HYDROGEOLOGIC APPRAISAL OF FIVE SELECTED AQUIFERS IN ERIE COUNTY, NEW YORK

By Todd S. Miller and Ward W. Staubitz

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CONTENTS

CONTENTS (continued)

ILLUSTRATIONS

ILLUSTRATIONS (continued)

TABLES

CONVERSION FACTORS AND ABBREVIATIONS

Factors for converting the units used in this report to International System (SI) 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)	2.59	square kilometer (km^2)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
million gallons per day (Mgal/d)	43.81	liter per second (L/s)
feet per mile (ft/mi)	0.1894	meter 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^2/d)	.0929	meters squared per day (m^2/d)
	--	milligrams per liter (mg/L)
	--	micrograms per liter (μg/L)
	--	micromhos per centimeter (μmho/cm)
	--	

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ABSTRACT

Hydrogeologic conditions and water quality within four unconsolidated glacial aquifers and a bedrock (Onondaga Limestone) aquifer were investigated during 1981-83 by the U.S. Geological Survey, in cooperation with the Erie County Department of Environment and Planning. The aquifers are in suburban areas of Buffalo and in major valleys in Erie County where development is increasing rapidly. The aquifers studied are in the Clarence-Lancaster-Newstead, Sardinia, Springville, and Alden areas.

Aquifers in the Clarence-Lancaster-Newstead area are a complex of morainal, outwash, and beach sand and gravel, as well as the Onondaga Limestone. Most wells tap the more productive limestone aquifer. Water quality in both aquifers is suitable for most uses except where road salt has caused contamination in shallow wells near the New York State Thruway. A landfill along the western part of the aquifer has affected the water quality in some areas along the landfill's perimeter.

Aquifers in the Sardinia and Springville areas consist of 10 to 95 feet of outwash sand and gravel separated from several deeper confined sand and gravel zones by till and lacustrine beds in buried preglacial valleys (400 to 600 feet deep). Water in both aquifers moves predominantly from the north and from the aquifers' edges to the center of the valley and discharges to the main streams in the middle of the valley and to springs along the southern edges of the aquifers. Water quality is generally suitable for most uses, although the Springville aquifer contains relatively high nitrate concentrations in some areas. A landfill adjacent to the Sardinia aquifer apparently has not affected the aquifer significantly.

Aquifers in the Alden area consist of two sand and gravel zones separated by 10 to 20 feet of clay or till. Water from the more productive lower zone is more mineralized than that in the upper zone as a result of ground-water recharge from the underlying shale.

INTRODUCTION

Ground water is a major source of water for the southern and eastern parts of Erie County. An understanding of the hydrogeology, water quality, and effects of landfills overlying or adjacent to important aquifers is needed by county and local planners to properly manage the ground-water resources.

Five aquifers were selected for study (fig. 1). The Alden aquifer and the two aquifers in the Clarence-Lancaster-Newstead area were selected because they are in areas of increased suburban growth, and the Springville and Sardinia aquifers were selected because they extend over large areas. In addition, a landfill overlies part of the Clarence-Lancaster-Newstead aquifer, and another is adjacent to the Sardinia aquifer. Four of these aquifers consist of coarse-grained glacial sediments such as outwash and morainal sand and gravel. The fifth, a 140-ft-thick limestone aquifer (Onondaga Limestone), underlies the unconsolidated deposits in the Clarence-Lancaster-Newstead area.

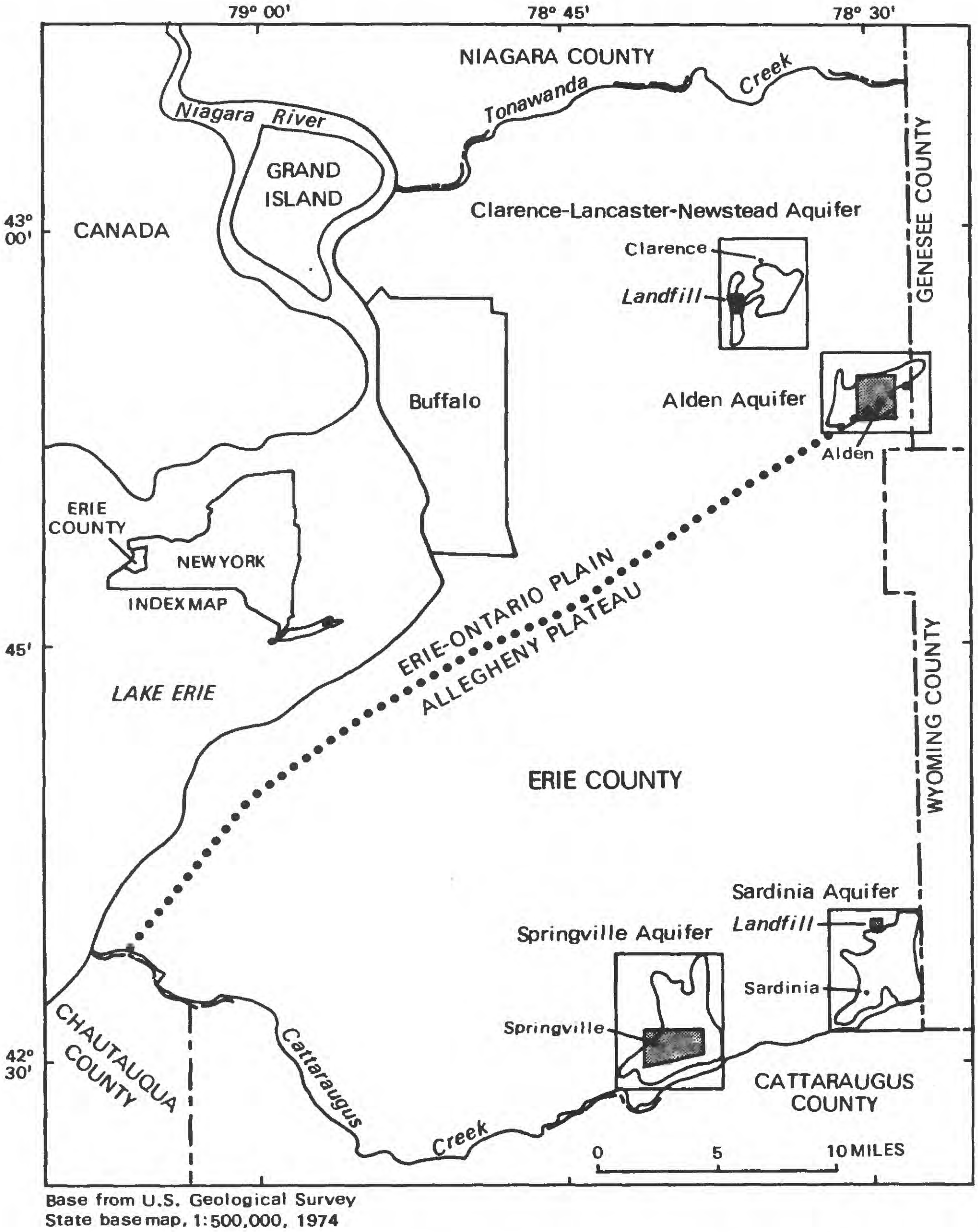


Figure 1.--Location of aquifers selected for study.

Purpose and Scope

In 1981, the U.S. Geological Survey began a 2-year study in cooperation with the Erie County Department of Environment and Planning to document the hydrogeologic characteristics of the five aquifers. This report describes the hydrologic boundaries, geologic framework, water-table altitude and direction of ground-water movement, locations of recharge and discharge, saturated thickness, water quality, and effects (if any) of landfills on or adjacent to the aquifers. Tables summarize water quality, ground-water use and well data, well locations, geology, aquifer thickness, and ground-water movement.

Previous Studies

Previous work by the U.S. Geological Survey (La Sala, 1968) delineated the four glacial sand and gravel aquifers (Clarence-Lancaster-Newstead, Sardinia, Springville, and Alden areas) and a part of the limestone aquifer (Onondaga Limestone) that underlies the Clarence-Lancaster-Newstead unconsolidated aquifer.

Acknowledgments

The Erie County Department of Environment and Planning staff provided background information, including historic records and published reports by consultants, and aided in sample collection. The Erie County Health Department Laboratory analyzed the water-quality samples. The Frey Well Drilling Company provided information on wells in the Alden area.

METHODS OF STUDY

Well Inventory and Test Drilling

Hydrogeologic information was collected and compiled from published data and fieldwork. A general well inventory was conducted to obtain data on water levels, saturated thickness, depth to bedrock, water use, and to locate wells accessible for sampling. Where information was lacking or more detail was desired, such as near the two landfills, four to eight 2-in-diameter PVC or steel observation wells were installed with a power auger.

At the landfills, observation wells were installed both upgradient and downgradient of the burial area to define the direction of ground-water movement and to determine ground-water quality. Maps of each site were constructed to show surficial geology, well locations, aquifer thickness, water levels, and direction of ground-water movement. Well data collected during this study and summarized in table 9 (at end of report) include owner, date drilled, depth of well, aquifer type, water level, water use, and availability of geologic log.

Water Sampling

Ground-water samples were collected and analyzed from all 2-in-diameter observation wells and selected private and municipal wells to document background water quality and identify areas affected by contamination.

Chemical analyses included specific conductance, pH, common anions and cations, trace metals, several nutrients, alkalinity, hardness, and total organic carbon. These constituents were selected because studies have shown that increased levels of chloride, sodium, sulfate, total hardness, organic carbon, and specific conductance are effective indicators of contamination from municipal landfill leachate (Zanoni, 1972, and Loe, 1970). In the Sardinia and Springville areas, three sets of samples (summer, winter, and spring) were collected by the U.S. Geological Survey and Erie County Department of Environment and Planning and analyzed by the Erie County Health Department Laboratory. Five sets (fall, spring, summer, winter, and spring) were collected and analyzed in the Clarence-Lancaster-Newstead area. No samples were collected in the Alden area because data collected by the Erie County Health Department were sufficient for the purposes of this study.

Nested piezometers were installed at several locations within all aquifers to evaluate water quality in a vertical profile. Chemical analyses were conducted by the Erie County Laboratory, which participated in the U.S. Geological Survey water-quality-assurance program.

Samples were collected at the 2-in-diameter wells by pumping or bailing each well so that at least three volumes of water in the casing were removed to ensure that the water sampled from the aquifer and had not been standing in the casing for an extended period. A peristaltic or bladder pump with silastic tubing or a stainless steel bailer was used to withdraw water. Private domestic wells were sampled at outside taps after the water had been run a few minutes to evacuate water that had been in the pipes.

AQUIFERS IN THE CLARENCE-LANCASTER-NEWSTEAD AREA

These two aquifers underlie parts of the towns of Clarence, Lancaster, Newstead, and Alden in the northeastern part of Erie County (fig. 2). The topography ranges from level to gently sloping except in the northern part, where the resistent Devonian Onondaga Limestone crops out to form a 50-ft escarpment (fig. 2).

Surface drainage flows south to Ellicott Creek and north to Ransom Creek. (Ellicott Creek then flows northwest 12 mi into Tonawanda Creek, and Ransom Creek flows 10 mi northwest, also to Tonawanda Creek.) The aquifer area contains several wetlands.

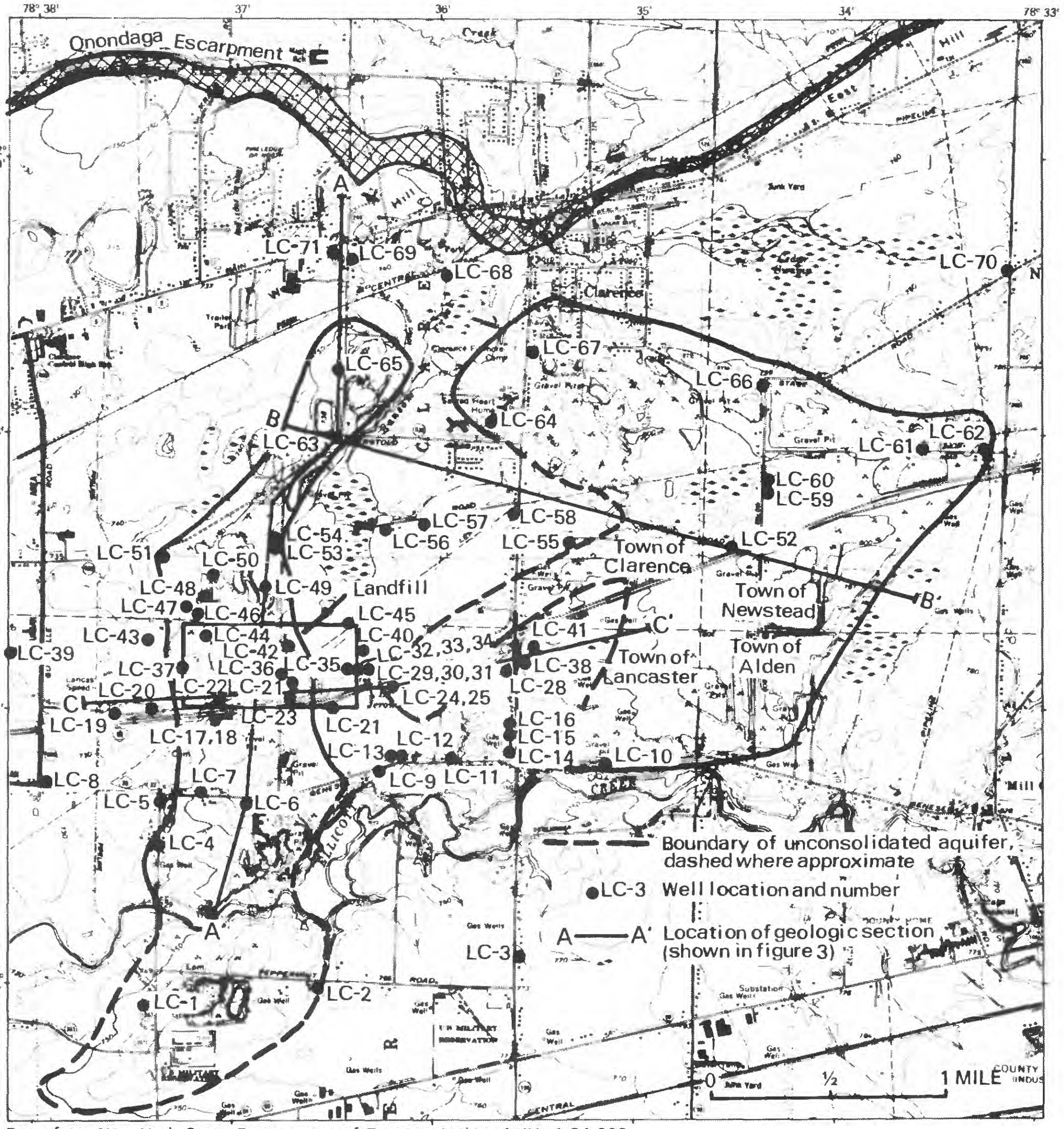
Land use is predominantly residential with extensive sand and gravel mining. A 0.1-mi^2 sanitary landfill is in operation north of the New York State Thruway along the western part of the area (fig. 2).

Population and Ground-Water Use

The area underlain by the sand and gravel aquifer has a population of about 1,000. A public water-supply system that withdraws water from the Niagara River, 17 miles west of the aquifer, serves part of the towns of Clarence and Lancaster, but some inhabitants use ground water from the

Onondaga Limestone or the sand and gravel deposits as their primary or secondary source. For example, a nursing home in Clarence uses ground water for air conditioning, and many residents use ground water to water lawns. Ground water is the sole source of water for the Town of Newstead.

Ground-water use is not quantified because the number of residences in Clarence and Lancaster that use ground water is unknown, because withdrawals at several commercial facilities and institutions are unmetered, and because use of wells installed in sand and gravel and the underlying bedrock to supplement the public water-supply system is sometimes unreported.



Base from New York State Department of Transportation, 1975, 1:24,000

Figure 2.--Location of wells, landfill, Onondaga Escarpment, and geologic sections in Clarence-Lancaster-Newstead area. (Geologic sections are shown in fig. 3.)

Hydrogeologic Framework

The unconsolidated surficial sand and gravel aquifer underlies parts of the gently westward sloping plain that overlies the Onondaga Limestone, as shown in figure 2. The part of the Onondaga Limestone that was investigated in this study is the part that directly underlies the unconsolidated aquifer.

Unconsolidated Aquifer

Glaciation of the area resulted in the deposition of a variety of sediments on the Onondaga Limestone. In the southwestern and central parts of the area (Muller, 1977), till overlies a poorly defined end moraine (poorly sorted silt, sand, gravel, and boulders that were deposited in front of the glacier) and subglacial or subaqueous outwash (sorted and stratified sand, or sand and gravel deposited by glacial meltwaters at the bottom of grounded ice). Logs of borings along the western side of the aquifer (section A-A', fig. 3) indicate 30 to 45 ft of sand with some gravel between a basal lodgment till 3 to 15 ft thick and an overlying surficial till. Well logs reveal that glacial sediments are thickest (30 to 45 ft) where they fill a buried north-south-trending preglacial valley incised into the Onondaga Limestone. (See section B-B' in fig. 3 and C-C' and the structure-contour map in fig. 4). The extent of the moraine in the center of the area is poorly defined because relatively few borings have been made and because its subdued, low to flat relief makes its extent difficult to trace.

Several borings in the southeastern part of the area reveal 20 to 30 ft of well-sorted stratified outwash sand and gravel underlain by 10 to 15 ft of lacustrine silt and sandy silt that is in turn underlain by 2 to 12 ft of

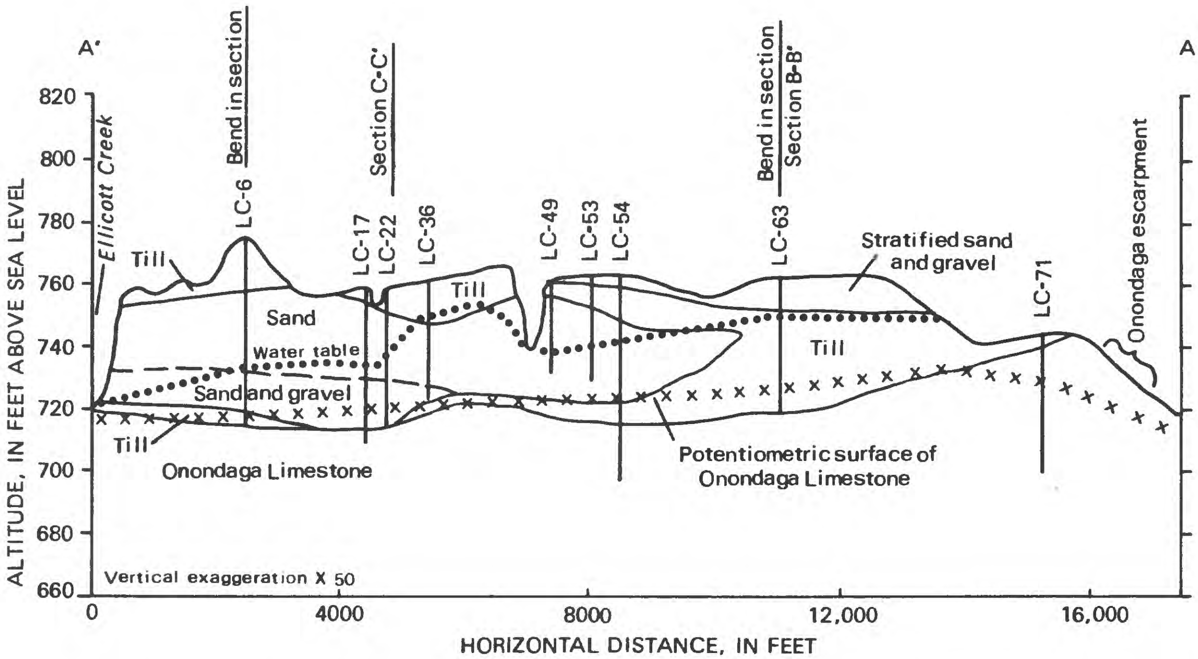


Figure 3A.--Geologic section A-A' north-south through Clarence-Lancaster-Newstead area. (Location is shown in fig. 2.)

lodgment till. (See section C-C' in fig. 3 and map in fig. 4.) A gravel pit in the central area near Jones and Stage Roads exposes morainal deposits of sand and gravel with large boulders of Onondaga Limestone (sec. B-B' in fig. 3). The morainal sand and gravel disappears near Stage Road south of Clarence. A large amount of the outwash and morainal deposits have been extracted by sand and gravel mining.

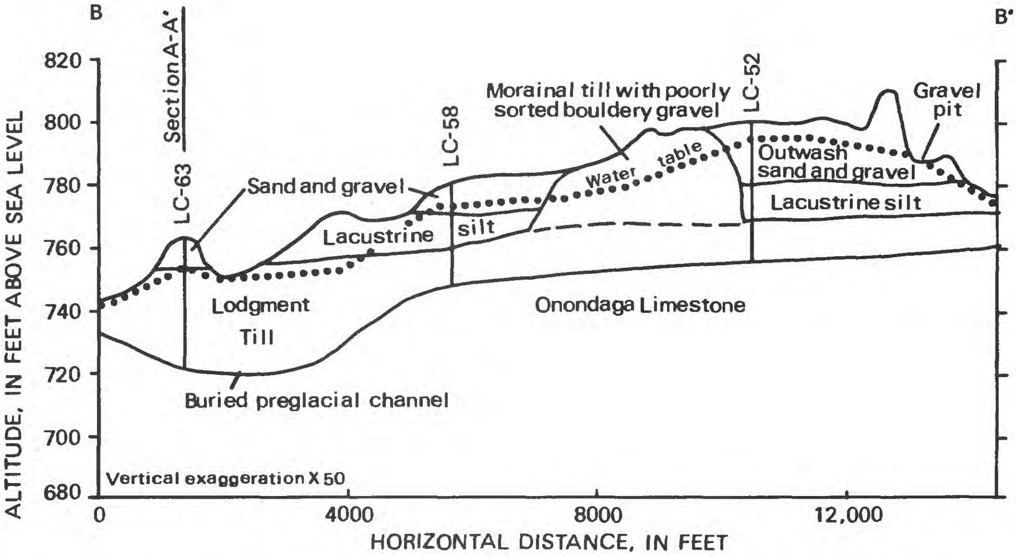


Figure 3B.--Geologic section B-B' through northern part of Clarence-Lancaster-Newstead area. (Location is shown in fig. 2.)

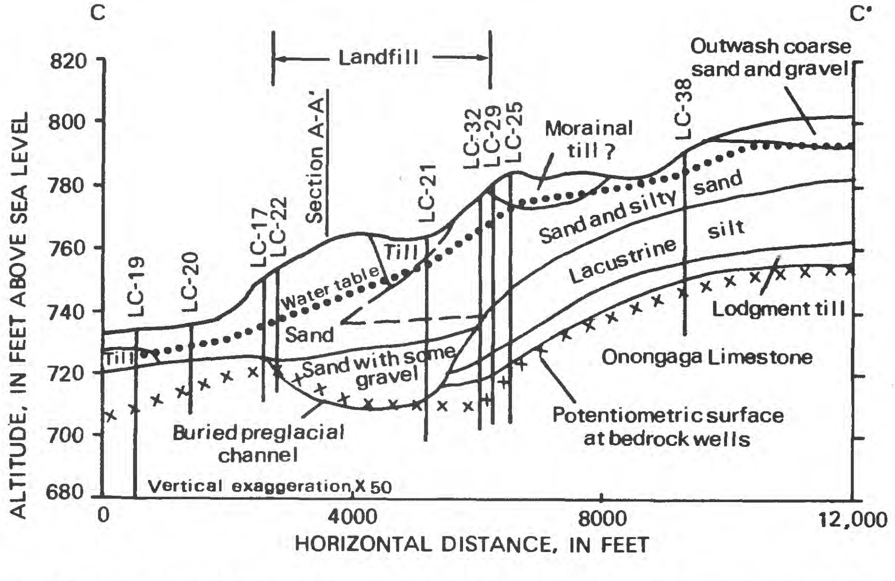
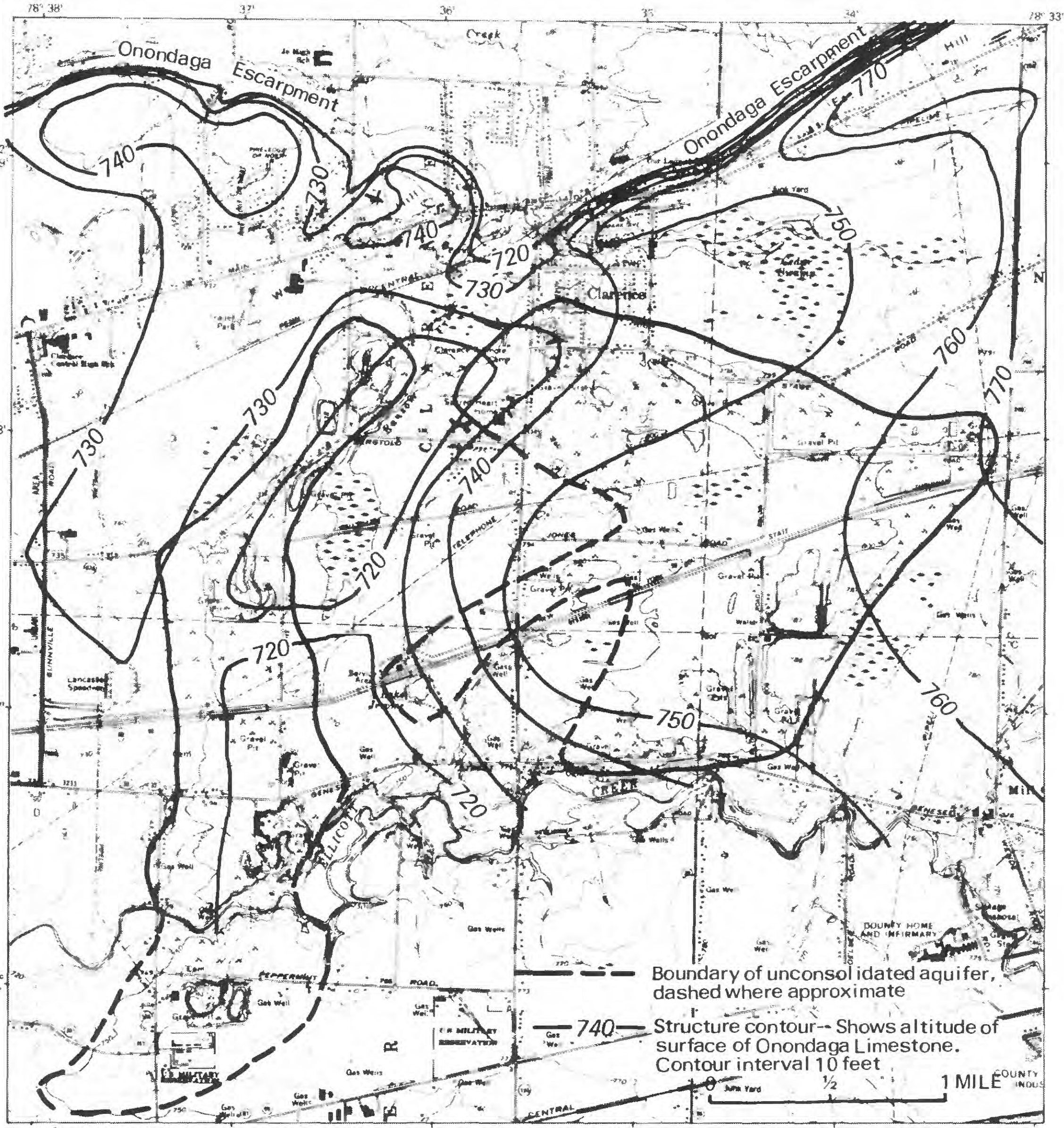


Figure 3C.--Geologic section C-C' through southern part of Clarence-Lancaster-Newstead area. (Location is shown in fig. 2.)



Base from New York State Department of Transportation, 1975, 1:24,000

Figure 4.--Altitude of top of Onondaga Limestone and boundary of unconsolidated aquifer in Clarence-Lancaster-Newstead area.

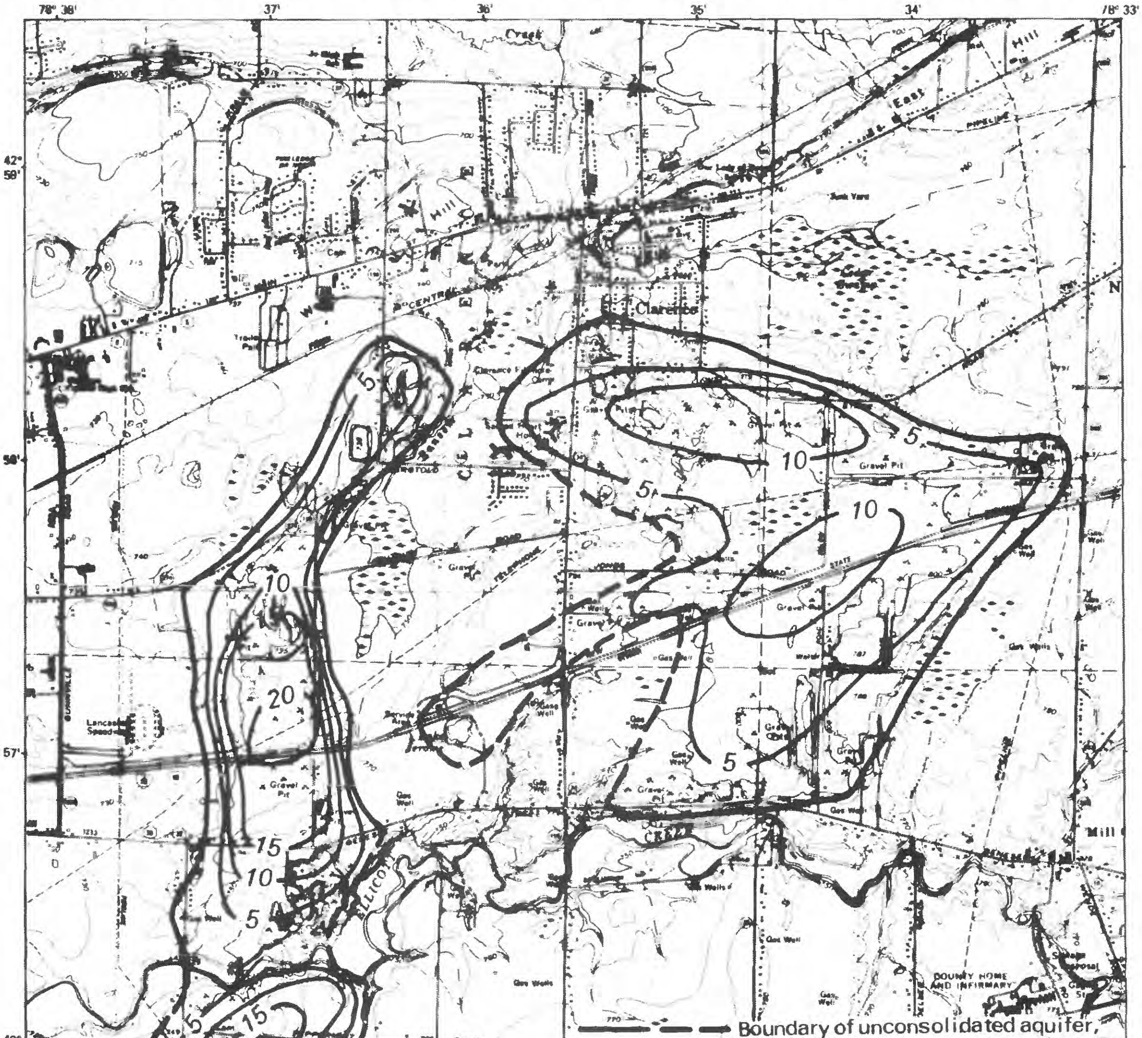
Onondaga Limestone

The Onondaga Limestone is a productive aquifer that extends from Buffalo to Albany as an east-west belt several miles wide. It is a massive cherty and argillaceous limestone approximately 140 ft thick (Buehler, 1966) where it has not been subjected to erosion. Along the escarpment in the Clarence area, it has been eroded to several tens of feet thick.

