Water Resources of the Albany-Schenectady-Troy Area New York

GEOLOGICAL SURVEY WATER-SUPPLY PAPER 1499-D

Prepared in cooperation with the State of New York and the U.S. Army, Corps of Engineers

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By H. N. HALBERG, O. P. HUNT, *and* F. H. PAUSZEK

WATER RESOURCES OF INDUSTRIAL AREAS

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WATER RESOURCES OF INDUSTRIAL AREAS

WATER RESOURCES OF THE ALBANY-SCHENECTADY-TROY AREA, NEW YORK

By H. N. HALBERG, O. P. HUNT, and F. H. PAUSZEK

ABSTRACT

The two major streams in the Albany-Schenectady-Troy area, the Hudson and Mohawk Rivers, assure an ample water supply for all foreseeable needs. The flows of the Hudson River above the Mohawk River, and those of the Mohawk River equal or exceed 1,300 and 580 mgd, respectively, 95 percent of the time. Ground water is available in moderate to large quantities from the unconsolidated deposits in the river valleys and old river channels, and in small quantities from the bedrock formations and fine-grained unconsolidated deposits. Small streams in the area are also important sources of water. The cities of Albany, Mechanicville, and Troy obtain their public water supplies from the headwaters of small tributaries of the Hudson River. These waters are unpolluted, and treatment costs are small.

Floods in the Albany-Schenectady-Troy area are not a serious problem. The major rivers fluctuate through a small range in stage and generally only a narrow strip along the streams is subject to flooding.

Use of water in the area is relatively great. The average withdrawal of water was about 829 mgd in 1953. Industry used about 765 mgd and most of the remainder, about 64 mgd, was used for domestic purposes. Of the 829 mgd withdrawn about 91 mgd was for public supplies, and about 738 mgd was self-supplied for industry and rural uses.

The uses of water in this area are mostly nonconsumptive and they cause little depletion of the supply; however, practically all withdrawal uses add dissolved or suspended matter to the water and decrease its usefulness for some purposes. On the other hand, some uses of water outside the area affect the supply within the area. Thus the supply available to the Albany-Schenectady-Troy area is reduced by diversions from Schoharie Creek for the water supply of New York City, but it is increased by the diversion from the Black River basin for improvement of navigation in the Erie (Barge) Canal. Storage of water in Delta Reservoir for improvement of navigation, in Hinckley Reservoir for improvement of navigation and the public supply of Utica, and in Sacandaga and Indian Lake Reservoirs for power development and improvement of navigation, increases the low flow available for other uses.

Water-bearing sand and gravel in the river valleys are the principal sources of ground water, especially where they are recharged by infiltration from streams. The most productive area is between Hoffmans and Schenectady where much larger quantities than the present 25 mgd could be withdrawn. More develop-

ment of ground water is possible in the flood plain of the Mohawk River between Vischer Ferry and Mohawk View and in the flood plain of the Hudson River between Troy and Castleton-on-Hudson.

Moderately large quantities of water, as much as 700 gpm or about 1 mgd, have been obtained from a single well in the ancient Colonie channel north of Shakers Village, and from the sand and gravel now buried beneath younger deposits. Smaller quantities of water, 100 gpm or less from a single well, can be obtained from some parts of the sand-plain areas and from other coarse-grained deposits; the most productive of these are the Albany-Schenectady sand plain, the Wynants Kill kame area, and the Schodack terrace. Other buried channels contain materials that are too fine to yield more than a few tens of gallons per minute to single wells. Most wells tap till or bedrock and yield less than 20 gpm. The depth to water in most wells in the Albany–Schenectady–Troy area is between 5 and 60 feet below the land surface.

Small streams like Lisha, Anthony, and Poesten Kills, and others that have large drainage areas are good sources of water. Streams that drain coarse-grained stratified deposits have the largest sustained yield per square mile; those that drain fine-grained stratified deposits have the smallest.

The mineral content indicates that surface water in the area is of good chemical quality, being soft to moderately hard, but softening may be required at some places for uses requiring low hardness. The water is of the calcium bicarbonate type. In general it contains less than 200 ppm of dissolved solids. Fragmentary information indicates that water from the Mohawk River is harder than that from the Hudson River.

Water from the sands and gravels is generally moderately hard to hard, being slightly harder and more mineralized than surface water. Water from the bedrock formations generally is even harder and more mineralized.

INTRODUCTION

The orderly and economical development of water resources to meet our increasing demands requires knowledge of the occurrence and use of water. Specifically, information is required about the sources of water, quantity available, chemical and physical quality, amount used, effect of use on the quantity and quality, and magnitude and frequency of floods. Such information is essential to the planning, construction, and operation of facilities that will provide water to satisfy increasing industrial and domestic demands, requirements of defense mobilization, and demands for water at times of disaster.

This report summarizes those types of information, expressed in general terms, insofar as data are available. Water-resources information has been collected in the Albany-Schenectady-Troy area since 1887; however, there are deficiencies of certain types of data, especially on the quality and use of the water. This report will aid in the early stages of planning by giving the sources of water, describing their quantity and quality, and by giving the range in water levels. The information in the report will probably be adequate, if used with economic factors, to select a source of water; however, additional infor-

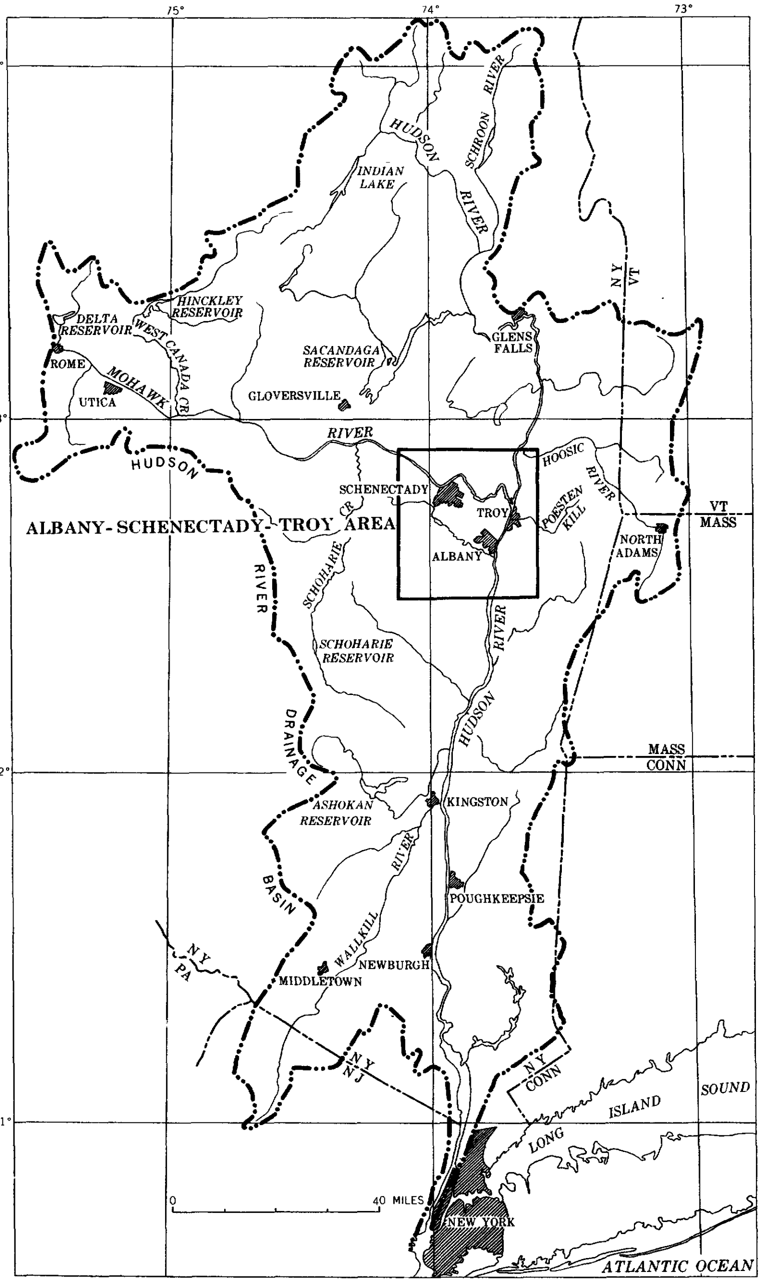

FIGURE 1.—Map of Hudson River basin showing location of report area.

mation and investigation may be required for the design of specific water-supply facilities.

The Albany-Schenectady-Troy area, most of which is highly industrialized, includes parts of Albany, Rensselaer, Saratoga, and Schenectady Counties (pl. 1 and fig. 1). The region described in this report encompasses 732 square miles of river valleys and adjacent hills and plateaus, and contains the cities of Albany, Cohoes, Mechanicville, Rensselaer, Schenectady, Troy, and Watervliet. Most of the region is a part of the Mohawk-Hudson lowland at altitudes between 10 and 400 feet above sea level. To the southwest the Helderberg cliffs and plateau rise 1,000 feet or more above the lowland. The lowland is bounded on the north by the Adirondack Mountains and on the east by Rensselaer plateau, both of which are outside the report area.

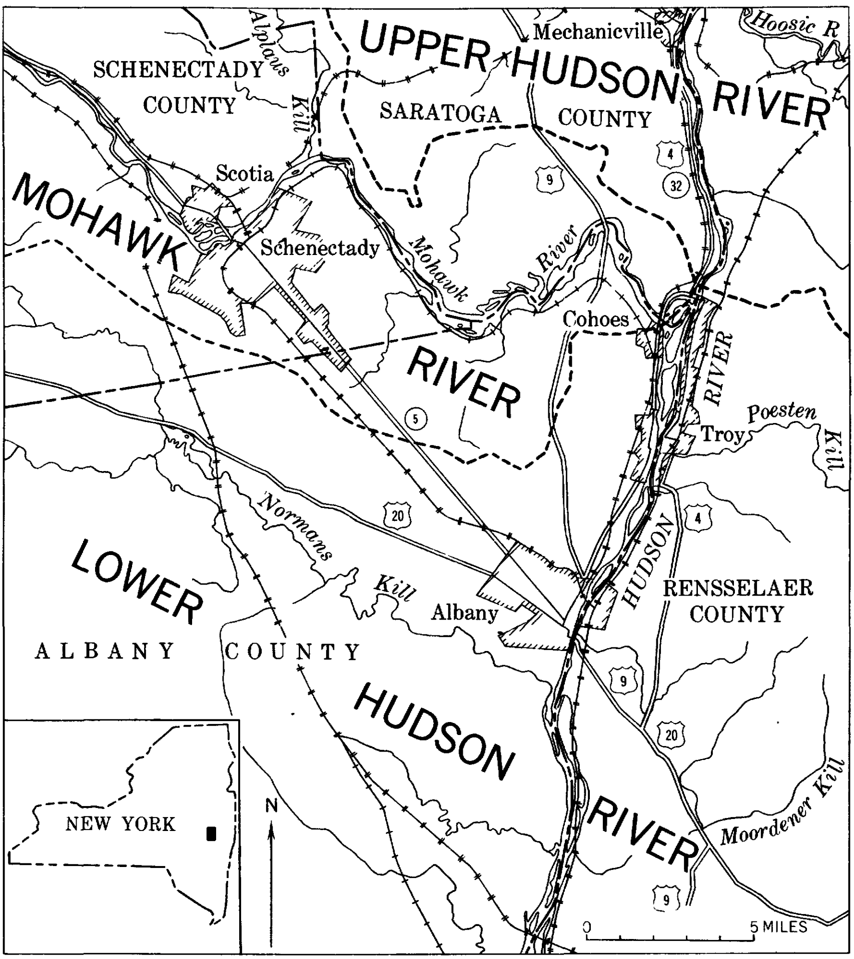

FIGURE 2.—Boundaries of subareas.

The availability and quantity of water varies widely throughout the Albany-Schenectady-Troy area. To increase the utility of the report and to simply the description of the water supply, the area has been divided into subareas: the Mohawk River, upper Hudson River, and lower Hudson River (fig. 2).

This report is one of a series describing the water resources of industrial areas of national importance. It was prepared by H. N. Halberg, hydraulic engineer, under the direct supervision of J. E. Upson, district geologist; O. P. Hunt, hydraulic engineer, under the direct supervision of A. W. Harrington, district engineer; and F. H. Pauszek, district chemist. L. A. Wiard, hydraulic engineer, did most of the early work on that part of the report relating to surface water. K. A. MacKichan, hydraulic engineer, assisted by J. C. Kammerer, geologist, was responsible for staff coordination.

Most of the basic data used in this report were collected by the U.S. Geological Survey as part of the programs in cooperation with the New York State Departments of Commerce, Conservation, Health and Public Works, the New York Water Power and Control Commission, and the U.S. Army, Corps of Engineers. Additional information was obtained from industries, public officials, and individuals. Much of the ground-water data used in the preparation of this report has been published by the New York Water Power and Control Commission in a series of cooperative Federal-State reports on Albany, Rensselaer, and Schenectady Counties (Arnow, 1949; Cushman, 1950; Simpson, 1952, respectively).

MOHAWK RIVER SUBAREA

The Mohawk River flows through the central part of the Albany-Schenectady-Troy area and empties into the Hudson River through several channels near Cohoes (pl. 1). The flood plain of the Mohawk River is narrow from Hoffmans to Schenectady, where it widens to about 2 miles. About 4 miles downstream from Schenectady the river enters a narrow rock channel in which it flows to Niskayuna. Downstream from Niskayuna the flood plain widens until the river enters the rocky channel through which it flows into the Hudson River.

Below Schenectady the Mohawk River flood plain is bordered by a lowland of sand plains, clay plains, and till-covered gently rolling country. (See pl. 1.) The sand-plain area lies southeast of Schenectady, and an arm of it crosses the Mohawk River near Dunsbach Ferry. Upstream from Schenectady the topography of the area bordering the flood plain is rougher than downstream. Industrial establishments are concentrated in the wider parts of the flood plain. The largest concentration of industry and population in the subarea is at Schenectady.

The Mohawk River is the channel of the Erie (Barge) Canal through most of the area. The river and extensive sand and gravel deposits under and along its channel are important sources of water.

GROUND WATER

MOHAWK RIVER FLOOD PLAIN

The 8-mile reach of the Mohawk River flood plain between Hoffmans and Schenectady, which is underlain by the river's preglacial channel (pl. 1; Simpson, 1952) is a present and potential source of large quantities of ground water; however, the most productive water-bearing beds probably lie between lock 8 in the Erie (Barge) Canal and Schenectady. Near lock 8 gravel beds more than 100 feet thick lie at and below river level (fig. 3). Between Schenectady and lock 8 the yields of 9 of the 10 Schenectady public-supply wells were about 3,600 gpm (gallons per minute) each, when tested in 1942 and 1943. These wells receive water that infiltrates from the river. One of the two public-supply wells of the village of Scotia has been pumped at the rate of 1,500 gpm, the other at 1,100 gpm. These two wells are in the Mohawk River flood plain about 1 mile north of the river but probably are not greatly affected by the river. (See Simpson, 1952, p. 1, 36, 59–65, 95.)

Between locks 8 and 9 yields of wells are moderate to high. The public-supply well of the village of Rotterdam Junction has been pumped at 310 gpm and 2 privately owned wells yielded 777 and 226 gpm. Between lock 9 and Hoffmans most of the gravel beds lie above river level and rest on thick beds of clay and sand which may extend from river level to considerable depth. Interfingered with these fine materials are beds of gravel which may not be connected hydraulically with the river.

According to Simpson (1952, p. 44) the yields of 27 wells (exclusive of the Schenectady public-supply wells) tapping stratified sand or gravel in the Mohawk River flood plain between Hoffmans and Schenectady ranged from 2 to 1,500 gpm and averaged 280 gpm.

The average withdrawal of ground water in the Hoffmans-Schenectady area was about 25 mgd (million gallons per day) in 1953 of which about 23 mgd was withdrawn in the vicinity of Schenectady. This 8-mile reach has produced large volumes of ground water continuously for more than 50 years with no sign of depletion of the supply. The sustained high production from wells in this area is probably due largely to induced infiltration from the Mohawk River.

The water levels in most wells tapping sand and gravel deposits

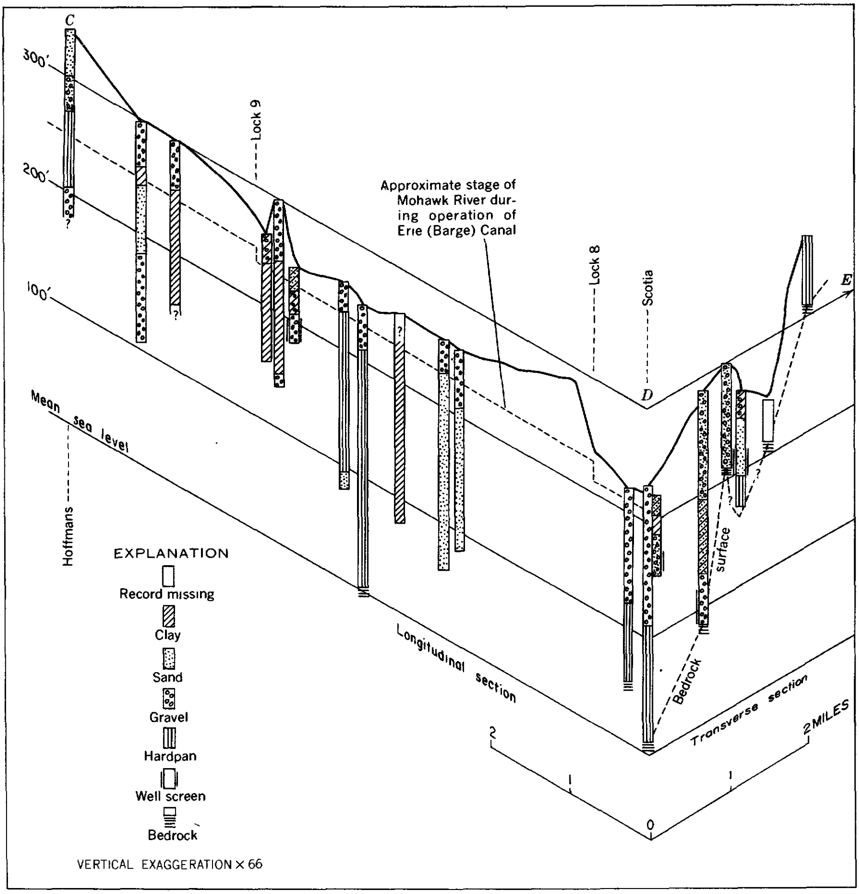

FIGURE 3.—Longitudinal section in the Mohawk River valley between Hoffmans and Schenectady and transverse section at Scotia. Location of section shown on plate 1.

underlying the alluvium in the Mohawk River flood plain near Schenectady are between 10 and 40 feet below land surface. The pattern of water-level fluctuations reflects changes in rates of pumping of nearby wells and changes in stage of the Mohawk River. Fluctuations of water level in a well at Schenectady illustrate the latter type of change. (See fig. 4.)

The alluvium in the Mohawk River flood plain is largely clay, silt, and sand. Because these deposits are not very thick and are relatively fine grained, they are not likely to yield large quantities of water.

REMAINDER OF THE SUBAREA

The Colonie and Alplaus buried channels, that part of the Mohawk buried channel south of the flood plain of the present Mohawk River, sand plains, till, and bedrock are also sources of ground water (pl. 1;

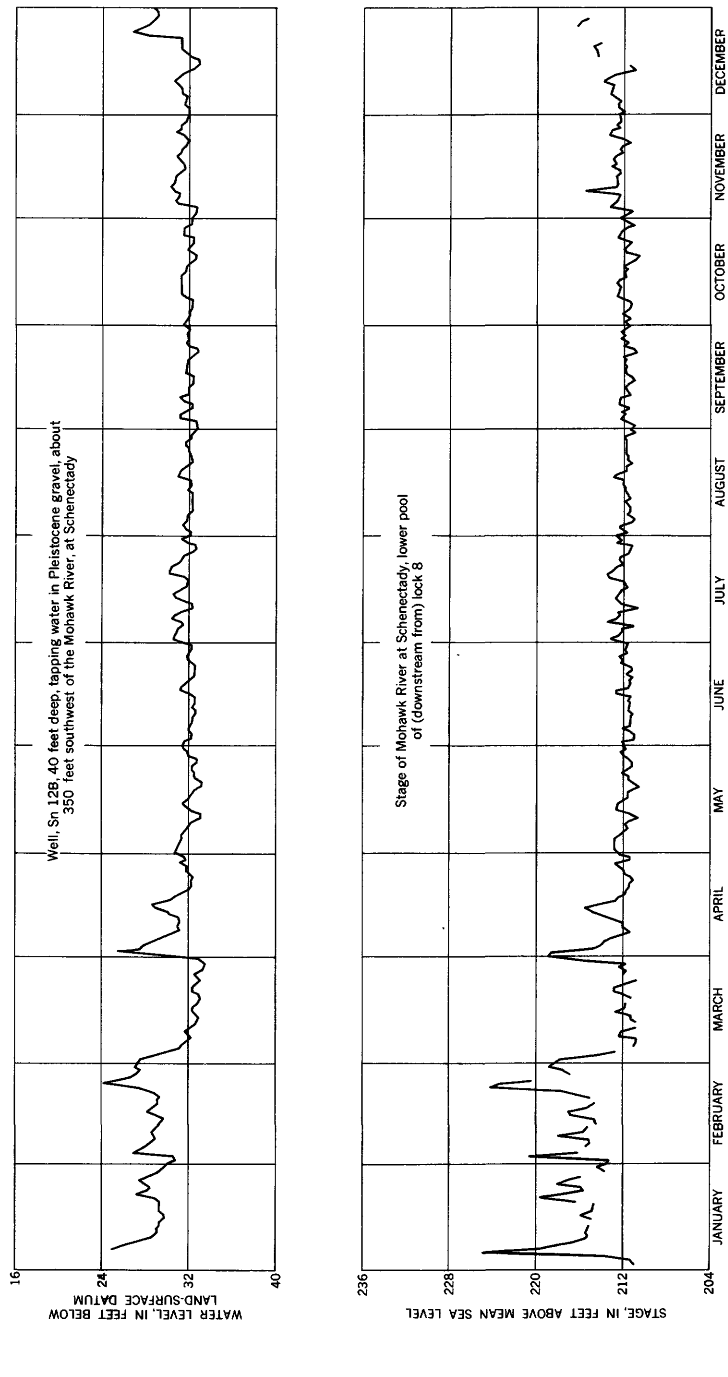

FIGURE 4.—Water level in well near Mohawk River and stages of Mohawk River at Schenectady, 1951.

