New Hampshire

Geologic Mapping

On September 30, 1998, representatives of the U.S. Geological Survey (USGS) joined the Commissioner of the New Hampshire Department of Environmental Services (NHDES), and the New Hampshire State Geologist as they presented Governor Jeanne Shaheen with the recently published Bedrock Geologic Map of New Hampshire (fig. 1). This map was published by the USGS, in cooperation with the State of New Hampshire and the Department of Energy. USGS scientists participated in the geologic fieldwork and preparation of the map.

As part of a bedrock aquifer assessment project, USGS geologists completed bedrock geologic maps of two 1:24,000-scale quadrangles in southern New Hampshire to determine if there is a correlation between rock type and the ground-water yields from wells drilled in these areas. The value of bedrock geologic maps for exploration of ground water in fractured bedrock in New England is being investigated.

Figure 1. The bedrock geologic map of New Hampshire is presented to Governor Jeanne Shaheen by representatives from the USGS and the NHDES.

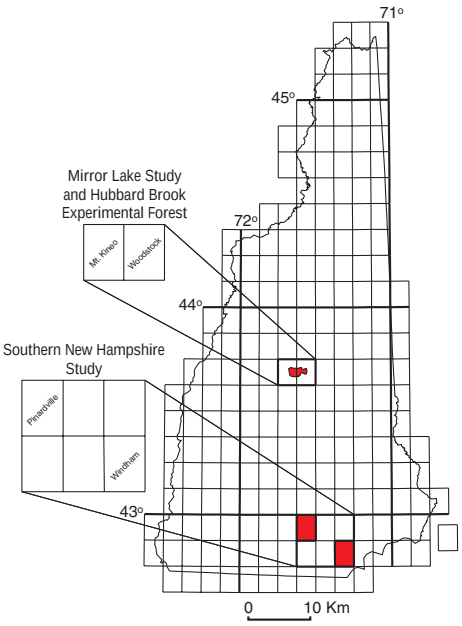

Figure 2. Index map of the Bedrock Regional Aquifer Study area in southern New Hampshire and at Mirror Lake, Grafton county, in west-central New Hampshire.

The USGS also is making a detailed bedrock geologic map of the Hubbard Brook watershed, a long-term research area of the U.S. Forest Service (USFS) in central New Hampshire and at the nearby Mirror Lake fractured bedrock research site (fig. 2). The geologic map data will be compared to subsurface bedrock structures observed in the two well fields at Mirror Lake to determine how well the subsurface structures characterize larger areas.

Detailed mapping of surficial geology by the USGS, in cooperation with the New Hampshire Department of Resources and Economic Development and NHDES, has continued for the last 10 years. About 30 percent of the State has been mapped and a variety of map products that show the distribution of sand, gravel, silt, clay, and till (unsorted sand, gravel, silt, and clay) are available. This mapping is supported by an external source of funding for the National Cooperative Geologic Mapping Program. The USGS program comprises a wide variety of economic and environmental issues by supporting geologic mapping projects in New Hampshire. These issues include forecasting resource management in the sand and gravel industry, ground-water management, transportation engineering, and environmental remediation.

Ground-Water Resources

Many towns and communities in New Hampshire have limited or no sand and gravel aquifers that can support high-yielding water wells. These towns must rely on surface-water sources or locate and drill high-yielding zones within fractured bedrock. Typically, bedrock wells provide low yields, but the USGS, in cooperation with the NHDES, is investigating methods of locating high-yielding zones in bedrock.

In New England, bedrock initially was fractured more than 90 million years ago when stresses in the earth folded and cracked the rock. The weathering has since produced surface patterns, that could indicate the location of underlying large fractures. Some of these fractures could act as pathways for ground-water flow that, when intercepted by drilled wells, have the potential of yielding large quantities of ground water for public supply. A series of

maps showing the location of these surface patterns statewide was produced by the New Hampshire Bedrock Aquifer Assessment project.

