

GROUND-WATER DATA FOR MICHIGAN 1990

by G.C. Huffman and C.R. Whited

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CONVERSION FACTORS

<u>Multiply</u>	<u>By</u>	<u>To obtain</u>
inch (in.)	25.4	millimeter
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
acre	0.4047	hectare
gallon (gal)	3.785	liter
gallon per minute (gal/min)	0.06308	liter per second
million gallons (Mgal)	3,785	cubic meters
gallon per minute per foot [(gal/min)/ft]	0.2070	liter per second per meter

Temperature in degrees Fahrenheit (°F) as follows:
 $^{\circ}\text{F} = 1.8 \times ^{\circ}\text{C} + 32$

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ABSTRACT

Water levels, locations, depths, and aquifers tapped are given for 107 observation wells. Tabulated data include a listing of ground-water reports in Michigan, extremes of water levels for calendar year 1990 and for the period of record, pumpage of most major ground-water users in the State, and a map showing previous collected water-quality data from selected wells. In 1990, the two largest municipal users of ground water were Lansing and Kalamazoo. Lansing pumped 7.2 billion gallons from the Saginaw Formation and glacial deposits; Kalamazoo pumped 7.0 billion gallons from glacial deposits only.

INTRODUCTION

Purpose and Scope

This report provides records of water levels and related data collected during 1990 for the principal aquifers of Michigan. Data on yield of supply wells, pumpage, quality of water, and hydrographs of observation wells for the past 5 years are shown in the text. Yearly hydrographs are included to illustrate seasonal changes in water levels. Records of water levels in observation wells, and records of pumpage by most major ground-water users during 1990 are given in tables 2 and 3. Distribution of observation wells is shown in figure 1. Locations of wells sampled for water-quality data and years sampled are shown in figure 2.

Use of Ground-Water Data

The quantity of water available from an aquifer can be determined by analysis of records of water levels and pumpage. Water-level records showing long-term effects of pumping can be used to estimate the capacity of aquifers to meet present needs and to predict the capacity of aquifers to meet future needs and to determine whether expansion of present supply systems is practical.

Water levels normally fluctuate annually and may exhibit trends long-term. A knowledge of fluctuations is important when planning construction that requires excavation. For example, when construction is planned after several years of drought, the likelihood that ground water will rise to predrought levels needs to be taken into consideration. In an area where the water level is declining because of pumping, projection of future water levels can be used to predict the installation depth of well intakes.

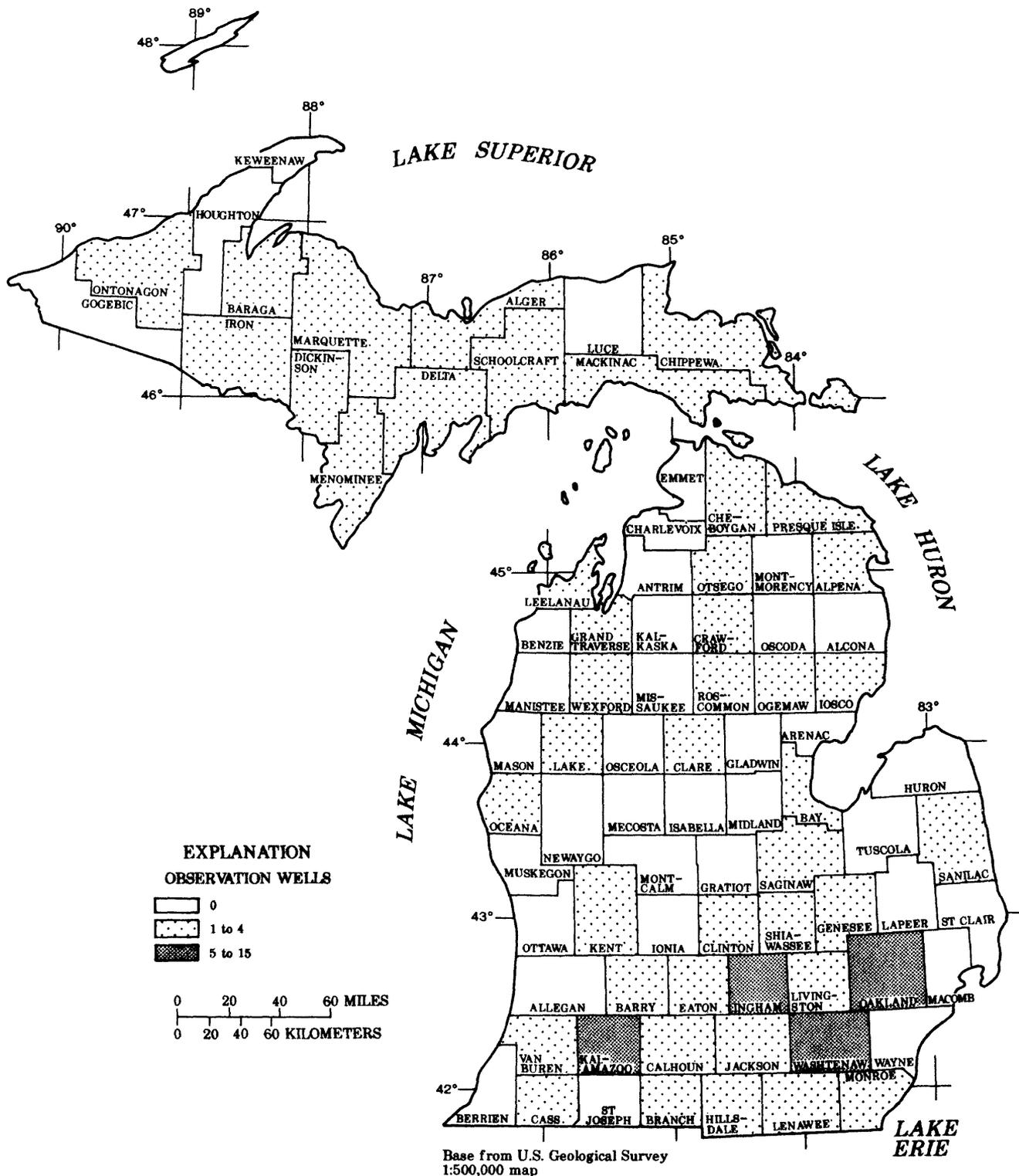


Figure 1.--Distribution of observation wells. (Water levels were monitored in 107 wells in 1990.)

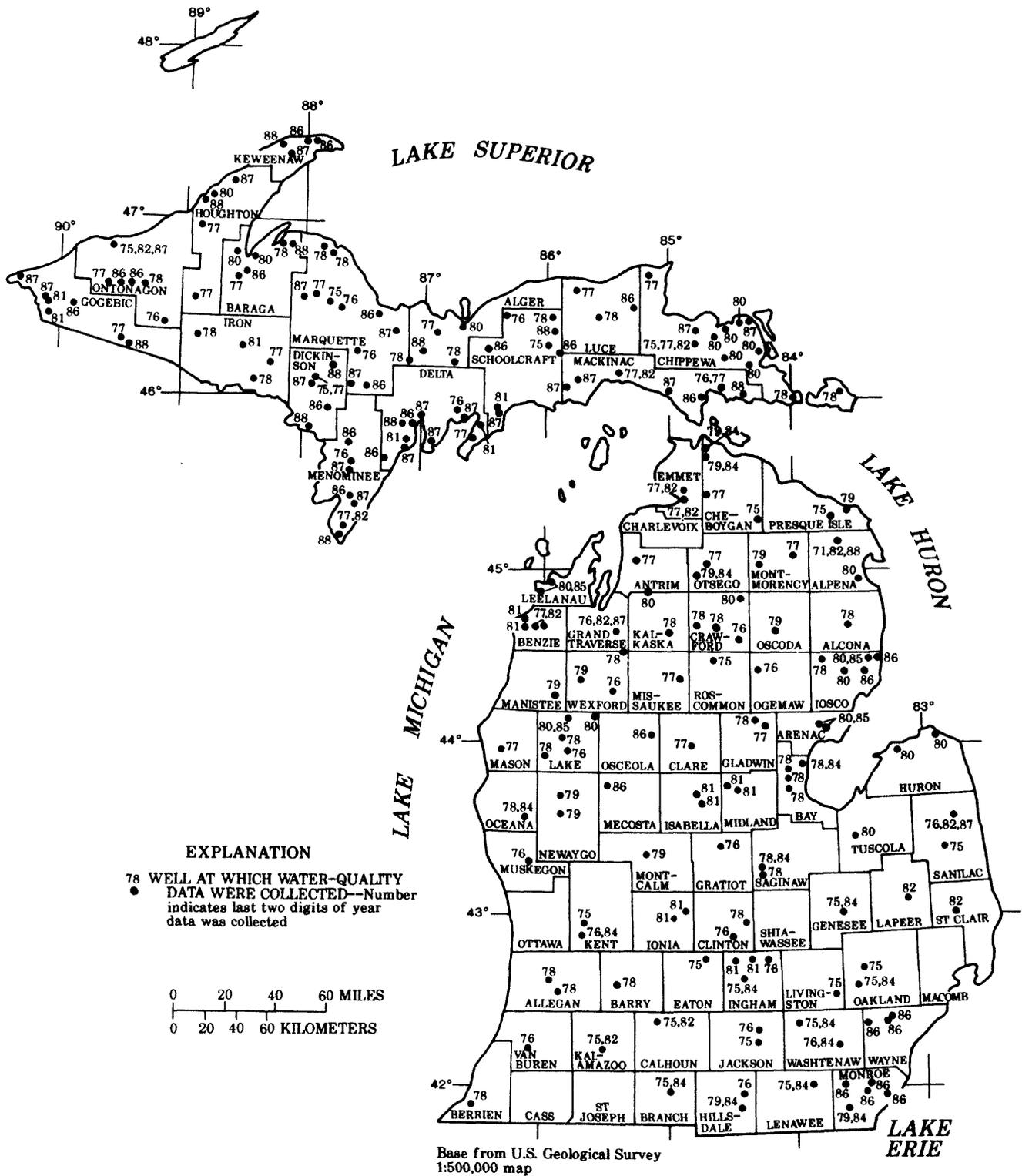


Figure 2.--Water-quality sampling sites and year sample was collected. (Water-quality data are given in the Michigan annual groundwater report for year in which sample was collected. Data for the years 1975-76 are in the annual report for 1977.)

Ground-Water Records and Reports

Tabulations and compilations of water-level measurements, hydrographs of ground-water wells, results of chemical analyses, water-temperature measurements, well records and logs, aquifer tests, records of pumping for public and industrial supplies, and water-resources reports are on file for public inspection. They can be examined at the office of the Michigan Department of Natural Resources, Geological Survey Division, 735 E. Hazel Street, Lansing, Michigan 48912, or at the office of the U.S. Geological Survey, Water Resources Division, 6520 Mercantile Way, Suite 5, Lansing, Michigan 48911. Records for the Upper Peninsula of Michigan are also on file at the office of the U.S. Geological Survey, 205 State Office Building, Escanaba, Michigan 49829.

Ground-water levels during 1935-74 are reported in a special series of U.S. Geological Survey Water-Supply Papers. Records since 1975 are reported annually in U.S. Geological Survey Water-Data Reports. Annual reports, titled "Summary of Ground-Water Conditions in Michigan," were begun in 1956 to supplement the Water Supply Paper and Water-Data Report series. The title of the report was changed to "Summary of Ground-Water Hydrological Data in Michigan" in 1967, and to "Ground-Water Data for Michigan" in 1973.

Areas covered by published reports that describe ground water in Michigan are shown in figure 3 and listed in table 1. In addition, publications dealing with ground water are listed in the references at the end of this report.

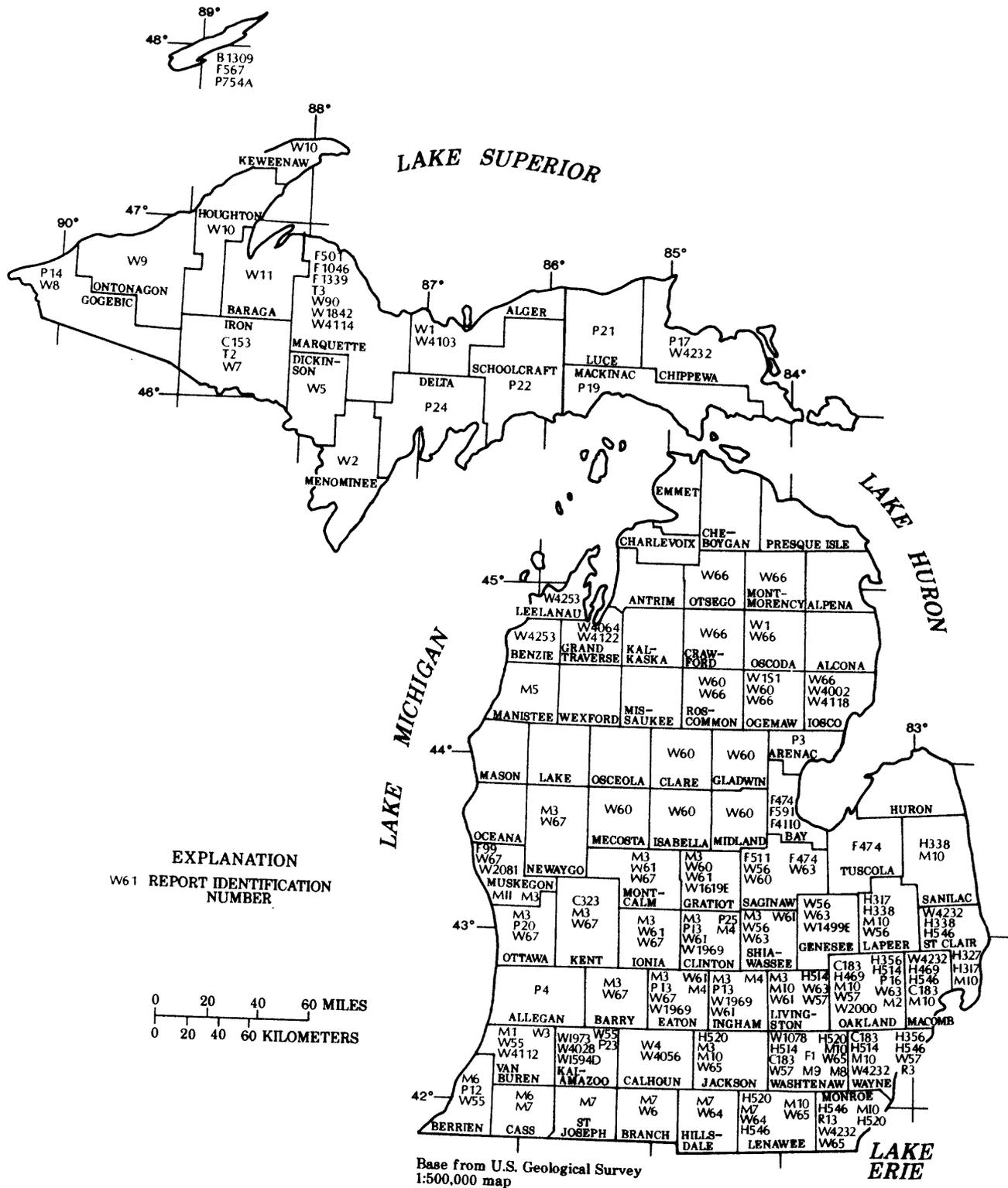


Figure 3.--Areas covered by published reports that describe ground water in Michigan. (See table 1 for report title.)

