	—	596	596	—	—	28	28
Puerto Rico	450	486	—	936	—	62	—	62	—	3	—	3
Rhode Island	130	3	—	133	—	3	—	3	—	7	—	7
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
South Dakota	18	—	—	18	1,087	772	—	1,859	391	855	—	1,246
Tennessee	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	85	—	85	—	—	—	—	280	63	—	343
Utah	911	30	—	941	—	—	—	—	1,194	124	—	1,318
Vermont	16	45	—	61	32	43	—	75	—	—	—	—
Virginia	234	503	—	737	—	36	—	36	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—	—	—	—	—
Washington	50	1,019	—	1,069	—	201	—	201	—	4	—	4
West Virginia	555	1,925	—	2,480	—	19	—	19	—	49	—	49
Wisconsin	97	83	—	180	13	40	—	53	13	—	—	13
Wyoming	—	—	374	374	—	—	299	299	—	—	881	881
Total River Miles Impaired	18,097	21,151	2,759	42,007	11,916	16,474	906	29,296	12,371	13,154	909	26,434
% of Impaired River Miles[a] Affected by Each Cause	8%	10%	1%	19%	5%	7%	<1%	13%	6%	6%	<1%	12%
% of Assessed River Miles Affected by Each Cause	3%	3%	<1%	7%	2%	3%	<1%	5%	2%	2%	<1%	4%
% of Total River Miles Affected by Each Cause	<1%	<1%	<1%	1%	<1%	<1%	<1%	1%	<1%	<1%	<1%	1%

Table A-3. (continued)

Habitat Alterations (9)				Flow Alterations (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
101	—	—	101	61	227	—	288
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	29	—	29	—	—	—	—
—	—	—	—	—	—	—	—
70	1,500	—	1,570	143	211	—	354
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
449	1,197	—	1,646	28	655	—	683
—	35	—	35	—	—	—	—
212	177	—	389	—	—	—	—
—	—	—	—	83	—	—	83
98	24	—	122	—	—	—	—
320	305	—	625	516	476	—	992
—	—	—	—	4	4	—	8
—	—	—	—	9	—	—	9
—	3	—	3	—	2	—	2
78	31	—	109	102	50	—	152
—	—	—	—	—	—	—	—
—	—	—	—	10	—	—	10
—	4,497	—	4,497	—	—	—	—
314	5,264	—	5,578	552	6,686	—	7,238
—	103	—	103	635	204	—	839
66	—	—	66	—	45	—	45
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
603	1,584	—	2,187	38	—	—	38
—	—	—	—	207	537	—	744
—	—	—	—	—	—	2	2
—	—	—	—	—	89	—	89
639	716	—	1,355	402	272	—	674
—	—	—	—	—	—	—	—
313	277	—	590	15	154	—	169
—	—	1,480	1,480	—	—	1,355	1,355
—	—	—	—	—	—	—	—
18	—	—	18	773	10	—	783
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
211	199	—	410	199	112	—	311
—	222	—	222	—	56	—	56
—	—	—	—	—	—	—	—
88	405	—	493	—	298	—	298
1	62	—	63	24	19	—	43
517	2,482	—	2,999	266	1,231	—	1,497
—	—	485	485	—	—	694	694
4,098	19,112	1,965	25,175	4,067	11,338	2,051	17,456
2%	9%	1%	11%	2%	5%	1%	8%
1%	3%	<1%	4%	1%	2%	<1%	3%
<1%	1%	—	1%	<1%	<1%	<1%	<1%

Table A-4., Leading Sources of Pollution in Assessed Rivers and Streams (miles)

State	Total Impaired Miles		Agriculture (general) (1)				Natural (2)			
	States Not Reporting Sources	States Reporting Sources	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	3,280	300	1,018	—	1,318	22	103	—	125
Alaska	2,889	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—		—	—	—	
Arizona	—	3,325	1,563	—	—	1,563	202	—	—	202
Arkansas	—	3,825	2,509	204	—	2,713	—	—	—	
California	—	4,650	2,472	2,568	—	5,040	—	—	—	
Colorado	—	3,486	585	1,503	—	2,088	—	—	—	
Connecticut	—	331	—	46	—	46	—	—	—	
Delaware	—	707	20	662	—	682	3	177	—	180
Delaware River Basin	—	—	—	—	—		—	—	—	
District of Columbia	—	38	—	—	—		—	10	—	10
Florida	—	2,633	162	1,518	—	1,680	—	—	—	
Georgia	—	2,889	—	—	—	—	—	—	—	
Gila River Indian Community	196	—	—	—	—		—	—	—	
Guam	—	—	—	—	—		—	—	—	
Hawaii	—	—	—	—	—		—	—	—	
Idaho	12,000	—	—	—	—		—	—	—	
Illinois	—	7,769	1,827	5,202	—	7,029	34	—	—	34
Indiana	—	1,647	512	—	—	512	—	—	—	
Iowa	—	9,488	8,689	773	—	9,462	56	69	—	125
Kansas	—	16,205	—	—	18,742	18,742	9,004	8	—	9,012
Kentucky	—	3,181	1,214	563	—	1,777	—	—	—	
Louisiana	—	4,817	2,602	2,794	—	5,396	—	—	—	
Maine	—	472	72	63	—	135	—	—	—	
Maryland	—	1,312	362	669	—	1,031	215	836	—	1,051
Massachusetts	—	951	4	32	—	36	50	142	—	192
Michigan	—	1,291	148	74	—	222	9	4	—	13
Minnesota	—	3,546	—	—	—		—	—	—	
Mississippi	—	32,134	27,492	1,827	—	29,319	8	3,145	—	3,153
Missouri	—	9,975	—	7,142	—	7,142	—	—	—	
Montana	—	13,906	—	—	8,108	8,108	427	7,701	—	8,128
Nebraska	—	5,799	4,346	—	—	4,346	—	1,198	—	1,198
Nevada	—	1,050	—	—	822	822	68	123	—	191
New Hampshire	—	227	—	1	—	1	—	—	—	
New Jersey	493	—	—	—	—		—	—	—	
New Mexico	—	3,226	2,550	367	—	2,917	77	116	—	193
New York	—	3,261	1,264	938	—	2,202	—	—	—	
North Carolina	—	10,303	—	—	5,777	5,777	—	—	—	
North Dakota	—	2,284	1,518	3,468	—	4,986	709	870	—	1,579
Ohio	—	4,772	630	1,312	—	1,942	—	—	—	
Ohio River Valley	—	981	—	1,308	—	1,308	—	—	—	
Oklahoma	—	2,950	—	—	4,015	4,015	57	—	—	57
Oregon	—	16,457	—	—	9,305	9,305	—	—	4,232	4,232
Pennsylvania	—	4,610	—	—	674	674	—	—	137	137
Puerto Rico	—	4,497	408	601	—	1,009	—	—	—	
Rhode Island	—	177	—	36	—	36	—	—	—	
South Carolina	—	1,112	395	213	—	608	—	—	—	
South Dakota	—	2,989	1,356	1,745	—	3,101	1,192	1,080	—	2,272
Tennessee	3,952	—	—	—	—		—	—	—	
Texas	—	3,726	—	—	151	151	731	20	—	751
Utah	—	3,264	184	974	—	1,158	2,566	1,274	—	3,840
Vermont	—	1,005	446	766	—	1,212	116	181	—	297
Virginia	—	3,537	432	452	—	884	—	—	—	
Virgin Islands	—	—	—	—	—		—	—	—	
Washington	—	3,647	214	1,838	—	2,052	9	825	—	834
West Virginia	—	4,205	257	692	—	949	120	162	—	282
Wisconsin	—	1,904	831	2,548	—	3,379	—	—	—	
Wyoming	—	4,037	—	—	2,478	2,478	—	—	1,854	1,854
Total River Miles Impaired	19,530	221,877	63,801	43,917	51,635	159,353	15,473	18,044	6,425	39,942
% of Impaired River Miles[a] Affected by Each Source			29%	20%	23%	72%	7%	8%	3%	18%
% of Assessed River Miles Affected by Each Source			10%	7%	8%	25%	2%	3%	1%	6%
% of Total River Miles Affected by Each Source			2%	1%	1%	4%	<1%	<1%	<1%	1%

[a]Includes only impaired river miles in States reporting sources affecting rivers and streams.
— None or not reported.
Source: 1992 State Section 305(b) reports.

Total Impaired River Miles in States Reporting Sources:	221,877 miles
Total Assessed River Miles:	642,881 miles
Estimate of Total River Miles in the Nation:	3,551,247 miles

Table A-4. (continued)

Municipal Point Sources (3)				Urban Runoff/Storm Sewers (4)				Resource Extraction (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
321	629	—	950	84	249	—	333	107	519	—	626
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	341	341	183	—	—	183	932	—	—	932
126	187	—	313	14	126	—	140	245	24	—	269
80	448	—	528	149	591	—	740	282	340	—	622
—	96	—	96	—	151	—	151	271	1,012	—	1,283
113	64	—	177	1	132	—	133	—	23	—	23
—	168	—	168	—	380	—	380	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	1	15	24	—	39	—	—	—	—
32	675	—	707	67	1,681	—	1,748	—	431	—	431
448	209	—	657	787	382	—	1,169	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
378	2,644	—	3,022	28	1,242	—	1,270	20	1,153	—	1,173
292	507	—	799	77	—	—	77	4	—	—	4
177	201	—	378	110	1,409	—	1,519	—	123	—	123
3,962	—	—	3,962	2,852	—	—	2,852	—	—	—	—
1,287	165	—	1,452	490	73	—	563	952	51	—	1,003
501	1,995	—	2,496	1,201	1,364	—	2,565	190	2,617	—	2,807
14	85	—	99	3	27	—	30	—	—	—	—
1	177	—	178	110	366	—	476	97	59	—	156
49	294	—	343	86	463	—	549	—	11	—	11
55	6	—	61	63	82	—	145	—	—	—	—
383	403	—	786	—	—	—	—	—	—	—	—
231	1,565	—	1,796	234	628	—	862	1,098	—	—	1,098
20	31	—	51	47	530	—	577	34	66	—	100
46	1,373	—	1,419	—	83	—	83	3	671	—	674
—	983	—	983	69	—	—	69	—	—	—	—
—	—	—	—	38	48	—	86	—	—	—	—
9	16	—	25	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
38	129	—	167	22	2	—	24	110	304	—	414
235	185	—	420	313	607	—	920	33	151	—	184
—	—	—	—	—	—	1,352	1,352	—	—	189	189
37	792	—	829	—	32	—	32	—	510	—	510
1,704	645	—	2,349	209	636	—	845	582	270	—	852
—	59	—	59	408	483	—	891	38	777	—	815
—	—	—	—	—	56	—	56	—	275	—	275
—	—	—	—	—	—	—	—	—	—	2,280	2,280
—	—	259	259	—	—	52	52	—	—	2,579	2,579
190	87	—	277	408	218	—	626	14	30	—	44
14	28	—	42	16	133	—	149	—	—	—	—
166	129	—	295	88	256	—	344	—	—	—	—
—	33	—	33	—	150	—	150	2	62	—	64
—	—	—	—	—	—	—	—	—	—	—	—
1,086	442	—	1,528	267	110	—	377	—	—	—	—
—	—	—	—	24	—	—	24	—	491	—	491
53	109	—	162	70	100	—	170	—	1	—	1
107	373	—	480	64	269	—	333	76	24	—	100
—	—	—	—	—	—	—	—	—	—	—	—
19	592	—	611	13	521	—	534	18	86	—	104
129	1,212	—	1,341	122	338	—	460	742	2,674	—	3,416
242	822	—	1,064	98	128	—	226	—	44	—	44
—	—	655	655	—	—	103	103	—	—	—	—
12,546	18,558	1,255	32,359	8,647	14,070	1,690	24,407	4,918	12,799	5,980	23,697
6%	8%	1%	15%	4%	6%	1%	11%	2%	6%	3%	11%
2%	3%	<1%	5%	1%	2%	<1%	4%	1%	2%	1%	4%
<1%	1%	<1%	1%	<1%	<1%	<1%	1%	<1%	<1%	<1%	1%

(continued)

Table A-4. (continued)

State	Industrial Point Sources (6)				Silviculture (7)				Hydro/Habitat Modification (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	18	433	—	451	25	193	—	218	68	312	—	380
Alaska	—	—	—		—	—	—		—	—	—	
American Samoa	—	—	—		—	—	—		—	—	—	
Arizona	—	—	210	210	—	—	154	154	—	—	1,563	1,563
Arkansas	205	62	—	267	36	157	—	193	—	—	—	
California	30	297	—	327	25	1,428	—	1,453	206	209	—	415
Colorado	117	16	—	133	—	43	—	43	—	16	—	16
Connecticut	—	—	—		—	—	—		—	—	—	
Delaware	2	110	—	112	—	—	—		—	20	—	20
Delaware River Basin	—	—	—		—	—	—		—	—	—	
District of Columbia	1	2	—	3	—	—	—		—	—	—	
Florida	98	430	—	528	—	154	—	154	20	834	—	854
Georgia	61	47	—	108	—	—	—		9	12	—	21
Gila River Indian Comm.	—	—	—		—	—	—		—	—	—	
Guam	—	—	—		—	—	—		—	—	—	
Hawaii	—	—	—		—	—	—		—	—	—	
Idaho	—	—	—		—	—	—		—	—	—	
Illinois	25	846	—	871	—	—	—		9	809	—	818
Indiana	90	27	—	117	—	—	—		31	—	—	31
Iowa	81	—	—	81	—	—	—		159	282	—	441
Kansas	1,300	—	—	1,300	—	—	—		83	—	—	83
Kentucky	180	25	—	205	—	34	—	34	110	69	—	179
Louisiana	685	1,875	—	2,560	130	1,037	—	1,167	543	1,932	—	2,475
Maine	102	169	—	271	—	—	—		—	—	—	
Maryland	—	—	—		—	—	—		2	1	—	3
Massachusetts	—	—	—		—	—	—		—	—	—	
Michigan	57	31	—	88	5	18	—	23	29	—	—	29
Minnesota	76	30	—	106	—	—	—		—	—	—	
Mississippi	349	1,821	—	2,170	1,528	523	—	2,051	109	75	—	184
Missouri	10	1	—	11	—	—	—		—	—	—	
Montana	—	339	—	339	2	1,387	—	1,389	—	35	—	35
Nebraska	—	563	—	563	—	—	—		—	140	—	140
Nevada	—	—	—		—	—	—		44	58	—	102
New Hampshire	—	13	—	13	—	—	—		—	—	—	
New Jersey	—	—	—		—	—	—		—	—	—	
New Mexico	—	—	—		17	104	—	121	144	523	—	667
New York	28	120	—	148	61	156	—	217	1,188	888	—	2,076
North Carolina	—	—	—		—	—	313	313	—	—	354	354
North Dakota	—	12	—	12	—	—	—		—	—	—	
Ohio	708	405	—	1,113	6	17	—	23	685	926	—	1,611
Ohio River Valley	—	350	—	350	—	—	—		—	—	—	
Oklahoma	—	—	—		—	126	—	126	—	—	—	
Oregon	—	—	—		—	—	7,580	7,580	—	—	—	
Pennsylvania	—	—	194	194	—	—	—		—	—	44	44
Puerto Rico	144	58	—	202	—	—	—		1	—	—	1
Rhode Island	—	28	—	28	—	—	—		—	—	—	
South Carolina	44	87	—	131	—	—	—		—	—	—	
South Dakota	11	—	—	11	—	—	—		—	—	—	
Tennessee	—	—	—		—	—	—		—	—	—	
Texas	95	12	—	107	—	—	—		—	—	—	
Utah	—	—	—		—	—	—		181	—	—	181
Vermont	10	23	—	33	2	9	—	11	—	—	—	
Virginia	94	58	—	152	—	—	—		—	—	—	
Virgin Islands	—	—	—		—	—	—		—	—	—	
Washington	285	842	—	1,127	102	473	—	575	16	1,129	—	1,145
West Virginia	359	449	—	808	129	262	—	391	14	20	—	34
Wisconsin	119	707	—	826	—	—	—		126	1,065	—	1,191
Wyoming	—	—	263	263	—	—	—		—	—	26	26
Total River Miles Impaired	5,384	10,288	667	16,339	2,068	6,121	8,047	16,236	3,777	9,355	1,987	15,119
% of Impaired River Miles[a] Affected by Each Source	2%	5%	—	7%	1%	3%	4%	7%	2%	4%	1%	7%
% of Assessed River Miles Affected by Each Source	1%	2%	—	3%	<1%	1%	1%	3%	1%	1%	—	2%
% of Total River Miles Affected by Each Source	—	—	—		—	—	—		—	—	—	

Appendix B

Individual State Data
Lakes, Reservoirs, and Ponds

Table B-1. Overall Designated Use Support in Lakes, Reservoirs, and Ponds (acres)

State	Fully Supporting				Threatened				Partially Supporting			
	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
Alabama	106,302	87,114		193,416	—	116,510	—	116,510	12,900	65,168		78,068
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	81	5,000	—	5,081	26,962	1,027		27,989	58,688	27,874		86,562
Arkansas	800	354,263	—	355,063	—	—	—	—	—	—	—	—
California	—	—	21,578	21,578	—	—	2,970	2,970	—	—	283,433	283,433
Colorado	94,647	35,523		130,170	—	—	—	—	—	12,930	—	12,930
Connecticut	23,722	13,744	—	37,466	882	1,916	—	2,798	—	3,143	—	3,143
Delaware	441	172	—	613	62	157	—	219	212	693	—	905
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	—	—	—	—	—	—	—	—	—
Florida	111,104	183,552	—	294,656	3,264	6,592	—	9,856	37,632	502,912	—	540,544
Georgia	1,788	355,374	—	357,162	—	—	—	—	201	29,134	—	29,335
Gila River Ind. Comm.	—	—	—	—	—	—	—	—	—	—	28	28
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Idaho	—	—	—	—	79,429	158,217	—	237,646	9,073	28,688	—	37,761
Illinois	367	1,406	—	1,773	4,031	13,173	—	17,204	49,708	53,662	—	103,370
Indiana	27,818	74,089	—	101,907	—	—	—	—	88	—	—	88
Iowa	1,353	—	—	1,353	21,904	1,333	—	23,237	22,349	491	—	22,840
Kansas	—	200	—	200	852	2,684	—	3,536	2,075	156,862	—	158,937
Kentucky	—	100,454	—	100,454	—	94,839	—	94,839	—	12,931	—	12,931
Louisiana	238,136	17,651	—	255,787	42,119	—	—	42,119	97,529	214,400	—	311,929
Maine	190,436	511,583	—	702,019	10,293	43,600	—	53,893	—	202,477	—	202,477
Maryland	16,072	—	—	16,072	917	—	—	917	3,906	—	—	3,906
Massachusetts[a]	726	2,050	—	2,776	1,986	3,211	—	5,197	4,744	6,902	—	11,646
Michigan	1,551	462,639	—	464,190	—	—	—	—	—	—	—	—
Minnesota	124,495	206,784	—	331,279	63,474	100,148	—	163,622	178,271	2,017,746	—	2,196,017
Mississippi	12,230	140,599	—	152,829	469	58,764	—	59,233	8,232	106,422	—	114,654
Missouri	12,750	152,802	—	165,552	7,663	81,326	—	88,989	—	4,366	—	4,366
Montana	312,593	58,968	—	371,561	8,270	129,357	—	137,627	98,352	357,242	—	455,594
Nebraska	—	34,401	—	34,401	2,608	26	—	2,634	—	57,390	—	57,390
Nevada	95,912	36,812	—	132,724	—	—	—	—	12,228	12,500	—	24,728
New Hampshire	58,045	72,605	—	130,650	5,779	3,800	—	9,579	5,516	3,195	—	8,711
New Jersey	—	—	—	—	—	—	—	—	—	—	—	—
New Mexico	85	62	—	147	45	13,390	—	13,435	40,273	89,839	—	130,112
New York	57,778	222,309	—	280,087	5,394	20,756	—	26,150	83,287	320,463	—	403,750
North Carolina	—	—	213,903	213,903	—	—	63,947	63,947	—	—	25,861	25,861
North Dakota	13,031	96	—	13,127	2,306	217,219	—	219,525	4,144	152,544	—	156,688
Ohio	—	—	259	259	—	—	6,265	6,265	—	—	66,835	66,835
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	8,684	90,363	—	99,047	33,587	197,276	—	230,863	25,120	216,522	—	241,642
Oregon	374,303	—	—	374,303	—	—	—	—	43,902	15,016	—	58,918
Pennsylvania	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico	939	668	—	1,607	1,382	967	—	2,349	2,110	1,000	—	3,110
Rhode Island	—	—	1,277	1,277	—	—	11,896	11,896	—	—	3,020	3,020
South Carolina	—	—	305,903	305,903	—	—	—	—	—	—	54,725	54,725
South Dakota	—	—	—	—	6	555,987	—	555,993	15,090	16,871	—	31,961
Tennessee	—	422,221	—	422,221	—	3,909	—	3,909	—	48,540	—	48,540
Texas	—	—	1,334,354	1,334,354	—	—	—	—	—	—	9,411	9,411
Utah	274,083	—	—	274,083	—	—	—	—	142,417	—	—	142,417
Vermont	1,783	17,570	—	19,353	1,157	16,396	—	17,553	167	89,865	—	90,032
Virginia	—	84,392	—	84,392	—	—	—	—	—	6,318	—	6,318
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	9,983	27,391	—	37,374	3,220	591	—	3,811	452	17,601	—	18,053
West Virginia	3	5,729	—	5,732	—	1,775	—	1,775	2	12,283	—	12,285
Wisconsin	30,592	14,914	—	45,506	14,774	30,049	—	44,823	10,729	41,761	—	52,490
Wyoming	—	32,169	—	32,169	1,409	4	—	1,413	29,538	33,822	—	63,360
Totals	2,202,633	3,825,669	1,877,274	7,905,576	344,244	1,874,999	85,078	2,304,321	998,935	4,939,573	443,313	6,381,821
% of Assessed Waters	28%	48%	24%	43%	15%	81%	4%	13%	16%	77%	7%	35%

[a]Does not include Quabbin Reservoir.

— None or not reported.
NA = Not applicable.
Source: 1992 State Section 305(b) reports.

