WATER INFORMATION SERIES REPORT 2

FLOWING WELLS IN MICHIGAN 1974

1977

Prepared by the United States Geological Survey in cooperation with the Michigan Geological Survey

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by: W. B. Allen

U. S. Geological Survey

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DEFINITION OF TERMS

AQUIFER: A formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

ARTESIAN WATER: Ground water that is under pressure significantly greater than atmospheric, and its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the material in which the artesian water occurs.

BEDROCK: The consolidated rock underlying the glacial drift or at the surface.

FLOWING WELL: A well from which water flows without pumping.

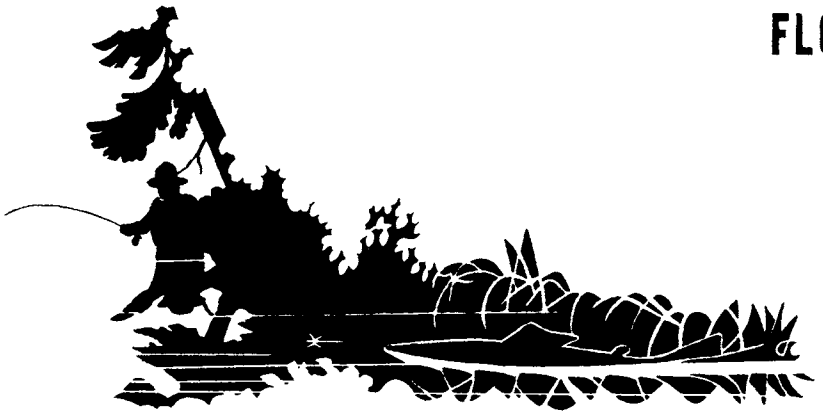
HEAD: The height above a standard datum of the surface of a column of water that can be supported by the static pressure at a given point.

RECHARGE: The process by which water is absorbed and is added to the zone of saturation, either directly into a formation or indirectly by way of another formation. Also, the quantity of water that is added to the zone of saturation.

SUBCROP: A bedrock formation or rock unit directly under the glacial drift.

TRANSMISSIVITY: The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of the aquifer under a unit hydraulic gradient.

WATER TABLE: That surface in an unconfined water body at which the pressure is atmospheric. It is defined by the levels at which water stands in wells that penetrate the water body just far enough to hold standing water.



FLOWING WELLS IN MICHIGAN 1974

by: W. B. Allen

ABSTRACT

Flowing wells yielding fresh water occur in both the glacial drift and the bedrock in Michigan. Most known flowing wells are in the Lower Peninsula because the greater population in that part of the State has led to more frequent drilling. A comparison of flowing-well areas in 1900 with those in 1970 shows a probable decline in head in the glacial drift and the Marshall and Saginaw bedrock formations in the central and southern parts of the Lower Peninsula. Wells having the greatest reported flows are from the Marshall and Saginaw Formations; wells having the greatest heads are from the Cambrian, Ordovician, and Silurian rock units. Flowing wells in Michigan are largely used for domestic water supplies, although a few are used for municipal and industrial supplies. In general, water from most flowing wells is suitable for domestic use; however, high iron, chloride, and hardness impair water quality at some locations.

INTRODUCTION

Leverett (1906) and Leverett and others (1906, 1907) described areas where well drillers had reported flowing wells and areas where flowing-well fields had been developed for municipal, industrial, and domestic supply. Since 1900 many of these wells have ceased to flow and many new flowing wells have been constructed. Some flowing-well areas have expanded, and a few new areas have been discovered. New well records and additional information about the geology, topography, and streamflow of Michigan have contributed to a better understanding of the hydrology of flowing wells.

The purpose of this report is to assemble basic data on flowing wells that yield fresh water and to group the wells according to the principal geologic formation or rock unit that they penetrate. The formations and units include the glacial drift, Saginaw Formation, and the Marshall Formation, plus Silurian-Devonian, Devonian, Silurian, and Cambrian-Ordovician rock units. If a large number of wells have been drilled in a small area, only a few representative well records were selected for inclusion in this report.

FLOWING WELLS

Plate 1 shows the location and heads of selected flowing wells in the glacial drift in Michigan. Flowing-well areas were delineated on the basis of different types of glacial features, such as lake plains, end moraines, till plains, and outwash channels. The areas delineated are those of many flowing wells; this does not imply that all wells drilled in these areas will flow. Areas where glacial drift is generally less than.25 feet thick have also been shown on plate 1.

Glacial drift in Michigan is composed of stratified materials deposited by glacial melt waters and unstratified materials deposited directly from glacial ice. Water sorting was slight. Stratified materials are chiefly lakebeds composed of fine sand and clay, and outwash deposits composed of more permeable sand and gravel. Unstratified materials are moraines composed of till that ranges in grain size from clay to gravel. Generally, the till is of low permeability. In the glacial drift only the more permeable beds of sand and gravel store and transmit substantial amounts of water to wells.

Plate 2 shows the locations and heads of flowing and nonflowing artesian wells in bedrock aquifers in Michigan. Nonflowing artesian wells were used to help delineate the flowing-well areas shown on figures 1-5.

Tables of basic well data include depth, thickness of rock units, head or water level, and free flow or pumping yield. Generally, only flowing wells drilled during 1965-70 are given in the tables. Data on flowing wells in 1900 were obtained from Leverett and others (1906); data on flowing wells in 1970 were obtained from the files and reports of the Michigan Geological Survey and the U. S. Geological Survey. Quality of water data are shown in the tables for a few of the flowing wells.

Flowing Wells in the Glacial Drift in the Lower Peninsula

Flowing wells are known to occur in nearly every county in the Lower Peninsula (plate 1). They are sparse, however, in the north-central and south-central parts, and in the "Thumb area" in the eastern part of the Peninsula, where the bedrock is close to the land surface and the glacial drift is thin. At the turn of the century most known flowing wells occurred in the southern half of the Peninsula. In the northern half, known flowing wells were widely scattered, principally in Manistee, Benzie, and Ogemaw Counties.

Table 1 shows that the depth of flowing wells in the Lower Peninsula ranges from 16 to 361 feet and that they have heads ranging from 1 to 40 feet above land surface. One well, in Isabella County, flows at a rate of 80 gpm (gallons per minute), and another, in Livingston County, flows at a rate of 70 gpm. The yield of wells, on pumping, ranges from 2 to 226 gpm.

Some flowing wells in Van Buren, Oakland, Gladwin, Isabella, Midland, Ogemaw, and Roscommon Counties are reported to yield hard water, which may be high in iron and locally high in chloride.

Flowing Wells in the Glacial Drift in the Upper Peninsula

Flowing wells in the glacial drift are common in the eastern third of the Upper Peninsula -- in Chippewa, Luce, and Mackinac Counties (pl. 1). They were also common in these counties in 1900, and since that time many new wells have been drilled. In the central and western parts of the Upper Peninsula the glacial drift is thin and unfavorable for flowing wells, although scattered flowing wells are known to occur. The depth of the wells in the Upper Peninsula ranges from 13 to 410 feet (table 2). The head ranges from 1 to 34 feet above land surface and the flow ranges from 1 to 350 gpm.

Decline in Head in Glacial Drift Aquifers

Head in the glacial drift aquifers has probably declined in places in the following counties: Allegan, Bay, Clinton, Genesee, Gratiot, Ionia, Kent, Lapeer, Monroe, Midland, Muskegon, Oakland, Oceana, Ottawa, and Sanilac. This decline is suggested by the fact that no wells drilled during 1965-70 have flowed, although such wells were common in 1900. It is possible that head has declined also in Berrien, Isabella, Lenawee, Newaygo, St. Clair, Tuscola, Van Buren, and Washtenaw Counties. In these counties many flowing wells were drilled before 1900, but only a few have been drilled since that time. In other counties, flowing wells constructed in recent years indicate that the head has remained relatively unchanged since 1900.

Flowing Wells in the Saginaw Formation

The Saginaw Formation is the youngest bedrock unit tapped by flowing wells in Michigan. It occurs in the central part of the Lower Peninsula, and underlies the glacial drift or the "red beds" bedrock unit (fig. 1). The Saginaw Formation consists of sandstone and shale having minor amounts of limestone, coal, and gypsum. The formation ranges from 75 to 350 feet in thickness. The overlying "red beds" are shaly and do not yield water to wells. The Saginaw Formation receives recharge in the subcrop area through the glacial drift. Generally the water is fresh, although in the northwestern part of the subcrop area data from oil wells indicate that the water is saline. Where the Saginaw underlies the "red beds", it probably contains salty water.