The Onondaga Limestone contains little primary porosity but does contain significant secondary openings in the form of joints and fractures, widened by solutioning. Where the widening of joints and fractures is significant, the overlying rock and sediments may collapse, forming sinkholes. Sinkholes were observed both east and west of the landfill area. Wells installed in the limestone typically yield 10 to 300 gal/min (La Sala, 1968). Most wells do not fully penetrate to the bottom of the Onondaga Limestone, so the thickness of this unit could not be determined.

Saturated Thickness

The unconsolidated aquifers lie within relatively thin outwash and morainal deposits that range in thickness from 5 to 55 ft; the saturated thickness is between 10 and 25 ft in most places (fig. 5). The thickest saturated deposits are in the buried preglacial valley. In the eastern part



Base from New York State Department of Transportation, 1975, 1:24,000

Figure 5.--Saturated thickness of unconsolidated aquifer in the Clarence-Lancaster-Newstead area.

of the aquifer, where much of the sand and gravel has been mined away, 5 to 14 ft of saturated sand and gravel overlies thin lake and till deposits (fig. 3, section B-B'). In the western part of the aquifer, 5 to 23 ft of saturated sand with some sand and gravel in the deeper zones overlies the buried bedrock valley (fig. 3, section A-A'). Saturated thickness is greatest (25 ft) in the area under the landfill. South of Ellicott Creek, a gravel pit and a log from well LC-2 indicate 5 to 15 ft of saturated morainal sand and sand and gravel.

Ground-Water Movement

Recharge

Unconsolidated aquifer.-Recharge to the unconsolidated aquifer, which contains the water table, is solely from precipitation that infiltrates downward to the water table. Because the unconsolidated aquifer is on a level area on a topographic high, it is not bounded by valley walls that could provide recharge, nor does it have streams to provide seepage from higher areas. Estimated average annual recharge ranges from 0.2 to 0.4 (Mgal/d)/mi^2 La Sala, 1968).

The water table rises and falls in response to changes in the rate of recharge and discharge of ground water. Water-level measurements were used to construct hydrographs (fig. 6), which indicate that most recharge occurs from October or November through April, when evapotranspiration is at a minimum,

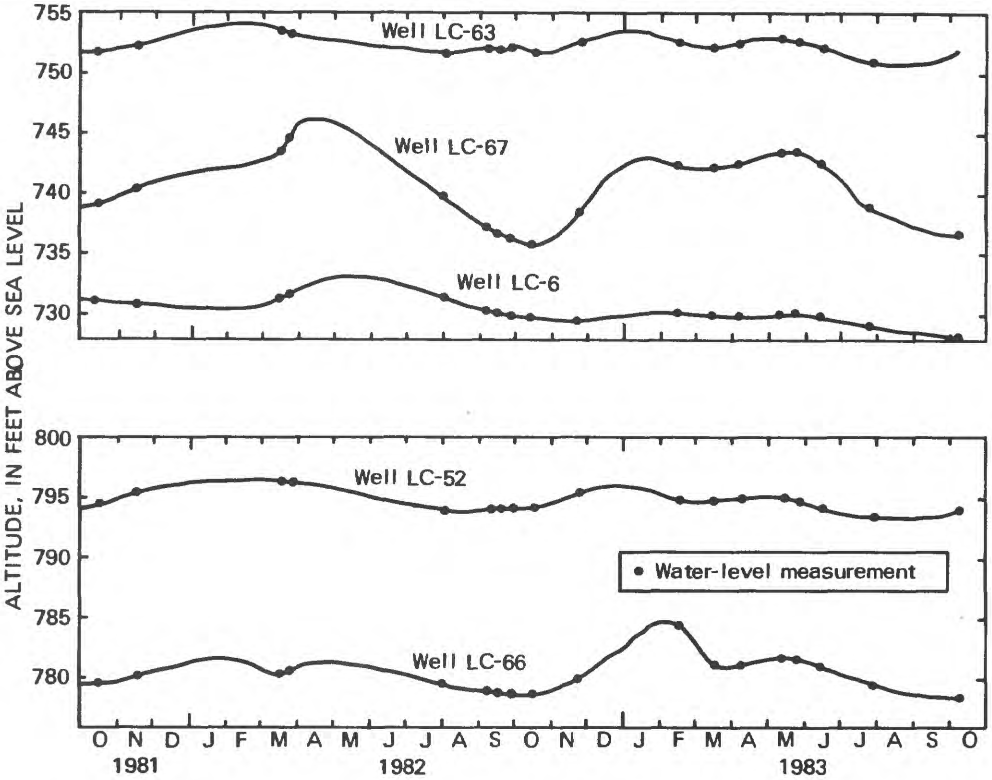


Figure 6.--1981-83 hydrographs of wells that tap the unconsolidated aquifer in Clarence-Lancaster-Newstead area. (Well locations are shown in fig. 2.)

and that water levels were highest in February. A second peak in May 1983 was due to an unseasonably wet spring. Annual water-level fluctuations ranged from 2 to 8 ft and averaged 4 ft. Water levels at wells LC-52, LC-63, and LC-6, which are near ground-water discharge areas such as ponds, wetlands, and streams, fluctuated less because relatively large amounts of ground water move from the edges of the aquifer toward these discharge areas. Water levels in wells LC-66 and LC-67, which are nearer the ground-water divide and further from discharge areas, fluctuated more because they have smaller catchment areas and receive less ground-water flow.

Onondaga Limestone aquifer.--Recharge to the limestone aquifer occurs (1) by infiltration of precipitation into the joints, fractures, and solution openings where the formation crops out at or near land surface, (2) by downward seepage of water from the overlying unconsolidated deposits and wetlands, (3) by seepage from storm runoff and streams flowing into sinks or swallets on top of the limestone, and (4) possibly by water that has been pumped out of a quarry 6 mi east of the study area and then discharged as surface flow, some of which may infiltrate back into the limestone.

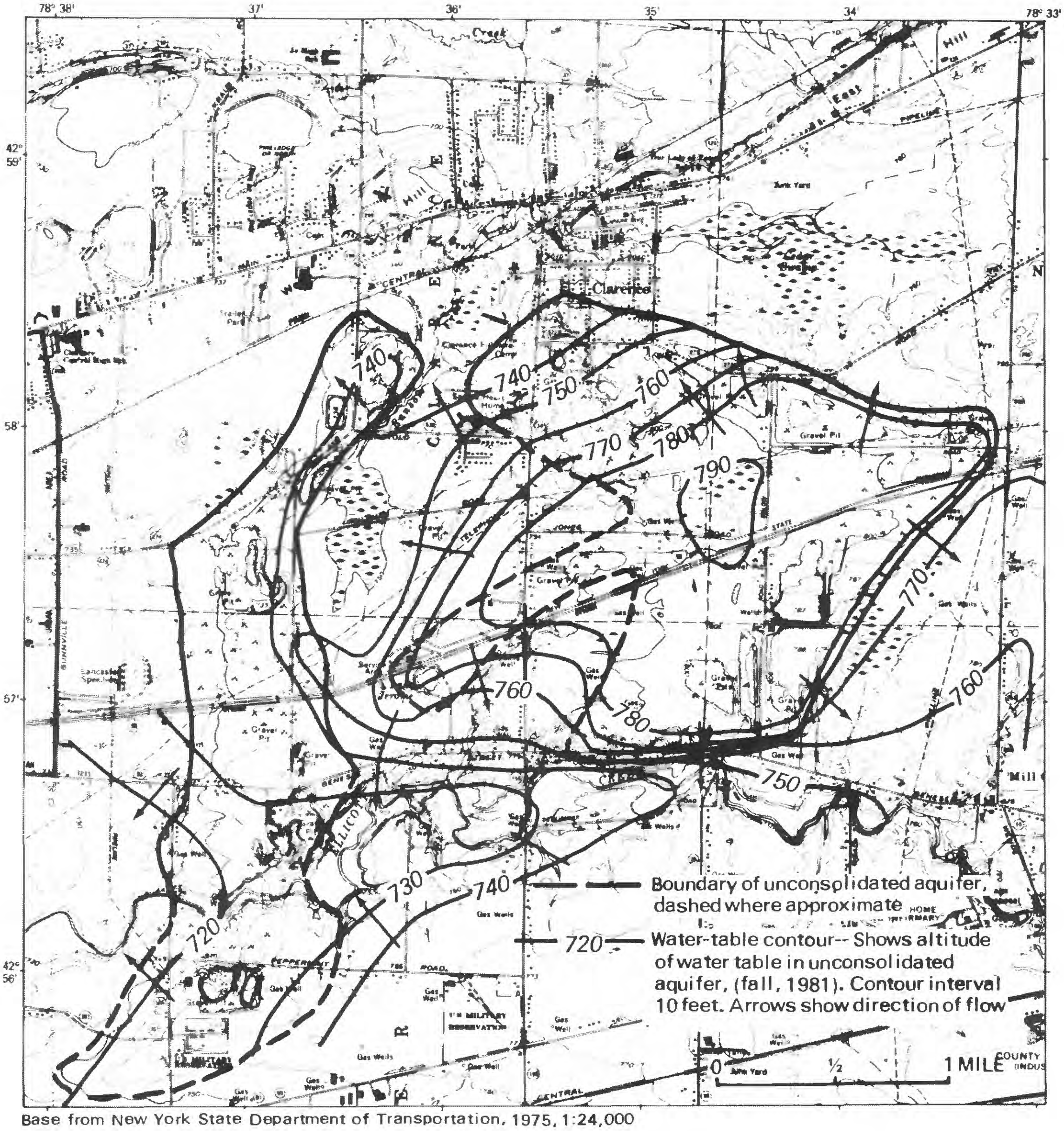
Discharge

Unconsolidated aquifer.--During the late spring, summer, and early fall, when most precipitation is lost through evapotranspiration, the ground-water discharge to springs, streams, wetlands, and underlying bedrock exceeds the recharge, and the water table declines. A map of the water-table altitude with directions of ground-water flow is given in figure 7. The contours are based on water levels measured by the U.S. Geological Survey and the Erie County Department of Environment and Planning on October 15, 1981, in shallow wells and where water was first encountered during the drilling of deeper wells. A ground-water divide trends roughly east-west through the unconsolidated deposits. Ground-water flow south of the divide moves predominantly south and southwestward and discharges into Ellicott Creek, and ground water south of Ellicott Creek moves northwestward into Ellicott Creek. Ground water north of the divide moves northward and discharges to surface-water bodies such as Tillman and Cedar Swamps, and ultimately into Ransom Creek, which flows north over the Onondaga Escarpment.

Deep piezometers in sets of nested piezometers near the landfill had lower potentiometric surfaces than shallow piezometers at the same location (Wehran Engineering and Recra Research, 1980), which indicates a significant downward gradient. Therefore, ground water in the unconsolidated aquifer moves not only laterally but also downward to the underlying limestone.

Onondaga Limestone aquifer.--Ground water leaves the limestone aquifer as pumpage from wells at quarries, private residences, institutions, and commercial facilities; as seepage to the underlying rock formations and to Ellicott Creek, and to streams and springs along the lower part of the face of the escarpment. Water levels measured during late summer and early fall of 1981 were used to compile a potentiometric-surface map of the Onondaga Limestone (fig. 8); the contours indicate a ground-water divide trending east-west approximately 1 mi south of the escarpment. Ground water south of the divide moves west-southwest and discharges into Ellicott Creek and quarries; ground water north of the divide flows north and discharges as springs and headwaters of streams at the base of the escarpment.

Several wetlands in the Clarence-Newstead area and many wells in the Newstead area went dry and had to be deepened during the summers of 1982 and 1983 because of severely declining water levels in the limestone aquifer. The cause of the decline is not known at this time. Water levels in the overlying unconsolidated deposits declined considerably less, probably because of the relatively impermeable lacustrine silt and lodgment till between the two layers, which retards vertical movement of ground water. If the confining unit were absent, ground water would have moved downward to recharge the limestone aquifer, and the water level in the sand and gravel would have declined more.



Base from New York State Department of Transportation, 1975, 1:24,000

Figure 7.--Water-table altitude in fall 1981 and direction of ground-water flow in unconsolidated aquifer, Clarence-Lancaster-Newstead area.

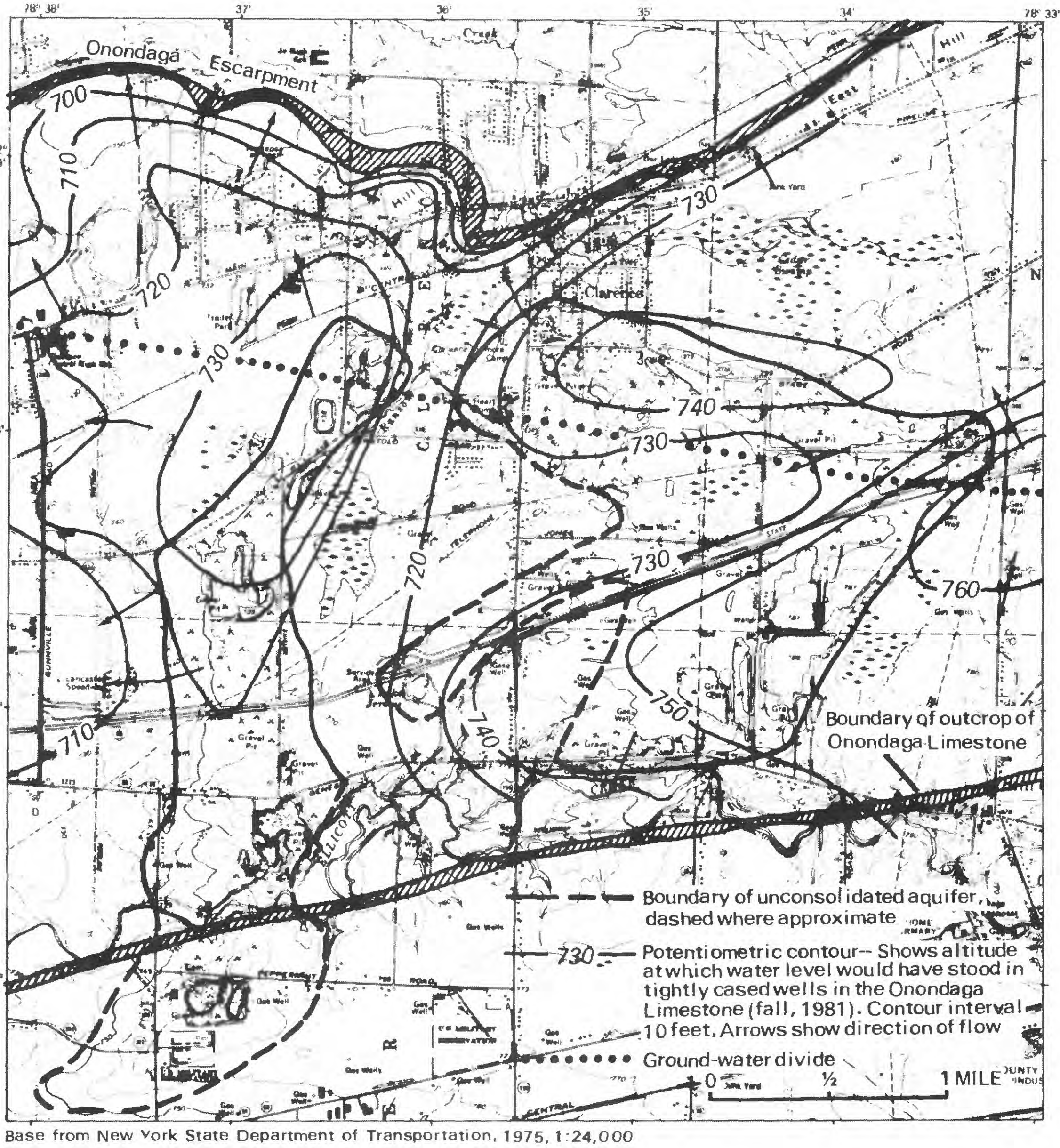


Figure 8.--Potentiometric surface in fall 1981 and directions of ground-water flow in upper part of the Onondaga Limestone aquifer in Clarence-Lancaster-Newstead area.

Water Quality

Water samples were collected from 15 wells in the Clarence-Lancaster-Newstead area during September 1981, March and August 1982, and February and June 1983. Chemical analyses for each well are given in table 10A (at end of report); average mean, median, maximum, and minimum values of each constituent from all wells are given in table 1. Seven of the wells tap sand or sand and

Table 1.--Minimum, maximum, mean, and median values and concentrations of water-quality constituents in samples from unconsolidated and limestone aquifers in Clarence, N.Y.

Constituent	Unconsolidated aquifer: No. of samples	Unconsolidated aquifer: Value or concentration: Minimum	Maximum	Mean	Median	Onondaga Limestone aquifer: No. of samples	Onondaga Limestone aquifer: Value or concentration: Minimum	Maximum	Mean	Median	New York State drinking-water standard[a]
Specific conductance (μmho/cm)	31	297	2,550	990	1,020	25	361	1,274	698	694	--
pH, lab (standard units)	31	6.8	8.3	--	7.8	25	7.3	8.1	--	7.7	--
Carbon, total organic (mg/L as C)	29	8.5	40	19	20	23	8	36	18	18	--
Hardness (mg/L as $CaCO_3$)	32	136	763	344	333	24	164	871	349	301	--
Alkalinity, lab (mg/L as $CaCO_3$)	31	52	415	240	231	25	151	268	218	225	--
Calcium, dissolved (mg/L)	32	16	183	87	33	25	2.1	258	88	79	--
Magnesium, dissolved (mg/L)	32	8.1	84	31	30	25	0.1	56	28	27	--
Potassium, dissolved (mg/L)	27	1	7.1	2.4	1.8	23	0	3.2	1.4	1.1	--
Sodium, dissolved (mg/L)	31	1.3	476	98	35	23	4	430	32	16	--
Chloride, dissolved (mg/L)	31	2.5	675	169	150	25	2.5	72	26	20	250
Fluoride, dissolved (mg/L)	32	<0.2	1.3	0.42	0.31	25	<0.2	1.1	0.33	<0.2	1.5
Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	31	0.1	15	2.2	0.38	25	0.1	4.9	1.2	0.9	10[b]
Phosphorus, ortho, dissolved (mg/L as P)	29	<0.01	0.4	0.6	0.02	20	<0.01	0.1	0.04	0.03	--
Sulfate, dissolved (mg/L as SO_4)	31	6	103	49	40	25	18	535	114	70	250
Arsenic, dissolved (μg/L)	31	<20	<20	<20	<20	23	<20	<20	<20	<20	50
Barium, dissolved (μg/L)	30	<200	700	250	<200	19	<200	400	230	<200	1,000
Cadmium, dissolved (μg/L)	31	<1	5	2	2	19	<1	2	1	<1	10
Chromium, dissolved (μg/L)	31	<10	<10	<10	<10	19	<10	<10	<10	<10	50
Copper, dissolved (μg/L)	29	<20	60	23	<20	19	<20	210	41	<20	1,000
Iron, dissolved (μg/L)	32	<50	4,700	520	<50	25	<50	310	77	<50	300[c]
Lead, dissolved (μg/L)	30	<10	200	24	<10	23	<10	20	10	<10	50
Manganese, dissolved (μg/L)	30	<10	1,700	210	90	23	<10	80	25	<10	300[c]
Mercury, dissolved (μg/L)	30	<0.4	4	0.6	<0.4	23	<0.4	0.8	0.4	<0.4	--
Selenium, dissolved (μg/L)	31	<1	2	1	<1	20	<1	<1	<1	<1	10
Silver, dissolved (μg/L)	31	<10	<10	<10	<10	20	<10	<10	<10	<10	50
Zinc, dissolved (μg/L)	30	<20	2,100	210	30	19	<20	220	60	40	5,000

a) Drinking-water standards from New York State Department of Health, 1964 and 1977. A dash indicates no data.
b) Only nitrate as N
c) If iron and manganese are both present, the total concentration of both substances should not exceed 300 μg/L.

gravel deposits and range in depth from 12 to 58 ft; seven wells tap the limestone aquifer and range in depth from 50 to 100 ft, and one 75-ft well taps shale that overlies the Onondaga Limestone at a depth of 75 ft. Locations of wells sampled are shown in figure 2.

Results of the analyses (tables 1 and 10A) indicate that, although the water quality of the unconsolidated deposits is generally similar to that of the underlying limestone bedrock, it varies areally and is locally of poor quality. The similarity of water in these two aquifers reflects their similar composition--the unconsolidated deposits contain an abundance of limestone clasts derived from the underlying Onondaga formation. Both aquifers have similar mean and median values of alkalinity, hardness, most major ions, and most metals (table 1).

Unconsolidated Aquifer

The variability in the ground-water quality of the unconsolidated deposits probably results from local variations in land use combined with the relatively high permeability of the surface deposits. The New York State drinking-water standards for iron and manganese were exceeded in 12 samples from five wells (table 10A). The standard for chloride was exceeded in eight samples from three wells; the standard for lead was exceeded in four samples from three wells, and the nitrate standard was matched or exceeded in three samples from one well.

The mean and median values of sodium, chloride, and specific conductance are also appreciably greater in the unconsolidated aquifer than in the bedrock aquifer. The elevated sodium and chloride concentrations and the resulting high specific conductance most likely result from the infiltration of road salts used on the New York State Thruway and other major roads in the area. For example, well LC-52, adjacent to the Thruway (fig. 2), had chloride concentrations ranging from 400 to 675 mg/L, and wells LC-8 and LC-6, south (downgradient) of the Thruway, had sodium concentrations ranging from 24 to 136 mg/L and chloride concentrations ranging from 75 to 400 mg/L.

Onondaga Limestone

Water quality in the bedrock aquifer is generally suitable for most uses. The New York State drinking-water standard for iron and manganese was exceeded at only one well and for sulfate at only one well.

The water quality deteriorates with depth. During the summer of 1982, several wells went dry. When they were deepened, the pumped water was more mineralized. For example, well LC-68, near the escarpment, was deepened in July 1982 from 40 ft to 62 ft. Comparison of water samples taken in March 1982 with those taken in February 1983 (table 10A, at end of report) shows that specific conductance increased from 396 to 1,270 mho, hardness increased from 206 to 871 mg/L as $CaCO_3$, calcium increased from 61 to 258 mg/L, sulfate increased from 49 to 533 mg/L, and alkalinity as $CaCO_3$ increased from 151 to 229 mg/L. The large increases in the calcium and sulfate concentrations may reflect upward-moving water from underlying gypsum-bearing rock formations such as the Camillus Shale of the Salina Group.

Effects of Landfill Near Lancaster

Location and Description

The landfill near Lancaster (fig. 3, section C-C') is excavated in the permeable silt, sand, and sand and gravel deposits that overlie the Onondaga Limestone. The landfill has been in operation since 1961 for the disposal of mostly residential and commercial refuse, although it may contain some industrial wastes. Local and county concern has prompted several geohydrologic studies in the landfill vicinity to determine whether leachate is moving offsite.

The landfill operation began in abandoned sand and gravel pits. Borings within the landfill revealed 20 to 40 ft of refuse overlying outwash or morainal deposits consisting of fine sand or fine sand and gravel that generally overlie the basal till (Wehran Engineering and Recra Research, 1980).

Borings along the perimeter of the landfill by Wehran Engineering during 1970-80 revealed 3 to 15 ft of till and sand deposits underlain by 20 to 50 ft of outwash and(or) morainal sands and gravelly sand that in turn overlie 0 to 10 ft of basal till. (Some borings did not encounter till.) The basal till is underlain by Onondaga Limestone.

Ground-Water Movement

Ground water is under water-table conditions in the upper sand, silt, and sand and gravel and in the refuse. Nested piezometers installed in the landfill vicinity reveal a significant downward component of ground-water flow into the Onondaga Limestone (Wehran Engineering and Recra Research, 1979, 1980); thus, leachate migration into the underlying sand, silt, and sand and gravel, and eventually into the Onondaga Limestone, is possible. The water-table contours (fig. 7) reveal a ground-water divide extending northeast-southwestward through the deposits; ground water north of the divide flows northwestward toward Tillman Swamp, and ground water south of the divide flows southwestward toward Ellicott Creek.

The discontinuous thin layer of relatively impermeable till that overlies the limestone is an important control on the amount of leachate that can infiltrate from the sand, silt, and sand and gravel into the limestone aquifer. The till is a discontinuous semiconfining layer separating the sand and gravel aquifer from the limestone. Wherever it is present, it would slow the rate of migration of leachate into limestone. The fine-grained portion (clay, silt, and fine sand) of the till would adsorb some of the constituents of the leachate. Where coarser deposits of silt and sand and gravel are in hydraulic contact with the limestone aquifer, leachate would readily infiltrate into the limestone.

Water levels in borings drilled into the Onondaga Limestone decreased progressively as the hole depth increased, indicating a significant downward component of ground-water flow. Water levels measured during the fall of 1981 in wells penetrating the upper 10 to 25 ft of the limestone (fig. 8) reveal that the direction of horizontal ground-water flow is westward. Thus, if leachate were to seep into the limestone beneath the landfill, it would move both vertically downward and westward.

Most private domestic wells in this area are drilled through the relatively thin saturated sand and gravel deposits and installed in the bedrock (Onondaga Limestone) to minimize the chance of drying up during a severe drought.

Ground-Water Quality

The local variability of ground-water quality makes the effects of the landfill difficult to evaluate. Wells LC-8 and LC-6, downgradient (0.5 mi southwest and 0.5 mi south, respectively) of the landfill (fig. 2), exhibited relatively high concentrations of some constituents that are indicators of landfill leachate. Other important indicator constituents were absent, however, and other sources of indicator constituents are in the vicinity. For example, well LC-8, a dug well 20 ft deep along a major highway 1,000 ft south (downgradient) of the New York State Thruway, had specific-conductance values ranging from 920 to 1,200 μmho, nitrate and nitrite concentrations ranging from 5.1 to 15 mg/L as N, hardness values ranging from 343 to 548 mg/L as $CaCO_3$, sodium concentrations ranging from 70 to 136 mg/L, and chloride concentrations ranging from 175 to 400 mg/L. Most of these concentrations are appreciably greater than the median values reported for wells tapping the unconsolidated deposits (table 1); however, the concentrations of metals and total organic carbon are not. Thus, the elevated specific conductance values and sodium and chloride concentrations are probably due to road salt. The high nitrate concentrations could be due to fertilizers or a septic system. Thus, the relatively poor quality of water from this well is not necessarily derived from the landfill. Water from well LC-39, which taps the limestone about 3,000 ft west (downgradient) of the landfill, yields water within the range of values measured elsewhere in the limestone aquifer.

In conclusion, no significant contamination of wells in the unconsolidated deposits or the upper part of the limestone could be directly attributed to the landfill. Head data from wells drilled in the Onondaga Limestone reveal a significant downward component of flow, which indicates that leachate from the landfill may be moving into deeper zones of the limestone. Only limited data on these deeper zones are available, however.

AQUIFER IN THE SARDINIA AREA

This aquifer, which includes about 9 mi^2 in the Town of Sardinia in the southeastern corner of Erie County (fig. 9), occupies a broad, flat, southward-draining valley bounded on the east and west by bedrock hills that rise as much as 250 ft above the valley floor, on the south by Cattaraugus Creek, and on the north by many small till hills. The western and central parts of the aquifer are drained by Hosmer Brook; the eastern area is drained by a small unnamed tributary to Cattaraugus Creek.

The hamlets of Sardinia and Chaffee lie on the aquifer, but the predominant land use is agriculture and pastureland. A landfill is excavated in a till hill adjacent to the northern border of the surficial aquifer (fig. 9).

Population and Ground-Water Use

Ground water is the principal source of water for the approximately 900 people living in the area underlain by the aquifer. The Chaffee community well serves 210 people (New York State Department of Health, 1982); the remaining population, institutions, livestock, and commercial facilities obtain water from individual private wells. Table 2 summarizes the estimated pumpage from the aquifer.

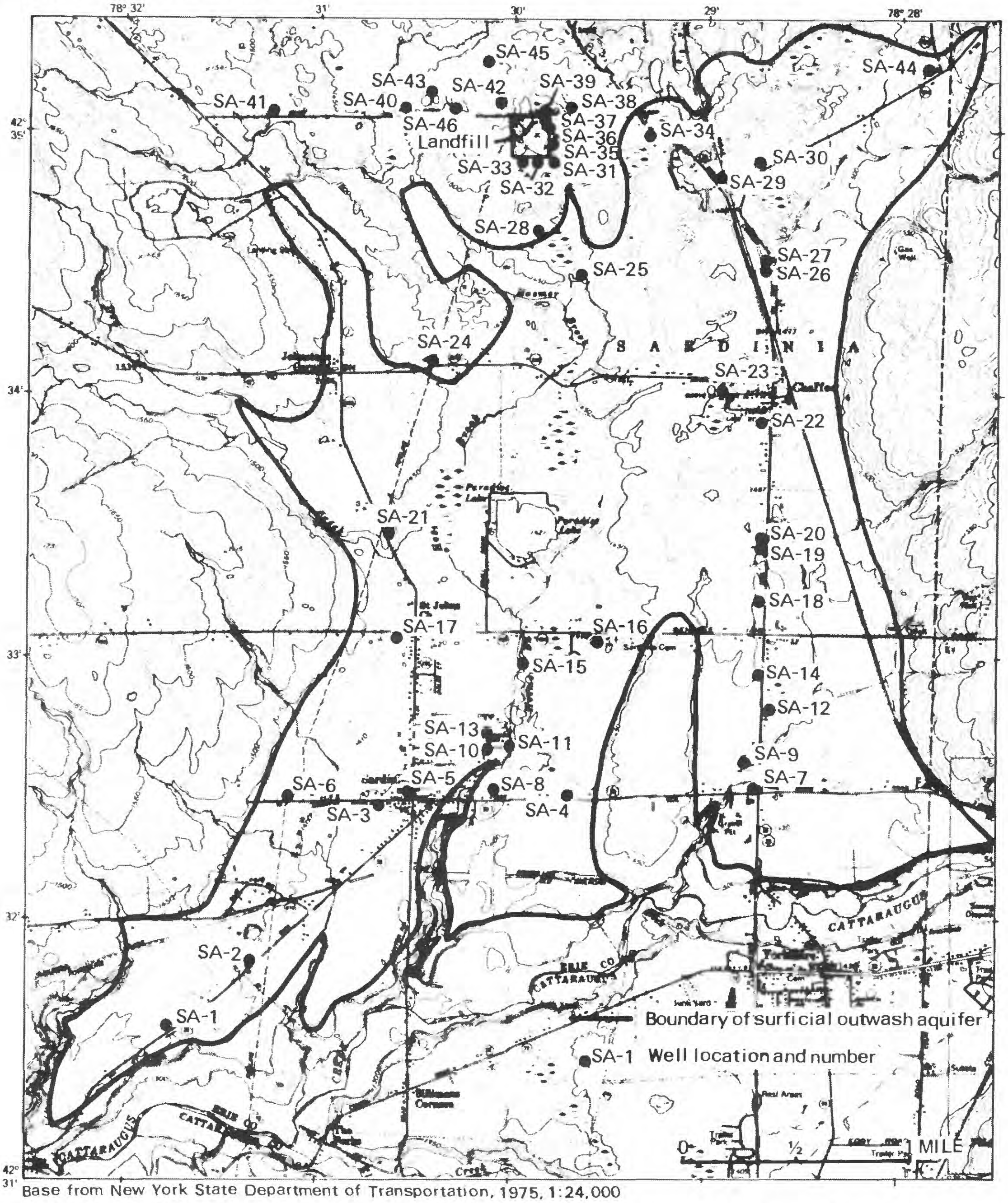


Figure 9.--Location of surficial outwash aquifer and wells in Sardinia area.

