DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
STATE OF MAINE, PUBLIC UTILITIES COMMISSION

HYDROLOGIC INVESTIGATIONS
ATLAS HA–486

Base from U.S. Geological Survey
Bridgewater, Houlton, and Mars Hill, 1951

Geology mapped in 1969

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.
1973—W72380

EXPLANATION

SURFICIAL GEOLOGY

SYSTEM	SERIES	GEOLOGIC UNIT	THICKNESS (FEET)	CHARACTER AND OCCURRENCE	WATER-BEARING CHARACTERISTICS
QUATERNARY	*Holocene*	Qs Swamp deposits	0-10^a	Peat, organic muck, and silt in poorly drained areas. Deposits are very thin in bogs created recently by beaver dams or works of man.	Not known to yield water to wells in the area. Swamp deposits release water slowly to underlying formations or to streams issuing from or flowing through them.
		Qal Alluvium	0-15^b	Silt, sand, and gravel deposits adjacent to some streams. In streambeds consists largely of boulders. Deposits are generally thin, discontinuous, and of small areal extent. They are subject to flooding.	Alluvium is not known to yield water to wells in the area.
	Pleistocene	Qow Outwash	0-65^b	Stratified sand and gravel deposits with some silt, clay, and cobbles. Occurs in outwash plains and valley trains of small areal extent.	Outwash deposits are not a major source of water to wells in the area because of their thinness and small areal extent. However, in places outwash is capable of yielding 50 gpm or more to individual wells. The water is of good chemical quality but is moderately hard.
		Qic Ice-contact deposits	0-56^a	Well-stratified to poorly stratified deposits of sand, gravel, and cobbles, with some silt, clay, and boulders. Landforms include eskers (locally called horsebacks), crevasse fillings, kames, kame fields, and kame terraces. Deposits rest on till or bedrock.	Ice-contact deposits have not been tapped extensively for water but yield large quantities (as much as 1,000 gpm) to a few public-supply or industrial wells. **Where the deposits have a thick zone of saturation and are in hydraulic continuity with an adjacent body of surface water as a source of induced recharge, they have considerable potential as productive aquifers. Some of the outcrop areas are isolated or too high topographically to be regarded as significant sources of ground water. The water contained in ice-contact deposits is of good quality but is moderately hard to hard.**
ORDOVICIAN TO QUATERNARY	*Pre-Pleistocene to Pleistocene*	Till Qgt Bedrock Till and bedrock	0-70^b	Till and bedrock are mapped together Till is an unsorted, unstratified mixture of silt, clay, sand, gravel, cobbles, and boulders, which was deposited directly from the glacial ice once covering the region. Till is widespread and generally forms a thin cover over the bedrock. It has been identified in test holes beneath ice-contact deposits. Till is dense except for the upper few feet, which may have been reworked by frost action or running water. The Carys Mills Formation, which consists mainly of gray limestone and calcareous shale and siltstone, is the most widespread bedrock formation in the area. Other formations include: the Spragueville Formation, which is similar in composition to the Carys Mills; the Bell Brook, Smyrna Mills, and Chandler Ridge Formations; and several unnamed and undivided rock units. Rock types in these formations are: slate, graywacke, siltstone, quartzite, argillite, and conglomerate. In addition, some intrusive igneous rocks occur.	Till is the source of small amounts of water to some dug wells and springs. A few drilled wells may obtain water from gravelly zones in till. The water is hard. Bedrock nearly everywhere contains enough water for farm and home use and, in places, enough for small-scale industrial uses or public supplies. The bedrock is dense, and water in it is contained primarily in secondary openings such as joints, fractures, solution openings, and cleavage or bedding planes. The depth at which such water-bearing zones will be reached in drilling and how much water will be available to wells cannot be predicted accurately. Water is of good chemical quality but is hard. Water in bedrock is generally under artesian conditions – that is, the water will rise to a level in a well above that at which it is reached by the drill. Several wells for which information is available flowed at the surface when drilled.

[a] Maximum value from log of test hole.
[b] Maximum value from well record.

FAVORABILITY AREAS

▩

More than 50 gallons per minute

Areas most favorable for the location of wells of 6-inch diameter or larger that will yield more than 50 gpm from unconsolidated deposits. Water-bearing materials are outwash and ice-contact deposits. The largest yields are obtainable where the deposits have a thick saturated section and where they are in contact with an adjacent body of surface water which provides a source of induced recharge. The largest reported yield is 1,000 gpm.

