DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
STATE OF MAINE PUBLIC UTILITIES COMMISSION

HYDROLOGIC INVESTIGATIONS
ATLAS HA-337

INTRODUCTION

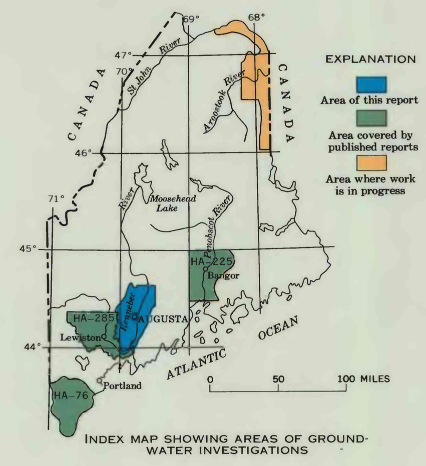
This report is one of a series describing the geologic and hydrologic conditions governing the occurrence of ground water in Maine. (See index map.) These reports are intended to provide information to those wishing to develop water supplies, particularly supplies large enough for public or industrial use, from ground-water sources. The magnitudes of yields that might be expected from properly located and constructed wells of 6 inches or more in diameter are indicated by the map showing ground-water favorability areas and surficial geology. This map gives a generalized interpretation of observed geologic and hydrologic data. It provides a logical basis for directing detailed exploration for ground water but does not eliminate the need for such exploration.

EXPLANATION

SURFICIAL GEOLOGY

System	Series	Geologic unit	Thickness (feet)	Character	Water-bearing characteristics
QUATERNARY	Holocene	Qal — Alluvium. *Shown only where extensive*	0-34*	Sand, silt, and clay, with some gravel, of river flood plains and fluviatile terraces	In valleys of small streams may occur as small discontinuous patches adjacent to channels, but in places along the Kennebec River between Shawmut and Richmond forms a mappable unit. Deposits are generally thin, fine grained, and subject to inundation by flooding, and are not considered a significant aquifer. In Dresden and Bowdoinham includes a few broad areas of fluviatile sand, which yields water to a few wells, but does not constitute a major aquifer because it is relatively thin and fine grained
		Qs — Swamp deposits. *Shown only where extensive*	0-18*	Partly decomposed organic matter—leaves, moss, rushes, heath plants, and grass—and some intermixed silt, clay, and sand	Yields water to some springs and dug wells. May contain a considerable amount of water, which may be released slowly to underlying deposits or to streams flowing through or issuing from them. Contained water is likely to be acidic, highly colored, or high in nitrate or other organic matter
		Qed — Eolian deposits. *Shown only where extensive*	0-25	Fine to medium sand and silt. Generally occurs as fixed, vegetated sand dunes, but also includes some areas of active dunes. Includes some patches of wind-deposited silt (loess)	A source of small quantities of water to a few dug or driven wells. Fineness of grain size and generally high topographic position preclude obtaining large yields from this unit