Table 1.--Published reports on ground water in Michigan

- B1309 -- Huber, M.K., 1975, The geologic story of Isle Royale National Park: U.S. Geological Survey Bulletin 1309.
- C153 -- Pettijohn, F.J., 1952, Geology of the northern Crystal Falls area, Iron County, Michigan: U.S. Geological Survey Circular 153.
- C183 -- Wisler, C.O., Stramel, G.J., and Laird, L.B., 1952, Water resources of the Detroit area, Michigan: U.S. Geological Survey Circular 183.
- C323 -- Stramel, G.J., Wisler, C.O., and Laird, L.B., 1954, Water resources of the Grand Rapids area, Michigan: U.S. Geological Survey Circular 323.
- F1 -- Fleck, W.B., 1980, Geology and hydrology for environmental planning in Washtenaw County, Michigan: U.S. Geological Survey Open-File Report unnumbered.
- F99 -- McDonald, M.G., and Fleck, W.B., 1978, Model analysis of the impact on ground-water conditions of the Muskegon County wastewater disposal system, Michigan: U.S. Geological Survey Open-File Report 78-99.
- F474 -- Mandle, R.J., and Westjohn, D.B., 1987, Preliminary interpretation of vertical electrical-resistivity soundings in the Saginaw Valley, Michigan: U.S. Geological Survey Open-File Report B7-474.
- F501 -- Doonan, C.J., and VanAlstine, J.L., 1982, Ground water and geology of Marquette County, Michigan: U.S. Geological Survey Open-File Report 82-501.
- F511 -- Handy, A.H., 1982, Water quality of coal deposits and abandoned mines, Saginaw County, Michigan: U.S. Geological Survey Open-File Report 82-511.
- F567 -- Grannemann, N.G., and Twenter, F.R., 1982, Ground water for public supply at Windigo, Isle Royale National Park, Michigan: U.S. Geological Survey Open-File Report 82-567.
- F591 -- Stark, J.R., and McDonald, M.G., 1980, Ground water of coal deposits, Bay County, Michigan: U.S. Geological Survey Open-File Report 80-591.
- F1046 -- Grannemann, N.G., 1978, Water supply potential of the Lake Sally system, Marquette County, Michigan: U.S. Geological Survey Open-File Report 78-1046.
- F1339 -- ____, 1979, Water resources of the Marquette Iron Range area, Marquette County, Michigan: U.S. Geological Survey Open-File Report 79-1339.
- H317 -- Knutilla, R.L., 1969, Water resources of the Belle River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-317.
- H327 -- ____, 1969, Water resources of the Pine River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-327.
- H338 -- ____, 1970, Water resources of the Black River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-338.
- H356 -- ____, 1971, Water resources of the River Rouge basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-356.
- H469 -- Nowlin, J.O., 1973, Water resources of the Clinton River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-469.
- H514 -- Larson, R.W., Allen, W.B., and Hanson, S.D., 1975, Water resources of the Huron River basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-514.
- H520 -- Knutilla, R.L., and Allen, W.B., 1975, Water resources of the River Raisin basin, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-520.
- H546 -- Twenter, F.R., Knutilla, R.L., and Cummings, T.R., 1975, Water resources of basins for minor streams draining into St. Clair River, Lake St. Clair, Detroit River, and Lake Erie, southeastern Michigan: U.S. Geological Survey Hydrological Investigation Atlas HA-546.
- M1 -- Terwilliger, F.W., 1954, The glacial geology and ground-water resources of Van Buren County, Michigan, pt. 1 of occasional papers for 1954 on the geology of Michigan: Michigan Geological Survey Publication 48.
- M2 -- Mozola, A.J., 1954, A survey of ground-water resources in Oakland County, Michigan, pt. 2 of occasional papers for 1954 on the geology of Michigan: Michigan Geological Survey Publication 48.
- M3 -- Vanlier, K.E., 1968, Comprehensive planning study of the Grand River basin, Michigan, Appendix E, Ground-water resources and geology of the Grand River basin, Michigan: U.S. Army Engineers District, Detroit, Michigan.
- M4 -- Vanlier, K.E., and Wheeler, M.L., 1968, Analog simulation of ground-water development of the Saginaw Formation, Lansing metropolitan area, Michigan: Tri-County Planning Commission, Lansing Ground-Water Report.
- M5 -- Childs, K.E., 1970, History of the salt, brine, and paper industries and their probable effect on the ground-water quality in the Manistee Lake area, Michigan: Michigan Department of Natural Resources.

Table 1.--Published reports on ground water in Michigan--Continued

- M6 -- Schneider, A.F., and Keller, S.J., 1970, Indiana Geological Survey regional geological map number 4: Indiana Department of Natural Resources.
- M7 -- Johnson, G.H., and Keller, S.J., 1972, Indiana Geological Survey regional geological map number 8: Indiana Department of Natural Resources.
- M8 -- Twenter, F.R., Knutilla, R.L., and Nowlin, J.O., 1976, Water resources of Washtenaw County, Michigan: Washtenaw County Metropolitan Planning Commission.
- M9 -- Borton, T.E., 1974, Planning perspectives on water resources, Washtenaw County, Michigan: Washtenaw County Metropolitan Planning Commission.
- M10 -- Twenter, F.R., 1975, Ground water and geology -- southeastern Michigan: U.S. Army Corps of Engineers.
- M11 -- Fleck, W.B., and McDonald, M.G., 1978, Three-dimensional finite-difference model of ground-water system underlying the Muskegon County wastewater disposal system, Michigan: U.S. Geological Survey Journal of Research, volume 6, number 3.
- P3 -- Pringle, G.H., 1937, Geology of Arenac County, Michigan: Michigan Geological Survey Progress Report 3.
- P4 -- Riggs, C.H., 1938, Geology of Allegan County, Michigan: Michigan Geological Survey Progress Report 4.
- P12 -- Stuart, W.T., and Stallman, R.W., 1945, Ground-water resources of the Benton Harbor area, Michigan: Michigan Geological Survey Progress Report 12.
- P13 -- Stuart, W.T., 1945, Ground-water resources of the Lansing area, Michigan: Michigan Geological Survey Progress Report 13.
- P14 -- Brown, E.A., and Stuart, W.T., 1951, Ground-water resources of the glacial deposits in the Bessemer area, Michigan: Michigan Geological Survey Progress Report 14.
- P16 -- Ferris, J.G., Burt, E.M., Stramel, G.J., and Crosthwaite, E.G., 1954, Ground-water resources of southeastern Oakland County, Michigan: Michigan Geological Survey Progress Report 16.
- P17 -- Vanlier, K.E., and Deutsch, Morris, 1958, Reconnaissance of the ground-water resources of Chippewa County, Michigan: Michigan Geological Survey Progress Report 17.
- P19 -- _____, 1958, Reconnaissance of the ground-water resources of Mackinac County, Michigan: Michigan Geological Survey Progress Report 19.
- P20 -- Deutsch, Morris, Burt, E.M., and Vanlier, K.E., 1959, Summary of ground-water investigations in the Holland area, Michigan: Michigan Geological Survey Progress Report 20.
- P21 -- Vanlier, K.E., 1959, Reconnaissance of the ground-water resources of Luce County, Michigan: Michigan Geological Survey Progress Report 21.
- P22 -- Sinclair, W.C., 1959, Reconnaissance of the ground-water resources of Schoolcraft County, Michigan: Michigan Geological Survey Progress Report 22.
- P23 -- Deutsch, Morris, Vanlier, K.E., and Giroux, P.R., 1960, Ground-water hydrology and glacial geology of the Kalamazoo area, Michigan: Michigan Geological Survey Progress Report 23.
- P24 -- Sinclair, W.C., 1960, Reconnaissance of the ground-water resources of Delta County, Michigan: Michigan Geological Survey Progress Report 24.
- P25 -- Vanlier, K.E., 1962, Summary of ground-water investigations in the Elsie area, Michigan: Michigan Geological Survey Progress Report 25.
- P754A -- Huber, N.K., 1973, Glacial and postglacial geologic history of Isle Royale National Park, Michigan: U.S. Geological Survey Professional Paper 754-A.
- R3 -- Mozola, A.J., 1969, Geology for land and ground-water development in Wayne County, Michigan: Michigan Geological Survey Report Investigation 3.
- R13 -- _____, 1970, Geology for environmental planning in Monroe County, Michigan: Michigan Geological Survey Report Investigation 13.
- T2 -- Stuart, W.T., Theis, C.V., and Stanley, G.M., 1948, Ground-water problems in the Iron River district, Michigan: Michigan Geological Survey Technical Report 2.
- T3 -- Stuart, W.T., Brown, E.A., and Rhodehamel, E.C., 1954, Ground-water investigations of the Marquette iron-mining district, Michigan: Michigan Geological Survey Technical Report 3.
- W1 -- Vanlier, K.E., 1963, Reconnaissance of the ground-water resources in Alger County, Michigan: Michigan Geological Survey Water Investigation 1.
- W2 -- _____, 1963, Ground water in Menominee County: Michigan Geological Survey Water Investigation 2.
- W3 -- Giroux, P.R., Hendrickson, G.E., Stojmenoff, L.E., and Whetstone, G.W., 1964, Water resources of Van Buren County, Michigan: Michigan Geological Survey Investigation 3.

Table 1.--Published reports on ground water in Michigan--Continued

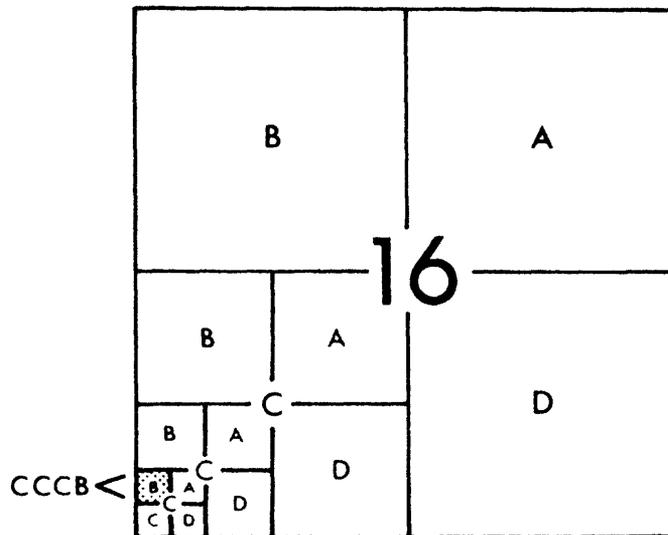
W4	-- Vanlier, K.E., 1966, Ground-water resources of the Battle Creek area, Michigan: Michigan Geological Survey Water Investigation 4.
W5	-- Hendrickson, G.E., and Doonan, C.J., 1966, Ground-water resources of Dickinson County, Michigan: Michigan Geological Survey Water Investigation 5.
W6	-- Giroux, P.R., Stoimenoff, L.E., Nowlin, J.O., and Skinner, E.L., 1966, Water resources of Branch County, Michigan: Michigan Geological Survey Water Investigation 6.
W7	-- Doonan, C.J., Hendrickson, G.E., 1967, Ground water in Iron County, Michigan: Michigan Geological Survey Water Investigation 7.
W8	-- _____, 1968, Ground water in Gogebic County, Michigan: Michigan Geological Survey Water Investigation 8.
W9	-- _____, 1969, Ground water in Ontonagon County, Michigan: Michigan Geological Survey Water Investigation 9.
W10	-- Doonan, C.J., Hendrickson, G.E., and Byerlay, J.R., 1970, Ground water and geology of Keweenaw Peninsula, Michigan: Michigan Geological Survey Water Investigation 10.
W11	-- Doonan, C.J., and Byerlay, J.R., 1973, Ground water and geology of Baraga County, Michigan: Michigan Geological Survey Water Investigation 11.
W55	-- Water resource conditions and uses in the Paw Paw River basin, 1955, (revised report in 1964): Michigan Water Resources Commission Report.
W56	-- Water resource conditions and uses in the Flint River basin, 1956: Michigan Water Resources Commission Report.
W57	-- Water resource conditions and uses in the Huron River basin, 1957: Michigan Water Resources Commission Report.
W60	-- Water resource conditions and uses in the Tittabawassee River basin, 1960: Michigan Water Resources Commission Report.
W61	-- Water resource conditions and uses in the Upper Grand River basin, 1961: Michigan Water Resources Commission Report.
W63	-- Water resource conditions and uses in the Shiawassee River basin, 1963: Michigan Water Resources Commission Report.
W64	-- Water resource conditions and uses in the Maumee River basin, 1964: Michigan Water Resources Commission Report.
W65	-- Water resource conditions and uses in the River Raisin basin, 1965: Michigan Water Resources Commission Report.
W66	-- Water resource conditions and uses in the Au Sable River basin, 1966: Michigan Water Resources Commission Report.
W67	-- Water resource conditions and uses in the Lower Grand River basin, 1967, (open file): Michigan Water Resources Commission Report.
W90	-- Twenter, F.R., 1981, Geology and hydrology for environmental planning in Marquette County, Michigan: U.S. Geological Survey Water-Resources Investigations, 80-90.
W1078	-- McGuinness, C.L., Poindexter, O.F., and Otton, E.G., 1949, Ground-water supplies of the Ypsilanti area, Michigan: U.S. Geological Survey Water-Supply Paper 1078.
W1499E	-- Wiitala, S.W., Vanlier, K.E., and Krieger, R.A., 1963, Water resources of the Flint area, Michigan: U.S. Geological Survey Water-Supply Paper 1499-E.
W1594D	-- Reed, J.E., Deutsch, Morris, and Wiitala, S.W., 1966, Induced recharge of an artesian glacial-drift aquifer at Kalamazoo, Michigan: U.S. Geological Survey Water-Supply Paper 1594-D.
W1619E	-- Vanlier, K.E., 1963, Ground-water resources of the Alma area, Michigan: U.S. Geological Survey Water-Supply Paper 1619-E.
W1842	-- Wiitala, S.W., Newport, T.G., and Skinner, E.L., 1967, Water Resources of the Marquette Iron Range area, Michigan: U.S. Geological Survey Water-Supply Paper 1842.
W1969	-- Vanlier, K.E., Wood, W.W., and Brunett, J.O., 1973, Water-supply development and management alternatives for Clinton, Eaton, and Ingham Counties, Michigan: U.S. Geological Survey Water-Supply Paper 1969.
W1973	-- Allen, W.B., Miller, J.B., and Wood, W.W., 1972, Availability of water in Kalamazoo County, Michigan: U.S. Geological Survey Water-Supply Paper 1973.
W2000	-- Twenter, F.R., and Knutilla, R.L., 1972, Water for a rapidly growing urban community -- Oakland County, Michigan: U.S. Geological Survey Water-Supply Paper 2000.
W2081	-- McDonald, M.G., 1980, Hydraulic characteristics of an underdrained irrigation circle, Muskegon County wastewater disposal system, Michigan: U.S.S. Geological Survey Water-Supply Paper 2081.

Table 1.--Published reports on ground water in Michigan--Continued

- W4002 -- Stark, J.R., Cummings, T.R., and Twenter, F.R., 1983, Ground-water contamination at Wurtsmith Air Force Base, Michigan: U.S. Geological Survey Water-Resources Investigations Report 83-4002.
- W4028 -- Rheume, S.J., 1990, Geohydrology and water quality of Kalamazoo County, Michigan, 1986-88: U.S. Geological Survey Water-Resources Investigations Report 90-4028.
- W4056 -- Grannemann, N.G., and Twenter, F.R., 1985, Geohydrology and ground-water flow at Verona Well Field, Battle Creek, Michigan: U.S. Geological Survey Water-Resources Investigations Report 85-4056.
- W4064 -- Twenter, F.R., Cummings, T.R., and Grannemann, N.G., 1983, Ground-water contamination in East Bay Township, Michigan: U.S. Geological Survey Water-Resources Investigations Report 85-4064.
- W4103 -- Handy, A.H., and Twenter, F.R., Water Resources of Pictured Rocks National Lakeshore, Michigan, 1985, U.S. Geological Survey Water-Resources Investigations Report 85-4103.
- W4110 -- Twenter, F.R., and Cummings, T.R., 1985, Quality of ground water in Monitor and Williams Townships, Bay County, Michigan: U.S. Geological Survey Water-Resources Investigations Report 85-4110.
- W4112 -- Cummings, T.R., Twenter, F.R., and Holschlag, D.J., 1984, Hydrology and land use in Van Buren County, Michigan: U.S. Geological Survey Water-Resources Investigations Report 84-4112.
- W4114 -- Grannemann, N.G., 1984, Hydrogeology and effects of tailing basins on the hydrology of Sands Plain, Marquette County, Michigan: U.S. Geological Survey Water-Resources Investigations Report 84-4114.
- W4122 -- Cummings, T.R., Gillespie, J.L., and Grannemann, N.G., 1990, Hydrology and land use in Grand Traverse County, Michigan: U.S. Geological Survey Water-Resources Investigations Report 90-4122.
- W4232 -- Gillespie, J.L., and Dumouchelle, D.H., 1989, Ground-water flow and quality near the upper Great Lakes connecting channels, Michigan: U.S. Geological Survey Water-Resources Investigations Report 88-4232.
- W4253 -- Handy, A.H., and Stark, J.R., 1984, Water resources of Sleeping Bear Dunes National Lakeshore, Michigan: U.S. Geological Survey Water-Resources Investigations Report 83-4253.
- W1S1 -- Knutilla, R.L., Twenter, F.R., and Larson, R.W., 1971, Upper Rifle River Basin -- An evaluation of its water resources and hydrologic environment: Michigan Geological Survey Water Information Series Report 1.

Well-Numbering System

The well-numbering system for Michigan indicates the location of wells within a rectangular subdivision of land with reference to the Michigan meridian and base line. The first two segments of the well number designate township and range, the third segment of the number designates the section, and the letters A through D designate successively smaller subdivisions of the section, as shown below. Thus, a well designated as 32N 6E 16CCCB is located to the nearest 2.5 acres and is within the shaded area in section 16.



For many wells in this report, locations are only given to the nearest 40-acre tract, for example, 16CC. In the event that two or more wells are in the same tract, sequential number designation is added--for example, 16CCCB1, 16CCCB2, etc. The Michigan Geological Survey uses a similar system except that numbers are used instead of letters.

Acknowledgments

Acknowledgment is made to personnel of Federal and State agencies, county and township governments, industrial concerns, well drillers, consultants, municipalities, and public utilities, without whose cooperation the accumulation of data presented in this report would not have been possible.

GROUND-WATER LEVELS

Water levels, measured in 107 observation wells throughout the State (fig. 1 and table 2) in 1990 generally follow precipitation trends. Levels usually rise when precipitation has been above normal and decline when precipitation has been below normal. Hydrographs (fig. 4) show that water levels are generally highest in spring. During the spring, snowmelt and rain constitute most of the annual recharge to ground-water reservoirs. However, if ice cover or ground frost persists during snowmelt, recharge will be impeded by the consequent decrease in infiltration rate, and overland flow will increase. Generally, recharge also is reduced during the summer when a large percentage of rainfall evaporates, transpires, or flows overland, depending on rainfall intensity and duration. Precipitation in autumn, when the evapotranspiration rate declines tends to cause water levels to rise. Little recharge occurs in Michigan during winter because of the generally low permeability of the ground during freezing temperatures.

