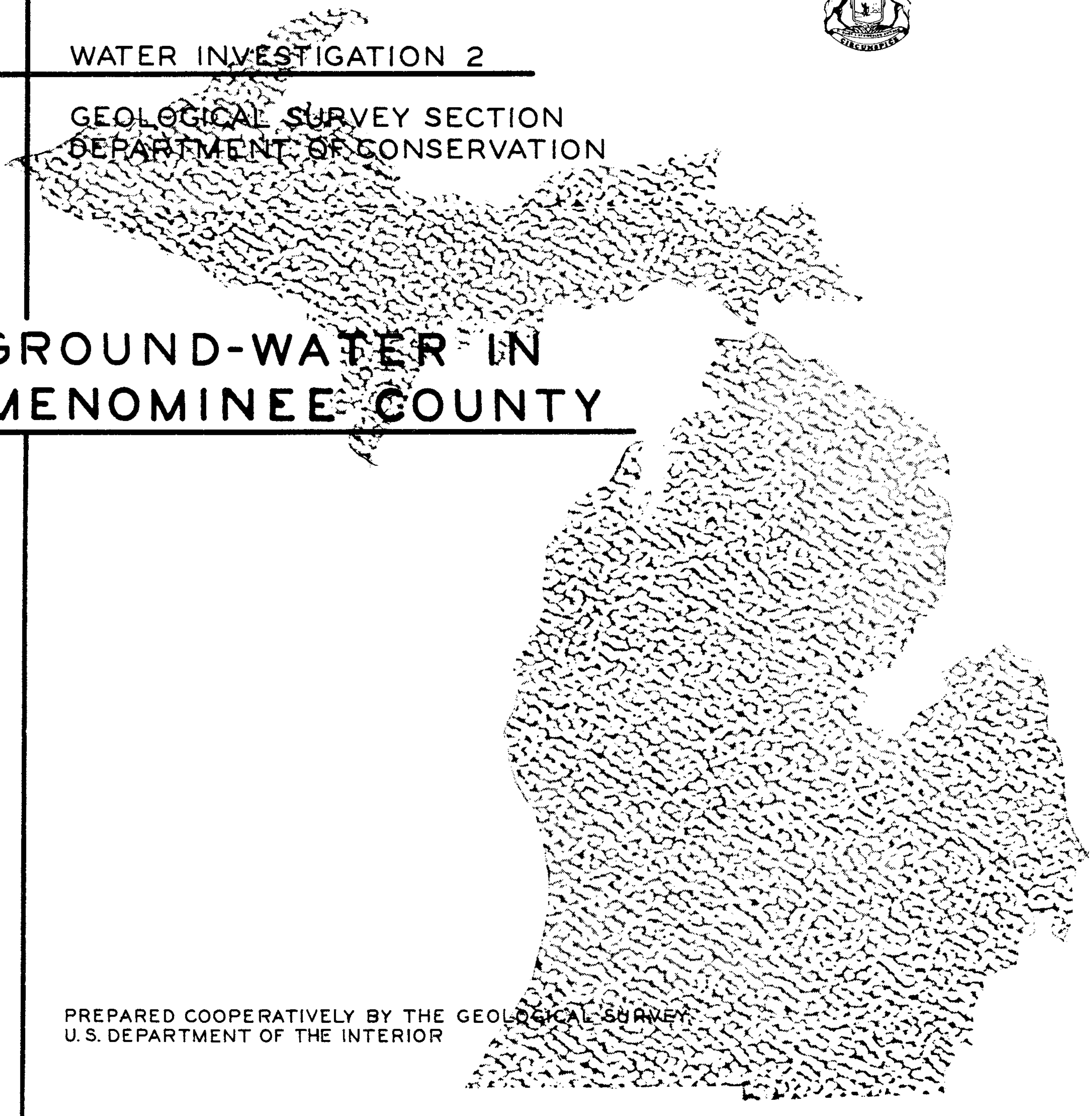
WATER INVESTIGATION 2

GEOLOGICAL SURVEY SECTION
DEPARTMENT OF CONSERVATION

GROUND-WATER IN MENOMINEE COUNTY



PREPARED COOPERATIVELY BY THE GEOLOGICAL SURVEY
U. S. DEPARTMENT OF THE INTERIOR

ACKNOWLEDGMENTS

This report would not have been possible without the cooperation of the well drillers working in Menominee County. They provided well records, well logs, water level data, quality of water information, data on well yields, and information on the depth to bedrock in various parts of the county. Special thanks are given to the Thomas Drilling Company of Peshtego, Wisconsin; Frank Kozikowski of Menominee, Michigan; C. O. Rice of Escanaba, Michigan; Loren Anderson of Wallace, Michigan; Henry Le Beau of Nadeau, Michigan; and Dick Rice of Corney, Michigan. The interest and cooperation of the many well owners in the county is also gratefully acknowledged. Thanks are also due the personnel of the various state, county, and local agencies who provided much information and valuable help.

The Michigan Geological Survey and the U. S. Geological Survey cooperate in a continuing study of the state's water resources. This report is a part of the continuing program.

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GROUND WATER IN MENOMINEE COUNTY

By

Kenneth E. Vanlier

INTRODUCTION

Most of us have read about impending water shortages, water pollution, and other water problems. Although it is true that some areas of the nation face water shortages, it is also true that many areas have ample, unused water resources. It is just as useful to provide information on the "water rich" areas of the country as it is to show that some are fast becoming "water poor".

Although Menominee County has some water problems (such as the "sulfur" odor of water from some wells), it has large undeveloped water supplies which could support a much larger economic and industrial base. The need for increased economic growth and development is demonstrated by the fact that the county has decreased slightly in population since 1940. Many people born and raised in the county have had to move to other areas to find employment.

Purpose

The purpose of this report is to provide information on the ground-water resources for those people developing water supplies for homes, farms, cottages and industries in the county. At the present time all the water users outside the City of Menominee obtain their water supplies from wells. Use of ground water in the rural areas of the county probably will continue, because adequate water supplies can be obtained from wells at reasonable cost. Increased use of water for modern home appliances, farm uses, and the increasing use of areas along lakes and rivers for cottages and resorts will result in expanded development of the ground-water resources. New industries in the county will also require additional ground-water development.

Economy and Water Development

Menominee County is in the south-central part of the Upper Peninsula (fig. 1). Menominee, (fig. 2), the largest city and the county seat, has a municipal water system supplied from Green Bay. Although the City of Menominee has some metal-fabricating industries, the economy of the county is related principally to the development and utilization of local natural resources including farming. The principal type of farming is dairy farming; however, some beef cattle are raised, and many different types of agricultural products are grown. Other industries utilizing natural resources include: production and processing of lumber and other forest

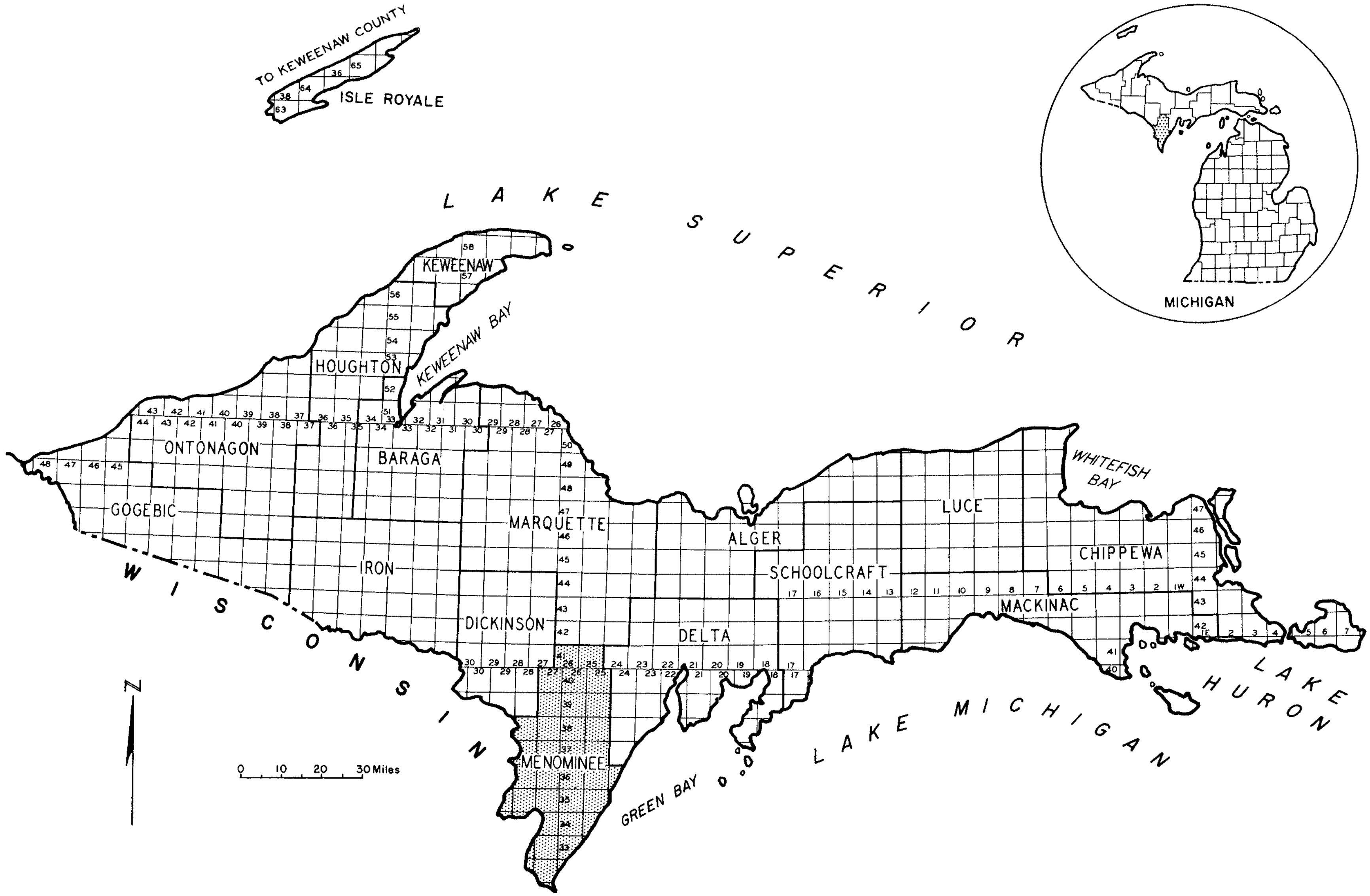


Figure 1. – Index map showing location of Menominee County, Michigan.

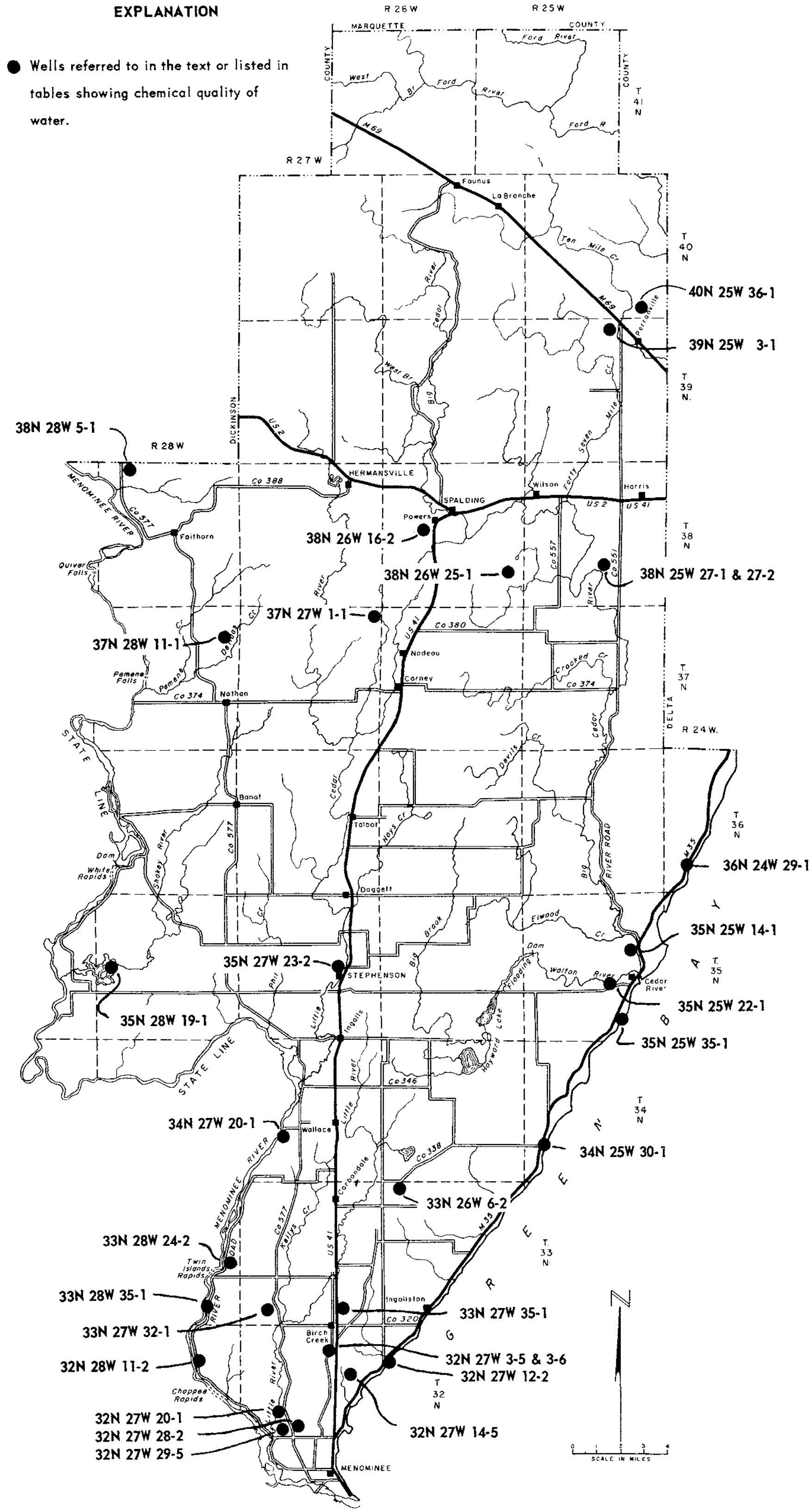


Figure 2. – Map of Menominee County showing well locations.

products, mink ranching, commercial fishing, serving the tourist trade, and providing recreational facilities. These industries, especially farming, are dependent upon wells for water supplies. It appears that economic growth in the rural areas will depend to a large extent upon continued development of local natural resources, including the water resources.

The Ground-Water Environment

Throughout history a certain amount of mysticism has been associated with underground water. This is quite natural as it cannot be seen, and we learn about it through observation of wells and springs. The occurrence and movement of underground water is controlled by natural physical laws, such as the law of gravity, and the more we learn the less mysterious it becomes.

Some materials in the earth's crust are like sponges in that they are full of small holes and channels through which ground water can move. If we can determine the depth, thickness and areal extent of these water-bearing materials, we can determine how much ground water is available. In many areas we can determine the main localities where precipitation enters the ground, and the rate at which water moves through the ground.

Earth materials that yield water to wells or springs are called aquifers. Although aquifers include many types of rock, they all contain openings through which water can move to wells or springs. There are five major aquifers or water-bearing rock units in the county (table 1). At least one of these units is present in all parts of the county. In many areas all five may be present. These water-bearing units are sources of

Table 1.--Water-bearing Rocks in Menominee County

Geologic Age	Geologic Names	Water-bearing rock units in Menominee County	Thickness (feet)	Lithology	Water-bearing characteristics
Pleistocene	Glacial drift:	GLACIAL DRIFT	0 to 200+	Most of the glacial deposits of the county are a mixture of clay, silt, sand and gravel. Locally, beds of water-bearing sand and gravel are included in the glacial deposits. The thickest, most extensive deposits of sand and gravel are along the Menominee River in the west-central part of the county.	The glacial drift deposits are a source of water to wells throughout the county. Most wells obtaining water from glacial deposits tap beds of coarse gravel. Some homes along Green Bay have shallow-driven wells which tap beds of lake-deposited sand. The glacial drift is an important source of water in the areas where the bedrocks yield "sulfur" water. Many of the wells obtaining water from the glacial drift in the "sulfur-water areas" are dug wells.
Middle Ordovician	Trenton Limestone Black River Limestone	UPPER LIMESTONES	0 to 300	Consists principally of beds of limestone and dolomite. Includes some beds of shale and shaly limestone and dolomite. In the southern part of the county the beds of shale and shaley limestone are thick and extensive.	These rocks are the source of water to most of the wells in the county. In the southern part of the county where the rocks are mantled by only a few feet of glacial drift, wells tapping the upper limestones generally are less than 40 feet deep. In the northern and central parts of the county wells tapping the upper limestones range from about 30 to about 300 feet in depth. In the southern part of the county these rocks yield water with a "sulfur" odor, especially at depths greater than 40 to 50 feet. Thus, wells in the southern part of the county generally are completed at as shallow a depth as is possible.
Early Ordovician Late Cambrian	St. Peter Sandstone Prarie du Chien Group Trempeleau Formation	MIDDLE LIMESTONES AND SANDSTONES	0 to 300	Consists of beds of limestone and dolomite, sandstone, sandy and shaley dolomite, and dolomitic sandstone. The beds of sandstone are thicker and more extensive in the northern part of the county.	Both beds of limestone and sandstone are sources of water to wells. Wells tapping these rocks range from about 30 to about 200 feet in depth. Most wells, however, are less than 100 feet deep. Yields water of good quality in parts of the area where upper limestones yield "sulfur" water. Locally, these sandstones and limestones may yield sulfur water.
Cambrian	Franconia Sandstone Dresback Sandstone	LOWER SANDSTONES	50 to 200	Consists of beds of pink, gray, and white sandstone. Some of the beds of sandstones contain large quantities of glauconite, a green mineral.	A source of water for domestic and farm needs in the areas where they are mantled directly by glacial drift. Where these rocks are covered by the middle limestones and sandstones and upper limestones they will yield 200 to 300 gpm to properly constructed deep wells.
Middle Precambrian Early Precambrian	Michigamme Slate Vulcan Iron Formation Randville Dolomite Quinnesec Formation	PRECAMBRIAN ROCKS	extend to great depth	Where the Precambrian rocks crop out in the western part of the county, they consist principally of dark gray-green schist, commonly called "green" stone. Wells at Powers penetrated several hundred feet of Randville Dolomite. Wells that were drilled to the Precambrian at Shakey Lakes Park and Stephenson penetrated pink granite.	These rocks are the source of water to a few wells in the west central part of the county where they crop out at the surface or are mantled directly by deposits of glacial drift. The permeability of these rocks results principally from jointing (fractures).

water for domestic and farm needs and locally could yield as much as 300 gallons per minute (gpm) to large-capacity wells. The large-capacity wells generally are deep and often tap more than one water-bearing unit.

