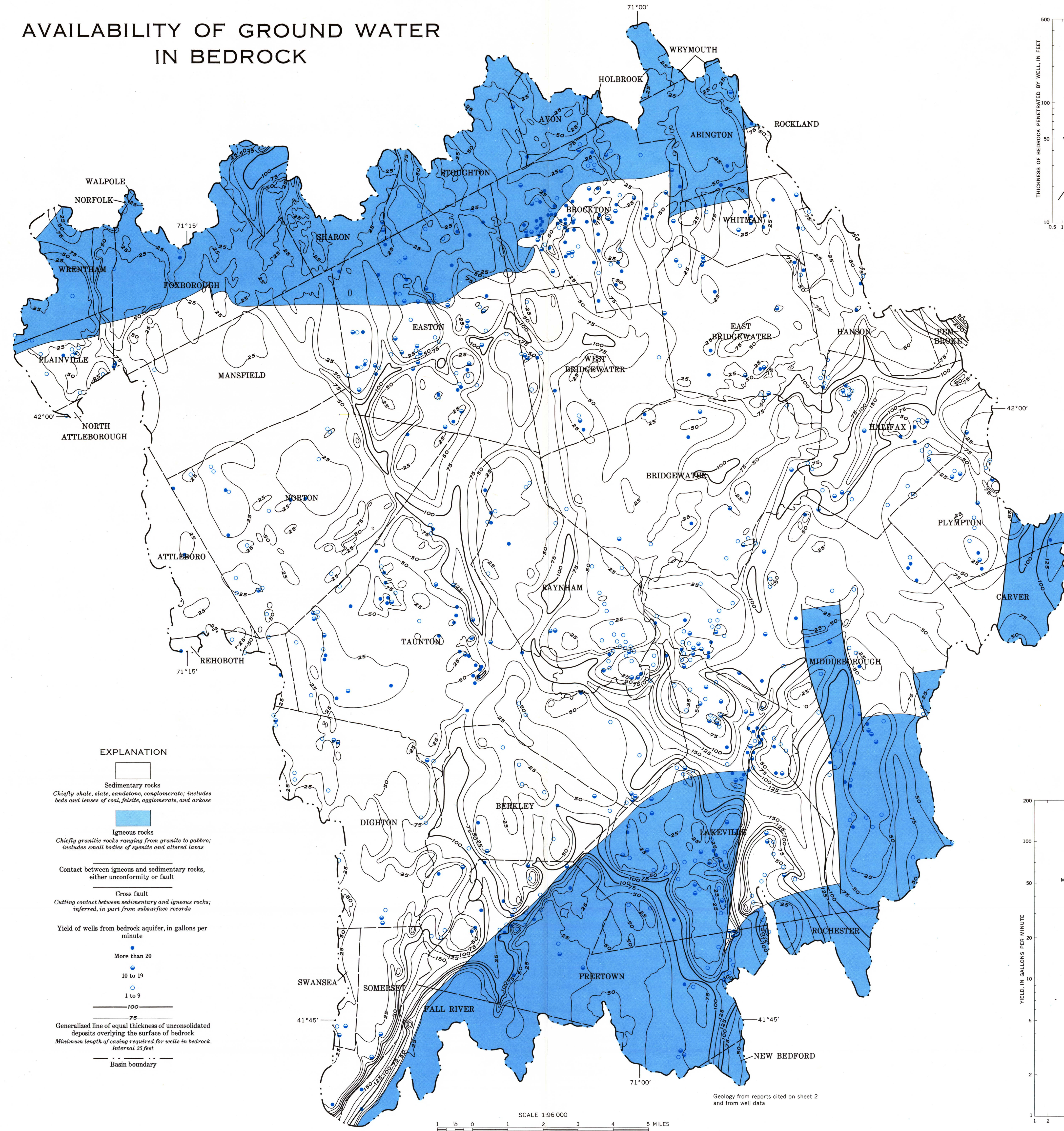
PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF MASSACHUSETTS
WATER RESOURCES COMMISSION

AVAILABILITY OF GROUND WATER IN BEDROCK



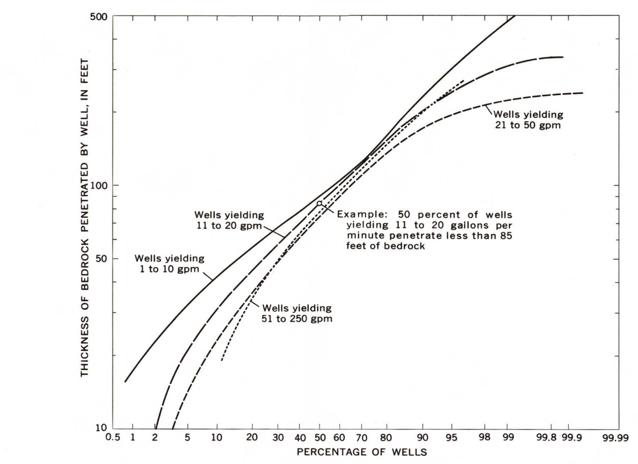


FIGURE 1.—*Yield of domestic wells and of industrial, commercial, and institutional wells in bedrock.*

Almost all water from the bedrock aquifers is obtained from secondary fractures, such as joints or faults, that are within the upper 200 feet of the bedrock. At depths greater than 200 feet below the bedrock surface the chances of increasing well yield significantly become less because the fractures are generally smaller and less numerous than in the upper 200 feet of bedrock (fig. 1). The most favorable sites for locating large supplies of water are faults and related fracture zones and along contacts between sedimentary and igneous rocks. Because much of the bedrock is covered by unconsolidated deposits, only limited data on the fracture systems and the rock types are available.

