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① NW Book 15
Subsurface Water Data

Seafarer Site Survey Upper Michigan Region

for
U.S. Navy
Naval Electronic Systems Command
Washington, D.C.

by
EDAW inc.
under contract to
GTE Sylvania
Communication Systems Division

NTA

BOOK 15

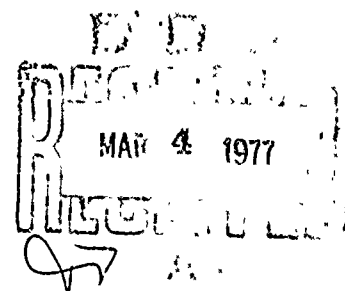
SUBSURFACE WATER DATA
of the
UPPER MICHIGAN REGION
PROJECT SEAFARER

for
U. S. Navy. Naval Electronic Systems Command

by
EDAW, Inc., 50 Green Street, San Francisco 94111

Under Contract to
GTE Sylvania, Communication Systems Division

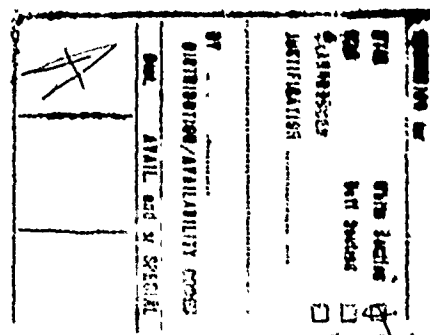
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A Subsurface Water Data Map has been prepared which shows locations of representative wells within the Study area, depth to water, and the quality of water available. The water table is near the surface with water encountered in most excavations greater than ten feet in depth. Water yields from wells vary considerably throughout the area ranging from a few gallons to tens of gallons per minute. The most promising areas for large scale ground water development appear to be areas of stratified glacial outwash sands and gravels along major streams where yields of several hundred gallons per minute are possible.		

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SUMMARY

The Subsurface Water Data Map shows locations of representative wells within the Study Area, depth to water at these locations, and the quality of the water present. The amount of subsurface water that can be extracted by wells within the Study Area varies greatly. Wells extract water both from bedrock aquifers and from glacial deposits that exist at the surface throughout most of the area. Moderate yields (a few tens of gallons per minute) are generally available from wells penetrating the Paleozoic sandstones and limestones at the southeast and northwest margins of the Study Area, but the older Precambrian crystalline rocks underlying the central portions of the area are generally dense and impermeable so that they yield very small amounts of water to wells. Consequently, near-surface glacial deposits may be the only available sources of ground water within areas of Precambrian bedrock. In other portions of the area where limestone and sandstone strata exist at depth, both the glacial deposits and the bedrock may serve as aquifers.

The glacial deposits vary greatly in composition according to their method of deposition. Coarse sands and gravels exist in some areas, while clayey lake deposits and till underlie others. The most promising areas for large-scale ground water development appear to be areas of stratified glacial outwash sands and gravels along major streams where yields of several hundred gallons per minute are possible from the fairly coarse and uniform sands and gravels present. In contrast, it may be difficult to obtain a few gallons per minute for a small domestic supply in some of the areas where dense Precambrian bedrock crops out at the ground surface, or where the glacial deposits are thin and/or clayey.

The water table is near the ground surface (0 to 10', 20', or 30') in much of the area. In some areas, however, depth to water is variable, ranging from a few feet in valleys underlain by glacial deposits to in excess of 100' in upland areas underlain by bedrock. There does not appear to have been any long-term rise or fall in ground water levels within most of the Study Area, although some local areas have probably experienced a lowering of the water table due to large-scale pumping operations in connection with mining activities. Water will be encountered in most excavations greater than 10' in depth. In excavations within Precambrian areas underlain by extensive thick glacial deposits of high permeability, such as outwash materials, flows of several hundred gallons per minute may be encountered.

The quality of the ground water throughout the Study Area is generally good. The only two minor water quality problems frequently encountered are hardness and excessive iron concentrations, both of which can usually be alleviated by standard water treatment methods. Some of the deeper (300' to 400') wells in bedrock produce water that is somewhat salty (250 to 400 ppm chloride). Also, there is some possibility of bacterial contamination of shallow aquifers by surface pollution sources, particularly within areas underlain by the Paleozoic limestone aquifers at the eastern and southeastern edges of the Study Area.

Areas underlain by coarse-grained glacial deposits, such as outwash, and by the more promising Paleozoic aquifers could support fairly extensive additional ground water development. Consequently, although the Precambrian rocks are capable of only very limited yields, in most areas the overlying glacial deposits would serve as a source of substantial amounts of ground water. Due to the variability in composition and thickness of the glacial deposits, it will probably be necessary to perform geophysical investigations and test drilling/test pumping operations to correctly locate future wells.

EVOLUTION

Processes and Time Leading to Existing Conditions

Ground water in the Study Area is found in both bedrock aquifers and in overlying unconsolidated deposits of glacial origin. Within the dense Precambrian rocks and the Paleozoic limestones and sandstones, water occurs in and moves through openings such as joints, fractures, and solution cracks. Many of these rocks had low porosities and permeabilities when they were first formed so that they could not readily store or transmit water. However, both porosity and permeability have been increased over long periods of time. For instance, the movement of water along joints in limestone formations gradually dissolves weaker portions of the rocks, and solution cavities and fissures are formed--openings which enable the limestone to function as an aquifer.

Within the unconsolidated glacial drift materials overlying the bedrock, water is found in the spaces between the grains of the material, and these deposits function as aquifers as soon as they are deposited. Materials such as outwash sands and gravels have undergone a sorting process while being transported by glacial melt-waters. Because of this sorting, the resulting deposits are stratified (deposited in layers) and some layers are composed of materials which are both reasonably coarse and fairly uniform in size. Deposits such as this have both high porosity and high permeability. Consequently, they can readily store and transmit large quantities of water and are excellent aquifers.

Conversely, lake bed deposits which formed in areas of ponded meltwater may be composed of predominantly fine-grained material such as clay or silt. They consequently have low permeabilities and generally are poor aquifers.

As water percolates through the aquifers, it dissolves minerals contained within the deposits. Thus, the chemical quality of the ground water is influenced by such factors as material type and the amount of time the water has been in contact with the aquifer. Much of the ground water within the Study Area is a calcium-magnesium-bicarbonate type that is rather hard because many of the aquifers through which the water has been moving (particularly the limestones) are rich in calcium and magnesium carbonate. The ground water also has significant concentrations of iron because the rocks and glacial deposits are rich in this metal in many areas.

The Study Area is sparsely populated, and man has probably had little effect on either the quality or quantity of ground water in most portions of the area. The principal water quality problems--hardness and excessive iron--are a reflection of natural processes. A few exceptions where man has affected the ground water regime exist, however. Bacterial contamination of shallow aquifers, particularly limestones, has occurred in isolated areas. The source of this pollution is probably barnyard waste or septic tank effluent. Large-scale pumpage of water flowing into mines has also caused lowering of the water table in the immediate vicinity of pumping operations. In some areas, where mining operations and the accompanying pumping have ceased, the natural ground water regime has been reestablished and water tables have risen. This has caused problems such as flooding of basements which were constructed during the time the water table was artificially lowered.

Anticipated Future Conditions

In the absence of large-scale development in the Study Area, it is unlikely that significant changes in either quantity or quality of ground water will take place within the foreseeable future. Ore beneficiation activities, particularly in the Iron Range area of Marquette County require fairly significant amounts of water, and significant increases in this industry could mean an increased demand upon available water resources. Water used in the ore beneficiation processes generally becomes degraded somewhat in quality, but it is usually passed through settling basins prior to being returned to streams. Additionally, in most instances the natural dilution process which occurs in the streams significantly reduces the contamination in a fairly short distance downstream.

Although the Precambrian rocks in the center of the Study Area are capable of yielding only small supplies of water, it is likely that the Paleozoic aquifers and many of the glacial drift deposits overlying the bedrock could support fairly extensive ground water withdrawals without adversely affecting the quantity of water available. Most of these aquifers are not extensively developed at present, and could support many more wells. However, the optimum development of ground water supplies (particularly in the heterogeneous glacial drift deposits) will require careful study and investigation to achieve the best results and to ensure that both subsurface and surface water supplies are not adversely affected. Obviously, any development which resulted in large amounts of waste water being generated and discharged into the ground could result in deterioration of ground water quality, and treatment of such discharges would be necessary.

DISTINCTIVE UNITS AND CHARACTERISTICS

Depth to Water

The Subsurface Water Data Map shows the locations of representative wells within the Study Area, along with information on the depth to water and ground water quality. Each well is assigned an identification number according to the well-numbering system commonly used in Michigan. The first two parts of the well number designate township and range, the third part of the number designates both the section number and the number of the individual wells within the section, and the fourth and fifth parts of the number indicate the location of the well down to the specific quarter-quarter section (40 acres) within which it is located. For example, a typical well number might read as follows: T44N R27W 17-1 NW SE. This number indicates well number one in section 17, Township 44 North, Range 27 West. In addition, NW SE indicates that the well is located in the northwest quarter of the southeast quarter of section 17. Identification numbers do not appear on the map, however, as they can be readily indexed by using the Michigan System.

The depth to water in each well is shown by the coding system presented in Table 1. Wells are grouped into 10' class intervals for depths up to 40', and into 20' class intervals for depths ranging from 40'-100'. Springs are indicated by the letter "S". Detailed information on each well appears in the Appendix. Where numerous wells are shown within a 40 acre area, only the range in depth and quality are indicated.

The water table is generally fairly shallow (0 to 10', 20' or 30' in depth) within the Study Area. Ground water is very close to the surface in valley areas, particularly in glacial drift deposits. Some hilltop wells have depths to water of more than 100'.

Quality of Water

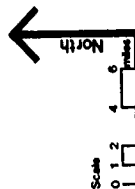
Nine important ions were selected, and wells having excessive amounts of these ions are shown by a coding system on the Subsurface Water Data Map. Since the water quality in the Study Area is good, in almost all cases the only important ion in excessive amounts was iron. This is the result of iron-rich bedrock and glacial deposits in parts of the area, which sometimes cause the iron concentration in the ground water to exceed the recommended limit of 0.3 mg/l. Although not coded on the map, another water quality problem in the

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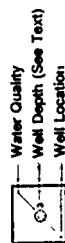
4	2	1	1
8	8	16	

6 Mile Square



SUBSURFACE WATER

WELL LABELING SYSTEM



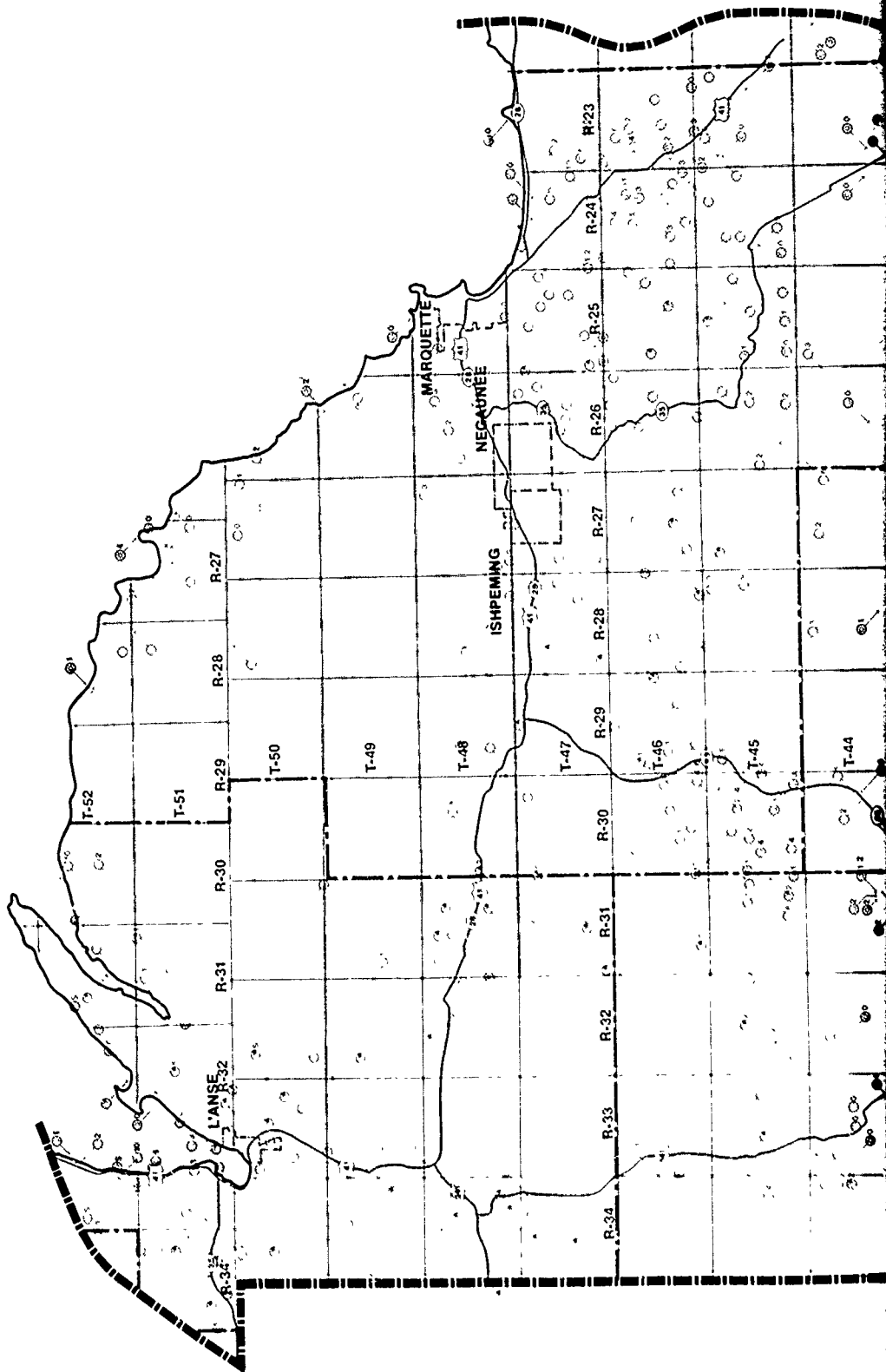
WATER QUALITY (Ion Content)
 NO₃ - Nitrate
 Cl - Chloride
 SO₄ - Sulfate
 HCO₃ - Bicarbonate
 Ca - Calcium
 Mg - Magnesium
 Na & K - Sodium & Potassium
 Fe - Iron
 Solid Sections Indicate an Ion Content
 Exceeding U.S. Public Health Dept. Standards
 (See Text)

88°45' 88°30' 88°15' 88°00' 87°45' 87°30' 87°15' 87°00' 47°00'

46°45'

46°30'

46°15'



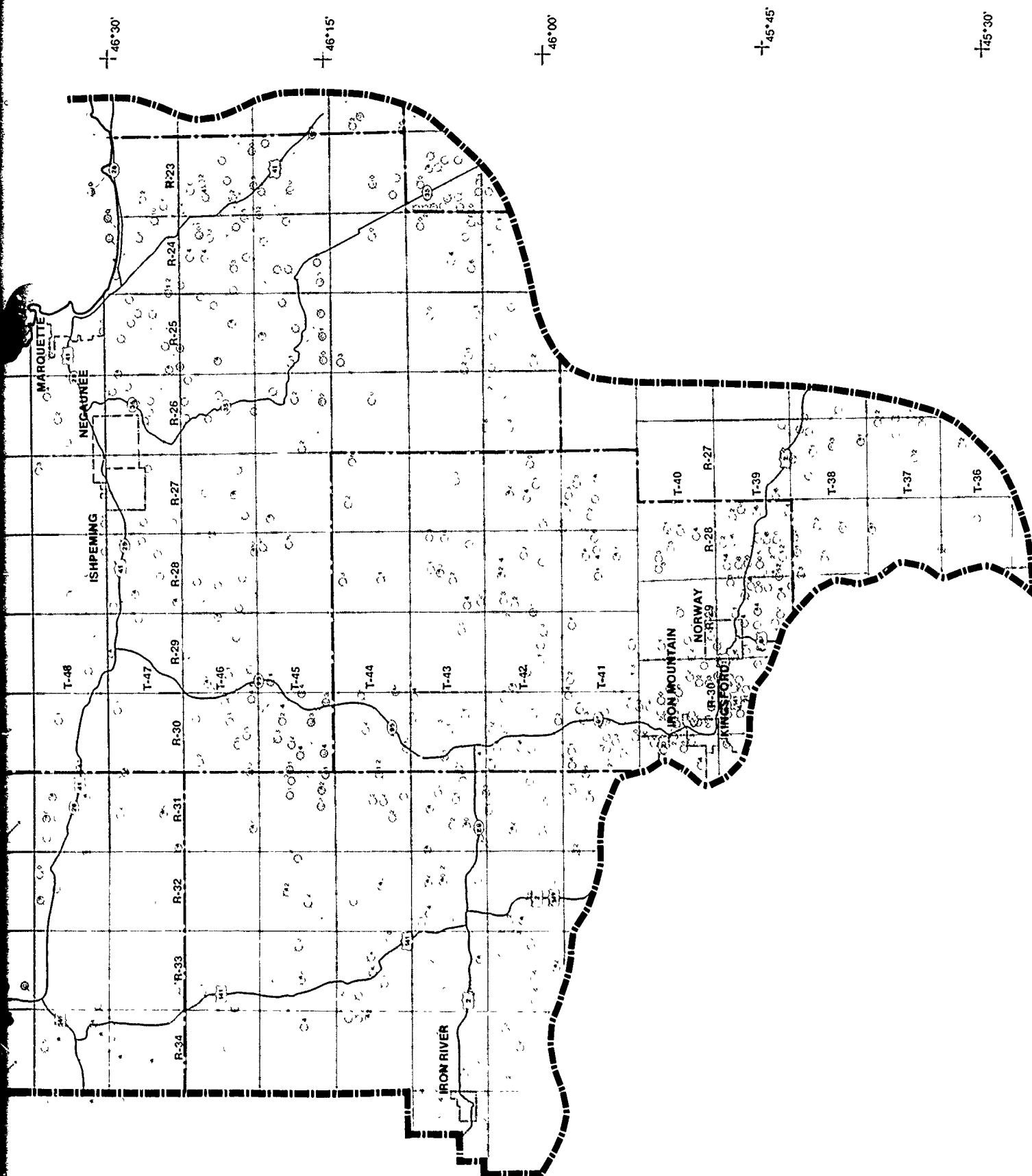


Table 1. LEGEND - DEPTH TO WATER IN WELLS

Spring	S
0-10 ft.	0
11-20 ft.	1
21-30 ft.	2
31-40 ft.	3
41-60 ft.	4
61-80 ft.	6
81-100 ft.	8
100 ft.	10

Study Area is high hardness values. Information on hardness is included with the detailed chemical analysis data of well water samples in Appendix C. The recommended limits for the various principal ions and for total dissolved solids appear in Table 2.

Table 2. RECOMMENDED LIMITS FOR DRINKING WATER*

<u>Constituent</u>	<u>Limit in milligrams/liter</u>
Total dissolved solids	1,000
Calcium (Ca)	200
Magnesium (Mg)	125
Sodium (Na)	200
Potassium (K)	10**
Bicarbonate (HCO_3)	500
Sulfate (SO_4)	250
Chloride (Cl)	250
Nitrate (NO_3)	45
Iron (Fe)	0.3

* Abstracted from U. S. Public Health Service, Publication No. 956 and other sources.

** No limit clearly defined for potassium; however, most potable ground water contains less than 10 milligrams/liter.

Aquifer Units

The various aquifer units can be divided into two broad categories--bedrock and overlying surficial deposits--the latter generally of glacial origin. Although glacial drift is used as a general term to describe deposits which are of glacial origin, it is possible to further subdivide the

glacial deposits into the principal surficial aquifer units based upon their composition and mode of formation. (Note: A more detailed description of the aquifer units listed below is presented in the Surficial Geologic Data and Bedrock Geologic Data reports.)

Surficial Deposits

Till Plains: Deposits with a flat or gently rolling surface which were deposited directly from the melting ice. Till plains can also be called ground moraines. Till is composed primarily of unsorted and unstratified mixtures of sand, silt, clay, and gravel. There are sometimes pockets or lenses of sand and gravel which occur within the unsorted till material.

Lake Bed Deposits: Deposits of silt, clay, and fine sand deposited in glacial lakes which formed from meltwater issuing from the glaciers. While these deposits are generally of low permeability and produce only small amounts of water, they sometimes overlies other more permeable deposits of sand or gravel which can be utilized as water sources.

Swamp Deposits and Recent Alluvium: These deposits are found along streams and in broad lowland areas. They consist of deposits of peat and muck, and sometimes also include or overlies sand and gravel deposits.

Outwash: Outwash is composed mainly of stratified deposits of sand and gravel, although scattered lenses of silt and clay may also be present. These are deposits which have been carried by braided streams or sheet runoff of meltwater issuing from the glacier front. Outwash plains are generally flat or gently sloping areas. Because of the sorting of the material as it is carried by the meltwater, the deposits are usually fairly permeable, and often are the most productive of the glacial aquifers.

Bedrock Aquifers

Trenton and Black River Limestones: Thin, irregular beds of gray to buff limestone and dolomite, including some interbedded shale and shaly limestone and dolomite. This unit is of Ordovician age and contains water in interconnected openings along bedding planes and fractures. Many of these openings have been enlarged by solution. Near-surface zones of the Trenton and Black River Limestones are sometimes subject to contamination from surface pollution sources.

Undifferentiated Dolomites, Limestones, and Sandstones of late Cambrian to early Ordovician age: These rocks consist of beds of limestone and dolomite, sandstone, sandy and shaly dolomite, and dolomitic sandstone. Both the limestone and sandstone beds yield water to wells.

Munising Sandstone: The Munising Sandstone is of Cambrian age, and is a fine, medium, and coarse-grained white, buff, and gray sandstone. The Munising contains some lenses of silt and shale and some conglomerate at the base.

Jacobsville Sandstone: This medium-grained quartz sandstone is of Cambrian or possibly Precambrian age, and is generally light red to brown in color, sometimes mottled and streaked with white and sometimes containing beds of fine-grained sandstone, shale, and conglomerate. The Jacobsville Sandstone is one of the most important bedrock aquifers in the area and, where glacial drift is thin or absent, may be an important source of water in some locations.

Precambrian Rocks: These are igneous, metamorphic, and sedimentary rocks which generally underlie the younger Paleozoic limestones and sandstones, and the glacial deposits. They generally have low porosity and permeabilities, and are consequently not important aquifers. Better yields can usually be obtained from the younger consolidated and unconsolidated aquifers which overlie the Precambrian rocks.

Ground Water Conditions in the Various Counties

Because the main source of ground water data is a series of reports, each dealing with the ground water resources of a particular county, the county-by-county approach has been used in discussing the ground water resources of the Study Area.

