GROUND-WATER LEVELS, FLOW, AND SPECIFIC CONDUCTANCE IN UNCONSOLIDATED AQUIFERS NEAR LAKE ERIE, CLEVELAND TO CONNEAUT, OHIO, SEPTEMBER 1984

By Alban W. Coen, III

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CONVERSION FACTORS AND ABBREVIATIONS

For the convenience of readers who may prefer to use metric (International System) units rather than the inch-pound units used in this report, values may be converted by using the following factors:

Multiply inch-pound unit	By	To obtain metric units
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
gallon per minute (gal/min)	0.06309	liter per second (L/s)

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

This report describes ground-water levels, flow, and specific conductance in aquifers along the southern shore of Lake Erie from Cleveland to Conneaut, Ohio. The data were collected in September 1984 as part of the U.S. Geological Survey's Northeast Glacial Buried Valley Regional Aquifer-System Analysis. The study area is about 60 miles long, extends inland from the lake about 10 miles, and encompasses parts of Cuyahoga, Lake, and Ashtabula Counties.

Water levels were measured in 202 existing wells, all of which were completed in the glacial deposits or at the contact with the underlying shale. Specific conductance was measured in 59 of the wells. Results of the survey are presented in table and map form.

Unconsolidated material throughout the area consists primarily of till, whereas the bedrock consists of Devonian shale. The till is composed chiefly of silt and clay with some sand and gravel, and is less than 50 feet thick in most areas. Some valleys are filled with as much as 200 feet of glacial till and outwash deposits that are mainly sand and gravel.

Ground-water levels in much of the area are within 20 feet of the land surface. Contours of ground-water levels resemble a subdued version of those of the land surface, which indicates that ground water generally flows from high areas to low areas following the land-surface gradient. Locally, ground water discharges into streams. Regionally, flow is towards the north-northwest, to Lake Erie.

Specific conductance ranged from 160 to 2,900 µS/cm (microsiemens per centimeter at 25 degrees Celsius) with a median of 540 µS/cm. Ground water with a specific conductance greater than 650 µS/cm is localized, with no specific spatial pattern; possible sources of elevated specific conductance are road-deicing salt, leachate from landfills, natural brines associated with oil and gas drilling, and the upward leakage of saline water from bedrock.

INTRODUCTION

The U.S. Geological Survey's Northeastern Glacial Buried Valley Regional Aquifer-System Analysis (RASA) project (Lyford and others, 1983) was established to study the hydrogeologic characteristics of unconsolidated glacial aquifers in the Northeastern United States. One aspect of this project is to determine water levels in unconsolidated aquifers along Lake Erie.

Lake Erie has great economic importance for millions of Americans and Canadians living along its shore. As the quality of the surface water flowing into the lake improves, increased interest is being focused on the effect of ground-water discharge directly to Lake Erie and to tributaries to Lake Erie. A major factor controlling the direction and rate of ground-water flow is the hydraulic gradient. Hydraulic gradient, the change in head per unit distance measured in the direction of steepest change, is determined by measuring water levels in wells in relation to a datum, usually sea level.

Specific conductance, the inverse of electrical resistivity, is a measure of the concentration of total dissolved solids in water. Specific conductance is described in terms of microsiemens per centimeter at 25 degrees Celsius and is abbreviated µS/cm. It can easily be measured in the field (Freeze and Cherry, 1979).

Purpose and Scope

This report presents a regional overview of ground-water levels, flow, and specific conductance in aquifers underlying an area along Lake Erie. The study area extends from Cleveland to Conneaut, Ohio, and includes parts of Cuyahoga, Lake, and Ashtabula Counties. The area is about 60 mi (miles) long and 10 mi wide (fig. 1).

The report includes results of water-level measurements from 202 wells and specific-conductance values of water from 59 wells measured in September 1984. Detailed description of the geology of the area was outside the scope of the study and was not attempted.

Hydrogeologic Setting

The study area includes two contrasting physiographic divisions--the lake plains and glaciated plateau (White, 1982, p. 7). Lake plains (fig. 2), underlain by soft Devonian shales that dip slightly to the south, are present in a band up to 7 mi wide along Lake Erie. The plain starts at an elevation of about 600 ft (feet) above sea level (about 30 ft higher than the water level of Lake Erie) and rises gently to about 750 ft in the south. Except for ancient postglacial sandy beach ridges, the plain is flat and poorly drained (White, 1982).

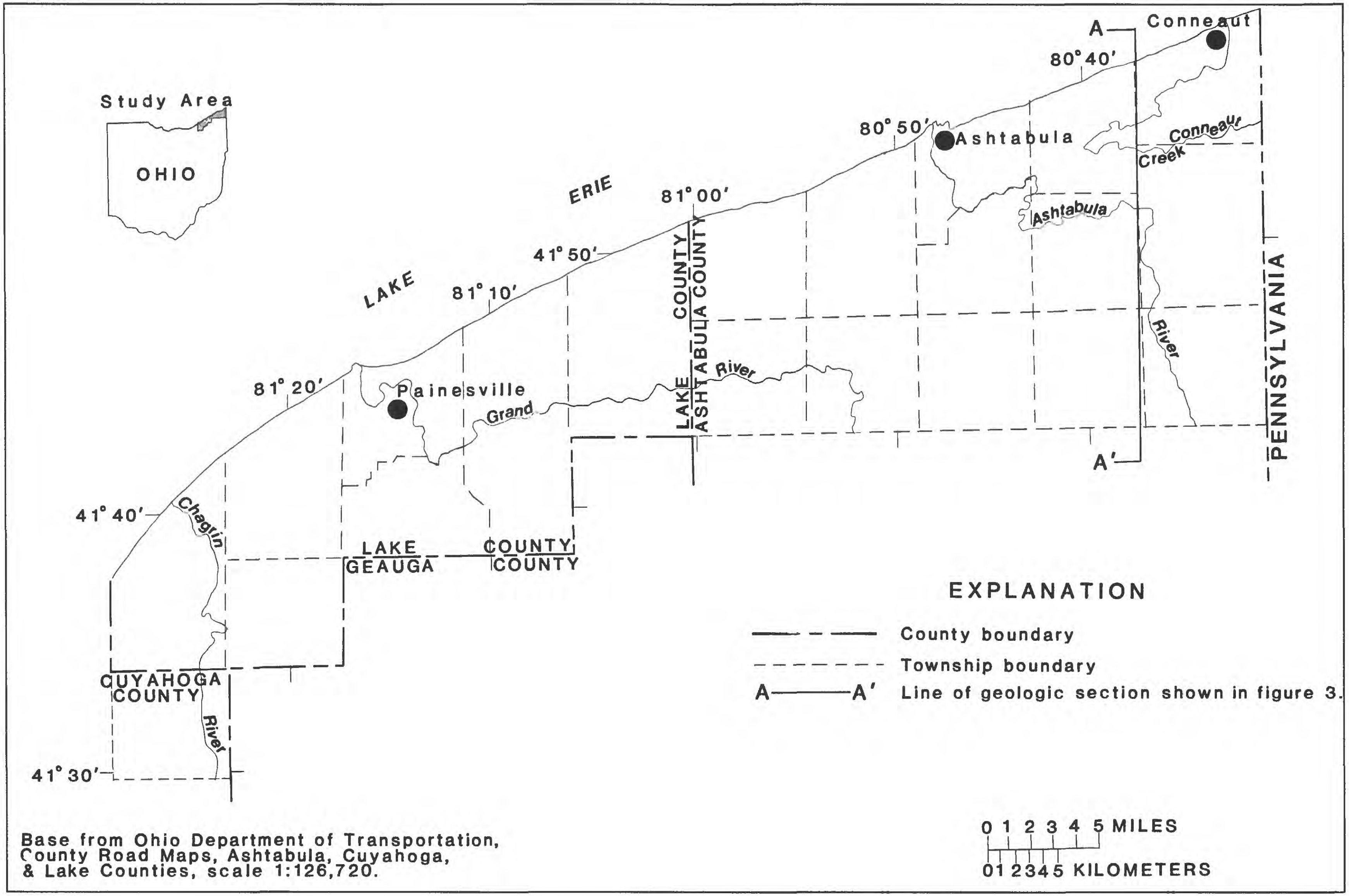


Figure 1.--Study area.

