Geology and Ground-Water Resources of Oswego County, New York

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations 81-60

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Unconsolidated deposits contain sufficient water for domestic and small farm needs except in areas mantled by silt and clay. Sand and gravel deposits are the best source of large quantities of water. Aquifers in glacial outwash are common in the eastern Tug Hill region, whereas kame, esker-kame, and beach aquifers predominate in the eastern and central regions. The principal sand and gravel aquifer, known as the Lacona-Williamstown aquifer, is 20 miles long, 0.5 to 3 miles wide, and 10 to 85 feet thick. Wells tapping the aquifer yield from 220 to 800 gallons per minute.

Fracturing, rather than rock type, is the controlling factor in the water-producing capacity of bedrock. Bedrock near or at the land surface provides adequate supplies for domestic and farm needs. Shallow wells in bedrock generally have water of fair to good quality, but mineral content increases with depth.

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By Todd S. Miller

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OSWEGO COUNTY PLANNING BOARD

Ithaca, New York

1982

UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

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CONVERSION FACTORS AND ABBREVIATIONS

Factors for converting the units used in this report to International System (SI) of metric units are shown below.

Multiply	By	To obtain SI units
inch (in)	2.54	centimeter (cm)
foot (ft)	.3048	meter (m)
mile (mi)	1.609	kilometer (km)
square mile (mi)	2.590	square kilometer (km)
gallons per minute (gal/min)	.06309	liters per second (l/s)
million gallons per day (Mgal/d)	.04381	cubic meters per second (m /s)
feet per mile (ft/mi)	.1894	meters per kilometer (m/km)
gallons per day (gal/d)	3.785	liters per day (l/d)
feet per day (ft/d)	.3048	meters per day (m/d)
feet squared per day (ft /d)	.0929	meters squared per day (m /d)
	--	milligrams per liter (mg/L)

GEOLOGY AND GROUND-WATER RESOURCES

OF OSWEGO COUNTY, NEW YORK

by

Todd S. Miller

ABSTRACT

Unconsolidated deposits of Pleistocene and Holocene age form a nearly continuous cover in Oswego County. Pleistocene deposits consist of lodgment and ablation tills, outwash, kame, beach and wave-delta sand and gravel, and lacustrine sand, silt, and clay. Holocene deposits consist of peat and muck deposited in wetlands, and alluvial silt, sand, and gravel deposited in stream valleys.

Unconsolidated deposits contain sufficient water for domestic and small farm needs except in areas mantled by silt and clay. Sand and gravel deposits are the best source of large quantities of water. Aquifers in glacial outwash are common in the eastern Tug Hill region, whereas kame, esker-kame, and beach aquifers predominate in the eastern and central regions. The principal sand and gravel aquifer, known as the Lacona-Williamstown aquifer, is 20 miles long, 0.5 to 3 miles wide, and 10 to 85 feet thick. Wells tapping the aquifer yield from 220 to 800 gallons per minute.

Fracturing, rather than rock type, is the controlling factor in the water-producing capacity of bedrock. Bedrock near or at land surface provides adequate supplies for domestic and farm needs. Shallow wells in bedrock have water of fair to good quality, but mineral content increases with depth.

INTRODUCTION

Oswego County, in north-central New York, has an area of 964 mi^2. Approximately 70 percent of the county's residents depend on ground water. A thorough knowledge of the local hydrogeology is needed to aid the county in developing and managing its ground-water resources.

Purpose and Scope

This report describes the relationship between geology and ground-water occurrence in Oswego County and indicates how much ground water is likely to be available in any given area. It is a companion to a series of 29 maps produced during 1978-80[1] to document the surficial deposits in the county's 29 quadrangles and includes a compilation of data on representative wells in each quadrangle.

Methods

Surficial geology and well locations were compiled on the 7.5-minute topographic quadrangle maps cited in the list of references. Well data were collected from well owners, drillers, and public and industrial supply records to document ground-water conditions. Data from selected wells are presented in table 1 (at end of report).

Acknowledgments

This study was done in cooperation with the Oswego County Planning Board. Thanks are given to the Oswego County Planning Board, drillers, and individual well owners who provided well information, and to Dr. Ernest H. Muller of Syracuse University for his assistance in mapping and for providing information on geologic conditions.

TOPOGRAPHY AND DRAINAGE

Oswego County lies within parts of two physiographic provinces--the Erie-Ontario Plain and the Tug Hill Plateau (fig. 1; also Miller, 1924). The western and central parts (Erie-Ontario Plain) consist of gently rolling hills ranging in altitude[2] from 246 to 600 ft; the northeastern section, which occupies part of the Tug Hill Plateau, slopes northeastward from the former shoreline of proglacial Lake Iroquois at 500 ft to the northeast corner of Oswego County at 1,720 ft (fig. 2). Location of Oswego County in relation to the physiographic provinces of New York State is shown in figure 1.

Glacial deposits overlie most of Oswego County. The Erie-Ontario Plain is characterized by numerous long, parallel, elliptical hills called drumlins; the Tug Hill Plateau contains irregular, low, knobby mounds of ablation moraine overlying drumlins and bedrock.

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[1] Quadrangle maps are listed in references section.

[2] Altitudes are in feet above National Geodetic Vertical Datum of 1929 (NGVD).

(2-Blank)

The entire county lies within the Lake Ontario drainage basin. Stream gradients on the Erie-Ontario Plain are low, but in the Tug Hill region, they range from low to steep. Major factors that control the direction of streamflow are the regional bedrock slope toward Lake Ontario and orientation of the drumlins.

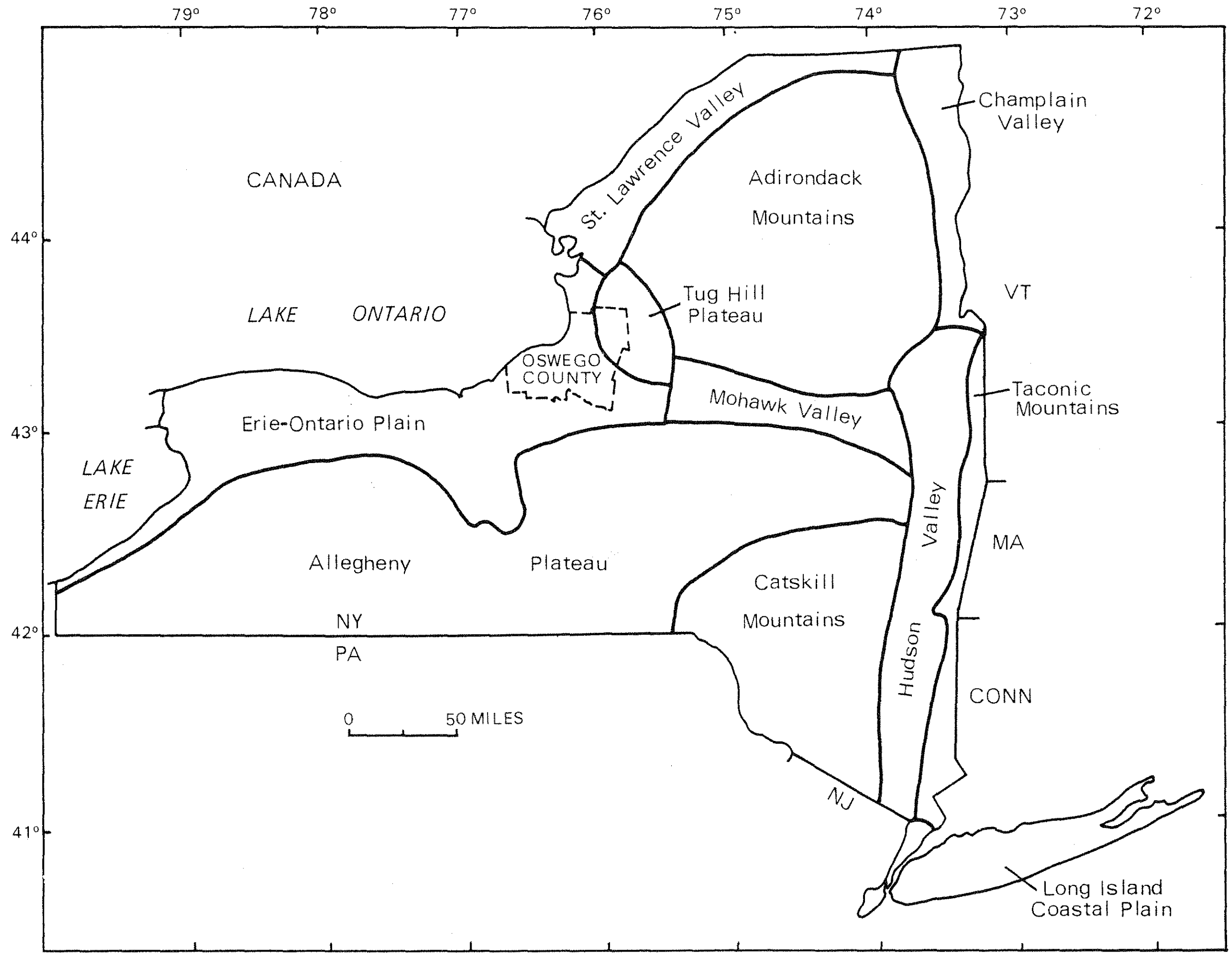


Figure 1.--Location of Oswego County and physiographic provinces of New York (Modified from Miller, 1924.)

GEOLOGY

Unconsolidated Quaternary sediments, deposited during and after the last glaciation (Wisconsinan), overlie most of the bedrock surface (fig. 2). Some bedrock is exposed where erosion has removed the overlying glacial sediments along segments of the Lake Ontario shoreline, in glacial meltwater channels on the Tug Hill Plateau, and in some channels of present drainage systems. These exposures indicate that the bedrock surface has a low and gently undulating relief in the Erie-Ontario Plain and a gently sloping surface with many deep ravines incised by glacial meltwater on the Tug Hill Plateau.

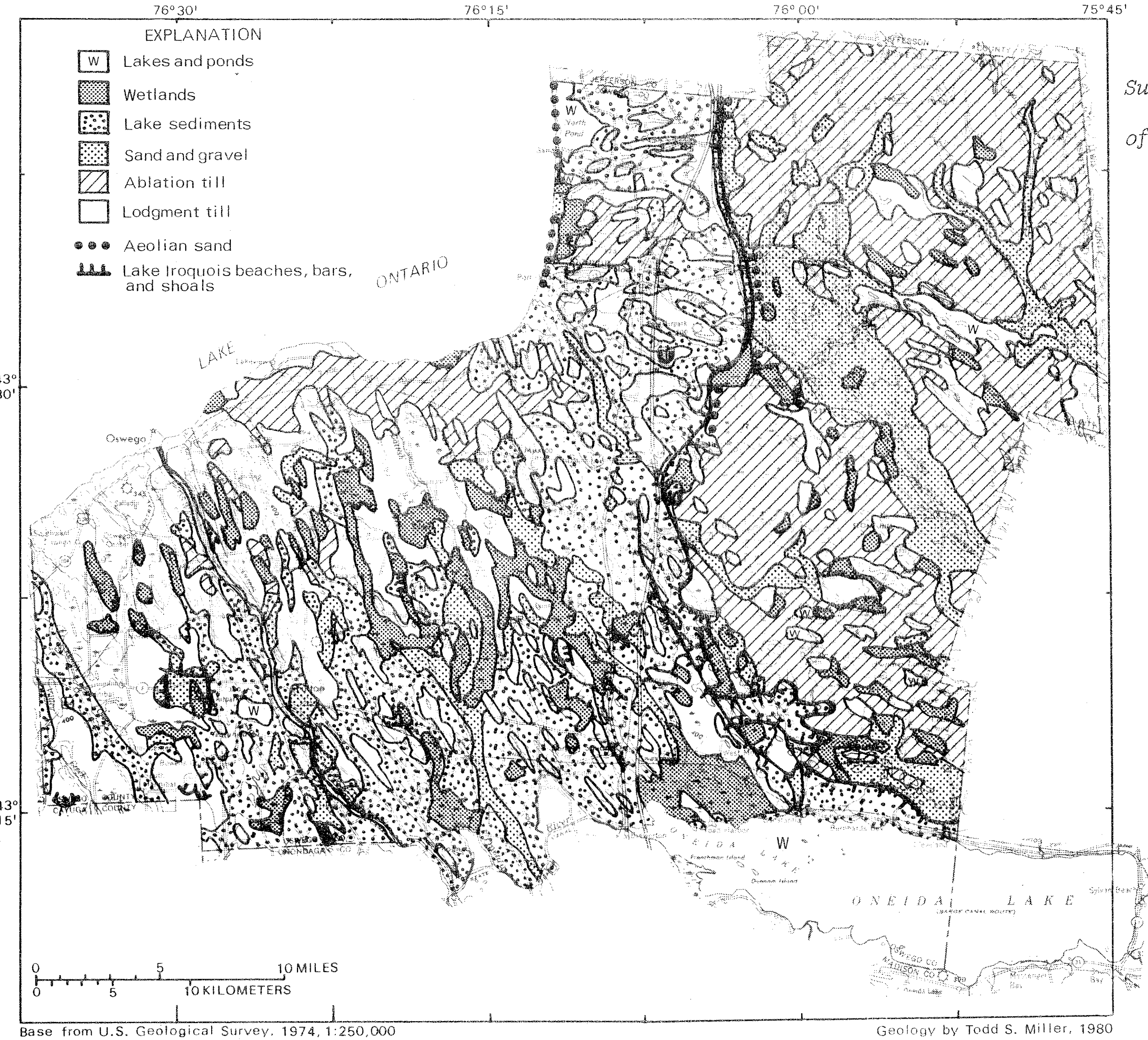


Figure 2.

Surficial geology of Oswego County.