Terms which are used in the discussion are defined as follows:

Water hardness scale:

soft	less than 60 mg/l hardness expressed as CaCO_3
moderately hard	60 to 120
hard	120 to 200
very hard	over 200

Well yield scale:

small yields	1 to 10 gpm
moderate yields	10 to 100
large yields	over 100

When the term "objectionable" or "excess" iron is used, it generally means iron concentrations greater than 0.3 mg/l. This is the limit suggested by the U. S. Public Health Service, and larger concentrations cause staining of laundry, sinks, and utensils, in addition to causing unpleasant taste and promoting the growth of iron bacteria.

Alger County

Only a narrow strip along the western edge of the County is within the Study Area. Surficial deposits within the northern third of this strip consist of glacial lake deposits which generally form only a thin veneer over high points in the underlying bedrock. Thicker deposits may be found locally where valleys or depressions exist in the bedrock surface. These lake deposits are generally well sorted, permeable sand. They form fairly important local sources of water where present in sufficient thickness, with yields of 10 to 20 gpm obtainable from properly constructed wells.

The surficial deposits mantling the southern two-thirds of the strip within the Study Area form a gently undulating till plain. The glacial drift deposits beneath this plain are generally quite thin, and the underlying bedrock is exposed along some road cuts as well as along the bottoms of many of the streams. This till plain consists of a poorly sorted mixture of sand, silt, clay, and rock. Because the till is thin and has generally low permeabilities, it is not an important source of water.

Directly underlying the till in this southern portion of the strip are the Trenton and Black River Limestone Formations. These rocks are the principal source of water in this part of the County. Water is found along joints, fractures, and bedding planes, especially where these openings have been enlarged by solution. Because the glacial drift deposits are thin, many of the wells which take water from the Trenton and Black River Limestones are less than 50' deep, and most are less than 100' deep. These formations yield small supplies of water for domestic and farm use, and locally can yield up to 20 gpm, particularly if wells are located near streams so that recharge from the stream can take place. The Trenton and Black River Formations produce water which is hard to very hard, and some wells also produce water containing excessive iron. The principal quality problem, however, is bacterial rather than chemical. These formations generally lie at a shallow depth so that there is little opportunity for filtration of organic pollutants which may originate from surface or near-surface sources such as barnyard waste and septic tank effluents. The relatively

large fissures in the limestone are not able to provide the same type of filtering action which normally occurs as bacterially contaminated water moves through appreciable thickness of granular materials such as sand and gravel. The thickness of the Trenton and Black River limestones ranges from a few feet at the north edge (approximately at Township 45 North) to over 200' in the southwestern corner of the County.

In the west-central part of the County, sandstones and dolomite of Cambrian and Ordovician age are the main source of water. The sandstone beds in the Cambro-Ordovician sequence tend to be thinner or are absent in the western part of the County, and most of the wells tapping these rocks take water from crevices and solution openings in the beds of dolomite, with yields of up to 50 gpm in some areas. The dolomites and sandstones are probably from 150' to 200' thick and produce water of good quality. The water from the dolomite portion of the sequence tends to be harder than that from the sandstone, although both the dolomite and the sandstone produce water which is softer than that from the overlying Trenton and Black River limestones and harder than that from the underlying Munising sandstone, which is of Cambrian age. This unit varies from 50' (southern Alger County) to 200' in thickness at its northern edge (approximately T46N). This formation consists of well sorted and weakly cemented sands of moderate permeability. The Munising sandstone has not been extensively developed as a source of ground water, although small to moderate yields would be possible from this unit.

In the northwestern part of the County, the Jacobsville sandstone of Cambrian to Precambrian age lies at shallow depth beneath the glacial lake deposits previously discussed, and is the principal aquifer in the area. Because the Jacobsville is a well cemented sandstone, its primary permeability is low; however, it has a fairly high secondary permeability due to openings along joints, fractures, and bedding planes. The Jacobsville attains thicknesses as great as 1,000' along the Lake Superior shoreline at the north edge of Alger County, although it becomes thinner to the south, and disappears entirely in southern Alger County. Most of the wells tapping the Jacobsville are less than 100' deep. The Jacobsville sandstone produces water which is generally moderately hard to hard, and in some areas it contains objectionable amounts of iron, although the excessive iron is satisfactorily reduced to acceptable levels by commonly used treatment methods. Some of the deeper wells in the Jacobsville produce water

having a high chloride content, so that it is generally advisable in western Alger County to complete wells in the Jacobsville at as shallow a depth as is practical.

It is likely that detailed investigations would be required to develop water supply systems producing more than 50 gpm in Alger County.

Delta County

The only portion of Delta County which falls within the Study Area is the extreme northwest corner. The surficial deposits in this part of the County consist mainly of fairly thin till plain deposits consisting of poorly sorted clayey material which generally has a low permeability. Consequently the only important aquifers in the area of interest are the bedrock aquifers lying beneath the thin mantle of glacial drift.

The main source of water in western Delta County is the Trenton and Black River limestones, and moderate amounts of water are available from these bedrock aquifers. The water is of the calcium-magnesium-bicarbonate type and is hard. In some areas, the Trenton and Black River Formations produce water which has a high chloride content. The thickness of these limestones varies from 150' to 300'. The specific capacity of wells tapping these limestones is generally low, and large yields are generally not obtainable from them.

Lying beneath the Trenton and Black River limestones but above the Precambrian rocks are the Munising sandstone and the Au Train Formation, a potential water source which may be treated as a single aquifer. The Munising sandstone, which ranges from 50' to 200' in thickness, is cemented with silica and is overlain by the Au Train Formation, a 300' thick sequence of thin to medium-bedded sandy dolomite and dolomitic sandstone containing lenses of quartz sand. Although the sandstone beds yield the majority of the water from the Munising and the Au Train, some water is also obtained from fractures and solution openings in the dolomite beds of the Au Train Formation. Some of the wells tapping the sandstone flow at the surface due to artesian pressure, and yields as great as 250 gpm have been reported. The Munising sandstone produces a calcium-magnesium-bicarbonate water which is generally of good quality. The Au Train Formation yields a similar type of water, although water from the more dolomitic parts of the Au Train Formation tends to be somewhat harder.

In general, development of ground water resources in Delta County will involve problems of water quality rather than problems in location of adequate quantities of water. Wells tapping both the Trenton and Black River limestones, and the underlying Munising and Au Train Formations have relatively high yields.

Menominee County

The Northwestern third of Menominee County lies within the Study Area. The surficial deposits in most of this northwestern part of the County consist of till plains, drumlins (low, smoothly rounded, elongated and oval hills whose long axis parallels the direction of movement of the glacier), and shallow outwash deposits. These surficial deposits are a mixture of clay, silt, sand, and gravel, generally less than 40' thick, but as much as 100' thick beneath some of the larger drumlins. The glacial deposits in the northern part of the County tend to be more sandy than those in central and southern Menominee County, and properly constructed wells may yield as much as 50 gpm from these deposits in some places.

Portions of the western edge of the County are underlain by moraine, which tends to be thicker and sandier than the glacial deposits in the central part of the County, and locally includes thick and extensive beds of sand and gravel. Properly constructed, large (8"-12") diameter wells yield 100 to 200 gpm from these deposits, which are potentially an important source of water.

Although significant yields are possible from wells tapping the glacial deposits, most wells obtain their water from the underlying bedrock aquifers. The uppermost bedrock units in much of the western part of the County are limestone and dolomite, sandy and shaly dolomite, and dolomitic sandstone. The sandstone beds are thicker and more extensive in the northern part of the County, and range in thickness from 0 to 300'. Wells tapping these aquifers are from 30' to 200' deep, average 70' to 80', and are mostly less than 100' in depth. The wells tapping these limestones and sandstones generally obtain yields of only 5 to 10 gpm; however, some wells may produce as much as 50 gpm. Water from this unit is generally of good quality, although it is hard, and in some areas contains objectionable amounts of iron. Both the hardness and excessive iron are amenable to treatment.

Lying beneath the Cambro-Ordovician limestones and sandstones are sandstones of Cambrian age. This unit consists of pink, gray, and white sandstone. The thickness varies from 200' in the southern part to 50' in northern part of Menominee County. Because these sandstones are overlain in most areas by shallower and more accessible aquifers (e.g., Cambro-Ordovician limestones and sandstones and glacial deposits), they are not generally very important for small domestic supplies of 5 to 10 gpm. They have considerable potential for moderate to large supplies, however, and properly constructed wells which were deep enough to tap the Cambrian sandstone could yield as much as 100 to 200 gpm. Wells presently tapping this sandstone for municipal or industrial use are about 400 or more feet deep. The quality of the water from this sandstone is generally good, low in iron content, and of moderate hardness.

The lowermost bedrock unit consists of rocks of Precambrian age, such as granite, schist, marble, and iron formations. The Precambrian rocks crop out in a narrow band along the west edge of the County. The Precambrian rocks are not important aquifers except in local areas in western Menominee County, where the glacial drift is thin or absent. In such areas, the Precambrian rocks yield small supplies of water from fractured and broken zones. Little is known about the chemical quality of water from the Precambrian rocks because so few wells tap this unit. One sample obtained from a well located at the west edge of the County was of good quality, with a total dissolved solids content of 315 ppm and a hardness of only 76 ppm.

In Menominee County, the natural ground water discharge from aquifers (spring flow) far exceeds present ground water pumpage so that there is a good potential for development of ground water resources in the County.

Marquette County

The economy of Marquette County is geared to the iron ore industry, and because of the water requirements in ore beneficiation processes, fairly heavy demands are made upon the water resources of the area. Almost all of this County lies within the Study Area.

The aquifers consist of bedrock, overlying glacial drift and alluvium. The bedrock is primarily of Precambrian age, although there are some areas of Cambrian sandstone in the eastern and southeastern part of the County. The glacial deposits consist of relatively thin till deposits overlying

the bedrock and also areas of fairly thick outwash deposits (up to 250' thick). The yields from Precambrian bedrock tend to be low, as these rocks generally have low porosity and permeability. The water supply potential of the glacial drift aquifers is related to both their composition and thickness. The best sources for ground water development are thick glacial outwash and alluvial deposits, while the least favorable areas are those in which Precambrian bedrock is overlain by only a thin mantle of glacial drift.

In the area southeast of Goose Lake, there is a fairly extensive outwash deposit consisting mainly of sand. Knobs of bedrock exposed in the outwash plain indicate a very irregular bedrock surface lying beneath the outwash deposits. However, the outwash material attains a thickness of as much as 240' in some areas. The depths to water in this material range from less than 5' to about 150'.

A pumping test conducted with a flowrate of 310 gpm and a duration of 15 hours in the outwash material indicated a coefficient of transmissibility of 130,000 gallons/day/foot and a storage coefficient of 0.16. The coefficient of transmissibility is an indication of the ability of the aquifer to transmit water, and values in excess of about 10,000 gpd/ft. generally indicate that wells will be able to supply municipal or industrial use. The storage coefficient gives an indication of the capacity of the aquifer to store water and generally ranges from about 0.01 to 0.35 for water table aquifers such as the glacial drift materials.

In the Humboldt area east of Lake Michigamme, the outwash has a saturated thickness of as much as 100', and pumping tests in this area indicate that the coefficient of transmissibility ranges from 7,000 to 20,000 gpd/ft. and averages about 12,000 gpd/ft.

Another area of extensive outwash deposits is in the West Branch Creek area east of Republic. The outwash in this area attains thicknesses of up to 160', and depths to water range from less than 10' to nearly 60' in this material. The coefficient of transmissibility in this area ranges from about 10,000 to 30,000 gpd/ft. Many stream valleys in this area contain deposits of outwash and alluvium which might provide moderate supplies of water. In the outwash and alluvial deposits, the total dissolved solids generally range from about 25 to 260 ppm.

In USGS Water Supply Paper 1842 by Wiitala, et al. (1967), results of chemical analyses of ground water from the Marquette-Iron Range area are presented, which indicate that the

outwash or alluvium produces soft to moderately hard water, with nearly one-half of the wells tapping these deposits having soft water (60 ppm or less). The most objectionable constituent of water from wells in the area covered by the report was iron. Of 37 samples analyzed for iron, more than half exceeded the recommended limit of 0.3 ppm, and about one-third had in excess of 1 ppm of iron. When the iron concentration is as great as 1 ppm, there is a possibility of precipitate formation and clogging of pipes. The maximum iron concentration found in waters from the outwash materials in the Iron Range area was 8.1 ppm.

Although detailed information on the water supply characteristics of the Cambrian sandstones which overlie the Precambrian rocks in the eastern part of the Marquette-Iron Range area was not given in Water Supply Paper 1842, it is probable that these sandstones would produce small to moderate yields from fractures and other openings.

Because the majority of Marquette County is underlain by dense Precambrian bedrock, the overlying glacial deposit aquifers are the most important sources of ground water, and the most promising areas are those where fairly extensive and thick outwash and alluvial deposits are found.

Dickinson County

Dickinson County lies completely within the Study Area, and the bedrock under most of the County is made up of igneous and metamorphic rocks of Precambrian age. Along the east edge of the County, the Precambrian rocks are overlain by sandstones of Cambrian age and sandy dolomites and dolomitic sandstones of Cambrian and Ordovician age.

Large diameter wells penetrating over 50' into these Cambro-Ordovician rocks may yield up to 50 gpm. If satisfactory yields are not obtained, wells may be deepened to penetrate the underlying Cambrian sandstones. In the Cambrian sandstones, large diameter wells which penetrate over 50' into the sandstone may yield as much as 100 gpm. The thickness of these Cambrian and Cambro-Ordovician deposits ranges from perhaps 100' at the east edge of the County to zero at approximately the west edge of Range 27 West.

In areas further west where the bedrock is of Precambrian age and crops out at the surface or has only a thin covering of glacial deposit, the potential for development of high capacity wells is poor. Although specific capacities of as much as 5 gpm/ft. of drawdown have been reported in wells tapping the Precambrian, most wells have a specific capacity of less than 1 gpm/ft. In the areas where the Precambrian bedrock crops out or lies at a shallow depth, the most

promising areas for wells are generally in the valleys where there is more likely to be somewhat thicker glacial deposits and more extensively weathered zones in the bedrock. If more than 20' of permeable glacial deposit overlying the bedrock is present, domestic supplies of a few gpm may be developed, and a few wells may yield more than 10 gpm. Because joints and fractures in the Precambrian bedrock tend to become smaller and less extensive with depth, it is generally futile to drill more than about 100' into bedrock.

In other areas of the County where thicker outwash deposits of sand and gravel overlie the Precambrian bedrock, wells over 12" in diameter may produce yields in excess of 100 gpm. The best sites for wells in outwash deposits are in valleys, on low terraces, or along streams where the potential for recharge is good.

Another surficial deposit found in Dickinson County is that of sandy till with pockets of sand and gravel. Although large diameter wells tapping sandy till along streams or near lakes may yield as much as 100 gpm, there is a possibility that yields may decline with time, since these aquifers are generally of small areal extent.

Glacial till deposits composed of unsorted and unstratified mixtures of sand, silt, clay, and stones will generally have only small yields, and only a few wells will yield more than 10 gpm. This material is often relatively impermeable, and dug wells having large infiltration areas and large storage capacities are sometimes more successful than smaller diameter drilled or driven wells.

Another category of surficial deposit found in Dickinson County is swamp deposits. These deposits include peat and muck, and are generally confined to flat lowland areas alongside streams, lakes, or former lakes. Because these deposits sometimes overlie thick deposits of sand and gravel, large diameter wells may yield 100 gpm.

Ground water in Dickinson County is generally hard to very hard (150 to 250 ppm with a few wells and springs more than 300 ppm). The iron content of both glacial deposit and bedrock wells is quite variable, and ranges from less than 0.1 ppm to more than 4 ppm. Both hardness and excessive iron are amenable to treatment, and the quality of ground water in the County is otherwise generally suitable for household and most other uses.

In summary, the glacial deposits are the major source of ground water in Dickinson County, but the physical properties of these materials vary widely, and they exhibit specific capacities ranging from less than 1 to more than 300 gpm/ft. of drawdown. Because the surface of the underlying bedrock is highly irregular (especially within areas of Precambrian rock), the glacial deposits also vary in thickness from 1' to more than 150'. Wells in the County range from 1½" to 60" in diameter and from 12' to more than 350' in depth, but most of the wells are 5" to 6" in diameter and 25' to 100' deep. The most favorable areas for large-scale ground water development are in sand and gravel deposits along major streams, while the least favorable areas are those in which Precambrian rocks crop out or are covered by only a thin mantling of glacial deposits.

Baraga County

Baraga County lies almost entirely within the Study Area. Water is obtained from both bedrock and glacial deposit aquifers. The glacial deposit aquifers are generally more productive, with yields ranging from 5 to 115 gpm and averaging about 30 gpm. Wells in the glacial deposits are generally less than 100' deep. The yield from the bedrock ranges from 1.5 to 50 gpm, with an average value of about 10 gpm.

In the northwest part of the County, most wells take their water from the Jacobsville sandstone bedrock and are from 100' to 500' deep. These wells generally penetrate 50 to 250 feet of sandstone. Wells deeper than about 200 feet may contain as much as 500 mg/l of chloride. The wells drilled in glacial deposits are shallower--perhaps no more than about 200' deep.

On the Abbaye Peninsula, both bedrock and glacial deposit wells are 100' to 200' deep, and may produce water having a high iron content. In northeastern Baraga County, a few wells obtain good quality water from glacial deposits although bedrock wells may produce water having a high chloride content. In the central portion of the County, there is very limited ground water development. Most household wells are in glacial deposits and are generally less than 100' deep. There are also some springs that yield water from glacial deposits. The wells tapping bedrock in this area are generally less than 100' deep and have only limited yields. In the south-central part of the County, conditions for ground water development appear to be unfavorable and very limited development has taken place.

In the Three Lakes resort area, most wells are less than 100' deep, and obtain water from the glacial deposits. Iron concentrations of over 5 mg/l are common in glacial deposit wells, although bedrock wells tend to produce water having a lower iron content.

There is a wide variation in water quality throughout the County. Shallow wells tapping the glacial materials tend to produce water having a low pH (acidic water). Most of the glacial deposit wells and a few of the bedrock wells have significant amounts of iron in their water, although iron content varies with well location.

Iron County

The eastern two-thirds of Iron County lies within the Study Area, and is underlain by hard and dense metamorphic and igneous Precambrian bedrock mantled by various types of glacial deposits. The wells tapping bedrock generally have low yields, with some wells yielding only about 1 gpm. Because fractures in the bedrock tend to become smaller and less numerous with depth, few wells are drilled more than 100' into the bedrock. The specific capacity of most wells drawing water from the bedrock is less than 1 gpm/ft. of drawdown. Most of the bedrock wells tend to have low iron content, although perhaps one-third of the wells have iron concentrations in excess of 0.3 ppm. The Precambrian rocks tend to yield moderately hard to hard water, and Doonan and Hendrickson (1967) state in their report that none of the samples tested from wells in the Precambrian were less than 60 ppm hardness.

Springs are not numerous in Iron County, and are found mainly in areas of moraines or till plain deposits. These springs typically yield only about 1 gpm, although springs emerging from outwash deposits near streams have been known to yield as much as 30 gpm.

Since bedrock within Iron County consists almost entirely of dense Precambrian rocks, the overlying glacial deposit which covers more than 90% of the area is the most important source of ground water. A variety of surficial deposits are present in the County.

Moraines are ice-deposited features formed along the edge of retreating glaciers and consist primarily of unsorted sand, gravel, silt, and clay, with occasional lenses of sand and gravel. Most of the wells tapping the morainal deposits are 5" to 6" in diameter and are generally less than 100' deep. They normally yield enough water for

domestic supplies, although specific capacities of most wells are less than 1 gpm/ft. of drawdown. The depth to water in the moraine deposits ranges from 3' near streams or lakes to as much as 133' in wells located on hilltops. Water from the moraines is generally hard, with perhaps 75% of the wells falling in the moderately hard to hard category. The water also tends to have fairly high iron concentrations, with perhaps only about one-third of the wells having less than the recommended limit of 0.3 ppm.

Till plain deposits are another source of ground water and have small to moderate yields. Localized areas can sometimes be found which contain lenses and pockets of sand and gravel, in which case larger yields may be obtainable. Depth to water in wells tapping the till plain deposits ranges from about 9' in low-lying areas to about 100' or more on the hilltops. Most of the wells tend to have a specific capacity of more than 1 gpm/ft. of drawdown, although specific capacity values in this material may range from less than 0.1 to more than 30 gpm/ft. The till plain wells generally produce rather hard water, with more than half in the moderately hard to hard class and about one-fourth in the very hard class. The iron content tends to be low, with most wells producing water having less than 0.3 ppm iron concentration.

The outwash plains, although of limited areal extent, are the most favorable areas for obtaining large supplies of ground water. Large diameter wells located along stream valleys produce enough water for municipal or industrial supplies, and yields of several hundred gpm are possible in some areas. Most of the high production wells in the County are near major streams, and it is probable that many of these wells are obtaining recharge from the streams. The specific capacities in the wells tapping the outwash deposits range from 0.1 to 28 gpm/ft. of drawdown, and depth to water in areas along streams is generally low, the water is mostly moderately hard to hard, and some of the water from these wells is very hard.

There are also some areas of swamp deposits in Iron County. In places along stream valleys where these fine-grained deposits are underlain by coarse sand and gravel, large municipal or industrial water supplies could be developed.

In general, the total dissolved solids content of ground water in Iron County is probably less than about 500 ppm. Much of the water tends to be moderately hard to hard, so that softening is often necessary or desirable. About

half the wells produce water having excessive (more than 0.3 ppm) iron, and iron removal is desirable. Some bacterial contamination from septic tank effluent may be present in some shallow aquifers in the southern part of the County. However, the water quality is generally satisfactory for most uses, and the iron and hardness problems can usually be solved by standard treatment methods.

To summarize, the main source of ground water in the County is the glacial deposits overlying the dense Precambrian bedrock. The most favorable areas for large-scale ground water development are outwash deposits located along major streams, while the least favorable areas are those in which bedrock crops out or has only a thin covering of glacial material. The most favorable areas for ground water development are in stream valleys or other low areas, although the thickness and composition of the glacial deposits present must be considered in addition to the topographic situation.

Houghton County

Only a very small part of east-central Houghton County lies within the Study Area. In this area, wells yielding up to about 50 gpm may be developed from the Jacobsville sandstone at depths ranging to about 500'. Water from depths of greater than 200' may be high in chloride.

Small yields may be expected from glacial deposits at depths probably less than 100'. The largest yields from surficial deposits can probably be expected from the alluvial deposits in the Sturgeon River valley. This Sturgeon River, which originates in Baraga County and flows generally west and then north before terminating in Portage Lake below Houghton City, is not to be confused with the Sturgeon River that originates near the Town of Sagola in Dickinson County and flows generally east and south through the Sturgeon River State Forest before emptying into the Menominee River below the Town of Vulcan.

RELATIONSHIP TO OTHER DATA

Depth to Water

Depth to water within the Study Area could prove to be of considerable importance in several respects. For construction operations involving large excavations, the depth to water could be of significance in the dewatering of excavation. Areas where water is near the surface could prove to be more difficult to dewater. Dewatering operations during construction excavation could conceivably cause a general lowering of the water table in the vicinity of any construction areas where large amounts of dewatering proved to be necessary. In some areas where mine dewatering has caused long-term lowering of the water table, flooding of basements has occurred due to rising water tables following cessation of pumping. A conceivable effect of a general lowering of the water table during construction would be a temporary decrease or perhaps even cessation in the yields of water wells located close to areas where large-scale dewatering operations were taking place. Large-scale ground water extractions carried out over a long period of time could conceivably cause some compaction of granular glacial deposits, with resulting land subsidence.