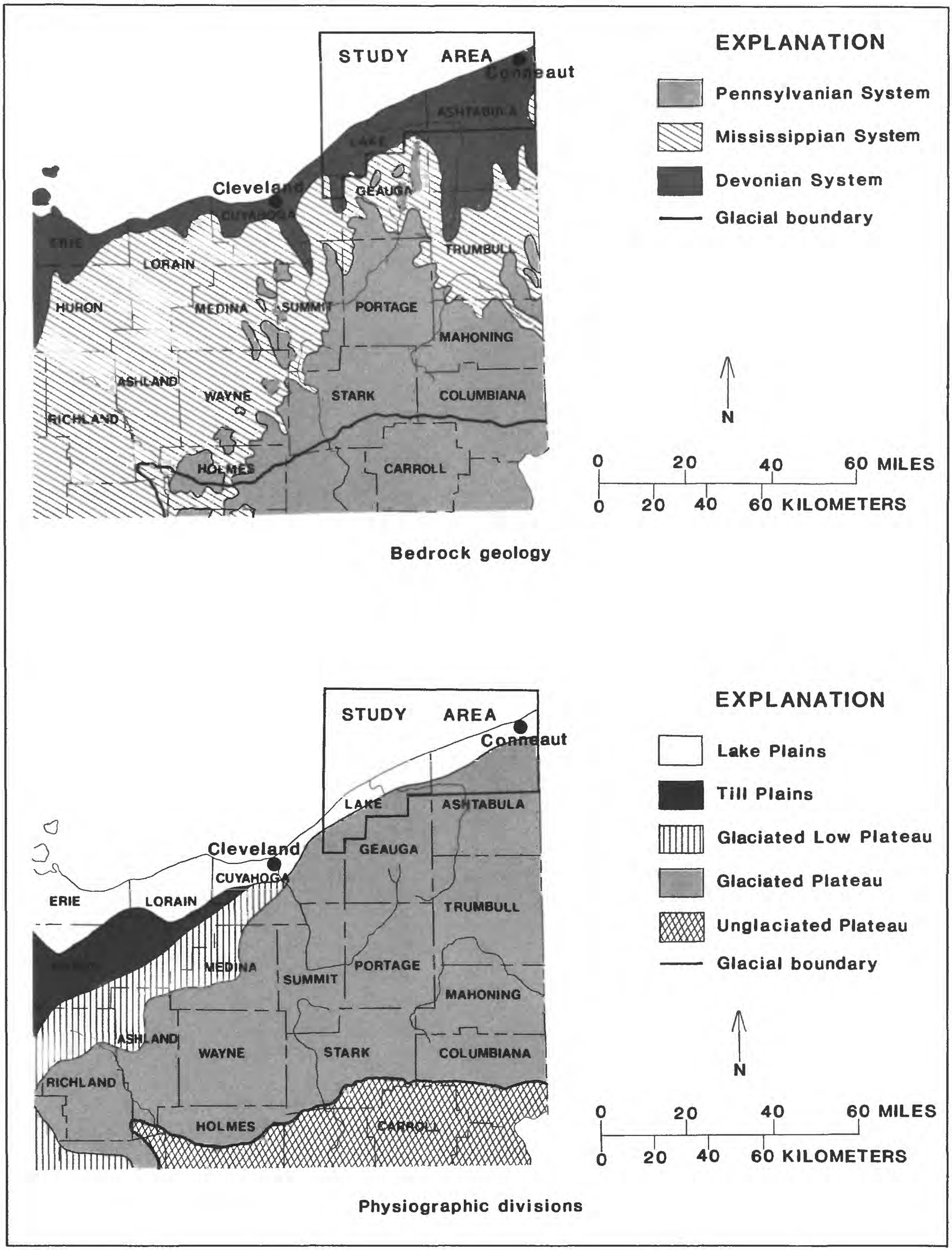


Figure 2.--Bedrock geology and physiographic divisions of northeasten Ohio (from White, 1982, figure 3 and 4).

South of the lake plain, the land slopes upward to the glaciated plateau (fig. 2), which is about 900 to 1,200 ft above sea level. The plateau is underlain mostly by shales of Devonian age. A small part of the plateau in the study area is capped by sandstone and conglomerates of Mississippian age and is cut by deep river valleys. The shales are exposed in some of the valley walls. The bedrock dips slightly to the south, away from Lake Erie. Representative geologic sections through the area are shown in figures 3 and 4.

Several times during the last 2 million years, glaciers advanced from the north, covered the area, and retreated. The glacial activity rounded off hills and deepened some of the valleys. Clay, silt, sand, and gravel were deposited as the glaciers advanced and retreated. Most of the area was covered with one or more layers of clay, silt, and sandy till, which, in total, usually are less than 50 ft thick. Interspersed in the till are lenses consisting almost entirely of sand and gravel. In parts of the area, a layer of "blue" clay separates an upper and lower layer in the glacial sediments.

During glaciation, many streams flowed north, toward the glaciers. They were dammed by the ice, which created proglacial lakes between the ice front and the uplands to the south. In valleys inundated by these lakes, sediment-laden meltwaters deposited clay and silt interlayered with sand and gravel. Some of the buried-valley deposits exceed 200 ft in thickness and consist predominantly of lake clays.

As the last glacier retreated about 15,000 years ago, the area began to rise slowly as it rebounded from the weight of the diminishing ice. Lake Erie began draining to the east and, as the level of the lake dropped, wave action cut a series of terraces in the shoreline, and sandy beach ridges were deposited on each terrace (fig. 4).

The courses of north-flowing streams in the area commonly made right-angle turns at the beach ridges, flowed west to breaches in the beach ridges, and then continued on to Lake Erie. As the lake level (stream-base level) dropped, the streams cut channels through the glacial sediments and into the shale bedrock. Today, major streams such as the Grand and Ashtabula Rivers are in deep bedrock gorges cut through the plateau above the lake plains.

Wells drilled in the till generally yield less than 3 gal/min (gallons per minute) (Crowell, 1979; Hartzell, 1978; and Schmidt, 1979). These wells commonly are completed in gravel or broken rock at the contact between the till and underlying shales. Many of the wells in the lake plains were hand dug and are completed in the till. Some of these wells are more than 100 years old. Typically, they are about 4 ft in diameter and less than 20 ft deep. Yield is usually enough for domestic use only.