Yield of bedrock wells ranges from a few pints to 250 gallons per minute (fig. 2). Domestic wells finished in igneous rock do not differ significantly in yield from those finished in sedimentary rock. However, yield of industrial wells finished in sedimentary rock is generally greater than that of wells in igneous rock.

To reach bedrock the driller must drill through and case off the unconsolidated overburden which is known to be as much as 216 feet thick. Thickness of overburden, therefore, is important in planning construction of a well and estimating its cost. The lines showing equal thickness of unconsolidated overburden on the bedrock geohydrologic map are generalized and do not show details of thickness change which may be as much as 100 feet locally. Evaluations based on the thickness lines shown on the map should be supplemented, if possible, by local inquiry.

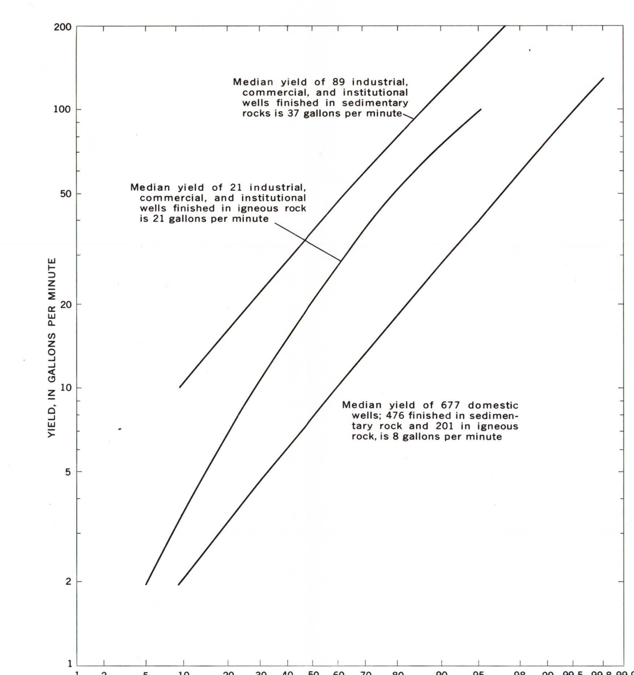
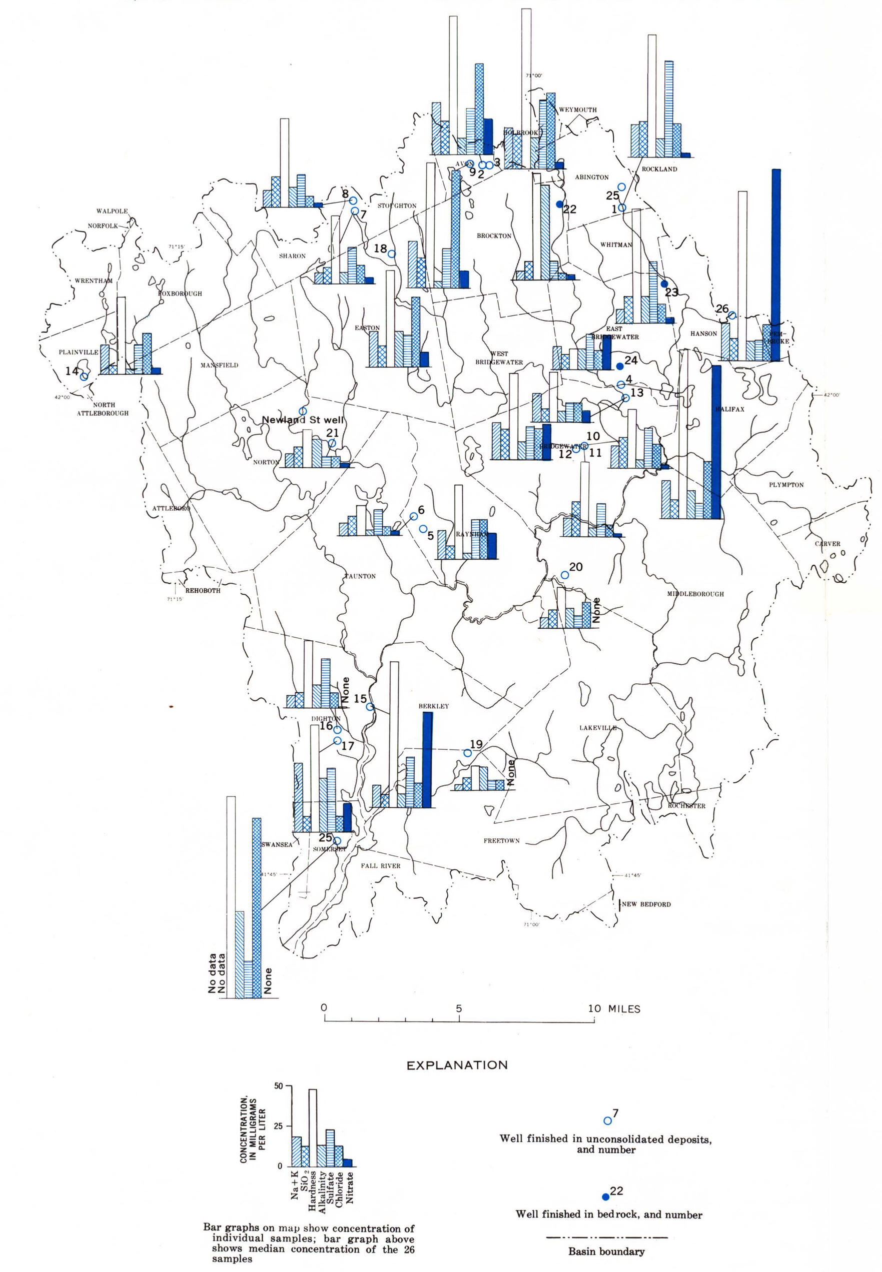


