GLACIAL HISTORY AND GEOHYDROLOGY OF THE IRONDEQUOIT CREEK VALLEY, MONROE COUNTY, NEW YORK

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 88-4145

Prepared in cooperation with

MONROE COUNTY ENVIRONMENTAL HEALTH LABORATORY

MONROE COUNTY DEPARTMENT OF ENGINEERING

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Ithaca, New York

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CONTENTS

ILLUSTRATIONS

ILLUSTRATIONS (continued)

PLATES

(in pocket)

PLATES (continued)

TABLES

CONVERSION FACTORS AND ABBREVIATIONS

The following factors may be used to convert the inch-pound units used in this report to metric (International System) units.

Multiply inch-pound unit	By	To obtain metric units
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	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)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
gallons per day (gal/d)	3.785	liters per day (L/d)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot squared per day (ft^2/d)	0.0929	meter squared per day (m^2/d)

Sea level: In this report "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called "Sea Level Datum of 1929."

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ABSTRACT

A buried segment of the Pinnacle Hills moraine, which fills the valley beneath the Irondequoit Creek flood plain at Browncroft Boulevard in Rochester, effectively separates the ground-water systems of the southern two-thirds of the Irondequoit Creek basin from that of the northern third. The glacial and postglacial deposits in the northern (lower) third of the basin consist of variable thicknesses of till and lacustrine sand and silt that interfinger with, and are overlain by, alluvial organic silt and sand. The lacustrine deposits contain lenses of coarser fluvial sand and gravel and occupy incised stream courses that were created during the rapid proglacial lake-level decline from the glacial Lake Iroquois stage, and the subsequent gradual return to the modern Lake Ontario level. Ground water within these deposits moves northward toward Lake Ontario.

The glacial and postglacial deposits just south (upstream) from the buried moraine segment consist of mixed sequences of till, fine to coarse sand and gravel, and lacustrine silt overlain by approximately 40 feet of silty, sandy alluvium. Ground water in this part of the basin moves northward toward the buried moraine, and the postglacial alluvium that overlies the buried moraine is the only significant hydraulic connection between the two ground-water systems.

The southern two-thirds of the basin are veneered with deposits of sand, silt, and clay that formed in proglacial lakes. Outwash from the receding ice front and other ice-contact sediments form lenses of coarser sand and gravel within these deposits. Kame-delta deposits are scattered along the sides of the valley floor, and kame-moraine deposits are present in upland areas. Recent alluvium fills incised channels in the lacustrine deposits along the creek. Ground water from upland areas flows toward the Irondequoit Creek valley and then northward parallel to the moderate gradient of Irondequoit Creek.

Ground-water levels were measured at the Powder Mills Park fish hatchery in the upper Irondequoit valley and in Ellison Park in the lower valley. Water levels in the upper valley are controlled primarily by precipitation and evapotranspiration. Recent development of the area upgradient from the hatchery seems to have affected ground water only minimally. Ground-water levels in the lower valley are controlled by the constriction of surface water and ground water through this postglacial valley section, and the main source of recharge to this area is precipitation. The quality of ground water in the lower valley appears to be stable along the valley axis but contains elevated chloride concentrations at shallow depths at several locations near the valley walls. Water in deeper parts of the aquifer has not been affected, presumably because it has a slight upward flow component.

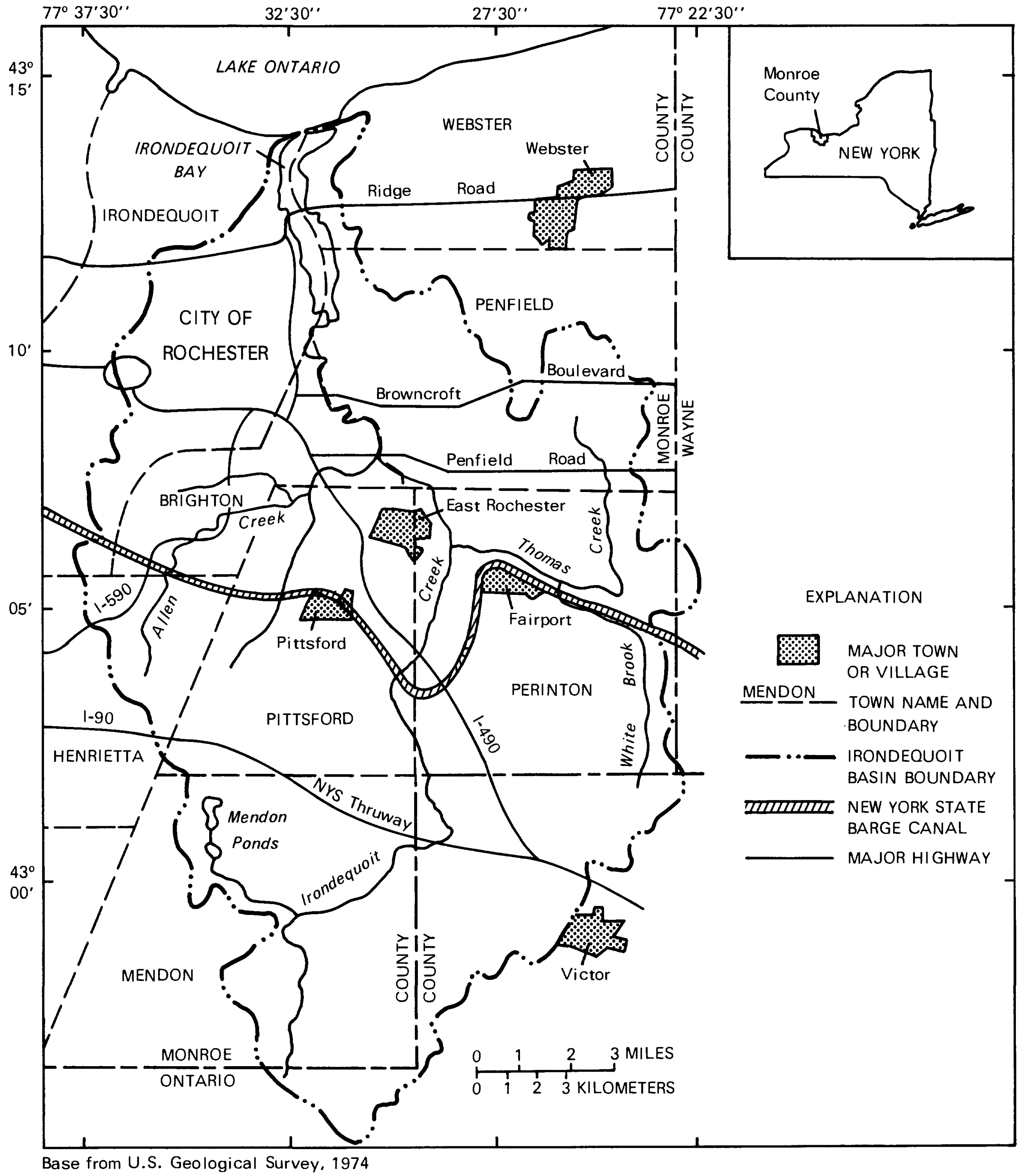


Figure 1.--Location and principal geographic features of the Irondequoit Creek basin.

INTRODUCTION

The area overlying the Irondequoit aquifer is changing in character from predominantly rural and agricultural to residential and commercial. Although the number of public water suppliers that use ground water as a primary water source has diminished since 1970, communities and individuals who continue to use ground water from the aquifer, especially in the southern part, are concerned about declines in its quality and quantity. Changes in the chemical quality of ground water have been noted in several parts of the basin. For example, the village of East Rochester (fig. 1) has reported increasing chloride concentrations that are attributed to the use of highway-deicing salts within the basin (R. Burton, Monroe County Health Department, oral commun., 1987).

Changes in land use may be responsible for changes in the quantity and quality of ground water. A growing concern is that development in the Irondequoit basin will result in the infiltration of salt and other contaminants directly to ground water through permeable surficial deposits. Additionally, the newer residential and urban developments contain storm sewers to carry storm runoff to the nearest local stream course or water body, which minimizes ground-water contamination but also reduces ground-water recharge. To evaluate the effects of land-use changes and storm-water-management practices on ground-water quantity and quality, the hydrogeology of the system must be documented. Of particular concern is the continuity between the aquifer in the southern part of the basin, where much of the development is occurring, and the aquifer in the northern part, where much of the water is being withdrawn.

In 1985, the U.S. Geological Survey, in cooperation with the Monroe County Department of Engineering and Environmental Health Laboratory, began a 2-year study to evaluate the effects of urbanization and stormwater-control practices on the surface-water and ground-water resources of the Irondequoit Creek basin. As part of that study, the Geological Survey evaluated the glacial stratigraphy of the buried Irondogenesee valley, especially the northern section, to determine the degree of continuity from south to north. Also as part of the study, the Survey collected data at two sites within the Irondequoit Creek valley to evaluate (1) the effects of urbanization on ground water, and (2) the effect of high flows within the broad Irondequoit Creek flood plain on ground-water quality.

Purpose and Scope

This report describes the glacial history of the Irondequoit valley and documents the geohydrologic conditions and ground-water quality at the two study sites along the creek. It includes five geologic sections and three tables of the water-quality data. These sections and other geohydrologic information were developed from borehole records that were compiled and analyzed to identify the geohydrologic characteristics that influence the movement of ground water within the 6-mi (mile) area from East Rochester to Irondequoit Bay (fig. 1). This compilation was based on the earlier work of Young (1980, 1983), Waller and others (1982), and Yager and others (1985).

Previous Investigations

The surface-water hydrology and urban runoff in the basin have been investigated by O'Brien and Gere (1982), Zarriello and others (1984), and Kappel and others (1986). The geology of the basin was described by Fairchild (1935) and Young (1980, 1983), and the hydrogeology of the basin was discussed by Waller and others (1982) and Yager and others (1985).

Acknowledgments

The Monroe County Environmental Health Laboratory provided equipment and personnel for the collection and chemical analysis of water samples and measurement of ground-water levels. Kenneth Reudin and Eileen Kennedy of the Powder Mill Park fish hatchery assisted in the collection of discharge data from the spring-fed hatchery pond and the measurement of ground-water levels at the hatchery.

GLACIAL HISTORY

Numerous glacial advances and retreats have shaped the landscape of the Irondequoit basin. The southern and central parts of the basin contain end moraines, drumlins, till plains, and small lake plains. The northern part of the basin, from Irondequoit Bay to Lake Ontario, contains beach ridges, moraines and lake plains. The glacial history of this area is complex, but the processes that most greatly affected the Irondequoit basins' current hydrogeologic regime were the last deglaciation and postglacial activity.

Glacial and Postglacial Processes

The main events that occurred during deglaciation and now influence the movement of ground water are described below in chronological order. (Locations of areas depicted in plates and text figures are shown in fig. 2).

1. Local deglaciation began when the Wisconsin ice sheet was just south of the Irondequoit Creek basin. Proglacial lakes inundated much of the basin south of the ice front, and the lake stages declined progressively as the ice retreated to the north and uncovered lower outlets.

2. The receding ice deposited a large kame moraine in the southern part of the town of Victor (fig. 1) and another near the New York State Thruway that may be laterally continuous with the kame complex near Mendon Ponds (fig. 1). This occurred at about the time that glacial Lake Warren at Victor was at a stage of 880 ft (feet) above sea level.

3. As the ice front continued to retreat, one of the readvances created the prominent Pinnacle Hills moraine near Rochester and formed glacial Lakes Dana and Dawson, which drained to the east along the Fairport-Lyons channel on the east side of the basin (fig. 3). Boring logs completed during this study indicate that the Pinnacle Hills moraine continues as a shallow buried ridge near the southern end of Irondequoit Bay.

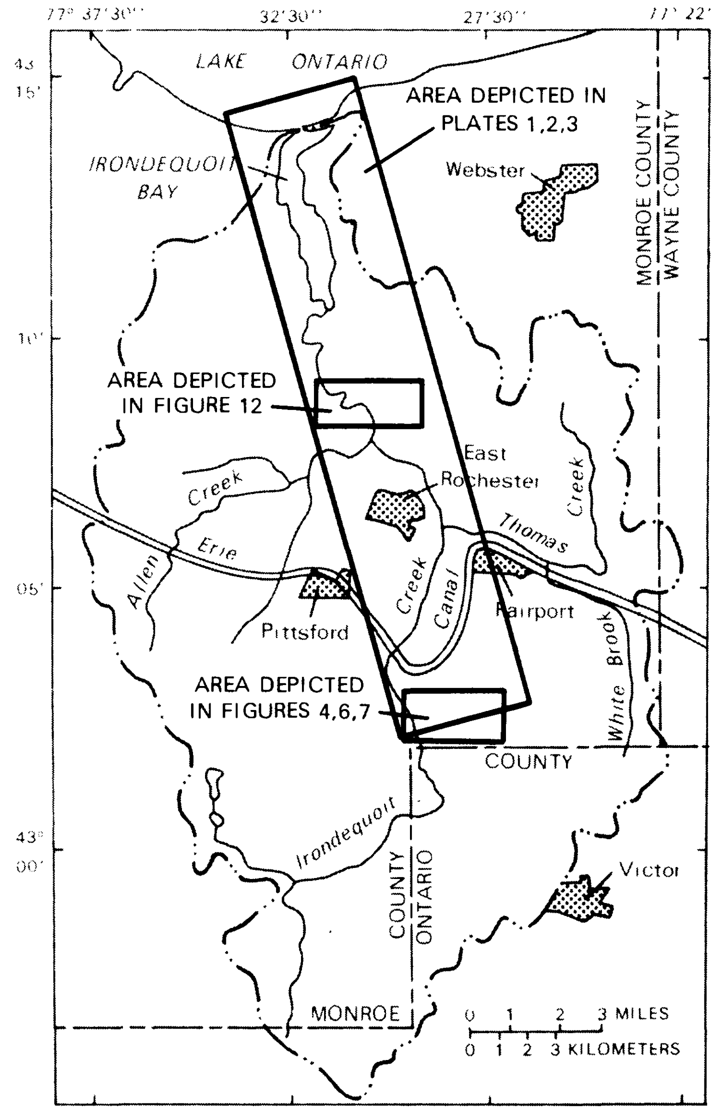


Figure 2.