Water Quality

All natural waters, including rain and snow, contain a small amount of dissolved mineral matter. When rain or melting snow run over the ground or seep into the earth, they come into contact with and dissolve other minerals. Thus, all ground water and water in streams and lakes contain mineral matter dissolved from the surrounding soils and rock. The types and amount of mineral matter in the water depends on the types of rock and soil in the locality. The chief constituents in most of the waters of Menominee County are salts of calcium and magnesium dissolved from limestone and dolomite the principal rock types in the areas. The waters also contain iron, manganese, and sodium, and some waters contain hydrogen sulfide.

Calcium and magnesium cause water to be hard. Iron and manganese in excess of 0.3 ppm cause staining of plumbing fixtures and laundry. Chlorides in excess of 250 ppm give water a salty taste and corrode plumbing systems, and sulfates in excess of 250 ppm may produce a laxative effect. Hydrogen sulfide gives water a "sulfur" or rotten egg odor.

Nearly all of the wells that produce water containing excessive amounts of chloride, sulfate, or hydrogen sulfide are in the southern part of the county. The area of high chloride and sulfate water extends southward into Wisconsin.

Some of the ground waters in Menominee County contain objectionable concentrations of nitrate. The presence of excessive nitrates in water commonly indicates pollution from agricultural and human wastes. For instance, wells in barnyards may yield water containing nitrates.

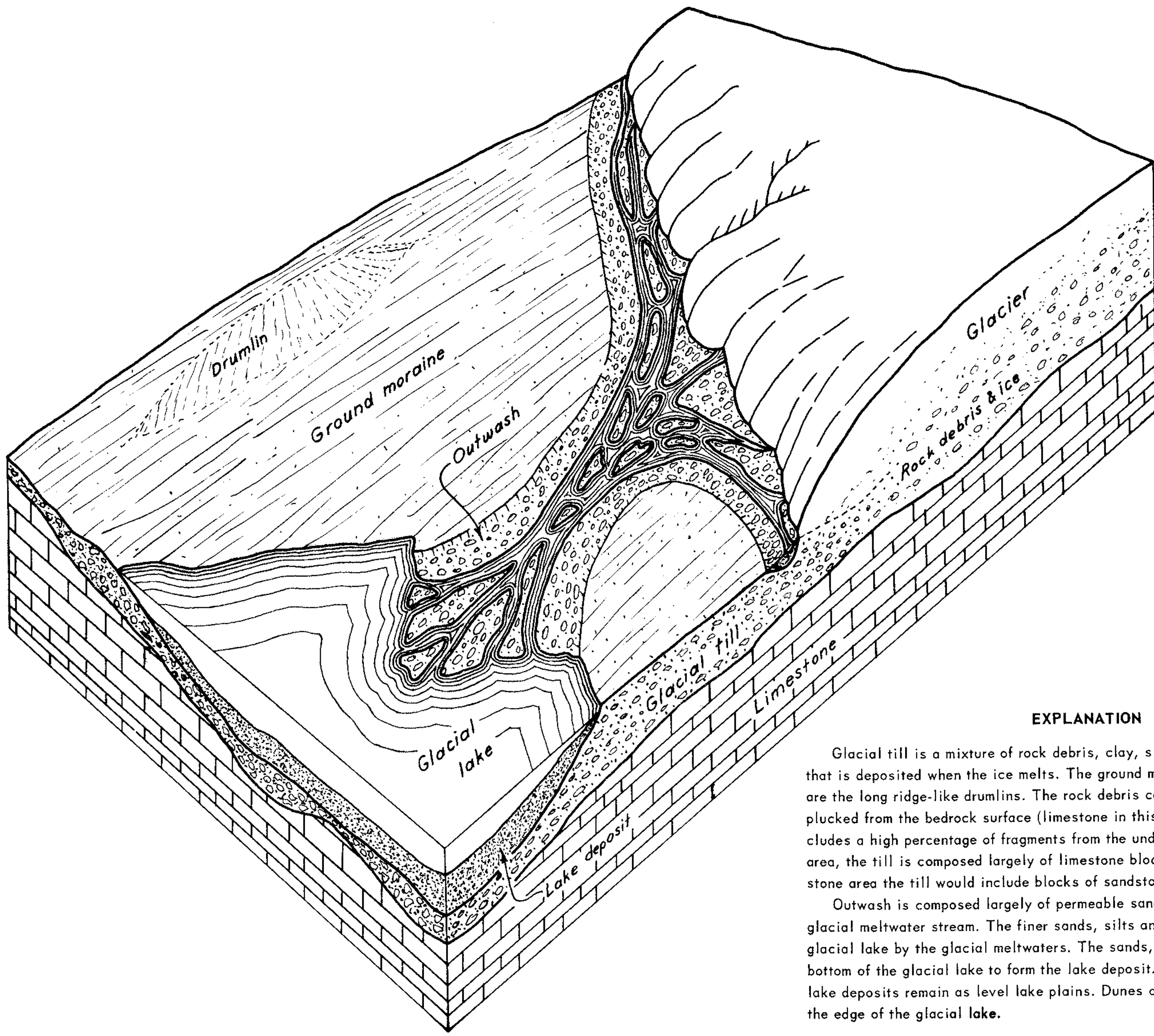
GROUND WATER RESERVOIRS

Glacial Aquifers

The uppermost earth materials over nearly all the county were deposited by glaciers which pushed across the county many thousands of years ago. Most of the surface features --- the hills, valleys, lakes, and streams --- were formed as a result of glacial activity. The most spectacular of the glacial features are the long northeast-southwest trending ridge-like hills called "drumlins". Most of the county is a large drumlin "field". The long axis or direction of the drumlins is parallel to the direction that the glacier moved as it pushed across the county.

Glacial materials can be separated into three broad groups: till, outwash, and lake-deposited sediments. Till is a mixture of clay, silt, and sand and gravel, including boulders, which was deposited directly by the glacier. Outwash is material that was washed out of the glacier by streams flowing from the melting ice and snow. Figure 3 illustrates the way these types of glacial material were deposited.

Many wells in the county obtain water from glacial aquifers. These wells are for the most part either drilled, cased, open-end wells which obtain water from beds of coarse gravel, or shallow-driven wells equipped with screened sandpoints. Very few of the drilled wells are equipped with well screens. Most of the water from the glacial drift ranges from hard to very hard and some contains objectionable amounts of iron.



EXPLANATION

Glacial till is a mixture of rock debris, clay, silt, sand, gravel, and boulders that is deposited when the ice melts. The ground moraines are underlain by till as are the long ridge-like drumlins. The rock debris carried by the glacier is torn and plucked from the bedrock surface (limestone in this sketch). The till therefore includes a high percentage of fragments from the underlying bedrock. In a limestone area, the till is composed largely of limestone blocks and fragments. In a sandstone area the till would include blocks of sandstone and would be sandy.

Outwash is composed largely of permeable sand and gravel deposited by the glacial meltwater stream. The finer sands, silts and clays are carried into the glacial lake by the glacial meltwaters. The sands, silts, and clay sink to the bottom of the glacial lake to form the lake deposit. When the lake recedes the lake deposits remain as level lake plains. Dunes and beaches sometimes form at the edge of the glacial lake.

Figure 3. – Diagrammatic sketch showing mode of deposition of glacial sediments.

A well topping glacial drift near Faithorn (38N 28W 5-1), see table below, produced water containing an excessive amount of nitrate in the spring of 1963. Nitrate commonly indicates pollution or contamination. The sample of water taken from the same well in August, 1963 had a much lower nitrate content, indicating that the contamination problem was temporary or seasonal. Additional data is needed to determine the actual source of pollution.

Chemical analysis of water samples from the glacial drift

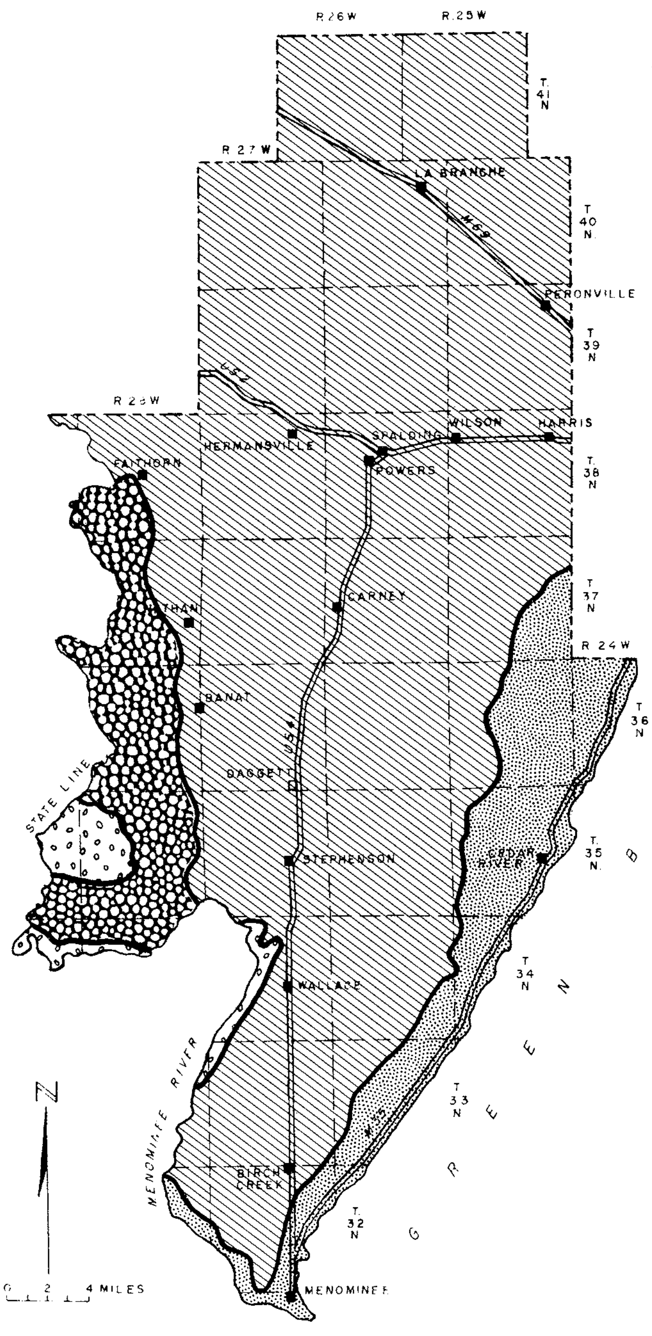
(analyses by the U. S. Geological Survey except for 38N 28W 5-1 by the Michigan Department of Health)

Well Number	Date collected	Chemical constituents (parts per million)											Specific conductance (micromhos at 25°C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCo_3$		
38N 28W 5-1	4- 5-63	.48	94	39	36	1.2	408	41	17	97	533	395	846	7.9
38N 28W 5-1	8-15-63	.1	--	--	--	---	---	--	15	19	---	390	---	---
25N 25W 14-1	6-21-62	.27	35	26	52	4.5	160	89	64	--	372	195	640	8.1
33N 28W 35-1	5- 8-62	.02	34	26	4.6	1.3	230	12	0	--	214	192	373	7.9
33N 26W 6-2	4- 4-63	.04	64	23	2.4	1.4	262	16	8.0	--	266	254	459	8.4

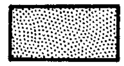
The county has four distinct types of glacial deposits which occur principally in four main areas (fig. 4). The availability of water from the glacial deposits varies considerably in these areas.

Area of Drumlins and Ground Moraine

The area of drumlins and ground moraine includes (fig. 4) more than three-fourths of the county. The glacial deposits in this area are composed principally of a mixture of clay, silt, sand, and gravel. These

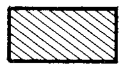


EXPLANATION



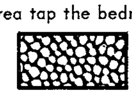
Area of shallow lake deposited sand and clay.

Most of the surficial deposits in this area are of sand. Locally, however, they are of clay and in many places clay underlies the lake sand at shallow depth. Generally, the water table is at or near the surface throughout this area. Locally, especially along the shore of Green Bay, beds of sand provide adequate water for household needs to shallow-driven wells. In some places, beds of gravel are present at the base of the lake-deposited sand and clay. These gravel beds are tapped by a few drilled wells. Most wells in this area, however, tap the bedrock aquifers.



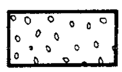
Area of till plains, drumlins and shallow outwash.

The glacial deposits in this area are composed principally of clay till. This till generally is not a source of water to drilled wells, although it will provide supplies adequate for farm or household needs to dug wells. Locally, within this area some drilled wells obtain water from beds of gravel which occur just above bedrock. This area includes some thin beds of surficial sand and gravel outwash which would yield water to wells. Most of this shallow outwash, however, occurs in swamp and marshland areas. Most wells in this area tap the bedrock aquifers.



Area of the Marenisco Moraine

The till of this area is very sandy. It includes beds of sand and gravel that are sources of water to wells supplying household and farm needs. Locally, the till may include beds of sand and gravel that would yield 100 to 200 gpm to properly constructed large diameter wells.



Principal areas of outwash

Outwash is composed of permeable sand and gravel. These deposits are sources of water to some wells supplying household and other needs demanding a few gpm. Locally, these deposits may yield several hundred gpm to properly constructed, large diameter screened wells. Wells completed in these deposits at the present time, 1962, are either driven wells equipped with sand points or are drilled wells with natural gravel screens.

Figure 4. – Map showing general types of surficial glacial deposits and general availability of water from glacial aquifers.

deposits generally are less than 40 feet thick, although they are more than 100 feet thick under some of the larger drumlins. This area also includes several dozen places of bedrock outcrop where the glacial deposits are absent. The glacial deposits are only a few feet thick in the vicinity of the areas of bedrock outcrop.

Most of the wells in the area of drumlins and ground moraine obtain water from the bedrock aquifers. The glacial drift deposits, however, are tapped by some wells, especially in the southern part of the county where the bedrock aquifers yield "sulfur" water. Wells tapping the drift in this area are of two types: large-diameter, shallow-dug wells; and drilled, cased wells completed in coarse gravel.

The glacial deposits in the northern part of the drumlin and ground moraine area tend to be more sandy than the deposits in the southern and central parts of the area. In some places in the northern part of the drumlin area the drift deposits may yield as much as 50 gpm to properly-constructed screened wells.

Areas of Glacial Lake Deposits

The flat, low-lying swampy area along Green Bay is underlain by lake-deposited clay, silt, and sand (fig. 4). These sediments were deposited in the ancient glacial lake that was a larger ancestor to the present Lake Michigan and Green Bay. The lake deposits generally form only a thin layer over deposits of glacial till, and hence in most places they are not an important source of water. Locally, along the shore of Green Bay, however, beds of lake-deposited sand are sources of water to shallow, small diameter, driven wells, and some drilled wells obtain water from beds of gravel underlying the lake deposits. Most wells in the area of lake deposits, however, obtain water from the bedrock aquifers.

Area of the Marenisco Moraine

The glacial deposits in the area of the Marenisco moraine in the western part of the county (fig. 4) are much thicker and more sandy than the glacial deposits in the central and southern parts of the county. As the soils in this area are not the best for agricultural purposes, the area has not been extensively developed into farmland and relatively few wells have been drilled.

The glacial deposits are potentially an important source of water and would yield adequate water for household needs throughout most of the area. Locally, thick and extensive beds of water-bearing sand and gravel may be included in the glacial drift in this area. Properly-constructed wells tapping such beds of sand and gravel would yield 100 to 200 gpm.

Areas of Outwash

Several areas along the Menominee River are underlain by deposits of sand and gravel outwash (fig. 4). A few wells obtain water from the outwash deposits in these areas to supply household and other needs demanding only a few gpm. Most of the wells tapping these deposits are shallow-driven wells or drilled-cased wells completed with the open end of the casing in coarse gravel to form a natural gravel screen. Locally, the deposits are thick enough to supply several hundred gallons per minute to properly-constructed wells equipped with well screens.

Bedrock Aquifers

If you have a well in Menominee County, the chances are about 10 to 1 that it is completed in one of the bedrock aquifers of the county. This is not that the bedrock aquifers yield a better quality of water, or that drillers prefer to complete wells in the bedrock, but simply that in most areas the bedrock aquifers are the only dependable sources of water to wells.

The bedrock aquifers consist of several rock types, of which the most predominant are limestone and sandstone. The term limestone as used here includes dolomite because most water well drillers do not distinguish between the two rock types. Beds of limestone and sandstone are present over all the county except for an area in the western part where Precambrian granites, schist and other types of crystalline rocks predominate.

The beds of limestone and sandstone dip gently towards Green Bay (fig. 5). They rest upon a variety of Precambrian rocks. The surface of the Precambrian rocks is more than 900 feet above sea level where the Precambrian crops out in the area along the Menominee River and is more than 100 feet below sea level along Green Bay (fig. 10).