	Pleistocene	Qow — Outwash	0-71*	Stratified sand and some gravel in outwash plains. May overlie or interfinger with marine deposits	Outwash yields small quantities of water to dug or driven wells. In a few areas properly constructed and developed wells might yield 50 to 100 gpm (gallons per minute), but generally yields of this magnitude are precluded by the fineness of grain size and lack of sufficient thickness of material. Water is generally of good quality
		Qm — Marine deposits	0-205*	Dark-blue to gray silt, clay, and fine to very fine sand. Tan colored where weathered. Contains layers of sand and gravel, a few inches to a few feet in thickness	Yields small quantities of water to dug wells and springs
		Qic — Ice-contact deposits	0-150*	Well-stratified to poorly stratified deposits of sand, gravel, and cobbles, with some silt, clay and boulders	The source of the largest supplies of ground water in the lower Kennebec Basin. Under most favorable conditions—where deposits are coarse grained, have a large saturated thickness, and are in hydraulic continuity with a body of surface water for induced recharge-yields of more than 1,000 gpm can be obtained. Water is of good quality though locally contains excessive iron
SILURIAN TO QUATERNARY	Pre-Pleistocene and Pleistocene	Qgt — Till / Bedrock		Till and bedrock are mapped together	
		Till	0-260*	A heterogeneous mixture of clay, silt, sand, gravel, cobbles, and boulders. Some deposits are sandy or gravelly and resemble ice-contact deposits except for lack of stratification. Other deposits are rich in clay and very dense or are very bouldery. In some exposures the upper few feet appears to have been washed by water	Till is widespread and is the source of water to many dug wells and springs and some drilled wells. Sustained yield of most dug wells is less than 1 gpm. Dug wells are likely to go dry in the summer. One drilled well in till is reported to yield 25 gpm. Water is generally of good quality except that dug wells are subject to contamination
		Bedrock		Igneous and metamorphic rocks including granite, pegmatite, gneiss, schist, slate, and phyllite	The bedrock formations are dense and impermeable and contain little water compared to their total volume. They contain recoverable water only in secondary openings such as cleavage or bedding planes, fractures, or solution openings. Based on present knowledge it is virtually impossible to predict accurately the depths at which water-bearing zones will be found and how much water will be available to wells. The water in bedrock is generally confined under artesian conditions—that is, the water will rise in a well to a level above that at which it is reached by the drill. Several wells for which information is available flowed at the land surface when drilled. Water is of good chemical quality but is moderately hard