Quality of Water

The quality of ground water and the amounts and types of dissolved materials in the water could have several effects. Various factors operate to affect the quality of the ground water. Lithology is one important factor, and in the Study Area, the rock types present have a definite effect on the dissolved materials found in the ground water.

Waters of the Study Area tend to be rich in calcium, magnesium, and bicarbonate because many of the rocks (particularly limestones) are rich in these materials and as water moves through the rocks, it becomes a calcium-magnesium-bicarbonate type water having a high degree of hardness. The fact that the waters of this region are very hard is significant. If the water is to be used for water supply purposes, it would cause the formation of scale in piping, water heaters, or other equipment through which the water passes. The water will probably require some treatment to remove the hardness before it will be suitable for use in many types of equipment.

In connection with hardness problems, it should be mentioned that a high concentration of total dissolved solids and/or high values of specific conductance in the water may mean it will have corrosive properties, and this is particularly true if chloride is present in appreciable quantities. A corrosive water could conceivably cause problems with buried metallic elements if they are not adequately protected. This should not be a problem in the Study Area, since electrical conductance values of the ground water are not excessive--generally less than 800 microhms, while TDS values are usually below 500 ppm.

In addition to lithology, another factor affecting ground water quality is the rock-water contact time. If the water moves slowly through the rocks and is in contact with the rocks for long periods of time, then there is more opportunity for the water to dissolve material from the rocks through which it is passing. Intensity and type of land use can affect ground water quality, and excessive amounts of nitrate, phosphate, sulfate, and chloride may be indicative of pollution problems. In the Study Area, there is some indication of bacterial contamination of shallow aquifers, particularly limestones, due to surface pollution sources, but this problem is not widespread or serious.

If disposal of significant quantities of waste waters through the use of septic tanks and leach fields is required, degradation in ground water could occur. There is some evidence of water quality degradation in shallow aquifers due to septic tank effluent in some of the more highly populated parts of southern Iron County.

Several important constituents of the water in wells were examined, and excess quantities are shown by a coding system on the data map. As previously mentioned, high total dissolved solids content or specific conductance may imply that the water will cause corrosion problems. Also, the total dissolved solids content is a good general indication of the overall suitability of the water for a variety of uses; and waters having a high TDS may contain dissolved minerals causing the water to have a disagreeable taste or to be unsuitable in some other respect. In the Study Area, there are very few wells having a TDS concentration in excess of 1,000 mg/l, and many of the wells have values of less than 500 mg/l, so that high TDS values are generally not a problem.

Calcium and magnesium can be dissolved from practically all soils and rocks, but particularly limestone and dolomite, which are abundant in portions of the area. Calcium and magnesium are the cause of most of the hardness and scale-forming properties in water, and it may prove desirable or

necessary to treat water which is excessively hard before it will be suitable for many uses to prevent scale formation in piping and other equipment. Sodium and potassium are also dissolved from almost all rocks and soils, and large amounts, in combination with chloride ion will cause the water to have a salty taste.

High bicarbonate levels in ground water can be caused by the action of dissolved carbon dioxide in water which is passing through carbonate-rich rocks such as limestones or dolomites. The diluted carbonic acid formed by the reaction of carbon dioxide and water dissolves the carbonate rocks, and a hard water, rich in calcium and magnesium bicarbonates is the result. The hard water will cause undesirable scale formation in piping and other equipment if it is not treated prior to use. Sulfate in ground water can be dissolved from rocks and soils which contain gypsum, iron sulfides, or other sulfur compounds. If calcium or magnesium are also present, the resulting calcium or magnesium sulfate may be one of the sources of hardness in the water. If sulfate is present in large amounts, it may impart a bitter taste to the water.

Because there are iron-bearing formations in parts of the Study Area, many of the wells produce water which has iron concentrations in excess of the recommended limit of 0.3 mg/l. As the ground water percolates through these iron-rich materials, iron is dissolved so that the ground water often contains significant quantities of iron. When this iron-rich ground water is pumped to the surface and exposed to the air, the iron oxidizes and produces a reddish brown sediment which causes staining problems in laundry, utensils, sinks, or other equipment in contact with the water. Iron-rich water may also have an unpleasant taste and will favor the growth of certain bacteria which utilize iron as part of their metabolism. These bacteria can form growths large enough to cause clogging of pipes, well screens, etc., so it is desirable to remove excessive iron to avoid these problems. Although many of the wells in the Study Area produce iron-rich water, standard treatment systems are generally effective in removing iron.

Chloride is dissolved from rocks and soils but is also present in sewage, and large amounts of chloride ions may be indicative of pollution problems. Large amounts of chloride will also increase the corrosiveness of water, and may give the water a disagreeable salty taste, especially if sodium is also present.

Nitrate in water may be caused by decaying organic matter, sewage, fertilizer, and nitrates in soil. It is not normally an important natural constituent of ground water, however, and high nitrate concentrations should be viewed as an indicator and a warning that pollution may be taking place, and that there is a possibility that harmful bacteria are present. Nitrate also encourages the growth of algae and other organisms which produce undesirable tastes and odors.

Aquifer Properties and Yields

One aquifer property of considerable importance is transmissibility, which is an indication of its ability to transmit water.

Although no values of transmissibility were available for the bedrock aquifers of the Study Area, it is probable that values in the Precambrian rocks are low. Some of the Paleozoic rocks bordering the Precambrian, however, probably have fairly high transmissibility values. Some of the glacial drift materials have high values of transmissibility, and pumping tests conducted in the Iron Range area of Marquette County indicated that glacial deposits in this area have transmissibility values ranging from 3,000 to as much as 150,000 gallons per day per foot (gpd/ft). Transmissibility is an important parameter in connection with such considerations as developing a ground water supply (high value of transmissibility desirable) or dewatering operations during construction (low value desirable).

Another important property of the aquifer is its porosity. The porosity is an indication of the void space within the aquifer and is an index of the aquifer's ability to store water. Although no porosity figures are given for the various aquifer units, it is probable that the Precambrian rocks have significantly lower porosity values than some of the younger Paleozoic rocks which border the Precambrian. The glacial drift materials which overlie both the Precambrian and Paleozoic bedrock in most of the Study Area generally have a higher porosity than the relatively dense Precambrian rocks. High porosity values and consequent large water storage potential would obviously be desirable from the viewpoint of developing a water supply, and undesirable when considering potential dewatering requirements.

Another property which is important is the specific capacity. This is an indication of the ability of the aquifer to supply water to a well, and large values would be desirable from a water-supply development viewpoint and undesirable from a dewatering viewpoint. Specific capacities in the Precambrian rocks are low, usually less than 1 gpm/ft.

Well yield data and specific capacity data are available on a fairly large number of wells in the Study Area. These data are tabulated in Appendix B. As can be seen from these data, while the dense Precambrian rocks generally have low yields and low specific capacities, the younger rocks such as the Paleozoic limestones and sandstones can have fairly high yields and specific capacities. In general, the highest yields and specific capacities are found in the glacial drift material, where yields can be several hundred gpm and specific capacity values of up to 70 gpm/ft.

The well yields from the Precambrian rocks are generally low, often less than 10 gpm. The most favorable areas for ground water development in the areas where Precambrian rocks are at, or near, the surface are generally the valleys where the bedrock may be more weathered and greater thicknesses of glacial overburden may be present. The Paleozoic sandstones and limestones generally have small to moderate yields, although yields from these rocks can be 200 to 300 gpm in some areas. Some of the glacial deposits, particularly outwash sands and gravels along major streams, can have high yields--as much as several hundred gpm.

VALIDITY

General Procedures

A bibliography of water-oriented data sources was compiled at the Michigan Technological University in Houghton, and was later expanded at the U. S. Geological Survey Library in Menlo Park, California, and the Stanford University Libraries. As publications were researched, additional data sources were found which were then added to the list.

A review of the data sources was made, and copies of valuable information were obtained. Visits were made and discussions were held with various individuals from universities, private companies, and both State and local government agencies in Michigan. A great deal of valuable information was obtained during these visits and discussions.

Pertinent information was abstracted from the various data sources and was synthesized into the drawings, tables, and text dealing with the subsurface water hydrology of the Study Area.

Data Sources

The primary source of data for ground water information in the Study Area was a series of reports, each usually dealing with a single county, which were done jointly by the USGS and the Geological Survey Division of the Michigan Department of Natural Resources. Reports were available for all eight counties of interest, although in the case of Marquette County, work is in progress, and the report has not yet been published. In Marquette County, the unpublished information was supplemented by USGS Water Supply Paper 1842, published in 1967. This report deals with both the surface water and ground water resources of the Marquette-Iron Range area in Marquette County. The County ground water reports are all fairly recent, the earliest (Delta County) being published in 1960.

These reports generally discussed items such as the bedrock and surficial geology and how they were related to the quantity and quality of ground water available. The various bedrock and glacial aquifers were described and discussed. Information on representative wells and springs was included, and in most cases, tabular data dealt with items of information such as well diameters, depths to water, depth of well, aquifer tapped, etc. Water quality data were also generally available, and some information on well

yields and specific capacities was usually available in these reports. In general, the county reports gave a good summary of ground water conditions in the area.

Data Reliability/Limitations

The county ground water reports utilized as the major source of information for this study are considered to be generally up to date and reliable. These reports were usually based upon geologic data and records of water wells from the files of the Michigan Geological Survey, the U. S. Geological Survey, and from private well drilling companies. This information was supplemented by field inventory of selected wells and reconnaissance mapping of surficial formations in the field. All of the data were then used in the preparation of the county reports.

Although these reports do not give data on all wells existing in the various counties, discussions with USGS officials in Escanaba, Michigan, revealed that the reports typically include tabular data on approximately one-half of the well records on file at the time the report was written. The data selected for inclusion in each report were carefully examined to give a representative and accurate picture of ground water conditions and resources in the county. Because these reports did not include all data on file, and because additional wells have been drilled since the reports were published, there was some concern about whether the county reports needed to be supplemented by additional information on file with the USGS. This question was brought up in discussions with the Escanaba office of the USGS, and it was decided that the county ground water reports gave an accurate picture suitable for the present study and that the reports need not be supplemented.

With respect to locational reliability of the wells, the well location and identification system used in Michigan has been previously discussed, and this system allows the location of wells to within a 40 acre area, and measuring 1/4 mile by 1/4 mile on the ground. With respect to chemical analyses, the laboratory analyses are considered to be very accurate. In some instances, analyses have been performed in the field using a portable analysis kit, and the results are probably accurate to within $\pm 10\%$ to $\pm 30\%$, depending upon the concentration and type of constituent being analyzed. Although five important cations and four important anions are included in the "excess ion" symbol shown on the map, it should be realized that in some cases, concentrations of some of these important ions have not been determined in the water analysis, so this represents a limitation on some of the water quality data appearing in the county ground water reports.

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APPENDIX A

RECORDS OF WELLS IN STUDY AREA

ALGER COUNTY
WELL RECORDS

Records of wells and test holes in Alger County

Aquifer: Cj, Jacobsville Sandstone; Cm, Munising Sandstone; Ocu, rocks of Ordovician and Cambrian age, undifferentiated; Obr, Black River Limestone; Ot, Trenton Limestone; Qgd, glacial drift, undifferentiated; Qs, glacial sand; Qg, glacial gravel; Qeg, glacial sand and gravel.

Use: D, domestic; I, industrial; N, not used; O, observation well; P, public supply; T, test well.

Depth to Water: In feet below land surface; M, measured; R, reported.

Altitude: In feet above mean sea level, estimated from U. S. Geological Survey topographic maps.

Well Number	Location in Section N E S	Owner	Driller	Year Drilled	Diameter (in.)	Depth (ft.)	Aquifer	Use	Depth to Water	M or R	Date Measured	Altitude	Remarks
47N 22W	5-1 SE SE	Tioga Tavern	-----	---	5	80	Cj	P	-----	-	-----	670	Bedrock near surface.
9-1 NW NE	Peter Arsenaault	-----	---	---	80	Cj	P	-----	-	-----	---	---	-----
44N 22W	5-1 SW 1/2	Mich. Ery. Dept.	Wm. Nance	---	5	45	Obr	P	22	R	1956	995	Bedrock at 21 feet.
9-1	-----	-----	-----	---	---	398	---	P	---	-	-----	935	Test well for mineral.

BARAGA COUNTY
WELL AND SPRING RECORDS

[illegible]

WELL DATA													
TOWNSHIP AND RANGE	SECTION NO.	WELL NO.	LOCATION		WELL DEPTH (feet)	WELL DIAMETER (inches)	ELEVATION AT BOTTOM OF WELL (feet)	WATER GAGING UNIT	FIELD (ft./in.)	ELECTRIC CABLE (feet)	DEPTH TO WATER (feet)	DATE OF MEASUREMENT	REMARKS
			%	%									
49N34W	32	1	SW	NW	63	1 1/4	1540	Gd			20	1968	
49N35W	34	1	NE	NE	33	5	1350	B+			12	1964	Perch R. Roadside Park
49N35W	28	1	SW	NE	19	7	1720	Gd			10.69	9-22-69	Leased to Mich. D.N.R.
49N32W	6	2	NW	SW	42	6	1680	B+			—	—	Will Pump 50 gal. then water
49N33W	18	1	NE	SW	11	6	1290	Gd			9.09	10-15-69	obs. well in forest reservoir
49N34W	14	1	SE	NE	139	6	1285	Gd			55	1956	Bavaga Correction Camp
	28	1	NW	SW	22	2	1270	Gd			—	—	Big Lake Campground
50N31W	26	1	SE	NW	—	1 1/4	1800	Gd			—	—	Well inside locked hunting area
50N32W	18	1	NW	NW	22	2	1170	Gd			—	—	Lewis Lake Campground, High Iron
50N33W	3	1	SW	SE	90	5	840	Gd			—	—	Water Cloudy
	5	1	SE	NE	160	6	610	B+			+1	9-22-69	Flowing well at edge of football field
	10	1	NE	NW	120	4	860	Gd			12	1969	
	11	1	NE	NW	—	—	1000	Gd			—	—	Dug well, buried, High Iron, Cloudy
	11	2	NW	NE	71	4	990	B+			—	—	Good yield, but high in Iron
	22	1	NW	NW	45	5	980	B+			—	—	Supplies vegetable, stone, pump 2 1/2 gal. in 10 min by hand
	28	2	SE	SE	30	5	1180	B+			—	—	Insufficient yield for Bavaga State Forest Survey
50N34W	1	1	NE	NW	305	—	615	P+			—	—	Pumped 4 hrs. with gas
	1	1	NE	SE	200	5	800	Gd			—	—	Insufficient yield for Bavaga State Forest Survey
51N1W	4	1	SW	SW	72	7	620	B+			—	—	120 ft. well in 5 min. lot
	8	1	SE	SW	80	6	610	B+			12	1969	Water slightly cloudy
51N2W	8		SW	NE	279	5	620	Gd			5	1964	
	8	2	NE	SW	137	5	620	Gd			8	1968	
	4	1	NW	NW	266	5	640	Gd			14	1967	
	20	1	SW	NW	168	5	860	B+			35	1968	
51N3W	15	1	SW	SW	320	—	610	B+			—	—	
	28	1	SW	NW	155	5	825	B+			40	1967	Well water, contains 25 mg/l Fe
	28	2	NW	NW	118	5	790	B+			30	1968	Soft water

WELL DATA

SECTION NO.	WELL NO.	LOCATION	WELL DEPTH (FEET)	WELL DIAMETER (INCHES)	ELEVATION OF GROUND SURFACE (FEET)	WATER BEARING UNIT	YIELD (GALLONS PER MINUTE)	WELL CAPACITY (GALLONS)	WATER IN WELL (FEET)	DATE OF MEASUREMENT	REMARKS
52N33W	22	NE NW	282	5	910	GD			220	1968	
52N33W	9	SW SW	227	6	660	GD			9	1952	
	10	NE NE	185	6	650	BL			5	1969	
	15	NE NE	72	14	660	GD			—	—	Hard water
	17	SW SW	375	5	780	BL			50	1962	A well 500 ft west, 1/2 S. slope, Flowing, gas, pressure, 100' water and 100' gas
	20	NE NE	216	6	680	GD	290 gpm (1951)		Flowing		
	21	SW SE	315	5	660	BL			Flowing	1969	
	24	SW SE	189	6	920	—			—	—	high iron
	24	NE NW	15	40	940	GD			—	—	water soft, high iron
	27	NW SE	200	—	780	BL			—	—	water hard, high iron
	36	NE NE	104	5	880	GD			70	1967	
52N33W	16	SE SW	151	6	720	BL			151	—	
	20	NE SW	22	7	765	GD			15	1969	Hard water
	28	SE SW	220	6	960	BL			30	1966	
52N33W	26	SW SW	26	—	720	GD			18	1969	
	27	SE NW	145	—	620	BL			—	—	
	27	NW NW	—	6	610	—			—	—	Arvon Turp. Fork
	29	SW SW	225	—	820	BL			—	—	Test pumped at 3 gpm
	32	NE SE	82	5	620	BL			14	1967	North well over 200 ft deep, 2nd Sand Beach Ridge, 1/2 S. slope, 2nd well, 100' gas and 100' water
52N33W	33	NE SE	167	—	610	BL			4	1969	
	34	NE SW	187	6	610	BL			—	—	
52N33W	2	SW SW	164	6	650	BL			18	1968	
	14	NW NW	210	5	620	BL			14	1968	
	14	NW NW	210	5	620	BL			30	1968	500' high, 1/2 S. slope
	16	NW NW	229	4	620	BL			—	1967	
	17	SW SW	124	5	710	BL			—	1967	
	20	NW NW	92	5	645	BL			16	1967	
	29	MS SE	19	60	700	GD			—	1969	Soft water

[illegible]

BARAGA COUNTY

RECORDS OF SPRINGS

Township	Range	Section	Location in Section	Date	Samples	Iron (Fe)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Total Dissolved Solids	Hardness (CaCO ₃)	Specific Conductance	pH	Temperature, °C	Estimated Yield, gpm
47N 31W	32	32	SE-NW	9-21-69	1	.50	—	11	0.5	0.3	55	35	85	5.8	8.5	10
48N 34W	17	17	NE-NE	9-19-69	1	0.10	166	12	10	1.7	214	139	330	7.7	8.0	2
49N 32W	6	6	SW-SW	9-22-69	1	1.3	140	9.0	3.0	1.3	155	122	245	7.9	14	—
49N 33W	18	18	SW-SE	9-10-69	1	0.50	—	80	18	1.6	—	85	220	6.9	—	—
50N 32W	18	18	SW-NE	9-22-69	2	2.2	107	12	1.0	0.3	114	85	200	7.3	8	2
50N 33W	28	28	SE-SW	9-20-69	1	0.30	—	15	15	2.7	139	114	250	6.9	8.5	2
51N 32W	25	25	NW-SE	8-12-69	1	0.50	32	1.0	8.5	0.1	65	50	115	5.9	12	3
52N 31W	19	19	SW-NW	8-13-69	1	0.10	—	—	—	—	—	50	110	5.9	9.5	—
53N 31W	35	35	SW-SE	9-13-69	1	0.10	33	5.0	1.1	1.0	55	35	95	5.9	9.5	1

DELTA COUNTY

WELL RECORDS

Records of wells and test holes in Delta County

Use: D, domestic; S, stock; P, public supply; I, industrial; To, oil test;
Ti, iron ore test; B, foundation boring; Tw, water test.

Water level: In feet below or above (+) land-surface datum; M, measured;
R, reported.

Altitude: In feet above mean sea level (estimated from advance prints of
U. S. Geological Survey topographic maps).

Well number	Location in section	Owner	Driller	Year drilled	Depth (ft.)	Diameter (in.)	Aquifer	Use	Water level	M or R	Date	Altitude	Remarks
43N 25W													
4-1	SE NE	H. Hansen	-	-	12	48	Qgd	DS	7	M	10-24-58	1005	Abandoned.
5-1	SE SE	Mrs. Leech	-	-	16	60	Qgd	D	9	M	10-24-58	1020	
5-2	SW SW	Lathrop School	-	-	150	6	Otb	P	21	M	10-24-58	1040	Do.
6-1	NE SE	G. R. Stegath	-	-	85	6	Otb	D	-	-	-	1040	
6-2	NW NE	C and NW Ry.	-	-	9	-	-	B	-	-	-	1051	Bedrock at 9 ft.
6-3	NE SE	Berthyl Hansen	Tom Rice and Son	1942	98	6	Otb	P	16	R	10-24-58	1040	
6-4	NW NW	David Williamson	D. Williamson	-	11	60	Qgd	D	7	M	10-27-58	1055	Bedrock at 10 ft.
8-1	SE SW	C and NW Ry.	-	-	11	-	-	B	-	-	-	1008	Bedrock at 11 ft.
8-2	SW NW	do.	-	-	10	-	-	B	-	-	-	1024	Bedrock at 10 ft.
21-1	SW NE	John Niemi	Tom Rice and Son	1944	84	5	Otb	DS	-	-	-	980	
21-2	NW NW	J. C. Bartlett	Fred Rice	1956	40	-	Otb	D	-	-	-	980	
21-3	NW NW	do.	-	-	10	1 1/2	Qgd	D	-	-	-	980	
24-1	NW NE	Toivo Lampi	-	1928	22	36	Qgd	D	-	-	-	940	Bedrock at 30 ft.
28-1	NW NE	C and NW Ry.	-	-	7	-	-	B	-	-	-	978	Bedrock at 7 ft.
28-2	NW SW	Victor Kallio	Tom Rice and Son	1943	30	5	Otb	DS	-	-	-	930	Bedrock at 10 ft.
28-3	SE SE	John Toyra	do.	1944	41	5	Otb	DS	-	-	-	975	Bedrock at 11 ft.
28-4	SW SE	Charles Valeen	do.	1943	102	5	Otb	DS	-	-	-	940	Bedrock at 12 ft.
32-1	NW SW	Sulo Auer	do.	1948	122	5	Otb	DS	-	-	-	980	Bedrock at 20 ft.
32-2	NW NW	Andrew Topala	do.	1943	84	5	Otb	DS	-	-	-	990	Bedrock at 9 ft.
34-1	SW NE	F. N. Mattila	do.	1940	365	4	Oat	DS	40	R	1940	960	
43N 22W													
5-1	SW SW	Erick Osterburg	-	-	7	60	Qgd	DS	3.4	M	10-24-58	950	Abandoned.
42N 23W													
4-1	SW NE	Edward Kaminen	Tom Rice and Son	1946	52	-	Otb	D	-	-	-	940	
5-1	NW NW	Asko Hamalainen	-	-	9	36	Qgd	D	5.5	M	10-29-58	970	

DICKINSON COUNTY

WELL RECORDS

Well Records

Explanation

Wells are identified according to their geographical township location, for example, "44N 30W 23-1 SE NE" refers to well #1 situated in the southeast quarter of the northeast quarter of section 23, of Township 44 North, Range 30 West. Altitudes are estimated from topographic maps.

