U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

WATER-RESOURCES INVESTIGATIONS REPORT 93-4167
Ground-water resources of the Blackstone River Basin, Massachusetts–PLATE 1
Izbicki, J.A.

SEISMIC REFRACTION

Seismic refraction was used to map depth to the water table, depth to bedrock, and the saturated thickness of aquifers along 10 sections having a total length of about three miles. The technique takes advantage of changes in the velocity of sound, and subsequent refraction, as it travels through different rock layers. In general, sound travels at about 1,000 feet per second in unsaturated, unconsolidated deposits; 5,000 feet per second in saturated, unconsolidated deposits; and about 15,000 feet per second in crystalline bedrock (Haeni, 1986a). Explosives were the primary sound source used in this study and the arrival times were recorded, in milliseconds, on a 12-channel seismograph. Data were analyzed using a seismic-refraction inverse modeling computer program (Scott and others, 1972; Scott, 1977) to produce the profiles shown on this plate. These profiles show land surface, water table, and bedrock elevations and help define subsurface features not obvious from surface geomorphology or lithologic data. Interpreted seismic refraction profiles were used in conjuction with test drilling data and other information to determine inputs for digital models used to estimate aquifer and basin yield.

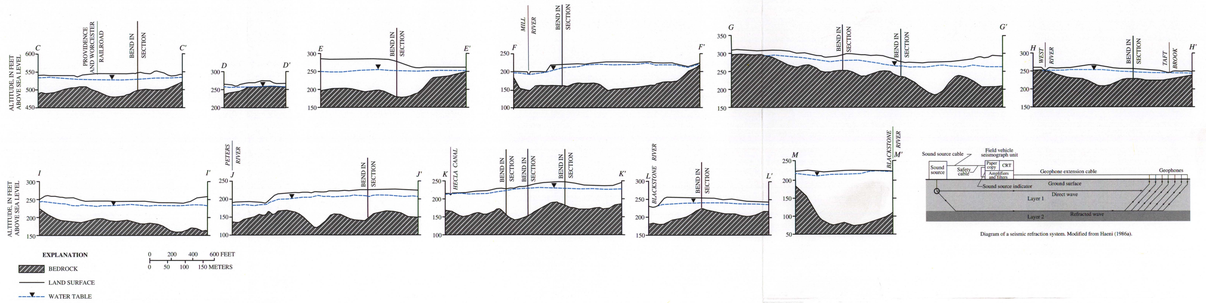
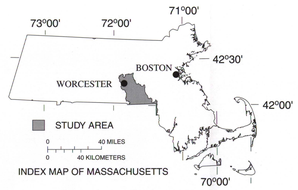


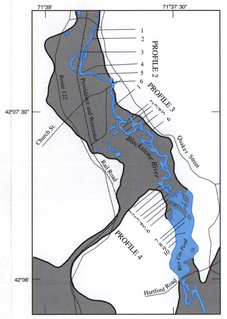
Diagram of a seismic refraction system. Modified from Haeni (1986a).

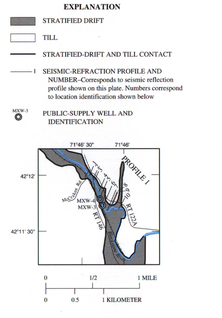


INDEX MAP OF MASSACHUSETTS

SEISMIC REFLECTION

Continuous marine-seismic reflection was used to map depth to bedrock and aquifer lithology along four profile reaches of the Blackstone River having a total length of about 10 miles. The technique takes advantage of contrasts in the velocity of sound, and subsequent reflection, as it travels through different rock layers (Haeni, 1986b; Sylwester, 1983). The technique requires a surface water body to transmit energy from the sound source to the river or lake bed and underlying deposits from which it is reflected back to hydrophones. Cobbles and boulders in bottom sediment can cause scattering of sound waves and prevent acoustic penetration resulting in a poor or unusable record. Similarly, aquatic vegetation may absorb sound energy and also prevent acoustic penetration into deeper deposits. Seismic-reflection data were collected in April 1986 to minimize interference from aquatic vegetation and to insure enough water was available in the river to float the equipment. However, coarse-grained river bed deposits, shallow water, and other interferences limited acoustic penetration, resulting in an unusable record over about half the area studied. Data were analyzed by comparing the reflected signal to signals obtained from similar studies by Haeni (1986b), Morrissey and others (1985), Sylwester (1983), and Hansen (1986). These profiles show water surface, streambed, bedrock, and aquifer lithology, and help define subsurface features not obvious from surface geomorphology or lithologic data. Interpreted seismic reflection profiles were used in conjuction with test drilling and other data to help characterize aquifers along the Blackstone River.





