Part I

Water Quality Assessments

River of Words 1998 Grand Prize Winner (Art, Grades K-2)
Alex Schneble, *The Night*, Grade 2, WA

John H. McShane, Yellowstone River, Yellowstone National Park (Hayden Valley)

Monitoring and Assessment

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. One of the goals of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." Monitoring activities are aimed at measuring progress toward achieving this goal.

States and other jurisdictions use monitoring information to assess the quality of water resources. These assessments characterize waters that support water quality standards, identify impaired waters, and describe potential causes and sources of impaired waters.

In 1997, EPA and the states set a goal to characterize all surface and ground waters in the United States. They developed a strategy to achieve comprehensive assessments within 5 years. This strategy embraces a variety of monitoring approaches to reflect the diversity among state monitoring programs. Most states focused on rivers and streams initially through a rotating basin approach. Many are expanding their efforts to include other waterbody types.

Monitoring our nation's waters is a big job. There are over 3.6 million miles of rivers and streams; 41.4 million acres of lakes, reservoirs, and ponds; 90,500 square miles of estuarine waters; 67,000 miles of coastal shoreline; and 5,500 miles of Great Lakes shoreline. To reach their goal of comprehensive assessments, states are looking beyond their own monitoring programs to identify opportunities to partner with other organizations collecting water quality data.

This chapter describes monitoring activities of local, state, federal, and volunteer organizations and efforts to share data in order to expand our knowledge of water quality in the United States. It also explains the process by which states use monitoring results to assess the quality of water resources.

Water Quality Monitoring – Who Collects the Data

Hundreds of organizations across the country conduct some type of water quality monitoring. States use much of these data, although not all of it, when reporting on water quality under Section 305(b) of the Clean Water Act. This section of the Act asks states to report on whether waters in the state are impaired or are supporting water quality standards. This includes the designated uses assigned to each waterbody and

Monitoring data are needed to

- Identify healthy and threatened waters that require protection
- Locate impaired waters for restoration
- Inform the public of use restrictions and cautions

One of the goals of the Clean Water Act is "to restore and maintain the chemical, physical, and biological integrity of the nation's waters." Monitoring activities are aimed at measuring progress toward achieving this goal.

the narrative and numeric water quality criteria adopted to protect the designated uses. States need specific monitoring data that they can use to evaluate whether the criteria are met and the uses supported.

Organizations conducting water resource monitoring include government agencies at all levels—federal, state, interstate, local, and tribal. They also include research organizations such as schools, universities, and foundations, as well as industries and volunteer organizations. Because there is so much data being collected by so many organizations, states face an enormous task of trying to assemble relevant data. Many states form monitoring councils to help coordinate monitoring efforts across organizations.

Monitoring Councils

Several states are forming monitoring councils to better utilize resources and maximize the quality and quantity of water resource monitoring data. A monitoring council brings together a network of stakeholders conducting monitoring for the purpose of collaborating, communicating, and exchanging information. A monitoring council provides a forum identifying environmental measures and the sampling and analytical methods most appropriate for answering local questions about local waters. Councils provide an opportunity to enhance mechanisms for data sharing and to test state-of-the-art tools such as geographic information system (GIS)-based mapping techniques. Many states are using monitoring councils to develop a Comprehensive State Monitoring Strategy.

The National Water Quality Monitoring Council was formed in October 1997 following the recommendations of the Intergovernmental Task Force on Monitoring Water Quality. Members include industry, academia, municipalities, agriculture, and volunteer monitoring groups. Current priorities of the Council include establishing the basis for rational monitoring programs, identifying comparable monitoring methods, expanding the use of comparable methods through multi-institutional collaborations, and improving access to monitoring data. For more information, visit the Council on the Internet at *http://water.usgs.gov/wicp/itfm.html*.

State and Tribal Agencies

Every state and territory collects data to characterize water quality. A growing number of tribes also monitor their water resources. States and tribes receive pollution control and environmental management grants from EPA that help them establish and maintain monitoring programs. These programs monitor a variety of water resource conditions including physical and chemical parameters, biological indicators, and habitat.

Often with limited resources, state and tribal monitoring programs support a number of objectives. In addition to assessment of whether waters are safe for drinking, swimming, fishing, and other beneficial uses, state and tribal monitoring is an integral part of

water management and regulatory programs.

States and tribes use monitoring data to review and revise existing water quality standards and to develop new standards. Many states are monitoring biological conditions in pristine waters to help develop standards that protect biological integrity. Recent efforts by a number of states have been aimed at developing standards for estuaries, beaches, and wetlands.

Monitoring data on biological integrity, physical conditions, and chemical concentrations are used to identify threatened and impaired waters for 303(d) lists. States use chemical concentrations and waterbody flow data to develop pollutant-specific total maximum daily loads. These are designed to achieve water quality standards in impaired waters.

To reduce current loads to the level specified in the TMDL, states use monitoring data to allocate the load reduction goals, called waste-load allocations for point source discharges and load allocations for nonpoint sources. Then states and tribes use monitoring data to determine the effectiveness of the source controls and to measure progress toward achieving the water quality standards.

States and tribes also conduct monitoring in response to citizen complaints or catastrophic events such as fish kills, chemical spills, and red tides.

Local Governments

Across the country, a number of local government agencies, such as city and county environmental offices, conduct water quality monitoring. Local governments that operate water and wastewater treatment plants monitor water quality. Drinking water facilities monitor both raw or intake water and the finished water that is distributed to customers. Wastewater treatment plants (called publicly owned treatment works) monitor the quality of their wastewater discharge and sometimes the quality of water entering the treatment works. Larger municipalities also monitor stormwater discharges, and older municipalities with combined sanitary and stormwater sewers also monitor overflow discharges.