▤

10 to 50 gallons per minute

Areas most favorable for the location of wells of 6-inch diameter or more that will yield from 10 to 50 gpm from unconsolidated deposits. Aquifers are ice-contact deposits or outwash where saturated thickness is small or where the aquifer is fine grained.

Areas where most wells will yield less than 10 gpm are shown without colored overprint. Aquifers include swamp deposits, alluvium, till, isolated or thin deposits of outwash or ice-contact deposits, and bedrock. About 40 percent of the bedrock wells for which information is available were capable of producing more than 10 gpm.

Contact

→
Direction of glacial striations
Tip of arrow indicates location of striations

○ Ar555
Well in unconsolidated deposits

● Ar285
Well in bedrock

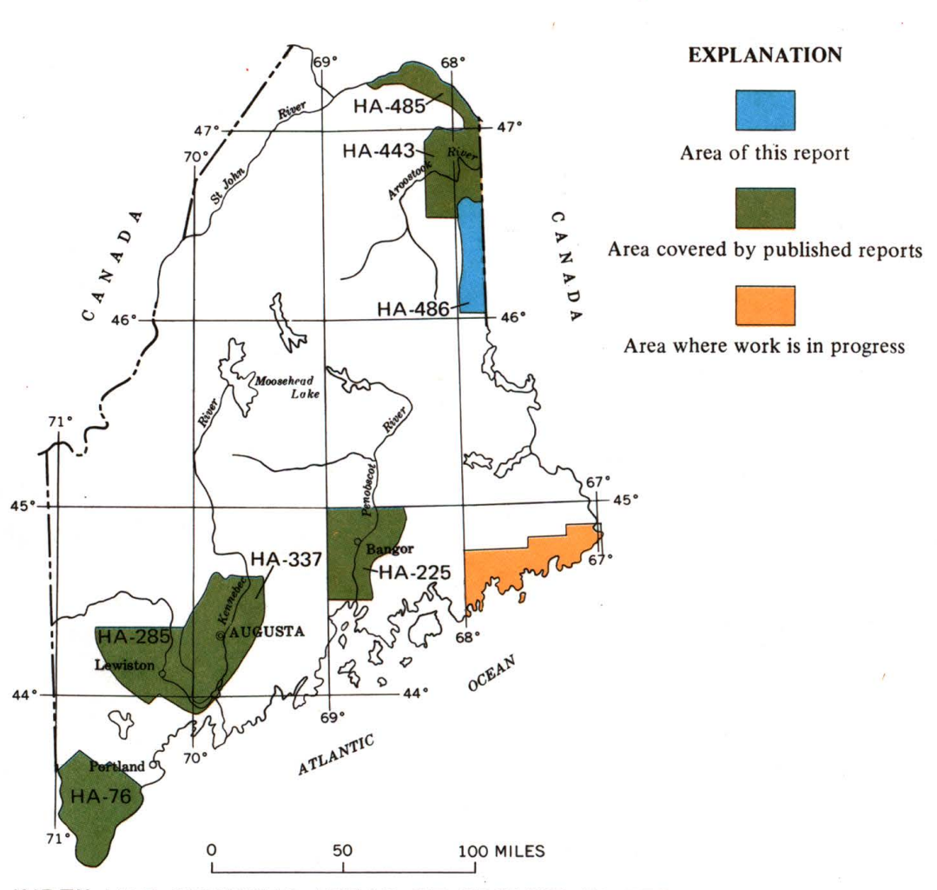
▲1.0180
Stream-gaging station

INTRODUCTION

This report describes briefly the geologic and hydrologic conditions governing the occurrence of ground water in an area of about 312 square miles in the drainage basins of Meduxnekeag River and Prestile Stream in Aroostook County in northern Maine.

This report is one of a series designed to provide information on ground water useful to those doing water-resources and land-use planning, and to those desiring to develop water supplies, particularly supplies large enough for public, industrial, or commercial use, from ground-water sources. The index map shows the area of this report, areas for which reports have been published, and areas where ground-water studies are in progress.

The magnitude of yields that might be expected from properly located and constructed wells of 6 inches or more in diameter in unconsolidated deposits is indicated by the map showing ground-water favorability and surficial geology. This map gives a generalized interpretation of observed geologic and hydrologic data. It provides a logical base for directing detailed exploration for ground water but does not eliminate the need for such exploration.