Simpson, 1949). The Colonie channel is a buried preglacial river valley whose northward extension is believed by Stoller (1911, p. 12) to have included a rock depression now occupied in part by Round Lake and Saratoga Lake (both lakes are north of the area of this report). Colonie channel extends southward from the vicinity of Round Lake, crosses the present Mohawk River near Verdun, and joins the preglacial Mohawk channel west of Albany. The most productive water-bearing beds in the buried valley are deposits of sand and gravel in the northern part of that section of the channel between the Mohawk River and the village of Colonie. The sand and gravel deposits underlie clay and silt and are coarser grained north of the village of Shakers than south of it. The deposits have accumulated in the channel to a maximum known depth of 305 feet; of this about 75 feet is sand and gravel.

The Latham Water District operates 8 wells near the axis of the Colonie channel. The wells are screened in gravel and are 48 to 244 feet deep. The yields of individual wells range from 118 to 705 gpm and the total yield is as much as 2,100 gpm (3 mgd). Recently the water district began to use surface water from Stony Creek north of the Mohawk River because water levels in the vicinity of the wells had declined appreciably.

The buried preglacial channel of the Mohawk River follows the flood plain of the present Mohawk River from Hoffmans to Schenectady; the yields of wells in this reach of the channel have been discussed above. At Schenectady the channel turns southward then southeastward, passes west of Albany, and joins the present Hudson River channel about 12 miles south of Albany. (See pl. 1; Simpson 1949, 1952). Well yields in the southward-trending part of the channel within the Mohawk River subarea are described below under the Albany-Schenectady sand plain.

The Alplaus channel is a small short buried channel that enters the buried Mohawk channel from the north a few miles south of Schenectady. (See pl. 1.) Mixed stratified deposits of fine gravel and sand interfingered with fine-grained deposits are the principal water-bearing materials in the buried Alplaus channel north of Scotia; they yield small to moderate supplies of water.

The Albany-Schenectady sand plain extends from southern Schenectady southeastward toward Albany (pl. 1) and covers part of the buried Mohawk, Alplaus, and Colonie channels. An arm of the sand plain extends northward across the Mohawk River along the Clifton Park-Halfmoon town line almost to the northern boundary of the Albany-Schenectady-Troy area.

The sand ranges in thickness from 10 to 100 feet and overlies beds of silt, clay, and till. The sands are not highly permeable, yielding only enough water for household supplies; in some places, however, the sand is thick enough to yield sufficient water for small industrial supplies. The yield of a well in shallow sand may be greatly reduced when the ground-water level is low and will not be increased by deepening the well if it already extends to, or close to, the bottom of the water-bearing sand.

An industrial well screened from 22 to 28 feet in the sand plain at Schenectady is reported to have yielded 150 gpm when it was installed in 1938 and later to have been pumped continuously at 45 gpm.

Water occurs also in the bedrock formations in the subarea, which include the Schenectady and Snake Hill formations and the Normanskill shales. (See fig. 5.) The yields in these and other bedrock formations in the Albany-Schenectady-Troy area vary widely, but the median yields of wells in all formations seem to be about the same, from 2 to 4 gpm, based on reported yields of about 240 wells (table 1). Small quantities of water sufficient for the needs of farms or households may be obtained from most wells. In Schenectady County the yields of wells in the Schenectady formation are greatest where the

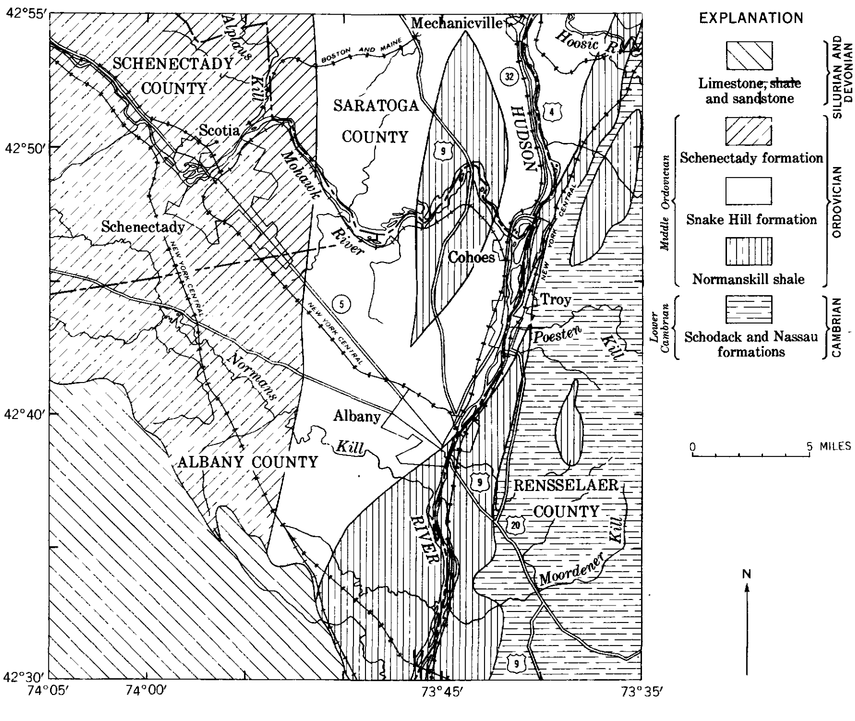

FIGURE 5.—Generalized bedrock geologic map.

TABLE 1.—*Yields, composition, and relative importance of water-bearing formations in the Albany-Schenectady-Troy area*

Age: Period	Age: Epoch	Name of geologic formation or unit	Number of wells for which data on depth and yield were obtained	Range in depth of wells (feet)	Range of yield of middle 80 percent of wells reported [1] (gpm)	Median yield (gpm)	Maximum yield reported (gpm)	Depth of maximum yielding well (feet)	Character of material and importance as a water-bearing formation
Quaternary	Recent	Alluvium	3	52–60	------	100	350	52	Sorted deposits mainly of clay and silt and more rarely of sand and gravel, forming part of the flood plains of the larger streams. Important aquifer when occurring as sand or gravel recharged through an adjacent streambed.
Do	Pleistocene	Stratified sand and gravel (fluvioglacial and lacustrine deposits).	115	6–103	4–1,250	40	3,600	56	Sorted sand, gravel, and silt deposited in former glacial lakes and streams. Sand and gravel, commonly restricted to main stream valleys and lowland, is most productive aquifer in report area, especially where recharged by overlying or nearby stream, or if in buried stream channel. Fine sand and silt yield small supplies for domestic use to dug wells of large diameter.
Do	do	Till	9	18–200	1–5	3	7	50	Unsorted mixture of boulders, gravel, sand, and clay deposited by glacial ice. Poor aquifer but of widespread areal extent, especially in upland areas. Supplies water to some domestic and farm wells.
Devonian and Silurian.	Middle and Early Devonian and Late Silurian.	(17 formations)	16	10–222	3–20	4	30	135	Limestones, shales, and sandstones in Helderberg Mountains and plateau in Albany County. Generally unimportant as an aquifer except for domestic supplies.
Ordovician	Middle Ordovician.	Schenectady formation.	73	29–550	0–12	2	[2] 150	175 210	Clayey shale interbedded with coarse-grained sandstone in northwestern and west-central part of report area. Very poor aquifer except where overlain by permeable sand and gravel.
Do	do	Snake Hill formation.	37	29–639	0–20	4	100	208	Folded shale with local layers of limestone and sandstone, in central and north-central part of report area. Poor aquifer in most places except for domestic supplies.
Do	do	Normanskill shale.	49	38–350	1–10	4	30	250	Folded clayey shale containing beds of chert and sandstone, in eastern parts of report area. Poor aquifer in most places except for domestic supplies.
Cambrian	Early Cambrian.	Schodack and Nassau formations.	66	50–340	1–10	4	30	69	Folded shales in easternmost parts of report area; includes some beds of quartzite, sandstone, and limestone. Poor aquifer in most places except for domestic supplies.

[1] Middle 80 percent refers to wells remaining after omitting wells having highest 10 percent and lowest 10 percent of yields reported. In general, 8 of every 10 wells drilled will have yields within the range indicated for the middle 80 percent, except in areas where test drilling has shown especially favorable or unfavorable ground-water conditions.
[2] Two wells have the same yield, which is the maximum reported for the Schenectady formation.

formation is covered by an appreciable thickness of sand or gravel which releases water readily to the underlying rock (Simpson, 1952, p. 25). The yields of 10 wells, which tap the Schenectady formation where the overburden is sand and gravel, ranged from 3 to 150 gpm and averaged 51 gpm; the median yield was 15 gpm. The yields of 29 wells, where the overburden is till and clay, ranged from 1 to 6 gpm and averaged 2.4 gpm (median 2 gpm). Where the overburden is thin or absent (less than 10 ft. thick), the yields of 9 wells ranged from 2 to 20 gpm and averaged 7.7 gpm (median 6 gpm). The yield that may be expected from wells that tap bedrock in Schenectady County is shown by a study of the reported yields of 65 wells, 60 of which tap the Schenectady formation. The following tabulation (after Simpson, 1952, p. 43) shows the percentages of the wells in five yield groups.

Yield (gpm)	*Percentage of wells*
Less than 1	9
1 to 5	46
5 to 10	23
10 to 50	11
More than 50	11

Till, an unsorted mixture of clay, sand, and boulders, forms a surficial blanket, generally not more than 30 feet thick; it is present nearly everywhere in the uplands. In the lowlands and valleys till occurs beneath the stratified deposits. Till is important as a source of small quantities of water sufficient for homes and small farms. Probably the maximum yield that can be obtained from unsorted clay or silt deposits in the till is about 200 gpd (gallons per day), according to Simpson (1952, p. 31). However, in some places the till contains discontinuous lenses of sand or other sorted material which yield larger quantities of water. Most of the wells in till are dug wells 10 to 20 feet deep and 2 to 4 feet in diameter.

WATER LEVELS IN WELLS

The depth to water in most wells in the Mohawk River subarea, as in other parts of the Albany-Schenectady-Troy area, is between 5 and 60 feet below the land surface (table 2). The median water level is 8 feet below land surface for wells that tap till, 14 feet for wells in other Pleistocene and Recent deposits, and 16 to 20 feet for wells in bedrock formations. In general, the water table is closer to the land surface in lowland areas than on or near the tops of the hills and uplands, but local geologic and hydrologic conditions may cause some variation from the general rule. Of the 280 wells inventoried from 1945–49 in the subarea, 7 were reported flowing.

TABLE 2.—*Water levels reported from wells in geologic formations in the Albany-Schenectady-Troy area, 1945–49*

Age	Name of geologic formation or unit	Number of wells for which data on water levels were reported	Depth to water in 4 out of 5 wells reported (feet)	Median depth to water (feet)	Average depth to water (feet)
Recent	Alluvium	[1] 7	(1)	[1] 14	[1] 15
Pleistocene	Stratified sand, gravel, and clay.	194	3–40	14	18
Do	Till	32	2–20	8	8
Middle and Early Devonian and Late Silurian.	Limestones, shales, and sandstones (17 formations).	24	5–60	20	25
Middle Ordovician	Schenectady formation	72	2–55	17	23
Do	Snake Hill formation	40	4–50	19	26
Do	Normanskill shale	50	8–76	20	28
Early Cambrian	Schodack and Nassau formations.	56	6–35	16	21
Total wells		[2] 475			

[1] Probably too small an amount of data to represent most of the alluvial deposits.
[2] Includes 18 flowing wells: 6 tap Pleistocene stratified deposits; 3 tap till; 1 taps a Devonian formation; 6 tap the Schenectady formation; and 2 tap the Schodack formation.

In most wells not greatly affected by pumping of nearby wells or by changes in river level, water levels fluctuate 5 to 15 feet a year; the fluctuations commonly follow the general seasonal patterns of precipitation, evapotranspiration, and streamflow. Water levels rise in the late fall, winter, and early spring in response to recharge from rain and melting snow, and they decline in the late spring, summer, and early fall in response to high discharge by transpiration and evaporation during the growing season (fig. 6).

QUALITY OF GROUND WATER

The small amount of data available on quality of water from various aquifers indicates that water from the unconsolidated formations, alluvium, and stratified deposits, is of somewhat better and more uniform quality than water from the bedrock formations (fig. 7).

Water from any formation varies widely in quality from place to place. The data available, however, do not indicate that the water in one subarea has a significantly different quality than that in another. Therefore, the following description of ground-water quality, based on data for the entire Albany-Schenectady-Troy area, applies to the Mohawk River subarea.

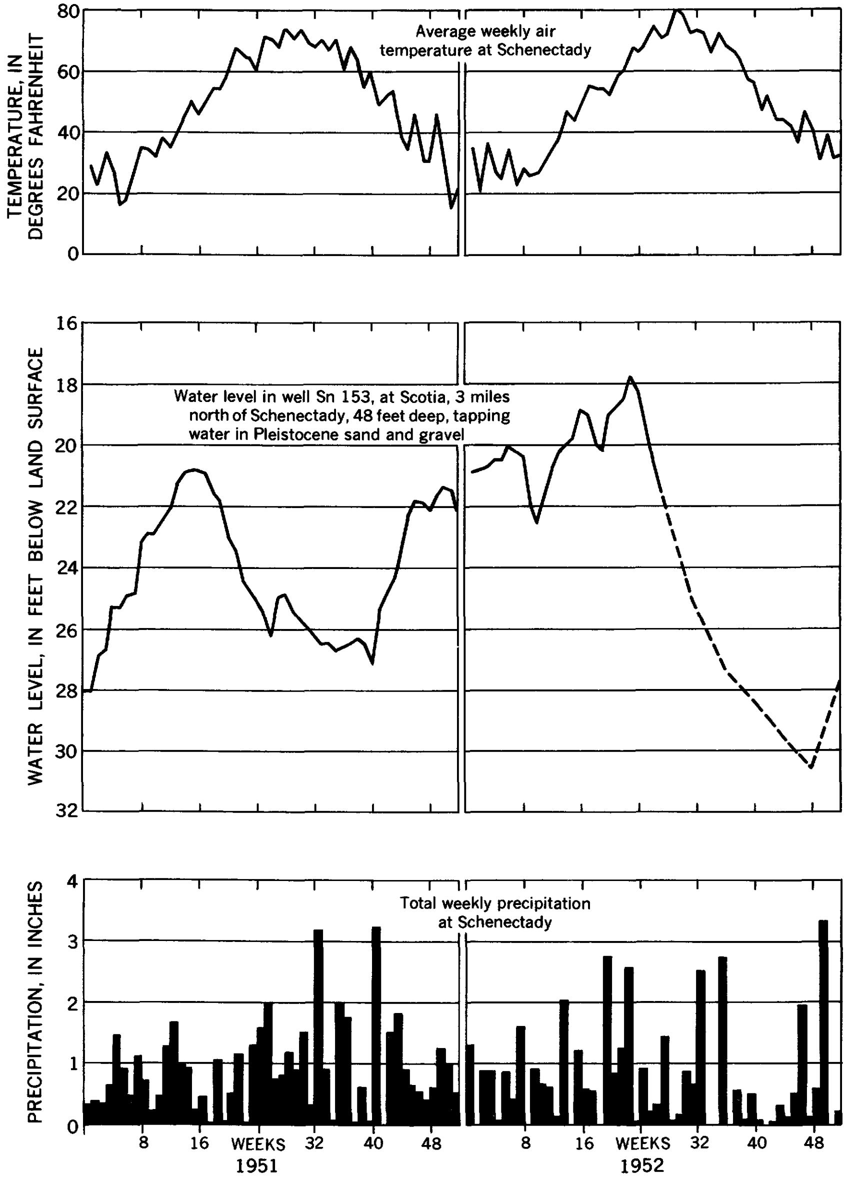

FIGURE 6.—Graph showing weekly fluctuation of ground-water level caused primarily by precipitation and evapotranspiration, 1951–52.

Dissolved solids in water from sand and gravel ranged from 78 to 497 ppm (parts per million); hardness as calcium carbonate ranged from 39 to 320 ppm; alkalinity as bicarbonate averaged about 200 ppm; the pH (hydrogen-ion concentration) values ranged from 6.6 to 8.3; and iron concentrations ranged from insignficant to highly undesirable concentrations. Several representative analyses of water from sand and gravel are given in table 3.

Water from bedrock contains more than 500 ppm dissolved solids in about 1 of 4 samples and the probability is about equal of obtaining moderately hard or hard water (fig. 7). The range of pH values (from 6.0 to 9.3) is greater than that of water from sand and gravel. Iron concentrations ranged from insignificant to highly undesirable concentrations.

The temperature of water from wells in the area is nearly constant throughout the year, except in wells that receive water by infiltration from adjacent streams or in the very shallow wells, in which the

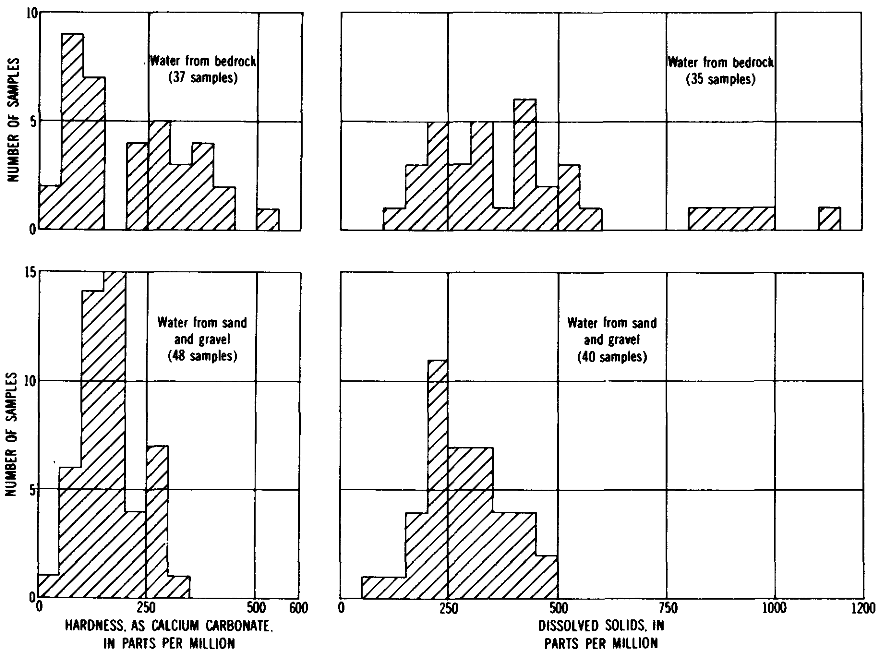

FIGURE 7.—Hardness and concentration of dissolved solids in ground water in the Albany-Schenectady-Troy area. Taken in part from Simpson (1952, table 11) and Cushman (1950).