The permeability of the Saginaw Formation is dependent upon the degree of fracturing, number of bedding planes, and openings between individual sand grains. Transmissivity values in the Lansing area reported by Vanlier and Wheeler (1970) range from 1,000 to 20,000 gpd per ft (gallons per day per foot). Stuart (1945) found transmissivities to be about 23,400 gpd per ft. The highest yields and the best quality of water are obtained from wells where the formation is overlain by permeable glacial drift.

Plate 2 shows the areas of fresh-water flowing wells in the Saginaw Formation and the head of selected wells. The plate also shows areas where flowing wells penetrate both the Saginaw and the underlying Marshall Formation. Flowing wells penetrating the Saginaw Formation are common in Bay, Clinton, Eaton, Gladwin, Gratiot, Ingham, Ionia, Jackson, Midland, Saginaw, and Tuscola Counties. The wells in the Saginaw Formation range from 50 to 600 feet in depth. The head ranges from 1 to 25 feet above land surface and the yield from 1 gpm to a pumped rate of 500 gpm (table 3).

In the central and southern parts of the subcrop area of the Saginaw Formation the head of flowing wells has declined. In Ingham and Eaton Counties several wells flowed in 1900. One well had a head of about 10 feet above land surface; by 1970 the water level in a nearby well was below land surface. Most wells in the two counties were not flowing in 1970. The water level in one well was 57 feet below land surface.

Communities that have or did have flowing wells yielding fresh water from the Saginaw Formation are: Standish, Pinconning, Gladwin, Flint, Clio, New Lathrop, Owosso, Bridgeport, Chesaning, Zilwaukee, Vassar, Akron, Caro, Mayville, Millington, Unionville, Lansing, Jackson, Eaton Rapids, Mason, Charlotte, and Grand Ledge. In some areas the quality of water is reported to be good, but in others it is reported to be hard and to have high iron and chloride contents.

Flowing Wells in the Marshall Formation

The Marshall Formation, the most productive bedrock aquifer in Michigan, underlies much of the Lower Peninsula (fig. 2). It has been developed for water supply by municipalities and industry in several areas, especially in the southern part of the subcrop area, where the glacial drift is relatively thin.

The Marshall Formation is as thick as 350 feet. It is composed of sandstone and minor amounts of siltstone, shale, and limestone. The formation is recharged through the glacial drift in the subcrop area. The permeability is dependent largely upon fractures in the well-cemented sandstone. A flow-net analysis in the Battle Creek area of Calhoun County by Vanlier (1966) indicates that the Marshall Formation has a transmissivity of about 250,000 gpd per ft. The formation is productive and contains water of good quality where it is overlain directly by permeable glacial drift. Where the formation is confined by younger bedrock the water is generally saline. Little is known about flowing wells in the northern part of the subcrop area because of the great thickness of overlying glacial drift. Information from a few oil well logs suggests that the water is saline.

Plate 2 shows where flowing wells occur in the Marshall Formation; it also shows where flowing wells penetrate both the Saginaw and Marshall Formations. Flowing wells are common in Allegan, Barry, Calhoun, Genesee, Hillsdale, Huron, Jackson, Kent, Lapeer, Livingston, Oakland, Ottawa, Sanilac, and Washtenaw Counties. The wells range from 40 to 450 feet in depth. The head ranges from 1 to 18 feet above land surface and the yield from 1 to 500 gpm (table 4).

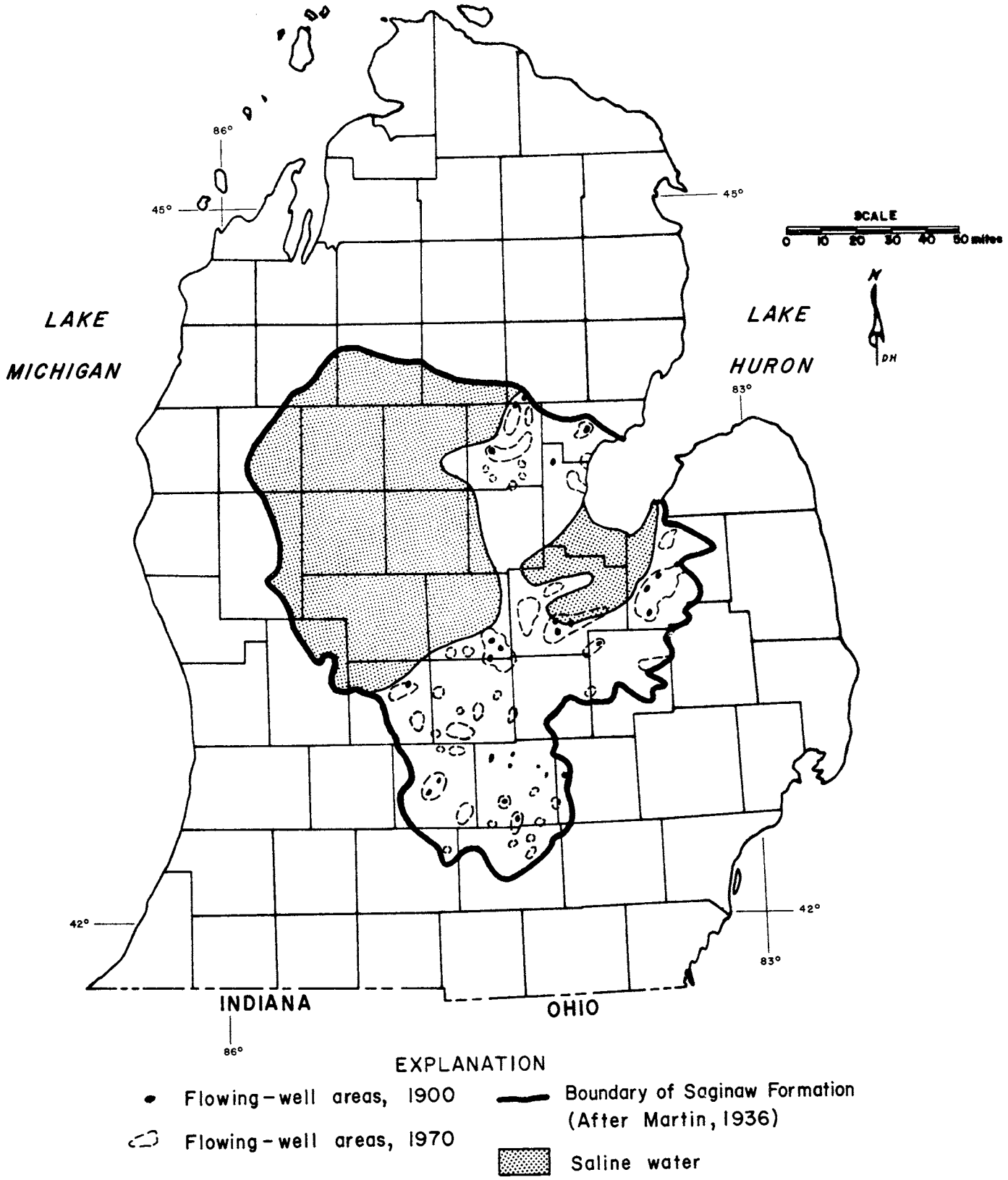


Figure 1.--Flowing-well areas in the Saginaw Formation in the Lower Peninsula. Flowing-well areas reported in 1900 are from Leverett (1906), Leverett and others (1906), and Leverett and others (1907); areas reported in 1970 are from the Michigan Geological Survey and published reports.