FIGURE 2.—*Relation of well yield to thickness of bedrock penetrated.*

QUALITY OF GROUND WATER

As shown by the chemical-quality map (fig. 3) and accompanying tables, ground water in the basin generally meets the standards recommended by U.S. Public Health Service (1962) for public water supplies. However, a large number of wells yield water that exceeds the standards for iron, manganese, and color. About one half of the test and public-supply wells and almost all of the bedrock wells exceed the standard—0.3 mg/l (milligrams per liter)—for iron (fig. 4). The maximum known concentration of iron is 40 mg/l. About one quarter of the test and bedrock wells and one half of the public-supply wells exceed the standard—0.05 mg/l—for manganese (fig. 4). The maximum known concentration of manganese is 2.2 mg/l.

Excessive manganese in iron water reduces well yield (table 1) by causing encrustation of the well screen. Wells with this problem must be cleaned periodically to maintain their yield.



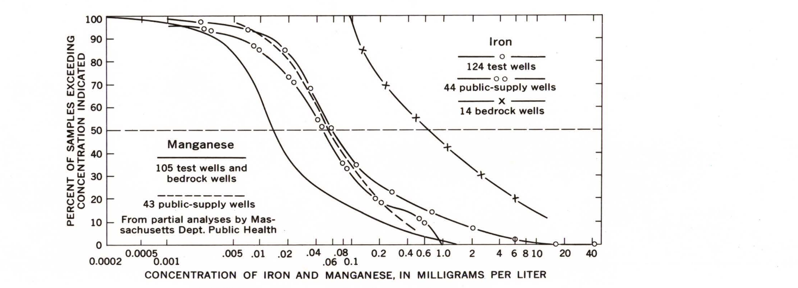


FIGURE 4.—*Concentration of iron and manganese.*

TABLE 1.—*Changes in the manganese content of Newland Street well, Station 3, Town of Norton. (Data from Massachusetts Department of Public Health and from Pittendreigh, 1963, p. 41.)*

Date of collection	Manganese (mg/l)	Remarks
6- 5-56	Very little	Well placed in service.
3-20-58	0.12	
7-16-58	.16	
12-23-58	.32	
4- 9-59	.25	Increase in manganese has cut yield from 450 to 275 gpm; well cleaned in 1959.
11-30-59	.50	
3- 1-61 to 4-21-61		Treated with chlorine and 25 mg/l glassy phosphate.
4-13-61	.00	
4-17-61	.06	
6-20-61	.09	
5- 1-61	.09	
5- 8-61	.19	
5-10-61	.19	
4- 1-62	.30	
5-31-66	.29	
8-22-67	.29	

TABLE 2.—*Summary of 26 ground-water analyses (Constituents, in milligrams per liter except pH, color, conductance, and turbidity; location of sample wells shown on fig. 3)*

Constituent	Maximum	Minimum	Median
Silica (SiO_2)----------	23	6.9	12
Iron (Fe)----------	.70	.00	.07
Manganese (Mn)----------	2.2	.00	.26
Calcium (Ca)----------	29	4	12
Magnesium (Mg)----------	14	1.0	3.8
Sodium (Na)----------	42	4.2	14
Potassium (K)----------	4.8	.2	1.8
Carbonate (CO_3)----------	3.6	.0	.0
Bicarbonate (HCO_3)----------	83	4	15
Sulfate (SO_4)----------	61	5.3	23
Chloride (Cl)----------	130	4.0	13
Fluoride (F)----------	.3	.0	.1
Nitrate (NO_3)----------	122	.0	.4
Dissolved solids----------	268	39	107
Hardness ($CaCO_3$)----------	116	13	48
Noncarbonate hardness----	96	0	32
pH----------	8.6	5.6	6.3
Color----------	27	0	2
Specific conductance----- (µmhos at 25°C)	369	43	135
Turbidity----------	7	0	0

