

GEO-6

2020

## New Hampshire Bedrock Aquifer Resource Assessment

In 1983, the New Hampshire Legislature passed Chapters 361 and 402 of the state statutes directing the development of expanded water resources information to support economic growth and wise management of resources. 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 groundwater resources. Studies under this program are funded jointly by the NHDES and USGS and are performed by USGS scientists in the New Hampshire-Vermont District in Pembroke, New Hampshire.

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 Groundwater withdrawn from fractured bedrock provides 25% of the total drinking water and 85% of the water for private domestic wells in the state.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

Demand for groundwater 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 for 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 groundwater resources.

The statewide bedrock aquifer resource assessment was initiated in 1994. The purpose of the study is to identify potential high-yielding sources of groundwater and analyze the quality of water from these sources. The results of this study will provide information useful to communities, as well as 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 for evaluating the groundwater development potential of bedrock aquifers in their jurisdictions.
- Produce statewide maps that identify the relative potential groundwater yields of bedrock aquifer.
- Describe the ambient quality of ground water in bedrock throughout the state and identify areas of potential bedrock water quality concerns, such as high concentrations of 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 variation in bedrock 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 using aerial photographs and other remotely sensed imagery. Fracture traces or lineaments on the land surface can be 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), side-looking radar (obtained from aircraft flown at an altitude of about 33,000 feet), high-altitude aerial photography (obtained from aircraft flown at about 40,000 feet above the land surface), and low altitude photography (obtained from aircraft flown at about 20,000 feet above the land surface). Observations in the field will also 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 50,000 bedrock wells that are in the NHDES well database. From this comparison, statistical relationships will be developed between yields of bedrock wells, in gallons per minute (gpm), 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 that show areas of potential development of groundwater supplies in bedrock aquifers. Maps also will be prepared to show areas with various background water quality characteristics.

Maps were compiled and produced using a computerized Geographic Information System (GIS). A GIS is a system where maps are stored, analyzed, and plotted by use of a computer.

Subsurface analyses using geophysical techniques will be employed 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 yielding zones in bedrock.

## **Products and Benefits**

The New Hampshire Bedrock Aquifer Resource Assessment will produce a number of products that will benefit development and management of ground-water resources in the state.

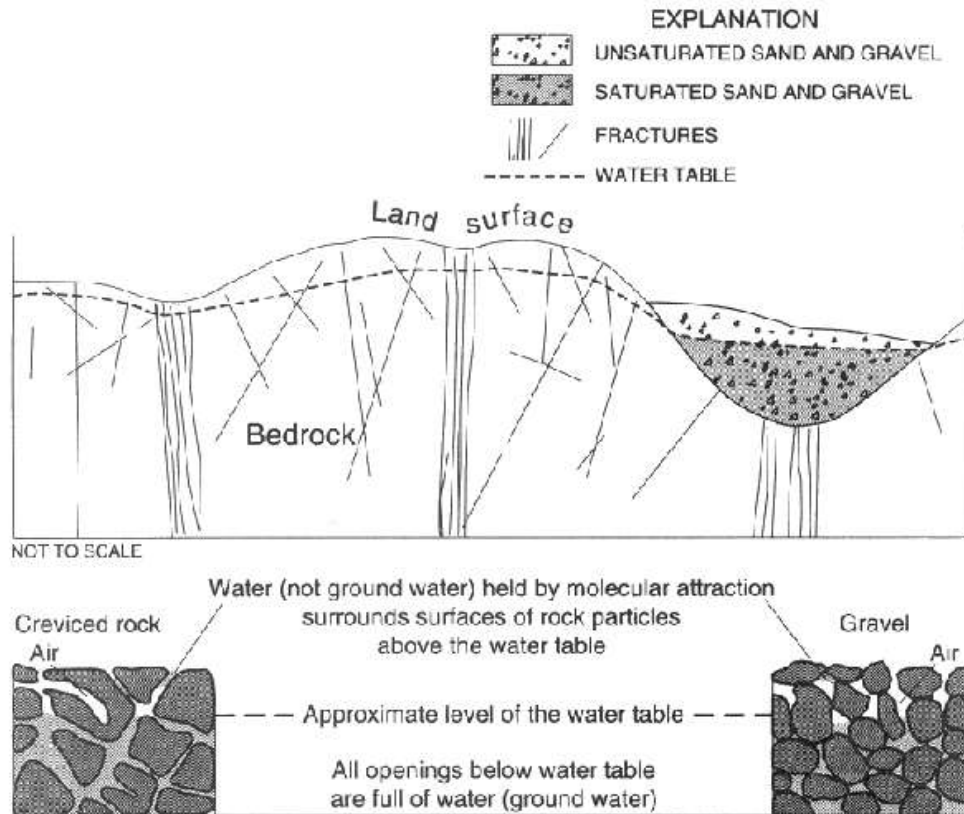
- Statewide maps providing the locations of major fracture traces on the land surface at a scale of 1:48,000 (1 inch: 4,000 feet).
- Predictive statistical relationships that can be used to assess the water-supply development potential of the bedrock aquifers throughout the state.
- State wide maps showing zones of relative 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 that can be used to identify potential need for treatment.
- Map products will be available in computerized GIS format.

### Timeframe

The statewide bedrock aquifer resource assessment was initiated 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 predictive relationships, water-quality data, and an assessment of geophysical techniques are planned for publication in the sixth and seventh year of the study.

### How groundwater occurs in the bedrock and sand and gravel in New Hampshire



### Contact

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