TABLE 3.—*Chemical analyses, in parts per million, of selected samples of ground water*

Location and symbol on plate 1	Date of collection	Water-bearing information	Depth of well (ft)	Diameter (inches)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO^3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$: Ca, Mg	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH	Color
Lower Hudson River subarea																							
Knox (A)	Sept. 10, 1947	Onondaga limestone	43	6	8.8	0.22	----	94	17	15	15	0	321	44	18	0.2	3.6	403	305	42	------	7.4	3
Voorheesville (B)	June 24, 1953	Pleistocene gravel	28	10	8.9	.00	----	77	12	19	19	0	198	88	20	.0	.6	332	242	79	500	7.6	5
Voorheesville (C)	Oct. 21, 1954	Pleistocene gravel	35	6	10	.03	0.04	86	19	12	1.8	0	288	68	11	.0	1.5	345	293	57	557	7.5	5
Albany (D)	Nov. 4, 1954	Pleistocene gravel	45	8	9.5	.41	.12	71	29	9.4	6.3	0	293	70	12	.0	.5	356	297	57	578	7.4	12
Near Albany (E)	Nov. 5, 1954	Pleistocene sand	34	1½	11	.11	.03	11	2.9	4.8	.4	0	32	21	2.0	.1	1.5	78	40	14	86.7	7.0	5
Upper Hudson River subarea																							
Near Mechanicville (F)	Nov. 5, 1954	Snake Hill formation	118	6	12	0.22	0.09	17	4.5	77	4.2	0	222	48	8.0	0.1	2.0	293	61	0	450	7.8	7
Near Clifton Park (G)	Oct. 19, 1954	Pleistocene sand and gravel.	52	6	9.2	.02	.04	25	4.8	1.9	.2	0	79	20	1.2	.0	2.0	107	82	18	170	7.7	2
Mohawk River subarea																							
Near Waterford (H)	Oct. 19, 1954	Normanskill shale	182	8	9.6	0.03	0.03	33	12	69	2.3	0	295	34	8.8	0.3	1.5	316	132	0	521	7.7	2
Waterford (I)	Oct. 19, 1954	Pleistocene sand and gravel.	21	1¼	6.3	.23	.07	26	5.8	115	2.0	0	171	94	77	.0	3.0	419	89	0	703	7.4	7
Near Schenectady (J)	Nov. 4, 1954	Snake Hill formation	29	6	13	.12	.13	77	22	18	13	0	294	86	6.0	.2	18	416	283	42	560	7.5	5
Schenectady Co. Airport (K)	Oct. 20, 1954	Stratified fine-grain deposits.	31	2	8.5	.14	.04	45	20	3.8	.7	0	178	48	4.2	.0	3.8	237	195	49	376	7.7	5
Schenectady (L)	Oct. 20, 1954	Schenectady formation	150	6	16	2.8	.36	114	31	27	2.7	0	403	86	24	1.5	1.1	533	412	82	814	7.3	7
Rotterdam Jct. (M)	Oct. 20, 1954	Pleistocene sand and gravel.	48	12	8.1	.03	.03	72	20	13	2.4	0	249	58	17	.0	6.8	316	262	58	532	7.6	5
Near Verdun (N)	Sept. 4, 1947	Pleistocene gravel	161	12	17	----	----	53	15	41		0	312	2.1	18	.2	.0	294	194	0	------	7.5	----

water temperature is affected by air temperature. Water from most wells that tap bedrock ranges in temperature from 49° to 53°F. Water from unconsolidated deposits at depths of a few tens of feet has a slightly wider range in temperature. In some places infiltration of stream water affects the temperature of water from wells in sand and gravel. For example, the temperature of water from some of the Schenectady public-supply wells fluctuates between 40° and 65°F. The extreme temperatures lag 1 or 2 months behind the corresponding extremes in temperature of the Mohawk River (fig. 8).

SURFACE WATER

MOHAWK RIVER

The flow of the Mohawk River in the Albany-Schenectady-Troy area is affected by several reservoirs and one diversion which exports water from the basin. Except for spillage during periods of high flow, the entire flow of Schoharie Creek above Schoharie Reservoir is diverted into Ashokan Reservoir for New York City's water supply. Delta Reservoir on the main river and Hinckley Reservoir on West Canada Creek are maintained primarily for navigation in connection with operation of the Erie (Barge) Canal (fig. 1). Some water is diverted into Delta Reservoir from the Black River basin through Black River Canal (flowing south) and Lansing Kill.

The flow of Mohawk River has been measured at Cohoes since 1925 (table 4 and pl. 2). Streamflow records were collected at Crescent Dam from 1917 to 1925 but are not comparable with the records at Cohoes because water was not diverted from Schoharie Creek during that time. The pattern of regulation by Delta and Hinckley Reservoirs and the diversion into and from the basin have remained practically unchanged during the time records have been collected at Cohoes; therefore, the records at this station were collected under present conditions of diversion and storage. In addition to the diversion from the basin at Schoharie Reservoir, water is diverted around the Cohoes gage during the navigation season in the Erie (Barge) Canal.

The flow of Mohawk River, like the flow of all streams in the Albany-Schenectady-Troy area, is likely to be high or moderate in the late winter or spring and low in the summer and fall. However, the

TABLE 4.—*Summary of streamflow data*

Index no. (pl. 1)	Location of gaging station	Drainage area (sq mi)	Elevation of gage (feet above mean sea level)	Period of record	Average flow		Maximum flow			Minimum daily flow		Remarks
					Quantity (mgd)	Number of years	Quantity (cfs)	Gage height (feet)	Date	Quantity (mgd)	Date	
------	Hoosic River near Eagle Bridge.	510	355.41	August 1910 to March 1922. July 1923 to date.	596	41	55,400	21.15	Dec. 31, 1948	19	Sept. 14, 1913	
1	Hudson River at Mechanicville.	4,500	------------	October 1887–September 1931.	4,803	66	120,000	--------	Mar. 28, 1913	--------	----------------	Regulated by Indian Lake Reservoir and since 1930 by Sacandaga Reservoir.
				October 1931–September 1956.[1]	----------	--------	118,000	--------	Jan. 1, 1949	39.7	Feb. 1, 1931.	
32	Mohawk River at Cohoes.	3,456	49.13	July 1925 to date..	3,707	28	130,000	22.57	Mar. 19, 1936	15	Aug. 24, 1941.	Below diversion.
					3,770	28				84	Jan. 17, 1931.	Above diversion.
34	Hudson River at Green Island.	8,090	−.31	February 1946 to date.	9,400	7	181,000	27.05	Dec. 31, 1948	821	Sept. 5, 1949.	
37	Poesten Kill near Troy.	89	[2] 321.46	July 1923 to date..	90.5	30	11,900	12.1	Sept. 22, 1938	1.2	Oct. 12–14, 1930.	Diversion from Quaken Kill, an upstream tributary.

[1] Record collected under present storage conditions.
[2] City of Troy datum.

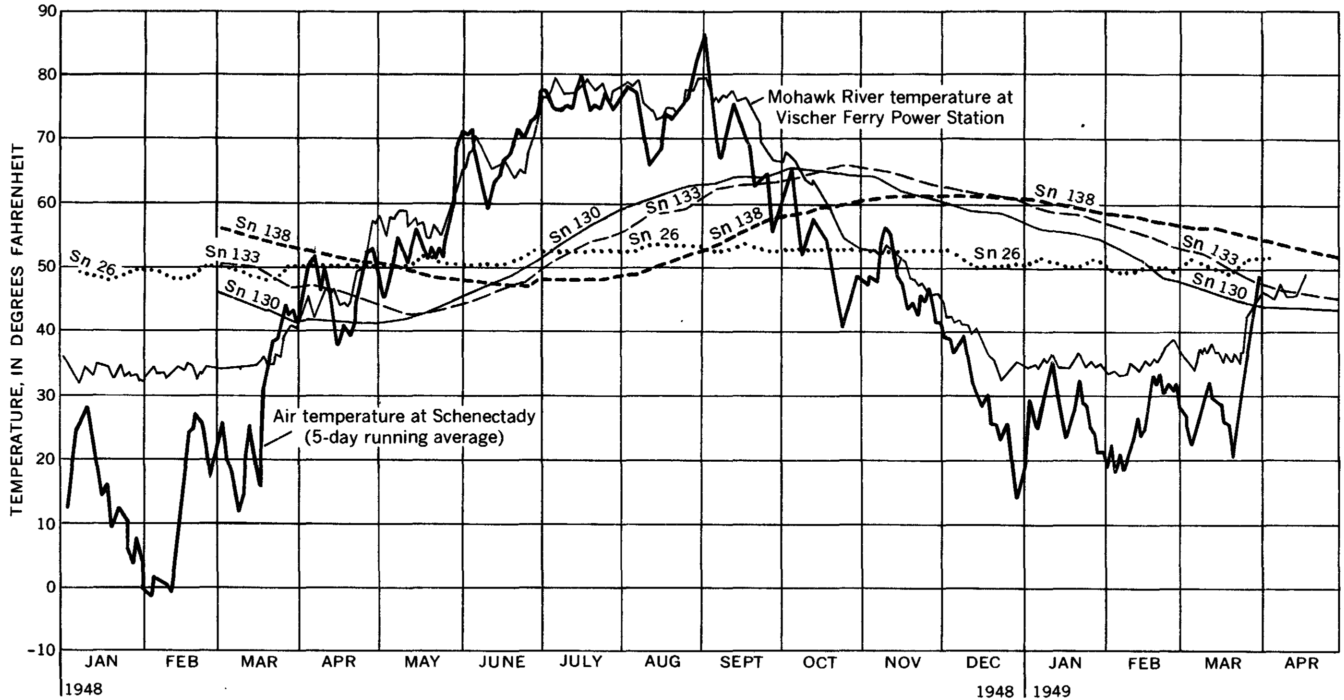

FIGURE 8.—Graph showing temperature fluctuations of water in wells Sn 26, Sn 130, Sn 133, and Sn 138, of Mohawk River water at Vischer Ferry hydroelectric power station, and of air at the Schenectady weather station, January 1948 to April 1949 (Simpson, 1952, p. 69).

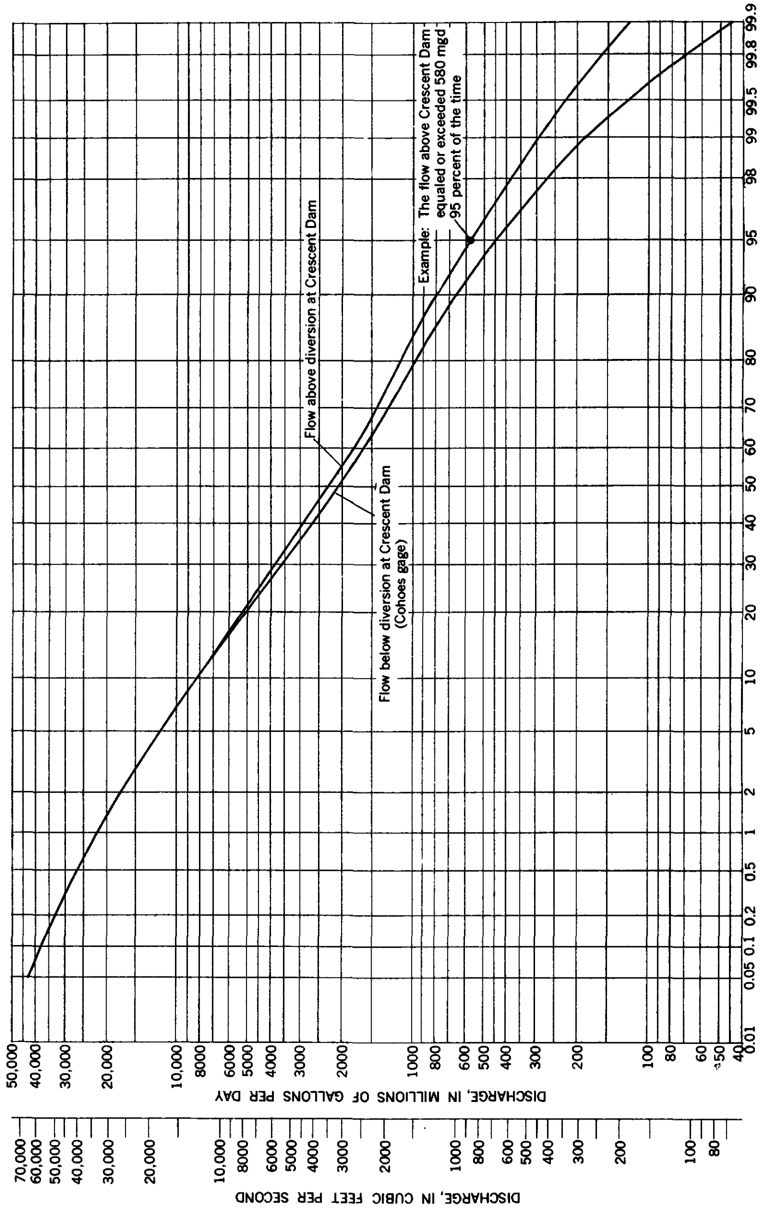

FIGURE 9.—Duration curve of daily flow, Mohawk River; based on records for water years 1926–54, from a drainage area of 3,456 square miles.

lowest flow of the year may occur during the winter when ice affects the flow. The flow-duration curve, figure 9, shows the percentage of time that the flow equaled or exceeded different quantities. The low-flow frequency curves, figure 10, show the average recurrence interval

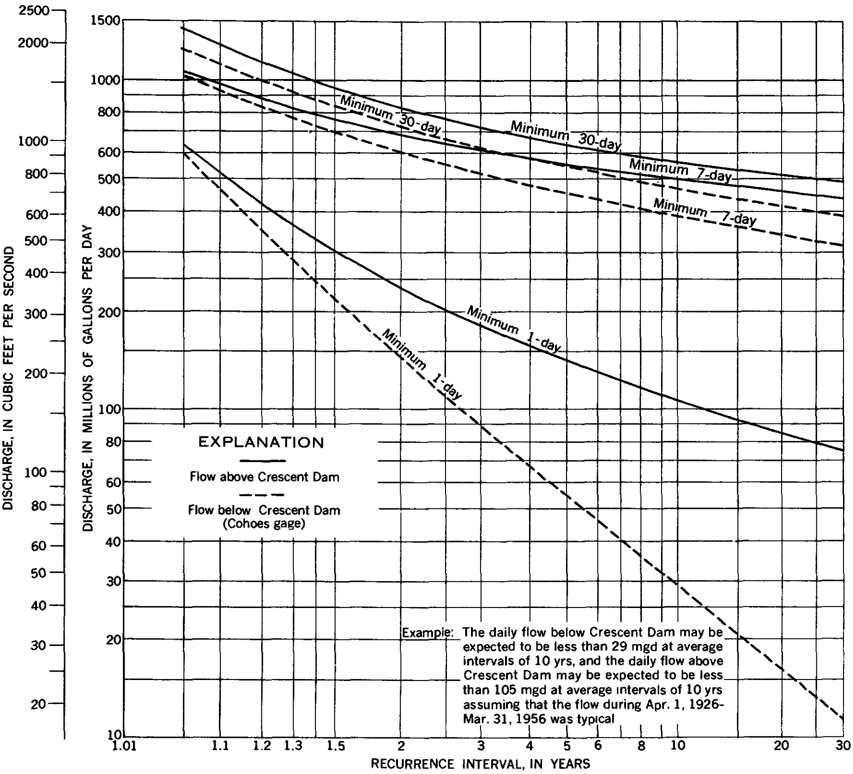

FIGURE 10.—Low-flow frequency curves, Mowhawk River; based on records for April 1, 1926, to March 31, 1956, from a drainage area of 3,456 square miles.

at which different flows occur as the annual minimum. The flow-duration curve and low-flow frequency curves can be used to predict the probable occurrence of low flows, assuming that meteorologic and other hydrologic conditions that influenced these curves remain almost unchanged and operation of storage reservoirs also remains unchanged. For example, over a period of many years the flow above Crescent Dam may be expected to be equal to or greater than 580 mgd 95 percent of the time. Below Crescent Dam the flow would be equal to or greater than 450 mgd 95 percent of the time (fig. 9). For any one year these figures, based on average conditions, do not apply; for example, a flow of 580 mgd or less above Crescent Dam would not occur every year. Figure 10 shows that the minimum daily flow above Crescent Dam may be expected to be less than 580 mgd at average intervals of 1.07 years or about 9 of 10 years.

Floods in the Mohawk River can be a serious problem. Records of floods are useful in the design of intake structures and docks and in locating building sites in areas that may be flooded. Hinckley, Delta, and Schoharie Reservoirs sometimes reduce flood flows greatly. As on other streams in the area, floods in the Mohawk River most likely occur in March, April, and May; however, a great flood may occur in any month. The recurrence intervals of annual peak stages at Cohoes below Crescent Dam are given in figure 11.

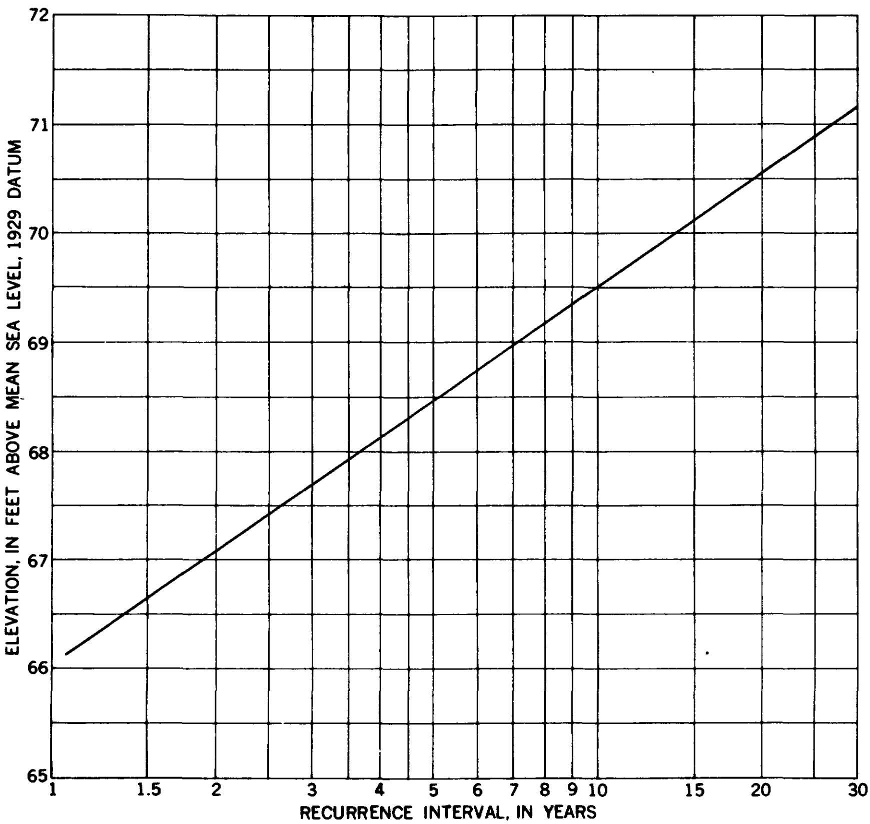

FIGURE 11.—Flood-stage frequency curve, Mohawk River at Cohoes; based on records for water years 1926–55.

The profiles of selected floods in that part of the Mohawk River within the report areas are given in figure 12. The approximate recurrence interval for each flood is given also.

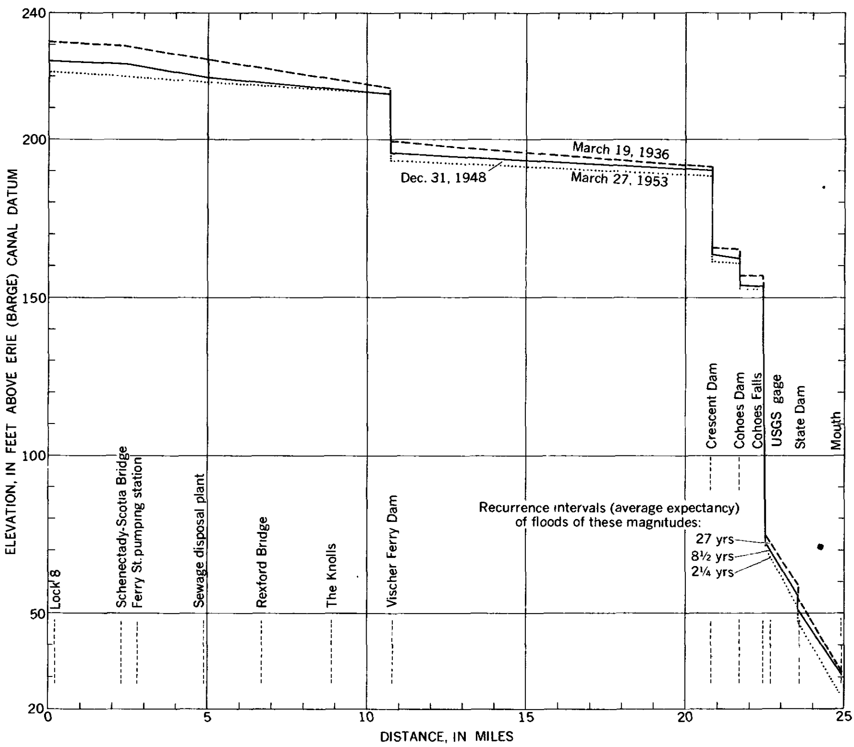

FIGURE 12.—Water-surface profiles during selected floods, Mohawk River from lock 8 to mouth.

The quality of Mohawk River water is satisfactory for most uses or the water can be treated economically for the removal of undesirable substances. The water is moderately hard—the median hardness as $CaCO_3$ is 103 ppm (fig. 13). Where a lower degree of hardness is needed, softening is required. The range in hydrogen-ion concentration during water years 1952 and 1953 expressed as pH was from 7.0 to 7.7. (See table 5 for a comprehensive analysis.) During 1952 dissolved solids in 10-day composites of daily samples fluctuated from 82 to 176 ppm. (fig. 14). The median concentration of dissolved solids is about 145 ppm (fig. 13).