Table B-1. (continued)

Not Supporting				Not Attainable				Total Assessed			
Eval-uated	Moni-tored	Not Specified	Total	Eval-uated	Moni-tored	Not Specified	Total	Eval-uated	Moni-tored	Not Specified	Total
—	4,480	—	4,480	—	—	—		119,202	273,272	—	392,474
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
722	704	—	1,426	—	—	—		86,453	34,605	—	121,058
—	—	—		—	—	—		800	354,263	—	355,063
—	—	—		—	—	—		—	—	307,981	307,981
40	—	—	40	—	—	—		94,687	48,453	—	143,140
—	—	—		—	—	—		24,604	18,803	—	43,407
81	987	—	1,068	—	—	—		796	2,009	—	2,805
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
—	238	—	238	—	—	—		—	238	—	238
27,704	87,360	—	112,064	—	—	—		176,704	780,416	—	957,120
—	8,305	—	8,305	—	—	—		1,989	392,813	—	394,802
—	—	125	125	—	—	—		153	—	—	153
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
142,212	910	—	143,122	—	—	—		230,714	187,815	—	418,529
62,977	20,757	—	83,734	—	—	—		117,083	88,998	—	206,081
101	—	—	101	—	—	—		28,007	74,089	—	102,096
1,300	—	—	1,300	—	—	—		46,906	1,824	—	48,730
337	9,119	—	9,456	—	—	—		3,264	168,865	—	172,129
—	6,738	—	6,738	—	—	—		—	214,962	—	214,962
60	—	—	60	2,393	—	—	2,393	380,237	232,051	—	612,288
—	—	—		—	—	—		200,729	757,660	—	958,389
106	—	—	106	—	—	—		21,001	—	—	21,001
1,137	475	—	1,612	2	14	—	16	8,595	12,652	—	21,247
931	25,334	—	26,265	—	—	—		2,482	487,973	—	490,455
86,138	105,762	—	191,900	—	—	—		452,378	2,430,440	—	2,882,818
46	82	—	128	—	—	—		20,977	305,867	—	326,844
70	28,566	—	28,636	—	—	—		20,483	267,060	—	287,543
5,251	9,400	—	14,651	—	—	—		424,466	554,967	—	979,433
—	38,523	—	38,523	—	—	—		2,608	130,340	—	132,948
39,800	16,005	—	55,805	—	—	—		147,940	65,317	—	213,257
4,176	464	—	4,640	—	—	—		73,516	80,064	—	153,580
—	—	—		—	—	—		—	—	—	
5	19	—	24	—	—	—		40,408	103,310	—	143,718
4,208	16,192	—	20,400	—	—	—		150,667	579,720	—	730,387
—	—	831	831	—	—	—		—	—	304,542	304,542
101,666	120,068	—	221,734	—	—	—		121,146	489,927	—	611,074
—	—	5,168	5,168	—	—	—		—	—	78,527	78,527
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
—	34,340	—	34,340	—	—	—		67,391	538,501	—	605,892
9,679	62,028	—	71,707	—	—	—		427,884	77,044	—	504,928
—	—	—		—	—	—		—	—	—	
—	3,521	—	3,521	—	—	—		4,431	6,156	—	10,587
—	—	556	556	—	—	—		—	—	16,749	16,749
—	—	21,400	21,400	—	—	—		—	—	382,028	382,028
24,791	70,713	—	95,504	—	—	—		39,887	643,571	—	683,458
—	64,656	—	64,656	—	—	—		—	539,326	—	539,326
—	—	160,774	160,774	—	—	—		—	—	1,504,539	1,504,539
33,578	—	—	33,578	—	—	—		450,078	—	—	450,078
81	100,007	—	100,088	—	—	—		3,188	223,838	—	227,026
—	52	—	52	—	—	—		—	90,762	—	90,762
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
864	20,594	—	21,458	—	—	—		14,519	66,177	—	80,696
—	1,730	—	1,730	—	—	—		5	21,517	—	21,522
10,884	58,031	—	68,915	—	—	—		66,979	144,755	—	211,734
—	28,480	—	28,480	—	—	—		30,947	94,475	—	125,422
555,945	944,640	188,854	1,689,439	2,395	14	—	2,409	4,104,305	11,584,895	2,594,366	18,283,566
33%	56%	11%	9%	99%	1%	—	1%	22%	63%	14%	46%

Table B-2a. Aquatic Life Use Support in Lakes (acres)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	213,492	131,902	1,620	—	—	347,014
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	7,152	40,413	72,117	1,376	—	121,058
Arkansas	355,063	—	—	—	—	355,063
California	21,578	2,970	283,433	—	—	307,981
Colorado	130,170	—	—	40	80	130,290
Connecticut	23,500	276	975	—	—	24,751
Delaware	2,314	—	125	166	—	2,605
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	136	—	—	103	—	239
Florida	294,656	9,856	540,544	112,064	—	957,120
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	28	125	—	153
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	249,951	38,458	129,732	—	418,141
Illinois	1,773	17,204	103,370	83,734	—	206,081
Indiana	78,818	—	88	101	—	79,007
Iowa	1,484	23,237	23,276	730	3	48,730
Kansas	200	28,914	142,639	376	—	172,129
Kentucky	156,974	49,239	2,469	6,280	—	214,962
Louisiana	—	—	—	—	—	—
Maine	702,095	80,966	175,328	—	—	958,389
Maryland	19,619	—	1,276	106	—	21,001
Massachusetts	9,722	6,869	3,884	477	—	20,952
Michigan	464,190	—	—	26,265	—	490,455
Minnesota	—	—	—	—	—	—
Mississippi	152,829	59,233	114,654	128	—	326,844
Missouri	175,275	110,239	1,959	70	—	287,543
Montana	325,920	—	621,353	26,505	—	973,778
Nebraska	83,215	4,567	9,725	35,972	—	133,479
Nevada	132,674	—	40,733	39,050	—	212,457
New Hampshire	141,243	8,025	3,743	570	—	153,581
New Jersey	—	—	—	—	—	—
New Mexico	674	12,909	130,112	23	—	143,718
New York	657,687	1,600	57,250	13,850	—	730,387
North Carolina	230,183	54,997	18,531	831	—	304,542
North Dakota	101,199	131,453	1,896	376,526	—	611,074
Ohio	259	6,265	66,835	5,168	—	78,527
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	—	—	—	—	—	—
Oregon	468,652	—	39,765	76,041	—	584,458
Pennsylvania	—	—	—	—	—	—
Puerto Rico	2,607	2,349	2,110	3,521	—	10,587
Rhode Island	8,448	4,944	2,795	562	—	16,749
South Carolina	318,083	—	42,525	21,400	—	382,008
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	1,504,539	—	—	—	—	1,504,539
Utah	274,083	—	142,417	33,578	—	450,078
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	30,582	591	1,907	953	—	34,033
West Virginia	7,774	1,775	10,244	1,730	—	21,523
Wisconsin	107,920	38,685	7,993	55,354	—	209,952
Wyoming	—	—	—	—	—	—
Totals	7,206,782	1,079,429	2,706,177	1,053,507	83	12,045,978
Percent of Assessed Waters	60%	9%	22%	9%	<1%	

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table B-2b. Fish Consumption Use Support in Lakes (acres)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	35,200	93,100	56,698	4,480	—	189,478
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	—	—	—	—	—	—
Arkansas	355,063	—	—	—	—	355,063
California	177,785	2,970	127,046	—	—	307,801
Colorado	117,240	—	—	12,930	—	130,170
Connecticut	21,195	33	2,875	—	—	24,103
Delaware	2,447	—	—	158	—	2,605
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	238	—	—	238
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	—	153	—	153
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	—	—	—	—	—
Illinois	123,264	941	6,965	16,524	—	147,694
Indiana	—	—	—	12	—	12
Iowa	491	722	—	—	3	1,216
Kansas	—	8,551	—	—	—	8,551
Kentucky	214,962	—	—	—	—	214,962
Louisiana	290,597	—	210,886	108,412	—	609,895
Maine	958,389	—	—	—	—	958,389
Maryland	20,901	—	—	100	—	21,001
Massachusetts	1,949	268	—	670	—	2,887
Michigan	467,705	—	—	22,750	—	490,455
Minnesota	46,671	1,132	2,168,357	6,869	—	2,223,029
Mississippi	—	—	—	—	—	—
Missouri	254,089	—	119	33,335	—	287,543
Montana	—	—	—	—	—	—
Nebraska	118,120	300	—	—	—	118,420
Nevada	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New Mexico	—	—	119,391	—	—	119,391
New York	596,137	—	131,300	2,950	—	730,387
North Carolina	280,672	—	23,530	340	—	304,542
North Dakota	—	—	339,307	—	—	339,307
Ohio	14,337	—	180	—	—	14,517
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	—	—	—	—	—	—
Oregon	485,646	—	14,858	4,424	—	504,928
Pennsylvania	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	1,504,539	—	—	500	—	1,505,039
Utah	—	—	—	279	—	279
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	25,167	—	—	—	—	25,167
West Virginia	91	—	—	—	—	91
Wisconsin	117,042	22,930	64,945	6,820	—	211,737
Wyoming	—	—	—	—	—	—
Totals	6,229,699	130,947	3,266,695	221,706	3	9,849,050
Percent of Assessed Waters	63%	1%	33%	2%	<1%	

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table B-2c. Swimming Use Support in Lakes (acres)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	200,100	80,132	18,280	—	—	298,512
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	90,832	23,905	4,428	1,086	—	120,251
Arkansas	355,063	—	—	—	—	355,063
California	117,616	24	70,161	—	—	187,801
Colorado	113,133	—	—	40	—	113,173
Connecticut	15,592	8,890	268	—	—	24,750
Delaware	964	—	739	902	—	2,605
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	238	—	238
Florida	294,656	9,856	540,544	112,064	—	957,120
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	28	125	—	153
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	377,115	31,711	7	—	408,833
Illinois	49,453	—	88,234	68,394	—	206,081
Indiana	97,372	—	88	89	—	97,549
Iowa	6,743	17,346	21,683	686	2,371	48,829
Kansas	200	143,713	24,722	373	—	169,008
Kentucky	214,743	—	219	—	—	214,962
Louisiana	320,210	—	273,569	16,116	—	609,895
Maine	702,019	207,110	49,260	—	—	958,389
Maryland	21,001	—	—	—	—	21,001
Massachusetts	8,118	2,368	9,522	928	—	20,936
Michigan	490,455	—	—	—	—	490,455
Minnesota	1,167,640	301,814	74,361	185,542	—	1,729,357
Mississippi	186,372	58,500	5,237	—	—	250,109
Missouri	163,200	97,178	5	72	27,088	287,543
Montana	486,238	—	465,238	22,302	—	973,778
Nebraska	88,339	3,217	39,833	1,034	—	132,423
Nevada	133,602	—	39,905	39,750	—	213,257
New Hampshire	141,815	1,554	5,421	4,072	—	152,862
New Jersey	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—
New York	607,587	1,400	116,650	4,750	—	730,387
North Carolina	264,604	—	—	62	—	264,666
North Dakota	2,134	218,294	14,821	375,501	—	610,750
Ohio	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	49,587	275,070	192,351	30,990	—	547,998
Oregon	491,649	—	13,218	61	—	504,928
Pennsylvania	—	—	—	—	—	—
Puerto Rico	2,940	2,016	3,680	1,951	—	10,587
Rhode Island	—	—	—	—	—	—
South Carolina	369,083	—	11,425	—	—	380,508
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	1,486,728	—	9,411	8,400	—	1,504,539
Utah	—	—	—	1,000	—	1,000
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	61,851	—	1,619	112	—	63,582
West Virginia	21,523	—	—	—	—	21,523
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	8,823,162	1,829,502	2,126,631	876,647	29,459	13,685,401
Percent of Assessed Waters	64%	13%	16%	6%	<1%	

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table B-2d. Secondary Contact Recreational Use Support in Lakes (acres)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	200,100	80,132	18,280	—	—	298,512
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	105	—	474	227	—	806
Arkansas	355,063	—	—	—	—	355,063
California	307,801	—	120,000	—	—	427,801
Colorado	32,071	—	—	—	—	32,071
Connecticut	16,227	7,353	1,170	—	—	24,750
Delaware	1,307	245	811	242	—	2,605
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	27	—	—	211	—	238
Florida	291,904	9,856	196,736	112,064	—	610,560
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	153	—	—	—	153
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	377,176	31,655	2	—	408,833
Illinois	—	—	—	—	—	—
Indiana	—	—	—	—	—	—
Iowa	—	—	—	—	—	—
Kansas	200	144,878	26,625	334	—	172,037
Kentucky	109,830	93,700	5,659	—	—	209,189
Louisiana	317,695	—	288,569	60	—	606,324
Maine	958,389	—	—	—	—	958,389
Maryland	—	—	—	—	—	—
Massachusetts	10,880	3,851	6,070	134	—	20,935
Michigan	490,455	—	—	—	—	490,455
Minnesota	—	—	—	—	—	—
Mississippi	317,881	1,594	7,323	46	—	326,844
Missouri	—	—	—	—	—	—
Montana	140,080	129,382	332,619	11,151	—	613,232
Nebraska	—	—	—	—	—	—
Nevada	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New Mexico	—	171	137	13	—	321
New York	683,537	2,050	43,000	1,800	—	730,387
North Carolina	230,183	54,997	18,531	831	—	304,542
North Dakota	2,134	233,115	—	375,501	—	610,750
Ohio	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Puerto Rico	4,906	335	3,949	1,397	—	10,587
Rhode Island	—	—	—	—	—	—
South Carolina	381,228	—	800	—	—	382,028
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	—	—	—	—	—	—
Utah	—	—	—	1,000	—	1,000
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	—	—	—	8	—	8
West Virginia	20,837	—	686	—	—	21,523
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	4,872,840	1,138,988	1,103,094	505,021	—	7,619,943
Percent of Assessed Waters	64%	15%	14%	7%	—	

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table B-2e. Drinking Water Supply Use Support in Lakes (acres)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	28,834	40,266	8,300	—	—	77,400
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	75,843	13,268	18,898	65	—	108,074
Arkansas	—	—	—	—	—	—
California	137,278	118,000	4,510	—	—	259,788
Colorado	109,474	—	—	—	—	109,474
Connecticut	—	—	—	—	—	—
Delaware	296	—	—	—	—	296
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	—	—	—
Florida	2,752	—	343,808	—	—	346,560
Georgia	—	—	—	—	—	—
Gila River Indian Community	—	—	—	153	—	153
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	393,120	—	140	—	393,260
Illinois	61,599	—	44,534	—	—	106,133
Indiana	32,000	—	—	—	—	32,000
Iowa	5,914	5,519	7,917	570	27,986	47,906
Kansas	200	47,619	93,941	9,040	—	150,800
Kentucky	80,623	—	5,826	458	—	86,907
Louisiana	—	—	—	—	—	—
Maine	958,313	—	—	76	—	958,389
Maryland	19,324	—	—	—	—	19,324
Massachusetts	—	—	—	—	—	—
Michigan	490,455	—	—	—	—	490,455
Minnesota	—	—	—	—	—	—
Mississippi	84,200	—	—	—	—	84,200
Missouri	27,834	69,203	1,478	288	188,740	287,543
Montana	291,650	—	314,041	12,900	—	618,591
Nebraska	—	—	—	—	—	—
Nevada	90,000	—	—	—	—	90,000
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—
New York	342,107	20,930	54,950	—	—	417,987
North Carolina	158,177	—	—	140	—	158,317
North Dakota	—	363,880	1,191	116,851	—	481,922
Ohio	128	9,389	60,748	9,679	—	79,944
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	56,330	6,306	8,800	—	—	71,436
Oregon	504,838	—	90	—	—	504,928
Pennsylvania	—	—	—	—	—	—
Puerto Rico	2,466	682	3,262	268	—	6,678
Rhode Island	—	—	—	—	—	—
South Carolina	381,228	—	—	—	—	381,228
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	1,332,646	—	—	151,874	—	1,484,520
Utah	450,078	—	—	—	—	450,078
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	—	—	—	—	—	—
West Virginia	5,037	1,750	—	—	—	6,787
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	5,729,624	1,089,932	972,294	302,502	216,726	8,311,078
Percent of Assessed Waters	69%	13%	12%	4%	3%	

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table B-2f. Agriculture Use Support in Lakes (acres)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	—	—	—	440	440	440
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	98,825	15,684	350	667	—	115,526
Arkansas	—	—	—	—	—	—
California	148,175	—	—	—	—	148,175
Colorado	148,943	—	—	—	—	148,943
Connecticut	—	—	—	—	—	—
Delaware	2,605	—	—	—	—	2,605
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	—	—	—
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Gila River Indian Community	28	—	—	—	125	153
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	—	401,698	388	129,722	—	531,808
Illinois	—	—	—	—	—	—
Indiana	106,203	—	—	—	—	106,203
Iowa	—	—	—	—	—	—
Kansas	—	132,032	15,003	—	—	147,035
Kentucky	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	958,389	—	—	—	—	958,389
Maryland	21,001	—	—	—	—	21,001
Massachusetts	—	—	—	—	—	—
Michigan	490,455	—	—	—	—	490,455
Minnesota	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—
Missouri	—	—	—	—	—	—
Montana	600,297	—	5,394	12,900	—	618,591
Nebraska	89,296	—	41,586	—	—	130,882
Nevada	—	—	11,400	—	—	11,400
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—
New York	730,387	—	—	—	—	730,387
North Carolina	230,183	54,997	18,531	831	—	304,542
North Dakota	—	365,071	—	116,851	—	481,922
Ohio	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	57,347	236	—	—	—	57,583
Oregon	504,928	—	—	—	—	504,928
Pennsylvania	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	381,228	—	—	—	—	381,228
South Dakota	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—
Texas	—	—	—	—	—	—
Utah	450,078	—	—	—	—	450,078
Vermont	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—
Wisconsin	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—
Totals	5,018,368	969,718	92,652	261,411	565	6,342,714
Percent of Assessed Waters	79%	15%	1%	4%	<1%	

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table B-3. Leading Causes of Impairment in Lakes (acres)

State	Total Impaired Acres		Metals (1)				Nutrients (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	82,548	—	—	—		—	—	—	
Alaska	—	—	—	—	—		—	—	—	
American Samoa	—	—	—	—	—		—	—	—	
Arizona	—	87,988	—	15,271	—	15,271	50	65,391	—	65,441
Arkansas	—	—	—	—	—		—	—	—	
California	—	283,433	214,200	34,936	—	249,136	145,800	5,570	—	151,370
Colorado	—	12,970	102	9,424	—	9,526	14	7,952	—	7,966
Connecticut[a]	—	3,143	—	—	—	—	3,856	2,095	—	5,951
Delaware	—	1,973	189	56	—	245	580	1,286	—	1,866
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	—	238	—	103	—	103	—	—	—	
Florida	—	652,608	—	—	—	—	27,392	116,608	—	144,000
Georgia	—	37,640	7,655	650	—	8,305	—	—	—	
Gila River Indian Community	—	153	—	—	—		—	—	—	
Guam	—	—	—	—	—		—	—	—	
Hawaii	—	—	—	—	—		—	—	—	
Idaho	—	180,883	—	811	—	811	31,644	146,430	—	178,074
Illinois	—	187,104	4,300	21,553	—	25,853	46,044	149,064	—	195,108
Indiana	—	189	—	45	—	45	122	12	—	134
Iowa	—	24,140	—	—	—		8,338	15,751	—	24,089
Kansas	—	168,393	5	136,701	—	136,706	4,077	159,924	—	164,001
Kentucky	—	19,669	5,314	—	—	5,314	9,520	—	—	9,520
Louisiana	—	311,989	60	—	—	60	22,932	63,410	—	86,342
Maine	—	202,477	—	—	—		2,463	61,165	—	63,628
Maryland	—	4,012	—	—	—	—	265	2,921	—	3,186
Massachusetts	—	13,258	572	—	—	572	5,424	5,025	—	10,449
Michigan	—	26,265	10,972	3,565	—	14,537	975	—	—	975
Minnesota	—	2,387,917	834,107	1,332,235	—	2,166,342	212,691	47,212	—	259,903
Mississippi	—	114,782	—	200	—	200	7,064	166,905	—	173,969
Missouri	—	33,002	—	—	—	—	1,155	178	—	1,333
Montana	—	470,245	16,449	302,175	—	318,624	—	319,316	—	319,316
Nebraska	—	95,913	4,626	74,680	—	79,306	—	12,211	—	12,211
Nevada	—	80,533	14,800	11,400	—	26,200	21,200	—	—	21,200
New Hampshire	—	13,351	—	—	—		4,728	12	—	4,740
New Jersey	—	—	—	—	—		—	—	—	
New Mexico	—	130,136	—	65,700	—	65,700	24	44,702	—	44,726
New York	—	424,150	6,500	8,600	—	15,100	163,900	103,100	—	267,000
North Carolina	—	26,692	9,680	—	—	9,680	18,020	90	—	18,110
North Dakota	—	378,422	—	339,307	—	339,307	7,374	6,294	—	13,668
Ohio	—	72,003	307	4,767	—	5,074	7,408	25,699	—	33,107
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	—	275,982	5,813	90,843	—	96,656	26,799	229,382	—	256,181
Oregon	—	130,625	—	—	—		—	—	115,965	115,965
Pennsylvania	—	—	—	—	—		—	—	—	
Puerto Rico	—	6,631	84	125	—	209	852	1,331	—	2,183
Rhode Island	—	3,576	441	371	—	812	80	1,184	—	1,264
South Carolina	—	76,125	—	—	—	—	—	—	—	
South Dakota	—	127,465	—	—	—	—	103,468	9,093	—	112,561
Tennessee	113,196	—	—	—	—		—	—	—	
Texas	—	170,185	—	—	—	—	—	—	—	
Utah	—	175,995	—	4,909	—	4,909	83,163	73,461	—	156,624
Vermont	—	190,120	—	2,499	—	2,499	121,420	58,785	—	180,205
Virginia	—	6,370	—	558	—	558	—	5,810	—	5,810
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	39,511	—	104	—	104	635	8,577	—	9,212
West Virginia	—	14,015	3,757	2,996	—	6,753	—	2,790	—	2,790
Wisconsin	—	121,405	71,765	—	—	71,765	—	—	57,865	57,865
Wyoming	—	91,840	—	—	25,730	25,730	—	—	40,618	40,618
Total Lake Acres Impaired	113,196	7,958,064	1,211,698	2,464,584	25,730	3,702,012	1,089,477	1,918,736	214,448	3,222,661
% of Impaired Lake Acres[b] Affected by Each Cause			15%	31%	<1%	47%	14%	24%	3%	40%
% of Assessed Lake Acres Affected by Each Cause			7%	13%	<1%	20%	6%	10%	1%	18%
% of Total Lake Acres Affected by Each Cause			3%	6%	<1%	9%	3%	5%	1%	8%

[a]Connecticut assessed some lakes as impaired by nutrients even though the lakes did not meet the Section 319 definition of impaired.

[b]Includes only impaired lake acres in States reporting causes affecting lakes.

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Total Impaired Lakes Acres in States Reporting Causes:	7,958,064 acres
Total Assessed Lake Acres:	18,283,566 acres
Estimate of Total Lake Acres in the Nation:	39,922,437 acres

Table B-3. (continued)

Organic Enrich./Low Dissolved Oxygen (3)				Siltation (4)				Priority Organics (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—	—	—	—	—	—	61,178	—	—	61,178
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	270	—	270	—	11,173	—	11,173	170	6	—	176
—	—	—	—	—	—	—	—	—	—	—	—
13,140	2,600	—	15,740	120,110	18,080	—	138,190	—	—	—	—
160	—	—	160	—	—	—	—	—	—	—	—
475	3,510	—	3,985	326	2,870	—	3,196	2,875	—	—	2,875
86	145	—	231	215	42	—	257	158	—	—	158
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
103	—	—	103	—	103	—	103	—	103	—	103
—	79,296	—	79,296	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
2,145	63,020	—	65,165	—	—	—	—	—	—	—	—
73,704	115,793	—	189,497	67,579	125,693	—	193,272	2,041	2,786	—	4,827
59	63	—	122	—	—	—	—	12	—	—	12
2,387	4,800	—	7,187	12,706	6,242	—	18,948	—	187	—	187
—	—	—	—	3,855	54,885	—	58,740	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
29,716	10,292	—	40,008	2,112	16,307	—	18,419	2,236	44,824	—	47,060
135,312	55,792	—	191,104	—	66,712	—	66,712	—	—	—	—
6	2,405	—	2,411	100	3,860	—	3,960	—	—	—	—
233	7,626	—	7,859	8	96	—	104	—	—	—	—
2,200	—	—	2,200	—	—	—	—	8,562	—	—	8,562
—	—	—	—	—	—	—	—	7,096	1,293,440	—	1,300,536
—	163,126	—	163,126	22	172,086	—	172,108	46	—	—	46
1,730	—	—	1,730	70	—	—	70	—	—	—	—
—	259,702	—	259,702	—	81,822	—	81,822	—	—	—	—
—	7,994	—	7,994	1,526	6,276	—	7,802	—	—	—	—
50,300	950	—	51,250	—	—	—	—	—	—	—	—
1,025	14	—	1,039	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	506	—	506	5	84,865	—	84,870	—	1,240	—	1,240
5,350	85,350	—	90,700	22,800	113,300	—	136,100	102,100	20,450	—	122,550
100	—	—	100	636	540	—	1,176	340	—	—	340
1,608	29,032	—	30,640	1,970	158	—	2,128	—	—	—	—
50,589	2,982	—	53,571	3,378	19,577	—	22,955	—	2,076	—	2,076
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
29,300	156,514	—	185,814	74,729	313,783	—	388,512	11,805	22,468	—	34,273
—	—	69,147	69,147	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
58	898	—	956	—	—	—	—	—	—	—	—
600	—	—	600	109	284	—	393	—	337	—	337
63,925	—	—	63,925	—	—	—	—	—	—	—	—
477	1,404	—	1,881	75,818	65,300	—	141,118	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
156,859	8,728	—	165,587	119,450	8,197	—	127,647	—	—	—	—
2,442	11,882	—	14,324	1,651	18,085	—	19,736	—	—	—	—
—	736	—	736	—	585	—	585	—	—	—	—
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
836	2,036	—	2,872	—	4,630	—	4,630	—	104	—	104
30	32	—	62	370	5,480	—	5,850	—	—	—	—
—	—	55,286	55,286	—	—	—	—	—	—	—	—
—	—	55,259	55,259	—	—	33,743	33,743	—	—	—	—
624,955	1,077,498	179,692	1,882,145	509,545	1,201,031	33,743	1,744,319	198,619	1,388,021	—	1,586,640
8%	14%	2%	24%	6%	15%	<1%	22%	2%	17%	—	20%
3%	6%	1%	10%	3%	7%	<1%	10%	1%	8%	—	9%
2%	3%	—	5%	1%	3%	<1%	4%	<1%	3%	—	4%

(continued)

Table B-3. (continued)