INDEX MAP SHOWING AREAS OF GROUND-WATER INVESTIGATIONS

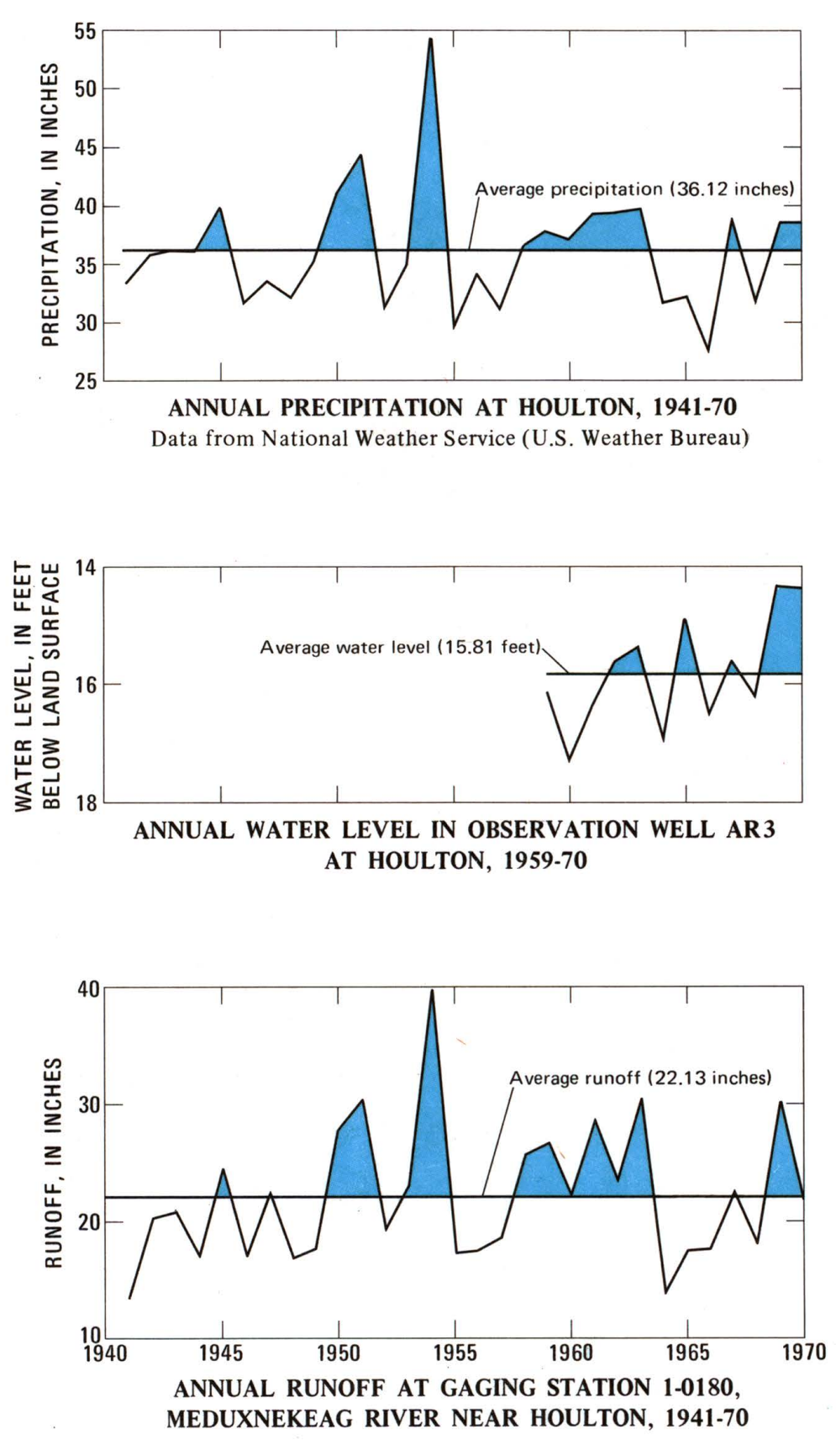
RELATION OF AVAILABILITY OF WATER TO CLIMATE

The climate of southern Aroostook County is characterized by moderately warm summers, cold winters, and abundant precipitation. The climate is influenced more by air moving in from the west and northwest than by air moving in from the Atlantic Ocean, which is more than 100 miles to the south, and hence the dominant temperature characteristics of the climate are those of a continental climate——wide temperature ranges from summer to winter and from day to night.