Although quantity of precipitation is a major factor affecting ground-water levels, many other natural factors, such as soil condition, composition of underlying rock, and slope of the land surface also affect water levels. Minor fluctuation in levels are caused by earth tides and variation in barometric pressure. Evapotranspiration causes small daily declines in water levels in some shallow wells. Pumping can lower water levels significantly. If withdrawals exceed recharge, long-term water-level declines will occur.

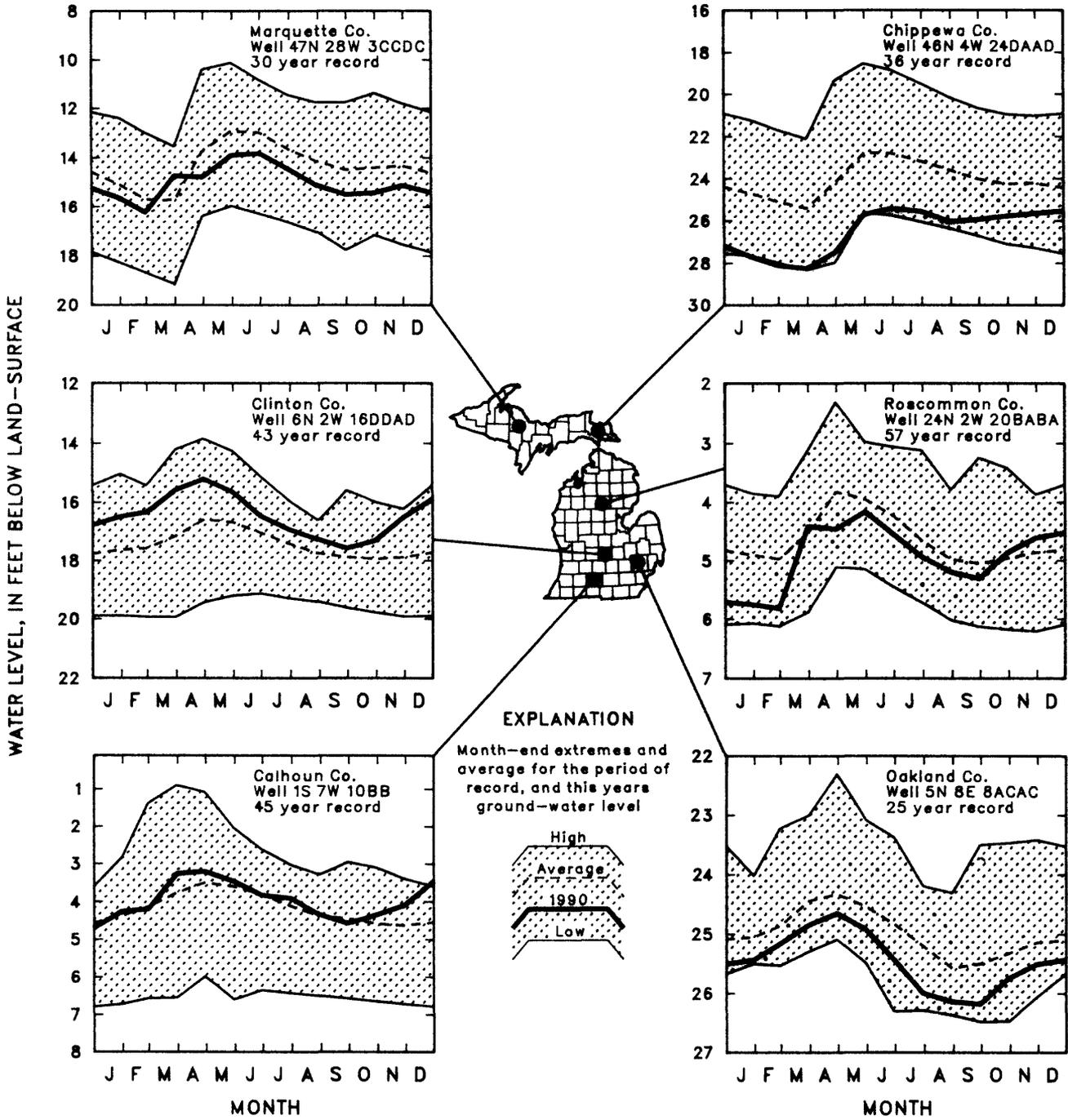
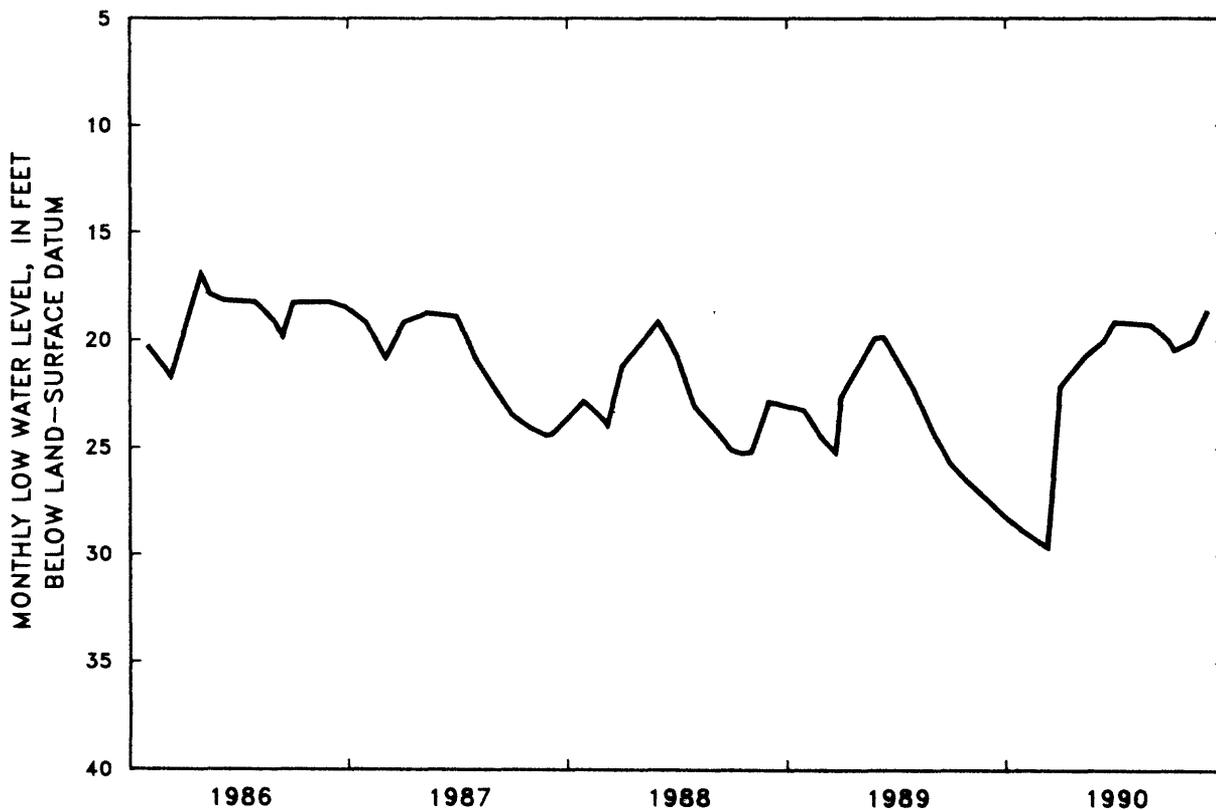
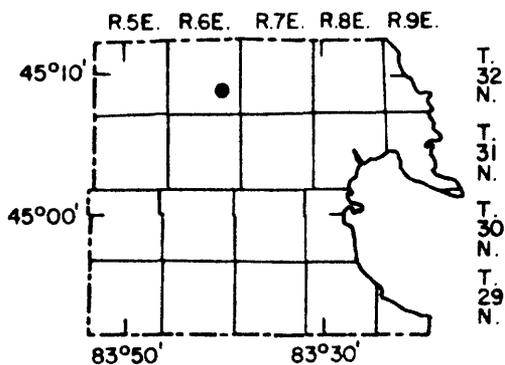


Figure 4.--Water levels in selected wells.

GROUND-WATER DATA, BY COUNTY

Variation of water levels and descriptions of some ground-water supplies in Michigan follow alphabetically, by county. Yield of supply wells and pumpage data are those reported by municipal water departments.

ALPENA COUNTY



Water levels in well 32N 6E 23DDDA1. Well is 88 ft deep and completed in sand. Water-quality data in ground-water reports for 1977 and 1982 (Huffman, 1979, 1983).

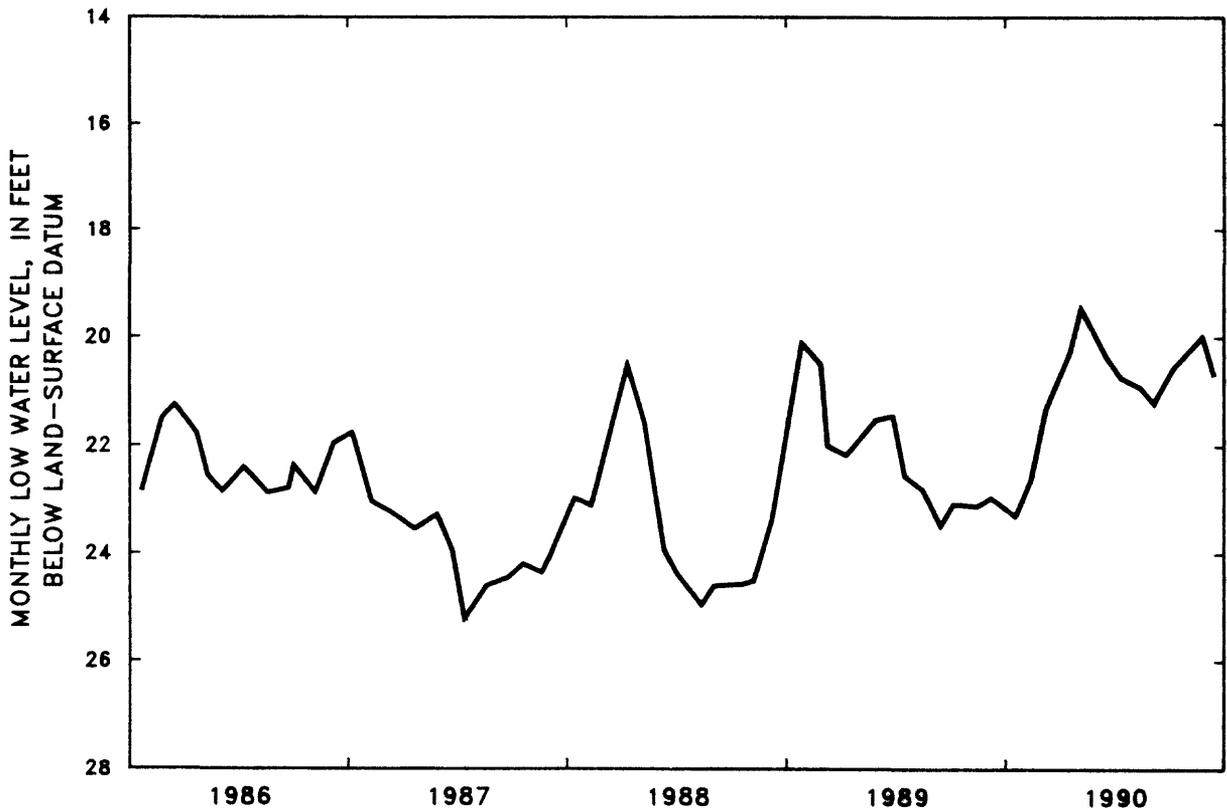
BRANCH COUNTY - CITY OF COLDWATER

SUPPLY AND SOURCE -- 4 wells, 117 to 129 ft deep, tap glacial deposits.

YIELD OF WELLS -- 1,200 to 2,850 gal/min; specific capacity -- 80 to 190 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1990 - 777
1989 - 1,018
1988 - 1,167
1987 - 1,078
1986 - 1,183



Water levels in well 6S 6W 22CAB1. Well is 113 ft deep and completed in glacial deposits.

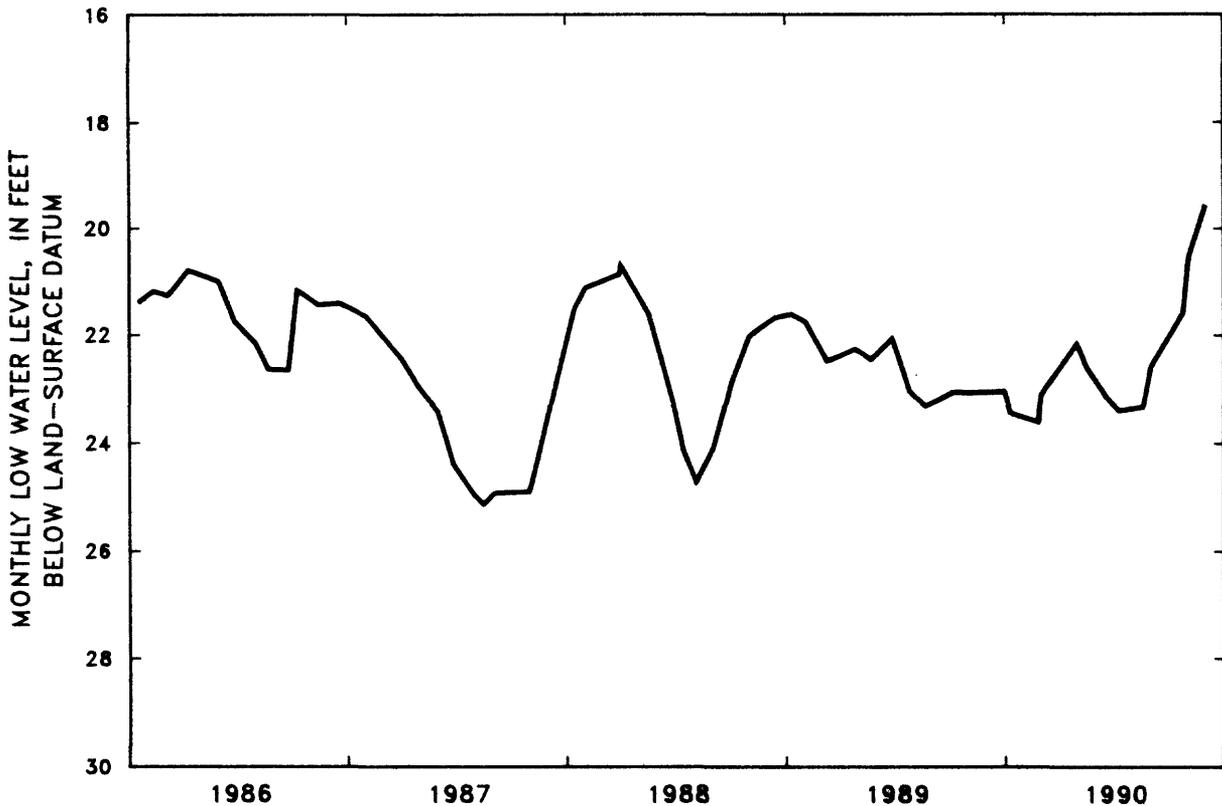
CALHOUN COUNTY - CITY OF BATTLE CREEK

SUPPLY AND SOURCE -- 38 wells, 110 to 180 ft deep, tap sandstones of Marshall Formation.

YIELD OF WELLS -- 300 to 1,400 gal/min; specific capacity -- 50 to 650 gal/min/ft of drawdown.