Glacial deposits consist of lodgment and ablation tills; kame, esker, outwash, beach and wave-delta sand and gravels; and proglacial lake deposits of fine sand, silt, and clay. End or recessional moraines deposited at the ice front form arcuate ridges consisting of ablation and lodgment tills. Ground moraine consisting predominantly of lodgment till but commonly having a veneer of ablation till at the surface forms drumlins. The origin of selected types of glacial deposits is depicted in the geologic section in figure 3; the distribution of these deposits is shown in figure 2. The surficial geology is shown in greater detail in the 29 quadrangle maps prepared during this study. (See list of references.)

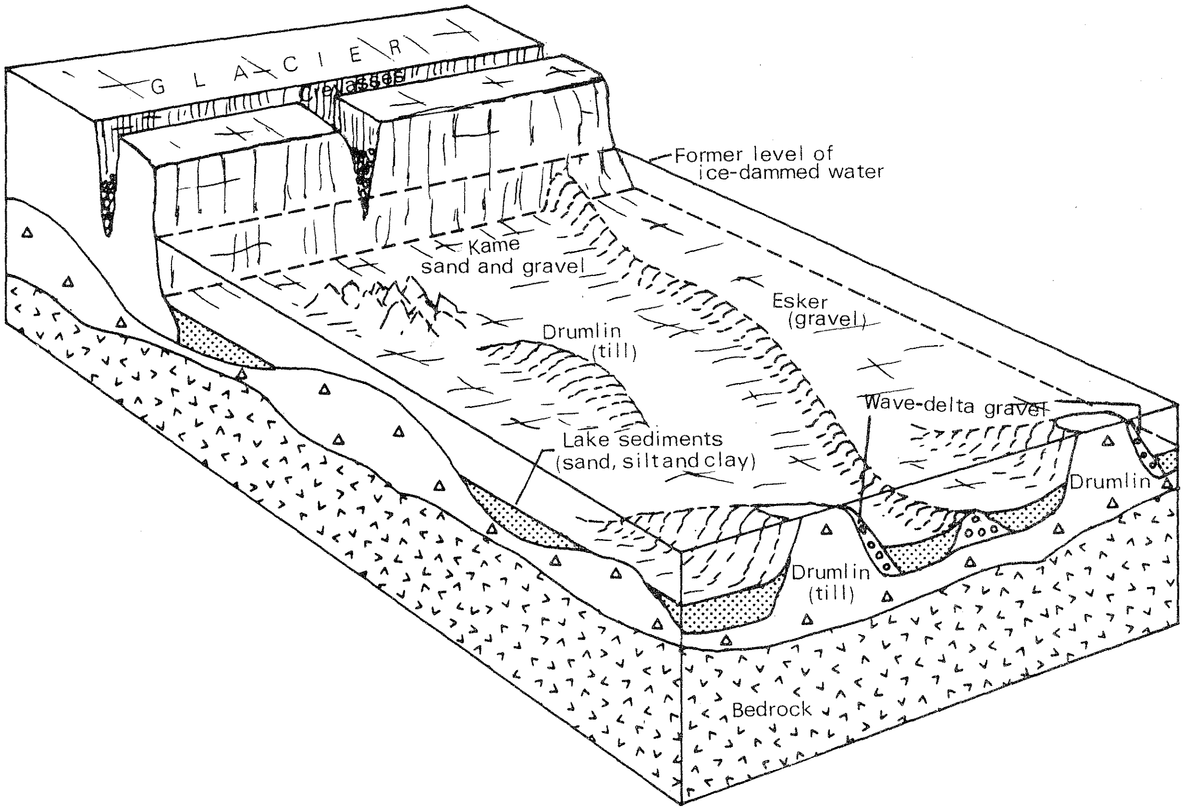


Figure 3.--Mode of deposition of common glacial deposits.

Bedrock

The bedrock consists of nearly flat-lying Ordovician and Silurian sedimentary formations that were deposited in marine and terrestrial environments 400 to 500 million years ago (Broughton and others, 1970). Older formations of Late Ordovician age crop out in northern Oswego County, and successively younger formations are exposed from there southward (figs. 4, 5). The younger rock units overlie the older units so that the age of units increases with depth. Bedrock dips to the southwest at approximately 50 ft/mi. A section of the bedrock formations is shown in figure 4.

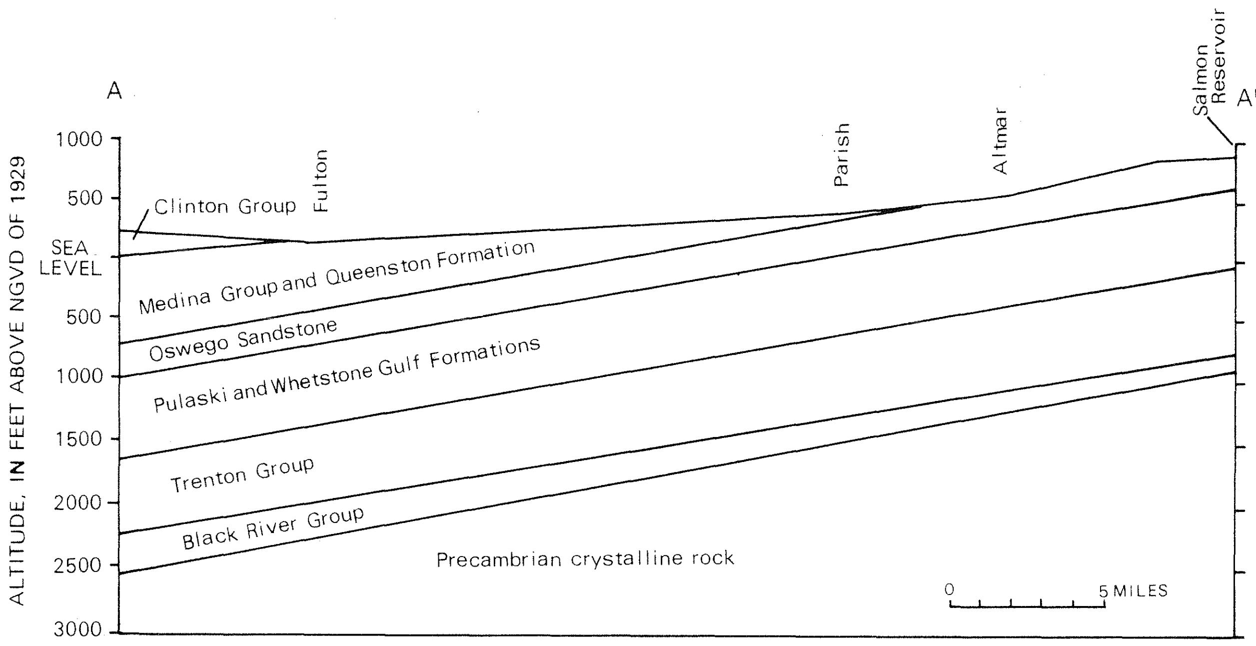


Figure 4.--Section showing relative position of bedrock formations in Oswego County. Location of section is shown in figure 5.

The oldest exposed formations are the fossiliferous Pulaski Formation and the Whetstone Gulf Formation (the local name), which grade upward from predominantly shale in the Whetstone Gulf and lower part of the Pulaski to siltstone in the upper part of the Pulaski (figs. 4 and 5). The overlying Oswego Sandstone grades upward from shale to very fine-grained sandstone in the lower part to fine-grained sandstone in the upper part.

The Queenston Formation and Medina Group (designated Albion Group by the U.S. Geological Survey) are commonly mapped together because they are difficult to differentiate. Both contain red shale, siltstone, and sandstone, and both were deposited under tidal flat and deltaic conditions (Patchen, 1978 p. 368). Exposure of Queenston and Medina sediments to an aerobic environment allowed iron to oxidize and produced the red color. Together the Pulaski, Oswego, and Queenston sequence represents the Queenston Delta, which extended westward from the ancient Taconic Mountains in the eastern part of New York State (fig. 1), the source of sediment for these formations.

Overlying and cropping out south of the Queenston-Medina sequence is the Clinton Group (figs. 4 and 5), which consists of green and gray marine sandstone, siltstone, shale, and hematitic limestone. The Clinton rocks are the youngest in the county.

Two significant bedrock troughs have been noted--the Salmon River trough near the village of Redfield and the Ninemile Creek trough west of the village of Hannibal (fig. 6). These troughs are preglacial valleys that were alined in the direction of glacier flow and extensively scoured. These troughs are typically U-shaped and contain varying amounts of drift.

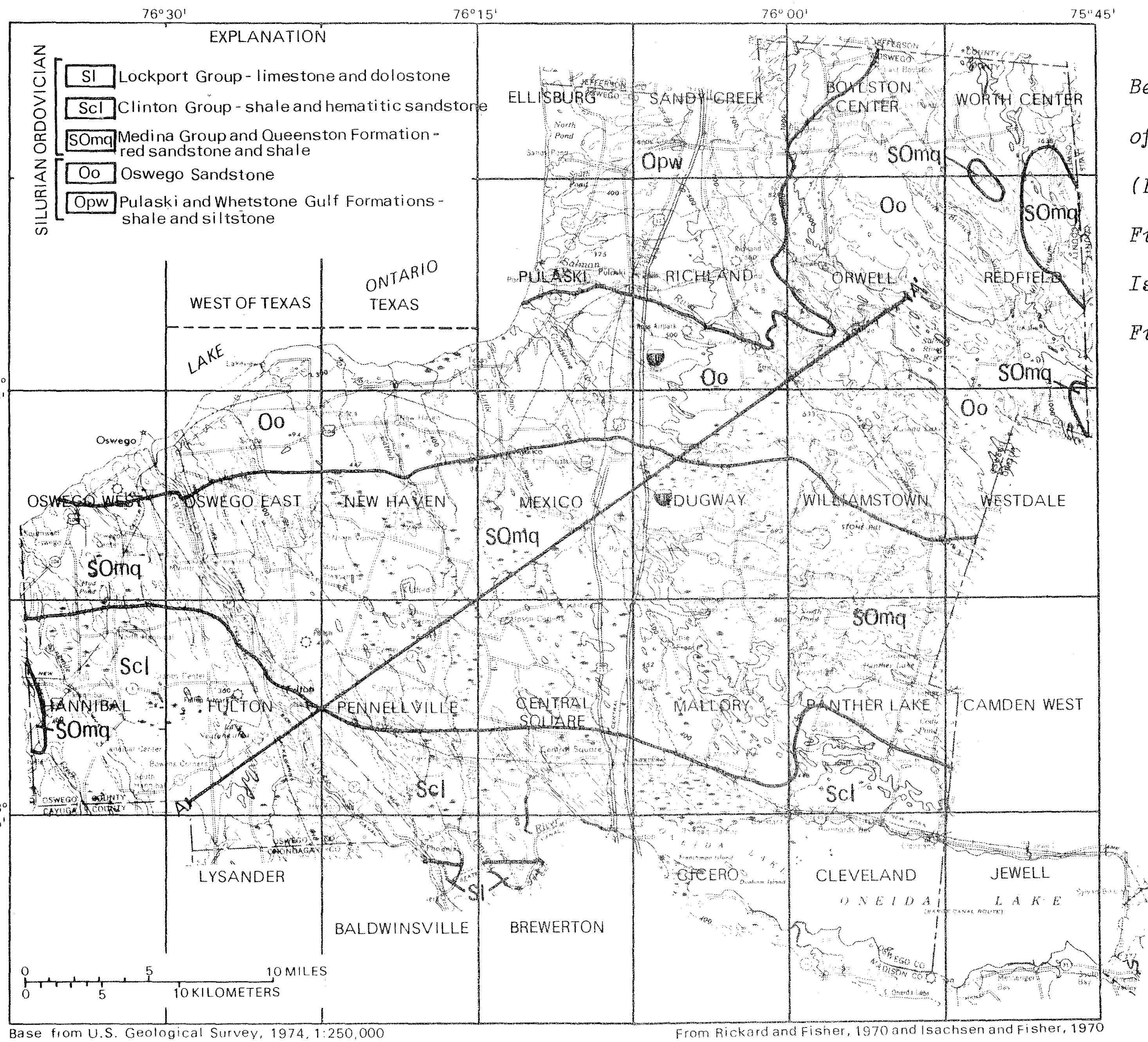
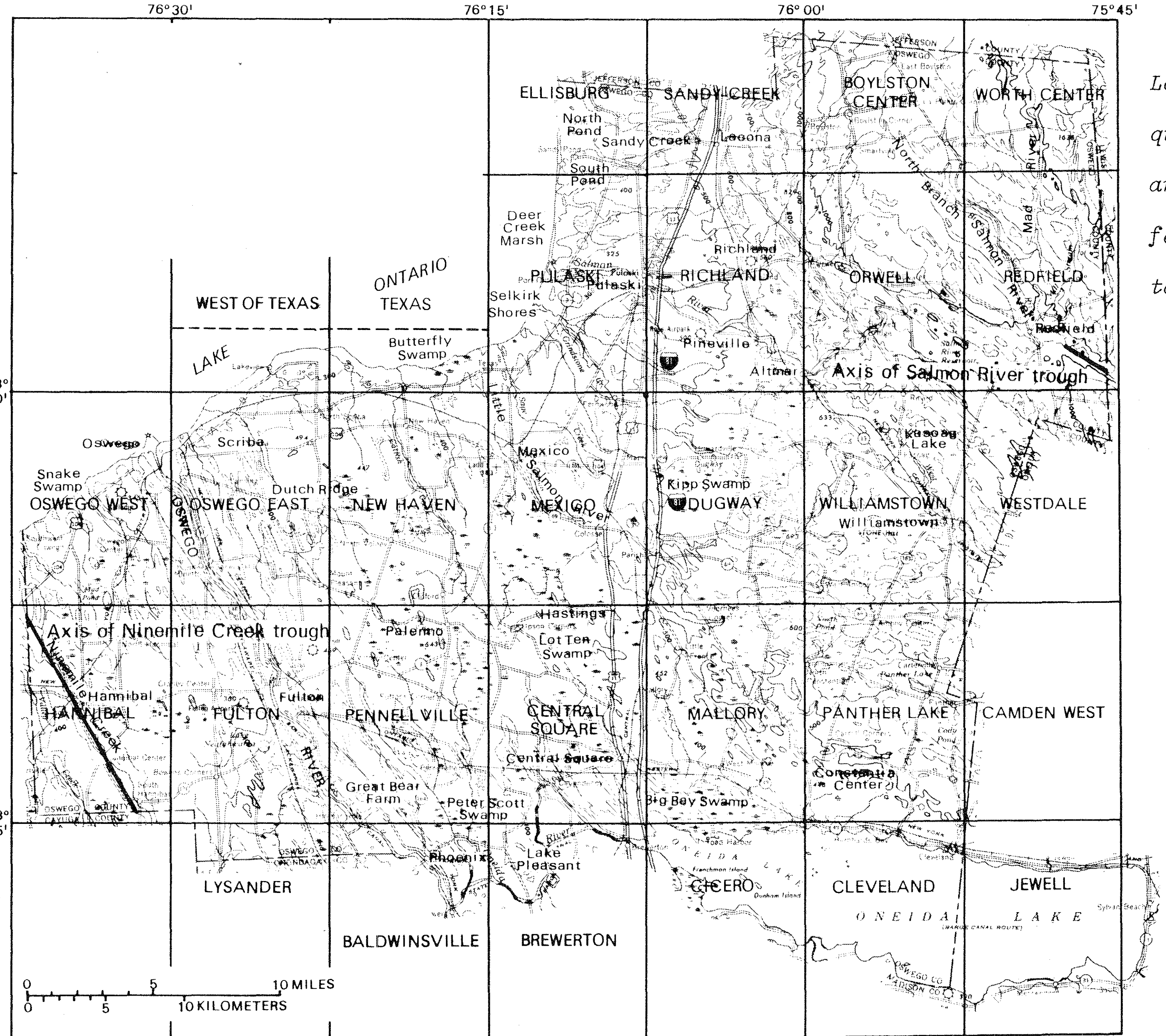