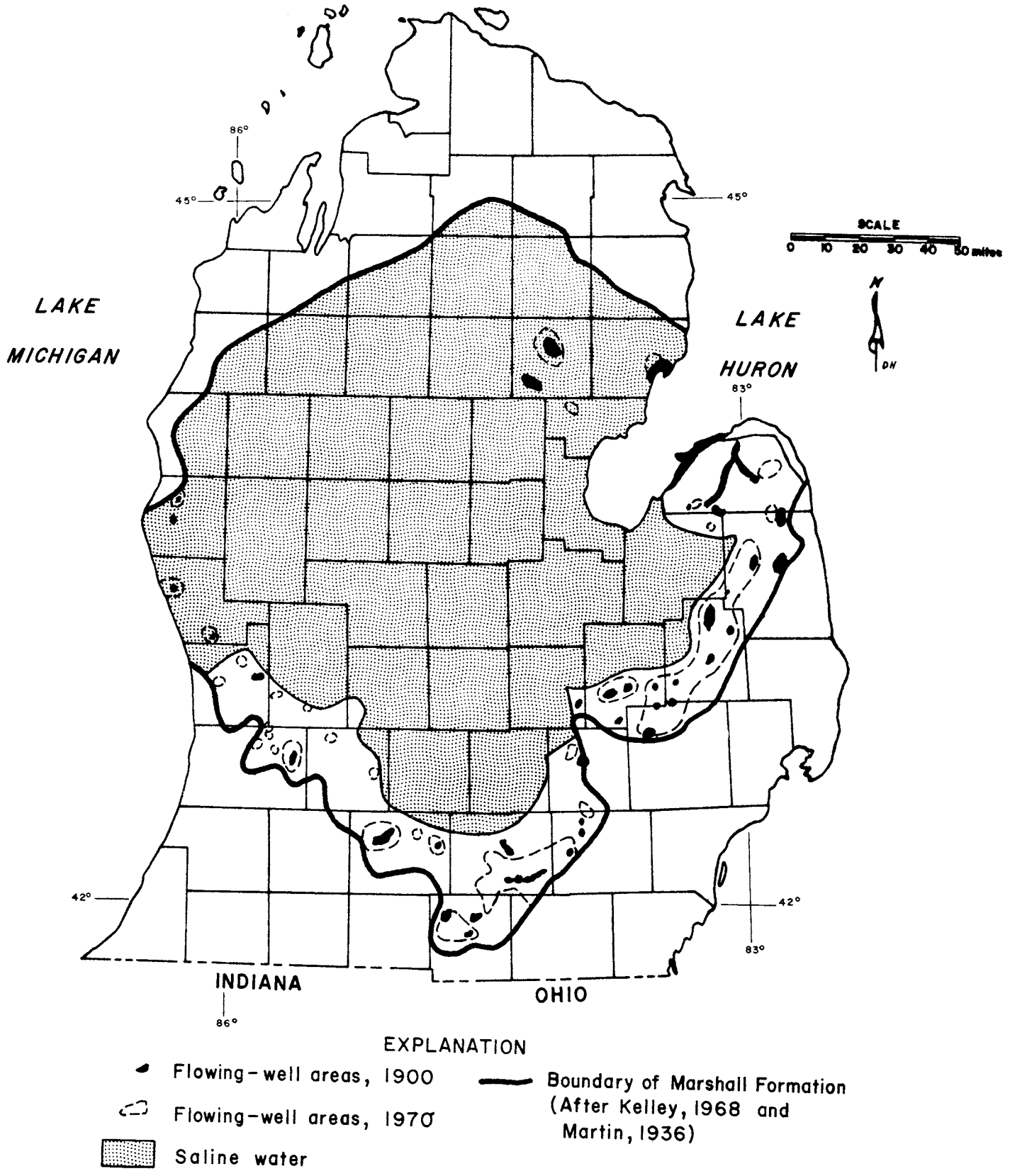


Figure 2.--Flowing-well areas in the Marshall Formation in the Lower Peninsula. Flowing-well areas reported in 1900 are from Leverett (1906), Leverett and others (1906), and Leverett and others (1907); areas reported in 1970 are from the Michigan Geological Survey and published reports.

There probably has been a decline in head in flowing wells throughout most of the subcrop area. In Kent, Allegan, and Calhoun Counties wells were known to be flowing in 1900. By 1970, water levels were as much as 8 feet below land surface in Kent County, 68 feet below land surface in Allegan County, and 20 feet below land surface in Calhoun County. At Battle Creek (Calhoun County) a well that was flowing in 1900 had a water level 30 feet below land surface in 1970. Water levels have declined below the land surface in other counties, as follows: Huron, about 5 feet; Sanilac, about 5 feet; Lapeer, about 4 feet; and Jackson, about 1 foot.

Communities that have or have had flowing wells that tap the Marshall Formation are Grand Rapids, Lansing, Jackson, Battle Creek, North Branch, Imlay City, Hadley, and Lapeer. In some counties, the quality of water is reported to be good, but in Calhoun, Hillsdale, Huron, and Jackson Counties the water is hard and has high iron and chloride content.

Flowing Wells in the Silurian-Devonian and Devonian Rock Units

Silurian-Devonian rock units are tapped by flowing wells in the southeastern part of the Lower Peninsula (fig. 3). Devonian rock units are tapped by flowing wells in the northern part of the Lower Peninsula. Where both Silurian and Devonian rocks occur, they consist of formations that are hydraulically interconnected. For this reason, the two are considered together as a single unit. The rocks are as thick as 800 feet and are composed of limestone and dolomite. They are recharged through the glacial drift and, in places, directly, where they are exposed. Only the top 100 to 200 feet of the Silurian and Devonian rocks contains fresh water. Where they are overlain by younger bedrock units and in the northeastern part of the subcrop area most of the water is saline.

Plate 2 shows areas of flowing wells in Silurian-Devonian rocks and the head in selected wells. Most flowing wells are in Monroe County. The depth of wells in Silurian-Devonian rocks ranges from 54 to 475 feet, the head ranges from 1 to about 5 feet above land surface, and the yield ranges from 10 to 40 gpm (table 5). The quality of water is reported to be good. La Salle Township (Monroe County) is the only community that has used flowing wells for municipal water supply. Most flowing wells are used for domestic supplies.

In the Devonian rock units of the northern area of the Lower Peninsula, most flowing wells are located in Charlevoix, Cheboygan, Emmet, and Presque Isle Counties. Here, the depth of the wells ranges from 61 to 206 feet, the head ranges from 1 to 15 feet above land surface, and the yield ranges from 5 gpm to a pumping rate of 40 gpm (table 6). Most wells are reported to yield water of good quality. Wells that are flowing or have flowed supply water to the communities of Charlevoix, Mackinaw City, Cheboygan, Rogers City, and Presque Isle.

Flowing Wells in the Cambrian-Ordovician and Silurian Rock Units of the Upper Peninsula

Cambrian-Ordovician and Silurian rock units are located in the southeastern part of the Upper Peninsula (fig. 4). The rock units consist of groups of rocks or formations that are hydraulically interconnected and are considered together as a rock unit. As a group, they are as thick as 1,600 feet and consist of limestone and dolomite. Locally, fractures and openings along bedding planes have been enlarged by solution. The rocks are recharged directly where they are exposed. Elsewhere, recharge is through the glacial drift.

Plate 2 shows the area of flowing wells in Cambrian-Ordovician, and Silurian rock units in the Upper Peninsula. Most flowing wells penetrate the Silurian rock units, although a few penetrate the Cambrian-Ordovician rock units. Where the Silurian rock units are overlain by glacial drift, the water is fresh. Flowing wells are most common in Mackinac and Schoolcraft Counties. According to Vanlier and Deutsch (1958), there are two permeable zones in the Silurian rock units. Water in the shallower zones has a lower head than water in the deeper zones. Thus, some wells have been drilled through the shallower zones into the deeper zones in order to obtain an adequate flow. In some places an adequate supply could probably be obtained from the shallower zones by pumping. An area in Mackinac County between Engadine and Naubinway has the highest artesian head. Vanlier and Deutsch (1958) report that a well drilled in about 1900 in Mackinac County had a head of 55 feet above land surface and a flow in excess of 75 gpm. Flowing wells in the Silurian rock units range from 47 to 426 feet in depth. Heads range from 1 to 84 feet above land surface, and flows range from 3 to 60 gpm (table 7). Most wells penetrating the upper zone are 75 to 100 feet deep, have a head of 1 to 10 feet above the land surface, and flow at 3 to 10 gpm. In the lower zone, wells are 200 to 250 feet deep, have a head of about 20 feet, and have a flow of about 25 gpm.

The chemical quality of water in the Silurian rock units varies widely. According to Vanlier and Deutsch (1958), water from the limestone is relatively high in calcium and carbonate. Water from the dolomite is relatively high in magnesium and bicarbonate. The water may contain objectionable amounts of iron,