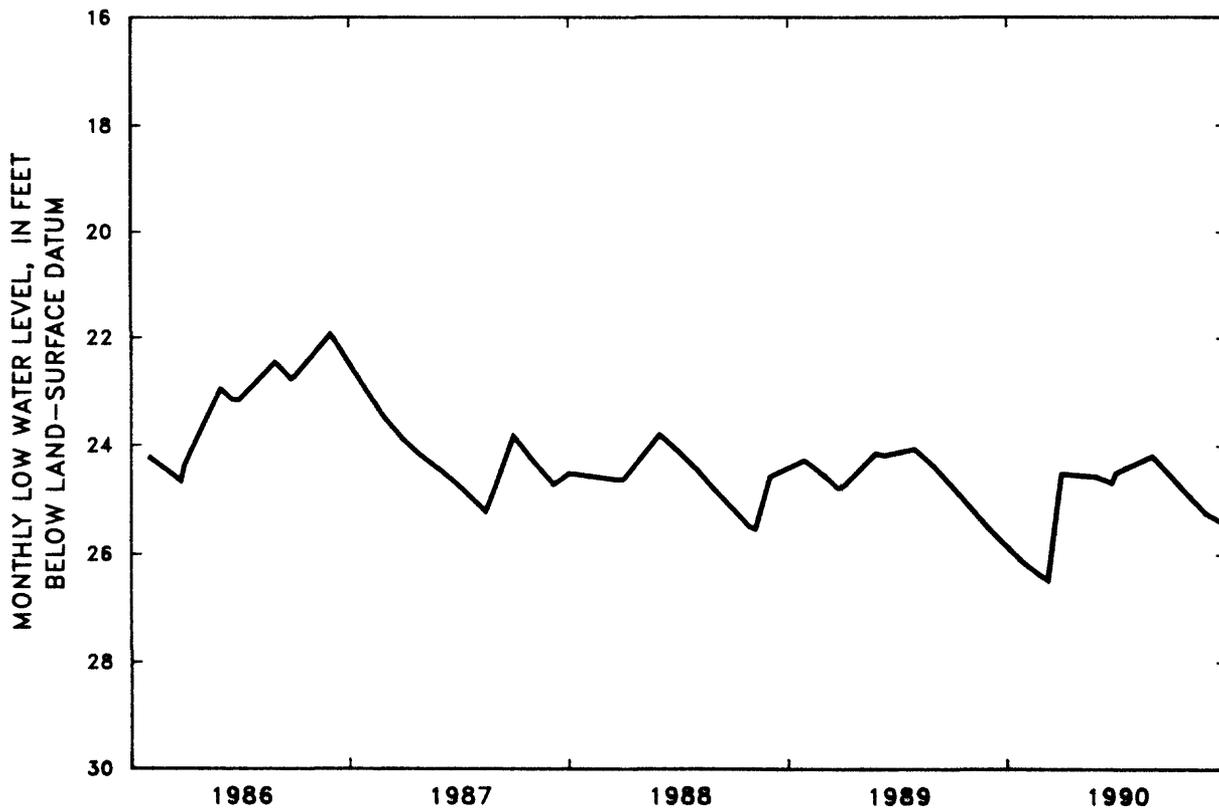
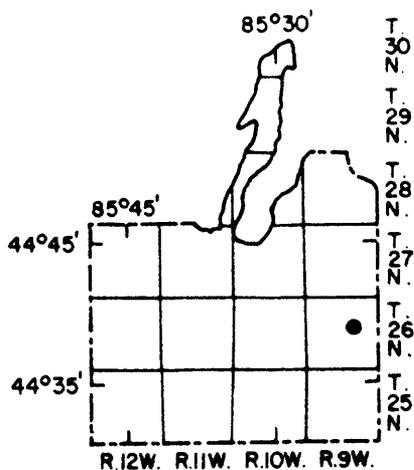
PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1990 - 4,129
1989 - 4,057
1988 - 4,230
1987 - 3,697
1986 - 3,518



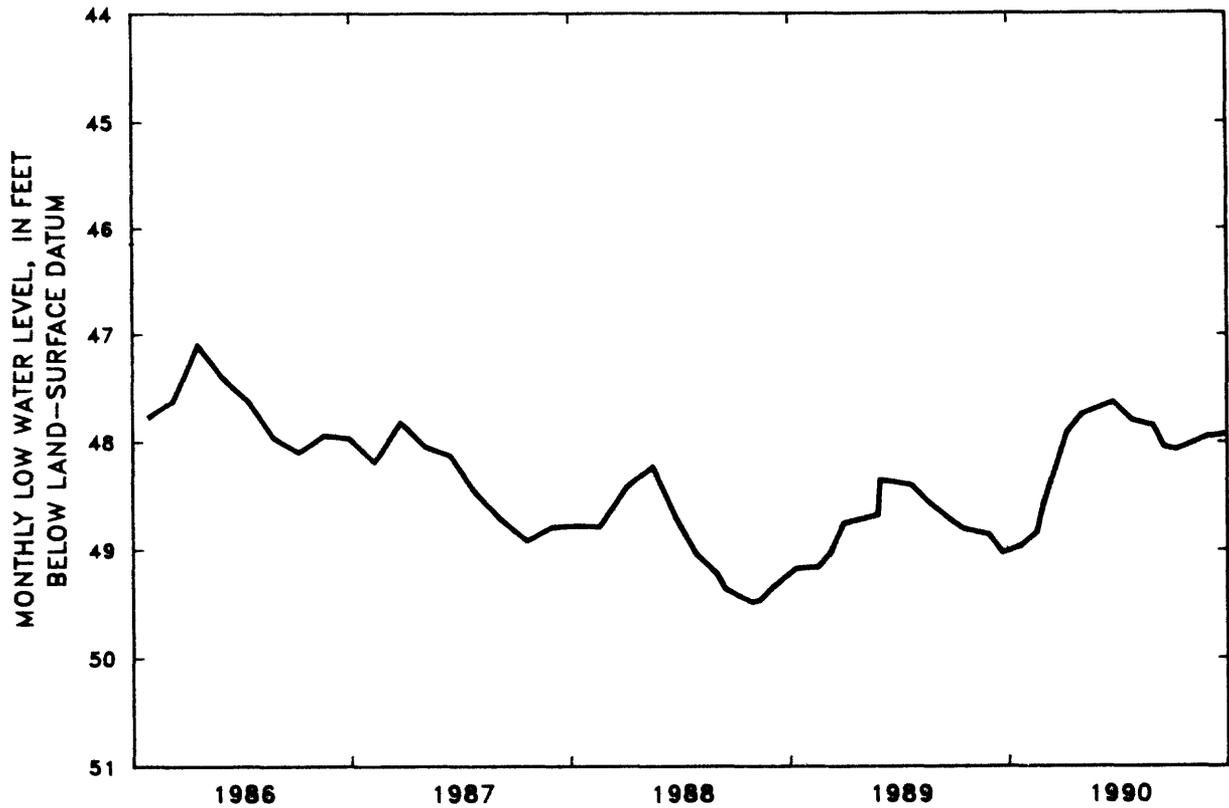
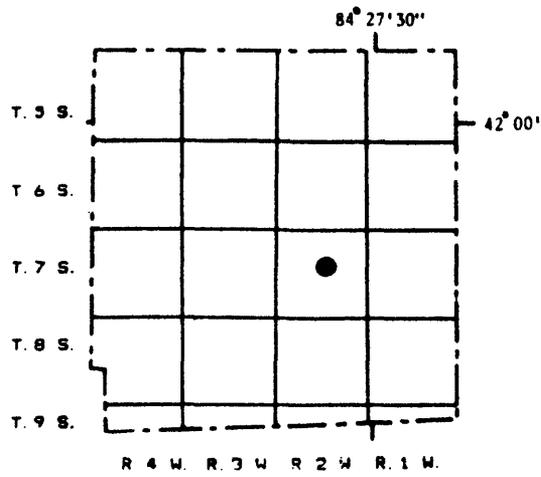
Water levels in well 1S 7W 32BDCC1. Well is 95 ft deep and completed in Marshall Formation. Water-quality data in ground-water reports for 1977 and 1982 (Huffman, 1979, 1983).

GRAND TRAVERSE COUNTY



Water levels in well 26N 9W 14ABAA1. Well is 80 ft deep and completed in sand. Water-quality data in ground-water reports for 1977 and 1982 (Huffman, 1979, 1983).

HILLSDALE COUNTY



Water levels in well 7S 2W 15BCBA1. Well is 150 ft deep and completed in glacial outwash. Water-quality data in ground-water reports for 1979 and 1984 (Huffman, 1980, 1985).

INGHAM COUNTY - CITY OF LANSING

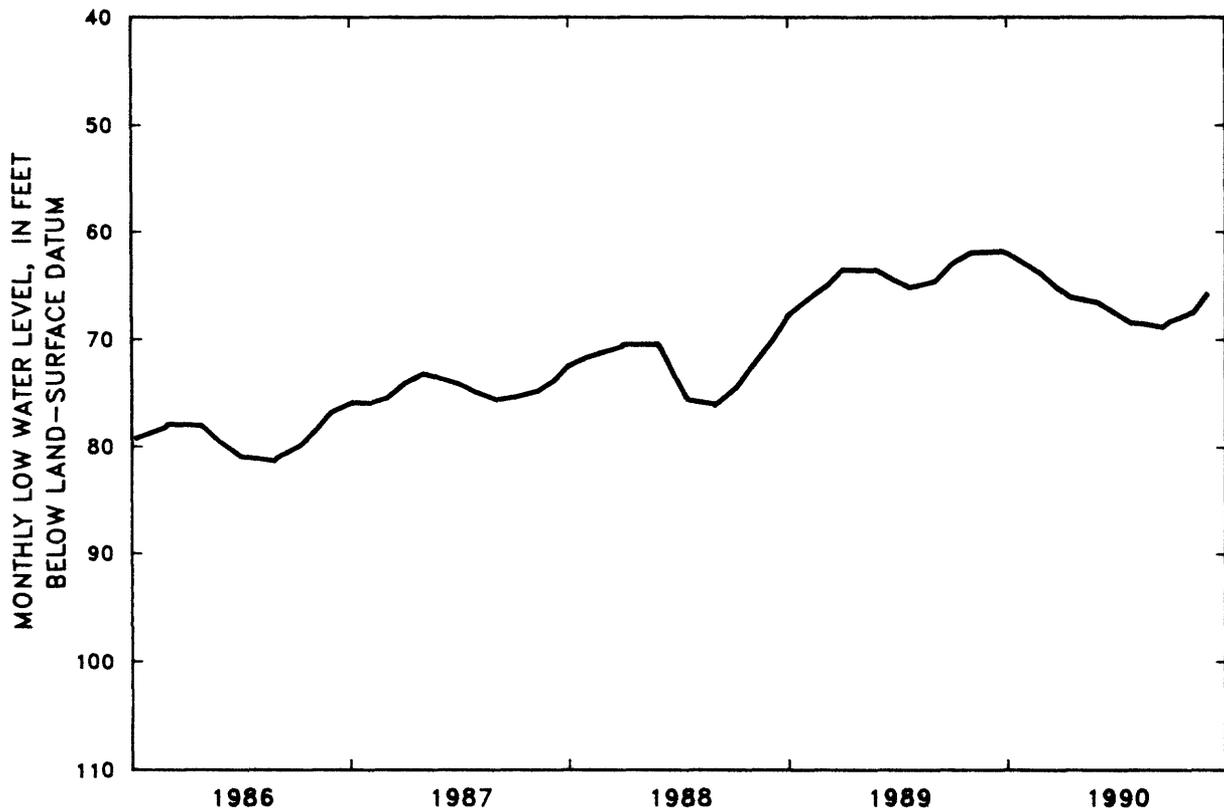
SUPPLY AND SOURCE -- 125 wells, 400 to 425 ft deep, tap sandstones of Saginaw Formation; 3 wells, 85 to 105 ft deep, tap sand beds in glacial deposits.

YIELD OF WELLS -- Sandstone - 100 to 700 gal/min; specific capacity -- 3 to 10 gal/min/ft of drawdown.

-- Glacial deposits - 790 to 1,200 gal/min, specific capacity -- 12 to 80 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1990 - 7,174
1989 - 7,217
1988 - 7,754
1987 - 7,838
1986 - 7,690



Water levels in well 4N 2W 17AB. Well is 424 ft deep and completed in Saginaw Formation.

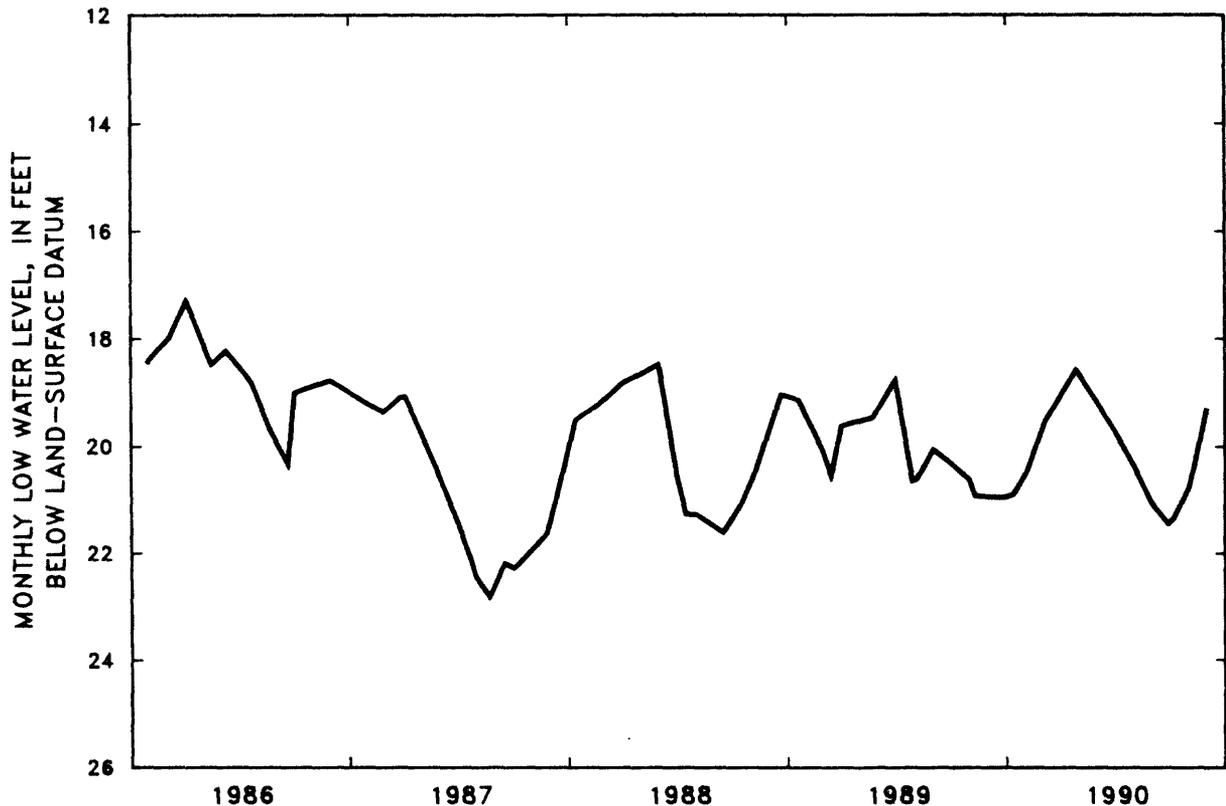
INGHAM COUNTY - CITY OF MASON

SUPPLY AND SOURCE -- 1 well, about 50 ft deep, taps glacial deposits; 2 wells, 218 and 223 ft deep, tap sandstones of Saginaw Formation.

YIELD OF WELLS -- 675 to 700 gal/min; specific capacity -- No. 3 yields 30 gal/min/ft of drawdown from the glacial deposits.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1990 - 280
1989 - 253
1988 - 299
1987 - 256
1986 - 232



Water levels in well 2N 1W 5BCAB1. Well is 210 ft deep and completed in Saginaw Formation. Water-quality data in ground-water reports for 1977 and 1984 (Huffman, 1979, 1985).

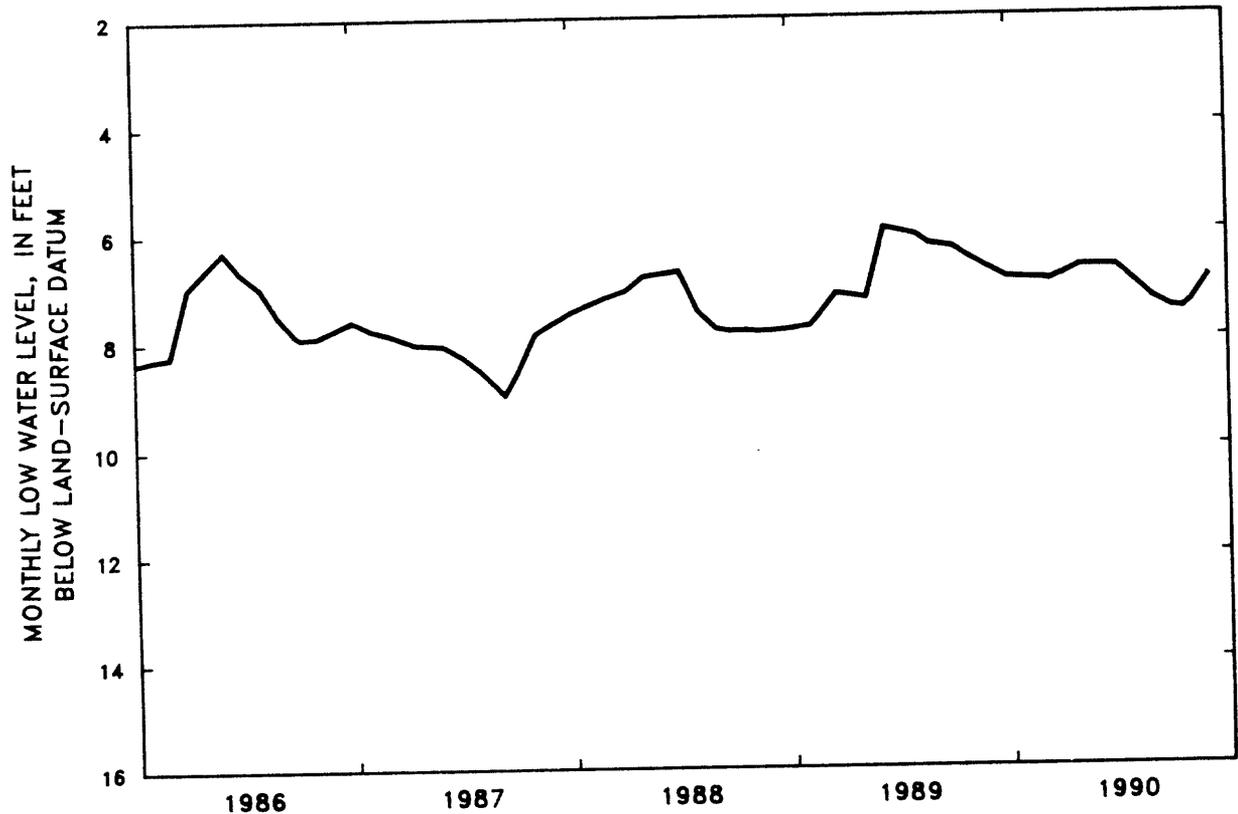
KALAMAZOO COUNTY - CITY OF KALAMAZOO

SUPPLY AND SOURCE -- 84 wells, 130 to 254 ft deep, tap glacial deposits.