Pc Precambrian
Pa Paleozoic
Gd Glacial Drift

D Domestic
S Stock
P Public supply

I Industrial
O Observation

Well Number	Location in section 1/4 1/4	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
44N 30W													
23-1	SE NE	Joe Dault	Anderson	1962	6	87	Pc	D	64	1962	1430	---	
23-2	SW NE	Joe Dault	Kleiman	1957	6	69	Pc	P	22	3-15-57	1420	60	
23-3	NE NE	F. J. DeGynor	Kleiman	1958	6	79	Pc	D	13	6-2-58	1420	68	
28-1	SE NE	Dick. Co. 4-H Club	Anderson	1951	6	185	Pc	P	110	8-13-51	1420	170	Well abandoned because of excessive silt. Cased to 170 feet.
33-1	NE NE	Bert Buckland	Kleiman	1962	3	71	Gd	D	32	7-16-62	1400	---	Cased to 68 feet.
44N 28W													
10-1	SE SW	Casper Uldriks	Kleiman	1962	3	59	Gd	D	36.27	7-30-64	1280	---	
27-1	SE SW	Cesar Almone	Omer	1934	60	13	Gd	D	11.16	9-9-64	1260	---	
44N 27W													
17-1	NW SW	J. McGregor	Kleiman	1956	6	43	Gd	D	22	6-9-56	1240	---	
43N 30W													
9-1	SW NW	O. Peterson	Anderson	----	5	28	Gd	D	18	----	1420	---	
9-2	NW SE	Lawrence Caray	Tuciminen	1960	6	107	Pc	D	34	1960	1360	102	Cased to 102 feet.
11-1	NE SW	Ired Janus	Kleiman	1963	6	68	Pc	D	41	6-13-63	1360	18	Cased to 20 feet.
29-1	NE NE	F. Van Gilder	Anderson	1950	5	73	--	D	38	1950	1410	---	Cased to 66 feet.
29-2	SW SE	Jnos Dishaw	Glasz	1934	6	69	Pc	D	38	9-24-63	1480	40	
29-3	SE SE	Sagola Township	-----	1923	6	115	Gd	P	-----	-----	1440	---	Supplies 50 families.
30-1	SW SE	E. Johnson	Chiocchi	----	5	196	Pc	D	40	-----	1330	40	Cased to 40 feet.
34-1	NW SW	Edgar Erickson	Kleiman	1960	5	93	Gd	D	20	7-27-60	1360	---	
43N 29W													
36-1	NE NW	-----	-----	1963 (1)	1 1/2	12	Gd	D	5.87	8-13-64	1180	---	
43N 28W													
23-1	NW SE	Paul Mariucci	Chiocchi	----	5	42	Pa	D	15	----	1190	22	Cased to 22 feet.
23-2	NE SW	John Cominsky	Kleiman	1959	5	60	Pa	D	31.19	3-18-64	1190	40	
23-3	NW SW	Gilbert J. Johnson	Omer	1963	1 1/2	28	Gd	D	4	11-11-63	1140	---	
23-4	SE SW	Norman Karstam	Kleiman	1961	3	49	Pa	D	44.47	8-24-64	1220	41	Cased to 45 feet.
23-5	SW SE	-----	-----	----	1 1/2	14	Gd	D	8.74	7-30-64	1200	---	Well abandoned.
27-1	SE NW	Sam Eufizzi	Chiocchi	----	5	62	Pa	D	30	----	1185	---	Cased to 22 feet.
43N 27W													
28-1	SE SE	Joseph Turini	Kleiman	1963	3	47	Pc	D	8	1963	1160	42	Cased to 42 feet.
42N 30W													
2-1	SE SE	Ron Koller	Kleiman	1964	4	30	Pc	D	18	2-4-64	1320	13	Cased to 16 feet.
4-1	NE SW	Donald Johnson	Kleiman	1961	5	42	Pc	D	35	4-27-61	1420	20	Cased to 25 feet.
7-1	SE SW	Don Dario	Kleiman	----	4	59	Pc	D	49	1963	1410	45	
11-1	SW NW	Norman Mainville	Kleiman	1963	6	70	Gd	D	28	6-14-63	1340	---	
18-1	NW SW	John R. Williams	Kleiman	1961	6	32	Gd	D	-----	----	1400	---	
18-2	SE NW	Frank Mortell	Chiocchi	----	5	159	Pc	D	-----	----	1410	140	
18-3	NE NW	Leo Hart	Kleiman	1964	4	92	Gd	D	67	3-12-64	1390	---	
24-1	NW NE	Paul Richards	Kleiman	1959	5	39	Pc	D	9.31	10-16-64	1320	38	
26-1	SE NE	Herbert Locarvilli	Kleiman	1958	6	36	Pc	D	23	9-24-58	1260	20	
28-1	SE SE	Elmer Schowalder	Chiocchi	----	5	203	Pa	D,S	40	----	1260	---	
32-1	NE SE	Clayton Rush	Kleiman	1957	6	133	Gd	D	70	7-25-57	1260	---	
33-1	NE SE	John Horwath	Chiocchi	----	5	105	Pc	P	-----	----	1260	---	Cased to 40 feet.
33-2	NE SE	Harry Horwath	Chiocchi	----	5	72	Pc	D	20	10-15-64	1260	---	Cased to 30 feet.
42N 29W													
22-1	NE SE	August Zamboni	Omer	----	24	24	Gd	D	21	10-14-64	1120	---	Dug well.
22-2	NE SE	Watson	-----	----	4	39	--	D	flows	10-14-64	1130	---	
22-3	NE SE	Joe Lajennesse	Kleiman	----	4	28	Gd	D	5	10-15-63	1130	---	
26-1	SE SE	Carlton Cook	Kleiman	1961	6	57	Pc	D	6	5-29-61	1220	45	
30-1	NW SE	M. A. Hanna Co.	Layne NW	1957	12	85	Gd	O	20.05	11-18-64	1260	---	
31-1	NE SE	M. A. Hanna Co.	Layne NW	1951	12	128	Pa	D?	54	4-2-51	1360	15	Used as domestic supply in iron ore plant.
32-1	SE NE	Roy Leonard	Kleiman	1958	6	38	Pa	D	23.67	3-19-64	1260	18	
32-2	NW SW	M. A. Hanna Co.	Layne NW	1958	10	161	Pc	O	16.01	11-18-64	1320	10	
33-1	NW SE	Elior Helander	T. Rice	1943	4	85	--	D	-----	----	1240	---	Had unpleasant taste 1963.
34-1	SW NE	Fabian Steinbrecker	Kleiman	1958	6	82	Pc	D	39	8-12-58	1240	18	
34-2	SE SE	Ronald Bergstrom	Kleiman	1960	6	101	Pc	D	61	4-13-60	1160	52	
42N 28W													
5-1	SE NW	Kenneth Sheldon	Kleiman	1956	6	55	Pa	D	38	9-22-56	1160	15	
5-2	NE SE	Edward Lantz	Chiocchi	----	5	96	Pa	D	42	----	1200	---	Cased to 32 feet.
5-3	NE NW	Oliver Jedvick	Chiocchi	----	5	205	Pc	D	52	----	1160	---	Cased to 175 feet.
5-4	NW NE	-----	Omer	1964	1 1/2	22	Gd	D	7.06	9-11-64	1160	---	
5-5	NE SE	Roy Lantz	Chiocchi	1964	6	60	Pa	D	30	10-23-64	1180	---	
20-1	NE SW	Rudy Gustafson	Omer	1964	5	67	Gd	D	30	9-11-64	1140	---	Pumps fine silty sand.
29-1	NW NE	Clark Lucas	Chiocchi	1964	5	94	Pc	D	35	9-11-64	1180	---	
35-1	SE NE	Edwin Ogan	Kleiman	1958	6	50	Gd	D	13	4-17-58	1120	---	

Well Records...Continued

Well Number	Location in section	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
42N 27W													
20-1	NE NW	Joe Trepanier	Chiocchi	----	5	60	Pa	D	21.92	9-14-64	1200	---	Cased to 25 feet.
26-1	SW NW	J. B. Erickson	Kleiman	1956	6	68	Gd	D	4	10- 2-56	1100	---	
29-1	NW SE	Sanford Olson	Chiocchi	----	5	72	Pa	D	44	----	1080	---	
32-1	SE NW	Wm. Daws	Chiocchi	----	5	76	Pa	D	50	----	1130	---	Cased to 32 feet.
32-2	SW SW	S. J. Peterson	Chiocchi	----	5	138	Pc	D	40	----	1120	---	Cased to 40 feet.
33-1	NE NW	E. W. LaFreniere	-----	----	36	12	Gd	O	11.19	3-17-64	1060	---	WMP obs. well #10.
41N 30W													
3-1	NE SW	Duane Pollack	Kleiman	1960	6	78	Gd	D	13	8-24-60	1260	78	Gravel 70 to 77 feet.
4-1	NE SW	E. J. Verrette	Kleiman	1958	6	80	Pc	D	39	3- 4-58	1300	75	Rock bluff 100' South.
16-1	NW NE	Herman Bremer	Kleiman	1958	6	40	Gd	D	4	6-19-58	1200	---	Rock bluff 100' West.
17-1	NE NE	Ellen Sjoquist	Kleiman	1958	6	30	Gd	D	24	7-31-58	1260	---	
25-1	NE SW	Dick. Co. Rd. Comm.	WMP Co.	1948	1 1/2	20	Gd	O	dry	11-19-64	1220	---	Contains water in spring.
25-2	SE NE	Oscar Martinson	Owner	----	48	12	Gd	O	11.42	12- 2-63	1200	---	WMP Co. obs. well.
25-3	SE NE	Oscar Martinson	Anderson	1949	6	54	--	D	33	9-49	1200	---	
25-4	NW SE	William Carolla	-----	----	6	60	--	D	-----	----	1240	---	
25-5	SE NW	Mal Martin	Kleiman	1955	6	120	Pc	D	14	7- 7-55	1260	63	
27-1	NW SE	John Colombo	Kleiman	1958	6	104	Gd	D	-----	----	1200	---	Pulled casing back to 51 ft.
27-2	SE SW	Darwin Wilson	Chiocchi	----	5	49	Gd	D	30	----	1190	---	
28-1	SE SE	Merriman Comm. Bldg.	Anderson	1957	6	70	--	P	37	1957	1170	---	Screen finish.
30-1	NE NW	Maitland Dow	Anderson	----	6	63	--	D	15	----	1180	---	
32-1	SE NE	Norm LaFarve	Kleiman	1964	7	150	Pc	D	18	5-20-64	1240	50	Cased to 54 feet.
34-1	SE SW	Elerde Falus	Anderson	----	6	128	--	D	85	----	1270	---	Screen finish.
41N 28W													
1-1	SE SE	Carl Johnson	Chiocchi	----	6	240	Pc	D	72	----	1160	---	Cased to 72 feet.
8-1	SE SE	John L. Peterson	Chiocchi	1953	4	42	Pa	D	16	1953	1150	8	
12-1	SE NE	Harry Peterson	C. Rice	1930	4 1/2	197	Pa?	D	50	3- 3-61	1040	---	
34-1	NW SW	Marlin & Griffie	Owners	1961	1 1/2	13	Gd	D	8.72	11-13-64	990	5	Pipe in fracture in bedrock.
41N 27W													
2-1	NE NW	A. Francke	Anderson	----	6	40	Gd?	D	34	----	1180	---	
6-1	SE SE	Allen Johnson	Chiocchi	----	5	105	--	D	8	----	1170	---	Cased to 88 feet.
7-1	NE NE	Pat Milligan, Jr.	Chiocchi	1959	5	109	Pc	D	67	1959	1180	---	Cased to 67 feet.
7-2	SW NW	Pat Milligan	Chiocchi	1963	5	72	Pc	D	22	1963	1060	---	Cased to 22 feet. Open finish.
7-3	NW SE	Foster City Cemetery	T. Rice	1948	6	55	--	P	-----	----	1060	---	
7-4	SW SW	Reuben Slogman	Chiocchi	----	5	96	Pa	D	64	----	1150	---	On top of bluff. Cased to 10 feet.
9-1	SE NW	Dale Sigler	Chiocchi	----	6	90	Pa	D	10	----	1040	---	Water contains 2.0 ppm iron.
40N 31W													
23-1	SE SE	Pine Mt. Corp.	Rometti	1961	6	116	Pa	I	50.72	9- 5-61	1165	32	
23-2	SE SE	Pine Mt. Corp.	Rometti	1961	6	150	Pa	I	-----	----	1165	32	
23-3	SE SE	Pine Mt. Corp.	Rometti	1961	6	125	Pa	I	-----	----	1170	32+	Cased to 34 feet.
40N 30W													
5-1	SW NW	John DeGrave	Anderson	1957	5	88	Gd?	D	67	1957	1200	---	
6-1	SE SW	Joseph Giachino	Rometti	1963	6	31	Gd	D	10	1963	1200	---	Screen finish.
6-2	SE SE	Joseph Langford	Kleiman	1958	6	82	Gd	D	-----	----	1180	---	
8-1	SW NW	Wes Fontenhio	Kleiman	1963	4	36	Gd	D	16	7-63	1120	---	
14-1	SE SW	Dave Heidke	Anderson	1962	6	110	Pc ?	D	78	9-62	1100	110	
14-2	SW SE	Wm. Haigh	Anderson	1964	6	110	--	D	72	1964	1100	---	Cased to 90 feet.
17-1	SE NE	Immanuel Baptist Church	Kleiman	1962	3	19	Gd	P	6	6-16-62	1180	---	
18-1	SE SW	Jerry Miksa	Kleiman	1959	6	78	Gd	D	17	6-13-59	1140	---	
18-2	SE SW	H. B. Miller	Kleiman	1959	6	79	Gd	D	39	10-21-59	1140	---	
18-3	SE SW	M. Tournant	Kleiman	1956	6	64	Gd	D	29	----	1140	---	
18-4	NE SW	F. Hermance	Kleiman	1958	6	71	Gd	P	34	10- 3-58	1160	---	
18-5	NE SW	Otto Kelberg	Kleiman	1960	6	83	Gd	P	27	5-19-60	1180	---	
18-6	NW NW	Charles Lindberg	Kleiman	1955	6	20	Gd	D	4	8-21-55	1160	---	
18-7	NE NW	Ervin Swolinski	Kleiman	1960	6	41	Gd	D	4	11-28-60	1180	---	
19-1	NE NW	Reuben Hamari	Kleiman	1959	6	81	Gd	D	35	9-26-59	1140	---	
19-2	NW NE	Bacco Const. Co.	Kleiman	1958	6	48	Gd	D	21	7- 1-58	1160	---	
19-3	SE NE	Esau Cohodes	Kleiman	1958	6	52	Gd	D	12	9-24-58	1140	---	
20-1	SE NE	City of Iron Mountain	-----	----	2	---	--	P	Flows	9-17-64	1160	---	Flows 20 ft. above lake
21-1	SE SW	Dickinson County	Kleiman	1957	6	30	Gd	D	4	11-15-57	1160	---	
23-1	NE NE	John Pengrazi	Kleiman	1963	4 1/2	60	Pc	D	14	11-63	1100	---	Cased to 29 feet.
23-2	NE SE	Eugene Bronz	Kleiman	1962	6	107	Pa	D	5	4-62	1180	100	Cased to 102 feet.
24-1	NE SW	John Fontecchio	Kleiman	1963	6	46	Gd	D	26	10- 1-63	1140	---	
27-1	NE SW	Allan Carlson	Kleiman	1959	6	75	Gd	D	26	4-20-59	1150	---	Occasionally shows slight red color.
27-2	SW NW	F. Pesavento	Kleiman	1959	6	65	Gd	D	36	4-16-59	1180	---	
27-3	SW SW	Richard Waldbillig	Kleiman	1955	6	64	Gd	D	28	10-20-55	1160	---	
28-1	SW NW	Jane Thekan	Kleiman	1962	6	49	Gd	D	5	4-26-62	1160	---	Water silty if pumped at more than 30 gpm.
31-1	SW NW	Zacks Fruit Co.	Kleiman	1958	6	70	Gd	I	14	----	1140	---	
40N 29W													
6-1	SW NW	Hich. Dept. Cons.	Kleiman	1964	4	30	Gd	-	17.97	9- 8-64	1120	27	Insufficient water to develop well. Casing pulled.
6-2	NW SW	Hich. Dept. Cons.	Kleiman	1964	4	37	Gd	-	12.22	9-11-64	1120	37	Screen plugged with silt. Casing pulled.
28-1	NE NW	George Branbick	Kleiman	1962	3	30	Gd	D	19	9-11-62	1160	---	
28-2	SW NE	Howard Hamill	Kleiman	1961	3	21	Pc	-	dry	10-30-61	1140	21	
29-1	SW SW	Stanish Bal	Anderson	1961	6	52	Pc ?	S	2	1961	1100	---	Cased to 18 feet.
31-1	SW SE	Joe Bariak	Anderson	1963	6	200	Pa	D	40	1963	1100	68	Cased to 68 feet.
40N 28W													
4-1	NE SE	C. M. Huck	Anderson	----	5	52	Gd?	D	36	----	1000	---	
4-2	NW SW	Anton Stekovitz	Anderson	----	6	80	Pc ?	D	35	----	990	---	Cased to 38 feet.
10-1	NE SW	Clyde Randall	Chiocchi	----	5	96	Pc	D	32	----	940	---	Cased to 35 feet.
12-1	NW NW	Wm. Asselin	Kleiman	1960	5	157	Gd	D	19	10-21-60	980	60	Cased to 60 feet. Casing dynamited at 41 ft. to provide additional supply

Well Records,--Continued

Well Number	Location in section T R	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
40N 28W													
(Cont'd)													
26-1	NE SE	H. Cousineau	Kielman	1963	3	70	Gd	D	19	5-10-63	980	---	
35-1	SW NE	Bernard Rossato	Kielman	1961	3	57	Gd	D	46	7-3-61	1000	---	
39N 31W													
12-1	NE SE	Wis. Mich. Power Co.	Anderson	----	6	345	--	-	8	----	1100	---	Open finish
12-2	NE SE	Wis. Mich. Power Co.	Anderson	----	8	72	--	-	45	----	1100	---	Screen finish
39N 30W													
1-1	SW NW	Glenn Anderson	Anderson	----	6	100	Pc	D	16	----	1060	30	
1-2	SW SW	Alfred Oelke	Chiocchi	----	5	327	Pc	-	75	----	1060	---	Cased to 73 feet.
2-1	NW SW	Louis Chiochi	Chiocchi	1963	6	228	Pc	D	40	1963	1040	37	Cased to 37 feet.
3-1	SE NE	Bretlung Township	-----	1962	20	125	Gd	P	-----	----	1040	---	Gravel pack finish.
3-2	SE NE	Bretlung Township	Layne NW	1953	8	160	Gd	P	60	4-53	1040	---	Screen finish.
4-1	NW NE	Guy Gustafson	Anderson	1960	6	35	Pc	P	28	4-61	1050	---	
8-1	NW	Wis. Mich. Power Co.	Anderson	1959	6	92	Pa	D	55	----	1000	---	Screen finish.
13-1	Center	Kimberly-Clark Corp.	Kielman	1956	6	140	Gd	O	132.75	10-28-64	1051	---	
13-2	NW SW	Kimberly-Clark Corp.	Kielman	1957	6	118	Gd	O	111.52	10-28-64	1041	---	
13-3	SW NW	Kimberly-Clark Corp.	Kielman	1956	6	50	Gd	O	dry	3-7-56	1052	50	
13-4	NE NW	Wallace Jones	Chiocchi	----	5	114	Gd	D	92	----	1040	---	
14-1	Center	Kimberly-Clark Corp.	Kielman	1956	6	95	Gd	O	78.41	10-28-64	1025	95	Gravel packed screen finish.
14-2	Center	Kimberly-Clark Corp.	Kielman	1957	6	30	Gd	O	12.68	10-28-64	960	---	Water level fluctuates with river.
39N 29W													
2-1	SW NE	Wm. LaVoie	Anderson	1946	5	72	Gd	D	36	9-64	980	---	
5-1	SE	Americo Tinti	Anderson	1949	6	174	--	D	75	1949	1040	---	Cased to 68 ft. Open finish.
8-1	NE SE	James Stewart	Kielman	1958	6	112	Gd	I	56	6-5-58	940	---	Water contains excessive ferric iron.
12-1	SW SW	Stan Baciak	Chiocchi	----	6	168	Pa	D	40	1963	1040	---	Open finish.
14-1	NW SW	Frances Girardi	Chiocchi	----	5	47	Gd	D	20	9-15-64	860	---	
14-2	SW SW	R. Haferkorn	Owner	----	36	21	Gd	S	12	1964	850	---	
15-1	SE SE	Joseph Haferkorn	Chiocchi	----	5	158	Gd	D	45	9-64	840	---	Slight taste.
17-1	SE NE	Lewis Rector	Kielman	1958	6	140	Pc	D	-----	----	940	50	
20-1	NW NE	Joe Palluch	Chiocchi	1961	6	40	Gd	D	15	----	----	---	
22-1	SW SE	Miko Mannicor	Kielman	1963	4	88	Gd	D	28	10-30-63	860	---	
25-1	NE NE	Francis Sweig	Kielman	1962	3	70	Gd	D	3	6-16-62	860	---	
26-1	NE SE	Adam Ball	Chiocchi	1959	5	349	Pc	D	60	----	----	80	
27-1	NE SE	City of Norway	Kielman	1958	6	40	Gd	D	10	11-26-58	----	---	Supplies 3 houses.
36-1	SE NE	Henry Varda	Kielman	1963	7	101	Pc	D	42	10-63	----	100	
39N 28W													
7-1	SW SW	Murriel Girard	Chiocchi	----	5	268	Pc	D	60	----	880	62	Cased to 62 feet.
7-2	SW SW	Joe Drie	Kielman	----	5	69	Gd	D	15	----	880	---	
8-1	SE NE	Wis. Mich. Power Co.	Anderson	1962	6	87	Pc	P	21.06	9-15-64	900	37	
14-1	NW NW	Pau. Hupp	Anderson	1959	6	39	Gd	D	25	1959	970	---	Screen finish.
14-2	SW SE	Robert Hunt	Glass	1962	6	167	Pc	D	90	6-3-61	1060	87	
16-1	NW NW	Steve Bubloni	Anderson	1963	6	150	Pc	D	72.57	9-15-64	1040	72	Cased to 100 feet.
16-2	SW SE	Frank Habamer	Anderson	----	6	42	Gd	D	18	----	1060	---	
18-1	NW NW	Kasjinski Tavern	Anderson	1961	6	72	Gd	P	51	9-61	900	---	Cased to bottom.
19-1	SW SW	Leonard Lositto	Kielman	1962	3	27	Pc	D	3	6-16-62	850	16	
19-2	SW SW	Sue McCormick	Kielman	1961	3	45	Pc	D	-----	----	850	42	
19-3	NW NW	Walter Breclaw	Chiocchi	----	5	275	Pc	D	76.42	5-14-64	860	---	Cased to 74 feet.
20-1	SW SE	George DeRidder	Kielman	1962	3	40	Gd	D	24	6-20-62	860	---	
20-2	SE SE	Ed. Rouchey	Kielman	1963	3	120	Gd	D	6	4-30-63	860	---	
21-1	NW SW	Clifford Frenn	Chiocchi	----	5	196	Pc	D	85	----	----	---	Cased to 96 feet.
24-1	SW SE	C. Linder	Lo Beau	1963	5	100	Pa	D	77.28	9-15-64	1020	---	Open finish.
25-1	NW NE	Richard Shog	Anderson	1948	6	88	--	D	61	1948	1000	---	Cased to 73 feet.
30-1	NW NE	Frank Bray	Kielman	1962	3	18	Gd	D	7	6-10-62	860	---	
30-2	NW NE	Ernst Gosanova	Kielman	1961	3	18	Gd	D	flow	6-9-61	860	---	Flowed 0.5 ft. above land surface 6-9-61
30-3	SW NE	Mary Johnson	Kielman	1962	3	34	Pc	D	17	6-7-62	860	23	Cased to 24 feet.
30-4	SW NE	Lee Johnson	Kielman	1962	3	27	Gd	D	flow	6-2-62	840	---	Flowed 5 gpm 3 ft. above land surface 6-2-62
30-5	SE NW	Harry Teafae	Chiocchi	----	5	368	Pc	D	28	----	----	---	Cased to 35 feet.
30-6	SW NW	Dickinson Co. Park	Chiocchi	----	5	91	Gd	P	47	----	----	---	
30-7	SW NE	Carroll Asp	Chiocchi	----	5	58	Pc	D	22	----	----	---	Cased to 38 feet.
30-8	SE NW	Carl Danellson	Chiocchi	1953	5	57	Pc	D	14	----	----	---	Cased to 20 feet.
32-1	SW SW	Julius Van Wiele	Owner	1950	6	132	Gd	S	20	1950	----	132	Pulled casing back 0.5 ft. into gravel
35-1	NW NW	Ed Hagenson	Lo Beau	1947	6	120	Pa	D	55	1947	----	96	Cased to 96 feet.

