U.S. Department of the Interior
U.S. Geological Survey

U.S. GEOLOGICAL SURVEY
National Water-Quality Assessment Program

INTRODUCTION

The Nation's water resources are the basis for life and our economic vitality. These resources support a complex web of human activities and fishery and wildlife needs that depend upon clean water. Demands for good quality water for drinking, recreation, farming, and industry are rising, and as a result, the American public is concerned about the condition and sustainability of our water resources. The American public is asking: Is it safe to swim in and drink water from our rivers or lakes? Can we eat the fish that come from them? Is our ground water polluted? Is water quality degrading with time, and if so, why? Has all the money we've spent to clean up our waters done any good? The U.S. Geological Survey's National Water-Quality Assessment (NAWQA) Program was designed to provide information that will help answer these questions.

Has all the money we've spent to clean up our waters done any good?

NAWQA is designed to assess historical, current, and future water-quality conditions in representative river basins and aquifers nationwide. One of the primary objectives of the program is to describe relations between natural factors, human activities, and water-quality conditions and to define those factors that most affect water quality in different parts of the Nation. The linkage of water quality to environmental processes is of fundamental importance to water-resource managers, planners, and policy makers. It provides a strong and unbiased basis for better decision-making by those responsible for making decisions that affect our water resources, including the United States Congress, Federal, State, and local agencies, environmental groups, and industry. Information from the NAWQA Program also will be useful for guiding research, monitoring, and regulatory activities in cost effective ways.

PROGRAM DESIGN

The NAWQA Program's unique design provides consistent and comparable information on water resources in 60 important river basins and aquifers across the Nation. Together, these areas account for 60 to 70 percent of the Nation's water use and population served by public water supplies and cover about one-half of the land area of the Nation. Investigations of these 60 areas, referred to as "study units," are the principal building blocks of the NAWQA Program.

The similar design of each investigation and use of standard methods make comparisons among the study units' results possible. Regional and national assessments can be made. These regional and national assessments, referred to as "National Synthesis," focus on priority national issues, including non-point source pollution, sedimentation, and acidification. Each issue is unique and manifests itself differently among the Nation's diverse geographic, geologic, hydrologic, and climatic settings. The challenge and goal for NAWQA is, therefore, to identify the common environmental characteristics associated with the occurrence of key water-quality constituents and to explain their differences throughout the Nation.

PROGRAM IMPLEMENTATION

In 1991, NAWQA began the transition from a pilot program to a full-scale program with the start of 20 study-unit investigations, along with synthesis activities on a national scale. In October, 1993, an additional 20 study-unit investigations started. When fully implemented in 1997, the program will include hydrologic investigations of 60 study areas that are distributed throughout the Nation.

To make the program cost effective and manageable, intensive assessment activities in each of the study units are being conducted on a rotational rather than a continuous basis, with one-third of the study units being studied intensively at any given time (Figure 1). For each study unit, 3- to 5-year periods of intensive data collection and analysis will be alternated with 5- to 6-year periods of less intensive study and monitoring. Locations of the 60 NAWQA study units and their proposed implementation dates are shown in figure 2.

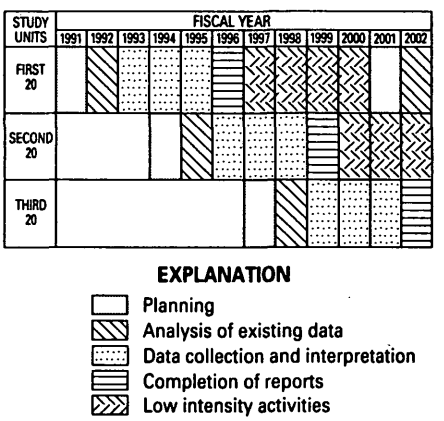

Figure 1. Timetable for the National Water-Quality Assessment Program Implementation.