Volunteer Monitoring

Volunteer monitors—private citizens who volunteer to regularly collect and analyze water samples, conduct visual assessments of physical conditions, and measure the biological health of waters—are a rapidly growing contingent providing increasingly important environmental information. Volunteers are analyzing water samples for dissolved oxygen, nutrients, pH, temperature, and a host of other water constituents; evaluating the health of stream habitats and aquatic biological communities; inventorying stream-side conditions and land uses that may affect water quality; cataloging and collecting beach debris; and restoring degraded habitats. Volunteer data are used to delineate and characterize watersheds, screen for water quality problems, and measure baseline conditions and trends, among other things.

For more information on volunteer monitoring, including a directory of organizations, visit the Internet site *http://www.epa.gov/owow/monitoring*.

Research Organizations and Other Private Entities

Private groups such as universities, watershed associations, environmental groups, and industries also conduct water quality monitoring. They may collect water quality data for their own purposes or to share with government decision-makers. Industrial and municipal dischargers may also conduct monitoring as part of their discharge permits.

This wealth of information from individual agencies cannot be easily aggregated to provide an overview of national water quality conditions because of inconsistencies in monitoring purpose and design as well as data collection methods and assessment procedures. In addition, data are often stored without accompanying descriptors, so other data users cannot determine whether the data are useful for their own purposes.

Federal Participants

A study undertaken by the Intergovernmental Task Force on Monitoring Water Quality found that 18 federal agencies conduct approximately 141 separate monitoring programs across the country. Most water quality monitoring supports specific programs or activities. The following five conduct either regional or national programs for water quality monitoring.

U.S. Environmental Protection Agency

■ **Environmental Monitoring and Assessment Program (EMAP)** – EMAP is a research program designed to develop the tools necessary to monitor and assess the status and trends of national ecological resources. EMAP's goal is to develop the scientific understanding for translating environmental monitoring data from multiple spatial and temporal scales into assessments of ecological condition and forecasts of the future risks to the sustainability of our natural resources.

EMAP is embarking on a 5-year project in the western United States known as the EMAP Western Pilot Study. Its primary goals are to assess the condition of the ecological resources of the West and to advance the science of ecosystem health monitoring. The study will generate state and regional scale assessments of the condition of ecological resources in the western United States through monitoring of coastal waters and rivers and streams. Using monitoring results and remote sensing, the study will identify stressors associated with the degradation of these resources.

The Western Pilot Study will assess environmental conditions in Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, North Dakota, Oregon, South Dakota, Utah, Washington, and Wyoming. It is a partnership between EPA's Office of Research and Development; EPA's Office of Water; EPA Regions 8, 9, and 10; the states and tribes in those regions; and additional federal partners such as the U.S. Geological Survey and the National Oceanic

and Atmospheric Administration (NOAA). Responsibilities for monitoring and assessment will be shared by these groups. All monitoring data will be housed in STORET (see the highlight on STORET and other information management tools on page 42).

■ **National Study of Chemical Residues in Fish** – In 1998, EPA and NOAA initiated a study to estimate the national distribution of the mean levels of selected persistent bioaccumulative toxic chemical residues in fish and shellfish tissue in U.S. waters. Both the shellfish and fish studies will continue through 2002 and are being coordinated with state and tribal efforts as part of President Clinton's Clean Water Action Plan. The shellfish survey is based on data obtained by NOAA's ongoing Mussel Watch Project. The focus of the survey is on mercury concentrations in bivalve mollusks.

The National Fish Survey is using a probability-based monitoring design to sample fish tissue in lakes and reservoirs. For these waterbodies, the survey will identify the chemicals found in the fish and characterize the levels of contamination in agricultural and nonagricultural areas of the United States.

■ **Nonpoint Source National Monitoring Program** – EPA developed the Section 319 National Monitoring Program to improve our understanding of nonpoint source (NPS) pollution and to rigorously evaluate the effectiveness of NPS pollution control activities. Under this program, EPA's Regional Offices nominate projects by forwarding state proposals to EPA Headquarters for review and concurrence. Projects are selected on a competitive basis from within each of the EPA Regions. EPA works with project sponsors to develop approvable 6- to 10-year projects. The project sponsors then work through the state/EPA Section 319 process to obtain approval and funding. As of September 1997, 20 projects had been approved.

U.S. Geological Survey

■ The National Water Quality Assessment (NAWQA) Program is designed to describe the status and trends in the quality of our nation's water resources and to provide a sound understanding of the natural and human factors that affect the quality of these resources. Investigations are being conducted in 59 areas called "study units." These investigations throughout the nation will provide a framework for national and regional water quality assessment. Regional and national synthesis of information from study units will consist of comparative studies of specific water quality issues using nationally consistent information.

■ Since 1995, the National Stream Quality Accounting Network (NASQAN) has focused on monitoring water quality in four of the nation's largest river systems—the Mississippi (including the Missouri and Ohio), the Columbia, the Colorado, and the Rio Grande. NASQAN operates a network of 40 stations where the concentration of a broad range of chemicals—including pesticides and trace elements—and stream discharge are measured. Prior to 1995, NASQAN monitored water quality at as many as 500 stations nationwide.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Region 7's Monitoring Strategy

In an effort to more comprehensively and confidently characterize the region's water resources, EPA Region 7 and the states in that Region (Iowa, Kansas, Missouri, and Nebraska) have embarked on a new joint monitoring strategy. The strategy seeks to create state monitoring partnerships. These monitoring partnerships are established to capitalize on scarce monitoring resources and to coordinate monitoring efforts among all the partners.

The New Monitoring Paradigm

The goals of Region 7's new monitoring strategy include increasing the percentage of waters assessed in the region, using indicators of biological integrity to describe aquatic communities, obtaining statistically comprehensive coverage of all waterbody types, and improving confidence in overall monitoring results. Steps EPA Region 7 has taken to date include

- **Forming an EPA water monitoring team** – Region 7 provided the internal organization (program managers, state coordinators, and technical monitoring experts) to help define the problem, develop a vision of how to solve the problem, and derive a process to achieve the solution.