IRON COUNTY
WELL RECORDS

Records of Wells

Aquifer: Pcr - Precambrian rocks; Pa - Paleozoic rocks; Gd - Glacial drift

Use: D - Domestic; S - Stock; P - Public Supply; I - Industrial;
O - Observation; T - Test Hole

WMP - Wisconsin-Michigan Power Company

Water level is in feet below land surface.

Well number	Location in section	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
41N 31W 10-1	SW NE	Iron Co. Rd..Comm.	WMP	----	1 1/2	17	Gd	O	14.53	11-1-65	----	---	WMP obs. well
14-1	SE NW	Dick Abraham	Kleiman	1961	3	106	Pcr	D	78	1961	1300	104	Water very cloudy
14-2	SW NE	C.J. Carlson	Rommetti	1959	6	103	Gd	D	68	1959	1300	103	Will supply comm. nursery by 1966
41N 32W 11-1	SE SE	George Gruell	Kleiman	1963	6	42	Gd	D	22	1963	1240	---	
42N 31W 6-1	SW SE	Leonard Olsen	Tuominen	1964	5	40	Gd	D	25	1964	1320	---	
6-2	NW NW	Mich. Dept. Cons.	Owner	1965	2	32	Gd	P	26	1965	1360	---	Glidden L. Camp- ground
33-1	NW SE	Iron Co. Rd. Comm.	WMP	1954	1 1/2	10	Gd	O	2.39	11-1-65	----	---	WMP obs. well
33-2	NW SE	J. Giachino	---	----	15	12	Gd	D	9.55	11-1-65	----	---	WMP obs. well
42N 32W 15-1	NW SE	E. Brauer	Tuominen	1965	5	86	Gd	D	22	1965	1310	---	
26-1	SE NW	Iron Co. Airport	Kleiman	1960	6	110	Gd	P	40	1960	1340	---	
29-1	NW NW	Mrs. Gursky	Tuominen	1961	5	90	Pcr	D	21.19	7-30-65	1400	52	Open casing, never used
42N 33W 1-1	NW NE	Mastadon Twp.	Owner	1958	8"X 12"	20	Pcr	P	7.76	7-16-65	1485	9	Equipped with chlorinator
1-2	SW NE	Mastadon Twp.	Wilcox	1954	6	100	Pcr	P	30	1954	----	5	Abandoned, re- placed by 1-1
12-1	SE SE	Village of Alpha	Layne N.W.	1930	16	43	Gd	P	-----	----	1400	---	Gravel pack
13-1	NE NE	Village of Alpha	Layne N.W.	1930	16	41	Gd	P	-----	----	1390	---	Gravel pack, stand by unit
13-2	NE NE	E. Kascielski	Tuominen	1960	5	90	Gd	P	3.09	8-11-65	1400	---	
15-1	SE NW	Wm. Jutila	Tuominen	1964	5	200	Pcr	D	43	1964	1435	156	
15-2	NE SE	J. Romanowski	Tuominen	----	5	43	Gd	D	29	----	1380	---	
28-1	SE SW	J. A. Gondek	Kleiman	1959	6	68	Gd	D	28	1959	1330	---	Dynamited boul- ders at 18'
42N 34W 9-1	SW NW	Village of Gastra	Layne N.W.	1945	---	150	Gd	P	86.88	7-21-65	1620	---	Gravel pack
13-1	SE NW	Stambaugh Twp.	Layne N.W.	1956	12	61	Gd	P	35.98	5-13-65	1450	---	Gravel pack
25-1	SE SE	Stambaugh Twp.	Tuominen	1964	6	88	Gd	P	41	1964	1400	---	
25-2	SE SE	R. Mathison	Tuominen	1961	5	99	Gd	D	30	1961	1395	---	
42N 35W 1-1	SW NW	City of Caspian	---	1927	10	60	Gd	P	-----	----	1480	---	Dug well 30'x 30' to 52' deep; two 10" casings to 60'. Used as stand- by unit.
1-2	SW NW	City of Caspian	Layne N.W.	1957	18	65	Gd	P	21.71	5-12-65	1480	---	Gravel pack
11-1	NW SE	Stambaugh Twp.	Layne N.W.	----	12	58	Gd	P	17.01	5-13-65	1615	---	
20-1	NE NE	Brule Mtn. Ski Area	Kleiman	1964	6	32	Gd	I	12	1964	1540	32?	Used for snow machine. Has been pumped @ 100 gpm.
20-2	NE NE	Brule Mtn. Ski Area	Wilcox & Audio	----	6	25	Gd	P	-----	----	1540	25?	During ski sea- son pump runs constantly.

Records of Wells---Continued

Well number	Location in section		Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
43N 31W	4-1	SE SW	Jack Sophie	Kleiman	1963	6	51	Pcr	P	14	1963	1390	15	Cased to 29'
	16-1	SW NE	Ray Peterson	Kleiman	1963	6	95	Pcr	D	23	1963	1420	---	Cased to 20'
	24-1	NW NE	P. Mitchell	Kleiman	1963	4	59	Pcr	D	9	1963	---	39	
	26-1	SE NE	Francis Drake	Kleiman	1963	4	30	Gd	D	18	1963	1400	---	Screen plugs with silt
	33-1	NE SE	Mansfield Twp.	Kleiman	1963	3	31	Gd	P	5	1963	1320	---	Dawson L. Park
	35-1	NE NW	Mansfield Twp.	Kleiman	1961	5	50	Gd	P	15	1961	1380	---	Twp. hall
	36-1	SE NW	Robt. Magray	Tuominen	1961	5	70	Pcr	D	12	1961	1420	38	
	36-2	NW NW	Alex MacLeod	Tuominen	1964	5	75	Pcr	D	21	1964	1405	71	1.5 ppm Fe
	1-1	NW SW	Stock	---	---	4	---	Gd?	D	---	---	1375	---	Hunting camp
	4-1	NW SE	Minarcik & Janov	---	---	1 1/2	51	Gd	D	41.26	8-17-65	1490	---	
43N 32W	4-2	NE SW	Paros	---	---	6	37 1/2	Gd?	D	23.69	8-17-65	1490	---	More than 4 ppm iron
	6-1	NW SW	James Whittock	Tuominen	---	3	68	Gd	D	13	---	1380	---	
	21-1	SE NW	City of Crystal Falls	Odgers	1929	10	90	Gd	P	22.87	5-10-65	1355	---	City well #1
	21-2	SE NW	City of Crystal Falls	Odgers	1929	10	90	Gd	P	---	---	1355	---	City well #2
	21-3	SE NW	City of Crystal Falls	Odgers	1929	10	85	Gd	P	---	---	1355	---	City well #3
	21-4	SE NW	City of Crystal Falls	Layne N.W.	1961	2	50	Gd	O	1.14	5-10-65	1355	---	Test hole
	21-5	SE NW	City of Crystal Falls	Layne N.W.	1961	2	69	Gd	O	8.07	5-10-65	1355	---	Test hole
	21-7	SE NW	City of Crystal Falls	Layne N.W.	1963	10	91	Gd	T	1	1963	---	92	Insufficient water, pipe pulled
	28-1	NE NE	City of Crystal Falls	Layne N.W.	1961	--	102	Gd	T	---	---	---	---	TH -pipe pulled
	28-2	NE NE	City of Crystal Falls	Layne N.W.	1961	--	90	Gd	T	---	---	---	---	TH -pipe pulled
	28-3	NE NE	City of Crystal Falls	Layne N.W.	1956	8	90	Gd	T	---	---	---	---	Insufficient H ₂ O; pipe pulled
	29-1	SE NE	City of Crystal Falls	---	---	--	---	Pcr	P	44.0	9-24-65	1360	---	Old diamond drill hole, has flowed many years
	14-1	SW SE	Crystal Falls Twp.	Layne N.W.	1950	10	55	Gd	P	21.22	5-10-65	1400	---	Lind well, gravel pack
	21-1	SE SW	Wm. Honkala	Kleiman	1961	6	145	Gd	D	125	1961	1540	---	
	27-2	SW NW	E. Reiman	Pickands-Mather	1950	3	53	Pcr	P	20	1950	1400	20	Drilled as iron ore Test hole
43N 33W	27-3	SW NW	E. Reiman	Pickands-Mather	1950	3	500+	Pcr	D	20	1950	1400	20	Do.
	31-1	SE SW	F. G. Pardee	Layne N.W.	1957	8	143	Gd	D	114	1957	1500	---	More than 4 ppm iron
	19-1	NW SW	Johnson	---	---	3	---	Gd?	O	67.44	11-18-65	1590	197	Ore expl. hole
	19-2	NE SW	Johnson	---	---	3	---	Gd?	O	73.92	11-18-65	1620	---	Ore expl. hole
	24-1	NW SE	Edw. Schlusser	Tuominen	1964	5	36	Gd	D	2	1964	1420	---	
	24-2	NW SE	J. Strazer	Tuominen	1964	5	32	Pcr	D	2	1964	1420	27	
	24-3	NW SE	W. J. Phillips	Kleiman	1964	6	38	Gd	D	4	1965	1420	---	
	28-1	NE NE	Bates Twp.	Layne N.W.	---	6	140	Gd	P	---	---	1630	---	Twp. #1, stand-by unit
	28-2	NE NE	Bates Twp.	Layne N.W.	---	6	140	Gd	P	---	---	1630	---	Twp. #2
	29-1	SW NE	Rogers Mine	---	---	48	---	Gd	O	16.75	11-18-65	1567	---	Mine drainage well
43N 35W	11-1	SE NE	J. J. Javerski	---	---	36	47	Gd	D	41.83	11-1-65	1565	---	WMP obs. well
	13-1	SW SE	F. Gondzwill	---	---	3	576	Pcr	O	54.99	11-18-65	1635	64	Ore expl. hole
	16-1	SE NE	Iron River Twp.	Layne N.W.	1956	10	84	Gd	P	19	1956	1530	83	Rodine well
	21-1	SW SE	Iron River Twp.	Layne N.W.	---	10	60	Gd	P	22.20	5-13-65	1540	---	Nash. well
	22-1	NW NE	Iron River Twp.	Layne N.W.	1956	10	150	Gd	T	---	---	1600	---	Test hole, dry
	23-1	NW NE	M. A. Hanna Co.	Layne N.W.	1963	48	80	Gd	I	36	1963	---	103	Mine drainage well
	24-1	NE SE	Johnson	E. J. Long-year Co.	1945	3	113	Gd	O	69.71	11-18-65	1600	113	Ore expl. hole

Records of Wells.--Continued

Well number	Location in section	Owner	Driller	Date drilled	Diameter	Depth	Aquifer	Use	Water level	Date	Altitude	Depth to bedrock	Remarks
43N 35W 25-1	SE NW	City of Stambaugh	---	1938	18	81	Gd	P	18	1946	1480	---	City #1; stand-by unit
25-2	SE NW	City of Stambaugh	Layne N.W.	1962	8	80	Gd	P	11.20	5-12-65	1480	---	City #2
26-1	SW NE	City of Iron River	Layne N.W.	----	2	130	Gd	O	25.64	11-18-65	1480	---	Test hole
26-2	SW NE	City of Iron River	---	1947?	20	170	Gd	P	-----	----	1480	---	City #2; stand-by unit
26-3	SW NE	City of Iron River	Layne N.W.	1952	16	130	Gd	P	34	1952	1480	---	City #1
28-1	SE SW	Lewis Gregg	---	----	36	20	Gd	D	15.90	9-12-45	1540	---	Destroyed
33-1	SE NW	Mich. Hwy. Dept.	WMP	----	1 1/2	12	Gd	O	5.25	11-1-65	1525	---	WMP obs. well
44N 31W 26-1	NE SE	T. J. Bailey	Kleiman	1964	4	39	Gd	D	21	1964	1395	---	On lot next to 26-1
26-2	NE SE	T. J. Bailey	Kleiman	1961	3	43	Gd	D	15	1961	1395	---	
26-3	NW SE	W. Hosking	Kleiman	1961	3	57	Gd	D	29	1961	1400	---	Supplies 8 cottages
26-4	NE SW	A. Peterson	Kleiman	1961	3	54	Gd	D	29	1961	1400	---	
26-5	SE SE	V. Ball	Kleiman	1961	3	41	Gd	D	3	1961	1390	---	
34-1	SE NW	F. Phelan	Kleiman	1957	6	100	Pcr	P	30	1957	1400	50	
44N 32W 16-1	SW NE	E. Bicigo	Owner	----	1 1/2	20	Gd	P	10 1/2	1965	1385	---	Supplies 4 cottages
17-1	NW SE	M. Smith	Tuominen	----	6	170	---	P	-----	----	1390	---	
44N 33W 6-1	NW SW	M. Virsen	---	----	6	125	---	D	-----	----	1555	---	Ledge nr. surface
7-1	SE NW	Robert Jacobson	Tuominen	1965	5	33	Gd	D	20	1965	1500	---	
7-2	NE SE	V. Hanttila	Tuominen	1963	5	146	Pcr	D	-----	----	1490	---	Yield dropped, well abandoned
7-3	NE NW	Henry Rajala	Tuominen	----	4	132	Pcr	D	-----	----	1515	103	
8-1	NE NE	Hematite Twp.	---	1947	21	44	Gd	P	5	1963	1445	---	Twp. well #2, stand-by unit
8-2	NE NE	Hematite Twp.	Layne N.W.	1937	8	30	Gd	P	4.95	5-5-65	1445	---	
8-3	NE NE	Hematite Twp.	Layne N.W.	1963	12	30	Gd	P	-----	----	1445	---	Gravel pack
10-1	SW SW	Iron Co. Rd. Comm.	WMP	----	1 1/2	9	Gd	O	6.65	11-1-65	1540	---	
16-1	SW NW	Crystal Falls Twp.	Layne N.W.	1950	8	56	Gd	P	8	1965	1450	---	Twp. well #1, gravel pack
16-2	NW NW	Crystal Falls Twp.	Layne N.W.	1965	16	58	Gd	P	7	1965	1450	---	
17-1	SW SW	Stuart Dickinson	Tuominen	1962	5	29	Gd	D	10	1962	1395	---	Twp. well #3, gravel pack
35-1	NW SE	A. Anderson	Tuominen	1961	5	31	Gd	D	-----	----	1410	---	
35-2	NW SE	Rev. C. Peterson	Tuominen	1965	5	17	Gd	D	4	1965	1410	---	
45N 31W 7-1	SE SE	Harry Patrick	---	----	1 1/2	---	Gd	P	-----	----	1490	---	Occasionally has musty smell
24-1	SE SE	K. Mattila	Owner	----	1 1/2	20	Gd	D	-----	----	1460	---	
25-1	NE NW	Chas. Blaim	Owner	----	1 1/2	25	Gd	D	-----	----	1450	---	Occasionally has musty smell
26-1	NW NE	J. Albrecht	Anderson	1961	5	99	Pcr	P	17	1961	1445	---	
45N 32W 5-1	SE SE	A. Rogers	Owner	1957	1 1/2	24	Gd	D	-----	----	1560	---	Dry awhile in '63
29-1	SW SW	A.&L. Aschliman	Former owner	----	1 1/2	30	Gd	D	-----	----	1540	---	
45N 33W 8-1	SW SW	Basilio Prandi	WMP	1959	1 1/2	33	Gd	O	27.11	11-1-65	----	---	WMP obs. well
8-2	SW SW	Basilio Prandi	Tuominen	----	6	91	Gd	D	-----	----	1570	---	
10-2	SE NW	Ervin Evans	---	----	1 1/2	32	Gd	D	9.04	5-5-65	1540	---	WMP obs. well
18-1	NW NW	F. Columbino	---	----	6	41	Gd	D	18.71	8-19-65	1545	---	
46N 31W 30-1	NE SW	USGS	USGS	1965	1 1/2	8	Gd	O	0	11-11-65	1560	- -	Casing removed
46N 33W 6-1	NE SW	Joseph Lang	---	1945	---	125	Pcr	D	-----	----	1520	40	WMP obs. well
18-1	SW NW	Mich. Hwy. Dept.	WMP	----	1 1/2	13	Gd	O	8.25	11-1-65	1550	---	
46N 34W 13-1	SW NW	J. Poulos	---	----	6	---	Gd	D	31.78	5-5-65	1520	---	WMP obs. well
14-1	NE NW	Oliver Iron Mining Co.	WMP	----	1 1/2	12	Gd	O	7.30	11-1-65	1520	---	

MARQUETTE COUNTY

WELL RECORDS

STATION NO.	WELL NO.	SECTION		WELL DEPTH (feet)	WELL DIAMETER (inches)	ELEVATION OF GROUND SURFACE AT WELL (feet)	WATER RISING UNIT	PIEDS (in./min)	PERCENTAGE CORRECTION (comp. ft)	DEPTH TO WATER (feet)	DATE OF MEASUREMENT	REMARKS
		1/4	3/4									
42N-11	1	SE	1/4	22	—	990	B+			18	1970	Dug well
	2	SE	NW	40	5	980	B+			10		Water is cloudy
	11	SW	NW	45	5	960	B+			11	—	
42N-25W	1	SE	NE	72	6	1040	B+			16	1969	Supplies Dwelling
	7	NE	SE	293	—	1020	B+			—	—	
	10	SE	SE	40	6	1030	B+			—	—	
	22	NE	SE	48	6	1000	B+			—	—	Water very hard
	32	NE	NE	55	5	1020	B+			22	1968	
	32	NE	NW	55	—	1020	B+			—	—	
42N-26W	2	SE	SE	40	6	1060	B+			—	—	Water very hard
	4	SE	SE	75	5	1120	B+			35	—	
	5	SE	SE	38	6	1100	B+			—	—	
	12	SW	NE	60	5	1040	B+			—	—	
43N-20W	1	SW	SW	42	4	1000	B+			42	1958	Compounded well
	33	SW	SE	61	5	1010	B+			61	1969	
	34	SW	SW	94	5	1030	B+			—	—	
	35	SE	SW	52	5	1000	B+			—	—	
42N-25W	5	SE	SW	60	6	1060	B+			5	1970	
	31	SW	SE	65	5	1100	B+			15	1960	Very hard water
	31	SW	SW	85	5	1100	B+			27	1967	
43N-26W	36	SW	NW	73	6	1100	B+			27	1970	Very hard water
	37	SW	SW	—	—	—	B			73	1970	
44N-11W	1	SW	NW	—	—	1070	B+			3	1970	
44N-11W	1	NW	SE	40	5	1090	B+			4	1967	Water very hard
44N-26W	6	SW	NE	67	5	1120	B+			67	1968	
44N-26W	12	SE	SE	34	2	1120	B+			34	—	Compounded well
	28	NE	SE	28	6	1120	B+			2.3	1026-70	
44N-26W	2	NW	SE	46	5	1100	B+			7	1965	Supplies 2 dwellings

WELL NO.	SECTION NO.	WELL NO.	LOCATION		WELL DEPTH (feet)	WELL DIAMETER (inches)	ELEVATION AT WELL (feet)	WELL SCREENING UNIT	FLOWS (gpm)	SPECIFIC CAPACITY (gpm/ft)	DEPTH TO WATER (feet)	DATE OF MEASUREMENT	REMARKS
			1/4	1/2									
45N20	7	1	NE	-	50	5	1150	5'			15	1970	Water very hard
45N20	7	2	SE	NE	58	6	1160	8'			10	1964	Sample clear
45N20	8	1	NW	SW	50	5	1140	8'			6	1970	
45N20	14	1	NW	NW	42	5	1100	8'			15	1967	
45N20	23	1	NE	NE	38	5	1100	8'			26	1969	
45N20	20	1	NW	-	30	2	1120	6d			-	-	Compounded
45N20	20	-	SE	SW	109	5	1115	6d			4	1957	
45N20	5	1	NW	NW	40	1 1/4	1115	6d			10	1970	
45N20	25	1	SW	SW	60	1 1/4	-	6d			11442 (elevation)	1964	
45N20	25	1	NE	NE	47	1 1/4	1120	6d			-	-	
45N20	27	1	SE	NW	68	5	1110	6d			11	1968	
45N20	28	2	NW	SE	40	10	1100	6d			10	1965	
45N20	28	3	NW	NE	37	8	1100	6d			15	1962	log to 103'
45N20	23	1	SW	NW	62	1 1/4	-	6d			1105.28 (elevation)	7-21-64	47°
45N20	23	1	NW	SE	65	1 1/4	-	6d			1104.88 (elevation)	-	47°
45N20	23	1	SE	SW	98	240	-	6d			1095.16 (elevation)	5-31-63	
45N20	25	1	NW	NW	160	5	1185	6d			24	1970	Supplies Jewelling
45N20	26	1	NE	SE	77	5	1200	6d			28	1970	
45N20	29	1	SE	SW	30	2	1220	6d			30	-	
45N20	8	1	NE	NE	15	1 1/4	-	6d			11209.73 (elevation)	7-22-64	
45N20	15	1	SW	NE	20	1 1/4	-	6d			11342.55 (elevation)	7-22-64	
45N20	11	1	NW	NE	180	6	1460	8'			14.5	-	
45N20	11	2	SE	NW	60	6	1420	6d			42.0	1969	
45N20	5	1	SE	SE	32	4	-	6d			14243.2 (elevation)	7-22-64	
45N20	1	1	SW	NW	30	36	1540	6d			26.20	4-24-64	
45N20	1	2	SE	NW	126	6	1540	8'			50	1962	
45N20	5	1	NE	SE	117	5	1560	6d			54	1967	
45N20	5	2	NE	SE	72	5	1560	6d			72	1967	