State	Suspended Solids (6)				Noxious Aquatic Plants (7)				Flow Alteration (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—	—	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	—	824	—	824	213	1,037	—	1,250	—	950	—	950
Arkansas	—	—	—	—	—	—	—	—	—	—	—	—
California	—	—	—	—	45,000	2,970	—	47,970	—	—	—	—
Colorado	—	—	—	—	—	—	—	—	—	—	—	—
Connecticut	—	—	—	—	3,430	622	—	4,052	—	—	—	—
Delaware	86	—	—	86	781	868	—	1,649	—	—	—	—
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	—	103	—	103	—	—	—	—	—	—	—	—
Florida	—	216,704	—	216,704	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	573	—	573	—	—	—	—
Gila River Indian Comm.	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Idaho	1,319	139,620	—	140,939	—	—	—	—	1,000	7,740	—	8,740
Illinois	73,058	121,206	—	194,264	29,129	105,066	—	134,195	10	67	—	77
Indiana	—	—	—	—	—	—	—	—	—	—	—	—
Iowa	—	—	—	—	—	258	—	258	—	—	—	—
Kansas	5	—	—	5	40	—	—	40	3,792	7,788	—	11,580
Kentucky	4,517	—	—	4,517	—	—	—	—	—	—	—	—
Louisiana	6,912	—	—	6,912	9,044	40,333	—	49,377	2,112	3,864	—	5,976
Maine	—	—	—	—	—	—	—	—	—	30	—	30
Maryland	—	—	—	—	—	408	—	408	—	—	—	—
Massachusetts	187	106	—	293	5,119	8,739	—	13,858	—	—	—	—
Michigan	—	—	—	—	—	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—	—	—	—	—	—
Mississippi	22	—	—	22	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—	—	—	—	—
Montana	—	310,844	—	310,844	—	306,019	—	306,019	—	363,221	—	363,221
Nebraska	—	16,123	—	16,123	250	—	—	250	—	—	—	—
Nevada	—	—	—	—	14,800	—	—	14,800	—	—	—	—
New Hampshire	—	—	—	—	5,001	440	—	5,441	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—	—	—	—	—
New Mexico	—	2,429	—	2,429	41	11,959	—	12,000	—	—	—	—
New York	—	—	—	—	1,650	58,300	—	59,950	47,200	9,400	—	56,600
North Carolina	—	—	—	—	1,416	600	—	2,016	—	—	—	—
North Dakota	—	—	—	—	—	—	—	—	221,568	—	—	221,568
Ohio	—	1,350	—	1,350	—	2,247	—	2,247	—	8,817	—	8,817
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	68,874	183,418	—	252,292	5,680	18,002	—	23,682	40,117	42,063	—	82,180
Oregon	—	—	15,594	15,594	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	133	3,822	—	3,955	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
South Dakota	359	29,133	—	29,492	102,468	5,483	—	107,951	—	7,868	—	7,868
Tennessee	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—	—	—
Utah	97,232	21	—	97,253	2,826	100,154	—	102,980	—	—	—	—
Vermont	—	—	—	—	21,639	8,444	—	30,083	7,482	441	—	7,923
Virginia	—	—	—	—	—	—	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	30	—	30	—	2,413	—	2,413	—	2,858	—	2,858
West Virginia	—	—	—	—	49	—	—	49	—	—	—	—
Wisconsin	—	—	—	—	—	—	86,545	86,545	—	—	—	—
Wyoming	—	—	—	—	—	—	—	—	—	—	9,420	9,420
Total River Miles Impaired	252,571	1,021,911	15,594	1,290,076	248,709	678,757	86,545	1,014,011	323,281	455,107	9,420	787,808
% of Impaired River Miles[a] Affected by Each Cause	3%	13%	<1%	16%	3%	9%	1%	13%	4%	6%	<1%	10%
% of Assessed River Miles Affected by Each Cause	1%	6%	<1%	7%	1%	4%	<1%	6%	2%	2%	<1%	4%
% of Total River Miles Affected by Each Cause	1%	3%	<1%	3%	1%	2%	<1%	3%	1%	1%	—	2%

Table B-3. (continued)

Pesticides (9)				Pathogen Indicators (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		18,280	—	—	18,280
—	—	—		—	—	—	
—	—	—		—	—	—	
170	—	—	170	50	100	—	150
—	—	—		—	—	—	
210	50	—	260	1,280	6,790	—	8,070
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		1,212	462	—	1,674
NA	NA	NA	NA	NA	NA	NA	NA
—	103	—	103	211	27	—	238
—	—	—		4,288	448	—	4,736
—	24,911	—	24,911	—	650	—	650
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	7,579	—	7,579	79	36,181	—	36,260
13,395	598	—	13,993	1,800	4,651	—	6,451
12	—	—	12	45	77	—	122
336	19,693	—	20,029	248	—	—	248
52,065	57,941	—	110,006	9,556	—	—	9,556
—	—	—		—	—	—	
—	25,844	—	25,844	9,248	257,263	—	266,511
—	—	—		—	—	—	
100	—	—	100	6	366	—	372
—	—	—		—	266	—	266
—	—	—		1	—	—	1
—	—	—		—	—	—	
5,961	165,815	—	171,776	—	7,569	—	7,569
33,622	—	—	33,622	2	70	—	72
—	—	—		1,399	13,312	—	14,711
3,365	—	—	3,365	—	38,733	—	38,733
—	—	—		—	—	—	
—	—	—		104	79	—	183
—	—	—		—	—	—	
—	326	—	326	—	—	—	
25,650	43,350	—	71,000	14,550	151,400	—	165,950
—	—	—		—	—	—	
—	—	—		—	—	—	
604	8,734	—	9,338	—	2,022	—	2,022
NA	NA	NA	NA	NA	NA	NA	NA
—	215,663	—	215,663	—	1,820	—	1,820
—	—	—		—	—	13,248	13,248
—	—	—		—	—	—	
—	738	—	738	1,325	1,494	—	2,819
—	—	—		290	581	—	871
—	—	—		12,200	25	—	12,225
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		16,230	1,581	—	17,811
—	—	—		1,000	—	—	1,000
—	—	—		844	10	—	854
—	210	—	210	52	286	—	338
NA	NA	NA	NA	NA	NA	NA	NA
6,621	—	—	6,621	41	1,818	—	1,859
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
142,111	573,555	—	715,666	94,341	528,081	13,248	635,670
2%	7%	—	9%	1%	7%	<1%	8%
1%	3%	—	4%	1%	3%	<1%	3%
<1%	1%	—	2%	<1%	1%	<1%	2%

Table B-4. Leading Sources of Impairment in Assessed Lakes (acres)

State	Total Impaired Acres		Agriculture (general) (1)				Urban Runoff/Storm Sewers (2)			
	States Not Reporting Sources	States Reporting Sources	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	82,548	620	4,000	—	4,620	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—
Arizona	—	87,988	—	—	31,876	31,876	—	—	416	416
Arkansas	—	—	—	—	—	—	—	—	—	—
California	—	283,433	25,111	1	—	25,112	120,640	2,781	—	123,421
Colorado	—	12,970	1,503	13,976	—	15,479	900	8,552	—	9,452
Connecticut	—	3,143	—	—	—	—	—	—	—	—
Delaware	—	1,973	—	2,168	—	2,168	—	1,444	—	1,444
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	—	238	—	—	—	—	211	27	—	238
Florida	—	652,608	1,920	630,912	—	632,832	—	646,528	—	646,528
Georgia	—	37,640	—	—	—	—	—	25,561	—	25,561
Gila River Indian Community	—	153	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—
Idaho	—	180,883	5,008	118,243	—	123,251	—	890	—	890
Illinois	—	187,104	141,887	46,057	—	187,944	2,986	83,669	—	86,655
Indiana	—	189	12	—	—	12	35	22	—	57
Iowa	—	24,140	15,612	7,811	—	23,423	5,194	2,209	—	7,403
Kansas	—	168,393	44,335	101,545	—	145,880	8,042	7,495	—	15,537
Kentucky	—	19,669	8,093	—	—	8,093	—	—	—	—
Louisiana	—	311,989	43,213	25,326	—	68,539	20,608	23,416	—	44,024
Maine	—	202,477	1,402	66,805	—	68,207	32,805	89,608	—	122,413
Maryland	—	4,012	271	4,647	—	4,918	110	384	—	494
Massachusetts	—	13,258	55	537	—	592	1,660	1,019	—	2,679
Michigan	—	26,265	—	—	—	—	2,245	—	—	2,245
Minnesota	2,102,552	285,365	—	—	—	—	—	—	—	—
Mississippi	—	114,782	171,758	1,300	—	173,058	22	1,400	—	1,422
Missouri	—	33,002	33,730	—	—	33,730	3,535	—	—	3,535
Montana	—	470,245	12,900	302,233	—	315,133	—	546	—	546
Nebraska	—	95,913	3,380	6,278	—	9,658	100	400	—	500
Nevada	—	80,533	14,800	108,000	—	122,800	—	—	—	—
New Hampshire	—	13,351	124	45	—	169	1,260	12	—	1,272
New Jersey	—	—	—	—	—	—	—	—	—	—
New Mexico	—	130,136	5	101,387	—	101,392	5	—	—	5
New York	—	424,150	71,600	74,600	—	146,200	19,400	24,400	—	43,800
North Carolina	—	26,692	1,149	340	—	1,489	715	90	—	805
North Dakota	—	378,422	4,354	12,810	—	17,164	—	22	—	22
Ohio	—	72,003	2,956	33,879	—	36,835	3,306	10,596	—	13,902
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	—	275,982	45,698	343,104	—	388,802	—	81,555	—	81,555
Oregon	—	130,625	—	—	98,145	98,145	—	—	10,866	10,866
Pennsylvania	—	—	—	—	—	—	—	—	—	—
Puerto Rico	—	6,631	—	1,125	—	1,125	112	73	—	185
Rhode Island	—	3,576	—	562	—	562	1,057	296	—	1,353
South Carolina	—	76,125	11,400	—	—	11,400	25	—	—	25
South Dakota	—	127,465	11,573	29,557	—	41,130	90	—	—	90
Tennessee	113,196	—	—	—	—	—	—	—	—	—
Texas	—	170,185	—	—	—	—	—	—	—	—
Utah	—	175,995	—	—	165,000	165,000	46,953	—	—	46,953
Vermont	190,120	—	—	—	—	—	—	—	—	—
Virginia	—	6,370	—	2,875	—	2,875	21	1,152	—	1,173
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	39,511	350	16,259	—	16,609	160	11,724	—	11,884
West Virginia	—	14,015	40	2,094	—	2,134	12	—	—	12
Wisconsin	121,405	—	—	—	—	—	—	—	—	—
Wyoming	—	91,840	—	—	63,229	63,229	—	—	1,434	1,434
Total Lake Acres Impaired	2,527,273	5,543,987	674,859	2,058,476	358,250	3,091,585	272,209	1,025,871	12,716	1,310,796
% of Impaired Lake Acres[a] Affected by Each Source			12%	37%	6%	56%	5%	19%	<1%	24%
% of Assessed Lake Acres Affected by Each Source			4%	11%	2%	17%	1%	6%	<1%	7%
% of Total Lake Acres Affected by Each Source			2%	5%	1%	8%	1%	3%	<1%	3%

[a]Includes only impaired lake acres in States reporting sources affecting lakes.
— None or not reported.
NA = Not applicable.
Source: 1992 State Section 305(b) reports.

Total Impaired Lake Acres in States Reporting Sources:	5,543,987 acres
Total Assessed Lake Acres:	18,283,566 acres
Estimate of Total Lake Acres in the Nation:	39,922,437 acres

Table B-4. (continued)

Hydro-Habitat Modification (3)				Natural (4)				Municipal Point Sources (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—	—	—	—	—	—	—	4,000	—	4,000
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	81,278	81,278	—	—	—	—	—	—	559	559
—	—	—	—	—	—	—	—	—	—	—	—
120,000	640	—	120,640	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	7,172	—	7,172
975	—	—	975	—	—	—	—	—	268	—	268
—	—	—	—	189	395	—	584	—	93	—	93
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
—	103	—	103	—	27	—	27	—	—	—	—
—	454,400	—	454,400	—	—	—	—	1,216	250,560	—	251,776
—	—	—	—	—	—	—	—	—	3,774	—	3,774
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
1,220	7,691	—	8,911	—	4,081	—	4,081	—	811	—	811
29,237	144,004	—	173,241	—	5,831	—	5,831	4,925	90,120	—	95,045
—	40	—	40	—	—	—	—	59	63	—	122
220	156	—	376	3,595	232	—	3,827	12	—	—	12
3,458	5,824	—	9,282	18,939	140,598	—	159,537	20,785	119,813	—	140,598
—	—	—	—	6,474	—	—	6,474	6,445	455	—	6,900
61,632	30,298	—	91,930	—	—	—	—	23,968	15,819	—	39,787
—	8,057	—	8,057	—	—	—	—	76	4,845	—	4,921
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	208	131	—	339	1,008	231	—	1,239
1,270	—	—	1,270	—	—	—	—	906	—	—	906
—	—	—	—	—	—	—	—	285,365	—	—	285,365
—	—	—	—	—	—	—	—	—	—	—	—
1,730	—	—	1,730	—	—	—	—	7	66	—	73
—	—	—	—	22,049	322,945	—	344,994	—	5,100	—	5,100
784	—	—	784	—	—	—	—	—	30,000	—	30,000
108,000	—	—	108,000	828	950	—	1,778	6,400	—	—	6,400
25	—	—	25	575	452	—	1,027	3,632	—	—	3,632
—	—	—	—	—	—	—	—	—	—	—	—
—	196	—	196	—	429	—	429	—	—	—	—
60,300	26,700	—	87,000	—	—	—	—	13,900	63,600	—	77,500
—	—	—	—	—	—	—	—	15,850	1,090	—	16,940
—	—	—	—	—	222,917	—	222,917	—	2,701	—	2,701
—	12,466	—	12,466	334	24,847	—	25,181	—	13,149	—	13,149
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
—	—	—	—	12,055	6,654	—	18,709	—	—	—	—
—	—	—	—	—	—	111,231	111,231	—	—	485	485
—	—	—	—	—	—	—	—	—	—	—	—
—	36	—	36	—	—	—	—	—	—	—	—
—	—	—	—	1,463	215	—	1,678	—	233	—	233
—	—	—	—	—	—	—	—	—	—	—	—
1,339	7,868	—	9,207	11,674	406	—	12,080	1,870	—	—	1,870
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	35,366	114,208	—	149,574	16,230	—	—	16,230
98,699	3,530	—	102,229	100,326	14,500	—	114,826	97,584	21	—	97,605
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	10	448	—	458
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
—	3,407	—	3,407	—	10,668	—	10,668	—	3,069	—	3,069
—	—	—	—	61	—	—	61	—	4	—	4
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	64,515	64,515	—	—	30,809	30,809
488,889	705,416	81,278	1,275,583	214,136	870,486	175,746	1,260,368	500,248	617,505	31,853	1,149,606
9%	13%	1%	23%	4%	16%	3%	23%	9%	11%	1%	21%
3%	4%	<1%	7%	1%	5%	1%	7%	3%	3%	<1%	6%
1%	2%	<1%	3%	1%	2%	<1%	3%	1%	2%	<1%	3%

(continued)

Table B-4. (continued)

State	Onsite Wastewater Disposal (6)				Flow Modification (7)				Contaminated Sediments (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—	—	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	—	—	92	92	—	—	—	—	—	—	—	—
Arkansas	—	—	—	—	—	—	—	—	—	—	—	—
California	25,640	820	—	26,460	—	—	—	—	—	—	—	—
Colorado	—	—	—	0	—	—	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—	—	—	—	—	—	—
Delaware	—	1,267	—	1,267	—	—	—	—	—	—	—	—
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	—	—	—	—	—	—	—	—	—
Florida	—	591,488	—	591,488	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—	—	—	—	—	—
Gila River Indian Comm.	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Idaho	—	—	—	—	—	—	—	—	—	—	—	—
Illinois	—	—	—	—	—	—	—	—	58,190	134,553	—	192,743
Indiana	—	—	—	0	—	—	—	—	—	—	—	—
Iowa	—	—	—	—	—	—	—	—	—	—	—	—
Kansas	—	—	—	0	—	—	—	—	—	—	—	—
Kentucky	3,109	317	—	3,426	—	—	—	—	334	—	—	334
Louisiana	—	—	—	0	—	—	—	—	—	—	—	—
Maine	—	—	—	0	—	—	—	—	—	18,432	—	18,432
Maryland	—	—	—	0	—	—	—	—	—	—	—	—
Massachusetts	376	984	—	1,360	—	—	—	—	697	5,649	—	6,346
Michigan	—	—	—	0	—	—	—	—	3,660	—	—	3,660
Minnesota	—	—	—	—	—	—	—	—	—	—	—	—
Mississippi	3,422	100	—	3,522	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—	—	—	—	—
Montana	—	9,708	—	9,708	—	299,629	—	299,629	—	2,066	—	2,066
Nebraska	—	—	—	—	—	—	—	—	—	—	—	—
Nevada	—	—	—	0	50,200	950	—	51,150	—	—	—	—
New Hampshire	—	—	—	0	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—	—	—	—	—	—
New York	57,300	96,850	—	154,150	—	—	—	—	23,800	18,100	—	41,900
North Carolina	—	—	—	0	—	—	—	—	9,680	—	—	9,680
North Dakota	—	—	—	0	221,568	—	—	221,568	—	—	—	—
Ohio	1,995	18,140	—	20,135	—	2,540	—	2,540	25	8,957	—	8,982
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	—	35,739	—	35,739	46,019	46,013	—	92,032	17,628	105,751	—	123,379
Oregon	—	—	13,129	13,129	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico	—	—	—	0	—	—	—	—	—	—	—	—
Rhode Island	—	532	—	532	—	—	—	—	—	—	—	—
South Carolina	—	—	—	0	—	—	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—	—	—
Utah	—	4,554	—	4,554	637	733	—	1,370	—	—	—	—
Vermont	—	—	—	—	—	—	—	—	—	—	—	—
Virginia	—	—	—	0	—	—	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	8,703	—	8,703	—	2,962	—	2,962	—	790	—	790
West Virginia	—	—	—	0	—	—	—	—	—	—	—	—
Wisconsin	—	—	—	—	—	—	—	—	—	—	—	—
Wyoming	—	—	—	0	44,938	—	—	44,938	—	—	—	—
Total Lake Acres Impaired	91,842	769,202	13,221	874,265	363,362	352,827	—	716,189	114,014	294,298	—	408,312
% of Impaired Lake Acres[a] Affected by Each Cause	2%	14%	<1%	16%	7%	6%	—	13%	2%	5%	—	7%
% of Assessed Lake Acres Affected by Each Cause	1%	4%	<1%	5%	2%	2%	—	4%	1%	2%	—	2%
% of Total River Miles Affected by Each Cause	<1%	2%	<1%	2%	1%	1%	—	2%	—	1%	—	1%

Table B-4. (continued)

Industrial Point Sources (9)				Resource Extraction (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
56,698	—	—	56,698	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
170	—	—	170	2,832	—	—	2,832
—	—	—	—	—	—	—	—
—	—	—	—	69,200	32,816	—	102,016
262	—	—	262	—	—	—	—
—	—	—	—	—	—	—	—
—	35	—	35	—	—	—	—
NA	NA	NA	NA	NA	NA	NA	NA
—	—	—	—	—	—	—	—
—	62,720	—	62,720	—	31,872	—	31,872
650	1,223	—	1,873	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	811	—	811	3	811	—	814
2,631	14,500	—	17,131	155	41,777	—	41,932
—	—	—	—	30	—	—	30
—	—	—	—	—	—	—	—
—	—	—	—	190	50	—	240
—	—	—	—	4,871	—	—	4,871
46,976	13,088	—	60,064	44,800	42,643	—	87,443
—	4,288	—	4,288	—	—	—	—
—	—	—	—	—	952	—	952
—	—	—	—	—	—	—	—
4,877	—	—	4,877	—	—	—	—
—	—	—	—	—	—	—	—
—	200	—	200	1,200	—	—	1,200
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
3,961	—	—	3,961	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
43,400	3,300	—	46,700	500	—	—	500
340	—	—	340	—	—	—	—
—	—	—	—	—	—	—	—
—	16,356	—	16,356	212	4,556	—	4,768
NA	NA	NA	NA	NA	NA	NA	NA
—	—	—	—	—	49,679	—	49,679
895	—	—	895	—	—	—	—
—	—	—	—	—	—	—	—
112	122	—	234				
—	—	—	—	—	—	—	—
800	—	—	800	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
96,900	21	—	96,921	2,815	—	—	2,815
—	—	—	—	—	—	—	—
—	448	—	448	—	—	—	—
NA	NA	NA	NA	NA	NA	NA	NA
—	—	—	—	—	—	—	—
12,000	—	—	12,000	3,911	8,040	—	11,951
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
270,672	117,112	—	387,784	130,719	213,196	—	343,915
5%	2%	—	7%	2%	4%	—	6%
1%	1%	—	2%	1%	1%	—	2%
1%	<1%	—	1%	<1%	1%	—	1%

Appendix C

Individual State Data
Estuaries and Coastal Waters

Table C-1. Overall Designated Use Support in Estuaries (square miles)

State	Fully Supporting				Threatened				Partially Supporting			
	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
Alabama	12	253	—	265	—	—	—	—	—	75	—	75
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
California	—	—	—	—	—	—	4	4	—	—	85	85
Connecticut	—	—	361	361	—	—	—	—	—	—	235	235
Delaware	—	—	—	—	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	216	—	216	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—	—	—	—	—
Florida	730	953	—	1,683	—	25	—	25	97	773	—	870
Georgia	443	10	—	453	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	718	32	—	750	88	13	—	101	—	3	—	3
Louisiana	851	594	—	1,445	2,614	—	—	2,614	864	—	—	864
Maine	1,423	50	—	1,473	—	—	—	—	—	36	—	36
Maryland	—	—	—	—	87	6	—	93	197	2,153	—	2,350
Massachusetts	65	2	—	67	—	1	—	1	5	17	—	22
Mississippi	—	1	—	1	—	13	—	13	—	5	—	5
New Hampshire	—	10	—	10	—	—	—	—	—	—	—	—
New Jersey	—	—	440	440	—	—	—	—	—	—	121	121
New York	—	1,106	—	1,106	—	1	—	1	—	166	—	166
North Carolina	—	—	2,721	2,721	—	—	131	131	—	—	269	269
Oregon	—	—	4	4	—	—	—	—	—	—	38	38
Puerto Rico[a]	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	—	—	141	141	—	—	14	14	—	—	21	21
South Carolina	—	—	310	310	—	—	—	—	—	—	101	101
Texas	—	—	1,318	1,318	—	—	—	—	—	—	150	150
Virginia	267	2,130	—	2,397	—	—	—	—	48	567	—	615
Virgin Islands	—	—	3	3	—	—	—	—	—	—	1	1
Washington	17	243	—	260	—	140	—	140	1	104	—	105
Totals	4,526	5,384	5,298	15,208	2,789	415	149	3,353	1,212	3,899	1,021	6,132
% of Assessed Waters	30%	35%	35%	56%	83%	12%	4%	12%	20%	64%	17%	23%

[a] Puerto Rico reported linear miles of estuarine impairments rather than square miles (see Chapter 8, Individual State Summaries, for more information).