Number on map	Local well number	Description of well or other source	Type of well[1]	Date sampled	Aquifer (Dominant material listed first)
1	ABW-50	Abington-Rockland Joint Water Board, Walnut Street Station	GP	1- 4-66	Sand and gravel
2	AVW-55	Town of Avon, well no. 1	GP	1-16-67	Gravel
3	AVW-56	Town of Avon, well no. 2	GP	1-16-67	Do.
4	EBW-5	H. Warren, 54 ft. well	T6	4-25-58	Sand and gravel
5	RAW-69	North Raynham Water District, First Street	GP	8-16-66	Gravel
6	RAW-10	North Raynham Water District well field	T6	8-16-66	Do.
7	SOW-107	Town of Stoughton, Station 4	GP	2-27-67	Gravel, sand
8	SOW-102	Town of Stoughton, Station 3	GP	2-27-67	Do.
9	AVW-54	Town of Avon, Porter Spring well	D	1-16-67	Gravel
10	BDW-71	Town of Bridgewater, Carver Pond no. 3	GP	1-23-67	Sand, gravel
11	BDW-72	Town of Bridgewater, Carver Pond no. 4	GP	1-23-67	Do.
12	--	Town of Bridgewater, High Street no. 2	GP	1-23-67	Sand
13	BDW-20	Town of Bridgewater, High Street no. 1	GP	1-23-67	Do.
14	PVW-51	Town of Plainville, George Street no. 1	GP	2-20-67	Gravel
15	DNW-9A	Bristol County Agricultural School	GP	3-27-56	Sand, gravel
16	SNW-216	Town of Somerset, Dighton Station no. 1	GP	2-27-67	Do.
17	SNW-217	Town of Somerset, Dighton Station no. 2	GP	2-27-67	Do.
18	EADW-1	Spring north of Elm Street, Easton	--	12- 8-67	--
19	PYW-60	Lincoln Park Trapshooting Club	T6	9-13-67	Gravel
20	MDW-175	Town of Middleborough, Clay Street test	T6	10-4-67	Sand, gravel
21	NRW-150	Town of Norton, Station 4, test well	T6	6-18-67	Sand, fine gravel
22	SNW-18	A.E. Hopgood well, 100 ft. deep	T6	8-24-56	Sedimentary rock
23	EBW-3	A. Shipping well, 90 ft. deep	T6	4-25-58	Do.
24	EBW-31	E.F. Hood & Sons, 625 ft. well	T6	4- 3-58	Do.
25	SNW-148	Town of Somerset, Pierce Lane well	GP	9-14-66	Sand and gravel
26	SNW-32	U.S. Geological Survey observation well	T6	4-24-58	Sand

Analyses 1-17 and 25 by Lawrence Experiment Station, Massachusetts Department of Public Health; analyses 18-24, 26, and 27 by U.S. Geological Survey.

[1] G, caisson; D, dug; GP, gravel packed; T, tubular (diameter of casing given in inches).

FIGURE 3.—*Chemical quality of ground water.*

Ground water is soft to moderately hard (<60 to 120 mg/l) and is acid to slightly acid (pH 4.5 to 7) (table 2). Hardness of both ground water and surface water used for public supply has increased since 1940, reaching maximum concentration at the end of the drought of 1963-67 (fig. 5). Since the end of the drought, hardness concentration has almost declined to pre-drought levels.

Chloride concentration of both ground and surface water has slowly increased in public supplies from the first analyses in 1890 (Jackson, 1905, pl. IV; Kingsbury and Smith, 1943; Motts and Saines, 1963, p. 23-38) to a maximum at the end of the drought of 1963-67 (fig. 6). The long-term increase was due to compounded contamination by dumps, sewage-disposal works, and use of salt on highways for snow and ice removal. The lack of water available for dilution during the drought accentuated the increase.

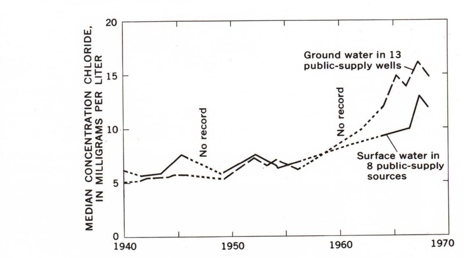


FIGURE 6.—*Increase in chloride concentration in ground water supplies compared to that in surface water.*

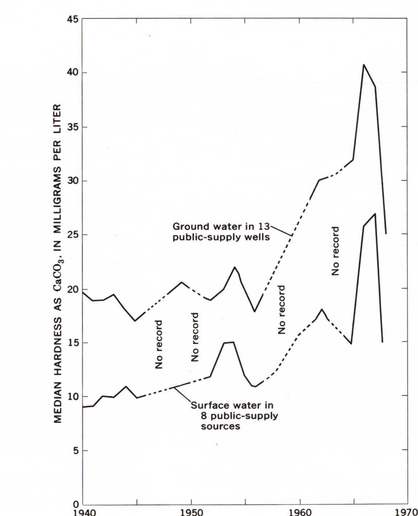


FIGURE 5.—*Increase in hardness of ground water supplies compared to that in surface water.*

The average temperature of ground water is about 11°C (52°F). Water temperature in unconsolidated deposits ranges from 7° to 12°C (45° to 54°F) and averages about 10°C (50°F). Seasonal temperature changes of several degrees may be expected to a depth of 30 to 50 feet below the land surface, the greatest change occuring at the water table. The time lag of these changes with respect to seasonal air-temperature changes increases with depth to as much as several months near the level of zero annual temperature change.