Figure 5. Bedrock geology of Oswego County. (From Rickard and Fisher, 1970, and Isachsen and Fisher, 1970.)



Base from U.S. Geological Survey, 1974, 1:250,000

Figure 6. Location of quadrangles and geographic features referred to in text.

The unconsolidated materials that cover the bedrock were deposited during and after the advance of Pleistocene ice sheets. The common types of deposits and their mode of formation are described in the paragraphs that follow.

Lodgment Till

Lodgment till was deposited beneath the advancing glacier and consists of poorly sorted sediments ranging in size from clay to boulders. This compact material was compressed beneath the advancing ice and is typically dense, firm, and relatively impermeable. Lodgment till contains pebbles and cobbles alined in the direction of glacier flow and, when exposed to air, developes a platy structure.

Typically at least 80 percent of the material that forms lodgment till is derived from local bedrock. For example, in the northern part of the county, till overlying the green Oswego Sandstone is olive green, and in the southern part of the county, till overlying red sandstones has a characteristic red color. Particle-size analyses by Soloman (1974) of till matrix from the Lake Ontario shore west of the city of Oswego revealed nearly equal proportions of sand and silt (45 percent each) and about 10 percent clay.

Lodgment till forms most of the 20- to 150-ft high drumlins that dominate the topography. The main axis of drumlins is alined with the direction of glacier flow (south to southeastward). Their lower parts are commonly covered with lake sediments or wetlands.

Ablation Till

Ablation till is drift that was carried on top of or within a glacier and was deposited as the ice melted. Ablation till in Oswego County consists of poorly sorted material ranging in size from silt to boulders and tends to be coarser, looser, and more permeable than lodgment till. Stones tend to be broken by frost action and are more angular than those in lodgment till. Till fabric or structure is absent except in local patches of stratified drift showing evidence of washing.

An extensive blanket of ablation moraine overlying lodgment till or bedrock covers a large part of the Tug Hill Plateau and the region just south of it (fig. 2). Till in this region has a silty sand matrix with pebbles and cobbles. Land surface of the Tug Hill area is characterized by a blanket of irregular knobs that are in places alined in arcuate ridges that mark temporary standstills of the ice front.

Ablation till forms the end moraine in the Texas and West of Texas quadrangles and the northern parts of the Oswego East, New Haven, and Mexico quadrangles (fig. 6). Till in this moraine contains large blocks of Oswego Sandstone and forms well-defined, arcuate, knobby ridges that reflect former ice-margin positions. This belt of ablation till is the result of a minor glacial readvance. Elsewhere, ablation till is present only in small patches of irregular relief.

Sand and Gravel

Sand is detrital material ranging from 0.005 to 0.08 inches in diameter; gravel is made up of particles ranging from 0.08 to 3.0 inches in diameter. Sand and gravel have a high porosity and are unconsolidated except where secondary calcite in ground water has cemented the grains.

In the western and central parts of the county, sand and gravel occurs in irregular patches of conical mounds or as long, sinuous deposits; in the east it occurs as linear deposits and as wide belts (fig. 2). In the detailed quadrangle maps cited in the list of references, sand and gravel deposits are differentiated according to mode of deposition; these forms include kame and esker, outwash, beach, wave-delta, delta, and aeolian deposits. Each of these is described in paragraphs that follow.

Kames and eskers.--Crevasses and openings in a glacier that became filled with sediment left conical mounds of stratified sand and gravel when the ice melted. Such deposits, known as kames, may consist of sand, gravel, or both. When sediments were deposited in streams flowing in subglacial tunnels, they formed long, sinuous ridges called eskers.

Significant kame deposits occur near Fulton in Fulton quadrangle, at Great Bear Farm in Pennelville quadrangle, near Lake Pleasant in Brewerton quadrangle, in areas south and east of Mexico in Mexico quadrangle, at Hastings in Central Square quadrangle, at the eastern margin of Central Square quadrangle, near Constantia Center in Panther Lake quadrangle, and southeast of Redfield in Redfield quadrangle (fig. 6). The largest esker-kame deposit forms a part of a sand and gravel complex also consisting of outwash, beach, and aeolian sediments that extends from Lacona to Williamstown (fig. 2). The Lacona-Williamstown deposit is 20 mi long, 0.5 to 3 mi wide, and 10 to 85 ft thick. This deposit was formed by ice-contact sediments accumulating at a stagnant ice front and by outwash and beach deposition. Sand and gravel deposits accumulated until the glacier's melting rate exceeded its rate of advance and the ice front retreated to the northwest. Smaller kame deposits are common throughout Oswego County.

Most of the kame deposits are associated with eskers. Glacial streams channeled sediment-laden meltwater on top of and within the ice southeastward to the ice margin. In the central part of the county, where subglacial tunnels connected with subglacial caverns, many eskers are associated with large kame deposits.

Also associated with kame deposits are bowl-shaped depressions called kettles, generally 10 to 25 ft deep, which were formed by the melting of buried or isolated ice blocks. When these depressions filled with water, they formed kettle lakes, of which Kasoag Lake in Williamstown quadrangle (fig. 6) is an example.

Outwash.--Stratified sand and gravel deposited by glacial meltwater beyond the ice front is known as outwash. Outwash that was deposited close to the ice front consists of coarse sand and gravel that could not be moved readily; the material at greater distances grades into progressively finer grained deposits. Outwash deposits typically form plains and valley trains having relatively flat surfaces that slope gently away from the former ice front.

Because outwash is formed by fluvial processes, it is uncommon in the western and central parts of Oswego County, which were inundated by proglacial Lake Iroquois (fig. 2) below 480 to 500 ft. One end moraine with an associated outwash plain, 1.5 mi east of Scriba in the Oswego East quadrangle (fig. 6), was just above lake level.

On the west margin of the Tug Hill Plateau, which was above Lake Iroquois, ice-marginal streams along the east edge of the retreating Ontario ice lobe deposited much outwash. Meltwater streams flowing south and southwestward along the ice margin carved deep incisions into bedrock and lodgment till and deposited sediments where stream gradients decreased. Outwash deposits left by ice-marginal meltwaters are visible along the west margin of the Tug Hill Plateau in the Sandy Creek, Boylston Center, Redfield, Richland, and Orwell quadrangles (fig. 2). (See also maps cited in list of references.)

The largest outwash deposit is in the preglacial valley of North Branch Salmon River in the Tug Hill Plateau (fig. 6). This valley was parallel to the direction of ice flow and thus received meltwaters carrying outwash for a longer time than the numerous short-lived, ice-marginal meltwaters.

Beaches, bars, and shoals.--Prominent beaches, bars, and shoals developed approximately 12,000 years ago along the shore of proglacial Lake Iroquois, which inundated most of western and central Oswego County. This lake formed in a basin in front of the glacier when the meltwater outlets were dammed by ice and topographic obstructions. Locations of major beaches, bars, and shoals are shown in figure 2; the Lake Iroquois beach roughly parallels the boundary between the Erie-Ontario Plain and Tug Hill Plateau (fig. 1).

In southern Oswego County, features created or modified by wave action, such as beaches, sea cliffs, and wave-cut drumlins, indicate that Lake Iroquois reached a maximum altitude of 480 to 500 ft. The beach rises northward at approximately 4 ft/mi; this rise is attributed to progressively greater crustal rebound to the north after removal of the ice load (Flint, 1971).

The Lake Iroquois beach from Lacona to Pineville (figs. 2 and 6) is exceptionally wide because large quantities of outwash sediments from the Tug Hill Plateau were being deposited in the lake, where they became reworked by wave action to form the beach.

In central and western Oswego County, less prominent shore features at altitudes of 430 to 460 ft, 415 to 425 ft, and 390 to 400 ft (Wright, 1973) represent lower substages of Lake Iroquois. These substages are indicated mainly by flattened drumlin tops, as depicted in figure 3. Dutch Ridge, in Oswego West quadrangle (fig. 6), is a typical drumlin whose top has been eroded to a flat surface (altitude 430 ft). Sutton and others (1972) identified four other post-Iroquois standstills in the coastal area of the eastern Ontario basin at elevations of 290 to 300 ft, 255 ft, and 215 ft. During one stage, the Dune stage (altitude 215 ft), when Lake Ontario was 30 ft lower than its present level, a wide beach developed that provided enough sand for dunes to form on the east side of the beach. These dunes are now partly inundated by Lake Ontario and form barrier beaches along the eastern Lake Ontario shore at North and South Ponds and Deer Creek Marsh (fig. 6).

Recent beach deposits of Lake Ontario between Oswego County's western boundary and the mouth of Little Salmon River (fig. 6) consist of a coarse cobble gravel with intervening sea cliffs cut into drumlins or bedrock. A sandy beach formed by the reworking of dune sand has developed from the mouth of Little Salmon River to the northern border of the county.

Wave-delta deposits.--Waves on Lake Iroquois, its substages, and other postglacial lakes have eroded the tops of drumlins to altitudes corresponding with lake levels and deposited stratified sand and gravel on the lee side. The presence of gravel on only the east flanks of drumlins indicates that currents flowed from west to east. As a result of winnowing, or separation of fine particles from coarser ones by wave action, a lag of boulders remains on top of the flat-topped drumlins. Wave-delta deposits are found along drumlins in the western and central part of the county. Figure 7 shows an east-west cross-sectional view through drumlin, beach, and wave-delta deposits.

Delta deposits.--The delta deposits consist of sediment deposited by meltwater flowing into Lake Iroquois from the Tug Hill Plateau. Coarse stratified sand and gravel was deposited near stream mouths, and finer material was deposited farther out in the lake. A major delta deposit is found near Pineville in Richland quadrangle (fig. 6), where Salmon River flowed into Lake Iroquois.

Lake Sediments

Lake sediments, also called lacustrine sediments, are deposits of sand, silt, and clay that settled out of suspension in lakes. The sediments of former Lake Iroquois are the most widespread type of surficial deposits in western and central Oswego County (fig. 2). Sand, silt, and clay blanketed the interdrumlin lowlands, the areas offshore from the postglacial beaches, and the mouths of streams that drained the Tug Hill Plateau into Lake Iroquois. The lake sediments generally overlie lodgment till or kame deposits.

Lake currents kept the tops of inundated drumlins free of fine sediment, but fine sand accumulated on their lower flanks. This material grades into finer particles of sand, silt, and clay toward the center of interdrumlin lowlands. A typical interdrumlin deposit is depicted in figure 8. Fine sand predominates just offshore from former high-energy environments such as beaches and deltas; deposits of finer particles consisting of silt and clay formed in the quieter water farther offshore.

Aeolian Sand

Lowering of lake levels exposed sand deposits to the wind until vegetation was reestablished. Aeolian sand formed dunes on the landward side of the Lake Iroquois beach from Lacona to Altmar (figs. 2, 6) and mantled the windward side of drumlins, ablation moraine, and kame deposits downwind adjacent to the beach. Sand dunes have also collected along the east shore of Lake Ontario from Selkirk Shores to North Pond (figs. 2, 6).