*Maximum values from drillers' logs.



INDEX MAP SHOWING AREAS OF GROUND-WATER INVESTIGATIONS

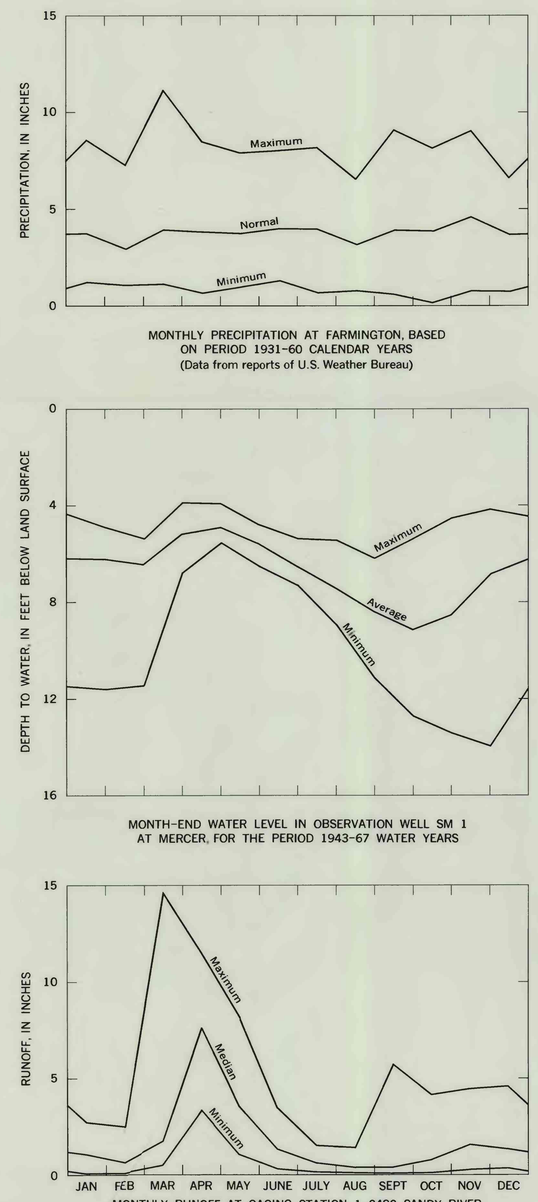
FAVORABILITY AREAS

More than 50 gpm

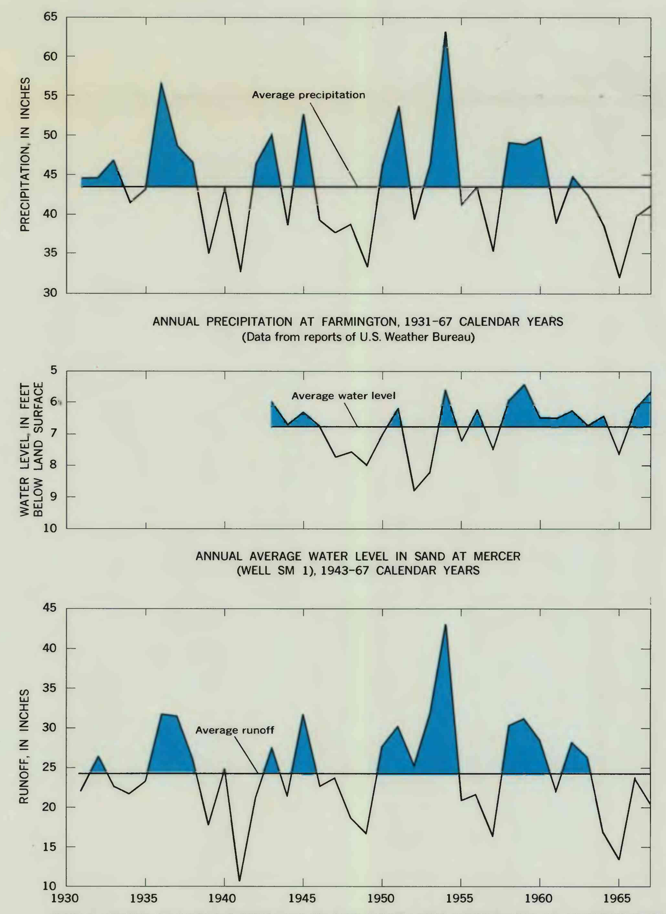
Areas most favorable for the location of wells that will yield more than 50 gpm (gallons per minute). Water-bearing materials are stratified sand and gravel of glaciofluvial origin, particularly ice-contact deposits. The largest yields are obtainable in valleys where the deposits have a large saturated thickness and are in hydraulic continuity with an adjacent body of surface water as a source of induced recharge. Under favorable circumstances as much as 1,250 gpm has been obtained from individual wells in the area. Water is generally of good chemical quality

