

## PROGRAM

In 1983, the New Hampshire Legislature passed Chapters 361 and 402 of the State statutes that directed the development of expanded water-resources information to support economic growth and wise management of the resource. This legislation was implemented by the New Hampshire Department of Environmental Services (NHDES), which entered into a long-term cooperative program with the U.S. Geological Survey (USGS) to assess the State's ground-water resources. Studies under this program are funded jointly by the NHDES and the USGS and are performed by USGS scientists in the New Hampshire-Vermont District in Bow, New Hampshire.

In New Hampshire, high-yielding supplies of ground water are found primarily in sand and gravel aquifers and within fractures in bedrock. The initial focus of the ground-water-resource assessment program has been to map and evaluate the sand and gravel aquifers in the State. This initial phase is nearing completion, and the focus of the program is shifting to an assessment of the bedrock aquifers. Ground water withdrawn from fractured bedrock provides 25 percent of the total drinking water and 85 percent of the water pumped from private domestic wells in the State. Ground water from bedrock also accounts for 8 percent of the drinking water supplied by public systems and 5 percent of the water used for commercial, industrial, and agricultural purposes.

Demand for ground water from the bedrock aquifer is continuously increasing as the cost of surface-water treatment increases and alternative sources are sought. In addition, not all communities have sand and gravel aquifers that can provide adequate water for public supply and commercial or industrial demands. Thus, evaluation of potential water availability from the bedrock aquifer is the next step in a comprehensive assessment of the State's ground-water resources.

The statewide bedrock-aquifer resource assessment began in 1994. The purpose of the study is to identify potential high-yielding sources of ground water and to analyze the quality of water from these sources. The results of this study will provide information useful to communities and to regional and State planners in the development of water supplies and the management of aquifer and wellhead-protection programs.

## OBJECTIVES

The major objectives of the bedrock-aquifer resource assessment are to—

- Identify geologic and other factors, such as rock type and fracture characteristics, that affect the yields of bedrock wells in New Hampshire
- Develop predictive tools and data needed by communities to evaluate the ground-water-development potential of bedrock aquifers in their jurisdictions
- Produce statewide maps that identify the high, medium, and low potential yields of bedrock aquifers
- Describe the ambient quality of ground water in bedrock throughout the State and identify areas of potential bedrock water-quality concerns, such as concentrations of high iron and manganese.

## APPROACH

Assessment of the potential for using the bedrock aquifer as a source of water supply is complex because of the wide areal variation in fracture characteristics. A method for locating high-yielding well sites that has worked well in New Hampshire is based on the identification of fracture traces on the land surface by means of aerial photographs and other remotely sensed imagery. Fracture traces on the land surface are indicators of fractures that extend to depth.

The following types of imagery will be used to analyze the State's land surface for the presence of bedrock fractures: Landsat imagery (obtained from satellites that orbit the Earth at an altitude of about 570 miles), high-altitude aerial photography (obtained from aircraft flown at about 40,000 feet above the land surface), side-looking radar (obtained from aircraft flown at an altitude of about 33,000 feet above sea level), and low-altitude photography (obtained from aircraft flown at about 20,000 feet above the land surface). Observations in the field also will be used to supplement fracture-characteristic data in some locations.

Fracture data obtained from the aerial and satellite imagery and field observations will be compared with data on water yields and water quality for more than 4,000 of the 40,000 bedrock wells in the New Hampshire Department of Environmental Services well data base. From this comparison, statistical relationships will be developed between yields of bedrock wells, in gallons per minute, and such factors as the proximity of the fracture traces on the land surface to the wells, bedrock type and age, thickness of the sediment overburden, physiography of the area, and types of well construction.

By using the established relationships, maps will be prepared to show areas of potential development of ground-water supplies from bedrock aquifers. Maps also will be prepared to show areal variability in ground-water quality.