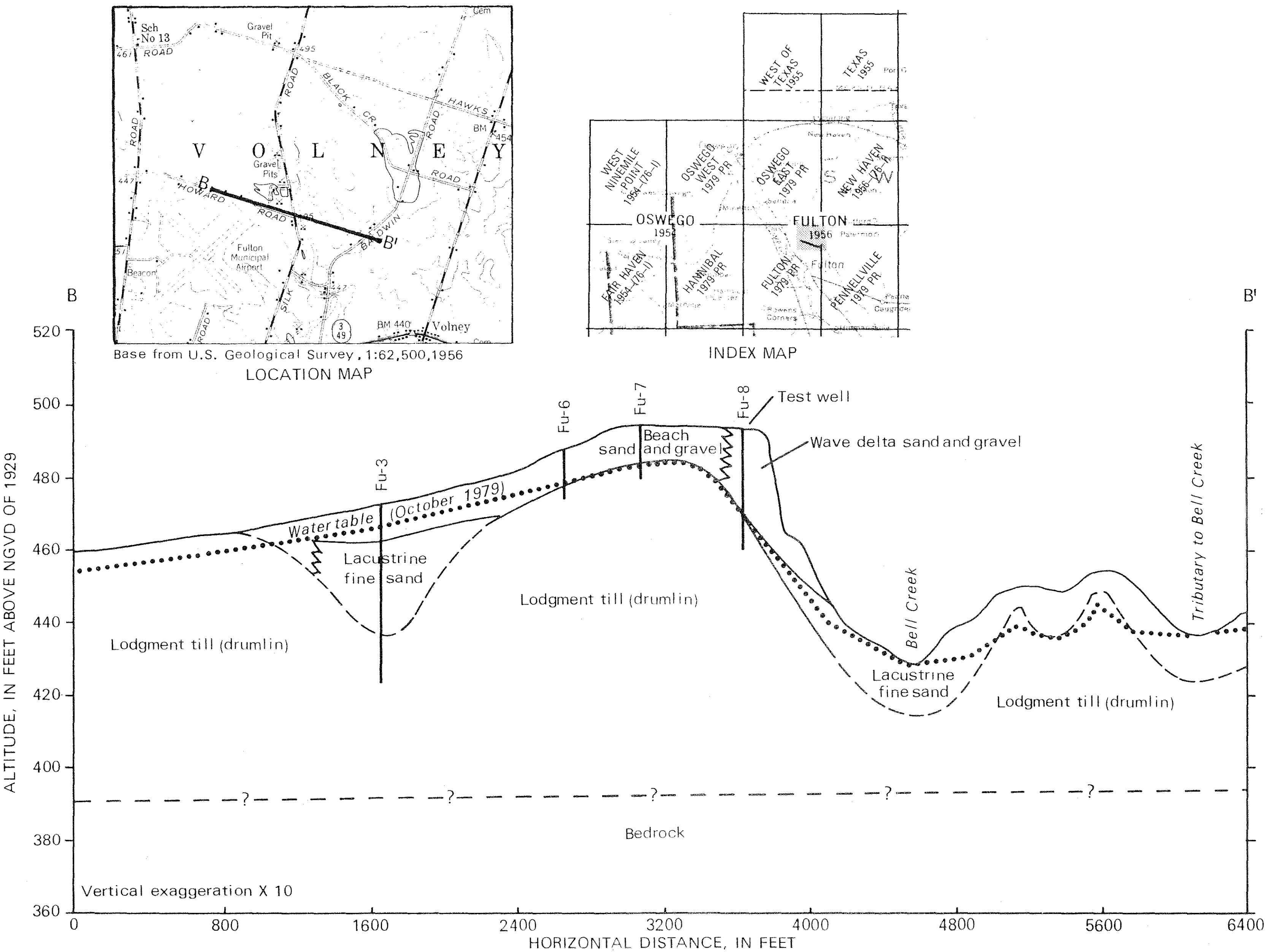


Figure 7.--Generalized section in Fulton quadrangle showing location of typical beach and wave-delta deposits.

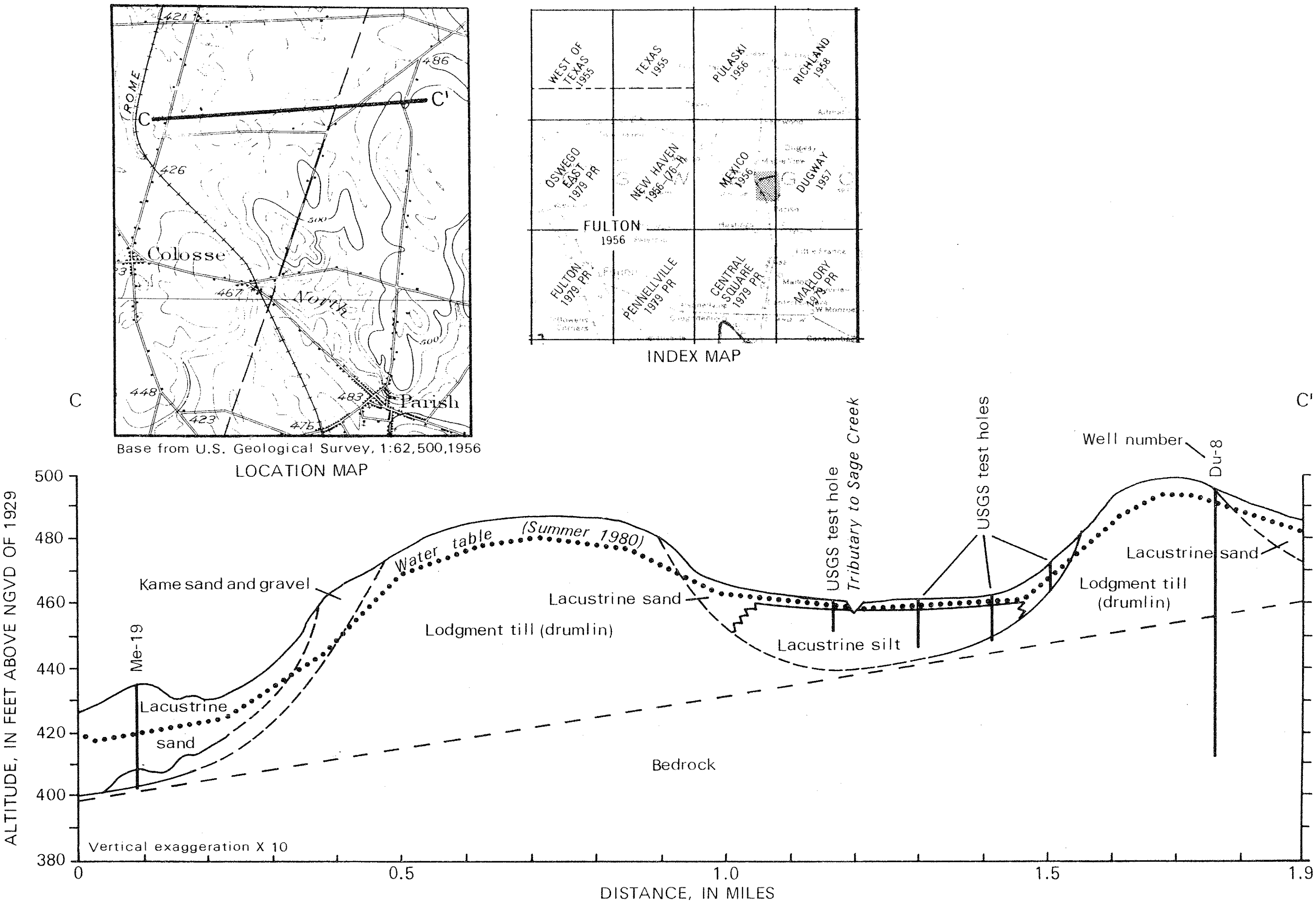


Figure 8.--Cross section of typical drumlin and interdrumlin deposits.

Wetlands.--Oswego County contains hundreds of wetlands, most of which formed during deglaciation, when drainage in low areas became blocked by glacial debris. Wetlands consist of shallow stagnant water, organic material, marl, peat, and muck. Many of the wetlands have been drained for agricultural use during the last two decades.

In the western and central parts of the county, wetlands commonly formed in swales, or depressions between drumlins, when the outlets were dammed by kame moraine, esker, beach, or ablation till deposits. The wetlands southeast of Palermo in Pennellville quadrangle (fig. 6) were created by esker and kame dams, and Kipp Swamp in Dugway quadrangle (fig. 6) formed behind a Lake Iroquois sand bar. Other wetland remnants of Lake Iroquois are Peter Scott swamp in Baldwinsville quadrangle, Big Bay swamp in Mallory quadrangle, and Lot Ten swamp in Mexico quadrangle (fig. 6). Wetlands also formed in former estuaries along Lake Ontario when the lake level rose in response to uplift of the St. Lawrence River outlet (Flint, 1971). Examples of estuary wetlands are Deer Creek marsh in Pulaski quadrangle, Butterfly swamp in Texas quadrangle, and Snake swamp in Oswego West quandrangle (fig. 6).

In the Tug Hill region, wetland formation has been categorized into six types (Jordan, 1978): intramorainal basins, basins related to stratified drift (such as those formed in kettle depressions), interdrumlin basins, bedrock basins, meltwater-channel basins, and large wetland basins (either intramoraine or interdrumlin). The most extensive type of wetland in the Tug Hill region is the intramoraine basin; these wetlands occupy isolated basins that formed between irregular ablation and recessional-moraine zones.

Alluvium.--Alluvium is significant only in the channel of the Salmon River in the reach from Altmar to Pulaski. In other streams, little alluvium has accumulated since postglacial time. Even along the county's largest waterway, the Oswego River, alluvial deposits are absent; this is attributed to gradual erosion.

GROUND-WATER OCCURRENCE

Ground water is available in most of the county and may be obtained from both bedrock and glacial deposits. Generally, larger water supplies can be obtained from sand and gravel deposits, less from bedrock, and the least from till or silt and clay deposits. Quantities obtainable from properly developed wells range from 0.25 gal/min in till or bedrock units to more than 1,000 gal/min in outwash sand and gravel.

In unconsolidated deposits, water is stored in the openings (pore space) between particles. The amount of pore space (porosity) determines the amount of water that can be stored but not how much can be withdrawn. The amount of water that an aquifer releases from storage is called specific yield. Coarse, well-sorted material such as gravel has high porosity and high specific yield; mixed deposits such as silt and gravel have low porosity and low specific yield, and well-sorted fine particles such as clay have high porosity but low specific yield.

The ground water is replenished by rain and snowmelt infiltrating through the soil to the saturated zone (water table) and moves downgradient from recharge areas to discharge areas such as streams, lakes, and wetlands. In recharge areas, annual water-level fluctuations are greater (5 to 25 ft) than in low discharge areas, where fluctuations are generally less than 10 ft.

The water table in unconsolidated deposits roughly parallels the land surface and is generally 5 to 30 ft beneath it. The general direction of ground-water movement in bedrock is toward Lake Ontario (Kantrowitz, 1970). Table 1 (at end of report) presents well data and ground-water levels in selected wells.

Bedrock

The bedrock is made up of sedimentary rocks in which secondary cementation has closed most of the original intergranular pore space. The total volume of openings in such material seldom exceeds 5 percent. However, bedrock typically contains numerous fractures through which water can move freely, and wells tapping bedrock can draw water from these fractures.

Because fracturing generally decreases with depth, water is obtained principally from the upper levels of a bedrock unit. Fracturing, rather than rock type, is the controlling factor in the water-producing capacity of bedrock. Yields of bedrock wells range from 1 to 125 gal/min, but most average 10 gal/min. Most bedrock is overlain by relatively impermeable lodgment till, which acts as a confining layer, so that water in bedrock is commonly under artesian pressure. Water levels in many wells penetrating bedrock rise above bedrock surface in response to water pressure in the formation. Bedrock units generally provide water adequate for domestic, small farm, and commercial use.

Regional ground-water flow in bedrock is northward to Lake Ontario. Recharge occurs from water infiltration through the overburden and possibly from ground water originating in the Finger Lakes region to the south. Ground water moving toward Lake Ontario becomes brackish as it dissolved materials from the rock, including salts of Silurian evaporite beds (Kantrowitz, 1970).

Chemical quality of water in bedrock depends on the depth of well penetration and rock type. Generally, ground water more than 100 ft below land surface is brackish, whereas ground water above that depth is less mineralized.

In the upper 100 ft of the Oswego Sandstone (figs. 4 and 5), the water is generally of suitable quality for drinking; water from the Queenston-Medina sequence contains some iron, and water from the Clinton Group contains salt, iron, and hydrogen sulfide.

Lodgment Till

Lodgment till, with its compactness and poorly sorted matrix of clay, silt, and sand surrounding pebble- to boulder-size material, has a low porosity and low specific yield and therefore does not yield water readily. However, these deposits can generally supply domestic and small farm needs if large-diameter dug wells are installed. Dug wells are typically 3 ft in diameter and

10 to 20 ft deep. Dug wells are successful because they provide a large surface area from which water may drain slowly from the till, and they also provide considerable storage capacity. Sustained yields of a dug well in lodgment till ranges from about 0.25 to 1 gal/min., but, because of the well's large storage capacity, it can be pumped at 10 gal/min for about 30 minutes before becoming dry. It would take 5 to 20 hours for the well to refill.

Movement of water through lodgment till is slow. As an example, water in a till with a silty sand matrix could move about 3.6 ft/yr. The velocity is estimated to be 0.01 ft/d from a hydraulic conductivity of 0.1 ft/d, a hydraulic gradient of 3 ft (vertical) per 100 ft (horizontal), and a porosity of 0.3. The water table in lodgment till roughly parallels land surface. Depth to water typically ranges from 5 to 20 ft.

Ablation Till

Ablation till is generally too thin and too impermeable to yield large quantities of water but, as a result of its higher sand content and less compact nature, it will yield slightly more water than lodgment till. Thickness typically ranges from 1 to 25 ft. Many areas of ablation till may be seasonally saturated. Ablation till provides sufficient water for domestic and small farm use, generally through dug wells.