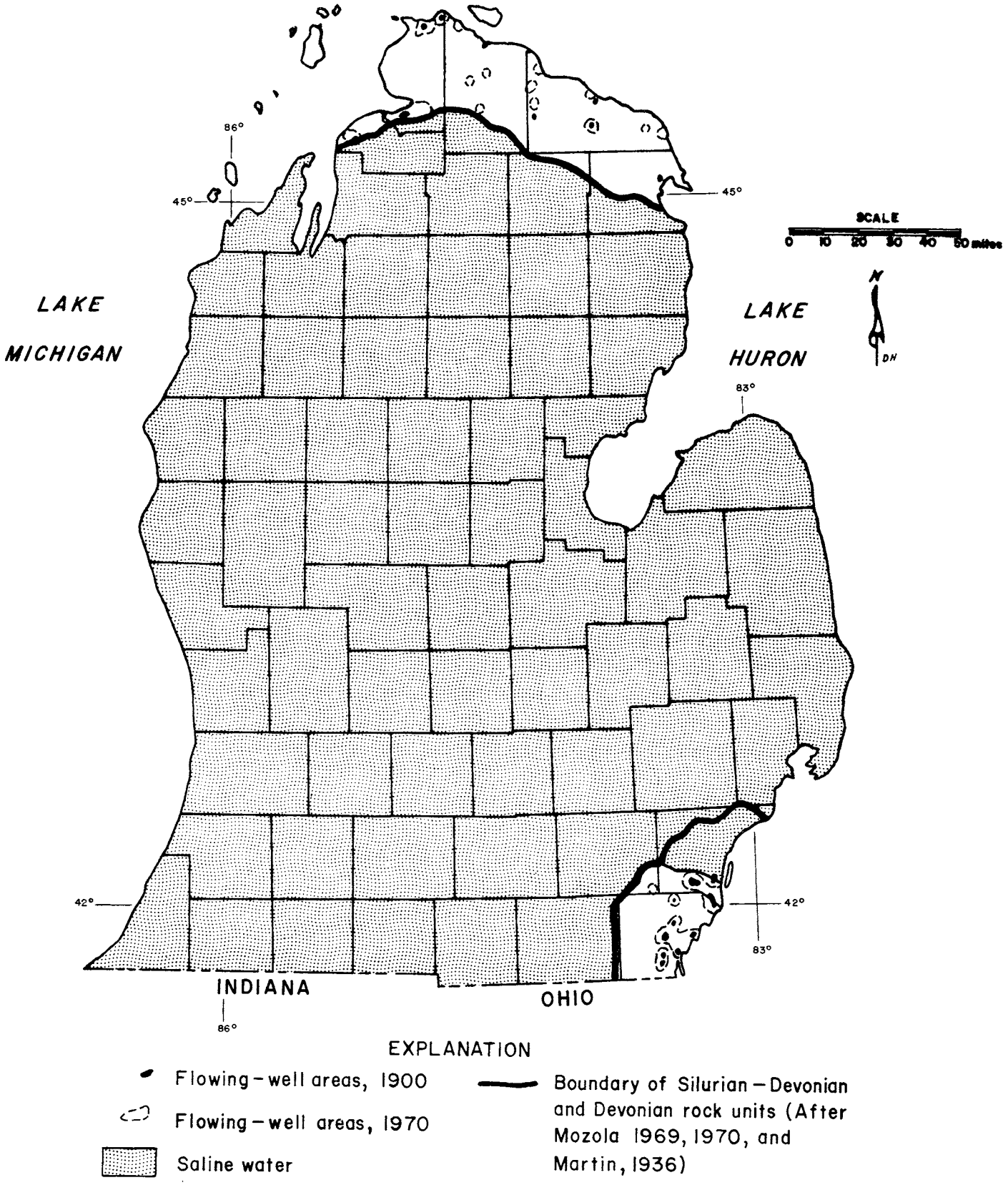


Figure 3.--Flowing-well areas in the Devonian and Silurian-Devonian rock units in the Lower Peninsula. Flowing-well areas reported in 1900 are from Leverett (1906); Leverett and other (1906), and Leverett and others (1907); areas reported in 1970 are from Michigan Geological Survey and published reports.

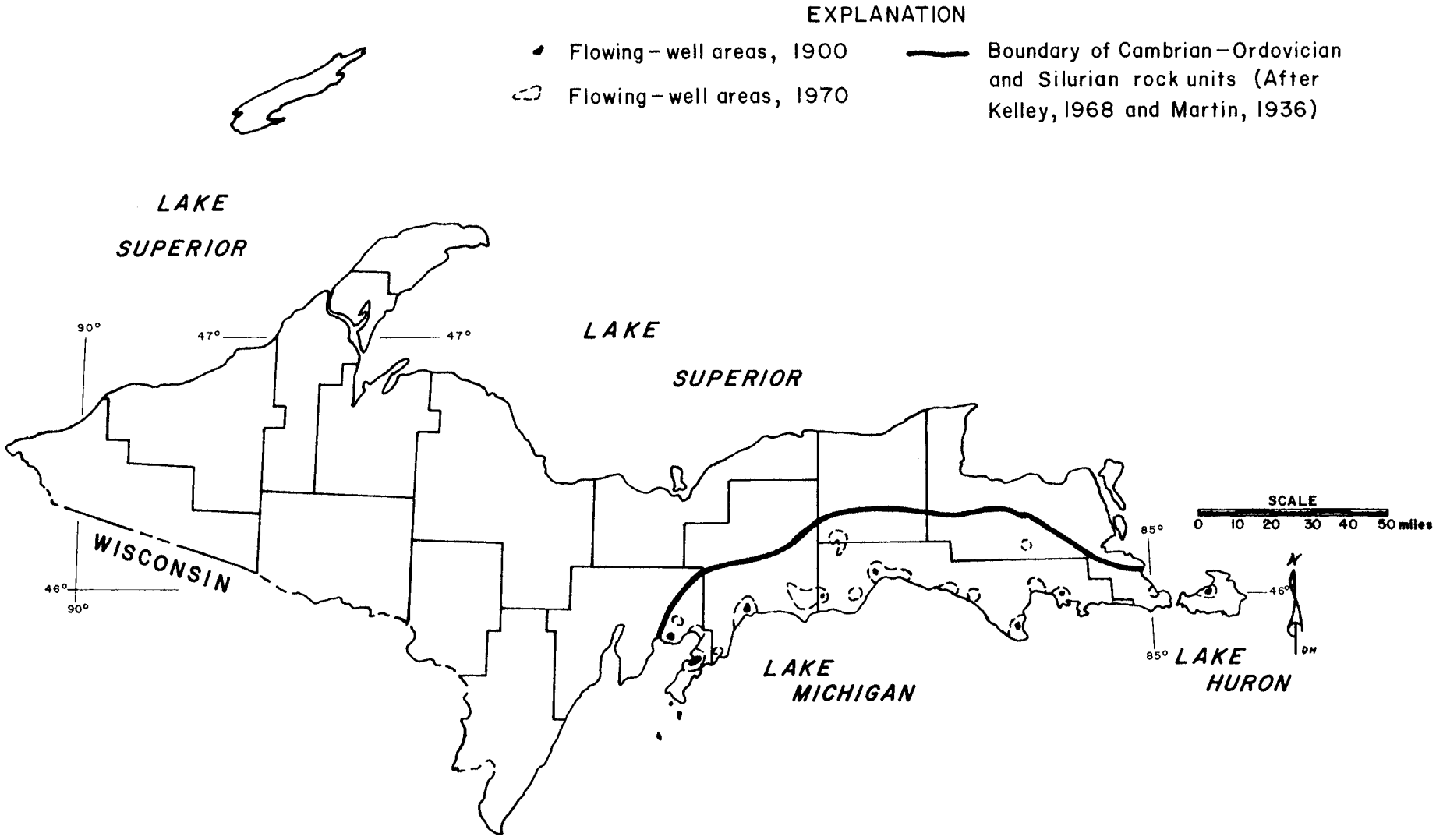


Figure 4.--Flowing-well areas in the Cambrian-Ordovician, and Silurian rock units in the Upper Peninsula. Flowing-well areas reported in 1900 are from Leverett (1906); areas reported in 1970 are from Michigan Geological Survey and published reports.