Table 2.--Estimated pumpage from Sardinia aquifer, 1982

	Population served	Average pumpage (gal/d)
Chaffee municipal supply	210	21,000
Private water supplies	700*	70,000*
Commercial (restaurants, motels, etc.)	--	40,000*
Stock	--	20,000*
TOTAL		151,000

* Estimated

Hydrogeologic Framework

The Sardinia aquifer (fig. 10) occupies a deep north-south-trending glacially scoured valley that is partly filled with glacial sediments up to 600 ft thick (Calkin and others, 1974). The aquifer consists of surficial outwash sand and gravel deposited by glacial meltwater during the Lake Escarpment glaciation approximately 12,000 years ago (Calkin, 1982). The southward sloping pitted outwash plain extends southward from the Lake Escarpment moraine to Cattaraugus Creek. The aquifer is bounded on the west and east by bedrock hills of Devonian shale, siltstone, and sandstone covered with till 5 to 25 ft thick. The outwash (Qog and Qos in fig. 10) reaches a thickness of 95 ft in the northern part of the aquifer in front of the moraine (Oem in fig. 10) and forms a wedge that thins southward (10 to 15 ft thick) to Cattaraugus Creek. The creek has incised through the outwash and partly into underlying till and lacustrine deposits. The incision has left the outwash as bluffs standing 50 ft above the creek. A thin (0 to 20 ft), irregular buried layer of lacustrine fine sand, silt, and clay is present in the sand and gravel deposits in the central and eastern part of the aquifer.

The aquifer is underlain by relatively impermeable clay till and lacustrine deposits that form most of the valley fill. These deposits are as much as 600 ft thick (Calkin and others, 1974) and are interbedded with thin, confined sand and gravel deposits, some of which are significant water-bearing zones under artesian pressure. (See section A-A' in fig. 11.) Near Sardinia, where the surficial outwash is thin, many private wells are installed in these buried sand and gravel deposits at depths ranging from 110 to 344 ft. A protruding bedrock hill in the southern part of the area splits the aquifer into two parts (section B-B' and fig. 11).

The headwaters of Hosmer Brook originate at a former spillway (in the Lake Escarpment moraine) of a proglacial lake that occupied the Cazenovia River valley north of the moraine (fig. 10). Water flowing from the spillway partly eroded a channel in previously deposited outwash (Qog in fig. 10) 3 mi long and 1 mi wide in the middle of the valley. A veneer of later outwash (Qos) was deposited in this eroded area. Sections C-C' and D-D' in figure 11 show in detail the hydrogeologic conditions in the area of the moraine-outwash contact and the landfill, respectively.

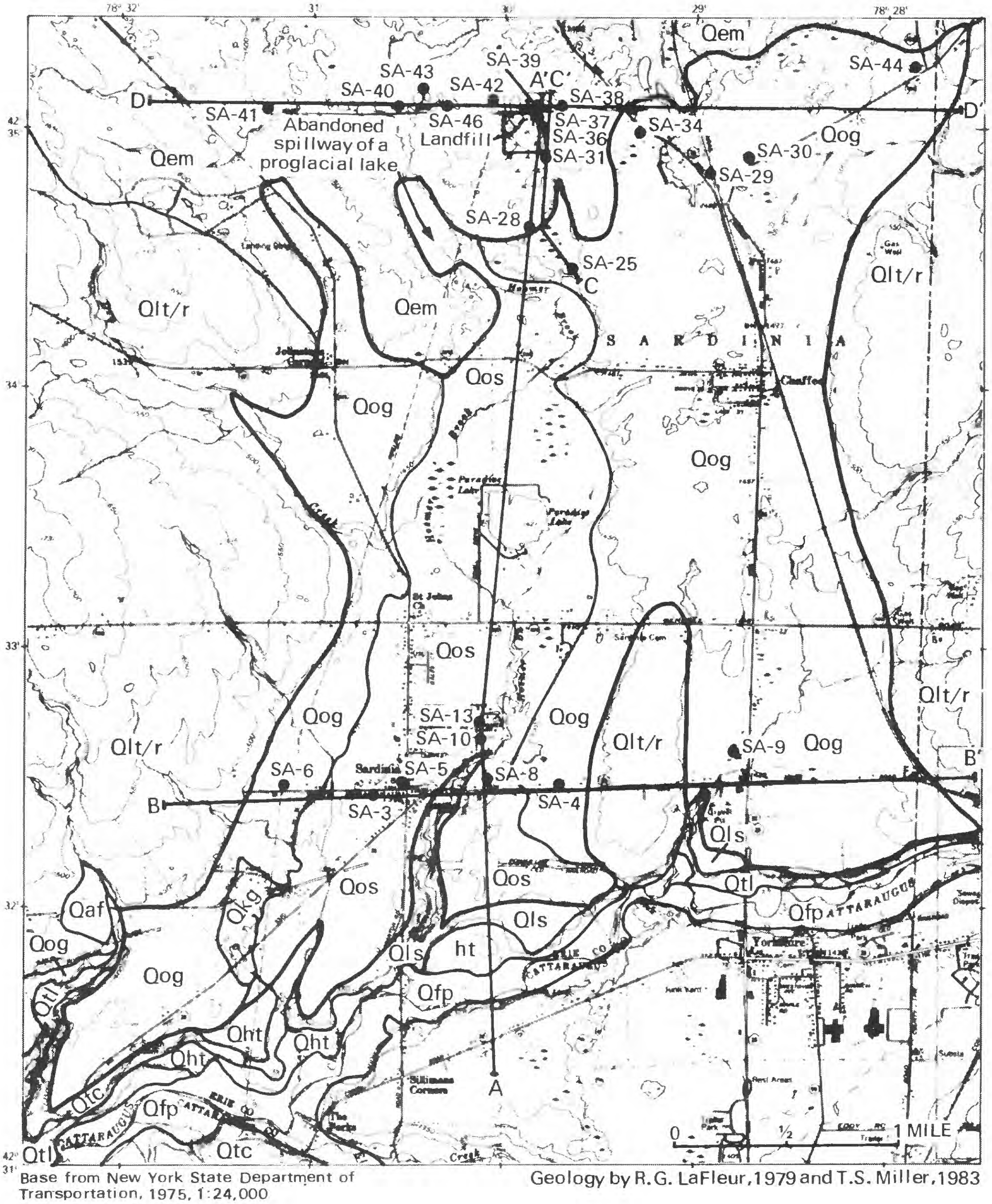


Figure 10.--Surficial geology and location of geologic sections in Sardinia area.

EXPLANATION

——— Boundary of surficial outwash aquifer in Sardinia area

A____A' Location of geologic section

SA-4 Well used in section

System	Series	Glaciation	Moraine or drift sheet		
QUATERNARY	HOLOCENE			Qfp	Flood plain; gravel, silt alluvium
				Qtl	Landslides, slumps; developed on exposures of clayey till (Qtc)
				Qht	High terraces of Cattaraugus Creek and tributaries; gravel and silt alluvium, wood bearing
	PLEISTOCENE	WISCONSINAN	LAKE ESCARPMENT	Qem	End moraine; till with some mixed gravel and sand
				Qos	Lake outwash, pebble gravel, sand; incised into earlier outwash
				Qog	Outwash; cobble gravel, sand
				Qls	Lacustrine sand, silt, some pebble gravel
				Qkg	Ice-contact cobble gravel, sand; kamic
			LAVERY	Qtc	Till, clayey with pebbles and cobbles; deformed silt stringers, minor overridden pebble gravel, sand; mainly reworked lacustrines
			KENT	Qlt/r	Lodgment till overlying bedrock

The Lake Escarpment moraine, which forms the northern boundary of the surficial outwash aquifer, consists of a clayey-silt till 20 to 63 ft thick with discontinous sand, and sand and gravel stringers. The fine-grained texture of the till and the sparsity of pebbles (typically forming less than 2 percent of the till) suggest that the till was derived from reworked fine-grained lake deposits from the Cazenovia River valley to the north that were transported by the ice during the Lake Escarpment readvance.

Well logs from south of Hand Road reveal an interlayering of till between sand and gravel deposits that suggests that the ice front of the Lake Escarpment readvance oscillated and overrode sand and gravel deposits. A core sample from well site SA-39, along Hand Road, revealed that the readvance incorporated some of the underlying sand and gravel into the bottom of till deposits and that incomplete scouring left some of the sand and gravel intact below the till. The altitude of the upper surface of this gravel is generally from 1,443 to 1,448 ft above sea level (fig. 11, section C-C'), but little information is available to determine its lower surface altitude. Well logs suggest that this sand and gravel layer is hydraulically connected to the surficial aquifer (fig. 11, section C-C'). This buried sand and gravel is the source of water for homes along Hand Road (fig. 11, section D-D').

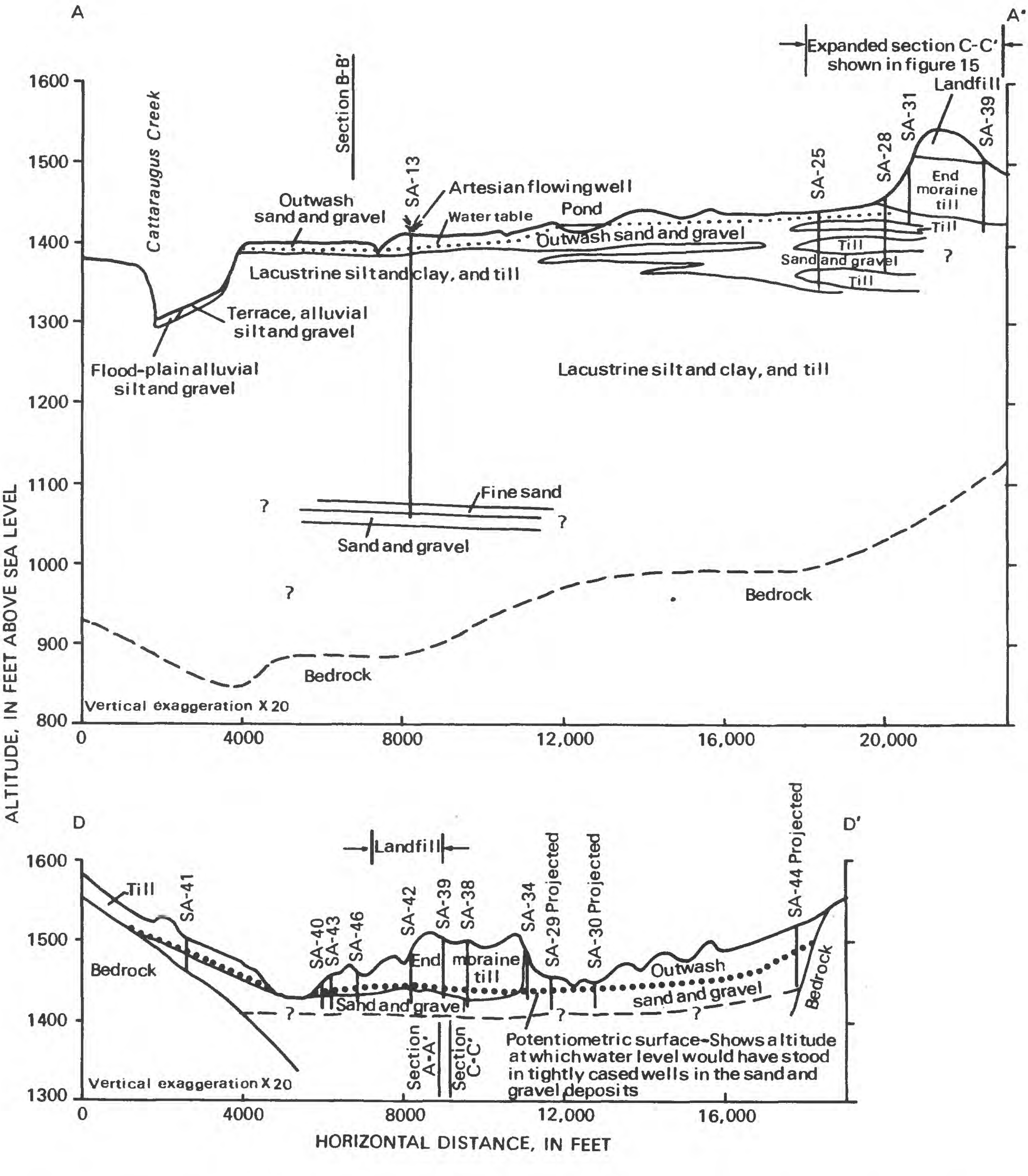


Figure 11.--Geologic sections through Sardinia area; A-A', north-south through Sardinia area and D-D', along Hand road.

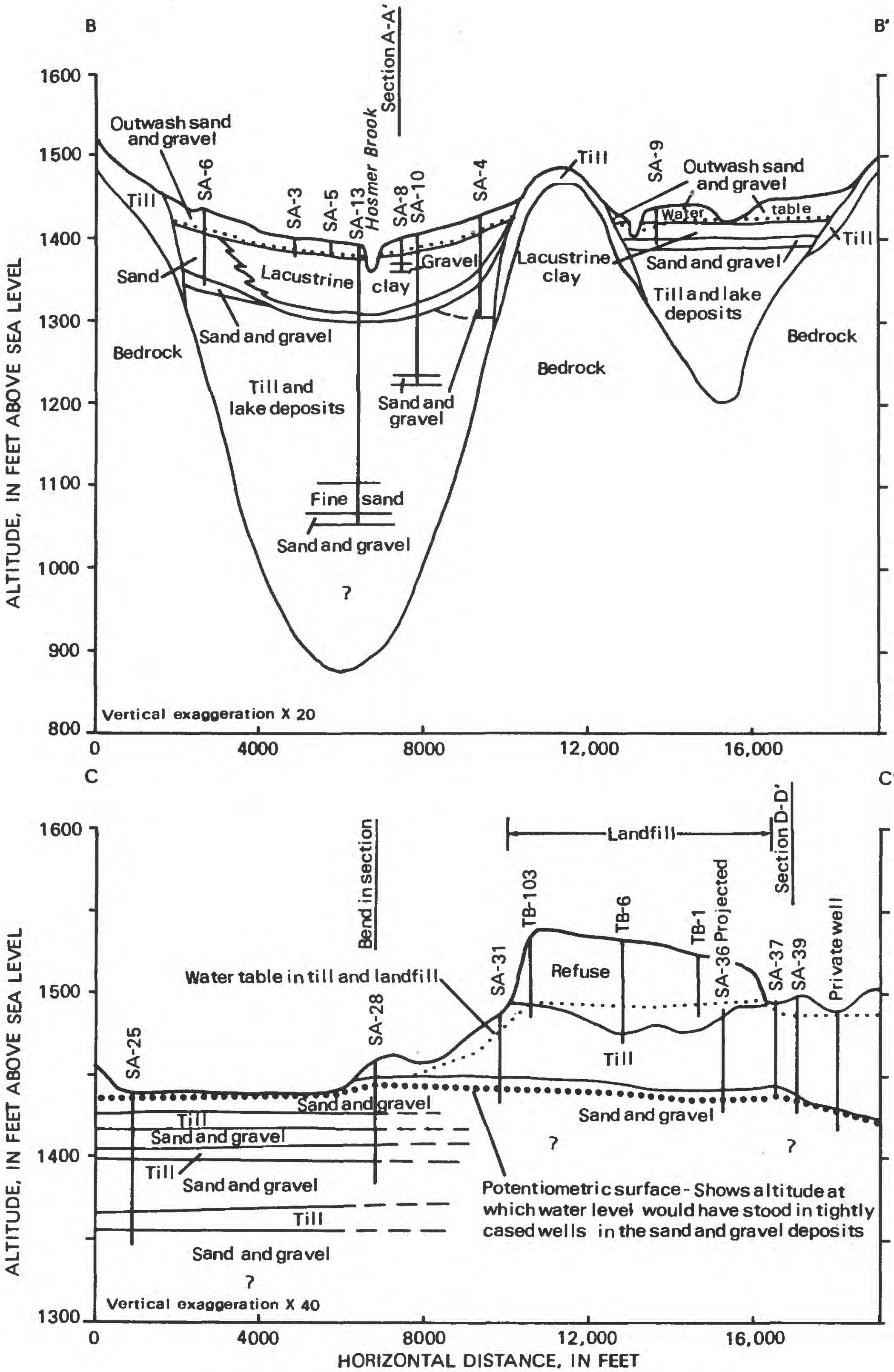


Figure 11 (continued).--Geologic sections through Sardinia area; B-B', east-west through southern part of area and C-C', north-south in landfill vicinity.

Saturated Thickness

The estimated saturated thickness of the surficial aquifer ranges from 5 ft to more than 60 ft. The deeper, confined aquifers are not included in these thickness values, nor is the relatively thin (5 to 20 ft), discontinuous lacustrine unit within the eastern part of the aquifer. The aquifer materials range in size from fine sand to coarse cobbles.

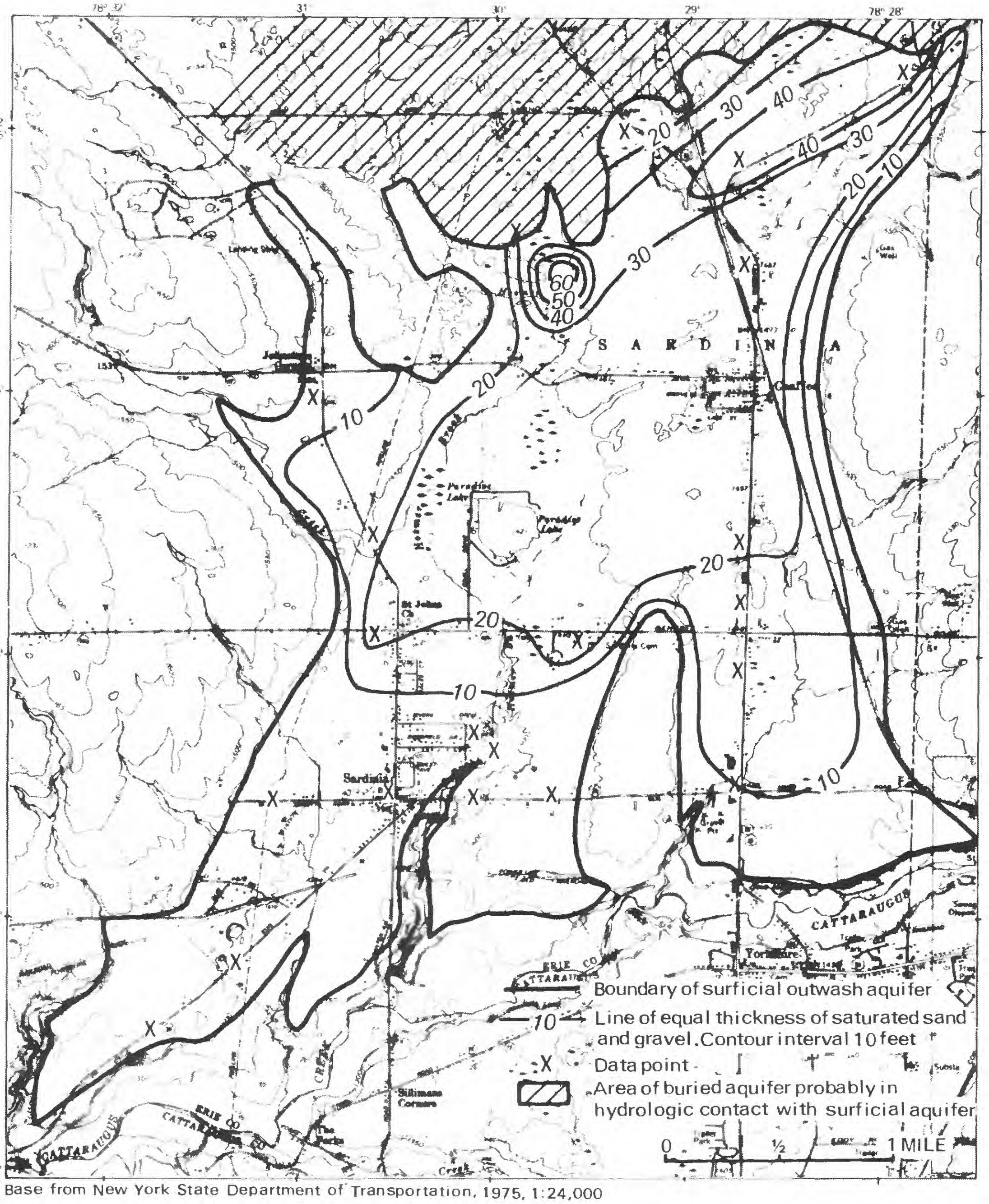


Figure 12.--Thickness and location of aquifer in Sardinia area.

The aquifer thickness is greatest (20 ft to as much as 95 ft) in the northern part of the aquifer, just south of the moraine, and saturated thickness exceeds 60 ft (fig. 12). In this area, the relatively impermeable lake deposits within the surficial sand and gravel are thin or absent. Saturated thickness may be thicker in the vicinity of kettleholes, where depressions caused by the melting of buried ice blocks became filled with collapsed outwash sand and gravel.

The saturated thickness thins southward and, at the village of Sardinia, is less than 25 ft (fig. 12). Wells in Sardinia are either shallow (less than 25 ft) or very deep (110 to 344 ft). For example, well SA-13 was drilled 344 ft before a significant buried water-producing zone was encountered. Several private residences along the southern edge of the aquifer obtain water from springs discharging at the contact between sand and gravel and the basal clay till or lacustrine deposits.

Ground-Water Movement

Recharge

The aquifer is recharged by precipitation on the land, by seepage from the tributary streams that drain the till-mantled uplands and flow onto the aquifer, and by subsurface flow from the till and bedrock along the sides of the valley. Hydrographs of water levels from several wells (fig. 13) indicate

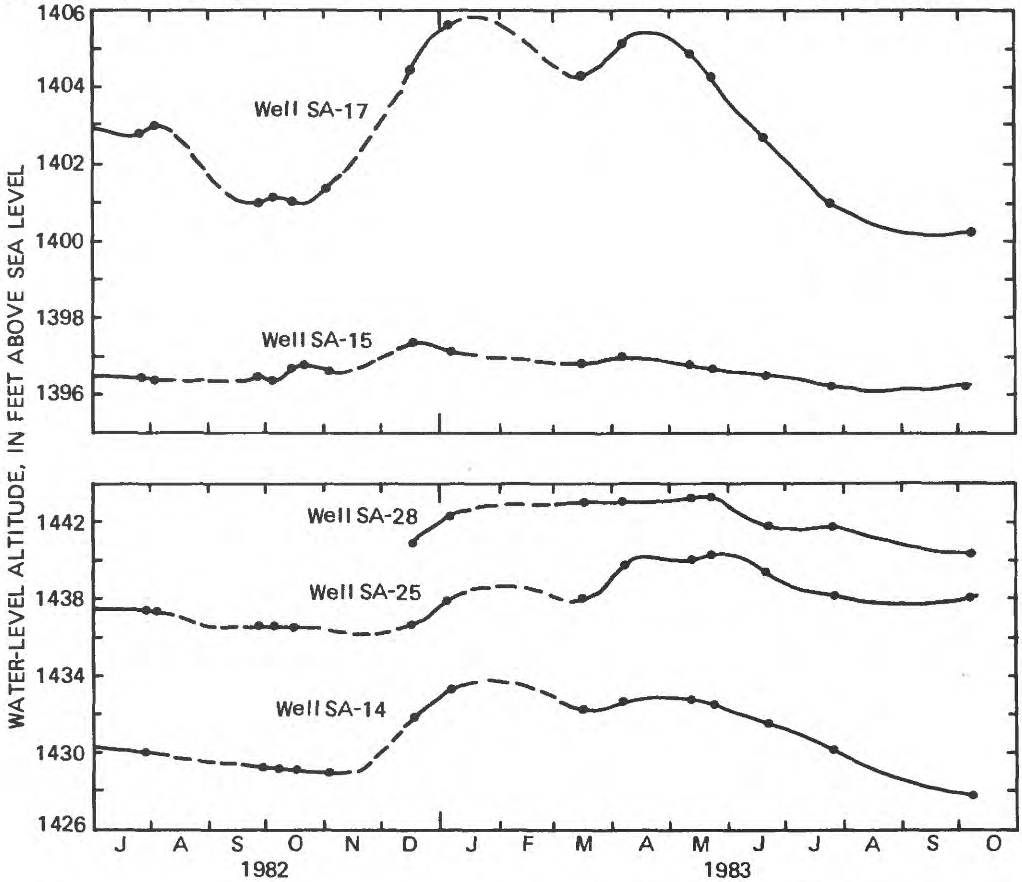


Figure 13.--1982-83 hydrographs of wells in Sardinia area.

that most recharge occurs from late fall through early spring (November through April), when evapotranspiration is at a minimum. A significant second peak occurred during April and May 1983, when precipitation was considerably higher than the seasonal norm. During the growing season, evapotranspiration exceeds recharge from precipitation, so that precipitation recharges the water table only during extremely wet periods in summer. Ground-water levels declined from May until October. Wells SA-15 and SA-23, near Hosmer Brook, show annual water-level fluctuations of only 1 to 3 ft; this reflects the movement of ground water from recharge areas to Hosmer Brook. In contrast, wells SA-28 and SA-17, at the north and west edges of aquifer, respectively, are far from streams and show water-level fluctuations of 4 to 5 ft.

Average annual recharge to the sand and gravel aquifer is estimated to be 1 (Mgal/d)/mi^2. This estimate is derived as follows: (1) direct infiltration of about 40 in/yr on the surface of the sand and gravel aquifer averages 500,000 (gal/d)/mi^2; (2) runoff from till uplands that drains onto and seeps into the aquifer is about 50,000 (gal/d)/mi^2; and (3) ground-water recharge to the sand and gravel deposits from adjacent till and bedrock is approximately 400,000 gal/d (La Sala, 1968).

Discharge

Ground water discharges from the aquifer by pumping, by seepage to Hosmer Brook and the tributary on the eastern side of the aquifer (fig. 9), by springs along the southern aquifer boundary, by underflow northward beneath the Lake Escarpment moraine in the northeast part of the aquifer, and by evapotranspiration. Direction of flow is controlled by hydraulic gradients and is shown by arrows on the water-table map (fig. 14).

Ground water in the extreme northeastern part of the aquifer flows northwest and discharges as underflow beneath the moraine. (Little information is available on the northern extent of the buried aquifer beneath the moraine.) Elsewhere, ground water flows predominantly southward and into Hosmer Brook, which then discharges into Cattaraugus Creek.

Water Quality

Water samples were collected from 15 wells in the Sardinia area in August 1982 and January and May 1983 (table 10B). Seven of the wells tap unconfined surficial sand and gravel deposits at depths ranging from 17 to 69 ft; the other eight tap confined sand and gravel deposits at depths of 27 to 344 ft. Three sets of nested piezometers were installed near the Chaffee landfill--SA-25 (01, 02, 03) southeast of the landfill, SA-28 (01, 02) south of the landfill, and SA-39 north of the landfill. (Well locations are shown in fig. 9.) The piezometer at SA-39 was rendered inoperative when a sampler became lodged in the well, and no data were collected from this site. Water samples were also taken from a private well (SA-46) northwest of the landfill along Hand Road and from a private well (SA-34) east of the landfill along route 16.

Chemical analyses indicate that the water quality of the Sardinia aquifer is generally good. This aquifer had the least mineralized water of the five aquifers studied. The water is moderately hard to very hard with values ranging from 92 to 274 mg/L as $CaCO_3$ and a median value of 172 mg/L as $CaCO_3$.