10–50 gpm

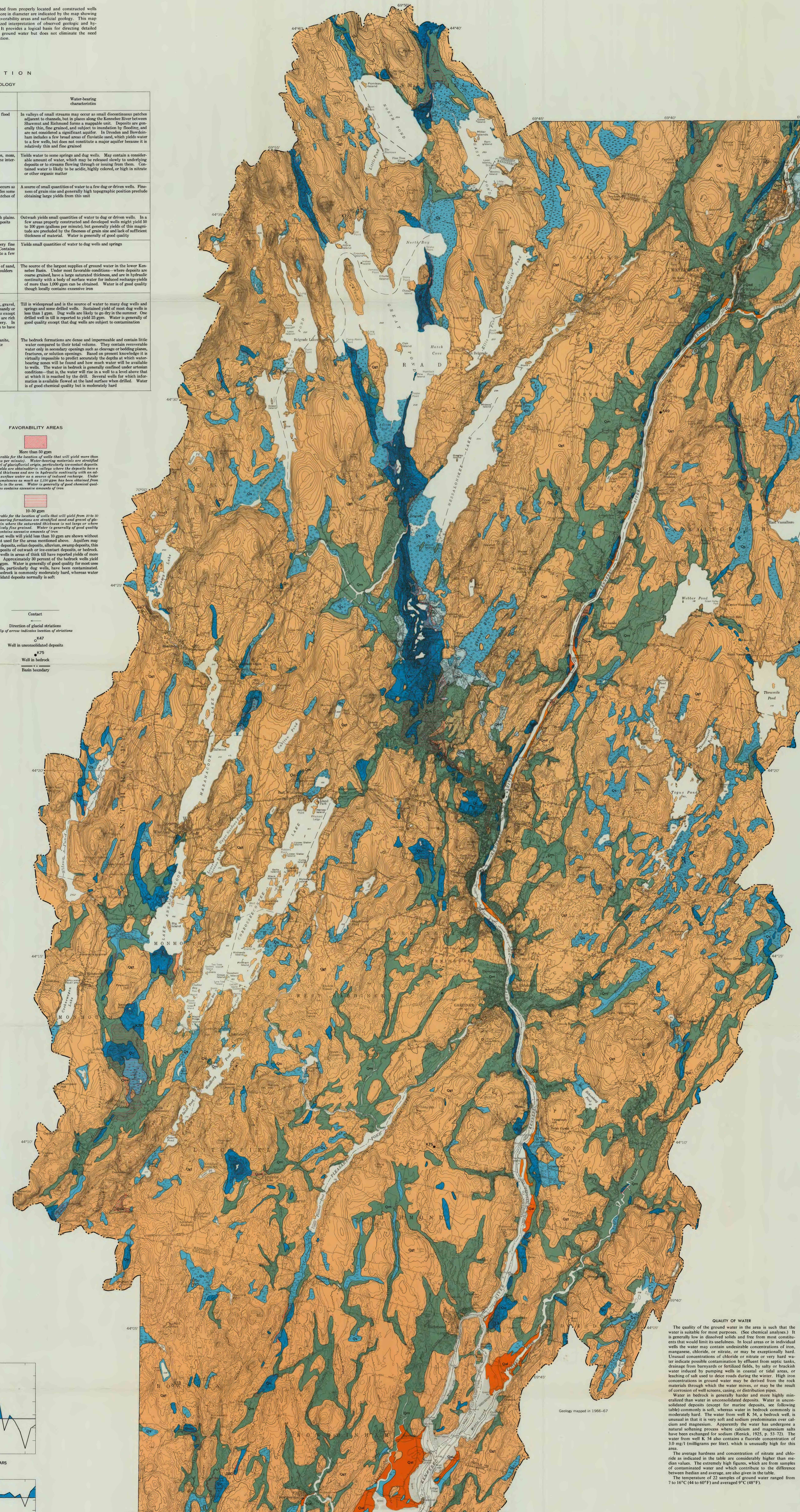
CLIMATE, GROUND-WATER LEVELS, AND STREAMFLOW



CORRELATION OF MONTHLY PRECIPITATION, MONTH-END GROUND-WATER LEVEL, AND MONTHLY RUNOFF IN THE SANDY RIVER BASIN, A PART OF THE KENNEBEC RIVER BASIN ADJACENT TO THE MAPPED AREA



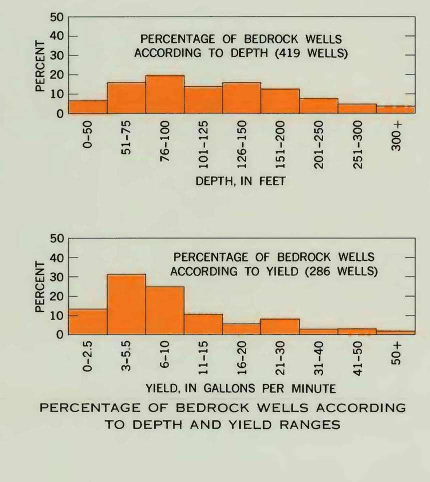
CORRELATION OF PRECIPITATION, GROUND-WATER LEVELS AND RUNOFF IN THE SANDY RIVER BASIN