Lake Sediments

Lake deposits are composed of sand, silt, and clay. Sand and silty sand are somewhat permeable and may yield low to moderate amounts of water to wells, but silt and clay are virtually impermeable and are the poorest aquifers in the county. Although silt and clay are porous, the stored water is held as a film by surface tension around the particles, so that water yield is low. In areas of silt and clay, wells must be drilled into an underlying, more permeable, unit such as bedrock.

Well-sorted sand having little or no silt could yield as much as 50 gal/min to wells. The higher the silt content, the poorer the yield. Lake deposits are prevalent in lowlands, where the water table is generally less than 10 ft below land surface and undergoes annual fluctuations of less than 6 ft. Dug and drilled wells can yield water sufficient for domestic and farm use. Dug wells are typically constructed in the late summer or early fall, when water levels are lowest and wells can be dug the deepest.

Assuming a ground-water gradient common to lowlands of 1 ft (vertical) to 100 ft (horizontal) and a porosity of 35 percent, ground-water movement in fine sand is estimated to be 30 ft/yr, and in clayey silt 0.001 ft/yr.

Aeolian Sand

Sand dunes on the east side of former Lake Iroquois beach are either too thin to yield water or are above the water table, but they serve as recharge areas to the Lacona-Williamstown aquifer (fig. 2). Dunes along the eastern

Ontario shore from Selkirk to North Pond (figs. 2, 6) yield moderate amounts of water, but excessive withdrawal may induce water of poor quality from Lake Ontario or adjacent swamps.

Wetlands

Water from wetlands is typically unsuitable for drinking and domestic use because it may contain relatively high concentrations of iron and decaying organic material. However, wetlands play an important role in the environment by retaining pollutants, storing water during floods, and providing wildlife habitat. Wetlands are generally ground-water discharge areas, and the water level in wetlands commonly represents the water table.

Sand and Gravel

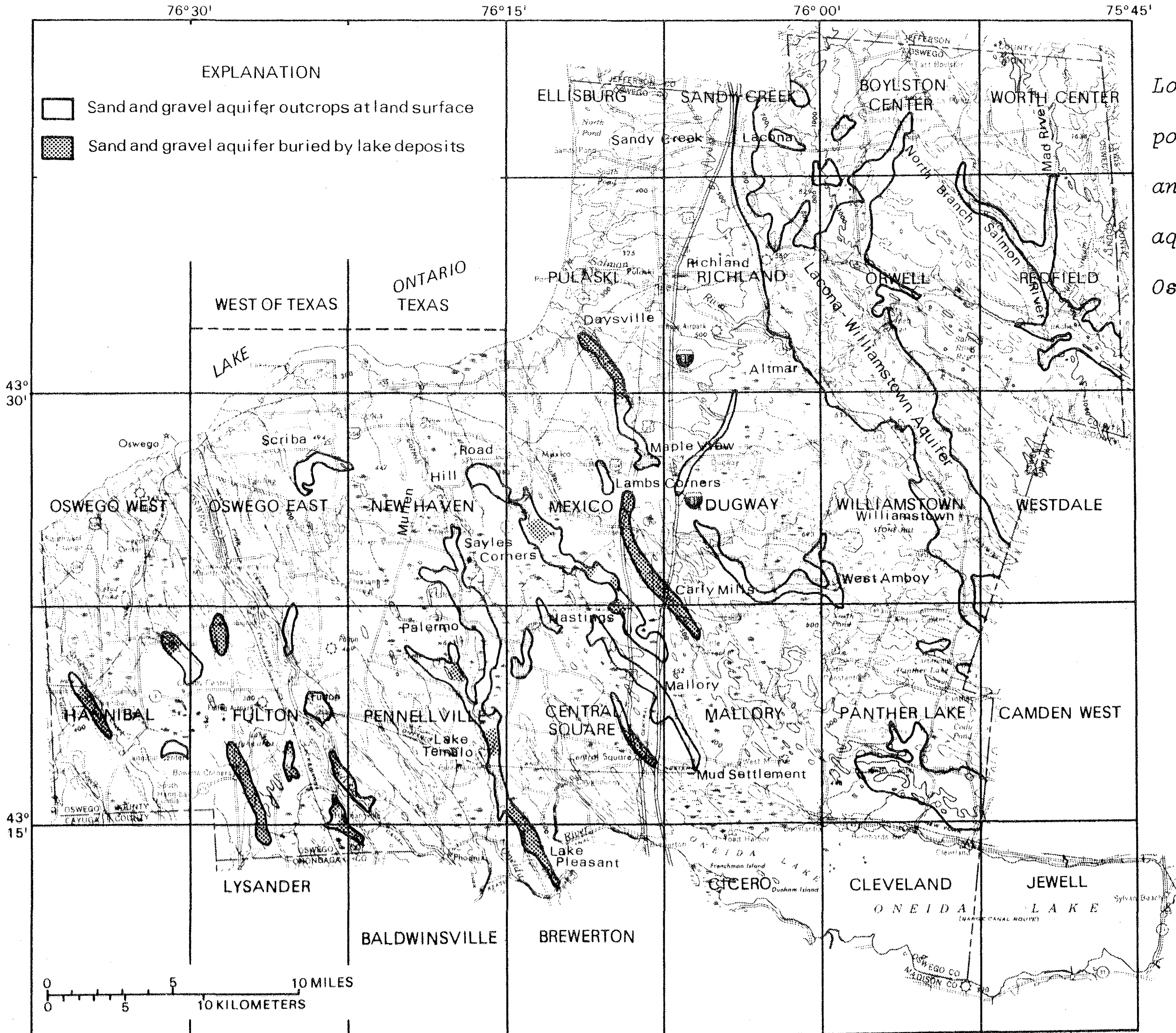
Sand and gravel deposits such as outwash, beaches, kame moraines, and esker-moraine complexes have the greatest potential for ground-water development. These deposits have high porosity and yield large amounts of water to properly constructed wells. Potential well yields range from 50 to 1,500 gal/min.

Most of the townships are underlain by some sand and gravel deposits. Deposits may be at land surface or partly or entirely buried beneath fine-grained lacustrine deposits. The maximum thickness shown in well logs was 125 ft at Great Bear Farm in Pennellville quadrangle (fig. 6); elsewhere, average thickness is generally 25 to 50 ft. Thin deposits (5 to 25 ft thick) in topographic highs are usually unsaturated or only seasonally saturated and are not reliable water sources. Useful sand and gravel aquifers are either in topographic lows or are of sufficient thickness to extend tens of feet below the water table. The locations of potential sand and gravel aquifers in Oswego County are shown in figure 9.

The largest sand and gravel aquifer is a beach, outwash, and esker-kame moraine complex extending as a belt from the northern county border north of Lacona to the eastern boundary 2 mi east of Williamstown (fig. 9). The Lacona-Williamstown aquifer is 20 mi long and ranges in width from 0.5 to 3 mi. It is widest near Altmar. Thickness ranges from 10 to 85 ft.

The Lacona-Williamstown aquifer is tapped by three significant well fields; one is owned by the villages of Sandy Creek and Lacona, one by a paper company near Richland, and the other by a State fish hatchery near Altmar. Two wells 1.5 mi north of Lacona (SC-5 and SC-7, table 1) supply Sandy Creek and Lacona. These wells tap a beach deposit about 30 ft thick; their yields are reported to range from 200 to 400 gal/min each.

The paper company's well field at Richland (fig. 6) taps beach and kame moraine deposits; the 12-inch diameter wells (Ri-11 and Ri-13, table 1) are reported to yield 800 gal/min each. Water levels during spring are generally 8 to 10 ft below land surface and decline 25 to 30 ft in late fall. Water quality meets U.S. Environmental Protection Agency drinking standards; hardness ranges from 100 to 200 mg/L.



Base from U.S. Geological Survey, 1974, 1:250,000

Figure 9. Location of potential sand and gravel aquifers in Oswego County.

The State fish hatchery near Altmar (fig. 9) contains 25 test wells and several production wells that tap a kame moraine deposit. Sand and gravel ranges in thickness from 30 to 85 ft and overlies bedrock and till. Results of five pumping tests (Irving, 1975) indicate that specific capacity (rate of discharge from well per unit of drawdown) ranged from 5.5 to 30 gal/min per ft of drawdown, and transmissivity (rate at which water flows through a unit width of the aquifer under a unit hydraulic gradient) ranged from 60,000 to 100,000 (gal/d)/ft. Well yields ranged from 100 to 400 gal/min.

The valley of the North Branch Salmon River (fig. 9) contains an outwash deposit 6 mi long and about 0.25 mi wide. This aquifer extends another 2 mi eastward into Lewis County as a kame moraine plug in the Salmon River trough. The deposit is thickest where the Mad River, the largest ice margin channel of Oswego County, deposited its sediment load at the confluence of the North Branch Salmon River and Mad River valleys.

Areally extensive but thin (10 to 30 ft thick) outwash aquifers line the west flank of the Tug Hill Plateau. These aquifers are common in Boylston Center, Richland, and Orwell quadrangles (fig. 6), but relatively little hydrologic data are available from these areas.

In the Tug Hill region, most beach and outwash aquifers are in hydraulic contact with streams, and a large percentage of water withdrawn from wells may be induced from these streams. As a result, the wells may be shallow and inexpensive to operate, but the quality of water from such wells is similar to that in the streams. The quality of ground water in the Tug Hill region is generally good. Results of 25 shallow ground-water samples collected and analyzed by U.S. Geological Survey, Oswego County Health Department, and engineering consultants revealed a range of hardness of 60 to 200 mg/L, with 150 mg/L the average, and a range of chloride from 2 to 19 mg/L, with 7 mg/L the average. Because the Tug Hill region is sparsely populated and virtually unindustrialized, the streams and ground water are not subject to significant contamination.

In the central and western part of the county, sand and gravel aquifers consist of kame and kame-esker deposits. Beach and wave-delta deposits in this region are generally unsuitable as aquifers because they are weakly developed or are on topographic highs above the water table. Except for a small area near Scriba (fig. 9), the region contains few outwash deposits because it was inundated by proglacial Lake Iroquois.

Discontinuous kame aquifers are common near Fulton and in the southern part of Fulton quadrangle (fig. 9). Lacustrine sand mantles some of the deposits so that their extent can be determined only from test drilling. Fulton obtains its water supply from kame deposits adjacent to Lake Neahtahwanta, along the east bank of the Oswego River, and at Great Bear Farm (fig. 6). Wells at Great Bear Farm range from 67 to 125 ft in depth and yield 100 to 600 gal/min (Geraghty and Miller, 1967). Wells along the Oswego River south of Fulton are about 40 ft deep and yield 200 to 400 gal/min (Barton, Brown, Clyde and Loguidice, 1967). Water levels and water quality at Great Bear Farm wells indicate that the Oswego River is far enough downgradient from pumping wells that river water is not induced into the wells. Chemical quality of water from the other wells close to the Oswego River (within 200 ft) suggests that the well field south of Fulton may be inducing recharge from the river.

The central part of the county contains many small, irregularly distributed kame deposits. These are shown on the 7.5-minute quadrangles cited in the list of references but are too small to be plotted in figure 9. Small deposits may yield enough water for domestic, farm, and small municipal uses. The villages of Hannibal and Central Square obtain water from deposits of this type.

Several esker-kame deposits extend diagonally across central Oswego county from northwest to southeast (fig. 9; detailed maps showing the location of these deposits are cited in the list of references). The larger belts extend (1) from Sayles Corners through Palermo and through Lake Temalo to Lake Pleasant in Pennellville, Central Square, and Brewerton quadrangles; (2) from Mullen Hill Road at the east border of New Haven quadrangle past and 1.5 mi south of Mexico through Hastings and Mallory to Mud Settlement in Mallory quadrangle; (3) from Lamb's Corners through Carly Mills in Mexico and Mallory quadrangles; (4) from Daysville to Maple View in Pulaski and Mexico quadrangles; and (5) from Parish Center to West Amboy in Dugway and Williamstown quadrangles.

Most esker-kame deposits are poorly defined because they are partly covered by lacustrine deposits, are discontinuous, and have irregular physical characteristics such as varying thickness and width. Little hydrologic data on these deposits are available.

Several communities in Oswego County obtain water from the esker-kame deposits; among them are Phoenix, Mexico, and Central Square (fig. 9). Two Phoenix wells (Br-1 and Br-2, table 1), 1 mi northwest of Lake Pleasant, have reported yields of 700 and 400 gal/min., respectively. Two Mexico wells, about 1.5 mi south of the village, yield 225 and 340 gal/min. The transmissivity of this aquifer is 80,000 (gal/d)/ft (Andrews, 1957).

SUMMARY AND CONCLUSIONS

Glacial sediments and marshes constitute most of the surface of Oswego County, which has few bedrock outcrops. Lodgment till in the form of drumlins and lake deposits is the most common type of deposit in the central and western part of the county; ablation till overlying lodgment till is the most common type on the Tug Hill Plateau. Extensive kame, outwash, and beach sand and gravel deposits are numerous along the west margin of the Tug Hill Plateau; small, patchy kame and beach deposits are common in the western and central regions. Bedrock consists of nearly flat-lying shale, siltstone, and sandstone.

The principal aquifers are kame, esker-kame, beach, and outwash deposits consisting of sand and gravel. Outwash aquifers are the most common type in the Tug Hill region, whereas kame, esker-kame, and beach aquifers predominate elsewhere. The largest sand and gravel aquifer is the Lacona-Williamstown aquifer, which is 20 mi long, 0.5 to 3 mi wide and 10 to 85 ft thick, and yields from 200 to 800 gal/min.

Ground water is available everywhere in quantities generally sufficient for domestic and farm use and, in some areas, in quantities sufficient for municipal and industrial supplies. Bedrock, lodgment till, ablation till, and lacustrine sand can yield sufficient quantities of water for farm and domestic use. In bedrock, the extent of fracture development rather than rock type is the major factor affecting water yield. Large-diameter dug wells are the only type that can obtain sufficient water from lodgment till, ablation till, and lacustrine silty sand.