- **Working to build partnerships** – Region 7 and the states worked hard to establish monitoring partnerships within each state. The Region provides support to the partnerships through sharing of technical expertise, providing analytical services, and through direct funding of monitoring programs such as R-EMAP.

- **Creating a monitoring and assessment framework** – As shown in the figure, the State/Regional Assessment Framework draws on information from a number of different sources. The goal of the framework is to create a powerful, scientifically defensible assessment of a state's water resources.

- **Using R-EMAP to help build the framework** – R-EMAP is a partnership among states, EPA's Environmental Monitoring and Assessment Program (EMAP), EPA's Regional offices, and other federal agencies. R-EMAP produces ecological assessments at regional, state, and local scales.

- **Conducting workshops** – Region 7 sponsors workshops for states on topics varying from monitoring design to data analysis techniques to developing biocriteria and even biological taxonomy.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

These efforts all focus on improving long-term baseline monitoring and building the working relationships needed to do so.

For More Information

Lyle Cowles, EPA Region 7
(913) 551-5042
e-mail: cowles.lyle@epa.gov

Region 7 State/Regional Assessment Framework

Goal: To create a powerful, scientifically valid assessment of each state's water quality and riparian resources that can also be aggregated to assess all of Region 7.

State/EPA Field Empirical Data

- Water Quality
- Biological Integrity
- Habitat Quality
- Fish Tissue Quality
- Sediment Quality

NRI Data

- Land Use/Cover; Soil Information
- Irrigation Practices
- Pesticide Application Rates
- Conservation Practices (inc. CRP)
- Ground Water Vulnerability

NPDES & 319 Data (Point & Nonpoint)

- Discharge Permits
- Nonpoint Source Control Practices

Nebraska 305(b) | Iowa 305(b)

Water Quality Assessment
(with Environmental Indicators)

305(b) Kansas | 305(b) Missouri

USGS/NAWQA and Other Data

- Tribes
- Great Plains Program
- U.S. Fish and Wildlife Service
- Universities

Remote Sensing Data

- Land Use/Land Cover
- Greenness
- Riparian Corridor Quality
- Habitat Quality

Partners are organized by common monitoring objectives and data are collected using a scientifically defensible monitoring network design.

■ The USGS is the lead agency in monitoring atmospheric deposition in the United States. The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) is designed to determine variations in atmospheric deposition that occur on a weekly basis and to collect wet and dry deposition products for analysis of elements and compounds that can contribute to the chemical composition of surface waters.

U.S. Fish and Wildlife Service

■ The National Wetlands Inventory (NWI) was established to generate information about the characteristics, extent, and status of the nation's wetlands and deepwater habitats. The NWI has mapped 89% of the lower 48 states and 31% of Alaska. About 39% of the lower 48 states and 11% of Alaska are digitized. Congressional mandates require the NWI to produce status and trends reports to Congress at 10-year intervals. In 1982, the NWI produced the first comprehensive, statistically valid estimate of the status of the nation's wetlands and wetland losses and in 1990 produced the first update. Future national updates are scheduled for 2000, 2010, and 2020.

National Oceanic and Atmospheric Administration

■ NOAA monitors the nation's coastal and estuarine environments to assess their condition and whether their condition is being affected by human activities. Traditionally, monitoring involved efforts to inventory the characteristics of coastal and estuarine areas, their resources, and the human pressures that threaten them. More recently, the role of monitoring has been expanded to include an examination of the complex cause-and-effect relationships that have developed through human-induced pressures on coastal areas, such as the effects of metals, pesticides, and nutrients on fish abundance, reproductive success, and ability to feed.

Tennessee Valley Authority (TVA)

■ Water quality and aquatic life monitoring is conducted by TVA in the Tennessee River system to identify pollution problems in specific watersheds. TVA's program includes measurement of physical, chemical, and biological parameters at strategic locations. In 1994, TVA launched the Clean Water Initiative to make the Tennessee River system the cleanest and most productive commercial river system in the United States. TVA's approach is receiving widespread acclaim and helping shape national water policy.

Type of Data Collected

State water quality assessments are normally based on five broad types of monitoring data, in keeping with the goals of the CWA: biological integrity, chemical, physical, habitat, and toxicity. Each type of data provides useful information about the quality of water resources. Together these data help managers identify and address water quality problems.

Biological Integrity Data

Biological integrity data represent an objective measurement of aquatic biological communities, including aquatic insects, fish, or algae. These data are used to evaluate the condition of an aquatic ecosystem with respect to the presence of human perturbation.

Most states use biological integrity data to interpret narrative criteria or qualitative descriptions in their water quality standards of aquatic life use support goals. A few states have adopted numeric biological criteria into their water quality standards.

Over the past few years, EPA has distributed guidance on developing numeric biological criteria for rivers and streams and, in 1999, for lakes. This guidance supplements previous guidance on conducting biological assessments. It describes the process of combining individual measures or metrics of biological health into a single value or index. The metrics fall within four categories of characteristics of biological health:

- Species composition
- Species richness
- Community structure and function
- Individual organism health.

Eight to twelve of the metrics are selected for inclusion in the index. They are selected based on their ability to predict associations between environmental quality and biological integrity.

Numeric biological criteria are developed using least impaired or pristine waters as the reference condition. The metrics are measured and the index calculated for the reference condition. The resulting numeric biological criteria define the threshold of biological integrity that is desired for all waters in the same designated use category. Numeric biological criteria are adopted as part of the state's water quality standards.

When a state with numeric biological criteria conducts a biological assessment of a waterbody, it collects data on each of the metrics, calculates the index score, and compares the score to the criterion. The index score provides an overall measure of biological integrity. States also examine the individual metrics because each one provides information on biological health and can be an early sign of change.