Precipitation in this area averages about 36 inches per year. (See annual precipitation graph.) During 1941–70, annual precipitation at Houlton has ranged from a low of 27.52 inches in 1966 to a high of 54.28 inches in 1954. Precipitation is generally between 2 and 4 inches a month. According to records of the National Weather Service, October receives the greatest amount (normal 3.79 inches) and February receives the least (normal 2.52 inches). During the period of the 1959–70 water years——the period for which data on ground-water levels are available for comparison with precipitation and streamflow——November has been the wettest month (average 4.31 inches) and March has been the driest (average 1.91 inches). (See monthly precipitation graph.)

Although monthly precipitation is normally fairly evenly distributed throughout the year, ground-water level and streamflow respond more to seasonal climatic changes than directly to precipitation. Of the approximately 36 inches of precipitation that falls annually on the area, about 22 inches runs off in streams and most of the remaining 14 inches is returned to the atmosphere by evaporation and transpiration. During the summer months, because of evapotranspiration losses, very little ground-water recharge occurs and the water table declines. Runoff also declines during this period. At the end of the growing season the ground-water table and streamflow are usually low. Streamflow increases and the ground-water table rises in the fall when losses of water to evapotranspiration are reduced and rainfall has a greater opportunity to run off or to reach ground-water reservoirs. Streamflow and the water table again decline during the winter when most of the precipitation falls as snow and remains on the ground. When the accumulated snow, which has an average water content of about 6 inches in this area (Hayes, 1972), melts it is a significant source of streamflow and ground-water recharge, as indicated by the spring peaks on hydrographs showing fluctuations in runoff and ground-water table (monthly graphs).

Annual correlations between precipitation, runoff, and ground-water levels are observable even though monthly correlations of precipitation with streamflow and ground-water levels are obscured by climatic changes (annual graphs). Annual runoff and amount of ground water in storage, which is indicated by ground-water levels, generally respond directly to the amount of precipitation. Years of above-average precipitation are ordinarily years when ground-water levels and runoff are above average, and conversely, years of below-average precipitation are usually years when streamflow and water levels are below average.