Trace elements—arsenic, barium, cadmium, chromium, copper, cyanide, fluoride, lead, selenium, and silver—in ground-water samples from the Pierce Lane and Dighton Station wells, town of Somerset, did not exceed the recommended standards in 1964 and 1966, according to analyses by Massachusetts Department of Public Health. Analyses are not available for other wells.

Saline or brackish ground water having a chloride concentration greater than 500 mg/l is restricted to aquifers bounding the estuary of the Taunton River in Berkley, Freetown, Fall River, Dighton, and Somerset. Overpumping of wells in aquifers adjacent to the estuary has induced movement of the fresh water-salt water interface toward the wells. Consequently some wells have been abondoned or their pumping rates decreased because of the increased salinity. Flooding of lowlands bordering the estuary during the 1938 hurricane contaminated many dug and tubular wells finished in unconsolidated aquifers but did not contaminate wells finished in bedrock (Hynes, 1942, p. 355 and 359).

QUALITY OF SURFACE WATER

Surface water is generally soft (<60 mg/l hardness), slightly acid (average pH of 6.5), and low in dissolved mineral content. Surface waters receive many types of industrial waste and municipal sewage effluent. However, with treatment and pollution abatement, the water is suitable for domestic use. Even without treatment, the water is suitable for agricultural and many industrial uses.

Specific conductance is an indicator of the amount of mineral matter dissolved in the water. Because specific conductance can be measured in the field, an approximation of selected mineral constituents can be determined in the field (see figs. 7-10). Graphs show that the specific conductance and dissolved mineral content is greater at low discharge than at high discharge. Data for the Taunton River, however, plot in two curves that appear to show that specific conductance may increase or decrease with discharge.

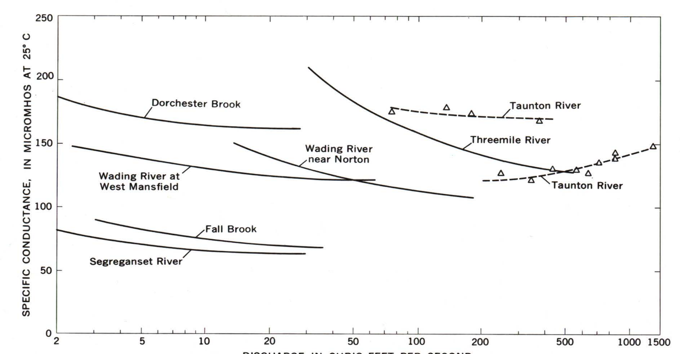


FIGURE 7.—*Relation of specific conductance and discharge for six gaging stations.*

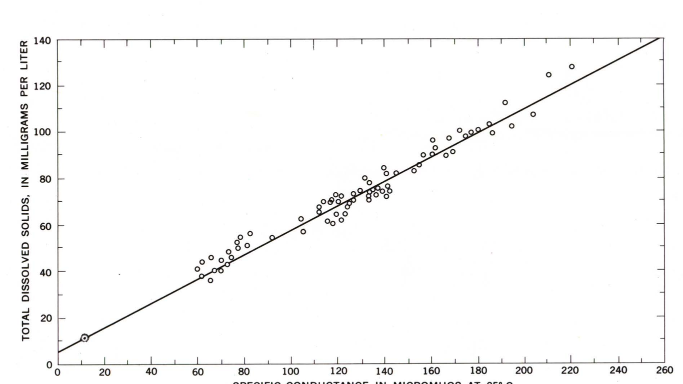


FIGURE 8.—*Relation between specific conductance and total dissolved solids.*

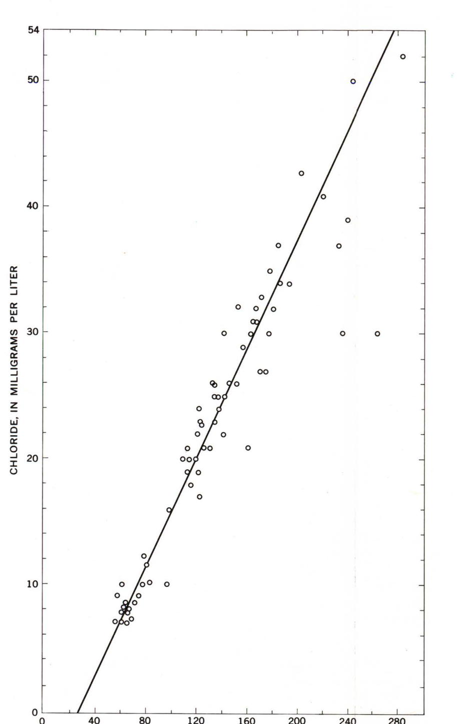


FIGURE 9.—*Relation between specific conductance and chloride concentration.*

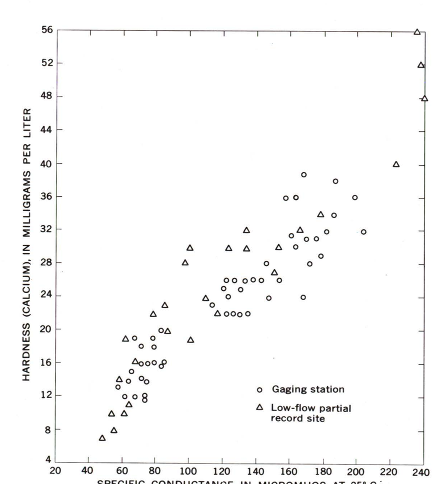


FIGURE 10.—*Relation between specific conductance and hardness.*

Samples collected during low flow show the probable maximum concentration of chemical constituents in surface water (see fig. 11 and table 3).