As part of this project, the USGS, in cooperation with the NHDES, is comparing the quality of well water with the type of rock in which wells were drilled. More than 20,000 wells drilled in New Hampshire since 1982 were geographically located and a total of 1,353 bedrock wells were matched with 1,818 water-quality samples. These correlations will be used to assess the probable chemical character of water withdrawn from various rock types throughout the State. Chemical constituents of the bedrock aquifers are being mapped and analyzed in collaboration with the New England Coastal Basins National Water-Quality Assessment (NAWQA) Program.

A better understanding of the sources and processes of water flow through fractures in crystalline bedrock is needed to protect existing water supplies and to locate high-yielding sources of water. New methods for these purposes are being investigated by the USGS. Advanced geophysical techniques (such as borehole radar) were used to locate the nature and extent of fractures in bedrock in the towns of Seabrook and Rye, and at the USGS Mirror Lake fractured-bedrock research site near Thornton.

The USGS is assessing new methods for collecting high-resolution digital images of rocks and fractures below the surface. A new borehole-camera technique can obtain digital video images of the inside of a well above and below the water surface. The camera captures an image of the borehole wall (fig. 3). The images provide data that can be used to describe the rock type(s) and fractures in the boreholes, identify on-site contamination, and aid in planning for the collection and interpretation of other geophysical data.

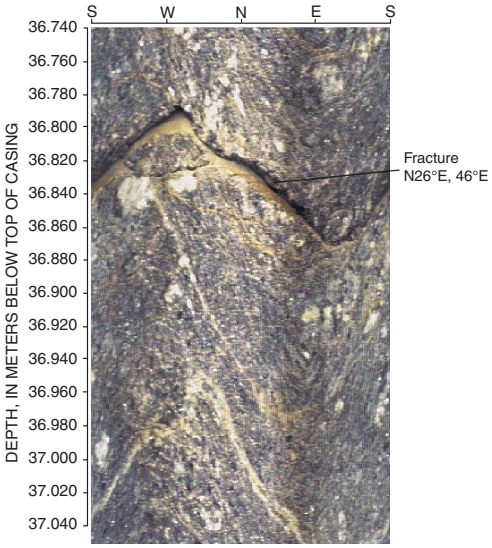

Figure 3. A digital optical image that represents an "unrolled" 360-degree scan of the borehole wall.

Topographic Mapping

USGS topographic maps of New Hampshire's White Mountain National Forest are scheduled for revision in 1999. In an agreement between the USGS and the U.S. Forest Service (USFS), the USFS will update the maps to show additional features required for national forest management. The source images for these map revisions are digital orthophoto quadrangles (DOQ's) that were produced from aerial photographs taken from 1992 through 1994. These DOQ's of the White Mountain National Forest are available to the public from the USGS.

As part of the National Aerial Photography Program (NAPP), the USGS obtained new black-and-white aerial photographs of southern New Hampshire in the spring of 1998. The collection of photographs for the remainder of the State is scheduled for 1999. NAPP photographs also are available to the public through the USGS.

Many of the New Hampshire 1:24,000-scale and 1:25,000-scale topographic maps are scheduled to be revised during the next several years. The USGS plans to work with State and Federal agencies and Earth Science Corps volunteers to improve map content.

Biological Diversity

An important issue in the northeastern United States is how best to allocate limited resources for land conservation to maintain diverse plant and animal populations. In New Hampshire, USGS scientists are constructing computer-based models to predict distributions of vertebrates and to determine the degree of protection through land conservation that is needed for regions of high vertebrate diversity. Digital maps describing land-cover patterns, vertebrate species distributions, and conservation areas are being used as tools to help provide critically needed information on relations between the distribution of terrestrial vertebrates and habitats in the region. The results of the project may assist government officials and land managers in making sound decisions for land conservation. The work is being supported by the New Hampshire Fish and Game Department and the U.S. Fish and Wildlife Service.