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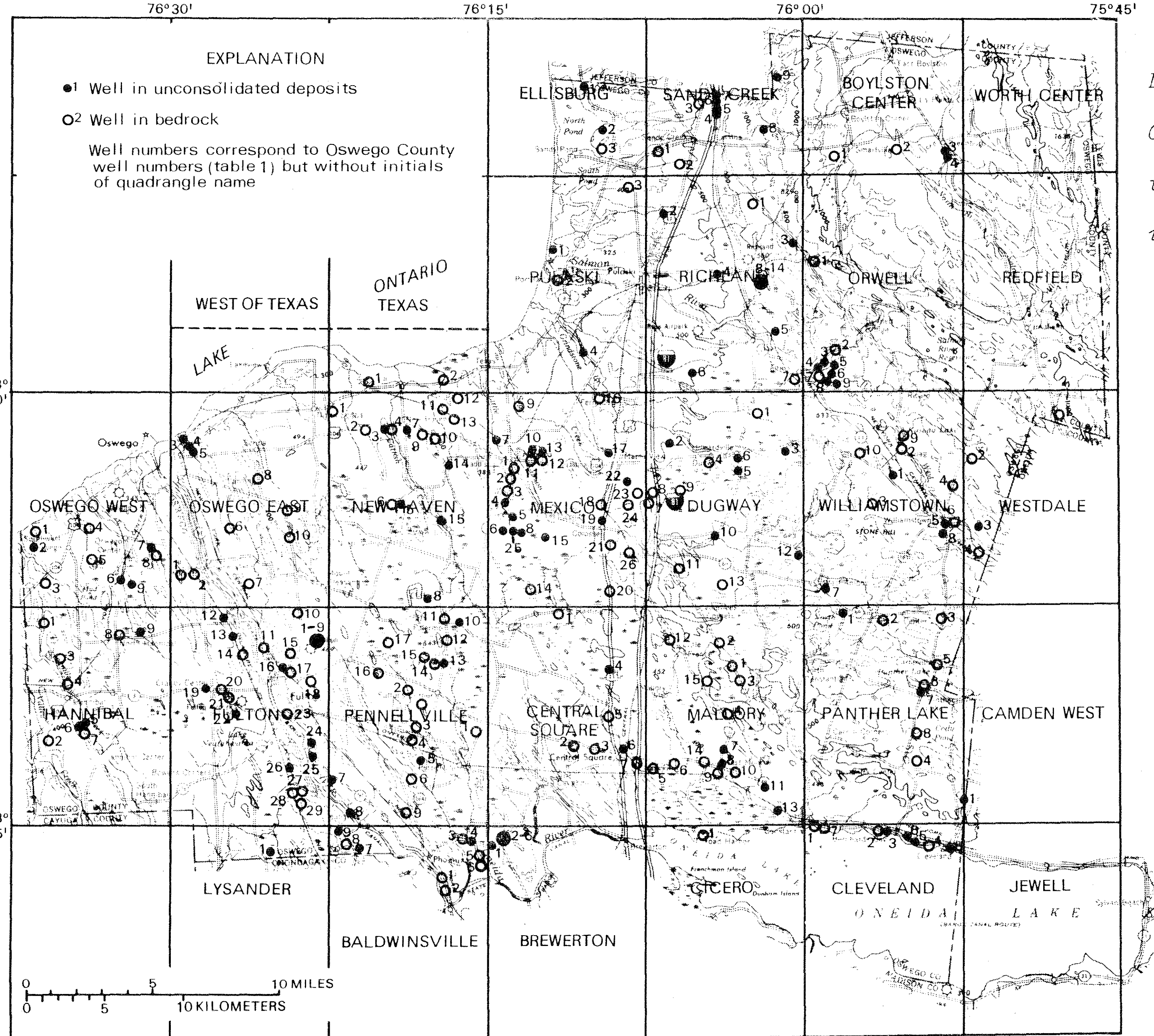
TABLE 1

Data on selected wells in Oswego County, New York

[Locations are shown on next page]

EXPLANATION

Each well has a county number and a U.S. Geological Survey number. County numbers indicate well location by quadrangle; for example, wells in Boylston Center quadrangle are designated BC-1, BC-2, etc., and wells in Ellisburg quadrangle are designated El-1, El-2, etc. Geological Survey numbers are based on latitude and longitude to facilitate retrieval of computer data. Because the entire county is within latitude 42° and 43° and longitude 75° and 77°, the digits 4 and 7 are omitted, and location is indicated by the second digit of the degree and the two digits of minutes. Wells within each 1-minute rectangle are numbered consecutively in the order in which they were inventoried. For example, well 318-603-1 is at 43°18' lat. and 76°03' long. and was the first well inventoried within that 1-minute rectangle.



Base from U.S. Geological Survey, 1974, 1:250,000

Figure 10. Location of Oswego County wells and test holes listed in table 1.

FOOTNOTES TO TABLE 1

1. Type of well:

Drl = drilled
Dug = dug
Drv = driven

2. Aquifer type

Ss = sandstone
Sh = shale
Silt = silt
Fill = fill
Sand = sand
S&G = sand & gravel
Grvl = gravel
Till = till
Clay = clay

3. Altitude:

in feet above National Geodetic Vertical Datum of 1919 (NGVD), estimated from topographic maps.

4. Water Use

A = abandoned
C = commerical
D = domestic
PS = public supply
T = test
I = industrial
In = institutional
O = observation
U = unused

5. Remarks

H2S = noticeable odor of hydrogen sulfide

hard = occupant reports hard water

Fe = water contains relatively high concentration of iron and commonly stains porcelain fixtures

yield (e) = estimated yield

yield (m) = measured yield during pumping test

yield (r) = reported yield

temp = temperature, in °F

Cl = chloride concentration

$CaCo_3$ = calcium carbonate concentration

Table 1.--Data on Selected Wells in Oswego County (Continued)

[Locations are given in fig. 10; depths are in feet below National Geodetic Vertical Datum of 1929]

Oswego County well number	USGS well number	Owner	Year completed	Type of well[1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type [2]	Altitude (ft)	Water level: Depth below land surface (ft)	Water level: Date of measurement	Geol. log	Water use [4]	Remarks[5]
BALDWINSVILLE QUADRANGLE															
Ba-1	313-617-1	M. Walker	1960	Drl	25	16	6	16	Ss-Sh	370	9	7-29-60	No	D	Yield (r) 20 gal/min
Ba-2	312-617-1	West Phoenix Co., Inc.	1959	Drl	52	40	6	40	Sh	380	--	--	No	C	Soft
Ba-3	314-615-1	H. Lewis	1961	Drl	92	78	6	77	Ss-Sh	370	5	1961	No	U	Salty
Ba-4	314-615-2	do	1961	Drl	77	77	6	77	S & G	370	30	1961	No	D	Salty
Ba-5	314-615-3	J. Palmer	1959	Drl	92	80	6	80	Ss-Sh	370	0	1959	No	U	Salty; yield (r) <1 gal/min
Ba-6	313-615-1	P. Smith	1956	Drl	52	40	6	40	Ss-Sh	370	--	--	No	D	H_2S; Fe
Ba-7	314-621-1	S. Brostek	1959	Drl	72	63	6	63	Ss-Sh	380	12.6	7-06-61	No	U	Salty
Ba-8	314-621-2	L. Burghdurf	1955	Dug	15	--	18	--	Sand	390	10.1	9-22-59	No	D	--
Ba-9	314-621-3	C. Raymo	--	Drl	101	60	6	59	Sh	410	--	--	No	D	--
BOYLSTON CENTER QUADRANGLE															
BC-1	338-558-1	L. Byrons	1979	Drl	28	11	6	11	Ss	1180	7	1979	No	D	--
BC-2	338-555-1	G. McDougal	1962	Drl	32	18	6	18	Ss	1300	7.7	7-14-80	No	D	--
BC-3	338-552-2	C. Yerden	1979	Drl	61	61	6	--	Grvl	1300	12	1979	No	O	--
BC-4	338-552-1	do	1958	Drl	72	72	8	--	Grvl	1315	--	--	No	D	--
BREWERTON QUADRANGLE															
Br-1	314-614-1	Village of Phoenix	1930	Dug	25	--	300	--	S & G	370	11.9	6-28-62	No	PS	Yield (r) 700 gal/min
Br-2	314-614-2	do	1948	Drl	45	28	24	--	S & G	375	10	1-01-62	No	PS	Yield (r) 400 gal/min
Br-3	314-614-3	do	1967	Drl	43	43	4	--	S & G	380	--	--	Yes	U	--
Br-4	314-614-4	Kline	1967	Drl	62	--	4	--	S & G	378	--	--	Yes	U	Test hole
Br-5	314-614-5	do	1967	Drl	52	52	4	--	S & G	370	6.2	6-21-67	Yes	U	--
Br-6	314-614-6	do	1967	Drl	55	55	4	--	S & G	370	--	--	Yes	U	--
CAMDEN WEST QUADRANGLE															
CW-1	315-552-1	Village of Cleveland	1967	Drl	34	--	4	46	S & G	535	4.3	1967	Yes	U	--
CICERO QUADRANGLE															
Ci-1	314-604-1	J. Dyer	1940	Drl	101	86	6	86	Ss-Sh	385	19.1	7-25-60	Yes	D	--
CLEVELAND QUADRANGLE															
Cl-1	314-559-2	F. Lambert	1959	Drl	103	68	6	68	Ss-Sh	395	26.5	8-22-60	No	D	Yield (r) 7 gal/min
Cl-2	314-556-1	S. Aloi	1959	Drl	138	132	6	132	Ss-Sh	390	19.2	8-24-60	No	U	H_2S; salty; yield (r) 8 gal/min
Cl-3	314-555-1	Winn's Trailer Park	1955	Drl	57	57	6	--	S & G	370	6	1955	No	D	H_2S; yield (r)

Oswego County well number	USGS well number	Owner	Year completed	Type of well[1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type[2]	Altitude (ft)[3]	Water level: Depth below land surface (ft)	Water level: Date of measurement	Geol. log	Water use[4]	Remarks
CLEVELAND QUADRANGLE (continued)															
Cl-4	314-554-2	J. Hampson	1955	Drl	101	86	6	86	Ss-Sh	405	17.3	8-25-66	No	D	Hard; Fe; yield (r) 3 gal/min
Cl-5	314-555-3	Murphy	1967	Drl	35	35	6	64	S & G	375	4	9-14-67	Yes	U	--
Cl-6	314-555-2	Murphy	1967	Drl	40	40	6	76	S & G	375	5	9-14-67	Yes	U	Yield (r) 75 gal/min
Cl-7	314-559-3	E. Will	1967	Drl	61	--	6	60	Sh	374	--	--	Yes	T	--
Cl-8	314-553-1	Swarthout	1967	Drl	34	--	6	--	--	376	--	--	Yes	T	--
CENTRAL SQUARE QUADRANGLE															
CS-1	322-611-1	A. Baldwin	1967	Drl	55	--	6	--	Sh	485	19	8-15-68	No	D	Yield (e) 5 gal/min
CS-2	317-610-1	L. Matzke	1955	Drl	87	60	6	60	Ss-sh	420	17	1955	No	D	H_2S; hard, yield (r) 2 gal/min
CS-3	317-609-1	C. Chesebro	1959	Dug	25	--	24	--	Till	440	21.9	8-19-60	No	D	--
CS-4	320-609-1	A. Watson	1959	Drl	42	42	6	--	S & G	470	--	--	No	D	--
CS-5	318-608-1	R. Johnson	1948	Drl	90	--	6	--	Ss	460	41.8	9-07-60	No	D	--
CS-6	317-608-1	Village of Central Square	1929	Dug	21	--	216	--	S & G	390	11	1960	No	PS	Yield (m) 425 gal/min
CS-7	317-607-1	L. Mallory	1958	Drl	92	90	6	90	Sh	440	44	8-19-60	No	D	--
DUGWAY QUADRANGLE															
Du-1	329-602-1	O. Lewis	1967	Drl	125	--	6	80	Ss	565	38	8-14-68	No	U	
Du-2	328-606-1	C. Vanauken	--	Dug	8	--	36	--	Sand	518	6	8-14-68	No	D	
Du-3	328-600-1	N.Y.S.Dept. of Environmental Conservation	1938	Dug	15	--	48	--	Till	636	8	8-14-68	No	I	
Du-4	327-604-1	G. Ulrich	1957	Drl	192	192	6	--	Ss	601	18	8-14-68	No	D	
Du-5	327-603-1	J. Hier	--	Dug	17	--	40	--	Sand	546	7	8-14-68	No	U	
Du-6	327-603-1	J. Hier	--	Dug	16	--	43	--	Sand	542	10	8-14-68	No	D	
Du-7	326-607-4	J. Furkhamer	1967	Drl	92	--	--	48	Ss-Sh	485	--	--	No	D	Fe, H_2S
Du-8	326-607-5	L. Ware	1960	Drl	72	28	6	28	Ss-Sh	487	6	8-02-80	No	D	H_2S
Du-9	326-605-1	R. Preeman	1967	Drl	78	78	6	--	Ss-Sh	540	21	8-13-68	No	D	
Du-10	325-604-1	K. Kinney	--	Dug	8	--	30	--	Till	527	2	8-13-68	No	D	
Du-11	324-606-1	G. Reese	1964	Drl	76	76	6	--	Ss-Sh	544	35	8-13-68	No	D	
Du-12	324-600-1	J. Gryziek	--	Dug	26	--	30	--	Till	600	19	8-13-68	No	U	
Du-13	323-604-1	R. Allis	1962	Drl	40	--	6	--	Ss-Sh	568	8	8-13-68	No	D	
ELLISBURG QUADRANGLE															
El-1	340-610-1	Freeman's Motel	1967	Dug	12	--	42	--	Grvl	250	6	8-08-68	No	C	
El-2	339-609-1	R. Bixby	1966	Dug	15	15	36	--	S & G	258	6	8-08-68	No	D	
El-3	338-609-1	--	1978	Drl	36	36	--	36	Sh	291	2	1978	No	D	Artesian well
FULTON QUADRANGLE															
Fu-1	321-622-2	Oswego County	1979	Drl	58	--	8	--	--	490	Dry	9-12-79	Yes	T	
Fu-2	321-622-7	do	1979	Drl	14	14	2	--	Till	490	7.5	10-15-79	Yes	O	