TABLE 3.—*Summary of 31 analyses of samples collected at low-flow partial-record sites, August 1967. (Constituents, in milligrams per liter except* pH, *color, and conductance; location of sampled sites shown on fig. 11).*

Constituent	Maximum	Minimum	Median
Silica (SiO_2)------------	19	5.4	9.4
Iron (Fe)----------------	2.4	.07	.56
Manganese (Mn)-----------	.53	.06	.13
Calcium (Ca)-------------	24	1.8	8.7
Magnesium (Mg)-----------	6.1	.6	1.6
Sodium (Na)--------------	50	4.5	12
Potassium (K)------------	7.8	0	.8
Bicarbonate (HCO_3)--------	64	3	16
Carbonate (CO_3)----------	0	0	0
Sulfate (SO_4)------------	55	1.8	11
Chloride (Cl)------------	83	7.1	20
Fluoride (F)-------------	.6	.1	.2
Nitrate (NO_3)------------	34	.4	1.6
Dissolved solids---------	251	34	76
Hardness ($CaCO_3$)---------	85	7	30
Noncarbonate hardness-----	62	4	15
pH----------------------	7.4	5.1	6.7
Color--------------------	380	7	80
Specific conductance------ (µmhos at 25°C)	448	48	124

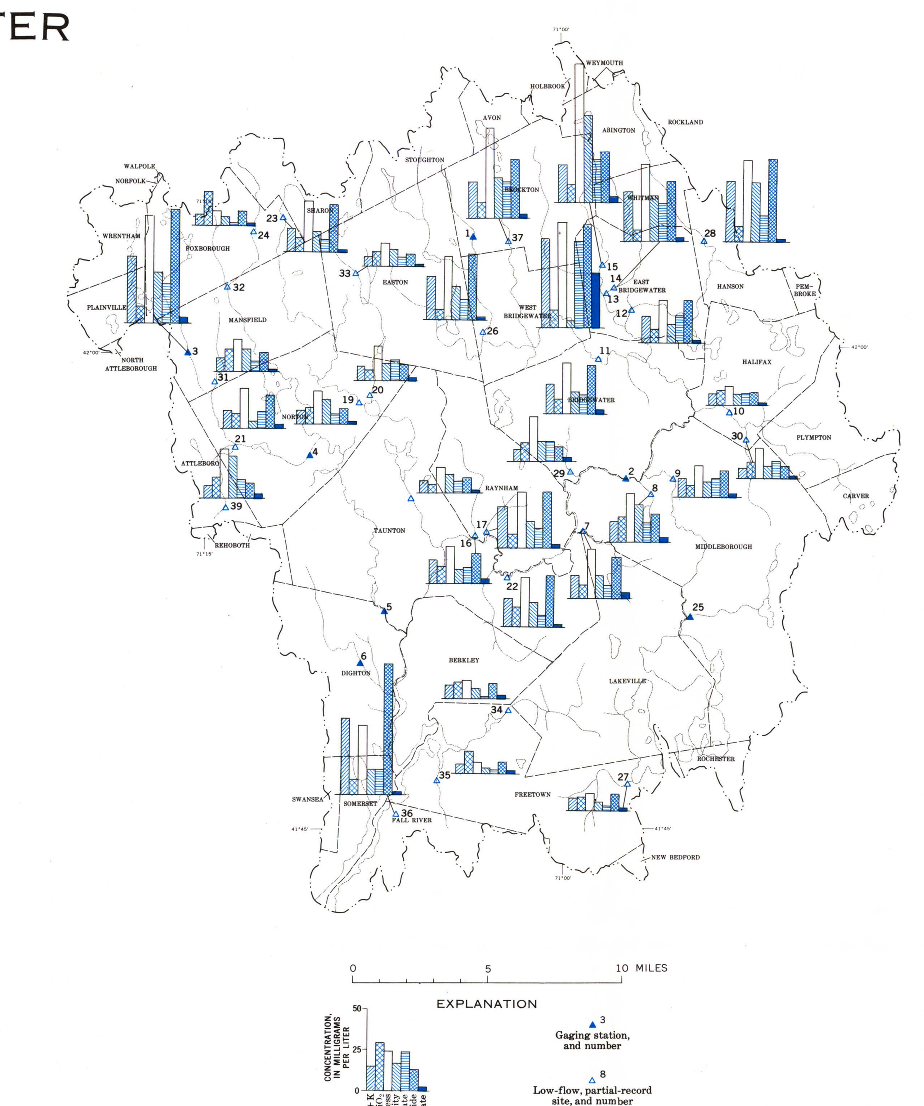


FIGURE 11.—*Chemical quality of samples from selected streams during base flow period, August 22-25, 1967.*

Color exceeds the recommended standard of 15 units (U.S. Public Health Service, 1962) at all seven gaging stations much of the time. Most determinations of color from water samples collected at the gaging stations are within or very near the range of values for the two stations on the Wading River shown on the graph (fig. 12).