Water is contained principally in openings along fractures in the bedrock aquifers, but also moves between the grains of sand in beds of sandstone. A permeable zone in a bedrock aquifer may be quite extensive so that nearly all the wells in an area are completed at about the same depth. Locally, however, it is necessary to drill some wells much deeper than other nearby wells.

The bedrocks of the county can be separated into four distinct water-bearing units (fig. 6, table 1). Some wells obtain water from more than one of these water-bearing units.

Upper Limestones

The uppermost bedrock aquifer in the eastern part of the county is composed principally of limestone. As these limestones overlie the other bedrock aquifers they are herein referred to as the upper limestones.

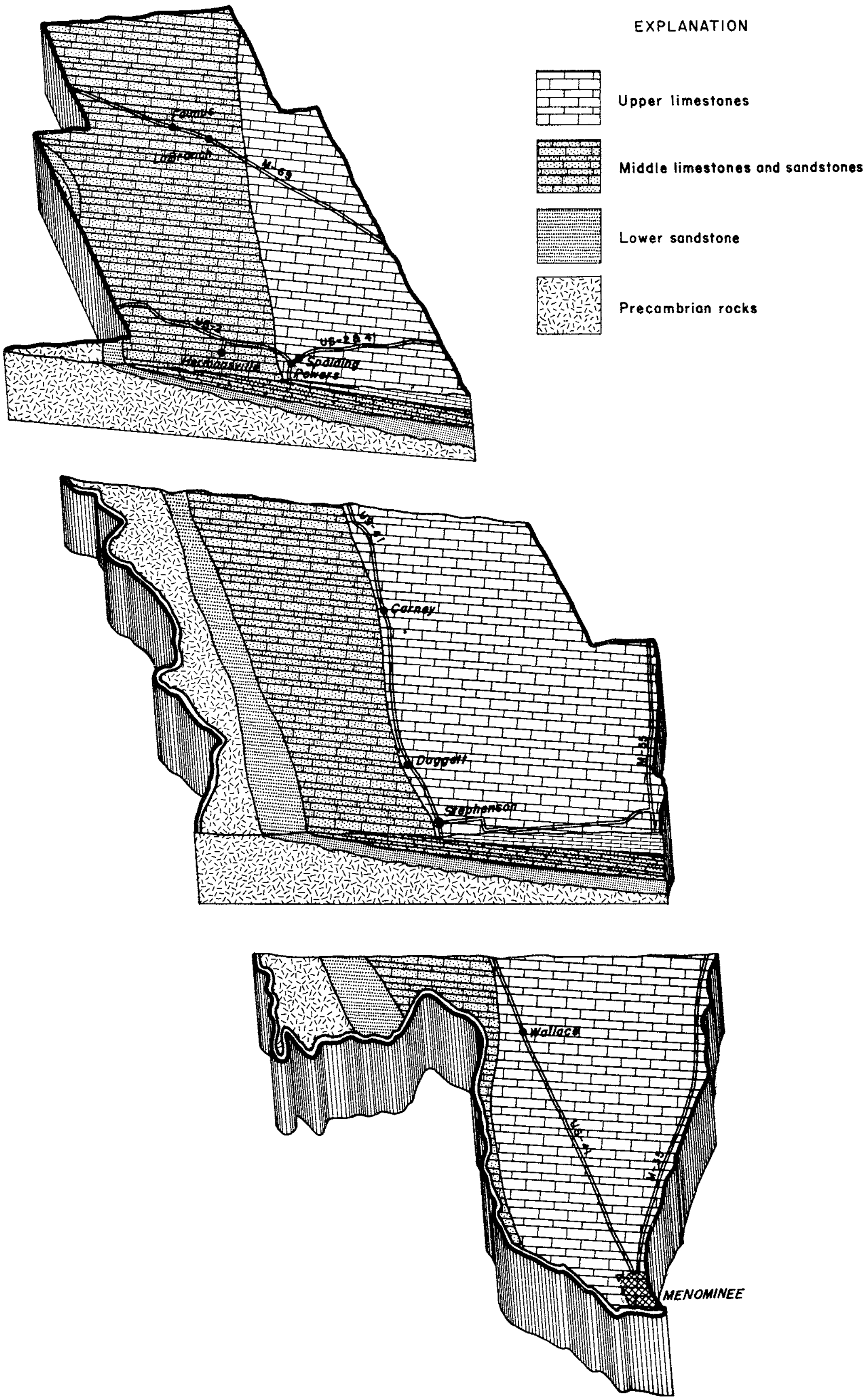
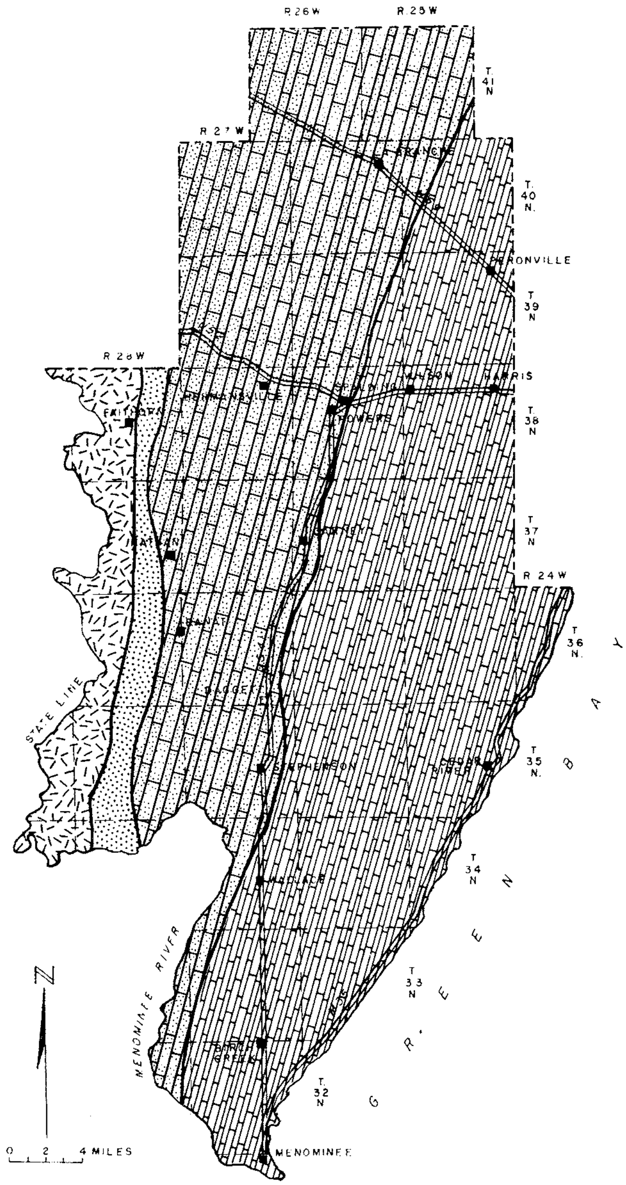


Figure 5. – Schematic split block diagram showing bedrock geology and structure of Menominee County.



EXPLANATION

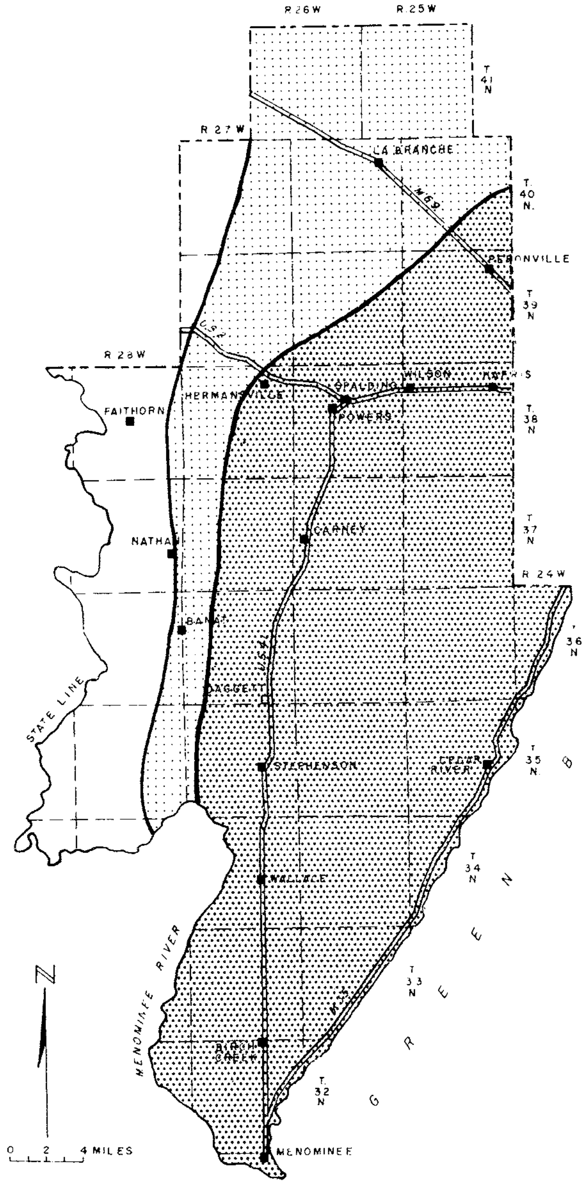
Area where the upper limestones are the chief source.

Area where the middle limestones and sandstones are the chief source.

In this area the lower sandstones are a source of small supplies of water. Most wells in this area tap glacial aquifers.

Locally within this area the Precambrian rocks will yield small supplies of water. Most wells in this area tap glacial aquifers.

a. Sources of small supplies of water for household, farm and other needs requiring 5 to 10 gpm.



EXPLANATION

The lower sandstones will yield from 50 to 100 gpm to individual wells throughout most of this area.

The lower sandstones will yield from 100 to 300 gpm to individual wells throughout most of this area.

b. Chief source of moderate to large supplies of water (50 to 300 gpm).

Figure 6. – Map showing source and availability of water from bedrock aquifers.

The upper limestones are the principal source of water for household use and other needs demanding a few gpm in more than half the county (fig. 6). These rocks are thickest along Green Bay, become thinner, and pinch out to the west. They include some beds of shale and shaly limestone. Apparently the beds of shale are thicker and more extensive in the southern part of the county than in the northern part.

In several dozen places in the county, the upper limestones are at the surface or buried by only a few feet of glacial material. Generally, however, they are covered by 20 feet or more of glacial debris. Under some of the larger hills the limestones are covered by more than 100 feet of glacial material (see "glacial aquifers" above).

Nearly all the wells tapping the upper limestones provide water for household or farm use or supply other needs where a maximum of 5 to 10 gpm (gallons per minute) is needed. In a few localities wells in the upper limestones might yield as much as 100 gpm.

Because so much of the county is underlain by the upper limestone aquifers, it would seem that in these areas there are no problems in obtaining adequate water for household or farm needs. The principal water problem in the area of upper limestones, however, is that locally the water has an obnoxious "sulfur" odor.

Many of the wells tapping the upper limestones in the southern part of the county produce "sulfur" water --- water containing hydrogen sulfide gas (fig. 7). The "sulfur" water has an odor --- somewhat similar to the odor of rotten eggs --- and in general wells yielding "sulfur" water are not altogether satisfactory sources of water supply. The amount of sulfur gas in the water can be reduced by some types of home water-

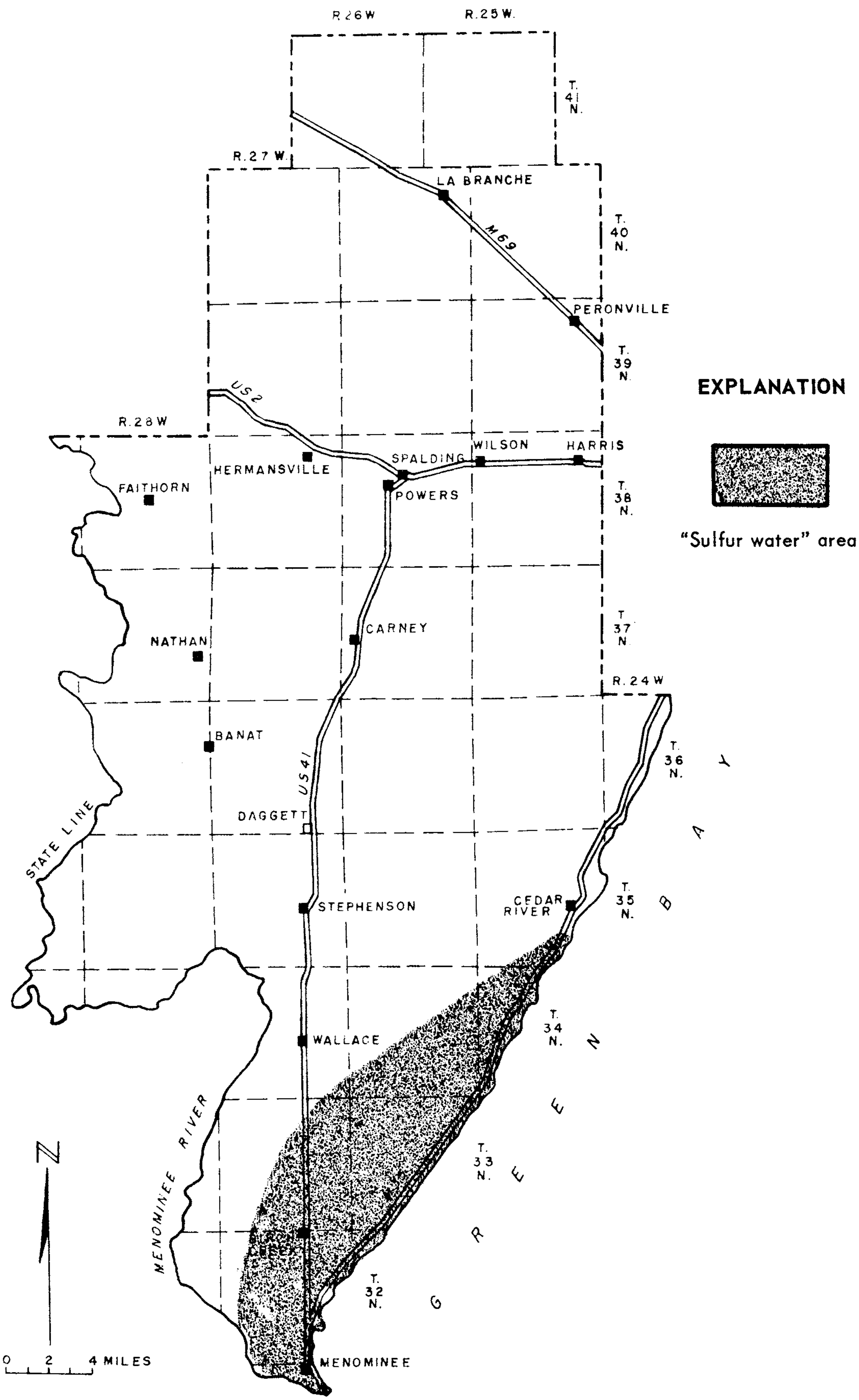


Figure 7. — Area where some wells yield sulfur water.

treatment equipment or by aeration (exposing to the air) prior to use. The shallower beds of limestone tend to be free from the "sulfur" gas. Thus, within the area where wells yield sulfur water, well drillers try to complete wells as shallow as possible. In some places, however, even the shallow limestone beds contain "sulfur" water.

Outside of the sulfur water areas water from the upper limestones is of fairly good chemical quality. It is hard and locally contains enough dissolved iron to cause staining, but otherwise is satisfactory for most uses (see table below). The objectionable concentrations of hardness and iron can be reduced by commonly-used home-treatment equipment.

Locally, where the beds of limestone are at the surface or at shallow depth, they are subject to contamination from barnyard wastes, septic tank effluents and other wastes disposed of on the surface.

Chemical analyses of water samples from the upper limestones
(analyses by the U. S. Geological Survey)

Well number	Date collected	Chemical constituents (parts per million)											Specific conductance (micromhos at 25° C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Dissolved solids	Hardness as $CaCo_3$		
40N 25W 36-1	4- 5-63	1.3	67	23	6.5	3.7	294	33	8.0	---	280	262	507	7.3
39N 25W 3-1	4-15-63	.85	82	21	3.4	1.7	330	24	5.0	---	303	291	535	7.2
38N 25W 27-1	4-15-63	.33	94	30	8.3	7.4	338	47	36	---	430	358	710	7.1
38N 25W 27-2	4-15-63	.07	119	22	3.8	1.3	412	30	14	---	441	388	723	7.0
36N 24W 29-1	4- 5-63	----	26	14	31	2.9	174	24	10	---	209	123	568	8.0
35N 25W 22-1	8-16-63	----	39	22	45	10	226	62	30	2.9	337	188	566	7.3
35N 25W 22-1	6- 9-62	.01	45	30	42	28	240	65	38	---	422	236	704	8.6
35N 25W 35-1	4- 4-63	.48	50	24	8.4	1.9	280	9.6	8.0	---	266	224	442	7.4
33N 27W 35-1	4- 5-63	.10	67	31	7.8	3.4	254	69	31	---	350	295	582	7.6
32N 27W 12-2	5- 5-62	.55	39	23	7.2	1.6	236	6.0	6.0	---	237	192	382	7.9
32N 27W 14-5	6-21-62	.39	48	34	4.4	1.0	248	29	6.0	---	284	260	480	8.6

Middle Limestones and Sandstones

Beds of limestone and sandstone that underlie the upper limestones are an important water-bearing unit in Menominee County. As these beds are overlain by the upper limestones and are underlain by a lower sandstone unit, they are referred to herein as the "middle limestones and sandstones".