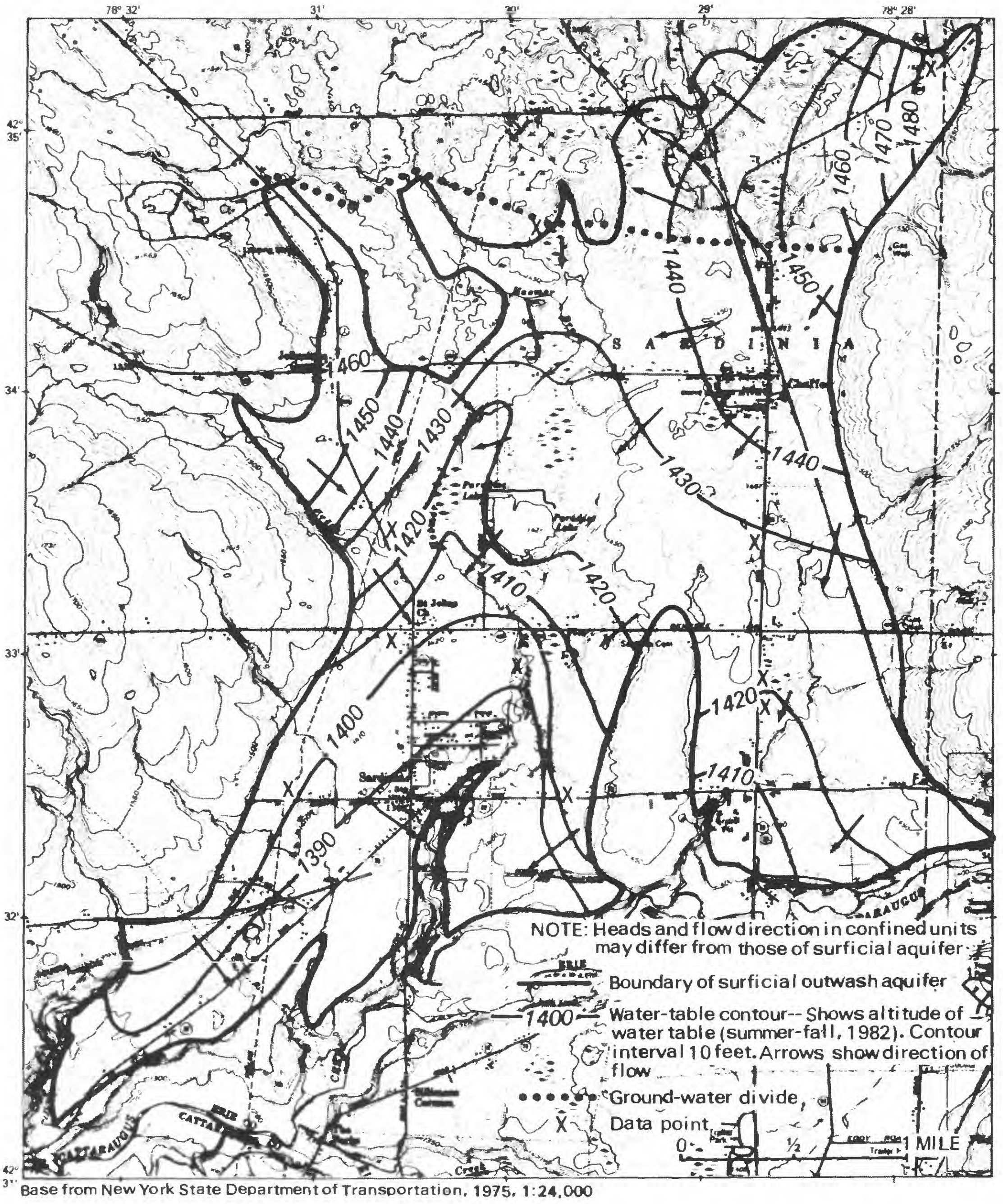


Figure 14.--Water-table altitude and direction of ground-water ia flow in Sardinia area.

Water samples met New York State drinking-water standards for all inorganic constituents except iron and manganese, which were exceeded in 17 samples from nine wells. The concentrations of iron and manganese in these wells do not present a health hazard but could be of concern from an esthetic standpoint. Minimum, maximum, mean, and median values for all inorganic constituents measured are listed in table 3 along with the State drinking-water standards.

Table 3.--Minimum, maximum, mean, and median values and concentrations of water-quality constituents from wells in the Sardinia aquifer.

Constituent	No. of samples	Value or concentration: Minimum	Maximum	Mean	Median	New York State drinking-water standard[a]
Specific conductance (μmho/cm)	38	130	680	369	357	--
pH, lab (standard units)	38	6.7	8.1	--	7.8	--
Carbon, total organic (mg/L as C)	37	1	22	11	11	--
Hardness (mg/L as $CaCO_3$)	38	54	320	173	172	--
Alkalinity, lab (mg/L as $CaCO_3$)	38	43	251	150	152	--
Calcium, dissolved (mg/L)	38	16	97	51	54	--
Magnesium, dissolved (mg/L)	38	3.3	19	11	11	--
Potassium, dissolved (mg/L)	38	.5	2.6	1.2	1.1	--
Sodium, dissolved (mg/L)	38	1.4	37	7.8	4.3	--
Chloride, dissolved (mg/L)	38	.5	35	14	14	250
Fluoride, dissolved (mg/L)	38	<.2	.2	<.2	<.2	1.5
Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	38	.01	7.1	1.35	.6	10[b]
Phosphorus, ortho, dissolved (mg/L as P)	37	0	.11	.03	.02	--
Sulfate, dissolved (mg/L as SO_4)	38	4.3	51	25	23	250
Arsenic, dissolved (μg/L)	38	<20	<20	<20	<20	50
Barium, dissolved (μg/L)	38	<200	700	270	<200	1,000
Cadmium, dissolved (μg/L)	38	<1	<1	<1	<1	10
Chromium, dissolved (μg/L)	38	<10	<10	<10	<10	50
Copper, dissolved (μg/L)	38	<10	60	23	20	1,000
Iron, dissolved (μg/L)	38	50	3,300	370	50	300c
Lead, dissolved (μg/L)	38	<10	20	11	<10	50
Manganese, dissolved (μg/L)	38	<10	1,500	210	60	300c
Mercury, dissolved (μg/L)	38	.1	.4	<.4	<.4	--
Selenium, dissolved (μg/L)	37	<1	<1	<1	<1	10
Silver, dissolved (μg/L)	37	<10	<10	<10	<10	50
Zinc, dissolved (μg/L)	38	4	1,230	120	<20	5,000

a) Drinking-water standards from New York State Department of Health, 1964 and 1977.
b) Only nitrate as N
c) If iron and manganese are both present, the total concentration of both substances should not exceed 300 μg/L.

Because the unconfined sand and gravel aquifer is exposed at land surface, it is potentially susceptible to contamination from surface sources. Several of the shallow wells (SA-15, SA-14, SA-34, and SA-2) that tap the surficial aquifer had elevated levels of NO_2 and NO_3, Cl, and total organic carbons, which are characteristically derived from septic tanks, fertilizers, or other surface sources.

Effect of Landfill Near Chaffee

Location and Description

The landfill near Chaffee is on Hand Road north of and adjacent to the surficial sand and gravel aquifer (fig. 9). The potential for leachate migration from the landfill to the surficial and buried aquifers has given rise to local concern. In 1982, the U.S. Geological Survey conducted test drilling, installed nested piezometers at three sites, and sampled ground water at two of the piezometer sites and two private wells to determine whether leachate has migrated offsite.

The landfill is excavated in a morainal hill near the terminus of the Lake Escarpment readvance. Test drilling within and around the landfill showed the underlying material to consist of 30 to 65 ft of silty clay to clayey-silt till with some silt, sand, and sand and gravel stringers. The base of the till lies at altitudes of 1,443 to 1,448 ft. A sand and gravel aquifer of undetermined thickness underlies the till (fig. 11, sections C-C', D-D').

Well logs reveal that the surficial morainal till pinches out south of the landfill, and interlayering of outwash sand and gravel and buried till layers extend at least as far south as well SA-25 (fig. 11, section C-C'). The buried till layers were encountered at the same altitudes in well SA-28. A deep (100- to 200-ft) test boring would be needed in the landfill vicinity to define the deeper subsurface hydrogeology.

A leachate-collection system was installed around the perimeter of the landfill in 1981. A 20-ft-deep trench was dug and the materials and ground-water conditions examined by a consulting geologist, who reported that the trench was installed in predominantly clayey-silt till with discontinuous lenses of fine sand to gravelly sand. Sand lenses were orientated horizontally and vertically. Permeability tests of the till indicated values of 4×10^{-7} cm/s or less (Earth Dimensions, Inc., 1981); permeability tests of the silt and sandy silt lens revealed permeabilities of 1×10^{-6} and 1×10^{-5} cm/s, respectively. Ground water was observed to seep out of some of the sand and gravelly sand lenses. Leachate odor and color were noted in two areas, one of which penetrated refuse (Earth Dimensions, Inc., 1981). The trench was backfilled with clayey silt to seal off horizontal paths of leachate migration through the lens, although little is known of the extent of vertical lenses below the landfill.

Ground-Water Movement

The surficial till contains a water table that probably roughly parallels the surface topography. Well logs indicate that the water level ranges from

6 to 22 ft below land surface. A relatively shallow depth to water also is indicated by seeps encountered during trench construction. The upper zone of the sand and gravel aquifer underlying the till unit contains a thin unsaturated zone, which indicates little or no hydraulic connection with the overlying till. A ground-water divide intersects the buried sand and gravel aquifer in the vicinity of well SA-28. If leachate were to migrate downward through the till, the contaminants would enter the buried sand and gravel aquifer and would move northward. If leachate escaped as springs along the south border of the landfill and flowed southward toward Hosmer Brook as surface runoff, it could move into the surficial outwash sand and gravel.

Ground-Water Quality

Comparison of mean and median values of chemical constituents of water from the wells surrounding the landfill with those from other wells in the Sardinia aquifer reveals that water in the landfill vicinity had higher concentrations of dissolved iron, manganese, zinc, and sulfate (table 4). Elevated concentrations of these constituents have been reported to be characteristic of landfill leachate (Nicholson and others, 1983). However, elevated concentrations of hardness, Ca, Mg, Na, Cl, total organic carbon, K, and heavy

Table 4.--Median values of selected constituents of water in Sardinia aquifer near and at distance from Chaffee landfill.

Constituent	Near landfill		Not near landfill	
	Mean	Median	Mean	Median
Specific conductance (μmho/cm)	374	386	363	335
pH, lab (standard units)	7.7	7.8	7.6	7.8
Carbon, total organic (mg/L as C)	12	12		9.2
Hardness (mg/L as $CaCO_3$)	183	182	165	166
Alkalinity, lab (mg/L as $CaCO_3$)	149	149	151	155
Calcium, dissolved (mg/L)	54	55	48	47
Magnesium, dissolved (mg/L)	12	12	11	11
Sodium, dissolved (mg/L)	4.5	3.4	11	5.4
Chloride, dissolved (mg/L)	14	15	14	11
Nitrogen, NO_2+NO_3 dissolved (mg/L as N)	.41	.18	2.2	1.4
Phosphorus, ortho dissolved (mg/L as P)	.02	.03	.03	.01
Sulfate, dissolved (mg/L as SO_4)	31	29	20	18
Iron, dissolved (mg/L)	.49	.22	.26	.05
Manganese, dissolved (mg/L)	.28	.29	.15	.02
Zinc, dissolved (mg/L)	.20	.025	.05	.02

metals such as Cu, Ni, and Pb, are also characteristic of landfill leachate but were not observed at the wells close to the landfill. In addition, the high mean value of zinc in wells close to the landfill results from the extremely high zinc value from the deep observation well (SA-25-03), which has a galvanized screen that probably contaminated the samples. Deleting the zinc values for well SA-25-03 from the analyses gives a mean and median zinc value similar to background levels. Because elevated concentrations of iron, manganese, and sulfate are not associated with any of the other indicators of landfill leachate, the landfill is probably not the source of these constituents.

The differences between ground-water quality at the landfill and that in surrounding areas are probably due to differences in geology. The wells that the U.S. Geological Survey sampled in the landfill vicinity draw water from the confined sand and gravel deposits beneath the relatively thick till. These confined deposits are likely to have a more reducing environment, in which iron and manganese become more soluble than in the unconfined surficial sand and gravel deposits elsewhere in the Sardinia aquifer. Also, the water quality at well SA-46, downgradient from the landfill, is similar to that of wells upgradient from the landfill and does not have appreciably greater concentrations of constituents that are indicators of landfill leachate.

In summary, results of the water-level measurements and the water-quality sampling together indicate that leachate has not migrated any great distance to the south, east, or northwest of the landfill. Northward migration could not be evaluated because the wells north of the landfill were not operational, and other data on this area are insufficient for interpretation.

AQUIFER IN THE SPRINGVILLE AREA

This sand and gravel aquifer occupies approximately 9.5 mi^2 of the town of Concord along the southern border of Erie County (fig. 15). The Springville area lies within the glaciated Allegheny Plateau, an area characterized by rounded hills with a network of drift-filled valleys. The aquifer occupies a broad valley-outwash plain bounded on the north by the morainal till of the Lake Escarpment moraine, on the east and west by till-mantled bedrock hills that rise as much as 300 ft above the plain, and to the south by the north slope of the Cattaraugus River valley. The outwash plain is drained by Spring Brook, which flows into Cattaraugus Creek.

Land use in the outlying areas beyond the Village of Springville is predominantly crop and dairy farming; the village contains some commercial establishments and light industry. Small gravel mining operations are scattered throughout the area.

Population and Ground-Water Use

Ground water is the principal source of water for approximately 5,200 people in the area underlain by the aquifer. The aquifer serves the Village of Springville (pop. 4,285, U.S. Bureau of Census, 1980), two trailer parks, several farms, and approximately 700 people in the rural areas. Table 5 lists the 1980 pumpage by various water users.

The single largest user of ground water is the Village of Springville, which pumps an average of 631,000 gal/d, about 35 percent of which is used by several small industries and commercial facilities (Greenly and Hansen, 1970). Several private homes use water from springs at the south edge of the aquifer.

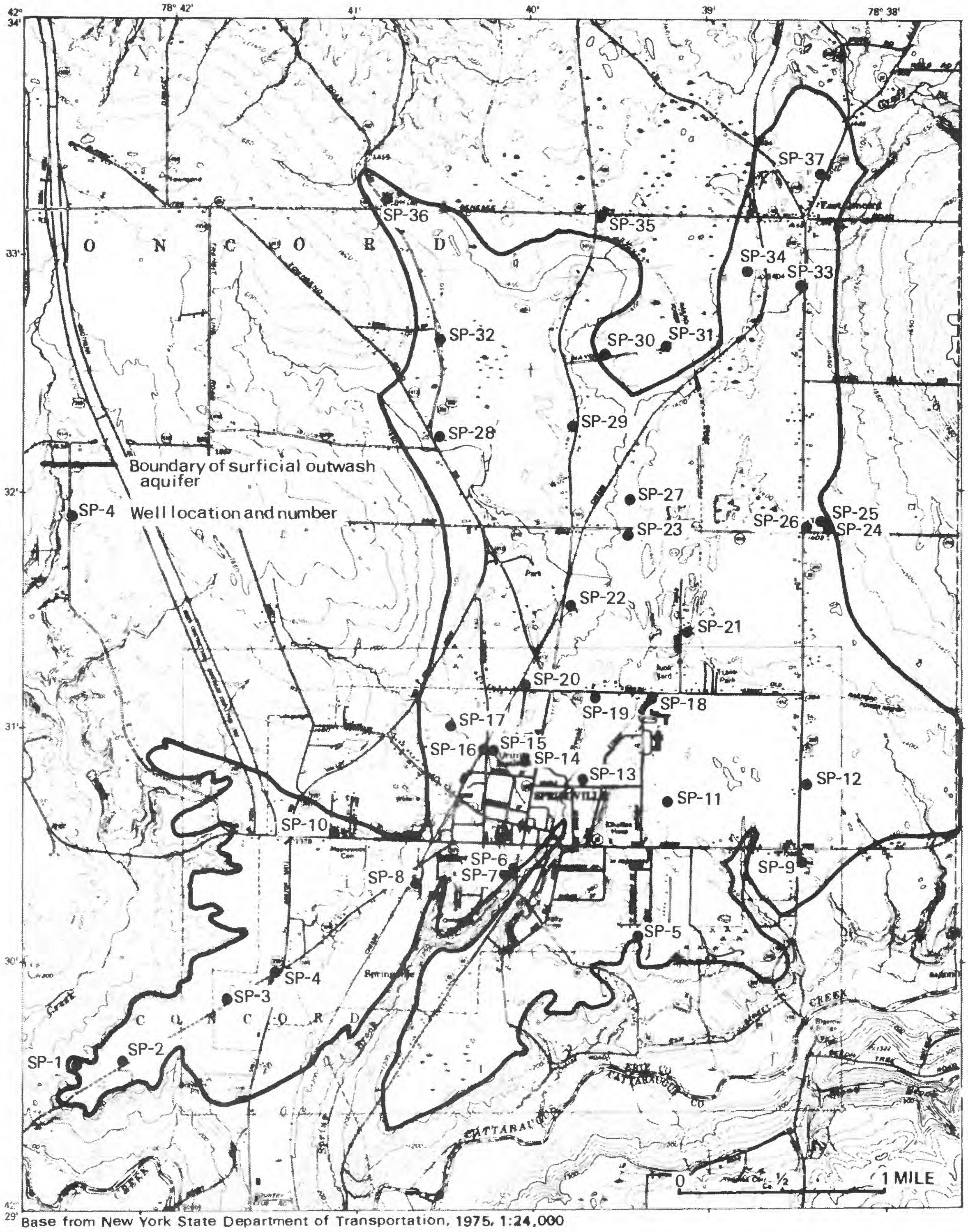


Figure 15.--Location of surficial outwash aquifer and wells in Springville area.

Table 5.--Population and pumpage in Springville area, 1982

Source	Population served	Average pumpage (gal/d)
Municipal community water system		
1. Village of Springville	[1]4,285	[2]631,000
Other community water systems		
1. Perkins Trailer Park	[3]75	[4]7,500
2. Springville Mobile Village	[3]114	[4]11,400
Private water supplies	[5]700	[4]70,000
TOTAL	5,174	719,900

1 U.S. Bureau of Census, 1980
2 Unpublished data from New York State Department of Health
3 New York State Department of Health, 1982
4 Assumed 100 gal/d per person
5 Estimated

Hydrogeologic Framework

The Springville aquifer occupies a deep north-south-trending glacially scoured valley that is partly filled with glacial sediments. Till-mantled bedrock hills border the aquifer on the east and west. Wisconsin glaciation north of Cattaraugus Creek severely altered the preglacial drainage features. The last glacial episode to affect the Springville area occurred during the Lake Escarpment readvance, about 14,000 years ago (Calkin, 1982), which marked an oscillating stand of the ice front in the northern part of the aquifer area. The receding ice deposited small undulating knobs and mounds of morainal till in the northern part of the Springville area, and meltwater deposited a sand and gravel outwash plain with a gently sloping surface from south of the moraine to the present location of Cattaraugus Creek (fig. 16). The outwash deposits form a wedge-shaped aquifer, thickest in front of the moraine and thinning southward, that terminates at the north wall of Cattaraugus Creek Valley, as shown in section A-A' of figure 17.

An exposed cut along the north bank of Cattaraugus Creek shows about 10 ft of outwash overlying clayey till deposited during Lavery glaciation (La Fleur, 1980). The till is highly susceptible to slumping along the steep banks of the creek. Underlying the till are interbedded lacustrine silt/clay and sand and gravel sediments deposited during pro-Lavery, Erie, and Kent stadial and interstadial periods of the Wisconsin glaciation (LaFleur, 1980). Little information on depth to bedrock is available; several borings in the Village of Springville to depths of 260 ft did not encounter bedrock.

Test drilling by Layne, Inc., in 1967, in the Village of Springville, revealed that, in the middle of the valley, an area of surficial outwash deposits 2.5 mi long and 3,000 ft wide had been eroded by glacial meltwater. In this area a veneer of alluvial and outwash silt, sand, and gravel (Qos in

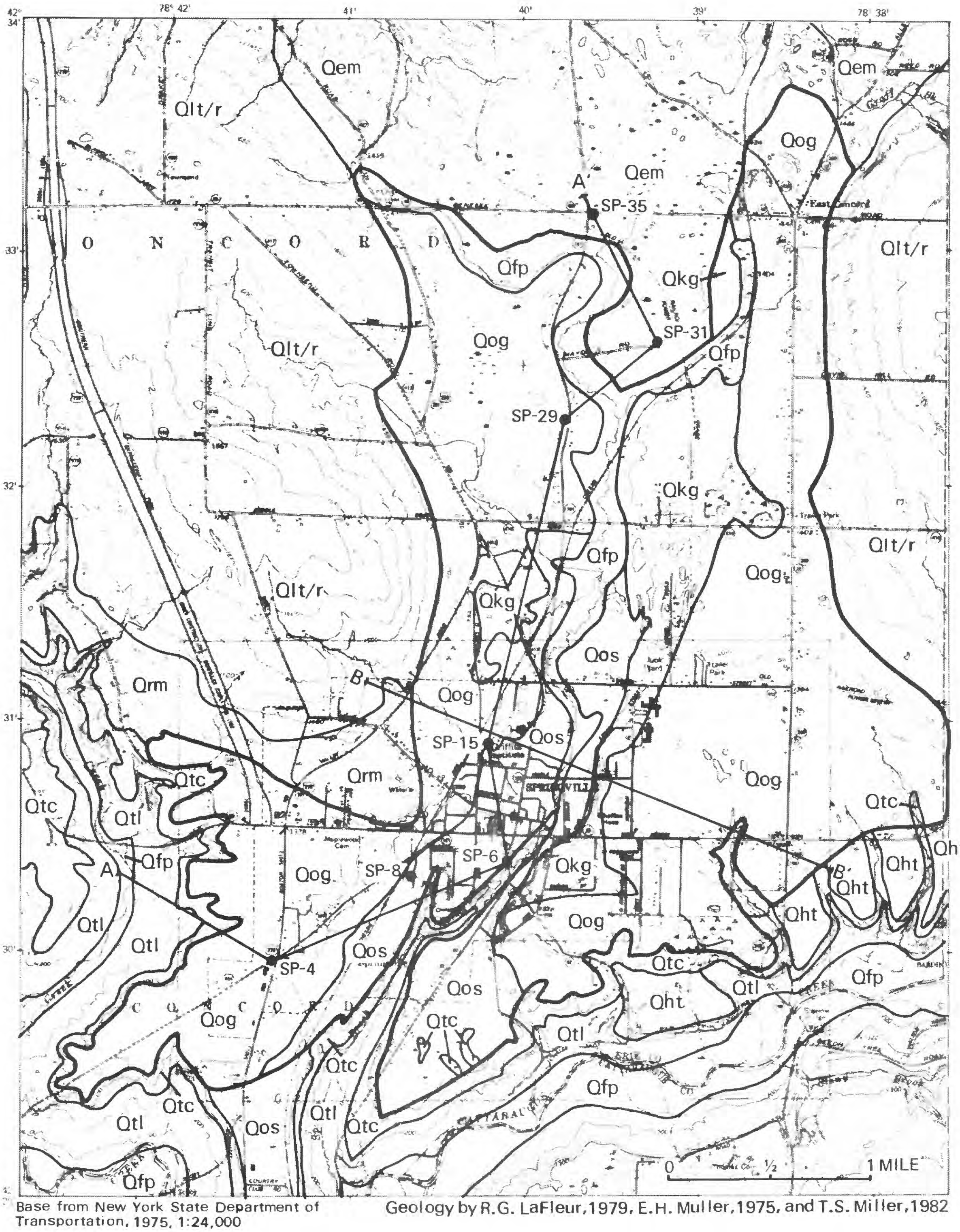


Figure 16.--Surficial geology and location of geologic sections in Springville area.

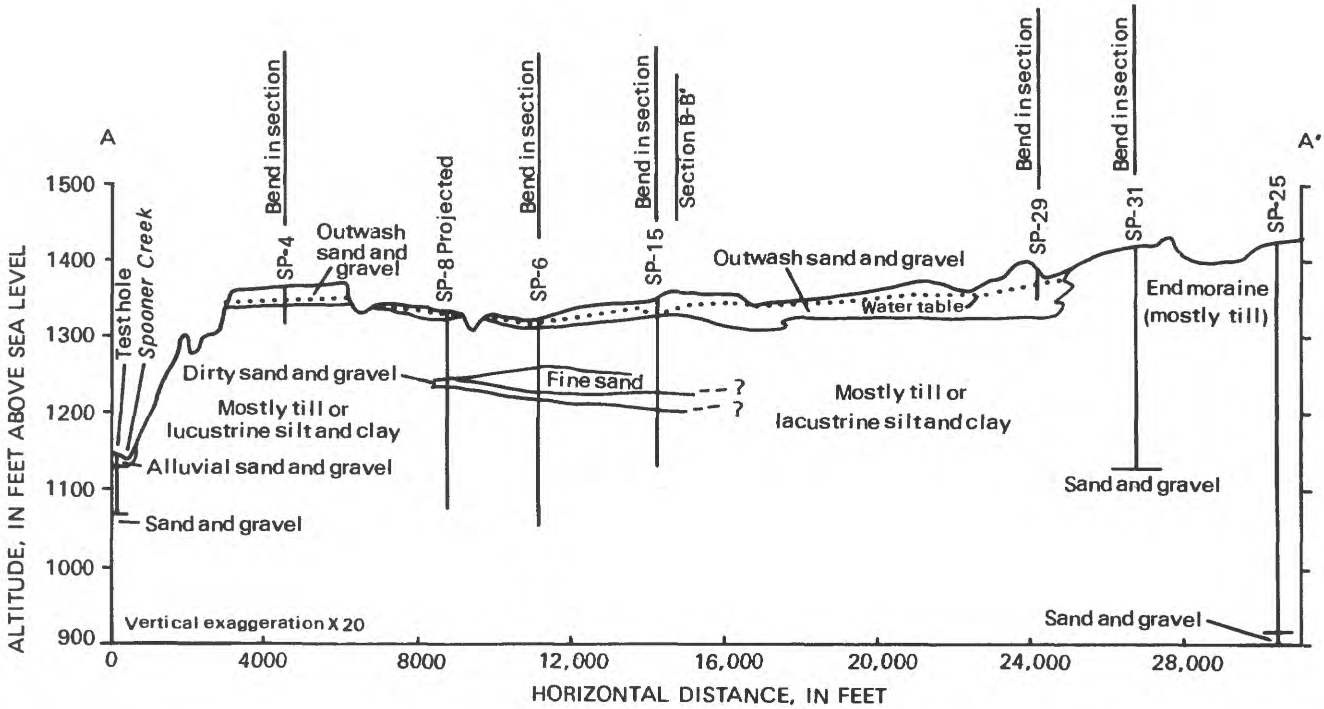
fig. 16) overlies silty clay till. Because most of the older outwash had been eroded away, the village wells are installed in discontinuous confined sand and gravel layers between depths of 85 and 145 ft (altitude 1,255 and 1,195 ft; see fig. 17, section B-B'). East of the village these buried sand and gravel layers are absent or lie at greater depths.

In the southern and southwestern parts of the area, the surficial outwash and confined aquifers end at the Cattaraugus Creek and Spooner Creek valleys, which are incised 150 to 180 ft into drift and, in one short stream reach, into bedrock.

EXPLANATION

———	Boundary of surficial outwash aquifer in Sardinia area
A———A'	Location of geologic section
SP-29	Well used in section

System	Series	Glaciation	Moraine or drift sheet		
QUATERNARY	HOLOCENE			Ofp	Alluvial silt and gravel
				Qtl	Landslides, slumps; covering clayey till
				Qht	High terraces of silt and gravel
	PLEISTOCENE	WISCONSINAN	LAKE ESCARPMENT	Qem	End moraine; till with some mixed sand and gravel
				Qos	Lake outwash incised into earlier outwash; sand and gravel
				Qog	Outwash; cobble gravel, sand
				Qls	Lacustrine sand, silt, and clay
				Qkg	Ice-contact, kame sand and gravel
			LAVERY	Otc	Till, clayey with embedded cobbles with occasional silt, sand, and gravel stringers
			KENT	Orm	Ground moraine; till and some stratified drift
				Qlt/r	Lodgment till overlying bedrock



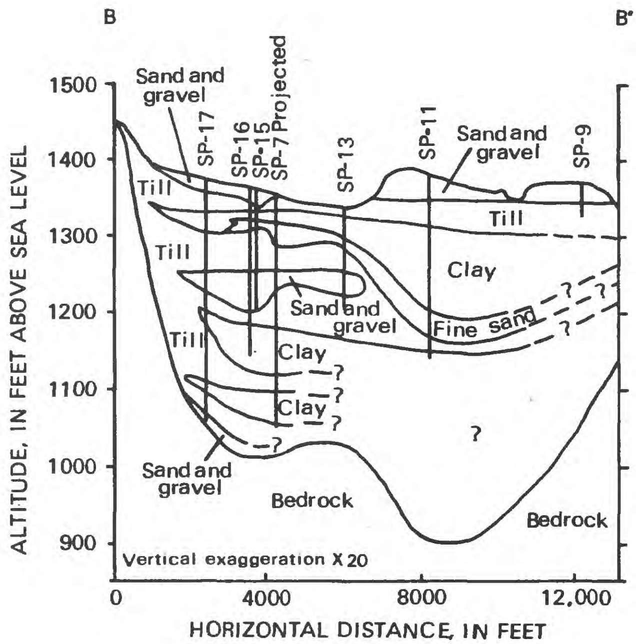
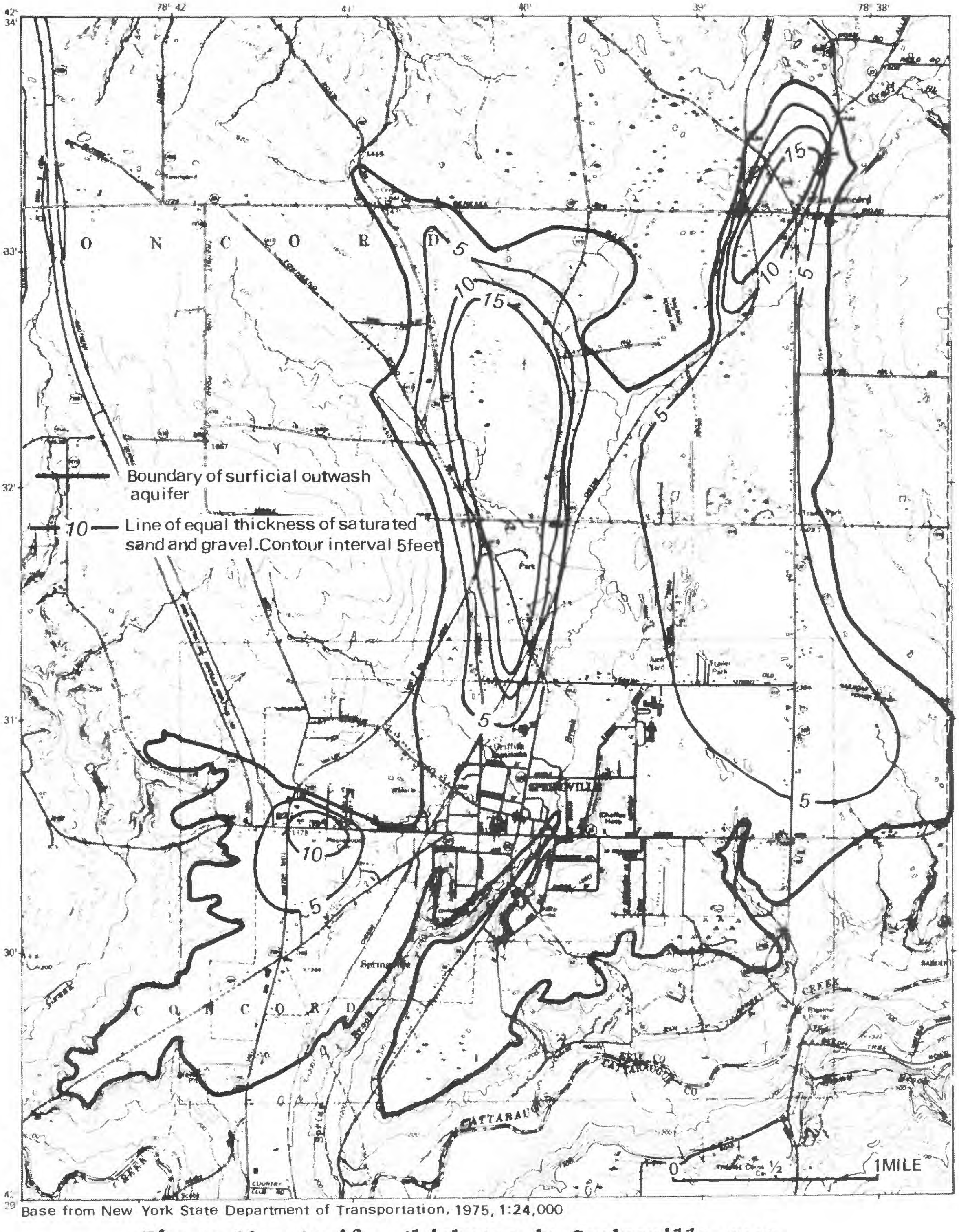


Figure 17.--Geologic sections through Springville area; A-A', north-south through aquifer area and B-B', east-west through central part of aquifer.