Chemical Data

All state water quality standards include numeric criteria for chemical pollutants. These pollutants include metals such as lead and mercury, organic chemicals such as pesticides and PCBs, nutrients such as nitrogen and phosphorous, and bacteria such as *Escherichia coli*. Numeric criteria exist for over 150 pollutants.

The criteria establish thresholds for pollutant concentrations in ambient waters and protect specific uses. For example, there are criteria that protect aquatic organisms from acute and chronic effects of exposure to specific chemicals. Another set of criteria establish thresholds for human health. These criteria protect humans from exposure

Biological integrity is the condition of a waterbody displayed as "a balanced, integrated, adaptive community of organisms having a species composition, diversity and functional organization comparable to that of the natural habitat of the region."

Karr, J.R., and D. R. Dudley. 1981. Ecological perspective on water quality goals. *Environ. Manage.* 5:55-68.

through drinking, swimming, and consuming fish and shellfish.

States compare ambient monitoring data to chemical criteria when assessing whether water quality supports water quality standards. Monitoring for specific chemicals in waterbodies helps states identify the specific pollutants causing impairment. It also helps states trace the source of impairment.

Physical Attribute Data

Physical data include characteristics such as temperature, flow, dissolved oxygen, suspended solids, turbidity, conductivity, and pH. Most states have adopted numeric criteria in their water quality standards defining acceptable levels or ranges for specific physical attributes.

Physical attributes are useful screening indicators of potential problems. Many of them work together with chemical pollutants to mediate or exaggerate the toxic effects of chemicals. For example, metals become more bioavailable in low pH or acidic waters. This makes metals more likely to harm fish.

Habitat Data

The purpose of habitat monitoring is to provide information about the ability of a waterbody to support various forms of aquatic life. Habitat assessment typically supplements other types of water quality monitoring. The quality and quantity of available habitat affect the structure and function of biological communities.

Habitat assessments generally include a description of the site and surrounding land use, description of the waterbody origin and type, summary of the riparian vegetation along the shoreline and the aquatic vegetation, and measurement of parameters such as width, depth, flow, and substrate. The combination of habitat assessments, biological assessments, and chemical and physical data provides insight into the presence of chemical and nonchemical stressors to the aquatic ecosystem.

Toxicity Data

Toxicity testing is used to determine whether aquatic life beneficial use is being attained. Toxicity data are generated by exposing selected organisms such as fathead minnows, daphnia, or algae to known dilutions of wastewater discharge or ambient water samples. These tests are called bioassays. They are conducted to document the presence of a toxicity effect at either an acute or chronic concentration.

Acute effects will lead to excessive mortality rates over the span of a few hours to a few days. Such severe levels of toxicity can often be easily compared to chemical analyses for metals or organic toxins to confirm which pollutants are of concern.

Chronic toxicity involves exposing the most sensitive life stages of an organism. These tests assess effects of longer-term exposure. Chronic bioassay tests are especially helpful to document cases where one or more pollutants are present at fairly low concentrations.

When performed using a sample from a discharge, bioassays are called Whole Effluent Toxicity (WET) tests and are often included as a routine monitoring requirement in

many industrial or municipal point source discharges. Bioassays can be useful for ambient waters where nonpoint source factors are suspected. Bioassays geared to ambient stream conditions can help to determine whether poor biological integrity is related to toxins, poor habitat, or a combination of the two.

Data and Information Management

A number of data and information management systems handle the enormous amount of water quality data generated by EPA and the states. Many of the data systems can be accessed via the Internet. Several data management systems are described below.

■ **STORET** – The STORET (STOrage and RETrieval) database is a repository for water quality and biological monitoring data and is used by state environmental agencies, EPA staff, federal agencies, and many others. The original STORET began operating in the 1960s. A modernized, more user-friendly version replaced it in 1998. This modern system runs on personal computers and includes a feature for data sharing. EPA encourages users to transmit their data over the Internet to the STORET warehouse. This key feature helps environmental managers gather and analyze all relevant and available data when evaluating the condition of water resources. Data can be downloaded from the Internet at *http://www.epa.gov/storet*. For more information on STORET, see the highlight on New Information Management Tools (page 42).

■ **Ecological Data Application System** – The Ecological Data Application System (EDAS) is designed to facilitate data analysis, particularly the calculation of biological metrics and indices. It is intended to take biological data from STORET and help states perform assessments. EDAS is a custom-designed relational database application for use with Microsoft Access 97.

■ **Assessment Database** – The Assessment Database (ADB) is a data management tool being used by states to record surface water quality assessment results and generate reports for use in preparing 305(b) reports. The ADB is a complete replacement for the EPA Waterbody System (WBS). The ADB was designed based on requests and feedback from WBS users. Like its predecessor, the ADB contains information that program managers can access quickly on the water quality status of a particular waterbody. Data elements include waterbody identification, location, designated use support status, causes of impairment, and sources of impairment. For more information on the Assessment Database, see the highlight on New Information Management Tools (page 42). In the future the ADB will be linked to STORET.

■ **Permit Compliance System** – Information on water discharge permits is contained in the Permit Compliance System (PCS), a national computerized management information system. This system automates the entry, update, and retrieval of National Pollutant Discharge Elimination System (NPDES) data and tracks permit

issuance, permit limits and monitoring data, and other data pertaining to facilities regulated under NPDES. PCS records water discharge permit data on more than 75,000 facilities nationwide. For more information, visit the PCS web site at *http://www.epa.gov/envirofw/html/pcs/pcs_overview.html*.

■ **Safe Drinking Water Information System** – The Safe Drinking Water Information System (SDWIS) is used by EPA to store basic information about the nation's drinking water supply. SDWIS/FED is the national version of the database, used by EPA to track violations of drinking water requirements. SDWIS/STATE is an optional version states can use to store three major categories of information: inventory, sampling, and monitoring. Inventory data include information on individual water systems such as the system location, size, and population served. Sampling data include laboratory results for chemical, microbiological, and radiological contaminants regulated by EPA and the state. Monitoring information contains the schedule for sampling required under each EPA rule. Additional information on SDWIS/FED is available on the Internet at *http://www.epa.gov/safewater/sdwisfed/sdwis.htm*.