Water Quality

In 1991, the USGS began the NAWQA Program to describe the quality of the Nation's water resources, and to identify the natural and manmade factors that affect it. The program provides information that is useful to water-resource policymakers and managers at National, State, and local levels. Parts of central and eastern New Hampshire are included in the 22,900-square-mile New England Coastal Basins NAWQA study area, which also encompasses western and central Maine, eastern Massachusetts, and most of Rhode Island. In New

Hampshire, this area includes the drainage basins of the Merrimack, Androscoggin, and Saco Rivers, as well as the smaller coastal drainage basins. A 3-year effort of intensive field-data collection began in 1998 with the collection of streambed sediment, fish tissue, and water samples. The amount of nutrients flowing to coastal waters from the major rivers in eastern New England and the influence of various levels of urbanization on water quality in streams and aquifers and on stream ecology will be assessed by this monitoring.

As part of the effort, existing ground-water-quality data were analyzed to determine if concentrations of arsenic in ground water—at levels of concern to public health—are related to regional geology. The USGS compared arsenic data from 800 public-supply wells in eastern New England and found that arsenic was present in more than 46 percent of wells drilled in metamorphic rocks that contain appreciable amounts of calcium carbonate. In contrast, arsenic was detected in only 22 percent of wells drilled in other rock types (fig. 4). A better understanding of the potential effect of regional geology on ground-water quality will help water managers in siting wells that comply with U.S. Environmental Protection Agency (EPA) drinking-water standards.

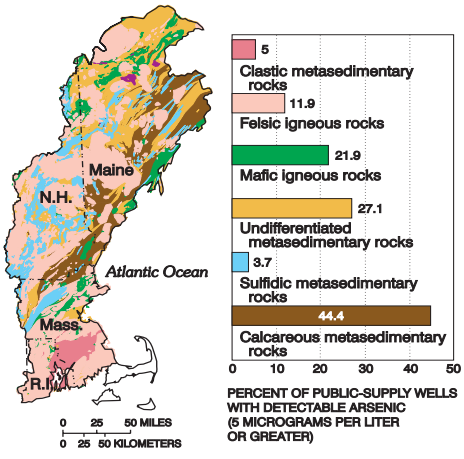

Figure 4. Types of rock with the percentage of wells where arsenic concentrations exceeded a detection limit of 5 micrograms per liter or greater in the New England Coastal Rivers Basin study area.

The USGS, in cooperation with the NHDES and the EPA, is studying the movement and degradation of chemical (tetrachloroethylene) contamination in parts of a glacial-drift river-valley aquifer in Milford (fig. 5). The aquifer is an important source of water for commercial and State fish hatcheries, supplying more than 2 million gallons of water per day (Mgal/d). Before the contamination was identified, the aquifer had supplied more than 1 Mgal/d to two municipal water-supply wells. Through extensive monitoring of contaminant levels and the modeling of ground-water flow, the USGS is providing information to the State and EPA to help assess and improve the design and operation of the remediation effort.

A new collaborative study between the USGS and the University of New Hampshire will examine the inflow of ground water, nutrients, and contaminants to the Great Bay Estuary in southeastern New Hampshire. Factors such as water use, land use, and ground-water flow affect the amount and quality of ground and surface water discharged to the Bay. The quantity and quality of ground water flowing into the Bay and the effects of this influx of fresh water on marine environments and ecosystems have not been studied previously. The study results will be used to determine the extent to which ground water is a factor in determining the overall water quality of this estuarine system.

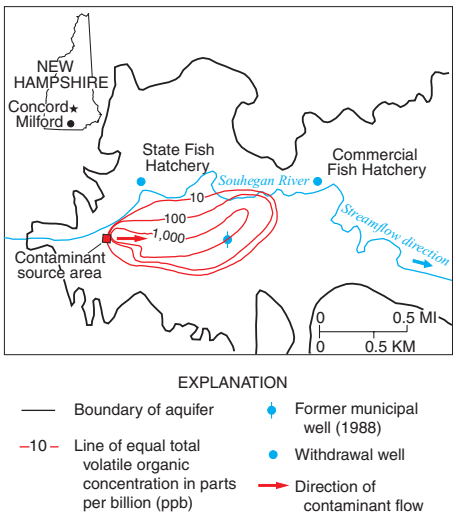

Figure 5. Aquifer boundary, ground-water withdrawal locations, and the extent of contaminant plume in Milford.