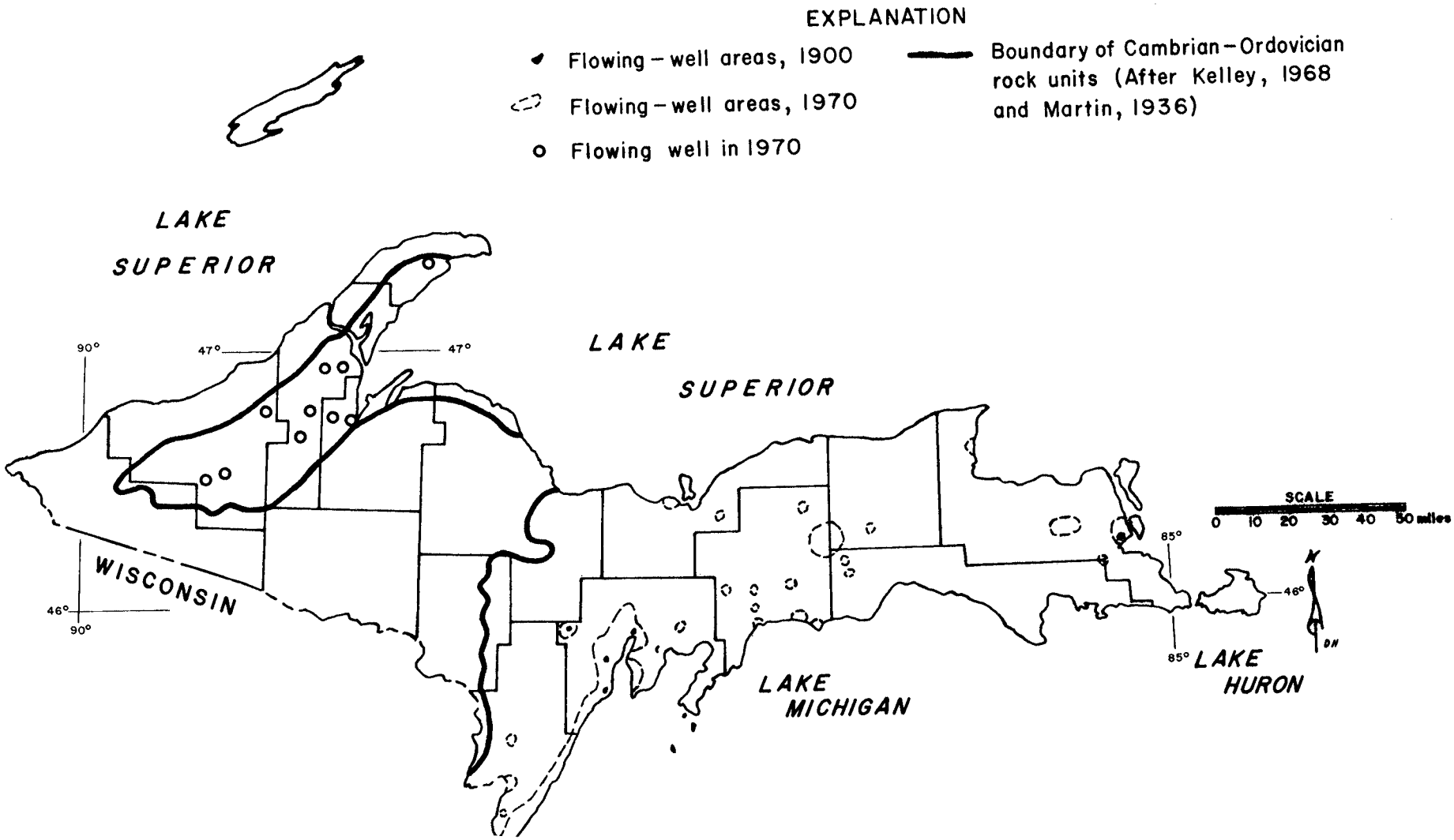


Figure 5.--Flowing-well areas in the Cambrian-Ordovician rock units in the Upper Peninsula. Flowing-well areas reported in 1900 are from Leverett (1906); areas reported in 1970 are from Michigan Geological Survey and published reports.

chloride, and sulfate and may be too hard for use without treatment.

Flowing Wells in the Cambrian-Ordovician Rock Units

Cambrian-Ordovician rock units are located in the eastern half and north-central part of the western half of the Upper Peninsula (fig. 5). In the eastern half the rock units consist of sandstone, carbonate rocks, and some shale. The rock units are as thick as 2,600 feet, and are hydraulically connected at places. In the western part of the Upper Peninsula, the rocks are chiefly sandstones of Cambrian or Precambrian age. In this report all are considered to be a water-bearing unit. The rocks are recharged directly, where they are exposed, or through the glacial drift, where they underlie it. In the southeastern part of the Upper Peninsula, the Cambrian-Ordovician rock units are overlain by younger bedrock of Silurian age. Water from most flowing wells is used for domestic supply; however, Escanaba (Delta County) and Manistique (Schoolcraft County) have used flowing wells for municipal water supplies.

Plate 2 shows the areas of flowing wells in the Cambrian-Ordovician rock units and the head in selected wells. The plate also shows areas where the Silurian rocks overlie the Cambrian-Ordovician rocks. Flowing wells penetrating Cambrian-Ordovician rock units are most common in Delta and Menominee Counties. Rapid River, Escanaba, and Menominee used these flowing wells for municipal water supplies in 1900, and they are still used, with little change in head. The flow of the wells seems to increase as depth increases. In Delta and Menominee Counties, the depth of flowing wells ranges from 25 to 753 feet. The head ranges from 1 to 40 feet above land surface, and the yield ranges from 1 to 55 gpm (table 8).

Flowing wells in the Cambrian-Ordovician rock units yield water of variable quality. In the northeastern part of the subcrop area, water having a high chloride content is common; in the southern part, water having a high sulfate content is common. Saline water zones also occur, especially where the rock units are overlain by younger bedrock.

SUMMARY

Flowing wells occur at many locations in Michigan's Upper and Lower Peninsulas. Fresh water is obtained from flowing wells drilled in the glacial drift, in the Saginaw and Marshall Formations, and in the Silurian, Devonian, Silurian-Devonian, and Cambrian-Ordovician rock units. The greatest number of flowing wells occur in the Lower Peninsula, where data indicate that head has declined since 1900, primarily in the central and southern part of the Lower Peninsula in wells drilled in the glacial drift and in the Saginaw and Marshall Formations.

Table 9 summarizes data on flowing wells in Michigan. Wells having the greatest reported flow tap the Saginaw and Marshall Formations; those having the greatest heads tap the Silurian-Devonian and Cambrian-Ordovician rock units.

In general, water obtained from fresh water flowing wells throughout the State is suitable for domestic, municipal, and industrial uses. At some locations, however, high iron, chloride, and hardness impair water quality.

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Table 1.--Records of selected flowing wells in glacial drift in the Lower Peninsula of Michigan.

Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride), and Hd (hardness) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Alcona	25N-9E-34NE	-	57	1	-	
	26N-9E-9NW	-	41	1	15	
	27N-7E-1NW	-	82	-	60	
	27N-8E-22NE	-	120	6	4	
	27N-9E-24NW	-	129	40	17	
	28N-5E-20SE	-	166	4	5	
	28N-8E-30NW	-	38	4	12	
	28N-9E-23NE	-	119	-	-	
Allegan	1N-14W-26NE	-	67	2	7p	
	2N-12W-26SW	-	36	4	15p	
	2N-13W-18NW	-	85	2	20p	
	4N-11W-20SE	-	97	6	15p	
	4N-16W-2NE	-	87	-	15p	
Alpena	29N-8E-29SW	-	116	3	6p	
	30N-5E-18SE	-	104	-	5p	
Antrim	29N-9W-3SE	-	77	2	-	
	30N-7W-31SW	-	52	1	35p	
	30N-8W-19SW	-	60	1	10p	
	31N-8W-7NE	-	86	2	40p	
	31N-8W-20SW	-	190	10	20p	
Bay	15N-3E-26SW	-	95	1	-	
	17N-4E-36SW	-	34	2	-	
Benzie	25N-15W-3NW	-	159	-	15p	
	26N-14W-8SE	-	133	-	13p	
	26N-14W-12SE	-	83	-	45p	
	26N-15W-3NE	-	172	3	-	
Berrien	3S-17W-11SE	-	130	4	-	
	4S-17W-3SE	-	50	6	30	
	5S-17W-1NW	-	70	2	3	
	8S-19W-9NW	-	43	-	15p	
Cass	5S-13W-8NW	-	105	-	15p	
Charlevoix	32N-5W-26SE	-	88	6	4	
	32N-6W-24SW	-	84	-	20p	
	32N-7W-2SW	-	48	3	60	
	33N-7W-34NW	-	50	-	15p	
Cheboygan	35N-2W-9NE	-	194	18	50	
	35N-3W-5	-	36	2	10p	
	35N-3W-8NW	-	135	-	-	
	36N-2W-3NE	-	45	-	20	
	36N-2W-9SE	-	254	10	10	

Table 1.--Records of selected flowing wells in glacial drift in the Lower Peninsula of Michigan.--continued

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Cheboygan (continued)	36N-3W-13NW	-	93	6	10	
	36N-3W-35SE	-	116	4	20	
	37N-1W-29SE	-	34	4	5 15p	
	37N-2W-34SE	-	178	10	15	
	38N-1W-33NE	-	47	2	10	
	38N-2W-14SW	-	165	8	25p	
	39N-3W-35SW	-	75	1	10	
Clare	17N-3W-24NE	-	105	-	-	
	17N-4W-14SE	-	144	-	2	
	17N-4W-32NW	-	200	-	1	
	17N-5W-21NE	-	160	-	10p	
	19N-3W-14NE	-	110	-	10	
	19N-3W-22NW	-	77	-	2	
Clinton	7N-1W-14NE	-	75	-	-	
Crawford	26N-1W-11NE	-	96	-	10p	
	26N-2W-12SW	-	238	-	15	
	26N-3W-7SE	-	32	-	16p	
Emmet	35N-4W-10SW	-	89	8	-	
	35N-5W-13SE	-	210	20	10	
	36N-4W-24SW	-	178	2	20p	
Genesee	6N-8E-27NE	-	92	1	32p	
	8N-8E-16NW	-	74	-	8p	
Gladwin	17N-1W-35NE	-	145	-	4p	
	17N-2W-20NE	-	170	-	40	
	18N-1W-31SE	-	147	-	7p	
	19N-1E-15NW	-	105	-	2	
	19N-1W-26SE	-	90	-	10p	
	19N-2W-20NW	-	30	-	10p	
	20N-1E-9NW	-	32	-	10p	Fe 1.3, Cl 0, and Hd 180
	20N-1E-35NE	-	170	-	10p	
	20N-1W-35SE	-	170	17	1 5p	
	20N-2E-7SW	-	92	-	5p	
Grand Traverse	27N-10W-18SW	-	164	-	5 10p	
	27N-11W-25SW	-	44	2	12p	
	28N-9W-22SW	-	76	-	10 60p	
Gratiot	9N-1W-7	676	25	3	1	
	9N-2W-35SW	-	98	8	75p	
	11N-3W-20NW	-	105	-	-	
	11N-4W-30NE	-	140	-	-	
Hillsdale	5S-1W-1SW	1,112	40	1	3	
	6S-1W-16NE	-	50	15	-	
	7S-3W-19SE	-	125	14	5	
	8S-2W-33NE	-	27	8	4	