YIELD OF WELLS -- 200 to 2,000 gal/min; specific capacity -- 7 to 100 gal/min/ft of drawdown.

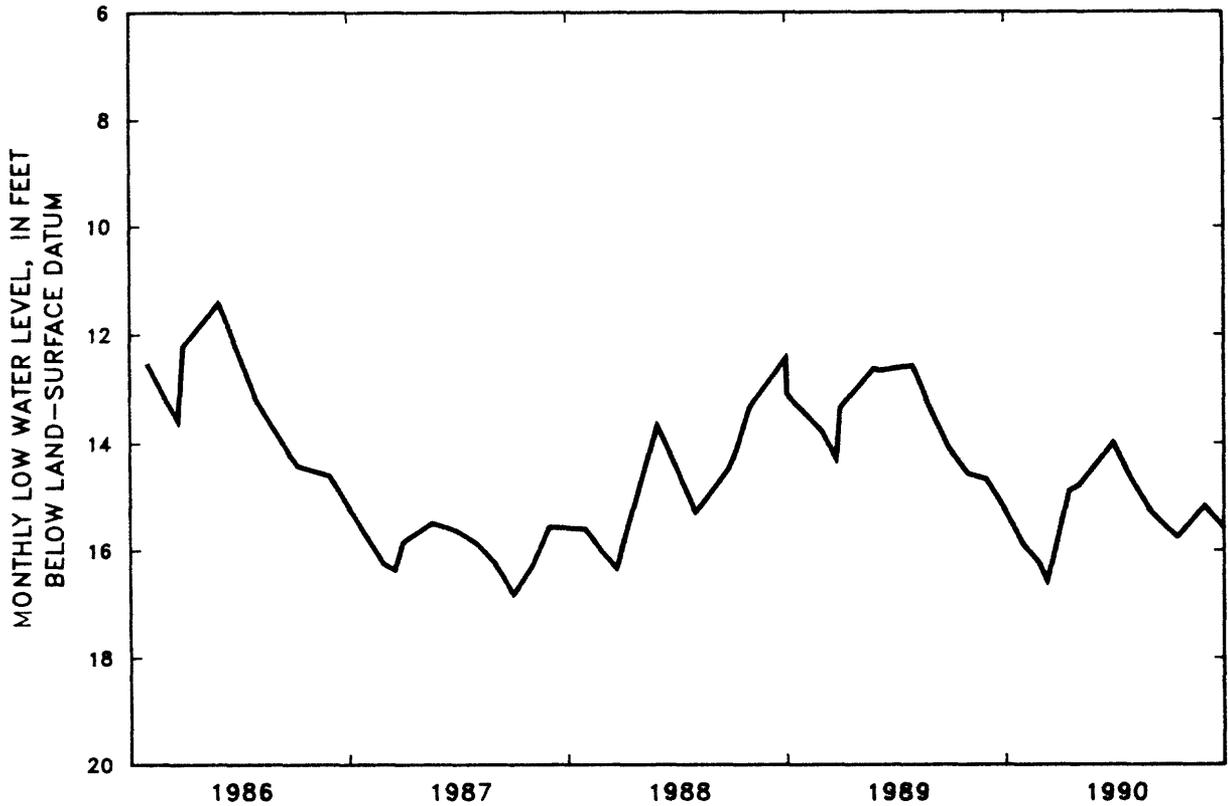
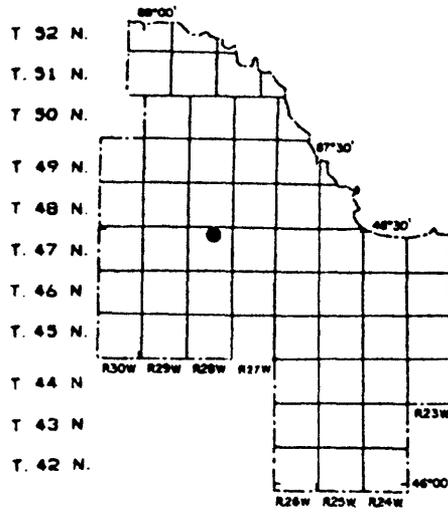
PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1990 - 7,036
1989 - 6,749
1988 - 7,422
1987 - 6,450
1986 - 6,638



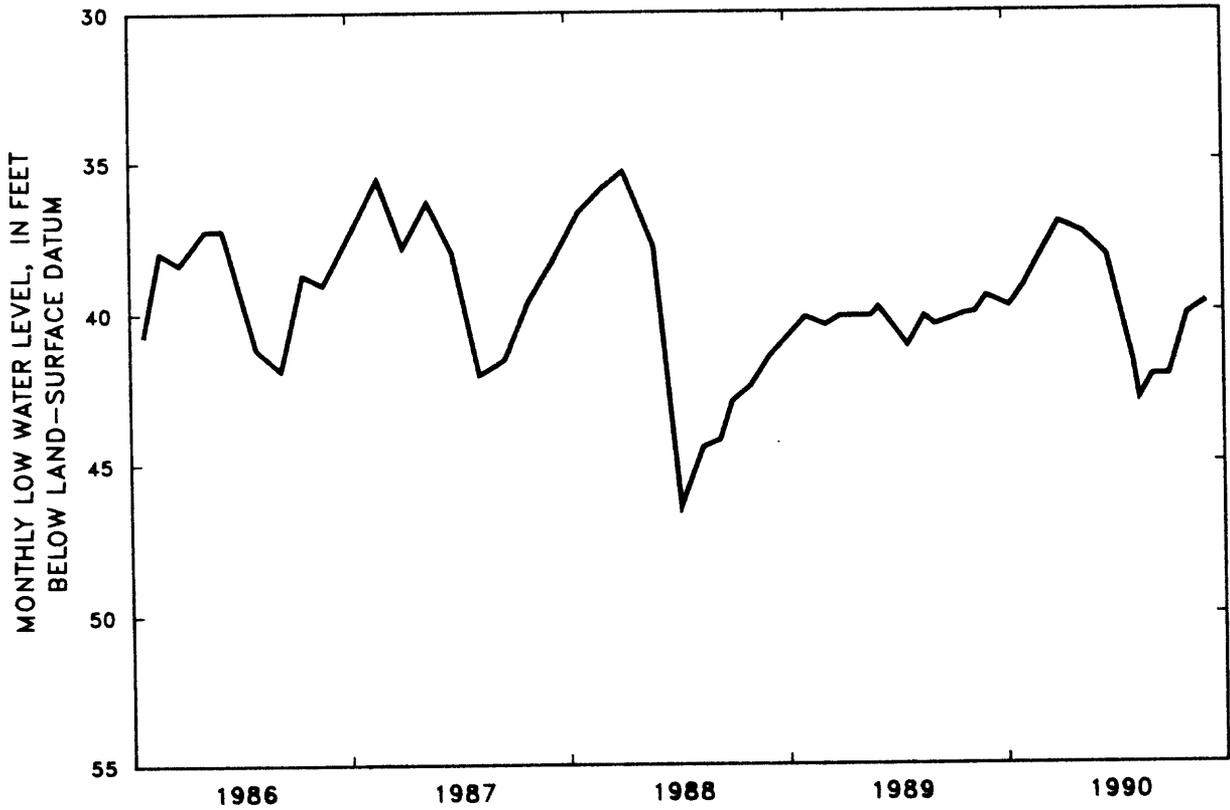
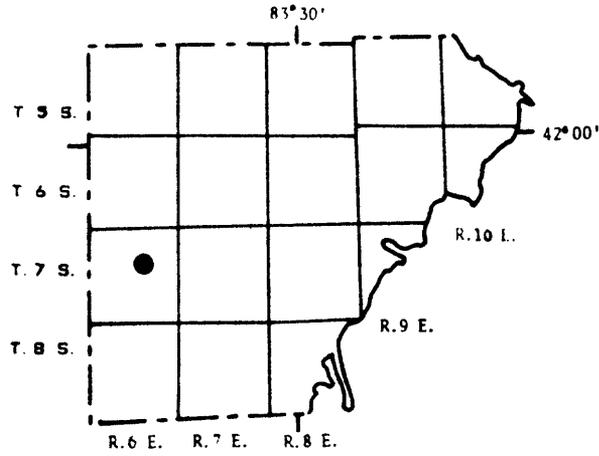
Water levels in well 2S 11W 22CD. Well is 137 ft deep and completed in outwash.

MARQUETTE COUNTY - IRON RANGE AREA



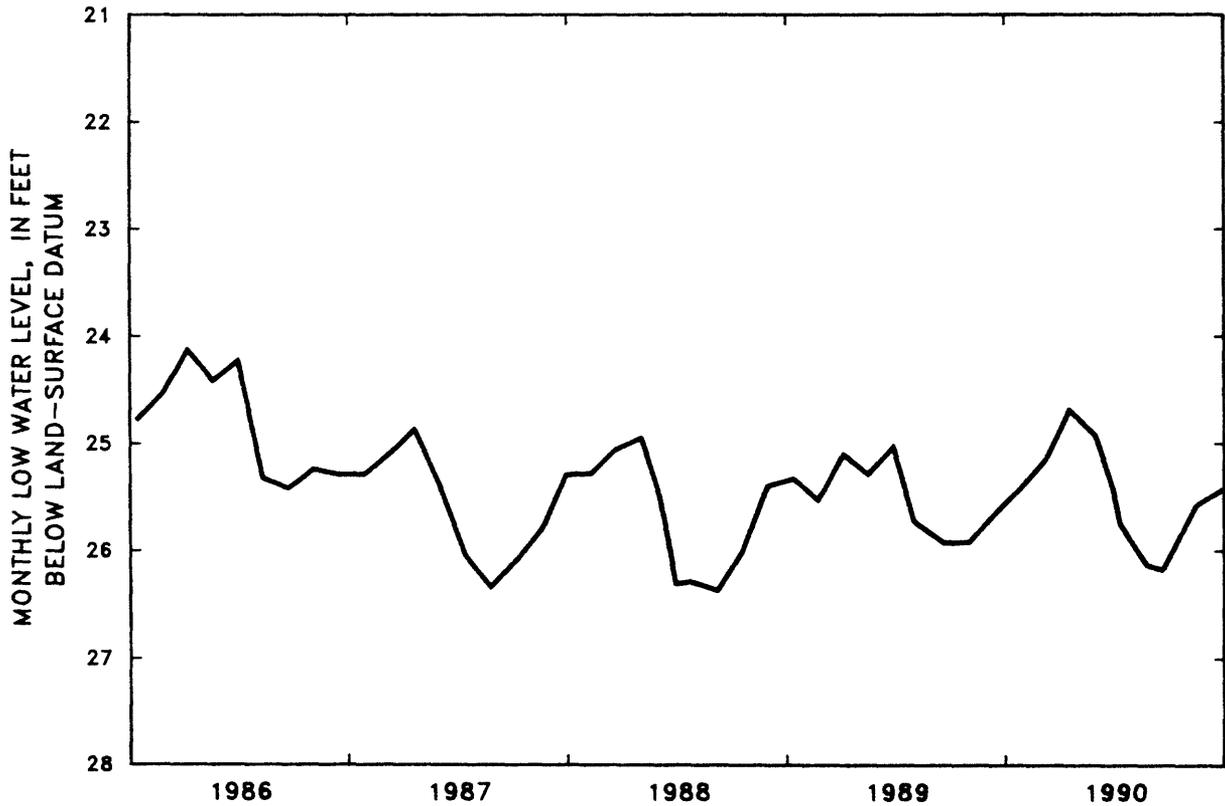
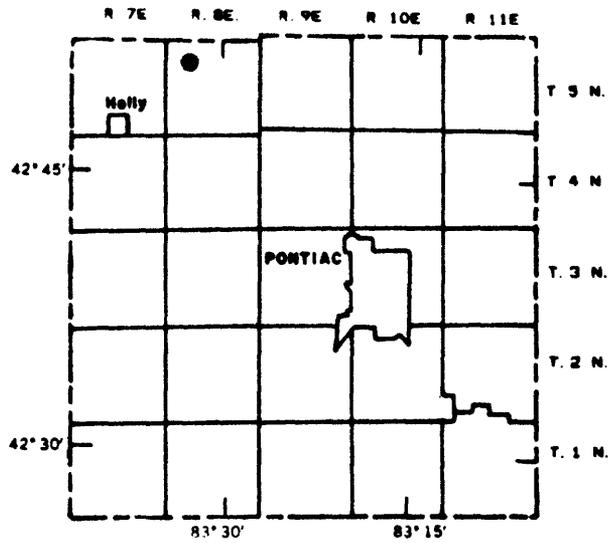
Water levels in well 47N 28W 3CCDC1. Well is 75 ft deep and completed in outwash. Levels are typical of ground-water wells in Marquette Iron Range. Water-quality data in ground-water report for 1977 (Huffman, 1979).

MONROE COUNTY



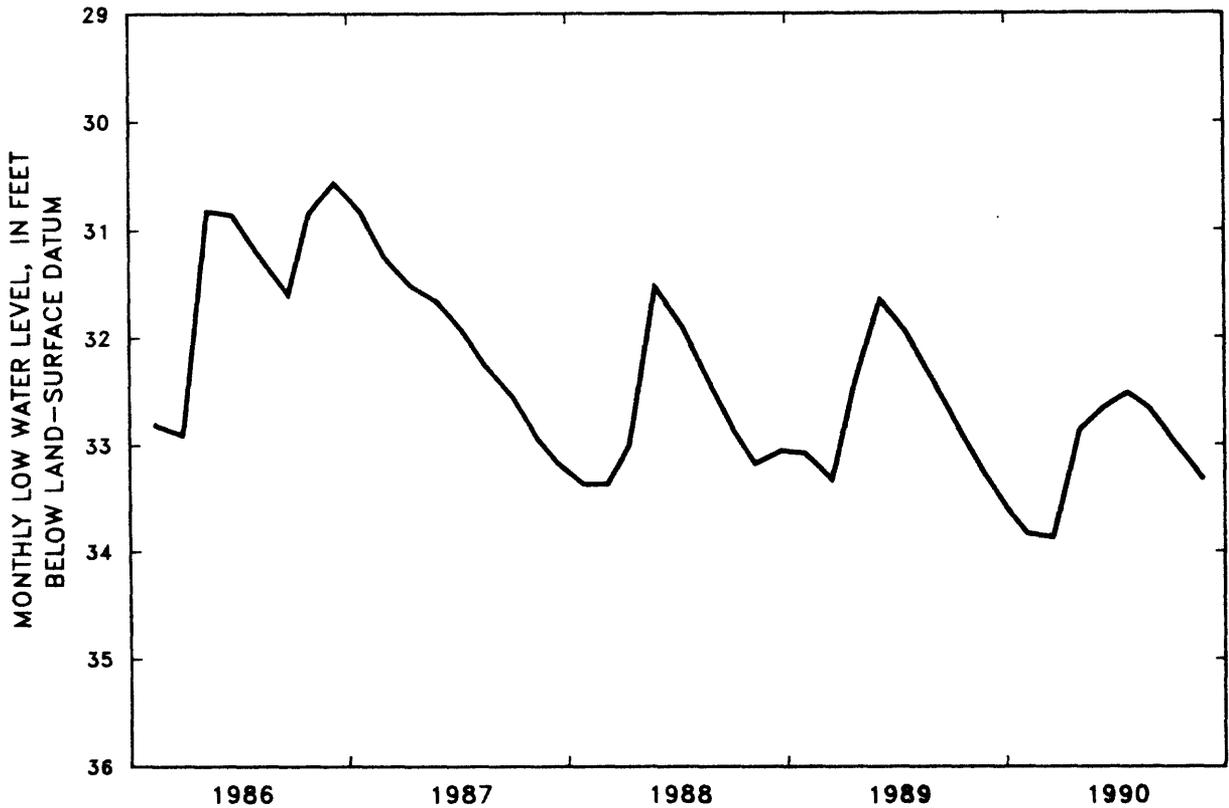
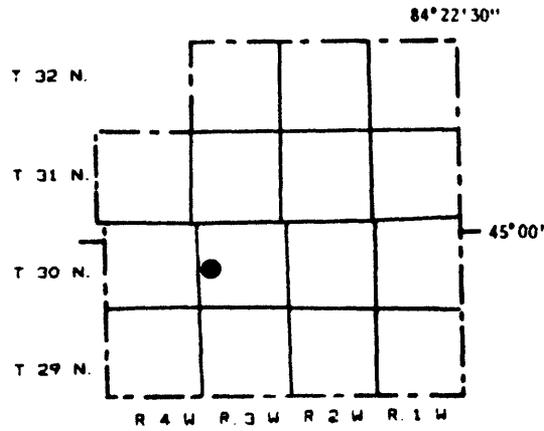
Water levels in well 7S 6E 15ACAA1. Well is 73 ft deep and completed in Detroit River Group. Water-quality data in ground-water reports for 1979 and 1984 (Huffman, 1980, 1985).