Location of areas represented in figures 4, 6, 7, 12 and plates 1, 2, and 3.

4. Ice stagnation in the upper Irondequoit valley created the Powder Mill kame area between Pittsford and the New York State Thruway. Glacial Lake Dawson formed, with a stage of 475 ft above sea level, and the effects of its waves can be seen as beach lines on the Pinnacle Hills kame moraine (pls. 1A, 1B).

5. Continued retreat of the ice created Lake Iroquois (435 ft above sea level) at Rochester. A minor readvance of ice into the lower eastern side of the Irondequoit valley created a moraine north of the Lake Iroquois Beach complex (pl. 1B) that may be correlative with the Carleton moraine west of Rochester. The moraine has not been traced continuously across the northern parts of the Irondequoit basin, however. Sediment that settled in Lakes Dawson and Iroquois filled much of what is now the upper Irondequoit Creek basin and partly obscured the underlying glacial stratigraphy and topography (pl. 1A).

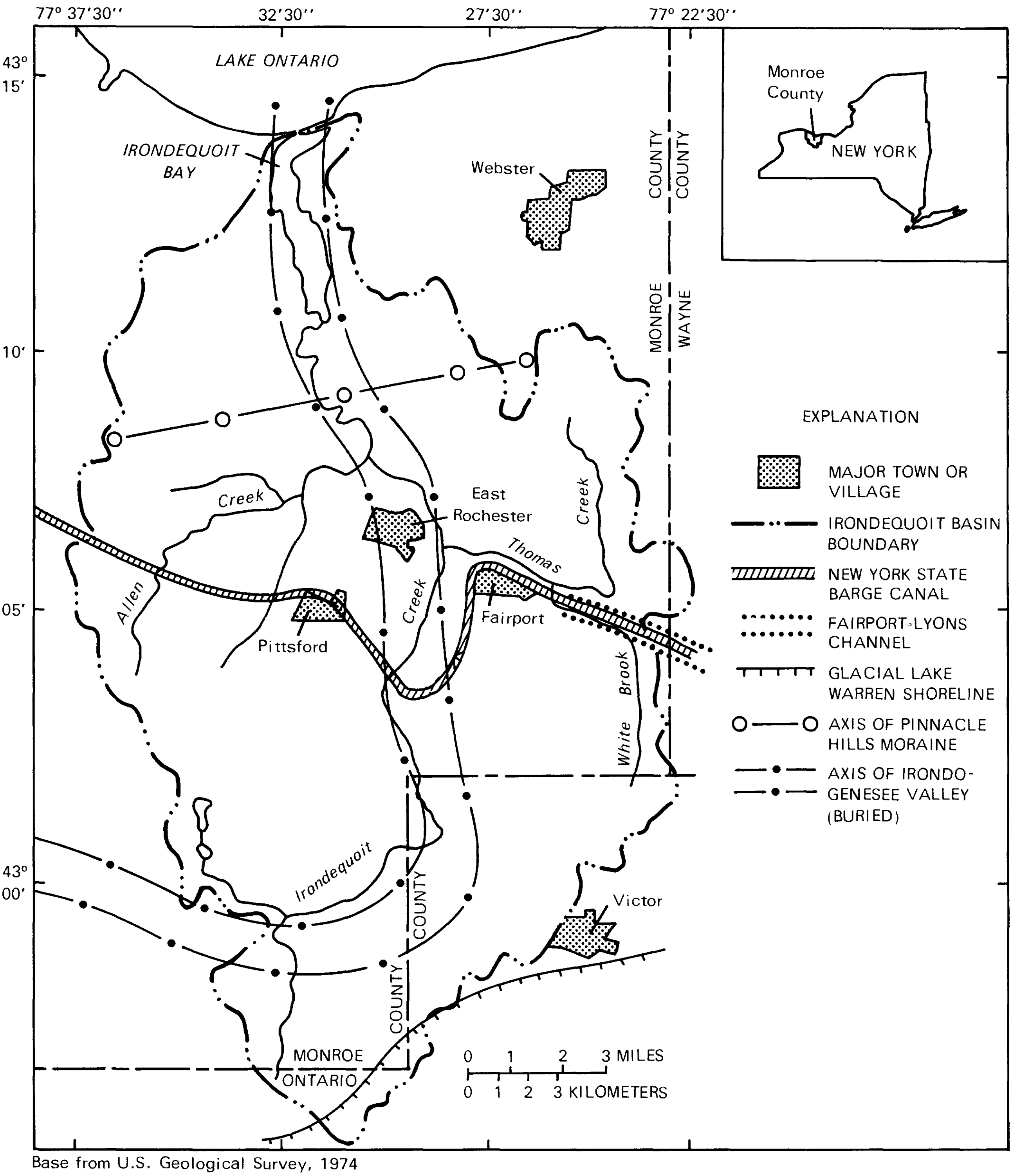


Figure 3.--Location of major preglacial and interglacial features of the Irondequoit Creek basin.

6. When the ice sheet finally retreated from the St. Lawrence valley, glacial Lake Iroquois drained rapidly, and the level of Lake Ontario at Rochester fell far below the present level. This caused ancestral Irondequoit Creek to become incised in the glacial sediments beneath Irondequoit Bay. Although the level has not been verified, it was at or below present sea level (Young, 1983, 1988; Sutton and others, 1972). The isostatic post-glacial uplift of the St. Lawrence outlet caused a gradual rise in the water level of Lake Ontario (still continuing today), which progressively flooded the lower Irondequoit valley and created Irondequoit Bay. Since this time, the northeastern shoreline of Lake Ontario has been rising as the lake basin slowly tilts about a northwest-trending axis near Oswego. (See also Mullen and Prest, 1985; Anderson and Lewis, 1985).

The sequence of incised glacial deposits that partly filled the Irondequoit valley during deglaciation have been covered by postglacial sediments; together these materials form the present aquifer system in the Irondequoit Bay area.

Events Accompanying and Following the Post-Iroquois Low Stand of Lake Ontario

Borehole logs and geologic information from the Irondequoit valley indicate that postglacial fluviolacustrine and fluviodeltaic materials have been deposited progressively southward in the Irondequoit valley as the level of Lake Ontario continues to rise (pl. 2, section 3). The gradual rise in lake level also has caused the head of Irondequoit Bay to move southward over these deposits.

During and immediately after the post-Iroquois low stand of Lake Ontario, Irondequoit Creek cut deeply into the glacial sediments in the valley now occupied by Irondequoit Bay. At the same time, the creek deposited fluvial gravel along this reach, which has been intersected in boreholes obtained for construction of the Irondequoit Bay Bridge (pl. 3, section 6) and in exploratory water-well logs from the sand bar at the mouth of the bay (pl. 2, Town of Webster well field).

This downcutting was restricted by shallow bedrock 9 mi south of the bay near Penfield Road (Penfield well field, pl. 1A). At this location, Irondequoit Creek uncovered shallow bedrock on the east side of the ancestral bedrock valley. The alluvium deposited during this downcutting appears to form the only significant subsurface ground-water connection between the deep and shallow aquifers north and south of the buried Pinnacle Hills moraine.

The inferred stratigraphic relations between the transgressive lacustrine sequence beneath Irondequoit Bay and the fluviodeltaic sediments now prograding into the head of the bay are depicted on plate 2. Section 1 (pl. 1A) depicts thick till in the valley near Browncroft Boulevard; this till is the subsurface continuation of the Pinnacle Hills moraine. This buried section of the moraine consists of relatively impermeable till and is similar to the till that forms the eastern surface extention of the moraine. The more obvious kame moraine segment to the west is composed largely of stratified glacial outwash.

GEOHYDROLOGY

Bedrock Geology

The Irondequoit Creek basin extends from outcrops of the Devonian Onondaga Limestone in the southern headwaters of the basin to the Ordovician Queenston Shale at the mouth of Irondequoit Bay on Lake Ontario. These rocks dip gently to the south-southwest at about 55 ft/mi in Monroe County. Subsurface data, where available, suggest that the bedrock in Monroe County contains small open folds and faults with a predominantly northwest trend. In the area of Victor, on the eastern edge of the basin (fig. 1), bedrock data from oil- and gas-well logs suggest structures with a more north-south trend (Kreidler and others, 1972).

The section of the buried Irondogenesee valley that lies beneath Irondequoit Creek extends from Mendon Ponds through Irondequoit Bay (fig. 2). The topography of the buried valley reflects glacial scouring of a cuestaform landscape that developed on the gently dipping bedrock.

The northern section of this buried valley is roughly perpendicular to the regional strike of the Silurian Lockport Dolomite bedrock, but major tributaries to the buried channel system in the southern section are aligned with belts of softer shales in the Silurian Salina Group, which underlies the Onondaga Limestone. The bedrock channel at Irondequoit Bay has at least 400 ft of relief and extends to an elevation of 120 ft below sea level. The channel has been assumed to represent a preglacial or interglacial course for an ancestral Genesee River. The Genesee River has not occupied this course since the retreat of the last ice sheet about 12,000 years ago, however, and the shape of the buried valley is attributed largely to glacial scouring (Young, 1983). Deep test wells near Rush (fig. 1) show the buried valley to be largely filled with till (Kammerer and Hobba, 1967), and test borings completed during this study south of the head of Irondequoit Bay confirm that the valley is largely filled with till where the projected trend of the Pinnacle Hills moraine crosses the valley.

Geohydrologic Framework of the Aquifer System

The lower basin between the mouth of Irondequoit Bay and Penfield Road (fig. 1) can be grouped into three segments according to the type of deposits and their hydrologic characteristics (pls. 1A, 1B).

Segment A-B

This segment extends 3.5 mi south from the mouth of the bay (sand bar) to the buried Pinnacle Hills moraine. Sediments in this segment consist largely of lacustrine silt and clay and the incised alluvial channel deposits of Irondequoit Creek that were deposited as the bay rose toward its present level after postglacial incision.

Segment B-C

This 1.3-mi segment encompasses the buried moraine and the overlying 38 ft of fluvial silt, sand, and gravel. The moraine itself was incised about

20 ft by the ancestral Irondequoit Creek (pl. 1A, section 1). This incised channel has gradually filled with alluvial silt, sand, and gravel similar to the modern channel deposits. Borings 87-1 and 87-2 (pl. 1A, section 1) indicate till at 38 ft below land surface on both margins of the modern channel. Chadwick (1917) and Fairchild (1928) discussed the significance of the narrow constrictions in the present-day Irondequoit flood plain (arrows in pl. 1A, section B-C enlargement) resulting from deposition of glacial sediments. Chadwick also noted that the Irondequoit Creek "canal" (dashed lines on pl. 1A, section B-C enlargement) on the east side of the valley was excavated through two narrow meander necks (north and south of Browncroft Boulevard) to serve Zarges Mills--and thereby established that this channel was not part of the natural drainage system.

Segment C-D

This 1.5-mi segment (pl. 1A) extends from the Zarges Mill to Penfield Road. This reach contains about 38 ft of alluvium similar to that of segment B-C that formed by aggradation within the channel during the postglacial rise in bay level. The contact between a glacial sand and gravel outwash layer, exposed by incision by the creek, and the overlying finer grained fluvial and lacustrine materials deposited since deglaciation, is marked by a sharp upward change from coarse sand and gravel (outwash deposits) to fine silt, clay, and organic material (alluvial deposits). This change records the southward (upstream) migration of the deeper, quiet-water environment as the bay level rose.

The borings shown on plate 1A, section 1, indicate a marked stratigraphic change between 219 and 224 ft above sea level (26 to 31 ft below the present flood-plain surface). Above these elevations, the logs record mostly sand, silt, organic material, and wood fragments, with lesser amounts of sand and fine gravel, ranging from gray to brown. Below these elevations, the sediments become more compact (sampler blow counts double or triple) and are described in sewer borings as red-brown till or a mixture of silt, clay, sand, and gravel. (Several engineering companies and individuals produced these logs, and, although the field descriptions differ slightly, the interpretation of till as the dominant material at these shallow depths appears consistent with the "soils" designations.) In some of the borings, the sediment immediately below the soft, organic, fluvial deposits is glacial outwash, consistent with the 27 ft of outwash gravel intersected between the Lake Iroquois sediments and the till in U.S. Geological Survey boring 86--B1 (plate 1A, section B-C enlargement) as well as the layer of outwash sand and gravel exposed beneath the Lake Iroquois sediments in the hillside just east of boring B-67 (fig. 1A, section B-C enlargement).

Thus the Pinnacle Hills moraine at Browncroft Boulevard clearly divides the lower ancestral Irondogenesee Valley into three segments. Further upstream, south of the bedrock threshold near Penfield Road, the valley consists largely of glacial sediments that have been continuously incised by the creek since deglaciation. The section north of the moraine was incised and later filled in by the rising bay level, as indicated by the complex section in the Irondequoit Bay Bridge borings (pl. 3, section 6). Thus, the restricted aquifers north and south of the moraine have distinctly different origins and have only a limited subsurface connections through the incised part of the moraine. The 2.8-mi-long intermediate section from B to D (pl. 1B) has experienced incision to the same depth as the moraine and is undergoing continuing fluvial aggradation. This section contains about 38 ft of finer organic silt and sand over coarser glacial outwash and till. The localized outwash deposits are probably related to the ice position marked by the adjacent moraine.