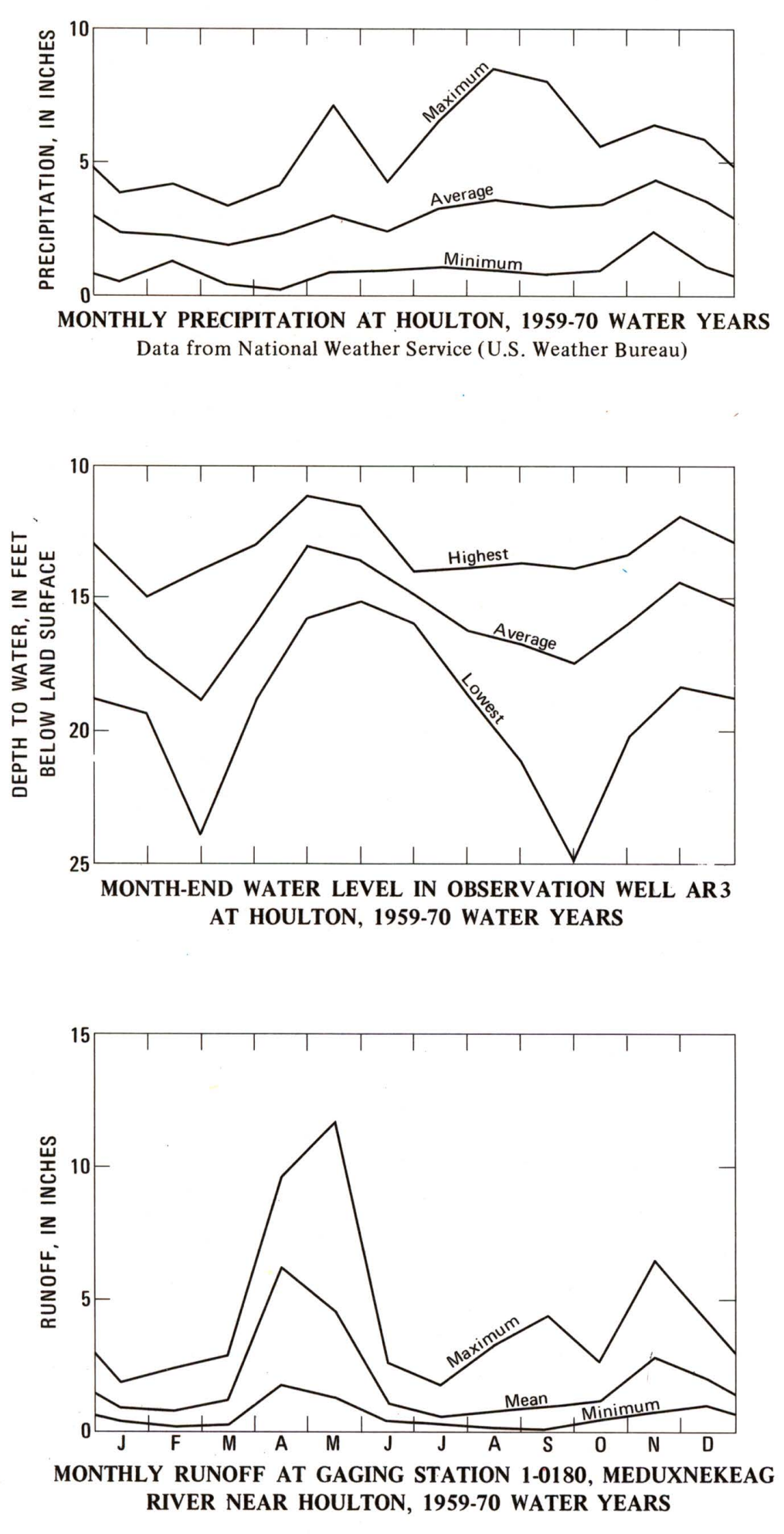


ANNUAL PRECIPITATION AT HOULTON, 1941-70
Data from National Weather Service (U.S. Weather Bureau)

ANNUAL WATER LEVEL IN OBSERVATION WELL AR3 AT HOULTON, 1959-70

ANNUAL RUNOFF AT GAGING STATION 1-0180, MEDUXNEKEAG RIVER NEAR HOULTON, 1941-70

CORRELATION OF ANNUAL PRECIPITATION, GROUND-WATER LEVELS, AND RUNOFF



MONTHLY PRECIPITATION AT HOULTON, 1959-70 WATER YEARS
Data from National Weather Service (U.S. Weather Bureau)