The middle limestones and sandstones include several geologic formations (table 1). Locally the unit includes several beds of sandstone (see log of well 34N 25W 30-1, table 3); in other areas it is composed principally of limestone. Well drillers report that this middle bedrock unit includes some beds of shale or "soapstone". (Some well drillers use the term "soapstone" for shale or shaly limestone and dolomite.) The greatest thicknesses of shale have been reported in wells in the southern part of the county.

Both the limestone beds and the sandstone beds of this unit yield water to wells, as some wells reportedly produce water from a bed of sandstone and others from limestone. Undoubtedly, most wells obtain some water from both sandstone and limestone if both rock types are penetrated.

Most wells tapping the middle limestones and sandstones are in the west-central part of the county where these rocks crop out at the surface or are mantled directly by glacial drift (fig. 8). Wells in this area range from about 30 to 200 feet and average about 76 feet in depth. In general, wells obtaining water from this unit yield only 5 to 10 gpm. Some wells, however, probably would yield as much as 50 gpm if they were equipped with larger-capacity pumps.

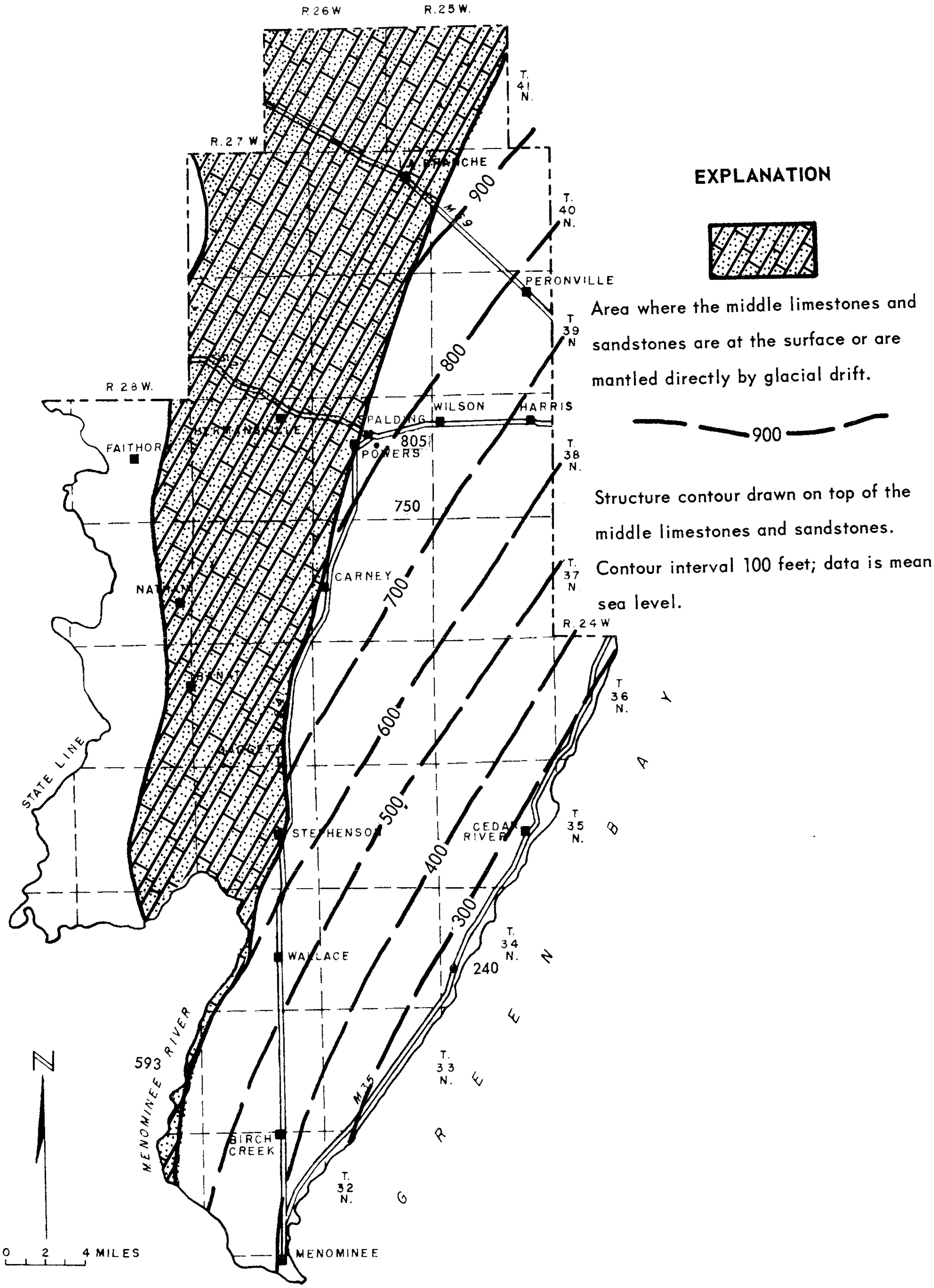


Figure 8. – Structure-contour map showing extent of the middle limestones and sandstones.

The middle limestones and sandstones are also a source of water in the area where they are overlain by the upper limestones. In this area they are tapped by only a few wells. The wells drilled through the upper limestones into the middle limestones and sandstones are in the area where the upper limestones yield sulfur water (fig. 7). Well 34N 25W 30-1 (table 2 and 3) penetrates about 300 feet of upper limestone and 450 feet of the middle limestones and sandstones. The upper limestones yielded "salt and sulfur" water to this well; the middle limestones and sandstones, however, yield good water.

Most wells tapping this unit yield water of good quality although it is hard and locally contains objectionable amounts of iron. The hardness and the iron content can be reduced to satisfactory levels by commonly-used types of home water-treatment equipment. The following table lists analysis of water from wells tapping the middle limestones and sandstones.

Chemical analyses of water samples from middle limestones and sandstones
(analyses by the U. S. Geological Survey)

Well number	Date collected	Chemical constituents (parts per million)										Specific conductance (micromhos at 25°C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids	Hardness as $CaCo_3$		
38N 26W 25-1	5- 8-62	0.10	59	25	2.2	2.5	288	18	1.5	260	250	473	7.8
37N 27W 1-1	5- 7-62	.93	57	33	3.8	2.2	288	42	7.0	309	278	524	8.1
34N 27W 20-1	4- 4-63	.59	40	21	6.3	3.6	238	12	10	187	187	370	7.6
34N 25W 30-1	4- 4-63	.18	41	19	43	4.4	152	80	56	230	180	561	7.5
33N 28W 24-2	4- 4-63		47	25	6.4	2.0	250	24	4	231	220	425	7.6
32N 28W 11-2	4- 5-63	.92	48	23	3.8	3.0	254	16	5.0	223	215	410	7.7
32N 27W 3-5	6-30-60	5.6	374	87	235	18	110	1390	172	2480	1290	2870	6.8

Wells 32N 27W 3-5, 20-1, 28-2, and 29-5 (tables 2 and 2) produced "sulfur" water from the middle limestones and sandstones in the area where the overlying upper limestones also yield sulfur water. The occurrence and areal distribution of sulfur water in the middle limestones and sandstones is not known. It probably is somewhat smaller than the area where the upper limestones yield sulfur water (fig. 7).

The source of the "sulfur" (hydrogen sulfide gas) in the aquifers of the county also is not fully understood. Well 32N 27W 3-5 taps a bed of sandstone containing a large percentage of pyrite (fool's gold), a mineral composed of iron and sulfur. Chemical reduction of the pyrite could result in "sulfur" gas. The water from well 32N 27W 3-5 also contains excessive amounts of sulfate and chloride (see table above). The origin and occurrence of high sulfate and chloride concentrations in ground water in the southern part of the county are discussed in the following section.

Lower Sandstones

A series of sandstone formations which lie below the middle limestones and sandstones is an important source of water to wells in Menominee County. The sandstones dip gently toward Green Bay below the middle limestones and sandstones (fig. 5). The "lower" sandstones are also an important aquifer in the eastern part of the Upper Peninsula and in the eastern part of Wisconsin. The sandstones generally range from about 50 to 200 feet in thickness. However, they are more than 200 feet thick in the southern part of the county and less than 50 feet thick in some areas in the northern part of the county.

The lower sandstones are tapped by a few wells near the west boundary of the county, where they are mantled directly by glacial drift (fig. 9), and by several deep wells in the area where they are overlain by other bedrock aquifers. In general the sandstones are not an important source of water to wells supplying household needs, as in most areas they are overlain by shallower, more accessible aquifers. The aquifer is, however, an important source of water to wells supplying municipal and industrial needs. The village of Stephenson, the White House Milk Company at Stephenson, and the Pinecrest Sanatorium at Powers have deep wells that tap the lower sandstone. Each of these wells yields more than 200 gpm of water of good quality.

In the southern part of the county the lower sandstones may yield water of poor quality. Water sampled from well 32N 27W 3-6, which taps the lower sandstone, produced excessively hard water containing more than 1400 ppm of sulfate (see table below). This well is less than two miles from well 33N 27W 32-1 which produces water containing only 38 ppm of sulfate. Wells tapping the lower sandstones in adjacent parts of Wisconsin, however, also produce water with excessive concentrations of sulfate. Other areas of high sulfate and chloride are present to the south in Wisconsin and to the north in Delta County, Michigan. Additional data are needed to accurately define areas in Menominee County where the lower sandstones contain water of poor quality.

The lower sandstone unit has considerable potential as a source of moderate to large supplies of water for municipal and industrial use over one-half of the county and, thus, is one of the most important aquifers in

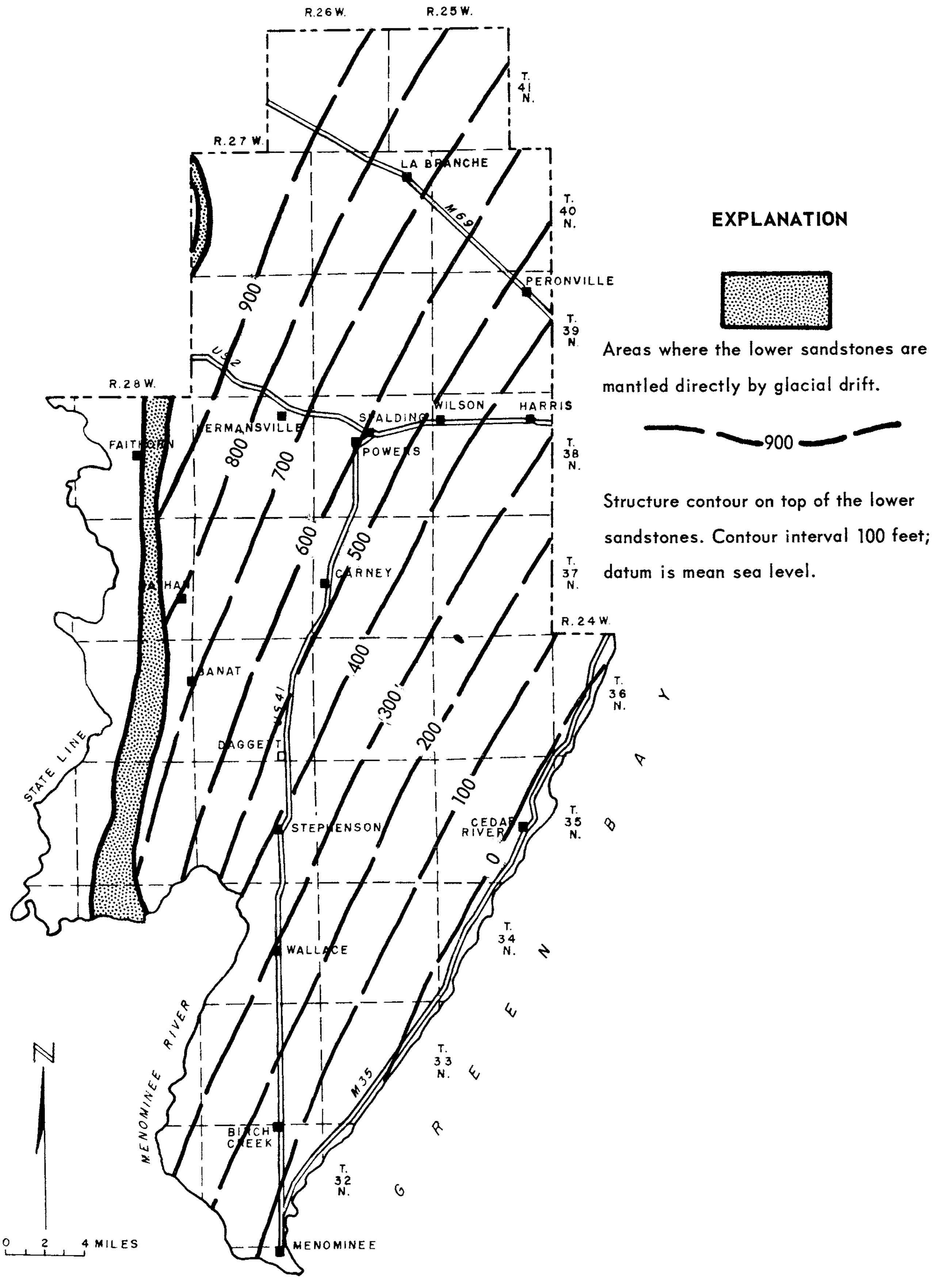


Figure 9. – Structure-contour map showing extent of the lower sandstones.

Chemical analyses of water samples from lower sandstones
(analyses by the U. S. Geological Survey except as noted)

Well number	Date collected	Chemical constituents (parts per million)										Specific conductance (micromhos at 25° C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids	Hardness as $CaCo_3$		
38N 26W 16-2	4- 8-63	0.62	52	22	9.4	4.2	280	16	1.0	235	220	441	7.3
37N 28W 11-1	4- 5-63	.33	88	37	3.4	1.4	306	97	27	460	372	681	7.7
35N 27W 23-2[2]	12- 9-52		64	22	6.3	9	288	14	9	272	250	530	7.6
33N 27W 32-1	4- 5-63	18	55	16	21	3.8	242	38	18	277	203	468	8.0
32N 27W 3-6[2]	1956								96		1675		
32N 27W 3-6[2]	3- 3-60		260	73	299		290	1410	95		950		
32N 27W 3-6[2]	3- 3-60		280	97	267		230	1450	110		1100		

[2] Analyses by the Michigan Department of Health

the county (fig. 6). Although an individual well tapping this aquifer may yield as much as 300 gpm, interference between wells would decrease individual well yields if several wells are drilled in the same locality. Interference between wells decreases with increasing distance between wells.

Precambrian Rocks

The lowest and deepest aquifer in the county is composed of very ancient crystalline, metamorphic and sedimentary rocks, such as granite, schist, marble and iron formation. These Precambrian rocks are sometimes referred to as the "basement" rocks as they are under all of the other rock formations in the county (fig. 6).

The Precambrian rocks are not an important source of water except in the western part of the county where they crop out at the surface or are mantled directly by glacial drift (fig. 10). In this area they are the only source of water if the glacial drift is not present or does not yield water.

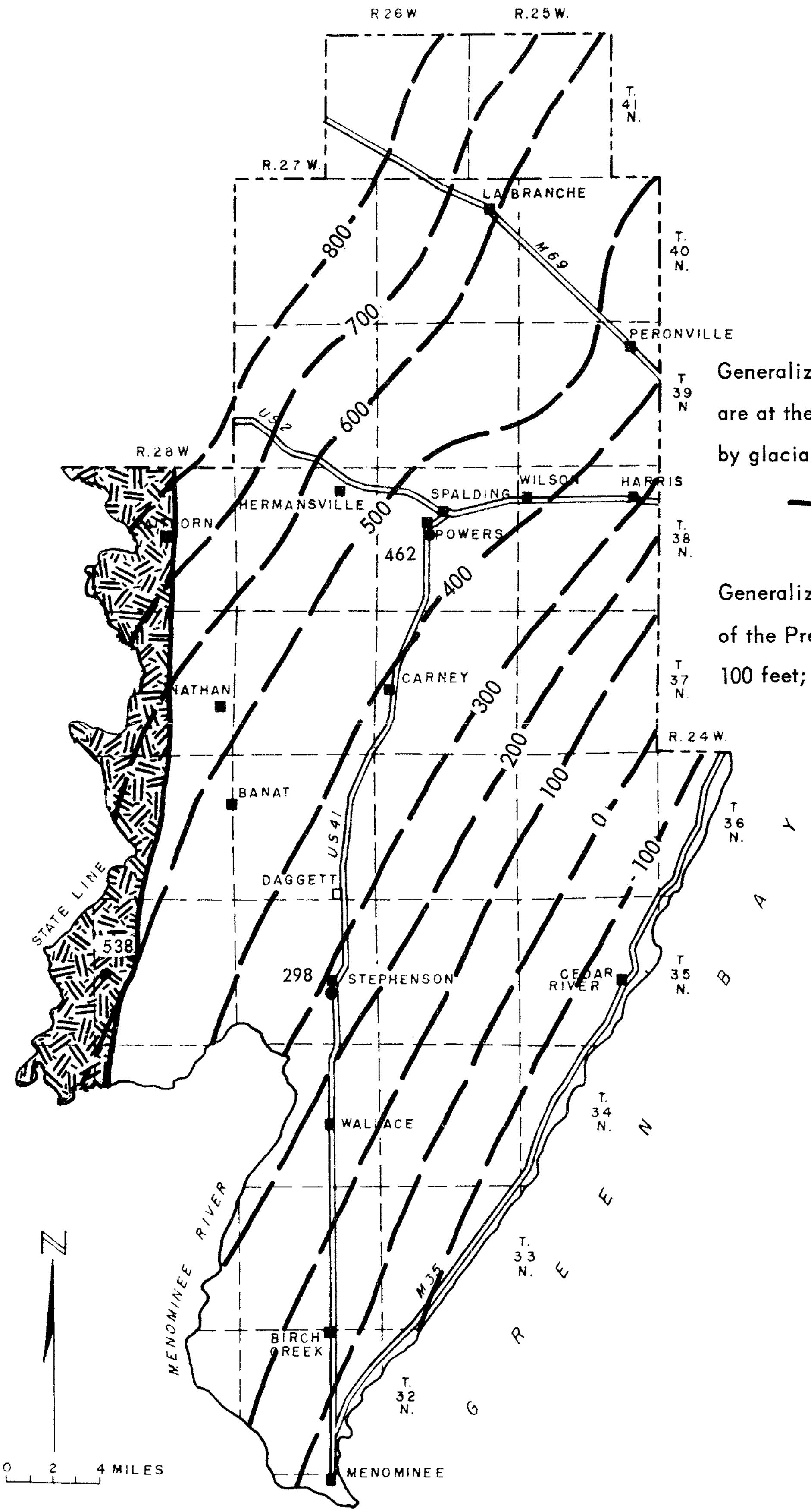
Ground water is contained principally in the openings along the fractures (cracks) in the Precambrian rocks. These rocks are more fractured and broken near the surface than they are at depth. The weight of the overlying rocks tends to squeeze the openings together and in most areas these rocks probably do not yield water at depths of more than 200 to 300 feet.