Irondequoit Valley

Upper Irondequoit Valley

The study site in the upper Irondequoit valley is at Powder Mill Park in the town of Perinton. The eastern watershed boundary is formed by Turk and Baker Hills, which consist of sandy kame and kame-moraine deposits. The uplands on the west side of the valley are covered by thick lacustrine sand, silt, and clay. The sediments within the valley are both lacustrine and ice-contact deposits and include a long esker just west of the Powder Mill fish hatchery (fig. 4). The surrounding uplands contain several kettle lakes. Along the eastern side of the valley, near the hatchery, three springs at the base of the valley wall discharge to a pond that serves as the water supply

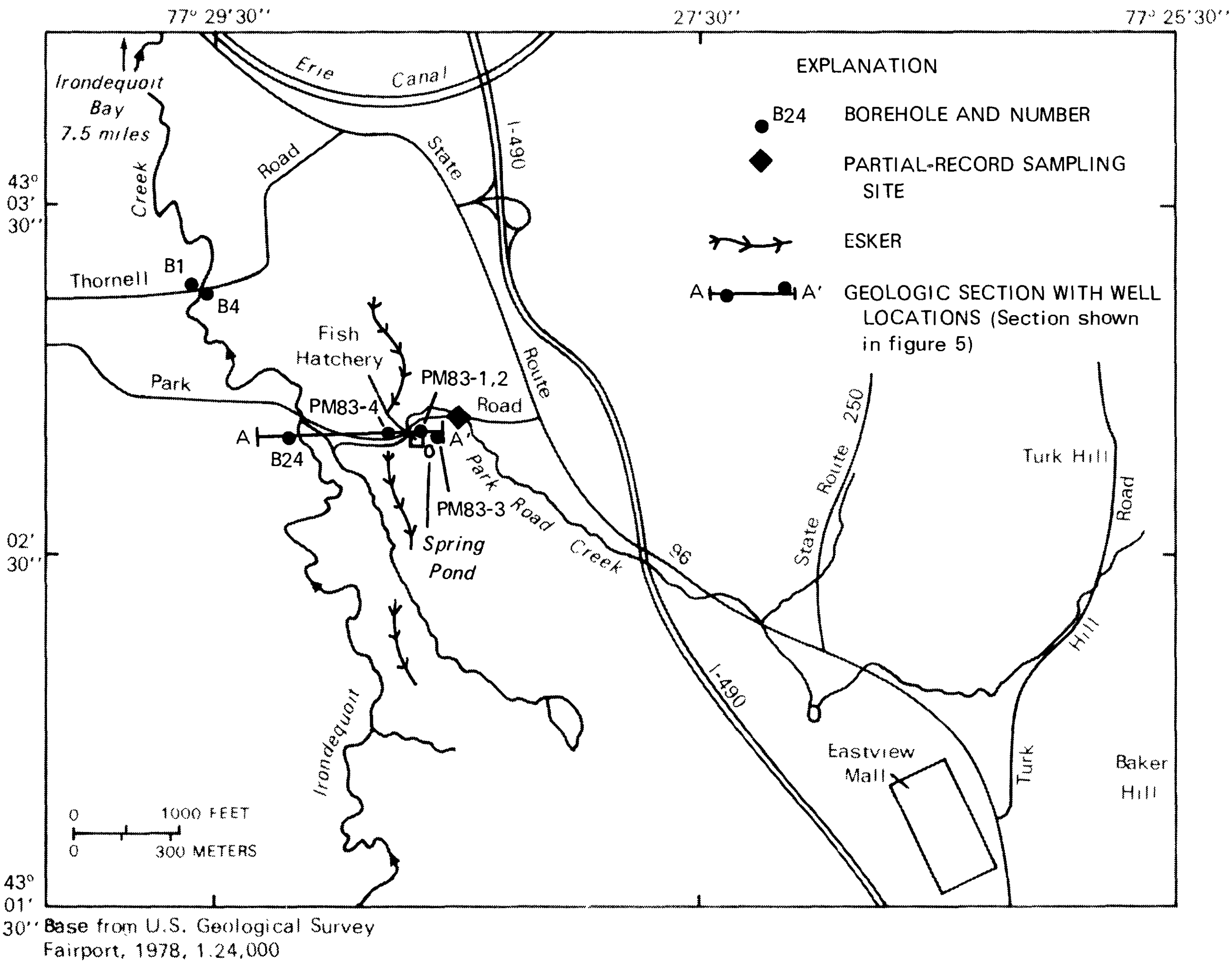


Figure 4.--Location and principal features of the upper Irondequoit Valley study area. (Location shown in fig. 2.)

for the hatchery (fig. 4 and 5). Smaller springs discharge in the central part of the valley.

Glacial Stratigraphy.--The generalized glacial stratigraphy in this area is depicted in figure 5. The east side of the valley contains lacustrine sand and silt and a thin, sandy till. A layer of coarse, cemented gravel is exposed along the valley wall north of the hatchery pond and was intersected only in drill hole PM-83-3. It was not found elsewhere but may extend further; hillside exposures and well-log data from the upland areas east of the hatchery are too limited to verify its extent.

The valley floor consists of recent alluvium as well as a sequence of lacustrine sand and silt, as noted in boreholes PM-83-1, PM-83-4, and B24 (fig. 5). Two deep borings along Irondequoit Creek have been projected into the Powder Mill area (fig. 5); they are on Thornell Road 3,500 ft downvalley, close to the western valley wall, and indicate roughly the same stratigraphy but at a slightly lower elevation.

In the central part of section A-A' at borehole PM-83-4, the lacustrine and till sequence changes abruptly to a relatively clean sand and gravel. This change may be the edge of a buried esker because this test hole is aligned with the esker complex that trends north-south through this area (fig. 4). The gap in the esker where this test hole was drilled probably is natural and is due either to postglacial stream erosion or to depositional irregularities during deglaciation. Some exposures in the side of the ridge, long considered an esker from writings of Fairchild (1928, 1935), expose only clast-poor till. The feature may be a crevasse filling in some places.

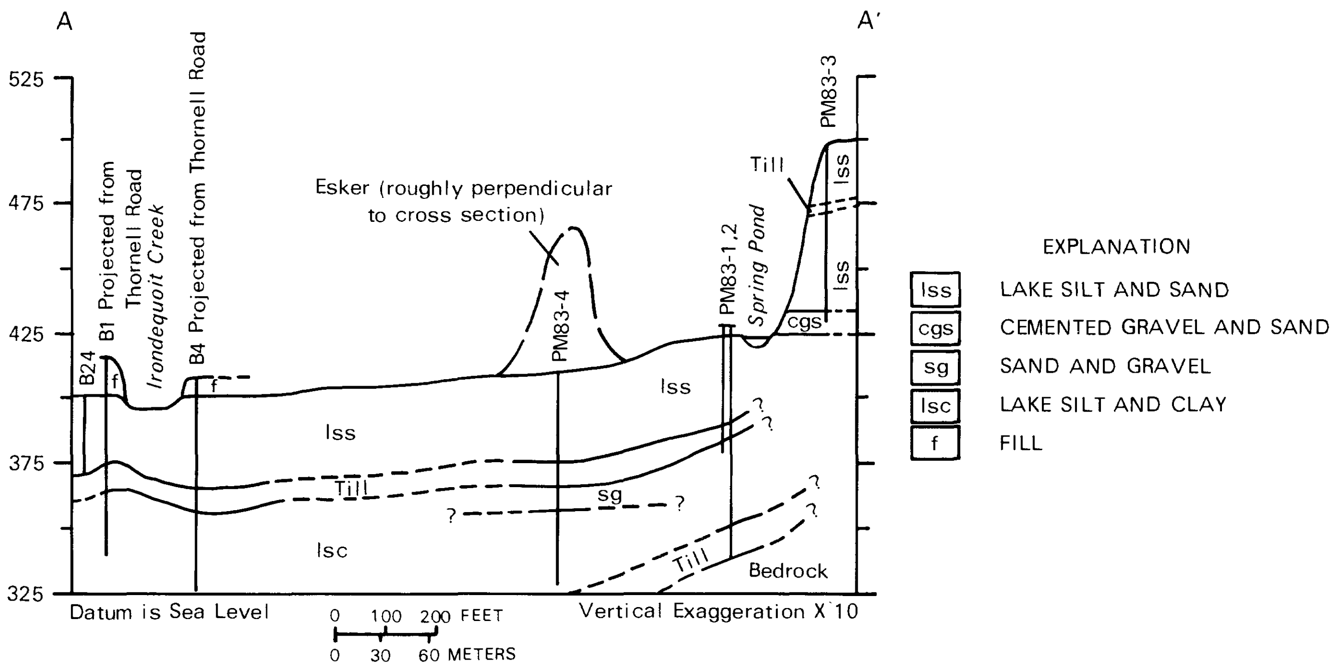


Figure 5.--Geologic section A-A' showing generalized glacial stratigraphy along Park Road from Irondequoit Creek to the eastern valley wall. (Location is shown in fig. 4.)

Ground-water flow.--The ground-water flow patterns near Powder Mill Park are described by Yager and others (1985). The water table slopes steeply to the west from the Turk and Baker Hill area, roughly parallel to the surface topography. Within the valley, it is nearly flat, with a northward, downvalley slope.

The ground-water subbasin for the hatchery (fig. 6) was delineated from the water-table-surface map developed by Yager and others (1985). The subbasin area encompasses approximately 1.1 mi^2, most of which was agricultural land and undeveloped woodlands and fields until 1981, when extensive development began (fig. 7). The area now contains several professional office complexes in the west-central part, several housing developments on the bluffs overlooking the hatchery, and a mixed commercial/residential development on the western slopes of Turk Hill. The area under development (0.273 mi^2) covers nearly 25 percent of the hatchery's ground-water basin.

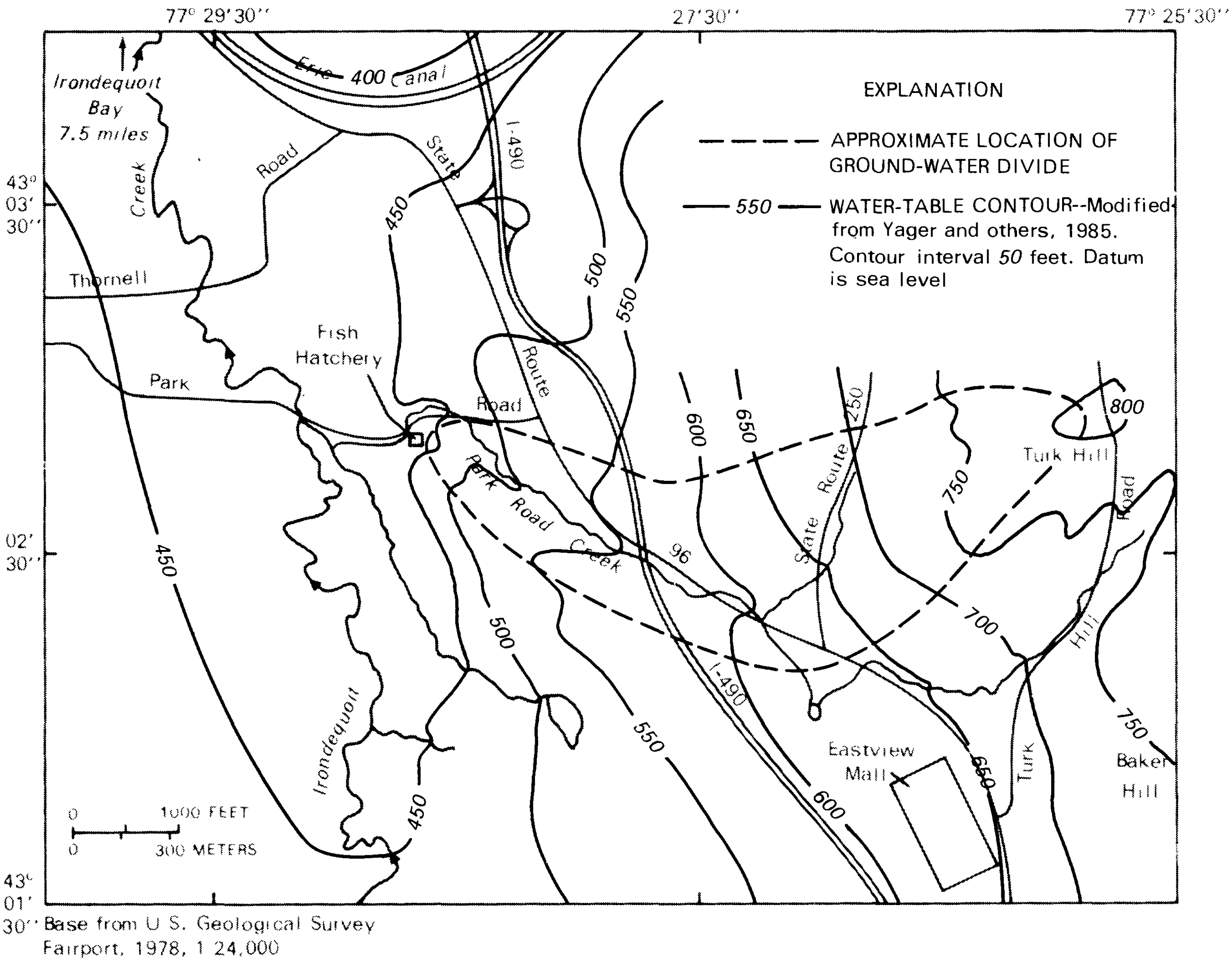


Figure 6.--Average water-table altitude in the upper Irondequoit Creek study area and location of assumed ground-water subbasin for the hatchery pond. (Location is shown in fig. 2. Water levels from Yager and others, 1985, pl. 4.)