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-1. (continued)

Not Supporting				Not Attainable				Total Assessed			
Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
—	3	—	3	—	—	—	—	12	331	—	343
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	89	89
—	—	4	4	—	—	—	—	—	—	600	600
—	29	—	29	—	—	—	—	—	29	—	29
—	—	—	—	—	—	—	—	—	216	—	216
—	6	—	6	—	—	—	—	—	6	—	6
5	147	—	152	—	—	—	—	832	1,898	—	2,730
237	164	—	401	—	—	—	—	680	174	—	854
—	—	—	—	—	—	—	—	—	—	—	—
—	20	—	20	—	—	—	—	806	68	—	874
20	—	—	20	—	—	—	—	4,349	594	—	4,943
7	118	—	125	—	—	—	—	1,430	204	—	1,634
8	71	—	79	—	—	—	—	292	2,230	—	2,522
42	92	—	134	—	—	—	—	112	112	—	224
—	—	—	—	—	—	—	—	—	19	—	19
5	14	—	19	—	—	—	—	5	24	—	29
—	—	53	53	—	—	—	—	—	—	614	614
—	258	—	258	—	—	—	—	—	1,531	—	1,531
—	—	—	—	—	—	—	—	—	—	3,121	3,121
—	—	19	19	—	—	—	—	—	—	61	61
—	—	—	—	—	—	—	—	—	—	—	—
—	—	17	17	—	—	—	—	—	—	193	193
—	—	15	15	—	—	—	—	—	—	426	426
—	—	453	453	—	—	71	71	—	—	1,992	1,992
7	60	—	67	—	—	—	—	322	2,757	—	3,079
—	—	1	1	—	—	—	—	—	—	5	5
3	585	—	588	—	—	—	—	21	1,072	—	1,093
334	1,567	562	2,463	—	—	71	71	8,861	11,265	7,101	27,227
14%	64%	23%	9%	—	—	100%	<1%	33%	41%	26%	74%

Table C-2a. Aquatic Life Use Support in Estuaries (square miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	328	—	—	3	—	331
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	—	4	85	—	—	89
Connecticut	375	—	223	2	—	600
Delaware	—	—	17	12	—	29
Delaware River Basin	132	59	25	—	—	216
District of Columbia	—	—	1	4	—	5
Florida	1,683	25	870	152	—	2,730
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	4,673	—	269	—	—	4,942
Maine	1,475	—	36	122	—	1,633
Maryland	—	93	2,350	79	—	2,522
Massachusetts	114	1	31	51	—	197
Mississippi	1	13	5	—	—	19
New Hampshire	28	—	—	—	—	28
New Jersey	—	—	—	—	—	—
New York	1,513	—	16	1	—	1,530
North Carolina	2,721	131	269	—	—	3,121
Oregon	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	178	8	—	7	—	193
South Carolina	341	—	97	11	—	449
Texas	1,991	—	—	—	—	1,991
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	490	—	13	32	—	535
Totals	16,043	334	4,307	476	—	21,160
Percent of Assessed Waters	76%	2%	20%	2%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-2b. Fish Consumption Use Support in Estuaries (square miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	328	—	—	3	—	331
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	7	2	80	—	—	89
Connecticut	600	—	—	—	—	600
Delaware	29	—	—	—	—	29
Delaware River Basin	191	—	—	25	—	216
District of Columbia	—	—	6	—	—	6
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	2,502	—	—	21	—	2,523
Massachusetts	9	—	—	46	—	55
Mississippi	—	—	—	—	—	—
New Hampshire	28	—	—	—	—	28
New Jersey	—	—	—	—	—	—
New York	1,415	—	115	—	—	1,530
North Carolina	2,721	131	269	—	—	3,121
Oregon	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	1,947	—	—	44	—	1,991
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	23	—	—	—	23
Totals	9,777	156	470	139	—	10,542
Percent of Assessed Waters	93%	1%	4%	1%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-2c. Shellfishing Use Support in Estuaries (square miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	196	—	75	3	—	274
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	7	2	3	—	—	12
Connecticut	483	—	—	117	—	600
Delaware	—	—	10	—	—	10
Delaware River Basin	—	—	—	42	—	42
District of Columbia	—	—	—	—	—	—
Florida	878	25	472	74	—	1,449
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	281	—	3	139	11	434
Maryland	1,646	6	97	90	—	1,839
Massachusetts	77	—	14	132	—	223
Mississippi	—	—	5	4	—	9
New Hampshire	10	—	—	19	—	29
New Jersey	440	—	121	53	—	614
New York	1,344	1	4	182	—	1,531
North Carolina	—	—	59	—	—	59
Oregon	4	—	38	19	—	61
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	1,308	—	139	453	71	1,971
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	208	139	88	620	—	1,055
Totals	6,882	173	1,128	1,947	82	10,212
Percent of Assessed Waters	67%	2%	11%	19%	1%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-2d. Swimming Use Support in Estuaries (square miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	327	—	—	—	—	327
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	9	1	3	—	—	13
Connecticut	538	1	59	3	—	601
Delaware	9	—	17	3	—	29
Delaware River Basin	205	—	—	—	—	205
District of Columbia	—	—	—	5	—	5
Florida	1,683	25	870	152	—	2,730
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	3,299	—	1,063	580	—	4,942
Maine	1,631	—	—	3	—	1,634
Maryland	2,520	—	—	2	—	2,522
Massachusetts	99	8	59	48	—	214
Mississippi	—	—	—	—	—	—
New Hampshire	28	—	—	—	—	28
New Jersey	—	—	—	—	—	—
New York	1,456	—	1	73	—	1,530
North Carolina	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	353	—	35	12	—	400
Texas	1,977	—	10	—	—	1,987
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	482	—	15	34	—	531
Totals	14,616	35	2,132	915	—	17,698
Percent of Assessed Waters	83%	<1%	12%	5%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-2e. Secondary Contact Recreational Use Support in Estuaries (square miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	328	—	—	3	—	331
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	89	—	—	—	—	89
Connecticut	538	1	59	3	—	601
Delaware	29	—	—	—	—	29
Delaware River Basin	11	—	—	—	—	11
District of Columbia	—	—	5	1	—	6
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	3,689	—	1,233	20	—	4,942
Maine	—	—	—	—	—	—
Maryland	—	—	—	—	—	—
Massachusetts	192	—	11	2	—	205
Mississippi	6	5	7	—	—	18
New Hampshire	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—
New York	1,519	—	11	—	—	1,530
North Carolina	2,721	131	269	—	—	3,121
Oregon	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	420	—	15	—	—	435
Texas	4	—	—	—	—	4
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	487	—	32	13	—	532
Totals	10,033	137	1,642	42	—	11,854
Percent of Assessed Waters	85%	1%	14%	<1%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-3. Leading Causes of Estuarine Impairments (square miles)

State	Total Impaired Waters		Nutrients (1)				Pathogen Indicators (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	78	—	—	—		78	—	—	78
Alaska	—	—	—	—	—		—	—	—	
American Samoa	—	—	—	—	—		—	—	—	
California	—	85	2	1	—	3	2	—	—	2
Connecticut	—	239	236	15	—	251	13	125	—	138
Delaware	—	29	26	3	—	29	14	15	—	29
Delaware River Basin	—	—	—	—	—		—	—	—	
District of Columbia	—	6	—	1	—	1	1	5	—	6
Florida	—	1,022	95	300	—	395	—	44	—	44
Georgia	—	401	—	—	—		85	4	—	89
Guam	—	—	—	—	—		—	—	—	
Hawaii	23	—	—	—	—		—	—	—	
Louisiana	—	884	55	808	—	863	—	622	—	622
Maine	—	161	—	—	—		38	—	—	38
Maryland	—	2,429	404	2,102	—	2,506	59	638	—	697
Massachusetts	—	156	—	21	—	21	96	51	—	147
Mississippi	—	5	—	14	—	14	—	18	—	18
New Hampshire	—	19	—	—	—		19	—	—	19
New Jersey	—	174	70	—	—	70	142	—	—	142
New York	—	424	1	108	—	109	266	35	—	301
North Carolina	—	269	—	—	113	113	—	—	59	59
Oregon	—	57	—	—	—		—	—	56	56
Puerto Rico[a]	—	—	—	—	—		—	—	—	
Rhode Island	—	38	—	14	—	14	28	4	—	32
South Carolina	—	116	—	—	—		28	9	—	37
Texas	—	603	—	—	—		174	362	—	536
Virginia	—	682	236	127	—	363	—	163	—	163
Virgin Islands	—	2	—	—	—		—	—	—	
Washington	—	693	—	—	—		45	301	—	346
Total Estuarine Area Impaired	23	8,572	1,125	3,514	113	4,752	1,088	2,396	115	3,599
% of Impaired Estuarine Area[b] Affected by Each Cause			13%	41%	1%	55%	13%	28%	1%	42%
% of Assessed Estuarine Area Affected by Each Cause			4%	13%	—	17%	4%	9%	—	13%
% of Total Estuarine Area Affected by Each Cause			3%	10%	—	13%	3%	6%	—	10%

[a] Puerto Rico reported linear miles of estuarine impairments rather than square miles (see Chapter 8, Individual State Summaries, for more information).
[b] Includes only impaired estuarine waters in States reporting causes of estuarine impairments.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired Estuarine Miles in States Reporting Causes:	8,572 square miles
Total Assessed Estuarine Miles:	27,227 square miles
Estimate of Total Estuarine Miles in the Nation:	36,890 square miles

Table C-3. (continued)

Organic Enrich./Low Dissolved Oxygen (3)				Siltation (4)				Suspended Solids (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	1	1	4	—	5	—	—	—	—
7	19	—	26	—	—	—	—	—	—	—	—
13	3	—	16	—	—	—	—	—	12	—	12
—	—	—	—	—	—	—	—	—	—	—	—
1	—	—	1	1	—	—	1	1	—	—	1
—	29	—	29	—	—	—	—	111	323	—	434
3	102	—	105	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	746	—	746	—	187	—	187	—	187	—	187
1	—	—	1	—	—	—	—	—	—	—	—
293	616	—	909	14	670	—	684	—	—	—	—
—	48	—	48	—	—	—	—	—	—	—	—
—	2	—	2	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	140	—	—	140	—	—	—	—
10	114	—	124	1	26	—	27	15	30	—	45
—	—	32	32	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	7	—	7	—	—	—	—	—	—	—	—
86	—	—	86	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
133	63	—	196	—	—	—	—	229	2	—	231
—	—	—	—	—	—	—	—	—	—	—	—
68	514	—	582	—	—	—	—	—	—	—	—
616	2,263	32	2,911	157	887	—	1,044	356	554	—	910
7%	26%	<1	34%	2%	10%	—	12%	4%	6%	—	11%
2%	8%	—	11%	1%	3%	—	4%	1%	2%	—	3%
2%	6%	—	8%	—	2%	—	3%	1%	2%	—	2%

(continued)

Table C-3. (continued)

State	Oil and Grease (6)				Pesticides (7)				Salinity/TDS/Chlorides (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—	—	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
California	—	—	—	—	76	1	—	77	—	—	—	—
Connecticut	1	—	—	1	—	—	—	—	—	—	—	—
Delaware	—	—	—	—	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	—	1	—	1	—	1	—	1	—	—	—	—
Florida	—	—	—	—	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	1	—	1	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Louisiana	262	560	—	822	—	187	—	187	20	560	—	580
Maine	—	—	—	—	—	—	—	—	—	—	—	—
Maryland	—	—	—	—	27	—	—	27	—	—	—	—
Massachusetts	—	2	—	2	—	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	70	—	—	70	—	—	—	—
New York	—	22	—	22	—	—	—	—	—	—	—	—
North Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico[a]	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—	—	—
Virginia	—	21	—	21	158	94	—	252	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—	—	—	—	—
Washington	—	5	—	5	—	—	—	—	—	—	—	—
Total Estuarine Area Impaired	263	611	—	874	331	284	—	615	20	560	—	580
% of Impaired Estuarine Area[b] Affected by Each Cause	3%	7%	—	10%	4%	3%	—	7%	—	7%	—	7%
% of Assessed Estuarine Area Affected by Each Cause	1%	2%	—	3%	1%	1%	—	2%	—	2%	—	2%
% of Total Estuarine Area Affected by Each Cause	1%	2%	—	2%	1%	1%	—	2%	—	2%	—	2%

Table C-3. (continued)

Priority Organics (9)				Metals (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
1	—	—	1	77	1	—	78
1	20	—	21	—	—	—	
—	—	—		—	1	—	1
—	—	—		—	—	—	
—	1	—	1	—	4	—	4
—	—	—		—	—	—	
—	18	—	18	16	68	—	84
—	—	—		—	—	—	
—	—	—		—	—	—	
—	20	—	20	—	—	—	
3	—	—	3	—	—	—	
—	—	—		—	—	—	
1	7	—	8	—	30	—	30
1	—	—	1	9	—	—	9
—	—	—		—	—	—	
70	—	—	70	—	—	—	
120	6	—	126	—	32	—	32
—	—	65	65	—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	7	—	7	—	7	—	7
—	—	—		—	—	—	
—	24	—	24	1	—	—	1
—	6	—	6	1	44	—	45
—	—	—		—	—	—	
—	31	—	31	—	14	—	14
197	140	65	402	104	201	—	305
2%	2%	1%	5%	1%	2%	—	4%
1%	1%	—	1%	—	1%	—	1%
1%	—	—	1%	—	1%	—	1%

Table C-4. Leading Sources of Estuarine Impairments (square miles)

State	Total Impaired Waters		Municipal Point Sources (1)				Urban Runoff/Storm Sewers (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	78	3	—	—	3	—	75	—	75
Alaska	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—
California	—	85	75	—	—	75	78	3	—	81
Connecticut	—	239	263	182	—	445	—	340	—	340
Delaware	—	29	—	25	—	25	—	29	—	29
Delaware River Basin	—	—	—	—	—	—	—	—	—	—
District of Columbia	—	6	—	—	—	—	1	2	—	3
Florida	—	1,022	—	744	—	744	3	944	—	947
Georgia	—	401	4	107	—	111	5	—	—	5
Guam	—	—	—	—	—	—	—	—	—	—
Hawaii	23	—	—	—	—	—	—	—	—	—
Louisiana	—	884	—	809	—	809	—	621	—	621
Maine	—	161	117	6	—	123	—	—	—	—
Maryland	—	2,429	389	341	—	730	188	238	—	426
Massachusetts	—	156	10	81	—	91	10	105	—	115
Mississippi	—	5	—	9	—	9	—	18	—	18
New Hampshire	—	19	5	—	—	5	—	—	—	—
New Jersey	—	174	140	—	—	140	280	—	—	280
New York	—	424	57	210	—	267	124	69	—	193
North Carolina	269	—	—	—	—	—	—	—	—	—
Oregon	—	57	—	—	53	53	—	—	17	17
Puerto Rico[a]	—	—	—	—	—	—	—	—	—	—
Rhode Island	—	38	—	30	—	30	7	26	—	33
South Carolina	—	116	—	12	—	12	29	—	—	29
Texas	—	603	134	92	—	226	—	—	—	—
Virginia	—	682	236	110	—	346	4	267	—	271
Virgin Islands	—	2	—	—	—	—	—	—	—	—
Washington	—	693	—	139	—	139	—	104	—	104
Total Estuarine Area Impaired	292	8,303	1,433	2,897	53	4,383	729	2,841	17	3,587
% of Impaired Estuarine Area[b] Affected by Each Source			17%	35%	1%	53%	9%	34%	—	43%
% of Assessed Estuarine Area Affected by Each Source			5%	11%	—	16%	3%	10%	—	13%
% of Total Estuarine Area Affected by Each Source			4%	8%	—	12%	2%	8%	—	10%

[a]Puerto Rico reported linear miles of estuarine impairments rather than square miles (see Chapter 8, Individual State Summaries, for more information).
[b]Includes only impaired estuarine waters in States reporting sources of estuarine impairments.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired Estuarine Miles in States Reporting Sources:	8,303 sq. mi.
Total Assessed Estuarine Miles:	27,227 sq. mi.
Estimate of Total Estuarine Miles in the Nation:	36,890 sq. mi.

Table C-4. (continued)

Agriculture (general) (3)				Industrial Point Sources (4)				Natural (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		3	—	—	3	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
79	1	—	80	—	1	—	1	—	—	—	
—	247	—	247	—	49	—	49	—	231	—	231
13	16	—	29	—	1	—	1	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	4	—	4
—	552	—	552	15	280	—	295	—	—	—	
—	—	—		34	130	—	164	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
374	—	—	374	20	747	—	767	—	—	—	
—	—	—		—	—	—		—	—	—	
643	1,046	—	1,689	86	9	—	95	253	212	—	465
—	2	—	2	—	—	—		—	11	—	11
—	—	—		1	13	—	14	—	—	—	
—	—	—		—	—	—		—	—	—	
70	—	—	70	—	—	—		—	—	—	
—	5	—	5	—	19	—	19	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	53	53	—	—	42	42	—	—	—	
—	—	—		—	—	—		—	—	—	
—	1	—	1	—	16	—	16	—	—	—	
—	—	—		14	11	—	25	—	—	—	
—	—	—		1	24	—	25	—	—	—	
236	19	—	255	1	283	—	284	—	183	—	183
—	—	—		—	—	—		—	—	—	
4	178	—	182	—	102	—	102	61	264	—	325
1,419	2,067	53	3,539	175	1,685	42	1,902	314	905	—	1,219
17%	25%	1%	43%	2%	20%	1%	23%	4%	11%	—	15%
5%	8%	—	13%	1%	6%	—	7%	1%	3%	—	4%
4%	6%	—	10%	—	5%	—	5%	1%	2%	—	3%

(continued)

Table C-4. (continued)

State	Resource Extraction (6)				Construction (7)				Contaminated Sediments (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—	—	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
California	75	—	—	75	—	2	—	2	—	—	—	—
Connecticut	—	—	—	—	—	—	—	—	1	49	—	50
Delaware	—	—	—	—	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	1	—	—	1	—	—	—	—	—	—	—	—
Florida	—	90	—	90	—	482	—	482	—	—	—	—
Georgia	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—	—	—	—
Louisiana	207	615	—	822	—	—	—	—	—	—	—	—
Maine	—	—	—	—	—	—	—	—	—	—	—	—
Maryland	—	—	—	—	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—	—	34	—	34
Mississippi	—	6	—	6	—	—	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	140	—	—	140	—	—	—	—
New York	—	—	—	—	—	—	—	—	120	36	—	156
North Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico[a]	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—	—	—	—	7	—	7
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—	—	—
Virginia	—	—	—	—	—	13	—	13	158	94	—	252
Virgin Islands	—	—	—	—	—	—	—	—	—	—	—	—
Washington	—	4	—	4	—	27	—	27	—	35	—	35
Total Estuarine Area Impaired	283	715	—	998	140	524	—	664	279	255	—	534
% of Impaired Estuarine Area[b] Affected by Each Source	3%	9%	—	12%	2%	6%	—	8%	3%	3%	—	6%
% of Assessed Estuarine Area Affected by Each Source	1%	3%	—	4%	1%	2%	—	2%	1%	1%	—	2%
% of Total Estuarine Area Affected by Each Source	1%	2%	—	3%	—	1%	—	2%	1%	1%	—	1%

Table C-4. (continued)

Atmospheric Deposition (9)				Hydrologic/Habitat Modification (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	71	—	71
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		75	4	—	79
—	230	—	230	—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	1	—	1
—	—	—		—	202	—	202
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	2	—	2
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
228	8	—	236	—	20	—	20
—	—	—		—	—	—	
—	—	—		—	82	—	82
228	238	—	466	75	382	—	457
3%	3%	—	6%	1%	5%	—	6%
1%	1%	—	2%	—	1%	—	2%
1%	1%	—	1%	—	1%	—	1%

Table C-5. Overall Designated Use Support in Ocean Coastal Waters (shore miles)

State	Fully Supporting				Threatened				Partially Supporting			
	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
Alabama	50	—	—	50	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
California	—	—	628	628	—	—	—	—	—	—	62	62
Connecticut	—	—	—	—	—	—	—	—	—	—	—	—
Delaware	25	—	—	25	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—	—	—	—	—
Florida	609	245	—	854	—	—	—	—	19	17	—	36
Georgia	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	476	150	—	626	18	23	—	41	—	27	—	27
Louisiana	—	—	—	—	—	—	—	—	—	—	—	—
Maine	—	—	—	—	—	—	—	—	—	—	—	—
Maryland	—	32	—	32	—	<1	—	<1	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	10	—	10	—	71	—	71
New Hampshire	—	18	—	18	—	—	—	—	—	—	—	—
New Jersey	—	—	107	107	—	—	—	—	—	—	—	—
New York	—	60	—	60	—	—	—	—	—	57	—	57
North Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico	135	56	—	191	112	67	—	179	10	27	—	37
Rhode Island	—	—	—	—	—	—	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—	—	—
Virginia	120	—	—	120	—	—	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—	—	—	—
Totals	1,415	561	735	2,711	130	100	—	230	29	199	62	290
% of Assessed Waters	52%	21%	27%	80%	57%	43%	—	7%	10%	69%	21%	9%

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-5. (continued)

Not Supporting				Not Attainable				Total Assessed			
Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
—	—	—		—	—	—		50	—	—	50
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	10	10	—	—	—		—	—	700	700
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		25	—	—	25
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
12	—	—	12	—	—	—		640	262	—	902
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	80	—	80	—	—	—		494	280	—	774
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	32	—	32
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	81	—	81
—	—	—		—	—	—		—	18	—	18
—	—	39	39	—	—	—		—	—	146	146
—	3	—	3	—	—	—		—	120	—	120
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	23	—	23	—	—	—		257	173	—	430
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		120	—	—	120
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
12	106	49	167	—	—	—		1,586	966	846	3,398
7%	63%	29%	5%	—	—	—		47%	28%	25%	17%

Table C-6a. Aquatic Life Use Support in Ocean Coastal Waters (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	50	—	—	—	—	50
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—
Delaware	25	—	—	—	—	25
Delaware River Basin	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—
Florida	846	—	35	12	—	893
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	32	—	—	—	—	32
Massachusetts	—	—	—	—	—	—
Mississippi	10	—	71	—	—	81
New Hampshire	18	—	—	—	—	18
New Jersey	128	—	—	—	—	128
New York	120	—	—	—	—	120
North Carolina	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Puerto Rico	346	55	18	9	—	428
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	624	—	—	—	—	624
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
Totals	2,199	55	124	21	—	2,399
Percent of Assessed Waters	92%	2%	5%	1%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-6b. Fish Consumption Use Support in Ocean Coastal Waters (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	50	—	—	—	—	50
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—
Delaware	25	—	—	—	—	25
Delaware River Basin	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	32	—	—	—	—	32
Massachusetts	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—
New Hampshire	18	—	—	—	—	18
New Jersey	70	—	50	—	—	120
New York	60	—	60	—	—	120
North Carolina	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	624	—	—	—	—	624
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
Totals	879	—	110	—	—	989
Percent of Assessed Waters	89%	—	11%	—	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-6c. Shellfishing Use Support in Ocean Coastal Waters (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	50	—	—	—	—	50
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—
Delaware	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—
Florida	70	—	—	—	—	70
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	32	<1	—	—	—	32
Massachusetts	—	—	—	—	—	—
Mississippi	—	—	60	—	—	60
New Hampshire	18	—	—	—	—	18
New Jersey	107	—	—	39	—	146
New York	117	—	—	3	—	120
North Carolina	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	624	—	—	—	—	624
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
Totals	1,018	<1	60	42	—	1,120
Percent of Assessed Waters	91%	—	5%	4%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-6d. Swimming Use Support in Ocean Coastal Waters (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	50	—	—	—	—	50
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—
Delaware	25	—	—	—	—	25
Delaware River Basin	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	32	—	—	—	—	32
Massachusetts	—	—	—	—	—	—
Mississippi	—	10	71	—	—	81
New Hampshire	18	—	—	—	—	18
New Jersey	128	—	—	—	—	128
New York	120	—	—	—	—	120
North Carolina	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Puerto Rico	286	97	25	20	—	428
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	624	—	—	—	—	624
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
Totals	1,283	107	96	20	—	1,506
Percent of Assessed Waters	85%	7%	6%	1%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-6e. Secondary Contact Recreational Use Support in Ocean Coastal Waters (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Alabama	50	—	—	—	—	50
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
California	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—
Delaware	25	—	—	—	—	25
Delaware River Basin	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	—	—	—	—	—	—
Maryland	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—
Mississippi	10	—	71	—	—	81
New Hampshire	18	—	—	—	—	18
New Jersey	—	—	—	—	—	—
New York	120	—	—	—	—	120
North Carolina	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Puerto Rico	372	45	—	11	—	428
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
Texas	—	—	—	—	—	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	—	—	—	—	—	—
Totals	595	45	71	11	—	722
Percent of Assessed Waters	82%	6%	10%	2%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table C-7. Leading Causes of Ocean Coastal Water Impairments (shore miles)

State	Total Impaired Waters		Pathogen Indicators (1)				Metals (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—	—	—		—	—	—	
Alaska	—	—	—	—	—		—	—	—	
American Samoa	—	—	—	—	—		—	—	—	
California	72	—	—	—	—		—	—	—	
Connecticut	—	—	—	—	—		—	—	—	
Delaware	—	—	—	25	—	25	—	—	—	
Delaware River Basin	—	—	—	—	—		—	—	—	
District of Columbia	—	—	—	—	—		—	—	—	
Florida	—	48	—	—	—		—	—	—	
Georgia	—	—	—	—	—		—	—	—	
Guam	—	—	—	—	—		—	—	—	
Hawaii	107	—	—	—	—		—	—	—	
Louisiana	—	—	—	—	—		—	—	—	
Maine	—	—	—	—	—		—	—	—	
Maryland	—	—	—	—	—		—	—	—	
Massachusetts	—	—	—	—	—		—	—	—	
Mississippi	—	71	41	40	—	81	30	51	—	81
New Hampshire	—	—	—	—	—		—	—	—	
New Jersey	39	—	—	—	—		—	—	—	
New York	—	60	3	—	—	3	—	—	—	
North Carolina	—	—	—	—	—		—	—	—	
Oregon	—	—	—	—	—		—	—	—	
Puerto Rico	—	60	25	21	—	46	4	3	—	7
Rhode Island	—	—	—	—	—		—	—	—	
South Carolina	—	—	—	—	—		—	—	—	
Texas	—	—	—	—	—		—	—	—	
Virginia	—	—	—	—	—		—	—	—	
Virgin Islands	—	—	—	—	—		—	—	—	
Washington	—	—	—	—	—		—	—	—	
Total Shoreline Miles Impaired	218	239	69	86	—	155	34	54	—	88
% of Impaired Shoreline Miles Affected by Each Cause			29%	36%	—	65%	14%	23%	—	37%
% of Assessed Shoreline Miles Affected by Each Cause			2%	3%	—	5%	1%	2%	—	3%
% of Total Shoreline Miles Affected by Each Cause			—	—	—	1%	—	—	—	

[a]Does not include the Alaska coastline.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired Coastal Shoreline Miles in States Reporting Causes:	239 miles
Total Assessed Coastal Shoreline Miles:	3,366 miles
Estimate of Total Coastal Shoreline Miles in the Nation:	20,121 miles[a]

Table C-7. (continued)

Priority Organics (3)				Unknown Toxicity (4)				Nutrients (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		17	—	—	17
—	—	—		—	—	—		—	—	—	—
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	11	—	11	—	40	—	40	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
57	3	—	60	—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	1	—	1	4	1	—	5	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
57	15	—	72	4	41	—	45	17	—	—	17
24%	6%	—	30%	2%	17%	—	19%	7%	—	—	7%
2%	—	—	2%	—	1%	—	1%	1%	—	—	1%
—	—	—		—	—	—		—	—	—	

(continued)

Table C-7. (continued)