Table 1.--Records of selected flowing wells in glacial drift in the Lower Peninsula of Michigan.--continued

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Ionia	7N-7W-28NE	-	58	-	17p	
	8N-8W-12NW	-	45	-	10p	
Iosco	22N-8E-17NE	-	55	-	8p	
	24N-9E-3SE	-	34	2	9p	
Isabella	13N-3W-11SW	-	50	-	20	
	14N-3W-35NW	-	69	-	8p	Fe 0.9, Cl 11, and Hd 260
	14N-4W-11NE	-	80	-	6p	
	14N-5W-22SW	-	110	-	80	
	14N-6W-19SW	-	93	-	2 10p	
	15N-3W-29SE	-	92	-	7	Fe 2.5, and Hd 580
	15N-4W-16NE	-	95	3	32p	
	15N-5W-11SE	-	190	-	15p	
	16N-3W-33NW	-	147	-	-	
	16N-4W-25SE	-	65	-	10	
	16N-5W-36SE	-	80	-	30p 6p	
Ingham	17N-17W-28SE	-	197	-	-	
	18N-17W-20NE	-	89	-	-	
Kalamazoo	2S-11W-28NE	771	175	19	-	Fe 0.5, Cl 16, and Hd 260
Kalkaska	25N-6W-4NE	-	40	41	15p	
	25N-7W-12SW	-	116	-	10p	
Kent	6N-11W-23NW	705	121	-	-	Fe 0.15, Cl 38, and Hd 1,600
	8N-10W-19SE	-	151	4	25p	
	8N-10W-29NE	-	65	11	12p	
	10N-10W-4	897	41	3	2	
Lapeer	9N-11E-8NE	-	24	5	5	
	10N-10E-14SE	-	63	2	15p	
Leelanau	28N-12W-11SE	-	125	-	5 30p	
	29N-11W-11SE	-	177	-	10 25p	
	29N-11W-28SW	-	51	-	5 5p	
	29N-12W-25SE	-	361	14	-	
	29N-13W-11SE	-	200	-	5	
	30N-11W-33NE	-	50	-	-	
	30N-12W-23SE	-	62	-	10p	
	31N-11W-3NE	-	74	-	10p	
Lenawee	5S-3E-21NE	907	80	4	5	
	5S-5E-2SE	735	45	2	1	
	5S-5E-12E	730	125	3	9	
	6S-5E-6NE	730	136	3	20	
	7S-4E-16SW	715	130	5	6p	
	8S-1E-25NE	-	74	-	12	
	8S-2E-31NW	-	112		10p	

Table 1.--Records of selected flowing wells in glacial drift in the Lower Peninsula of Michigan.--continued

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Livingston	1N-3E-34SW	-	67	1	2p	
	1N-5E-15NE	-	46	1	20p	
	1N-5E-33NW	-	65	3	10	
	2N-6E-20NE	-	73	2	15p	
	2N-6E-27NE	-	169	1	-	
	3N-6E-27NE	-	47	5	70	
	4N-6E-9SE	-	43	20	20	
Macomb	3N-12E-13NE	-	110	-	15p	
	3N-12E-15SW	-	76	3	4p	
	4N-12E-26NE	-	71		75	
	4N-12E-27NW	-	123		100p	
	4N-13E-6NW	-	183	1	20p	
	4N-13E-10NE	-	77	2	4p	
Manistee	23N-14W-19NE	-	95	-	-	
	23N-15W-31NW	-	77	18	-	
	23N-16W-25SW	-	238		10 35p	
	23N-16W-26SE	-	59	2	10p	
Mecosta	16N-10W-10SE	-	100	4	35p	
Midland	13N-1W-1SE	-	30	-	12p	Fe 0.5, Cl 3, and Hd 160
	13N-2E-6NW	-	52	-	10p	
	13N-2W-17NW	-	80	-	6p	Fe 0.7, Cl 50, and Hd 540
	13N-2E-34SE	-	189	-	15p	
	14N-1E-36SE	-	73	-	10p	
	14N-2E-29NE	-	107	-	10p	
	14N-2W-32NW	-	70	-	-	Fe 0.7, Cl 28, and Hd 350
	15N-2W-4SE	-	48	1	10p	Fe 0.6, Cl 0, and Hd 220
	16N-1W-26SW	-	62	-	15	Fe 0.6, Cl 34, and Hd 420
	16N-1W-27NE	-	106	-	20	Fe 0.8, Cl 200, and Hd 520
Missaukee	21N-5W-2NW	-	40	-	-	
	21N-7W-7SW	-	185	-	80	
	22N-5W-34NE	-	63	-	-	
Monroe	5S-6E-2NE	680	20	8	-	
	5S-6E-30E	682	54	3	-	
Montcalm	9N-6W-12	777	16	2	1	
Montmorency	29N-3E-12NW	-	80	-	40	
	29N-4E-10SE	-	111	-	10p	
	30N-4E-25NW	-	170	-	2p	
	31N-4E-3NE	-	110	-	-	
Muskegon	9N-14W-6SE	-	169	-	40p	
	10N-13W-23SW	-	59	8	15	

Table 1.--Records of selected flowing wells in glacial drift in the Lower Peninsula of Michigan.--continued

County	Well location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Newaygo	11N-11W-7NE	-	140	-	-	
	12N-12W-22SW	-	125	-	-	
	12N-12W-27NW	-	128	-	4 17p	
	13N-14W-15NE	-	150	-	-	
Oakland	1N-9E-12NE	-	77	-	25p	Fe 2.0, Cl 68, and Hd 370
	1N-9E-17NE	-	244	-	50p	Fe 2.3, Cl 51, and Hd 260
	1N-10E-6NE	-	56	1	15p	Fe 2.3, Cl 51, and Hd 320
	3N-9E-28SW	-	47	-	15p	Fe 3.0, and Hd 205
	3N-11E-4NE	800	123	2	226p	Fe 1.1, Cl 8, and Hd 320
	3N-11E-27NE	-	134	3	10p	
Oceana	13N-15W-5NW	-	116	-	9	
	13N-18W	638	107	7	1	
	15N-17W-26SW	-	154	-	2	
Ogemaw	21N-1E-12SW	-	53	-	15p	Fe 0.2, Cl 0, and Hd 200
	21N-1E-13NE	-	36	2	-	
	21N-2E-5SW	908	59	-	-	
	22N-1E-25SE	-	62	-	5	
	22N-2E-6NE	-	61	-	60p	Fe 0.7, Cl 0, and Hd 230
	22N-2E-32SE	-	166	-	9p	Fe 2.0, and Hd 140
	22N-2E-33NE	-	102	-	10p	Fe 2.7, Cl 7, and Hd 170
	23N-2E-12NE	-	68	-	50p	Fe 0.4, Cl 2, and Hd 230
	23N-2E-35NW	-	92	-	5p	Fe 0.4, Cl 0, and Hd 180
	23N-3E-6SE	-	208	14	67	
	23N-3E-6NW	-	110	-	-	Fe 0.9, Cl 0, and Hd 180
	23N-4W-22NE	-	83	-	25	
	24N-3E-31NW	-	67	-	60p	Fe 0.5, Cl 1, and Hd 190
Osceola	17N-10W-14NE	-	110	-	10p	
	18N-7W-11NE	-	116	-	6	
	18N-8W-25SW	-	335	-	10p	
	18N-10W-20SW	-	40	-	8p	
	20N-7W-33NE	-	128	-	10	
Oscoda	25N-1E-13SE	-	75	-	15	
Ottawa	9N-13W-8	702	42	12	6	
Presque Isle	35N-2E-5SE	-	103	-	-	Fe 7.5, Cl 50 and Hd 100
	36N-2E-30NE	-	159	-	-	Fe 0.5, Cl 12, and Hd 170

Table 1.--Records of selected flowing wells in glacial drift in the Lower Peninsula of Michigan.--continued