Recharge.--Ground water in the upper Irondequoit valley is recharged primarily by precipitation that falls in the upland areas on the west side of Turk Hill and infiltrates the upland glacial sand and silty sand deposits; runoff from the uplands also infiltrates the sandy deposits along some of the tributary streambeds. Some upward leakage from deeper glacial deposits and the deep bedrock system also may occur.

Water-level data (table 1) and hydrographs from wells PM-83-1, PM-83-2, and PM-83-4 (fig. 8, p. 15) indicate that most recharge takes place during the nongrowing season (November through April), when evapotranspiration is at a minimum. Ground-water levels are affected not only by departures from average monthly precipitation, but also by the combined influence of precipitation and evapotranspiration rates. Therefore, surplus precipitation (precipitation exceeding the average monthly amount) in the nongrowing season may result in significant recharge and a rise in water levels, but surplus precipitation during the growing season may not. Precipitation deficits (precipitation less than the average monthly amount) during the nongrowing season may have little effect on ground-water levels, but deficits during the growing season may cause a diminished recharge and a decline in water levels.

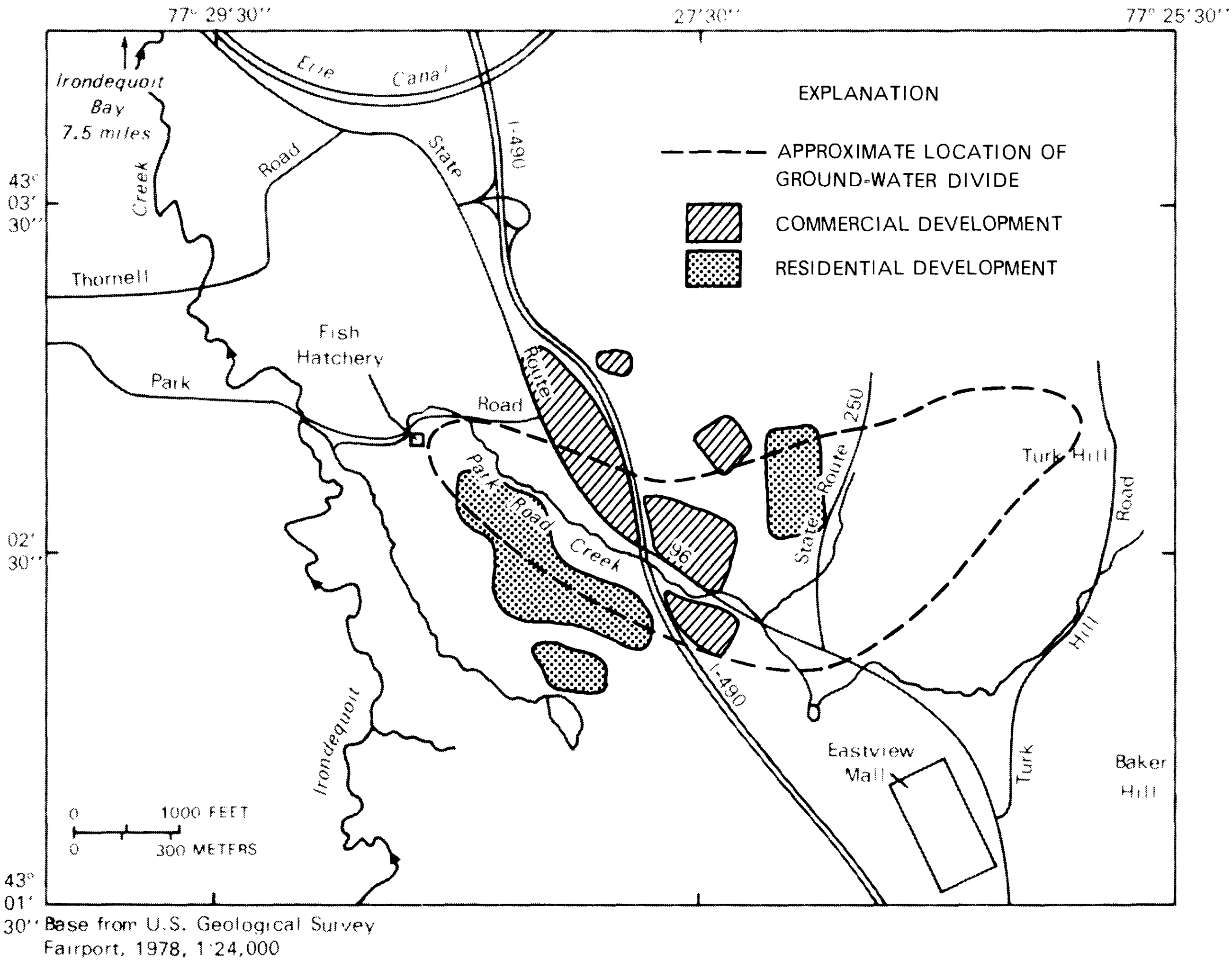


Figure 7.--Areas of recent (1982-87) commercial and residential development in the ground-water subbasin of the hatchery pond.

Table 1.--*Measured water levels at Powder Mill Park, 1983-87.*

[Values are in feet above sea level. Well locations shown in fig. 4. Dashes indicate no measurement.]

Date	Well PM-83-1	Well PM-83-2	Well PM-83-4	Date	Well PM-83-1	Well PM-83-2	Well PM-83-4	Date	Well PM-83-1	Well PM-83-2	Well PM-83-4
831109	438.07	437.89	--	841214	440.31	440.29	430.73	860103	440.57	440.03	430.58
831206	438.62	438.62	430.11	841221	440.28	440.24	430.75	860116	440.46	440.10	430.55
831209	438.61	438.62	430.11	841228	440.28	440.34	430.73	860123	440.98	440.77	430.59
831215	438.94	438.67	430.34	850104	440.46	440.63	530.76	860203	441.06	440.89	430.72
831229	439.25	439.98	430.42	850111	440.46	440.44	430.77	860214	441.16	440.70	430.85
840104	439.02	439.91	430.35	850118	440.34	440.20	430.76	860221	441.40	441.09	430.69
840112	439.00	438.84	430.24	850125	440.24	440.10	430.75	860228	441.22	440.87	430.69
840120	438.92	439.77	430.27	850201	440.69	439.87	430.76	860407	441.45	441.35	430.77
840127	438.90	438.89	430.26	850215	440.26	439.87	430.73	860430	441.38	441.16	430.77
840210	438.86	438.67	430.27	850222	440.22	439.75	430.70	860719	439.98	439.56	430.64
840216	439.22	439.28	430.27	850301	440.74	440.46	430.74	860725	439.88	440.53	440.07
840302	438.99	438.67	430.34	850308	440.81	440.61	430.76	860819	440.53	440.16	430.73
840309	439.03	439.02	430.15	850315	440.83	440.63	430.77	860828	440.07	439.96	430.66
840323	439.38	439.36	430.39	850322	440.82	440.54	440.58	860903	440.06	439.66	430.63
840329	439.35	439.36	430.41	850329	440.91	440.58	430.80	860912	439.83	439.41	430.60
840406	439.51	439.74	430.48	850405	440.91	440.79	430.82	860918	439.81	439.33	430.61
840416	439.41	439.41	430.44	850412	440.96	440.41	430.83	860925	439.90	439.41	430.62
840425	439.74	439.93	430.50	850502	550.92	550.57	530.78	860930	440.16	439.96	430.67
840504	439.89	440.04	430.53	850510	440.91	440.52	430.82	861010	449.39	440.02	430.69
840511	444.15	444.48	430.31	850517	440.84	440.45	430.79	861017	440.50	440.07	430.72
840529	440.07	440.12	430.60	850531	440.69	440.36	430.75	861024	440.46	440.04	430.73
840609	440.21	440.15	430.74	850611	440.64	440.33	430.75	861031	440.19	400.09	430.73
840618	439.96	439.95	430.71	850618	440.68	440.32	430.72	861107	440.45	440.04	430.75
840620	439.73	439.84	430.64	850705	440.44	439.93	430.76	861114	440.42	440.05	430.75
840706	439.55	439.49	430.64	850719	440.16	439.57	430.65	861121	440.48	440.07	430.75
840720	439.31	439.06	430.60	850726	439.94	439.32	430.58	861205	440.57	440.18	430.83
840727	439.01	438.74	430.55	850802	439.48	439.48	430.49	861212	440.58	440.17	430.87
840803	439.04	438.64	430.50	850816	438.94	439.02	430.85	861219	440.54	440.11	430.88
840815	438.83	439.92	430.49	850823	438.77	438.83	430.37	861226	440.45	440.04	430.86
840824	439.00	439.06	430.53	850901	439.34	439.00	430.34	870102	440.37	439.97	430.86
840831	439.00	439.32	430.53	850909	439.28	438.91	430.37	870109	440.38	439.93	430.85
840914	439.41	439.32	430.52	850916	439.11	439.51	--	870116	440.33	439.93	430.88
840921	439.27	439.22	430.53	850923	439.24	438.48	430.35	870123	440.64	440.23	430.88
841012	438.97	438.82	430.54	851003	439.07	438.50	430.29	870130	440.50	440.09	430.88
841019	439.04	439.08	430.55	851015	439.00	438.63	430.32	870206	440.27	439.84	430.85
841026	440.37	440.40	430.69	851028	439.58	439.02	430.35				
841115	440.47	440.32	430.72	851114	440.26	439.97	430.40				
841126	440.31	440.21	430.73	851129	440.60	440.28	430.48				
841130	440.31	440.25	430.72	851206	440.74	440.39	430.54				
841210	440.15	440.35	430.72	851213	440.74	440.43	430.54				

For example, ground-water levels during October and November 1984, when the precipitation deficit was approximately 3 inches, rose sharply as a result of reduced evapotranspiration. From April through October 1985, during the growing season, precipitation recorded at the U.S. Weather Bureau Station at the Rochester airport was below normal every month and had a 7-month deficit of 5.07 inches, during which time the ground-water levels declined steadily. In November, the combination of reduced evapotranspiration and a precipitation surplus of 4.34 inches restored ground-water levels to pre-April 1985 levels.

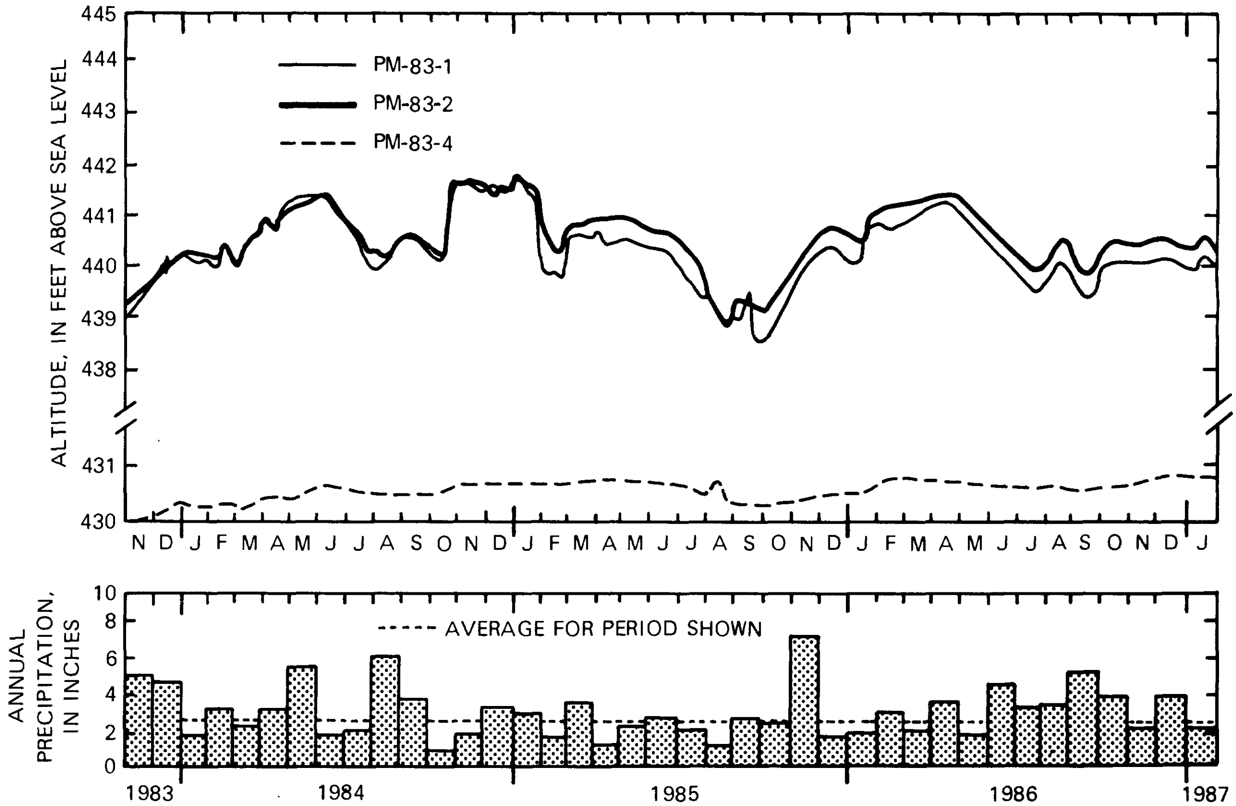


Figure 8.--Water levels in three Powder Mill Park observation wells (above) and monthly precipitation (below), November 1984 through January 1987. (Site locations are shown in fig. 4.)

Discharge.--Ground water discharges from this area as springs along the base of the east valley wall, as seepage to Irondequoit Creek, and as underflow northward through the unconsolidated deposits of the Irondequoit Creek valley.

