DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE MASSACHUSETTS WATER RESOURCES COMMISSION
BOSTON, MASSACHUSETTS

HYDROLOGIC INVESTIGATIONS
ATLAS HA-662 (SHEET 2 OF 2)

GROUND-WATER AVAILABILITY

WATER USE

Table 4. **Public water-supply systems**

TOWN Water system, and source of water	Pumping capacity of each source (Mgal/d)	Total capacity of each system (Mgal/d)	1976 pumpage from each source (Mgal/d)	1976 total pumpage from each system (Mgal/d)
ACTON				
Acton Water Department				
Eight gravel-packed wells	2.89	2.89[1]	1.39	1.39
ASHLAND				
Ashland Public Works Department, Water and Sewer Division				
Two gravel-packed wells	4.46	4.46	1.41	1.41
AYER				
Public Works Department				
One gravel-packed well[2]	1.5	—	.32[3]	.32[3]
BILLERICA				
Public Works Department, Water Department				
Concord River	14.0	14.0	3.79	3.79
CHELMSFORD				
Center Water District				
Sixteen gravel-packed wells				
One tubular well field	7.64	7.64	2.24	2.24
East Water District				
Two gravel-packed wells	.94	.94	.114	.114
North Water District				
Three gravel-packed wells	1.83	1.83	.839	.839
South Water District				
All water from Center Water District[4]	—	—	—	—
CONCORD				
Public Works Department, Water and Sewer Division				
Five gravel-packed wells	3.96	—	.954	—
Nagog Pond in Littleton-Acton	1.73	5.69	1.05	2.004
DRACUT				
Dracut Water Department				
Seven gravel-packed wells	4.32	—	1.087	1.087
Authorized from Lowell	.65	4.97	—	—
DUNSTABLE				
Dunstable Water Department				
One dug well	0.11	—	—	—
One tubular well field	0.11	0.22	0.016	0.016
FRAMINGHAM				
Public Works Department, Water Department				
Three gravel-packed wells	2.5	—	1.11	—
Four MDC connections	37.45	20.0[5]	8.15	9.26
GROTON				
Groton Water Company				
Baddacook dug well	.35	—	.123	—
Shattuck gravel-packed well	.32	.68	.082	.205
HOPKINTON				
Hopkinton Water Board, Water Department				
Three gravel-packed wells	1.54	1.54	.517	.517
HUDSON				
Public Works Department				
Two gravel-packed wells	1.75	—	1.38	—
Two standy gravel-packed wells[6]	.81	—	—	—
Gates Pond	1.58[7]	4.14	.56	1.94
LITTLETON				
Littleton Light and Water Department				
Two gravel-packed wells	.86	—	.912	—
One 8-inch well field	.50	1.36	—	.912
LOWELL				
Lowell Water Department				
Merrimack River pumping station	40.0	—	11.399	—
One standby gravel-packed well	.71	40.71	—	11.399
MARLBOROUGH				
Marlborough Public Works Department, Water and Sewer Division				
Lake Williams	1.44	—	.468	—
Lake Millham	1.44	—	.696	—
MDC connection	5.04	7.92	1.021	2.185
MAYNARD				
Maynard Public Works Department				
Three gravel-packed wells	1.86	—	.596	—
White Pond	.6	2.46	.721	1.317
NATICK				
Public Works Department, Water and Sewer Division				
Six gravel-packed wells (Sudbury River basin)	8.06	—	4.03	—
One dug well (Sudbury River basin)	1.43	—	.087	—
Four gravel-packed wells (Charles River basin)	3.82	13.31	—	4.117[8]
NORTHBOROUGH				
Northborough Water Department				
Three gravel-packed wells	1.05	—	.673	—
One MDC connection	1.08[9]	—	.034	.707
SHREWSBURY				
Shrewsbury Water and Sewer Department				
One gravel-packed well (Assabet River basin)	.32	—	.084[9]	.084[9]
Gravel-packed wells (Blackstone River basin)	5.18	5.50	—	—
SOUTHBOROUGH				
Southborough Water Department				
Two MDC connections	2.88[10]	2.88	.478	.478
SUDBURY				
Sudbury Water District				
Five gravel-packed wells	3.86	—	1.623	—
One standby gravel-packed well[11]	.24	4.10	0.0	1.623
STOW				
Harvard Acres				
One gravel-packed well	.33	.33	.024	.024
Assabet Water Company				
One gravel-packed well	.14	.14	.012	.012
WESTBOROUGH				
Westborough Public Works Department, Water and Sewer Division				
Four gravel-packed wells	1.7	—	.784	—
Sandra Pond	.75	2.45	.682	1.466
WESTFORD				
Westford Water Department				
Four gravel-packed wells	2.74	—	.857	—
One tubular well field	.72	3.46	—	.857
WAYLAND				
Wayland Water Department				
Seven gravel-packed wells	4.90	4.90	1.518	1.518