Saturated Thickness

Saturated thickness of the sand and gravel (fig. 18) is greatest (15 to 20 ft) in the northern part of the valley and thins to less than 5 ft to the south and in the central part.



Base from New York State Department of Transportation, 1975, 1:24,000

Figure 18.--Aquifer thickness in Springville area.

The deeper confined sand and gravel units, which are discontinuous and lie beneath the upper till and lacustrine deposits (see fig. 17), provide the largest well yields (tens to more than several hundred gal/min). The upper till and lacustrine deposits beneath Springville are 80 to 90 ft thick, and the underlying sand and gravel deposits, mostly 4 to 15 ft thick, lie between depths of 84 and 150 ft below land surface. East of Springville the till and lacustrine deposits thicken (fig. 17, section B-B'), and the depth to buried sand and gravel layers increases. Well SP-35 along the northern edge of the aquifer is 528 ft deep and taps a buried sand and gravel layer (altitude 902 ft) that is probably overlying or near bedrock. The floor of the buried bedrock valley probably lies at an altitude of 900 ft.

Ground-Water Movement

Recharge

Aquifer recharge results from precipitation infiltrating downward through permeable soils to the water table, by seepage from tributary streams that originate in the till-mantled uplands and flow onto the aquifer, and by subsurface flow from the adjacent till and bedrock on the sides of the valley. Hydrographs of the water levels of several wells (fig. 19) indicate that most recharge occurs from November through April. Although about 40 percent of the average annual precipitation (approximately 42 inches) falls during the growing season--May through September (Dethier, 1966)--nearly all is evaporated or transpired by vegetation so that little water recharges the aquifer during this period. Average annual recharge to the aquifer ranges from 0.4 to 1.0 (Mgal/d)/mi^2 (La Sala, 1968).

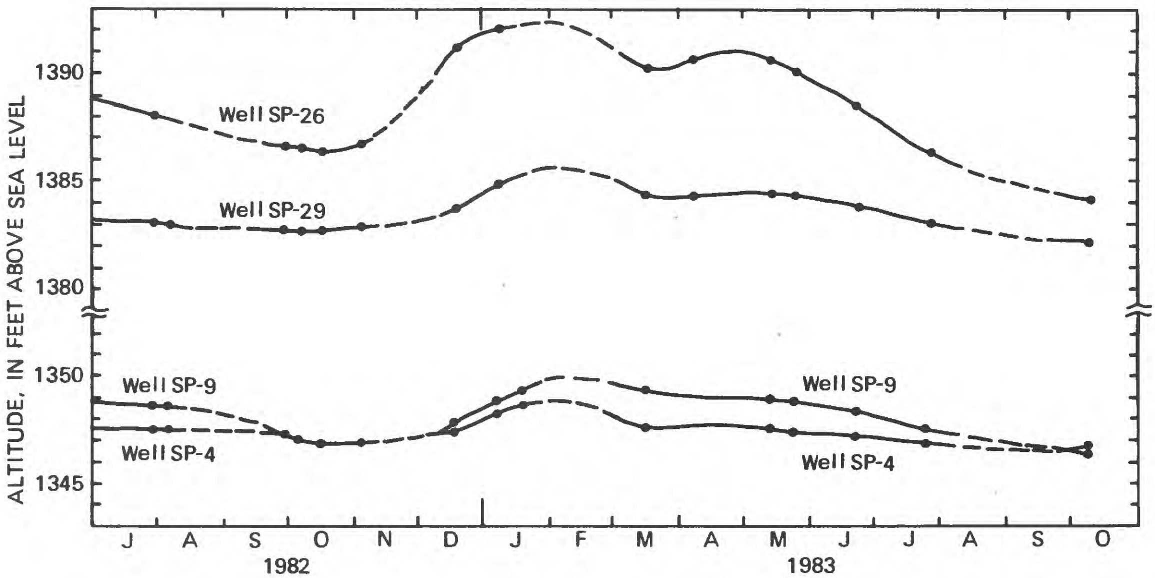


Figure 19.--Hydrographs of wells tapping Springville aquifer, July 1982 through October 1983. (Locations are shown in fig. 15.)

Discharge

Ground-water discharge occurs by pumpage, seepage into Spring Brook, spring flow from the base of the aquifer along the valley walls at Spring Brook, Cattaraugus Creek, Spooner Creek, and the edges of the older outwash (Qog in fig. 16) in the middle of the valley, and by evapotranspiration. Great Bear Spring, 1,000 ft north of Middle Road, flows from the edge of the older outwash and was once a water supply for Springville.

The direction of ground-water flow is controlled by hydraulic gradients and is indicated by arrows in figure 20. Ground water in this area generally flows from north to south and from the east, west, and north perimeter of the aquifer toward the center of the valley. A ground-water mound in the southwestern part of the aquifer causes ground water there to flow west to Spooner Creek, south to Cattaraugus Creek, and east to Spring Brook.

Water Quality

Ground-water samples were collected during August 1982 and January and May of 1983 (table 10C) from eight wells and two springs in the Springville area. Six of the wells tap the surficial sand and gravel aquifer at depths ranging from 22 to 56 ft; the other two tap deep, confined sand and gravel deposits at depths of 137 and 300 ft. The two springs emanate from the edge of the surficial sand and gravel aquifer. Locations of wells and springs are shown in figure 20.

Chemical analyses indicate the water in the Springville aquifer to be suitable or marginally suitable for most uses (table 6). Hardness values range from 78 to 445 mg/L as $CaCO_3$ (moderately hard to very hard) with a median value of 238 mg/L as $CaCO_3$ (very hard). Seven of the ten sampling sites had very hard water, two had hard water, and one had moderately hard water. Iron and manganese exceeded the New York State drinking-water standards in eight samples from four wells.

The New York State drinking-water standard for nitrate (10 mg/L) was matched in the last sample taken from well SP-9, in the southeast part of the aquifer, and the standard was approached in samples from several other wells. The chloride standard (250 mg/L) was nearly exceeded in samples from wells SP-9 and SP-26 along the eastern edge of the aquifer, and, although no drinking-water standard has been established for sodium, the sodium concentration in some of the shallow wells exceeded the recommended concentration of 20 mg/L (U.S. Environmental Protection Agency, 1976) for people on sodium-restricted diets. Minimum, maximum, mean, and median values for all inorganic constituents measured in the Springville aquifer are listed in table 6 along with the New York State drinking-water standards.

Because the unconfined sand and gravel aquifer is exposed at land surface, some recharge occurs directly from the surface, thereby making the aquifer susceptible to contamination from surface sources. Results of the water-quality analyses indicate that soluble material is indeed entering the aquifer from surface sources. For example, the nitrate concentrations were uniformly higher in the Springville aquifer than in the other four aquifers studied.

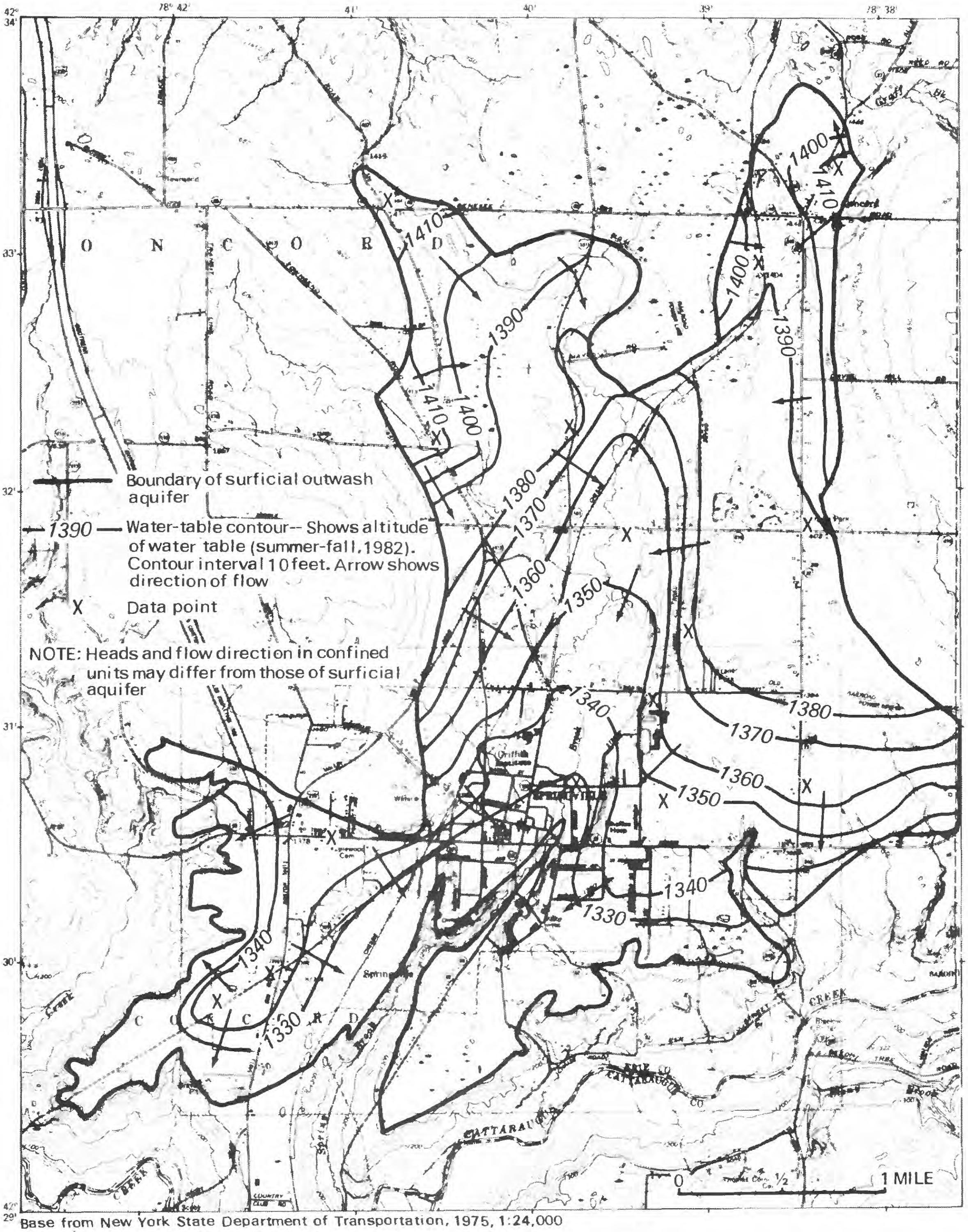


Figure 20.--Potentiometric-surface altitude and direction of ground-water flow in Springville area.

Table 6.--Minimum, maximum, mean, and median values and concentrations of water-quality constituents from Springville aquifer.

Constituent	No. of samples	Value or concentration				New York State drinking-water standard[a]
		Minimum	Maximum	Mean	Median	
Specific conductance (μmho/cm)	28	227	1,360	574	495	--
pH, lab (standard units)	28	7.0	8.0	--	7.8	--
Carbon, total organic (mg/L as C)	28	1	116	17	8.2	--
Hardness (mg/L as $CaCO_3$)	28	78	445	253	238	--
Alkalinity, lab (mg/L as $CaCO_3$)	28	60			182	--
Calcium, dissolved (mg/L)	28	23	145	77	70	--
Magnesium, dissolved (mg/L)	28	5.0	27	15	15	--
Potassium, dissolved (mg/L)	28	.5	9.6	2.7	1.7	--
Sodium, dissolved (mg/L)	28	3.0	165	23	9.9	--
Chloride, dissolved (mg/L)	28	10	225	48	19	250
Fluoride, dissolved (mg/L)	28	<.2	1.1	.23	<.2	1.5
Nitrogen, NO_2+NO_3, dissolved (mg/L as N)	27	.1	10	4.5	4.7	10[b]
Phosphorus, ortho, dissolved (mg/L as P)	28	.01	.48	.05	.02	--
Sulfate, dissolved (mg/L as SO_4)	28	16	139	36	29	250
Arsenic, dissolved (μg/L)	28	<20	<20	<20	<20	50
Barium, dissolved (μg/L)	28	<200	500	243	<200	1,000
Cadmium, dissolved (μg/L)	28	<1	9	1.4	<1	10
Chromium, dissolved (μg/L)	28	<10	<10	<10	<10	50
Copper, dissolved (μg/L)	28	<20	50	22	<20	1,000
Iron, dissolved (μg/L)	28	50	2,900	337	50	300[c]
Lead, dissolved (μg/L)	28	<10	20	10	<10	50
Manganese, dissolved (μg/L)	28	<10	8,300	670	30	300[c]
Mercury, dissolved (μg/L)	28	<.4	<.4	<.4	<.4	--
Selenium, dissolved (μg/L)	28	<1	10	1.3	<1	10
Silver, dissolved (μg/L)	28	<10	<10	<10	<10	50
Zinc, dissolved (μg/L)	28	<20	300	41	<20	5,000

a) Drinking water standards from New York State Department of Health, 1964 and 1977. A dash indicates no data.
b) Only nitrate as N.
c) If iron and manganese are both present, the total concentration of both substances should not exceed 300 μg/L.

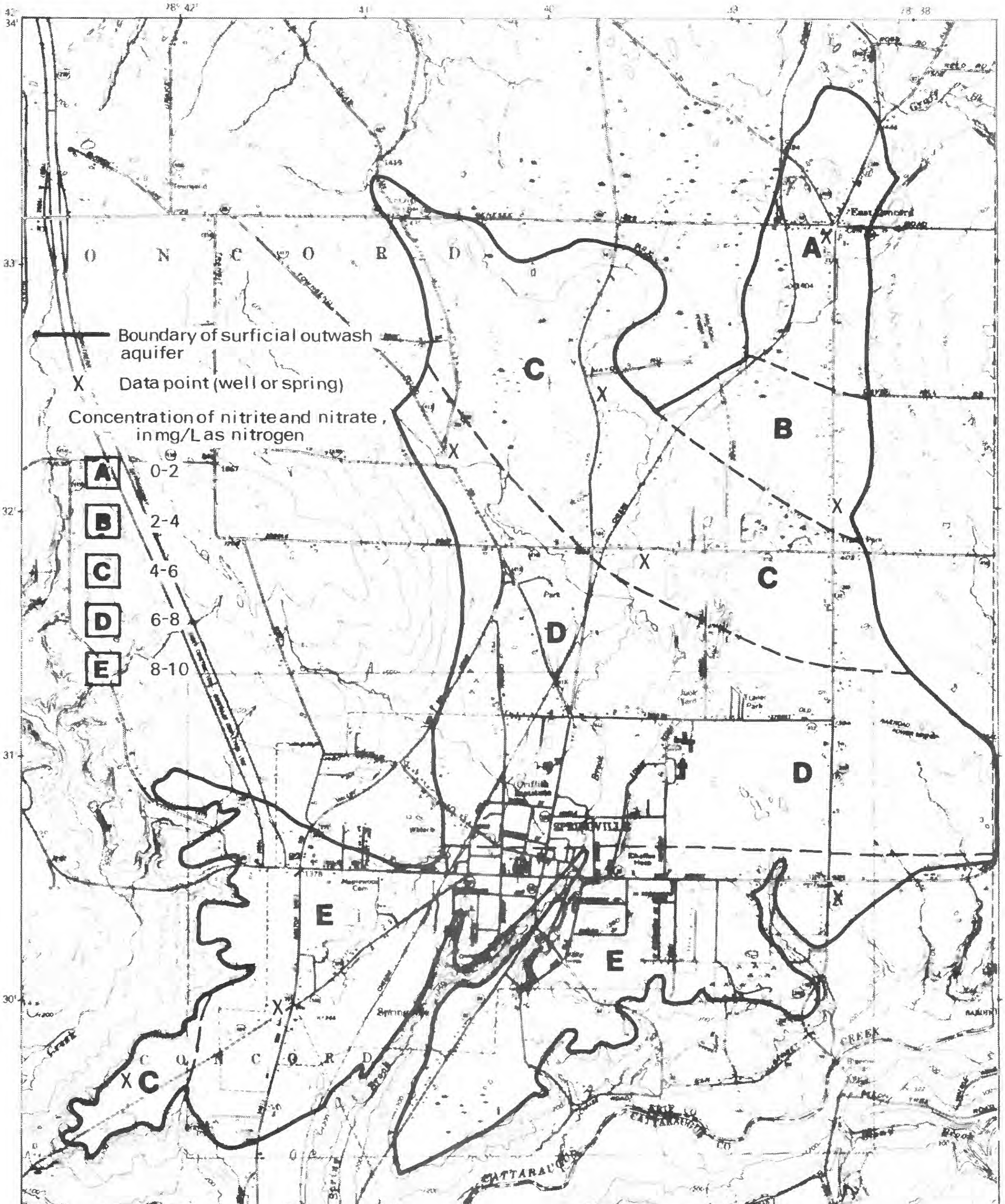


Figure 21.--Areal distribution of nitrate concentrations in Springville area.

Nitrate concentrations in the two springs and all shallow wells exceeded 2.6 mg/L and in four wells exceeded 7.5 mg/L. The nitrate concentrations (fig. 21) appear to increase southwestward, following the direction of ground-water flow, which suggests that nitrates accumulate in the ground water as it flows beneath this largely agricultural valley. Alternatively, the high nitrate concentrations may reflect only local influences because shallow wells that had high nitrogen concentrations are in or near fields under agricultural production. However, the relatively high nitrate concentrations measured in water from all wells tapping the surficial aquifer indicate a moderate concentration of nitrate throughout the aquifer. Freeze and Cherry (1979) report that, in areas where nitrate contamination is extensive, fertilizer is generally the primary nitrogen source.

Three shallow wells (SP-9, SP-26, SP-37) contained elevated concentrations of sodium and chloride. These wells show no other pattern, but all are close to major highways, which suggests that the aquifer is influenced by road salt locally but has not been widely affected by sodium and chloride.

The ground water in the deep, confined sand and gravel layers appears to be protected from surface contamination. The two deep wells (SP-15 in Springville and SP-31 north of the aquifer) had low concentrations of nitrate, sodium, and chloride (table 6); the latter well, 300 ft deep, also had the second lowest concentration of dissolved solids (as determined by specific conductance). In contrast, the first well, 137 ft deep, had relatively hard water with high levels of iron, manganese, and sulfate and also contained a high concentration of fluoride (1.1 mg/L in one sample, which is near the drinking-water standard of 1.5 mg/L).

AQUIFER IN THE ALDEN AREA

The Alden sand and gravel aquifer occupies approximately 4.2 mi^2 of the Town and Village of Alden in east-central part of Erie County and 0.15 mi^2 of Genesee County (fig. 22). The aquifer is in the glaciated Erie lowlands. The area consists of gently rolling beach ridges, which are bordered on the north by a flat to gently sloping lake plain and on the south by many small hummocky morainal mounds of till. Most of the area is drained by tributaries to Ellicott Creek, which flows westward along the northern perimeter of the aquifer and into the Niagara River. The west and southwest part of the aquifer is drained by tributaries to Cayuga Creek, which flows into Lake Erie.

Land use is predominantly residential and agricultural. Residential areas include the Village of Alden in the center of the aquifer and corridors of suburban residences along state and county roads.

Population and Ground-Water Use

Ground water is the sole source of water for approximately 3,800 people living in the area underlain by the aquifer. Industry and residents of the Village of Alden (population 2,488, U.S. Bureau of Census, 1980) are supplied by a public water-supply system that uses a well field consisting of three drilled wells and three dug wells installed in sand and gravel deposits. The remainder of the residences, farms, and commercial facilities use individual private wells. Table 7 summarizes the estimated pumpage from the aquifer.

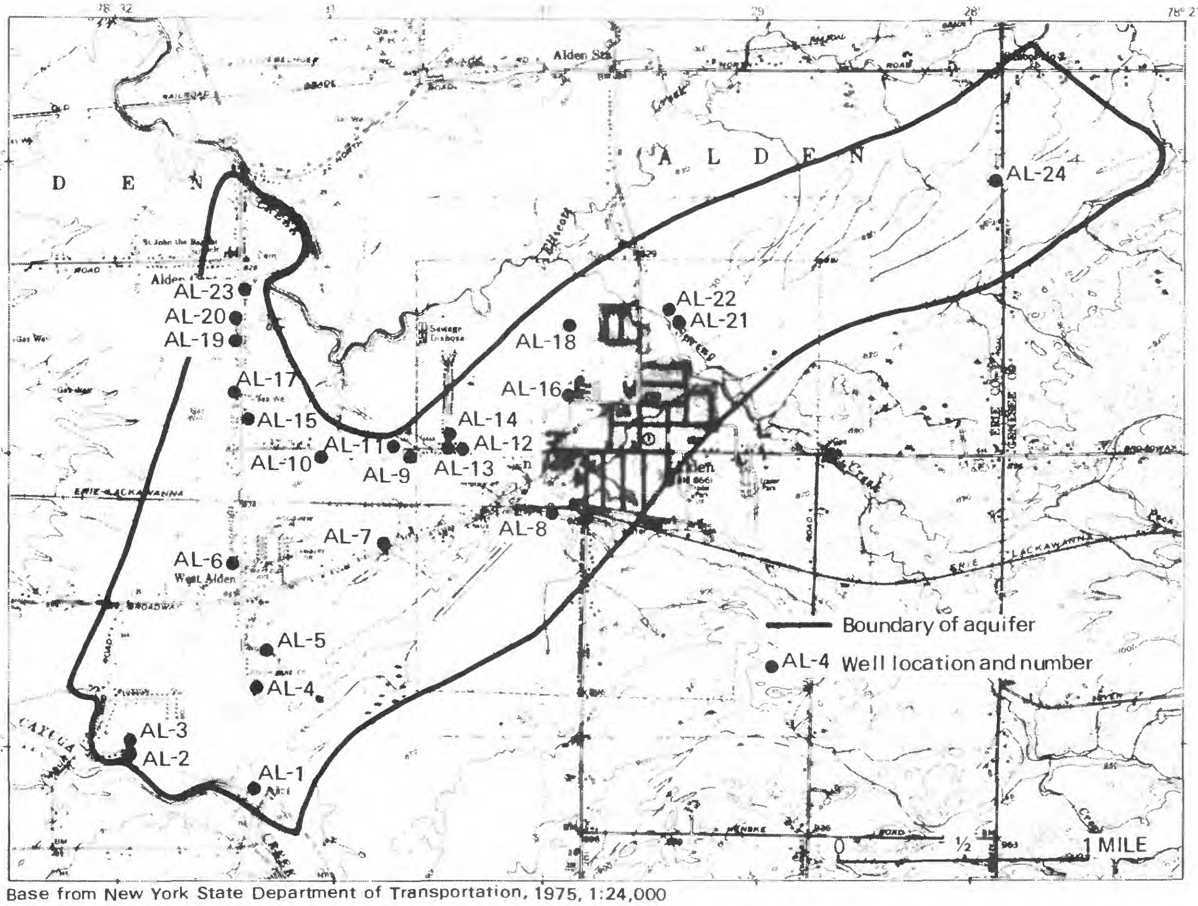


Figure 22.--Location of aquifer and wells in Alden area.

Hydrogeologic Framework

Deglaciation during late Wisconsin time resulted in deposition of morainal till (Marilla moraine) south of the aquifer, the beaches and deltaic sand and gravel that form the aquifer, and extensive lacustrine silt and clay and till deposits northwest of the aquifer (Calkin, 1982). The distribution of surficial deposits is shown in figure 23.

The aquifer was formed when fluvial material, transported by north-flowing Cayuga Creek and other small tributaries that drained the uplands to the south, was deposited into a proglacial lake (Lake Warren) to form a delta. Wave action reworked the deltaic deposits to form long, linear beach ridges.

Table 7.--Estimated population and pumpage from Alden aquifer, 1982

	Population	Pumpage (gal/d)
Alden municipal supply		
Domestic water consumption	[1]2,500	[2]250,000
Industrial		*37,000
Other (institutions, parks, fire fighting, etc.)		*43,000
Private water supplies	*1,300	*130,000
Commercial		*20,000
Stock		*5,000
	3,800	485,000

* Estimated
[1] U.S. Bureau of Census, 1980
[2] Unpublished data from New York State Department of Health

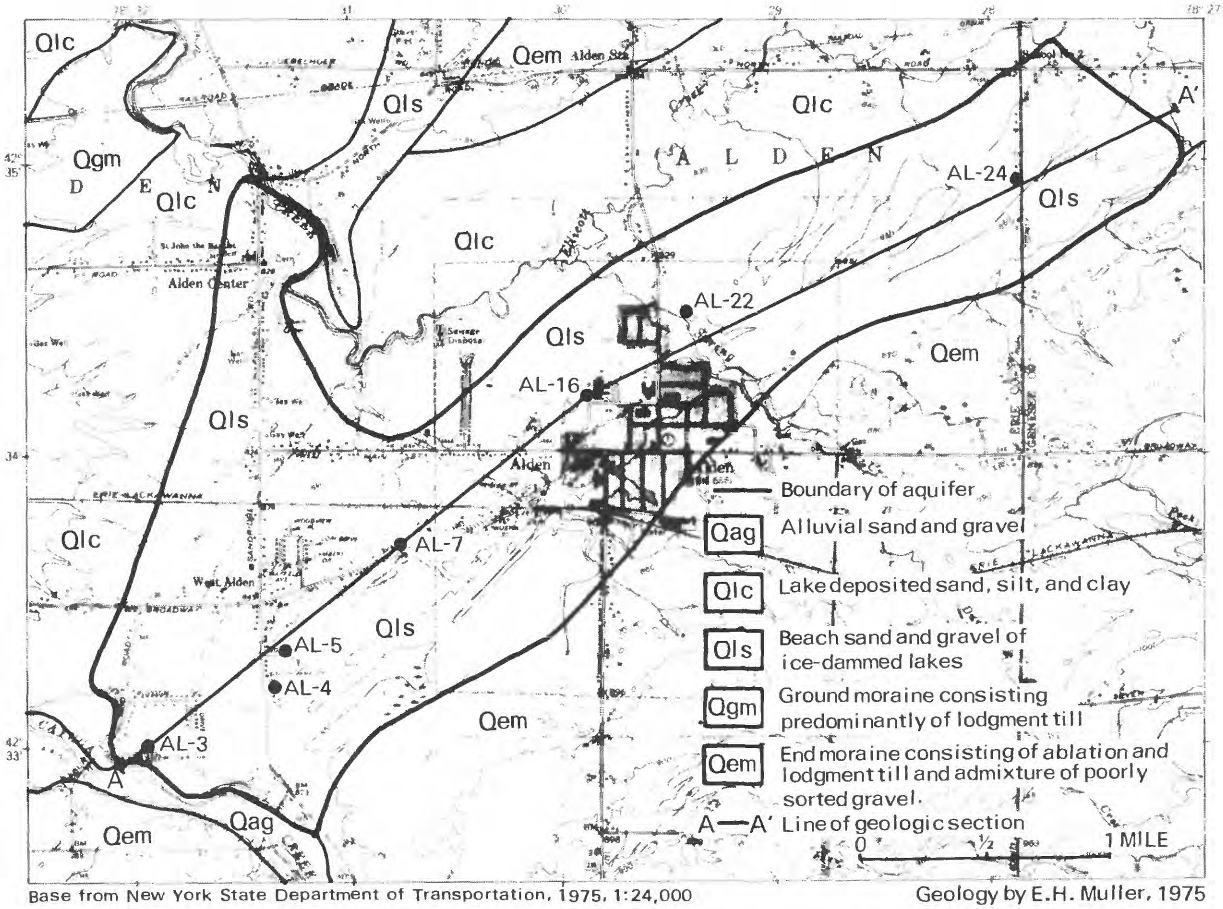


Figure 23.--Surficial geology and lines of geologic sections A-A' in Alden area.

No test holes were drilled by the U.S. Geological Survey during this study, but subsurface information was provided by Harold and Michael Frey of Frey Well Drilling of Alden, and was obtained from Village of Alden well records and from wells inventoried by the Geological Survey. Well logs were unavailable, except those for the village well field; therefore, subsurface information in the Alden area is inferred. The well driller indicated, in general, 10 to 20 ft of sand and gravel overlying 10 to 20 ft of till or sandy clay, which in turn overlies 5 to 15 ft of sand and gravel over shale bedrock. A generalized section is shown in figure 24. Most wells tapping this aquifer are installed in the lower sand and gravel zone, but, because this zone is thin (5 to 15 ft), the wells are commonly extended 6 to 8 ft into the shale to provide a "storage reservoir" as shown schematically in figure 25.

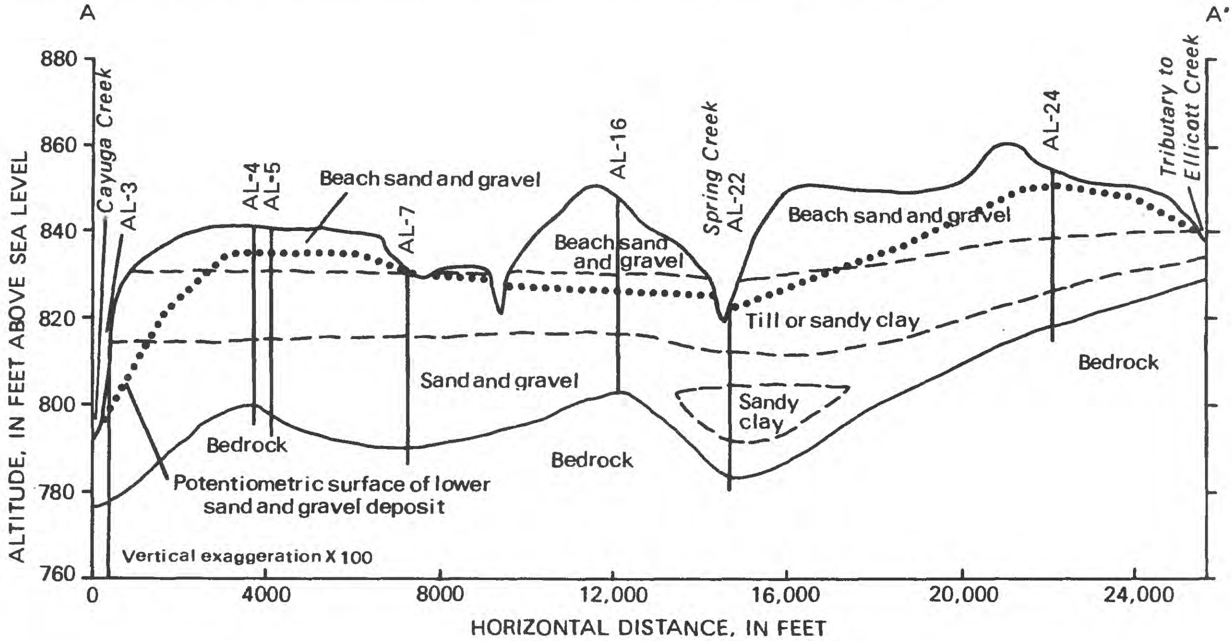


Figure 24.--Geologic section A-A' through the Alden area.