State	Chlorine (6)				Oil and Grease (7)				Thermal Modification (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—		—	—	—		—	—	—	
Alaska	—	—	—		—	—	—		—	—	—	
American Samoa	—	—	—		—	—	—		—	—	—	
California	—	—	—		—	—	—		—	—	—	
Connecticut	—	—	—		—	—	—		—	—	—	
Delaware	—	—	—		—	—	—		—	—	—	
Delaware River Basin	—	—	—		—	—	—		—	—	—	
District of Columbia	—	—	—		—	—	—		—	—	—	
Florida	—	—	—		—	—	—		—	—	—	
Georgia	—	—	—		—	—	—		—	—	—	
Guam	—	—	—		—	—	—		—	—	—	
Hawaii	—	—	—		—	—	—		—	—	—	
Louisiana	—	—	—		—	—	—		—	—	—	
Maine	—	—	—		—	—	—		—	—	—	
Maryland	—	—	—		—	—	—		—	—	—	
Massachusetts	—	—	—		—	—	—		—	—	—	
Mississippi	—	—	—		—	—	—		—	—	—	
New Hampshire	—	—	—		—	—	—		—	—	—	
New Jersey	—	—	—		—	—	—		—	—	—	
New York	—	—	—		—	—	—		—	—	—	
North Carolina	—	—	—		—	—	—		—	—	—	
Oregon	—	—	—		—	—	—		—	—	—	
Puerto Rico	3	2	—	5	—	3	—	3	1	2	—	3
Rhode Island	—	—	—		—	—	—		—	—	—	
South Carolina	—	—	—		—	—	—		—	—	—	
Texas	—	—	—		—	—	—		—	—	—	
Virginia	—	—	—		—	—	—		—	—	—	
Virgin Islands	—	—	—		—	—	—		—	—	—	
Washington	—	—	—		—	—	—		—	—	—	
Total Shoreline Miles Impaired	3	2	—	5	—	3	—	3	1	2	—	3
% of Impaired Shoreline Miles Affected by Each Cause	1%	1%	—	2%	—	1%	—	1%	—	1%	—	1%
% of Assessed Shoreline Miles Affected by Each Cause	—	—	—		—	—	—		—	—	—	
% of Total Shoreline Miles Affected by Each Cause	—	—	—		—	—	—		—	—	—	

Table C-7. (continued)

Other Inorganics (9)				pH (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—

Table C-8. The Leading Sources of Ocean Coastal Water Impairments (shore miles)

State	Total Impaired Waters		Urban Runoff/Storm Sewers (1)				Land Disposal (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—
California	72	—	—	—	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—	—	—	—	—
Delaware	—	—	—	25	—	25	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—	—	—
Florida	—	48	—	28	—	28	—	12	—	12
Georgia	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—
Hawaii	107	—	—	—	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—	—	—	—	—
Maine	—	—	—	—	—	—	—	—	—	—
Maryland	—	—	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—	—	—
Mississippi	—	71	—	81	—	81	—	71	—	71
New Hampshire	—	—	—	—	—	—	—	—	—	—
New Jersey	39	—	—	—	—	—	—	—	—	—
New York	—	60	—	—	—	—	—	—	—	—
North Carolina	—	—	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—	—	—
Puerto Rico	—	60	1	6	—	7	15	3	—	18
Rhode Island	—	—	—	—	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—	—
Total Shoreline Miles Impaired	218	239	1	140	—	141	15	86	—	101
% of Impaired Shoreline Miles Affected by Each Source			—	59%	—	59%	6%	36%	—	42%
% of Assessed Shoreline Miles Affected by Each Source			—	4%	—	4%	—	3%	—	3%
% of Total Shoreline Miles Affected by Each Source			—	1%	—	1%	—	—	—	1%

[a]Does not include the Alaska coastline.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired Coastal Shoreline Miles in States Reporting Sources:	239 miles
Total Assessed Coastal Shoreline Miles:	3,366 miles
Estimate of Total Coastal Shoreline Miles in the Nation:	20,121 miles[a]

Table C-8. (continued)

Municipal Point Sources (3)				Contaminated Sediments (4)				Recreational Activities (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	25	—	25	—	—	—		—	25	—	25
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	21	—	21	—	—	—		—	30	—	30
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	3	—	3	57	3	—	60	—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
12	8	—	20	—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
12	57	—	69	57	3	—	60	—	55	—	55
5%	24%	—	29%	24%	1%	—	25%	—	23%	—	23%
—	2%	—	2%	2%	—	—	2%	—	2%	—	2%
—	—	—		—	—	—		—	—	—	

(continued)

Table C-8. (continued)

State	Agricultural (general) (6)				Hydrological Habitat Modification (7)				Industrial Point Sources (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Alabama	—	—	—		—	—	—		—	—	—	
Alaska	—	—	—		—	—	—		—	—	—	
American Samoa	—	—	—		—	—	—		—	—	—	
California	—	—	—		—	—	—		—	—	—	
Connecticut	—	—	—		—	—	—		—	—	—	
Delaware	—	—	—		—	—	—		—	—	—	
Delaware River Basin	—	—	—		—	—	—		—	—	—	
District of Columbia	—	—	—		—	—	—		—	—	—	
Florida	—	47	—	47	—	47	—	47	—	—	—	
Georgia	—	—	—		—	—	—		—	—	—	
Guam	—	—	—		—	—	—		—	—	—	
Hawaii	—	—	—		—	—	—		—	—	—	
Louisiana	—	—	—		—	—	—		—	—	—	
Maine	—	—	—		—	—	—		—	—	—	
Maryland	—	—	—		—	—	—		—	—	—	
Massachusetts	—	—	—		—	—	—		—	—	—	
Mississippi	—	—	—		—	—	—		—	21	—	21
New Hampshire	—	—	—		—	—	—		—	—	—	
New Jersey	—	—	—		—	—	—		—	—	—	
New York	—	—	—		—	—	—		—	—	—	
North Carolina	—	—	—		—	—	—		—	—	—	
Oregon	—	—	—		—	—	—		—	—	—	
Puerto Rico	—	3	—	3	—	—	—		9	2	—	11
Rhode Island	—	—	—		—	—	—		—	—	—	
South Carolina	—	—	—		—	—	—		—	—	—	
Texas	—	—	—		—	—	—		—	—	—	
Virginia	—	—	—		—	—	—		—	—	—	
Virgin Islands	—	—	—		—	—	—		—	—	—	
Washington	—	—	—		—	—	—		—	—	—	
Total Shoreline Miles Impaired	—	50	—	50	—	47	—	47	9	23	—	32
% of Impaired Shoreline Miles Affected by Each Source	—	21%	—	21%	—	20%	—	20%	4%	10%	—	13%
% of Assessed Shoreline Miles Affected by Each Source	—	1%	—	1%	—	1%	—	1%	—	1%	—	1%
% of Total Shoreline Miles Affected by Each Source	—	—	—		—	—	—		—	—	—	

Table C-8. (continued)

Drainage/Filling (9)				Construction (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	17	—	17
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	30	—	30	—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—

Table C-9. Characteristics of National Estuary Program (NEP) Sites

Estuary	Physical Features			Natural Resources			Economic Activities				Susceptibility to Pollution	
				Classified Shellfish Waters			Land Use (% of EDA)		Point Sources of Pollution			
	Water Surface Area (sq. mi.)	Daily Freshwater Inflow (100 cfs)	Volume (billion cu. ft.)	Wetlands (sq. mi.)	Total (sq. mi.)	Approved (sq. mi.)	Urban	Agri-culture	Industry	Muni-cipal	Dissolved Concen-tration Potential	Particle Retention Efficiency
Casco Bay	164	21	191	61	168	144	14	10	40	10	M	H
Massachusetts Bay	981	65	2,014	141	141	79	122	6	115	34	M-H	M-H
Buzzards Bay	228	12	215	75	199	184	13	6	7	5	H	H
Narragansett Bay	165	32	139	155	165	110	26	9	113	24	M	H
Long Island Sound	1,281	300	2,192	315	1,342	1,122	25	14	226	87	L	H
Hudson River/ Raritan Bay	298	267	172	269	257	0	24	25	582	287	M	M
Delaware Estuary	768	198	448	641	623	549	24	42	181	153	M	M
Delaware Inland Bays	32	3	4	ND	30	19	10	46	9	7	H	M
Albemarle-Pamlico Sounds	2,949	460	1,081	1,768	3,088	2,524	9	59	103	84	M	M
Indian River Lagoon	280	14	51	161	106	34	17	30	14	54	H	H
Sarasota Bay	44	4	8	ND	ND	ND	28	26	6	11	H	M
Tampa Bay	346	24	123	394	88	9	17	40	69	29	H	H
Barataria-Terrebonne Bays	1,326	101	200	1,458	782	623	9	30	1	51	M-H	M
Galveston Bay	540	152	92	374	547	0	16	50	747	566	M	M
Santa Monica Bay	211	9	1,844	4	0	0	60	2	6	4	M	H
San Francisco Bay	716	370	412	909	125	0	27	86	178	87	M	M-H
Puget Sound	1,292	942	7,081	387	141	94	27	16	308	72	L-H	M-H
Total	11,621	2,974	16,267	7,112	7,802	5,491			2,705	1,565		

H = High
M = Medium
L = Low

EDA = Estuary drainage area
ND = No data

Source: NOAA, *Estuaries of the United States: Vital Statistics of a National Resource Base*. A Special 20th Anniversary Report. U.S. Department of Commerce. October 1990.

NOTE: This table does not include the four estuaries added to the National Estuary Program in 1992.

Table C-10. Point Source Problems at National Estuary Program Sites

Cause	Industrial Discharges – Direct	Industrial Discharges – Indirect	Sewage Treatment Plants	Combined Sewer Overflows	Stormwater	Animal Feedlots
Toxicants	AP, C, D, G, LIS, M, N, NY, PS, SF, SMB	BT, C, D, G, LIS, M, N, NY, PS, SF, SMB	G, M, N, PS, SF	B, D, LIS, N, NY, PS, SF	C, D, G, N, PS, SF, SMB	AP
Pathogens			B, D, G, LIS, M, N, PS, SMB	AP, C, D, LIS, M, N, NY, PS, S	AP, B, C, D, DIB, I, LIS, M, N, PS, SMB	AP, DIB, G, PS
Eutrophication	AP, T	T	AP, BT, C, G, I, LIS, M, NY, PS, S, SMB	LIS, M, N, NY, S	BT, DIB, I, T	DIB
Habitat Loss/ Modification	AP, G, M, SF, T	G, SF, T	AP, G, I, M, SF	AP, M, SF	AP, G, I, SF, T	
Changes in Living Resources	AP, C, D, LIS, M, N, NY, PS, SF, T	D, LIS, M, N, NY, PS, SF, T	AP, D, G, I, LIS, M, N, NY, SMB	D, LIS, M, N, NY, PS, SF	D, DIB, G, I, M, PS, S, SF, T	DIB

AP = Albemarle-Pamlico Sound
B = Buzzards Bay
BT = Barataria-Terrebonne Estuary
C = Casco Bay
D = Delaware Estuary
DIB = Delaware Inland Bays
G = Galveston Bay
I = Indian River Lagoon
LIS = Long Island Sound
M = Massachusetts Bay
N = Narragansett Bay
NY = New York-New Jersey Harbor
PS = Puget Sound
S = Sarasota Bay
SF = San Francisco Bay
SMB = Santa Monica Bay
T = Tampa Bay

Source: NOAA, *Estuaries of the United States: Vital Statistics of a National Resource Base*. A Special 20th Anniversary Report. U.S. Department of Commerce. October 1990.

Table C-11. Nonpoint Source Problems at National Estuary Program Sites

Cause	Agriculture	Suburban and Urban	Mining	Silviculture	Construction	Septic Systems	Landfills	In-place Sediments	Atmospheric Deposition	Ground-water
Toxicants	AP, B, BT, C, G, PS, SF, T	BT, D, G, LIS, M, N, NY, PS, SF, SMB, T	BT	PS			AP, N, NY, LIS	AP, B, C, D, G, LIS, M, N, NY, PS, SF, SMB, T	AP, G, M, PS	C, G
Pathogens	BT, DIB, G, PS	BT, D, I, LIS, M, N, NY, S, SMB			DIB	AP, B, BT, C, DIB, G, I, M, N, PS, S, T				
Eutrophication	AP, B, BT, C, DIB, G, I, LIS, PS, S, T	BT, I, LIS, N, S, T	AP, T		DIB, G, S	B, C, DIB, G, I, M, N, T		M	G, M, N, SMB	DIB, N
Habitat Loss/ Modification	AP, G, PS, SF, T	G, I, S, T	AP, BT, T	PS	AP, D, DIB, G, I, M, N, T		BT, G			
Changes in Living Resources	AP, DIB, G, SF, T	D, M, NY, S, SF, T			D, DIB, M, S	B, DIB, I, PS		B, D, M, N, NY, PS, SF, SMB		DIB

AP = Albemarle-Pamlico Sound
B = Buzzards Bay
BT = Barataria-Terrebonne Estuary
C = Casco Bay
D = Delaware Estuary
DIB = Delaware Inland Bays
G = Galveston Bay
I = Indian River Lagoon
LIS = Long Island Sound
M = Massachusetts Bay
N = Narragansett Bay
NY = New York-New Jersey Harbor
PS = Puget Sound
S = Sarasota Bay
SF = San Francisco Bay
SMB = Santa Monica Bay
T = Tampa Bay

Source: NOAA, *Estuaries of the United States: Vital Statistics of a National Resource Base*. A Special 20th Anniversary Report. U.S. Department of Commerce. October 1990.

Table C-12. Other Sources of Problems at National Estuary Program Sites

Cause	Shipping Marinas	Dredging	Shoreline Development	Freshwater Inflow	Sealevel Rise	Other
Toxicants	C, D, DIB, G, I, M, PS, SMB, T	G, M, NY, SF		BT, M, SF		SMB – ocean dump site
Pathogens	C, DIB, G, LIS, M		B, DIB, M, S			SMB – 301
Eutrophication	C, DIB, G	G, T	DIB, M, N	I		
Habitat Loss/ Modification	BT, C, G, I, M, PS, S, T	AP, C, DIB, G, I, M, PS S, SF, T	AP, B, C, D, DIB, G, I, N, NY, LIS, M, S, SF, PS, T	AP, BT, G, I, SF, T		
Changes in Living Resources	C, D, DIB, I, SF, T	AP, DIB, G, M, S, SF, T	B, D, DIB, G, I, N, LIS, M, S, SF, T	BT, G, SF, T		

AP = Albemarle-Pamlico Sound
B = Buzzards Bay
BT = Barataria-Terrebonne Estuary
C = Casco Bay
D = Delaware Estuary
DIB = Delaware Inland Bays
G = Galveston Bay
I = Indian River Lagoon
LIS = Long Island Sound
M = Massachusetts Bay
N = Narragansett Bay
NY = New York-New Jersey Harbor
PS = Puget Sound
S = Sarasota Bay
SF = San Francisco Bay
SMB = Santa Monica Bay
T = Tampa Bay

Source: NOAA, *Estuaries of the United States: Vital Statistics of a National Resource Base*. A Special 20th Anniversary Report. U.S. Department of Commerce. October 1990.

Appendix D

Individual State Data
Wetlands

Table D-1. Current Sources of Direct Wetlands Losses

State	Agriculture	Commercial Development	Residential Development	Highway Construction	Impound-ments	Resource Extraction
Alabama	—	1	—	1	1	1
Alaska	1	1	—	—	—	1
American Samoa	—	—	—	—	—	—
Arizona	—	—	—	—	—	—
Arkansas	1	—	—	—	—	—
California	—	—	—	—	—	—
Colorado	—	—	—	—	—	—
Connecticut	—	1	1	1	—	—
Delaware	1	—	1	—	—	—
Delaware River Basin	1	—	—	—	1	—
District of Columbia	—	—	—	—	—	—
Florida	—	—	—	—	—	—
Georgia	—	—	—	—	1	—
Guam	—	—	—	—	—	—
Hawaii	1	1	—	1	—	—
Idaho	1	—	1	—	1	1
Illinois	—	—	—	—	—	—
Indiana	1	1	1	1	1	1
Iowa	1	1	—	—	—	—
Kansas	—	—	—	—	—	—
Kentucky	—	—	—	—	—	—
Louisiana	1	1	1	1	—	1
Maine	—	1	1	—	1	1
Maryland	1	1	1	1	—	—
Massachusetts	1	—	1	1	—	—
Michigan	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—
Mississippi	1	1	1	1	1	1
Missouri	—	—	—	—	—	—
Montana	—	—	—	—	—	—
Nebraska	1	1	—	1	—	—
Nevada	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—
New Jersey	—	1	1	—	—	—
New Mexico	—	—	—	—	—	—
New York	—	—	—	—	—	—
North Carolina	1	1	1	1	1	1
North Dakota	—	—	—	—	—	—
Ohio	—	—	—	—	—	—
Oklahoma	—	—	—	—	—	—
Oregon	—	—	—	—	—	—
Pennsylvania	1	1	1	1	1	1
Puerto Rico	1	1	1	—	—	—
Rhode Island	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—
South Dakota	1	—	—	—	—	—
Tennessee	1	1	1	1	—	—
Texas	—	—	—	—	1	—
Utah	—	—	—	—	—	—
Vermont	1	1	—	—	1	—
Virginia	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—
Washington	1	1	1	1	—	1
West Virginia	—	—	—	—	—	—
Wisconsin	1	1	1	1	1	1
Wyoming	—	—	—	—	—	—
Total Number of States	21	19	16	14	12	11

1 = The State reported that the source caused current wetlands losses.

— None or not reported.

Source: 1992 State Section 305(b) Reports.

Table D-1. (continued)

Industry	Dredged Material Disposal	Silviculture	Natural	Mosquito Control
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	1	—	—	—
—	—	—	—	—
—	—	—	—	—
1	—	—	1	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	1	1	1	—
—	—	—	—	—
1	1	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
1	1	—	1	—
—	1	—	—	—
—	—	1	1	—
—	—	—	—	1
—	—	—	—	—
—	—	—	—	—
1	—	—	1	—
—	—	—	—	—
—	—	—	—	—
1	—	—	—	—
—	—	—	—	—
—	—	—	—	—
1	—	—	—	—
—	—	—	—	—
—	—	1	—	—
—	—	—	—	—
—	—	—	—	—
—	1	—	—	—
—	—	—	—	—
1	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	1	—
1	1	—	—	—
—	—	1	—	—
—	—	—	—	—
—	—	1	—	—
—	—	—	—	—
—	—	—	—	—
1	1	1	1	—
—	—	—	—	—
1	1	1	—	—
—	—	—	—	—
11	9	7	7	1

Table D-2. Overall Designated Use Support in Wetlands (acres)

State	Fully Supporting				Threatened				Partially Supporting			
	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
Alabama	—	—	—	—	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—	—	—	—	—	—
Arkansas	—	—	—	—	—	—	—	—	—	—	—	—
California	—	—	780	780	—	—	—	—	—	—	60,078	60,078
Colorado	80	—	—	80	—	—	—	—	—	—	—	—
Connecticut	—	—	—	—	—	—	—	—	—	—	—	—
Delaware	—	—	—	—	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—	—	—	—	—
Florida	—	—	—	—	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—	—	—	—	—	—
Gila River Ind. Comm.	—	—	—	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—	—	—	—
Hawaii	36,328	—	—	36,328	15,474	—	—	15,474	—	—	—	—
Idaho	—	—	—	—	—	—	—	—	—	—	—	—
Illinois	—	—	—	—	—	—	—	—	—	—	—	—
Indiana	—	—	—	—	—	—	—	—	—	—	—	—
Iowa	969	—	—	969	8,215	—	—	8,215	13,665	—	—	13,665
Kansas	—	—	—	—	—	—	—	—	—	34,256	—	34,256
Kentucky	—	—	—	—	—	—	—	—	—	—	—	—
Louisiana	—	—	—	—	—	—	—	—	—	—	—	—
Maine	—	—	—	—	—	—	—	—	—	—	—	—
Maryland	—	—	—	—	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—	—	—	—	—
Michigan	—	—	—	—	—	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—	—	—	—	—
Montana	—	—	—	—	—	—	—	—	—	—	—	—
Nebraska	—	—	—	—	—	—	—	—	—	—	—	—
Nevada	—	—	—	—	—	—	—	—	12,000	—	—	12,000
New Hampshire	—	—	—	—	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—	—	—	—	—	—
New York	—	—	—	—	—	—	—	—	—	—	—	—
North Carolina	—	—	5,256,000	5,256,000	—	—	—	—	—	—	2,577,000	2,577,000
North Dakota	—	—	—	—	—	—	—	—	—	—	—	—
Ohio	—	—	—	—	—	—	—	—	—	—	—	—
Ohio River Valley	—	—	—	—	—	—	—	—	—	—	—	—
Oklahoma	—	—	—	—	120	—	—	120	—	—	—	—
Oregon	—	—	—	—	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—	—	—	—	—	—
Tennessee	—	—	—	—	—	—	—	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—	—	—	—	—
Utah	—	—	—	—	—	—	—	—	—	—	—	—
Vermont	—	—	—	—	—	—	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—	—	—	—	—	—	—
Wisconsin	—	—	—	—	—	—	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—	—	—	—	—	—	—
Totals	37,377	—	5,256,780	5,294,157	23,809	—	—	23,809	25,665	34,256	2,637,078	2,696,999
% of Assessed Waters	1%	—	99%	50%	100%	—	—	<1%	1%	1%	98%	26%

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table D-2. (continued)

Not Supporting				Not Attainable				Total Assessed			
Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	60,858	60,858
—	—	—		—	—	—		80	—	—	80
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		51,802	—	—	51,802
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
3,640	—	—	3,640	—	—	—		26,489	—	—	26,489
—	—	—		—	—	—		—	34,256	—	34,256
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
24,169	—	—	24,169	—	—	—		36,169	—	—	36,169
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	2,474,000	2,474,000	—	—	—		—	—	10,307,000	10,307,000
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		120	—	—	120
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
27,809	—	2,474,000	2,501,809	—	—	—		114,660	34,256	10,367,858	10,516,774
1%	—	99%	24%	—	—	—		1%	<1%	99%	10%

Table D-3. Causes Degrading Wetlands Integrity

State	Sediment	Nutrients	Water Diversions	Pesticides	Salinity	Heavy Metals	Ponding	Weeds
Alabama	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—	—
Arkansas	1	—	1	—	—	—	—	—
California	—	—	—	—	—	—	—	—
Colorado	—	—	—	—	—	—	—	—
Connecticut	1	1	—	—	1	—	—	1
Delaware	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—
Florida	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Idaho	1	1	1	—	—	—	—	—
Illinois	—	—	—	—	—	—	—	—
Indiana	—	—	—	—	—	—	—	—
Iowa	1	1	—	1	—	—	—	—
Kansas	—	—	—	—	—	—	—	—
Kentucky	—	—	—	—	—	—	—	—
Louisiana	1	1	1	—	1	—	—	—
Maine	1	—	—	—	—	—	—	—
Maryland	—	—	—	—	—	—	—	—
Massachusetts	1	—	—	1	—	1	—	—
Michigan	—	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—
Montana	—	—	—	1	1	—	—	—
Nebraska	—	—	—	—	—	—	—	—
Nevada	—	—	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—	—
New York	—	—	—	—	—	—	—	—
North Carolina	1	1	1	1	1	—	1	1
North Dakota	—	—	—	—	—	—	—	—
Ohio	—	—	—	—	—	—	—	—
Oklahoma	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—
Pennsylvania	1	—	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—
South Dakota	1	1	—	—	—	—	—	—
Tennessee	1	—	1	—	—	—	—	—
Texas	—	—	—	—	—	—	—	—
Utah	—	—	—	—	—	—	—	—
Vermont	—	—	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—
Washington	1	1	1	1	—	1	1	1
West Virginia	—	—	—	—	—	—	—	—
Wisconsin	1	1	—	—	—	1	1	—
Wyoming	—	—	—	—	—	—	—	—
Total Number of States	13	8	6	5	4	3	3	3

1 = The State reported that the pollutant or process degrades wetlands integrity.

— None or not reported.

Source: 1992 State Section 305(b) Reports.

Table D-3. (continued)

Low DO	pH	Selenium
—	—	—
—	—	—
—	—	—

Table D-4. Sources of Integrity Degradation in Wetlands

State	Agriculture	Development	Channelization	Road Construction	Urban Runoff	Resource Extraction	Landfills	Natural
Alabama	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—	—
Arkansas	1	1	1	—	—	—	—	—
California	—	—	—	—	—	—	—	—
Colorado	—	—	—	—	—	—	—	—
Connecticut	—	—	—	1	1	—	1	1
Delaware River Basin	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—
Florida	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Idaho	1	1	1	—	1	—	—	—
Illinois	—	—	—	—	—	—	—	—
Indiana	—	—	—	—	—	—	—	—
Iowa	1	—	1	—	1	—	—	1
Kansas	—	—	—	—	—	—	—	—
Kentucky	—	—	—	—	—	—	—	—
Louisiana	1	1	1	1	—	1	—	—
Maine	1	1	1	1	—	—	—	—
Maryland	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—
Michigan	—	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—
Montana	1	—	—	—	—	—	—	—
Nebraska	—	—	—	—	—	—	—	—
Nevada	—	—	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—	—
New York	—	—	—	—	—	—	—	—
North Carolina	1	1	1	1	1	1	1	1
North Dakota	—	—	—	—	—	—	—	—
Ohio	—	—	—	—	—	—	—	—
Oklahoma	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	1	1	—	—
Puerto Rico	—	1	—	1	—	—	—	—
Rhode Island	—	—	—	—	—	—	—	—
South Carolina	—	—	—	—	—	—	—	—
South Dakota	1	—	—	—	—	—	—	1
Tennessee	1	1	1	1	—	—	1	—
Texas	—	—	—	—	—	—	—	—
Utah	—	—	—	—	—	—	—	—
Vermont	—	—	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—
Washington	1	1	1	1	1	1	1	1
West Virginia	—	—	—	—	—	—	—	—
Wisconsin	1	1	1	1	1	1	1	—
Wyoming	—	—	—	—	—	—	—	—
Total Number of States	11	9	9	8	7	5	5	5

1 = The State reported that the source degrades wetlands integrity.