[1]System capacity presently reduced to 1.88 Mgal/d due to chemical contamination of two wells.
[2]Additional supply wells located in Nashua River basin.
[3]Does not include pumpage from wells outside of study area.
[4]Center Water District pumpage includes all water used by this system.
[5]Reflects authorized MDC withdrawal of 17.5 Mgal/d.
[6]Standby use because of high iron concentration in pumped water.
[7]Safe yield reported as 0.32 Mgal/d.
[8]Authorized withdrawal is 1.5 Mgal/d.
[9]Estimated from information supplied by water department.
[10]Authorized withdrawal is 2.0 Mgal/d.
[11]Standby use because of high chloride and sodium concentration in pumped water.

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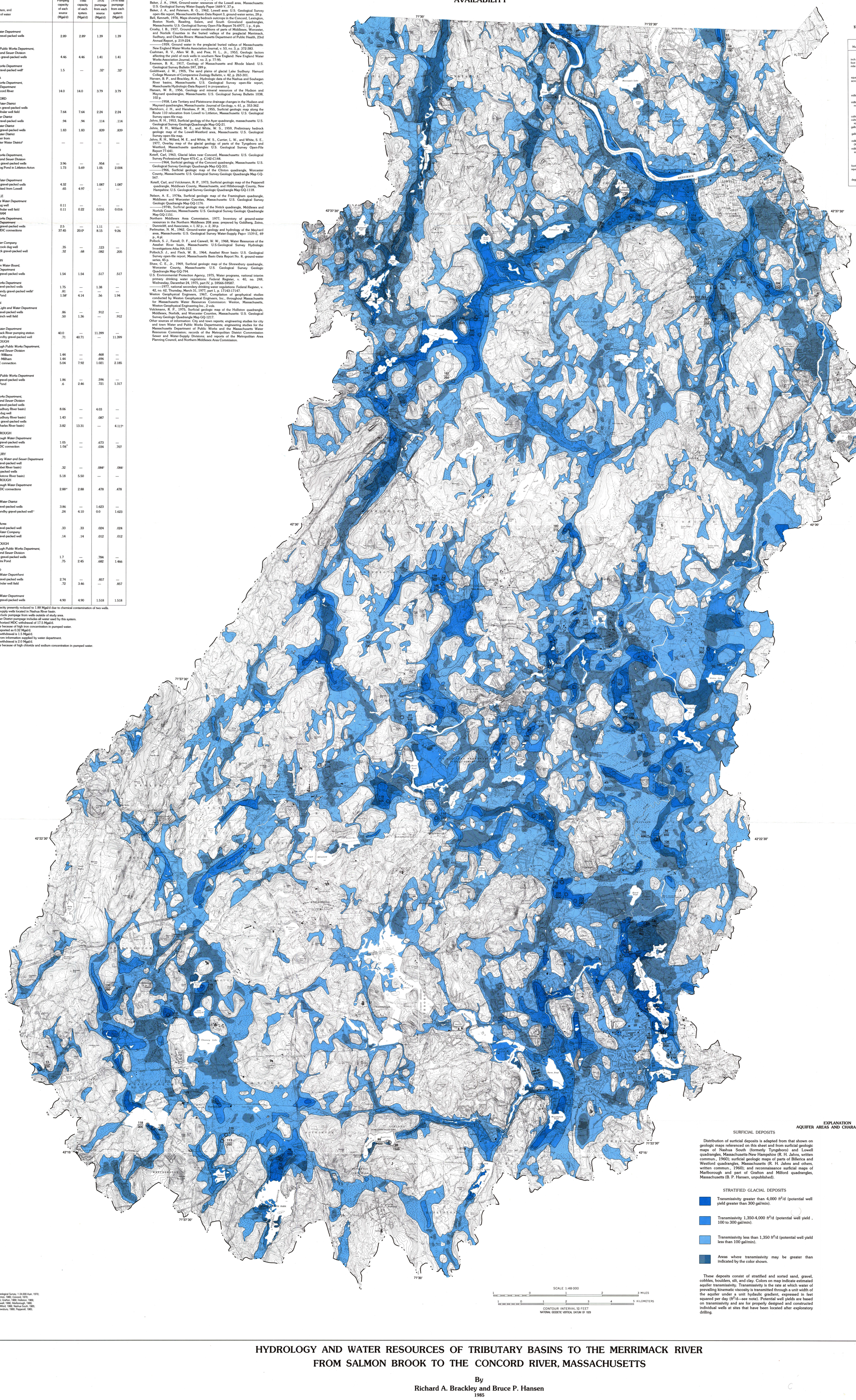