OAKLAND COUNTY



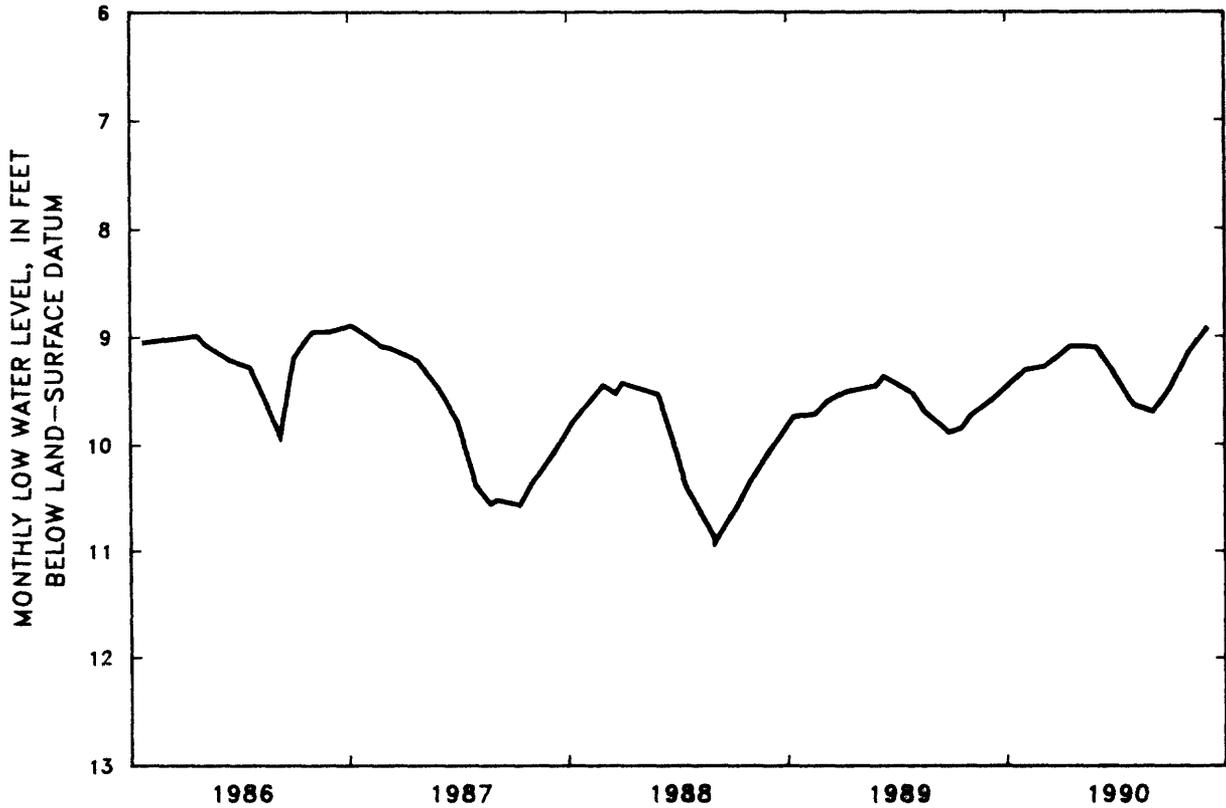
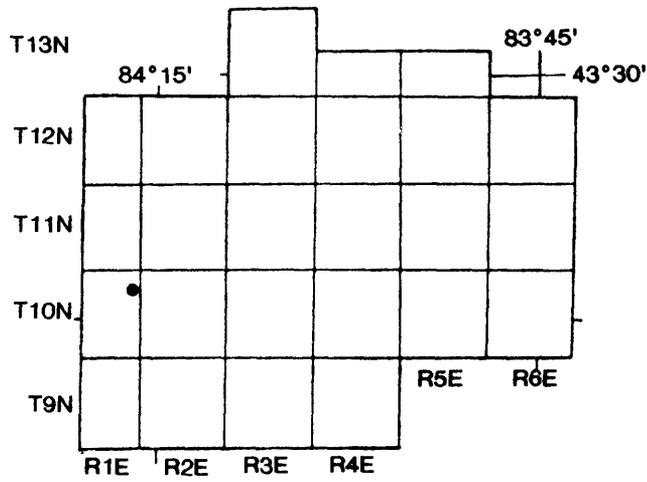
Water levels in well 5N 8E 8ACAC1. Well is 42 ft deep and completed in glacial deposits.

OTSEGO COUNTY



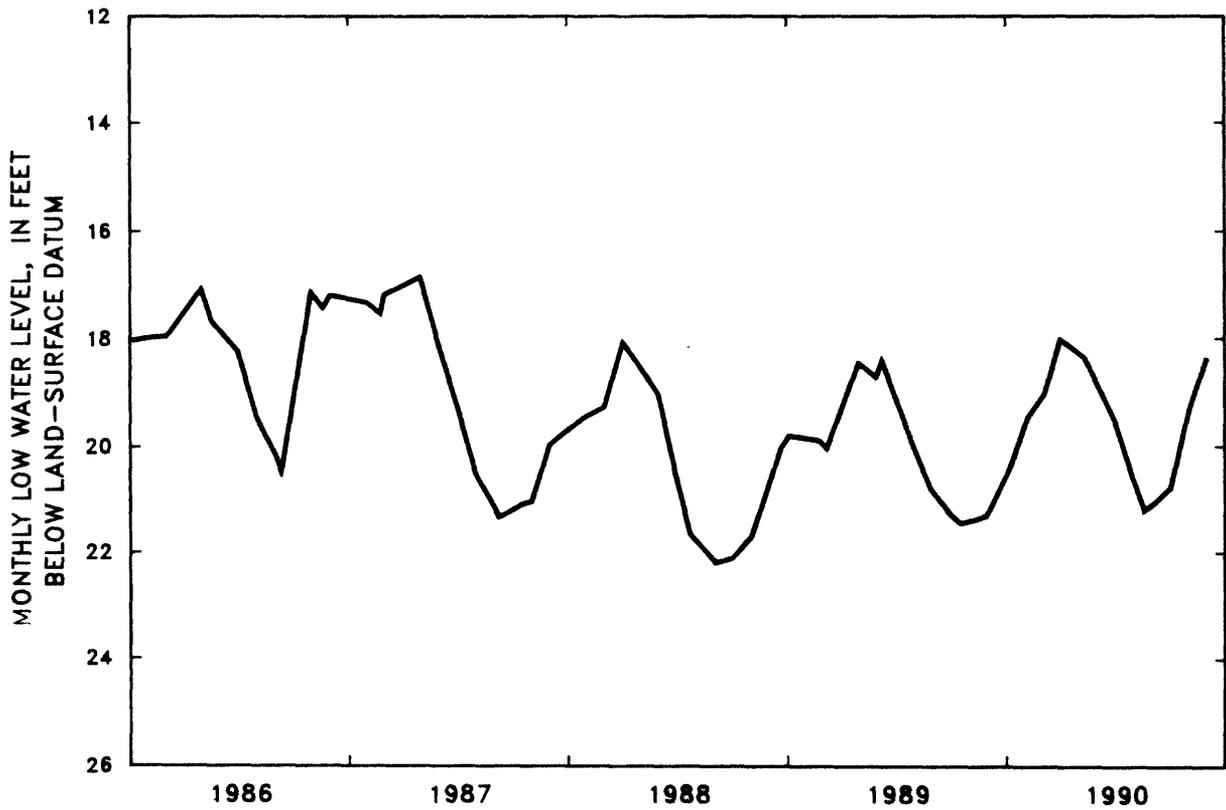
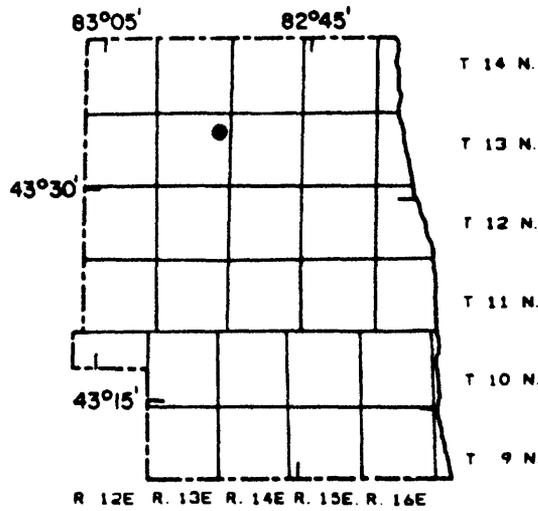
Water levels in well 30N 3W 19ABBB1. Well is 90 ft deep and completed in glacial outwash. Water-quality data in ground-water reports for 1979 and 1984 (Huffman, 1980, 1985).

SAGINAW COUNTY



Water levels in well 10N 1E 22DADA1. Well is 210 ft deep and completed in Saginaw Formation. Water-quality data in ground-water reports for 1977 and 1984 (Huffman, 1979, 1985).

SANILAC COUNTY



Water levels in well 13N 13E 12ADA1. Well is 130 ft deep and completed in Marshall Formation. Water-quality data in ground-water reports for 1977 and 1982 (Huffman, 1979, 1983).

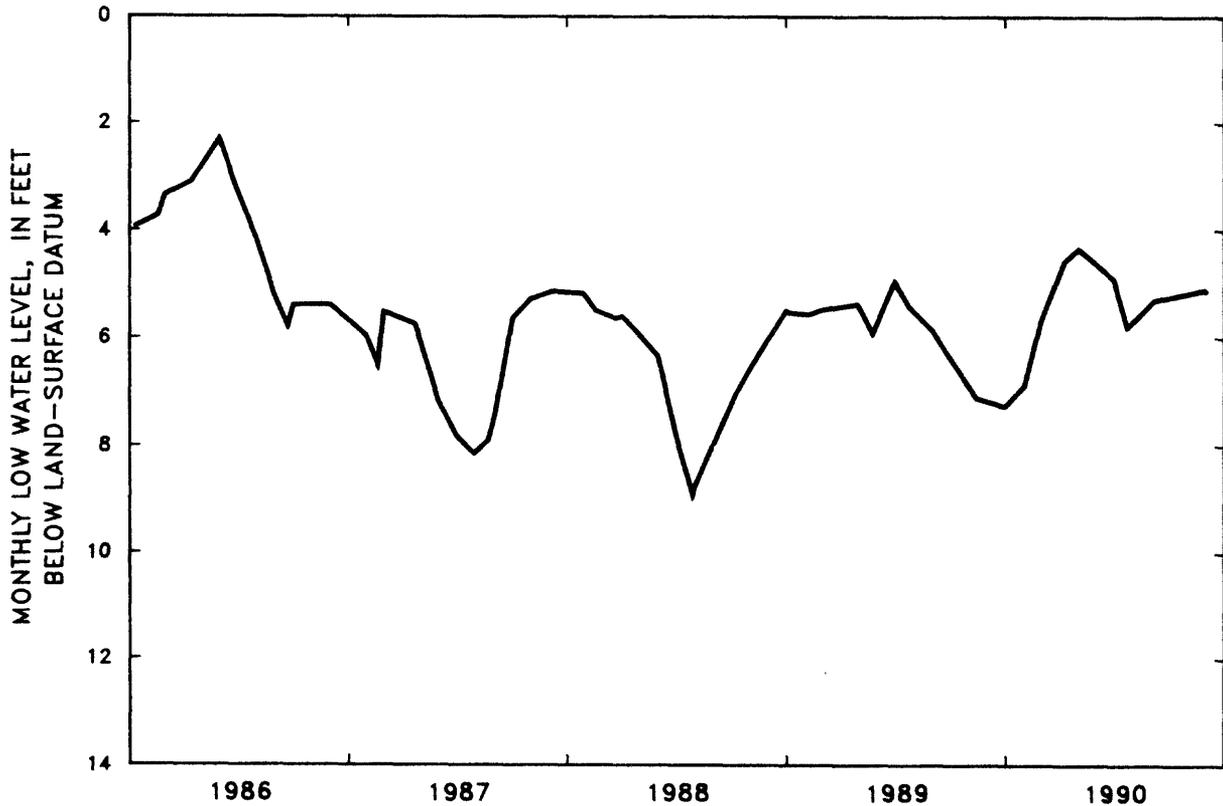
WASHTENAW COUNTY - CITY OF ANN ARBOR

SUPPLY AND SOURCE -- 3 wells, 91 to 196 ft deep, tap glacial deposits; most water is pumped from the Huron River.

YIELD OF WELLS -- 1,050 to 4,860 gal/min; specific capacity -- 20 to 600 gal/min/ft of drawdown.

PUMPAGE -- Total annual ground-water pumpage, in million gallons, for past 5 years (ground water is used to augment supply from Huron River).

1990 - 1,067
1989 - 1,240
1988 - 1,136
1987 - 957
1986 - 1,044



Water levels in well 3S 6E 16BCCD1. Well is 55 ft deep and completed in glacial deposits. Water-quality data in ground-water reports 1977 and 1984 (Huffman, 1979, 1985).

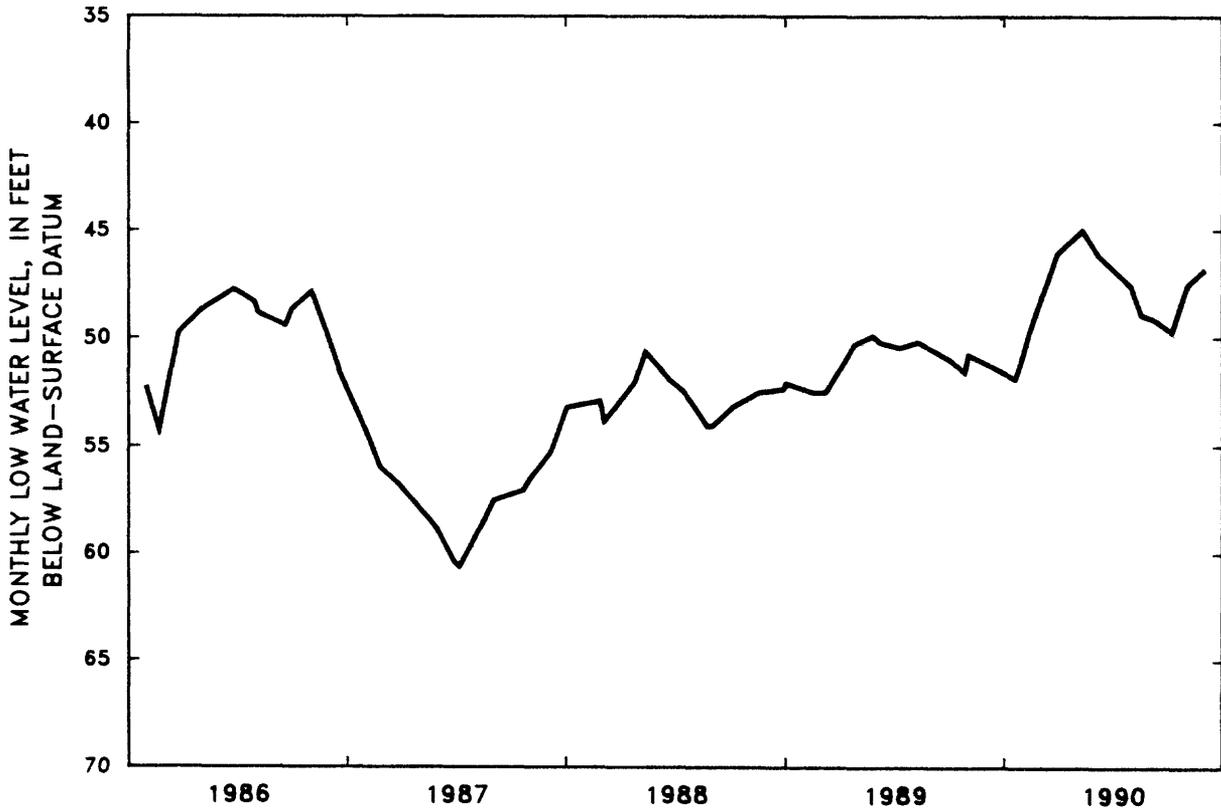
WASHTENAW COUNTY - CITY OF YPSILANTI

SUPPLY AND SOURCE -- 6 wells, 87 to 102 ft deep, tap glacial deposits.

YIELD OF WELLS -- Average 450 gal/min; specific capacity -- 25 to 180 gal/min/ft of drawdown.

PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

1990 -	904
1989 -	960
1988 -	1,275
1987 -	1,220
1986 -	925



Water levels in well 3S 7E 9ADBC1. Well is 94 ft deep and completed in glacial deposits.

Table 2.--Records of ground-water wells in Michigan

COUNTY AND WELL NUMBER: See section in text entitled "Well-numbering system."

NAME: CCC - Civilian Conservation Corp.; MDNR - Michigan Department of Natural Resources; MDOT - Michigan Department of Transportation; Twsp - Township; USFS - U.S. Forest Service; WEP - Wisconsin Electric Power Company; D - Deep; S - Shallow.

AQUIFER:	112GLCL	Glacial deposits	337MRSL	Marshall Formation	3610DVCU	Ordovician, Upper
	112GRVL	Gravel	341TRVR	Traverse Group	365TBRV	Trenton-Black River Group
	112OTSH	Outwash	344DUND	Dundee Formation	368PRDC	Prairie du Chien Group
	112SAND	Sand	34BDRRV	Detroit River Group	372MNSG	Munising Sandstone
	112SDGV	Sand and Gravel	355SLINH	Salina Formation	42DFRED	Freda Sandstone
	324SGNW	Saginaw Formation	355MNSQ	Manistique Dolomite		

ELEVATION: Land-surface datum in feet above National Geodetic Vertical Datum of 1929.

MEASUREMENTS FREQUENCY: R - Continuous recorder, D - Daily, W - Weekly, M - Monthly, Q - Quarterly, A - Annually.