Discharge from the hatchery pond was measured for 23 months starting in December 1983 (table 2). The average discharge was 0.41 ft^3/s (cubic feet per second) and ranged from 0.209 ft^3/s in June 1984 to 0.506 ft^3/s in January 1985. Discharge at the hatchery springs is directly proportional to water levels measured at wells PM-83-1 and PM-83-2. Water levels at PM-83-1 can be used to predict the pond discharge through straight-line linear regression. The resultant equation (p. 16) has a correlation coefficient of 0.68.

$$Qp = ((WL - 438.0) \times 0.0661) + 0.272, \quad (1)$$

where: Qp = flow, in ft^3/s, from the pond; and
WL = water level at well PM-83-1, in feet above sea level.

Table 2.--Discharge from spring-fed fish-hatchery pond at Powder Mill Park, December 1983 to February 1987.

[ft^3 = cubic feet per second; gal/min = gallon per minute]

Date	Discharge (ft^3/s)	Discharge (gal/min)	Date	Discharge (ft^3/s)	Discharge (gal/min)
12/15/83	0.310	139	2/20/85	0.414	186
2/16/84	.378	170	2/26/85	.430	193
3/9/84	.310	139	3/20/85	.431	193
4/6/84	.394	177	4/16/85	.424	190
4/25/84	.369	166	4/29/85	.421	189
5/17/84	.403	181	5/29/85	.433	194
6/28/84	.209	94	10/28/85	.378	170
9/14/84	.378	170			
10/15/84	.308	138	No measurements 11/85 to 9/86		
10/24/84	.441	198			
			9/17/86	.479	215
11/26/84	.454	204	10/10/86	.456	205
12/12/84	.463	208	12/22/86	.476	214
1/3/85	.461	207	1/15/87	.434	195
1/14/85	.506	227	2/6/87	.482	216

Water Quality.--Water samples were collected from the three springs that feed the hatchery pond between April 1984 and April 1986 for chemical analysis (table 3, p. 18). Results indicate that the water quality is similar among the three springs. The low total Kjeldahl nitrogen concentration suggests minimal agricultural or septic-waste influences. Specific conductance, pH, and concentration of selected ions are relatively uniform within each spring, as indicated in figure 9. As ground-water levels and pond discharge fluctuate in response to precipitation and evapotranspiration, the quality of the water appears to remain relatively constant, as indicated in figure 10.

The sodium, chloride, and sulfate concentrations are high, which may be indicative of an upward component of flow from the deeper regional flow system. The source of these elevated concentrations probably is the Salina shales, which are rich in these constituents.

The Monroe County Environmental Health Laboratory conducted a short-term water-quality study of Park Road Creek, a tributary of Irondequoit Creek that flows north and east of the hatchery (fig. 6). Samples were collected between January and September 1983; results are included in table 2. Mean concentrations of nutrients, specifically total Kjeldahl nitrogen and total phosphorus, were higher in Park Road Creek than in the hatchery springs, and dissolved chloride and sulfate concentrations were similar or slightly lower. These data are not conclusive but suggest that the springs and Park Road Creek do not have a common source.

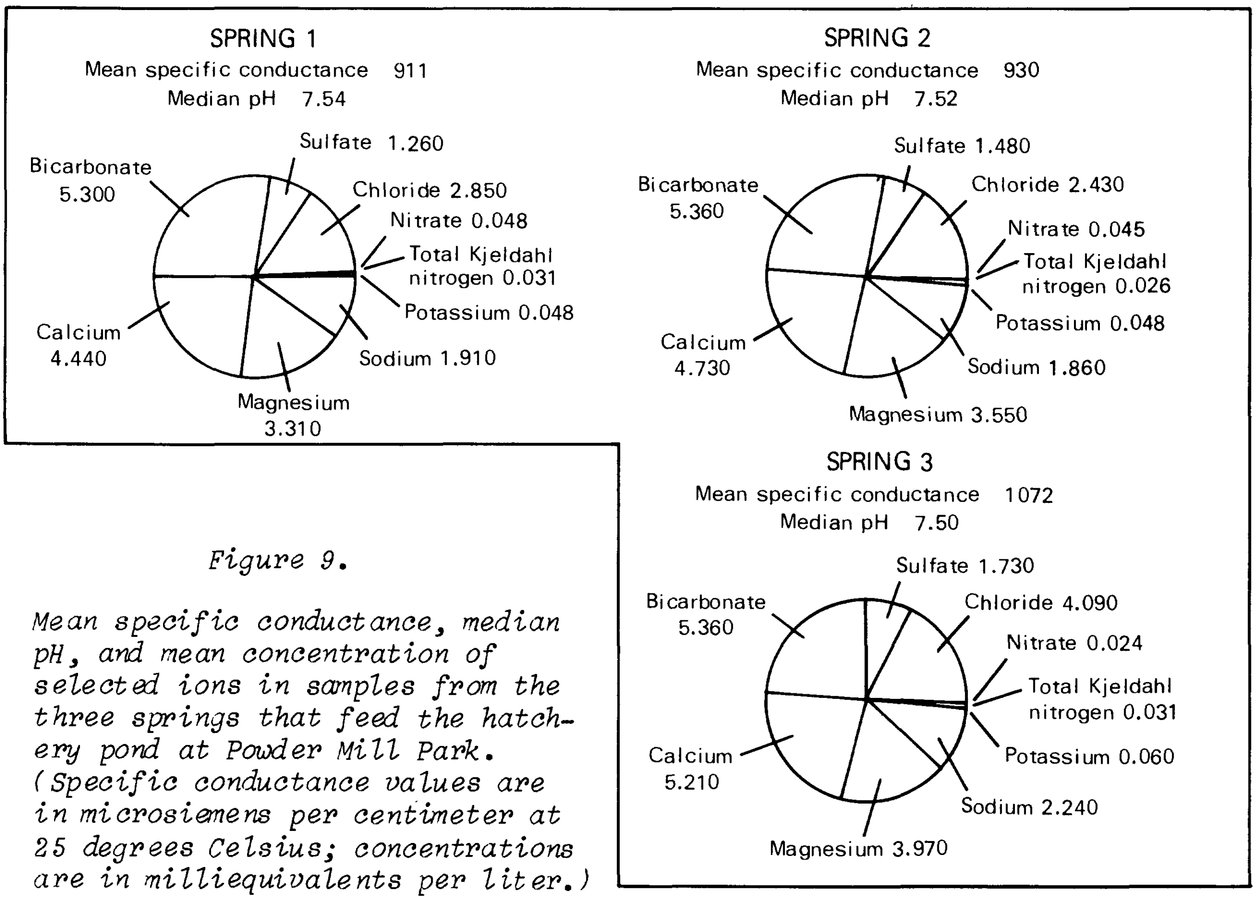


Figure 9.

Mean specific conductance, median pH, and mean concentration of selected ions in samples from the three springs that feed the hatchery pond at Powder Mill Park. (Specific conductance values are in microsiemens per centimeter at 25 degrees Celsius; concentrations are in milliequivalents per liter.)

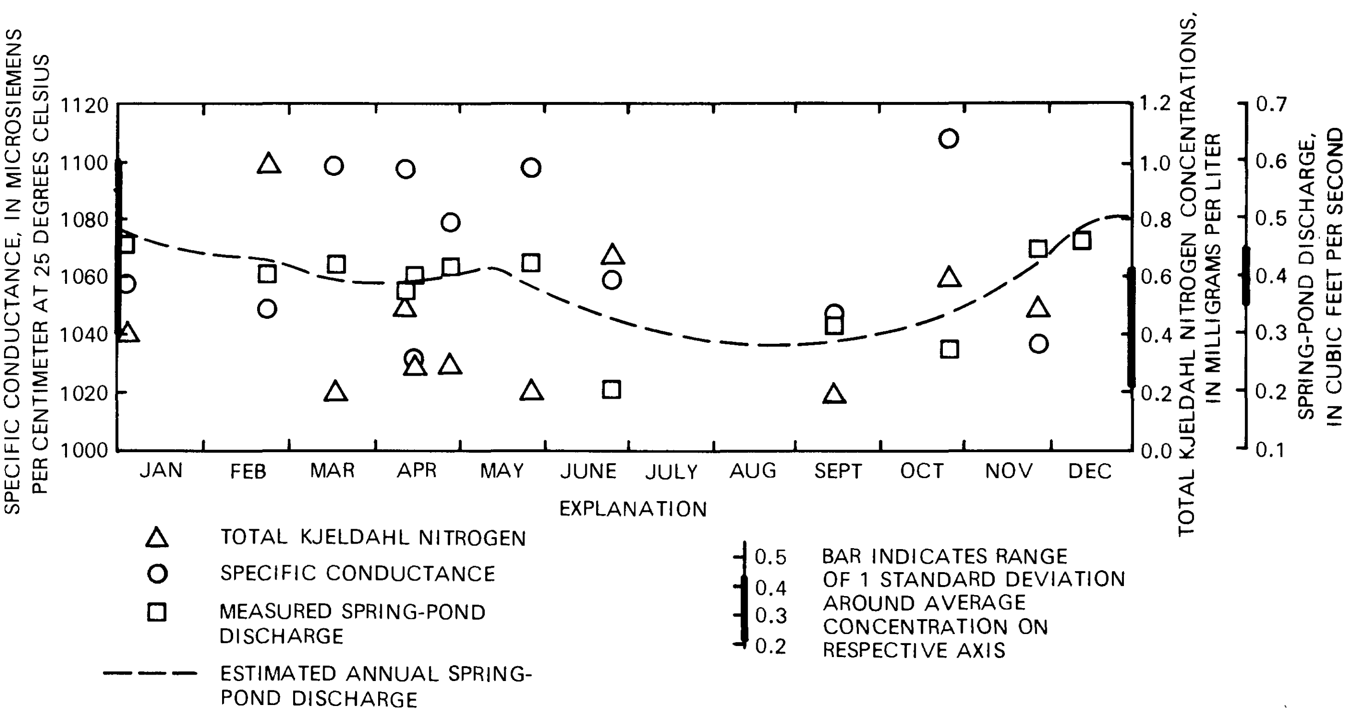


Figure 10.--Yearly cycle of specific conductance, Kjeldahl nitrogen concentrations, and spring-pond discharge. (Data collected April 1984 through April 1986.)

Table 3.--Statistics on selected water-quality characteristics of water samples from

[Concentrations in milligrams per liter; µS/cm, microsiemens per centimeter at 21°C;

Statistic	Nitrogen (as N) Nitrate + nitrate	Total Kjeldahl	Ammonia	Phosphorus (as P) Total	Ortho	Specific conductance (µS/cm)	Temperature (°C)	pH (units)
				Spring 1				
Median	2.98	0.437	0.039	0.019	0.007	911	8.3	7.54
Maximum	4.80	1.30	.160	.120	.021	1,240	14.4	8.10
Minimum	2.00	<.01	<.01	<.01	<.005	844	5.6	7.20
Standard deviation	.504	.262	.032	.019	.006	59.4	1.36	.127
Number of samples	52	51	52	50	51	50	38	50
				Spring 2				
Median	2.78	0.364	.028	.012	.004	930	8.6	7.52
Maximum	4.30	1.10	.050	.080	.018	1,080	14.4	7.70
Minimum	1.40	<.01	<.01	<.01	<.005	800	7.8	7.30
Standard deviation	.441	.233	.027	.012	.003	32.5	.96	.094
Number of samples	51	50	51	5	51	49	36	49
				Spring 3				
Median	1.48	0.423	.015	.017	.005	1,072	8.6	7.50
Maximum	5.50	1.00	.080	.120	.075	1,120	13.9	7.70
Minimum	.93	<.01	<.01	<.01	<.005	899	7.8	7.30
Standard deviation	.622	.186	.015	.027	.010	35.6	.94	.101
Number of samples	51	50	51	50	51	49	36	49
				Park Road Creek				
Median	1.042	2.567	.043	.183	.016	--	--	--
Maximum	2.40	36.6	.470	2.000	.076	--	--	--
Minimum	.40	.60	<.01	.050	<.005	--	--	--
Standard deviation	.427	4.985	.057	.253	.018	--	--	--
Number of samples	62	52	64	64	64	--	--	--

springs and Park Road Creek at Powder Mill Park, April 1984 through April 1986.

< less than; analysis by Monroe County Environmental Health Laboratory.]

	Dissolved constituents							
Statistic	Alkalinity (as $CaCO_3$)	Hardness (as $CaCO_3$)	Chloride	Sulfate	Sodium	Calcium	Potassium	Magnesium
				Spring 1				
Median	265	378	101	60.5	43.9	90.0	1.88	40.2
Maximum	282	434	124	110	49	108	2.70	49
Minimum	261	343	80	39	39	78	1.50	36
Standard deviation	5.22	19.1	7.32	14.2	2.62	5.25	.245	2.30
Number of samples	58	50	51	49	52	51	52	51
				Spring 2				
Median	268	400	104	71	42.7	94.7	1.86	43.1
Maximum	279	450	145	90	52.0	113	2.60	54
Minimum	258	369	96	51	39.0	83	1.4	38
Standard deviation	6.82	12.6	6.41	9.7	3.12	5.56	.212	2.72
Number of samples	49	50	51	50	51	51	53	50
				Spring 3				
Median	268	445	145	83.2	51.4	104.3	2.36	48.3
Maximum	279	486	156	110	58.0	124	3.50	54.0
Minimum	260	382	103	62	39.0	87	1.80	40.0
Standard deviation	5.38	13.1	8.63	10.6	3.39	6.48	.361	2.16
Number of samples	49	50	51	51	51	50	49	51
				Park Road Creek				
Median	--	--	104	42.4	--	--	--	--
Maximum	--	--	260	215	--	--	--	--
Minimum	--	--	36	15.1	--	--	--	--
Standard deviation	--	--	37.1	36.7	--	--	--	--
Number of samples	--	--	62	64	--	--	--	--

Lower Irondequoit Valley

The lower Irondequoit valley study area is in Ellison Park, in the town of Penfield (fig. 1), where the form of the underlying preglacial Irondogenesee valley is more evident than in the upper valley. From East Rochester northward through Irondequoit Bay to Lake Ontario, the valley floor is more than 150 ft below the surrounding uplands, and the flood plain of Irondequoit Creek is generally more than 1 mi wide (fig. 11A, p. 22). Bedrock is exposed along Irondequoit Creek where the creek enters the valley from the east and along Allen Creek where it enters the valley on the west near the Penfield Road (pls. 1A, 1B).