— None or not reported.

Source: 1992 State Section 305(b) Reports.

Table D-4. (continued)

Industrial Runoff	Onsite Systems	Irrigation	Recreation	Municipal Sewage	Silviculture	Industrial Sewage	Oil Extraction
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1	1	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	1	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	1
—	—	—	—	1	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—

Table D-5. Development of State Wetland Water Quality Standards

State	In Place				Under Development			
	Use Classification	Narrative Biocriteria	Numeric Biocritieria	Anti-degradation	Use Classification	Narrative Biocriteria	Numeric Biocriteria	Anti-degradation
Alabama	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	1	—	—	1
Arkansas	—	—	—	—	—	—	—	—
California	1	—	—	1	—	—	—	—
Colorado	1	—	—	1	—	—	—	—
Connecticut	—	1	1	1	1	—	—	—
Delaware	1	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—
Florida	1	1	—	1	—	—	—	—
Georgia	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	1	—	—	—
Idaho	—	—	—	—	—	—	—	—
Illinois	1	—	—	1	—	1	—	—
Indiana	—	—	—	—	—	—	—	—
Iowa	1	1	—	1	—	—	—	—
Kansas	1	1	—	—	—	—	—	—
Kentucky	1	—	—	—	—	—	—	—
Louisiana	1	1	1	1	1	—	1	—
Maine	1	—	—	1	—	—	—	—
Maryland	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	1	—	1	1	—
Michigan	—	—	—	1	—	1	1	—
Minnesota	1	—	—	1	1	1	1	—
Mississippi	—	—	—	—	—	—	—	—
Missouri	1	1	1	1	—	—	—	—
Montana	—	—	—	—	—	1	1	1
Nebraska	—	—	—	—	1	1	1	1
Nevada	—	—	—	—	—	—	—	—
New Hampshire	—	—	—	1	—	1	—	—
New Jersey	—	—	—	—	—	—	—	—
New Mexico	—	—	—	1	—	—	—	—
New York	—	—	—	—	—	—	—	—
North Carolina	—	—	—	1	1	1	1	1
North Dakota	—	—	—	—	1	1	1	1
Ohio	—	—	—	1	—	—	—	—
Oklahoma	—	—	—	—	—	—	—	—
Oregon	—	—	—	1	1	1	1	—
Pennsylvania	1	1	1	1	—	—	—	—
Puerto Rico	—	—	—	1	—	—	—	—
Rhode Island	1	—	—	1	—	—	—	—
South Carolina	—	—	—	—	1	—	—	—
South Dakota	1	—	1	1	—	—	1	1
Tennessee	—	—	—	—	—	1	—	—
Texas	1	1	1	1	1	—	—	—
Utah	—	—	—	1	—	—	—	—
Vermont	—	—	—	1	—	—	—	—
Virginia	—	—	—	1	1	1	1	—
Virgin Islands	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—
West Virginia	—	—	—	1	—	1	1	—
Wisconsin	1	1	—	1	—	—	—	—
Wyoming	—	—	—	—	—	—	—	—
Totals	17	9	6	27	12	13	12	6

1 = The State reported program status.

— None or not reported.

Source: 1992 State Section 305(b) Reports.

Table D-5. . (continued)

Proposed				
Use Classification	Narrative Biocriteria	Numeric Biocriteria	Anti-degradation	Implementation Process
—	—	—	—	
—	1	1	—	
—	—	—	—	
—	—	—	—	Riparian areas
—	—	—	—	
—	—	—	—	Regional Water Boards
—	—	—	—	
—	—	—	—	Municipal jurisdiction for Inland Waters
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	1	—	
—	—	—	—	
—	—	—	—	
1	—	—	—	
1	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	1	
—	—	—	—	Limited
—	1	—	—	In place for Thibodaux Swamp
—	—	—	—	Limited
—	—	—	—	
1	—	—	—	
1	1	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	
—	—	—	—	401, Coastal Area Management Act
1	—	1	1	
—	—	—	—	
—	—	—	—	
—	—	—	—	Clean Stream Laws
1	—	—	—	Water Quality Standards
—	—	—	—	401
1	—	—	1	
—	1	—	—	
—	—	—	1	Regulations
—	—	—	—	Limited
—	—	—	—	
—	—	—	—	401
—	—	—	—	
—	—	—	—	
1	1	1	1	Wetlands Standards
1	—	—	—	
—	—	—	—	NR 103 (Wetlands Standards)
—	—	—	—	
9	5	4	5	

Appendix E

Individual State Data
Public Health and Aquatic Life Concerns

Table E-1. Number and Extent of Fishing Restrictions Reported by the States

State	Rivers and Streams		Lakes and Reservoirs		Great Lakes Shore		Estuaries	
	Number of Restrictions	Total Miles Affected	Number of Restrictions	Total Acres Affected	Number of Restrictions	Total Miles Affected	Number of Restrictions	Square Miles Affected
Alabama	3	246	3	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	1	—
Arizona	3	—	1	—	—	—	—	—
Arkansas	3	107	1	10	—	—	—	—
California	6	—	10	—	—	—	1	—
Colorado	—	—	8	—	—	—	—	—
Connecticut	2	119	1	45	—	—	1	600
Delaware	3	39	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—
District of Columbia	1	6	—	—	—	—	—	—
Florida	27	—	36	—	—	—	—	—
Georgia	5	583	1	24,911	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Idaho	—	—	—	—	—	—	—	—
Illinois	6	467	10	23,489	2	63	—	—
Indiana	19	331	1	12	1	43	—	—
Iowa	2	77	1	150	—	—	—	—
Kansas	1	10	—	—	—	—	—	—
Kentucky	3	789	—	—	—	—	—	—
Louisiana	3	51	3	107	—	—	2	—
Maine	3	236	—	—	—	—	—	—
Maryland	1	60	1	100	—	—	2	—
Massachusetts	12	—	7	—	—	—	2	—
Michigan	35	—	19	—	8	3,288	—	—
Minnesota	55	—	432	—	1	272	—	—
Mississippi	5	—	2	—	—	—	—	—
Missouri	1	1,076	—	33,334	—	—	—	—
Montana	1	—	—	—	—	—	—	—
Nebraska	3	28	—	—	—	—	—	—
Nevada	1	—	1	—	—	—	—	—
New Hampshire	1	—	—	—	—	—	—	—
New Jersey	8	—	5	—	—	—	6	—
New Mexico	3	—	24	—	—	—	—	—
New York	24	—	25	—	1	492	2	—
North Carolina	6	—	6	—	—	—	1	—
North Dakota	3	509	10	339,306	—	—	—	—
Ohio	15	635	3	—	1	—	—	—
Ohio River Valley	—	—	—	—	—	—	—	—
Oklahoma	1	—	2	—	—	—	—	—
Oregon	2	—	1	—	—	—	—	—
Pennsylvania	24	—	2	—	1	—	1	—
Puerto Rico	—	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—	—	—
South Carolina	1	—	2	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—	—
Tennessee	7	133	11	103,628	—	—	—	—
Texas	6	254	5	500	—	—	2	58
Utah	1	—	1	—	—	—	—	—
Vermont	1	7	1	—	—	—	—	—
Virginia	8	458	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—
Washington	1	—	1	—	—	—	—	—
West Virginia	7	440	—	—	—	—	—	—
Wisconsin	71	—	170	—	3	—	—	—
Wyoming	—	—	—	—	—	—	—	—
Totals	394	6,661	807	525,592	18	4,158	21	658

— None or not reported.

Source: USEPA Fish Consumption Advisory Database, September 1993.

Table E-1. (continued)

Ocean Shore		Multiple Waters Affected		
Number of Restrictions	Total Miles Affected	Number of Restrictions	Total Acres Affected	Total Number of Restrictions
—	—	—	—	6
—	—	—	—	—
—	—	—	—	1
—	—	—	—	4
—	—	1	—	5
12	—	—	—	29
—	—	—	—	8
—	—	—	—	4
—	—	—	—	3
—	—	—	—	—
—	—	—	—	1
1	—	13	—	77
—	—	—	—	6
—	—	—	—	—
—	—	—	—	—
—	—	—	—	—
—	—	—	—	18
—	—	—	—	21
—	—	—	—	3
—	—	—	—	1
—	—	1	—	4
—	—	—	—	8
—	—	—	—	3
—	—	—	—	4
—	—	1	—	22
—	—	—	—	62
—	—	1	—	489
—	—	—	—	7
—	—	3	—	4
—	—	—	—	1
—	—	—	—	3
—	—	—	—	2
—	—	—	—	1
1	—	1	—	21
—	—	—	—	27
2	—	—	—	54
—	—	—	—	13
—	—	—	—	13
—	—	—	—	19
—	—	—	—	—
—	—	—	—	3
—	—	—	—	3
—	—	—	—	28
—	—	—	—	—
—	—	1	—	1
—	—	—	—	3
—	—	—	—	—
—	—	1	—	19
—	—	—	—	13
—	—	—	—	2
—	—	—	—	2
—	—	—	—	8
—	—	—	—	—
—	—	—	—	2
—	—	—	—	7
—	—	—	—	244
—	—	—	—	—
16	—	23	—	1,279

Table E-2. Number of Fishing Restrictions Caused by Individual Pollutants

State	Mercury	PCBs	Chlordane	Dioxin	DDT
Alabama	1	1	3	—	1
Alaska	—	—	—	—	—
American Samoa	1	1	—	—	1
Arizona	3	—	3	—	4
Arkansas	—	1	—	4	—
California	11	10	1	3	11
Colorado	3	—	—	—	—
Connecticut	1	3	—	—	—
Delaware	—	2	—	1	1
Delaware River Basin	—	—	—	—	—
District of Columbia	—	1	1	—	—
Florida	77	—	—	—	—
Georgia	3	1	2	—	—
Guam	—	—	—	—	—
Hawaii	—	—	—	—	—
Idaho	—	—	—	—	—
Illinois	—	7	10	—	—
Indiana	—	18	3	—	—
Iowa	—	2	2	—	—
Kansas	—	—	1	—	—
Kentucky	—	4	1	—	—
Louisiana	1	5	—	1	—
Maine	—	—	—	3	—
Maryland	—	—	3	1	—
Massachusetts	3	10	3	4	3
Michigan	27	34	2	4	—
Minnesota	479	74	—	3	—
Mississippi	—	5	—	3	—
Missouri	—	1	1	—	—
Montana	1	—	—	—	—
Nebraska	—	—	2	—	3
Nevada	2	—	—	—	—
New Hampshire	—	—	—	1	—
New Jersey	—	14	8	6	—
New Mexico	27	—	—	—	—
New York	9	38	7	7	3
North Carolina	6	—	—	5	—
North Dakota	13	—	—	—	—
Ohio	—	15	4	—	—
Ohio River Valley	—	—	—	—	—
Oklahoma	1	1	1	—	—
Oregon	2	—	—	—	—
Pennsylvania	1	19	21	2	—
Puerto Rico	—	—	—	—	—
Rhode Island	—	1	—	—	—
South Carolina	1	2	—	—	—
South Dakota	—	—	—	—	—
Tennessee	2	12	6	1	—
Texas	1	4	3	3	1
Utah	—	—	—	—	—
Vermont	1	2	—	—	—
Virginia	3	3	—	1	—
Virgin Islands	—	—	—	—	—
Washington	—	—	—	1	1
West Virginia	—	3	1	4	—
Wisconsin	219	25	7	1	—
Wyoming	—	—	—	—	—
Totals	899	319	96	59	29
Percentage[a]	70%	25%	8%	5%	2%

[a] Percentage of 1,279 advisories.

— None or not reported.

Source: USEPA Fish Consumption Advisory Database, September 1993.

Table E-3. Sources of Pollutants Causing Fishing Restrictions

State	Industrial Discharges	Unknown	Agriculture	Urban Runoff/ Storm Sewers	Resource Extraction	Natural	Atmospheric Deposition
Alabama	—	—	—	—	—	—	—
Alaska	—	—	—	—	4	—	—
American Samoa	—	—	—	—	—	—	—
Arizona	—	—	3	—	—	—	—
Arkansas	4	—	—	—	—	—	—
California	—	—	—	—	—	—	—
Colorado	—	—	—	—	—	—	—
Connecticut[a]	2	3	—	—	—	—	—
Delaware	1	3	—	1	—	—	—
Delaware River Basin	—	5	—	—	—	—	—
District of Columbia	—	1	—	—	—	—	—
Florida	—	—	—	—	—	—	—
Georgia	1	—	—	—	—	3	—
Guam	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—
Idaho	—	—	—	—	—	—	—
Illinois	—	—	—	—	—	—	—
Indiana	—	—	—	—	—	—	—
Iowa	2	—	—	2	—	—	—
Kansas	—	—	—	1	—	—	—
Kentucky	3	—	—	1	—	—	—
Louisiana	6	—	—	—	—	—	—
Maine	3	—	—	—	—	—	—
Maryland	1	3	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—
Michigan	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—
Mississippi	6	—	—	—	—	—	—
Missouri	1	—	4	15	1	—	—
Montana	—	—	—	—	—	—	—
Nebraska	—	—	2	—	—	—	—
Nevada	1	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—
New York	19	24	16	—	—	—	—
North Carolina	—	—	—	—	—	—	—
North Dakota	—	12	—	—	—	—	—
Ohio	11	5	—	—	—	—	—
Ohio River Valley	—	—	—	—	—	—	—
Oklahoma	—	3	—	—	—	—	—
Oregon	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—	—
Rhode Island	—	—	—	—	—	—	—
South Carolina	2	1	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—
Tennessee	6	—	—	—	—	—	—
Texas	3	1	—	2	—	—	—
Utah	—	1	—	—	—	—	—
Vermont	—	3	—	—	—	—	—
Virginia	5	—	—	—	—	—	1
Virgin Islands	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—
West Virginia	2	4	—	—	—	—	—
Wisconsin	—	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—	—
Totals	79	69	25	22	5	3	1

[a] Advisories based on historic discharges and activities that have resulted in residual sediment contamination and/or fish tissue contamination.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-4. Drinking Water Restrictions Reported by the States

State	Number of Closures	Number of Advisories	Reasons for Closures and Advisories
Alabama	—	—	
Alaska	—	—	
American Samoa	—	—	
Arizona	—	—	
Arkansas	—	—	
California	—	—	
Colorado	—	—	
Connecticut	3	—	Color, odor, turbidity, sediment, algae, giardia, construction
Delaware	—	—	
Delaware River Basin	—	—	
District of Columbia	—	—	
Florida	—	—	
Georgia	—	—	
Gila River Indian Community	—	—	
Guam	—	—	
Hawaii	—	—	
Idaho	—	—	
Illinois	—	—	
Indiana	—	—	
Iowa	—	3	Nitrate
Kansas	—	—	
Kentucky	—	—	
Louisiana	—	—	
Maine	1	—	TRIS
Maryland	—	—	
Massachusetts	—	—	
Michigan	9	—	Chemical plant spills, oil spill from power plant
Minnesota	—	—	
Mississippi	—	—	
Missouri	—	—	
Montana	—	—	
Nebraska	—	—	
Nevada	—	—	
New Hampshire	—	—	
New Jersey	—	—	
New Mexico	—	—	Giardia, bacteria
New York	3	—	Giardia
North Carolina	—	—	
North Dakota	—	—	
Ohio	5	—	Oil spill, toluene spill, raw sewage discharge, cyanide spill
Ohio River Valley	—	—	
Oklahoma	—	2	Trihalomethane
Oregon	—	—	
Pennsylvania	—	—	
Puerto Rico	—	2	Drinking plant failures
Rhode Island	—	—	
South Carolina	—	—	
South Dakota	—	—	
Tennessee	—	—	
Texas	—	—	
Utah	—	—	
Vermont	—	14	Boil water notice
Virginia	—	—	
Virgin Islands	—	—	
Washington	—	—	
West Virginia	12	—	Turbidity, diesel, fuel oil, raw sewage
Wisconsin	—	—	
Wyoming	—	—	
Totals	33	21	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-5. Contact Recreation Restrictions Reported by the States

State	Number of Contact Recreation Restrictions	Reasons for Restrictions
Alabama	—	
Alaska	5	Fecal coliforms
American Samoa	—	
Arizona	2	Fecal coliforms
Arkansas	3	Fecal coliforms from runoff
California	—	
Colorado	1	Fecal coliforms
Connecticut	52	Bacteria from CSOs, rainfall, and sewer line rupture
Delaware	7	Pathogens
Delaware River Basin	—	
District of Columbia	1	Bacterial pollution from CSOs in all district waters
Florida	22	Leaking septic tanks, WWTP discharges, sewage spills, heavy rains
Georgia	1	Fecal coliform bacteria—attributed to water fowl
Gila River Indian Community	—	
Guam	—	
Hawaii	—	
Idaho	—	
Illinois	1	Fecal coliforms
Indiana	—	
Iowa	—	
Kansas	—	
Kentucky	1	
Louisiana	7	Industrial runoff, septic tanks, animal discharges, abandoned hazardous waste sites, industrial and municipal discharges, farm runoff
Maine	2	CSOs, raw sewage
Maryland	2	Fecal coliform bacteria
Massachusetts	59	
Michigan[a]	20	Fecal coliforms from CSOs, sewer pipeline break, agriculture, domestic sewage, industry
Minnesota	—	
Mississippi	—	
Missouri	—	
Montana	—	
Nebraska	1	Fecal bacteria
Nevada	—	
New Hampshire	—	
New Jersey	—	
New Mexico	1	Medical waste
New York	91	Bacteria, algae, and turbidity from storm runoff and sewage bypass
North Carolina	—	
North Dakota	—	
Ohio	7	PCBs, dioxin, PAHs, mirex, chlordane
Ohio River Valley	2	Bacteria from CSOs, urban runoff, municipal discharges
Oklahoma	—	
Oregon	—	
Pennsylvania	—	
Puerto Rico	—	
Rhode Island	1	Bacteria
South Carolina	1	Bacteria, shigella outbreak from septic tanks and other NPS
South Dakota	5	Fecal coliforms
Tennessee	44	Bacteria (42); toxics in water or sediment (2)
Texas	—	
Utah	5	Bacteria
Vermont	20	Coliform, CSO
Virginia	1	Bacterial contamination
Virgin Islands	4	High bacteria content from sewage
Washington	—	
West Virginia	—	
Wisconsin	2	Bacteria and clarity possibly related to CSOs
Wyoming	—	
Totals	371	

[a] Michigan reported 8 specific incidents of waterborne disease (Swimmer's Itch and Giardia).

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-6. Sources Associated with Shellfish Harvesting Restrictions

State	Urban Runoff/ Storm Sewers	Marinas	Municipal Discharges	Industrial Discharges	Other Point Sources	Septic Tanks	CSOs	Hydro-modification
Alabama	—	—	—	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
California	—	—	—	—	—	—	—	—
Connecticut	[a]	—	13	1	—	—	[a]	—
Delaware	—	—	—	—	—	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—
Florida	—	—	—	—	—	—	—	—
Georgia	—	4	2	2	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Louisiana	—	—	—	3	—	—	—	—
Maine	—	—	—	—	—	—	—	—
Maryland	4	—	—	—	4	9	—	—
Massachusetts	—	—	—	—	—	—	—	—
Mississippi	1	—	1	—	—	1	—	—
New Hampshire	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—
New York	62	—	2	—	—	—	1	—
North Carolina	—	—	—	—	—	—	—	—
Oklahoma	—	—	—	—	—	—	—	—
Oregon	1	—	5	4	—	5	—	—
Pennsylvania	—	—	—	—	—	—	—	—
Rhode Island	28	38	17	9	—	9	5	—
South Carolina	47	9	20	21	34	—	—	4
Texas	—	—	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—
Totals	143	51	60	40	38	24	6	4

[a] Precautionary closures are imposed at all conditional shellfish beds during and 48 hours following rain events.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-7. Fish Kills Caused by Pollution

State	Total Number of Kills Caused by Pollutants and Natural Causes	Caused by Pollution		Kills Caused by Toxic Pollutants		Kills Caused by Conventional Pollutants	
		Total No. Fish Kills	Total No. Fish Killed	Number of Fish Kills	Number of Fish Killed	Number of Fish Kills	Number of Fish Killed
Alabama	28	7	—	1	—	5	—
Alaska	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—
Arizona	2	2	120	2	120	—	—
Arkansas	15	15	162,690	5	9,240	8	25,700
California	21	21	—	16	—	5	—
Colorado	4	4	1,000	2	—	1	—
Connecticut	26	9	16,000	9	16,000	—	—
Delaware	19	17	—	2	—	2	—
Delaware River Basin	—	—	—	—	—	—	—
District of Columbia	1	1	—	—	—	1	—
Florida	275	20	1,066,272	7	1,058,827	7	3,825
Georgia	40	40	186,304	16	63,952	21	114,553
Guam	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—
Idaho	7	7	451,300	4	331,300	1	10,000
Illinois	19	19	200,407	—	—	—	—
Indiana	72	20	7,719	1	700	2	—
Iowa	35	19	249,104	5	216,347	10	32,463
Kansas	56	56	1,100,122	8	4,194	46	95,928
Kentucky	33	30	127,208	4	40,369	16	73,595
Louisiana	106	64	400,000	25	400,000	—	—
Maine	2	2	850	2	850	—	—
Maryland	116	15	—	10	—	5	—
Massachusetts	97	70	—	10	—	20	—
Michigan	8	8	350,610	2	—	6	350,610
Minnesota	31	12	60,660	4	22,730	4	37,827
Mississippi	37	26	13,585	2	150	8	2,327
Missouri	—	—	—	—	—	—	—
Montana	7	7	—	3	—	2	—
Nebraska	60	32	29,592	3	236	11	163
Nevada	12	11	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—
New Mexico	10	9	—	2	—	2	—
New York	20	20	111,525	8	54,710	9	61,715
North Carolina	—	—	—	—	—	—	—
North Dakota	—	—	—	—	—	—	—
Ohio	54	54	41,318	9	2,694	28	34,257
Ohio River Valley	—	—	—	—	—	—	—
Oklahoma	35	35	34,404	3	1,557	17	22,420
Oregon	17	17	110,600	4	6,300	6	100,046
Pennsylvania	42	42	128,113	10	25,720	11	17,303
Puerto Rico	11	11	—	2	—	3	—
Rhode Island	11	1	8	1	8	—	—
South Carolina	88	21	18,373	21	18,373	—	—
South Dakota	9	2	50	1	50	—	—
Tennessee	48	43	215,684	19	135,867	13	79,036
Texas	15	15	—	11	—	—	—
Utah	10	9	4,541	3	1,164	2	57
Vermont	2	2	2,000	—	—	1	—
Virginia	96	94	—	11	—	20	—
Virgin Islands	6	6	5,500	—	—	4	5,500
Washington	—	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—	—
Wisconsin	17	15	11,000	—	—	11	7,000
Wyoming	—	—	—	—	—	—	—
Totals	1,620	930	5,106,659	248	2,411,458	308	1,074,325
Percentages		57%		26%		32%	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-7. (continued)

Kills Caused by Habitat Modification		Kills Caused by Unspecified/Unknown Pollutants		Kills Due to Natural Causes	
Number of Fish Kills	Number of Fish Killed	Number of Fish Kills	Number of Fish Killed	Number of Fish Kills	Number of Fish Killed
—	—	1	—	21	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	2	127,750	—	—
—	—	—	—	—	—
—	—	1	1,000	—	—
1	1,000	7	1,000	8	3,000
—	—	13	—	2	—
—	—	—	—	—	—
—	—	—	—	—	—
1	1,570	—	—	255	3,800,000
—	—	3	7,799	—	—
—	—	—	—	—	—
—	—	—	—	—	—
2	110,000	—	—	—	—
—	—	—	—	—	—
—	—	17	7,019	9	4,979
—	—	4	294	11	10,184
—	—	2	1,000,000	—	—
—	—	—	—	3	7,000
—	—	39	—	42	—
—	—	—	—	—	—
—	—	47	—	54	—
2	—	38	—	27	—
—	—	—	—	—	—
—	—	4	103	19	60,051
3	6,500	13	4,608	11	9,080
—	—	—	—	—	—
—	—	2	—	—	—
4	28,040	14	1,153	28	12,396
3	—	8	—	1	19,000
—	—	—	—	—	—
—	—	—	—	—	—
4	—	1	—	1	—
—	—	3	5,100	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	17	—	—	—
—	—	—	—	—	—
—	—	15	10,427	—	—
5	3,764	2	490	—	—
—	—	21	85,090	—	—
—	—	6	—	—	—
—	—	—	—	10	121,608
—	—	—	—	67	—
—	—	1	—	7	—
—	—	13	781	5	700
—	—	4	—	—	—
2	320	2	3,000	1	—
1	2,000	—	—	—	—
—	—	63	—	2	—
—	—	2	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	4	4,000	2	—
—	—	—	—	—	—
28	153,194	369	1,259,614	586	4,047,998
3%		39%			