Coinciding with the study-unit investigations are the national synthesis assessments. The large geographic extent and large variability in environmental factors throughout the Nation, and limited resources make it necessary to focus on a limited set of high priority water-quality issues. Generally, two to four national synthesis topics will be studied at a given time. Two issues of national priority—the occurrence of nutrients and pesticides in rivers and ground water— were selected as the first issues investigated by national synthesis. These topics were ranked among the highest in importance because of widespread environmental and public health concerns and because information necessary for a national assessment of these contaminants was incomplete.

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National Water-Quality Assessment Program • Highlights of Selected NAWQA Findings

DDT IN THE YAKIMA RIVER BASIN (52)

In the Yakima River Basin, the insecticide DDT, banned more than 20 years ago, was detected at elevated concentrations in water, stream sediment, and fish tissue. These findings suggest a potential health concern, especially to the local population of Native Americans who rely on fish as a major source of food, and pose a continued threat to fish-eating birds. The DDT contamination is related to the erosion of contaminated soils in irrigated areas.

RADON FOUND IN GROUND-WATER IN THE NEVADA BASIN AND RANGE (56)

Radon, a gas resulting from the natural decay of uranium, has been found in water from a number of wells used for domestic supply in the Carson and Truckee River Basins. Radon concentrations greater than 2,000 picocuries per liter (pCi/L) are common in samples from wells in the western portions of the basins near Lake Tahoe. The Nevada Division of Health recommends that water be treated when radon levels in drinking-water supplies exceed 300 pCi/L.

FEW PESTICIDES FOUND IN GROUND WATER IN THE UPPER RIO GRANDE VALLEY (46)

In an area of intense agriculture in the San Louis Valley, Colorado, the northern part of the Rio Grande Valley Study Unit, pesticides were detected in only 5 of the 35 wells installed in the shallow aquifer. The monitor wells are dispersed among 2,000 center-pivot irrigation systems covering about 270,000 acres. Major crops include alfalfa, potatoes, small grains, and vegetables. Samples from the wells were analyzed for 90 pesticides and their degradation products. A total of four pesticides (metolachlor, p,p'DDE, metri-buzin, and prometon) were detected in the upper 10 feet of the saturated zone, with a maximum concentration of 0.07 micrograms per liter.

PESTICIDE MANAGEMENT IN THE LOWER KANSAS RIVER BASIN (37)

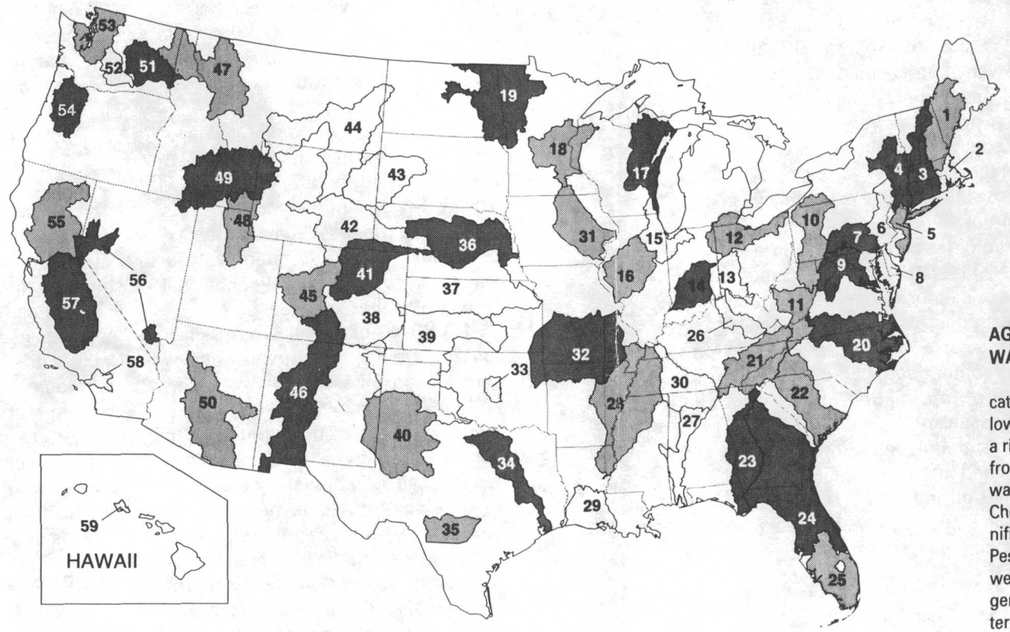
In the Lower Kansas River Basin, NAWQA findings on the occurrence and temporal distribution of atrazine (a herbicide widely used in the production of corn and soybeans) in water-supply reservoirs were used by the Kansas State Board of Agriculture as the basis for establishing a pesticide management area in northern Kansas. The management area is the first in the Nation that focuses on reducing the amount of atrazine in runoff to streams and reservoirs.