Water Information

The amount of water in New Hampshire's rivers, streams, lakes, and reservoirs is measured and monitored by the USGS hydrologic data-collection program. These data are used for

- forecasting floods and droughts
- flood warning and flood-plain management
- water-resources planning
- designing and operating projects for water supply, hydroelectric power, flood control, and pollution control
- designing bridges and culverts, and
- hydrologic research.

Long-term records are needed to evaluate the responses of hydrologic systems to natural climatic variations and human-induced stresses so that potential problems can be defined early and appropriate planning and management actions can be taken by local and State agencies. Streamflow monitoring also provides baseline

data on the flow characteristics of rivers and streams. In New Hampshire, surface-water data are collected (fig. 6) from a network of 52 stations, and a ground-water-monitoring network provides monthly water-level data for 28 wells. Records are published monthly and annually. The network is operated by the USGS, in cooperation with the NHDES, U.S. Army Corp of Engineers, several towns, municipalities, and utility companies.

Real-time streamflow data, by way of satellite and telephone telemetry, are available on the World Wide Web for 37 locations in New Hampshire at:

http://nh.water.usgs.gov

Figure 6. A technician is preparing to measure streamflow by lowering a current meter from a cable car suspended over a river in New Hampshire.

This real-time streamflow information is critical for the flood forecasting and response activities of the National Weather Service, the New Hampshire Office of Emergency Management, and other State and local officials.

Changing patterns in water use require that available supplies and demands be carefully evaluated. Without adequate information, decisionmakers are not equipped to address critical and competing demands related to water supply, hydropower, snowmaking, water quality, and the potential effects of streamflow withdrawals on ecosystems. In 1995, 450 million gallons of freshwater were used in New Hampshire (fig. 7).

The USGS, in cooperation with the NHDES, Water Division, is working to improve the State's water-use information. Completion of a statewide water-use data base is planned for 1999. This data base will include site-specific data, as well as compilations at the county and major drainage-basin levels. The data-base-management system permits water to be tracked from the point of withdrawal to the point of return into the environment. These water-use data will be available to Federal and State agencies, educators, consultants, and other organizations or individuals concerned with water resources.

Wildlife

A concern about the decline of the American woodcock during the last three decades across most of eastern North America has encouraged USGS scientists to study the demographics and habitat requirements of the popular game bird. In New Hampshire, the research is being carried out in cooperation with the U.S. Fish and Wildlife Service (USFWS), the New Hampshire Fish and Game Department, Dartmouth College, the Wildlife Management Institute, and the Ruffed Grouse Society. Two separate woodcock populations are recognized and managed by the USFWS. Both populations have dwindled since the early 1970's, with a greater drop in the eastern region (2.5 percent per year) than in the central region (1.6 percent per year). To understand how habitat modification is affecting the populations, USGS biologists are studying sources of mortality, survival rates, and patterns of woodcock movement and habitat use. Results of these studies will help management agencies set harvest regulations and identify beneficial forest management practices. The goal of the Federal American Woodcock Management Plan is to stabilize and increase woodcock populations to 1985 levels by the year 2005.

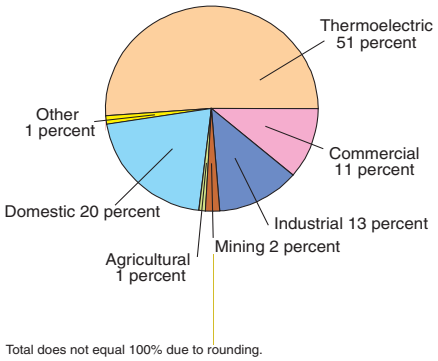

Figure 7. Total freshwater use by category in New Hampshire (1995).

USGS office locations

The USGS has 44 employees in New Hampshire

USGS State Representative

361 Commerce Way
Pembroke, NH 03275-3718
(603) 226-7800
FAX (603) 226-7894

USGS Home Page

http://www.usgs.gov

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