Well 38N 26W 16-1 at Powers obtained some water from Precambrian dolomite (Randville Dolomite) at a depth greater than 500 feet. The openings in the dolomite, however, have been enlarged by solution and thus remain open at much greater depth.

As only a few wells in the county are completed in Precambrian rocks little is known of the chemical quality of the water from the Precambrian. Well 35N 28W 19-1 (as shown in table below) yielded good water with only 76 ppm of hardness.

Chemical analysis of water sample from Precambrian rocks
(analysis by the U. S. Geological Survey)

Well number	Date collected	Chemical constituents (parts per million)										Specific conductance (micromhos at 25° C)	pH
		Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids	Hardness as $CaCo_3$		
35N 28W 19-1	4- 5-63	--	21	5.8	95	3.4	80	4.8	154	315	76	630	7.6



EXPLANATION

Generalized areas where Precambrian rocks are at the surface or are mantled directly by glacial drift.

800

Generalized structure contour drawn on top of the Precambrian rocks. Contour interval 100 feet; datum is mean sea level.

Figure 10. – Structure-contour map showing extent of Precambrian rocks.

THE ORIGIN, MOVEMENT AND DISCHARGE OF GROUND WATER

Ground-water is a renewable resource because it is continually replenished by precipitation. The process whereby precipitation falls on the ground, evaporates, is used by plants, or moves to the lakes and rivers and then to the ocean, eventually to evaporate and return to the atmosphere, is called the hydrologic cycle. The ground-water phase of the hydrologic cycle involves the recharge to, movement in, and discharge from the ground-water reservoirs. Under natural conditions water infiltrates into the ground-water reservoirs and under the force of gravity moves by underflow to the lakes, swamps and streams. This recharge to the aquifers is balanced by natural discharge.

This balance is disturbed when water is pumped from a well. In time an aquifer will adjust to the withdrawal of water from the well and a new "balance" will be established. This new balance would be achieved by an increase in recharge to the aquifer and/or a decrease in natural discharge from the aquifer. The amount of water discharging naturally from the aquifers in Menominee County greatly exceeds the amount of water pumped from wells. Thus, the potential for development of the ground-water resources of the county exceeds any forseeable development for many years to come.

The shape of the water table, the top of the ground-water reservoir, in Menominee County is somewhat similar to the shape of the land surface (fig.11) except that the "hills" on the water table are not so high, and the gradients are not so steep. In many low areas the water table surface and the land surface coincide. These areas are swampy or have a stream running

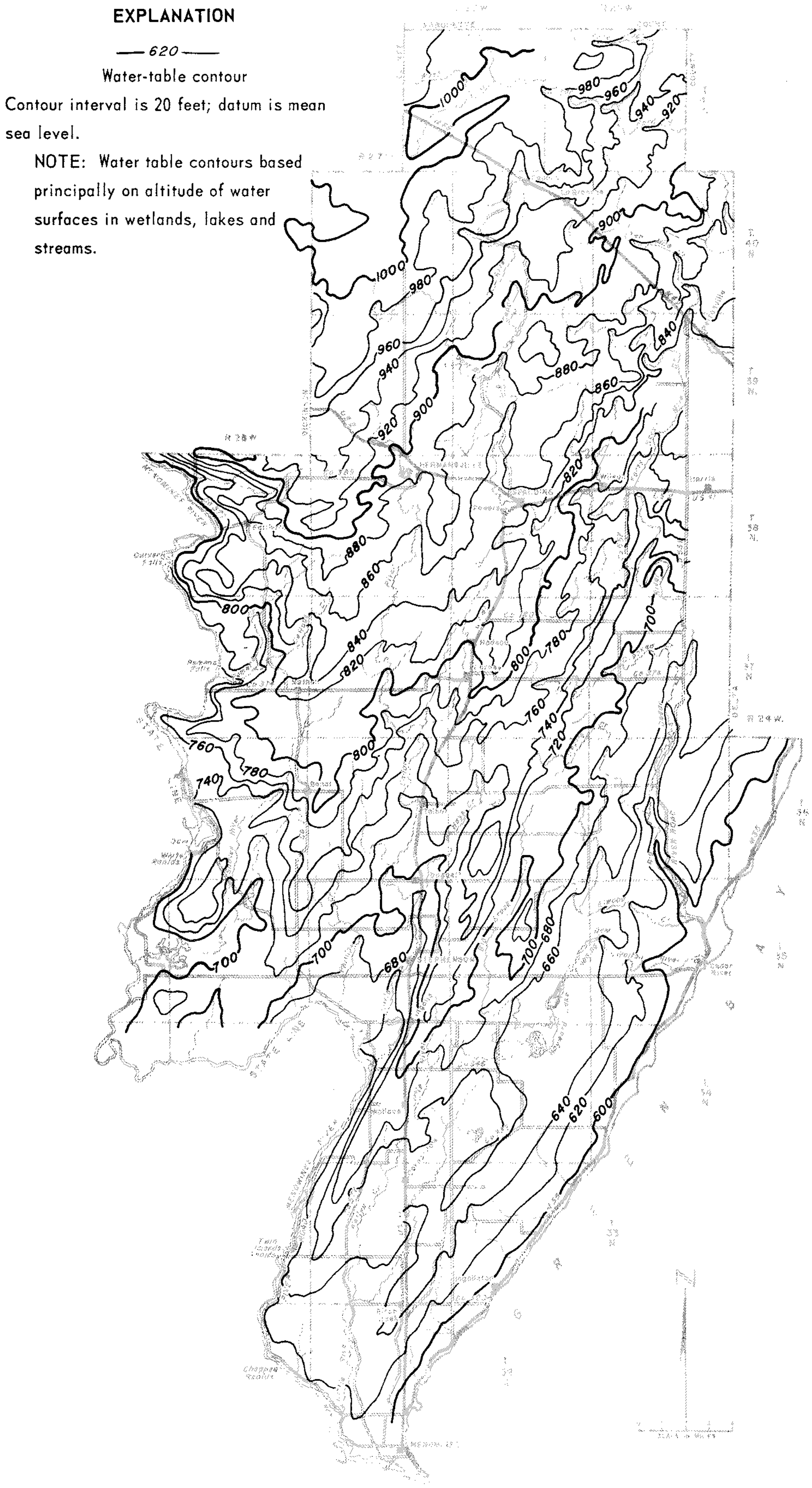


Figure 11. – Map showing generalized contours on the water table in Menominee County.

through them. The piezometric (water pressure) surfaces in the deeper aquifers are somewhat similar in shape to the water table. The "hills" in the piezometric surface are not as high as the water-table hills, the slopes are not as steep, and the valleys, are not as low. The piezometric surfaces are above the land surface in some areas, and wells tapping the artesian aquifers in these areas flow. The largest areas of artesian flow occur along the shore of Green Bay.

SUMMARY AND CONCLUSIONS

Menominee County is underlain by five major water-bearing units. Each of these units includes a variety of rock types and include one or more geologic formations.

Water for household, farm, and other needs requiring from 5 to 10 gpm can be obtained from wells throughout the county. Wells supplying these needs range from less than 20 to 720 feet in depth. Most wells, however, are less than 100 feet deep, and most are drilled, cased wells, and obtain water from bedrock aquifers. Dug and driven wells are also used.

Moderate to large supplies of water (50 to 300 gpm per well) can be obtained from the lower sandstone unit throughout most of the county. Except for a small area in the southern part of the county, the water from this aquifer is of good chemical quality, low in iron and of moderate hardness. Wells presently tapping this aquifer for municipal or industrial supply are about 400 or more feet deep.

In a few localities the other water-bearing units may yield moderate supplies of water (50 to 100 gpm) and it may be possible to develop several hundreds of gpm from wells tapping glacial outwash in the western part of the county.

The quality of water from the five water-bearing units varies considerably. Most of the water is hard and some of the water contains objectionable amounts of iron. The greatest quality problem, however, is in the southern part of the county where the bedrock aquifers yield "sulfur" water. The "sulfur" water problem generally is overcome by completing wells at as shallow a depth as is possible. In some of this area dug wells provide the most satisfactory source of water for household use.

SELECTED REFERENCES

This list is provided for those who wish to obtain additional information on the general geology or water resources of Menominee County. The reports can be obtained from or examined at the offices of the Michigan Geological Survey in Escanaba and Lansing.

Hamblin, W. K., Cambrian Sandstones of Northern Michigan: Michigan Geological Survey (Publication 51), 1958.

Ryling, Roy W., A Preliminary Study of the Distribution of Saline Water in the Bedrock Aquifers of Eastern Wisconsin: Wisconsin Geological and Natural History Survey, University of Wisconsin (Information Circular Number 5).

Verweibe, W. A., Geology of Menominee County: Michigan Land Economic Survey (geologic report with maps), 1925.

Verweibe, W. A., Surface Geology of Menominee County: Michigan Academy of Science Papers (Volume 7), 1926, pp. 167-169.

Reports on the ground-water resources of Delta, Alger, and other counties in the eastern part of the Upper Peninsula can be obtained from the Michigan Department of Conservation.

Table 2.--Records of wells

Well number: The well numbering system used in this report is based on the location of the well. The first two segments of the well number designate the township and range. The third segment designates the section and a number assigned to each well in a section. Thus, well 40N 25W 8-1 is well number 1 in section 8, township 40 north, range 25 west.

Water-bearing strata: gd - glacial drift; gg - glacial gravel; ul - upper limestones; mls - middle limestones and sandstones; ls - lower sandstones; Pcr - Precambrian rocks. (Note: for geologic names of water-bearing strata, see table 1).

Use: D - domestic; S - stock; P - public supply; I - industrial; N - not used.

Specific capacity: Yield in gallons per minute per foot of drawdown.

Altitude: Altitudes are in feet above mean sea level, as estimated from U. S. Geological Survey topographic maps.

Well number	Location	Owner	Driller	Date drilled	Diameter	Depth	Water-bearing unit	Use	Water level	M or R	Date	Specific capacity	Altitude	Depth to bedrock	Remarks
40N 25W															
8-1	NE¼ SE¼; section 8	Ray Dube	T. Rice + Son	1947	5	43	ul	S	10	R	1947	---	890	---	
15-1	SW¼ SW¼; section 15	Charles Zawecki	-----	1944	--	90	ul	D	-----	-	----	---	895	---	
25-1	NE¼ NE¼; section 25	--------	-----	----	5	47	ul	N	6.94	M	4- 9-63	---	888	---	
35-1	NE¼ SW¼; section 35	John Bloniarz	T. Rice + Son	1948	5	41	ul	N	-----	-	----	---	825	---	Cased to 35 ft.
36-1	NW¼ SW¼; section 36	Stanley Polishak	T. Rice	1920	6	200	ul	D,S	45	R	1962	---	870	---	
39N 25W															
1-1	SE¼ NE¼; section 1	Charles Zawecki	T. Rice + Son	1944	5	90	ul	D	-----	-	----	---	817	---	Cased to 30 ft.
2-1	SW¼ NW¼; section 2	Frank Deptula	T. Rice + Son	1946	6	39	ul	S	2	R	1962	---	835	---	Well flowed when first drilled.
2-2	SW¼ NW¼; section 2	Frank Deptula	T. Rice + Son	1946	6	39	ul	N	-----	-	----	---	825	---	
2-3	SW¼ NW¼; section 2	Frank Deptula	-----	1918	6	45	ul	D	8	R	1962	---	830	---	
3-1	SE¼ NW¼; section 3	Frank Janik	T. Rice + Son	1946	5	49	ul	D,S	7	R	1962	---	845	15	
4-1	SE¼ SE¼; section 4	Walter Pragacz	C. O. Rice	1958	5	41	ul	D	20	R	1958	---	855	---	
17-1	SE¼ SW¼; section 17	Edward Polka	T. Rice + Son	1944	5	100	ul	D,S	-----	-	----	---	855	---	
38N 28W															
5-1	NW¼ NW¼; section 5	Julius Van Wiele	J. Van Wiele	1947	6	80	gg	D	35	R	1962	---	980	---	
9-1	SE¼ NW¼; section 9	Craig Johnston	H. Klieman	1961	3	19	gg	D	8	R	6- 1-61	.66	843	---	
11-1	NW¼ NW¼; section 11	Dr. Arthur Costa	Wm. Klieman	1959	6	57	gg	D	26.5	R	9- 2-59	---	950	---	
22-1	NW¼ NW¼; section 22	Walter LaGrave	F. Kozikowski	1961	5	62	gg	D	21.5	R	1961	4	865	---	
26-1	SE¼ SW¼; section 26	Charles Hanna	F. Kozikowski	1961	5	106	gg	D	13	R	1961	1.5	855	---	
38N 27W															
2-1	SW¼ SE¼; section 2	Ted Peterson	Henry Le Beau	1960	5	75	mls	D	19	R	1960	---	890	42	
2-2	NW¼ SE¼; section 2	Wildwood Resturant	Henry Le Beau	1960	5	77	mls	D	26	R	11-30-60	8	900	60	
2-3	NE¼ SW¼; section 2	St. Mary's Parish	C. O. Rice	1951	--	120	mls	D	-----	-	----	---	920	---	
2-4	SE¼ SW¼; section 2	Frank Rodman	Henry Le Beau	1962	5	110	mls	D	-----	-	----	---	900	---	Cased to 50 ft.
2-5	NE¼ NE¼; section 2	Robert Petrick	Henry Le Beau	1961	5	60	mls	D	20	R	1961	---	905	---	Bedrock near surface.
11-1	NW¼ NE¼; section 11	Alex Ginnera	C. O. Rice	1959	5	60	mls	D	12	R	10- 6-59	1	900	47	
12-1	SE¼ SW¼; section 12	Rueben Erickson	T. Rice + Son	1945	5	65	mls	D	-----	-	----	---	---	---	Cased to 49 ft.
13-1	SE¼ SE¼; section 13	Ed Bellmonte	T. Rice + Son	1944	5	67	mls	D	-----	-	----	---	---	---	Cased to 28 ft.
15-1	NW¼ SW¼; section 15	Bill Moore	Thomas Co.	1960	4	75	mls	D	40	R	1960	---	---	2	
16-1	NE¼ SE¼; section 16	Bill Moore Mink Ranch	-----	----	--	400?	ls	S	-----	-	----	---	---	---	Reported to be more than 400 ft. deep.
37N 26W															
8-1	NW¼ NW¼; section 8	Pipkorn Bros.	E. A. Anderson	1947	8	130	mls	S	20	R	1947	1	875	---	Cased to 17 ft.
10-1	SW¼ SW¼; section 10	St. Francis Church	C. O. Rice	1959	5	83	mls	P	8	R	1959	1.3	855	4	
10-2	SW¼ SW¼; section 10	T. Frazer	T. Rice + Son	1943	4	46	ul	D	-----	-	----	---	855	---	
10-3	NE¼ NW¼; section 10	Lawrence Murray	T. Rice + Son	1944	5	75	ul+ mls	D	-----	-	----	---	930	---	
12-1	SW¼ SE¼; section 12	Donald McNeely	T. Rice + Son	1943	5	63	ul	D	10	R	1944	---	795	---	
15-1	NW¼ NW¼; section 15	Noble Graham	C. O. Rice	1959	5	140	mls	D	10	R	1959	.2	850	4	
15-2	NW¼ NW¼; section 15	D. Pirlot	T. Rice + Son	1943	4	45	mls	D	-----	-	----	---	850	---	
16-1	SW¼ NW¼; section 16	Chicago + Northwestern RR	-----	1934	8	994	ls, Pcr	N	20.11	M	4- 9-63	---	867	42	
16-2	NE¼ NW¼; section 16	Pinecrest Sanatarium (1)	Layne-Northwest	1952	12	430	ls	P	55	R	1952	---	900	78	
16-3	NE¼ NW¼; section 16	Pinecrest Sanatarium	-----	----	--	425	ls	P	-----	-	----	---	890	---	
16-4	SE¼ NW¼; section 16	Walter Orniel	T. Rice + Son	1944	5	115	mls	D	-----	-	----	---	870	---	Cased to 63 ft.
16-5	SW¼ SW¼; section 16	John Fazer	Henry Le Beau	1960	5	68	ul	D	24	R	9-25-60	---	890	58	
16-6	NW¼ NW¼; section 16	Powers-Spalding Locker Plant	T. Rice + Son	1945	5	47	ul	P	-----	-	----	---	850	---	
16-7	SW¼ NW¼; section 16	Alex Bouty	Henry Le Beau	1959	5	67	ul, mls	D	12	R	8-22-59	---	865	57	
25-1	NW¼ NW¼; section 25	August Veeser	Henry Le Beau	1958	5	87	mls	D	-----	-	----	---	825	---	Bedrock near surface.
26-1	SE¼ NW¼; section 26	Herman Hafeman	T. Rice + Son	1943	5	84	mls	N	18	R	1943	---	830	---	Cased to 16 ft.
38N 25W															
10-1	NE¼ SE¼; section 10	Alex Jorvesz	T. Rice + Son	1944	5	75	ul	D,S	16	R	1962	---	770	---	Cased to 29 ft.
11-1	SE¼ NE¼; section 11	Mary Pirlot	C. O. Rice	1952	5	43	ul	N	-----	-	----	---	---	---	Cased to 19 ft.
11-2	SE¼ NE¼; section 11	Harris High School	T. Rice + Son	1943	--	100	ul	P	-----	-	----	---	---	---	
11-3	SE¼ NE¼; section 11	Genevieve Harris	Henry Le Beau	1954	5	156	ul	D	-----	-	----	---	---	---	Cased to 8 ft.
11-4	NE¼ SE¼; section 11	Algot Erickson	C. O. Rice	1962	5	175	ul	D	-----	-	----	---	---	---	
11-5	SW¼ NE¼; section 11	-----	-----	----	4	29	---	N	9.08	M	4- 9-63	---	---	---	
15-1	NW¼ NW¼; section 15	Edward Hart	T. Rice + Son	1943	4	55	ul	S	8	R	1963	---	761	---	Cased to 20 ft.
27-1	NW¼ NE¼; section 27	Hubert Vandermissen	C. O. Rice	1957	5	43	ul	D	5	R	1957	---	740	---	Cased to 23 ft.