Glacial Stratigraphy.--The generalized glacial stratigraphy of this area is shown in geologic section 1 (pl. 1), which indicates a sequence of fluvial and lacustrine silts and sands overlying a till of variable thickness that overlies bedrock. The valley-floor stratigraphy between Browncroft Boulevard and Blossom Road is depicted in three valley cross sections (fig. 11B, p. 23) that show a sequence of fluvial and lacustrine silts and sands overlying undifferentiated sand and gravel units (sections A, C). Bedrock is assumed to be at depths of 200 ft or more along the central axis of the valley, as indicated by several boreholes drilled along the valley wall (Yager and others, 1985) and by the depths to bedrock at borehole 86-B-1 (298 ft) and borehole 86-B-2 (211 ft), just north of this area. Along the main channel of Irondequoit Creek, a silty lacustrine unit is overlain by alluvial sand and silt, whereas north of the sand hill the lacustrine unit is overlain by a sequence of peat and muck deposits (section B-B" in fig. 11B). This variable postglacial sequence in the lower valley resulted from postglacial activity that continues today, including glacial rebound, the gradual rise in the level of Lake Ontario, and the migration of the head of the Irondequoit embayment from the bay's southern margin upstream through the Ellison Park area (pl. 2). All these events have caused fluvial aggradation of the flood plain by at least 38 ft.

Ground-Water Flow.--The regional ground-water flow pattern at the Ellison Park site is similar to that at the upper valley site (fig. 12). The water table slopes gently toward the valley in the upland areas (Yager and others, 1985); then, at the valley wall, it steepens toward the flood plain, where it becomes nearly flat, with a gradient northward toward Irondequoit Bay.

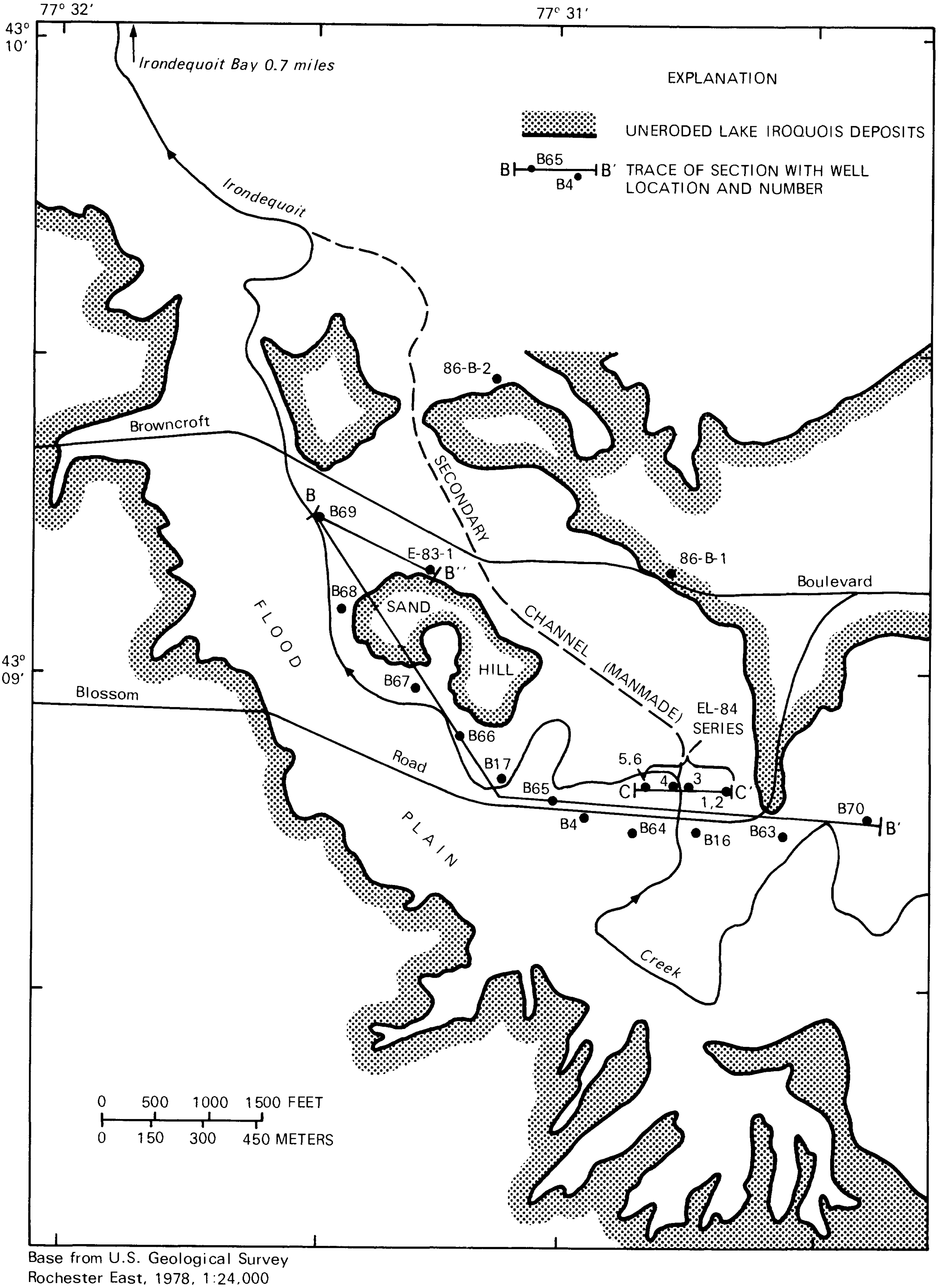
The ground-water gradient near Irondequoit Creek is affected by the stage of the creek but is inversely proportional to the distance from the creek (table 4). Water levels at wells EL-84-1 (screened 20 ft below land surface) and EL-84-2 (screened 45 ft below land surface), along the east valley wall about 400 ft from the creek (fig. 11A), generally are several feet above creek level as a result of ground-water recharge from the valley wall and upland areas. The water level at well EL-84-3, approximately 20 ft east of the creek and screened 20 ft below land surface, generally is higher than the creek but lower than the water levels in wells EL-84-1 and EL-84-2. Water levels at wells EL-84-4, EL-84-5, and EL-84-6, screened 20, 20, and 45 ft below land surface, respectively, across the creek and in the central part of the valley, are similar to those at well EL-84-3, even though well EL-84-4 is 20 ft west of the creek and wells EL-84-5 and EL-84-6 are 450 ft from the creek. The ground-water gradient in the central part of the Irondequoit Creek valley is nearly flat where the creek meanders between the east and west valley walls (fig. 11A).

The general direction of the ground-water flow is toward the creek, but during high creek stages, the gradient can reverse, and some of the streamflow infiltrates into the streambanks as temporary storage or to the water table as recharge. As the creek's stage falls, the gradient again reverses toward the stream. The amount of bank storage is small because the alluvial deposits have low permeability.

Table 4.--Measured water levels at the Ellison Park site, 1984-86.

[Dashes indicate no measurement; water levels are in feet above sea level; well locations shown in fig. 11A.]

Date	EL-84-1	EL-84-2	EL-84-3	EL-84-4	EL-84-5	EL-84-6	Irondequoit Creek
840806	254.52	255.51	254.76	255.09	253.25	253.87	248.87
840827	251.78	251.84	249.92	249.93	249.94	250.02	248.44
840926	251.19	252.74	250.53	250.43	250.24	250.40	249.17
841003	251.69	251.60	249.83	249.81	249.78	249.89	248.50
841004	248.37	251.53	249.64	252.89	249.63	249.70	248.47
841005	251.45	251.48	249.62	249.62	249.57	249.66	248.40
841009	251.45	251.50	249.62	249.57	249.67	249.64	248.37
841010	251.43	251.42	251.70	249.55	249.55	249.64	248.37
841109	251.43	251.47	251.75	249.66	249.04	249.77	248.41
841203	251.71	251.74	252.02	250.01	249.94	250.63	248.58
841212	251.66	251.71	251.99	250.14	250.03	250.15	248.91
850219	251.68	251.66	251.97	250.04	249.98	250.08	248.79
850224	253.03	252.88	252.27	--	251.85	251.70	251.99
850227	252.77	253.74	252.93	252.06	251.16	252.78	253.85
850301	254.25	252.98	254.02	255.23	252.61	252.55	250.92
850308	252.95	252.62	253.26	251.50	250.64	251.78	249.92
850313	252.69	253.08	251.42	251.47	251.26	251.27	250.57
850326	252.22	252.22	250.42	250.38	250.37	250.45	249.07
850326	252.20	252.13	250.36	250.43	250.39	250.51	249.03
850401	252.77	252.84	252.73	--	--	--	253.02
850405	252.82	252.80	251.24	251.26	251.11	251.53	249.57
850426	252.17	252.19	250.26	252.88	249.95	250.88	248.82
850603	251.66	251.50	249.83	249.85	249.80	249.91	248.57
850617	251.84	251.86	250.29	250.28	250.16	250.26	249.17
850821	250.46	251.22	249.14	248.50	247.39	248.54	248.07
850918	251.26	251.26	249.34	249.31	249.24	249.41	248.15
851021	251.29	251.30	249.63	249.62	249.49	249.49	248.38
851115	252.39	252.39	251.39	251.21	251.00	250.98	250.48
851120	252.41	252.42	250.43	250.83	250.45	250.43	248.91
851127	252.63	252.63	251.49	251.42	251.10	251.12	250.68
851211	252.17	252.16	250.83	251.16	250.42	250.69	249.23
851213	252.29	252.31	250.90	250.87	250.71	250.66	249.81
860122	253.15	253.24	252.61	252.76	252.55	252.57	252.34
860205	252.51	252.59	251.89	251.74	--	--	248.96
860312	251.95	252.53	251.62	251.55	251.34	--	250.92
860417	253.35	253.46	253.38	253.23	252.77	252.71	253.88
860430	251.59	253.22	250.07	250.41	250.41	251.32	248.94



Base from U.S. Geological Survey
Rochester East, 1978, 1:24,000

Figure 11A.--Physiography of the lower Irondequoit valley.

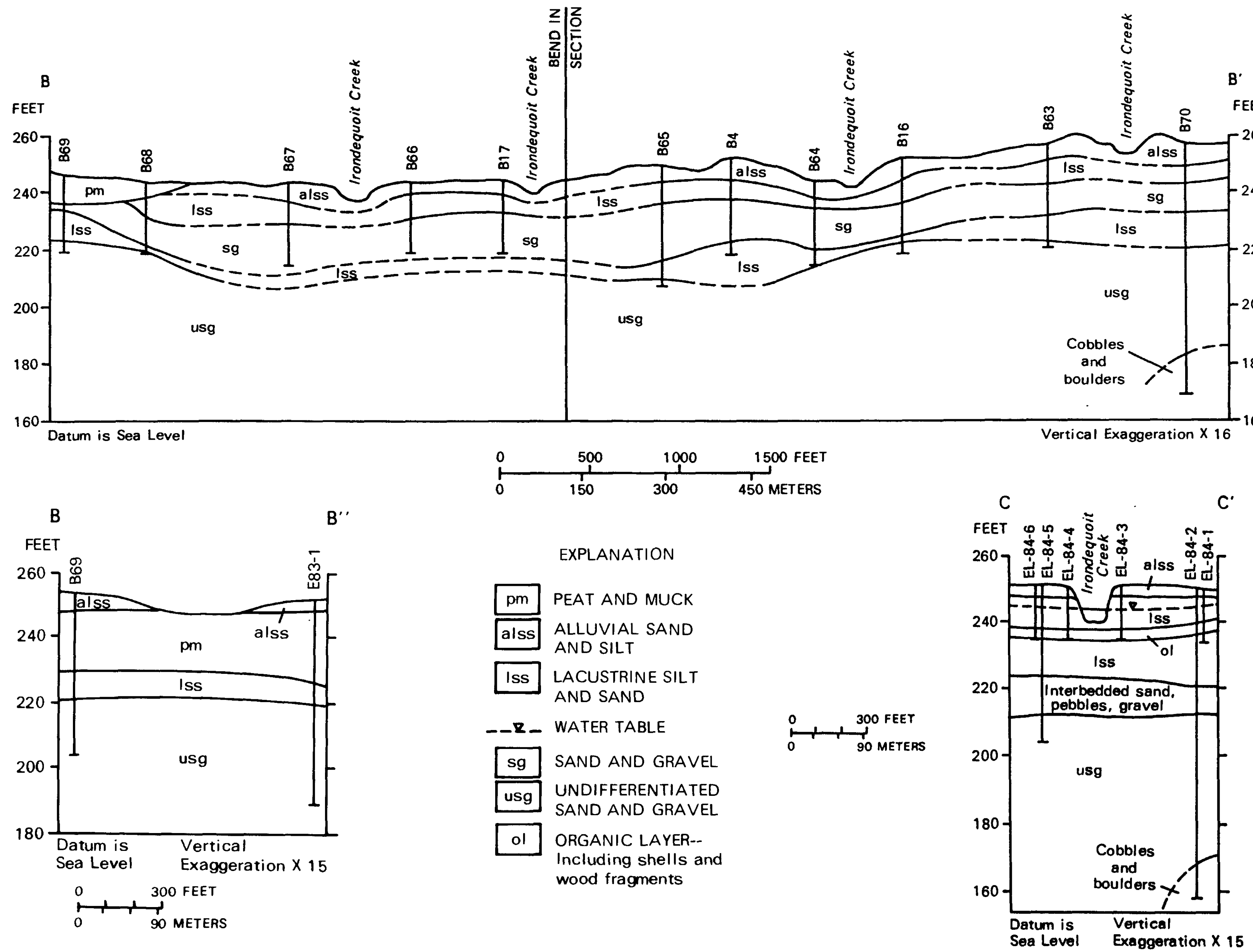


Figure 11B.--Generalized glacial stratigraphy along three geologic sections in the lower Irondequoit Creek valley. Locations are shown in fig. 11A.