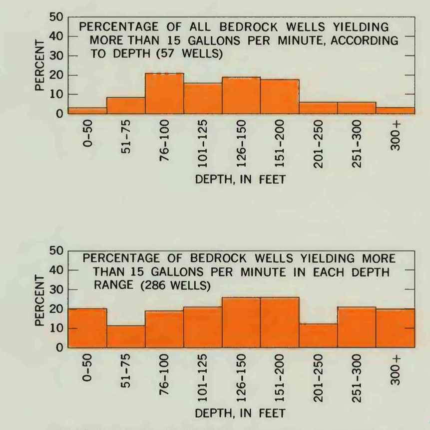
WELLS COMPLETED IN BEDROCK

The bedrock wells recorded during this study ranged from 26 to 700 feet in depth. The average depth was 135 feet and the median depth was 115 feet. (See graphs below.) The yields of bedrock wells ranged from 0 to 67 gpm (gallons per minute). The average yield was 11 gpm and the median yield was 7 gpm. Yield figures are based on information supplied by drillers from bailing or pumping tests that were made at the time of drilling.

Of the 286 bedrock wells of known yield, 57, or about 1 in 5, had yields of more than 15 gpm. (See graphs below.) The largest number of wells for which information is available is in the 76- to 100-foot depth range, and as might be expected, the greatest number of wells of large yield (more than 15 gpm) is in this depth range as well as the greatest number yielding 15 gpm or less. However, a slightly larger percentage of the wells in the 101- to 125-, 126- to 150-, and 151- to 200-foot depth range than in the 76- to 100-foot range had yields exceeding 15 gpm.



PERCENTAGE OF BEDROCK WELLS ACCORDING TO DEPTH AND YIELD RANGES



PERCENTAGE OF BEDROCK WELLS YIELDING MORE THAN 15 GALLONS PER MINUTE

QUALITY OF WATER

The quality of the ground water in the area is such that the water is suitable for most purposes. (See chemical analyses.) It is generally low in dissolved solids and free from most constituents that would limit its usefulness. In local areas or in individual wells the water may contain undesirable concentrations of iron, manganese, chloride, or nitrate, or may be exceptionally hard. Unusual concentrations of chloride or nitrate or very hard water indicate possible contamination by effluent from septic tanks, drainage from barnyards or fertilized fields, by salty or brackish water induced by pumping wells in coastal or tidal areas, or leaching of salt used to deice roads during the winter. High iron concentrations in ground water may be derived from the rock materials through which the water moves, or may be the result of corrosion of well screens, casing, or distribution pipes.

Water in bedrock is generally harder and more highly mineralized than water in unconsolidated deposits. Water in unconsolidated deposits (except for marine deposits, see following table) commonly is soft, whereas water in bedrock commonly is moderately hard. The water from well K 54, a bedrock well, is unusual in that it is very soft and sodium predominates over calcium and magnesium. Apparently the water has undergone a natural softening process where calcium and magnesium salts have been exchanged for sodium (Renick, 1925, p. 53–72). The water from well K 54 also contains a fluoride concentration of 3.0 mg/l (milligrams per liter), which is unusually high for this area.

The average hardness and concentration of nitrate and chloride as indicated in the table are considerably higher than median values. The extremely high figures, which are from samples of contaminated water and which contribute to the difference between median and average, are also given in the table.

The temperature of 22 samples of ground water ranged from 7 to 16°C (44 to 60°F) and averaged 9°C (48°F).

TABLE 1.—*Average, median, and extreme values of nitrate, chloride, hardness, and pH of ground water in the lower Kennebec River basin.*

Based on analyses made by Division of Sanitary Engineering State Bureau of Health. Analyses in miligrams per liter, except pH.