NITRATE CONCENTRATIONS DO NOT MEET STATE AND FEDERAL DRINKING WATER STANDARDS IN THREE AREAS OF UPPER SNAKE RIVER BASIN (49)

Water-quality data from the files of the USGS and the Environmental Protection Agency collected from 1980 to 1991 showed nitrate concentrations in samples of ground water at three locations failed to meet Federal and State drinking water standards and were greater than 10 milligrams per liter. These samples were from wells at the Idaho National Engineering Laboratory, the Fort Hall area north of Pocatello, Idaho, and the area surrounding Burley, Idaho. Nitrate concentrations are increasing through time in eight wells near Burley and northwest of Pocatello. Organic compounds were detected in 17 of the 211 wells sampled.

GROUND WATER CONTRIBUTES HIGH LEVELS OF DISSOLVED SOLIDS TO RED RIVER DURING PERIODS OF LOW FLOW (19)

Analyses of samples of ground water and samples from tributaries and along the main stem of the Red River of the North showed that during low stage and low flow conditions in March and December, ground water contributes a large percentage of the flow. The ground water contains significantly higher levels of dissolved solids than snowmelt and surface runoff. Flow from most tributaries contain higher levels of dissolved solids than the main stem. Reconnaissance sampling of fish tissue and stream sediment showed only trace levels of heavy metals and organic carbons.



NUTRIENT LEVELS REMAIN UNCHANGED IN TRINITY RIVER BASIN STREAMS AND GROUND WATER (34)

Water-quality trends were evaluated for about 4,800 samples from streams and 1,500 samples from wells. Concentrations of total nitrogen and phosphorus have not changed significantly from 1974 to 1991 at most sites, although there was a decrease in phosphorus concentrations near Dallas. Spatial variations in chemical concentrations in streams are related primarily to point sources and reservoirs. The largest nutrient concentrations occur downstream from Dallas, where streamflow is dominated by treated wastewater. The smallest concentrations occur just downstream from reservoirs, which act as sinks for nutrients. The largest concentrations of nitrate in ground water have been detected in samples from the Queen City and Nacatoch aquifers. Concentrations tend to decrease with depth.

LAND USE AND SOILS AFFECT NUTRIENT AND SEDIMENT LEVELS IN WESTERN LAKE MICHIGAN DRAINAGES (17)

Land use was the primary factor influencing the distribution of nutrient and sediment concentrations in streams. Concentrations were directly related to the input from atmospheric deposition and fertilizer and manure use. Concentrations in stream runoff were highest from agricultural areas and urban areas and were lowest in streams draining forested areas. The amount of clay in soils affects the occurrence of some constituents, particularly in agricultural areas and in ground water. Significantly higher concentrations of nitrates were found in water draining agricultural areas with sandy soils than from those with clayey soils. Trends in water-quality and sediment discharge from 1971 to 1990 were also identified.