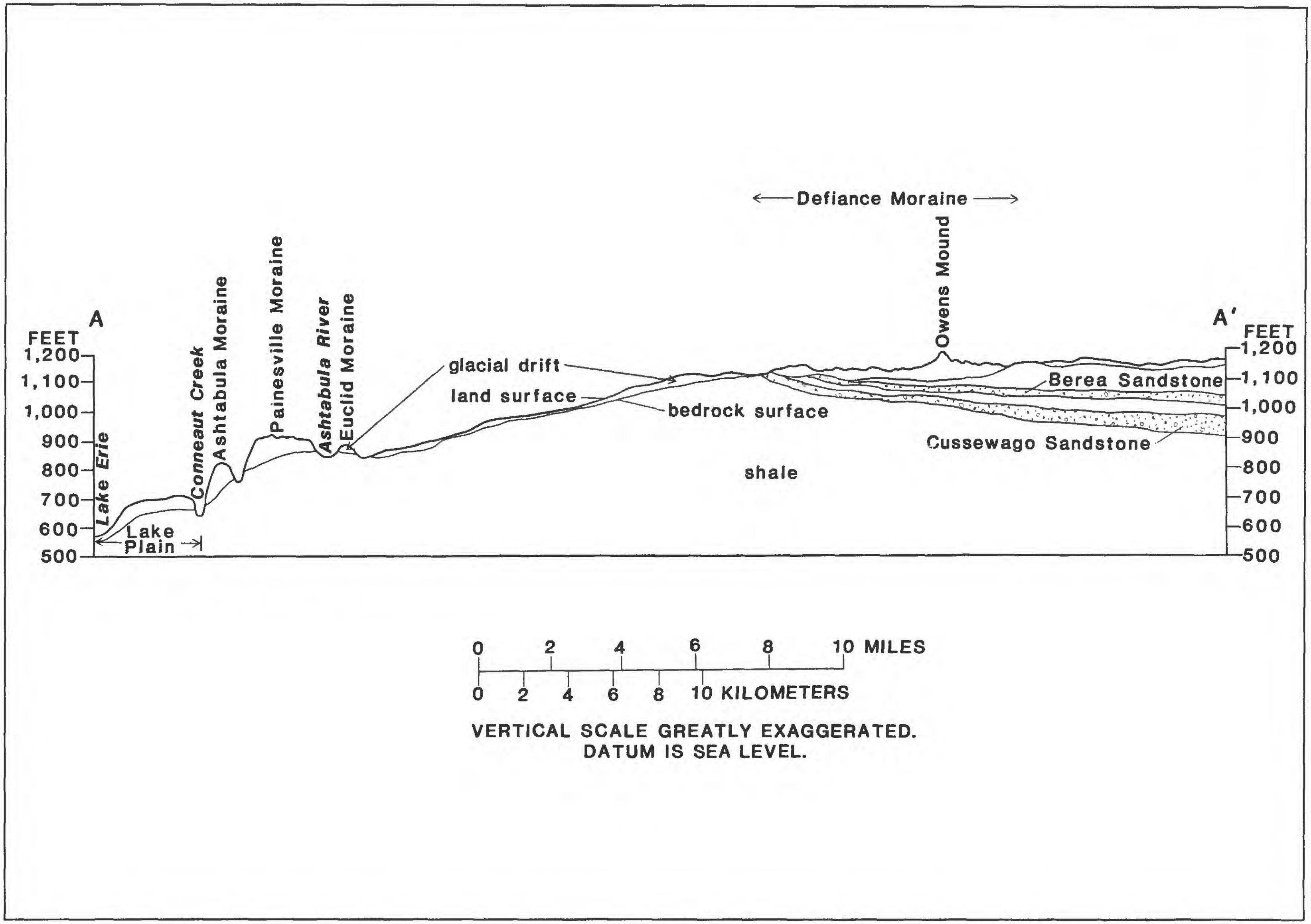


Figure 3.--North-south section across Ashtabula County (modified from White and Totten, 1979; location of section A-A' is shown in figure 1).

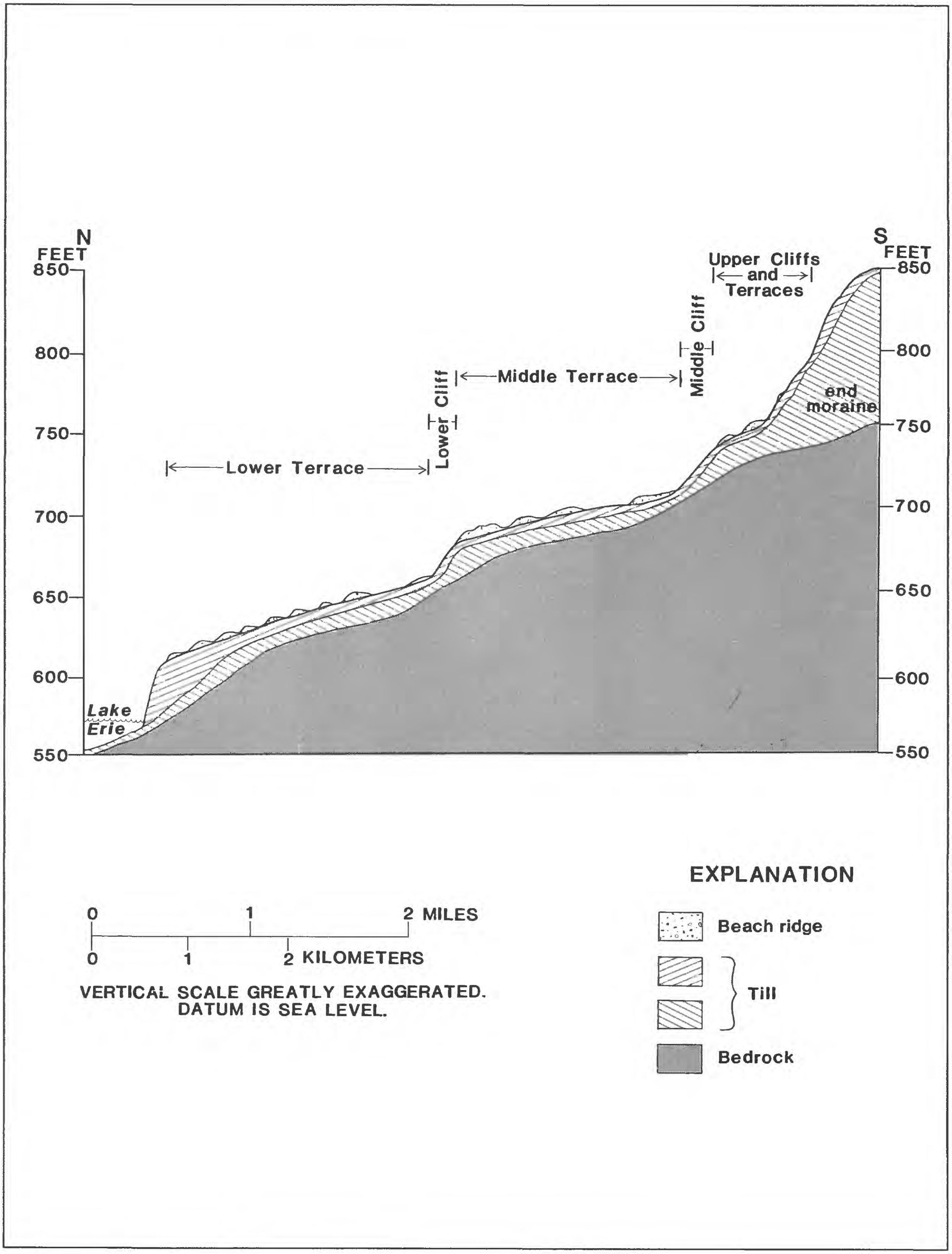


Figure 4.--Generalized geologic section along Lake Erie shoreline in Lake and Ashtabula Counties showing unconsolidated deposits (from White, 1982).

Outwash and ice-laid deposits in the buried valleys yield more water to wells than do till deposits. Some wells produce up to 50 gal/min (Crowell, 1979; Hartzell, 1978; and Schmidt, 1979). Because the sand and gravels are not always continuous deposits, the yield to wells can differ greatly within a small area. Some lacustrine deposits in the dammed valleys yield very little water to wells.

The unconsolidated deposits are treated as one aquifer for the purpose of this regional study. Different types of deposits have different hydraulic properties. Many of the sand and gravel lenses and layers are discontinuous and difficult to correlate from one well to another. However, the deposits seem to be hydraulically connected, as the measured ground-water levels are locally uniform.

The ground-water system is confined by clays and tills in many areas, and some wells flow; however, the system is unconfined or only semiconfined in other areas. The beach ridges are sandy and permeable. The clays and tills are poorly permeable. A detailed examination of the properties of the unconsolidated deposits was beyond the scope of this study.

Methods of Study

Approximately 300 well logs were selected from the files of the Ohio Department of Natural Resources, Division of Water; almost all are for domestic wells. An effort was made to select wells that are completed in unconsolidated sediments (usually sand and gravel). Many of the logs do not indicate the level where water was first encountered. Some logs indicate water in the gravel or in broken or weathered rock just above the shale. A few logs indicate that, because of low yields in the unconsolidated deposits, the wells were drilled into the shale to provide a reservoir to store water for the pump. Many of the wells were selected if it could be reasonably assumed that they were completed in glacial sediments. No wells drilled into sandstone were selected.

During the periods September 10-14 and September 18-19, 1984, 202 wells were located (fig. 5), and water levels were measured (table 1, at back of report). In some cases, the wells for which logs were available could not be located or measured, so nearby wells with similar characteristics were measured if possible.

Some information gathered from well owners consists of approximations (for example, many well depths were estimated). Land-surface elevations at the wells were estimated from U.S. Geological Survey 7.5-minute topographic maps in the field, and are believed to be accurate to within 5 ft. Depths to water were measured with a steel tape with an accuracy of 0.01 ft.

Latitude and longitude for each well were digitized from U.S. Geological Survey topographic maps. The water-level altitude was calculated by subtracting the depth to water from the land-surface elevation after correcting for the difference between the measurement point and the land surface. All information was entered into the U.S. Geological Survey's Ground-Water Site Inventory (GWSI) computer data base (Mercer and Morgan, 1982).

Specific conductance of water was measured with a portable meter in the field at 59 of the wells where their diameter and plumbing permitted access. Many of the measurements were made at dug wells. It was not possible to pump all the wells before measuring. Because most wells were domestic wells that were used regularly, all measurements were considered to be representative of local ground water even if pumping before measurement was not possible.

GROUND-WATER LEVELS AND FLOW

The altitudes of the ground-water levels in the study area are shown in figure 6. The contours imply a gradual northwestward slope of the water table toward Lake Erie. The slope is more gentle and consistent in the lake plains than in the rest of the area. Along the lake plains, ground water is encountered usually within 10 to 20 ft of the ground surface. Farther south, where the land rises to the Allegheny Plateau, the depth to water ranges from 5 to greater than 50 ft.

Locally, ground water discharges to streams, and the water table slopes toward streams. This is shown in places where several wells were measured near streams, and by the manner in which the ground-water levels follow the land surface on the lake plains.