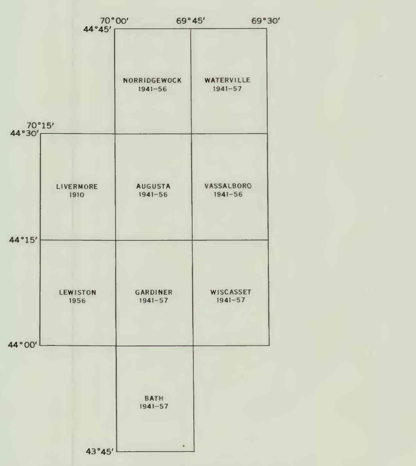
Aquifer	Bedrock	Marine deposits	Ice-contact deposits	Till	All unconsolidated deposits
Number of samples	93	7	17	71	95
Nitrate (N) Range	Trace – [1] 20	0.04–2.0	0.01–70	Trace – 35	Trace – 70
Average	1.21	.65	.29	1.44	1.28
Median	.09	.52	.25	.27	.30
Chloride Range	1 – [2] 700	1 – 550	1 – 26	1 – 115	1 – 550
Average	24	106	6	16	20
Median	7	34	4	7	6
Hardness Range	10 – 690	52 – 160	22 – 470	20 – 238	20 – 610
Average	104	206	76	70	80
Median	83	145	42	57	56
pH Range	6.3 – 8.6	6.4 – 7.3	6.1 – 7.9	5.7 – 8.9	5.7 – 8.9
Average	7.5	7.0	6.8	6.9	6.9
Median	7.5	7.1	6.7	6.9	6.9

[1] According to U.S. Public Health Service standards for drinking water, nitrate (as N) should not exceed about 10 mg/l.

[2] According to U.S. Public Health Service standards for drinking water, chloride should not exceed 250 mg/l.

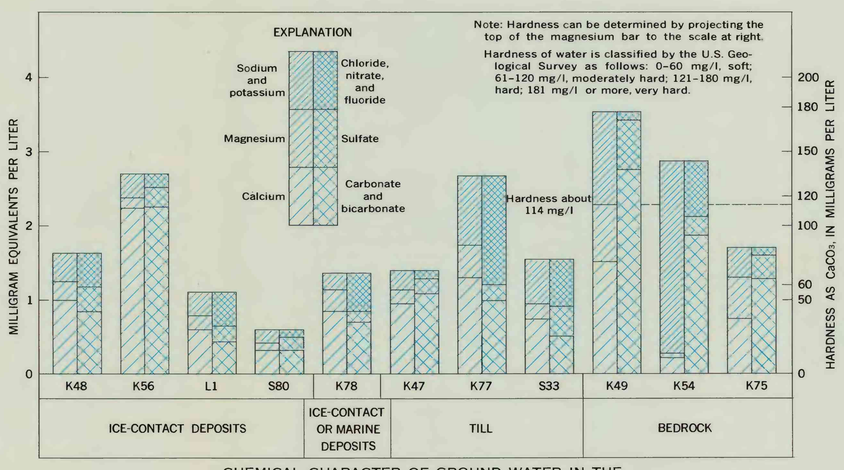
SELECTED REFERENCES

Hayes, G. S., 1966, Surface-water resources of Maine: Maine Water Util. Assoc. Jour., v. 42, no. 1, p. 21–25.
Leavitt, H. W., and Perkins, E. H., 1935, Glacial geology of Maine, v. 2, *of* A survey of road materials and glacial geology of Maine: Maine Tech. Expt. Sta. Bull. 30, 232 p.
Prescott, G. C., Jr., 1968, Records of selected wells, springs, and test holes in the lower Kennebec River basin: U.S. Geol. Survey open-file report.
Renick, B. C., 1925, Base exchange in ground water by silicates as illustrated in Montana: U.S. Geol. Survey Water-Supply Paper 520–D, p. 53–72.



INDEX SHOWING TOPOGRAPHIC QUADRANGLES USED IN BASE MAP

Base from U.S. Geological Survey topographic quadrangles (See index, lower right)



CHEMICAL CHARACTER OF GROUND WATER IN THE LOWER KENNEBEC RIVER BASIN

GROUND-WATER FAVORABILITY AREAS AND SURFICIAL GEOLOGY OF THE LOWER KENNEBEC RIVER BASIN, MAINE

By
Glenn C. Prescott, Jr.

1969

For sale by U.S. Geological Survey, price 75 cents