HUDSON RIVER NAWQA TEAM WORKS WITH EDUCATION GROUPS TO EXTEND EARTH-SCIENCE CURRICULUM (4)

The Hudson River NAWQA Team is working with the River Watch Network, the Adirondack Park Interpretive Centers, and the Adirondack Teacher's Center to help local high-school teachers expand their earth-science curriculum. The program gives the schools the opportunity to measure chemical, physical, and biological characteristics of streams in their area and to interact with other schools and water-resource professionals in evaluating that data.

AGRICULTURAL CHEMICALS IN SHALLOW GROUND-WATER ON THE DELMARVA PENINSULA (8)

Water-quality studies in the Delmarva Peninsula indicated that concentrations of nitrates are elevated in shallow ground water beneath agricultural areas and may pose a risk to those residents who drink shallow ground water from these areas. The study also indicated that ground water with elevated concentrations of nitrate discharge to Chesapeake Bay and its tributaries, and is probably a significant source of nitrates to the ecosystem of the Bay. Pesticides, which are used primarily on corn and soybeans, were detected at very low levels. The concentrations are generally at levels that do not violate Federal drinking water standards.

POULTRY AND LIVESTOCK CONTRIBUTE MORE THAN HALF THE NUTRIENT LOADS IN THE APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN (23)

Nutrient loads to rivers were estimated using water-quality data from 1990. Load sources included poultry and livestock, fertilizers, atmospheric deposition, and municipal wastewater treatment plants. In 1990, more than half of the total nutrient loads, 120,000 tons of total nitrogen and 28,000 tons of phosphorus, came from poultry and manure.

EXPLANATION

- Studies started in fiscal year 1991
- Studies started in fiscal year 1994
- Studies proposed to begin in fiscal year 1997

NAWQA study unit name and map identification number

1. Northern New England Basins
2. Southeastern New England
3. Connecticut, Housatonic, and Thames River Basins
4. Hudson River Basin
5. Long Island-New Jersey coastal drainages
6. Delaware River Basin
7. Lower Susquehanna River Basin
8. Delmarva Peninsula
9. Potomac River Basin
10. Allegheny and Monongahela Basins
11. Kanawha-New River Basin
12. Lake Erie-Lake Saint Clair drainage
13. Great and Little Miami River Basins
14. White River Basin
15. Upper Illinois River Basin
16. Lower Illinois River Basin
17. Western Lake Michigan drainage
18. Upper Mississippi River Basin
19. Red River of the North
20. Albemarle-Pamlico drainage
21. Upper Tennessee River Basin
22. Santee Basin and Coastal drainage
23. Apalachicola-Chattahoochee-Flint River Basin
24. Georgia-Florida Coastal Plain
25. Southern Florida
26. Kentucky River Basin
27. Mobile River and tributaries
28. Mississippi Embayment
29. Chicot-Evangeline
30. Lower Tennessee River Basin
31. Eastern Iowa Basins
32. Ozark Plateaus
33. Central Oklahoma aquifer
34. Trinity River Basin
35. South Central Texas
36. Central Nebraska Basins
37. Kansas River Basin
38. Upper Arkansas River Basin
39. Central High Plains
40. Southern High Plains
41. South Platte River Basin
42. North Platte River Basin
43. Cheyenne and Belle Fourche Basins
44. Yellowstone Basin
45. Upper Colorado Basin
46. Rio Grande Valley
47. Northern Rockies Intermontane Basins
48. Great Salt Lake Basins
49. Upper Snake River Basin
50. Central Arizona Basins
51. Central Columbia Plateau
52. Yakima River Basin
53. Puget Sound Basin
54. Willamette Basin
55. Sacramento Basin
56. Nevada Basin and Range
57. San Joaquin-Tulare Basins
58. Santa Ana Basin
59. Oahu
60. Cook Inlet Basin

Figure 2. National Water-Quality Assessment Program study units, with highlights of selected preliminary findings.

The next topic for national synthesis is the occurrence and distribution of volatile organic compounds (VOCs.) Many VOCs are toxic and are a major focus of a number of Federal regulations related to water quality. Major work elements planned for the study of VOCs in 1994 and 1995 are to (1) identify regulated and non-regulated VOCs; (2) determine the amounts of VOCs released to water, land, and air, and (3) evaluate strategies to characterize the use and releases of VOCs to the environment, including ground water.