■ **National Listing of Fish and Wildlife Advisories** – The Office of Science and Technology developed a database for states to report fish advisory information and fish tissue contaminant data that support advisory determinations. The National Listing of Fish and Wildlife Advisories (NLFWA) contains fish and wildlife advisory information reported nationwide by states, including the waterbody affected, type of species, type of pollutants, type of advisory, geographic extent of the advisory, and name of a state contact person. In addition, the database contains information on contaminants in fish tissue. The database is available on the Internet at *http://www.epa.gov/ost/fish*.

■ **The Toxics Release Inventory** – The Toxics Release Inventory (TRI) stores data about toxic chemicals used, manufactured, treated, transported, or released into the environment. The Emergency Planning and Community Right-To-Know Act and the Pollution Prevention Act established reporting requirements for manufacturing and other facilities that meet certain conditions about the volume of toxic materials they use or manufacture. Additional information on the TRI is available on the Internet at *http:/www.epa.gov/opptintr/tri/*.

Using Data To Describe Water Quality

Currently, to assess the quality of their waters, states and tribes compare monitoring results to water quality standards. As described in Chapter 1, water quality standards consist of designated uses and specific criteria designed to protect each use.

Data collected by state, local, tribal, and federal agencies and public, academic, and private partners are needed to build the assessments used to make better water resource management decisions.

Without data, we simply cannot know where water quality problems exist, where we need to focus our efforts, or where progress has been made.

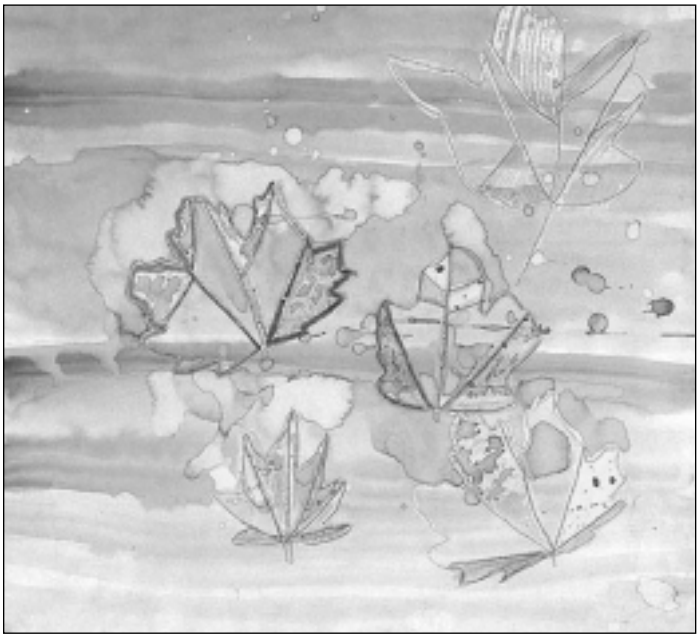
Assessments performed as part of the 305(b) process provide important information for making decisions about water resources. For example, assessments can be used to identify threatened and impaired waters for 303(d) listings and development of total maximum daily loads, establish point source discharge limits, determine restoration priorities for Unified Watershed Assessments, develop nonpoint source management measures, and protect drinking water sources.

EPA works closely with its local, state, and federal partners to improve the quality and increase the amount of the data used to support water quality assessments. EPA recognizes the most effective way to achieve these goals is to look for opportunities to integrate the monitoring efforts of its diverse partners. One such opportunity promoted by EPA is an integrated assessment and reporting process.

EPA envisions that the same monitoring data and decision criteria used to assess water quality for state 305(b) water quality inventories may also support the identification of impaired waters for state 303(d) lists. This information, together with geographic mapping tools, land use information, and data on terrestrial ecosystem quality, forms the basis for states identifying priority watersheds and developing watershed restoration strategies (which are part of the Unified Watershed Assessments under the Clean Water Action Plan).

As these data layers become available, they will be put on the Internet as part of the Index of Watershed Indicators. The IWI is continuing to evolve to include more detailed georeferenced data. The data used to generate the maps will be accessible through the Internet from a number of sources (e.g., STORET). These data display tools will allow the public greater access to water information locally, and they will provide better, more useful access for Congress to evaluate water information on local, regional, and national scales.

Ultimately, we will be able to observe trends in water quality both nationally and at the watershed level. This will provide Congress and citizens with the information needed to assess EPA's progress toward its goals under the Government Performance for Results Act.



River of Words 1999 Finalist, Amanda Morris, *Untitled*, Age 7, VA

HIGHLIGHT HIGHLIGHT HIGHLIGHT

New Information Management Tools

EPA is offering several new information management tools to help states take advantage of new data technologies. These tools help states obtain and integrate data for analysis of water quality trends. The Assessment Database, STORET, Index of Watershed Indicators, Reach Indexing Tool, and the Watershed Information Network are all examples of new tools made available to states by EPA to help them obtain and manage data.