Of the monthly samples collected at six gaging stations (fig. 13), 47 percent exceed 0.3 mg/l iron and 92 percent exceed 0.05 mg/l manganese—the recommended standards of the U.S. Public Health Service (1962) for public-water supplies.

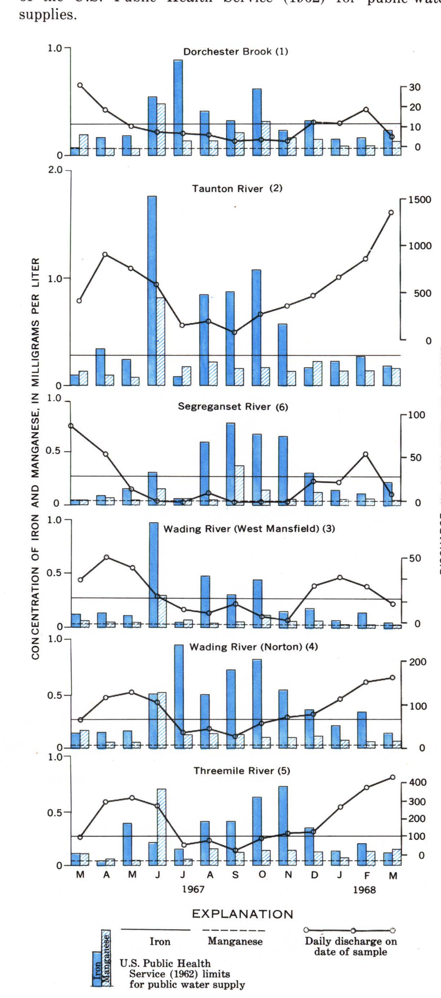


FIGURE 13.—*Relation of discharge to concentration of iron and manganese at six gaging stations, 1967-68.*

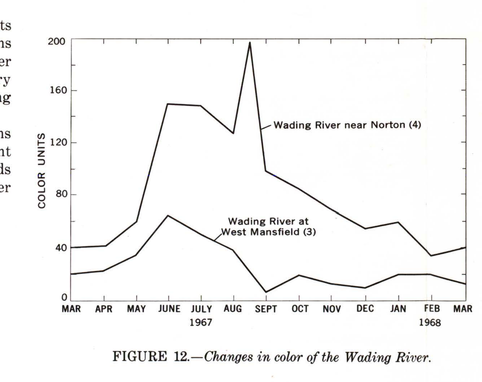


FIGURE 12.—*Changes in color of the Wading River.*

Sediment load is greatest during high flows. The usual sediment load of the Taunton River at State Farm is less than 10 tons per day; however, a load of about 675 tons per day has been recorded (table 4). High sediment loads can be a problem to industrial users who pump water directly from streams to their plants.

Turbidity, the ability of water to transmit or reflect light, is caused by the presence of insoluble material. High turbidity is not limited to periods of high discharge (table 4). Turbidity exceeded the U.S. Public Health Service (1962) recommended standards of 5 units on three of the monthly measurements between May 1967 and December 1968.

TABLE 4.—*Analyses of suspended sediment and turbidity of Taunton River at State Farm*

Date of collection	Instantaneous flow (cfs)	Sediment concentration (mg/l)	Measured sediment load (tons/day)	Turbidity (as mg/l S_1O_2)
5- 1-67	535	6	8.7	4
5-25-67	605	32	52.3	2
5-29-67	2,290	11	68.0	2
7-14-67	362	9	8.8	3
12-22-67	340	6	5.5	4
2- 5-68	2,020	10	54.5	3
3- 8-68	333	19	17.1	3
3-19-68	4,380	57	674.1	9
4-26-68	896	20	48.4	9
6-19-68	510	19	26.2	5
7-26-68	124	14	4.7	-
9-12-68	111	8	2.4	1
10-18-68	43	10	1.2	3
12- 3-68	309	10	8.3	7