In most of the study area, the ground-water levels resemble a subdued version of the land surface; thus, ground-water flow usually follows the land-surface gradient. At a few sites on the lake plains and glaciated plateau, water levels in adjacent shallow and deep wells indicate a vertical hydraulic gradient. The gradient was downward on the glaciated plateau (a recharge area) and upward near the Lake (a discharge area).

Water enters the ground-water system in the study area as underflow from south of the study area (upgradient) and as recharge from precipitation, mainly on the beach ridges. Water leaves the system as discharge to streams and Lake Erie, evapotranspiration, and withdrawal by pumping.

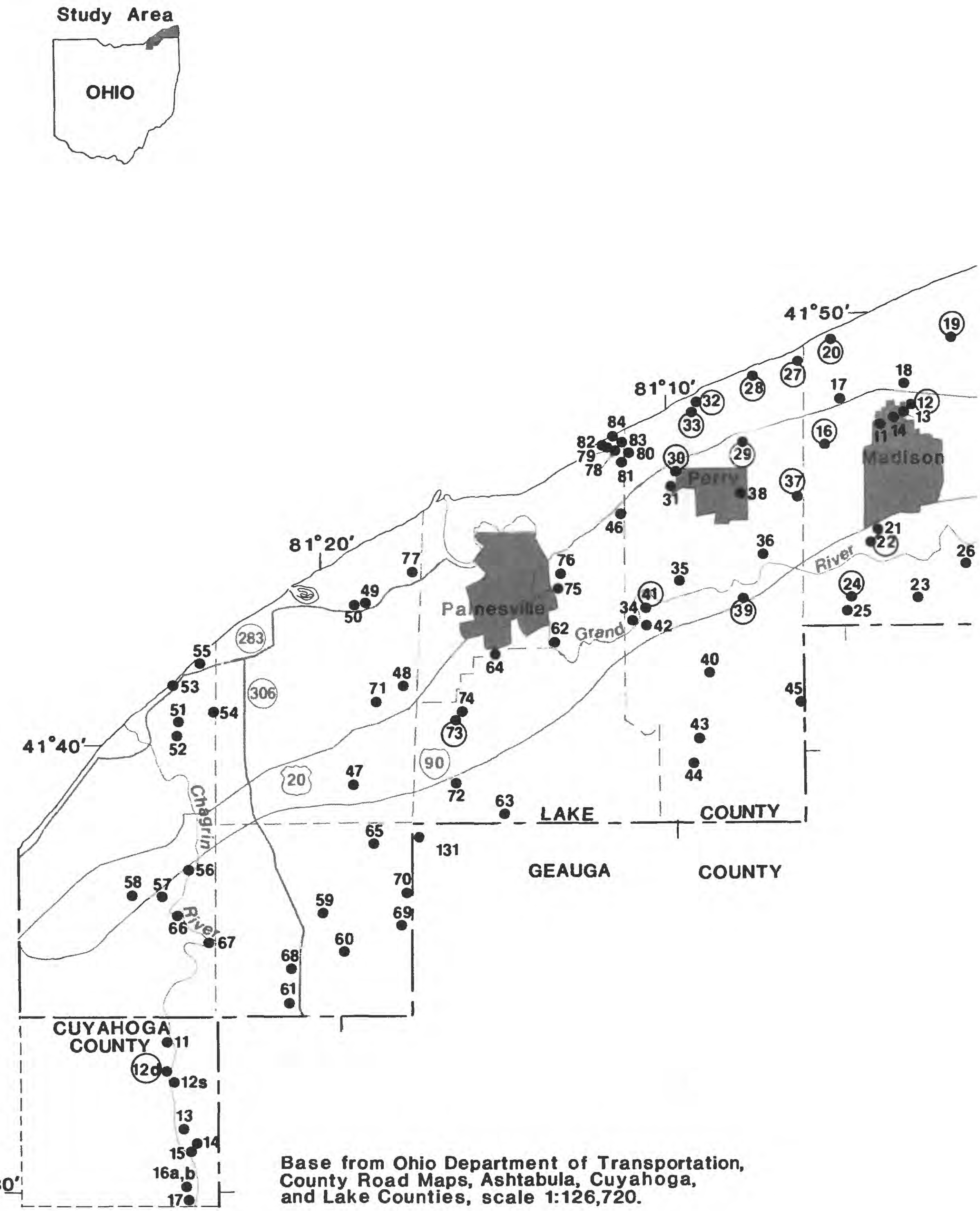
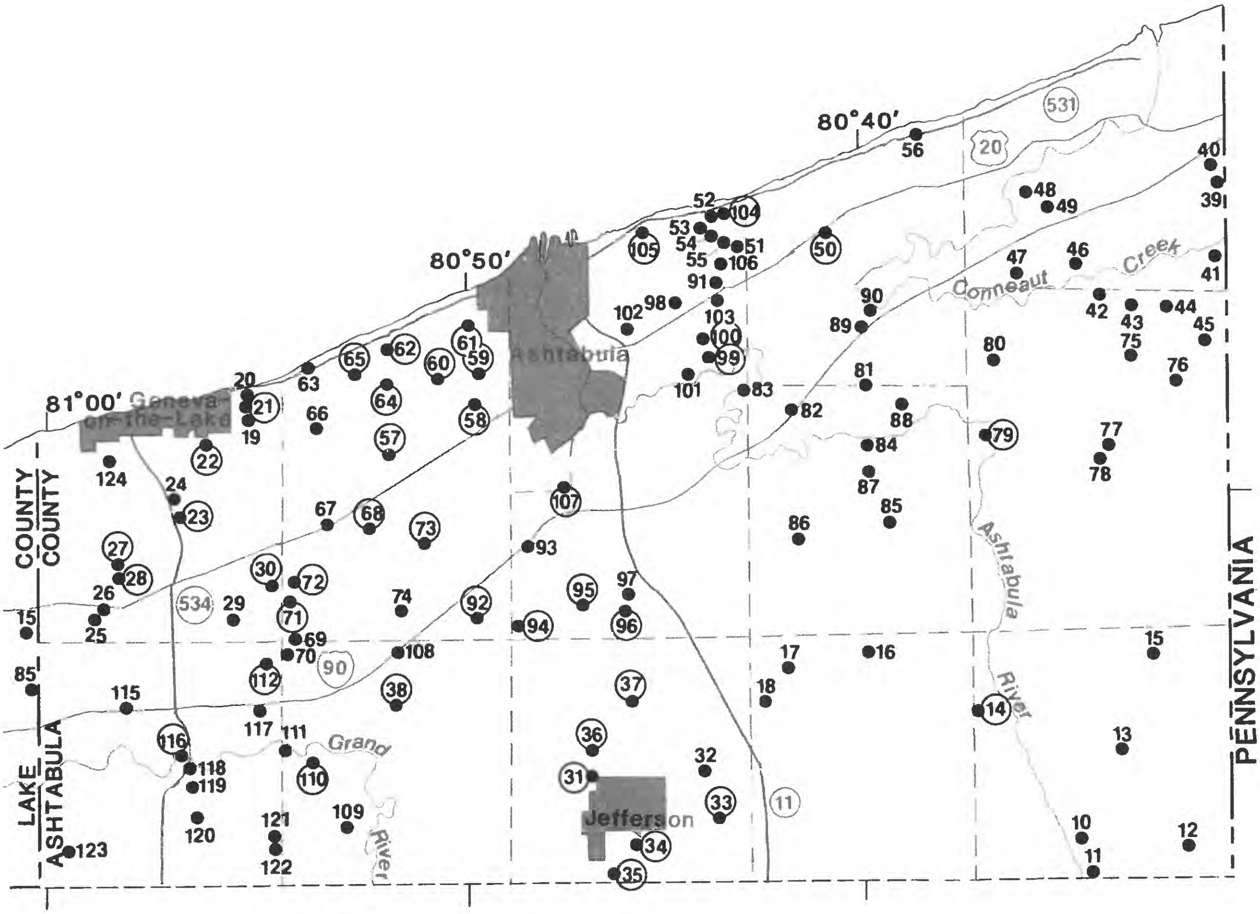


Figure 5.--Location of measured wells (county prefixes have been omitted from well numbers).



EXPLANATION

●40 MEASURED WELL AND NUMBER--Water-level measurement only.

●(38) MEASURED WELL AND NUMBER--Water-level and specific-conductance measurements.