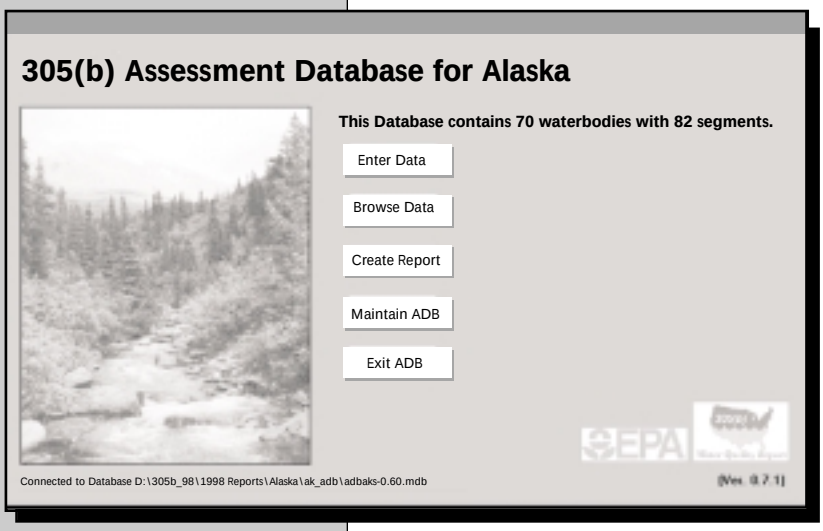
The Assessment Database

The Assessment Database (ADB) is a relational database application for tracking water quality assessment data. All states assess their individual waterbodies for degree of designated use support (e.g., "fully supporting aquatic life; not supporting primary contact recreation"). If a waterbody's uses are impaired, the stressors and sources of impairment are also determined (e.g., "causes/stressors are nutrients and sediment; sources are urban runoff and row crop agriculture"). States need to track this information and many other types of assessment data for thousands of waterbodies and integrate it into meaningful reports. The ADB is designed to make this process accurate, straightforward, and user-friendly for participating states, territories, tribes, and basin commissions.

The ADB supports three principal functions:

- Improve the quality and consistency of water quality reporting
- Reduce the burden of preparing reports under Sections 305(b), 303(d), 314, and 319 of the Clean Water Act
- Improve water quality data analysis.

The ADB provides user-friendly data entry forms and automates the production of reports that states



HIGHLIGHT HIGHLIGHT HIGHLIGHT

submit to EPA through the 305(b) process.

For More Information

Tod Dabolt, EPA
(202) 260-3697
e-mail: Dabolt.Thomas@epamail.epa.gov

STORET (data STOrage and RETrieval system)

EPA maintains two data management systems containing water quality information for the nation's waters: the Legacy Data Center (LDC) and the data STOrage and RETrieval system (STORET). The LDC contains historical water quality data dating back to the early part of the 20th century and collected up to the end of 1998. STORET contains data collected beginning in 1999 and older data that have been properly documented and migrated from the LDC.

Both systems contain raw biological, chemical, and physical data on surface and ground water collected by federal, state, and local agencies; tribes; volunteer groups; academics; and others. All 50 states, the District of Columbia, territories, and jurisdictions of the United States, along with portions of Canada and Mexico, are represented in these systems.

Each sampling result in the LDC and in STORET is accompanied by information on where the sample was taken (latitude, longitude, state, county, Hydrologic Unit Code, and a brief site identification); when the sample was gathered; the medium sampled (e.g., water, sediment, fish tissue); and the name of the organization that sponsored the monitoring. In addition, STORET contains information on why the data were gathered; sampling and analytical methods used; the laboratory used to analyze the samples; the quality control checks used when sampling, handling the samples, and analyzing the data; and the personnel responsible for the data.

For More Information

http://www.epa.gov/owow/STORET/

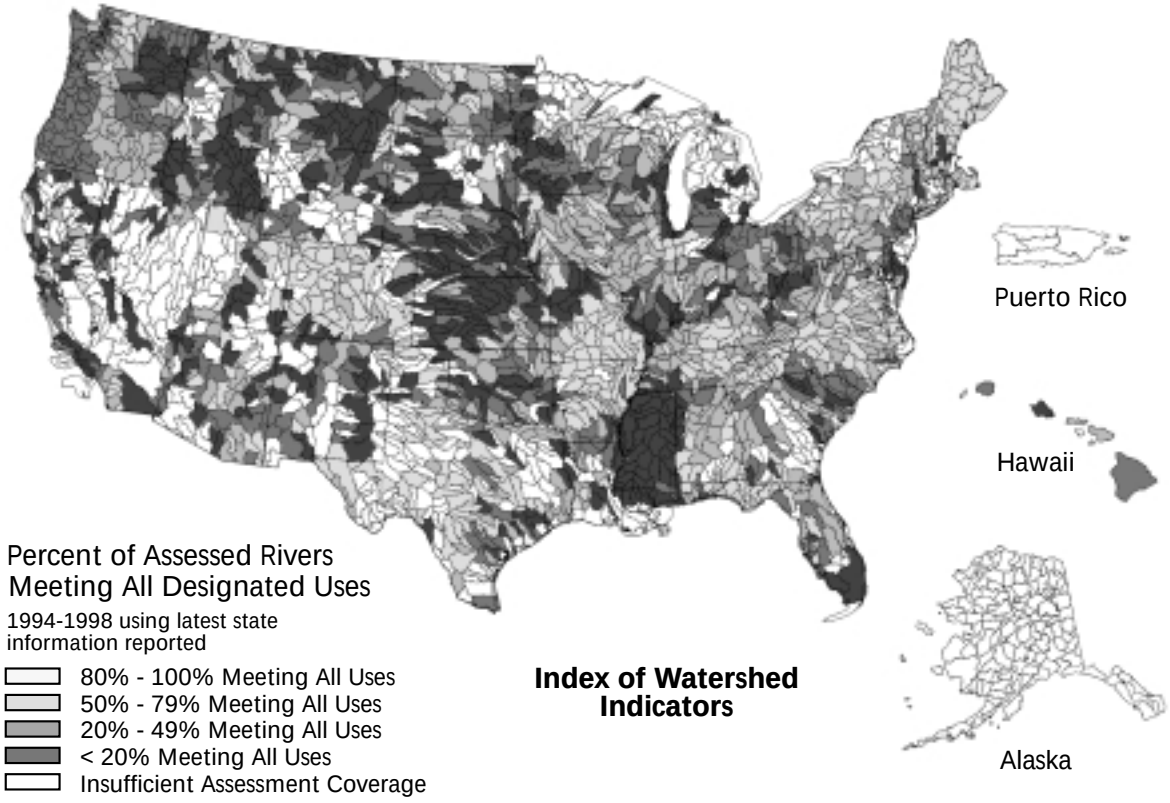
Index of Watershed Indicators

The EPA Office of Water and its many public and private partners developed the Index of Watershed Indicators (IWI) to present the health of the nation's aquatic resources. IWI is designed to collect,

