GROUND-WATER RESOURCES OF THE SYRACUSE AREA[1]

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All but the largest public water systems in the Syracuse area obtain their supply from wells or springs. Almost all farms and homes in rural areas are supplied by private wells or springs and many industries also rely on ground-water supplies to meet their needs. Current withdrawal of ground water in the area is believed to be only a fraction of the available supply. The quality of water, however, is not always suitable for many uses, including public supply.

Ground water occurs in fractures and bedding joints of consolidated rocks and in pore spaces of unconsolidated deposits. The quantity of water available depends on the nature of the aquifer and the source of recharge. Adequate supplies for domestic and farm needs (100 to 1,000 gallons per day) are almost always available. Larger quantities of water for industrial and public supplies can generally be obtained from stratified coarse-grained deposits and, less frequently, from bedrock with prominent fractures, particularly where these aquifers are in hydraulic contact with a surface-water body which acts as a source of recharge. Ground-water quality depends on the chemical characteristics of the aquifer material, and flow pattern within the ground-water reservoir, and the quality of the recharge water. The factors most commonly affecting the quality of the ground water in the Syracuse area are hardness, iron, hydrogen sulfide, and salinity.

Ground water in consolidated rocks

Table 1 shows the rock units in the Syracuse area, their dominant lithologies, and the quality of the ground water that may be expected in wells tapping each unit. Wells in the limestone units, and the Camillus Shale, Syracuse Salt, and Vernon Shale will yield as much as 230 gpm (gallons per minute) because of enlargement of fractures by the solution of the carbonates and evaporites. The yield of wells drilled in these units for domestic, farm, and other small supplies averages about 15 to 20 gpm. Wells in the other rock units in the area generally yield less than 10 gpm and are inadequate for most public or industrial needs.

Carbonate (temporary) hardness results from the solution of limestone or dolomite by ground water. The hardness of water in the Camillus and Vernon Shales is predominantly noncarbonate (permanent) hardness resulting from the solution of gypsum or anhydrite. The source of hydrogen sulfide is believed to be pyrite found in the Hamilton Group and the Lorraine and Utica Shales, and sphalerite found in the Lockport Dolomite. Although traces of iron are found in water from all the rock units, it is present in objectionable concentrations most often in the Camillus and Vernon Shales where it is probably related to the occurrence of hematite, siderite, and pyrite.

The presence of saline water (here defined as water containing more than 250 parts per million of chloride) is not shown in Table 1 because its occurrence is more closely related to patterns of ground-water movement than it is to

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[1]Data contained in this summary were collected by the U.S. Geological Survey in cooperation with the New York State Water Resources Commission. Publication authorized by Director, U. S. Geological Survey.

the chemical characteristics of the water-bearing units. Although the only salt beds in the area are found within the Syracuse, most wells tapping this formation in its outcrop area do not yield salty water because the salt at shallow depths has been almost completely dissolved. Wells drilled into the Syracuse in the area south of its outcrop generally yield saline water, and commercial brine is obtained from deep wells in Tully Valley, about 12 miles south of Syracuse. At these wells, the salt occurs 300 to 500 feet below sea level and the brine is produced by injecting fresh water into the beds and then pumping it out after it has dissolved the salt.

The major area of natural saline-water occurrence is along the lowlands occupied by Oneida Lake and the Oneida, Oswego, and Seneca Rivers. This area coincides with the major area of ground-water discharge and the presence of saline water is believed to be due to the upward and northward movement of ground water that has been in contact with and partially dissolved the salt beds beneath the Appalachian Plateau. Wells drilled more than 100 feet into the Genesee Formation or Hamilton Group in the valleys of the plateau area may also yield saline water. The occurrence of this water may be related to connate water within the rock units or to the upward movement of water from the salt beds.

Ground water in unconsolidated deposits

A till sheet commonly about 30 feet thick mantles the entire upland area in the Appalachian and Tug Hill Plateaus and a large part of the Ontario lowland. Adequate supplies of water for domestic and farm supplies are generally available from dug wells or springs, although shallow wells on hillsides and hilltops frequently are inadequate during long dry periods.