Table E-8. Pollutants Causing Fish Kills

State	BOD/DO	Pesticides	Manure/ Silage	Oil and Gas	Chlorine	Ammonia	Temp-erature	Acidity	Nutrients
Alabama	4	1	1	1	—	—	—	—	—
Alaska	—	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—
Arizona	1	1	—	—	—	—	—	—	—
Arkansas	3	1	1	1	—	1	—	2	1
California	—	—	—	—	—	—	—	—	—
Colorado	1	—	—	—	—	—	—	—	—
Connecticut	3	2	—	1	1	2	—	—	1
Delaware	—	1	—	—	1	—	—	—	2
Delaware River Basin	—	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	—	—	—	—	—	1
Florida	5	5	—	—	1	1	1	2	—
Georgia	15	4	2	2	4	3	1	1	—
Gila River Indian Community	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—
Idaho	—	2	—	—	—	—	—	—	—
Illinois	—	—	—	—	—	—	—	—	—
Indiana	2	1	17	5	1	1	2	—	—
Iowa	9	2	—	—	—	9	1	1	—
Kansas	41	7	—	5	—	1	—	—	—
Kentucky	3	1	6	2	1	—	—	—	—
Louisiana	—	25	—	—	—	—	—	—	—
Maine	—	2	—	—	—	—	—	—	—
Maryland	25	3	—	1	5	—	9	—	—
Massachusetts	15	6	—	2	—	—	—	2	—
Michigan	—	—	4	—	1	—	—	—	—
Minnesota	1	—	—	1	—	—	1	—	1
Mississippi	14	1	—	1	—	1	1	—	—
Missouri	—	—	—	—	—	—	—	—	—
Montana	—	—	1	—	—	—	—	—	—
Nebraska	26	—	8	1	—	2	3	—	—
Nevada	—	—	—	—	—	—	—	—	—
New Hampshire	—	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—	—
New Mexico	5	—	—	1	1	—	3	1	—
New York	4	3	4	1	2	1	—	1	—
North Carolina	—	—	—	—	—	—	—	—	—
North Dakota	—	—	—	—	—	—	—	—	—
Ohio	4	1	11	8	3	1	—	—	3
Ohio River Valley	—	—	—	—	—	—	—	—	—
Oklahoma	6	2	5	6	—	—	—	—	1
Oregon	1	1	—	3	1	1	—	1	1
Pennsylvania	2	1	4	4	8	—	—	—	1
Puerto Rico	5	2	—	—	—	—	—	—	1
Rhode Island	—	1	—	—	—	—	—	—	—
South Carolina	—	12	—	1	1	—	—	—	1
South Dakota	—	—	—	—	1	—	—	—	—
Tennessee	8	1	3	8	3	2	1	3	—
Texas	—	2	—	—	1	2	—	—	—
Utah	1	1	—	1	2	—	—	—	—
Vermont	—	—	1	—	—	—	—	—	—
Virginia	7	4	1	2	3	2	—	5	—
Virgin Islands	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—	—	—	—
Wisconsin	10	—	—	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—	—	—	—
Totals	221	96	69	58	41	30	23	19	14

[a]BOD/DO = Biological oxygen demand/dissolved oxygen.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-8. (continued)

Unspecified Organics	Siltation/ Sediment	Metals	Priority Organics
—	—	—	—
—	—	—	—
—	—	—	—
—	—	1	—
—	—	—	3
—	—	—	—
—	—	1	—
—	1	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	1	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	1	2	—
—	1	—	1
—	—	—	—
—	—	—	—
—	—	—	—
1	1	2	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	1	—
1	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	3	—	—
—	—	1	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
2	2	—	—
4	—	—	—
—	—	—	—
—	—	—	—
—	1	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
11	10	9	4

Table E-9. Sources of Pollutants Causing Fish Kills

State	Natural	Agriculture	Industrial Discharges	Municipal Discharges	Other Spills	Pesticide Application	Hydro-modification	Low Flows	Drinking Supply Discharges
Alabama	—	2	—	4	1	—	—	—	—
Alaska	—	—	3	1	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	1	—	—	—
Arkansas	—	2	4	—	2	—	—	—	—
California	—	—	—	—	—	—	—	—	—
Colorado	—	—	1	—	—	—	—	—	—
Connecticut	8	1	5	—	1	2	—	4	—
Delaware	3	—	—	—	—	1	—	—	—
Delaware River Basin	—	—	—	—	—	—	—	—	—
District of Columbia	—	—	—	1	—	—	—	—	—
Florida	—	3	—	1	—	1	—	1	—
Georgia	—	8	10	9	2	2	2	—	1
Gila River Indian Community	—	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—	—
Idaho	—	2	—	—	2	1	1	1	—
Illinois	—	3	3	2	—	—	—	—	—
Indiana	—	—	—	—	—	—	—	—	—
Iowa	11	14	5	2	—	—	—	—	—
Kansas	16	20	3	2	—	—	—	—	—
Kentucky	2	6	—	10	3	1	—	1	—
Louisiana	42	25	16	3	—	—	—	—	—
Maine	—	—	—	—	—	—	—	—	—
Maryland	54	5	1	3	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—	—
Michigan	—	4	2	—	—	—	1	—	1
Minnesota	—	—	—	—	—	—	—	—	—
Mississippi	11	3	2	3	—	—	—	3	—
Missouri	—	—	—	—	—	—	—	—	—
Montana	—	1	—	—	—	—	—	—	—
Nebraska	23	10	—	—	1	—	4	—	—
Nevada	—	—	—	—	—	—	—	3	—
New Hampshire	—	—	—	—	—	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—	—
New Mexico	1	—	1	—	1	—	—	2	1
New York	—	4	2	4	3	3	—	—	1
North Carolina	—	—	—	—	—	—	—	—	—
North Dakota	—	—	—	—	—	—	—	—	—
Ohio	—	19	4	6	—	—	—	—	—
Ohio River Valley	—	—	—	—	—	—	—	—	—
Oklahoma	—	6	1	5	11	1	—	—	—
Oregon	—	—	3	1	3	—	5	—	—
Pennsylvania	—	6	—	2	3	—	—	—	3
Puerto Rico	—	1	—	1	—	2	—	—	—
Rhode Island	—	—	—	—	—	1	—	—	—
South Carolina	—	1	—	1	—	12	—	—	—
South Dakota	7	—	—	—	—	—	—	—	1
Tennessee	5	4	14	2	8	1	—	—	1
Texas	—	1	7	2	3	2	—	—	—
Utah	1	1	—	1	1	1	—	2	—
Vermont	—	1	—	—	—	—	1	—	—
Virginia	—	2	10	3	—	—	—	—	—
Virgin Islands	—	—	—	—	—	—	—	—	—
Washington	—	—	—	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—	—	—	—
Wisconsin	4	2	5	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—	—	—	—
Totals	188	157	102	69	45	32	14	17	9

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-9. (continued)

Resource Extraction	Swimming Pools	Construction	Urban Runoff/ Storm Sewers
—	—	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	—	—	—
—	1	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	—	—	1
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	1	—
2	—	—	—
—	—	—	—
—	—	—	—
—	—	1	—
—	—	—	—
—	—	—	—
—	—	—	1
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	—	—	—
1	5	1	—
—	—	—	—
—	—	—	—
—	—	—	1
—	—	—	—
—	—	2	—
—	—	—	—
—	—	—	—
—	—	—	—
1	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
9	6	5	3

Table E-10. Sediment Contamination Reported by the States

State	Number of Sites	Contaminants of Concern	Sources of Contaminants
Alabama	5	Metals, organics	
Alaska	18	Oil, metals	Oil spills, resource extraction
American Samoa	1	PCBs, metals, oil and grease	
Arizona	1	Pesticides (DDE and toxaphene)	Agricultural runoff, irrigation, landfills
Arkansas	—	DDT, DDE, DDD, chlordane, pesticides	
California	—		
Colorado	—		
Connecticut	9	PCBs, lead, mercury, PAHs, and miscellaneous toxicity	Industrial activity, shooting range, runoff, municipal activity
Delaware	5	Metals and priority organics	Runoff, industry, ground water contamination, Superfund site
Delaware River Basin	—	Cadmium, zinc, copper, nickel, DDT, dieldrin, lindane	
District of Columbia	12	PCBs, chlordane, DDT byproducts, copper, lead, zinc, phenols	Combined sewer overflows
Florida	25	Cadmium, copper, mercury, lead, zinc, chromium, arsenic	
Georgia	—		
Guam	—		
Hawaii	—		
Idaho	—		
Illinois	195	Arsenic, cadmium, chromium, copper, lead, mercury, zinc, chlordane, DDT, dieldrin, PCBs, heptachlor epoxides	Point sources and urban runoff
Indiana	13	PCBs, metals, pesticides, PAHs, cyanide, phthalates	Unknown, multiple
Iowa	1	PCBs	Industry
Kansas	—		
Kentucky	—		
Louisiana	13	Petroleum hydrocarbons, halogenated hydrocarbons, priority pollutants, dioxin, PCBs, heavy metals, creosote, halogenated aliphatic aromatics	Industrial discharges, industrial runoff, and industrial spills
Maine	8	Cadmium, copper, dioxin, toluene, TCE, PCBs, tris, dimethyl formamide, chlorinated solvents	Landfill, salvage yard, industry
Maryland	7	Metals, organics	Industry, urban runoff
Massachusetts	—		
Michigan	17	PCBs, metals	Combined sewer overflows, industrial discharges
Minnesota			
Mississippi	14	Metals, organic toxics	Industrial discharges, industrial nonpoint sources, and industrial spills
Missouri	11	*Chlordane, PCBs, lead, zinc, radioactivity	Urban runoff, agricultural runoff, USDOE plant, lead mill tailing, industry
Montana	—		
Nebraska	—		
Nevada	7	Mercury, pesticides, organics	Mercury mill, irrigation flows

(continued)

Table E-10. (continued)

State	Number of Sites	Contaminants of Concern	Sources of Contaminants
New Hampshire	—		
New Jersey	—		
New Mexico			
New York	28	Priority organics and heavy metals	Industrial discharges, hazardous waste disposal, agriculture, urban stormwater runoff
North Carolina	105		
North Dakota	—		
Ohio	124	Arsenic, cadmium, copper, chromium, lead, zinc	
ORSANCO	—		
Oklahoma	16	DDT, heptachlor, cadmium, lead, arsenic, copper	Unknown
Oregon	17	Priority pollutants	
Pennsylvania	—		
Puerto Rico	—		
Rhode Island	6	Metals, PCBs, petroleum, hydrocarbon	Historical, industrial impacts (no longer discharging)
South Carolina	3	Mercury, PCBs, dioxin	Discontinued point sources
South Dakota	—		
Tennessee	30	PCBs, chlordane, lead, mercury, dioxin	Historical industrial discharges and spills, current industrial discharges
Texas	—		
Utah	—		
Vermont	—		
Virginia	—		
Virgin Islands	—		
Washington	—		
West Virginia	—		
Wisconsin	79	PCBs, dioxin, PCP, PBB, arsenic, cadmium, mercury, zinc, chromium, oil and grease, pesticides, PAHs	Industry, agriculture, landfills, municipal discharges, in-place contaminants, wood treatment plant
Wyoming			
Total	770		

Source: 1992 State Section 305(b) reports.

— Not reported.

PAH = Polycyclic aromatic hydrocarbons.
PCB = Polychlorinated biphenyls.
PBB = Polybrominated biphenyls.
TCE = Trichloroethylene.
USDOE = U. S. Department of Energy.

* Missouri also reports that chlordane contaminates sediments at approximately half of their 3,200 waterbodies.

Table E-11. Size of Waters Affected by Toxic Substances

State	Rivers and Streams		Lakes and Reservoirs		Estuaries		Oceans	
	Monitored for Toxics	Elevated Toxics	Monitored for Toxics	Elevated Toxics	Monitored for Toxics	Elevated Toxics	Monitored for Toxics	Elevated Toxics
Alabama	886	281	61,178	61,178	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona	2,690	2,441	61,509	32,941	—	—	—	—
Arkansas	355	84	155,344	22,666	—	—	—	—
California	5,339	3,152	329,174	228,174	91	86	—	—
Colorado	9,315	1,265	51,606	12,930	—	—	—	—
Connecticut	573	158	11,268	2,875	558	49	—	—
Delaware	231	99	620	403	14	1	25	—
Delaware River Basin	120	6	—	—	53	25	—	—
District of Columbia	38	14	238	103	6	3	—	—
Florida	1,072	678	142,720	74,880	481	235	99	99
Georgia	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	18	—	—	—	100	—	10	—
Idaho	1,225	1,225	32,000	32,000	—	—	—	—
Illinois	8,181	1,929	147,800	36,222	—	—	—	—
Indiana	5,335	1,845	23,500	815	—	—	—	—
Iowa	1,669	218	5,638	320	—	—	—	—
Kansas	16,006	706	172,129	—	—	—	—	—
Kentucky	—	—	—	—	—	—	—	—
Louisiana	307	59	—	9,118	—	—	—	—
Maine	865	237	38,106	400	10	10	—	—
Maryland	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—
Michigan	6,098	746	290,633	23,090	—	—	—	—
Minnesota	3,662	1,652	2,223,029	2,175,226	—	—	—	—
Mississippi	2,330	758	60,235	6,007	18	10	81	81
Missouri	3,432	761	236,873	7,824	—	—	—	—
Montana	43,674	4,502	615,935	270,847	—	—	—	—
Nebraska	1,602	587	92,585	46,885	—	—	—	—
Nevada	1,487	134	227,427	77,550	—	—	—	—
New Hampshire	8,763	13	5,635	137	—	—	—	—
New Jersey	—	—	—	—	—	—	—	—
New Mexico	—	3,618	—	122,338	—	—	—	—
New York	3,400	538	668,000	135,000	1,530	120	120	60
North Carolina	[a]	[a]	294,107	10,020	—	—	—	—
North Dakota	5,826	764	437,671	339,307	—	—	—	—
Ohio	7,901	2,127	98,445	13,941	—	—	—	—
Ohio River Valley	954	954	—	—	—	—	—	—
Oklahoma	400,472	1,844	569,038	201,265	—	—	—	—
Oregon	—	741	19,282	19,282	21	21	—	—
Pennsylvania	7,284	2,305	—	—	—	—	—	—
Puerto Rico	1,047	1,017	3,616	1,981	1	1	171	50
Rhode Island	256	123	647	441	23	7	—	—
South Carolina	3,739	30	509,438	—	694	<1	—	—
South Dakota	3,080	163	548,000	—	—	—	—	—
Tennessee	10,834	883	501,427	75,067	—	—	—	—
Texas	3,802	309	157,236	500	919	58	—	—
Utah	4,994	780	450,078	4,909	—	—	—	—
Vermont	—	—	—	—	—	—	—	—
Virginia	10,633	935	—	—	1,384	228	—	—
Virgin Islands	—	—	—	—	3	1	—	—
Washington	2,040	1,116	58,994	2,535	1,402	94	—	—
West Virginia	2,169	1,895	16,186	8,464	—	—	—	—
Wisconsin	1,234	508	601,594	214,164	—	—	—	—
Wyoming	2,113	595	70,069	2,750	—	—	—	—
Totals	597,051	44,795	9,989,009	4,274,554	7,307	948	506	290
Percentages	17%	8%	25%	43%	20%	13%	3%[b]	57%

[a] North Carolina monitors toxics at 350 ambient monitoring sites, but the State does not relate the data to waterbodies.
[b] Excluding the Alaska shoreline.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table E-11. (continued)

Great Lakes		Total Wetlands	
Monitored for Toxics	Elevated Toxics	Monitored for Toxics	Elevated Toxics
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	106,753	79,041
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
63	63	—	—
43	43	—	—
—	—	—	—
—	—	34,256	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
3,288	3,288	—	—
272	272	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	26,169	26,169
—	—	—	—
—	—	—	—
—	—	—	—
577	492	—	—
—	—	—	—
—	—	—	—
236	236	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
840	840	—	—
—	—	—	—
5,319	5,234	167,178	105,210
99%	98%	<1%	63%

Appendix F

Individual State Data
Great Lakes

Table F-1. Overall Designated Use Support in the Great Lakes (shore miles)

State	Fully Supporting				Threatened				Partially Supporting			
	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
Illinois	—	—	—		—	63	—	63	—	—	—	
Indiana[a]	—	—	—		—	—	—		—	43	—	43
Michigan[b]	—	—	—		—	—	—		—	—	—	
Minnesota	—	—	—		—	—	—		—	—	—	
New York	—	85	—	85	—	—	—		—	492	—	492
Ohio	—	—	—		—	—	—		—	236	—	236
Pennsylvania	—	—	—		—	—	—		—	—	—	
Wisconsin	—	—	—		—	—	—		630	210	—	840
Totals	—	85	—	85	—	63	—	63	630	981	—	1,611
% of Assessed Waters	0%	100%	—	2%	0%	100%	—	1%	39%	61%	—	30%

[a] Entered aquatic life support data in lieu of overall use support data.
[b] Michigan classifies all of its waters as either fully supporting or not supporting designated uses.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-1. (continued)

Not Supporting				Not Attainable				Total Assessed			
Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total	Evaluated	Monitored	Not Specified	Total
—	—	—		—	—	—		—	63	—	63
—	—	—		—	—	—		—	43	—	43
—	3,288	—	3,288	—	—	—		—	3,288	—	3,288
—	272	—	272	—	—	—		—	272	—	272
—	—	—		—	—	—		—	577	—	577
—	—	—		—	—	—		—	236	—	236
—	—	—		—	—	—		—	—	—	
—	—	—		—	—	—		630	210	—	840
—	3,560	—	3,560	—	—	—	—	630	4,689	—	5,319
0%	100%	—	67%	0%	0%	—	0%	12%	88%	—	99%

Table F-2a. Aquatic Life Use Support in the Great Lakes (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Illinois	—	63	—	—	—	63
Indiana	—	—	43	—	—	43
Michigan	—	—	—	3,288	—	3,288
Minnesota	—	—	—	23	—	23
New York	577	—	—	—	—	577
Ohio	—	—	236	—	—	236
Pennsylvania	—	—	—	—	—	—
Wisconsin	—	720	120	—	—	840
Totals	577	783	399	3,311	—	5,070
Percent of Assessed Waters	11%	15%	8%	65%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-2b. Fish Consumption Use Support in the Great Lakes (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Illinois	—	—	—	63	—	63
Indiana	—	—	—	43	—	43
Michigan	—	—	—	3,288	—	3,288
Minnesota	—	—	—	272	—	272
New York	85	—	492	—	—	577
Ohio	—	—	236	—	—	236
Pennsylvania	—	—	—	—	—	—
Wisconsin	—	—	840	—	—	840
Totals	85	—	1,568	3,666	—	5,319
Percent of Assessed Waters	2%	—	29%	69%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-2c. Swimming Use Support in the Great Lakes (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Illinois	62	—	1	—	—	63
Indiana	43	—	43	—	—	86
Michigan	3,287	—	—	1	—	3,288
Minnesota	23	—	—	—	—	23
New York	483	—	94	—	—	577
Ohio	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Wisconsin	780	—	40	20	—	840
Totals	4,678	—	178	21	—	4,877
Percent of Assessed Waters	96%	—	4%	<1%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-2d. Secondary Contact Use Support in the Great Lakes (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Illinois	—	—	—	—	—	—
Indiana	—	—	—	—	—	—
Michigan	3,288	—	—	—	—	3,288
Minnesota	—	—	—	—	—	—
New York	572	—	5	—	—	577
Ohio	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Wisconsin	780	—	60	—	—	840
Totals	4,640	—	65	—	—	4,705
Percent of Assessed Waters	99%	—	1%	—	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-2e. Drinking Water Supply Use Support in the Great Lakes (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Illinois	63	—	—	—	—	63
Indiana	43	—	—	—	—	43
Michigan	3,208	—	—	80	—	3,288
Minnesota	—	—	—	—	—	—
New York	576	—	1	—	—	577
Ohio	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Wisconsin	820	—	20	—	—	840
Totals	4,710	—	21	80	—	4,811
Percent of Assessed Waters	98%	—	<1%	2%	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-2f. Agriculture Use Support in the Great Lakes (shore miles)

State	Fully Supporting	Threatened	Partially Supporting	Not Supporting	Not Attainable	Total Assessed
Illinois	—	—	—	—	—	—
Indiana	43	—	—	—	—	43
Michigan	3,288	—	—	—	—	3,288
Minnesota	—	—	—	—	—	—
New York	577	—	—	—	—	577
Ohio	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—
Wisconsin	800	—	40	—	—	840
Totals	4,708	—	40	—	—	4,748
Percent of Assessed Waters	99%	—	1%	—	—	

— None or not reported.

Source: 1992 State Section 305(b) reports.

Table F-3. Leading Causes of Great Lakes Impairments (shore miles)

State	Total Impaired Waters		Priority Organics (1)				Metals (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Illinois	—	—	63	—	—	63	—	—	—	
Indiana	—	43	—	—	—	—	—	—	—	
Michigan	—	3,288	3,288	—	—	3,288	—	—	—	
Minnesota	—	272	—	272	—	272	—	272	—	272
New York	—	492	388	104	—	492	—	—	—	
Ohio	—	236	4	186	—	190	86	129	—	215
Pennsylvania	—	—	—	—	—	—	—	—	—	
Wisconsin	—	840	840	—	—	840	—	100	—	100
Total Shore Miles Impaired	—	5,171	4,583	562	—	5,145	86	501	—	587
% of Impaired Shore Miles[a] Affected by Each Cause			89%	11%	—	99%	2%	9%	—	11%
% of Assessed Shore Miles Affected by Each Cause			86%	11%	—	97%	2%	9%	—	11%
% of Total Shore Miles Affected by Each Cause			85%	10%	—	96%	2%	9%	—	11%

[a] Includes only impaired shore miles in States reporting causes affecting the Great Lakes.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired Great Lakes Shore Miles in States Reporting Causes:	5,171 shore miles
Total Assessed Great Lakes Shore Miles:	5,319 shore miles
Estimate of Total Great Lakes Shore Miles in the Nation:	5,382 shore miles

Table F-3. (continued)

Organic Enrich./Low Dissolved Oxygen (3)				Nutrients (4)				Siltation (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
—	44	—	44	77	21	—	98	6	63	—	69
75	46	—	121	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—
75	100	—	175	75	100	—	175	—	75	—	75
150	190	—	340	152	121	—	273	6	138	—	144
3%	4%	—	7%	3%	2%	—	5%	<1%	3%	—	3%
3%	4%	—	6%	3%	2%	—	5%	<1%	3%	—	3%
3%	3%	—	6%	3%	2%	—	5%	<1%	3%	—	3%

(continued)

Table F-3. (continued)

State	Pathogen Indicators (6)				Noxious Aquatic Weeds (7)				Taste and Odor (8)			
	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Illinois	—	—	—	—	—	—	—	—	—	—	—	—
Indiana	—	—	—	—	—	—	—	—	—	—	—	—
Michigan	—	—	—	—	—	—	—	—	1	—	—	1
Minnesota	—	—	—	—	—	—	—	—	—	—	—	—
New York	21	23	—	44	—	23	—	23	—	—	—	—
Ohio	—	—	—	—	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—	—	—	—	—	—
Wisconsin	—	80	—	80	75	—	—	75	—	40	—	40
Total Shore Miles Impaired	21	103	—	124	75	23	—	98	1	40	—	41
% of Impaired Shore Miles[a] Affected by Each Cause	<1%	2%	—	2%	1%	<1%	—	2%	<1%	1%	—	1%
% of Assessed Shore Miles Affected by Each Cause	<1%	2%	—	2%	1%	<1%	—	2%	<1%	1%	—	1%
% of Total Shore Miles Affected by Each Cause	<1%	2%	—	2%	1%	<1%	—	2%	<1%	1%	—	1%

Table F-3. . (continued)

Ammonia (9)				Chlorine (10)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	—	—		—	—	—	
—	20	—	20	—	20	—	20
—	20	—	20	—	20	—	20
—	<1%	—	<1%	0%	<1%	—	<1%
—	<1%	—	<1%	0%	<1%	—	<1%
—	<1%	—	<1%	0%	<1%	—	<1%

Table F-4. Leading Sources of Great Lakes Impairments (shore miles)

State	Total Impaired Waters		Atmospheric Deposition (1)				Contaminated Sediments (2)			
	States Not Reporting Causes	States Reporting Causes	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
Illinois	—	—	63	—	—	63	4	—	—	4
Indiana	—	43	—	43	—	43	—	—	—	—
Michigan	3,287	1	—	—	—	—	—	—	—	—
Minnesota	—	272	—	—	—	—	—	—	—	—
New York	—	492	—	—	—	—	388	58	—	446
Ohio	—	236	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—	—	—	—
Wisconsin	—	840	—	840	—	840	310	—	—	310
Total Shore Miles Impaired	3,287	1,884	63	883	—	946	702	58	—	760
% of Impaired Shore Miles[a] Affected by Each Source			3%	47%	—	50%	37%	3%	—	40%
% of Assessed Shore Miles Affected by Each Source			1%	17%	—	18%	13%	1%	—	14%
% of Total Shore Miles Affected by Each Source			1%	16%	—	17%	13%	1%	—	14%

[a] Includes only impaired shore miles in States reporting sources affecting the Great Lakes.