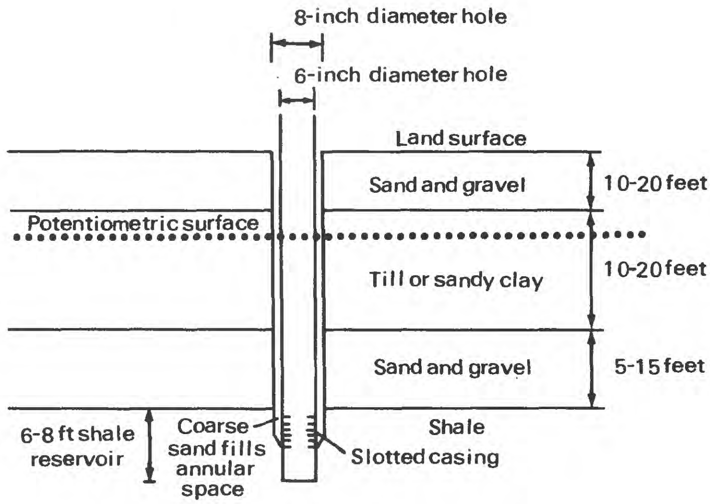


Figure 25.--Construction of typical wells in Alden area.

Saturated Thickness

Aquifer material consists of sediments ranging from fine sand to coarse gravel. Few wells tap the 10- to 20-ft upper sand and gravel zone, which is unsaturated or only thinly saturated (less than 5 ft). Well logs and drillers indicate that the lower sand and gravel zone, generally 5 to 15 ft thick, is confined beneath a relatively impermeable till or sandy clay layer 10 ft thick and overlying shale (fig. 24).

Ground-Water Movement

Recharge

Ground water in the upper sand and gravel zone, where present, is under water-table conditions. Because few parts of the upper zone are saturated, the water-level data were too scant for construction of a water-table map. Recharge to the upper sand and gravel zone occurs solely from precipitation, and the average annual replenishment is estimated to range from 0.2 to 0.4 (Mgal/d)/mi^2 (La Sala, 1968). A pumping test at the Village of Alden dug wells revealed a "safe" yield of approximately 75 gal/min or 108,000 gal/d.

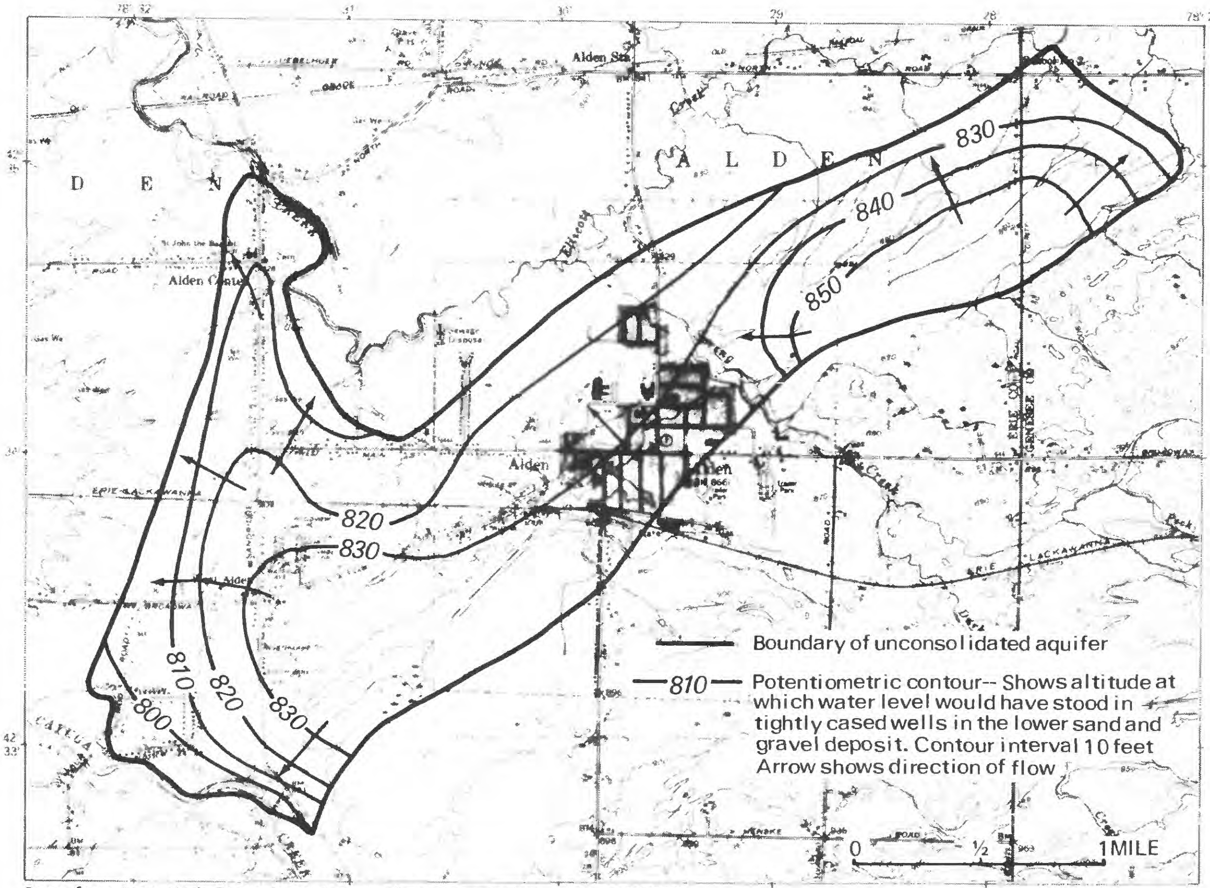
Recharge to the lower aquifer is more complex. Where the water table in the upper aquifer is above the potentiometric surface of the lower aquifer, some ground water may infiltrate downward through the till or sandy clay confining beds to the lower sand and gravel. Where the water table is below the potentiometric surface, such as where artesian flow occurs, the lower aquifer may discharge to the upper aquifer.

The chemical quality of ground water in the lower aquifer suggests that some of the water may be derived from the underlying shale. Recharge probably also occurs along the southern edge of the aquifer, where bedrock crops out in Spring Brook at State Highway 20. The lower gravel may also crop out in this area and receive recharge from precipitation and seepage from Spring Brook. Peripheral recharge to the lower sand and gravel may also occur from seepage from the till and(or) bedrock in this area, and by infiltration of runoff from the till uplands to the south.

Discharge

Discharge from the upper zone occurs by evapotranspiration, by seepage into streams, and by pumping dug wells in the Village of Alden near Spring Brook. Discharge from the lower aquifer occurs by pumping of village and private drilled wells and by seepage into Ellicott and Cayuga Creeks.

Water levels in some wells tapping the lower sand and gravel zone in the northern part of the aquifer were above the top of that zone (some wells flowed), which indicates confined conditions. A potentiometric-surface map of the lower zone (fig. 26) was drawn from water-level measurements made by the Geological Survey mostly during November 1982 and supplemented by measurements made by Frey Drillers and Village of Alden during 1960-81. Water in the central and eastern parts of the aquifer flows mainly north-northwestward into Ellicott Creek; water in the western part flows westward into Cayuga Creek and tributaries to Cayuga Creek.



Base from New York State Department of Transportation, 1975, 1:24,000

Figure 26.--Potentiometric surface and direction of ground-water flow in lower sand and gravel aquifer in Alden area.

Water Quality

Water-quality data from the Alden sand and gravel aquifer were obtained by the Erie County Department of Health in a single sampling of four public water-supply wells (AL-21, AL-8, AL-18, and AL-16) in April 1982 (table 10D). Results of the analyses indicate that the water quality of the sand and gravel aquifer is generally fair to good.

Nitrate and nitrite concentrations were all below 2.3 mg/L as N, and few of the New York State drinking-water standards were exceeded. The poorest water was from wells AL-18 and AL-16 (fig. 22), which exceeded the State drinking-water standards for iron, sulfate, and total dissolved solids. These constituents, which probably originate from natural sources, do not present a health hazard but could be an esthetic concern. Minimum, maximum, and mean values for all inorganic constituents measured are listed in table 8 along with the New York State drinking-water standards.

The water quality in individual wells varied with the depth of the wells. The higher dissolved-solids concentrations in water from the deeper wells is consistent with the observation that water from the underlying shale bedrock may be discharging upward to the sand and gravel zone that overlies bedrock.

Table 8.--Minimum, maximum, and, mean values and concentrations of water-quality constituents from Alden aquifer.

Constituent	No. of samples	Minimum	Maximum	Mean	New York State drinking-water standard[a]
Specific conductance (µmhos/cm)	--	--	--	--	--
pH, lab (standard units)	4	7.3	7.7	7.6	--
Carbon, total organic (mg/L as C)	4	4.7	13	9.7	--
Hardness (mg/L as $CaCO_3$)	4	170	653	387	--
Alkalinity, lab (mg/L as $CaCO_3$)	4	145	283	232	--
Calcium, dissolved (mg/L)	4	62	247	149	--
Magnesium, dissolved (mg/L)	4	7.2	25	15	--
Potassium, dissolved (mg/L)	--	--	--	--	--
Sodium, dissolved (mg/L)	4	1.9	22	13	--
Chloride, dissolved (mg/L)	4	5.0	40	26	250
Fluoride, dissolved (mg/L)	4	<0.2	<0.2	<0.2	1.5
Nitrogen, NO_2+NO_3 dissolved (mg/L as N)	4	0.1	2.7	0.8	10[b]
Phosphorus, ortho, dissolved (mg/L as P)	--	--	--	--	--
Sulfate, dissolved (mg/L as SO_4)	4	23	376	156	250
Arsenic, dissolved (µg/L)	4	<20	<20	<20	50
Barium, disolved (µg/L)	4	<200	<400	300	1,000
Cadmium, dissolved (µg/l)	4	<1	<1	<1	10
Chromium, dissolved (µg/L)	4	<10	<10	<10	50
Copper, dissolved (µg/L)	4	<20	40	30	1,000
Iron, dissolved (µg/L)	4	<50	480	250	300[c]
Lead, dissolved (µg/L)	4	<10	<10	<10	50
Manganese, dissolved (µg/L)	4	<10	120	40	300[c]
Mercury, dissolved (µg/L)	4	<0.4	<0.4	<0.4	--
Selenium, dissolved (µg/L)	4	<1	<1	<1	--
Silver, dissolved (µg/L)	4	<10	<10	<10	50
Zinc, dissolved (µg/L)	4	<20	40	30	5,000

a) Drinking-water standards from New York Department of Health, 1964 and 1977. A dash indicates no data.
b) Only nitrate as N.
c) If iron and manganese are both present, the total concentration of both substances should not exceed 300 µg/L.

Site AL-21, in the northern part of town, contains three dug wells, 14 ft deep, that produced water with the lowest measured dissolved-solids concentration. Here, a sandy clay lens separates the lower sand and gravel aquifer from the upper aquifer (fig. 24). The dug wells draw water from the upper till or sandy clay lens and probably from the upper zone of the lower sand and gravel aquifer. Because a second lower sandy clay lens overlies the shale, water from dug wells is probably unaffected by water from the shale, which would explain their relatively low dissolved-solids concentrations.

Wells AL-8 and AL-16, near the center of Alden, tap the lower sand and gravel aquifer that overlies bedrock and are screened from 27 and 45 ft, respectively. Water from these wells contained elevated concentrations of dissolved solids, hardness, calcium, magnesium, iron, manganese, sulfate, sodium, and chloride. Because both wells are in contact with the shale, some of their water is probably derived from the shale. Similarly, well AL-18, in the northern part of Alden, taps the lower sand and gravel aquifer and extends 2 ft into the shale (La Sala, 1968, p. 101) and produces water with the highest concentration of dissolved solids, hardness, calcium, magnesium, iron, manganese, sulfate, sodium, and chloride.

A local driller reported that about 90 percent of wells in the Alden area have iron bacteria encrustation. The encrustation, which can clog screens and reduce water yields, can be removed by adding acid and surging the well.

SUMMARY

Aquifers in the Clarence-Lancaster-Newstead area.--This area contains a discontinuous surficial aquifer of morainal, beach, and outwash sand and gravel overlying the Onondaga Limestone, which generally yields 10 to 100 gal/min; most wells in the area tap this aquifer. Quality of water in the unconsolidated deposits is similar to that of the limestone except that the limestone has a higher concentration of sulfate, which is probably due to solution of gypsum minerals. Quality of water in the shallow wells is variable, especially in those along and downgradient of the New York State Thruway, where sodium and chloride concentrations are elevated. A landfill is excavated in the surficial deposits in the western part of the aquifer, but no significant contamination directly attributable to the landfill in the area was detected in wells (sampled during this study) tapping either the unconsolidated deposits or the upper part of the limestone. Water levels in nested piezometers at the landfill indicated a significant downward component of ground-water flow. Little water-quality data are available to determine the effect of the landfill in deeper water-bearing zones of the limestone, however.

Aquifers in the Sardinia and Springville areas.--The two surficial glacial outwash sand and gravel aquifers in these areas occupy deep, glacially scoured valleys and overlie mostly nonwater-bearing sediments that contain several buried sand and gravel deposits. The best sources of ground water are in the northern parts of the aquifers, where the aquifers are thickest and near recharge areas. A landfill adjacent to the Sardinia aquifer has not significantly

affected the water quality of the surficial aquifer, but more data would be needed to determine the effects on the confined sand and gravel aquifer along the northern perimeter of the landfill.

Aquifer in the Alden area.--This aquifer consists of an upper sand and gravel zone and a more productive lower zone on top of shale bedrock. The two zones are separated by a sandy clay or till layer. Water from the lower zone is more highly mineralized, probably because it is partly derived from the underlying shale.

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Table 9.--Records of selected wells in Erie County, New York

NUMBERING AND ARRANGEMENT OF WELLS

All wells and borings are identified by latitude and longitude to the nearest second, as measured from 71/2-minute topographic maps, scale 1:24,000. The location of each well or boring record was plotted on these maps by U.S. Geological Survey staff during a visit to the site or from large-scale engineering drawings.

The location of each well and boring is shown on maps within the text. Data are arranged in 1-minute strips of latitude. Each table begins with the southernmost strip followed by other strips successively farther north.

FOOTNOTES AND ABBREVIATIONS

1. Type of well

Drl = drilled
Dug = dug
Drv = driven

2. Aquifer type

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

3. Land-surface altitude

in feet above National Geodetic Vertical Datum of 1929 (NGVD), estimated from topographic maps.

4. Water use

A = abandoned
C = commercial
D = domestic
PS = public supply
I = industrial
In = institutional
O = observation
U = unused
F = farm

5. Remarks

Yield (e) = estimated yield

Yield (m) = measured yield during pumping test

Yield (r) = reported yield

F = fine
M = medium
C = coarse

Table 9.--Records of selected wells in Erie County, New York

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Casing depth (ft)	Casing diam (in)	Depth to bedrock (ft)	Aquifer type	Altitude surface (ft)	Water-level depth below land surface (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
LANCASTER-CLARENCE-NEWSTEAD AREA (Well locations shown in fig. 2.)																
LC-1	4255 56 7837 26		J. Guenther	1947*	Drl	75	--	6	--	Shale	760	30	Summer/82	No		*.
LC-2	4255 58 7836 34		F. Long	1977	Drl	57	--	6	57	S&G	755	22.1	9-23-81	No	U	*., silty sand at surface, S&G on top of bedrock
LC-3	4256 05 7835 33		Huber	1964	Drl	68.5	--	6	--	Sh	770	18.7	7-23-64	No	D	
LC-4	4256 28 7837 21		P. Lindhardt	1957	Drl	39	--	6	--	S&G	744	28.1	8-27-81	No	U	
LC-5	4256 38 7839 22	81-1b	US Geol Survey	1981	Aug	22(b)	--	--	22	Till	744	--	--	Yes	A	
LC-6	4256 38 7836 55	81-2D	US Geol Survey	1981	Aug	57.5	55	2	61	S&G	775	42.8	9-03-81	Yes	0	*.
LC-7	4256 40 7837 09		Reigle	1959*	Drl	90*	--	6	40*	LS	763	23.8	8-26-81	No	U	Yield 18 gal/min
LC-8	4256 43 7837 55		T. Martino	--	Dug	20*	--	--	--	Sand	732	--	--	No	U	*.
LC-9	4256 46 7836 16	81-6b	US Geol Survey	1981	Aug	57(b)	--	--	57	Silt	767	--	--	Yes	A	
LC-10	4256 47 7835 04		H. Ringer	1954	Drl	100	--	6	--	LS	795	--	--	No	D	*.
LC-11	4256 48 7835 55		C. Suess	1958	Drl	59	--	6	34	LS	759	29.6	8-19-64	No	D	*., yield 250 gal/min
LC-12	4256 48 7836 12		H. Choate	1966*	Drl	60*	--	6	--	S&G	765	22	8-12-81	No	D	
LC-13	4256 49 7836 12		J. Hunt and Karn	--	Drl	--	--	6	--	LS	770	--	--	No	D	*.
LC-14	4256 50 7835 37		Huber	--	Drl	76	--	6	--	LS	783	40.7	8-27-81	No	--	
LC-15	4256 55 7835 38		Keppner	--	Drl	60*	--	6	--	LS	785	--	--	No	--	
LC-16	4256 56 7835 36		O. Gaines	1951*	Drl	80*	--	6	--	LS	785	35*	1981	No	--	
LC-17	4256 58 7837 03	B-23D	Pine Hill Conc	1979	Drl	43	41	1.25	23.5	LS	752	32.5	10-15-81	Yes	0	
LC-18	4256 58 7837 03a	B-23S	Pine Hill Conc	1979	Drl	21	19	1.25	23.5	Sand	752	18.2	10-15-81	Yes	0	
LC-19	4256 58 7837 32	W-8	Lancaster Lndfl	1981	Drl	68	18	4	8	LS	730	23	10-15-81	Yes	0	
LC-20	4256 59 7837 25	W-3	Lancaster Lndfl	1979	Drl	27.3	13	4	10.5	LS	735	18.8	10-15-81	Yes	0	
LC-21	4257 00 7836 30	W-7	Lancaster Lndfl	1980	Drl	64.5	49	4	46.5	LS	761	51.5	10-15-81	Yes	0	<1 gal/min.
LC-22	4257 01 7837 02	B-18	Lancaster Lndfl	1979	Drl	44	42	4	45	Sand	760	25.3	9-20-79	Yes	0	
LC-23	4257 02 7836 40	W-1	Lancaster Lndfl	1978	Drl	49	--	4	--	Sand	766	33.5	10-15-81	Yes	0	
LC-24	4257 05 7836 11	B-24S	Pine Hill Conc	1979	Drl	35	33	1.25	59	Sand	785	11.9	10-15-81	Yes	0	
LC-25	4257 05 7836 11a	B-24D	Pine Hill Conc	1979	Drl	82	80	1.25	59	LS	785	58.7	10-15-81	Yes	0	
LC-26	4257 05 7836 21	B-17	Lancaster Lndfl	1979	Drl	28	26	--	53	Sand	769	10.8	1979	Yes	0	
LC-27	4257 05 7836 39	B-19	Lancaster Lndfl	1979	Drl	50	48	1.25	--	Sand	774	35.3	9-20-79	Yes	0	
LC-28	4257 07 7835 38		T. Fiordaliso	1973	Drl	90	40	6	40	LS	788	47.1	8-26-81	No	M	
LC-29	4257 07 7836 17a	B-15D	Lancaster Lndfl	1979	Drl	69	67	1.25	51	LS	773	65.9	10-15-81	Yes	0	
LC-30	4257 07 7836 17b	B-15I	Lancaster Lndfl	1979	Drl	43	41	1.25	51	Silt	773	11.4	10-15-81	Yes	0	
LC-31	4257 07 7836 17c	B-15S	Lancaster Lndfl	1979	Drl	21	19	1.25	51	Sand	773	10.7	10-15-81	Yes	0	
LC-32	4257 07 7836 18a	B-16D	Lancaster Lndfl	1979	Drl	72	70	1.25	52	LS	774	45.8	Mar.1979	Yes	0	
LC-33	4257 07 7836 18b	B-16I	Lancaster Lndfl	1979	Drl	42	40	1.25	52	S&Si	774	15.0	Mar.1979	Yes	0	
LC-34	4257 07 7836 18c	B-16S	Lancaster Lndfl	1979	Drl	22	20	1.25	52	Sand	774	11.6	Mar.1979	Yes	0	
LC-35	4257 07 7836 21	B-13	Lancaster Lndfl	1979	Drl	23	21	1.25	52	S&Si	771	17.7	Mar.1979	Yes	0	

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Casing depth (ft)	Casing diam (in)	Depth to bedrock (ft)	Aquifer type	Altitude surface (ft)	Water-level depth below land surface (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
LANCASTER-CLARENCE-NEWSTEAD AREA (continued)																
LC-36	4257 07 7836 45	B-2	Lancaster Lndfl	1972	Drl	38(b)	--	--	--	Sand	759	9.0	5-16-72	Yes	A	
LC-37	4257 07 7837 15	B-22	Lancaster Lndfl	1979	Drl	36	34	1.25		Fill	772	32.1	8-23-79	Yes	O	Well installed in refuse.
LC-38	4257 09 7835 32		B. Streeter	1968	Drl	60*	40*	6	40*	LS	790	43.9	8-26-81	No	D	
LC-39	4257 12 7838 05		Kans Supply	--	Drl	30*	--	6	5	LS		--	--	No	I	*.
LC-40	4257 12 7836 19	B-14	Lancaster Lndfl	1979	Drl	43	41	1.25	44	S&G?	764	12.6	Spring 79	Yes	O	
LC-41	4257 13 7835 29		Auction House	--	Drl	--	--	6	--	LS	792	40.2	8-26-81	No	C	
LC-42	4257 13 7836 42	B-20	Lancaster Lndfl	1979	Drl	47	45	1.25	--	S&Si	779	Dry	3-05-81	Yes	O	
LC-43	4257 15 7837 25	W-4A	Lancaster Lndfl	1981	Drl	95	20	4	8.2	LS	738	66.8	10-15-81	Yes	O	
LC-44	4257 17 7837 09	B-21	Lancaster Lndfl	1979	Drl	30.5	28	1.25	--	S&Si	766	22.7	3-05-81	Yes	O	
LC-45	4257 19 7836 27	W-6A	Lancaster Lndfl	1981	Drl	92	42	4	32	LS	755	65.6	10-15-81	Yes	O	
LC-46	4257 20 7837 11	W-2	Lancaster Lndfl	1978	Drl	30	--	--	30	till?	752	9.0[1]	3-05-81	Yes	O	
LC-47	4257 23 7837 13	B-12	Lancaster Lndfl	1979	Aug	16	15	1.0	16	Sand	745	--	--	Yes	O	
LC-48	4257 24 7837 09	B-10	Lancaster Lndfl	1979	Aug	27	26	1.0	27	till?	751	13.5	8-23-79	Yes	O	
LC-49	4257 27 7836 48	B-8	Lancaster Lndfl	1979	Aug	29	28	1.0	--	Sand	762	16*	2-13-79	Yes	O	
LC-50	4257 30 7836 09	B-9	Lancaster Lndfl	1979	Aug	28	27	1.0	--	Sand	748	14*	2-14-79	Yes	O	
LC-51	4257 32 7837 17	B-11	Lancaster Lndfl	1979	Aug	21	20	1.0	21	Sand	744	4*	2-15-79	Yes	O	
LC-52	4257 33 7834 31	81-8	US Geol Survey	1981	Aug	16	6	2	42	S&G	798	3.1	10-15-81	Yes	O	*.
LC-53	4257 33 7836 49	B-7	Lancaster Lndfl	1979	Aug	28	27	1.0	--	Sand?	758	17.7	8-23-79	Yes	O	
LC-54	4257 34 7836 49	W-5	Lancaster Lndfl	1980	Drl	66	50	4	48	LS	762	37.1	10-15-81	Yes	O	Yield 2 gal/min.
LC-55	4257 35 7835 19	81-10b	US Geol Survey	1981	Aug	17(b)	--	--	--	till	788	--	--	Yes	A	
LC-56	4257 38 7836 14		E. Kruetinger	1969	Drl	43	43	6	41.5	LS	760	--	--	No	D	Yield 40 gal/min.
LC-57	4257 38 7836 08		D. Volker	1981	Drl	50	30	6	28.5	LS	763	34.5	9-23-81	No	D	*., yield 10 gal/min.
LC-58	4257 42 7835 38	81-3b	US Geol Survey	1981	Aug	35(b)	--	--	35	--	784	7*	9-04-81	Yes	A	
LC-59	4257 46 7836 52		C. Reinecke	1979	Drl	73	--	6	--	LS	792	--	--	No	D	*., yield 50 gal/min.
LC-60	4257 48 7836 52		T. Hoffman	1979	Drl	70	--	6	--	LS	792	48.3	8-06-81	No	D	Yield 10 gal/min.
LC-61	4257 57 7833 35		Porter	1960	Drl	72	--	6	--	LS	803	49*	8-07-81	No	D	
LC-62	4257 57 7833 17	81-9b	US Geol Survey	1981	Aug	20(b)	--	--	20	--	794	5.5	9-08-81	Yes	A	
LC-63	4257 58 7836 30	81-7	US Geol Survey	1981	Aug	12	10	2	46	S&G	761	9.4	10-15-81	Yes	O	*.
LC-64	4258 02 7835 45		Brothers of Mercy	1973	Drl	75	44	12	42	LS	770	28	10-03-73	No	I	Yield=1,200gal/min,DD=24 ft
LC-65	4258 07 7836 30		Poety	1954	Drl	--	--	--	--	LS	762	24.2	8-06-81	No	D	
LC-66	4258 11 7834 23	81-5	US Geol Survey	1981	Aug	32	22	2	52	S&G	799	19.1	10-15-81	Yes	O	*.
LC-67	4258 18 7835 30	81-4	US Geol Survey	1981	Aug	43.5	41.5	2	47	S&G	770	31.1	10-15-81	Yes	O	*.
LC-68	4258 34 7835 58		R. Twele	--	Drl	62	--	6	1	LS	720	7.5 42	July 1980 7-12-82	No	D	*. Well deepened 7-12-82 from 40 to 62 ft when well dried up in summer.
LC-69	4258 34 7836 27		V. Billingsley	1947*	Drl	49*	--	6	--	LS	738	14*	8-06-81	No	D	Yield=10 gal/min.
LC-70	4258 35 7833 12		B. Fields	1960	Drl	62.6	--	6	13*	LS	775	22.7	8-18-64	No	D	Yield=300 gal/min.
LC-71	4258 39 7836 31		M. Stage	1936	Drl	46	--	6	1	LS	745	15*	Aug. 1981	No	D	Overflows in spring

1/ Depth from top of casing.

