

In 1991, the U.S. Geological Survey (USGS), U.S. Department of the Interior, began a full-scale National Water-Quality Assessment (NAWQA) program. The objectives of the NAWQA program are to describe the present and future water quality of large, representative parts of the United States's surface- and ground-water resources and to identify the primary natural and man-made factors that affect the quality of these resources. The final product of the program will be information that may be used by water-resource policy makers and managers at national, State, and local levels.

The NAWQA program encompasses 60 study units. These units are delineated by hydrologic systems that include parts of most of the Nation's major river basins and aquifer systems. Study units range in size from 1,000 mi<sup>2</sup> (square miles) to more than 60,000 mi<sup>2</sup> and represent 60 to

70 percent of the Nation's water use and population served by public water supplies. The first group of 20 study-unit investigations began in 1991. A second group of 20 study-unit investigations began in 1994, which includes the Northern New England Basins study unit.

### SCOPE OF STUDY

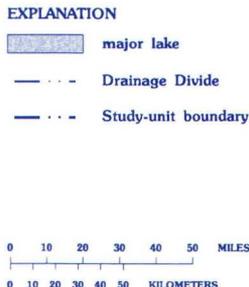
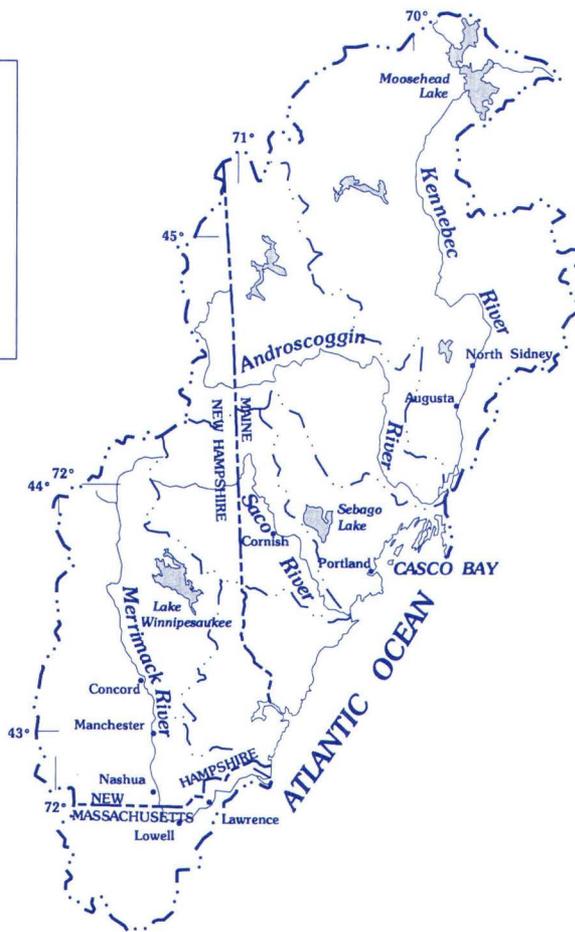
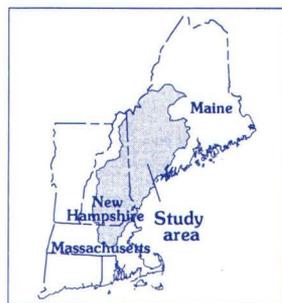
Each study-unit investigation will consist of a high-intensity phase, followed by a low-intensity phase. The high-intensity phase will cover the first 6 years of the study. During this phase, existing water-quality data and basin characteristics will be evaluated; data for evaluation of surface-water and ground-water quality, river-bed sediments, and aquatic organisms will be collected; and technical and nontechnical reports and papers describing study results will be prepared. During the 4-year low-intensity

phase, water-quality sampling will be less frequent than it will be during the high-intensity phase.

Surface water will be sampled at about 20 sites at weekly to monthly intervals during the high-intensity phase of the study. These sites will represent environmental settings characteristic of the study unit. Major water-quality constituents to be analyzed at these sites include suspended sediment, nutrients, major ions, and trace elements. River-bed sediment and fish tissue samples will be collected at 30 to 40 sites and analyzed for trace metals, pesticides, and other constituents. In addition, an ecological study will be made of the relations among the chemical and physical characteristics of streams in the study unit and biological communities (fish, aquatic insects, algae, and streamside vegetation). Particular water-quality issues related to sediment and fish tissue will also be studied. Ground-water surveys will be done for major aquifers and shallow ground waters. A study-unit survey of about 20 wells will provide a broad assessment of water quality in the most important aquifer systems with an emphasis on volatile organic carbons (VOC's). A survey will be done to assess the relation of the quality of recently recharged ground waters to land use and geohydrologic setting. Studies of ground-water flow will be done to characterize spatial and temporal water quality of shallow ground water along a flowpath for particular environmental settings. Water-quality data from all the sampling efforts will be published annually.