Table 2.--Records of wells - Continued

Well number	Location	Owner	Driller	Date drilled	Diameter	Depth	Water-bearing unit	Use	Water level	M or R	Date	Specific capacity	Altitude	Depth to bedrock	Remarks
38N 25W															
27-2	NW¼ NE¼; section 27	Hubert Vandermissen	C. O. Rice	----	6	100	ul	S	-----	-	----	---	740	---	Yields red water.
33-1	SW¼ NE¼; section 27	M. J. Otvadavec	T. Rice + Son	1944	5	109	ul	D,S	15	R	1944	---	735	---	Cased to 47 ft.
34-1	NW¼ SW¼; section 34	Howard Strahl	T. Rice + Son	1943	6	121	ul	D,S	-----	-	----	---	770	---	Cased to 102 ft.
37N 28W															
11-1	NE¼ SW¼; section 11	Edmund Hanna	F. Kozikowski	1961	5	62	ls	S	20	R	4-12-61	3.5	850	50	
37N 27W															
1-1	NW¼ SE¼; section 1	Andrew Benson	T. Rice + Son	1944	5	47	---	S	20	R	1962	---	---	---	Cased to 27 ft.
23-1	NW¼ NW¼; section 23	Lester Le Beau	T. Rice + Son	1944	5	45	mls	N	21.56	M	5- 4-62	---	845	---	Cased to 23 ft.
37N 26W															
7-1	SE¼ SE¼; section 7	Hector Trombley	Henry Le Beau	1959	5	60	mls	S	13.5	R	10-10-59	---	830	35	
7-2	SE¼ SE¼; section 7	Sundquist + Fougetti	Dick Rice	1960	5	86	mls	D	28	R	11-20-60	---	---	---	Cased to 38 ft.
19-1	SE¼ SE¼; section 19	Bernard Tobin	T. Rice	1937	5	53	mls	D	-----	-	----	---	790	---	
19-2	SE¼ SE¼; section 19	Steve Thomas	T. Rice	1930	5	67	mls	D	-----	-	----	---	790	---	Cased to 32 ft.
19-3	SE¼ NE¼; section 19	George Braosko	T. Rice + Son	1943	5	40	mls	D	-----	-	----	---	800	---	Cased to 31 ft.
19-4	SE¼ NE¼; section 19	Carney School	T. Rice + Son	1944	6	41	mls	D	-----	-	----	---	800	---	Cased to 33 ft.
19-5	NE¼ SE¼; section 19	Frigo Dairy	Dick Rice	----	5	105	mls	I	-----	-	----	---	790	---	Yielded 40 gpm.
19-6	SE¼ SE¼; section 19	Henry Lickman	T. Rice + Son	1943	4	50	mls	D	-----	-	----	---	810	---	Cased to 42 ft.
19-7	NE¼ NE¼; section 19	Peterson Bros. IGA Store	Henry Le Beau	1958	5	99	mls	D	-----	-	----	---	815	---	
19-8	NE¼ NE¼; section 19	Peterson Bros.	Henry Le Beau	1954	5	40	mls	N	4.08	M	9-14-59	---	---	---	
19-9	SE¼ SE¼; section 19	Peterson Bros.	-----	----	4	12	mls	N	-----	-	----	---	775	---	Flows
19-10	NE¼ SE¼; section 19	Mich. State Hwy. Dept.	-----	----	4	--	mls	O	5.49	M	9-14-59	---	---	---	Well is in right of way of US Hwy 41.
19-11	NW¼ SE¼; section 19	Carl Guard	Dick Rice	1960	5	48	mls	D	-----	-	----	---	785	---	Cased to 20 ft.
20-1	NW¼ NW¼; section 20	Mike Doloc	Dick Rice	1960	5	72	mls	D	30	R	11-13-60	---	---	---	Cased to 57 ft.
20-2	NW¼ SW¼; section 20	Coffee Shop	Dick Rice	1960	5	30	mls	P	-----	-	----	---	796	---	Cased to 18 ft.
37N 25W															
2-1	SW¼ SW¼; section 2	Howard Strahl	-----	----	5	87	ul	D,S	30	R	1962	---	700	---	
11-1	SW¼ NE¼; section 11	Emanuel Rotheaux	T. Rice + Son	1944	5	60	ul	D,S	-----	-	----	---	680	---	Cased to 30 ft.
14-1	SW¼ NE¼; section 14	Ignas Depas	T. Rice + Son	1943	5	91	ul	D	-----	-	----	---	680	---	Cased to 68 ft.
27-1	NE¼ SE¼; section 27	Willard Lanoville	C. O. Rice	1958	5	89	ul	D	-----	-	----	---	660	---	Cased to 44 ft.
36N 28W															
8-1	NW¼ NE¼; section 8	F. Eickert	Thomas Co.	1961	6	40	gg	D	-----	-	----	---	760	---	
24-1	SW¼ SE¼; section 24	John Kipple	T. Rice + Son	1944	5	100	mls	D	-----	-	----	---	790	---	Cased to 60 ft.
36N 27W															
2-1	SE¼ SE¼; section 2	Frank Zemba	T. Rice + Son	1943	5	100	mls	N	20.24	M	7-26-62	---	760	---	Cased to 73 ft.
31-1	NE¼ SW¼; section 31	Emil Carlson	T. Rice + Son	1945	5	62	mls	D,S	-----	-	----	---	775	---	Cased to 17 ft.
36N 26W															
31-1	SW¼ NW¼; section 31	Ed Melhoff	T. Rice + Son	1944	5	80	ul	D,S	30.0	M	7-24-62	---	740	---	Cased to 24 ft.
36-1	NW¼ NW¼; section 36	Steve Sakovitz	T. Rice + Son	1943	5	35	ul	D,S	5.95	M	8-10-62	---	700	---	Cased to 18 ft.
36N 24W															
4-1	SW¼ NE¼; section 4	Fred Bennett	C. O. Rice	1959	6	207	ul	P	10	R	1959	1.5	600	34	
9-1		Wm. J. Winkler	Fred Rice	1959	5	47	gg	D	7	R	1959	---	---	---	Open end of casing in gravel
35N 28W															
19-1	NW¼ NW¼; section 19	Shakey Lake Park	Henry Le Beau	1960	5	170	Pcr	P	7	R	1960	---	700	162	Granite at 162 ft.
21-1	SW¼ SW¼; section 21	J. Homernik	L. Anderson	1960	4	64	gg	D	24	R	----	.6	710	---	
36-1	NE¼ NW¼; section 36	Lester Sand	L. Anderson	----	5	52	gg	D	16	R	----	---	715	---	
35N 27W															
2-2	NE¼ NW¼; section 2	Mrs. Peterson	T. Rice + Son	1943	4	59	mls	D	-----	-	----	---	715	---	Cased to 28 ft.
2-3	NW¼ NE¼; section 2	Dr. Heidenreich	Henry Le Beau	1960	5	53	mls	D	10	R	6-10-60	---	715	20	
2-4	SW¼ SE¼; section 2	Roger Raboin	Henry Le Beau	1960	5	50	mls	D	7	R	9-27-60	---	685	21	
6-1	NE¼ NW¼; section 6	Ralph Paulson	T. Rice + Son	----	5	37	mls	D	-----	-	----	---	760	---	Cased to 27 ft.
11-1	NW¼ SE¼; section 11	James Hacker	F. Kozikowski	1961	5	46.5	mls	D	4.5	R	8- 2-61	---	690	44	
13-1	SW¼ SE¼; section 13	Gail Bowers	T. Rice + Son	1944	5	67	mls	D,S	7	R	1944	---	745	---	Cased to 50 ft.
13-2	SW¼ SE¼; section 13	Gail Bowers	-----	----	36	24	gd	D	10.89	M	8-10-62	---	745	---	Dug well
23-1	SW¼ NW¼; section 23	Village of Stephenson (1)	Layne-Northwest	1938	8	364	ls	P	20	R	8- 1-62	5	678	25	
23-2	NW¼ NW¼; section 23	Village of Stephenson (2)	Layne-Northwest	1953	8	345	ls	P	24	R	8- 1-62	8	677	5	Flowed in April 1962
23-3	SW¼ SW¼; section 23	White House Milk Co.	Milager Well Drilling	1937	12	395	ls	I	-----	-	----	---	---	38	
26-1	NE¼ SW¼; section 26	Warren Hubbard	T. Rice + Son	1943	4	75	mls	D	-----	-	----	---	735	---	Cased to 65 ft.
33-1	NE¼ SW¼; section 33	Hannah Hulsizer	Henry Le Beau	1960	5	35	mls	D	Flow	R	1960	---	670	30	
35-1	SE¼ SE¼; section 35	Charles Hansen	T. Rice + Son	1944	5	55	mls	D	-----	-	----	---	740	---	Cased to 28 ft.
35-2	NE¼ NW¼; section 35	Walt + Kathy Brock	F. Kozikowski	1961	5	80	mls	D	22	R	12- 4-61	---	700	58	
36-1	SW¼ SW¼; section 36	Clifton Swanington	T. Rice + Son	1944	5	89	ul	D,S	-----	-	----	---	725	---	Cased to 26 ft.
35N 26W															
18-1	SW¼ NW¼; section 18	Harry E. Johnson	T. Rice + Son	1943	5	55	ul	D	-----	-	----	---	735	---	Cased to 26 ft.
19-1	NE¼ SW¼; section 19	Art Corey	T. Rice + Son	1943	5	70	ul	D	-----	-	----	---	775	---	Cased to 52 ft.
29-1	NW¼ NE¼; section 29	Joe Chatlash	T. Rice + Son	1943	--	70	ul	D	-----	-	----	---	710	---	
35N 25W															
11-1	SE¼ SE¼; section 11	Otto Eichmeyer	L. Anderson	1959	4	129	ul	D	-----	-	----	.2	695	---	Flowed in 1959, Cased to 50 ft.

Table 2.--Records of wells - Continued

Well number	Location	Owner	Driller	Date drilled	Diameter	Depth	Water-bearing unit	Use	Water level	M or R	Date	Specific capacity	Altitude	Depth to bedrock	Remarks
35N 25W															
12-1	NW¼ NE¼; section 12	Robert Roubal	F. Kozikowski	1957	5	32	ul	D	-----	-	----	---	585	19	
12-2	SE¼ NE¼; section 12	Ted Pasek	T. Rice + Son	1943	5	15	gg	D	-----	-	----	---	590	---	
13-1	SW¼ SE¼; section 13	V. La Bouef	L. Anderson	1962	--	78	ul	D	18	R	7-62	---	590	59	
14-1	NW¼ NE¼; section 14	H. E. Smith	H. E. Smith	1958	1¼	50	ul	D	-----	-	----	---	588	50	Flows.
20-1	NW¼ SE¼; section 20	Joel Wirtkivetz	T. Rice + Son	1944	5	83	ul	D	1.85	M	7-24-62	---	620	40	
22-1	SW¼ SW¼; section 22	Ben Foley	T. Rice + Son	1943	5	75	ul	S	Flow	R	1943	---	605	---	Cased to 10 ft.
22-2	SW¼ SW¼; section 22	Ben Foley	C. O. Rice	1957	5	65	ul	D	-----	-	----	---	605	13	
23-1	NE¼ SE¼; section 23	Staghles Place	T. Rice + Son	1948	5	67	ul	D	Flow	R	1962	---	587	---	Cased to 62 ft.
23-2	SW¼ NE¼; section 23	Paddy's Tavern	T. Rice + Son	1948	6	48	ul	P	-----	-	----	---	590	---	Cased to 32 ft.
23-3	NW¼ NE¼; section 23	Mrs. Haberland	T. Rice + Son	1944	5	41	ul	D	-----	-	----	---	590	---	Cased to 37 ft.
23-4	SE¼ NE¼; section 23	Cedar Harbor Store	C. O. Rice	1953	6	42	ul	P	-----	-	----	---	590	---	Cased to 36 ft.
24-1	NE¼ NW¼; section 24	Robert Pecotte	F. Kozikowski	1961	4	61	gg	D	2	R	1962	.5	588	---	
24-2	SW¼ NW¼; section 24	Louis Ruleau	L. Anderson	1960	4	175	ul	D	Flow	R	1960	1.3	588	55	
27-1	SW¼ SE¼; section 27	Felix Strehl	T. Rice + Son	1944	5	90	ul	N	-----	-	----	---	592	---	Cased to 35 ft.
35-1	NW¼ NW¼; section 35	J. W. Wells State Park	G. Olson + Son	1934	--	176	ul	P	-----	-	----	---	587	31	Flowed when first drilled.
34N 27W															
1-1	NW¼ NW¼; section 1	Harold Schenvogt	T. Rice + Son	1944	5	70	ul	D	-----	-	----	---	725	24	
2-1	NW¼ NE¼; section 2	Leonard Swaningson	Henry Le Beau	1952	6	52	ul	D	6	R	1952	---	740	---	
2-2	NE¼ SW¼; section 2	Henry Haferman	L. Anderson	1960	4	33	gg	D	16	R	1960	---	730	---	
4-1	SW¼ SE¼; section 4	R. Jarett	L. Anderson	----	--	40	mls	D	0	R	1962	---	655	24	
9-1	NW¼ NE¼; section 9	G. Leanna	L. Anderson	----	--	48	mls	D	29	R	1963	---	670	40	
12-1	SE¼ SE¼; section 12	Ted Grinsteiner	Thomas Co.	1954	--	66	mls	D	18	R	1954	---	695	38	
20-1	SE¼ SE¼; section 20	O. R. Eggers	L. Anderson	1961	5	84	mls	D	-----	-	----	---	670	65	
21-1	SW¼ SW¼; section 21	Wm. Smith	L. Anderson	----	--	78	mls	D	30	R	----	---	700	47	
22-1	NE¼ NE¼; section 22	Lutheran Church	L. Anderson	1960	4	79	ul	P	30	R	1960	.6	700	27	
23-1	NW¼ SW¼; section 23	Mellen Twp. School	H. Le Beau	1955	6	99	ul	P	17	R	1955	---	695	30	
25-1	NW¼ NW¼; section 25	Loren R. Anderson	L. Anderson	----	5	33	ul	D	15	R	----	---	680	20	
33-1	NE¼ NW¼; section 33	John Miller	L. Anderson	1960	4	30	ul	D	9	R	6-60	---	695	23	
34N 26W															
21-1	SE¼ SE¼; section 21	Harold Freis	L. Anderson	1960	5	143	ul	D	-----	-	----	---	680	8	Yields water with sulfur odor.
34N 25W															
3-1	NW¼ NW¼; section 3	Robert Ruleau	F. Kozikowski	1960	5	35	gg	D	4	R	10-18-60	2	590	---	
6-1	NW¼ NE¼; section 6	Mathew Weinshrot	C. O. Rice	1952	6	41	gg	D	-----	-	----	---	650	---	
30-1	SE¼ NE¼; section 30	Harry Poulson	-----	1934	5	450	mls	D	22+	R	1962	---	590	50	Flows, 3.3 gpm.
31-1	SE¼ NE¼; section 31	Paul Haring	L. Anderson	1960	4	47	ul	D	12	R	4-60	1	588	44	
33N 28W															
24-1	NE¼ NW¼; section 24	C. McConnell	F. Kozikowski	1960	5	61	mls	D	4.26	M	8-10-62	7.5	640	59	
24-2	SE¼ NW¼; section 24	P. Wesolowski	P. Wesolowski	1962	5	64	mls	D	15.53	M	8- 8-62	---	636	43	
25-1	NE¼ NW¼; section 25	T. Dawydko	F. Kozikowski	1959	5	68	gg	D	-----	-	----	---	655	---	
26-1	SW¼ NE¼; section 26	Ann Tenny	-----	1944	6	90	mls	D	Flow	R	1962	---	640	---	
35-1	NW¼ SE¼; section 35	T. Younk	F. Kozikowski	1956	5	77	gg	D	-----	-	----	---	630	---	
35-2	NE¼ SE¼; section 35	J. Ciszewiski	F. Kozikowski	1960	5	101	mls	D	40	R	4-23	1	675	99	
33N 27W															
11-1	NW¼ SW¼; section 11	David Kintgen	F. Kozikowski	1961	4	27	ul	D	3	R	11-61	7	710	20	
23-1	NW¼ NW¼; section 23	Robert Nemetz	F. Kozikowski	1960	5	22	ul	D	2	R	10-60	2.5	640	---	
32-1	NW¼ SE¼; section 32	George Dax	-----	1900	10	720	ls	D	1+	R	1905	---	650	---	Main water-bearing strata at 620 ft.
34-1	SW¼ SE¼; section 34	B. G. Champeau	F. Kozikowski	1961	5	19	ul	D	9	R	1961	10	655	18	
35-1	NW¼ NW¼; section 35	Mich. Hwy. Dept.	E. Anderson	1957	5	147	ul	P	16	R	1957	---	655	12	
35-2	SW¼ NW¼; section 35	Aug Beyer	F. Kozikowski	1956	5	23	ul	D	-----	-	----	---	650	20	
33N 26W															
1-1	NW¼ SE¼; section 1	Wilfred Hupy	F. Kozikowski	1959	5	56	gg	D	-----	-	----	---	586	---	
1-2	SW¼ NE¼; section 1	Henry Werner	F. Kozikowski	1959	5	54	gg	D	-----	-	----	---	588	---	
6-1	NE¼ NW¼; section 6	Harold Massey	F. Kozikowski	1957	5	40	---	D	-----	-	----	---	680	---	
6-2	SE¼ NW¼; section 6	John Zurawski	F. Kozikowski	1956	5	110	---	N	-----	-	----	---	675	22	Yields sulfur water.
6-3	SE¼ NW¼; section 6	John Zurawski	-----	----	--	20	gd	D	17	R	1962	---	675	---	Goes dry in summer.
7-1	SE¼ NE¼; section 7	Fred Patz	-----	----	48	22	ul	D	9.16	M	7-27-62	---	672	---	Yields sulfur water.
7-2	NW¼ NW¼; section 7	Fred Patz	F. Kozikowski	1959	5	26	ul	N	6.78	M	7-27-62	---	670	12	
12-1	SW¼ SW¼; section 12	Clifford Teepe	F. Kozikowski	1956	5	30	gg	D	2.6	M	7-25-62	---	590	---	
12-2	NW¼ SW¼; section 12	Old Ingalstone School	-----	----	--	52	ul	N	Flows	M	5- 5-62	---	592	---	Yields sulfur water.
12-3	NW¼ NW¼; section 12	Klieber	F. Kozikowski	1957	5	43	gg	D	-----	-	----	---	590	---	
12-4	SW¼ NW¼; section 12	Floyd Beattie	F. Kozikowski	1959	5	45	gg	D	3	M	9-25-59	---	590	---	
18-1	NE¼ SW¼; section 18	Antone Beyer	F. Kozikowski	1961	5	25	ul	D	13	R	6-61	5	586	23	
22-1	NW¼ NE¼; section 22	Bertha Tepe	F. Kozikowski	1961	5	42	gg	D	6	R	5-60	1	590	---	
22-2	NE¼ SW¼; section 22	Howard Caylor	F. Kozikowski	1961	6	44	ul	D	Flow	R	1961	15	588	43	
22-3	SW¼ SW¼; section 22	Carl Gulbransen	F. Kozikowski	1959	5	36	gg	D	-----	-	----	---	586	---	
27-1	NW¼ NW¼; section 27	Sam Harl	F. Kozikowski	1956	5	39	ul	P	-----	-	----	---	587	37	
32N 28W															
2-1	NW¼ NW¼; section 2	Joe Mikalas	Thomas Co.	1955	6	93	mls	D	Flows	R	1962	---	630	48	
2-2	SW¼ NW¼; section 2	T. Banaszynski	Thomas Co.	1951	6	174	mls	D	35	R	1951	---	660	110	
3-1	NE¼ NE¼; section 3	S. Ostrenga	F. Kozikowski	1957	5	95	mls	D	-----	-	----	---	630	48	
11-1	NE¼ NW¼; section 11	E. Dvoracek	Thomas Co.	1955	6	181	mls	D	30	R	1955	.2	655	114	
11-2	SW¼ SW¼; section 11	H. E. Smith	-----	1958	6	156	mls	D	-----	-	----	---	625	50	Flows.
13-1	NW¼ SW¼; section 13	James F. Motti	F. Kozikowski	1961	5	42	mls	D	9	R	1961	7	630	41	
14-1	NW¼ NW¼; section 14	Exore Dechine	Thomas Co.	1952	6	49	gg	D	-----	-	----	---	620	---	
32N 27W															
3-1	NE¼ NE¼; section 3	Fred Kohrt	F. Kozikowski	1957	5	25	ul	D	-----	-	----	---	652	20	
3-2	NE¼ NW¼; section 3	Elmer Lensmeier	F. Kozikowski	1957	5	27	gg	D	-----	-	----	---	660	---	
3-3	NE¼ SE¼; section 3	Menominee Twp. Hall	F. Kozikowski	1959	6	36	ul	D	-----	-	----	---	655	18	
3-4	SE¼ SE¼; section 3	A. A. Theuerkauf	F. Kozikowski	1957	6	26	ul	D,S	-----	-	----	---	655	5	