County	Well location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Roscommon	22N-3W-2SW	-	236	3	15p	
	22N-4W-13NW	-	48	-	-	
	23N-1W-8NE	-	97	3	10p	
	23N-1W-30SW	-	38	-	30p	Fe 0.3, Cl 1, and Hd 200
	23N-4W-9NE	-	68	3	20p	
Saginaw	10N-1E-32SE	-	143	1	25p	
	12N-1E-24NW	-	50	-	12p	
St. Clair	5N-15E-13SW	-	76	-	10p	Fe 1.0, and Hd 170
	5N-16E-30SW	-	123	6	50p	Fe 1.0, and Hd 100
St. Joseph	7S-9W-19NW	-	80	-	10p	
	8S-11W-1NE	-	55	1	2	
Tuscola	10N-8E-1SW	-	82	-	11p	
	11N-10E	-	66	10	6	
Van Buren	1S-14W-3NW	-	31	7	20	
	1S-14W-19NW	-	68	6	-	
	1S-15W-25SW	-	76	5	-	
	2S-13W-29NE	-	62	-	5	
	2S-14W-32NW	-	64		-	Fe 0.0, and Hd 260
	3S-16W-14SW	-	60	12	15	
	4S-14W-29SW	-	100	F	-	Fe 0.0, and Cl 14
Washtenaw	1S-4E-12NE	-	108	4	10p	
	1S-5E-6NE	-	80	7	20p	
	2S-5E-14SE	-	52	1	20	
	2S-7E-15SE	-	95	3	15p	
	3S-3E-2NE	930	54	8	8	
	3S-6E-16NW	820	32	7	45	
	4S-3E-3SE	888	35	2	3	
Wexford	24N-11W-31NW	-	39	2	5	

Table 2.--Records of selected flowing wells in glacial drift in the Upper Peninsula of Michigan

Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride), Hd (hardness), and DS (dissolved-solids content) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Chippewa	43N-1W-13SW	635	114	8	6	
	44N-1E-11SE	585	-	-	-	
	44N-2E-6SE	582	80	-	-	
	44N-2W-6SE	685	280	-	-	Fe 0.0, and Hd 140
	44N-2W-6SW	682	285	22	1	
	44N-3W-16NW	690	120	-	-	
	45N-1E-4NW	650	30	3	-	
	46N-1E-31SW	650	78	-	1	
	46N-2W-22NE	630	410	-	-	
	46N-2W-34SE	640	235	-	-	
	46N-5W-30NE	840	185	-	1	
	46N-6W-22SW	800	47	5	2	
	47N-1W-28SW	630	197	-	-	
	47N-2W-29SW	608	50	-	-	
	47N-2W-34SE	610	88	-	-	
	47N-6W-14SE	630	43	-	-	
Delta	40N-19W-21SW	590	80	-	10	
	41N-18W-31SW	620	18	-	-	
Dickinson	39N-28W-30-4	840	27	3	5	
Houghton	52N-35W-25-1	700	168	-	25	Fe 0.7, Cl 1, and Hd 90
	55N-34W-8-1	615	146	1	10	Fe 0.2, Cl 14, and Hd 88
	56N-32W-21-1	655	140	1	1	Fe 0.01, Cl 3, and Hd 82
Luce	45N-10W-11NW	-	60	6	1	
	45N-10W-11NW	-	156	5	10	
	45N-11W-3NW	-	61	2	-	
	45N-12W-26NW	-	-	8	-	
	46N-9W-19SE	-	135	-	-	Hd 160
	46N-9W-19SW	-	38	3	-	
	46N-10W-23SE	-	160	-	-	
	46N-11W-33NW	-	40	21	350	Fe 0.18, DS 162, and Hd 160
Mackinac	43N-1W-1NE	-	88	6	-	
	43N-2W-30NW	-	140	-	-	
	43N-3W-14SW	-	210	34	-	Fe 0.05, DS 147, and Hd 140
	43N-3W-23SW	-	100	12	15	
Ontonagon	47N-38W-12-1	1,170	300	-	-	
	50N-39W-29-1	1,040	-	-	-	Fe 0.2, Cl 5, and Hd 140
	53N-37W-13-1	740	108	2	2	Fe 0.01, Cl 100, and Hd 15

Table 2.--Records of selected flowing wells in glacial drift in the Upper Peninsula of Michigan.--continued

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Head (feet)	Yield (gpm)	Remarks
Schoolcraft	41N-16W-4SE	620	154	-	3	Fe 0.3, and Hd 320
	41N-16W-8SE	620	80	2	12	
	41N-16W-17NE	620	78	10	65	Fe 0.0 and Hd 120
	41N-16W-28NE	590	88	8	20	
	43N-13W-2NW	-	13	1	-	

Table 3.--Records of selected flowing wells in the Saginaw Formation of Michigan.

Thickness: Thickness of bedrock penetrated below bottom of casing; Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride), and Hd (hardness) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Arenac	18N-4E-10	-	350	210	8	-	Drilled in 1900
	19N-4E-3	-	200	10	-	5p	
Bay	16N-4E-12	-	113	53	1	-	
Clinton	5N-3W-16	-	160	65	2	60p	
	5N-3W-21	-	150	40	4	37p	
	5N-4W-14	-	185	106	-	30	
	5N-4W-18	-	120	50	-	10	
	6N-1W-13	-	180	45	-	-	
	6N-2W-4	-	220	66	2	60p	
	6N-2W-20	-	180	47	2	-	
	6N-3W-8	-	180	90	-	-	
	7N-1W-3	-	215	50	3	30p	
	7N-4W-26	-	320	50	3	30p	Fe 0.5, pH 8.0, and Hd 290
	8N-1W-4	-	200	40	2	-	
	8N-3W-19	-	230	43	-	60p	
Eaton	1N-3W-8	-	200	100	10	-	
	1N-3W-9	-	370	197	3	15p	
	2N-3W-13	-	97	30	-	18p	
	3N-5W-24	-	311	275	-	30p	
	4N-3W-6	-	90	46	-	10	
	4N-3W-7	-	110	39	-	40p	
	4N-4W-5	-	215	25	-	60p	
Genesee	7N-5E-31	-	183	74	-	90p	
	8N-7E-21	-	200	17	-	50p	
	8N-8E-19	-	265	93	4	9p	
Gladwin	18N-1W-1	-	280	100	-	4	Drilled in 1900
	18N-1W-6	-	600	250	2	350	Fe 0.9, Cl 1.0, and Hd 460
	18N-2W-12	765	180	20	25	100	
	20N-1E-25	-	225	13	-	6	
	20N-1W-25	-	230	29	-	7	
Gratiot	9N-1W-7	-	270	170	2	2	Drilled in 1900 Fe 2.8, Cl 29, and Hd 140
	9N-1W-10	-	220	95	1	50p	
	9N-1W-35	-	230	35	-	20	
	9N-2W-19		340	45	6	-	
	9N-3W-29	-	420	80	1	80p	
Ingham	1N-1W-21		180	80	10	25	Water has hydrogen sulfide odor. Head 10 ft in 1898; 6 in 1906
	1N-1W-33	-	250	43	3	30p	
	1N-1E-35	-	215	136	2	50p	

Table 3.--Records of selected flowing wells in the Saginaw Formation of Michigan.--Continued

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Ingham (Continued)	1N-2E-12	-	185	132	1	500p	
	1N-2W-29	-	180	137	4	20p	
	3N-1E-32	-	460	411		28p	
	3N-2E-4	-	138	54	4	35p	
Ionia	6N-5W-32	-	260	10	-	-	
	7N-6W-24	-	260	10	-	10	
	7N-6W-30	-	246	21	-	50p	Fe 1.0, pH 7.0, and Hd 360
	8N-5W-24	-	275	30	2	30p	Hd 340
Jackson	1S-1W-13	920	233	183	4	-	
	1S-1W-19	-	50		3	37p	
Midland	13N-1W-9	-	195	5	-	15p	
	14N-1W-6	-	212	99	2	6p	
	14N-1E-27	-	295	55	-	6p	
	15N-2E-12	-	291	67	1	5p	Fe 0.3, Cl 150, and Hd 240
	15N-2E-20	-	338	4	4	1	
Saginaw	9N-2E-20	-	184	54	-	30p	
	10N-1E-36	-	325	15	10	8p	
	10N-4E-14	-	66	24	1	5p	
	11N-2E-31	-	285	45	2	-	
	12N-3E-26	-	555	174	6	212p	
Tuscola	10N-7E-14	-	173	23	2	11p	
	11N-7E-28	-	134	16	3	-	
	11N-8E-23A	-	112	34	-	9p	
	12N-9E-19A	-	174	9	-	12p	
	14N-8E-22	-	265	79	3	2	Reported salty at 250 feet