MONTH-END WATER LEVEL IN OBSERVATION WELL AR3 AT HOULTON, 1959-70 WATER YEARS

MONTHLY RUNOFF AT GAGING STATION 1-0180, MEDUXNEKEAG RIVER NEAR HOULTON, 1959-70 WATER YEARS

CORRELATION OF MONTHLY PRECIPITATION, MONTH-END GROUND-WATER LEVEL, AND MONTHLY RUNOFF

WELLS COMPLETED IN BEDROCK

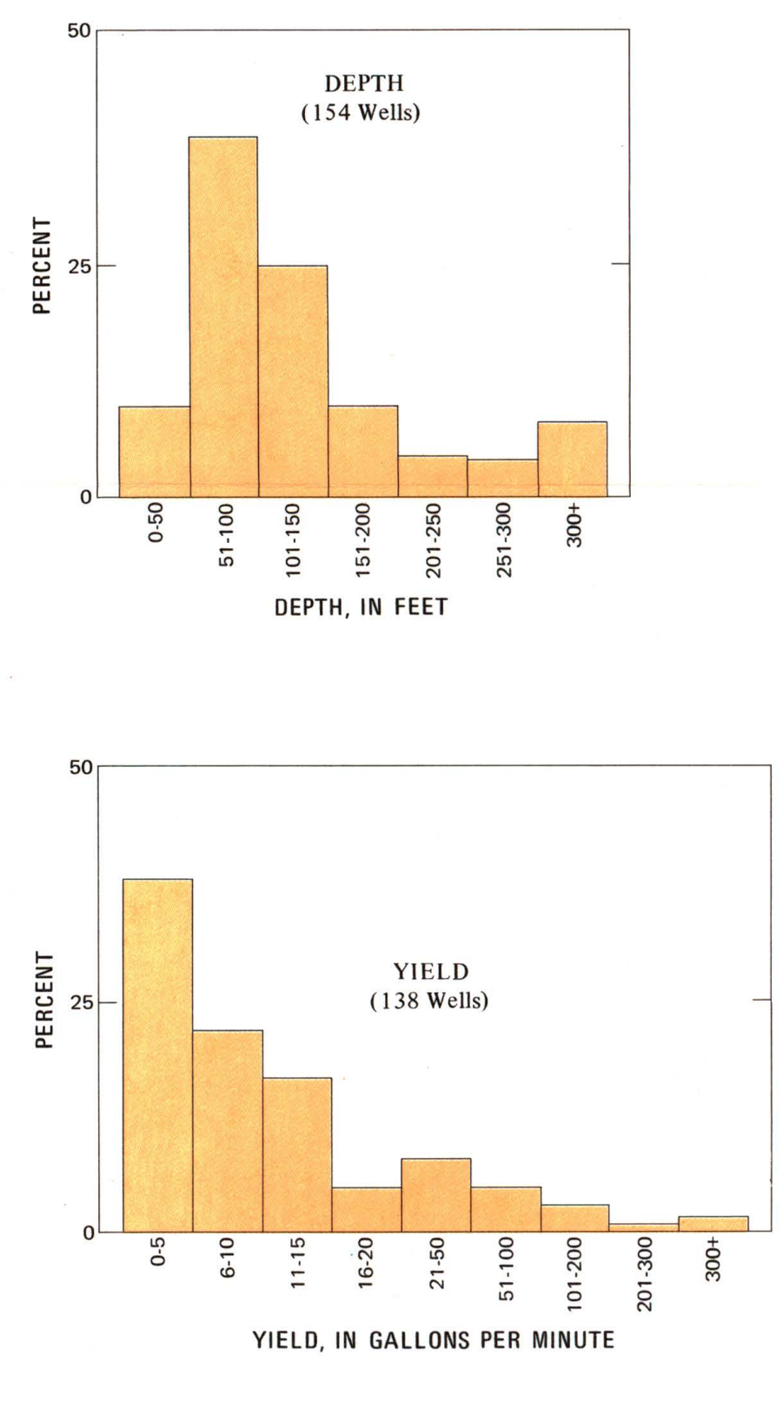
The bedrock wells recorded during this study range from 22 to 800 feet in depth. Average depth is 145 feet and median depth is 110 feet. Twenty-five wells, or about 16 percent, are deeper than 200 feet (bedrock well graphs). Of these 25 wells, nine were drilled for industrial supplies and are much deeper than most domestic wells. Only 16 domestic wells, or about one in nine, are deeper than 200 feet. The average depth of the domestic wells is 125 feet.

Drilling to depths greater than 200 feet does not always increase the yield, as the well may not penetrate additional water-bearing zones. One 500-foot well produced 400 gpm (gallons per minute) but a 510-foot well produced only 1 gpm. On the other hand, a 70-foot well reportedly yields 60 gpm. Information is generally not available on the depth of the water-bearing zones in the wells for which depth and yield are known.