Section No.	Section	Well No.	Location		Well Depth (feet)	Well Diameter (inches)	Elevation at Well (feet)	Water Level (feet)	Total (feet)	Pumping Capacity (gpm)	Water in Well (feet)	Date of Measurement	Remarks
			1/4	1/4									
40N20W	5	1	NE	SW	52	6	1560	6d			33	1965	
	5	2	NE	SW	52	6	1560	6d			34	1965	
	5	2	NW	SE	26	3	1530	6d			8	1961	
	8	1	NW	SE	42	6	1535	6d			15	1965	
	13	1	NE	SW	45	6	1500	6d			14	1968	
	19	1	SE	NW	20	6	1470	6d			6	1966	
	22	1	NE	SW	54	4	1500	6d			24	1966	
	26	1	SE	SE	137	6	1480	6d			40	1969	
	26	2	SE	SE	57	5	1480	6d			31	1969	
	26	3	NE	SW	75	5	1490	6d			55	1967	
	28	1	NW	NE	69	5	1500	6d			44	1969	
	28	2	NW	SW	60	5	1500	6d			47	1969	
	30	1	SE	SE	50	5	1450	6d			16	1969	
40N23W	6	1	SE	SE	84	5	780	6d			5	1968	
	7	1	SW	SW	107	6	850	6d			65	1968	Very hard water
	7	2	SW	SW	101	4	845	6d			—	—	Hard water
	18	1	SE	SE	100	5	960	6d			45	1968	
	7	1	NW	SE	75	5	960	6d			25	1968	
	19	3	NE	SE	74	5	940	6d			21	1968	
	25	1	SE	SW	100	6	1070	6d			—	—	See lies dwelling
	29	1	SW	NW	170	6	1080	6d			38	1963	
	29	2	SE	SE	55	6	1100	6d			—	—	
	30	1	NE	SE	85	5	1100	6d			25	1956	
	32	1	NW	SE	55	6	1100	6d			25	1970	
40N30W	1	1	SW	SW	62	6	760	6d			10	1968	
	2	1	SW	SW	116	5	790	6d			45	1969	
	11	1	NE	SE	190	5	800	6d			—	—	
	11	2	SW	SW	111	5	800	6d			25	1967	

WELL DATA														() = Elevation	
Location and Date	Section No.	Well No.	Location		Well Depth (feet)	Well Diameter (inches)	Elevation at Ground Surface (feet)	Water Level (feet)	Water Level (feet)	Water Level (feet)	Water Level (feet)	Water Level (feet)	Water Level (feet)	Date of Measurement	Remarks
46N24W	1	1	1/4	1/4	150	5	780	820	820	820	820	820	820	1968	
	23	1	SE	SW	25	—	880	—	—	—	—	—	—	—	Water high in iron
	24	1	NW	NE	88	5	900	—	—	—	—	—	—	1968	
	36	1	NW	NW	62	—	880	—	—	—	—	—	—	—	
	36	1	SW	NE	60	6	780	—	—	—	—	—	—	—	
46N25W	2	1	NE	SE	12	4 1/4	—	—	—	—	—	—	—	1-22-64	
	5	1	SW	SW	34	1 1/4	—	—	—	—	—	—	—	7-22-64	48°
	9	1	SW	SW	85	1 1/4	—	—	—	—	—	—	—	7-21-64	48°
	11	1	NW	SW	193	6	—	—	—	—	—	—	—	2-25-63	52°
	16	1	SE	SE	48	1 1/4	—	—	—	—	—	—	—	7-21-64	47°
	36	5	NW	SW	144	12	—	—	—	—	—	—	—	7-22-64	
	36	6	NW	SW	144	12	—	—	—	—	—	—	—	7-22-64	
46N26W	2	1	SW	SW	47	1 1/4	—	—	—	—	—	—	—	—	
	12	1	SE	SE	24	1 1/4	—	—	—	—	—	—	—	7-21-64	48°
	21	1	SW	SW	32	1 1/4	—	—	—	—	—	—	—	7-24-64	47°
46N27W	2	1	SW	NE	100	1 1/4	—	—	—	—	—	—	—	—	
	17	1	SE	SE	31	1 1/4	—	—	—	—	—	—	—	7-21-64	47°
	19	1	SW	SE	62	1 1/4	—	—	—	—	—	—	—	7-21-64	48°
	31	1	SW	SW	71	1 1/4	—	—	—	—	—	—	—	7-21-64	49°
46N28W	1	1	SE	NW	96	6	—	—	—	—	—	—	—	7-21-63	50°
	5	1	SW	NW	22	1 1/4	—	—	—	—	—	—	—	7-21-64	50°
	2	1	NW	SW	49	1 1/4	—	—	—	—	—	—	—	11-14-62	
	12	5	NW	SW	15	1 1/4	—	—	—	—	—	—	—	7-22-64	
	15	1	NE	SE	55	1 1/4	—	—	—	—	—	—	—	7-22-64	48°
	27	1	NE	SE	71	1 1/4	—	—	—	—	—	—	—	7-22-64	49°
	32	1	SE	SW	28	1 1/4	—	—	—	—	—	—	—	7-22-64	49°
46N29W	8	1	NE	SE	44	6	—	—	—	—	—	—	—	7-22-64	
	18	1	SE	NW	102	—	1480	—	—	—	—	—	—	1968	

WELL DATA													
TOWN AND RANGE	SECTION NO.	WELL NO.	SECTION CORNER		WELL DEPTH (feet)	WELL DIAMETER (inches)	ELEVATION AT TOP OF WELL (feet)	WATER BEARING UNIT	FIELD (ACRES)	SPECIFIC CAPACITY (gpm/ft)	WATER IN WELL (feet)	DATE OF INSTALLATION	REMARKS
			1/4	3/4									
46N27W	18	2	NW	SE	50	6	1480	Gd			14	1961	
	17	3	NW	SE	56	6	1490	Gd			13	—	
	18	4	NW	SE	62	6	1480	Gd			13	1964	AT 1/2 mi. E.
	18	5	NW	SE	46	12	1480	Gd			15	1968	
	30	1	NW	NE	60	6	1480	Gd			7	1961	
	18	6	NW	SE	33	1 1/4	—	Gd			(1475.87)	7-12-64	50°
	22	1	NW	NE	31	1 1/4	—	Gd			(1492.32)	7-21-64	47°
	20	1	NE	NE	4-	6	—	Gd			(1537.00)	8-23-62	
	36	1	SW	NE	32	1 1/4	—	Gd			(1469.79)	7-21-63	50°
46N30W	16	1	NW	SW	62	6	29	Gd			29	1958	
	22	1	NW	NE	51	5	20	Gd			20	1968	
	26	1	NE	SW	99	5	40	B+			40	1969	
	13	1	NW	NE	47	6	—	Gd			(1490.53)	5-16-62	49° 20' gpm
47N23W	3	1	NW	NE	50	6	610	B+			7	1969	
	7	1	SW	SW	48	5	640	Gd			28	1	
47N24W	10	1	SW	NE	29	1 1/4	615	Gd			—	—	
	11	1	SE	NW	209	5	615	B+			8	1969	
	15	1	NW	SW	210	4	700	Gd			94	1965	MINIUM SUPPLY
	15	2	NE	SW	1415	6	700	Gd			87	1964	BLACK HOP SUPPLY
	21	1	SE	SE	125	5	680	Gd			21	1969	
	21	2	SE	SE	135	7	680	NE			15	1969	AGNANDER WATER
	21	3	SE	SE	63	7	680	Gd			15	1969	
	22	1	SW	SE	126	5	700	Gd			82	1969	
	18	1	SE	SW	75	2	—	—			(612.70)	1969	
	28	1	SW	SW	91	1 1/4	—	Gd			(649.53)	1969	
	25	1	NE	NW	220	6	820	Gd			140	1968	MINIUM SUPPLY
	25	2	NE	NW	170	5	820	Gd			—	1970	MINIUM SUPPLY
	25	2	SW	NW	167	5	820	Gd			—	1970	MINIUM SUPPLY

() = Elevation

WELL DATA

WELL NO.	SECTION NO.	WELL NO.	SECTION NO.	WELL DEPTH (feet)	WELL DIAMETER (inches)	ELEVATION IN GROUND SURFACE AT WELL (feet)	WELL HEADS UNIT	YIELD (gall/min)	SPECIFIC CAPACITY (gpm/ft)	DEPTH TO WATER (feet)	DATE OF MEASUREMENT	REMARKS
47024W	35	4	SW SE	130	5	740	BR			65	1967	
	35	5	NW SE	132	5	760	BR			45	1968	
47025W	12	1	NE SW	86	1 1/4		GD			676	1964	
	15	1	SW SW	235	6		GD			(1016.56)	1964	
	19	1	SW SW	86	1 1/4		GD			(1184.92)	1964	
	20	1	SW SW	103	1 1/4		GD			(1150.39)	1964	
	21	1	SW SW	161	1 1/4		GD			(1093.00)	1964	
	22	2	SE NW	135	1 1/4		GD			(986.29)	1964	
	27	1	SE SW	82	1 1/4		GD			(1016.74)	1964	
	32	1	NE SW									
47026W	29	1	SW NW	34	8	1290	GD			16	1957	STAND BY UNIT
	29	2	SW NW	38	10	1290	GD					MAIN SOURCE
	24	1	SW NE	32	1 1/4		GD			(1203.16)	1964	48°
	25	1	NE NE	35	1 1/4		GD			(1199.86)	1964	
	25	2	NW SW	26	1 1/4		GD			(1203.68)	1964	47°
	25	3	NW SE	26	1 1/4		GD			(1203.99)	1964	47°
	26	1	NW SE	35	1 1/4		GD			(1210.79)	1964	47°
	29	3	SW NW	34	8		GD			(1274.0)	1957	200 GPM
	30	3	SW NE	50	12		GD			(1291.0)	1962	200 GPM
	35	1	NW NW	15	1 1/4		GD			(1201.87)	1964	45°
	36	1	NW NW	28	1 1/4		GD			(1203.22)	1964	
	36	9	NW NW	65	8		GD			(1203.08)	1964	440, 310 GPM
47027W	8	1	SE NW	162	6		GD					
47028W	12	1	NE SW	97	5	1490	GD			F	1967	MAIN SOURCE
	12	2	NE SW	30	8	1490	GD					
	1	1	NW SE	206	48		GD			(1499.81)	1963	
	3	1	SW SW	68	8		GD			(1559.72)	1964	RECORDER
	4	1	NE NE	95	8		GD			(1567.60)	1964	

WELL DATA

SECTION NO.	WELL NO.	LOCATION SECTION	WELL DEPTH (feet)	WELL DIAMETER (inches)	ALLOCATION IN GROUND SURFACE AT WELL (feet)	WELL STARTING UNIT	YIELD (gallons/min)	TESTING CAPACITY (gpm/ft)	DEPTH TO WATER (feet)	DATE OF MEASUREMENT	REMARKS
48N26W	1	1/4 1/4	12	1 1/4	—	—	—	—	(155.55)	1964	47°
		1/4 1/4	—	1	—	—	—	—	(1542.01)	1962	
		1/4 1/4	30	2	—	—	—	—	(1515)	1963	
		1/4 1/4	38	1 1/4	—	—	—	—	(1502.38)	1964	47°
		1/4 1/4	—	—	—	—	—	—	(1441.125)	1964	47°
		1/4 1/4	52	1 1/4	—	—	—	—	(1440.21)	1964	47°
		1/4 1/4	57	7	610	GD	—	—	6	—	
		1/4 1/4	91	5	1010	GD	—	—	40	1968	
		1/4 1/4	70	5	1010	GD	—	—	35	1966	
		1/4 1/4	97	5	1420	GD	—	—	39	1967	
		1/4 1/4	39	6	1310	GD	—	—	25	1968	
		1/4 1/4	55	6	—	GD	—	—	(1396.30)	7/21/64	47°
		1/4 1/4	31	1 1/4	—	GD	—	—	(1273.49)	7/21/64	46°
		1/4 1/4	1 1/4	20	—	GD	—	—	(1551.39)	7/21/64	
		1/4 1/4	38	96	—	GD	—	—	(1550)	6/4/62	
		1/4 1/4	50	6	—	GD	—	—	(1550)	"	
		1/4 1/4	110	6	1690	GD	—	—	9	1953	supplies 2
		1/4 1/4	21	1 1/4	—	—	—	—	(1551.61)	7/21/64	
		1/4 1/4	32	1 1/4	—	—	—	—	(1554.67)	"	
		1/4 1/4	89	6	—	GD	—	—	(1593)	5/16/62	
		1/4 1/4	41	6	1600	GD	—	—	15	1968	
		1/4 1/4	77	5	740	Br	—	—	28	1969	
		1/4 1/4	66	5	605	Br	—	—	3	1967	water red
		1/4 1/4	99	5	750	Br	—	—	28	1967	
		1/4 1/4	96	5	750	Br	—	—	13	1969	
		1/4 1/4	92	5	740	Br	—	—	7	1969	
		1/4 1/4	23	1 1/4	1120	GD	—	—	—	—	
		1/4 1/4	126	5	640	Br	—	—	52	1968	

[illegible]

MENOMINEE COUNTY

WELL RECORDS

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 27N 27W 8-1 is well number 1 in section 8, township 27 north, range 27 west.

Water-bearing strata: gl - glacial drift; gg - glacial gravel; ul - upper limestone; als - middle limestone and sandstones; ls - lower sandstones; Pr - 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	N or R	Date	Specific capacity	Altitude	Depth to bedrock	Remarks
26N 27W															
5-1	M ₂ M ₂ ; section 5	Julius Van Vickle	J. Van Vickle	1947	6	80	gl	D	75	N	1962	---	850	---	
9-1	SE ₁ M ₂ ; section 9	Craig Johnston	H. Kloman	1961	3	19	gl	I	8	R	6-1-61	---	845	---	
11-1	M ₂ M ₂ ; section 11	Dr. Arthur Coates	Wm. Kloman	1959	3	27	gl	I	86.5	R	9-2-59	---	850	---	
22-1	M ₂ M ₂ ; section 22	Walter Ladrow	F. Kozibowski	1961	3	68	gl	D	81.5	R	1961	---	865	---	
26-1	SE ₁ M ₂ ; section 26	Charles Hanna	F. Kozibowski	1961	3	106	gl	D	15	R	1961	1.5	855	---	
26N 27W															
2-1	M ₂ SE ₁ ; section 2	Ed Peterson	Henry Le Beau	1960	3	73	als	D	19	R	1960	---	890	42	
2-2	M ₂ SE ₁ ; section 2	Wildwood Restaurant	Henry Le Beau	1960	3	77	als	D	26	R	11-30-60	---	900	60	
2-3	M ₂ SE ₁ ; section 2	St. Mary's Parish	C. O. Rice	1951	---	120	als	D	---	---	---	---	960	---	Cased to 90 ft. Reinst near surface
2-4	SE ₁ M ₂ ; section 2	Frank Rodman	Henry Le Beau	1960	3	110	als	D	---	---	---	---	900	---	
2-5	M ₂ SE ₁ ; section 2	Robert Patrick	Henry Le Beau	1961	3	60	als	D	80	R	10-6-59	---	900	47	
11-1	M ₂ SE ₁ ; section 11	Alex Ginzora	C. O. Rice	1959	3	65	als	D	12	R	1961	---	905	---	Cased to 47 ft.
12-1	SE ₁ M ₂ ; section 12	Ruben Erickson	T. Rice + Son	1945	3	67	als	D	---	---	---	---	---	---	Cased to 28 ft.
13-1	SE ₁ M ₂ ; section 13	Ed Bellmonte	T. Rice + Son	1945	3	75	als	D	40	R	1960	---	---	2	
15-1	M ₂ SE ₁ ; section 15	Bill Moore	Thomas Co.	---	---	400	ls	S	---	---	---	---	---	---	Reported to be more than 400 ft. deep.
16-1	M ₂ SE ₁ ; section 16	Bill Moore Mink Ranch	---	---	---	---	---	---	---	---	---	---	---	---	
27N 27W															
11-1	M ₂ SE ₁ ; section 11	Edward Hanna	F. Kozibowski	1961	3	62	ls	S	20	R	4-12-61	3.5	850	30	
27N 27W															
1-1	M ₂ SE ₁ ; section 1	Andrew Benson	T. Rice + Son	1944	3	47	---	S	20	R	1962	---	---	---	Cased to 27 ft.
23-1	M ₂ M ₂ ; section 23	Lester Le Beau	T. Rice + Son	1944	3	45	als	N	21.56	N	5-4-62	---	845	---	Cased to 23 ft.
27N 26W															
7-1	SE ₁ SE ₁ ; section 7	Reeter Tremblay	Henry Le Beau	1959	3	60	als	S	15.5	R	10-10-59	---	830	35	Cased to 38 ft.
7-2	SE ₁ SE ₁ ; section 7	Sundquist + Pougetti	Dick Rice	1960	3	86	als	D	28	R	11-20-60	---	---	---	Cased to 31 ft.
10-3	SE ₁ M ₂ ; section 19	George Brando	T. Rice + Son	1945	3	40	als	D	---	---	---	---	800	---	Cased to 35 ft.
19-4	SE ₁ M ₂ ; section 19	Carney School	T. Rice + Son	1944	6	61	als	D	---	---	---	---	800	---	
19-7	M ₂ M ₂ ; section 19	Peterson Bros. TGA Store	Henry Le Beau	1958	3	99	als	D	---	---	---	---	815	---	
19-8	M ₂ M ₂ ; section 19	Peterson Bros.	Henry Le Beau	1954	3	40	als	N	6.08	N	9-14-59	---	---	---	
19-11	M ₂ SE ₁ ; section 19	Carl Guard	Dick Rice	1960	3	48	als	D	---	---	---	---	785	---	Cased to 20 ft.
26N 26W															
8-1	M ₂ M ₂ ; section 8	F. Siebert	Thomas Co.	1961	6	40	gl	D	---	---	---	---	760	---	Cased to 60 ft.
24-1	SE ₁ SE ₁ ; section 24	John Kippie	T. Rice + Son	1944	3	100	als	D	---	---	---	---	790	---	
26N 27W															
2-1	SE ₁ SE ₁ ; section 2	Frank Seuba	T. Rice + Son	1945	3	100	als	N	20.24	N	7-26-62	---	760	---	Cased to 75 ft.

APPENDIX B
WELL YIELDS

BARAGA COUNTY

WELL YIELDS

WELL YIELDS

<u>Well Number</u>	<u>Aquifer</u>	<u>Yield</u> (gpm)	<u>Drawdown</u> (feet)	<u>Duration</u> <u>of Test</u> (hours)	<u>Specific</u> <u>Capacity</u> (gal/min/ft drawdown)
	Br - bedrock Gd - glacial drift				
48N 31W 17-1	Br	4	67	1	0.06
35-2	Gd	6	61	10	0.16
48N 34W 21-1	Gd	10	20	24	0.50
49N 34W 14-1	Gd	115	32	5	3.60
51N 31W 8-1	Br	10	15	10	0.66
51N 32W 8-1	Gd	30	15	2	2.00
8-2	Gd	20	52	2	0.40
9-1	Gd	30	2	2	15.00
30-1	Br	3	85	2	0.03
51N 33W 28-1	Br	5	30	2	0.16
28-2	Br	5	30	2	0.10
32-1	Gd	5	45	2	0.11
36-1	Gd	20	5	4	4.00
52N 31W 32-1	Br	9	11	4	0.81
52N 33W 2-2	Br	50	100	48	0.50
14-1	Br	5	82	2	0.06
14-2	Br	5	86	2	0.06
14-3	Br	1.5	180	1	0.01
27-1	Br	10	4	2	2.50
27-2	Br	9	26	4	0.34
34-2	Br	10	20	2	0.50

DICKINSON COUNTY

WELL YIELDS

PUMP TEST RESULTS

Well Number	Aquifer Pc = Precambrian Pa = Paleozoic Gd = Glacial drift	Yield (gal/min)	Drawdown (feet)	Duration of test (Hours)	Specific Capacity (gal/min/ft/ drawdown)
39N 28W 7-1	Pc	5	--	--	--
14-1	Gd	5	--	--	--
14-2	?	8	60	1	0.1
19-1	Pc	17	4	2	4.3
19-2	Pc	9	40	1½	0.2
19-3	Pc	12	--	--	--
20-1	Gd	30	--	--	--
20-2	Gd	20	15	2	1.3
24-1	Pa	240	--	--	--
30-1	Gd	5	6	½	0.8
30-2	Gd	40	10	2	4.0
30-3	Gd	5	--	--	2.5
30-4	Gd	10	4	¼	--
39N 29W 8-1	Gd	20	1½	2	13.3
22-1	Gd	15	4	8	3.8
25-1	Gd	30	10	2	3.0
36-1	Pc	20	10	2	2.0
39N 30W 3-2	Gd	125	12	8	10.4
4-1	Pc	20	10	--	2.0
40N 28W 12-1	Gd	4	90	½	0.04
26-1	Gd	3	40	1	0.8
35-1	Gd	3	5	2	0.6
40N 29W 28-1	Gd	3	8	1	0.4
40N 30W 8-1	Gd	15	4	4	3.8
17-1	Gd	3	8	1	0.4
18-2	Gd	30	5	8	6.0
18-4	Gd	12½	10	1	1.3
18-5	Gd	25	12	2	2.0
18-7	Gd	5	18	--	0.3
19-3	Gd	350?	--	6	--
21-1	Gd	15	4	3	3.8
23-1	Pc	6	56	2	0.1
28-1	Gd	30	20	6	1.5
40N 31W 24-1	Pa	15	3	1	5.0