Stratified drift mantles the remainder of the area, notably in the valleys of the Appalachian Plateau, most of the Ontario Lowland, and the lower parts of the valleys of the Tug Hill Plateau. Deposition of stratified drift occurred under four conditions: 1) proglacial deposition during free drainage, 2) deposition in ice-dammed valleys, 3) deposition during Great Lakes drainage, and 4) deposition in Lake Iroquois.

Coarse-grained glaciofluvial deposits consisting largely of sand and gravel occur south of the Valley Heads moraine and in many places form a large part of the moraine itself. The sand and gravel are well sorted and are probably the most permeable water-bearing material in the area. The city of Cortland, located about 27 miles south of Syracuse and 14 miles south of the Valley Heads moraine, pumps more than 2.5 mgd (million gallons per day) from these deposits. Somewhat similar sands and gravels, deposited during free glacial drainage in the Tug Hill Plateau area, may be expected along West Branch Fish Creek.

During deglaciation of the Appalachian Plateau, lakes existed in the major valleys, dammed between the bedrock divide to the south and the ice tongue to the north. Although data are scanty, the deposits in the valleys appear to become coarser with increasing depth which is consistent with a concept of a receding source of sediment. Small but adequate domestic and farm supplies can generally be obtained from wells dug in lacustrine sand, silt or clay, and driven screened wells are common where lacustrine sands occur at shallow depths. Because the layers of gravel in these deposits are lenticular, few wells drawing from gravel yield more than 100 gpm and the average yield of such wells is only about 30 gpm.

With further deglaciation, the ice margin was against the escarpment of the

Appalachian Plateau, and eastward drainage of the ancestral Great Lakes was initiated in ice-marginal channels. Deposition of sand and gravel occurred wherever the Great Lakes waters entered standing water in the north-south valleys or where westward recession of the ice front enabled the water to abandon the marginal channels and utilize the larger north-south valleys as outlets to the lowland north of the escarpment. These sand and gravel deposits are probably not as permeable as the valley train material south of the Valley Heads moraine. They are, nevertheless, a potential source of large ground-water supplies because they generally occur in areas where stream infiltration is possible. Examples of wells in this type of deposit are a public-supply well for the village of Fayetteville that has been test pumped at 500 gpm, and a public-supply well for the village of Chittenango that yields 350 gpm.

During the last stages of deglaciation in the Syracuse area, Lake Iroquois, a proglacial ancestral Lake Ontario, occupied the lowland north of the Appalachian escarpment. Melt-water streams deposited outwash deltas in the lake which were subsequently reworked and covered by finer grained lacustrine deposits as the ice continued to recede. The sand and gravel, where it is in hydraulic contact with a surface-water body may yield large quantities of water. The village of Fulton has pumped as much as 3.3 mgd from a well field adjacent to the Oswego River. Individual wells in this system yield as much as 800 gpm.

For the most part, none of the unconsolidated deposits in the Syracuse area have undergone significant transport by ice or melt water. Therefore, the chemical nature of the deposits and, to a large measure, the quality of the ground water derived from them, is generally similar to that of the underlying bedrock. Saline water occurs notably in a few of the north-south valleys where ground water has been able to move from the truncated salt beds of the Syracuse into relatively permeable valley-fill material.

Table 1.--Water-bearing units and quality of ground water

Rock unit	Lithologic type	Quality of water
Genesee Formation	shale	generally good
Tully Limestone	limestone	hard
Hamilton Group	shale, limestone	hard, hydrogen sulfide
Onondaga Limestone	limestone	hard
Helderberg Group	limestone	hard
Cobleskill Limestone	limestone	hard
Bertie Limestone (of Salina Group)	limestone, dolomite, some shale	hard
Camillus Shale (of Salina Group)	shale, gypsum, dolomite	hard, iron
Syracuse Salt (of Salina Group)	shale, gypsum, dolomite, salt	hard, iron
Vernon Shale (of Salina Group)	shale, some gypsum & dolomite	hard, iron
Lockport Dolomite	dolomite	hard, hydrogen sulfide
Clinton Group	sandstone & shale, some limestone	hard
Albion Group[1]	sandstone	generally good
Queenston Shale	sandstone	generally good
Oswego Sandstone	sandstone	generally good
Lorraine Shale	shale	hydrogen sulfide
Utica Shale	shale	hydrogen sulfide

[1]Approximately equivalent to Medina Group of N.Y. State Geological Survey usage.