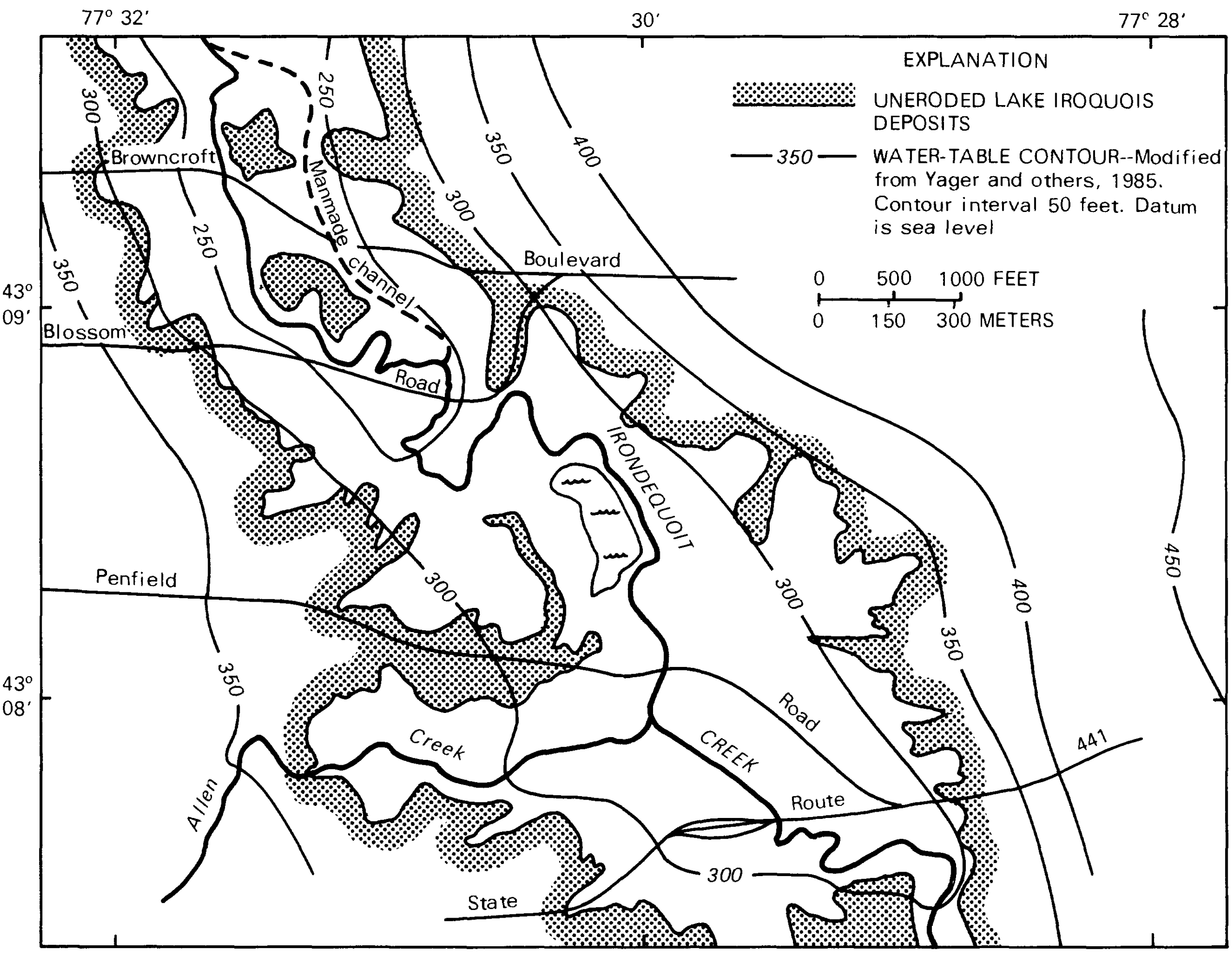


Figure 12.--Water-table configuration beneath the lower Irondequoit Creek valley. (Location is shown in fig. 2. Modified from Yager and others, 1985.)

Recharge.--The primary source of recharge in the lower basin is precipitation that infiltrates the alluvial deposits of the flood plain, runoff from the uplands that infiltrates the flood-plain deposits, tributary flow that infiltrates to the aquifer, and underflow from the aquifer system that lies upgradient to the south. Upward leakage from lower glacial deposits and from the deep bedrock system might also contribute some recharge to this area, as indicated by the general increase in heads with well depth (EL-84-2 and EL-84-6), which does not occur in the shallower companion wells, EL-84-1 and EL-84-5, respectively (table 4). Short-term recharge can occur through the alluvial deposits of the flood plain during high flows.

Discharge.--Ground water in this area generally discharges by northward seepage to Irondequoit Creek and as northward underflow through the unconsolidated deposits toward the Irondequoit wetlands and bay. Ground water also discharges by evapotranspiration from flood-plain and wetland vegetation.

Water quality.--Water samples were collected from six wells in Ellison Park and from Irondequoit Creek during March and October 1985 and January, April, and November 1986; the results are summarized in table 5. Although the number of samples is small, results indicate that the water quality is locally variable. The differences are greatest on the eastern side of Irondequoit Creek; for example, water from shallow wells E-84-1 and EL-84-3, both of which are east of the creek (fig. 11A, section C-C'), has higher sodium and chloride concentrations than water from the other wells in Ellison Park.

The highest concentrations of sodium and chloride were in well EL-84-1 and are attributed to stormwater runoff from Blossom Road that flows into a swale along the east valley wall near wells EL-84-1 and EL-84-2 (Angelo Anello, Park Supervisor, Ellison Park, oral commun., 1986). Storm runoff and road salt from Blossom Road probably infiltrate and percolate to the ground-water system and then move toward Irondequoit Creek. Wells EL-84-3 (next to the creek) and EL-84-1 (at the valley wall) are screened at similar depths and yield water with similar chloride concentrations (fig. 13, p. 28). Water from well EL-84-2, adjacent to well EL-84-1 but 25 ft deeper, had lower concentrations of all constituents, which indicates that the sodium and chloride ions are not derived from a deeper source.

Water from well EL-84-4, EL-84-5, and EL-84-6, on the western side of Irondequoit Creek, also had lower concentrations of sodium and chloride than the shallow wells on the eastern side of the creek. These concentrations probably indicate normal background conditions of ground water in the lower valley. The low concentrations of dissolved sulfate in wells EL-84-4 and EL-84-6 probably are indicative of the decayed organic matter noted in the drilling logs; the samples, when collected, gave off a strong smell of hydrogen sulfide gas, which indicates a reducing environment in which sulfide gas is the predominant form of sulfur and dissolved ammonia the predominant form of nitrogen.

As with wells EL-84-1, EL-84-2, and EL-84-3, the concentrations of ions in water from wells west of Irondequoit Creek differed from those in Irondequoit Creek. Because this section of Irondequoit Creek is a ground-water discharge area (ground water flows toward the creek), stormwater goes into temporary storage and drains out when the creek recedes; therefore, the stream water does not affect ground-water quality beneath the adjacent flood plain.

Suitability of Ground Water for Public Supply

Local water agencies and water-well drillers have assumed that the buried Irondogenesee valley constitutes a continuous aquifer and that the well fields for the towns of Webster, East Rochester, and Penfield are all drawing water from it. The altitudes of the respective facies illustrated on the maps and geologic sections herein indicate, however, that the aquifer is much more complex than previously assumed and can be viewed as three discrete systems. The following paragraphs explain the hydrologic setting of the northern, central, and southern parts of the aquifer system in relation to water supplies.

Table 5.--Summary statistics of selected chemical characteristics of water

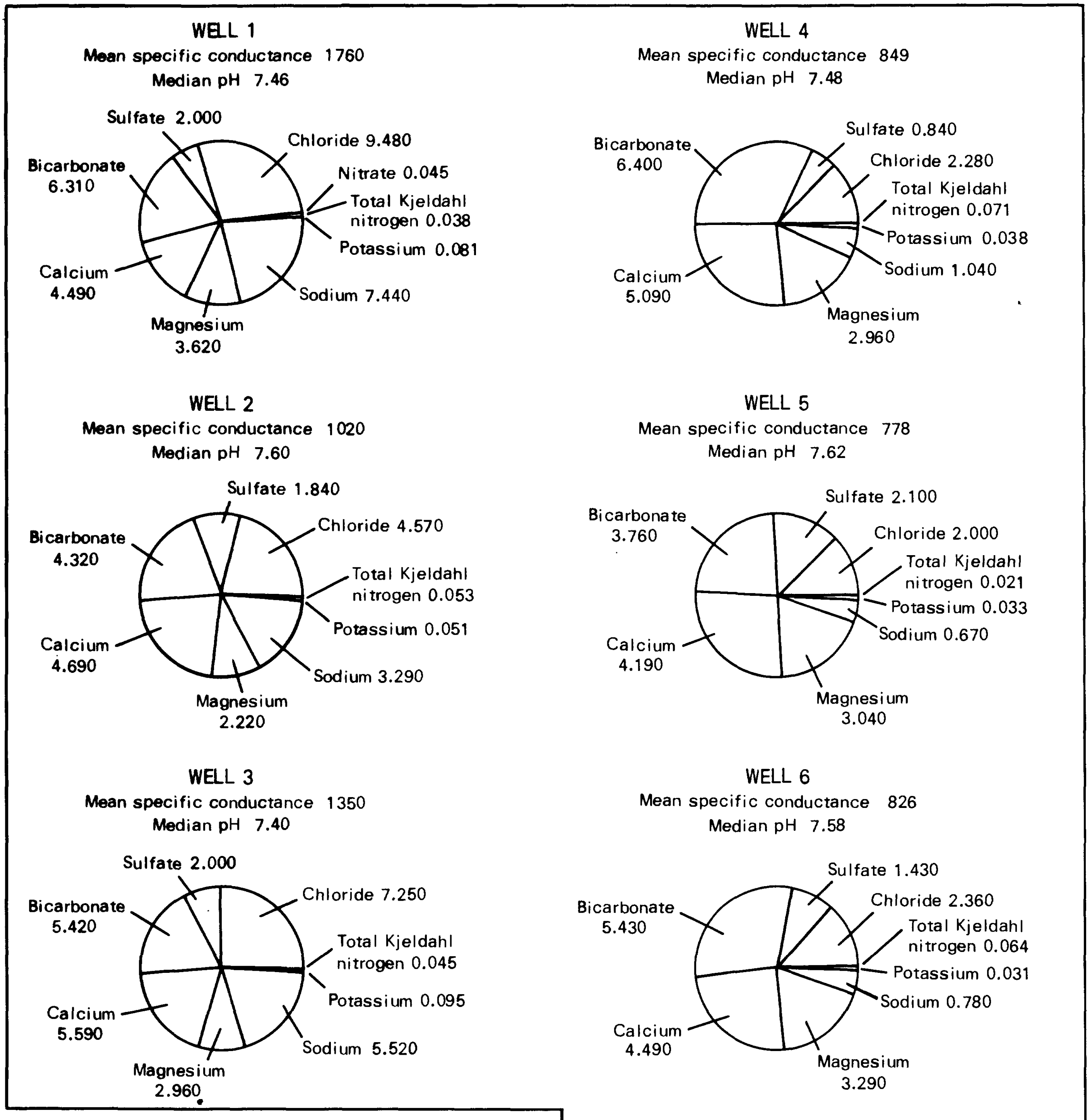
[Well locations shown in fig. 6. All concentrations in milligrams per liter.

Statistic	Nitrogen (as N) Nitrite + nitrate	Total Kjeldahl	Ammonia	Phosphate (as P) Total	Ortho	Specific conductance (μs/cm)	pH (units)	Alkalinity (as $CaCO_3$)
				Well 1				
Median	2.7	0.73	0.036	0.079	0.005	1,760	7.46	316
Maximum	2.9	1.50	.06	.12	.008	1,790	7.60	329
Minimum	2.2	.40	.02	.05	<.005	1,700	7.30	306
				Well 2				
Median	.20	.64	.078	.091	.005	1,020	7.60	213
Maximum	.48	.98	.10	.15	.010	1,070	7.70	235
Minimum	.03	.50	.04	.03	<.005	945	7.50	195
				Well 3				
Median	.58	.62	.015	.036	.004	1,350	7.40	267
Maximum	.86	.90	.02	.08	.006	1,500	7.50	295
Minimum	.15	.40	<.01	.02	<.005	1,995	7.20	247
				Well 4				
Median	.05	1.0	.526	.084	.027	849	7.48	324
Maximum	.13	1.50	.66	.10	.052	895	7.60	369
Minimum	.02	.60	.45	.07	.009	796	7.40	276
				Well 5				
Median	.07	.36	.040	.042	<.005	778	7.62	200
Maximum	.18	.70	.07	.06	.005	805	7.80	216
Minimum	<.01	.19	.02	.02	<.005	730	7.50	183
				Well 6				
Median	.06	.72	.144	.070	.045	826	7.58	266
Maximim	.15	1.60	.17	.12	.005	840	7.70	325
Minimum	<.01	.37	.12	.05	.003	801	7.50	233
				Irondequoit Creek				
Median	1.2	.80	.031	.083	.013	891	8.1	202
Maximum	2.0	1.20	.07	.14	.031	1,080	8.4	223
Minimum	.61	.70	<.01	<.01	<.005	532	7.9	158

samples from wells and Irondequoit Creek at Ellison Park, 1985-86.