Table 1.--Data on Selected Wells in Oswego County (Continued)

[Locations are given in fig. 10; depths are in feet below National Geodetic Vertical Datum of 1929]

Oswego County well number	USGS well number	Owner	Year completed	Type of well [1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type [2]	Altitude (ft) [3]	Depth below land surface (ft)	Date of measurement	Geol. log	Water use [4]	Remarks [5]
HANNIBAL QUADRANGLE															
Ha-1	322-636-1	E. Hall	1966	Drl	2559	124	9	--	--	310	--	--	Yes	U	Wildcat well
Ha-2	318-635-1	Adamy	1979	Drl	95	55	6	55	Ss	365	30	6-02-79	Yes	D	Yield (r) 5 gal/min
Ha-3	320-634-1	Draper	1979	Drl	100	60	6	60	Ss	485	25	7-10-79	Yes	D	Yield (r) 2 gal/min
Ha-4	319-634-1	Pitchard	1979	Drl	42	30	6	30	Ss	340	10	1979	Yes	D	Yield (r) 30 gal/min
Ha-5	318-634-1	H. Hendricks	1967	Drl	28	--	6	--	S & G	325	15.3	1967	Yes	U	
Ha-6	318-634-2	do	1967	Drl	23	--	6	--	S & G	328	15.2	1967	Yes	U	
Ha-7	318-634-3	D. Cooper	1978	Drl	62	40	6	40	Ss-Sh	348	15	5-10-80	Yes	D	Yield (r) 8 gal/min
Ha-8	321-631-1	M. Kranz	1952	Drl	41.5	18	8	18	Sh	360	5.6	5-29-80	No	D	Hard; some iron
Ha-9	321-630-1	C. Scruton	1960	Drl	80	80	8	--	Grvl	339	--	--	No	D	
Ha-10	320-630-1	M. Benedict	1971	Drl	54	--	--	--	Ss-Sh	438	26	8-12-80	No	D	
LYSANDER QUADRANGLE															
Ly-1	313-625-1		1976	Drl	102	77	--	77	Sh	395	87	--	No	D	Yield (e) 40 gal/min
MALLORY QUADRANGLE															
Ma-1	320-603-1	D. Calella	1959	Drl	37	10	6	10	Ss	530	13.2	7-25-60	No	D	
Ma-2	320-603-2	J. O'Donnell	1959	Dug	17	--	20	--	Till	510	15.6	7-25-60	No	D	
Ma-3	319-602-1	F. Fisher	1957	Drl	36	20	6	20	Ss	490	16	1957	No	D,S	
Ma-4	318-603-1	C. York	1959	Drl	42	38	6	38	Ss	490	4.6	7-21-60	No	D	
Ma-5	317-606-1	W. Devendorf	1955	Drl	62	62	6	--	S & G	420	10.4	8-19-60	No	D	Yield (r) 15 gal/min
Ma-6	317-606-2	C. Spooner	1943	Drl	43	43	6	--	S & G	410	25	1950	No	D,S	Yield (r) >30 gal/min
Ma-7	317-603-1	J. Cunningham	1957	Drl	92	92	6	--	S & G	455	29.1	7-25-60			
Ma-8	416-604-1	J. Sauer	1945	Drl	22	--	6	--	S & G	400	7.7	7-25-60	No	D	Cl=8 mg/L, 7-25-60
Ma-9	316-604-2	E. Guiles	1954	Drl	--	52	6	52	Ss	395	6.8	8-22-60	No	D	Salty, cl=475 mg/L, 8-24-60
Ma-10	316-602-1	K. Hayes	1955	Drl	78	55	6	55	Ss	460	16.9	8-24-60	No	D,S	H_2S, yield(r)10 gal/min
Ma-11	316-601-1	L. Kukko	1959	Dug	15	--	36	--	Till	448	11.2	8-22-60	No	D	
Ma-12	321-606-1	R. Donegan	1975	Drl	60	60	6	--	Sand	505	4	1975	No	D	
Ma-13	315-601-1	Constantia School	1945	Drl	80	--	6	--	S & G	440	11	8-24-60	No	I	Cl=50 mg/L, 8-24-60
Ma-14	317-604-1	A. Green	1945	Drl	91	91	6	90	Ss-Sh	425	22	1945	No	D,S	Yield (r) 15 gal/min, 1=1.5 mg/L, 8-22-60
Ma-15	319-604-1	H. Bean	1975	Drl	120	75	6	75	Ss-Sh	525	--	--	No	D	
MEXICO QUADRANGLE															
Me-1	327-613-1	Village of Mexico	1957	Drl	17	--	--	17	--	375	--	--	Yes	U	Test hole
Me-2	327-613-2	do	1957	Drl	18	--	8	18	--	368	--	--	Yes	U	
Me-3	326-613-1	do	1957	Drl	9	--	8	9	--	393	--	--	Yes	U	
Me-4	326-613-2	do	1957	Drl	27	--	8	27	Till	405	--	--	Yes	U	Yield (m) 5 gal/min
Me-5	325-613-1	do	1957	Drl	21	--	8	21	Grvl&Clay	409	--	--	Yes	U	Yield (m) 3 gal/min

Oswego County well number	USGS well number	Owner	Year completed	Type of well[1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type[2]	Altitude (ft)[3]	Water level: Depth below land surface (ft)	Water level: Date of measurement	Geol. Log	Water use[4]	Remarks[5]
MEXICO QUADRANGLE (continued)															
Me-6	325-613-2	do	1957	Drl	53	--	6	53	--	430	--	--	Yes	U	
Me-7	328-624-1	do	1957	Drl	21	--	6	21	--	344	--	--	Yes	U	
Me-8	325-613-3	do	1967	--	32	--	6.75	--	Clay	413	10.2	1967	Yes	U	
Me-9	329-613-1	M. Lape	1955	Drl	28	8	6	--	Ss-Sh	387	7	8-12-68	No	D	
Me-10	327-612-1	Village of Mexico	1957	Drl	26	--	8	26	Grvl&Clay	402	6	1957	Yes	U	Yield (m) 10 gal/min
Me-11	327-612-2	do	1957	Drl	45	--	6	26	Ss	418	12	1957	Yes	U	Yield (m) 15 gal/min
Me-12	327-612-3	do	1957	Drl	26	--	8	26	Grvl&Clay	391	13	1957	Yes	U	Yield (m) 48 gal/min
Me-13	327-612-4	do	1957	Drl	58	--	--	58	Grvl&Clay	400	18.6	1957	Yes	U	Yield (m) 30 gal/min
Me-14	323-612-1	A. Mowins	1968	Drl	75	73	6	--	Ss-Sh	483	19	8-15-68	No	D	
Me-15	325-612-1	H. Dunn	1964	Dug	4	4	42	--	Sand	444	3	8-13-68	No	D	
Me-16	329-609-1	L. Bellow	1967	Drl	41	41	6	--	Ss	410	9	8-12-68	No	D	
Me-17	327-609-2	L. Howard	--	Dug	12	12	42	--	Sand	431	4	8-13-68	No	D	
Me-18	326-609-1	O. Edwards	--	Drl	200	--	8	--	Ss-Sh	433	8.2	5-28-80	No	D	Good well recovery; black stains; hard.
Me-19	325-609-1	E. Sexton	1973	Drv	37	--	2	--	Grvl	435	--	--	No	D	Good well recovery
Me-20	323-609-1	H. Pangburn	--	Drl	54	--	6	--	Ss-Sh	442	2.5	8-13-68	No	D	
Me-21	325-608-1	R. Stoddard	1948	Drl	105	105	6	--	Ss-Sh	476	30	8-13-68	No	D	
Me-22	326-607-1	A. Conrad	1975	Drl	40	38	--	--	Grvl	475	1.8	5-28-80	No	D	Soft
Me-23	326-607-2	G. Beaubien	1955	Drl	30	--	6-8	--	--	465	0	5-10-80	No	D	Hard
Me-24	326-607-3	L. Gates	1970	Drl	60	--	10	--	Ss-Sh	465	--	--	No	D	Good well recover
Me-25	325-613-4	Village of Mexico	1967	Drl	60	60	6.75	64	S & G	410	15.3	1967	Yes	U	
Me-26	324-607-2	L. Henderson	1967	--	17	--	6.75	--	--	478	--	--	Yes	U	
NEW HAVEN QUADRANGLE															
NH-1	329-622-1	E. Girard	1957	Drl	78	--	6	--	Ss	420	43	8-07-68	No	D	
NH-2	328-620-1	D. Spencer	1961	Drl	86	--	6	--	Ss	363	--	--	No	D	
NH-3	328-619-2	C. Blunt	--	Dug	27	--	--	--	Grvl	398	22	8-07-68	No	D	
NH-4	328-619-1	do	1965	Drl	120	40	6	40	Ss	398	40	8-07-68	No	D	
NH-5	326-619-1	A. Sheldon	--	Drl	30	6	--	--	Grvl	420	3	8-06-68	No	D	
NH-6	326-619-1	do	--	Drl	135	130	6	--	Ss-Sh	460	40	8-06-68	No	D	
NH-7	328-618-1	Village of New Haven	1979	Drl	53	53	6	--	S & G	430	--	--	No	PS	Yield (r) 25 gal/min
NH-8	322-618-1	R. Sanderson	1968	Drl	63	63	6	--	Grvl	500	20	8-06-68	No	D	
NH-9	328-617-1	F. Elmhurst	1978	Drl	112	--	6	74	Ss	400	--	--	No	D	Yield (r) 5 gal/min
NH-10	328-617-2	Fisher	1976	Drl	88	--	6	68	Ss	390	--	--	No	C	Yield (r) 8 gal/min
NH-11	328-617-3	C. Woolson	1968	Drl	53	--	6	40	Ss	350	--	--	No	D	Yield (r) 40 gal/min
NH-12	329-616-1	T. Winks	--	Drl	80	--	6	61	Ss	310	--	--	No	D	Yield (r) 5 gal/min
NH-13	328-616-1	W. Watson	1978	Drl	53	--	6	52	Ss	330	--	--	No	D	Yield (r) 15 gal/min
NH-14	327-616-1	B. Edick	1977	Drl	70	--	6	--	S & G	420	--	--	No	D	
NH-15	325-616-1	L. Gates	1967	Drl	36	36	6	--	Sand	414	5	8-06-68	No	D	

Table 1.--Data on Selected Wells in Oswego County (Continued)

[Locations are given in fig. 10; depths are in feet below National Geodetic Vertical Datum of 1929]

Oswego County well number	USGS well number	Owner	Year completed	Type of well[1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type[2]	Altitude (ft)[3]	Water level: Depth below land surface (ft)	Water level: Date of measurement	Geol. log	Water use[4]	Remarks[5]
OSWEGO EAST QUADRANGLE															
OE-1	324-629-1	A. Mangano	1950	Drl	57	54	6	54	Ss	350	24.3	8-02-60	No	D	Yield (r) 4 gal/min
OE-2	324-628-1	J. Castigalia	1959	Drl	208	70	6	70	Ss	330	40	1959	No	U	Salty
OE-3	PAS-1a	City of Oswego	1979	Drl	9.5	7.0	2	11	Fill	260	6.3	10-15-79	Yes	U	
OE-4	PAS-3	Pollution Abatement Service	1979	Drl	13	10.5	2	---	S	273	.6	10-15-79	Yes	U	
OE-5	PAS-11a	City of Oswego	1980	Drl	10.25	7.4	2	---	Till	280	5.7	4-22-80	Yes	U	
OE-6	325-627-1	Santoro	1979	Drl	95	45	6	44	Ss	399	35	6-01-79	Yes	D	Yield (r) 3 gal/min
OE-7	323-626-1	Bellinger	1980	Drl	87	30	6	30	Ss	419	35	4-10-80	Yes	D	Yield (r) 2 gal/min
OE-8	327-625-1	D. LaFave	1979	Drl	99	99	6	76	Ss	410	---	--	Yes	D	Yield (r) 1.5 gal/min
OE-9	325-624-1	R. Burdick	1956	Drl	65	40	6	40	Ss	460	---	--	No	D	Yield (r) 10 gal/min
OE-10	324-624-1	S. Mistretta	1952	Drl	117	30	6	30	Ss	400	---	--	No	D	Yield (e) 1 gal/min
ORWELL QUADRANGLE															
Or-1	334-559-1	E. Pizon	1967	Drl	136	100	6	100	Ss	870	54	8-14-68	No	D	
Or-2	331-558-2	N.Y.S.Dept. of Environmental Conservation	1974	Drl	40	37	6	36	Ss	597	10	10-24-74	Yes	T	Yield (m) 50 gal/min
Or-3	330-559-2	Do	1974	Drl	43	43	8	44	S & G	572	8.1	1-08-75	Yes	In	Production well
Or-4	330-559-1	Do	1974	Drl	42	42	6	40	Ss-S&G	555	1.0	11-06-74	Yes	T	
Or-5	330-559-3	Do	1974	Drl	53	53	6	---	S & G	571	7.4	10-29-74	Yes	O	Yield (m) 150 gal/min from open end
Or-6	330-559-4	Do	1974	Drl	53	53	12	---	S & G	572	8.2	11-12-74	Yes	O	Yield (m) 460 gal/min
Or-7	330-559-5	Do	1974	Drl	75	57	8	52	Ss	568	2.6	11-14-74	Yes	In	Production well, yield (m) 280 gal/min
Or-8	330-559-6	Do	1974	Drl	33	33	8	33	S & G	574	5.6	1-08-75	Yes	In	Production well, yield (m) 303 gal/min
Or-9	330-558-1	Do	1974	Drl	84	84	8	---	S & G	611	26.6	12-17-74	Yes	In	Production well, yield (m) 367 gal/min
OSWEGO WEST QUADRANGLE															
OW-1	325-636-1	P. Weber	1973	Drl	120	---	---	---	Ss	310	---	---	No	D	Yield (e) 2 gal/min
OW-2	324-636-1	C. Groat	---	Dug	36	---	---	---	Till	326	8	6-04-80	No	D	Hard
OW-3	323-636-1	M. Stock	1968	Drl	156	156	6	156	Sh	345	---	--	No	D	H_2S; yield (r) 0.5 gal/min
OW-4	325-633-1	D. Geers	1963	Drl	95	95	---	--	Sh	355	---	--	No	D	Hard; H_2S
OW-5	324-633-1	R. Brooker	1968	Drl	101	---	---	--	Ss	365	---	--	No	D	H_2S; yield (r) 13 gal/min
OW-6	323-631-1	M. Allen	---	Dug	30	---	---	30	Till	348	8.4	5-29-80	No	D	Hard