BEDROCK TOPOGRAPHY IN THE ONEIDA LAKE AREA, NEW YORK

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The accompanying map of the buried bedrock surface in the Oneida Lake area (figure 1) is based on data from approximately 375 water wells in the lowland area (below the 500 foot contour) and from outcrops and scattered well data in the uplands (above the 500 foot contour). The data were collected as part of a study of ground-water resources in the Syracuse area being made by the U.S. Geological Survey in cooperation with the New York State Water Resources Commission. The bedrock topography of the area has been affected by preglacial stream erosion, glacial ice erosion, and ice-marginal stream erosion.

The preglacial drainage consisted of a major stream that flowed through the lowland now occupied by Oneida Lake and the Oswego River, and several short tributary streams. The tributary streams flowing north crossed the geologic structure (obsequent streams) whereas those flowing east or west followed the geologic structure (subsequent streams) and probably were initially developed on the relatively weak shales above (south of) the Lockport Dolomite. If it is assumed that the subsequent channels would migrate down the dip of the Lockport and that at least the south wall of the valley would be developed in the weaker shales, then it follows that the contact between the Lockport and the overlying shales should, in places, be drawn in closer correspondence with the south wall of the bedrock valley. Because of an absence of exposures in this area, the mapped contact is hypothetical (Broughton and others, 1961). Further study of bedrock topography and well logs promises to provide more detailed data for geologic mapping.

The major preglacial valley, that of the ancestral Oneida-Oswego River, appears to be a continuation of the upper Mohawk River valley (Delta Reservoir in fig. 1) north of Rome. The Mohawk Lowland, as far as Little Falls (approximately 30 miles southeast of Rome), defined as the area below the 400 foot contours south of Rome (fig. 1), may also have been a tributary or the headwaters of the ancestral Oneida-Oswego River. West of Rome the bedrock valley closely paralleled the present drainage and eventually joined the trunk river which occupied the Lake Ontario basin. Between Fulton and the west end of Oneida Lake the channel is indistinct, and the bedrock surface lacks appreciable relief.

Prominent features of glacial erosion in the Oneida Lake area are the closed basins and deepened valleys caused by the concentrated flow of ice into pre-existing channels. Wells drilled during the last century at the southern end of Onondaga Lake indicate that bedrock is about 50 feet below sea level. The altitude of the rock surface in the Onondaga valley, 16 miles south of the lake, is 250 feet above

[1]Publication authorized by Director, U. S. Geological Survey.