HIGHLIGHT HIGHLIGHT HIGHLIGHT

organize and evaluate multiple sources of environmental information on a watershed basis. The individual indicators presented in the IWI are developed to provide information on the health of watersheds in an easy to understand format. The goals of IWI are to

- Depict the current condition of the watershed and indicate its vulnerability to future degradation
- Educate and empower citizens through easy access to both summary information and the underlying details
- Provide a set of tools for water resource managers at all watershed scales
- Help measure progress toward watershed goals.



Index of Watershed Indicators

HIGHLIGHT HIGHLIGHT HIGHLIGHT

IWI contains tools and resources that allow users to find and manipulate data on a watershed. For example, Locate Your Watershed allows users to find their watershed using the county name or place name or by picking it off a map. A variety of options provide ways to find drinking water sources for a particular watershed or county. Enviromapper for Watersheds provides interactive geographic information system (GIS) functionality using environmental spatial data. The Map Library serves as an atlas of watershed data layers. It provides links to on-line collections of maps for viewing.

Some of the data layers include

- 305(b) water quality assessment results (see figure)
- 303(d) impaired waters
- Unified Watershed Assessment rankings
- Waters supporting drinking water use
- Contaminated sediments
- Ambient water quality data
- Urban runoff potential
- Agricultural runoff potential.

For More Information

http://www.epa.gov/surf/iwi

Reach Indexing Tool

The Reach Indexing Tool (RIT) is a software tool designed to assist users in the process of linking water quality information to the EPA Reach File 3 (RF3). RF3 is a hydrographic database that displays waters at a scale of 1 to 100,000. During the reach indexing process, waterbody identifiers from a state's database become linked or georeferenced to the appropriate RF3 stream segments. This allows the information contained in the database to be mapped.

In an ongoing effort to supply readily available information to the public, EPA is mapping information to improve its usefulness. For example, states recently submitted revised 303(d) lists of impaired waters. EPA worked with the states to generate maps showing the location of these waters. A national map of the 303(d) listed waters is available as an IWI data layer. Individual state maps can also be accessed on the IWI web page using Locate Your Watershed at *http://www.epa.gov/surf/locate*.

For More Information

Tod Dabolt, EPA
(202) 260-3697
e-mail: Dabolt.Thomas
@epamail.epa.gov

HIGHLIGHT HIGHLIGHT HIGHLIGHT

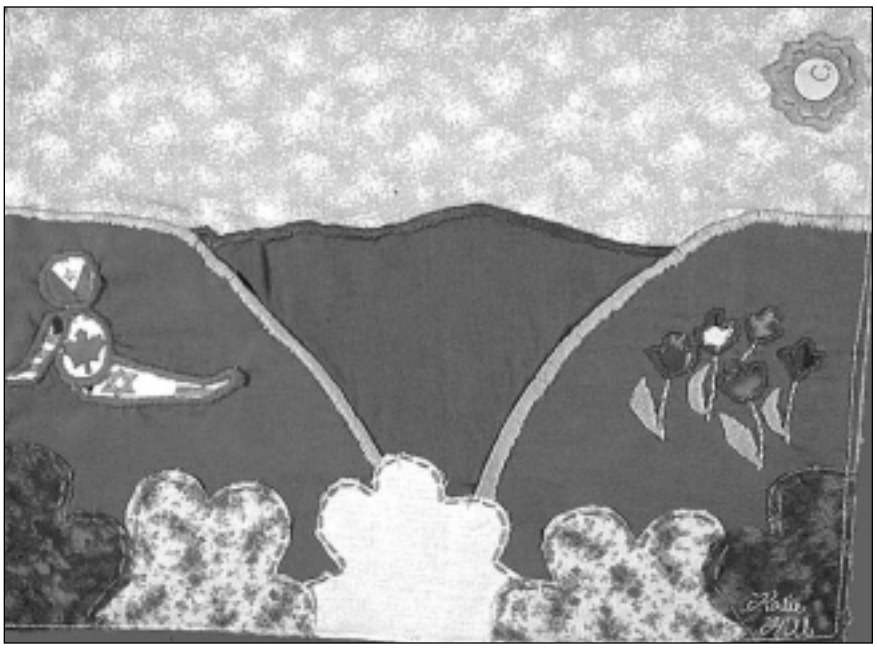
Watershed Information Network

The Internet-based Watershed Information Network (WIN) is a roadmap of consolidated watershed information and services to help communities protect and restore water quality. A tremendous amount of water quality information is now easier to find and understand, and new information and features are continually being added to WIN.

WIN can help citizens answer questions such as what is my watershed address, what is the health of my watershed, what data maps and assistance are available for my watershed, and how can I get involved in protecting and restoring water quality. Decision makers can use it in watershed protection and restoration activities.

For More Information

http://www.epa.gov/win/



River of Words 1999 Finalist, Katie Hill, *A Watershed for Everyone*, Age 17, NC

HIGHLIGHT HIGHLIGHT HIGHLIGHT

Nutrients and Pesticides: NAWQA Program Highlights National Research

Background

In 1991, Congress authorized the National Water Quality Assessment (NAWQA) Program. The purpose of the program is to understand, at a national scale, spatial water quality patterns, water quality trends over time, and how human activities and natural factors affect water quality. The U.S. Geological Survey (USGS) designed this program to focus on more than 50 river basin and aquifer systems across the United States as "study units" using a consistent, standardized, scientifically based approach. Research examines how water quality patterns are related to factors such as chemical use, land use, climate, geology, topography, and soils.