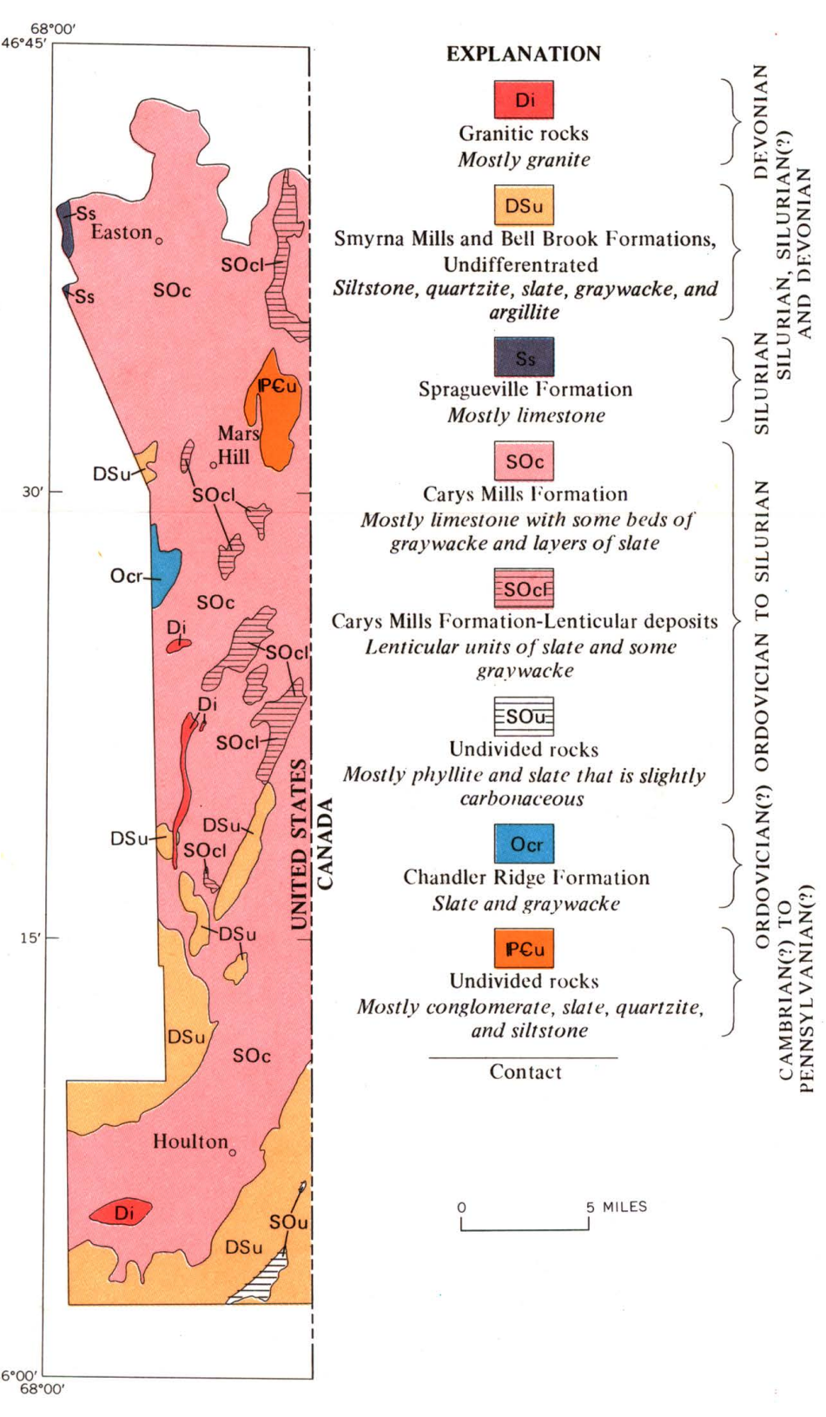
The yields of 138 wells range from 1 quart per minute to 400 gpm. The average yield is 24 gpm and the median is 8 gpm. The yields of 52 wells, or about 38 percent of the total, are in the 0–5 gpm range. Sixteen wells, or about 11 percent of the total, are reported to have yields of less than 3 gpm.

Insufficient data are available to permit valid comparisons of the water-bearing potential of the various bedrock formations, as most of the wells for which information was collected obtain water from the Carys Mills Formation. However, as in the lower Aroostook River basin to the north (Prescott, 1972) it appears likely that ground water percolating through the openings in the limestone of the Carys Mills Formation has enlarged these openings, so that the Carys Mills may contain and transmit larger quantities of ground water than the other, largely noncalcareous, formations.

The outcrop area for the various formations is shown on the generalized bedrock geologic map.