Daily specific conductance ranged from 108 to 301 micromhos at 25°C; the median specific conductance is about 229 micromhos at 25°C; (fig. 13). Specific conductance is a measure of the capacity of water

TABLE 5.—*Chemical analyses, in parts per million, of selected samples of surface water*

[Sampling localities shown on pl. 1]

Source of sample and date of collection	Discharge (mgd)	Water temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCO_3$: Ca, Mg	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25° C)	pH	Color
Upper Hudson River subarea																				
Anthony Kill at Mechanicville:																				
May 26, 1954	79.5	58	3.0	0.16	0.00	21	5.8	1.3		58	22	5.5	0.1	0.7	112	76	29	178	7.3	10
Sept. 2, 1954	20.4	--------	6.6	.19	.00	34	5.8	5.6	1.7	89	42	5.6	.0	2.5	162	109	36	249	7.4	18
Hoosic River near Eagle Bridge:																				
June 22, 1954	354	--------	2.9	.04	.05	23	6.4	4.4	.7	93	14	5.8	.0	2.0	107	84	8	187	7.6	2
Hudson River at Mechanicville:																				
July 7, 1954	2,200	--------	3.6	.10	.07	17	3.4	8.8	.4	53	22	6.5	.2	1.1	113	56	13	150	6.7	30
Mohawk River subarea																				
Mohawk River at Vischer Ferry Dam:																				
Oct. 1, 1951, to Sept. 30, 1952 [1]	5,380	--------	5.6	0.03	------	30	5.0	5.6	1.2	92	23	6.3	0.1	2.0	136	96	20	216	------	11
Oct. 1, 1952, to Sept. 30, 1953	3,910	--------	4.0	.02	.01	33	4.6	8.3	1.6	95	29	8.9	.1	2.0	153	103	25	242	------	15
Mohawk River at Cohoes:																				
Jan. 9, 1952	3,990	--------	5.5	.24	.00	32	4.9	3.0	1.1	94	22	3.6	.2	2.2	129	100	23	207	7.7	19

Lower Hudson River subarea

Hudson River at Green Island:																				
June 16, 1954	10,300		3.6	0.27	0.10	19	3.8	3.5	0.5	60	15	3.5	0.2	1.0	88	63	14	139	6.9	10
Aug. 25	1,870		1.4	.23	.00	20	3.2	9.8	1.1	57	26	8.8	.0	2.8	115	63	16	174	7.0	38
Posten Kill near Troy:																				
June 21, 1954	58.9		6.3	.19	.03	7.8	1.8	2.2	.4	19	13	1.5	.2	1.4	49	27	11	65.5	6.6	10
East Branch Hunger Kill at Guilderland:																				
May 26, 1954	2.32	48	10	.22	.01	30	5.8	1.8		91	22	3.0	.0	1.2	127	99	24	213	8.0	5
Aug. 27	2.05		8.3	.11	.00	37	4.3	2.8	.3	116	21	1.8	.0	2.5	136	110	15	224	8.0	4
Mill Creek at Rensselaer:																				
May 20, 1954	5.64	53	4.3	.16	.01	21	6.8	1.5		60	26	4.5	.1	1.0	113	80	31	194	7.6	8
Aug. 27	1.27	71	3.1	.28	.00	38	9.8	9.9	1.6	134	40	6.4	.0	2.0	190	135	25	306	7.8	14
Moordener Kill near Castleton:																				
May 20, 1954	17.7	51	6.7	.08	.00	17	4.7	3.0		46	22	4.0	.1	2.1	96	62	24	157	7.5	10
Aug. 27	3.44	64	6.5	.09	.00	36	7.1	5.9	1.0	117	28	6.0	.0	3.2	158	119	23	258	8.0	7
Vloman Kill at Cedar Hill:																				
May 20, 1954	3.36	58	3.6	.17	.00	47	12	.9		130	46	9.0	.3	.7	209	167	60	352	7.8	8
Aug. 27	.35	68	.9	.18	.00	45	10	12	4.1	163	40	8.8	.0	1.2	209	153	20	350	7.6	12

[1] Average of samples collected during this period.

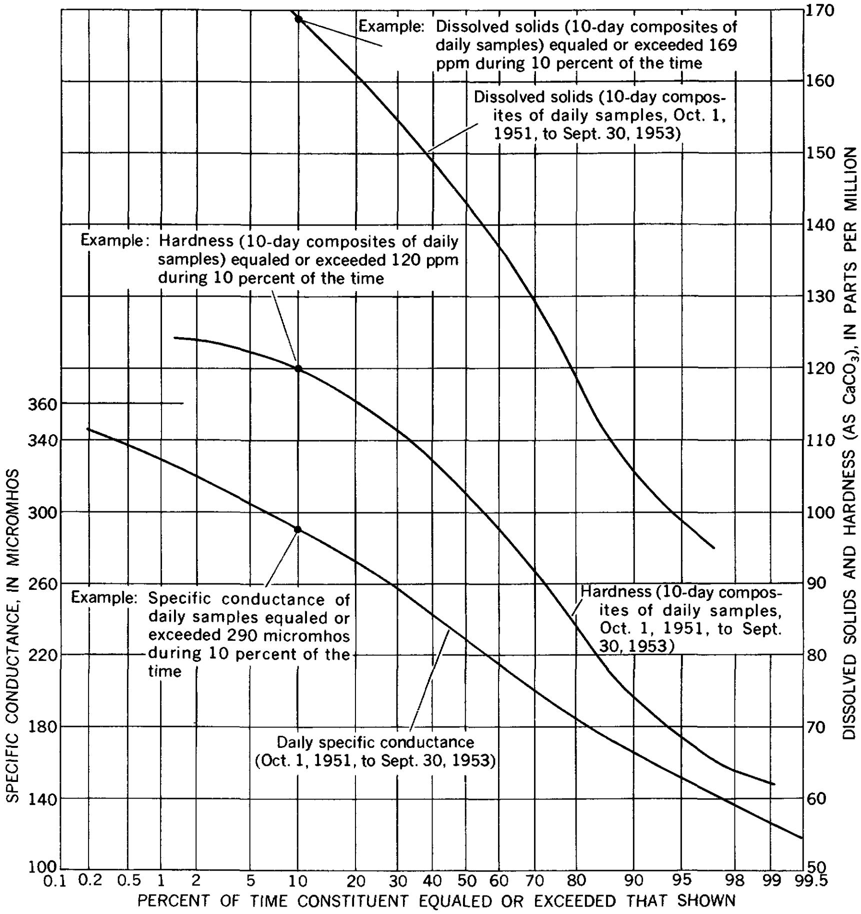

FIGURE 13.—Cumulative-frequency curve of hardness, dissolved solids, and specific conductance, Mohawk River at Vischer Ferry Dam.

to conduct an electric current; it varies with the quantity of dissolved mineral constituents, degree of ionization of these constituents, and temperature of the water. Conductance is useful in indicating the total concentration of solutes in water.

Color fluctuates seasonally; it is highest in the fall and lowest during the other seasons of the year. Average color for Mohawk River water was about 14 units (based on the platinum-cobalt standard) in 1952–53.

The temperature of Mohawk River water follows the same seasonal pattern as the air temperature in the region. In 1952 and 1953 the average water temperature (based on two daily readings) fluctuated between 32° and 80° F; the median temperature was 52° F. (See

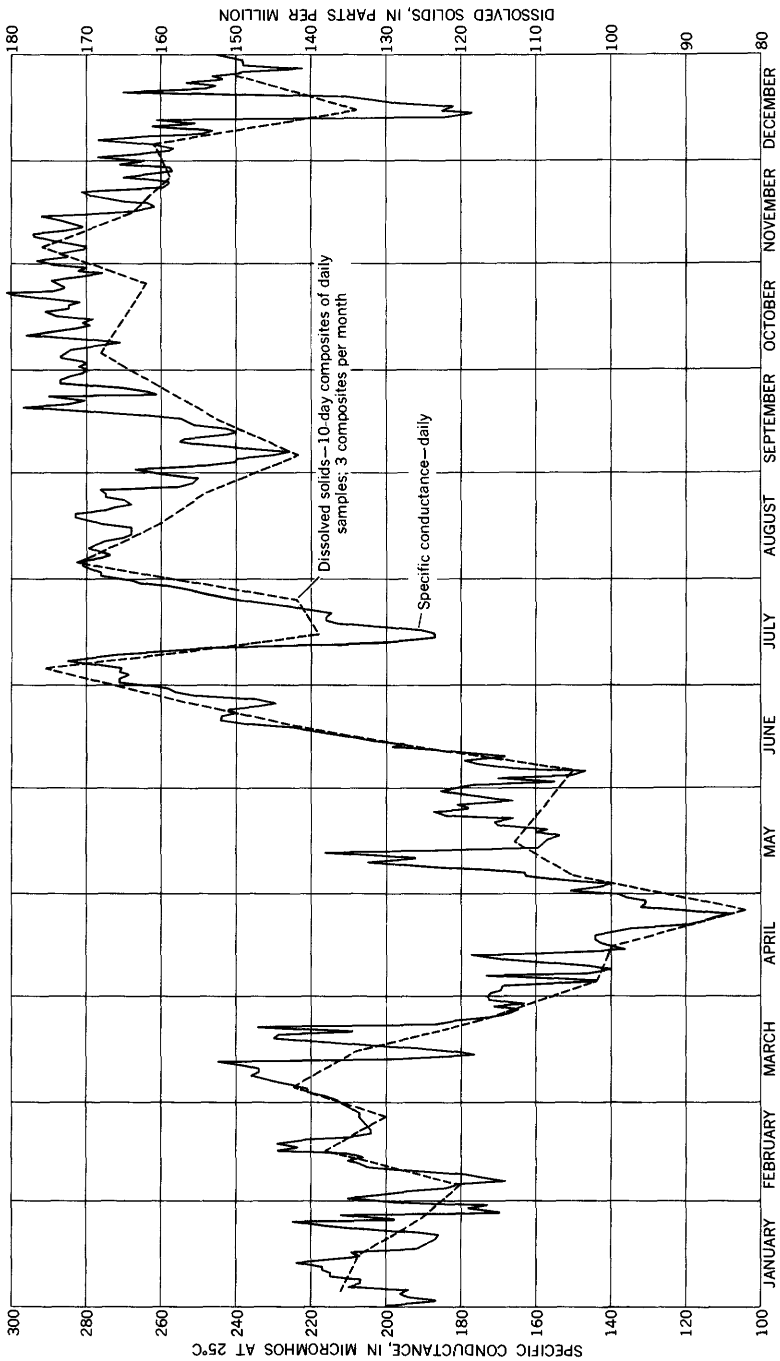

FIGURE 14.—Specific conductance and dissolved solids, Mohawk River at Vischer Ferry Dam, January to December 1952.

fig. 15.) The water temperature is higher than 71° F only about 25 percent of the time. In some places the temperature of river water may be affected by the inflow of industrial effluent.

Fluctuations in water temperatures of the Mohawk River and the Hudson River at two locations are shown in figure 16.

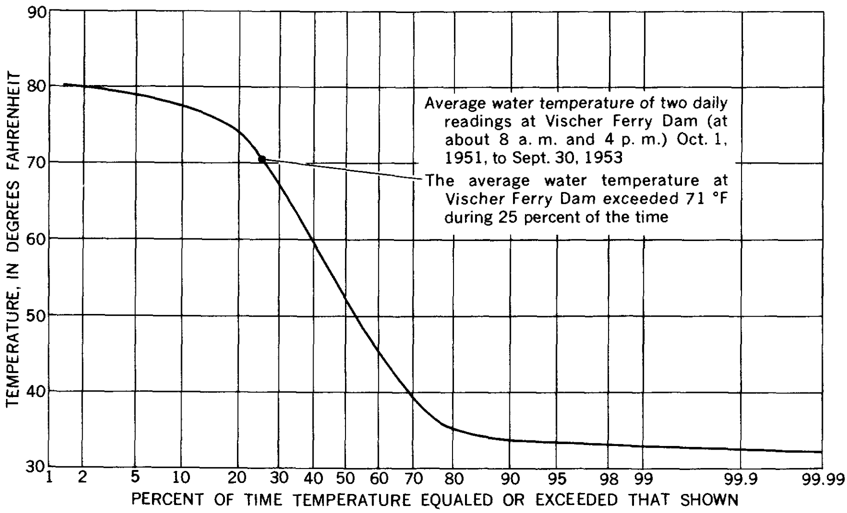

FIGURE 15.—Cumulative frequency curve of average water temperatures (two daily readings), Mohawk River.

SMALL STREAMS

Many small streams enter Mohawk River between Hoffmans and the mouth of the river. Although discharge measurements have been made on several of these (pls. 1 and 2), a reliable estimate of the low-flow characteristics is possible for only five of the streams. For these streams, the flow that was equaled or exceeded 95 percent of the time ranges from 0.004 to 0.028 mgd per sq mi of drainage area. (See table 6.) This low yield is due to the till or stratified fine-grained deposits that underlie most of the drainage basin of these streams and which release rather small quantities of water to streamflow during dry periods. (See pl. 1.) Although the low-flow characteristics of other small streams in the subarea may be similar to those of the five small streams shown in tables 6 and 7, the effect of local variations in geology and topography makes such a generalization suitable for reconnaissance purposes only.

Of the five small streams in the Mohawk River subarea for which low-flow analyses have been made, Alplaus Kill and Delphus Kill have the highest yields per square mile. With respect to total yield during

TABLE 6.—*Duration of low flow of selected small streams*

[Based on discharge measurements and records in the vicinity adjusted to the period 1912–55]

Index No. (pl. 1)	Stream and location	Drainage area (sq mi)	Flow which was equaled or exceeded for indicated percentage of time: Million gallons per day						Million gallons per day per square mile					
			60	70	80	90	95	98	60	70	80	90	95	98
	Upper Hudson River subarea													
4	Anthony Kill at Mechanicville	62.4	13	8.8	5.6	3.3	2.3	1.7	0.21	0.14	0.090	0.053	0.037	0.027
	Mohawk River subarea													
11	Sandsea Kill at Pattersonville	9.56	0.72	0.40	0.18	0.078	0.041	--------	0.075	0.042	0.019	0.008	0.004	--------
12	Plotter Kill at Rynex Corners	3.70	.23	.14	.071	.036	.022	--------	.062	.038	.019	.010	.006	--------
20	Alplaus Kill at Glenridge	54.3	12	7.7	4.3	2.3	1.5	1.1	.23	.14	.079	.042	.028	0.020
27	Lisha Kill near Niskayuna	18.2	2.4	1.3	.58	.24	.14	.085	.13	.071	.032	.013	.008	.005
29	Delphus Kill at Dunsbach Ferry	1.74	.37	.24	.14	.073	.048	.034	.21	.14	.080	.042	.028	.020
	Lower Hudson River subarea													
40	Van Rensselaer Creek at Menands	0.64	0.61	0.57	0.54	0.50	0.48	0.46	0.95	0.89	0.84	0.78	0.75	0.72
43	Mill Creek at Rensselaer	13.2	2.3	1.5	.88	.50	.34	.25	.17	.11	.067	.038	.026	.019
44	Normans Kill at Pine Grove	41.2	3.5	2.0	.91	.41	.23	.14	.087	.049	.022	.010	.006	.003
46	East Branch Hunger Kill at Guilderland	1.58	2.0	2.0	1.9	1.9	1.8	1.8	1.3	1.3	1.2	1.2	1.1	1.1
47	Normans Kill at State Highway 43, Albany [1]	169	50	35	23	14	9.9	7.5	--------	--------	--------	--------	--------	--------
49	Moordener Kill near Castleton-on-Hudson	29.7	6.5	4.4	2.7	1.6	1.1	.83	.22	.15	.091	.054	.037	.028
50	Vloman Kill at Cedar Hill near Selkirk	29.8	2.2	1.2	.54	.23	.13	.078	.074	.040	.018	.008	.004	.003
53	Coeymans Creek at South Bethlehem	34.6	10	7.1	4.5	2.7	1.9	1.5	.29	.21	.13	.078	.055	.043

[1] Regulated flow.

TABLE 7.—*Magnitude and frequency of annual low flow of selected small streams*

[Results of a regional analysis of streamflow from Apr. 1, 1911, to Mar. 31, 1955]

Index No. (pl. 1)	Stream and location	Drainage area (sq mi)	Lowest flow for recurrence interval and consecutive period indicated (mgd)						Lowest flow for recurrence interval and consecutive period indicated (mgd per sq mi)					
			2-year recurrence interval			5-year recurrence interval			2-year recurrence interval			5-year recurrence interval		
			1 day	7 days	30 days	1 day	7 days	30 days	1 day	7 days	30 days	1 day	7 days	30 days
4	Anthony Kill at Mechanicville	62.4	1.86	2.22	3.44	1.06	1.39	2.16	0.030	0.036	0.055	0.017	0.022	0.035
11	Sandsea Kill at Pattersonville	9.56	.028	.040	.085	.012	.017	.038	.003	.004	.009	--------	--------	--------
12	Plotter Kill at Rynex Corners	3.70	.016	.021	.039	.008	.010	.020	.004	.006	.011	--------	--------	--------
20	Alplaus Kill at Glenridge	54.3	1.04	1.41	2.34	.59	.81	1.35	.017	.023	.038	.009	.013	.022
27	Lisha Kill at Niskayuna	18.2	.084	.12	.26	.039	.058	.12	.005	.007	.014	.002	.003	.007
29	Delphus Kill at Dunsbach Ferry	1.74	.035	.045	.075	.019	.026	.044	.020	.026	.043	.011	.015	.025
40	Van Rensselaer Creek at Menands	.64	.46	.48	.50	.43	.45	.48	.72	.75	.78	.67	.70	.75
43	Mill Creek at Rensselaer	13.2	.25	.32	.51	.15	.19	.31	.019	.024	.039	.011	.014	.023
44	Normans Kill at Pine Grove	41.2	.16	.22	.45	.065	.094	.21	.004	.005	.011	.002	.002	.005
46	East Branch Hunger Kill at Guilderland	1.58	1.77	1.80	1.85	1.72	1.75	1.79	1.12	1.14	1.17	1.09	1.11	1.13
47	Normans Kill at State Highway 43, Albany	169	7.55	9.41	14.0	4.72	6.04	9.09	--------	--------	--------	--------	--------	--------
49	Moordener Kill near Castleton-on-Hudson	29.7	.83	1.06	1.65	.50	.64	1.03	.028	.036	.055	.017	.022	.035
50	Vloman Kill at Cedar Hill near Selkirk	29.8	.077	.12	.24	.035	.054	.11	.003	.004	.008	.001	.002	.004
53	Coeymans Creek at South Bethlehem	34.6	1.45	1.83	2.78	.90	1.15	1.77	.042	.053	.080	.026	.033	.051

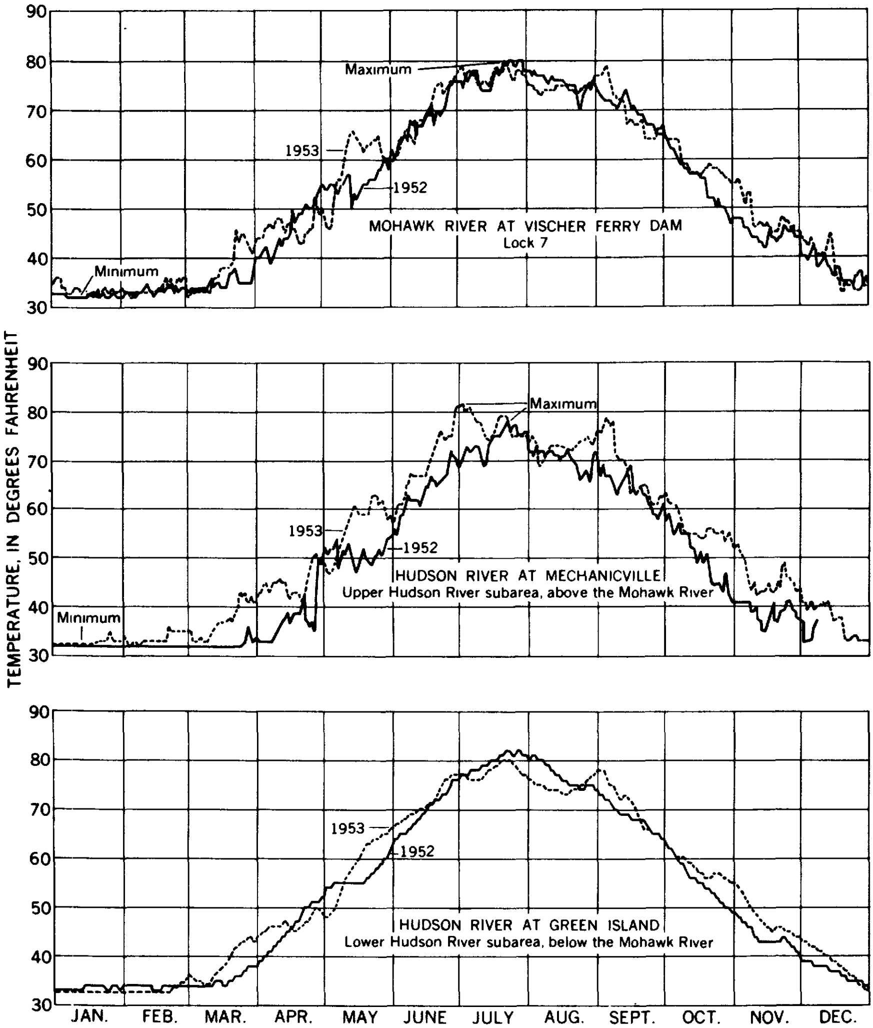

FIGURE 16.—Temperature of Mohawk River water at Vischer Ferry Dam and Hudson River water at Mechanicville and Green Island, 1952 and 1953; daily readings at about 8 p.m.

periods of low flow, Alplaus Kill is the only one whose flow at the 95-percent duration point (flow equaled or exceeded 95 percent of the time), is more than 1 mgd.