— None or not reported.

Source: 1992 State Section 305(b) reports.

Total Impaired Great Lakes Shore Miles in States Reporting Sources:	1,884 shore miles
Total Assessed Great Lakes Shore Miles:	5,319 shore miles
Estimate of Total Great Lakes Shore Miles in the Nation:	5,382 shore miles

Table F-4. (continued)

Land Disposal (3)				Urban Runoff/Storm Sewers (4)				Combined Sewer Overflow (5)			
Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total	Major	Mod/ Min	Not Specified	Total
—	—	—		—	63	—	63	—	10	—	10
—	—	—		—	—	—		—	43	—	43
—	—	—		—	—	—		1	—	—	1
—	—	—		—	—	—		—	—	—	
—	492	—	492	14	21	—	35	21	14	—	35
20	4	—	24	—	—	—		—	—	—	
—	—	—		—	—	—		—	—	—	
—	60	—	60	—	100	—	100	—	60	—	60
20	556	—	576	14	184	—	198	22	127	—	149
1%	30%	—	31%	1%	10%	—	11%	1%	7%	—	8%
<1%	10%	—	11%	<1%	3%	—	4%	<1%	2%	—	3%
<1%	10%	—	11%	<1%	3%	—	4%	<1%	2%	—	3%

(continued)

Table F-4. (continued)

State	Construction (6)			
	Major	Mod/ Min	Not Specified	Total
Illinois	—	—	—	—
Indiana	—	—	—	—
Michigan	—	—	—	—
Minnesota	—	—	—	—
New York	6	35	—	41
Ohio	—	—	—	—
Pennsylvania	—	—	—	—
Wisconsin	—	—	—	—
Total Shore Miles Impaired	6	35	—	41
% of Impaired Shore Miles[a] Affected by Each Source	<1%	2%	—	2%
% of Assessed Shore Miles Affected by Each Source	<1%	1%	—	1%
% of Total Shore Miles Affected by Each Source	<1%	1%	—	1%

Appendix G

Individual State Data
Section 314 Clean Lakes Data

Table G-1. Trophic Status of Significant Publicly Owned Lakes

State	Total		Assessed		Oligotrophic		Mesotrophic	
	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes
Alabama	43	469,653	22	392,474	—	—	7	82,762
Alaska	—	—	2	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona[a]	235	128,436	10	—	1	—	2	—
Arkansas[b]	77	355,063	—	—	—	—	—	—
California	—	—	—	—	—	—	—	—
Colorado	176	149,023	87	102,623	11	8,223	30	42,454
Connecticut	105	24,941	105	24,941	7	1,549	61	16,165
Delaware	47	2,973	—	—	—	—	—	—
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	1	103	1	103	—	—	—	—
Florida[c]	145	968,320	106	—	58	—	25	—
Georgia	27	—	—	—	—	—	—	—
Gila River Indian Comm.	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Idaho	2,557	515,510	38	397,147	7	173,801	7	29,932
Illinois	298	155,433	298	155,433	3	75	23	6,185
Indiana	—	—	186	74,144	59	38,773	106	30,598
Iowa	115	42,974	115	42,974	—	—	—	—
Kansas	238	172,129	220	171,857	—	—	46	80,883
Kentucky	—	—	102	214,962	11	63,513	30	42,444
Louisiana	75	699,722	30	455,476	—	—	—	—
Maine	2,312	958,499	1,732	926,593	143	103,841	1,017	667,387
Maryland	62	21,001	62	21,001	3	1,339	14	6,559
Massachusetts	—	—	320	54,846	9	25,549	84	10,662
Michigan	704	489,407	704	489,407	111	174,068	364	176,715
Minnesota	11,842	3,290,101	1,738	—	236	—	598	—
Mississippi	127	313,538	34	298,652	—	—	—	—
Missouri	—	—	108	262,028	3	293	34	84,082
Montana	—	—	1,378	643,146	452	254,692	428	348,522
Nebraska	—	—	64	127,517	—	—	4	37,970
Nevada	—	—	12	—	3	—	7	—
New Hampshire	830	161,090	507	152,862	161	110,586	223	34,030
New Jersey	—	—	—	—	—	—	—	—
New Mexico	174	151,320	66	145,042	12	10,027	19	70,108
New York	7,648	730,387	1,896	349,842	398	62,150	375	208,360
North Carolina	145	304,542	145	304,542	38	73,395	32	106,081
North Dakota	216	619,088	149	604,292	—	—	12	369,339
Ohio	—	—	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	—	—	149	—	22	—	66	—
Oregon	—	—	202	—	59	—	72	—
Pennsylvania	125	—	54	—	1	—	41	—
Puerto Rico	18	—	18	—	1	—	6	—
Rhode Island	58	7,035	58	7,035	5	388	42	5,810
South Carolina	43	476,001	40	474,651	—	—	6	28,807
South Dakota	—	—	120	—	—	—	8	—
Tennessee	123	539,326	123	539,326	20	97,044	36	115,862
Texas	108	—	—	—	—	—	—	—
Utah	139	450,078	139	450,078	23	76,323	72	225,222
Vermont	—	—	—	215,469	—	9,306	—	178,985
Virginia	248	161,554	62	90,763	3	5,348	20	4,285
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	—	148	—	25	—	81	—
West Virginia[d]	93	21,522	—	—	—	—	—	—
Wisconsin	14,973	—	127	—	30	—	48	—
Wyoming	—	—	—	—	—	—	—	—
Totals	44,127	12,378,769	11,477	8,189,226	1,915	1,290,283	4,046	3,010,209
Percentages					17%	16%	35%	37%

[a] Arizona's significant public lakes do not include lakes under the jurisdiction of American Indian Tribes.
[b] Arkansas calculated and ranked all 77 significant public lakes by a trophic index, but did not assign a trophic class to each index.
[c] Florida reports the number of lake reaches in each trophic category. The State has 101 significant public lakes comprised of 145 lake reaches.
[d] West Virginia reports total number of publicly owned lakes, some of which may not be "significant."

— None or not reported.
NA = Not applicable.
Source: 1992 State Section 305(b) reports.

Table G-1. (continued)

Eutrophic		Hypereutrophic		Dystrophic		Unknown	
Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes
15	309,712	—	—	—	—	21	77,179
2	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
39	46,900	7	5,046	—	—	—	—
21	5,901	16	1,326	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
1	103	—	—	—	—	—	—
23	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
24	193,414	—	—	—	—	25	21,382
141	60,453	131	88,720	—	—	—	—
21	4,773	—	—	—	—	—	—
115	42,974	—	—	—	—	—	—
101	80,486	73	10,488	—	—	18	272
58	108,877	3	128	—	—	—	—
30	455,476	—	—	—	—	—	—
572	155,365	—	—	—	—	6	110
45	13,103	—	—	—	—	—	—
169	15,428	57	3,170	1	37	2,547	96,327
229	138,624	—	—	—	—	—	—
586	—	318	—	—	—	—	—
34	298,652	—	—	—	—	—	—
66	176,949	5	704	—	—	249	25,515
371	39,262	—	—	127	670	502	20,217
46	81,086	14	8,461	—	—	—	—
2	—	—	—	—	—	11	—
123	8,246	—	—	—	—	—	—
—	—	—	—	—	—	—	—
34	64,902	—	—	1	5	—	—
282	54,195	—	—	841	25,137	5,692	270,692
57	108,340	8	1,470	10	15,256	—	—
58	150,298	79	84,654	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
28	—	33	—	—	—	—	—
61	—	10	—	—	—	—	—
12	—	—	—	—	—	—	—
11	—	—	—	—	—	—	—
10	817	—	—	1	20	—	—
34	445,844	—	—	—	—	—	—
27	—	85	—	—	—	7	—
48	309,443	19	16,977	—	—	—	—
—	—	—	—	—	—	—	—
40	44,104	4	104,429	—	—	—	—
—	26,810	—	—	—	368	—	12,914
39	81,130	—	—	—	—	—	—
—	—	—	—	—	—	—	—
41	—	1	—	—	—	—	—
—	—	—	—	—	—	—	—
47	—	2	—	—	—	511	—
—	—	—	—	—	—	—	—
3,670	3,521,667	865	325,573	981	41,493	9,589	524,608
32%	43%	8%	4%	8%	0.5%	84%	6%

Table G-2. Acidity in Significant Publicly Owned Lakes

State	Number of Lakes Assessed for Acidity	Acreage of Lakes Assessed for Acidity	Number of Lakes Exhibiting High Acidity[a]	Acreage of Lakes Exhibiting High Acidity[a]
Alabama	—	—	—	—
Alaska	—	—	1	1,850
American Samoa	—	—	—	—
Arizona	—	—	—	—
Arkansas	77	—	8	—
California	—	—	—	—
Colorado	—	—	—	—
Connecticut	105	24,941	12	1,828
Delaware	30	—	8	—
Delaware River Basin	NA	NA	NA	NA
District of Columbia	—	—	—	—
Florida	7	—	4	—
Georgia	—	—	—	—
Gila River Indian Comm.	—	—	—	—
Guam	—	—	—	—
Hawaii	—	—	—	—
Idaho	—	—	—	—
Illinois	—	—	—	—
Indiana	—	—	—	—
Iowa	9	2,445	—	—
Kansas	—	168,877	—	—
Kentucky	—	—	—	—
Louisiana	8	43,465	8	43,465
Maine	1,004	713,387	59	697
Maryland	62	21,001	—	—
Massachusetts	—	—	12	—
Michigan	704	489,407	—	—
Minnesota	1,153	—	218	—
Mississippi	—	—	—	—
Missouri	107	263,124	—	—
Montana	—	—	—	—
Nebraska	—	—	—	—
Nevada	—	—	—	—
New Hampshire	549	153,581	40	3,277
New Jersey	—	—	—	—
New Mexico	—	—	—	—
New York	1,526	97,825	642	23,462
North Carolina	145	304,542	—	—
North Dakota	192	611,074	—	—
Ohio	—	—	—	—
Ohio River Valley	NA	NA	NA	NA
Oklahoma	—	—	—	—
Oregon	—	—	—	—
Pennsylvania	—	—	—	—
Puerto Rico	—	—	—	—
Rhode Island	58	7,035	10	1,097
South Carolina	—	—	—	—
South Dakota	—	—	—	—
Tennessee	123	539,326	3	2,864
Texas	4	—	—	—
Utah	—	—	—	—
Vermont	200	—	7	114
Virginia	62	90,762	—	—
Virgin Islands	NA	NA	NA	NA
Washington	—	—	—	—
West Virginia	—	—	—	—
Wisconsin	698	211,735	6	—
Wyoming	—	—	—	—
Totals	6,823	3,742,527	1,038	78,654
Percentages			15%	2%

[a] Includes lakes threatened by high acidity (i.e., low pH) due to natural causes.

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table G-3. Sources of High Acidity in Lakes

State	Acid Deposition		Acid Mine Drainage		Natural Sources		Other	
	Number of Lakes Impacted	Acreage Lakes Impacted	Number of Lakes Impacted	Acreage Lakes Impacted	Number of Lakes Impacted	Acreage Lakes Impacted	Number of Lakes Impacted	Acreage Lakes Impacted
Alabama	—	—	1	1,850	—	—	—	—
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona	—	—	—	—	—	—	—	—
Arkansas	—	—	—	—	8	—	—	—
California	—	—	—	—	—	—	—	—
Colorado	—	—	—	—	—	—	—	—
Connecticut	—	—	—	—	12	1,828	—	—
Delaware	—	—	—	—	8	—	—	—
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	—	—	—	—	—
Florida	—	—	—	—	—	—	—	—
Georgia	—	—	—	—	—	—	—	—
Gila River Indian Comm.	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Idaho	—	—	—	—	—	—	—	—
Illinois	—	—	—	—	—	—	—	—
Indiana	—	—	—	—	—	—	—	—
Iowa	—	—	—	—	—	—	—	—
Kansas	—	—	—	—	—	—	—	—
Kentucky	—	—	—	—	—	—	—	—
Louisiana	—	—	—	—	8	43,465	—	—
Maine	41	—	—	—	24	—	—	—
Maryland	—	—	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—
Michigan	—	—	—	—	—	—	—	—
Minnesota	—	—	—	—	—	—	—	—
Mississippi	—	—	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—
Montana	—	—	—	—	—	—	—	—
Nebraska	—	—	—	—	—	—	—	—
Nevada	—	—	—	—	—	—	—	—
New Hampshire	19	1,681	—	—	21	1,596	—	—
New Jersey	—	—	—	—	—	—	—	—
New Mexico	—	—	—	—	—	—	—	—
New York	397	17,550	—	—	—	—	—	—
North Carolina	—	—	—	—	—	—	—	—
North Dakota	—	—	—	—	—	—	—	—
Ohio	—	—	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—
Pennsylvania	—	—	—	—	—	—	—	—
Puerto Rico	—	—	—	—	—	—	—	—
Rhode Island	10	1,097	—	—	10	1,097	—	—
South Carolina	—	—	—	—	—	—	—	—
South Dakota	—	—	—	—	—	—	—	—
Tennessee	—	—	3	2,864	—	—	—	—
Texas	—	—	—	—	—	—	—	—
Utah	—	—	—	—	—	—	—	—
Vermont	7	114	—	—	—	—	—	—
Virginia	—	—	—	—	—	—	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	—	—	—	—	—	—	—
West Virginia	—	—	—	—	—	—	—	—
Wisconsin	—	—	—	—	—	—	—	—
Wyoming	—	—	—	—	—	—	—	—
Totals	474	20,442	4	4,714	91	47,986	—	—

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

Table G-4. Trends in Significant Publicly Owned Lakes

State	Total		Assessed		Improving		Stable	
	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes	Number of Significant Public Lakes	Acreage of Significant Public Lakes
Alabama	43	469,653	43	469,653	1	440	42	469,213
Alaska	—	—	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—	—	—
Arizona	235	128,436	—	—	—	—	—	—
Arkansas	77	355,063	11	167,550	1	—	10	—
California	—	—	—	—	—	—	—	—
Colorado	176	149,023	7	8,553	—	—	7	8,553
Connecticut	105	24,941	105	24,940	10	10,519	89	13,609
Delaware	47	2,973	—	—	—	—	—	—
Delaware River Basin	NA	NA	NA	NA	NA	NA	NA	NA
District of Columbia	1	103	—	—	—	—	36	707
Florida	145	968,320	56	914	15	173	—	—
Georgia	27	—	—	—	—	—	—	—
Gila River Indian Comm.	—	—	—	—	—	—	—	—
Guam	—	—	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—	—	—
Idaho	2,557	515,510	13	159,959	6	7,457	5	57,897
Illinois	298	155,433	98	—	25	—	27	—
Indiana	—	—	186	—	59	—	106	—
Iowa	115	42,974	114	42,939	5	1,793	90	38,319
Kansas	238	172,129	123	164,288	5	19,042	93	121,482
Kentucky	—	—	91	214,962	3	294	80	211,993
Louisiana	75	699,722	—	—	—	—	—	—
Maine	2,312	958,499	223	—	12	—	190	—
Maryland	62	21,001	—	—	—	—	—	—
Massachusetts	—	—	—	—	—	—	—	—
Michigan	704	489,407	210	299,942	40	58,283	143	205,801
Minnesota	11,842	3,290,101	161	—	26	—	129	—
Mississippi	127	313,538	—	—	—	—	—	—
Missouri	—	—	—	—	—	—	—	—
Montana	—	—	1	122,535	—	—	—	—
Nebraska	—	—	12	34,499	1	208	9	33,491
Nevada	—	—	61	—	1	—	54	—
New Hampshire	830	161,090	316	128,377	134	45,935	14	765
New Jersey	—	—	—	—	—	—	—	—
New Mexico	174	151,320	—	—	—	—	—	—
New York	7,648	730,387	—	—	—	—	—	—
North Carolina[a]	145	304,542	94	286,065	16	54,307	65	212,156
North Dakota	216	619,088	189	487,858	1	412	162	64,099
Ohio	—	—	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA	NA	NA
Oklahoma	—	—	—	—	—	—	—	—
Oregon	—	—	—	—	—	—	—	—
Pennsylvania	125	—	—	—	—	—	—	—
Puerto Rico	18	—	—	—	—	—	—	—
Rhode Island	58	7,035	—	—	—	—	—	—
South Carolina	43	476,001	40	474,651	8	161,975	30	260,796
South Dakota	—	—	97	657,289	24	37,245	46	58,668
Tennessee	123	539,326	123	539,326	6	6,643	87	522,699
Texas	108	—	—	—	—	—	—	—
Utah	139	450,078	89	165,056	27	9,087	44	149,360
Vermont	—	—	—	—	—	—	—	—
Virginia	248	161,554	62	90,862	5	20,217	55	70,389
Virgin Islands	NA	NA	NA	NA	NA	NA	NA	NA
Washington	—	—	104	—	20	—	70	—
West Virginia	93	21,522	—	—	—	—	—	—
Wisconsin	14,973	—	49	48,880	20	22,287	24	23,150
Wyoming	—	—	—	—	—	—	—	—
Totals	44,127	12,378,769	2,678	4,588,568	471	456,317	1,707	2,523,146
Percentages					18%	10%	64%	55%

[a] North Carolina counted High Rock Lake as both improving and degrading because fish consumption use improved on 1,900 acres but 13,850 acres became more degraded by eutrophication.

— None or not reported.
NA - Not applicable.

Source: 1992 State Section 305(b) reports.

Table G-4. (continued)

Degrading	
Number of Significant Public Lakes	Acreage of Significant Public Lakes
—	—
—	—
—	—
—	—
—	—
—	—
—	—
6	812
—	—
NA	NA
5	34
—	—
—	—
—	—
—	—
—	—
2	94,605
46	—
21	—
19	2,827
25	23,764
8	2,145
—	—
21	—
—	—
—	—
27	35,858
6	—
—	—
—	—
1	122,535
2	800
6	—
168	81,677
—	—
—	—
—	—
13	19,602
26	422,827
—	—
NA	NA
—	—
—	—
—	—
—	—
—	—
2	51,880
27	561,376
30	9,984
—	—
18	6,609
—	—
2	257
NA	NA
14	—
—	—
5	3,443
—	—
500	1,441,034
19%	31%

Table G-5. Clean-Lakes Program Projects

State	Phase 1 Projects		Phase 2 Projects		Phase 3 Projects	
	Number of Projects Initiated	Number of Projects Completed	Number of Projects Initiated	Number of Projects Completed	Number of Projects Initiated	Number of Projects Completed
Alabama	2	—	—	—	—	—
Alaska	—	—	—	—	—	—
American Samoa	—	—	—	—	—	—
Arizona	3	—	—	—	—	—
Arkansas	—	—	—	—	—	—
California	—	—	—	—	—	—
Colorado	—	1	—	1	—	—
Connecticut	7	7	3	3	—	—
Delaware	4	—	1	—	—	—
Delaware River Basin	NA	NA	NA	NA	NA	NA
District of Columbia	—	—	—	—	—	—
Florida	2	1	1	—	—	—
Georgia	6	—	—	—	—	—
Gila River Indian Community	—	—	—	—	—	—
Guam	—	—	—	—	—	—
Hawaii	—	—	—	—	—	—
Idaho	3	4	3	—	—	—
Illinois	18	11	8	5	2	—
Indiana	3	—	—	—	—	—
Iowa	2	5	4	5	1	—
Kansas	—	6	1	1	—	—
Kentucky	1	1	—	—	—	—
Louisiana	—	—	—	—	—	—
Maine	1	—	2	2	1	—
Maryland	3	1	7	3	—	—
Massachusetts	—	—	—	—	—	—
Michigan	6	—	2	—	1	—
Minnesota	21	—	13	—	1	—
Mississippi	—	3	—	—	—	—
Missouri	4	4	1	3	—	—
Montana	4	2	1	1	—	—
Nebraska	—	—	—	—	—	—
Nevada	—	—	—	—	—	—
New Hampshire	9	7	1	1	1	—
New Jersey	2	—	5	3	—	—
New Mexico	—	1	—	—	—	—
New York	3	10	3	7	—	—
North Carolina	2	—	—	—	—	—
North Dakota	2	2	2	2	—	—
Ohio	—	—	—	—	—	—
Ohio River Valley	NA	NA	NA	NA	NA	NA
Oklahoma	17	—	4	—	1	—
Oregon	1	—	—	—	—	—
Pennsylvania	5	—	2	—	—	—
Puerto Rico	—	—	—	—	—	—
Rhode Island	1	2	—	—	—	—
South Carolina	3	1	1	1	—	—
South Dakota	8	8	1	1	1	—
Tennessee	5	2	—	—	—	—
Texas	3	1	1	—	—	—
Utah	3	6	3	1	—	—
Vermont	—	—	—	—	—	—
Virginia	—	1	1	2	—	—
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	4	—	14	14	—	—
West Virginia	—	—	—	—	—	—
Wisconsin	3	1	1	—	several	
Wyoming	—	—	—	—	—	—
Totals	161	88	86	56	9	—

— None or not reported.
NA = Not applicable.

Source: 1992 State Section 305(b) reports.

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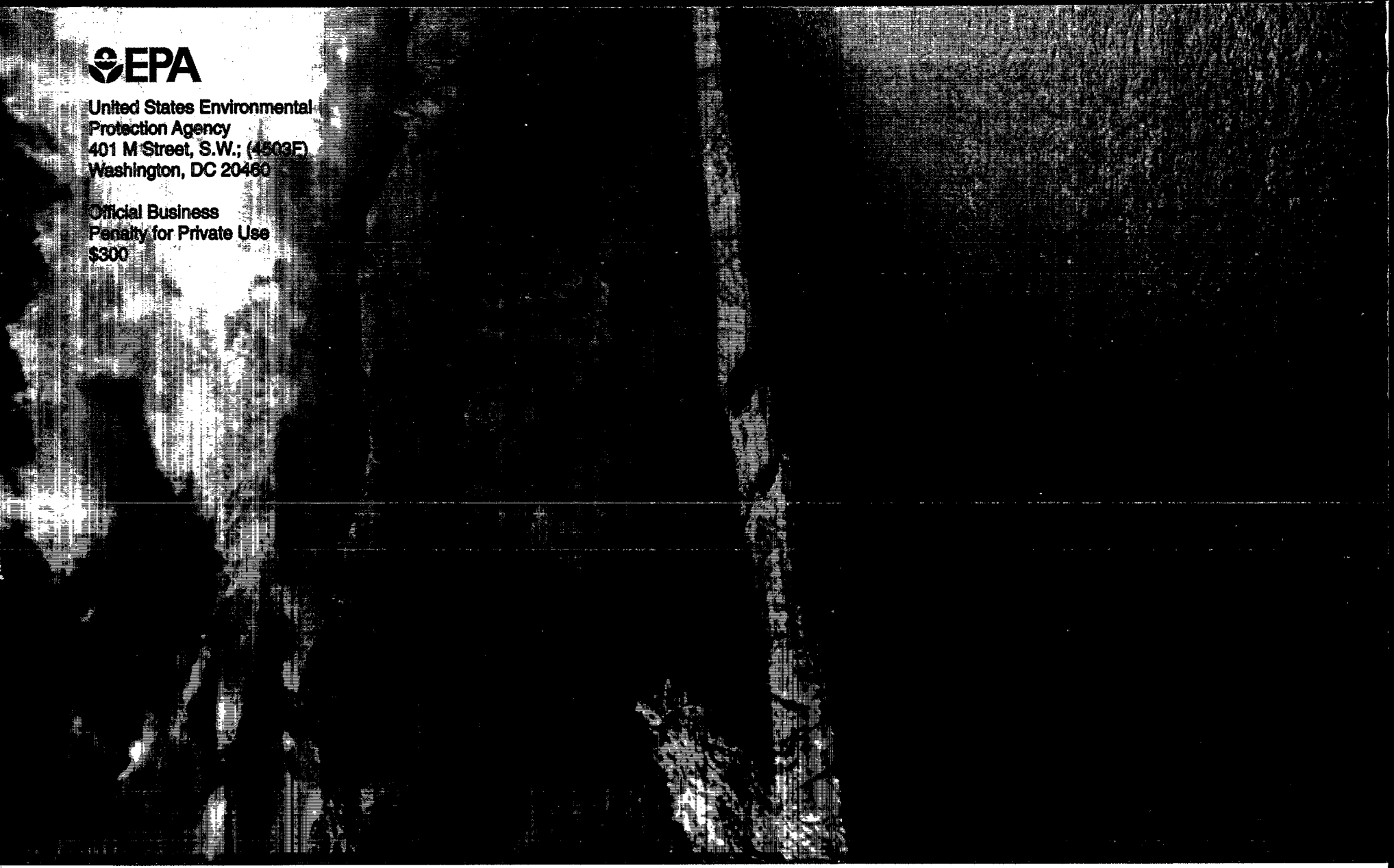

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