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

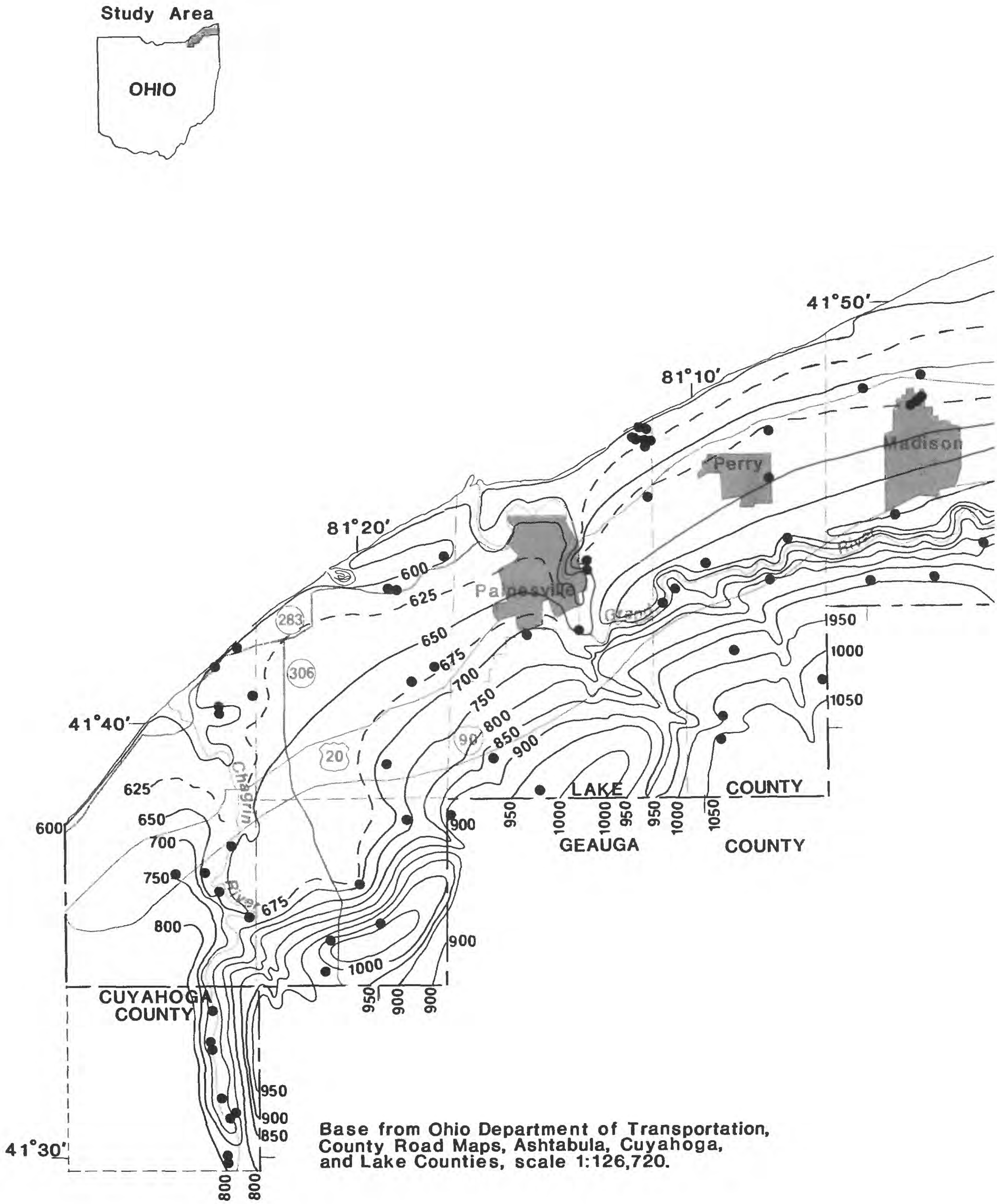
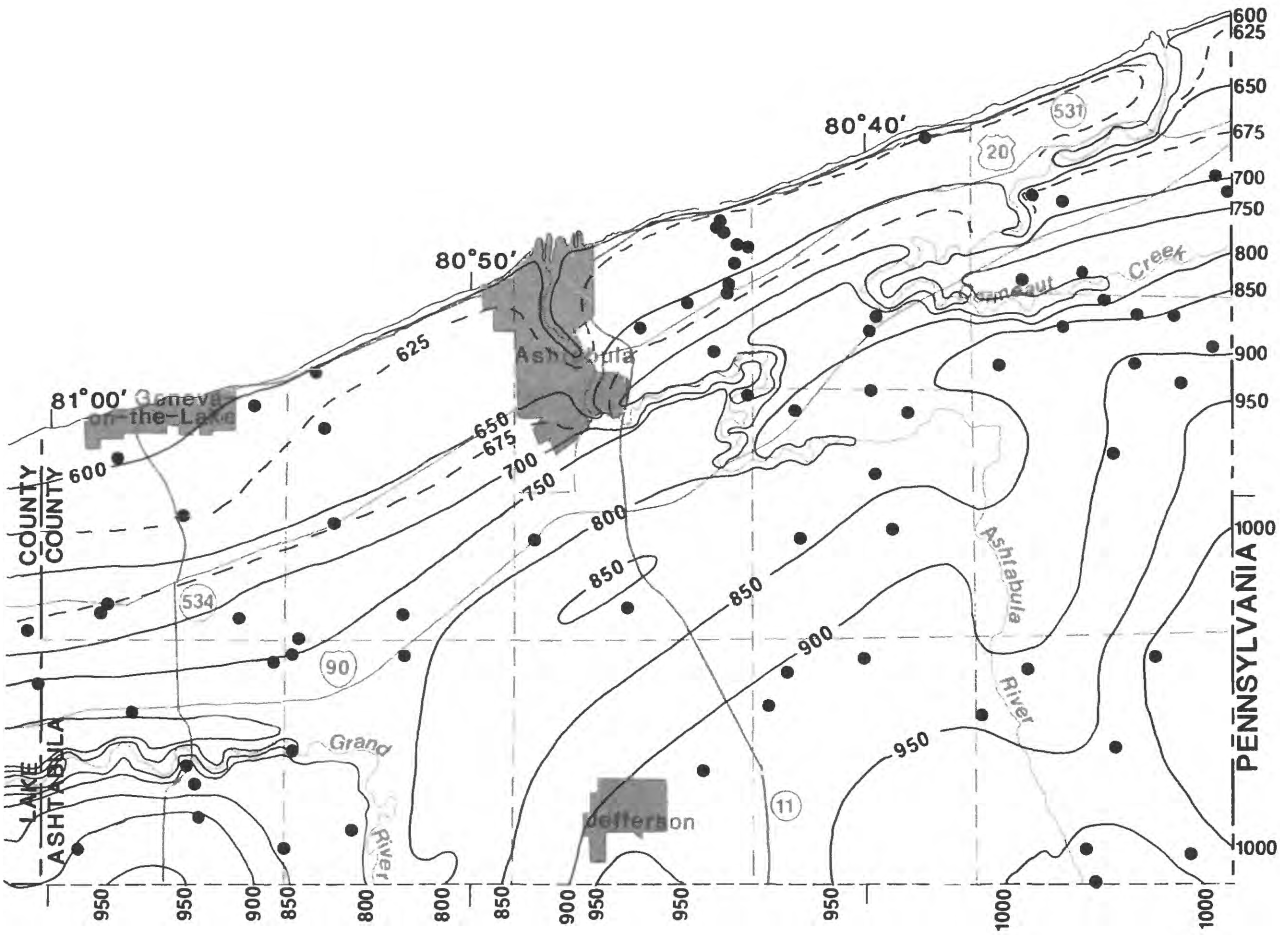


Figure 6.-Level of ground water in unconsolidated depcsits in the study area.



EXPLANATION

—— 600 —— WATER-LEVEL CONTOUR--Shows altitude of ground-water level, in feet above sea level; interval is 50 feet.

— -625 — — INFERRED WATER-LEVEL CONTOUR--Shows altitude of ground-water level, in feet above sea level; interval is 50 feet.

● MEASURED WELL—Value is altitude of water level, in feet above sea level.

0 1 2 3 4 5 MILES

0 1 2 3 4 5 KILOMETERS

Possible routes of ground-water flow to Lake Erie include--

1. Discharge to streams. Many gaining streams in the study area flow directly into Lake Erie.
2. Seepage into Lake Erie from beach cliffs. Bedrock is below lake level along the shore at most of the study area, and the beach cliffs are composed of unconsolidated glacial deposits. Water flows through the sediments above bedrock or above an impermeable layer in the till into Lake Erie.

The effect of the deep east-west river valleys (the Grand River Valley, for example) on the ground water could not be fully determined by this reconnaissance study. Some seeps were seen in the till and shale cliffs along the rivers. These rivers (and many smaller streams) probably intercept ground water and hasten its flow to Lake Erie.