Oswego County well number	USGS well number	Owner	Year com-pleted	Type of well	Depth of well (ft)[1]	Depth of casing (ft)	Diam-eter (in)	Depth to bed-rock (ft)	Aquifer type [2]	Alti-tude (ft)[3]	Water level: Depth below land surface (ft)	Water level: Date of measure-ment	Geol. log	Water use [4]	Remarks[5]
OSWEGO WEST QUADRANGLE (continued)															
OW-7	325-630-2	M. Moshier	1956	Dug	15	--	48	--	Till	380	--	--	No	D	Inadequate in summer
OW-8	325-630-1	E. Spaar	1957	Drl	170	40	6	40	Ss	380	54.6	8-02-60	No	D	Iron; yield (e) 2 gal/min
OW-9	323-631-2	R. Schneider	1968	Drl	67	44	6	44	Ss-S&G	360	--	--	No	D	Yield (r) 5 gal/min
PANTHER LAKE QUADRANGLE															
PL-1	322-558-1	M. Rozoick	1959	Dug	27	--	36	--	Till	640	14.1	9-07-60	No	D	
PL-2	322-556-1	E. Brude	1951	Drl	130	--	6	--	Ss	640	50.7	9-07-60	No	D	Yield (r) 2 gal/min
PL-3	322-553-1	American Tel	1956	Drl	189	--	6	--	Ss	760	28.8	7-19-60	No	C	Yield (r) 8 gal/min
PL-4	316-555-1	L. Dodge	1959	Drl	102	--	6	--	Ss-Sh	580	28	7-20-60	No	D	Cl=1.0 mg/L, 7-20-60
PL-5	320-553-1	Amboy School	1935	Drl	55	--	6	--	Ss	580	11.7	7-20-60	No	In	Cl= .5 mg/L, 7-20-60
PL-6	319-554-1	Spoon Restaurant	1946	Drl	90	--	6	--	Ss	600	--	--	No	C	Cl=7.5 mg/L, 7-20-60
PL-7	319-554-2	V. Sellinger	1930	Drl	27	27	1.25	--	S & G	600	--	--	No	D	Cl=7.5 mg/L, 7-20-60
PL-8	317-554-1	J. Darling	--	Dug	19	--	24	--	S & G	600	14.4	7-20-60	No	D	Cl=38 mg/L, 7-20-60
PENNELLVILLE QUADRANGLE															
Pe-1	318-615-1	F. Craner	1947	Drl	91	--	6	--	Ss	440	--	--	No	D	H_2S; Fe
Pe-2	319-618-2	M. DuBois	1957	Drl	120	80	6	80	Ss	460	30	1957	No	D	
Pe-3	318-617-1	M. Rauhala	1941	Drl	86	62	6	60	Ss	450	27.3	7-28-60	No	D	
Pe-4	318-617-2	R. Kastler	1957	Drl	64	60	6	60	Ss	450	13.2	7-28-60	No	D	
PE-5	317-617-1	K. Reynolds	1952	Drl	90	90	6	90	S & G	400	22.2	7-28-60	No	D	Yield (r) 20 gal/min
Pe-6	316-617-1	W. Phinney	1950	Drl	116	54	6	54	Ss-Sh	400	19	7-28-60	No	D	Hard; temp 48.5°F,1960
Pe-7	316-622-1	R. Howard	1957	Drl	45	45	6	--	S & G	430	17.3	3-27-61	No	D	Hard; yield (r) 5 gal/min
Pe-8	315-621-1	Great Bear Spring Co.	1959	Dug	10	--	240	--	S & G	390	--	--	No	D	Yield (m) 50 gal/min
Pe-9	315-618-1	R. Haner	1959	Drl	172	--	6	--	Ss-Sh	400	--	--	No	--	Salty
Pe-10	321-616-1	Mexico Center Sch.District	1955	Dug	29	--	18	--	Sand	450	6.3	7-27-60	No	Ps	Yield (r) 10 gal/min
Pe-11	321-616-2	J. Sanders	1941	Dug	140	--	6	--	Ss	470	--	--	No	U	Salty
Pe-12	321-616-3	T. Elhage	1958	Drl	124	109	6	109	Ss	480	35	1958	No	D	H_2S; yield (r) 5 gal/min
Pe-13	320-617-3	W. Whipple	1957	Drl	68	68	6	--	S & G	460	--	--	No	D	Yield (r) 15 gal/min
Pe-14	320-617-1	A. McGinley	1920	Drl	75	30	6	30	Ss	470	31.5	7-27-60	No	D	Hard
Pe-15	320-617-2	R. McGinley	1959	Drl	43	--	6	--	Ss	470	29.6	7-28-60	No	D	
Pe-16	320-619-1	W.W. Hough	1953	Drl	123	27	6	27	Ss	440	--	--	No	D	Hard
Pe-17	320-619-2	T. Heaphy	1962	Drl	2592	--	--	--	--	462	75	--	Yes	U	Wildcat well
Pe-18	319-617-1	J. Doss	1956	Drl	41	41	6	--	S & G	460	5	1956	No	D	Yield (r) 15 gal/min
PULASKI QUADRANGLE															
Pu-1	335-612-1	R. Brennan	--	Drv	13	11	1.25	--	Sand	254	8	8-05-68	No	D	
Pu-2	333-611-1	C. Peters	--	Drl	126	--	6	--	Sh	298	50	8-12-68	No	D	Poor well recovery
Pu-3	336-607-1	M. Hurd	1921	Drl	220	50	6	50	Sh	385	1	9-03-68	No	U	
Pu-4	331-610-1	Nicholson	1964	Drl	1531	--	--	40	--	306	78	--	Yes	U	Wildcat well

Table 1.--Data on Selected Wells in Oswego County (Continued)

[Locations are given in fig. 10; depths are in feet below National Geodetic Vertical Datum of 1929]

Oswego County well number	USGS well number	Owner	Year completed	Type of well[1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type[2]	Altitude (ft)[3]	Depth below land surface (ft)	Date of measurement	Geol. log	Water use[4]	Remarks[5]
RICHLAND QUADRANGLE															
Ri-1	336-602-1	D. Ridgeway	1925	Drl	40	40	6	--	Ss	692	32	8-27-68	No	D	
Ri-2	335-606-1	H. Grinnel	1961	Dug	8	--	42	--	Silt	400	7	8-27-68	No	D	
Ri-3	335-600-1	J. Schroeder	--	Dug	12	--	24	--	Till	792	11	8-27-68	No	U	
Ri-4	334-603-1	R. Cornwell	1961	Drl	50	50	6	--	S & G	495	13	8-26-68	No	D	Good well recovery
Ri-5	332-601-1	R. Ackley	1860	Dug	17	--	60	--	S & G	565	14	8-27-68	No	U	Good well recovery
Ri-6	330-605-1	T. Orychkewych	-	Dug	19	--	50	--	Sand	450	8	8-14-68	No	D	
Ri-7	330-600-1	C. Durst	1951	Drl	76	75	6	--	Ss	580	22	8-14-68	No	D	
Ri-8	334-602-1	Schoeller Paper Co.	1968	Drl	43	43	6	--	S & G	573	21.5	7-01-71	No	O	
Ri-9	334-602-2	Do	--	Drl	36	36	6	--	S & G	551	--	--	No	O	
Ri-10	333-602-2	Do	1968	Drl	51	51	6	--	S & G	558	21	9-01-72	No	O	
Ri-11	333-602-3	Do	--	Drl	58	58	12	--	S & G	555	--	--	No	I	Hardness (as $CaCO_3$)=108, 3-10-77
Ri-12	334-601-1	Do	--	Drl	38	38	6	--	S & G	580	--	--	No	O	
Ri-13	334-601-2	Do	--	Drl	49	49	12	--	S & G	559	--	--	No	I	Hardness (as $CaCO_3$)=196, 3-10-77
Ri-14	334-602-3	Do	1968	Drl	47	47	6	--	S & G	569	--	--	No	O	
SANDY CREEK QUADRANGLE															
SC-1	338-606-1	Reserve Gas Co.	1962	Drl	1393	--	--	9	--	416	90	--	Yes	U	Wildcat well
SC-2	337-605-1	D. Payne	--	Drl	65	--	6	--	Sh	501	19	8-27-68	No	D	
SC-3	340-604-1	J. Yell	1967	Drl	37	30	6	--	Sh	513	1	8-27-68	No	D	
SC-4	339-604-4	Town of Sandy Creek	1965	Drl	42	--	--	38	S & G	554	--	--	Yes	U	Test well
SC-5	340-604-3	Do	1965	Drl	25	--	24	26	S & G	539	--	--	Yes	PS	Production well; yield (r) 400 gal/min
SC-6	340-604-4	Do	1965	Drl	30	--	--	28	S & G	542	--	--	Yes	U	Test well
SC-7	340-604-2	Do	1965	Drl	32	--	24	32	S & G	546	--	--	Yes	PS	Production well; yield (r) 200 gal/min
SC-8	339-601-1	C. Caufield	--	Dug	11	--	36	--	S & G	781	9	8-27-68	No	D	
SC-9	340-601-1	F. Stone	--	Dug	17	--	48	--	Till	872	11	8-27-68	No	D	
TEXAS QUADRANGLE															
Te-1	330-620-1	H. Cota	1967	Drl	32	--	6	--	Ss	310	18	8-07-68	No	D	Yield (r) 8 gal/min
Te-2	330-617-1	R. Rebbeor	--	Drl	43	43	6	--	Ss	265	12	8-07-68	No	D	Yield (e) 12 gal/min
Te-3	330-618-1	M. Leichman	1975	Drl	16	--	6	12	Ss	293	15	--	Yes	D	
WESTDALE QUADRANGLE															
We-1	329-548-1	T. Poole	1963	Drl	76	54	6	54	Ss	925	40	1963	No	D	Yield (m) 18 gal/min; Cl=13 mg/L, 7-21-64

Oswego County well number	USGS well number	Owner	Year completed	Type of well[1]	Depth of well (ft)	Depth of casing (ft)	Diameter (in)	Depth to bedrock (ft)	Aquifer type[2]	Altitude (ft)[3]	Water level: Depth below land surface (ft)	Water level: Date of measurement	Geol. log	Water use[4]	Remarks[5]
WESTDALE QUADRANGLE (continued)															
We-2	327-552-1	H. Wiggins	1958	Drl	19	19	6	19	Ss	780	9.2	9-19-60	No	D	Yield (e) 10 gal/min
We-3	325-551-1	J. Britton	1930	Dug	20	--	--	--	Till	760	17	7-10-80	No	D	
We-4	324-551-1	L. Burmingham	1977	Drl	62	12	6	12	Sh	630	55	1979	Yes	D	Yield (r) 4 gal/min
WILLIAMSTOWN QUADRANGLE															
Wi-1	328-555-1	C. Cox	1963	Drl	53	53	6	--	S & G	640	18.9	7-28-64	No	D	
Wi-2	328-555-2	C. Roser	1953	Drl	80	80	6	--	Ss	684	37	8-14-68	No	D	
Wi-3	327-556-1	J. McCullagh	1967	Drl	40	10	6	10	Ss	655	17	8-14-68	No	D	
Wi-4	326-553-1	Kellogg	1962	Drl	1697	292	10	--	--	730	68	1967	Yes	U	Wildcat well
Wi-5	325-553-1	Sage	1959	Dug	9	9	76	--	S & G	603	26	7-19-60	No	In	Cl=.5 mg/L, 7-19-60
Wi-6	325-553-2	Dairyman's League	1916	Drl	80	75	6	75	Ss	600	50	10-14-59	No	C	Cl=21 mg/L, 7-20-60
Wi-7	323-559-1	M. Roziock	--	Dug	27	--	36	--	Till	640	14.1	9-07-60	No	D	Cl=13 mg/L, 9-07-60
Wi-8	325-553-3	M. Castle	1979	Drl	126	126	8	--	Grvl	600	22	1979	Yes	D	Yield (r) 7 gal/min
Wi-9	329-555-1	G. Trumble	1978	Drl	38	35	6	35	Ss	695	20.8	8-10-80	No	D	Yield (r) 9 gal/min
Wi-10	328-557-1	H. Trumble	1962	Drl	96	90	6	88	Ss	685	--	--	No	D	