Chemical analyses are available for two small streams which are tributary to the Mohawk River in this subarea (table 5): Alplaus Kill at Glenridge and Stony Brook at Vischer Ferry.

Available data indicate that dissolved solids in water from Alplaus Kill fluctuated from 114 ppm during periods of high flow to 205 ppm during low flow. The range of hardness as $CaCO_3$ followed a similar pattern—67 to 136 ppm. The chemical constituents of water from Alplaus Kill were principally calcium and bicarbonate with lesser quantities of other mineral constituents normally found in surface water. However, concentrations of iron at times exceeded 0.3 ppm, and would have to be reduced for some uses of the water.

The range of dissolved solids in water from Stony Brook was narrower than that for Alplaus Kill—107 to 140 ppm. The water was moderately hard—61 to 109 ppm. The chemical constituents of water from Stony Brook consisted principally of calcium and bicarbonate.

PUBLIC WATER-SUPPLY SYSTEMS

Public water-supply systems serve most of the domestic users as well as some of the industrial users of water in the subarea. The major systems in the Mohawk River subarea are those of Schenectady, Cohoes, Latham, and Waterford (fig. 17). Schenectady has an ample source of water in its well field in the flood plain of the Mohawk River. Waterford obtains its water from the Hudson River and the Latham Water District obtains water from wells in the Colonie buried channel and from Stony Creek, a tributary of the Mohawk River. The Stony Creek surface-water supply was developed recently to relieve the draft on the wells because the water level in the vicinity of the wells had declined greatly. Cohoes obtains its water from the Mohawk River. Descriptive data on the water-supply systems are given in table 8.

The finished water from the public supplies, with respect to chemical and physical characteristics, meets the drinking-water standards of the U.S. Public Health Service for interstate carriers, which are generally accepted for public water supplies. The Schenectady water was the hardest of any of the public supplies in the area—160 ppm. It also had the highest concentration of dissolved solids—197 ppm. In contrast, the Troy water contains 61 ppm of dissolved solids and has a hardness of 40 ppm. The median concentration of dissolved solids of the 10 public water supplies listed in table 8 is about 125 ppm; median hardness is 85 ppm.

It is estimated that of the total population of 403,800 served by these public supplies, 239,400 use water having a dissolved-solids content and hardness less than the median values of 125 and 85 ppm, respectively. Analyses of water from public water supplies in the area are given in table 9.

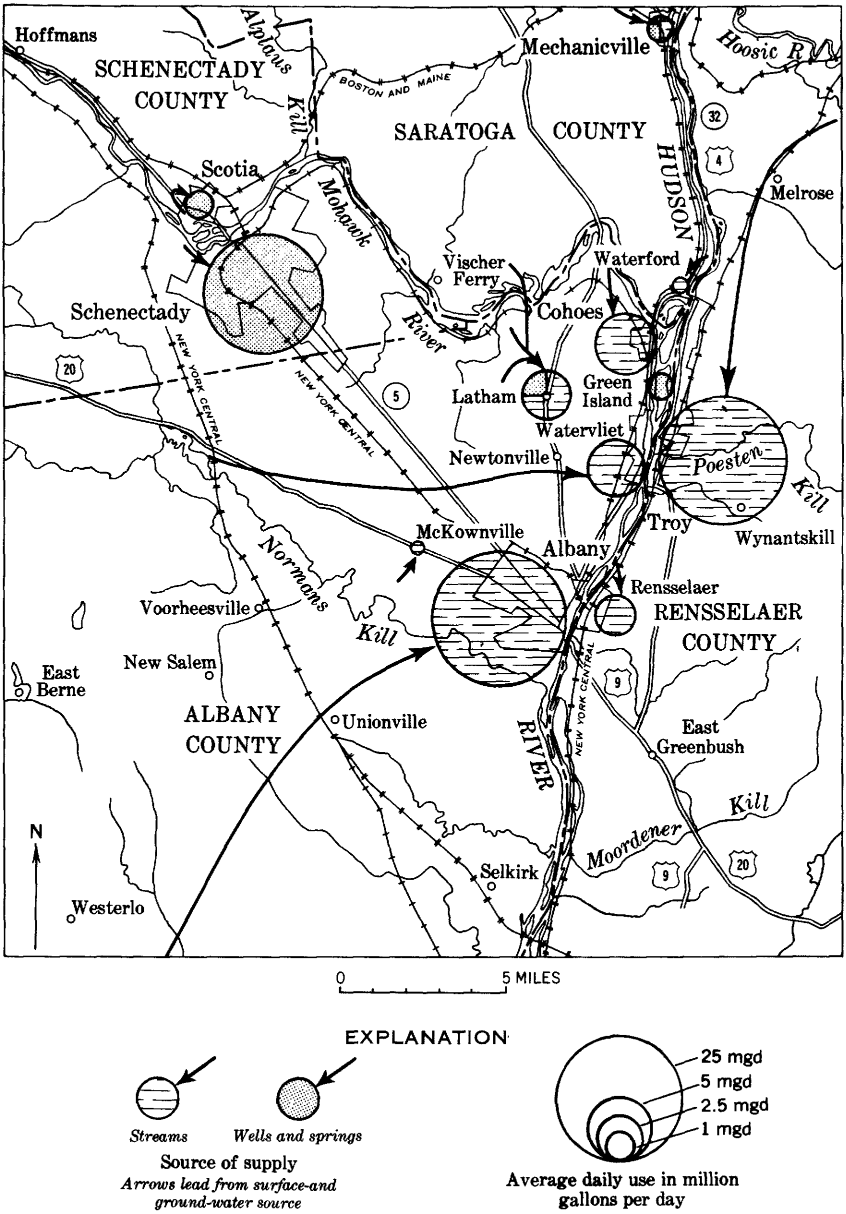

Figure 17.—Source of and demand on major public-water supplies in the Albany-Schenectady-Troy area, 1953.

TABLE 8.—*Major public water-supply systems*

[Municipally owned except McKownville]

Public water supply	Population (1950 census)	Estimated population served	Source of water	Impounded storage (millions of gallons)	Treatment	Rated capacity (mgd)	Daily use in 1953 (mgd)	
							Maximum	Average
Albany	134, 995		Hannacrois and Basic Creeks.	13, 000	Aeration, coagulation with alum, sedimentation, rapid sand filtration, chlorination, adjustment of pH with lime.	30	28. 48	23. 8
Cohoes	21, 272	25, 000	Mohawk River	72	Coagulation with alum, sedimentation, rapid sand filtration, chlorination.	10	4. 5	4
Green Island	4, 016	4, 260	Infiltration galleries	. 5	Coagulation with alum, chlorination, rapid sand filtration	1	. 7	. 5
Latham		25, 000	Wells, Stony Creek	1, 859	Activated charcoal, chlorination, filtration, alum and lime.	3	4. 9	2. 9
McKownville		1, 200	Krum Kill	. 25	Chlorination, alum, lime	. 6	. 2	. 1
Mechanicville	7, 385	8, 400	Baker and Plum Brooks; tributaries of Anthony Kill; springs.	104	Coagulation with alum, activated carbon, sedimentation, filtration.	2. 16	. 9	. 8
Rensselaer	10, 856	15, 000	Hudson River		Prechlorination, coagulation with alum, sedimentation, filtration, chlorination, soda ash.	3. 6	3. 4	2. 2
Schenectady	91, 785	93, 200	Wells	20	Chlorination		33	22
Troy	72, 311	75, 000	Tomhannock Creek and Quacken Kill.	13, 000	Chlorination	40	31	27
Waterford	2, 968	6, 000	Hudson River		Sedimentation, filtration, chlorination, adjustment of pH	1. 5	. 7	. 5
Watervliet	15, 197	20, 000	Normans Kill, Bozen Kill and Black Creek.	1, 700	Prechlorination, coagulation with alum, activated carbon, sedimentation, filtration, chlorination, adjustment of pH with lime.	5	5	4

UPPER HUDSON RIVER SUBAREA

The Hudson River rises in the Adirondack Mountains and flows southward through the area in a flood plain ranging in width from ½ to 1½ miles. The flood plain is bordered by a lowland comprising clay plains near the river. To the east of the clay plains is a gently rising area of till and bedrock and west of the clay plain are areas of till and sand plains and sandhills. Tributaries enter the river through steep narrow valleys.

The largest concentrations of population and industry are at Mechanicville and Waterford. A paper plant in Mechanicville uses large quantities of water. Other water-using factories produce textiles and machinery. The channel of the Hudson River serves as the Champlain (Barge) Canal. The Hudson and Hoosic Rivers are the chief sources of water in this subarea but some water is available from wells and small streams.

GROUND WATER

The formations in this subarea do not yield water to wells readily; however, small quantities of water may be obtained from alluvium, stratified deposits, and bedrock.

The alluvial deposits of the Hudson River consist chiefly of clay and silt which contains sand and gravel lenses in a few places. Because the deposits are relatively fine grained and not very thick, they are not likely to yield large quantities of water.

The delta formed by the ancestral Hoosic River where it entered glacial Lake Albany west of Schaghticoke, rests on a layer of till about 40 feet thick which in turn rests on bedrock. The deltaic material consists of about 100 feet of fine-grained stratified material, chiefly clayey sand, which is overlain by more than 200 feet of coarse sand and gravel. The present Hoosic River has cut through all these deposits and into the underlying bedrock; therefore the deposits are thoroughly drained and storage of large quantities of water is not possible.

The yields of wells in bedrock, till, and stratified fine-grained deposits in the subarea range widely. Generally, however, yields are small but sufficient for the needs of households and farms. The bedrock formations in the subarea are the Schenectady and Snake Hill formations, Normanskill shale, and the Schodack formation. (See fig. 5). The median yield of reported wells that tap these formations is very nearly the same, between 2 and 4 gpm (table 1).

A till blanket, commonly not more than 30 feet thick, covers much of the higher parts of the subarea. Cushman (1950, p. 17) reports that the average yield of 15 wells drawing water from till in Rensselaer

County is about 10 gpm; however, the reported yield of wells that tap till in the Albany-Schenectady-Troy area is somewhat less, the median yield is only 3 gpm. The fine-grained stratified deposits yield very little water to wells.

Depths to water in wells and fluctuations of water level in the subarea are about the same as elsewhere in the Albany-Schenectady-Troy area, as described on page 13, table 2, and figure 6. Of the 75 wells inventoried during 1945–49 in this subarea, 5 wells were reported to be flowing.

The quality of ground water in the subarea is about the same as the quality of ground water elsewhere in the Albany-Schenectady-Troy area (p. 16).

SURFACE WATER

HUDSON RIVER

The flow of the Hudson River is affected by the operation of Sacandaga Reservoir on the Sacandaga River and Indian Lake Reservoir on the Indian River. (See fig. 1.) Sacandaga Reservoir, completed in 1930, has a usable capacity of about 256,000 million gallons and impounds water from a drainage area of 1,044 square miles. It controls practically the entire flow of Sacandaga River and provides flood-control and low-water stream regulation for sanitary improvement, navigation, and waterpower. Indian Lake Reservoir, built in 1845 and rebuilt in 1898, has a usable capacity of about 34,000 million gallons from a drainage area of 131 square miles. It is used primarily for power development for industrial needs, and to improve navigation in the lower Hudson River. These reservoirs have an appreciable effect on the flow of the Hudson River. In some months during late summer and fall when streamflow normally is low, more than half the flow of the Hudson River above the Mohawk River is water released from storage.

The flow of the Hudson River above the Mohawk River and within the Albany-Schenectady-Troy area is measured at Mechanicville (table 4). Although streamflow records have been collected at Mechanicville since 1887, the flow records prior to the construction of Sacandaga Reservoir in 1930 are not comparable to those collected since 1930 because of the regulation by the reservoir.

The lowest daily flow that occurred during water years 1931–54 was 397 mgd, or 614 cfs (cubic feet per second), on February 1, 1931. The duration curve of daily flow (fig. 18) shows the percentage of time that the flow equaled or exceeded different quantities and the low-flow frequency curve (fig. 19) shows the recurrence interval for different low flows. These curves are based on records subsequent to construc-

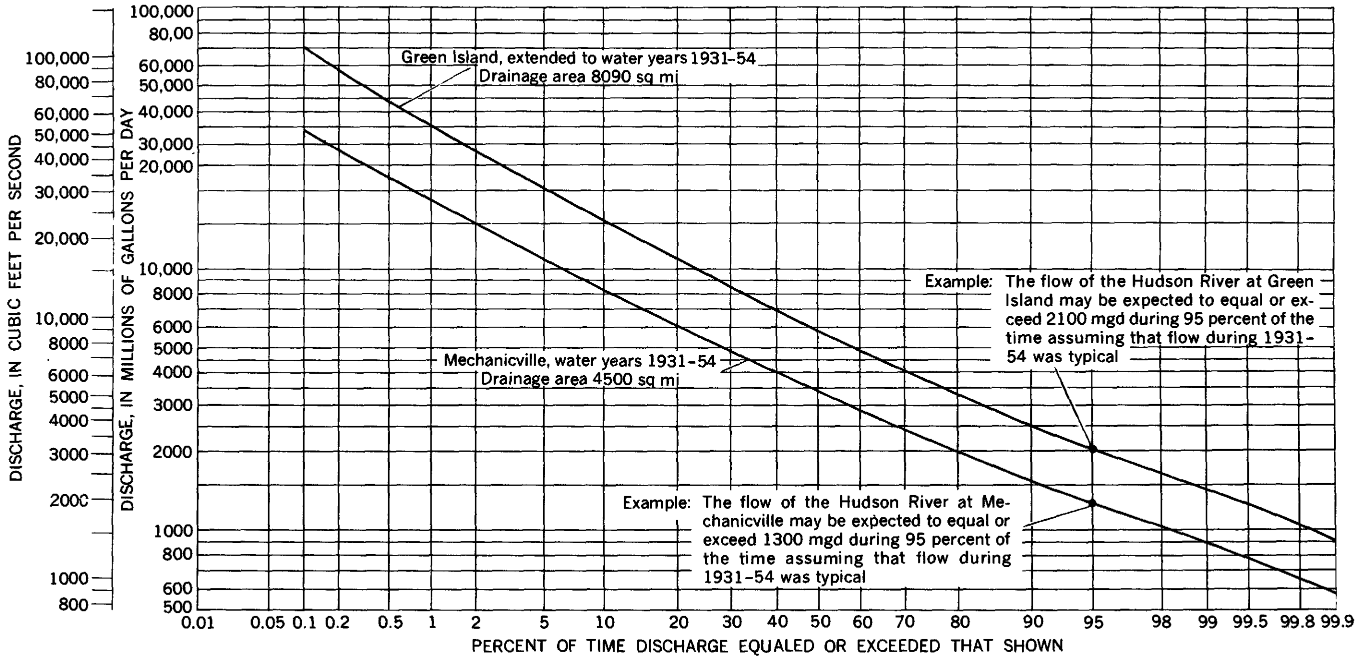

FIGURE 18.—Duration curve of daily flow, Hudson River at Green Island; extended to water years 1931–54, from a drainage area of 8,090 square miles.

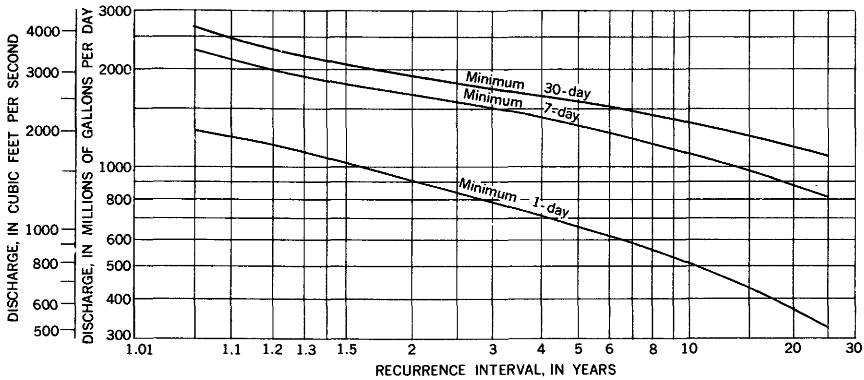

FIGURE 19.—Low-flow frequency curves, Hudson River at Mechanicville; based on records for April 1, 1930, to March 31, 1956, from a drainage area of 4,500 square miles.

tion of Sacandaga Reservoir and therefore, show the low flow that was experienced with Indian Lake and Sacandaga Reservoirs in use. These curves may be used to predict the probable occurrence of low flow of the Hudson River, provided the flow during the period was typical and provided the reservoirs are operated in the same manner as in the past.

Floods in the Hudson River are affected by storage in Sacandaga Reservoir and to a much lesser extent by storage in Indian Lake Reservoir and in Tomhannock Reservoir in the Hoosic River basin. As on other streams in the Albany-Schenectady-Troy area, floods are most likely to occur during March, April, and May; however, a flood may occur in almost any month. (See figs. 20 and 26.) The curve of average recurrence interval of annual peak stages at Mechanicville is given in figure 21. As this curve is based on records collected since Sacandaga Reservoir was built, it reflects the operational effect of Sacandaga and Indian Lake Reservoirs and the natural storage effect of Tomhannock Reservoir. The profiles of selected floods on the Hudson River and their average recurrence intervals are given in figure 22.

Note that the flood flow of the Mohawk River was so great during the 1936 flood to cause flood stages on the Hudson River below the Mohawk River to be the highest of record since 1913. (See also fig. 12.)

Although the water is polluted, the mineral content of Hudson River water is such that the water is satisfactory for most uses or if necessary, it can be improved by simple treatment. The water contains moderate concentrations of dissolved solids and is soft (analyses) are given in table 5). The chemical constituents are principally calcium and bicarbonate. At times, the color of the water is high and may have to be reduced depending on the use of the water.

The temperature of Hudson River water follows the same seasonal pattern as the air temperature in the region but lags slightly behind it. In some places the water temperature may be affected by inflow of industrial wastes. In 1952 and 1953 water temperatures fluctuated between 32° and 82° F (fig. 16). The water temperature was less than 60° F during 7½ months in 1953 and during 8 months in 1952.

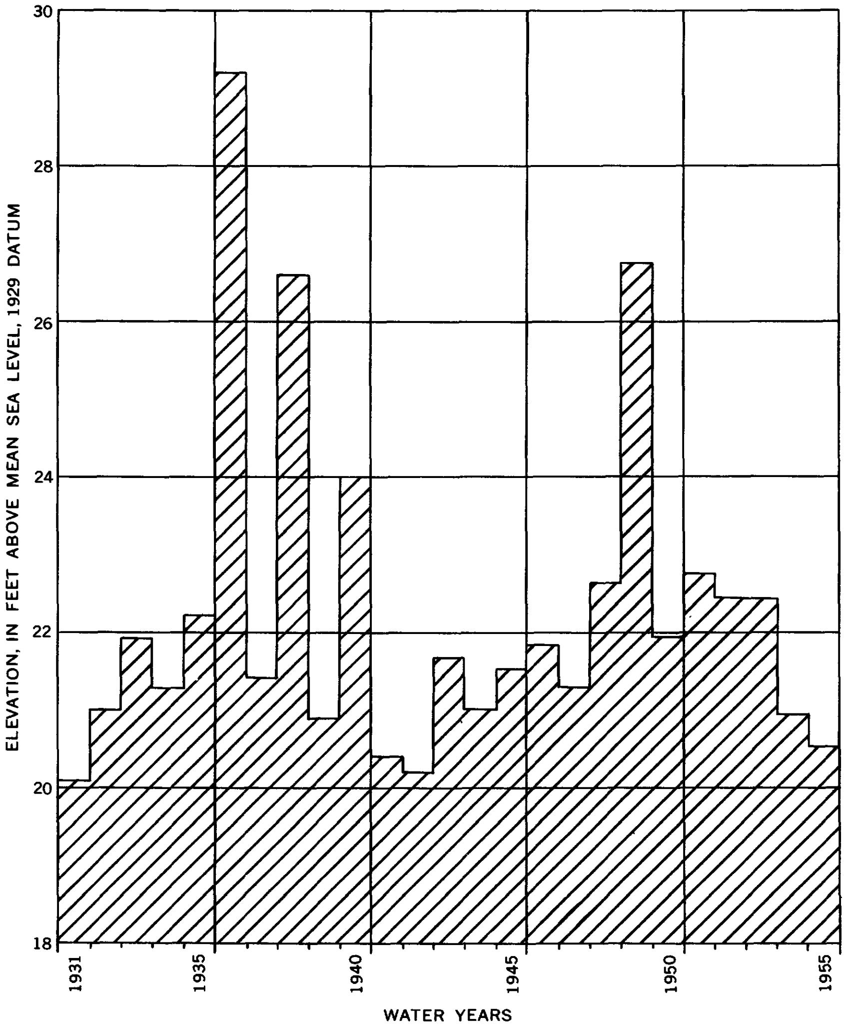

FIGURE 20.—Stages of annual floods, Hudson River at Green Island, water years 1931–55.