IRON COUNTY

WELL YIELDS

WELL YIELDS

Well Number	Aquifer Pcr - Precambrian rocks Gd - Glacial drift	Yield (gal/min)	Drawdown (feet)	Duration of test (hours)	Specific capacity (gal/min/ft/ drawdown)	Surface formation
41N 31W 14-1	Pcr	17	7	4	2.4	Moraine
41N 32W 11-1	Gd	30	5	2	6.0	Outwash
42N 31W 6-1	Gd	5	4	----	1.2	Outwash
42N 32W 15-1	Gd	480	43	----	11.0	Outwash
26-1	Gd	20	6	2	3.3	Outwash
29-1	Pcr	1	--	----	----	Till plain
42N 33W 1-1	Pcr	5	--	----	----	Till plain
1-2	Pcr	8	55	8	0.1	Till plain
13-1	Gd	60	--	----	----	Outwash
13-2	Gd	8	--	----	----	Outwash
15-2	Gd	5	--	----	----	Till plain
28-1	Gd	20	--	----	----	Outwash
42N 34W 9-1	Gd	300	19	4	15.7	Till plain
13-1	Gd	79	21	11	3.8	Till plain
25-1	Gd	20	4	6	5.0	Outwash
25-2	Gd	8	30	----	0.3	Outwash
42N 35W 1-1	Gd	240	--	8	----	Till plain (?)
1-2	Gd	480	16	9.5	30.0	Till plain (?)
11-1	Gd	125	--	----	----	Swamp deposit
20-1	Gd	15	5	2	3.0	Bedrock at or near surface
20-2	Gd	10	--	----	----	Bedrock at or near surface
43N 31W 4-1	Pcr	40	20	1	2.0	Outwash
16-1	Pcr	10	50	2	0.2	Till plain
24-1	Pcr	3	28	3	0.1	Outwash
26-1	Gd	10	4	2	2.5	Outwash
33-1	Gd	10	6	2	1.7	Outwash
35-1	Gd	30	6	1.5	5.0	Outwash
36-1	Pcr	6	14	----	0.4	Outwash
36-2	Pcr	16	2	----	8.0	Outwash
43N 32W 6-1	Gd	8	17	----	0.5	Moraine
21-1	Gd	250	--	----	----	Swamp deposit
21-2	Gd	400	--	----	----	Swamp deposit
21-3	Gd	400	--	----	----	Swamp deposit
21-6	Gd	30	--	----	----	Swamp deposit
28-2	Gd	150	--	----	----	Outwash
43N 33W 21-1	Gd	30	5	3	6.0	Till plain
31-1	Gd	50	--	2	----	Moraine
43N 34W 24-1	Gd	8	9	----	0.9	Moraine
24-2	Pcr	8	16	----	0.5	Moraine
24-3	Gd	30	10	2	3.0	Swamp deposit
28-1	Gd	200	--	----	----	Till plain
43N 35W 16-1	Gd	85	3	1	28.0	Outwash
21-1	Gd	250	--	----	----	Till plain
23-1	Gd	1,770	--	----	----	Till plain
26-2	Gd	400	--	----	----	?
44N 31W 26-1	Gd	10	--	----	----	Moraine
26-2	Gd	5	20	4	0.3	Moraine
26-3	Gd	35	5	4	7.0	Moraine
26-4	Gd	25	15	3	1.7	Moraine
26-5	Gd	30	10	2	3.0	Moraine
44N 33W 7-1	Gd	6	8	----	0.8	Till plain
8-3	Gd	200	--	6	----	Outwash
16-1	Gd	100	6	6	17.0	Till plain
16-2	Gd	400	--	11	----	Till plain
17-1	Gd	8	4	----	2.0	Till plain
35-1	Gd	3	10	----	0.3	Moraine
35-2	Gd	7	6	----	1.0	Moraine
45N 31W 26-1	Pcr	14	70	5	0.2	Outwash

APPENDIX C

WATER QUALITY

BARAGA COUNTY
WATER QUALITY

FORMATION AND ZONE	SECTION NO.	WELL NO.	LOGGING SECTION		DATE SAMPLED	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	IRON (Fe)	MANGANESE (Mn)	COPPER (Cu)	NITRATE (NO ₃)	CHLORIDE (Cl)	NITRATE (NO ₃)	TOTAL SULFATE (SO ₄)	TOTAL CHLORIDE (Cl)	pH
			1/4	3/4													
47N 32W	25	1	See well log		9/21/69	—	—	—	1.5	—	1.5	15	32	4.3	32	50	6.0
47N 32W	18	1	"		9/19/69	—	—	—	75.0	—	1.0	9.0	—	0.1	130	245	6.8
48N 31W	17	1	"		8/20/69	—	—	—	0.40	—	1.3	7.0	93	0.0	104	160	7.9
48N 31W	17	2	"		8/21/69	—	—	—	0.20	—	0.5	5.0	102	0.1	110	145	8.2
48N 31W	17	3	"		"	—	—	—	<0.10	—	0.7	2.0	10	0.2	<30	<50	6.1
48N 31W	21	1	"		9/21/69	—	—	—	75.00	—	4.5	8.0	—	0.0	117	200	7.4
48N 31W	33	1	"		8/21/69	—	—	—	75.0	—	1.0	0.0	56	0.0	53	38	6.8
48N 31W	35	1	"		9/17/69	—	—	—	<0.10	—	8.5	17	30	31	98	150	7.5
48N 31W	35	2	"		"	—	—	—	2.00	—	0.5	16	35	0.5	55	34	7.6
48N 31W	35	3	"		9/21/69	—	—	—	0.60	—	0.5	9.0	—	0.7	<30	<50	5.8
48N 31W	8	1	"		8/24/69	—	—	—	1.9	—	2.2	4.0	45	0.0	65	42	7.1
48N 31W	6	1	"		9/24/69	—	—	—	<0.10	—	1.0	11	—	5.7	220	182	7.5
48N 31W	18	1	"		9/23/69	—	—	—	<0.10	—	10	22	—	0.8	—	196	—
48N 31W	18	2	"		"	—	—	—	0.60	—	0.0	18	205	0.1	221	142	8.5
48N 31W	21	1	"		9/17/69	—	—	—	1.4	—	0.0	15	—	0.1	202	150	7.8
48N 31W	21	2	"		9/23/69	—	—	—	75.0	—	1.0	7.0	—	2.3	—	34	0.0
48N 31W	22	1	"		9/17/69	—	—	—	75.0	—	4.0	8.0	—	0.3	—	85	7.2
48N 31W	22	2	"		9/24/69	—	—	—	0.30	—	3.2	7.0	—	4.8	—	78	6.5
48N 31W	28	1	"		9/22/69	—	—	—	0.30	—	2.0	11	—	5.7	202	164	7.7
48N 31W	29	1	"		"	—	—	—	0.10	—	0.5	9.0	127	0.2	130	86	8.0
48N 31W	31	1	"		"	—	—	—	0.30	—	1.0	14	—	0.2	162	132	7.9
48N 31W	32	1	"		"	—	—	—	1.9	—	0.0	7.0	—	1.2	—	124	7.4
48N 31W	34	1	"		9/17/69	—	—	—	0.10	—	5.0	10	110	1.1	133	98	7.3
48N 31W	32	1	"		9/17/69	—	—	—	75.0	—	1.5	10	—	0.2	52	30	6.0
48N 31W	6	2	"		9/22/69	—											

CHEMICAL ANALYSIS OF WATER

FARMING UNIT	SECTION NO.	WELL NO.	ANALYSIS		DATE SAMPLED	CATION (mg)	MAGNESIUM (mg)	SODIUM (mg)	POTASSIUM (mg)	IRON (mg)	MANGANESE (mg)	ZINC (mg)	COPPER (mg)	NITROGEN (mg)	TOTAL NITROGEN (mg)	TOTAL PHOSPHORUS (mg)	PH	
			%	%														
	28	1	See well data		9/12/67	—	—	—	—	0.30	44	8.0	1.0	0.2	52	35	80	7.8
SIN 30W	18	1	"		9/22/67	—	—	—	—	75.0	—	6.0	0.0	0.0	101	65	155	6.3
SIN 33W	3	1	"		9/23/67	—	—	—	—	6.10	139	7.0	159	0.1	468	255	880	7.8
	5	1	"		9/24/67	—	—	—	—	0.10	129	2.0	5.0	0.2	143	103	225	8.1
	10	1	"		"	—	—	—	—	0.10	209	7.0	4.0	0.2	214	110	350	8.5
	11	1	"		9/23/67	—	—	—	—	75.0	—	11	0.5	0.1	97	64	150	6.9
	11	2	"		"	—	—	—	—	1.2	—	16	1.0	0.1	188	144	300	6.4
	22	1	"		9/16/67	—	—	—	—	0.20	—	10	3.5	0.1	143	103	220	8.3
	28	2	"		7/20/67	—	—	—	—	75.0	154	16	6.5	0.8	176	136	270	8.4
SIN 34W	9	1	"		9/10/67	—	—	—	—	2.5	209	8.0	1.0	0.2	208	172	320	8.0
SIN 34W	4	1	"		9/14/67	—	—	—	—	0.20	155	3.0	1.5	1.1	196	127	260	7.8
	8	1	"		"	—	—	—	—	0.30	56	4.0	1.5	0.1	71	46	110	6.5
SIN 30W	9	1	"		8/13/67	—	—	—	—	1.1	175	0.0	0.3	0.1	182	128	280	8.0
	30	1	"		"	—	—	—	—	0.20	151	1.5	0.6	0.1	159	104	240	7.6
SIN 33W	15	1	"		7/23/67	—	—	—	—	0.20	—	25	7.1	2.9	306	60	475	6.5
	28	1	"		9/9/67	—	—	—	—	2.5	—	10	4.5	0.1	84	50	150	6.2
	28	2	"		"	—	—	—	—	0.10	—	9.0	1.5	0.4	65	50	100	5.9
	32	1	"		"	—	—	—	—	<0.10	—	12	18	2.7	200	168	320	7.7
SIN 34W	5	1	"		"	—	—	—	—	<0.10	—	5.0	1.0	0.7	208	154	320	7.8
	7	1	"		9/10/67	—	—	—	—	3.5	—	9.0	1.0	0.2	—	23	75	5.5
	9	1	"		9/9/67	—	—	—	—	<0.10	121	11	2.5	0.3	124	85	285	8.3
	10	1	"		9/11/67	—	—	—	—	0.20	101	54	19	0.4	202	92	330	8.2
	15	1	"		9/11/67	—	—	—	—	<0.10	—	10	1.0	0.2	—	250	530	7.3
	17	1	"		9/12/67	—	—	—	—	0.30	—	14	16	0.5	—	225	480	7.1
	18	1	"		"	—	—	—	—	0.10	137	12	3.0	0.9	136	97	210	7.1
	20	1	"		"	—	—	—	—	<0.10	124	10	2.5	0.5	127	92	160	7.1
	21	1	"		9/11/67	—	—	—	—	0.40	189	8.0	7.1	0.4	325	54	500	8.5
	21	1	"		"	—	—	—	—	1.0	—	11	3.5	2.4	75	50	115	5.5

CHEMICAL ANALYSES OF WATER FROM WELLS (ANALYSES ARE GIVEN IN MILLIGRAMS/LITER)																		
FORMATION AND DEPTH	SECTION NO.	WELL NO.	LOCATION		DATE SAMPLED	CALCIUM (cc)	MAGNESIUM (cc)	SODIUM (cc)	POTASSIUM (cc)	IRON (cc)	MANGANESE (cc)	NITRATE (cc)	CHLORIDE (cc)	NITRATE (mg)	TOTAL SULFATES AS SO ₄	TOTAL CHLORIDE AS CL	TOTAL SOLIDS	
			1/4	1/2														
SDN20W	24	2	SEC well	1/4	9/10/69	—	—	—	—	—	—	14	3.5	2.1	38	15	55	5.4
	27	1	"	"	"	—	—	—	—	—	—	8.0	1.0	0.2	280	200	430	8.0
	36	1	"	"	9/9/69	—	—	—	—	—	—	15	3.2	2.6	—	193	400	7.5
	16	1	"	"	9/12/69	—	—	—	—	—	—	7.0	0.5	0.4	143	107	225	7.4
	20	1	"	"	8/14/69	—	—	—	—	—	—	9.0	8.5	3.9	325	202	450	7.5
SDN31W	28	1	"	"	8/19/69	—	—	—	—	—	—	5.0	6.5	1.7	156	91	230	6.0
	26	1	"	"	8/14/69	—	—	—	—	—	—	4.0	1.5	5.8	100	64	155	6.3
	27	1	"	"	"	—	—	—	—	—	—	4.0	6.3	0.3	325	143	500	7.2
	27	2	"	"	9/16/69	—	—	—	—	—	—	11	5.5	0.3	—	61	240	7.0
	29	1	"	"	8/12/69	—	—	—	—	—	—	0.0	1.0	0.3	198	134	300	7.5
SDN32W	32	1	"	"	8/13/69	—	—	—	—	—	—	2.0	0.8	0.7	155	116	240	8.0
	33	1	"	"	8/13/69	—	—	—	—	—	—	0.0	0.3	0.0	175	126	260	7.9
	34	1	"	"	8/12/69	—	—	—	—	—	—	1.0	0.5	0.1	202	130	300	7.9
	2	1	"	"	8/27/69	—	—	—	—	—	—	31	68	0.2	280	94	450	8.3
	9	1	"	"	9/28/69	—	—	—	—	—	—	14	620	0.0	1365	525	2100	7.6
SDN33W	10	1	"	"	8/27/69	—	—	—	—	—	—	0.0	1.0	0.0	169	132	265	7.8
	14	1	"	"	8/29/69	—	—	—	—	—	—	12	39	0.0	247	100	400	7.7
	27	1	"	"	"	—	—	—	—	—	—	5.0	2.5	0.2	143	82	230	7.3
	29	1	"	"	8/21/69	—	—	—	—	—	—	10	6.0	12.0	62	38	105	6.0
	29	2	"	"	8/27/69	—	—	—	—	—	—	18	5.0	0.1	182	36	280	8.1
	34	1	"	"	"	—	—	—	—	—	—	5.0	3.0	0.1	195	94	300	7.7

SURFACE WATER QUALITY - BARAGA COUNTY

Lakes with outlets

Section & Number	Lake	Township	Range	Section	Location in Section	Date	Samples	Iron (Fe)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Total Dissolved Solids	Hardness (CaCO ₃)	Specific Conductance	pH	Temperature	Estimated Yield, gpm
28-1	CRAIG LAKE	49N	31W	28	SW-NE	9-22-69	0.50	6	11	1.0	0.1	<32	8	<50	6.7	180	—	—
27-1	KING LAKE	48N	35W	27	SE-NE	9-20-69	0.50	9	8.0	0.8	3.8	—	14	<50	6.9	130	—	—
24-1	WORM (VERMILAC) LAKE	48N	34W	24	NW-SE	9-20-69	0.30	10	6.0	1.0	1.4	—	15	<50	6.8	140	—	—
18-1	RUTH LAKE	48N	31W	18	SE-NE	8-12-69	.30	17	0.0	1.5	0.0	29	18	<50	6.9	20.5	—	—

SURFACE WATER QUALITY - BARAGA COUNTY

Lakes without "outlet"

Section & Number	Lake	Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Total Dissolved Solids	Hardness (CaCO ₃)	Specific Conductance	pH	Temperature	Estimated Yield, gpm
28-1	Big Lake	49N	34W	28	NW-SW	9/19/69	.10	2	17	0.0	0.2	-	3	50	5.9	2.0	-
18-1	Laws Lake	50N	32W	18	NW-NW	9/22/69	.20	67	8.0	0.0	0.4	58	48	90	7.0	18.5	-
33-1	Petticoat Lake	48N	31W	33	SW-SE	8/21/69	-	17	1.0	0.1	0.1	-	14	50	6.8	24.0	-

SURFACE WATER QUALITY - BARAGA COUNTY

Springs

Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Nitrate (NO_3)	Total Dissolved Solids	Hardness (CaCO_3)	Specific Conductance	pH	Temperature, °C	Estimated Yield, gpm
47N	31W	32	SE-NW	9-21-69	0.50	—	11	0.5	0.3	55	35	85	5.8	8.5	10
48N	34W	17	NE-NE	9-19-69	0.10	166	12	10	1.7	214	139	330	7.7	8.0	2
49N	32W	6	SW-SW	9-22-69	1.3	140	90	3.0	1.3	155	122	245	7.9	14	—
49N	33W	18	SW-SE	9-10-69	0.50	—	80	18	1.6	—	85	220	6.9	—	—
50N	32W	18	SW-NE	9-22-69	2.2	107	12	1.0	0.3	114	85	200	7.3	8	2
50N	33W	28	SE-SW	9-20-69	0.30	—	15	15	2.7	159	114	350	6.9	8.5	2
51N	33W	25	NW-SE	8-12-69	0.50	32	4.0	8.5	0.1	65	50	115	5.9	12	3
52N	31W	19	SW-NW	8-13-69	0.10	—	—	—	—	—	50	110	5.9	9.5	1
53N	31W	35	SW-SE	8-13-69	1.0	33	15.0	1.1	1.0	55	35	95	5.9	9.5	1

SURFACE WATER QUALITY - BARAGA COUNTY

Section & Number	Stream	Township	Range	Section	Location in Section	Date Samples	Iron (Fe)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Total Dissolved Solids	Hardness (CaCO ₃)	Specific Conductance	pH	Temperature	Estimated Yield, gpm
1-1	Hazel Creek	50N	34W	1	NE-SW	8/26/69	0.1	119	3.0	1.2	0.3	127	93	195	7.6	12	-
35-1	Huron River	52N	30W	35	NW-NW	8/19/69	0.1	66	3.0	1.0	0.1	65	50	100	7.8	10	-
26-1	Peshekee River	50N	31W	26	SW-NW	9/18/69	0.5	29	7.0	0	1.0	39	29	60	7.8	13	-
18-1	Silver River	51N	31W	18	SW-NW	8/14/69	0.4	-	-	-	-	-	65	115	8.5	19	-
12-1	Six Mile Creek	50N	34W	12	NW-NW	8/28/69	-	105	1.5	0.8	0.1	107	80	160	7.5	14	-
8*	Slate River	51N	31W	8	SE-NE	8/19/69	.10	68	3.0	1.0	0.2	75	54	115	7.5	18.5	-
8-1	Tioga River	48N	32W	8	SW-NW	8/20/69	0.50	51	0.0	0.5	0.1	54	42	83	7.1	150	-

* Source 8 does not appear on the Surface Water Data Map.

DELTA COUNTY
WATER QUALITY

Chemical analyses of ground-water samples in Delta County

Aquifer:

Depth: Sampling point in well, in feet below land surface. Where depth is not indicated, sample was collected from pump discharge or flow at well head.

Analyst: M, Michigan Department of Health; U, U. S. Geological Survey.

Potassium: + indicates potassium (K) included in value listed under sodium (Na).

Well number	Acifer	Depth	Analyst	Date collected	Chemical constituents (parts per million)													pH	Specific conductance (microhos at 25°C)	Temperature (°F)
					Silica (SiO ₂)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Fluoride (F)	Nitrate (NO ₃)	Total solids	Hardness as CaCO ₃			
43N 23W 6-1 21-3	Otb Ggd	.	M	10-24-58 3-3-53	.	16	36	27	7	.	312	0	2	.	.	.	250 90	.	500 .	

DICKINSON COUNTY

WATER QUALITY

LABORATORY ANALYSES OF WELL WATER
(By U. S. Geological Survey and Michigan Dept. of Health)

Well Number	Aquifer	Date Collected	Analyst	Chemical constituents in parts per million										pH
				Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium and Potassium (Na+K)	Bicarbonate (HCO ₃)	Sulphate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Dissolved solids	Hardness (CaCO ₃)	Specific Conductance (Micromhos @ 25°C)
44N 28W 10-1	Gd	7/31/64	USGS	---	---	---	---	184	19	1.5	0.1	---	189	314
43N 30W 29-3	Gd	1959	MDH	0.75	66	33	7.2	322	30	13	---	335	300	---
43N 30W 9-2	Pc	8/ 5/64	USGS	---	---	---	---	261	14	2.5	0.1	---	222	414
42N 28W 35-2														
(Spring)														
42N 28W 29-1	Gd	9/15/64	USGS	---	---	---	---	292	19	4.5	4.6	---	303	501
42N 27W 20-1	Pc	9/11/64	USGS	---	---	---	---	252	13	5.0	0.2	---	202	413
40N 30W 31-1	Pa	9/14/64	USGS	---	---	---	2.1	262	29	1.5	0.1	---	275	447
39N 30W 3-1	Gd	10/6/64	USGS	---	---	---	---	404	65	15	3.8	---	468	746
39N 28W 14-1	Gd	8/14/58	MDH	0.00	72	00	14.1	282	37	23	31	400	320	640
39N 28W 19-3	Gd	5/14/64	USGS	---	13	36	14.2	159	45	6	---	231	223	391
	Pc	5/14/64	USGS	---	34	31	20.3	250	25	13	---	257	221	469

Pc = Precambrian
Pa = Paleozoic
Gd = Glacial drift

FIELD ANALYSES OF WELL WATER

Well Number	Aquifer Pc=Precambrian Pa=Paleozoic Gd=Glacial drift	Date	Hardness (CaCO ₃)	Iron (Fe)	Specific Conductance (Micromohs at 25°C)	pH	Temperature (°F)
44N 30W 23-1	Pc	10/21/64	140	0.7	260	8.0	--
33-1	Gd	10/19/64	240	0.2	375	7.5	--
44N 28W 27-1	Gd	9/9/64	190	---	240	---	--
43N 30W 11-1	Pc	8/5/64	170	<0.1	290	7.5	--
43N 29W 11-1 (Spring)	Gd	8/10/64	190	---	320	6.9	--
43N 28W 23-3	Gd	8/5/64	240	0.5	380	7.5	--
43N 27W 28-1	Pc	10/23/64	270	0.2	440	7.5	48
42N 30W 2-1	Pc	10/18/64	150	0.3	260	7.0	49
4-1	Pc	10/16/64	340	<0.1	590	7.0	48
18-2	Pc	10/15/64	210	0.2	325	8.0	--
24-1	Pc	10/16/64	130	4.0	215	7.5	46
33-1	Pc	10/15/64	320	<0.1	700	7.0	51
33-2	Pc	10/15/64	230	<0.1	410	7.5	47
42N 29W 19-1 (Spring)	Gd	10/21/64	270	<0.1	450	8.0	--
22-1	Gd	10/14/64	380	<0.1	700	6.5	54
22-2 (Flows)	Gd(?)	10/14/64	260	<0.1	510	7.5	42
31-1	Pa	11/18/64	220	<0.1	420	7.0	--
33-1	--	10/7/64	290	<0.1	410	7.0	53
42N 28W 5-5	Pa	10/23/64	220	0.7	320	7.5	45
32-1 (Spring)	Gd	9/17/64	640	---	1580	6.8	47
42N 27W 20-1	Pa	9/14/64	290	1.5	395	7.0	45
32-2	Pc	9/14/64	140	<0.1	300	7.5	--
41N 30W 16-1	Gd	11/18/64	150	0.2	300	8.0	--
25-3	--	11/19/64	240	<0.1	400	7.5	--
32-1	Pc	11/19/64	270	0.1	500	7.5	--

Field Analyses of Well Water.--Continued

Well Number	Aquifer	Date	Hardness (CaCO ₃)	Iron (Fe)	Specific Conductance (Micromohs at 25°C)	pH	Temperature (°F)
	Pc=Precambrian Pa=Paleozoic Gd=Glacial drift						
41N 28W 8-1	Pa	11/6/64	220	< 0.1	360	7.5	48
8-2	Gd	11/6/64	260	< 0.1	400	7.5	47
28-1 (Spring)	Gd	11/13/64	220	0.3	325	7.5	47
34-1	Gd	11/13/64	140	0.5	230	7.5	47
41N 27W 9-1	Pa	10/5/64	260	2.0	675	7.5	--
40N 30W 5-1	Gd(?)	12/10/64	150	---	275	8.0	51
6-1	Gd	1964	260	< 0.1	---	7.5	56
14-1	Pc(?)	1964	290	0.1	580	7.5	49
14-2	--	12/14/64	240	1.5	420	7.5	48
20-1 (Flows)	--	1964	220	0.1	385	7.0	49
23-1	Pc	1964	300	0.2	500	7.5	--
40N 29W 6-2	Gd	9/11/64	240	0.2	---	8.0	--
40N 28W 10-1	Pc	12/9/64	270	< 0.1	640	8.0	47
39N 29W 2-1	Gd	1964	---	---	480	---	50
14-2	Gd	12/15/64	170	0.1	340	7.5	--
15-1	Gd	12/15/64	260	1.5	420	7.5	--
20-1	Gd	1964	---	---	335	---	49
22-1	Gd	1964	250	0.2	460	---	53
26-1	Pc	1964	---	---	435	---	51
36-1	Pc	1964	---	---	525	---	53
36-2	--	1964	---	---	425	---	51
39N 28W 16-1	Pc	1964	---	---	380	---	50
24-1	Pa	9/16/64	---	---	540	---	51
30-8	Pc	12/15/64	310	< 0.1	480	7.5	--
35-1	Pa	1964	---	---	660	---	53

(< = less than)

IRON COUNTY
WATER QUALITY

Laboratory Analysis of Ground Water - Iron County

Water-bearing aquifer: Pcr - Precambrian rocks
Pa - Paleozoic rocks
Gd - Glacial drift

Well Number	Aquifer	Date sampled	Temperature F	Specific conductance (Micromhos @ 25°C)	pH	in parts per million							Field Analysis Iron (Fe)
						Bicarbonate (HCO ₃)	Carbonate (CO ₃)	Sulfate (SO ₄)	Chloride (Cl)	Nitrate (NO ₃)	Hardness (CaCO ₃)	Hardness (Non-carbonate)	
43N 32W 29-1	Pcr	9-24-65	46	784	7.5	358	0	108	30	0.1	416	122	0.1
43N 33W 31-1	Gd	9-23-65	--	338	7.3	210	0	7.2	1.0	1.6	182	10	4.0
45N 32W 5-2 (Spring)	Gd	9-30-65	45	208	7.8	114	0	28	2.0	0.1	106	12	0

Field Analyses of Ground Water from Iron County

Aquifer: Pcr - Precambrian rocks; Pa - Paleozoic rocks;
Gd - Glacial drift.