PERCENTAGE OF BEDROCK WELLS ACCORDING TO DEPTH AND YIELD RANGES

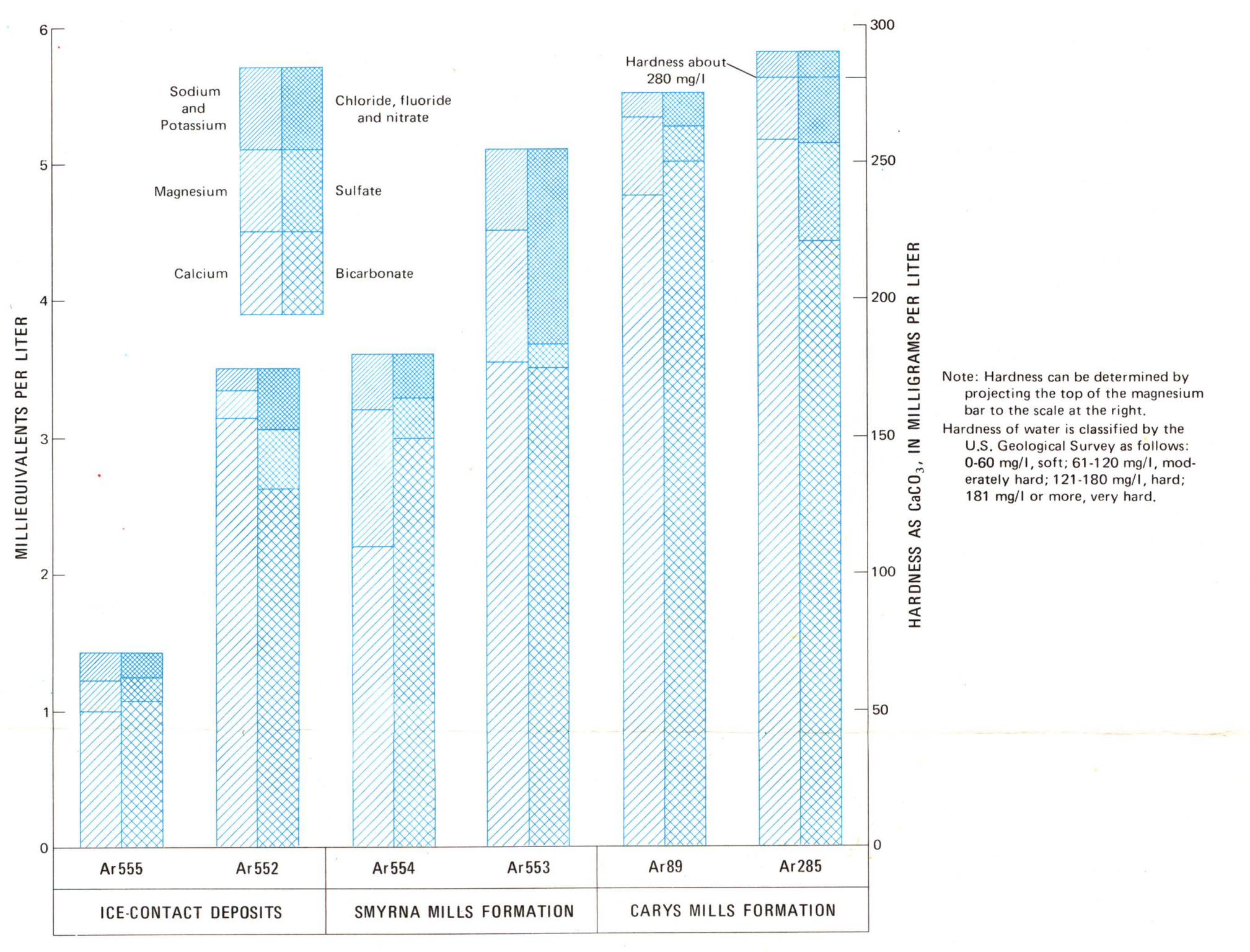


GENERALIZED BEDROCK GEOLOGIC MAP
(AFTER PAVLIDES, 1968, PL. 1)

QUALITY OF WATER

The quality of the ground-water in the area is generally good but the water is moderately hard to very hard. Water from bedrock, particularly the Carys Mills Formation, which consists largely of calcareous beds, is generally harder and more highly mineralized than water from unconsolidated formations. However, in much of the area the unconsolidated deposits contain abundant grains and pebbles of limestone which may contribute to hardness when dissolved by percolating water. The highest amount of hardness was about 280 mg/l (milligrams per liter) for water from the Carys Mills Formation (well Ar 285). The lowest hardness value was 61 mg/l for water from ice-contact deposits (well Ar 555). The hardness of water from well Ar 552, also in ice-contact deposits, was higher than that of water from well Ar 554, which obtains water from the Smyrna Mills Formation, a largely noncalcareous formation.

Dissolved solids ranged from 107 mg/l for a sample of water from ice-contact deposits (well Ar 555) to 355 mg/l for water from the Carys Mills Formation (well Ar 285). Ground water in bedrock is commonly alkaline, having a pH of 7.1 to 7.8. The pH of water in ice-contact deposits ranged from 6.5 in well Ar 555 to 7.9 in Ar 552. Chloride concentration is normally low and ranges from 4.0 to 47 mg/l in the samples analyzed. The highest value may be the result of contamination by road salt. The water from only one well sampled exceeds U.S. Public Health Service standards for iron. The excessive iron is believed caused by rusty pipe or a rusty pump rather than being a characteristic of the ground water. Average temperature of ground water is about 10.5°C (51°F).



CHEMICAL CHARACTER OF GROUND WATER

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SCALE 1:62 500
1 ½ 0 1 2 3 4 MILES
1 .5 0 1 2 3 4 KILOMETERS
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

GROUND-WATER FAVORABILITY AND SURFICIAL GEOLOGY OF PARTS OF THE MEDUXNEKEAG RIVER AND PRESTILE STREAM BASINS, MAINE

By

Glenn C. Prescott, Jr.

1973

For sale by U.S. Geological Survey, price $1.00 per set