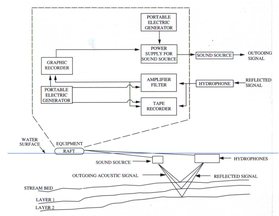
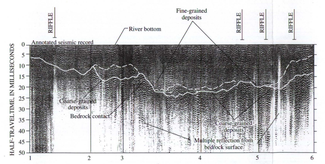
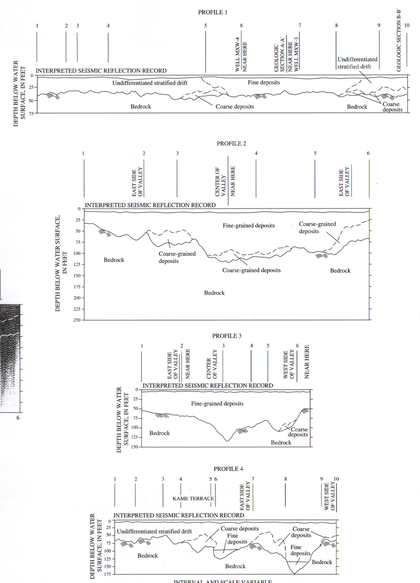


Diagram of a seismic reflection system. Modified from Morrissey and others (1985).



Sample seismic record for profile 2. Location identification number corresponds to identification number on map.



EXPLANATION

LITHOLOGY–Triangle indicates approximate position of the water table. Numbers show depth, in feet, below land surface datum. Patterns show generalized lithologic units and their position in the stratigraphic column. Vertical scale: 1 inch = 50 feet.

- Gravel; or sand and gravel
- Sand
- Silt; silt and clay; or clay
- Peat
- Fill
- Bedrock

GROUND-WATER FAVORABILITY AND TRANSMISSIVITY–Modified from Walker and Krejmas, 1986

- Areas where unconsolidated deposits are favorable for well yields of 25 gallons per minute or more. Transmissivity exceeds 4,000 feet squared per day
- Areas where unconsolidated deposits are favorable for well yields of 50 to 250 gallons per minute. Transmissivity ranges from 1,500 to 4,000 feet squared per day
- Areas where unconsolidated deposits are favorable for well yields of 50 gallons per minute or less. Transmissivity is less than 1,500 feet squared per day
- Areas where unconsolidated deposits consist primarily of till and are unfavorable for development of wells for public supply. Transmissivity is less than 500 feet squared per day

- WATER BODIES
- DRAINAGE BASIN BOUNDARY
- TOWN BOUNDARY
- BOUNDARY OF STUDY AQUIFERS
- STREAM (dashed where inferred)
- A A' SEISMIC REFRACTION LINE AND IDENTIFICATION–Corresponds to seismic refraction profile shown on this plate
- PROFILE 1 (1 2 3) SEISMIC REFLECTION PROFILE AND IDENTIFICATION–Corresponds to seismic reflection profile shown on this plate. Numbers correspond to location identification.
- MXW-3 PUBLIC-SUPPLY WELL AND IDENTIFICATION NUMBER
- XSW-31 SELECTED OBSERVATION WELL AND IDENTIFICATION NUMBER

SCALE 1:48,000
2 1 0 1 2 MILES
2 1 0 1 2 KILOMETERS

Base from U.S. Geological Survey digital data, 1:100,000, 1983
Universal Transverse Mercator Projection, Zone 19

USGS science for a changing world

GROUND-WATER RESOURCES OF THE BLACKSTONE RIVER BASIN, MASSACHUSETTS

by
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2000