OBSERVED WATER-LEVEL EXTREMES: Data for calendar years. In feet below or above (+) land surface. 1990 measurements underscored are extremes for period of record.

REMARKS: Water-level measurements are made by the U.S. Geological Survey unless otherwise noted.

County and well number (Twp, range, section)	Name	Depth of wells (feet)	Diam-eter (inches)	Aquifer	Eleva-tion	Years of record	Meas-ure-ment freq-ue-ncy	Observed water-level extremes				
								Through 1989		1990		
								Highest	Lowest	Highest	Lowest	
ALGER												
45N 19W 25BDCD1	CCC	66	6	112GLCL	850	32	Q	6.4 Jun 1960	14.2 Apr 1964	11.2 Jun	12.4 Dec	
ALPENA												
32N 6E 23DDDA1	Alpena State Forest	88	6	112SAND	713	14	R	13.6 May 1983	30.0 Mar 1982	17.9 Dec	29.6 Mar	
ARENAC												
19N 5E 7DABA1	Omer, D	185	6	324SGNW	667	11	M	8.3 Jul 1980	11.8 Aug 1988	11.1 Apr	11.7 Aug	
	7DABA2	Omer, S	21	6	112GLCL	667	11	M	2.3 May 1983	7.0 Oct 1987	2.5 Nov	5.4 Feb
BARAGA												
48N 32W 12DD	¹ WEP14	10	1	112GLCL	1,630	43	M	3.3 Apr 1965	9.9 Jan 1987	5.5 Jun	6.5 Dec	
BARRY												
4N 9W 5DA	Solomon Road	131	2	112GLCL	860	27	Q	111.5 Mar 1978	122.0 Mar 1965	115.4 Jul	116.4 Jan	
BAY												
17N 4E 22DCAA1	Pinconning Twp	110	6	324SGNW	620	29	M	0.0 Mar 1976	10.5 Aug 1963	2.3 Nov	4.7 Aug	
BRANCH												
6S 6W 18CCCD1	Coldwater Twp	56	6	112OTSH	950	27	M	18.3 Mar 1976	28.3 Jul 1964	22.0 Jun	23.1 Feb	
	² 22CABA1	Coldwater Test 4	113	6	112GLCL	970	R	8.8 Jun 1989	25.9 May 1977	10.0 Mar	23.3 Jan	
CALHOUN												
1S 7W 108B	³ Sabin	12	1	112GLCL	908	45	W	0.9 Mar 1950	7.2 Dec 1964	3.2 Apr	4.8 Oct	
	² 32BDCD1	Pennfield Twp	95	6	337MRSL	845	R	15.6 Apr 1974	27.0 Aug 1964	18.9 Dec	23.6 Feb	
	^{2,3} 32DABD	Battle Creek	127	8	337MRSL	830.8	D	0.7 Apr 1950	16.8 Jul 1959	6.1 Dec	10.9 Aug	
2S 6W 25AA	^{2,3} Marshall	59	6	337MRSL	904.8	41	M	5.1 Mar 1989	9.7 Aug 1964	7.5 Apr	8.9 Oct	
CASS												
8S 14W 17BA	³ Little	55	28	112GLCL	840	46	M	46.2 Jul 1950	55.0 Mar 1957	51.0 Dec	52.9 Jan	

Table 2.--Records of ground-water wells in Michigan--Continued

County and well number (Twp, range, section)	Name	Depth of wells (feet)	Diam-eter (inches)	Aquifer	Eleva-tion	Years of record	Meas-ure-ment freq-ue-ncy	Observed water-level extremes			
								Through 1989		1990	
								Highest	Lowest	Highest	Lowest
<u>CHEBOYGAN</u>											
33N 1W 26DABA1	Pigeon River CCC	164	6	112SAND	933	25	R	55.2 May 1985	60.2 Jul 1982	58.2 Jul	59.9 Mar
39N 3W 29CBCB1	Mackinaw, D	125	6	344DUND	705	12	M	4.7 Apr 1986	11.7 Feb 1981	4.8 Mar	9.6 Jan
	29CBCB2	55	6	112SDGV	705	12	M	1.8 Apr 1986	6.5 Feb 1981	2.2 Mar	5.7 Jan
<u>CHIPPEWA</u>											
46N 4W 24DAAD1	Raco	54	6	1120TSH	850	36	R	18.4 Jun 1971	28.4 Apr 1964	25.4 Jul	28.4 Mar
<u>CLARE</u>											
17N 4W 34DCAD	Clare	91	4	112GLCL	850	16	R	7.9 Mar 1976	24.9 May 1977	9.0 Nov	15.0 Jun
<u>CLINTON</u>											
5N 2W 32DC	² Quarantine Farm	135	4	324SGNW	849.2	27	M	42.0 Sep 1944	99.2 May 1966	59.9 Dec	69.1 Apr
6N 1W 3BB2	Sleepy Hollow 5	62	1	112GLCL	814.0	21	A	37.6 Apr 1983	43.5 Nov 1966		37.2 Apr
	⁴ MDOT, U.S. 27	23	14	112GLCL	803.3	43	M	13.8 Apr 1974	19.9 Feb 1964	15.2 Apr	17.6 Sep
7N 1W 34CC	Sleepy Hollow 7	32	1	1120TSH	785.3	24	A	16.5 Apr 1983	20.3 Oct 1973		16.6 Apr
<u>CRAWFORD</u>											
25N 1W 15DDCD1	Eldorado	56	6	112GLCL	1,190	43	R	25.6 Nov 1986	36.0 Apr 1951	29.8 Jul	30.7 Mar
<u>DELTA</u>											
39N 23W 28AC	Schemmel	530	5	372MNSG	680	33	R	1.3 May 1960	8.7 Jul 1988	5.4 May	8.2 Aug
41N 18W 31CD	Isabella	250	5	3610DVCU	615	33	M	3.3 Sep 1979	6.9 Jul 1987	4.5 Oct	6.0 Jan
42N 19W 20AA	Pollack CCC	134	6	112GLCL	740	33	Q	23.4 Jul 1982	28.1 Feb 1977	25.8 Jun	26.7 Dec
43N 19W 24BB	Clarage	405	4	365TBRV	860	33	Q	77.0 Jul 1960	88.8 Oct 1966	79.9 Sep	80.5 Mar
<u>DICKINSON</u>											
43N 28W 32ADAB1	Felch	31	1	112SAND	1,160	25	M	13.0 Apr 1986	16.8 May 1968	15.1 Jun	16.2 Mar
<u>EATON</u>											
3N 3W 2BA	² Lansing, Stiefel	66	1	112GLCL	839	27	R	3.0 Jun 1986	18.0 Nov 1968	3.7 Mar	11.8 Nov
4N 3W 12C0	² Robins Road	381	6	324SGNW	861.9	38	R	64.5 Oct 1989	103.6 Aug 1969	65.5 Feb	88.8 Jul
<u>GENESEE</u>											
6N 7E 9DCCC1	^{2,5} Fisher Body No. 2	385	10	324SGNW	837.0	18	R	52.3 Dec 1975	87.7 Jul 1988	60.4 Mar	79.5 Aug
<u>GRAND TRAVERSE</u>											
26N 9W 14ABAA1	Fife Lake State Forest	80	6	112SAND	960	14	R	21.3 Oct 1986	28.0 Mar 1982	23.8 Jul	26.5 Mar
<u>HILLSDALE</u>											
7S 2W 10BDDD1	Pittsford Game Area	20	1	112SAND	1,070	25	M	5.8 Apr 1982	11.1 Sep 1967	6.6 Mar	8.4 Sep
	2W 15BCBA1	150	6	1120TSH	1,095	12	R	46.1 Apr 1982	49.5 Oct 1988	47.3 Jun	49.0 Jan

Table 2.--Records of ground-water wells in Michigan--Continued

County and well number (Twsp, range, section)	Name	Depth of wells (feet)	Diameter (inches)	Aquifer	Elevation	Years of record	Measurement frequency	Observed water-level extremes			
								Through 1989		1990	
								Highest	Lowest	Highest	Lowest
INGHAM											
2N 1E 34DB	Dansville Game Area	87	2	112GLCL	930	27	Q	22.4 Apr 1974	29.3 Oct 1964	22.8 May	25.7 Aug
1W 5BCAB1	² Mason	210	8	324SGNW	890	27	R	14.7 Mar 1973	23.8 Nov 1964	17.9 Apr	21.5 Sep
3N 1E 7DDCA1	Lotte	184	3	324SGNW	900	27	M	+2.4 Apr 1974	7.0 Nov 1964	0.1 Dec	2.9 Sep
2W 23BCBD	² Holt	188	8	324SGNW	895	9	R	18.3 May 1983	25.5 Oct 1985	19.5 Apr	<u>29.0 Dec</u>
4N 1W 16DA	² Meridian Twsp	398	4	324SGNW	841.2	23	M	6.3 Mar 1976	28.1 Jul 1988	23.6 Jan	<u>62.2 Nov</u>
28BCAD1	² Okemos	125	4	324SGNW	865	15	R	17.6 Apr 1985	24.2 Sep 1978	19.2 Apr	21.6 Oct
2W 9BD	² Lansing, Seymour	401	14	324SGNW	828.8	57	R	15.6 Mar 1931	179.4 Apr 1968	32.6 Dec	43.7 Jun
16DA	² Lansing, Cedar	417	12	324SGNW	829.1	46	R	28.3 Apr 1987	67.0 Aug 1949	<u>25.0 Oct</u>	28.9 Jun
17AB	² Lansing, Logan	424	20	324SGNW	858.7	60	R	34.3 Dec 1929	168.3 May 1968	60.4 Jan	68.8 Sep
22BC	² Lansing, P-5	338	12	324SGNW	823.6	61	M	7.1 Jul 1932	80.5 Feb 1979	21.4 Dec	25.1 Feb
24CA	² Spartan Village	453	10	324SGNW	853.4	46	R	25.5 Mar 1946	105.5 May 1972	54.1 Dec	72.8 Sep
27BB	² Fenner Arboretum	215	6	324SGNW	835	23	R	34.1 Nov 1989	89.5 Oct 1972	<u>29.0 Dec</u>	49.0 Jan
31CC	² Maybel Street	204	3	324SGNW	880.2	47	M	18.9 Apr 1952	45.9 Jul 1980	30.9 Apr	43.1 Jun
IOSCO											
24N 7E 13ADAD1	Oscoda	69	6	112SAND	760	11	M	27.3 Nov 1986	32.7 Mar 1982	31.2 Jul	32.2 Mar
IRON											
43N 35W 11AD	¹ WEP 23	47	36	112GLCL	1,565	46	M	35.3 Aug 1983	47.1 Aug 1949	40.7 Feb	42.9 Nov
20DC	¹ WEP 25	48	1	112GLCL	1,560	46	M	40.7 Jun 1973	48.3 Aug 1949	44.0 Oct	44.8 Feb
44N 37W 14BB	CCC Camp	102	6	112GLCL	1,730	32	Q	90.6 Sep 1986	97.1 Aug 1982	93.6 May	94.2 Nov
JACKSON											
3S 1W 11AA1	^{2,3} Jackson, 4a Belden	360	6	324SGNW, 337MRSL	935	33	D	18.6 Jan 1961	122.0 Jul 1988	39.1 Dec	89.2 Jul
KALAMAZOO											
2S 10W 4D	² Kalamazoo, Campbell	13	4	112TSH	836.5	22	R	1.9 Apr 1974	6.7 Sep 1988	4.4 Dec	6.7 Sep
26BBCC	² Kalamazoo, Morrow	46	4	112TSH	790	4	R	5.9 Apr 1988	13.1 Sep 1988	7.4 Apr	12.9 Jan
11W 20BB2	² Kalamazoo, Kendall	106	4	112TSH	880	26	R	12.5 Feb 1976	48.4 Jun 1971	18.5 May	37.2 Oct
22CD	² Kalamazoo, Stockbridge	137	4	112TSH	764.7	31	R	4.8 Feb 1975	31.1 Aug 1961	6.5 Dec	7.5 Oct
28AA	² Kalamazoo, Maple	245	4	112TSH	820	22	R	29.0 May 1988	73.1 Jul 1985	38.0 Apr	56.4 Jul
31CD	² Kalamazoo, Colony	226	4	112TSH	910	22	R	41.4 Sep 1982	71.8 May 1978	51.7 Jan	67.6 Aug
36CB	² Kalamazoo, Emerald	226	4	112TSH	860	22	R	25.4 Apr 1985	50.4 Jun 1971	26.6 Dec	42.9 Jun
3S 11W 4ABAD1	² Kalamazoo, K32S	36	4	112TSH	860	3	R	9.6 Mar 1989	15.9 Sep 1988	9.7 Dec	13.4 Jul
4ABAD2	² Kalamazoo, K32D	144	4	112TSH	860	3	R	11.1 Mar 1989	18.6 Sep 1988	11.2 Dec	16.5 Sep
14AA	² Upjohn 28	233	16	112TSH	870	24	R	23.5 Aug 1982	45.2 Jul 1977	33.2 May	44.0 Nov

Table 2.--Records of ground-water wells in Michigan--Continued

County and well number (Twsp, range, section)	Name	Depth of wells (feet)	Diam-eter (inches)	Aquifer	Eleva-tion	Years of record	Meas-ure-ment freq-ue-ncy	Observed water-level extremes			
								Through 1989		1990	
								Highest	Lowest	Highest	Lowest
<u>KALAMAZOO--Continued</u>											
3S 11W 22B8CD	² Portage	102	12	112GLCL	877	9	R	24.8 Apr 1985	28.6 Aug 1988	27.2 May	28.6 Oct
12W 11B0	² Kalamazoo, Atwater	248	3	1120TSH	880	30	R	+3.0 Sep 1969	1.1 Jul 1988	+0.8 Apr	1.0 Aug
11AD1	² Kalamazoo, Sabo-D	300	4	1120TSH	877	18	R	4.5 Jul 1973	16.6 Jul 1984	6.1 Apr	16.2 Jul
11AD2	² Kalamazoo, Sabo-S	38	6	1120TSH	877	18	R	9.1 Aug 1975	12.8 Aug 1984	10.1 Apr	12.6 Aug
4S 11W 3CDDA1	² Prairie View Park	190	4	1120TSH	870	22	R	18.0 Apr 1985	20.6 Dec 1977	18.8 May	20.1 Jan
<u>KENT</u>											
5N 12W 4DCCD1	Wyoming, Mobma	86	6	112GRVL	868.0	29	M	7.8 Oct 1978	12.9 Aug 1964	9.4 Mar	10.7 Jul
10N 12W 13DD	Rogue River Game Area	30	1	112GLCL	785	25	Q	0.8 Jan 1975	9.2 Oct 1969	5.5 May	7.1 Jan
<u>LAKE</u>											
20N 13W 13ACAC1	Irons	57	6	1120TSH	945	11	M	9.1 Oct 1986	18.0 Mar 1982	12.0 Jul	14.2 Feb
<u>LEELANAU</u>											
28N 14W 8DDCA1	Sleeping Bear, D	128	6	112SAND	750	11	M	111.2 Apr 1987	114.5 Jun 1984	112.5 Oct	112.7 Jun
18BABB1	Sleeping Bear, S	60	6	112SAND	625	11	R	20.8 Oct 1986	24.9 Nov 1982	22.9 Mar	24.5 Jan
<u>LENAWEE</u>											
5S 1E 12DDBD1	Onsted Game Area	39	1	112GLCL	1,000	25	M	15.9 Mar 1982	19.3 Sep 1971	16.4 Mar	17.3 Aug
<u>LIVINGSTON</u>											
1N 6E 13DBAB1	American Aggregate	29	2	1120TSH	930	21	R	12.1 Apr 1974	21.6 Oct 1979	14.7 Mar	16.5 Jan
<u>MACKINAC</u>											
41N 5W 23BC	Round Lake CCC	47	6	355SLIMH	610	35	Q	2.9 Apr 1985	17.8 Feb 1981	10.3 Apr	16.3 Jan
42N 2W 7AABB1	Pontchartrain CCC	102	6	355MNSQ	680	35	R	12.5 Apr 1985	32.3 Feb 1977	15.7 Mar	29.2 Jan
<u>MARQUETTE</u>											
47N 28W 3CCDC1	⁴ Ely Twsp	75	8	1120TSH	1,572.0	30	R	9.4 Apr 1985	19.3 Apr 1964	13.8 Jun	16.6 Mar
49N 30W 22AC	¹ WEP 13	17	1	112GLCL	1,680	43	M	0.6 May 1951	13.3 Sep 1948	9.1 Apr	10.0 Aug
<u>MENOMINEE</u>											
37N 26W 19DADA1	Carney	17	4	365TBRV	800	32	Q	3.3 Mar 1986	8.6 Jan 1977	4.1 Jun	5.8 Mar
<u>MONROE</u>											
7S 6E 15ACAA1	Petersburg, Rock	73	6	34BDRRV	860	12	R	32.3 Mar 1982	43.2 Oct 1985	36.8 Apr	42.9 Aug
15ADBB1	Petersburg Game Area	17	1	112GLCL	675	25	M	3.0 Feb 1966	7.6 Oct 1988	5.4 Mar	6.9 Sep
<u>OAKLAND</u>											
2N 7E 5BA	Honeywell Lake Road	44	2	112GLCL	1,020	23	R	23.9 Apr 1976	28.9 Dec 1971	26.1 May	27.8 Jan
8E 18DBAD1	² Proud Lake Park	45	6	1120TSH	910	22	R	2.8 May 1974	6.4 Sep 1971	4.1 Apr	5.9 Jan
3N 7E 5DA	Fish Lake Road	49	2	112GLCL	1,055	22	R	29.5 Jun 1976	38.7 Dec 1972	33.1 Jul	35.3 Jan