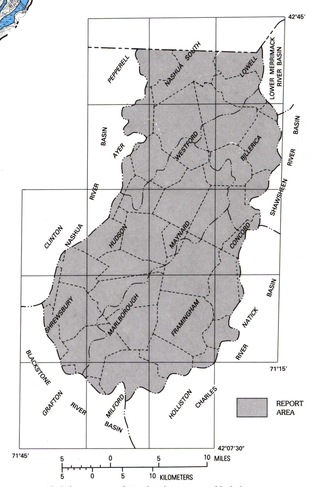

Figure 17.– **Index to topographic and geologic maps and hydrologic reports**

Topographic base maps from the U.S. Geological Survey 1:24000 and 1:25000 series are named on the index map (fig. 17). Geologic maps listed in "Selected Reference" on this sheet correspond to the topographic map with the same name. Adjacent river basins are shown on the map and correspond to the hydrology and water-resources reports listed in "Selected References."

METRIC CONVERSION FACTORS

Table 5. **Factors for converting inch-pound units to International System of Units (SI), with abbreviations**

Multiply inch-pound units	By	To obtain SI units
	Length	
inch (in)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
square mile (mi²)	2.590	square kilometer (km²)
acre	4,047	square meter (m²)
	0.4047	hectare (hm²)
	Volume	
million gallons (Mgal)	0.003785	cubic hectometer (hm³)
	3.785	cubic meter (m³)
million gallons per square mile (Mgal/mi²)	0.001461	cubic hectometer per square kilometer (hm³/km²)
	Flow	
cubic foot per second (ft³/s)	0.02832	cubic meter per second (m³/s)
cubic foot per second per square mile ([ft³/s]/mi²)	0.01093	cubic meter per second per square kilometer ([m³/s]/km²)
gallon per minute (gal/min)	6.309×10^{-5}	cubic meter per second (m³/s)
gallon per day (gal/d)	3.785×10^{-3}	cubic meter per day (m³/d)
million gallons per day (Mgal/d)	0.04381	cubic meter per second (m³/s)
million gallons per day per square mile ([Mgal/d]/mi²)	0.01691	cubic meter per second per square kilometer ([m³/s]/km²)
	Hydraulic Units	
foot per second (ft/s)	0.3048	meter per second (m/s)
square foot per day (ft²/d)	0.0929	square meter per day (m²/d)
	Temperature	
degree Fahrenheit (°F)	5/9(°F–32)	degree Celsius (°C)

GROUND WATER AVAILABILITY

SAND AND GRAVEL DEPOSITS

Individual wells yield as much as 2,200 gal/min from sand and gravel deposits. Water-saturated sand and gravel deposits constitute the most productive aquifers (fig. 16). During the melting of the last glacial ice sheet, soil and rock fragments were transported, sorted, and deposited by glacial meltwater as stratified sand and gravel in stream channels and as fine sand, silt, and clay in ponds and lakes. The greatest known saturated thickness of these deposits is 140 feet.

The transmissivities shown on the map are based on analyses of lithologic logs, aquifer tests, and specific capacities. Transmissivity estimates based on lithologic logs were made for more than 1,150 wells and borings fully or partly penetrating stratified glacial deposits. Transmissivity was calculated from specific-capacity data for 36 wells by methods of Hurr, 1966; Narasimhan, 1967; Meyer, 1963; and Walton, 1962.

Transmissivity of unconsolidated deposits ranges from less than 10 ft^2/d for thin deposits of silt and clay to more than 14,000 ft^2/d for large stratified thicknesses of coarse sand and gravel. Estimated transmissivity and well yield at any location may be more or less than estimated because of appreciable horizontal and vertical changes in lithology over short distances, characteristic of stratified glacial deposits. Exploratory test drilling is necessary to determine the exact location and extent of the best water-bearing deposits. Aquifer tests are necessary to evaluate the water-yielding capability of an aquifer at any location.

BEDROCK

The study area is underlain by a variety of crystalline bedrock types. Wells drilled in bedrock for domestic water supplies are commonly 100 to 300 feet deep and generally yield 2 to 10 gal/min. The maximum recorded yield from a bedrock well in the basin is 225 gal/min.

GROUND WATER QUALITY

Most ground water is of good quality and satisfactory for domestic and municipal use. In general, ground water is soft to moderately hard (hardness, 0-120 mg/L as $CaCO_3$) and mildly acid to slightly alkaline (pH, 6.0-7.5).