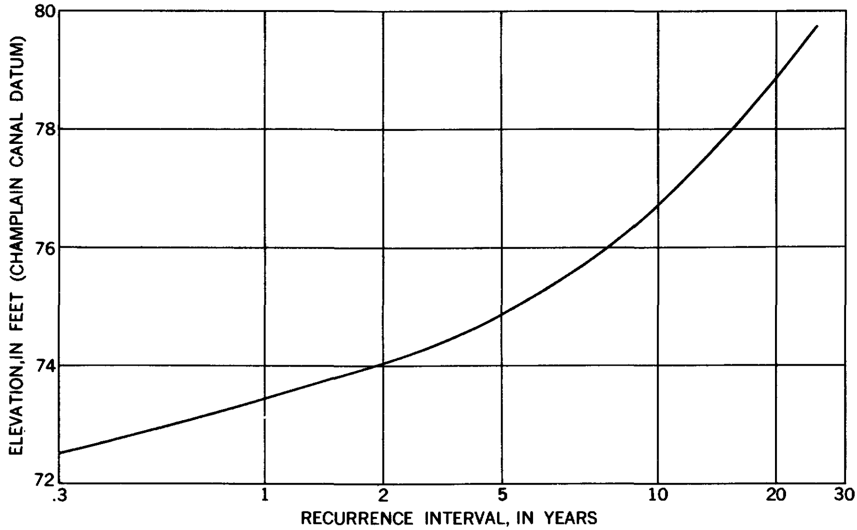

FIGURE 21.—Flood-stage frequency graph, Hudson River at Mechanicville; based on records for water years 1931–52.

HOOSIC RIVER

The Hoosic River rises in Massachusetts and Vermont and empties into the Hudson River 3 miles north of Mechanicville. The river flows through the northeast corner of the area; however, most of its drainage basin lies outside of the Albany-Schenectady-Troy area.

Hydroelectric plants on the Hoosic River develop power at Johnsonville and Schaghticoke. The Tomhannock Reservoir on Tomhannock Creek, a tributary of Hoosic River, is the main source of water for Troy. (See pl. 1). Tomhannock Reservoir has a drainage area of 67 square miles and a storage capacity of 12,000 million gallons. It was built in 1904.

The flow of the Hoosic River is measured at Eagle Bridge, outside the Albany-Schenectady-Troy area (table 4 and pl. 2). The flow-duration curve (fig. 23) and the low-flow frequency curve (fig. 24) show the low-flow characteristics. The curves show the flow above two run-of-the-river powerplants, which change the flow pattern greatly during periods of low flows.

The chemical quality of Hoosic River water is similar to that of water from the Hudson River above its confluence with the Mohawk River. The water is only slightly harder and somewhat more alkaline than water from the Hudson River (analysis given in table 5). The principal chemical constituents are calcium and bicarbonate.

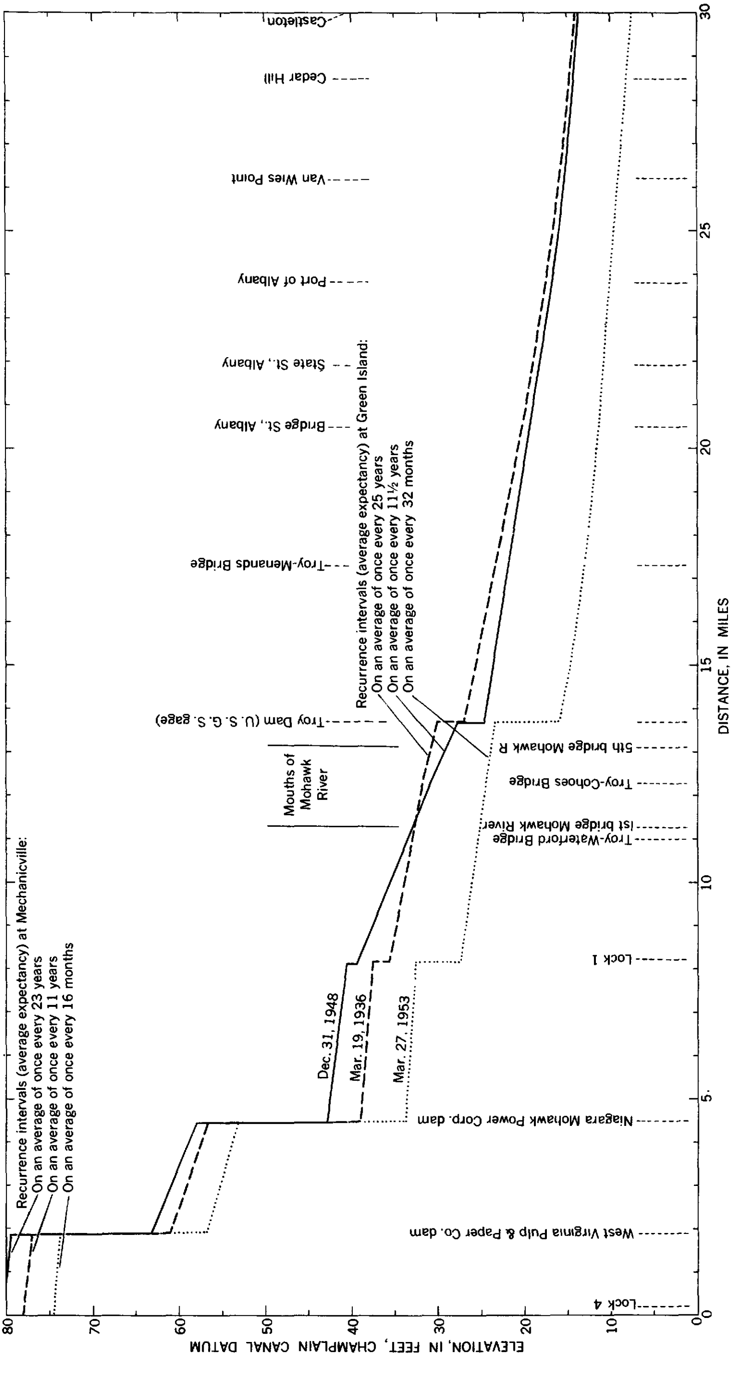

FIGURE 22.—Water-surface profiles during selected floods, Hudson River from lock 4, Champlain (Barge) Canal, to Castleton-on-Hudson.

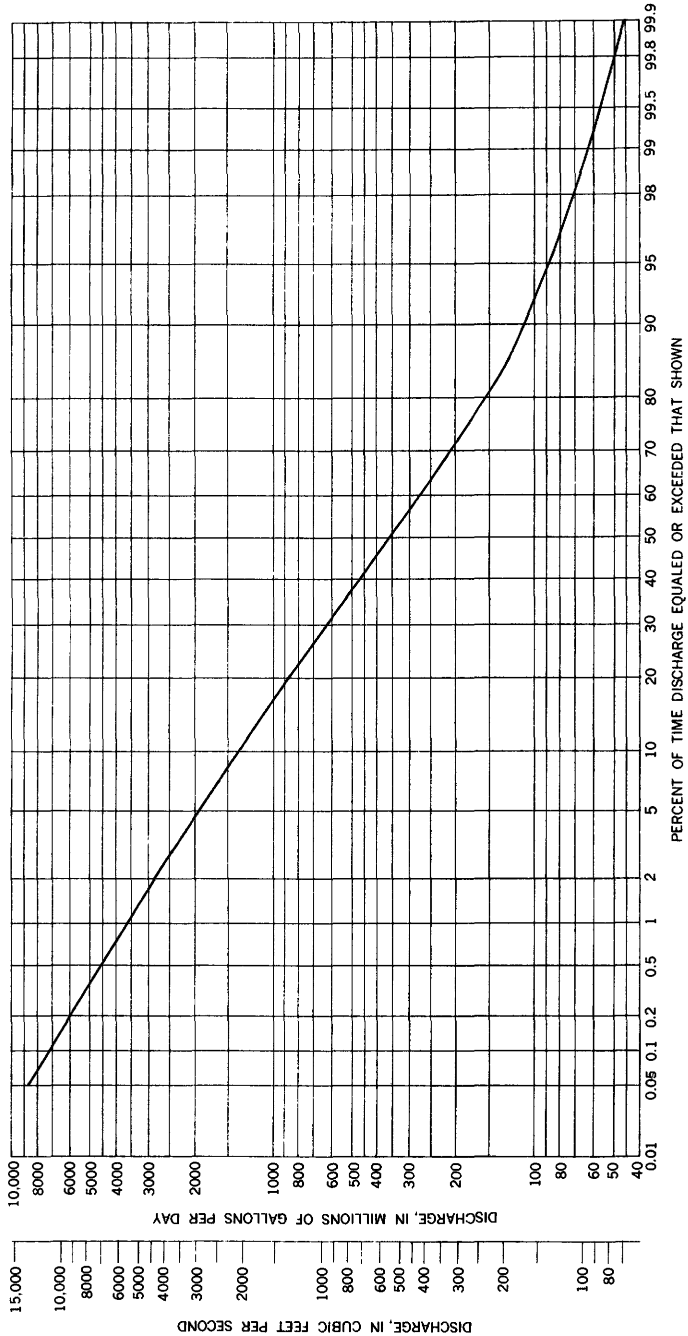

FIGURE 23.—Duration curve of daily flow, Hoosic River near Eagle Bridge; measured flow during water years 1924–55, from a drainage area of 510 square miles.

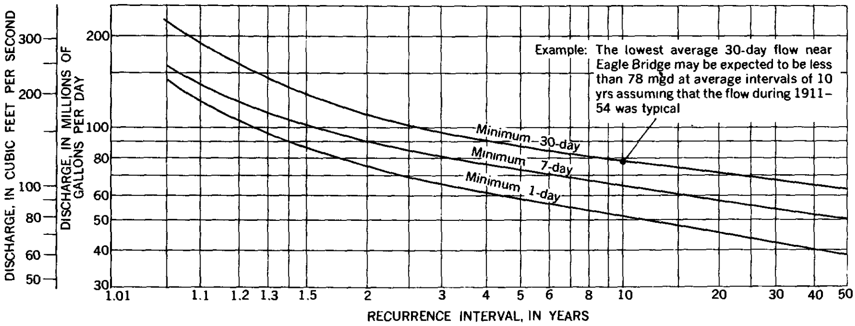

FIGURE 24.—Low-flow frequency curves, Hoosic River near Eagle Bridge; based on a regional analysis of records for April 1, 1911, to March 31, 1955, from a drainage area of 510 square miles.

Data on the temperature of Hoosic River water are not available. However, the temperature probably follows a seasonal pattern similar to that of the Mohawk and Hudson Rivers. As the Hoosic is shallower, the maximum temperature may be higher than that of the larger streams.

SMALL STREAMS

Anthony Kill (pl. 1), a tributary of the Hudson River at the northern edge of the report area, is the only small stream in the upper Hudson River subarea for which data on flow characteristics are available. It is the outlet of Round Lake and drains an area of 62.4 square miles, most of which is outside the report area. Mechanicville Reservoir, on a small tributary, has little effect on the flow of the stream because the drainage area of the tributary is only 5 percent of the total. The flow-duration data and low-flow frequency data are given in tables 6 and 7. The flow of Anthony Kill at Mechanicville equals or exceeds 2.3 mgd 95 percent of the time. This moderately well sustained dry-weather flow of Anthony Kill results from part of its basin being a sand-plain region similar to the Albany-Schenectady sand plain.

In view of the wide range in low-flow characteristics of the small streams in the other parts of the report area, no estimate can be made of the dry-weather flow of the other small tributaries of the Hudson River between Mechanicville and the Mohawk River. However, because they have small drainage basins, the amount of dry-weather flow available for use 95 percent of the time on any one stream is probably less than 1 mgd.

The water of Anthony Kill, based on analyses of two samples taken during 1954, is harder and has a higher concentration of dissolved solids than Hudson River water. It is also slightly more alkaline (table 5).

PUBLIC WATER-SUPPLY SYSTEMS

The public water-supply systems are probably the most economical source of small quantities of water for industrial use or of water of good sanitary quality. The only major system in the upper Hudson River subarea is at Mechanicville (fig. 17). Baker and Plum Brooks, small tributaries of Anthony Kill, are the source of supply. The rated capacity of the system is 2.16 mgd and the maximum daily demand was 0.9 million gallons in 1953. Additional information is given in table 8.

The finished water from the system meets U.S. Public Health Service standards for public water supplies and is about typical for the region; the concentration of dissolved solids in one sample was 117 ppm, hardness as calcium carbonate was 78 ppm, and the iron content was 0.10 ppm. An analysis of the sample is given in table 9.

LOWER HUDSON RIVER SUBAREA

The Hudson River below the Mohawk River is the combined flow of all streams in the Albany-Schenectady-Troy area and, therefore, is the largest source of water in the area. Large quantities of water from the Hudson River are used for cooling and other industrial purposes and some is used for public water supplies. In addition to the Hudson River, small streams and wells are sources of water.

The river flows in a flood plain ranging in width from ½ to 1 mile cut in a lowland area of thick clay, silt, sand, and till. From the outskirts of Albany northwest to Schenectady and Guilderland this lowland is an area of sand plains and sandhills. South and southwest of this sandy area is an area of flat clay plains that extends eastward beyond the flood plain of the Hudson ¼ to 2½ miles. East and west of the clay plains are gently rising, more hilly lowlands of till and bedrock. The western part of this gently rising lowland extends to the foot of the Helderberg escarpment, which rises abruptly more than 1,000 feet to the southwestward-sloping Helderberg plateau. The plateau is covered with a thin deposit of till interspersed with outcrops of the underlying limestones and shales.

Industry is concentrated along the flood plain of the river; the residential areas are on the other sections of the lowlands. Albany, the largest city in the area, is the State capital and a port of entry. Troy, at the head of river navigation, is an industrial and educational center.

Ground water is more plentiful in the lower Hudson River subarea (below the Mohawk River) than in the upper Hudson River subarea. Moderate to large supplies may be obtained at some places in the alluvium in the lower Hudson River flood plain and from sand plain, kame, and terrace deposits. Small supplies may be obtained from till and bedrock.

GROUND WATER

HUDSON RIVER FLOOD PLAIN

The alluvial deposits of the Hudson River flood plain below the Mohawk River consist chiefly of clay and silt which in some places is interstratified with lenses of sand and gravel (fig. 25). These water-bearing sand and gravel lenses sustain some industrial and public-supply wells of large capacity and are potential sources of additional large supplies.

The public-supply system of the town of Green Island pumps an average of about 0.5 mgd from an infiltration gallery, and the Borden Co. in Troy pumps about 0.12 mgd from three wells. Tests for the General Aniline Co. at Rensselaer indicated a potential yield of about 5,700 gpm from a horizontal collector-type well. At the Port of Albany, Cargill, Inc. has three wells drawing water from gravelly alluvium which yield 350, 100, and 75 gpm. At Green Island, Breakers Island, and Rensselaer, the high yields are probably due to induced infiltration of river water. Large supplies of ground water may be obtained at these and other places in the Hudson River flood plain where conditions are favorable for well installations inducing recharge from the river.

REMAINDER OF THE SUBAREA

Moderate quantities of water may also be obtained from coarse-grained deposits in the Wynants Kill kame area and the Schodack terrace, and small quantities may be obtained from bedrock and till.

The Wynants Kill kame area (pl. 1), 8 square miles in extent, is covered by irregularly shaped knobs, depressions, and small lakes. Underlying the area are deposits of gravel and sand as much as 120 feet thick that are interfingered with fine-grained materials. Wells in the Wynants Kill kame area yield moderate quantities of water and, according to Cushman (1950, p. 18), only a few wells tap the gravel and sand deposits. The largest development is at the Pawling Sanatorium where three wells have a maximum combined yield of 80 gpm.

The Schodack terrace lies east of the Hudson River in the southeastern corner of the Albany-Schenectady-Troy area (pl. 1). The terrace consists of well-sorted beds of coarse clean sand and gravel and ranges in thickness from zero at East Greenbush and Schodack Center to more than 100 feet near its center. The sand and gravel in the terrace are a potentially productive source of water because the stratified beds are thick and yield water freely to wells. The East

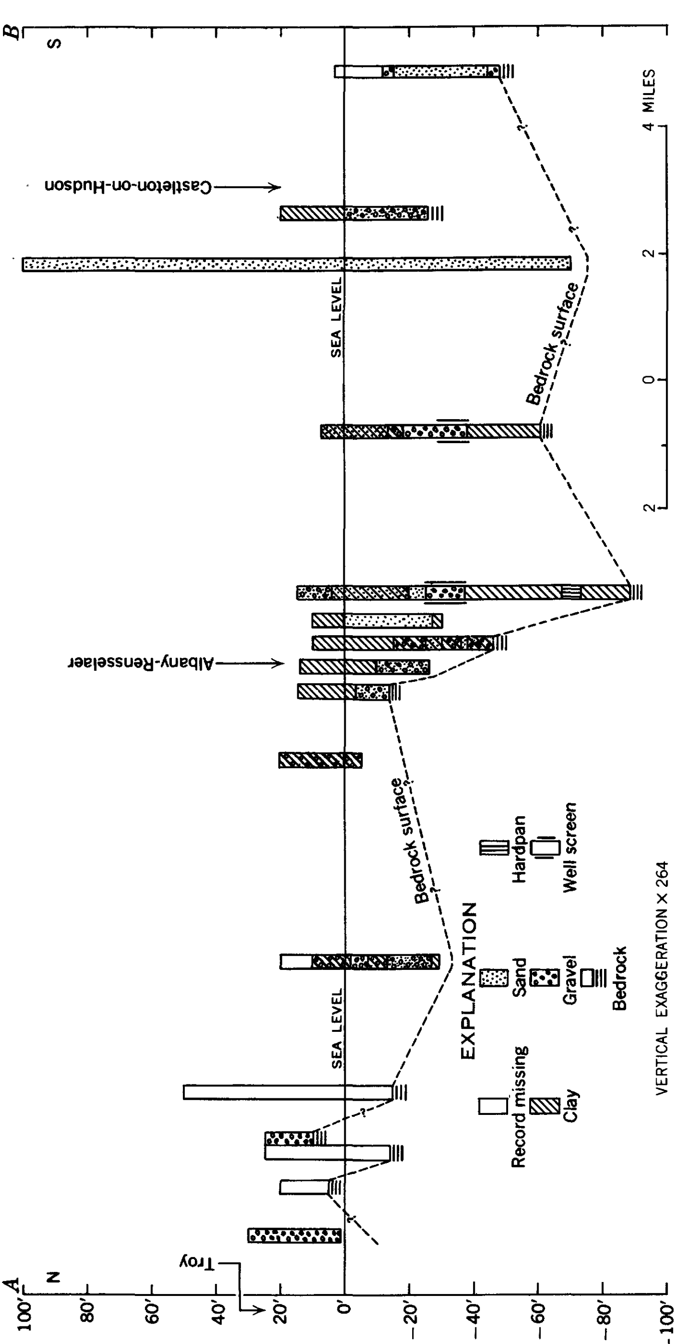

FIGURE 25.—Section showing unconsolidated deposits along the Hudson River between Troy and Castleton-on-Hudson. Location of section shown on plate 1.

Greenbush Terrace Water Co. public-supply well reportedly penetrates 10 feet of coarse sand beneath 60 feet of gravel and yields 50 gpm with a drawdown of only 4 inches.

The Albany-Schenectady sand-plain area extends into the lower Hudson River subarea (pl. 1). The buried channels in this part of the report area are mostly filled with clay and are not productive sources of water. In this part of the sand-plain area there is generally only enough water available for domestic use.

The Vorheesville deposit (pl. 1)., a small deltaic deposit northwest of Voorheesville and New Salem, contains gravel beds that are about 60 feet thick in some places. A buried channel that enters the Mohawk buried channel from the west near Voorheesville seems to underlie part of the deposit. These gravel beds are tapped by the public-supply wells of Voorheesville and Bethlehem Water District No. 1. Although the gravel beds are highly permeable, their small area extent probably precludes much further development.

Sand and gravel along Valatie Kill to the east of the Schadack terrace furnishes 140 gpm to a public-supply well at Nassau. Other coarse-grained deposits are near South Bethlehem and south of Watervliet Reservoir.

The yields of wells in bedrock, till, and stratified fine-grained deposits range widely but are generally inadequate for purposes other than domestic and farm use.