SELECTED REFERENCES

Allen, W. B., and Ryan, D. J., 1960, Ground-water map of the Fall River quadrangle, Massachusetts-Rhode Island: Rhode Island Water Resources Coordinating Board, Ground-Water Map 7.
Chute, N. E., 1950a, Surficial geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey. Geol. Quad. Map GQ-6.
——1950b, Bedrock geology of the Brockton quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-5.
——1965, Surficial geologic map of the Blue Hills quadrangle, Norfolk, Suffolk, and Plymouth Counties, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-463.
Cohen, Philip, and others, 1969, Hydrologic effects of the 1962-66 drought on Long Island, New York: U.S. Geol. Survey Water-Supply Paper 1879-F, p. F1-F18.
Hartshorn, J. H., 1960, Geology of the Bridgewater quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-127.
——1967, Geology of the Taunton quadrangle, Bristol and Plymouth Counties, Massachusetts: U.S. Geol. Survey Bull. 1163-D, p. 1-67.
Hynes, V. M., 1942, Salt content of wells in Massachusetts affected by the tidal wave and hurricane of 1938: New England Water Works Assoc. Jour., v. 56, no. 3, p. 355-360.
Jackson, D. D., 1905, Normal distribution of chlorine in natural waters of New York and New England: U.S. Geol. Survey Water-Supply Paper 144, p. 9-31.
Kingsbury, F. H., and Smith, E. W., 1943, Variability in the normal chloride of surface and ground water supplies in Massachusetts: New England Water Works Assoc. Jour., v. 57, no. 1, p. 10-14.
Knox, C. E., and Johnson, C. G., Jr., 1965, Flood frequency formulas for Massachusetts: U.S. Geol. Survey open-file rept., 10 p., 1 pl.
Knox, C. E., and Nordenson, T. J., 1955, Average annual runoff and precipitation in the New England-New York area: U.S. Geol. Survey Hydrol. Inv. Atlas HA-7.
Knox, C. E., and Soule, R. M., 1949, Hydrology of Massachusetts: Part 1. Summary of streamflow and precipitation records: U.S. Geol. Survey Water-Supply Paper 1105, 240 p.
Koteff, Carl, 1964, Geology of the Assawompset Pond quadrangle, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-265.
Mather, K. F., Goldthwait, R. P., and Thiesmeyer, L. R., 1942, Pleistocene geology of western Cap Cod, Massachusetts: Geol. Soc. America Bull., v. 53, p. 1127-1174.
Motts, W. S., and Saines, Marvin, 1969, The occurrence and characteristics of ground-water contamination in Massachusetts: Univ. Massachusetts (Amherst), Water Resources Res. Center, Pub. 7, 70 p.
Petersen, R. G., and Shaw, C. E., Jr., 1961, Ground water favorability map of the Brockton-Pembroke area, Massachusetts: Mass. Water Resources Commission, Hydrol. Inv. Map. HI-1.
——1967, Surficial geologic map of the Whitman quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-632.
Pittendreigh, L. M., 1963, Use of chemical injection wells to suppress biologic activity and to stabilize iron and manganese in ground waters: New England Water Works Assoc. Jour., v. 77, no. 1, p. 35-50.
Shaler, N. S., Woodworth, J. B., and Foerste, A. F., 1899, Geology of the Narragansett Basin: U.S. Geol. Survey Mon. 33, 402 p.
Shaw, C. E., Jr., and Petersen, R. G., 1967, Surficial geologic map of the Hanover quadrangle, Plymouth County, Massachusetts: U.S. Geol. Survey Geol. Quad. Map GQ-633.
U.S. Dept. Commerce, Weather Bureau, 1953, Climatic summary of the United States—supplement for 1931 through 1952: Washington, D.C., Climatography of the United States 11-23, New England, 91 p.
——1960, Climatic summary of the United States (to 1930): Washington, D. C., Climatography of the United States 10-23, New England, 44 p.
U.S. Geological Survey, 1954, Compilation of records of surface waters of the United States through September 1950, part 1-A, North Atlantic slope basins, Maine to Connecticut: U.S. Geol. Survey Water-Supply Paper 1301, 380 p.
——1962-65, Surface water records of Massachusetts, New Hampshire, Rhode Island, Vermont, 1961-64: Boston, Mass., Water Resources Division, (issued annually).
——1964, Compilation of records of surface waters of the United States, October 1950 to September 1960, part 1-A, North Atlantic slope basins, Maine to Connecticut: U.S. Geol. Survey Water-Supply Paper 1721, 317 p.
——1966-68, Water resources data for Massachusetts, New Hampshire, Rhode Island, Vermont, 1965-67: Boston, Mass., Water Resources Division, (issued annually).
U.S. Public Health Service, 1962, Public Health Service drinking water standards, 1962: U.S. Dept. Health, Education, and Welfare, Public Health Service, Pub. 956, 61 p.
Williams, J. R., 1968, Availability of ground water in the northern part Tenmile and Taunton River basins, southeastern Massachusetts: U.S. Geol. Survey Hydrol. Inv. Atlas HA-300.
Williams, J. R., and Willey, R. E., 1970, Taunton River basin: U.S. Geol. Survey basic-data rept. 12, Ground Water series, 102 p. (Incorporates data published in basic-data repts. 5, 7, and 10.)
Other sources of information:
City and town annual reports; annual reports and engineering studies by and for city and town Water Departments or departments of Public Works; engineering studies for Massachusetts Dept. Public Works and Water Resources Commission; Massachusetts House and Senate documents; Massachusetts and Federal census reports; records of Massachusetts Dept. Public Health; engineering reports prepared for Central Plymouth County Water District Commission and for Southeastern Massachusetts Regional Planning and Economic Development Commission.

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1973—W71345

WATER RESOURCES OF THE TAUNTON RIVER BASIN, SOUTHEASTERN MASSACHUSETTS

By
J. R. Williams, D. F. Farrell, and R. E. Willey
1973