Study Design

One of the challenges and goals of the study was to identify where nutrients and pesticides commonly occur in rivers and ground water and why some land use and environmental settings are more vulnerable to contamination than others, particularly during certain times of the year. To do this, water quality was monitored seasonally as well as during high-flow events over several years at carefully chosen sites in agricultural, urban, and undeveloped (mostly forested) settings.

Selected Findings

■ **Relative levels of nutrients and pesticides contamination are closely linked to land use and to the amounts and types of chemicals used in each setting**. Some of the highest concentrations of nitrogen and herbicides were detected in samples collected from streams and shallow ground water in agricultural areas. Some of the highest concentrations of phosphorus and insecticides were detected in samples collected from urban streams (see Table 1).

■ **Streams and ground water in basins with significant agricultural or urban development, or with a mix of these land uses, almost always contain complex mixtures of nutrients and pesticides**. Concentrations of nitrogen and phosphorus commonly exceed levels that can contribute to excessive plant growth in streams. The most prevalent nitrate contamination was

Results compiled from the first 20 NAWQA study units are available in the report *The Quality of Our Nation's Waters: Nutrients and Pesticides*, USGS Circular 1225, or on the Internet at *http://water.usgs.gov/pubs/circ/circ1225/*.

HIGHLIGHT HIGHLIGHT HIGHLIGHT

detected in shallow ground water (less than 100 feet below land surface) beneath agricultural and urban areas. Human health risks increase in those aquifers located in geologic settings, such as in sand, gravel, or karst (weathered carbonate rock), that enable rapid movement of water.

At least one pesticide was found in more than 90% of water and fish samples collected from streams and in about half of samples from shallow wells sampled in agricultural and urban areas. Concentrations of individual pesticides in samples from wells and as annual averages in streams were almost always lower than current EPA drinking water standards and guidelines. However, aquatic life may be more at risk than human health in agricultural areas.

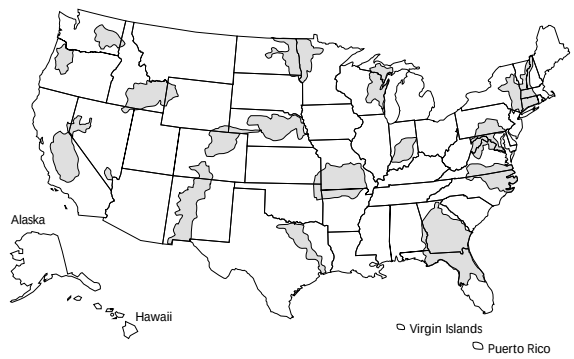


Figure 1. NAWQA Study Units

■ **Land and chemical use are important but not sole predictors of water quality**. Concentrations of nutrients and pesticides vary considerably from season to season, as well as among watersheds with differing vulnerability to contamination. The patterns reflect many factors, including soil type, slope, streamside vegetation, the frequency and magnitude of runoff from rainstorms or snowmelt, and irrigation and drainage practices. Concentrations of nutrients and pesticides are highest during rainstorms and snowmelt following chemical applications.

■ **Long-term trends are sometimes difficult to distinguish from short-term fluctuations, mainly because water quality is constantly changing from season to season and from year to year**. For many chemicals, it is too early to tell whether conditions are getting better or worse because historical data are insufficient or too inconsistent to measure trends. Despite these challenges, some trends are evident from monitoring of nutrients and pesticides. These trends show that changes in water quality over time frequently are controlled by factors similar to those that affect geographic variability, including natural features, chemical use, and management practices.

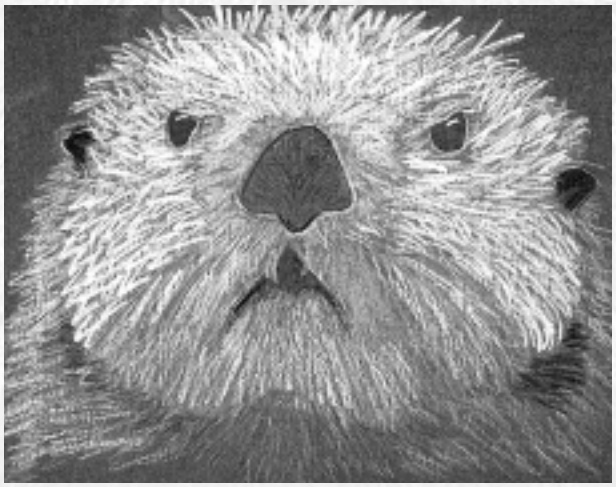
Table 1. Relative Level of Contamination

	Streams			Shallow Ground Water	
	Urban Areas	Agricultural Areas	Undeveloped Areas	Urban Areas	Agricultural Areas
Nitrogen	Medium	Medium-High	Low	Medium	High
Phosphorus	Medium-High	Medium-High	Low	Low	Low
Herbicides	Medium	Low-High	No Data	Medium	Medium-High
Currently Used Insecticides	Medium-High	Low-Medium	No Data	Low-Medium	Low-Medium
Historically Used Insecticides	Medium-High	Low-High	Low	Low-High	Low-High

Water Sheds Under Your Feet

The water under my feet moving fast to the street
flowing fast to the Anacostia, with all the trash,
sheds and puddles all in bubbles through the sewer
into the river, fast, fast, all the trash flowing right past
with all that I see and all that I saw I knew cleaning
the river would be a bore, we got together as a
team and started to clean, I looked around and
thought it was a dream I never thought the river would
get this clean, fast to the street water sheds under your feet

River of Words 1998 Anacostia Watershed Winner
Ann Shackelford, Grade 8



River of Words Finalist
Thomas Bradley, Age 13, *Beavis*, OK