Well Number	Aquifer	Date Sampled	In parts per million		Specific conductance (Micromohms at 25°C)	pH	Temperature of
			Hardness	Iron			
41N 31W 14-1	Pcr	7-29-65	170	>4.0	385	7.5	46
41N 32W 11-1	Gd	8-26-65	150	0	240	7.2	48
42N 31W 6-1	Gd	7-29-65	170	0.3	285	7.5	44
6-2	Gd	8-12-65	90	0.15	290	6.5	48
42N 32W 26-1	Gd	7-30-65	90	0.2	180	7.7	--
42N 33W 15-1	Pcr	8-11-65	170	0	290	7.3	--
42N 3	Gd	9-27-65	50	0	80	6.0	45
42N 35W 20-2							
43N 31W 4-1	Pcr	8-10-65	140	1.2	220	7.5	45
16-1	Pcr	8-11-65	310	0	480	7.0	--
33-1	Gd	7-16-65	170	0.6	295	7.0	46
36-2	Pcr	8-11-65	290	1.5	440	7.7	--
43N 32W 1-1	Gd	8-17-65	190	0.7	310	7.2	44
4-2	Gd	8-17-65	190	>4.0	310	7.5	45
43N 33W 21-1	Gd	5-11-65	170	0	280	7.5	--
27-2	Pcr	9- 9-65	290	0	520	7.0	--
27-3	Pcr	9- 9-65	240	0.7	400	7.2	--
43N 34W 24-1	Gd	8-11-65	150	0.4	245	7.5	--
43N 37W 33-3	Gd	9-22-65	30	1.5	450	6.0	--
44N 31W 26-1	Gd	8-12-65	170	0.2	220	7.5	47
34-1	Pcr	8-10-65	220	<0.1	380	7.2	--
44N 32W 16-1	Gd	8-17-65	150	2.0	275	7.1	52
17-1	---	8-18-65	140	0	280	7.8	47
44N 33W 6-1	---	8-19-65	150	<0.1	235	7.7	--
7-1	Gd	8-18-65	150	1.0	170	7.8	46
7-2	Pcr	8-18-65	120	0	225	7.7	--
17-1	Gd	8-18-65	170	0	310	7.7	--
35-1	Gd	8-12-65	150	0	270	7.7	--
45N 31W 7-1	Gd	8-25-65	100	0	205	7.1	52
24-1	Gd	8-25-65	200	0	360	7.5	--
25-1	Gd	8-25-65	120	0.5	225	7.0	--
26-1	Pcr	8-25-65	120	<0.1	220	8.0	--
45N 32W 5-1	Gd	8-13-65	70	>4.0	125	6.5	46
29-1	Gd	8-13-65	90	<0.1	165	7.0	45
45N 33W 8-2	Gd	8-19-65	100	2.0	175	7.9	46
46N 31W 30-1	Gd	11-11-65	20	1.0	50	6.0	45
46N 33W 6-1	Pcr	8-19-65	140	0	290	7.5	--

Well No.: 42N 34W 9-1

Laboratory analysis by Michigan Department of Health
(collected July 1959)

Silica (SiO ₂)	12	ppm
Iron (Fe)	0	
Calcium (Ca)	46	
Magnesium (Mg)	23	
Sodium and Potassium (Na+K)	3.1	
Chloride (Cl)	1	
Sulphate (SO ₄)	24	
Bicarbonate (HCO ₃)	228	
Total hardness (CaCO ₃)	210	
Fluoride (F)	0	
Total solids	225	

Field analysis by U. S. Geological Survey
(July 1965)

Specific conductance (Micromhos at 25°C)	400
pH	7.5
Iron	0

Well No.: 42N 35W 1-2

Laboratory analysis by Michigan Department of Health
(collected July 1959)

Silica (SiO ₂)	14	ppm
Iron (Fe)	0	
Calcium (Ca)	39	
Magnesium (Mg)	15	
Sodium and Potassium (Na+K)	3.6	
Chloride (Cl)	2	
Sulphate (SO ₄)	27	
Bicarbonate (HCO ₃)	171	
Total hardness (CaCO ₃)	160	
Fluoride (F)	0	
Total solids	182	

Field analysis by U. S. Geological Survey
(May 1965)

Specific conductance (Micromhos at 25°C)	310
pH	7.5
Iron	0
Temperature (°F)	44

Well No.: 43N 35W 26-3 city well No. 1

Laboratory analysis by Michigan Department of Health
(city well No. 1, July 1959)

Silica (SiO_2)	16 ppm
Iron (Fe)	0.2
Calcium (Ca)	106
Magnesium (Mg)	45
Sodium and Potassium (Na+K)	6.5
Chloride (Cl)	8.0
Sulphate (SO_4)	220
Bicarbonate (HCO_3)	285
Total hardness (CaCO_3)	451
Fluoride (F)	0.1
Total solids	590

Field test by U. S. Geological Survey
(May 1965)

Specific conductance (Micromhos at 25° C)	700
pH	7.0
Iron (ppm)	0.25
Temperature (°F)	50

Laboratory Analysis by Michigan Department of Health
 43N 32W 21-3 (collected July 1965) 43N 32W 21-4

	<u>Well No. 2</u>	<u>Well No. 3</u>
Silica (SiO ₂)	13 ppm	14 ppm
Iron (Fe)	1.0	1.5
Calcium (Ca)	38	35
Magnesium (Mg)	13	9.8
Sodium and Potassium (Na+K)	4.7	3.5
Chloride (Cl)	1.0	0
Sulphate (SO ₄)	24	5
Bicarbonate (HCO ₃)	161	161
Total Hardness (CaCO ₃)	150	128
Fluoride (F)	0	0
Total Solids	190	154

A flowing well on the east edge of the business district, known as Crystal Mineral Spring, was drilled many years ago as an iron ore test hole.

Laboratory analysis by U. S. Geological Survey
 (collected September 24, 1965)

	<u>Well 43N 32W 29-1</u>
Bicarbonate (HCO ₃)	358 ppm
Carbonate (CO ₃)	0
Sulphate (SO ₄)	108
Chloride (Cl)	30
Nitrate (NO ₃)	0.1
Hardness (CaCO ₃)	416
Hardness (Noncarbonate)	122
Iron (Fe) Field test	0.1
Specific conductance (Micromhos at 25°C)	784
pH	7.5

42N 33W 12-1

Laboratory analysis well No. 1 by Michigan Department of Health
 (collected February 1961--before treatment)

Silica (SiO ₂)	11 ppm
Iron (Fe)	1.4
Calcium (Ca)	20
Magnesium (Mg)	11
Sodium and Potassium (Na+K)	2.5
Chloride (Cl)	0
Sulphate (SO ₄)	22
Bicarbonate (HCO ₃)	97
Total hardness (CaCO ₃)	95
Fluoride (F)	0
Total solids	126

Laboratory analysis by Michigan Department of Health
42N 35W 11-1 42N 34W 13-1

	<u>Well #1</u> (July, 1959)	<u>Well #2</u> (Aug., 1959)
Silica (SiO ₂)	15 ppm	14 ppm
Iron (Fe)	0	0.1
Calcium (Ca)	32	53
Magnesium (Mg)	16	30
Sodium and Potassium (Na+K)	3.2	3.3
Chloride (Cl)	0	10
Sulphate (SO ₄)	18	13
Bicarbonate (HCO ₃)	159	290
Total hardness (CaCO ₃)	144	254
Fluoride (F)	0.1	0
Total solids	170	274

Laboratory Analysis of well No. 3 by Michigan Department of Health
(collected July 1965)

	44N 33W 8-3
Silica (SiO ₂)	12 ppm
Iron (Fe)	0.4
Calcium (Ca)	54
Magnesium (Mg)	21
Sodium and Potassium (Na+K)	30.1
Chloride (Cl)	37
Sulphate (SO ₄)	37
B carbonate (HCO ₃)	222
Total hardness (CaCO ₃)	222
Fluoride (F)	0
Total solids	322

42N 33W 12-1

Field analysis well No. 1 by U. S Geological Survey
(July 1965)

Specific conductance (Micromhos at 25°C)	195
pH	7.0
Iron (ppm)	0.7
Temperature (°F)	46

Laboratory analysis by Michigan Department of Health

	44N 33W 16-1 Well No. 1 (July, 1959)	43N 33W 14-1 Well No. 2 (July, 1959)	44N 33W 16-2 Well No. 3 (June 7, 1965)
Silica (SiO ₂)	13 ppm	11 ppm	-- ppm
Iron (Fe)	0	0.1	0.2
Calcium (Ca)	40	30	--
Magnesium (Mg)	20	14	--
Sodium and Potassium (Na+K)	4.8	3.1	--
Chloride (Cl)	6	0	1
Sulphate (SO ₄)	13	11	--
Bicarbonate (HCO ₃)	200	150	--
Total hardness (CaCO ₃)	182	132	160
Fluoride (F)	0	0	0.1
Total solids	244	158	--
Manganese (Mn)	--	--	0
Nitrates	--	--	0.5
Nitrates	--	--	.01
pH	--	--	8.1

Laboratory Analysis by Michigan Department of Health
(collected November 24, 1964)

	43N 34W 28-1 <u>Well No. 1</u>	43N 34W 28-2 <u>Well No. 2</u>
Silica (SiO ₂)	10 ppm	10 ppm
Iron (Fe)	0	0
Manganese (Mn)	0	0
Calcium (Ca)	42	48
Magnesium (Mg)	18	21
Sodium (Na)	2.0	2.3
Potassium (K)	1.0	1.4
Nitrate (NO ₃)	1.3	0.6
Chloride (Cl)	0	0
Sulphate (SO ₄)	33	37
Bicarbonate (HCO ₃)	200	225
Carbonate (CO ₃)	0	0
Hardness (CaCO ₃)	180	205
Fluoride (F)	0	0
Total solids	180	220
pH	7.7	7.5
Specific conductance (Micromhos at 25°C)	390	420

Laboratory analysis by Michigan Department of Health
(collected July 1959)

	43N 35W 16-1 <u>Ryden</u>	43N 35W 21-1 <u>Nash</u>
Silica (SiO ₂)	12 ppm	13 ppm
Iron (Fe)	0	0
Calcium (Ca)	32	36
Magnesium (Mg)	19	22
Sodium and Potassium (Na+K)	2.5	2.9
Chloride (Cl)	0	0
Sulphate (SO ₄)	5	11
Bicarbonate (HCO ₃)	154	174
Total hardness (CaCO ₃)	132	158
Fluoride (F)	0	0
Total Solids	148	172

MARQUETTE COUNTY

WATER QUALITY

CHEMICAL ANALYSIS OF WATER FROM WELLS
(ANALYSIS ARE GIVEN IN MILLIGRAMS/LITER)

WELL NO.	SECTION NO.	WELL DEPTH (ft)	WELL TYPE	DATE ANALYZED	TEMPERATURE (°C)	PH	ALUMINUM (mg/l)	MAGNESIUM (mg/l)	SODIUM (mg/l)	POTASSIUM (mg/l)	IRON (mg/l)	MANGANESE (mg/l)	COBALT (mg/l)	NITRATE (mg/l)	TOTAL DISSOLVED SOLIDS (mg/l)	TOTAL SOLIDS (mg/l)	ANALYST
W-1	1	2	SE	7/10/70	72	22	72	18	—	—	—	248	85	7.0	372	460	7.6
W-2	2	—	SE	9/1/70	70	18	70	18	—	—	—	243	25	1.0	346	440	—
W-3	1	1	SE	9/1/70	101	60	101	60	—	—	—	307	10	0	380	480	—
W-4	7	1	SW	9/1/70	57	27	57	27	—	—	—	303	10	0	252	440	—
W-5	—	1	SE	9/1/70	93	33	93	33	—	—	—	525	15	0	366	650	7.5
W-6	—	1	NE	9/1/70	81	25	81	25	—	—	—	342	20	0	306	500	—
W-7	—	1	SE	9/1/70	73	30	73	30	—	—	—	332	45	4.5	326	540	—
W-8	—	1	SE	9/1/70	44	33	44	33	—	—	—	343	85	1.9	352	580	—
W-9	5	1	SW	9/1/70	70	10	70	10	—	—	—	293	5	0	240	420	—
W-10	24	1	SW	9/1/70	51	20	51	20	—	—	—	256	10	0	210	300	—
W-11	—	1	NE	9/1/70	44	25	44	25	—	—	—	280	15	0	240	420	—
W-12	5	1	SE	9/1/70	63	12	63	12	—	—	—	259	10	0	208	300	—
W-13	21	1	SW	9/10/70	74	22	74	22	—	—	—	371	10	0	316	500	—
W-14	21	1	SW	9/1/70	45	34	45	34	—	—	—	288	10	0	256	380	—
W-15	20	1	SW	9/1/70	92	22	92	22	—	—	—	343	5	33	320	650	—
W-16	24	1	SW	9/1/70	84	20	84	20	—	—	—	422	20	1.6	356	750	—
W-17	20	1	SW	9/1/70	84	34	84	34	—	—	—	349	15	0	310	540	—
W-18	25	1	SW	9/10/70	103	18	103	18	—	—	—	307	65	1.5	328	600	—
W-19	7	1	NE	9/12/70	118	46	118	46	—	—	—	393	5	0	482	1000	—
W-20	6	1	SW	9/12/70	20	12	20	12	—	—	—	149	5	1.8	124	240	—
W-21	—	1	NE	9/1/70	42	19	42	19	—	—	—	190	15	2.3	184	320	—
W-22	5	1	SW	7/7/64	17	18	17	18	—	—	—	52	14	—	50	125	—
W-23	—	1	SW	9/1/70	30	52	30	52	—	—	—	78	26	0.2	96	274	—
W-24	—	1	SW	9/10/63	22	62	22	62	—	—	—	68	13	0.2	80	178	—
W-25	15	1	SW	9/1/70	17	11	17	11	—	—	—	118	10	0.1	100	199	—
W-26	—	1	NE	8/2/70	12	50	12	50	—	—	—	61	9.6	0.8	57	122	—
W-27	6	1	SE	9/22/70	31	8.3	31	8.3	—	—	—	49	4.5	1.6	112	360	—
W-28	25	1	SE	9/1/70	24	17	24	17	—	—	—	108	10	0	152	260	—

(REPLY/COMMITMENT ON BEHALF THE ISSUANT)
STIM FOR THE YEAR OF ISSUANCE TO BE

CHEMICAL ANALYSIS OF WATER FROM WELLS (ANALYSIS ARE GIVEN IN MICROGRAMM/LITER)																	
WELL NO. AND NAME	SECTION NO.	WELL AT	CATION FRACTION		DATE SAMPLED	CALCIUM (Ca)	MAGNESIUM (Mg)	SODIUM (Na)	POTASSIUM (K)	IRON (Fe)	MANGANESE (Mn)	ZINC (Zn)	COBALT (Co)	NICKEL (Ni)	TOTAL SOLIDS (ppm)	TOTAL SOLIDS (% dry)	pH
			1/4	1/2													
	29	1	SW	NW	9/25/70	24	10	—	—	—	102	15	4.0	—	100	180	—
	29	2	SE	SE	9/30/70	36	15	—	—	—	159	10	3.0	—	150	260	—
	32	1	NW	SE	9/24/70	51	15	—	—	—	178	15	5.2	—	190	420	—
46N 24W	23	1	SE	SW	9/30/70	12	7.3	—	—	—	46	10	1.5	—	76	340	—
46N 25W	26	1	NW	NW	9/30/70	24	6.3	—	—	—	120	0	2.0	—	86	160	—
	9	1			7/24/69	13	6.9	1.9	1.2	3.0	75	6.8	3.0	—	83	60	137
	11	1			7/24/69	12	1.4	1.5	.7	—	44	2.2	1.5	—	48	36	77
	16	1			7/24/69	20	4.4	4.6	4.4	.47	79	18	9.5	.06	96	62	190
	36	5			6/19/63	19	3.6	1.7	.9	.04	80	4.4	1.5	—	81	62	128
	36	6			"	17	3.4	.9	.7	.04	60	8.6	2.5	—	72	56	118
46N 26W	12	1			7/19/64	7.1	1.8	1.6	.6	—	24	11	2.0	—	50	35	69
	31	1			9/10/64	28	7.0	3.1	1.4	—	90	30	0	0	126	99	212
46N 27W	17	1			8/28/63	21	6.2	3.1	1.2	1.6	79	20	2.0	.1	102	78	175
	19	1			7/8/64	9.0	2.0	2.0	.8	—	23	5.6	1.0	—	51	30	80
	31	1			8/28/63	14	6.4	2.0	1.0	1.5	66	7.6	2.0	—	68	62	127
46N 28W	1	1			"	15	6.3	1.6	1.2	.23	47	4.8	8.5	.30	69	64	136
	9	1			"	4.0	1.9	1.2	.5	.50	16	7.4	9.5	.06	33	18	62
	15	1			7/19/64	11	3.5	.9	1.2	—	48	4.4	1.0	—	51	42	90
	27	—			"	16	3.1	2.3	1.2	—	51	15	2.8	—	75	53	128
	32				8/28/63	16	4.9	1.6	.7	—	51	26	5.0	.06	84	60	144
46N 29W	18	5			"	23	5.8	2.9	2.6	.45	93	20	10	.06	115	82	209
"	22	1			"	8.6	2.7	1.8	1.0	—	24	16	3.0	.03	45	32	85
	30	1			9/6/63	30	14	3.1	1.0	.10	102	13	2.9	0	160	133	240
	36	1			8/28/63	16	5.4	4.4	2.6	—	76	17	3.0	.03	88	62	154
47N 24W	28	1			7/8/64	18	7.4	2.6	2.3	—	73	24	4.0	—	105	76	178
47N 25W	12	1			"	18	4.5	3.8	2.5	—	44	34	4.0	—	96	62	162
	15	1			9/6/63	34	8.7	2.2	.6	.08	140	10	1	.01	131	121	238
	19	1			7/19/64	48	14	5.6	3.0	—	80	106	10	—	258	178	387

CHEMICAL ANALYSES OF WATER FROM WELLS (analyses are given in milligrams/liter)														
WELL NO.	SECTION NO.	DATE SAMPLED	CALCIUM		MAGNESIUM (mg)	SODIUM (mg)	IRON (mg)	MANGANESE (mg)	CHLORIDE (cc)	NITRATE (mg)	TOTAL DISSOLVED SOLIDS	TOTAL SOLIDS AT 60°C	PERCENT CHLORIDE AT 60°C	PH
			mg	%										
47N28W	20	1	7/25/63	22	5.2	3.1	1.6	8.1	74	27	108	76	188	6.4
	21	1	7/16/64	—	—	—	—	—	73	25	—	75	186	7.1
	22	1	8/28/63	41	11	2.9	1.7	—	134	46	186	147	304	6.7
	32	1	7/24/64	18	3.5	2.7	1.9	.25	63	17	86	60	151	6.7
47N26W	3	1	10/17/62	25	6.8	2.0	.6	5.6	107	3.6	127	90	181	6.8
	8	1	7/8/64	41	—	9.4	3.4	—	163	49	194	125	306	7.5
	15	1	"	10	—	3.7	2.3	—	18	7.5	64	36	110	9.7
	28	1	8/28/63	16	—	7.4	5.3	.38	82	18	103	67	187	6.6
47N24W	35	1	8/8/64	19	—	3.6	2.3	—	65	25	106	68	168	7.4
	19	1	9/28/61	25	16	9.0	.3	1.4	172	8.8	154	129	272	7.2
	24	1	7/25/63	45	9.2	9.6	3.3	2.4	86	88	228	190	440	6.9
	25	1	7/24/63	43	12	7.7	3.3	1.6	92	84	217	161	363	6.5
48N26W	25	2	7/9/64	12	4.9	3.3	4.0	—	42	24	88	50	133	8.0
	25	3	"	40	11	8.8	3.0	—	94	83	238	145	347	7.1
	26	1	"	8.2	4.3	1.2	.2	—	39	3.2	87	38	77	6.9
	36	1	"	30	2.5	4.8	2.2	—	27	71	157	86	224	7.2
47N24W	36	9	5/28/64	—	—	—	—	—	130	56	—	109	204	7.5
	2	1	9/6/63	57	2.0	1.8	.8	.14	28	10	34	22	62	6.6
	3	1	"	24	9.9	2.2	1.9	.23	20	15	207	101	248	6.3
	34	1	8/28/63	13	5.8	2.2	1.2	.66	85	1.6	94	56	151	6.6
48N26W	36	1	"	15	6.4	2.6	1.2	.36	68	13	83	64	145	6.7
	34	1	7/8/64	25	4.7	.9	2.0	—	92	5.2	102	82	169	7.8
	30	1	8/28/63	7.0	2.9	1.5	1.0	.29	40	1.8	—	36	30	6.5
	19	1	7/8/63	23	3.5	2.3	1.1	—	86	5.2	100	72	148	8.1
48N24W	26	1	8/28/63	2.8	1.1	1.2	.5	.62	26	5.2	26	12	48	6.8

MENOMINEE COUNTY

WATER QUALITY

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		
37N 28W 11-1	4- 5-63	.33	88	37	3.4	1.4	306	97	27	460	372	681	7.7

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 ^a (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	..	..

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		
37N 27W 1-1	5- 7-62	.93	57	33	3.8	2.2	268	42	7.0	309	278	524	8.1