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Cas-ing depth (ft)	Cas-ing diam (in)	Depth to bed-rock (ft)	Aqui-fer type	Alti-tude sur-face (ft)	Water-level depth below land sur-face (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
SARDINIA AREA (Well locations shown in fig. 2.)																
SA-1	4231 36 7831 44		Vasinek	1955	Drl	110	110	6	--	S&G	1,405	35	5-20-82	No	F	A second well 235 ft deep ends in S&G
SA-2	4231 50 7831 21		Schiener	1962	Drv	22	20	1.25	--	S&G	1,410	--	--	No	D	
SA-3	4232 27 7830 40		Domes	--	Drv	18	16	2.5	--	S&G	1,390	--	--	No	D	
SA-4	4232 29 7829 42		Kissel	1972	Drl	114	114	6	--	S&G	1,420	14.7	7-29-82	Yes	D	S&G 0-25, clay 25-70, layers sand and S&G 70-114, coarse gravel 114 ft
SA-5	4232 29 7830 32		Bleighley	1940	Drv	12	10	--	--	S&G	1,398	--	--	No	D	
SA-6	4232 29 7831 11		Loggans	1961	Drl	87	--	6	--	S&G	1,435	32	--	No	D	* in ENB-3
SA-7	4232 30 7828 44		Nichols Brk Motel	--	Drl	43	43	6	--	S&G	1,436	--	--	Yes	C	Yield (r) 50 gal/min; S&G 0-43 ft.
SA-8	4232 30 7830 05		Rice	1978	Drl	48	48	6	--	S&G	1,400	--	--	Yes		S&G 0-25, clay 25-35, S&G 35-48 ft.
SA-9	4232 35 7828 48		Diamond Saw	1957	Drl	42	42	6	--	S&G	1,435	--	--	Yes	I	Yield (r) 25 gal/min; S&G 0-20, clay 20-37, gravel 37-42 ft
SA-10	4232 41 7830 09		Hogan	1963	Drl	175	175	6	--	S&G	1,405	11.4	8-11-64	No	D	* in ENB-3
SA-11	4232 42 7830 02		Schiener	1962	Drl	28	--	2.5	--	S&G	1,400	--	--	No	D	*.
SA-12	4232 47 7828 41		Wertz	1958	Drl	29	29	6	--	Gravel	1,435	18.3	6-25-64	No	C	
SA-13	4232 48 7830 19		Meyers	1974	Drl	344	344	6,4	--	S&G	1,410	f	--	Yes	D	*; S&G 0-12, clay 12-100, sand 100-110, clay and clay and sand 110-342 ft
SA-14	4232 58 7828 43	82-4	USGS	1982	Aug	22	17	2	--	S&G	1,443	16.4	10-15-82	Yes	O	*; S&G 0-24, clay 24-32, S&G w/trace silt 32-40, clay 40-42, S&G 42-45, clay and pebbles 45-58 ft
SA-15	4232 58 7829 56	82-3	USGS	1982	Aug	17	12	2	--	S&G	1,399	4.6	10-15-82	Yes	O	*; silty sand 0-7, f.-m.sand 7-12, S&G 12-17, f.-c.sand 17-22, silt and clay 22-33 ft
SA-16	4233 03 7829 32		Bolt	1967	Drl	47	47	6	--	S&G	1,440	23.0	5-20-82	No	D	S&G 0-47 ft
SA-17	4233 05 7830 37	82-2	USGS	1982	Aug	46	36	2	--	S&G	1,425	23.9	10-19-82	Yes	O	*; silt,gravel 0-16, gravelly sand 16-19, S&G 19-56, f.-m.sand 56-72, silt and sand 72-78 ft
SA-18	4233 12 7828 44		Lynch	1962	Drl	42	42	--	--	S&G	1,448	--	--	Yes	C	Yield (r) 20 gal/min; S&G 0-42, clay 42 ft
SA-19	4233 25 7828 44		Greatwood	1960	Drl	51	--	6	--	Sand	1,449	20.0	6-25-64	No	D	Yield (r) 40 gal/min
SA-20	4233 27 7828 44		Ornce	1960	Drl	51	51	6	--	S&G	1,448	19.3	5-20-82	Yes	D	Yield (r) 20 gal/min; S&G

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long		Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Casing depth (ft)	Casing diam (in)	Depth to bedrock (ft)	Aquifer type	Altitude surface (ft)	Water-level depth below land surface (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
SARDINIA AREA (continued)																	
SA-21	4233 32	7830 40		Uhteg	--	Drl	41	41	6	--	S&G	1,450	28.2	5-20-82	No	D	*.
SA-22	4233 53	7828 42		Lewis	1980	Drl	69	69	6	--	S&G	1,462	35	9-80	Yes	D	*; S&G 0-34, f.sand 34-42, clay 42-58, f.sand 58-67, S&G 67-70 ft; yield (r) 50 gal/min.
SA-23	4234 00	7828 55		Chaffee Water Sply	1900	Drl	20	--	8	--	S&G	1,460	13.5	2-11-63	No	PS	Pumping rate ~ 100 gal/min
SA-24	4234 08	7830 26		Iroquois Gas Co	1964	Drl	--	--	12	112	Lockport Dolomite	1,465	--	--	No	GT	Yield (r) 0.5-1.0 gal/min; Lockport Dolomite at 2,728'
SA-25	4234 27	7829 38	82-1	USGS	1982	Aug	90	85	2	--	S&G	1,444	4.5	10-15-82	Yes	O	*; yield (m) 7 gal/min; S&G 0-15, till 15-22, S&G 22-35, till 35-39, S&G and silt 39-70, clay and silt w/tr. pebbles (till) 70-85, S&G 85-93. Two other wells installed at depths of 27 and 60 ft.
SA-26	4234 29	7828 43		Phelps	--	Drl	194	194	6	--	S&G	1,470	--	--	Yes	Ir,F	Yield (e) 10 gal/min; S&G 0-60, layers of sand and clay 60-180, S&G 180-194 ft
SA-27	4234 30	7828 43		Phelps	--	Drl	46	--	6	--	S&G	1,480	--	--	No	D	
SA-28	4234 38	7829 52	82-10A	USGS	1982	Aug	50	48	1.5	--	S&G	1,459	15.9	5-12-83	Yes	O	*; till 0-7, S&G 7-32, till 32-43, S&G 43-51, till 51-60, S&G 60-74 ft. A second well installed at 29 ft.
SA-29	4234 50	7828 58		Tavernier	--	Drl	90	--	6	--	S&G	1,480	34.4	5-20-82	No	D	
SA-30	4234 52	7828 45		Wiedemann	1980	Drl	65	65	6	--	S&G	1,478	--	--	Yes	D	S&G 0-65 ft.
SA-31	4234 53	7829 47	W-1	Chaffee Landfill	1980	Aug	54	52	2	--	S&G	1,490	52.0	11-30-80	Yes	O	Sand clayey silt w/trace pebbles (till) 0-10, clayey silt 10-22, clayey silt with tr. pebbles (till) 22-44, S&G 44-47, sandy silt 47-49, S&G 49-53, sandy silt 53-54'
SA-32	4234 53	7829 52	W-3	Chaffee Landfill	1980	Aug	14	12	2	—	Till	1,494	9.8	11-30-80	Yes	O	Sandy clayey silt w/trace pebbles (till) 0-14 ft.
SA-33	4234 53	7829 57	W-4	Chaffee Landfill	1980	Aug	43	41	2	--	Till	1,476	--	--	Yes	O	Clayey silt w/tr. pebbles

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long		Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Casing depth (ft)	Casing diam (in)	Depth to bedrock (ft)	Aquifer type	Altitude surface (ft)	Water-level depth below land surface (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
SARDINIA AREA (continued)																	
SA-34	4234 58	7829 17		Chaffee Equipment	--	Drl	--	--	6	--	S&G	1,485	--	--		C	*; S&G and silt and clay 0-12, till 12-18, S&G and and silt and clay 18-23, clay w/pebbles (till) 23-28, gravel, sand, silt and clay 28-52 ft.
SA-35	4234 58	7829 47	W-2	Chaffee Landfill	1980	Aug	14	12	2	--	Till	1,486	Dry		Yes	O	Clayey silt w/tr. pebbles (till) 0-14 ft.
SA-36	4235 02	7829 48	W-8	Chaffee Landfill	1981	Aug	58	56	2	--	S&G	1,489	--	--	Yes	O	Clayey silt w/tr. pebbles (till) 0-34, sandy clayey silt w/tr. pebbles (till) 43-54, S&G 54-58 ft.
SA-37	4235 03	7829 48	W-7	Chaffee Landfill	1981	Aug	58	56	2	--	S&G	1,494	55.0	8-27-81	Yes	O	Clayey silt w/tr. pebbles (till) 0-37, sand-silt-clay and gravel 37-39, sandy silt 39-42, clayey silt w/trace pebbles (till) 42-52, S&G 52-60 ft.
SA-38	4235 04	7829 42		Buncy	1966*	Drl	87	87	6	--	S&G	1,500	69	5-21-82	No	D	
SA-39	4235 04	7829 49	82-11A	USGS	1982	Aug	69	67	1.5	--	S&G	1,502	61.3	12-17-82	Yes	O	Silty clay w/tr. pebbles (till) 0-63, S&G 63-73 ft.
SA-40	4235 04	7830 30		Mader	1979	Drl	35*	35	6	--	S&G	1,440	10.7	5-12-82	No	D	
SA-41	4235 04	7831 14		Raymond	1940	Drl	34	34	6	34	S&G	1,500	10.0	8-12-64	No	U	
SA-42	4235 08	7829 57		Robins	--	Drl	47	43	6	--	S&G	1,470	29.3	5-20-82	No	-	Yield (r) 20 gal/min.
SA-43	4235 08	7830 27		Petrone	1959	Drl	25	--	6	--	S&G	1,440	16.6	8-12-64	No	D	*. in ENB-3
SA-44	4235 13	7827 51		Mitrowski	--	Drl	70	--	6	--	S&G	1,520	38	5-20-82	No	-	
SA-45	4235 16	7830 08		Sheridan	--	Drl	28*	--	6	--	S&G	1,445	--	--	No	D	
SA-46	4235 04	7830 18		Cook	--	Drl	31	--	6	--	S&G	1,453	17	2-22-83	No	D	*.

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Cas-ing depth (ft)	Cas-ing diam (in)	Depth to bed-rock (ft)	Aqui-fer type	Alti-tude sur-face (ft)	Water-level depth below land sur-face (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
SPRINGVILLE AREA (Well locations shown in fig. 2.)																
SP-1	4229 37 7842 34		Chandler	--	Spr	--	--	--	--	S&G	1,300	--	--	--	D	*.
SP-2	4229 37 7842 19		Gentner	1959	Drl	325	325	6	--	—	1,340	--	--	Yes	A	Dry hole; S&G 0-15 ft, clay and sand 15-325 ft.
SP-3	4229 53 7841 45		Gentner	--	Dug	16.6	--	24	--	S&G	1,355	13.3	5-07-64	No	F	
SP-4	4229 59 7841 28	82-7	USGS	1982	Aug	25	25	2	—	S&G	1,367	20.7	10-15-82	Yes	O	*; S&G 0-25, clay 25-35, silt and sand 35-65 ft
SP-5	4230 09 7839 25	TH-5		1967	Drl	105	105	6	--	S&G	1,375	68	5-11-67	Yes	U	Yield 12 gal/min; S&G 0-24, clay and gravel (till?) 24-96, S&G 96-107, clay and gravel (till?) 107-253 ft.
SP-6	4230 22 7840 06	2-T-5		1942	Drl	153	--	8	--	S&G	1,300	F	3-14-82	Yes	A	Flowed 1 gal/min at 96 ft; no significant aquifer encountered.
SP-7	4230 22 7840 07	2-T-4		1942	Drl	96	96	4	--	Sand	1,320	F	1-08-64	Yes	A	No significant aquifer; clay and gravel 0-21, f.sand 21-84, clay and sand 84-93, c.sand 93-95, clay and gravel 95-99, clay 99-263ft
SP-8	4230 22 7840 38	2-T-1		1941	Drl	260	260	6	--	--	1,330	40	10-23-41	Yes	A	No significant aquifer; fill 0-6, silt and clay 6-12, clay w/some pebbles (till?) 12-85, clay, ssnd and gravel 85-100, clay w/some gravel (till?) 100-220, ailty sand 220-225, clay w/some pebbles (till?) 225-260 ft.
SP-9	4230 25 7834 29	82-6	USGS	1982	Aug	23	23	2	--	S&G	1,366	22.1	10-15-82	Yes	O	*; S&G 0-22, sand 22-26, clay w/pebbles (till) 26-40'
SP-10	4230 34 7841 07	TH-4		1967	Drl	35	35	6	--	S&G	1,355	7	5-08-67	Yes	U	Yield-25 gal/min; drawdown = 12 ft; S&G 0-33, clay with tr.pebbles (till) 33-283 ft
SP-11	4230 42 7839 15	2-T-3		1941	Drl	230	--	6	--	--	1,385	40	11-27-41	Yes	A	S&G 0-29, clay w/tr. gravel (till) 29-51, S&G 51-55, clay w/tr. gravel (till) 55-62, clay 62-177, f.sand 177-203, clay w/tr. gravel 203-224, clay 224-230 ft.
SP-12	4230 45 7838 28		Mooney	1931	Drl	14	14	1.25	--	S&G	1,370	3.8	5-06-64	No	D	

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Casing depth (ft)	Casing diam (in)	Depth to bedrock (ft)	Aquifer type	Altitude surface (ft)	Water-level depth below land surface (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
SPRINGVILLE AREA (continued)																
SP-13	4230 46 7839 43	2-T-2		1941	Drl	97	97	8	--	S&G	1,342	15.5	11-15-41	Yes	A	Yield=62 gal/min; 36 ft drawdown; turbid; sand and gravel water-bearing zone 88-97 ft.
SP-14	4230 54 7840 02		Vil. of Springville	1944	Drl	137	122	18,12	--	S&G	1,350	27.4	8-05-44	Yes	PS	Pumping rate 630 gal/min; 16.4 ft drawdown after 8 hrs S&G 0-22, sandy clay 22-32, clay and gravel (till) 32-93, f.sand 93-108, till 108-110, S&G 110-112, gravel and clay 112-121, S&G 121-139 ft, screened from 122-137 ft
SP-15	4230 55 7840 12		Vil. of Springville	1942	Drl	159	144	18,10	--	S&G	1,350	37.7	5-14-42	No	PS	Pumping rate 600 gal/min; screened from 144-159. Static water level probably affected by other production well.
SP-16	4230 55 7840 13	2-T-6		1942	Drl	148	137	4	--	S&G	1,350	30	5-25-42	Yes	A	Yield=116 gal/min; drawdown 22 ft.
SP-17	4231 01 7840 28	TH-8		1967	Drl	--	--	--	--	--	1,370	--	--	Yes	A	No significant aquifer; clay and gravel 0-8, clay 8-15, gravel and clay 15-86, clay and gravel (till?) 86-253 ft
SP-18	4231 07 7839 20			1970	Aug	--	--	--	--	--	1,380	26	2-20-70	Yes	A	Foundation boring for water tank; S&G 0-28, silty clay 28-82 ft.
SP-19	4231 07 7839 39	TH-1		1967	Drl	193	193	6	--	--	1,343	--	--	Yes	A	Clay and gravel 0-8, sand 8-14, gravel and clay 14-36, clay and gravel (till?) 36-193 ft.
SP-20	4231 10 7840 02	TH-3		1967	Drl	143	130	6	--	Gravel and clay	1,358	--	--	Yes	A	No significant aquifer; gravel and clay 0-18, S&G 18-42, clay and gravel(till) 42-127, gravel and clay 127-140, clay and gravel 140-253 ft.
SP-21	4231 33 7839 08		Ploetz	1956	Drl	29	29	6	--	S&G	1,400	18.8	5-06-64	No	D	
SP-22	4231 30 7839 47		Taylor	--	Drv	12	10	1.5	--	S&G	1,350	--	--	No	D	

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Cas-ing depth (ft)	Cas-ing diam (in)	Depth to bed-rock (ft)	Aqui-fer type	Alti-tude sur-face (ft)	Water-level depth below land sur-face (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
SPRINGVILLE AREA (continued)																
SP-23	4231 49 7839 28			--	Dug	6	--	36	--	S&G	1,355	4	4-15-82	No	D	
SP-24	4231 50 7838 19		Perkins Trl.Park	1956	Drl	70	41	6	40	Shale	1,420	--	--	No	PS	
SP-25	4231 50 7838 20		Perkins Trl.Park	1968	Drl	99	38	6	38	Shale	1,425	--	--	No	PS	
SP-26	4231 50 7838 26	82-9	USGS	1982	Aug	22	20	2	--	S&G	1,402	16.2	10-15-82	Yes	O	*; S&G 0-32, till 32-33 ft
SP-27	4231 57 7839 26		Great Bear Spring	--	--	--	--	--	--	S&G	1,410	--	--	--	U	*.
SP-28	4232 16 7840 32		Fallon	1967	Drl	29	29	6	--	S&G	1,430	18.0	4-15-82	No	D	*.
SP-29	4232 23 7839 42	82-8	USGS	1982	Aug	22	19	2	--	S&G	1,395	5.9	10-15-82	Yes	O	*; S&G 0-23, silt and clay 23-29 ft.
SP-30	4232 32 7839 35		Knowlton	--	Dug	21	--	30	--	S&G	1,400	17.7	5-07-64	No	A	
SP-31	4232 23 7839 13		Luno	--	Drl	300	300	3	--	S&G	1,420	20	11-79	No	D	*.
SP-32	4232 37 7840 13		--	1957	Dug	20	--	24	--	S&G	1,452	--	--	No	D	
SP-33	4232 51 7838 28		Perkins Apts	1974	Drl	133	85	6	85	Shale	1,445	59.0	4-16-82	No	D	
SP-34	4232 53 7838 46		Perkins Apts	1979	Drl	33	33	6	--	S&G	1,420	15.0	4-16-82	No	D	
SP-35	4233 08 7839 37		Buzak	1963	Drl	528	--	7	--	S&G	1,430	200	4-03-63	No	D	Gas; iron.
SP-36	4233 12 7840 49		Zittel	1960	Dug	18	--	24	--	S&G	1,435	16	--	No	F	
SP-37	4233 18 7838 20		Miller	1963	Drl	56	--	6		S&G	1,450	29.0	5-07-64	No	F	*.

Table 9.--Records of selected wells in Erie County, N.Y. (continued)

Well no.	Location Lat-Long	Local well No.	Owner	Date drilled	Type of well	Well depth (ft)	Casing depth (ft)	Casing diam (in)	Depth to bedrock (ft)	Aquifer type	Altitude surface (ft)	Water-level depth below land surface (ft)	Date measured	Geol. log	Water use	Remarks (Depths are in feet below land surface; * = chem. analysis)
ALDEN AREA (Well locations shown in fig. 2.)																
AL-1	4252 50 7831 21		G. Schimmel	1980	Drl	72	30	6	30	S&G, Shale	815	20*	2-05-80	No	D	Yield (r) 2 gal/min
AL-2	4252 58 7831 57		B. Strunk	1979	Drl	99	--	6	--	Shale	815	35	9-01-79	No	D	Yield (r) 2 gal/min
AL-3	4253 00 7831 57		T. Schaffer	1979	Drl	108	48	6	48	Shale	820	37.4	11-22-82	No	D	Yield (r) 2 gal/min
AL-4	4253 17 7831 20		Guhl	1977	Drl	45	42	6	42	S&G	842	--	--	No	D	Yield (r)10 gal/min
AL-5	4253 22 7831 18		Fisher	1981	Drl	50	45	6	45	S&G	842	6 *	10-05-82	No	D	Yield (r) 5 gal/min
AL-6	4253 38 7831 27		Alden Lanes	1958	Drl	90*	90*	--	90*	S&G	838	8*	11-82	No	C	
AL-7	4253 43 7831 15		G. Eggleston	--	Drl	45*	40*	6	40*	S&G	831	--	--	No	D	
AL-8	4253 46 7829 56	2	Vil. of Alden	1961	Drl	27		60,18	27	S&G	840			No	PS	Yield (r) 75,000 gal/day, concrete tile 0-16 ft installed 1947, 18 in. dia. screen from 16-27 ft installed 1961. *.
AL-9	4254 00 7830 33		S. Williams	--	Drl	42*	42*	--	42*	S&G	817	1.5	11-23-82	No	D	
AL-10	4254 00 7830 52		E. Boldt	1980	Drl	114	--	--	--	Shale	830	13	6-09-80	No	D	
AL-11	4254 00 7830 36		V. Young	1978	Drl	47	47	8	40*	S&G,	811	6+	5-10-78	No	D	Yield (m) 20 gal/min
AL-12	4254 02 7830 23		R. Mitchell	1960	Drl	30	29	8	30*	S&G	828	2	11-15-82	No	F	Yield (r)150 gal/min
AL-13	4254 02 7830 24		C. Keller	1960	Drl	28	25*	6	25*	S&G	826	1.6	11-22-82	Mo	D	
AL-14	4254 05 7830 24		Lemaster	--	Drl	29	22*	6	22*	S&G	826	3.7	11-22-82	No	D	
AL-15	4254 08 7831 23		J. Arent	1978	Drl	63	59	6	59	S&G	835	17.2	11-22-82	No	D	Yield (r) 5 gal/min
AL-16	4254 12 7829 53	4	Vil. of Alden	1964	Drl	45	45	12	45	S&G	848	16	5-10-82	Yes	PS	Yield (m)220 gal/min, *.
												20	11-18-82			
AL-17	4254 13 7831 27		C. Schemel	1981	Drl	46	46	6	46*	S&G	834	12	6-24-82	No	D	Yield (m) 5 gal/min
												17.2	11-19-82			
AL-18	4254 24 7829 48	3	Vil. of Alden	1957	Drl	36	34	6	34	S&G	830	18.6	1-31-58	Yes	PS	Yield (m)220 gal/min, *.
AL-19	4254 55 7831 26		J. Hodge	1978	Drl	54	45	6	45	S&G	826	8.6	11-19-82	No	D	Yield (r) 8 gal/min
AL-20	4254 29 7831 56		Heerdt	1979	Drl	47	42	6	42	S&G	832	--	--	No	D	Yield (r) 7 gal/min
AL-21	4254 29 7829 23	1	Vil. of Alden	1900*	Dug	14	--	140	--	S&G	825	3.0	11-18-82	No	PS	One of 3 dug wells at Alden No. 1; Yield (r) 27,000 gal/day, *.
AL-22	4254 30 7829 27	Test well	Vil. of Alden	1979	Drl	42	42	6	42	S&G	824	1.0	1-26-79	Yes	U	Yield (m) 30 gal/min
AL-23	4254 41 7831 23		K. Margrey	1978	Drl	60	--	--	--	S&G	829	--	--	No	D	Yield (r) 5 gal/min
AL-24	4254 56 7827 52		W. Sarnecki	1972	Drl	40*	--	--	40*	S&G	855	2.0	11-22-82	No	D	Hard, iron

Table 10

Chemical Analysis of Water from Selected Wells

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection				
	LC-1 09 24 1981	LC-1 03 23 1982	LC-1 08 04 1982	LC-1 02 16 1983	LC-1 06 13 1983
SPECIFIC CONDUCTANCE (UMHOS)	642	642	623	637	620
PH LAB (STANDARD UNITS)	7.8	7.9	7.9	7.7	7.8
ALKALINITY LAB (MG/L AS CACO3)	235	240	240	246	238
CARBON TOTAL ORGANIC (MG/L AS C)	-	6.2	12	17	23
HARDNESS (MG/L AS CACO3)	295	275	301	290	272
CALCIUM DISSOLVED (MG/L)	39	39	43	42	38
MAGNESIUM DISSOLVED (MG/L)	48	43	47	45	43
POTASSIUM DISSOLVED (MG/L)	-	1.3	-	1.0	1.3
SODIUM DISSOLVED (MG/L)	-	19	21	18	19
CHLORIDE DISSOLVED (MG/L)	35	38	40	38	38
FLUORIDE DISSOLVED (MG/L)	0.8	0.9	1.0	1.0	0.9
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	1.6	<0.10	0.39	<0.10	<0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	0.035	0.030	0.010	1.16
SULFATE DISSOLVED (MG/L AS SO4)	40	43	46	44	48
ARSENIC DISSOLVED (UG/L)	-	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	400	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10	-	<10
COPPER DISSOLVED (UG/L)	-	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	130	90	180	100
LEAD DISSOLVED (UG/L)	-	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	-	<10	20	20	20
MERCURY DISSOLVED (UG/L)	-	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	-	<20	<20	<20	<20

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.) (continued)

	Well number and date of sample collection				
Constituent	LC-2 09 24 1981	LC-2 03 23 1982	LC-2 08 04 1982	LC-2 03 14 1983	LC-2 06 13 1983
SPECIFIC CONDUCTANCE (UMHOS)	431	487	425	481	500
PH LAB (STANDARD UNITS)	8.3	8.2	8.3	8.0	8.1
ALKALINITY LAB (MG/L AS CACO3)	240	242	240	231	251
CARBON TOTAL ORGANIC (MG/L AS C)	-	12	8.9	19	20
HARDNESS (MG/L AS CACO3)	185	187	187	180	181
CALCIUM DISSOLVED (MG/L)	18	19	17	16	18
MAGNESIUM DISSOLVED (MG/L)	34	34	35	34	33
POTASSIUM DISSOLVED (MG/L)	-	1.0	1.1	1.0	1.0
SODIUM DISSOLVED (MG/L)	-	29	32	28	30
CHLORIDE DISSOLVED (MG/L)	10	5.0	7.5	5.0	10
FLUORIDE DISSOLVED (MG/L)	1.0	1.3	1.1	1.3	1.0
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	1.9	<0.10	0.13	<0.10	<0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	0.04	0.12	0.03	0.12
SULFATE DISSOLVED (MG/L AS SO4)	6.0	8.6	6.7	19	80
ARSENIC DISSOLVED (UG/L)	-	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	<200	<200	300	<200
CADMIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	-	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	<50	<50	<50	220
LEAD DISSOLVED (UG/L)	-	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	-	30	40	80	20
MERCURY DISSOLVED (UG/L)	-	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	2	<1	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	-	<20	<20	2100	<20

Table 10A. *Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.) (continued)*

Constituent	Well number and date of sample collection				
	LC-6 11 19 1981	LC-6 03 24 1982	LC-6 08 04 1982	LC-6 02 15 1983	LC-6 06 13 1983
SPECIFIC CONDUCTANCE (UMHOS)	1300	853	1080	1270	1210
PH LAB (STANDARD UNITS)	7.6	7.6	7.8	7.4	8.0
ALKALINITY LAB (MG/L AS CACO3)	333	274	309	338	350
CARBON TOTAL ORGANIC (MG/L AS C)	11	16	23	23	30
HARDNESS (MG/L AS CACO3)	365	553	441	618	563
CALCIUM DISSOLVED (MG/L)	72	139	127	150	130
MAGNESIUM DISSOLVED (MG/L)	45	50	30	59	58
POTASSIUM DISSOLVED (MG/L)	--	1.4	1.9	1.4	1.8
SODIUM DISSOLVED (MG/L)	35	24	31	54	56
CHLORIDE DISSOLVED (MG/L)	200	75	175	250	225
FLUORIDE DISSOLVED (MG/L)	0.3	0.4	0.5	0.4	<.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	<0.10	<0.10	0.38	0.15	<0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	0.01	0.02	0.01	0.03
SULFATE DISSOLVED (MG/L AS SO4)	89	103	73	76	78
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	300	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	2	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	250	120	100	300	400
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	200	90	90	80	90
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	0.6
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	40	<20	<20

Table 10A. *Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.) (continued)*

	Well number and date of sample collection				
Constituent	LC-8 02 16 1983	LC-8 06 13 1983	LC-8 09 24 1981	LC-8 03 23 1982	LC-8 08 04 1982
SPECIFIC CONDUCTANCE (UMHOS)	920	1070	1110	1210	1700
PH LAB (STANDARD UNITS)	7.6	7.6	7.5	7.7	7.7
ALKALINITY LAB (MG/L AS CACO3)	218	227	214	140	190
CARBON TOTAL ORGANIC (MG/L AS C)	17	22	-	8.5	13
HARDNESS (MG/L AS CACO3)	373	343	425	370	548
CALCIUM DISSOLVED (MG/L)	128	116	147	125	183
MAGNESIUM DISSOLVED (MG/L)	13	13	14	14	22
POTASSIUM DISSOLVED (MG/L)	5.4	6.7	-	2.9	7.1
SODIUM DISSOLVED (MG/L)	70	86	-	101	136
CHLORIDE DISSOLVED (MG/L)	175	200	200	300	400
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	10	9.8	11	5.1	15
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	0.18	-	0.14	0.07
SULFATE DISSOLVED (MG/L AS SO4)	39	33	28	32	31
ARSENIC DISSOLVED (UG/L)	<20	<20	-	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	-	<200	<200
CADMIUM DISSOLVED (UG/L)	4	3	-	4	4
CHROMIUM DISSOLVED (UG/L)	<10	<10	-	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	-	<20	<20
IRON DISSOLVED (UG/L)	<50	190	590	70	<50
LEAD DISSOLVED (UG/L)	<10	<10	-	20	<10
MANGANESE DISSOLVED (UG/L)	<10	20	-	<10	20
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	-	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	-	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	-	<10	<10
ZINC DISSOLVED (UG/L)	610	640	-	450	1200

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

	Well number and date of sample collection				
Constituent	LC-10 09 23 1981	LC-10 03 23 1982	LC-10 08 04 1982	LC-10 03 14 1983	LC-10 06 13 1983
SPECIFIC CONDUCTANCE (UMHOS)	895	586	779	708	610
PH LAB (STANDARD UNITS)	7.5	7.7	7.8	7.8	7.7
ALKALINITY LAB (MG/L AS CACO3)	255	225	251	229	225
CARBON TOTAL ORGANIC (MG/L AS C)	17	17	20	21	18
HARDNESS (MG/L AS CACO3)	0.77	165	457	326	296
CALCIUM DISSOLVED (MG/L)	2.1	52	102	66	61
MAGNESIUM DISSOLVED (MG/L)	0.1	8.6	49	39	35
POTASSIUM DISSOLVED (MG/L)	0.4	1.0	1.2	1.0	1.0
SODIUM DISSOLVED (MG/L)	430	11	10	11	16
CHLORIDE DISSOLVED (MG/L)	10	15	20	20	22
FLUORIDE DISSOLVED (MG/L)	0.50	0.50	0.40	0.50	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	1.7	0.14	<0.10	<0.10	<0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.06	0.04	0.03	0.03	0.05
SULFATE DISSOLVED (MG/L AS SO4)	160	66	215	96	29
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	300	300	400	<200
CADMIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	-	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	140	310	110	<50
LEAD DISSOLVED (UG/L)	20	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	<10	30	80	60	<10
MERCURY DISSOLVED (UG/L)	<0.4	0.8	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	-	220	120	80	<20

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.) (continued)

	Well number and date of sample collection				
Constituent	LC-52 11 19 1981	LC-52 03 24 1982	LC-52 08 04 1982	LC-52 02 15 1983	LC-52 06 14 1983
SPECIFIC CONDUCTANCE (UMHOS)	2030	1560	2550	1560	1900
PH LAB (STANDARD UNITS)	7.8	7.8	7.9	7.0	8.0
ALKALINITY LAB (MG/L AS CACO3)	296	240	246	255	210
CARBON TOTAL ORGANIC (MG/L AS C)	23	15	27	21	21
HARDNESS (MG/L AS CACO3)	214	367	280	136	235
CALCIUM DISSOLVED (MG/L)	56	117	84	41	71
MAGNESIUM DISSOLVED (MG/L)	18	18	17	8.1	14
POTASSIUM DISSOLVED (MG/L)	-	1.7	2.6	1.0	2.1
SODIUM DISSOLVED (MG/L)	313	265	476	270	364
CHLORIDE DISSOLVED (MG/L)	500	400	675	450	550
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.80	0.30	3.4	1.8	0.26
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	0.40	0.02	0.10	0.01
SULFATE DISSOLVED (MG/L AS SO4)	57	39	44	89	33
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	300	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	3	3	2	3	5
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	4700	<50	<50	<50	<50
LEAD DISSOLVED (UG/L)	50	40	60	<10	<10
MANGANESE DISSOLVED (UG/L)	500	<10	20	<10	<10
MERCURY DISSOLVED (UG/L)	1.2	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	70	40	30	<20	<20

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection		
	LC-57 09 25 1981	LC-57 03 14 1983	LC-57 06 14 1983
SPECIFIC CONDUCTANCE (UMHOS)	558	595	600
PH LAB (STANDARD UNITS)	7.7	8.0	7.6
ALKALINITY LAB (MG/L AS CACO3)	220	229	192
CARBON TOTAL ORGANIC (MG/L AS C)	8.9	21	20
HARDNESS (MG/L AS CACO3)	300	302	255
CALCIUM DISSOLVED (MG/L)	59	65	79
MAGNESIUM DISSOLVED (MG/L)	37	34	14
POTASSIUM DISSOLVED (MG/L)	0.6	0.6	2.3
SODIUM DISSOLVED (MG/L)	8.9	4.0	18
CHLORIDE DISSOLVED (MG/L)	5.0	10	40
FLUORIDE DISSOLVED (MG/L)	0.3	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	2.2	<0.10	2.6
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.02	0.07	-
SULFATE DISSOLVED (MG/L AS SO4)	60	70	56
ARSENIC DISSOLVED (UG/L)	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	<200	<200
CADMIUM DISSOLVED (UG/L)	-	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10
COPPER DISSOLVED (UG/L)	-	30	60
IRON DISSOLVED (UG/L)	<50	<50	<50
LEAD DISSOLVED (UG/L)	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	30	<10	<10
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10
ZINC DISSOLVED (UG/L)	-	<20	70