Table 2.--Records of wells - Continued

Well number	Location	Owner	Driller	Date drilled	Diameter	Depth	Water-bearing unit	Use	Water level	M or R	Date	Specific capacity	Altitude	Depth to bedrock	Remarks
32N 27W															
3-5	SE¼ SE¼; section 3	A. A. Theuerkauf	C. O. Rice	1956	6	720	---	N	18.21	M	3- 3-60	---	655	---	Yields sulfur water.
10-1	NW¼ SE¼; section 10	Alex Malawlka	F. Kozikowski	1956	5	38	gg	D	-----	-	----	---	645	---	
11-1	SE¼ SE¼; section 11	Richard Parrette	F. Kozikowski	1960	5	35	ul	D	6	R	8-60	1.5	605	31	
12-1	SE¼ SE¼; section 12	Russell Anderson	F. Kozikowski	1958	5	38	ul	D	-----	-	----	---	585	32	
12-2	SE¼ SE¼; section 12	R. Noppenberg	F. Kozikowski	1958	5	38	ul	D	-----	-	----	---	585	32	Sulfur.
12-3	NW¼ NW¼; section 12	Stanley Wojcik	F. Kozikowski	1959	5	33	gg	D,S	-----	-	----	---	615	---	
13-1	NE¼ NW¼; section 13	George Everhard	F. Kozikowski	1959	5	42	ul	D	-----	-	----	---	586	22	
13-2	NW¼ SW¼; section 13	F. W. Uecke	Thomas Co.	1947	6	23	ul	N	7	R	6-47	---	587	16	
13-3	NW¼ SW¼; section 13	Floyd Orth	Thomas Co.	1947	5	26	ul	D	-----	-	----	---	585	17	
13-4	NE¼ NE¼; section 13	Louis Lemire	F. Kozikowski	1960	5	31	gg	D	1.5	R	5-60	2	585	---	
13-5	NE¼ NW¼; section 13	O. L. Paulson	A. Kienitz	1959	2	25	ul	D	1.5+	R	9-59	12	585	22	Flowed in 1959.
13-6	NE¼ NW¼; section 13	A. Kienitz	Thomas Co.	1947	5	322	ul, mls	D	Flow	R	1947	---	585	16	Yielded sulfur water
14-1	SW¼ NW¼; section 14	Donald Minzloff	F. Kozikowski	1959	5	265	ul	P	-----	-	----	---	617	---	
14-2	NW¼ SW¼; section 14	Smithway-Tire Co.	F. Kozikowski	1957	5	24	ul	P	-----	-	----	---	617	23	
14-3	SE¼ SE¼; section 14	Peter Entringer	F. Kozikowski	1958	5	25	ul	D	-----	-	----	---	588	22	
14-4	SE¼ SW¼; section 14	Fred Entringer	F. Kozikowski	1954	6	23	ul	D	5	R	1954	---	586	21	
14-5	NE¼ NW¼; section 14	Warren Klitzke	F. Kozikowski	1957	5	23	ul	D	-----	-	----	---	620	---	Nearby well about 58 ft. deep Yielded sulfur water
14-6	SW¼ SE¼; section 14	Reinhard Ries	F. Kozikowski	1960	5	21	ul	D	.94	M	7-31-62	.2	596	20	
14-7	SW¼ SE¼; section 14	John Lesjack Jr.	F. Kozikowski	1960	5	21	ul	D	2	R	7-25-60	2.5	596	18	
14-8	SW¼ SE¼; section 14	George Delfosse	F. Kozikowski	1956	5	23	gg	D	-----	-	----	---	590	---	
14-9	SW¼ SE¼; section 14	Robert Clausen	F. Kozikowski	1961	5	31	ul	D	-----	-	----	.6	605	26	
15-1	SW¼ NE¼; section 15	W. Lentz	Thomas Co.	1947	5	31	ul	N	8	R	1947	---	630	20	
19-1	SE¼ SE¼; section 19	Glen Kaetterhenry	F. Kozikowski	1956	5	55	ul	D	-----	-	----	---	615	40	
20-1	SE¼ NE¼; section 20	E. Bralmschreiber	Thomas Co.	1947	6	371	ul, mls	N	18	R	1947	---	640	26	Yields water with "sulfur" odor.
20-2	NE¼ SW¼; section 20	W. Zeratsky	F. Kozikowski	1956	5	50	ul	N	-----	-	----	---	622	37	Yields water with "sulfur" odor.
20-3	SE¼ SW¼; section 20	Robert Zeratsky	F. Kozikowski	1956	5	38	gd	D	-----	-	----	---	622	---	
22-1	NE¼ NE¼; section 22	A. Angoni	F. Kozikowski	1957	5	35	ul	D	-----	-	----	---	622	24	
22-2	NE¼ NE¼; section 22	Robert DeBoth	F. Kozikowski	1961	6	26.5	ul	D	3.5	R	6-61	30	615	25	
23-1	NE¼ SW¼; section 23	Bay Breeze Motel	F. Kozikowski	----	5	28	ul	D	-----	-	----	---	585	17	
23-2	SW¼ NE¼; section 23	E. Jansen	F. Kozikowski	1961	4	28	ul	D	3	R	8-61	.8	587	22	
23-3	NE¼ NE¼; section 23	Marcus Kronauer	Thomas Co.	1954	6	41	ul	D	8	R	6-54	---	585	40	
23-4	NE¼ NE¼; section 23	Roy Bates	Thomas Co.	1947	--	19	ul	D	4	R	1947	---	586	17	
27-1	SE¼ SW¼; section 27	Marvin Malmsten	F. Kozikowski	1958	5	28.5	ul	D	-----	-	----	---	613	24	
28-1	SE¼ NW¼; section 28	Alvin Chaltry	F. Kozikowski	1959	5	23.5	ul	D	-----	-	----	---	640	21	
28-2	NW¼ NW¼; section 28	Hamilton School	-----	1932	6	413	ul	D	-----	-	----	---	645	30	Yielded water with "sulfur" odor.
28-3	NE¼ SE¼; section 28	E. Rynning	F. Kozikowski	1961	5	22	ul	D	3	R	1961	3	622	18	
28-4	NW¼ SE¼; section 28	Gerald Cook	F. Kozikowski	1961	4	36	ul	D	14	R	1961	5	625	34	
28-5	SE¼ SE¼; section 28	E. Bramschrieber	Thomas Co.	1947	6	22	gg	D	8	R	1947	---	625	---	
29-1	SE¼ SW¼; section 29	Bob Kellmer	Thomas Co.	1951	6	72	ul	D	3	R	1951	---	615	22	
29-2	NE¼ SW¼; section 29	John Neumier	Thomas Co.	1952	6	68	ul	D	10	R	1952	---	620	50	
29-3	SW¼ SW¼; section 29	W. J. Culver	F. Kozikowski	1958	5	52	ul	D	-----	-	----	---	620	40	
29-4	SE¼ SW¼; section 29	Con Ahearn	F. Kozikowski	1956	5	26	ul	D	-----	-	----	---	630	22	
29-5	SE¼ NE¼; section 29	Salewsky Bros.	Thomas Co.	1946	8	385	ul	N	13	R	1946	---	630	25	Yields water with "sulfur" odor.
29-6	NW¼ SW¼; section 29	Morris Long	-----	1959	4	43	ul	D	-----	-	----	---	620	---	
29-7	NE¼ NE¼; section 29	Leonard Barcewski	F. Kozikowski	1961	5	61	ul	D	10	R	1961	.2	620	43	
30-1	SE¼ NE¼; section 30	Elmer Hornick	Thomas Co.	1955	6	50	gg,ul	D	10	R	1955	---	625	50	
32-1	NW¼ NW¼; section 32	Cephos Cook	F. Kozikowski	1961	4	30	ul	D	6	R	6-61	---	610	28	
32-2	SE¼ SE¼; section 32	W. Huppy	F. Kozikowski	1961	6	34	ul	D	5	R	5-61	.8	615	30	
33-1	SE¼ SE¼; section 33	Mrs. Erdman	F. Kozikowski	1960	5	35	ul	D	6	R	10-60	2	---	28	
33-2	SE¼ NW¼; section 33	O. Johnson	F. Kozikowski	1956	5	30	ul	D	-----	-	----	---	---	28	
33-3	SE¼ SE¼; section 33	Fred Spaude	Thomas Co.	1952	6	36	ul	D	10	R	1952	---	---	22	
34-1	NE¼ NE¼; section 34	Consolidated Products	Thomas Co.	1946	8	100	ul	D	10	R	1946	---	587	18	
34-2	NE¼ NE¼; section 34	Consolidated Products	Thomas Co.	1947	8	100	ul	D	10	R	1947	---	587	19	
32N 26W															
5-1	SW¼ SW¼; section 5	Frank Pawlowski	Thomas Co.	1954	6	33	ul	D	5	R	1954	---	585	32	
5-2	SW¼ SW¼; section 5	Henry Stanislawisk	Thomas Co.	1954	6	40	ul	D	5	R	1954	---	585	39	
5-3	NW¼ SE¼; section 5	C. F. Larson	Thomas Co.	1954	6	64	ul	D	6	R	1954	---	585	55	
6-1	SW¼ SE¼; section 6	A. R. Glaser	F. Kozikowski	1959	5	24	gg	D	-----	-	----	---	586	---	
7-1	NW¼ SW¼; section 7	Clarence Keller	Thomas Co.	1951	5	40	ul	D	5	R	1951	---	587	30	
7-2	NW¼ SW¼; section 7	Clarence Keller	Thomas Co.	1947	5	33	gg	D	-----	-	----	---	586	---	
7-3	NW¼ SW¼; section 7	Ed. Yeske	Thomas Co.	1947	5	34	ul	D	8	R	1947	---	588	32	
7-5	NW¼ NW¼; section 7	Mrs. Olsen	Thomas Co.	1954	6	37	ul	D	3	R	1954	---	587	36	
7-8	NE¼ NE¼; section 7	Max C. Hansen	Thomas Co.	1954	6	38	ul	D	4	R	1954	---	588	34	

Table 3.--Logs of wells in Menominee County

Thickness in feet. Depth in feet below land surface.

Altitude in feet above mean sea level.

Note: Except for underlined aquifer designations and noted sample logs, logs are from well drillers records and show drillers descriptive terms. Well drillers commonly use the term soapstone to describe shale or shaly limestone or dolomite and generally do not differentiate between limestone and dolomite, but use the term limestone for both rock types.

	Thick-ness	Depth
TOWNSHIP 38 NORTH; RANGE 28 WEST		
38N 28W 9-1		
C. Johnston		
SE¼ NW¼ Section 9		
Altitude: 843		
Glacial drift:		
Gravel, hardpan and boulders	12	12
Sand and hardpan	4	16
Pea gravel (water)	3	19
Precambrian rocks:		
Ledge (appears to be chert)	at	19
38N 28W 11-1		
A. Costa		
NW¼ NW¼ Section 11		
Altitude: 950		
Glacial drift:		
No record	44	44
Hardpan	12	56
Gravel	2	58
38N 28W 22-1		
W. La Grave		
NW¼ NW¼ Section 22		
Altitude: 865		
Glacial drift:		
Clay	40	40
Sand	20	60
Gravel	2	62
38N 28W 26-1		
C. Hanna		
SE¼ SW¼ Section 26		
Altitude: 855		
Glacial drift:		
Clay	60	60
Sand	10	70
Clay	10	80
Sand	20	100
Gravel	6	106
TOWNSHIP 38 NORTH; RANGE 27 WEST		
38N 27W 2-1		
T. Peterson		
SW¼ SE¼ Section 2		
Altitude: 890		
Glacial drift:		
Clay	42	42
Middle limestone and sandstone:		
Limestone	28	70
Sandstone	5	75
38N 27W 2-2		
Wildwood Restaurant		
NW¼ SE¼ Section 2		
Altitude: 900		
Glacial drift:		
Hardpan	60	60
Middle limestone and sandstone:		
Limestone	17	77
38N 27W 11-1		
A. Gennara		
NW¼ NE¼ Section 11		
Altitude: 900		
Glacial drift:		
Fill	4	4
Sand and stone	16	20
Hardpan	15	35
Red Hardpan	7	42
White Hardpan	5	47
Middle limestone and sandstone:		
Shell rock	2	49
Limestone	11	60
TOWNSHIP 38 NORTH; RANGE 26 WEST		
38N 26W 10-1		
St. Francis Church		
SW¼ SW¼ Section 10		
Altitude: 855		
Glacial drift:		
Sand and stones	4	4
Middle limestone and sandstone:		
Shell rock	6	10
Limestone	30	40
Limestone and sandstone	43	83
38N 26W 15-1		
N. Graham		
NW¼ NW¼ Section 15		
Altitude: 850		
Glacial drift:		
Fill, large stones and sand	4	4
Middle limestone and sandstone:		
Limestone	31	35
Limestone and sandstone	80	115
Sandstone	25	140
38N 26W 16-1		
Chicago and Northwestern Railroad		
SW¼ NW¼ Section 16		
Altitude: 867		
Glacial drift:		
Black Muck	0	20
Sand, boulders, clay	20	40
Drab clay	5	45
Sand and gravel	7	42
Middle limestone and sandstone:		
Limestone	52	105
Reddish brown sandstone	5	110
Shaley limestone	13	123
Shaley sandstone	4	127
Limestone	115	242
Lower sandstone:		
Sandstone, soft, brown	23	265
Sandstone, buff and gray	138	403
Precambrian rocks:		
Limestone	37	440
Gray limestone	5	445
Reddish limestone	67	512
White chalky limestone	18	530
White hard, limestone	53	583
Gray, chalky limestone	12	595
Gray, hard limestone	5	600
Gray limestone	394	994
38N 26W 16-2		
Pinecrest Sanitorium		
NE¼ NW¼ Section 16		
Altitude: 900		
Glacial drift:		
Boulders, large gravel and clay	78	78
Middle limestone and sandstone:		
Limestone, grey	172	250
Lower sandstone:		
Sandstone, red	5	255
Sandstone, brown	155	410
Sandstone, gray	20	430
38N 26W 16-5		
J. Fazer		
SW¼ SW¼ Section 16		
Altitude: 890		
Glacial drift:		
Hardpan	54	54
Gravel	4	58
Upper limestone:		
Limestone	10	68
38N 26W 16-7		
A. Bouty		
SW¼ NW¼ Section 16		
Altitude: 865		
Glacial drift:		
Hardpan	57	57
Middle limestone and sandstone:		
Limestone	10	67
TOWNSHIP 37 NORTH; RANGE 28 WEST		
37N 28W 11-1		
E. Hanna		
NE¼ SW¼ Section 11		
Altitude: 850		
Glacial drift:		
Hardpan	42	42
Sand	8	50
Lower sandstone:		
Sandstone	12	62
TOWNSHIP 37 NORTH; RANGE 26 WEST		
37N 26W 7-1		
H. Trombley		
SE¼ SE¼ Section 7		
Altitude: 830		
Glacial drift:		
Hardpan	35	35
Middle limestone and sandstone:		
Limestone	20	55
Sandstone	5	60
TOWNSHIP 36 NORTH; RANGE 28 WEST		
36N 28W 8-1		
Frances Eickert		
NW¼ NE¼ Section 8		
Altitude: 760		
Glacial drift:		
Clay and boulders	40	40
Streak of gravel at		40