µS/cm, microsiemens per centimeter. < less than. Number of samples = 5.]

Statistic	Dissolved							
	Hardness (as $CaCO_3$)	Chloride	Sulfate	Sodium	Calcium	Potassium	Magnesium	Total iron
Well 1								
Median	506	336	93	169	127	3.2	43	2.98
Maximum	545	342	100	180	142	3.4	47	4.9
Minimum	477	331	93	155	110	2.6	41	1.0
Well 2								
Median	339	163	84.1	78	92	2.0	26	3.64
Maximum	354	173	100	83	110	2.2	30	5.90
Minimum	317	146	75	67	82	1.7	24	.69
Well 3								
Median	441	257	95	124	113	3.4	34	2.32
Maximum	464	259	100	140	117	5.5	38	7.20
Minimum	414	254	88	115	110	2.5	31	.80
Well 4								
Median	416	81.5	37	24	104	1.4	35	2.02
Maximum	435	96.7	49	27	110	1.8	37	4.40
Minimum	402	62.6	26	19	97	1.2	33	.65
Well 5								
Median	373	76.5	100	15.4	87	1.2	37	1.06
Maximum	390	81.1	120	16	95	1.6	40	2.30
Minimum	342	63.8	90	15	81	1.9	34	.40
Well 6								
Median	397	84.5	64	19.2	92	1.1	40	6.31
Maximim	400	90.0	81	23	91	1.4	42	28
Minimum	393	73.6	47	17	99	1.9	38	.20
Irondequoit Creek								
Median	349	106	114	59.8	91	3.2	29	1.59
Maximum	449	134	162	65	125	4.0	36	6.10
Minimum	205	68.4	48	39	52	2.2	17	.22



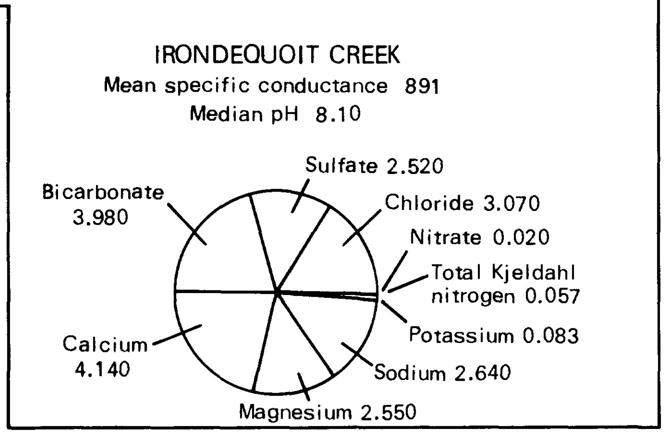


Figure 13.

Mean specific conductance, pH, and concentration of selected ions in samples from monitoring wells and Irondequoit Creek at Ellison Park, 1985-86. (Specific conductance values are in microsiemens per centimeter at 25 degrees Celsius; concentrations are in milligrams per liter. Sampling locations are shown in fig. 11A.)

Northern (Lower) Section (Plate 1A, section A-B)

The town of Webster's DeWitt well field taps till and outwash sediments adjacent to the incised postglacial channel-gravel deposits (pl. 3, section 4). The well field is so close to the incised channel of the ancestral Irondequoit Creek that it probably is drawing water laterally from the channel gravel. The static water level in the well field is essentially the same as the surface elevation of Irondequoit Bay.

The town of Webster reported an increasing chloride concentration in water from the DeWitt well field during the late 1970's. This may be a result of the well field's proximity to the bay-bottom fluvial channels, which were penetrated by more than 20 test borings before construction of the Irondequoit Bay bridge (pl. 3, section 6). The increase in chloride concentrations closely coincided with the completion of these borings. The bottom water of Irondequoit Bay contains elevated chloride concentrations from road-salt runoff (Diment and others, 1974), and water from the southernmost DeWitt wells (those nearest the bridge) have the highest chloride concentrations. The test holes may have allowed bottom water from the bay to enter this part of the aquifer. Another source of chloride may be the bedrock, which is known to contain various mineral salts. Elevated sodium chloride concentrations have been noted in several wells drilled to bedrock but screened in the glacial sediments at the DeWitt well field and at a deep well drilled to bedrock in the 1930's on the Stappenbeck property, just north of Browncroft Boulevard and east of Irondequoit Creek (W. Stappenbeck, property owner, oral commun., 1987). The bedrock wells throughout the county generally have much lower yields (25-30 gal/min) than the wells in the Webster field, however.

The sandbar well field at the mouth of the bay taps the same incised fluvial aquifer that formed during the lowest postglacial stage of Lake Ontario. This field was originally developed to replace the DeWitt field, but water-quality changes were also noted in these wells after they were placed in operation in 1977. Saltwater may have gradually been drawn into the aquifer at both fields, and the wells closest to the bridge borings experienced the earliest and greatest effect.

The current pumping scheme between the two well fields uses the DeWitt field as the primary source and the sandbar field as backup when daily pumpage exceeds 3 Mgal/d (generally April through August). The chloride concentrations have stabilized under this pumping scheme, but the source of the chloride has yet to be determined. If chloride concentrations continue to increase, further analysis of the problem may be needed.

Central Section (Plate 1A, Section B-C)

The thick till plug formed by the buried Pinnacle Hills moraine probably forms a partial barrier to the movement of deep ground water from the southern section (described below) of the valley into the buried valley north of the moraine. Additional test drilling along the modern channel near Browncroft Boulevard has confirmed a modest degree of hydraulic connection through the fluvial gravels that fill the channel incised across the moraine. The depositional environment of the delta formed during the rise of the bay would suggest, however, that fine-grained sediments reduce potential infiltration to the deeper, permeable gravels that must mark the lower limit of postglacial incision where the creek enters the bay.

Southern (Upper) Section (Plate 1A, Section D-E)

The use of ground water for public supplies is not extensive along section D-E nor in the remaining southern part of the Irondequoit basin. Reports of highly mineralized ground water from the area between the Village of Fishers and Powder Mill Park indicate that bedrock may be a potential source of highly mineralized water in the glacial aquifers. The Salina Group, which crosses the basin near the New York State Thruway, contains numerous mineral salts, including gypsum, and the glacial aquifer lies within a deep bedrock channel in this vicinity. Whether this upstream reach is hydraulically connected with that along the Thruway and further north within Ellison Park is unknown. High pumping rates from the valley fill of the upper basin could induce highly mineralized water to move laterally into the aquifer system.

NEED FOR CONTINUED STUDY

Northern and Central Sections

Most ground water that reaches the lower valley area must flow through the shallow flood-plain alluvium above the buried moraine near Browncroft Boulevard. Continued monitoring of ground-water levels and quality in the flood-plain sediments in Ellison Park and near Browncroft Boulevard would allow a realistic evaluation of the quantity and quality of the ground water moving through the flood plain. Water that infiltrates the flood plain is probably one of the primary sources of recharge to the northern aquifer system; Lake Ontario has been identified as another. Thus monitoring groundwater levels and quality in the flood plain upstream of the narrow section near Browncroft Boulevard would provide a means of determining ground-water conditions that influence the northern aquifer and of identifying changes in water quality before they become widespread in the aquifer.

Recharge from the valley walls north of the Browncroft Boulevard, along the sides of Irondequoit Bay, might be a lesser source of recharge to the northern aquifer system than ground water moving through the Irondequoit valley. Further investigation of the aquifer north of Browncroft Boulevard could provide information on the sources of chloride that enter the DeWitt well field. An infiltration study from the bay's uplands to Irondequoit Bay, south of the DeWitt field, might reveal the nature of lateral recharge to the northern aquifer as well as whether the chlorides are entering the aquifer from the bedrock or through some connection with the chloride-rich bay-bottom waters.

The 1987 borings in Ellison Park confirm the depth of the silty, sandy fluvial sediments in the postglacial fluvial reach of the aggraded Irondequoit Creek channel. Further studies of the chemical and hydraulic properties of ground water in this reach near the moraine (including the deep well 86-B-2 installed in November 1986 north of the Pinnacle Hills moraine) would define the movement of most of the ground water and contaminants that pass through the fluvial sediments above the till.

Southern Section

Flow from the Powder Mill Park spring pond is controlled by precipitation and evapotranspiration within this subbasin. The recent urbanization of more than 25 percent of the subbasin (fig. 7) may change the infiltration and runoff rates in this area and may affect the rate of discharge from the pond as well as the seasonal flow of Park Road Creek. Because no changes have been noted to date, the discharge from the pond and water levels in the Powder Mill Park wells and other wells within the basin would require continued monitoring to determine what effect the increasing development may have. Periodic chemical analysis of water samples from at least one of the three springs, several wells, and several of the creeks within the basin would be needed to determine long-term trends in ground-water quality.

Monroe County and the Town of Perinton have recently formulated a plan to study drainage and erosion in this part of the Irondequoit basin (R. A. Gallucci, Monroe County Department of Engineering, written commun., 1987). This study is intended to (1) determine the effectiveness of the stormwater flow system within the watershed, especially in areas of current and future development and in areas prone to sheet or gully erosion, (2) reduce erosion along steep slopes and areas under development, and (3) prevent urban flooding by increasing infiltration of storm runoff into the ground-water system through porous storm-drainage systems and infiltration ponds. Continued monitoring of ground-water quantity and quality at the Powder Mill Park site would enhance the drainage and erosion study by determining the effect of surface-runoff-management practices on ground water.

SUMMARY

This report describes the glacial history of the Irondequoit Creek basin and the geohydrologic conditions at two sites--one in the upper part of the basin and one in the lower part.

Glacial oscillations in the Irondequoit valley left a buried moraine beneath Irondequoit Creek at Browncroft Boulevard that effectively separates the ground-water system of the southern (upper) two-thirds of the basin from the northern (lower) third. The last retreat of glacial ice from the region about 12,000 years ago was followed by the rapid fluvial incision to near sea level of the glacial section near what is now the mouth of Irondequoit Bay. The subsequent isostatic rebound of the eastern end of Lake Ontario resulted in the rise of the modern lake level and deposition of lacustrine sediments in Irondequoit Bay. This controlled the fluvial aggradation of the Irondequoit Creek valley section through the Pinnacle Hills moraine, raising the flood plain of Irondequoit Creek through Ellison Park. The accumulation of these fluvial deposits across the buried Pinnacle Hills moraine appears to be the only shallow hydraulic connection between the northern and southern ground-water systems.

Ground-water-level measurements at the Powder Mill Park fish hatchery in the upper Irondequoit valley indicate that ground-water recharge is controlled primarily by precipitation and evapotranspiration upgradient from the springs that feed the hatchery pond. Discharge from the ground-water system is by evapotranspiration, discharge to the hatchery pond and to Irondequoit Creek, and by underflow in the glacial sediments beneath Irondequoit Creek. The quality of ground water in this area appears to be minimally affected by recent changes in land use upgradient of the springs. Continued discharge and water-quality monitoring at the hatchery pond should indicate the extent to which urbanization upgradient from the subbasin will affect the quantity and quality of ground water.

Ground-water level measurements in Ellison Park in the lower Irondequoit valley indicate that ground-water recharge is controlled by interaction of the glacial aquifer and the stage of Irondequoit Creek. The primary source of recharge to this area is the infiltration of precipitation and runoff in the uplands and valley into the glacial outwash and alluvial flood-plain deposits. Other sources include tributary flow that infiltrates the aquifer, underflow from the aquifer system that lies to the south, and upward leakage from lower glacial deposits and, possibly, from the deep bedrock system. High flows may cause short-term recharge from the creek to the flood-plain deposits. Discharge from the ground-water system generally occurs through evapotranspiration, discharge to Irondequoit Creek, and underflow that follows the creek through the buried Pinnacle Hills moraine. Water stored in streambank and flood-plain deposits during high flows later discharges to the creek.

At the buried moraine, ground water passes through a restricted, 38-ft-thick section of more permeable, alluvial Holocene sand and gravel and glacial outwash that occupy the flood plain and postglacially incised channel. This is probably the only location at which substantial volumes of ground water from the southern aquifer can enter the aquifer system north of the moraine beneath Irondequoit Bay.

Ground-water quality in the lower valley (Browncroft Boulevard-Penfield Road) appears to be minimally affected by fluctuations in the chemical quality of Irondequoit Creek. The ground-water quality in the central part of the valley appears to be stable, but human activities have had some effect, especially near the eastern valley wall, as evidenced by elevated concentrations of dissolved sodium chloride at shallow depths, possibly as a result of road-salt runoff from a nearby highway that accumulates in a wetland swale near the valley wall. Water quality in the deeper parts of this aquifer has not been affected because the ground water has a slight upward flow component in this area.

Further investigation of the shallow alluvial flood-plain system in the area of the buried Pinnacle Hills moraine and along the shore of Irondequoit Bay could help determine (1) the amount of ground-water discharge from the aquifer south of the moraine through the flood-plain alluvium into the aquifer north of the moraine beneath Irondequoit Bay, and (2) the amount of recharge to the northern aquifer system that occurs along the shoreline of Irondequoit Bay, through the bay-shore and bay-bottom sediments, and from the deeper bedrock system.

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