The beach ridges, which rise above the lake plains, are major areas of recharge. Beach ridges have little effect on the regional flow patterns, although they add to the quantity of water in the system.

SPECIFIC CONDUCTANCE OF GROUND WATER

Specific conductance of water in 59 of the measured wells ranged from 200 to 2,900 µS/cm; the data are presented in figure 7 and table 1 (at back of report). Two-thirds of the values were less than 650 uS/cm, and one-third exceeded 650 µS/cm; the median value was 540 µS/cm. No spatial pattern of high (greater than 650 µS/cm) specific-conductance values was noted. Some high values were near potential problem areas, such as landfills. Others were on beach ridges, which may be easily contaminated by salting of major roads along the ridges. Some high values were in areas where residents tell of nearby oil and gas drilling and brine dumping. In addition, some high specific conductances could result from upward leakage of water from bedrock.

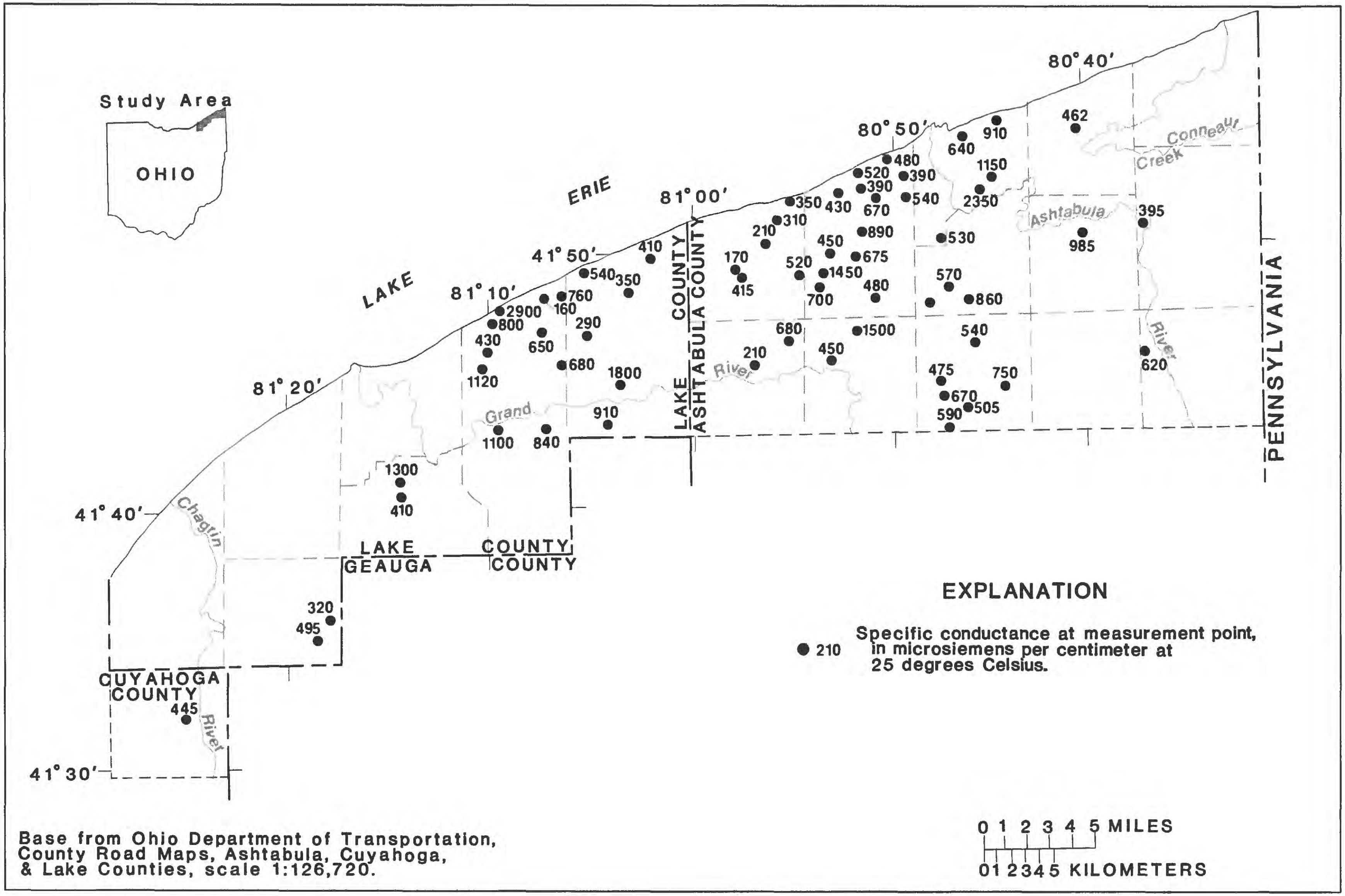


Figure 7.--Specific conductance of ground water in the study area.

SUMMARY AND CONCLUSIONS

The ground-water levels determined as part of this study indicate that the hydraulic gradient and, hence, the direction of ground-water flow is to the north-northwest toward Lake Erie. Locally, the direction of ground-water flow follows the slope of the land surface; ground-water discharges into streams and rivers, which flow into Lake Erie. In the Lake Plains area, ground water is usually within 20 ft of the land surface. The shallowness of water levels in unconsolidated sediments indicates that recharge is rapid in areas such as the beach ridges, and that the sediments are susceptible to contamination. The susceptibility of parts of the aquifers to contamination and the regional flow of ground water toward Lake Erie can have a major effect on local water users and on Lake Erie itself.

Most of the specific-conductance values ranged from 200 to 650 µS/cm, but about a third of them were higher. Values greater than 650 µS/cm did not form an areal pattern that could be related to the geology or hydrology of the area; they most likely reflect increased concentrations of dissolved solids resulting from human activities.

Many thin, discontinuous sand and gravel deposits underlie the area, and information on their extent is sparse. Additional data on the extent and continuity of the glacial aquifers would be important in future assessments of the contribution of ground water to Lake Erie.

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Table 1.--Data for selected wells near Lake Erie, Cleveland to Conneaut, Ohio, September 1984

[µS/cm, microsiemens per centimeter at 25 degrees Celsius; S&G, well completed in sand and gravel; Sh, well completed as open hole in shale below screened sand-and-gravel interval. Dash indicates no data available. Water-use designations: D, domestic; U, unused; P, public supply; T, institution; C, commercial; S, stock; R, recreation; I, industrial; and Z, other.]