Table 10A. *Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)*

Constituent	Well number and date of sample collection			
	LC-59 09 23 1981	LC-59 03 23 1982	LC-59 08 04 1982	LC-59 06 14 1983
SPECIFIC CONDUCTANCE (UMHOS)	769	769	694	930
PH LAB (STANDARD UNITS)	7.7	7.7	7.7	7.7
ALKALINITY LAB (MG/L AS CACO3)	214	225	214	231
CARBON TOTAL ORGANIC (MG/L AS C)	14	16	14	19
HARDNESS (MG/L AS CACO3)	464	469	327	284
CALCIUM DISSOLVED (MG/L)	156	143	103	61
MAGNESIUM DISSOLVED (MG/L)	18	27	17	32
POTASSIUM DISSOLVED (MG/L)	2.4	2.4	2.9	0.5
SODIUM DISSOLVED (MG/L)	18	18	23	4.1
CHLORIDE DISSOLVED (MG/L)	40	40	72	15
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	2.7	1.6	1.7	<0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	-	0.06	0.10
SULFATE DISSOLVED (MG/L AS SO4)	142	112	76	62
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	300	<200	<200
CADMIUM DISSOLVED (UG/L)	-	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10	<10
COPPER DISSOLVED (UG/L)	-	30	90	50
IRON DISSOLVED (UG/L)	<50	<50	60	<50
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	<10	<10	<10	20
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	-	60	30	40

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

	Well number and date of sample collection					
Constituent	LC-61 10 27 1981	LC-61 03 23 1982	LC-61 08 04 1982	LC-13 09 23 1981	LC-13 02 16 1983	LC-13 06 13 1983
SPECIFIC CONDUCTANCE (UMHOS)	755	825	750	361	396	400
PH LAB (STANDARD UNITS)	7.5	7.5	7.6	8.1	7.9	8.1
ALKALINITY LAB (MG/L AS CACO3)	251	268	248	164	185	177
CARBON TOTAL ORGANIC (MG/L AS C)	-	21	24	8.0	12	13
HARDNESS (MG/L AS CACO3)	397	442	355	164	171	164
CALCIUM DISSOLVED (MG/L)	103	121	91	23	24	23
MAGNESIUM DISSOLVED (MG/L)	34	34	31	26	27	26
POTASSIUM DISSOLVED (MG/L)	-	3.2	3.1	-	0.5	0.8
SODIUM DISSOLVED (MG/L)	-	17	18	34	17	16
CHLORIDE DISSOLVED (MG/L)	40	40	40	2.5	2.5	2.5
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	0.3	1.0	1.1	0.9
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	4.9	1.3	1.0	1.50	1.56	<0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	0.01	0.10	-	0.01	0.03
SULFATE DISSOLVED (MG/L AS SO4)	100	105	94	26	32	27
ARSENIC DISSOLVED (UG/L)	-	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	<200	<200	-	<200	<200
CADMIUM DISSOLVED (UG/L)	-	<1	2	-	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10	-	<10	<10
COPPER DISSOLVED (UG/L)	-	<20	<20	-	<20	<20
IRON DISSOLVED (UG/L)	<50	100	<50	<50	240	<50
LEAD DISSOLVED (UG/L)	-	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	-	20	<10	<10	<10	<10
MERCURY DISSOLVED (UG/L)	-	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	<1	<1	-	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10	-	<10	<10
ZINC DISSOLVED (UG/L)	-	50	60	-	<20	<20

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection			
	LC-63 06 18 1982	LC-63 08 04 1982	LC-63 02 16 1983	LC-63 06 14 1983
SPECIFIC CONDUCTANCE (UMHOS)	-	-	1133	1130
PH LAB (STANDARD UNITS)	-	-	7.4	7.6
ALKALINITY LAB (MG/L AS CACO3)	-	-	382	415
CARBON TOTAL ORGANIC (MG/L AS C)	-	-	22	40
HARDNESS (MG/L AS CACO3)	763	-	403	409
CALCIUM DISSOLVED (MG/L)	167	128	97	96
MAGNESIUM DISSOLVED (MG/L)	84	59	39	41
POTASSIUM DISSOLVED (MG/L)	4.4	4.0	2.0	2.6
SODIUM DISSOLVED (MG/L)	209	191	76	90
CHLORIDE DISSOLVED (MG/L)	-	-	175	150
FLUORIDE DISSOLVED (MG/L)	-	<0.2	0.3	0.4
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	-	-	2.9	2.3
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	-	0.01	0.02
SULFATE DISSOLVED (MG/L AS SO4)	-	-	40	37
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	500	300	<200	300
CADMIUM DISSOLVED (UG/L)	<1	2	2	2
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	-	<20	<20
IRON DISSOLVED (UG/L)	<50	<50	140	<50
LEAD DISSOLVED (UG/L)	30	50	<10	<10
MANGANESE DISSOLVED (UG/L)	770	460	220	230
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	4.0	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	30	90	30	<20

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection				
	LC-66 11 19 1981	LC-66 03 24 1982	LC-66 08 04 1982	LC-66 02 15 1983	LC-66 06 13 1983
SPECIFIC CONDUCTANCE (UMHOS)	384	417	297	396	1020
PH LAB (STANDARD UNITS)	7.9	7.8	7.9	7.8	6.8
ALKALINITY LAB (MG/L AS CACO3)	160	177	173	177	52
CARBON TOTAL ORGANIC (MG/L AS C)	13	25	17	16	10
HARDNESS (MG/L AS CACO3)	182	199	161	211	465
CALCIUM DISSOLVED (MG/L)	-	48	38	53	127
MAGNESIUM DISSOLVED (MG/L)	-	19	16	19	36
POTASSIUM DISSOLVED (MG/L)	-	1.6	1.6	1.1	1.5
SODIUM DISSOLVED (MG/L)	9.4	3.0	1.9	1.4	1.3
CHLORIDE DISSOLVED (MG/L)	10	5.0	5.0	5.0	2.5
FLUORIDE DISSOLVED (MG/L)	0.4	0.5	0.5	0.5	0.4
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.10	<0.10	1.5	0.12	0.12
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	0.03	0.05	0.01	0.08
SULFATE DISSOLVED (MG/L AS SO4)	62	61	14	28	24
ARSENIC DISSOLVED (UG/L)	20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	700	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	1	<1	<1	3	2
CHROMIUM DISSOLVED (UG/L)	10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	-	<20	<20	<20	60
IRON DISSOLVED (UG/L)	-	<50	<50	230	4100
LEAD DISSOLVED (UG/L)	-	<10	<10	<10	60
MANGANESE DISSOLVED (UG/L)	-	410	370	320	1740
MERCURY DISSOLVED (UG/L)	-	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	-	50	<20	<20	420

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection LC-67 11 19 1981	LC-67 03 24 1982	LC-67 08 04 1982	LC-67 06 14 1983	LC-67 03 14 1983	LC-67 06 14 1983
SPECIFIC CONDUCTANCE (UMHOS)	552	586	609	520	637	610
PH LAB (STANDARD UNITS)	7.5	7.8	7.9	7.9	7.6	7.7
ALKALINITY LAB (MG/L AS CACO3)	197	222	229	222	210	218
CARBON TOTAL ORGANIC (MG/L AS C)	24	14	27	24	24	20
HARDNESS (MG/L AS CACO3)	165	322	314	299	268	258
CALCIUM DISSOLVED (MG/L)	33	81	68	70	86	82
MAGNESIUM DISSOLVED (MG/L)	20	29	35	30	13	13
POTASSIUM DISSOLVED (MG/L)	-	1.7	2.2	2.2	2.4	2.3
SODIUM DISSOLVED (MG/L)	16	8.1	9.6	8.2	18	23
CHLORIDE DISSOLVED (MG/L)	25	18	22	20	36	42
FLUORIDE DISSOLVED (MG/L)	0.3	<0.2	0.4	0.3	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.40	0.31	0.67	0.40	0.49	0.37
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	0.02	0.07	0.01	0.03	0.02
SULFATE DISSOLVED (MG/L AS SO4)	65	102	70	66	51	40
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	300	<200	300	<200	<200
CADMIUM DISSOLVED (UG/L)	2	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	60	<20	<20	<20	60	210
IRON DISSOLVED (UG/L)	4300	<50	<50	<50	<50	<50
LEAD DISSOLVED (UG/L)	200	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	330	110	30	30	<10	<10
MERCURY DISSOLVED (UG/L)	0.5	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	220	50	50	<20	40	160

Table 10A. Chemical analysis of water from selected wells in Clarence, Lancaster, and Newstead. (Analyses by Erie County Laboratory. Well locations shown in fig. 2. UMHOS is microhomos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection				
	LC-68 09 24 1981	LC-68 03 24 1982	LC-68 08 04 1982	LC-68 02 16 1983	LC-68 06 14 1983
SPECIFIC CONDUCTANCE (UMHOS)	516	396	779	1274	1270
PH LAB (STANDARD UNITS)	7.5	7.7	7.6	7.3	7.6
ALKALINITY LAB (MG/L AS CACO3)	162	151	251	229	229
CARBON TOTAL ORGANIC (MG/L AS C)	-	10	36	15	21
HARDNESS (MG/L AS CACO3)	198	206	432	871	800
CALCIUM DISSOLVED (MG/L)	53	61	107	258	228
MAGNESIUM DISSOLVED (MG/L)	16	13	40	55	56
POTASSIUM DISSOLVED (MG/L)	-	1.2	1.1	0.90	1.1
SODIUM DISSOLVED (MG/L)	-	7.9	6.8	5.8	6.1
CHLORIDE DISSOLVED (MG/L)	45	20	22	20	20
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	0.3	<0.2	<0.2
NITROGEN.NO2+NO3 DIS.(MG/L AS N)	4.2	0.90	0.80	<0.10	0.18
PHOSPHORUS.ORTHO DIS.(MG/L AS P)	-	0.07	0.05	0.01	0.01
SULFATE DISSOLVED (MG/L AS SO4)	18	49	186	535	453
ARSENIC DISSOLVED (UG/L)	-	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	-	300	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	-	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	-	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	<50	<50	70	<50
LEAD DISSOLVED (UG/L)	-	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	-	<10	60	60	70
MERCURY DISSOLVED (UG/L)	-	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	-	<20	<20	60	30

Table 10B. Chemical ananlyses of water from selected wells in Sardinia. (Analyses by Erie County Laboratory. Well locations shown in fig. 9. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	SA-2 01 05 1983	SA-2 05 24 1983	SA-13 08 03 1982	SA-13 01 05 1983	SA-13 05 24 1983
	Well number and date of sample collection				
SPECIFIC CONDUCTANCE (UMHOS)	354	340	311	326	330
PH LAB (STANDARD UNITS)	7.0	7.9	8.1	7.8	8.0
ALKALINITY LAB (MG/L AS CACO3)	144	156	153	155	158
CARBON TOTAL ORGANIC (MG/L AS C)	14	9.2	15	5.2	9.2
HARDNESS (MG/L AS CACO3)	183	169	92	93	93
CALCIUM DISSOLVED (MG/L)	55	51	25	26	25
MAGNESIUM DISSOLVED (MG/L)	11	10	7.1	6.7	7.2
POTASSIUM DISSOLVED (MG/L)	1.4	1.2	1.1	1.1	1.1
SODIUM DISSOLVED (MG/L)	5.3	5.4	37	35	36
CHLORIDE DISSOLVED (MG/L)	7.5	10	18	18	18
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	2.5	2.2	<0.1	<0.1	<0.1
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	0.03	0.10	0.04	0.03
SULFATE DISSOLVED (MG/L AS SO4)	20	18	4.3	5.2	4.4
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	300	400	700	600
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	50	50	270	130	150
LEAD DISSOLVED (UG/L)	<10	20	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	<10	<10	20	40	40
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	70	70	<20	<20	30

Table 10B. Chemical ananlyses of water from selected wells in Sardinia. (Analyses by Erie County Laboratory. Well locations shown in fig. 9. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection					
	SA-17 08 02 1982	SA-17 01 06 1983	SA-17 05 24 1983	SA-21 08 03 1982	SA-21 01 05 1983	SA-21 05 23 1983
SPECIFIC CONDUCTANCE (UMHOS)	212	176	290	176	156	130
PH LAB (STANDARD UNITS)	7.9	7.7	7.8	6.7	7.0	7.0
ALKALINITY LAB (MG/L AS CACO3)	82	176	80	50	61	43
CARBON TOTAL ORGANIC (MG/L AS C)	7.3	8.0	4.3	6.6	1.0	6.5
HARDNESS (MG/L AS CACO3)	108	100	99	66	75	54
CALCIUM DISSOLVED (MG/L)	33	31	30	20	23	16
MAGNESIUM DISSOLVED (MG/L)	6.1	5.6	5.9	3.9	4.2	3.3
POTASSIUM DISSOLVED (MG/L)	1.5	1.1	1.0	1.1	1.0	0.80
SODIUM DISSOLVED (MG/L)	4.4	3.1	3.0	3.1	3.6	2.5
CHLORIDE DISSOLVED (MG/L)	7.5	10	7.5	7.5	0.5	5.0
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.87	1.7	1.1	0.73	0.37	0.24
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.03	0.02	0.04	0.10	0.02	-
SULFATE DISSOLVED (MG/L AS SO4)	13	14	14	14	16	13
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	<200	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	40	60	40
IRON DISSOLVED (UG/L)	400	50	50	50	120	50
LEAD DISSOLVED (UG/L)	<10	<10	20	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	130	<10	<10	<10	<10	20
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20

Table 10B. Chemical ananlyses of water from selected wells in Sardinia. (Analyses by Erie County Laboratory. Well locations shown in fig. 9. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

	Well number and date of sample collection					
Constituent	SA-14 08 02 1982	SA-14 01 05 1983	SA-14 05 24 1983	SA-15 08 02 1982	SA-15 01 05 1983	SA-15 05 24 1983
SPECIFIC CONDUCTANCE (UMHOS)	566	680	547	481	566	530
PH LAB (STANDARD UNITS)	7.9	7.6	7.7	7.8	7.6	7.6
ALKALINITY LAB (MG/L AS CACO3)	207	251	238	212	227	225
CARBON TOTAL ORGANIC (MG/L AS C)	20	20	22	20	19	11
HARDNESS (MG/L AS CACO3)	252	320	265	254	274	269
CALCIUM DISSOLVED (MG/L)	76	97	78	72	80	78
MAGNESIUM DISSOLVED (MG/L)	15	19	17	18	18	18
POTASSIUM DISSOLVED (MG/L)	1.9	1.6	1.6	2.6	1.7	1.8
SODIUM DISSOLVED (MG/L)	18	15	14	5.9	5.1	5.4
CHLORIDE DISSOLVED (MG/L)	20	35	28	10	18	12
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	7.0	6.0	6.3	1.8	1.9	2.9
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.05	0.01	-	0.06	0.01	0.01
SULFATE DISSOLVED (MG/L AS SO4)	19	22	23	31	35	32
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	<200	<200	<200	300
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	50	50	50	2900	50	130
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10	20
MANGANESE DISSOLVED (UG/L)	20	<10	<10	1500	420	510
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	<20	230	160	90

Table 10B. Chemical ananlyses of water from selected wells in Sardinia.
(Analyses by Erie County Laboratory. Well locations shown in fig. 9.
UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection SA-25-02 08 02 1982	SA-25-02 01 05 1983	SA-25-02 05 24 1983	SA-25-03 08 03 1982	SA-25-03 01 05 1983	SA-25-03 05 24 1983
SPECIFIC CONDUCTANCE (UMHOS)	394	382	390	354	326	360
PH LAB (STANDARD UNITS)	7.8	7.8	7.9	7.7	7.6	7.7
ALKALINITY LAB (MG/L AS CACO3)	156	155	151	136	126	134
CARBON TOTAL ORGANIC (MG/L AS C)	12	14	10	17	13	8.1
HARDNESS (MG/L AS CACO3)	178	187	175	190	169	168
CALCIUM DISSOLVED (MG/L)	56	60	55	58	53	51
MAGNESIUM DISSOLVED (MG/L)	9.2	9.0	9.2	11	8.9	9.8
POTASSIUM DISSOLVED (MG/L)	0.60	1.0	0.80	1.0	1.0	0.70
SODIUM DISSOLVED (MG/L)	9.8	8.8	9.2	2.2	2.1	2.3
CHLORIDE DISSOLVED (MG/L)	14	18	15	12	20	18
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.01	1.6	0.10	0.18	0.17	0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	0.05	0.01	0.02	0.01	0.01
SULFATE DISSOLVED (MG/L AS SO4)	29	29	24	36	23	26
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	220	300	300	300	300	400
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<10	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	320	230	260	1700	3300	1400
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	470	510	550	480	460	510
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	-	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	-	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	30	620	1230	710

Well has galvanized (zinc coated) screen.

Table 10B. Chemical ananlyses of water from selected wells in Sardinia. (Analyses by Erie County Laboratory. Well locations shown in fig. 9. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection					
	SA-22 08 03 1982	SA-22 01 05 1983	SA-23 05 24 1983	SA-23 08 02 1982	SA-25-01 01 05 1983	SA-25-01 05 24 1983
SPECIFIC CONDUCTANCE (UMHOS)	326	340	430	411	425	370
PH LAB (STANDARD UNITS)	7.9	8.1	7.8	7.8	7.8	7.9
ALKALINITY LAB (MG/L AS CACO3)	123	126	164	162	161	162
CARBON TOTAL ORGANIC (MG/L AS C)	11	5.3	6.4	14	13	10
HARDNESS (MG/L AS CACO3)	169	164	201	167	199	187
CALCIUM DISSOLVED (MG/L)	48	46	59	47	60	55
MAGNESIUM DISSOLVED (MG/L)	12	12	13	12	12	12
POTASSIUM DISSOLVED (MG/L)	0.50	1.0	1.6	1.4	1.2	1.2
SODIUM DISSOLVED (MG/L)	4.1	3.6	5.4	8.3	6.5	7.7
CHLORIDE DISSOLVED (MG/L)	7.5	28	15	20	18	18
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.75	0.10	7.1	0.80	0.60	1.2
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.11	0.02	-	0.11	0.03	0.01
SULFATE DISSOLVED (MG/L AS SO4)	37	38	18	30	31	29
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	<200	<200	<200	300
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20	40
IRON DISSOLVED (UG/L)	50	550	50	50	50	50
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	60	50	<10	280	140	190
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	<20	50	<20	<20

Table 10B. Chemical ananlyses of water from selected wells in Sardinia.
(Analyses by Erie County Laboratory. Well locations shown in fig. 9.
UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection				
	SA-46 01 06 1983	SA-46 05 23 1983	SA-34 08 03 1982	SA-34 01 05 1983	SA-34 05 24 1983
SPECIFIC CONDUCTANCE (UMHOS)	496	490	396	396	390
PH LAB (STANDARD UNITS)	7.7	7.7	7.8	8.0	7.9
ALKALINITY LAB (MG/L AS CACO3)	235	229	149	146	147
CARBON TOTAL ORGANIC (MG/L AS C)	12	20	15	2.5	9.8
HARDNESS (MG/L AS CACO3)	262	239	207	199	197
CALCIUM DISSOLVED (MG/L)	75	66	58	55	54
MAGNESIUM DISSOLVED (MG/L)	18	18	15	15	15
POTASSIUM DISSOLVED (MG/L)	1.0	0.80	0.70	1.0	0.50
SODIUM DISSOLVED (MG/L)	4.1	4.1	2.0	1.8	1.7
CHLORIDE DISSOLVED (MG/L)	12	7.5	18	13	15
FLUORIDE DISSOLVED (MG/L)	<0.20	<0.20	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.10	0.10	0.10	0.10	0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.01	-	0.04	0.02	0.01
SULFATE DISSOLVED (MG/L AS SO4)	19	18	45	41	40
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	300	300	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	440	50	310	270	210
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	330	310	60	50	60
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	240	140	<20	<20	<20

Table 10B. Chemical ananlyses of water from selected wells in Sardinia. (Analyses by Erie County Laboratory. Well locations shown in fig. 9. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection			
	SA-28-01 01 05 1983	SA-28-01 05 24 1983	SA-28-02 01 05 1983	SA-28-02 05 24 1983
SPECIFIC CONDUCTANCE (UMHOS)	312	250	297	300
PH LAB (STANDARD UNITS)	8.0	7.5	7.0	7.6
ALKALINITY LAB (MG/L AS CACO3)	102	65	133	127
CARBON TOTAL ORGANIC (MG/L AS C)	-	4.7	12	11
HARDNESS (MG/L AS CACO3)	155	112	152	142
CALCIUM DISSOLVED (MG/L)	44	25	51	42
MAGNESIUM DISSOLVED (MG/L)	11	12	6.1	9.0
POTASSIUM DISSOLVED (MG/L)	1.9	2.0	1.0	0.70
SODIUM DISSOLVED (MG/L)	3.2	3.5	1.4	2.1
CHLORIDE DISSOLVED (MG/L)	10	7.5	5.0	5.0
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	0.20	0.26	0.60	1.1
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.02	0.03	0.01	0.01
SULFATE DISSOLVED (MG/L AS SO4)	51	40	16	22
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	400	<200	300
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	30	<20	30
IRON DISSOLVED (UG/L)	50	50	50	50
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	500	20	90	20
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	260	90

Table 10C. Chemical analyses of water from selected wells in Springville. (Analyses by Erie County Laboratory. Well locations shown in fig. 15. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection				
	SP-1 08 05 1982	SP-1 01 06 1983	SP-1 05 23 1983	SP-4 01 06 1983	SP-4 05 24 1983
SPECIFIC CONDUCTANCE (UMHOS)	495	510	485	425	540
PH LAB (STANDARD UNITS)	8.0	8.0	7.8	7.0	7.7
ALKALINITY LAB (MG/L AS CACO3)	179	185	1168	118	218
CARBON TOTAL ORGANIC (MG/L AS C)	20	4.9	7.1	1.8	21
HARDNESS (MG/L AS CACO3)	252	267	227	156	219
CALCIUM DISSOLVED (MG/L)	76	82	68	49	68
MAGNESIUM DISSOLVED (MG/L)	15	15	14	8.2	12
POTASSIUM DISSOLVED (MG/L)	2.4	3.1	2.8	2.0	2.7
SODIUM DISSOLVED (MG/L)	3.4	3.9	3.1	16	9.8
CHLORIDE DISSOLVED (MG/L)	12	18	12	20	18
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	4.9	4.7	7.8	8.1	-
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.09	0.02	0.02	-	0.01
SULFATE DISSOLVED (MG/L AS SO4)	48	47	45	27	32
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	<50	<50	2900	860
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	<10	<10	<10	4900	8300
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	50	90	30	30

Table 10C. *Chemical analyses of water from selected wells in Springville. (Analyses by Erie County Laboratory. Well locations shown in fig. 15. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)*

Constituent	Well number and date of sample collection					
	SP-9 08 05 1982	SP-9 01 06 1983	SP-9 05 23 1983	SP-14 08 05 1982	SP-14 01 06 1983	SP-14 05 23 1983
SPECIFIC CONDUCTANCE (UMHOS)	849	991	860	694	496	540
PH LAB (STANDARD UNITS)	7.8	7.6	7.6	7.8	7.6	7.8
ALKALINITY LAB (MG/L AS CACO3)	220	251	244	225	157	168
CARBON TOTAL ORGANIC (MG/L AS C)	28	9.1	116	24	7.5	7.0
HARDNESS (MG/L AS CACO3)	353	401	366	351	245	225
CALCIUM DISSOLVED (MG/L)	110	126	112	96	70	62
MAGNESIUM DISSOLVED (MG/L)	19	21	21	27	17	17
POTASSIUM DISSOLVED (MG/L)	3.9	4.2	4.6	1.0	1.0	0.70
SODIUM DISSOLVED (MG/L)	58	59	59	11	9.7	10
CHLORIDE DISSOLVED (MG/L)	125	200	150	15	22	15
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	1.10	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	9.4	7.2	10	0.90	0.12	0.22
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.06	-	0.02	0.03	0.01	0.48
SULFATE DISSOLVED (MG/L AS SO4)	43	52	38	139	73	70
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	400	<200	<200	300
CADMIUM DISSOLVED (UG/L)	<1	9	2	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	50	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	130	140	1120	170	620
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	2400	260	30	190	20	90
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	40	<20	<20	<20	300

Table 10C. Chemical analyses of water from selected wells in Springville.
(Analyses by Erie County Laboratory. Well locations shown in fig. 15.
UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection					
	SP-26 08 05 1982	SP-26 01 06 1983	SP-26 05 23 1983	SP-27 08 05 1982	SP-27 01 06 1983	SP-27 05 23 1983
SPECIFIC CONDUCTANCE (UMHOS)	1360	991	718	396	425	410
PH LAB (STANDARD UNITS)	7.4	7.2	7.6	7.0	7.9	7.9
ALKALINITY LAB (MG/L AS CACO3)	391	307	261	166	164	164
CARBON TOTAL ORGANIC (MG/L AS C)	56	14	8.9	21	1.9	4.1
HARDNESS (MG/L AS CACO3)	445	294	298	215	211	194
CALCIUM DISSOLVED (MG/L)	145	98	96	63	63	56
MAGNESIUM DISSOLVED (MG/L)	20	12	14	14	13	13
POTASSIUM DISSOLVED (MG/L)	4.0	2.0	3.3	1.0	1.0	0.80
SODIUM DISSOLVED (MG/L)	165	85	33	3.7	3.3	3.4
CHLORIDE DISSOLVED (MG/L)	225	125	55	12	12	10
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	4.5	2.4	5.2	4.8	4.3	4.3
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.04	0.01	0.01	0.04	0.02	0.01
SULFATE DISSOLVED (MG/L AS SO4)	31	21	20	24	22	22
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	300	<200	<200	400
CADMIUM DISSOLVED (UG/L)	<1	2	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	<50	2100	50	50	50	50
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	1700	460	40	<10	<10	20
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	40	<20	<20	<20	<20	<20

Table 10C. Chemical analyses of water from selected wells in Springville. (Analyses by Erie County Laboratory. Well locations shown in fig. 15. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection SP-28 08 05 1982	SP-28 05 23 1983	SP-31 08 05 1982	SP-31 01 05 1983	SP-31 05 23 1983
SPECIFIC CONDUCTANCE (UMHOS)	227	240	297	312	340
PH LAB (STANDARD UNITS)	7.0	7.0	8.0	8.0	7.8
ALKALINITY LAB (MG/L AS CACO3)	130	60	158	116	112
CARBON TOTAL ORGANIC (MG/L AS C)	7.4	1.0	10	1.0	3.7
HARDNESS (MG/L AS CACO3)	78	86	158	149	150
CALCIUM DISSOLVED (MG/L)	23	26	45	43	42
MAGNESIUM DISSOLVED (MG/L)	5	5.2	11	10	11
POTASSIUM DISSOLVED (MG/L)	1.4	1.3	0.60	1.0	0.50
SODIUM DISSOLVED (MG/L)	14	12	3.4	3.0	3.1
CHLORIDE DISSOLVED (MG/L)	30	32	12	12	10
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	1.4	2.6	0.10	0.12	0.10
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.07	0.03	-	0.02	0.04
SULFATE DISSOLVED (MG/L AS SO4)	16	16	37	38	33
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	<200	<200	<200	<200
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	50	<20	<20	<20
IRON DISSOLVED (UG/L)	50	50	200	200	170
LEAD DISSOLVED (UG/L)	<10	20	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	<10	30	60	50	60
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	10	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	<20	<20	<20

Table 10C. Chemical analyses of water from selected wells in Springville. (Analyses by Erie County Laboratory. Well locations shown in fig. 15. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	SP-29 08 05 1982	SP-29 01 06 1983	SP-29 05 23 1983	SP-37 01 05 1982	SP-37 08 05 1982	SP-37 05 23 1983
	Well number and date of sample collection					
SPECIFIC CONDUCTANCE (UMHOS)	439	467	420	849	680	640
PH LAB (STANDARD UNITS)	7.9	7.8	7.8	7.3	7.7	7.7
ALKALINITY LAB (MG/L AS CACO3)	177	196	173	329	274	235
CARBON TOTAL ORGANIC (MG/L AS C)	21	3.0	6.1	27	32	3.5
HARDNESS (MG/L AS CACO3)	234	242	212	426	363	276
CALCIUM DISSOLVED (MG/L)	69	72	62	136	114	84
MAGNESIUM DISSOLVED (MG/L)	15	15	14	21	19	16
POTASSIUM DISSOLVED (MG/L)	0.90	1.0	0.70	9.6	9.0	5.4
SODIUM DISSOLVED (MG/L)	7.2	9.0	7.6	20	19	17
CHLORIDE DISSOLVED (MG/L)	22	18	18	52	38	50
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	4.7	4.4	5.7	8.1	7.3	8.9
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	0.07	0.03	0.02	0.01	0.20	0.01
SULFATE DISSOLVED (MG/L AS SO4)	20	21	17	22	21	21
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	<200	300	<200	500	<200	400
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	<20	<20	<20	<20	<20	<20
IRON DISSOLVED (UG/L)	50	50	50	50	50	50
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	30	20	<10	<10	<10	<10
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<1	<1	<1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	<20	<20	140	<20	40

Table 10D. Chemical analyses of water from selected wells in Alden. (Analyses by Erie County Laboratory. Well locations shown in fig. 22. UMHOS is micromhos; MG/L is milligrams per liter; UG/L is micrograms per liter.)

Constituent	Well number and date of sample collection			
	AL-21 04 19 82	AL-8 04 19 82	AL-18 04 19 82	AL-16 04 19 82
SPECIFIC CONDUCTANCE (UMHOS)	-	-	-	-
PH LAB (STANDARD UNITS)	7.7	7.5	7.3	7.7
ALKALINITY LAB (MG/L AS CACO3)	145	244	283	257
CARBON TOTAL ORGANIC (MG/L AS C)	4.7	10	11	13
HARDNESS (MG/L AS CACO3)	170	297	653	428
CALCIUM DISSOLVED (MG/L)	62	122	247	164
MAGNESIUM DISSOLVED (MG/L)	7.2	10	25	17
POTASSIUM DISSOLVED (MG/L)	-	-	-	-
SODIUM DISSOLVED (MG/L)	1.9	18	9.2	22
CHLORIDE DISSOLVED (MG/L)	5.0	40	20	38
FLUORIDE DISSOLVED (MG/L)	<0.2	<0.2	<0.2	<0.2
NITROGEN,NO2+NO3 DIS.(MG/L AS N)	<0.1	2.7	<0.1	<0.1
PHOSPHORUS,ORTHO DIS.(MG/L AS P)	-	-	-	-
SULFATE DISSOLVED (MG/L AS SO4)	23	28	376	195
ARSENIC DISSOLVED (UG/L)	<20	<20	<20	<20
BARIUM DISSOLVED (UG/L)	400	<200	200	300
CADMIUM DISSOLVED (UG/L)	<1	<1	<1	<1
CHROMIUM DISSOLVED (UG/L)	<10	<10	<10	<10
COPPER DISSOLVED (UG/L)	20	40	<20	<20
IRON DISSOLVED (UG/L)	<50	<50	420	480
LEAD DISSOLVED (UG/L)	<10	<10	<10	<10
MANGANESE DISSOLVED (UG/L)	<10	10	20	120
MERCURY DISSOLVED (UG/L)	<0.4	<0.4	<0.4	<0.4
SELENIUM DISSOLVED (UG/L)	<1	<1	<.1	<1
SILVER DISSOLVED (UG/L)	<10	<10	<10	<10
ZINC DISSOLVED (UG/L)	<20	40	40	<20