The bedrock formations in the lower Hudson River subarea are the Silurian and Devonian limestones, shales, and sandstones, Schenectady and Snake Hill formations, Normanskill shale, and Schodack and Nassau formations. (See fig. 5.) Throughout the Albany-Schenectady-Troy area, the median yield of wells that reportedly tap the Schenectady formation is 2 gpm and those that tap the other bedrock formations is 4 gpm. (See table 1.)

The uplands and other areas are underlain by a blanket of till, generally not more than 30 feet thick, from which yields of a few gallons per minute are an important source of water in areas not adjacent to more productive sources of supply. The stratified fine-grained deposits of sand and clay also yield small quantities of water. The fine sands yield about the same quantity of water as the bedrock formations noted above, but the clays yield little or no water.

In the lower Hudson River subarea, depths to water in wells and fluctuations of water level are about the same as in other parts of the Albany-Schenectady-Troy area, as described on page 12, and in table 2 and figure 6. Of the 320 wells inventoried in the lower Hudson River subarea during 1945–49, there were 6 flowing wells, including 5 in Albany County.

QUALITY OF GROUND WATER

Ground water in the lower Hudson River subarea has about the same quality as ground water in the Mohawk River subarea (p. 13). The chief difference is that some limestone occurs in this subarea whereas the bedrock in the Mohawk River basin is all shale and sandstone. In general the water from the limestone contains a higher concentration of dissolved solids and is harder than water from the shale and sandstone. The dissolved solids in water from the limestone are predominantly calcium bicarbonate with lesser amounts of magnesium and other constituents. Analyses of ground-water sources located in the lower Hudson River subarea are given in table 3.

SURFACE WATER

HUDSON RIVER

The flow of the Hudson River below the Mohawk River is affected by regulation and diversions in both the Mohawk River and upper Hudson River basins and by Alcove, Basic, and Watervliet Reservoirs on small tributaries.

The flow of the Hudson River below the Mohawk River is measured at Green Island (table 4 and pl. 2). Prior to 1948 streamflow or stage records were collected near the present site by the Ford Motor Co. and the Corps of Engineers.

The lowest daily flow that occurred during water years 1947–54 at Green Island was 821 mgd, equivalent to 1,270 cfs (cubic feet per second) on September 5, 1949. Regulation of the streamflow is such that the minimum daily flow each week commonly occurs on Monday or Tuesday. The flat slope of the duration curve for the Hudson River below the Mohawk River is due in part to the low flow being well maintained by release from storage in Sacandaga Reservoir. (See fig. 18.) Under present conditions of regulation, the flow that was equaled or exceed 95 percent of the time at Green Island is 2,100 mgd.

Floods in this part of the river are affected by storage in Sacandaga Reservoir and to a lesser extent by storage in Hinckley, Delta, Indian Lake, and Schoharie Reservoirs. Floods are most likely to occur during March, April, and May; however, a flood may occur in any month (fig. 26). The highest flood on record since the construction of Sacandaga Reservoir was that of March 1936. Figure 20 shows the highest flood in each year since the construction of Sacandaga Reservoir and figure 27 shows the recurrence interval of floods during water years 1931–55. The profile of selected floods on the Hudson River and their average recurrence intervals are given in figure 22.

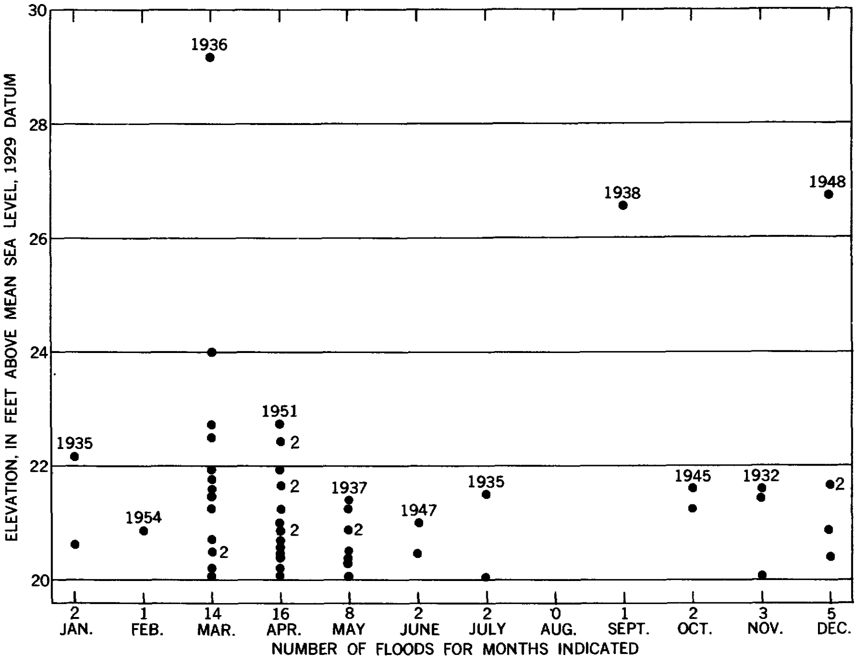

FIGURE 26.—Magnitude and number of floods, by months, Hudson River at Green Island, water years 1931–55.

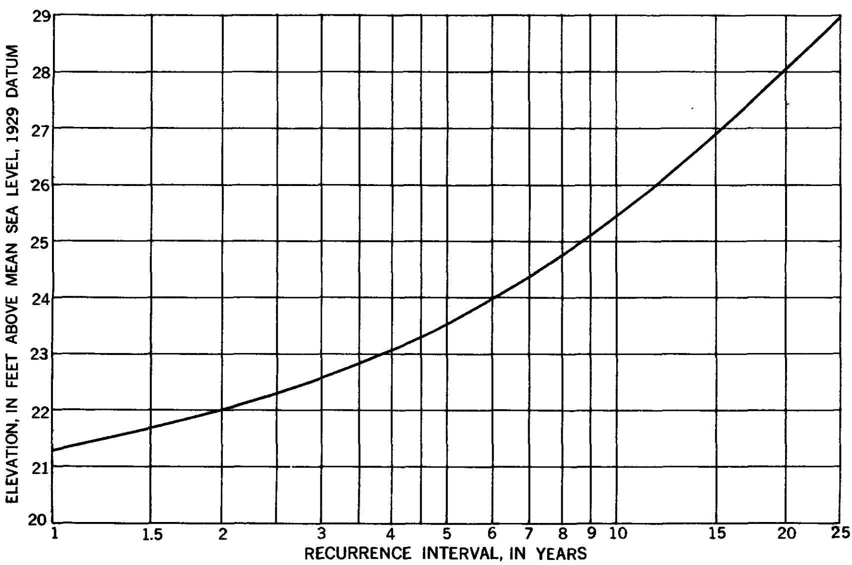

FIGURE 27.—Flood-stage frequency curve, Hudson River at Green Island; based on records for water years 1931–55.

The quality of water from the Hudson River from both below and above the Mohawk River is very similar. Analyses of two samples (table 5) indicate that water below the Mohawk River is slightly harder and more mineralized. The pH of one sample was 6.9 and of the other was 7.0. The water is of the calcium bicarbonate type and is satisfactory for most uses.

The temperature of Hudson River water from both below and above the Mohawk River is similar. In 1952 and 1953 it ranged from 32° to 82°F. During 1952 the water temperature was less than 60°F for almost 8 months, and during 1953 it was less than 60°F for a little more than 7 months (fig. 16).

POESTEN KILL

Poesten Kill is a tributary to the Hudson River at Troy. It rises in steep wooded hills and flows through hilly wooded farmland. The lower 2 miles of the stream is in the city of Troy. The city diverts as much as 8 mgd from Quacken Kill, a tributary of Poesten Kill. This diversion is made at a Martin Dunham Reservoir (capacity, 4 million gallons), which impounds water from a drainage area of 11.6 square miles. The diversion has for many years amounted to almost the entire flow of Quacken Kill at that point during periods of low flow.

The flow of Poesten Kill is measured near Troy (table 4; pl. 2). The minimum daily discharge during water years 1924–54 was 1.2 mgd (1.9 cfs) on October 12–14, 1930. The drainage basin of Poesten Kill is largely underlain by till and bedrock. Figure 28 shows that the dry-weather flow is moderately well sustained (5.4 mgd at the 95-percent duration point). Low-flow frequency curves are given in figure 29.

Floods on Poesten Kill commonly cause little damage, even within the city of Troy. Cellars near the mouth of the stream occasionally may be flooded and operations at some plants curtailed. The five greatest floods on Poesten Kill at the Troy gage during water years 1924–52 are as follows:

Date	*Peak discharge (cfs)*	*Elevation (feet, city of Troy datum)*
Nov. 4, 1927	7, 030	329. 9
Mar. 12, 1936	4, 750	328. 9
Sept. 22, 1938	11, 900	333. 6
Mar. 31, 1940	4, 320	328. 4
Dec. 31, 1948	10, 100	332. 7

Water from Poesten Kill has the characteristic good quality of water from other streams in the area. A sample collected on June 21, 1954, had the lowest concentration of dissolved solids and the lowest

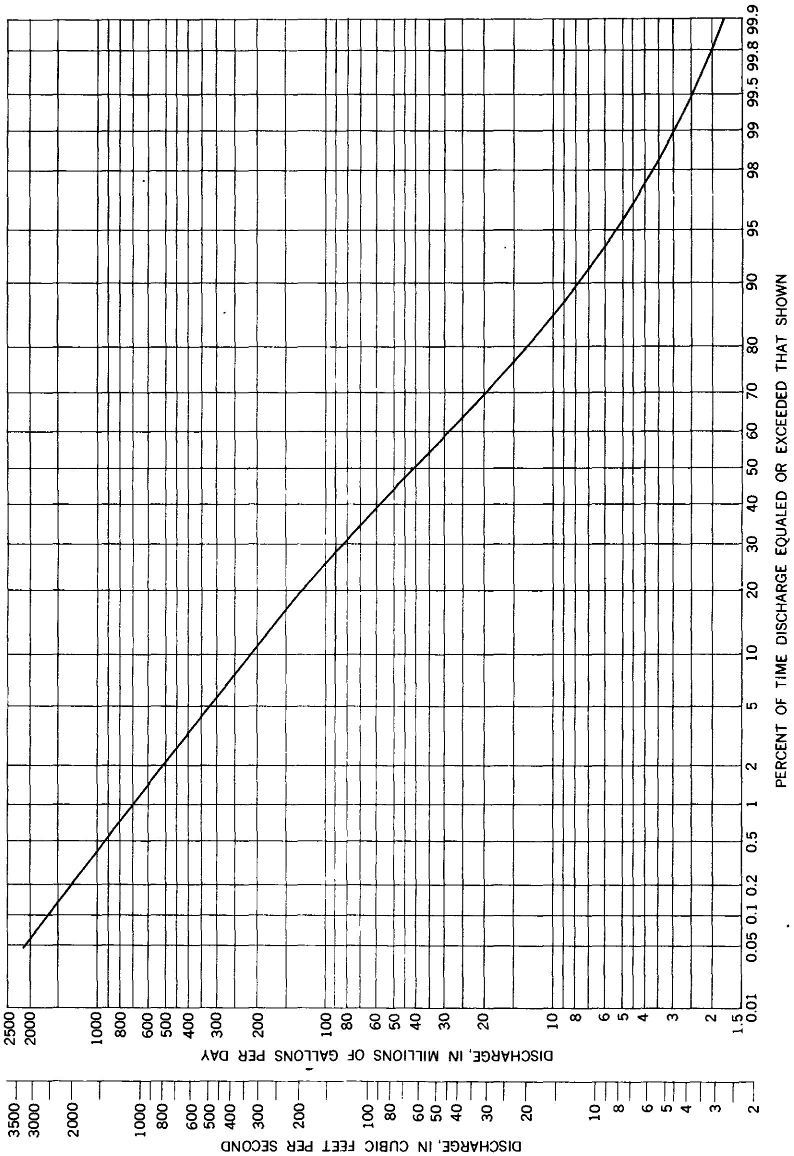

FIGURE 28.—Duration curve of daily flow, Poesten Kill near Troy; based on records of flow during water years 1924–54, from a drainage area of about 89 square miles.

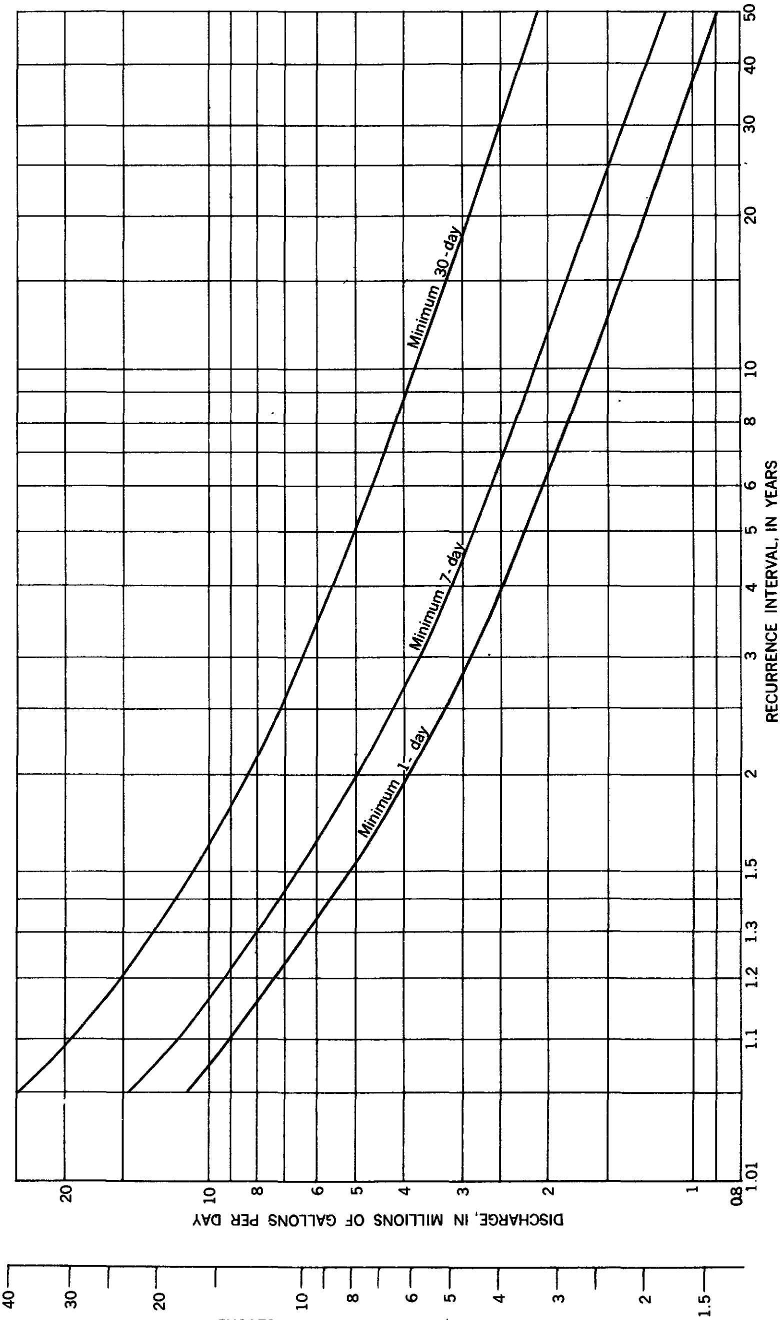

FIGURE 29.—Low-flow frequency curves, Poesten Kill near Troy; based on a regional analysis of records for April 1, 1911, to March 31, 1955.

hardness of any water sampled in the area. It also had the lowest alkalinity. An analysis of this sample is given in table 5. Data on the temperature of Poesten Kill water are not available; however, the temperature probably follows the characteristic seasonal pattern of other stream water in the area and averages about the same as the air temperature of the region.

SMALL STREAMS

The low-flow part of the duration curve and the recurrence interval of low flows have been computed for eight small streams by correlating a few discharge measurements with the records for nearby streams (tables 6 and 7).

For these small streams the flow at the 95-percent duration point (flow equaled or exceeded 95 percent of the time) ranges from 0.004 to 1.1 mgd per sq mi of drainage area (table 6). This wide range indicates that the flow of small streams is well sustained in dry weather if the stream drains coarse-grained deposits but is poorly sustained if the stream drains till or fine-grained deposits. No reliable estimate of the low-flow characteristics of an ungaged stream in this area can be made without a few low-flow discharge measurements at the site in question.

Wynants Kill, a tributary to the Hudson River from the east, drains the area immediately south of the Poesten Kill basin. There are several lakes in the Wynants Kill basin, all of which are popular resort areas. The lake levels are regulated during the summer to the best advantage for recreational use. Wynants Kill has been, but is no longer, an important source of power.

Base flow of Wynants Kill is sustained at a high level by the lakes, and by the high yield of the sandy Wynants Kill kame area, in which about 25 percent of its basin lies. The stream is not included in tables 6 or 7 for lack of sufficient information, but it is estimated that the flow at the 95-percent duration point is more than 5 mgd.

Van Rensselaer Creek drains part of the Albany-Schenectady sand-plain area near Menands. (See pl. 1.) It has an unusually well sustained dry-weather flow of 0.75 mgd per sq mi at the 95-percent duration point. Data on the temperature and quality of the water are not available.

Mill Creek, a small tributary on the east bank of the Hudson River near Rensselaer, drains a basin of rolling farmland that is largely underlain by till. Its dry-weather flow, 0.026 mgd per sq mi at the 95-percent duration point, is much better sustained than some streams such as Lisha Kill and Vloman Kill, but not nearly as well sustained as that of Van Rensselaer Creek and East Branch Hunger Kill.

Analyses of two samples collected in 1954 indicate that water from Mill Creek is a little harder than water from most other streams in the area for which chemical data are available. The hardness as calcium carbonate of one sample was 80 ppm and of another 135 ppm. Concentrations of dissolved solids were a little higher than for most small streams in the area, 113 and 190 ppm. However, the water is satisfactory for most uses. Analyses of the two samples are given in table 5.

Temperature of the water taken at the time of sampling is shown in table 5; other temperature data are not available.

East Branch Hunger Kill, a small creek tributary to Normans Kill near Guilderland (pl. 1), drains a part of the Albany-Schenectady sand-plain area. It has a well-sustained dry-weather flow of about 1.1 mgd per sq mi at the 95-percent duration point. East Branch Hunger Kill and Van Rensselaer Creek have the highest sustained dry-weather flow per square mile of any of the streams measured in the Albany-Schenectady-Troy area. Other streams draining similar sand-plain areas probably also have well-sustained flows.

Analyses of two water samples collected during 1954 indicate that the quality of water from East Branch Hunger Kill is about average for the region. The concentrations of dissolved solids were 127 and 136 ppm, hardness as calcium carbonate was 99 and 110 ppm, and color was low (table 5). The temperature of the water sampled was recorded, but other data on water temperature are not available.

Normans Kill, which has the largest drainage basin in this part of the report area, drains an area underlain by several types of water-yielding material. (See pl. 1.) The flow in the lower part of the basin is regulated by storage and diversion from Watervliet Reservoir so that flow figures do not represent natural yield. Under present conditions of regulation and diversion a flow of about 10 mgd near the mouth at Albany is available 95 percent of the time. Above the reservoir the dry-weather flow is poorly sustained with a flow of only 0.006 mgd per sq mi at the 95-percent duration point.

Moordener Kill, tributary to the Hudson River from the east (pl. 1), drains an area of rolling farmland. The surficial geology of the Moordener Kill drainage basin is different from that of Mill Creek in that the area is partly underlain by till and partly by terrace deposits of Pleistocene sand and gravel. Several discharge measurements made on Moordener Kill, at a site where the drainage area is 29.7 square miles, indicate a flow of 0.037 mgd per sq mi at the 95-percent duration point.

Analyses of two water samples collected during 1954 indicate that quality of water from Moordener Kill is about typical of the small streams sampled in the area. The concentrations of dissolved solids were 96 and 158 ppm; hardness as calcium carbonate was 62 and 119 ppm; and values for color were 10 and 7 units (based on the platinum-cobalt standard). The analyses are given in table 5.

The water temperature was taken at the time of sampling, but other temperature data are not available.

Vloman Kill, a tributary of Hudson River from the west just north of Castleton-on-Hudson (pl. 1), drains farmland and wooded areas. Almost the entire drainage basin is underlain by fine-grained stratified deposits. Several discharge measurements made at a site where the drainage area is 29.8 square miles show that the dry-weather flow is very poorly sustained, only 0.004 mgd per sq mi at the 95-percent duration point. Such poorly sustained flow is probably typical of drainage basins underlain by fine-grained stratified deposits.

Each of two water samples collected in 1954 had the highest concentration of dissolved solids, 209 ppm, of any water sample from the area. The water was also harder than any other; the hardness expressed as calcium carbonate was 167 and 153 ppm. Color was low, 8 and 12. Analyses are given in table 5.

The water temperature was taken at the time of sampling, but other temperature data are not available.

Coeymans Creek, a small tributary of the Hudson River in the vicinity of South Bethlehem has only a moderately well sustained dry-weather flow (0.055 mgd per sq mi at the 95-percent duration point) but because of the relatively large drainage area, the flow at South Bethlehem is one of the largest in the area (1.9 mgd at the 95-percent duration point).