The maps will be compiled and produced using a computerized Geographic Information System (GIS), whereby maps are stored, analyzed, and plotted by use of a computer.

Subsurface analyses of fracture zones by geophysical techniques will be used at some of the highest yielding bedrock-well sites in the State. These analyses will identify and demonstrate new tools and procedures for identifying high-yield zones in bedrock.

## PRODUCTS AND BENEFITS

The Assessment of Ground-Water Supply Potential of Bedrock in New Hampshire will produce a number of products that will benefit development and management of ground-water resources in the State—

- Statewide maps showing the locations of major fracture traces on the land surface at a scale of 1:48,000 (1 inch = 4,000 feet)
- Predictive statistical relationships that can be used to assess the water-supply-development potential of the bedrock aquifer throughout the State
- Statewide maps showing zones of high, medium, and low potential water yield at a scale of 1:48,000

- An evaluation of the effectiveness of geophysical tools and procedures used in locating potential high-yield zones at specific bedrock-well sites
- Reconnaissance-level maps and assessment of the quality of water from the bedrock aquifer
- Map products that will be available in computerized Geographic Information System format.

## TIMEFRAME

The statewide bedrock-aquifer assessment began in February 1994 and is currently ongoing. The initial products—statewide fracture-trace maps—are planned to be produced by the end of the third year of the study. Final maps of potential water yield and reports providing statistical relationships, water-quality data, and an assessment of geophysical techniques are planned for publication in the sixth and seventh years of the study.

## SELECTED REFERENCES

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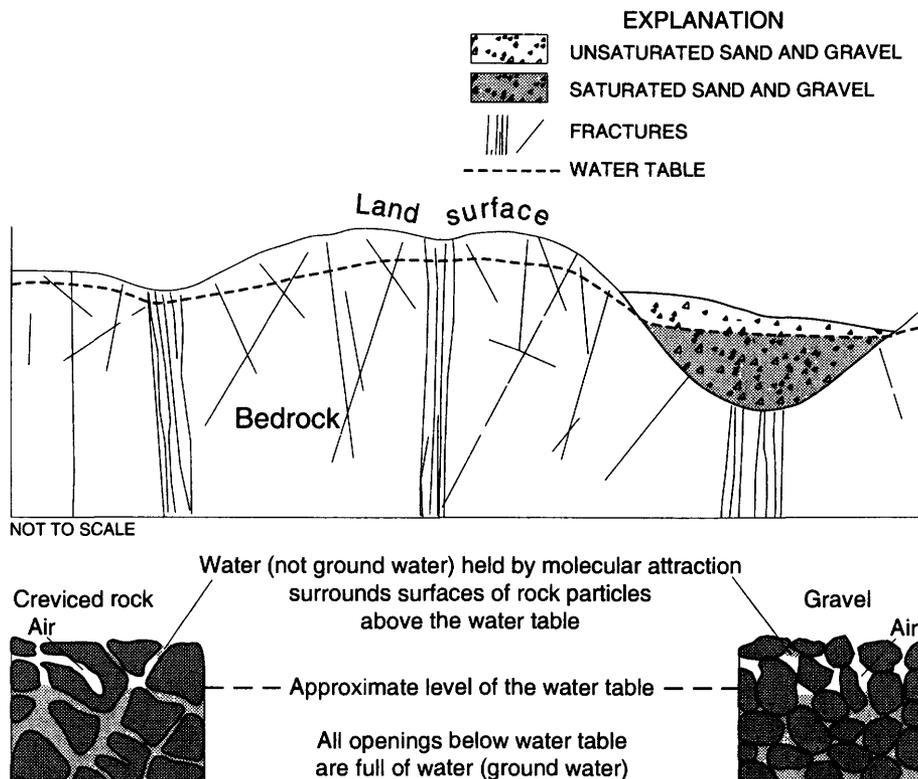
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Hydrogeologic section showing ground water in bedrock and sand and gravel in New Hampshire.