Local number	Location		Completed in:	Altitude of land surface (feet)	Date of measurement	Water level below land surface (feet)	Specific conductance (µS/cm)	Water use
AB-10	lat 414334	long 803427	S&G	1,022	09/10/84	2.35	--	D
AB-11	lat 414253	long 803415	Sh	1,031	09/10/84	7.01	--	D
AB-12	lat 414322	long 803159	Sh	1,010	09/10/84	18.90	--	D
AB-13	lat 414511	long 803348	S&G	995	09/10/84	5.80	--	U
AB-14	lat 414528	long 803658	Sh	962	09/10/84	10.42	620	D
AB-15	lat 414655	long 803258	Sh	1,021	09/10/84	10.68	--	D
AB-16	lat 414658	long 803937	Sh	928	09/10/84	12.55	--	D
AB-17	lat 414647	long 804138	S&G	909	09/10/84	5.29	--	D
AB-18	lat 414611	long 804204	Sh	910	09/10/84	5.01	--	D
AB-19	lat 415132	long 805431	S&G	610	09/10/84	1.90	--	D
AB-20	lat 415139	long 805432	S&G	580	09/10/84	6.41	--	D
AB-21	lat 415136	long 805432	S&G	610	09/10/84	.50	350	U
AB-22	lat 415032	long 805538	Sh	615	09/10/84	6.94	310	U
AB-23	lat 414930	long 805611	Sh	630	09/10/84	5.16	210	D
AB-24	lat 414933	long 805611	S&G	630	09/10/84	15.35	--	D
AB-25	lat 414801	long 805810	S&G	675	09/10/84	10.85	--	D
AB-26	lat 414759	long 805817	S&G	680	09/10/84	6.20	--	D
AB-27	lat 414811	long 805755	S&G	660	09/10/84	6.25	170	D
AB-28	lat 414821	long 805758	Sh	665	09/10/84	3.71	415	D
AB-29	lat 414747	long 805455	Sh	735	09/10/84	55.95	--	D
AB-30	lat 414820	long 805359	S&G	735	09/10/84	22.42	520	D
AB-31	lat 414511	long 804651	S&G	869	09/10/84	5.06	670	D
AB-32	lat 414457	long 804356	Sh	925	09/10/84	5.47	--	U
AB-33	lat 414420	long 804323	Sh	930	09/10/84	7.00	750	D
AB-34	lat 414348	long 804550	S&G	955	09/10/84	5.72	505	D
AB-35	lat 414302	long 804620	Sh	962	09/10/84	7.43	590	D
AB-36	lat 414518	long 804652	Sh	872	09/10/84	10.23	475	D
AB-37	lat 414608	long 804522	Sh	875	09/10/84	7.40	540	D
AB-38	lat 414620	long 805055	Sh	805	09/10/84	19.65	1,500	D
AB-39	lat 415526	long 803103	S&G	750	09/11/84	14.00	--	D
AB-40	lat 415545	long 803126	S&G	692	09/11/84	8.49	--	D
AB-41	lat 415401	long 803126	S&G	845	09/11/84	30.38	--	D
AB-42	lat 415327	long 803402	S&G	822	09/11/84	27.60	--	D
AB-43	lat 415306	long 803322	S&G	881	09/11/84	2.50	--	D
AB-44	lat 415312	long 803229	S&G	900	09/11/84	37.58	--	D
AB-45	lat 415245	long 803131	S&G	907	09/11/84	24.62	--	S
AB-46	lat 415358	long 803438	S&G	836	09/11/84	59.28	--	D
AB-47	lat 415351	long 803611	S&G	855	09/11/84	68.69	--	U
AB-48	lat 415518	long 803603	S&G	681	09/11/84	9.06	--	D
AB-49	lat 415508	long 803510	S&G	690	09/11/84	4.49	--	D
AB-50	lat 415427	long 804129	S&G	670	09/11/84	Spring	462	P
AB-51	lat 415429	long 804316	S&G	638	09/11/84	-.38	--	U
AB-52	lat 415437	long 804335	S&G	630	09/11/84	5.02	--	U
AB-53	lat 415438	long 804336	S&G	630	09/11/84	1.43	--	U
AB-54	lat 415443	long 804334	S&G	635	09/11/84	4.79	--	U

Table 1.--Data for selected wells near Lake Erie, Cleveland to Conneaut, Ohio, September 1984--Continued

Local number	Location		Com-pleted in:	Alti-tude of land surface (feet)	Date of measure-ment	Water level below land surface (feet)	Spe-cific conduc-tance (µS/cm)	Water use
AB-55	lat 415429	long 804319	S&G	638	09/11/84	1.72	--	U
AB-56	lat 415624	long 803847	S&G	645	09/11/84	10.29	--	R
AB-57	lat 415025	long 805135	Sh	652	09/11/84	9.00	890	D
AB-58	lat 415114	long 804958	S&G	650	09/11/84	8.54	540	D
AB-59	lat 415153	long 804949	S&G	633	09/11/84	5.63	390	D
AB-60	lat 415152	long 805108	S&G	630	09/11/84	1.40	670	D
AB-61	lat 415251	long 804955	S&G	635	09/11/84	5.48	480	D
AB-62	lat 415240	long 805143	S&G	626	09/11/84	2.75	520	U
AB-63	lat 415212	long 805340	S&G	615	09/11/84	3.05	--	D
AB-64	lat 415157	long 805151	S&G	631	09/11/84	3.70	390	D
AB-65	lat 415157	long 805256	S&G	625	09/11/84	.80	430	D
AB-66	lat 415115	long 805314	S&G	631	09/11/84	2.40	--	D
AB-67	lat 414924	long 805305	S&G	676	09/11/84	5.36	--	U
AB-68	lat 414918	long 805242	S&G	695	09/11/84	4.10	450	D
AB-69	lat 414721	long 805352	Sh	785	09/11/84	70.42	--	D
AB-70	lat 414715	long 805356	Sh	795	09/11/84	77.83	--	D
AB-71	lat 414806	long 805354	S&G	715	09/11/84	Flowing	700	D
AB-72	lat 414824	long 805344	S&G	745	09/11/84	18.34	1,450	D
AB-73	lat 414914	long 805042	S&G	755	09/11/84	26.53	675	D
AB-74	lat 414747	long 805103	S&G	834	09/11/84	72.00	--	D
AB-75	lat 415219	long 803323	S&G	915	09/12/84	12.00	--	R
AB-76	lat 415155	long 803134	Sh	951	09/12/84	5.42	--	U
AB-77	lat 415039	long 803355	S&G	912	09/12/84	2.60	--	T
AB-78	lat 415038	long 803356	S&G	912	09/12/84	11.18	--	T
AB-79	lat 415050	long 803653	Sh	840	09/12/84	6.68	395	S
AB-80	lat 415214	long 803659	S&G	890	09/12/84	14.62	--	U
AB-81	lat 415148	long 803923	S&G	858	09/12/84	42.85	--	D
AB-82	lat 415130	long 804112	S&G	862	09/12/84	43.67	--	U
AB-83	lat 415147	long 804232	S&G	711	09/12/84	13.73	--	D
AB-84	lat 415043	long 803931	S&G	840	09/12/84	15.75	--	Z
AB-85	lat 414925	long 803901	S&G	870	09/12/84	9.42	--	D
AB-86	lat 414909	long 804110	S&G	851	09/12/84	4.70	--	D
AB-87	lat 415014	long 803916	S&G	858	09/12/84	10.28	--	T
AB-88	lat 415129	long 803812	S&G	875	09/12/84	61.29	--	D
AB-89	lat 415257	long 804004	S&G	780	09/12/84	25.28	--	U
AB-90	lat 415317	long 803958	S&G	780	09/12/84	13.40	--	U
AB-91	lat 415345	long 804326	S&G	660	09/12/84	5.06	--	U
AB-92	lat 414745	long 804932	S&G	835	09/12/84	14.97	480	D
AB-93	lat 414907	long 804741	S&G	865	09/12/84	74.66	--	U
AB-94	lat 414738	long 804801	S&G	858	09/12/84	29.67	2,150	D
AB-95	lat 414749	long 804711	S&G	875	09/12/84	13.51	570	U
AB-96	lat 414750	long 804523	S&G	850	09/12/84	11.55	860	D
AB-97	lat 414752	long 804523	S&G	852	09/12/84	14.17	--	D
AB-98	lat 415322	long 804410	S&G	652	09/12/84	1.29	--	U
AB-99	lat 415234	long 804336	Sh	728	09/12/84	8.00	2,350	D
AB-100	lat 415240	long 804336	S&G	724	09/12/84	2.81	1,150	C
AB-101	lat 415211	long 804446	S&G	740	09/12/84	12.60	--	U
AB-102	lat 415258	long 804517	S&G	653	09/12/84	2.45	--	U
AB-103	lat 415342	long 804308	Sh	662	09/12/84	23.76	--	U
AB-104	lat 415503	long 804319	S&G	634	09/12/84	5.42	910	U

Table 1.--Data for selected wells near Lake Erie, Cleveland to Conneaut, Ohio, September 1984--Continued