The first two years of both study-unit investigations and national synthesis studies involve compilation and analysis of existing information. In addition to USGS data, information and methods developed by other Federal agencies, as well as by State and local agencies, universities, and volunteer organizations are reviewed and integrated as appropriate. This preliminary information on water-quality conditions, trends, and functions forms the basis of a three-year period of intensive data collection and analysis to fill identified gaps in subsequent years.

Perennial data collection and sequential assessments in the study units and regional and national synthesis are key attributes of the program, not only to define changes and trends, but also to build an evolving understanding of water quality in each of the study units and across the Nation. This understanding will be achieved through careful analysis and interpretation of long-term data sets on the physical, chemical, and biological characteristics of the water resource. The data sets will be related to carefully compiled information on hydrology and geology and changes in land-use activities and management practices. The long-term commitment of the NAWQA Program to water-quality monitoring at local, regional, and national scales is designed to answer critical questions about the status and trends in the quality of our Nation's water.

EARLY FINDINGS

The NAWQA Program is producing many useful findings about our local, regional, and national water resources. Selected preliminary findings from the study-unit investigations are shown in figure 2. Selected early results from the National Syntheses on Pesticides and Nitrates include the following:

- A review of existing information on pesticides in the atmosphere showed that pesticides have been detected in most samples analyzed throughout the Nation. Pesticides were ubiquitous and were generally detected wherever they were sought. The degree of use and environmental persistence explain the dominant patterns in frequency of detection. The review revealed that no consistent, long-term studies at a national scale have been done.

- A statistical analysis of the occurrence of nitrate in streams at about 150 sites in 10 States in the Midwest, showed there was a relation between the concentration of nitrate and each of the following: the amount of precipitation, rate of streamflow, the acreage of the basin planted in corn, the acreage planted in soybeans, cattle density, and population density. These findings help State and local managers to focus scarce monitoring resources to the most critical areas.

- Estimates of point- and non-point-source nitrogen loadings were made for about 90 watersheds throughout the United States. The relative proportions of input to streams vary as a function of climate, hydrology, land use, population, and physiography. A large percentage of point-source loads occur near cities. Nonpoint loading varies widely, and is strongly influenced by precipitation and runoff. However, no single non-point-nitrogen source is dominant everywhere. Information derived from NAWQA study units will aid in the development of methods to reduce point- and nonpoint-source nitrogen loading.

- Effects of agricultural activities on ground-water quality were studied in five regions from New York to Nebraska. The quality of water in surficial, unconsolidated aquifers was affected by the geology and soils, land-management practices, fertilizer use, and the amount of irrigation. Concentrations of nitrate were greatest in areas that are heavily irrigated or areas that have well-drained soils or sediments.

Results from the NAWQA Program are being released to the public through a variety of publications as elements of the studies are completed.

COMMUNICATION AND COORDINATION

Communication and coordination between U.S. Geological Survey personnel and other interested scientists and water-management organizations are critical components of the NAWQA program. Early in the program, the National Academy of Sciences reviewed the proposed activities and issued a report supporting the program. Since 1991, the NAWQA Advisory Council, a panel of Federal scientists, has met to ensure use of the best and most current scientific methods and to ensure national relevance of the program's findings. In 1993, representatives from National, State, and regional organizations; Native American groups; professional and technical societies; public interest groups; private industry; and the academic community were invited to join the Council.

At the study-unit level, each investigation now underway has a local liaison committee consisting of representatives with water-resources responsibilities or interests from Federal, State, and local agencies, universities, and the private sector. Specific activities of each liaison committee include (1) the exchange of information about water-quality issues of regional and local interest, (2) the identification of sources of data and information, (3) assistance in the design and scope of project products, and (4) the review of project planning documents and reports.

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