PUBLIC WATER-SUPPLY SYSTEMS

The public water-supply systems may be an economical source of water for industries that require small quantities of water or that require water of good sanitary quality. The major systems in the lower Hudson River subarea are those of Albany, Green Island, McKownville, Rensselaer, Troy, and Watervliet (fig. 17); some of them obtain a major part of their water from outside the areas they serve. Albany's supply is imported into the Albany-Schenectady-Troy area from Alcove Reservoir on Hannacrois Creek (92 percent), and Basic Reservoir on Basic Creek (8 percent). Alcove Reservoir was built in 1930 and has a usable capacity of 12,100 million gallons; Basic Reservoir, built in 1928, has a capacity of 716 million gallons. Additional information is given in table 8.

An analysis of a sample of finished water from the Albany supply indicated that the water is of excellent chemical quality, somewhat less mineralized, and less hard than most of the public supplies in the region (table 9).

Green Island obtains its water from two infiltration galleries located on Center Island in the Hudson River. Water is pumped from the receiving wells to the filtration plant located on Green Island. Alum and chlorine are applied in the conduit. An analysis of the finished water (table 9) shows that the water was moderately hard (hardness as $CaCO_3$, 128 ppm) and contained 0.4 ppm of iron.

McKownville takes its water from Krum Kill, a small tributary of Normans Kill. An analysis of the water showed a concentration of iron of 0.44 ppm, which is sometimes sufficient to cause staining of bathroom fixtures and other porcelain surfaces. Except for the high concentration of iron in the one sample analyzed, the water was similar to other public water supplies in the area. An analysis of the water is given in table 9.

Rensselaer obtains its water from the Hudson River. A sample of finished water indicated that the water was about typical for the area (table 9).

Troy obtains water from Tomhannock Reservoir on Tomhannock Creek, Martin Dunham Reservoir on Quacken Kill (a tributary of Poesten Kill), and Bradley Lake (Frear Park). The village of Menands obtains its water from Troy. Tomhannock Reservoir has a capacity of 12,000 million gallons and furnishes about 70 percent of the city supply. Martin Dunham Reservoir has a capacity of 4 million gallons and supplies the part of Troy about 14th Street, about 30 percent of the water used. Bradley Lake (Frear Park) is used as an auxiliary supply. A sample of finished water from Tomhannock Reservoir had the lowest content of dissolved solids and hardness reported for a public water-supply system in the area. Concentration of dissolved solids was 61 ppm, and hardness as calcium carbonate was 40 ppm. An analysis of the water is given in table 9. Descriptive information on the Rensselaer and Troy water systems is given in table 8.

Watervliet takes its supply from Watervliet Reservoir on Normans Kill. The reservoir has a usable capacity of 1,500 million gallons and the drainage area above the reservoir is 121 square miles. Additional descriptive information is given in table 8. An analysis of the water indicates that it is a little more mineralized and a little harder than most public supplies in the area. The concentration of dissolved solids was 183 ppm, and hardness expressed as calcium carbonate was 146 ppm. An analysis of the water is given in table 9.

TABLE 9.—*Chemical analyses, in parts per million, of finished water from public water supplies*

City	Date of Collection	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue on evaporation at 180°C)	Hardness as $CaCO_3$		Turbidity	Specific conductance (micromhos at 25°C)	pH	Color
																	Ca, Mg	Noncarbonate				
Albany	Jan. 16, 1952	41	1.8	0.00	0.00	18	2.2	1.7	0.9	0	41	21	2.4	0.0	0.2	70	54	21	4.2	122	8.1	2
Cohoes	Jan. 16, 1952	39	5.5	.06	.00	32	5.9	4.0	1.1	0	86	34	5.1	.0	1.4	132	105	34	6.5	222	7.1	4
Green Island [1]	Mar. 31, 1951	------	------	.40	------	------	------	------	------	------	173	------	17	.05	1.0	------	128	------	------	------	7.1	5
Latham	Oct. 21, 1954	58	3.2	.03	.17	36	7.9	2.8	2.7	0	111	36	3.2	.1	.5	165	123	32	------	249	7.2	10
McKownville	Feb. 28, 1955	38	8.0	.44	.46	28	5.0	12	2.3	0	80	30	14	.0	1.8	173	91	25	------	245	7.2	17
Mechanicville	Feb. 28, 1955	37	6.8	.10	.28	23	4.8	2.0	1.7	0	37	47	2.0	.0	1.1	117	77	47	------	174	6.7	3
Rensselaer	Oct. 21, 1954	61	2.6	.12	.10	18	3.2	12	.9	0	49	34	9.3	.0	.6	119	58	18	------	187	6.9	17
Schenectady	Oct. 7, 1948	------	7.0	.09	------	49	9.1	9.6		0	165	31	9.0	.1	.2	197	160	25	------	342	7.7	2
Troy [2]	Jan. 23, 1952	------	3.5	.08	.00	12	2.5	2.2	1.2	0	33	14	3.1	.1	1.3	61	41	14	------	98.6	6.9	4
Waterford	Feb. 28, 1955	32	5.0	.13	.23	22	3.1	4.6	1.8	0	39	36	7.6	.0	1.2	110	68	36	------	168	7.3	7
Watervliet	Oct. 20, 1954	------	2.0	.03	.04	38	12	4.5	1.7	0	116	51	6.9	.1	.5	183	145	50	------	297	7.7	7

[1] Analysis of finished water by the New York State Department of Health. Reported hardness is total hardness as $CaCO_3$.
[2] Finished water from Tomhannock Reservoir.

PRESENT USE OF WATER

About 829 mgd was used in the Albany-Schenectady-Troy area during 1953 (table 10). Industry used about 765 of the 829 mgd. Most of the remainder, about 64 mgd, was used for domestic, rural, and stock supplies (fig. 30). A very small quantity was used for irrigation.

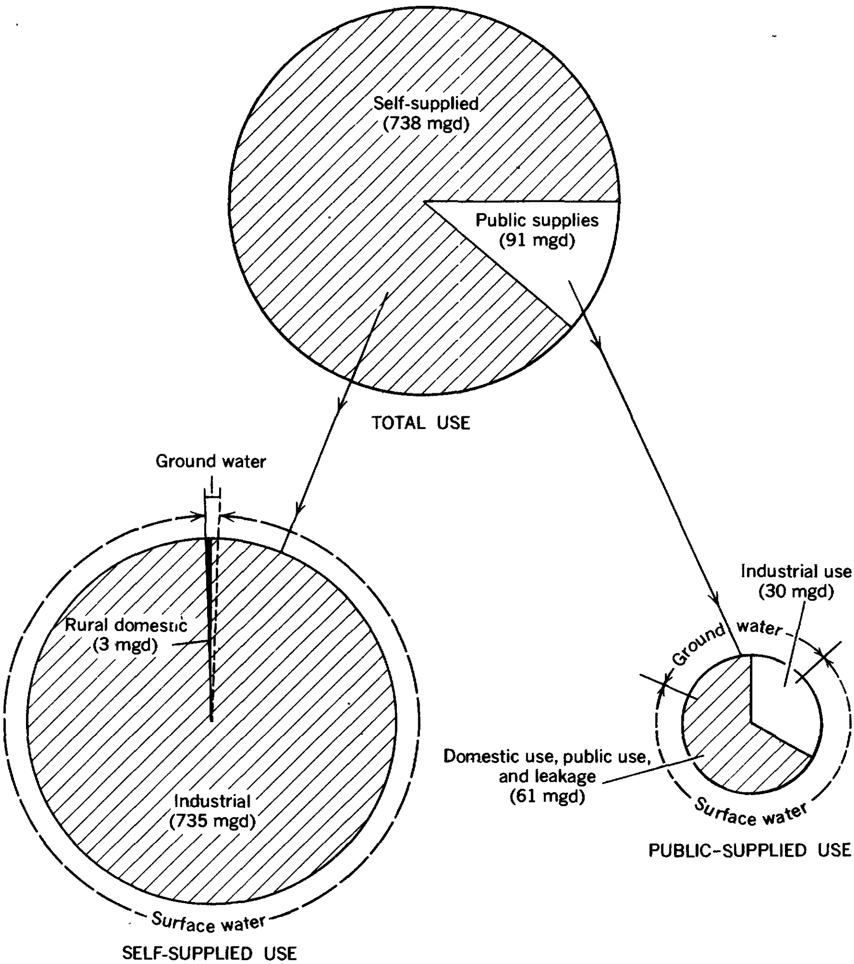

FIGURE 30.—Water used during 1953.

Public water supplies furnished about 91 mgd to more than 90 percent of the population of the area. About 20 percent of the water furnished by the Albany public water-supply system was used by industry and about 80 percent for domestic purposes. About 40 percent of the water delivered by the other two large systems in the area, Troy and Schenectady, was used by industry, and about 40 percent of the water furnished by the Latham system also was used by industry. The approximate percentages of water furnished to industry by other water supplies in the area were as follows: Cohoes, 75 percent; Rensselaer, Waterford and Watervliet, 50 percent; Green Island, 45 percent; and Mechanicville, 22 percent. All water distributed by the McKownville Water District was used for domestic purposes.

TABLE 10.—*Average use of water in the Albany–Schenectady–Troy area in 1953, in million gallons per day*

Use	From public supply [1]			Self-supplied			Total
	Surface water	Ground water	Total	Surface water	Ground water	Total	
Domestic, public, and leakage	44.8	16.1	60.9				60.9
Industrial	18.3	12.2	30.5	732.3	2.1	734.4	764.9
Rural domestic					3	3	3
Total	63.1	28.3	91.4	732.3	5.1	737.4	828.8

[1] Includes public supplies listed in table 8 and other smaller public supplies.

Industries used about 734 mgd of self-supplied water during 1953. About 715 mgd of this was withdrawn from the Hudson and Mohawk Rivers, 17 mgd from small streams, and about 2.1 mgd from wells.

Industry uses water for cooling, boiler feed, in manufacturing processes, and for sanitary and service needs. Table 11 shows the quantity of water used by the major type of industries inventoried in the area and the percentage used for different purposes. The data include water from all sources; however, most of it was self-supplied. Most of the water was used for cooling (629 of 765 mgd). The steam-electric plant of the Niagara Mohawk Power Corp. at Glenmont is the largest single user of water in the area; 523 mgd is withdrawn from the Hudson River, but most of it is returned to the river after cooling the condensers. About one-third of the ground water was used as process water in the manufacture of electrical machinery. Industry uses about 15 percent more water in summer than in winter, the result of greater demand for air conditioning and refrigeration.

About 48,000 people in the Albany-Schenectady-Troy area live outside areas served by public water-supply systems and must obtain their water from individually owned sources, generally wells and springs.

TABLE 11.—*Use of water by selected industries, 1953*

Type of industry	Total use (mgd)	Purpose for which water was used (percentage of total)			
		Cooling	Processing	Boiler feed	Sanitary and service
Manufacturing of textiles and clothing	1.79	10.4	69.2	7.2	13.2
Food processing	2.24	27.8	45.9	9.9	16.4
Beverages	.21	16.0	37.7	1.5	44.8
Brewing	1.05	20.5	49.6	14.7	15.2
Manufacture of ice	.31	16.6	82.1	.6	.7
Chemicals and allied products	13.71	80.5	12.4	3.6	3.5
Manufacture of paper and paper products	56.75	29.3	67.8	2.5	.4
Transportation (operations)	1.90	16.2	16.8	43.4	23.6
Steel	6.69	80.6	9.5	7.9	2.0
Heavy industry (except electrical machinery)	14.94	25.1	35.0	.2	39.7
Metal fabrication (except electrical machinery)	1.39	39.0	26.0	15.0	20.0
Manufacture of electrical machinery	125.31	85.9	8.3	1.9	3.9
Generation and distribution of electricity and distribution of gas	525.02	91.7	8.2	.1	0
Printing and publishing	.83	55.7	5.7	4.8	33.8
Miscellaneous industries	2.92	16.3	71.6	2.8	9.3
All types	755	83.4	13.9	0.9	1.8

It is estimated that this group of people use about 3 mgd. This figure includes the use of water for residences and farms but does not include use of water for irrigation or livestock.

A small amount of water is used in the area for irrigating truck gardens, golf courses, and lawns. Some of the water is drawn from privately owned wells, but a large part of it is drawn from public systems supplied from ground-water or surface-water sources. Several truck farms are irrigated with water from the Latham Water District.

POSSIBILITY OF FURTHER DEVELOPMENT

The Albany-Schenectady-Troy area has an abundant supply of water. Only a small fraction of the river water is withdrawn, and most of the water withdrawn is not consumed. Large quantities of ground water may be obtained wherever deposits of coarse-grained sand and gravel exist along the main river channels or in the preglacial buried valleys and especially where induced recharge from streams is possible.

The average temperature of surface water in the area is about 52°F, nearly the same as that of water from wells. The temperature of river water ranges from the freezing point to slightly more than 80°F. The temperature of ground water from heavily pumped wells near the Mohawk River ranges from about 40° to about 65°F. The temperature of water from other wells averages about 49°F and fluctuates only 4° to 6°F.

Water from sand and gravel is generally moderately hard to hard; it is slightly harder and more mineralized than surface water. Water from bedrock formations generally is even harder and more mineralized.

MOHAWK RIVER VALLEY

Present withdrawals of water from the Mohawk River is only a small part of the flow, and most of the water withdrawn is not consumed. The flow above Crescent Dam equals or exceeds 580 mgd 95 percent of the time. Part of the flow of the river is diverted into the Erie (Barge) Canal at Crescent Dam during the navigation season. The flow below Crescent Dam equals or exceeds 450 mgd 95 percent of the time.

Mohawk River water has such a low mineral content that it is satisfactory for most uses. It is moderately hard, and treatment is necessary if soft water is required.

The flood plain of the Mohawk River between Hoffmans and Schenectady is one of the best areas for further development of large quantities of ground water. In some places the aquifers are hydraulically connected with the river, which permits recharge of the aquifers with river water. Wells in the sand and gravel deposits of the flood plain near lock 8 yield as much as 3,600 gpm. Wells in other parts of the flood plain yield 2 to 1,500 gpm and average 280 gpm. Groundwater development is also feasible from the sand and gravel deposits beneath the alluvium between Vischer Ferry and Mohawk View where the Colonie channel crosses the Mohawk River.

Water from the unconsolidated deposits has about the same chemical quality as water from the Mohawk River, especially where pumping has induced infiltration of river water.

HUDSON RIVER VALLEY

Present withdrawal from the Hudson River is only a small part of the flow and most of the water withdrawn is not consumed. The flow above the Mohawk River equals or exceeds 1,300 mgd 95 percent of the time, and the flow below the river equals or exceeds 2,100 mgd 95 percent of the time. Water from the Hudson River seems to be slightly less mineralized and softer than water from the Mohawk River.

The valley fill of the Hudson River flood plain is mostly clay and silt; however, at some places the silt and clay is interstratified with water-bearing sand and gravel. Tests by industry (p. 45) have indicated that wells yielding as much as 5,700 gpm could be developed at one site where the sand and gravel aquifer is hydraulically connected to the river. Where the aquifer is not connected to the river, wells probably would yield 75 to 350 gpm. The quality of water from the alluvium is similar to that of the river water, especially where infiltration has been induced.

HOOSIC RIVER BASIN

The dry weather flow of the Hoosic River near Eagle Bridge is well sustained; it equals or exceeds 0.18 mgd per sq mi 95 percent of the time. Powerplants at Johnsonville and Schaghticoke cause a diurnal fluctuation and some regulation at low flows. Water from the Hoosic River seems to be slightly harder and a little more alkaline than Hudson River water.

The unconsolidated deposits in the Hoosic delta are not sufficiently saturated to be a source of large quantities of water.

BURIED-CHANNEL AND OTHER COARSE-GRAINED DEPOSITS

The norhern reaches of the Colonie channel are a source of moderately large quantities of ground water. Wells in this channel range in depth from 48 to 244 feet and yield as much as 700 gpm near the axis of the channel. Deposits south of the village of Shakers are less favorable for large yields. Other buried channels in the area contain fine-grained deposits that are not likely to yield large quantities of water.

Water from the buried channels is likely to be slightly harder and more mineralized than water from the Mohawk or Hudson Rivers. A few wells will yield water containing objectionable quantities of iron.

Other coarse-grained deposits, such as those in the sand-plain and kame areas, and deltaic and terrace deposits may yield moderate quantities of water. The most favorable areas for further development are the Albany-Schenectady sand plain, the Wynants Kill kame area, and the Schodack terrace. Wells in these areas yield as much as 150 gpm. Other deposits are either developed or their capabilities are not known. Further exploration of these deposits may reveal that additional water could be developed. The chemical character of water from the coarse-grained deposits is similar to that of water from the buried channels.

SMALL STREAMS

The possibility of developing further supplies from the small streams in the report area depends on their flow characteristics, which in turn depend on the storage and release of water by the aquifers that supply the dry-weather flow. However, the yields show only in a general way a relation with the underlying aquifers that are shown on plate 1. Hence the only way to determine the quantity of water available at a particular site is to make measurements of discharge during periods of low flow, and relate the results to the streamflow on the same day at other stream-gaging stations in the area.

Low-flow characteristics of 14 small streams in the report area determined in this way are shown in tables 6 and 7. These show that the flow available 95 percent of the time exceeds 1 mgd at some sites on Alplaus Kill, Coeymans Creek, and Normans, East Branch Hunger, Moordener, and Anthony Kills.

PUBLIC WATER-SUPPLY SYSTEMS

The public water supply systems may be the cheapest and most satisfactory source of small quantities of water for industrial use or good-quality water for other uses. The capacities of the systems of most of the large cities exceed present peak demands, and adequate water is available to permit expansion of the system. Some of the smaller cities, however, are finding it more and more difficult to supply sufficient quantities of water of good quality.

The finished water from the public-supply systems is similar to the water withdrawn from wells and streams, and it meets all U.S. Public Health Service standards.

SELECTED REFERENCES

Arnow, Theodore, 1949, The ground-water resources of Albany County, N.Y.; New York Water Power and Control Comm. Bull. GW–20, 56 p.

Cook, J. H., 1930, Glacial geology of the Capital District, *in* Ruedemann, Rudolf, Geology of the Capital District: New York State Mus. Bull. 285, p. 181–199.

Cushman, R. V., 1950, The ground-water resources of Rensselaer County, N.Y.: New York Water Power and Control Comm. Bull. GW–21, 56 p.

Knox, C. E., 1956, Index of surface-water records, pt. 1, North Atlantic slope basins, to September 30, 1955: U.S. Geol. Survey Circ. 381, 30 p.

Knox, C. E., and Nordenson, T. J., 1955, Average annual runoff and precipitation in the New England-New York area: U.S. Geol. Survey Hydrologic Atlas HA 7, 6 p.

Lohr, E. W., and Love, S. K., 1954, The industrial utility of public water supplies in the United States, 1952, pt. 1, States east of the Mississippi River: U.S. Geol. Survey Water-Supply Paper 1299, 639 p.

New York State Water Pollution Control Board, 1950, Rules and classifications and standards of quality and purity for water of New York State: Office Public Health Education, New York State Dept. Health, 14 p.

——— 1952, The Mohawk River drainage basin: recommended classifications and assignments of standards of quality and purity for designated waters of New York State: Mohawk River Drainage Basin Survey Series, rept. 2, 245 p.

Ruedemann, Rudolf, 1930, Geology of the Capital District: New York State Mus. Bull. 285, 218 p.

Simpson, E. S., 1949, Buried preglacial ground-water channels in the Albany-Schenectady area in New York: Econ. Geology, v. 44, no. 8, p. 713–720.

Simpson, E. S., 1952. The ground-water resources of Schenectady County, N.Y.: New York Water Power and Control Comm. Bull. GW-30, 110 p.

Simpson, E. S., Beetem, W. A., Ruggles, F. H., Jr., and others, 1959, Hydrologic and tracer studies in the Mohawk River at Knolls Atomic Power Laboratory: U.S. Atomic Energy Comm., Research and Development Rept. 50-45, p. 285.

Stoller, J. H., 1911, Glacial geology of the Schenectady quadrangle: New York State Mus. Bull. 15, 44 p.

——— 1920, Glacial geology of the Cohoes quadrangle: New York State Mus. Bull. 215, 216, 47 p.

Thomas, N. D. and Harbeck, G. E., Jr., 1956, Reservoirs in the United States; U.S. Geological Survey Water-Supply Paper 1360-A, p. 1-99.

U.S. Geological Survey, Quality of surface waters of the United States, pt. 1-4, North Atlantic slope basins to St. Lawrence River basin: issued annually as U.S. Geol. Survey Water-Supply Papers.

——— Surface-water supply of the United States, pt. 1, North Atlantic slope basins and pt. 1-B North Atlantic slope basins, New York to York River: issued annually as U.S. Geol. Survey Water-Supply Papers.

——— Water levels and artesian pressures in observation wells in the United States, pt. 1, Northeastern States: issued annually as U.S. Geol. Survey Water-Supply Papers.

Woodworth, J. B., 1905, Ancient water levels of the Champlain and Hudson Valleys: New York State Mus. Bull. 84, 265 p.

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