Table 3.--Logs of wells in Menominee County, Continued

	Thick-ness	Depth
TOWNSHIP 35 NORTH; RANGE 28 WEST		
35N 28W 19-1		
Shakey Lake Park		
NW¼ NW¼ Section 19		
Altitude: 700		
Glacial drift:		
Sand	140	140
Hardpan and clay	22	162
Precambrian rocks:		
Granite	8	170
35N 28W 21-1		
J. Homernik		
SW¼ SW¼ Section 21		
Altitude: 710		
Glacial drift:		
Topsoil	2	2
Hardpan	38	40
Clay	10	50
Sand	4	54
Clay	6	60
Gravel	4	64
TOWNSHIP 35 NORTH; RANGE 27 WEST		
35N 27W 2-3		
Dr. Heidenreich		
NW¼ NE¼ Section 2		
Altitude: 715		
Glacial drift:		
Hardpan	20	20
Middle limestone and sandstone:		
Limestone	30	50
Sandstone	3	53
35N 27W 2-4		
R. Raboin		
SW¼ SE¼ Section 2		
Altitude: 685		
Glacial drift:		
Sand	10	10
Hardpan	11	21
Middle limestone and sandstone:		
Sandstone	29	50
35N 27W 11-1		
J. Hacker		
NW¼ SE¼ Section 11		
Altitude: 690		
Glacial drift:		
Clay	38	38
Sand	2	40
Gravel	4	44
Upper limestone:		
Rock	2.5	46.5
35N 27W 23-1		
Village of Stephenson		
SW¼ NW¼ Section 23		
Altitude: 678		
Glacial drift:		
Clay and coarse rock	25	25
Middle limestone and sandstone:		
Decomposed limerock	6	31
Limestone	116	147
Lime and shale streaks	7	154
Gray rock	65	219
Lower sandstone:		
Sandstone	145	145
Precambrian rocks:		
Granite at		364
35N 27W 23-3		
White House Milk Co.		
SW¼ SW¼ Section 23		
Altitude: 683		
(Log from samples)		
Glacial drift:		
Silt, sandy, very dolomitic	10	10
Sand, fine to medium, gray	10	20
Silt, light gray, very dolomitic	10	30
Till, many pebbles of dolomite	8	38
Middle limestone and sandstone:		
Dolomite, light gray; oolitic chert; sandstone; shale	12	50
Dolomite, silty light gray	95	145
Dolomite, silty, light gray, glauconitic	5	150
Dolomite, silty, pink, glauconitic	5	160
Dolomite, sandy, gray pyritic	10	170
Lower sandstones:		
Sandstone, fine, to medium, gray, dolomitic	25	205
Siltstone, sandy, gray dolomitic	5	210
Sandstone, fine to medium, gray dolomitic	40	250
Sandstone, medium to coarse, light gray, dolomitic	30	280
Sandstone, fine to coarse, light gray	30	310
Sandstone, fine to medium, pink, gray	15	325
Sandstone, fine to coarse, light gray	32	357
Siltstone, gray	3	360
Sandstone, medium to coarse, light gray	15	375
Sandstone, fine to medium, light gray	10	385
Precambrian rocks:		
Granite, pink	10	395
35N 27W 33-1		
H. Hulsizer		
NE¼ SE¼ Section 33		
Altitude: 670		
Glacial drift:		
Sand	25	25
Clay	5	30
Middle limestone and sandstone:		
Limestone	5	35
35N 27W 35-2		
W. Brock		
NE¼ NW¼ Section 35		
Altitude: 700		
Glacial drift:		
Clay	58	58
Upper limestone:		
Rock	22	80
TOWNSHIP 35 NORTH; RANGE 25 WEST		
35N 25W 24-1		
R. Pecotte		
NE¼ NW¼ Section 24		
Altitude: 588		
Glacial drift:		
Sand	20	20
Clay	10	30
Sand	20	50
Sand and gravel	6	56
35N 25W 24-2		
Louis Ruleau		
SW¼ NW¼ Section 24		
Altitude: 588		
Glacial drift:		
Black muck	4	4
Hardpan	33	37
Fine sand	13	50
Clay	5	55
Upper limestone:		
Limestone	45	100
Limestone with clay pockets	50	150
Limestone	25	175
35N 25W 35-1		
J. W. Wells State Park		
NW¼ NW¼ Section 35		
Altitude: 587		
Glacial drift:		
Sand, brown, fine to medium	11	11
Clay, tan, sandy	5	16
Sand, tan, fine to medium, clayey and gravel	15	31
Upper limestone:		
Limestone, gray and tan sand	5	36
Limestone, gray and tan, dolomite, sugar texture	10	46
Limestone, blue gray, dolomite, some pyrite	112	158
Dolomite, gray, sugary textured	5	163
Limestone, gray	13	176
TOWNSHIP 34 NORTH; RANGE 27 WEST		
34N 27W 2-2		
Henry Haferman		
NE¼ SW¼ Section 2		
Altitude: 730		
Glacial drift:		
Red sand and large rocks	8	8
Hardpan	9	17
Soft sand	8	25
Clay	5	30
Gravel	3	33
34N 27W 12-1		
T. Grinsteiner		
SE¼ SE¼ Section 12		
Altitude: 695		
Glacial drift:		
Clay	38	38
Upper limestone:		
Limestone	28	66
34N 27N 22-1		
Lutheran Church		
NE¼ NE¼ Section 22		
Altitude: 700		
Glacial drift:		
Topsoil and sand	1	1
Hardpan	21	22
Red clay	5	27
Upper limestone:		
Limestone	52	79

Table 3.--Logs of wells in Menominee County, Continued

	Thick-ness	Depth
34N 27W 33-1		
J. Miller		
NE¼ NW¼ Section 33		
Altitude: 695		
Glacial drift:		
Top soil	4	4
Red sand	8	12
Hardpan	11	23
Upper limestone:		
Limestone	7	30
TOWNSHIP 34 NORTH; RANGE 25 WEST		
34N 25W 3-1		
R. Ruleau		
NW¼ NW¼ Section 3		
Altitude: 590		
Glacial drift:		
Sand	30	30
Gravel	5	35
34N 25W 30-1		
H. Poulson		
SE¼ NE¼ Section 30		
Altitude: 590		
Glacial drift:		
Top soil, hardpan, rocky, muddy clay	50	50
Upper limestone:		
Limestone	27	75
(Slow seepage of "sulfur" water at 75 feet)		
Hard limestone	100	175
Hard limestone, creviced (small flow of salt and sulfur water)	45	220
Limestone, crevice (fair water)	105	325
Hard limestone (dry)	25	350
Middle limestone and sandstone:		
Sandstone (good water)	10	360
Limestone	35	395
Sandstone (good water)	5	400
Sandstone and limestone, alternate strata (good water)	40	440
Limestone	10	450
34N 25W 31-1		
P. Haring		
SE¼ NE¼ Section 31		
Altitude: 588		
Glacial drift:		
Bay sand	12	12
Clay	15	27
Sand and large rocks	17	44
Upper limestone:		
Limestone	3	47
TOWNSHIP 33 NORTH; RANGE 28 WEST		
33N 28W 24-1		
C. McConnell		
NE¼ NW¼ Section 24		
Altitude: 640		
Glacial drift:		
Gravel	10	10
Sand	10	20
Sand and gravel	15	35
Sand	15	50
Gravel	9	59
Middle limestone and sandstone:		
Sandstone	2	61

	Thick-ness	Depth
33N 28W 24-2		
P. Wesolowski		
SE¼ NW¼ Section 24		
Altitude: 636		
Glacial drift:		
Sand and quicksand	43	43
Middle limestone and sandstone:		
Sandstone	21	64
33N 28W 35-1		
J. Ciszewski		
NE¼ SE¼ Section 35		
Altitude: 675		
Glacial drift:		
Hardpan	40	40
Clay and gravel	5	45
Sand	5	50
Clay	35	85
Sand	14	99
Middle limestone and sandstone:		
Rock	2	101
TOWNSHIP 33 NORTH; RANGE 27 WEST		
33N 27W 11-1		
David Kintgen		
NW¼ SW¼ Section 11		
Altitude: 710		
Glacial drift:		
Clay	20	20
Upper limestone:		
Rock	7	27
33N 27W 35-1		
Mich. Hwy. Dept.		
NW¼ NW¼ Section 35		
Altitude: 655		
Glacial drift:		
Drift	12	12
Upper limestone:		
Limestone	16	28
Shale, green	68	96
Limestone	51	147
TOWNSHIP 33 NORTH; RANGE 26 WEST		
33N 26W 7-1		
F. Patz		
NW¼ NW¼ Section 7		
Altitude: 670		
Glacial drift:		
Drift	12	12
Upper limestone:		
Rock	14	26
33N 26W 18-1		
A. Beyer		
NE¼ SW¼ Section 18		
Altitude: 650		
Glacial drift:		
Clay	23	23
Upper limestone:		
Rock	2	25
33N 26W 22-1		
B. Tepe		
NW¼ NE¼ Section 22		
Altitude: 590		
Glacial drift:		
Sand	40	40
Gravel	2	42

	Thick-ness	Depth
33N 26W 22-2		
H. Caylor		
NE¼ SW¼ Section 22		
Altitude: 588		
Glacial drift:		
Clay	43	43
Upper limestone:		
Rock	1	44
TOWNSHIP 32 NORTH; RANGE 28 WEST		
32N 28W 2-1		
J. Mikalas		
NW¼ NW¼ Section 2		
Altitude: 630		
Glacial drift:		
Hardpan and stones	48	48
Middle limestone and sandstone:		
Limestone	42	90
Sandstone	3	93
32N 28W 2-2		
T. Banaszynski		
SW¼ NW¼ Section 2		
Altitude: 660		
Glacial drift:		
Sand	8	8
Clay	92	100
Shell and gravel	10	110
Middle limestone and sandstone:		
Blue shale	30	140
Lime and sandstone	28	168
Blue shale	6	174
32N 28W 11-1		
Emil Dvoracek		
NE¼ NW¼ Section 11		
Altitude: 655		
Glacial drift:		
Clay	60	60
Quicksand	35	95
Sand and clay	13	108
Gravel	2	110
Clay	4	114
Middle limestone and sandstone:		
Limestone	20	134
Soapstone (blue shale)	26	160
Limestone	21	181
32N 28W 13-1		
James F. Motti		
NW¼ SW¼ Section 13		
Altitude: 630		
Glacial drift:		
Sand	32	32
Sand and gravel	9	41
Middle limestone and sandstone:		
Rock	1	42
32N 28W 14-1		
E. Deschine		
NW¼ NW¼ Section 14		
Altitude: 620		
Glacial drift:		
Sand	18	18
Clay, soft	27	45
Gravel	4	49

Table 3.--Logs of wells in Menominee County, Continued

	Thick-ness	Depth
TOWNSHIP 32 NORTH; RANGE 27 WEST		
32N 27W 11-1		
R. Parrette		
SE¼ SE¼ Section 11		
Altitude: 605		
Glacial drift:		
Sand	6	6
Clay	23	29
Gravel	2	31
Upper limestone:		
Rock	4	35
32N 27W 13-2		
F. W. Uecke		
NW¼ SW¼ Section 27		
Altitude: 587		
Glacial drift:		
Sand	5	5
Sand clay	11	16
Upper limestone:		
Limestone	7	23
32N 27W 13-6		
A. Kienitz		
NE¼ NW¼ Section 13		
Altitude: 585		
Glacial drift:		
Sand	16	16
Upper limestone:		
Limestone	14	30
Soapstone	126	156
Limestone, brown	56	212
Soapstone	43	255
Middle limestone and sandstone:		
Grit	15	270
Limestone	20	290
Soapstone	32	322
32N 27W 14-4		
F. Entringer		
SE¼ SW¼ Section 14		
Altitude: 586		
Glacial drift:		
Sand	10	10
Clay	11	21
Upper limestone:		
Shell	2	23
32N 27W 20-1		
E. Bramschrieber		
SE¼ NE¼ Section 20		
Altitude: 640		
Glacial drift:		
Clay	26	26
Upper limestone:		
Shell rock	4	30
Rock, slate	100	130
Limestone	10	140
Soapstone	50	190
Middle limestone and sandstone:		
Soapstone	40	230
Soapstone, blue and limestone	25	255
Soapstone, sandy	58	313
Soapstone, red	12	325
Soapstone, gray	25	350
Limestone, brown	21	371
32N 27W 22-2		
R. DeBoth		
NE¼ NE¼ Section 22		
Altitude: 615		
Glacial drift:		
Sand	20	20
Sand and gravel	5	25
Upper limestone:		
Rock	1.5	26.5
32N 27W 23-3		
M. Kronauer		
NE¼ NE¼ Section 23		
Altitude: 585		
Glacial drift:		
Sand	3	3
Clay	37	40
Upper limestone:		
Limestone	1	41
32N 27W 28-2		
Hamilton School		
NW¼ NW¼ Section 28		
Altitude: 645		
Glacial drift:		
Clay	30	30
Upper limestone:		
Limestone and soapstone, gray	165	195
Middle limestone and sandstone:		
Limestone and sandstone, gray	190	385
Limestone, gray and brown (Sulfur water at 260 and 413)	28	413
32N 27W 29-1		
Bob Kellner		
SE¼ SW¼ Section 29		
Altitude: 615		
Glacial drift:		
Sand	10	10
Clay	12	22
Upper limestone:		
Shell limestone	2	24
Soapstone (blue shale)	48	72
32N 27W 29-5		
Salewsky Bros.		
SE¼ NE¼ Section 29		
Altitude: 630		
Glacial drift:		
Clay	25	25
Upper limestone:		
Shell	5	30
Limestone, gray	10	40
Soapstone, gray	72	112
Limestone, gray	5	117
Soapstone, gray	11	128
Limestone, gray	52	180
Middle limestone and sandstone:		
Soapstone, gray	143	323
Soapstone, red	19	342
Soapstone, gray	26	368
Limestone, brown	17	385
32N 27N 29-7		
L. Barcewski		
NE¼ NE¼ Section 29		
Altitude: 620		
Glacial drift:		
Sand	4	4
Clay	39	43
Upper limestone:		
Rock	18	61
32N 27W 30-1		
Elmer Hornick		
SE¼ NE¼ Section 30		
Altitude: 625		
Glacial drift:		
Sand	10	10
Clay	38	48
Gravel	2	50
Upper limestone;		
Limestone	at	50
32N 27W 32-1		
Cephos Cook		
NW¼ NW¼ Section 32		
Altitude: 610		
Glacial drift:		
Sand	20	20
Clay	8	28
Upper limestone:		
Rock	2	30
32N 27W 34-1		
Consolidated Products		
NE¼ NE¼ Section 34		
Altitude: 587		
Glacial drift:		
Sand and rocks	6	6
Clay and stones	12	18
Upper limestone:		
Limestone, brown	58	76
Soapstone	24	100
TOWNSHIP 32 NORTH; RANGE 26 WEST		
32N 26W 5-1		
Frank Pawlowski		
SW¼ SW¼ Section 5		
Altitude: 585		
Glacial drift:		
Sand	5	5
Clay	25	30
Gravel	2	32
Upper limestone:		
Shell limestone	1	33
32N 26W 5-3		
C. F. Larson		
NW¼ SE¼ Section 5		
Altitude: 585		
Glacial drift:		
Clay and stones	55	55
Upper limestone:		
Limestone	9	64
32N 26W 7-8		
Max C. Hanson		
NE¼ NW¼ Section 7		
Altitude: 588		
Glacial drift:		
Sand	5	5
Clay	29	34
Upper limestone:		
Shell limestone	4	38