Local number	Location		Completed in:	Altitude of land surface (feet)	Date of measurement	Water level below land surface (feet)	Specific conductance (µS/cm)	Water use
AB-105	lat 415455	long 804439	S&G	632	09/12/84	6.72	640	D
AB-106	lat 415412	long 804304	S&G	645	09/12/84	4.48	--	D
AB-107	lat 415012	long 804642	S&G	815	09/12/84	26.39	530	U
AB-108	lat 414707	long 805053	S&G	850	09/13/84	64.30	--	U
AB-109	lat 414353	long 805237	Sh	818	09/13/84	15.68	--	D
AB-110	lat 414526	long 805326	S&G	761	09/13/84	9.20	450	D
AB-111	lat 414527	long 805407	Sh	773	09/13/84	24.26	--	D
AB-112	lat 414655	long 805419	S&G	800	09/13/84	11.22	680	D
AB-115	lat 414602	long 805726	Sh	820	09/13/84	33.08	--	D
AB-116	lat 414535	long 805622	S&G	860	09/13/84	5.14	210	U
AB-117	lat 414602	long 805427	S&G	855	09/13/84	81.77	--	C
AB-118	lat 414501	long 805616	S&G	820	09/13/84	15.72	--	D
AB-119	lat 414228	long 805609	Sh	845	09/13/84	37.86	--	D
AB-120	lat 413716	long 805605	Sh	920	09/13/84	9.73	--	D
AB-121	lat 413236	long 805405	S&G	875	09/13/84	26.95	--	D
AB-122	lat 413236	long 805405	Sh	870	09/13/84	50.32	--	D
AB-123	lat 413132	long 805916	S&G	935	09/13/84	6.60	--	D
AB-124S	lat 415040	long 805816	S&G	600	09/19/84	2.20	--	U
AB-124D	lat 415040	long 805816	S&G	600	09/19/84	8.73	--	D
CU-11	lat 413336	long 812427	S&G	691	09/14/84	14.02	--	U
CU-12S	lat 413249	long 812424	S&G	720	09/14/84	7.12	--	U
CU-12D	lat 413249	long 812424	Sh	720	09/14/84	45.09	445	D
CU-13	lat 413145	long 812413	S&G	715	09/14/84	23.04	--	D
CU-14	lat 413122	long 812354	S&G	750	09/14/84	41.44	--	T
CU-15	lat 413115	long 812359	Sh	738	09/14/84	57.68	--	C
CU-16A	lat 413020	long 812413	Sh	798	09/14/84	25.35	--	D
CU-16B	lat 413020	long 812413	Sh	798	09/14/84	25.95	--	D
CU-17	lat 413019	long 812412	Sh	789	09/14/84	7.95	--	U
GE-131	lat 413808	long 811721	S&G	1,015	09/18/84	23.27	--	D
L-11	lat 414730	long 810256	S&G	680	09/11/84	4.37	--	P
L-12	lat 414736	long 810234	S&G	680	09/11/84	7.68	350	P
L-13	lat 414735	long 810235	S&G	680	09/11/84	6.74	--	P
L-14	lat 414734	long 810237	S&G	680	09/11/84	6.49	--	P
L-15	lat 414721	long 810024	S&G	695	09/11/84	14.22	--	D
L-16	lat 414658	long 810512	S&G	690	09/11/84	7.77	290	D
L-17	lat 414753	long 810436	S&G	675	09/11/84	17.95	--	I
L-18	lat 414811	long 810245	S&G	670	09/11/84	8.70	--	U
L-19	lat 414910	long 810119	Sh	630	09/11/84	4.86	410	D
L-20	lat 414916	long 810520	S&G	630	09/11/84	31.11	540	D
L-21	lat 414450	long 810349	S&G	840	09/11/84	45.95	--	D
L-22	lat 414447	long 810348	S&G	830	09/11/84	20.29	1,800	D
L-23	lat 414334	long 810234	Sh	900	09/11/84	21.50	--	T
L-24	lat 414321	long 810432	S&G	910	09/11/84	2.15	910	U
L-25	lat 414321	long 810432	S&G	930	09/11/84	8.66	--	D
L-26	lat 414424	long 810112	S&G	805	09/11/84	9.65	--	D
L-27	lat 414844	long 810601	S&G	625	09/12/84	8.63	760	D
L-28	lat 414829	long 810723	S&G	625	09/12/84	11.70	160	D
L-29	lat 414656	long 810725	S&G	685	09/12/84	16.14	650	D
L-30	lat 414618	long 810936	S&G	685	09/12/84	12.70	430	D
L-31	lat 414553	long 810936	S&G	695	09/12/84	6.17	1,120	D

Table 1.--Data for selected wells near Lake Erie, Cleveland to Conneaut, Ohio, September 1984--Continued

Local number	Location		Com-pleted in:	Alti-tude of land surface (feet)	Date of measure-ment	Water level below land surface (feet)	Spe-cific conduc-tance (µS/cm)	Water use
L-32	lat 414723	long 810939	S&G	615	09/12/84	12.48	2,900	D
L-33	lat 414718	long 810938	S&G	625	09/12/84	11.09	800	U
L-34	lat 414247	long 811111	Sh	790	09/12/84	61.32	--	U
L-35	lat 414349	long 810938	Sh	820	09/12/84	57.10	--	D
L-36	lat 414421	long 810717	Sh	840	09/12/84	68.10	--	U
L-37	lat 414528	long 810612	Sh	730	09/12/84	8.65	650	U
L-38	lat 414548	long 810724	Sh	705	09/12/84	7.87	--	D
L-39	lat 414322	long 810731	Sh	840	09/12/84	18.36	840	D
L-40	lat 414203	long 810848	S&G	965	09/12/84	15.69	--	D
L-41	lat 414303	long 811039	S&G	735	09/12/84	3.05	1,100	D
L-42	lat 414302	long 811038	Sh	750	09/12/84	16.70	--	D
L-43	lat 414019	long 810923	S&G	1,005	09/12/84	3.01	--	D
L-44	lat 413948	long 810905	S&G	1,060	09/12/84	3.83	--	D
L-45	lat 414111	long 810626	Sh	1,035	09/12/84	15.89	--	D
L-46	lat 414524	long 811114	S&G	688	09/13/84	6.36	--	C
L-47	lat 413914	long 811916	S&G	772	09/13/84	65.80	--	T
L-48	lat 414129	long 811753	S&G	688	09/13/84	28.65	--	D
L-49	lat 414314	long 811900	S&G	627	09/13/84	9.59	--	U
L-50	lat 414306	long 811913	S&G	627	09/13/84	9.41	--	U
L-51	lat 414014	long 812437	S&G	617	09/13/84	27.05	--	U
L-52	lat 414012	long 812438	Sh	592	09/13/84	2.01	--	U
L-53	lat 414127	long 812420	S&G	612	09/13/84	1.90	--	U
L-54	lat 414045	long 812304	S&G	625	09/13/84	5.47	--	D
L-55	lat 414153	long 812334	S&G	609	09/13/84	4.27	--	U
L-56S	lat 413726	long 812342	S&G	615	09/13/84	3.76	--	U
L-56D	lat 413726	long 812342	S&G	615	09/13/84	5.79	--	U
L-57	lat 413659	long 812408	S&G	636	09/13/84	2.55	--	U
L-58	lat 413643	long 812515	S&G	765	09/13/84	16.15	--	U
L-59	lat 413629	long 812006	Sh	690	09/14/84	21.59	--	D
L-60	lat 413535	long 811913	S&G	1,065	09/14/84	62.48	--	D
L-61	lat 413435	long 812110	S&G	1,085	09/14/84	99.78	--	D
L-62	lat 414216	long 811332	S&G	615	09/14/84	6.24	--	U
L-63	lat 413839	long 811424	Sh	995	09/14/84	8.14	--	D
L-64	lat 414204	long 811511	S&G	710	09/14/84	5.14	--	U
L-65	lat 413755	long 811835	S&G	715	09/14/84	6.33	--	D
L-66	lat 413620	long 812412	S&G	629	09/14/84	3.39	--	U
L-67	lat 413551	long 812315	S&G	661	09/14/84	6.28	--	U
L-68	lat 413512	long 812051	S&G	1,065	09/18/84	2.01	--	Z
L-69	lat 413549	long 811758	S&G	1,120	09/18/84	71.42	--	D
L-70	lat 413643	long 811729	S&G	1,000	09/18/84	2.85	--	P
L-71	lat 414059	long 811829	S&G	681	09/18/84	10.59	--	Z
L-72	lat 413921	long 811555	S&G	925	09/18/84	31.80	--	D
L-73D	lat 414037	long 811519	Sh	767	09/18/84	48.43	1,300	D
L-73S	lat 414037	long 811519	S&G	767	09/18/84	3.72	410	U
L-74	lat 414039	long 811519	S&G	773	09/18/84	7.80	--	U
L-75	lat 414339	long 811316	S&G	690	09/19/84	8.38	--	U
L-76	lat 414344	long 811318	S&G	689	09/19/84	6.08	--	U
L-77	lat 414356	long 811716	S&G	595	09/18/84	1.82	--	U
L-78	lat 414638	long 811152	S&G	620	09/18/84	1.72	--	U
L-79	lat 414637	long 811142	S&G	624	09/18/84	4.39	--	U

Table 1.--Data for selected wells near Lake Erie, Cleveland to Conneaut, Ohio, September 1984--Continued

Local number	Location		Completed in:	Altitude of land surface (feet)	Date of measurement	Water level below land surface (feet)	Specific conductance (µS/cm)	Water use
L-80	lat 414623	long 811128	S&G	631	09/18/84	2.85	--	U
L-81	lat 414622	long 811133	S&G	630	09/18/84	9.66	--	U
L-82	lat 414636	long 811139	S&G	626	09/18/84	2.79	--	U
L-83	lat 414644	long 811136	S&G	615	09/18/84	3.28	--	U
L-84	lat 414647	long 811139	S&G	621	09/18/84	4.50	--	U
L-85D	lat 414627	long 805941	S&G	760	09/13/84	31.26	--	D
L-85S	lat 414627	long 805941	S&G	760	09/13/84	2.00	--	U