### STUDY UNIT DESCRIPTION

The Northern New England Basins study unit is an 18,600 mi<sup>2</sup> drainage basin that encompasses western and central Maine, central and eastern New Hampshire, and northeastern Massachusetts. This area includes the drainage basins of the Kennebec, Androscoggin, Saco, and Merrimack Rivers, as well as small coastal drainage



basins between the Merrimack and Kennebec River Basins. The Kennebec River Basin, the largest in the study unit, drains a 5,890 mi<sup>2</sup> area. The Merrimack River Basin drains a 5,010 mi<sup>2</sup> area, the Androscoggin River Basin drains a 3,520 mi<sup>2</sup> area, and the Saco River Basin drains a 1,700 mi<sup>2</sup> area. Mean annual streamflow in these rivers ranges from 2,700 ft<sup>3</sup>/s (cubic feet per second) in the Saco River at Cornish, Maine, to 9,080 ft<sup>3</sup>/s in the Kennebec River at North Sidney, Maine. Streamflow in these rivers is regulated by upstream lakes, reservoirs, and (or) powerplants.

The study unit contains a large number of natural lakes; many of which are enlarged and controlled by dams. They include Moosehead and Sebago Lakes in Maine (117 mi<sup>2</sup> and 45 mi<sup>2</sup>, respectively) and Lake Winnepesaukee in New Hampshire (69 mi<sup>2</sup>). Many of the surface waters in the study unit are valuable recreational resources that are used extensively for fishing, swimming, and boating. High quality cold- and warm-water fish communities are found throughout the study unit.

An estimated 2.8 million people lived in the study unit as of 1990. Population centers are typically in the lower parts of the drainage basins and include Lowell and Lawrence, Massachusetts; Nashua and Manchester, New Hampshire; and Portland, Maine. The study unit is 80 percent forested; 6 percent agricultural; 6 percent residential, commercial, and industrial; and 8 percent other land uses. Major industries include pulp and paper production, silvicultural, hydroelectric-power generation, manufacturing, service, and seasonal recreation.

The study unit is located entirely within the New England Physiographic Province and is characterized by hilly to mountainous terrain. Elevations in the study unit range from sea level along the coast to greater than 6,000 ft above sea level in the White Mountains. Average annual precipitation is 40 to 50 in. (inches) with higher amounts in the mountainous regions. Average annual runoff is 20 to 40 in., depending on location in the study unit. Average annual air temperatures vary north to south, but

ranges from 40 to 46 °F (degrees Fahrenheit).

Two principal types of aquifers underlay the study unit: stratified-drift aquifers and fractured bedrock aquifers. During the retreat of the last glaciers more than 14,000 years ago, meltwater streams deposited stratified drift (sand, gravel, silt, and clay) in most valleys. Bedrock in the study unit ranges in age from Precambrian to Mesozoic and includes fractured crystalline igneous rocks and metamorphic rocks.

Historically, rivers in the Northern New England Basins study unit have played a role in the development of the region's economy. Transportation of timber to mills and shipping ports and the generation of power to run the sawmills and industrial mills depended on the fast-flowing streams. Presently (1994), these streams and rivers continue to be used as important water resources. In 1990, approximately 783 Mgal/d (million gallons per day) was withdrawn from the rivers and streams and 170 Mgal/d was pumped from aquifers in the study unit.

## MAJOR WATER-QUALITY ISSUES

Water quality in the study unit has improved over the past 30 years because of gains in the treatment of municipal and industrial wastes. However, a number of important water-quality issues remain. These issues are the subject of ongoing research and (or) management programs, which include the Merrimack River Initiative, Casco Bay National Estuaries Program, anadromous fish restoration, and evaluations of ground-water availability and quality. Some of the important water-quality issues that currently face water-resource managers are--

- A lack of information on the presence and distribution of toxic substances in surface and ground waters.
- The effects of land use and combined sewer overflows (CSOs) on surface-water quality.
- The presence of high concentrations of naturally occurring trace elements and

radon gas in some aquifers and the occurrence of synthetic, organic-chemical contamination in ground water.

- The contribution of upland sources to downstream contaminants in coastal waters.
- The relation of fish and aquatic-insect communities to upstream land-use practices.
- The effect of atmospheric deposition on lakes and headwater streams.

## COMMUNICATION AND COORDINATION

Communication and coordination between the USGS and other scientific and water-management organizations are critical components of the NAWQA program. Each study-unit investigation will include a local liaison committee consisting of representatives from Federal, State, and local agencies, universities, and the private sector who have water-resources responsibilities. Objectives of the committee will be to exchange information about regional and local water-quality issues, identify sources of data and information, assist in the design and scope of project products, and review project-planning documents and reports. The liaison committee for the Northern New England Basins study unit will be formed in 1994—*Sarah M. Flanagan and Keith W. Robinson*

### Information on technical reports and hydrologic data related to the NAWQA Program can be obtained from:

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U.S. Geological Survey  
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(603) 225-4681

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(207) 622-8201