Iron, or manganese, or both, in excess of EPA (U.S. Environmental Protection Agency, 1975) recommended limits for drinking water (0.3 mg/L and 0.25 mg/L, respectively) were present in water from some wells. Water is likely to contain excess concentrations of these metals where the water is chemically reducing. This condition is common under and adjacent to swampy areas containing organic material.

Chloride concentrations are generally less than 10 mg/L; however, many wells have elevated chloride concentrations, which are presumably a result of highway salting and an increase in the discharge of wastewater. Chlorided concentrations in ground water exceeding EPA's recommended limit of 250 mg/L for drinking water have been caused by the outside storage of deicing salt. These elevated concentrations have resulted in the closing of a municipal well field in Sudbury and in the contamination of private wells in Carlisle.

Complex organic compounds in low concentrations considered unsafe for human consumption have been detected in ground water at several locations. Benzene, toluene, trichloroethylene, chloroform, and chlorobenzene are examples of hydrocarbons detected in ground water in the area. The presence of these chemicals in ground water has resulted from faulty methods of use, storage, and disposal. The presence of these chemicals has resulted in the closing of at least three public-supply wells in Acton and Hudson.

Base from U.S. Geological Survey, 1:24,000 Ayer, 1970; Billerica, 1966; Clinton, 1965; Concord, 1970; Framingham, 1965; Grafton, 1969; Holliston, 1969; Hudson, 1966; Lowell, 1966; Marlborough, 1969; Maynard, 1965; Milford, 1968; Nashua South, 1965; Natick, 1970; Shrewsbury, 1969; Pepperell, 1965; Westford, 1966

SCALE 1:48 000
1 0 1 2 3 MILES
1 0 1 2 3 4 5 KILOMETERS
CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION
AQUIFER AREAS AND CHARACTERISTICS

SURFICIAL DEPOSITS

Distribution of surficial deposits is adapted from that shown on geologic maps referenced on this sheet and from surficial geologic maps of Nashua South (formerly Tyngsboro) and Lowell quadrangles, Massachusetts-New Hampshire (R. H. Jahns, written commun., 1960); surficial geologic maps of parts of Billerica and Westford quadrangles, Massachusetts (R. H. Jahns and others, written commun., 1960); and reconnaissance surficial maps of Marlborough and part of Grafton and Milford quadrangles, Massachusetts (B. P. Hansen, unpublished).

STRATIFIED GLACIAL DEPOSITS

Transmissivity greater than 4,000 ft^2/d (potential well yield greater than 300 gal/min).

Transmissivity 1,350-4,000 ft^2/d (potential well yield , 100 to 300 gal/min).

Transmissivity less than 1,350 ft^2/d (potential well yield less than 100 gal/min).

Areas where transmissivity may be greater than indicated by the color shown.

These deposits consist of stratified and sorted sand, gravel, cobbles, boulders, silt, and clay. Colors on map indicate estimated aquifer transmissivity. Transmissivity is the rate at which water of prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient, expressed in feet squared per day (ft^2/d—see note). Potential well yields are based on transmissivity and are for properly designed and constructed individual wells at sites that have been located after exploratory drilling.

TILL DEPOSITS

Transmissivity, 0-100 ft^2/d (potential well yield generally less than 10 gal/min).

Till is a poorly sorted mixture of clay, silt, sand, gravel, and cobbles, with low transmissivity and thus is not a good aquifer. However, where saturated, till may provide low yields sufficient to supply single-family homes from dug wells. Some minor stratified glacial deposits are included in the areas mapped as till because they have little or no saturated thickness and have potential well yields similar to till. Also included are areas where bedrock is exposed.

BEDROCK

Crystalline bedrock underlies the entire study area. Yields are commonly 2–10 gal/min to individual wells.

WELL LOCATIONS

63/75 Public water-supply well or well field. (See table 4.).

Upper number identifies well. The U.S. Geological Survey numbers all wells consecutively within each town. Lower number, if present, is reported pumping capacity, in gallons per minute.

38 Observation wells

Wells where the U. S. Geological Survey makes monthly water-level measurements. Number is U. S. Geological Survey well number.

Basin boundary

NOTE.—ft^2/d is a mathematical reduction of cubic feet of water per day per foot of aquifer cross section.

HYDROLOGY AND WATER RESOURCES OF TRIBUTARY BASINS TO THE MERRIMACK RIVER FROM SALMON BROOK TO THE CONCORD RIVER, MASSACHUSETTS

By
Richard A. Brackley and Bruce P. Hansen

1985

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