Table 4.--Records of selected flowing wells in the Marshall Formation of Michigan

Thickness: Thickness of bedrock penetrated below bottom of casing; Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride), Hd (hardness), and DS (dissolved-solids content) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Allegan	3N-12W-12	-	277	165	18	12p	
	4N-13W-17	-	125	60	12	35	
	4N-14W-6	-	85	13	2	25p	
Barry	3N-8W-17	-	450	90	-	500	
	4N-9W-6	-	400	90	1	-	
Calhoun	1S-7W-32	828	133	150	8	7p	Fe 0.84, Cl 5, and Hd 260
	2S-7W-7	832	100	80	5	-	Fe 0.5, DS 300, and Hd 280
Hillsdale	6S-3W-20	-	95	17	10	15p	
	6S-3W-35	-	225	25	-	5	Fe 1.0, Cl 1,100, and Hd 310
	6S-4W-34	-	108	18	15	5	
Huron	16N-11E-21	-	165	75	-	10p	Fe 0.4, DS 350, and Hd 280
	16N-13E-1	-	140	38	-	20p	
Jackson	3S-1E-30	-	78	25	1	30	Fe 0.5, DS 500, and Hd 300
	4S-1W-12	-	40	6	3	-	
	4S-2E-2	-	135	3	6	20p	
Kent	5N-11W-6	-	230	98	3	45	
	5N-12W-1	-	215	83	5	325p	
	5N-12W-14	-	132	42	4	30p	
	6N-10W-33	-	212	12	-	10	
Lapeer	6N-9E-9	-	150	50	5	-	
	6N-10E-7	-	157	69	-	10	
	7N-11E-14	-	200	37	7	-	
	8N-11E-22	-	245	33	3	10p	
	8N-11E-23	-	116	16	15	5	
	9N-12E-9	-	159	50	3	1	
Lenawee	5S-1E-15	-	46+	-	5	20p	
Livingston	1N-3E-36	-	120	20	-	30p	
	1N-4E-25	-	110	12	-	20p	
	3N-4E-22	-	120	35	10	25	
Oakland	5N-8E-4	-	175	6	2	4	
	5N-8E-5	-	106	-	10	-	
Ottawa	7N-13W-20	-	218	89	-	115p	

Table 4.--Records of selected flowing wells in the Marshall Formation of Michigan.--Continued

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Sanilac	13N-12E-	-	150	15	-	3	
Tuscola	14N-11E-36	-	250	21	-	15p	
Washtenaw	3S-3E-29	-	84	14	10	200	

Table 5.--Records of selected flowing wells in the Silurian-Devonian rock units of the Lower Peninsula of Michigan

Thickness: Thickness of bedrock penetrated below bottom of casing; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Value of Cl (chloride) is in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Monroe	7S-8E-22	-	66	51	2	15p	
	7S-8E-26	-	68	23	5	25p	
	7S-8E-29	-	81	26	5+	20p	
	7S-9E-18	-	64	38	1	10	
	7S-9E-20	-	63	8	5	25p	
	7S-9E-29	-	74	20	5	35p	
	7S-9E-35	-	55	43	5	10p	
	8S-7E-32	-	54	5	-	-	Drilled in 1900
Washtenaw	4S-7E-29	-	118	11	-	10p	
Wayne	4S-9E-17	-	475	-	-	40	Drilled about 1903 Cl 370, and pH 5.9

Table 6.--Records of selected flowing wells in the Devonian rock units of Michigan

Thickness: Thickness of bedrock penetrated below bottom of casing; Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride), and Hd (hardness) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Charlevoix	33N-8W-1	-	104	16	6	25p	
	34N-7W-30	-	135	60	4	7	
	34N-8W-27	-	103	63	10	30p	
Cheboygan	36N-3W-35	-	176	67	3	25	
	39N-3W-27	-	125	103	5	10p	
Emmet	35N-4W-35	-	206	42	8	-	
	35N-5W-31	-	93	51	15	20	
	39N-4W-22	-	180	75	1	10	
Presque Isle	33N-8E-13	-	66	19	2	5p	
	34N-7E-27	-	91	33	2	40p	
	35N-2E-7	-	61	2	-	5	Fe 0.05, Cl 100, and Hd 120
	35N-5E-8	-	121	4	2	5p	

Table 7.--Records of selected flowing wells in the Silurian rock units of the Upper Peninsula of Michigan

Thickness: Thickness of bedrock penetrated below bottom of casing; Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride); SO_4 (sulfate), and Hd (hardness) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Chippewa	42N-4E-20	-	95	72	4	3	Fe 0.0, and Hd 240
	42N-6E-18	-	47	15	-	15p	
Delta	39N-18W-7	590	233	-	18	60	Drilled in 1905
	39N-18W-17	1,940	247	-	22	-	Fe 0.80, Cl 6, and Hd 450
	39N-18W-17	593	195	-	6	25	Drilled in 1902
	39N-19W-13	-	75	60	9	25p	
	40N-18W-4	1,956	117	-	5	-	
	40N-18W-5	1,958	426	-	-	-	Cl 10, and Hd 950
Luce	45N-12W-34	-	58	-	8	-	SO_4 1,200, and Hd 1,800
Mackinac	42N-3W-3	-	108	-	8	-	
	42N-3W-9	-	125	-	-	-	Fe 0.09, Cl 3, and Hd 300
	42N-3W-10	-	135	-	23	10	
	42N-7W-10	-	60	27	2	4p	Fe 0.0, and Hd 170
	43N-9W-29	-	215	-	84	-	
	43N-10W-1	-	178	52	15	20	Fe 0.2, and Hd 340
	43N-10W-26	-	188	-	67	-	
	44N-11W-19	-	70	-	3	-	
	44N-12W-36	-	128	-	5	-	Fe 0.0, Cl 18, and Hd 1,600
Schoolcraft	41N-16W-4	-	136	16	2	15p	
	41N-16W-8	620	102	-	2	9	
	41N-16W-11	-	103	6	6	15p	
	41N-16W-11	610	250	-	-	5	Drilled in 1892. Fe trace, Cl 5, SO_4 870, and Hd 1,000
	41N-16W-12	610	220	-	-	25	Fe trace, Cl 12, and Hd 880
	42N-13W-20	640	75	-	9	8	Fe 0.0, Cl 3.0 and Hd 180
	42N-13W-30	640	87	-	6	4	
	42N-14W-25	-	80	-	3	-	
	42N-14W-35	-	123	-	1	-	
	42N-14W-36	630	88	-	10	6	Fe 1.0, Cl 4.0, and Hd 200
	42N-15W-13	-	127	122	10	10p	

Table 8.--Records of selected flowing wells in the Cambrian-Ordovician rock units of the Upper Peninsula of Michigan.

Thickness: Thickness of bedrock penetrated below bottom of casing; Altitude: Land surface datum in feet above mean sea level; Head: Static head, in feet above land surface; Yield: p is pumped rate; Remarks: Values of Fe (iron), Cl (chloride), and Hd (hardness) are in milligrams per liter.

County	Well Location	Altitude of land surface (feet)	Depth of well (feet)	Thickness of rock units (feet)	Head (feet)	Yield (gpm)	Remarks
Delta	37N-24W-27	600	286	-	3	1	Cl 11, and Hd 140
	37N-24W-34	590	350	-	40	20	Cl 7, and Hd 120
	38N-23W-16	603	709	-	21	-	Fe 0.2, Cl 36, and Hd 150
	39N-22W-29	588	753	-	22	55	Fe 0.25, Cl 16, and Hd 180
	40N-22W-10	585	312	-	23	-	Cl 1, and Hd 100
	41N-20W-20	-	263	259	1	10p	
	41N-21W-29	-	237	234	2	8p	
	42N-21W-33	650	292	-	12	-	Cl 13, and Hd 230
	42N-22W-26	770	590	-	3	-	Fe 0.97, Cl 12, and Hd 240
Menominee	32N-27W-13	585	25	-	2	-	
	34N-25W-30	590	450	400	22	3	Fe 0.18, Cl 56, and Hd 180
	35N-25W-10	-	73	4	2	15p	
	36N-24W-29	-	224	173	-	10p	

Table 9.--Summary of flowing-well data of Michigan

Yield: p is pumped rate

Geologic unit	Well depth (feet)	Maximum Head (feet)	Yield (gpm)
Glacial drift (Lower Peninsula)	16-361	41	1-226p
Glacial drift (Upper Peninsula)	13-410	34	1-350
Saginaw Formation	50-600	25	1-500p
Marshall Formation	40-450	18	1-500
Silurian and Devonian rock units	54-475	5+	10-40
Devonian	61-206	15	5-40p
Silurian rock units	47-426	84	3-60
Cambrian and Ordovician rock units	25-753	40	1-55