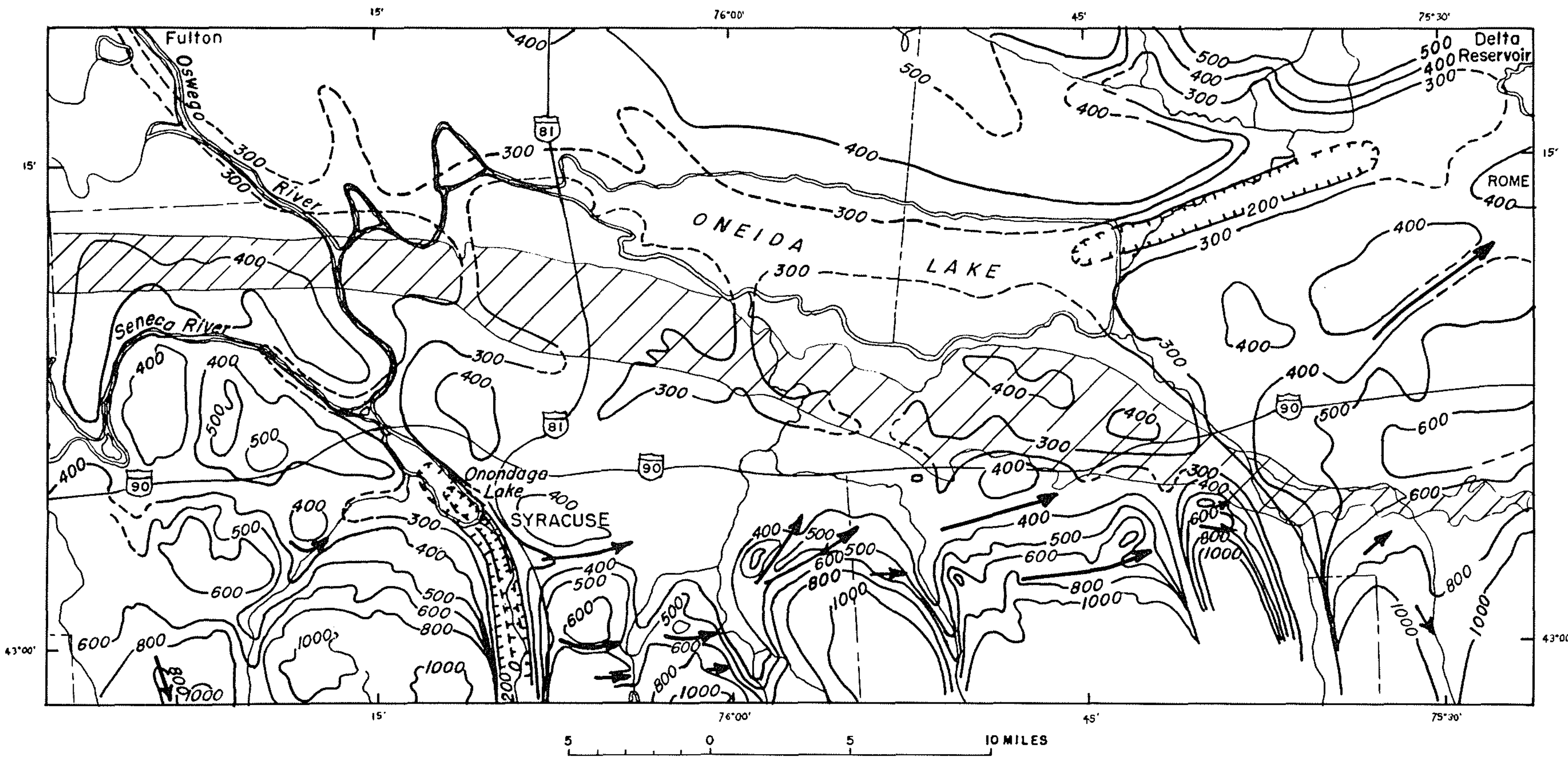

Fig. 1. Bedrock topography in the Oneida Lake area.

sea level. Closed basins also exist just south of the mapped area in many of the other north-south valleys of the southern upland area. A closed basin was formed in the channel of the ancestral Oneida-Oswego River by ice that was moving eastward around the northern highlands (Tug Hill Plateau). A similar basin exists in the Mohawk Lowland east of the area. Differential erosion by the ice has doubtless carved other smaller basins throughout the Oneida Lake area.

Bedrock erosion by ice-marginal streams was initiated when the ice abutted against the southern upland area. Presumably erosion took place during each advance and retreat of the ice as melt water and the discharge of the ancestral Great Lakes flowed along and under the ice margin. Only the larger features of Great Lakes ice-marginal drainage are shown in figure 1. The reader is referred to another section of this guidebook for a more complete discussion of marginal drainage. Owing to the cover of glacial drift which mantles the area, postglacial bedrock erosion has been largely limited to stream erosion in a few upland areas, and to solution of the carbonate rocks.

References cited

Broughton, J. G. and others, 1961, Geologic map of New York: N.Y. State Museum and Science Service, Geological Survey, Map and Chart Series No. 5.