Table 2.--Records of ground-water wells in Michigan--Continued

County and well number (Twp, range, section)	Name	Depth of wells (feet)	Diameter (inches)	Aquifer	Elevation	Years of record	Measurement frequency	Observed water-level extremes			
								Through 1989		1990	
								Highest	Lowest	Highest	Lowest
<u>OAKLAND--Continued</u>											
3N 10E 13AC	Oakland University	183	6	112GLCL	940	10	R	55.0 Nov 1989	93.5 Jul 1963	<u>54.6 Nov</u>	56.5 Jul
5N 8E 8ACAC1	Holly Recreation Area	42	1	112GLCL	930	25	M	22.3 Apr 1974	26.5 Sep 1966	24.7 Apr	26.2 Sep
<u>OCEANA</u>											
13N 15W 18AAAA1	Hesperia	79	6	1120TSH	703	13	R	35.8 Dec 1986	41.0 Mar 1982	39.8 Jan	<u>41.1 Dec</u>
<u>OGEMAW</u>											
23N 1E 2BAAA1	Rose City Road, D	105	1	112GLCL	1,265	23	Q	73.3 Apr 1987	78.2 Apr 1969	74.6 Nov	75.6 Sep
2BAAA2	Rose City Road, S	20	1	112SAND	1,265	23	Q	7.6 Apr 1976	13.6 Dec 1972	10.5 Nov	13.2 Feb
<u>ONTONAGON</u>											
51N 41W 8BDBC1	Silver City	100	6	420FRED	620	33	Q	8.2 Apr 1959	21.8 Dec 1976	10.3 May	14.7 Aug
<u>OTSEGO</u>											
30N 3W 19ABBB1	Gaylord	90	6	1120TSH	1,308	12	M	30.6 Dec 1986	35.8 Apr 1982	32.5 Jul	33.9 Mar
<u>PRESQUE ISLE</u>											
33N 6E 8BBBB1	Styma	61	6	341TRVR	800	32	Q	4.8 Mar 1984	18.8 Mar 1963	5.7 Mar	13.8 Oct
<u>ROSCOMMON</u>											
24N 2W 20BABA1	⁴ Exp. Station	14	8	1120TSH	1,145.3	57	R	2.1 Apr 1976	6.2 Dec 1949	4.1 May	5.8 Mar
<u>SAGINAW</u>											
10N 1E 22DADA1	Marion Springs, D	210	6	324SGNW	657	13	R	7.9 Feb 1981	10.9 Sep 1988	8.5 Dec	9.7 Sep
<u>SANILAC</u>											
13N 13E 12ADAA1	Minden Game Area	130	6	337MRSL	805	14	R	15.5 Apr 1985	22.7 Oct 1979	17.6 Apr	21.2 Aug
<u>SCHOOLCRAFT</u>											
45N 13W 16CCCB1	Seney	154	4	3610DVCU	710	39	R	4.6 Apr 1971	6.5 Oct 1963	4.9 Mar	5.8 Sep
47N 16W 30BBBB1	Cusino CCC	57	6	368PRDC	900	34	R	5.6 Apr 1985	16.4 Feb 1977	8.8 Apr	15.8 Mar
<u>VAN BUREN</u>											
2S 13W 2BBCB1	Almena, D	108	4	112GLCL	737	10	M	4.7 Oct 1986	10.7 Aug 1981	4.7 Nov	7.0 Sep
2BBCB2	Almena, S	44	4	112GLCL	737	10	M	8.4 Oct 1986	12.6 Sep 1984	9.8 Nov	11.8 Sep
<u>WASHTENAW</u>											
2S 3E 9DAAB2	² Waterloo Park	48	6	112SDGV	970	22	R	4.1 May 1974	7.0 Aug 1971	4.3 May	6.0 Aug
3S 6E 16BCCD1	² Ann Arbor	55	10	112GLCL	821.5	28	R	0.7 Mar 1974	15.9 Oct 1964	2.5 May	7.1 Jan
7E 5BB	² Ypsilanti, Superior	69	8	112GLCL	720	29	R	1.8 Feb 1965	21.4 Dec 1965	1.8 Feb	2.9 Aug
9ADBC1	² Ypsilanti, Gilbert	94	6	112GLCL	710	40	R	29.1 Nov 1945	78.8 Oct 1974	42.8 May	51.9 Jan
24CA1	² Ypsilanti Twp, 104	87	4	112GLCL	665.6	45	R	5.8 Jan 1950	22.7 Feb 1971	12.8 Mar	14.5 Sep

Table 2.--Records of ground-water wells in Michigan--Continued

County and well number (Twsp,range,section)	Name	Depth of wells (feet)	Diam- eter (inches)	Aquifer	Eleva- tion	Years of record	Meas- ure- ment freq- uency	Observed water-level extremes			
								Through 1989		1990	
							Highest	Lowest	Highest	Lowest	
<u>WASHTENAW</u> --Continued											
3S 7E 24CD	² Ypsilanti Twsp, 117	75	6	112GLCL	657.8	44	R	4.7 Oct 1981	63.2 Feb 1970	8.1 Mar	33.3 Sep
<u>WEXFORD</u>											
22N 12W 13BA	² Harrietta Fish	141	4	112GLCL	1,060	30	R	+13.8 Mar 1970	1.6 Jan 1981	+7.8 Jul	+1.9 Feb

- 1 Measured by WEP.
- 2 Water levels affected by pumping.
- 3 Measured by owner.
- 4 Federal key well.
- 5 Discontinued.

Table 3.--Reported ground-water pumpage in 1990
 [Figures in millions of gallons]

County and water user	Total	Maximum day	Minimum day	County and water user	Total	Maximum day	Minimum day
ALCONA				CLINTON			
Harrisville	27.2	0.164	0.026	Fowler	26.7	0.230	0.034
ALGER				Maple Rapids	27.3	.123	.043
Chatham	9.0	.027	a--	Ovid	80.2	.356	.100
ALLEGAN				St. Johns	404.1	1.811	.618
Allegan	339.5	1.662	.444	Westphalia	26.0	.161	.043
Fennville	201.7	--	--	CRAWFORD			
Otsego	433.5	1.964	.859	Grayling	251.8	.923	.433
Plainwell	196.8	1.222	.305	DICKINSON			
Saugatuck	178.8	--	--	Breitung Township	49.4	--	--
ANTRIM				EATON			
Bellaire	83.0	.393	.191	Bellevue	56.3	.271	.084
Central Lake	59.1	.276	.143	Charlotte	394.3	2.105	.742
Mancelona	158.4	.962	.148	Delta Township	1,069.0	5.920	1.260
BARRY				Eaton Rapids	276.3	1.212	.492
Middleville	94.7	.432	.160	Grand Ledge	282.3	1.541	.488
Nashville	48.5	.216	b.000	Sunfield	26.1	--	--
BENZIE				EMMET			
Beulah	23.1	.145	.034	Harbor Springs	173.1	2.210	.300
Frankfort	82.7	.371	.146	Petoskey	381.7	1.389	.898
BERRIEN				GENESEE			
Berrien Springs	156.2	1.142	.269	Beecher Metro District	499.1	1.967	1.176
Buchanan	250.2	1.623	.266	Burton	217.4	1.617	.458
Coloma	95.1	.828	.091	Davison	242.3	1.096	.421
Niles	710.0	3.880	1.100	Fenton	336.5	1.511	.659
Niles Township	86.1	.866	.089	Grand Blanc	413.1	1.883	.847
Watervliet	86.4	.438	.000	Grand Blanc Township	280.6	.932	.667
BRANCH				Linden	71.5	--	--
Coldwater	777.4	3.765	.858	GLADWIN			
Coldwater Regional Center	101.8	.998	.105	Beaverton	54.8	--	--
Quincy	92.9	--	--	GOGEBIC			
CALHOUN				Ironwood	507.0	--	--
Albion	898.7	3.602	1.535	Marenisco Township	37.6	.143	.080
Athens	36.5	.265	.030	Wakefield	112.9	.528	.137
Battle Creek	4,129.1	16.840	5.330	GRAND TRAVERSE			
Battle Creek Township	489.0	3.300	.000	Kingsley	41.9	--	--
Homer	65.7	.382	.097	GRATIOT			
Marshall	642.9	2.870	.880	Alma	7.4	--	--
CASS				Breckenridge	42.7	.184	.056
Cassopolis	99.5	.469	.141	Ithaca	95.1	--	--
Dowagiac	336.3	1.791	.556	St. Louis	168.4	.860	.240
CHARLEVOIX				HILLSDALE			
Boyne City	258.5	1.154	.491	Hillsdale	405.8	1.755	.733
East Jordan	306.4	1.480	.500	Jonesville	112.1	.563	.178
CHEBOYGAN				Litchfield	90.0	.500	.113
Mackinaw City	110.0	--	--	Waldron	34.2	--	--
CHIPPEWA				HOUGHTON			
Kinross Township	240.2	1.123	.451	^c Adams Township	109.8	.406	.230
CLARE				^d Adams Township	345.9	1.192	.764
Clare	199.9	1.286	.371	Chassell Township	37.1	--	--
Farwell	52.7	--	--	Houghton	394.9	1.445	.720
Harrison	81.1	.335	.141	^e Northern Michigan Water	374.1	1.534	.792

Table 3.--Reported ground-water pumpage in 1990--Continued
[Figures in millions of gallons]

County and water user	Total	Maximum day	Minimum day	County and water user	Total	Maximum day	Minimum day
HURON				LAPEER			
Elkton	33.3	0.162	0.072	Columbiaville	23.5	--	--
Pigeon	55.9	.343	.022	Dryden	19.8	0.178	0.020
				North Branch	40.2	--	--
INGHAM				LEELANAU			
Lansing Township	258.7	--	--	Northport	25.2	.139	.015
Lansing	7,174.3	21.390	13.000				
Mason	280.3	--	--	LENAWEE			
Michigan State University	1,540.8	4.777	1.301	Britton	18.1	.084	.033
Stockbridge	51.1	.158	.122	Clinton	117.7	.491	.194
Webberville	51.7	.221	.095	Hudson	133.3	--	--
Williamston	104.0	.659	.031	Morenci	96.7	.425	.152
				Onsted	39.1	.188	.061
IONIA				Tecumseh	321.3	1.477	.231
Ionia	643.7	2.563	1.201	LIVINGSTON			
Michigan Training Unit, Ionia	50.1	.248	.120	Brighton	340.0	2.300	.860
Muir	56.7	.309	.100	Fowlerville	114.0	.503	.196
Pewamo	19.1	.080	.020	Green Oak Township	85.5	--	--
Portland	191.4	.701	.306	Howell	566.7	2.371	.918
Saranac	64.4	.434	.059				
IOSCO				LUCE			
Oscoda Township	292.5	1.534	.488	Newberry	143.5	.628	.154
Wurtsmith AFB	703.8	2.701	.817	Newberry Health Center	20.3	--	--
IRON				MACOMB			
Alpha	8.9	.058	.011	Armada	40.4	--	--
Caspian	91.0	.374	.167	Richmond	153.1	.598	.320
Crystal Falls	156.4	.616	.329	MANISTEE			
Crystal Falls Township	58.9	--	--	Filer Township	56.1	.414	.049
Iron River	129.0	.748	.161	Manistee	383.4	1.728	.703
Stambaugh	62.6	.654	.121	MARQUETTE			
ISABELLA				Ishpeming Township	108.7	--	--
Mt. Pleasant	913.4	3.859	.949	K.I. Sawyer AFB	502.1	2.685	.662
JACKSON				Powell Township	11.6	.100	.014
Concord	52.0	1.122	.000	MENOMINEE			
Grass Lake	242.8	1.614	.289	Stephenson	39.6	.288	.062
Jackson	3,103.5	12.020	4.460	MISSAUKEE			
Springport	55.9	.430	.034	Lake City	49.8	.437	.042
State Prison, Jackson	579.7	--	--	MONROE			
KALAMAZOO				Petersburg	54.2	.257	.060
Augusta	36.5	.455	.060	MONTCALM			
Galesburg	70.	.355	.140	Carson City	129.0	.545	.224
Kalamazoo	7,035.9	--	--	Edmore	57.8	.424	.007
Parchment	158.3	1.476	.200	Greenville	837.0	3.718	1.082
Portage	1,406.4	11.067	2.024	Howard City	51.4	2.563	.937
Upjohn Company	8,837.8	30.639	17.041	Sheridan	35.0	--	--
Vicksburg	100.0	.958	.106	MUSKEGON			
KALKASKA				Montague	106.4	.698	.119
Kalkaska	175.4	.913	.232	NEWAYGO			
KENT				Freemont	567.5	2.645	.162
Alloytek	24.5	--	--	Hesperia	26.0	--	--
Cedar Springs	109.8	.567	--	Newaygo	55.1	.619	.082
Kent County Airport	924.7	--	--	White Cloud	56.3	.300	.083
Plainfield Township	932.9	5.890	1.640				
LAKE							
Baldwin	70.6	.513	.031				

Table 3.--Reported ground-water pumpage in 1990-Continued
[Figures in millions of gallons]

County and water user	Total	Maximum day	Minimum day	County and water user	Total	Maximum day	Minimum day
OAKLAND				SAGINAW			
Holly	175.2	0.742	0.370	Chesaning	108.2	0.572	0.135
Independence Township	336.6	--	--	SANILAC			
Milford	244.2	1.309	.306	Crosswell	165.1	.831	.180
Orion Township	16.2	.089	.032	Deckerville	45.2	.285	.035
Oxford	233.8	1.198	.218	Marlette	85.7	.582	.129
Rochester	771.7	3.403	.999	Peck	16.5	.150	.020
South Lyon	525.0	--	--	Port Sanilac	51.4	--	--
Southfield	5.9	--	--	Sandusky	120.8	.527	.065
Sylvan Lake	88.0	--	--	SHIAWASSEE			
Walled Lake	34.4	--	--	Bancroft	16.4	--	--
Waterford Township	2,387.7	--	--	Byron	22.7	.115	.034
Wolverine Lake	58.7	--	--	Durand	131.0	.459	.292
OCEANA				Perry	65.2	.522	.115
Hart	236.0	--	--	TUSCOLA			
Shelby	124.2	--	--	Akron	1.4	--	--
OGEMAW				Caro	221.5	1.016	.267
West Branch	96.6	.522	.000	Cass City	106.4	.511	.202
ONTONAGON				Kingston	15.7	.087	.023
Bergland Township	8.8	--	--	Mayville	24.8	--	--
Rockland Township	10.6	.046	.016	State Hospital, Caro	52.5	.240	.105
OSCEOLA				Vassar	215.6	.998	.279
Evart	523.7	2.684	.304	VAN BUREN			
Reed City	167.4	--	--	Bangor	64.7	.384	.014
OTSEGO				Decatur	89.3	--	--
Gaylord	217.7	--	--	Gobles	23.8	.200	.030
PRESQUE ISLE				Hartford	73.6	.381	.039
Onaway	76.9	.496	.183	Lawrence	33.3	--	--
Rogers City	159.7	0.879	0.299	Lawton	354.2	1.978	.272
ROSCOMMON				Paw Paw	191.6	--	--
Roscommon	63.5	--	--	WASHTENAW			
ST. CLAIR				Ann Arbor	^h 1,067.3	--	--
Capac	42.8	.432	.065	Chelsea	188.3	.803	.371
Yale	87.4	.288	.101	Dexter	101.9	.790	.010
ST. JOSEPH				Milan	337.0	2.160	.560
Constantine	89.7	.365	.084	Saline	392.2	1.922	.564
Sturgis	789.8	3.385	.941	Webster Township	38.7	.382	.029
				Ypsilanti	903.8	3.913	1.508
				Ypsilanti Township	1,616.1	9.508	.165
				WEXFORD			
				Cadillac	840.6	3.503	1.229
				Manton	102.0	.437	.149

^a Indicates data not available.

^b Plant was down.

^c Amount pumped to supply South Range, Baltic, Painsdale, Trimountain.

^d Amount pumped to supply Houghton, Hancock, Portage Township, Copper Range Company, and Atlantic Mine.

^e Amount pumped to supply Calumet, Calumet Township, Copper City, Lake Linden, Laurium, Osceola Township, Torch Lake Township, Ahmeek, and Allouez Township.

^f Supplies water to Lyons.

^g Wholly or partly estimated.

^h Also diverted 4,635 million gallons from Huron River.

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<u>Year</u>	<u>WSP Number</u>	<u>Year</u>	<u>WSP Number</u>	<u>Year</u>	<u>WSP Number</u>
1935	777	1944	1016	1953	1265
1936	817	1945	1023	1954	1321
1937	840	1946	1071	1955	1404
1938	845	1947	1096	1956-57	1537
1939	886	1948	1126	1958-62	1782
1940	906	1949	1156	1963-67	1977
1941	936	1950	1165	1968-72	2140
1942	944	1951	1191	1973-74	2164
1943	986	1952	1221		

U.S. Geological Survey Water-Data Reports

<u>Year</u>	<u>WDR Number</u>	<u>Year</u>	<u>WDR Number</u>
1975	MI-75-1	1983	MI-83-1
1976	MI-76-1	1984	MI-84-1
1977	MI-77-1	1985	MI-85-1
1978	MI-78-1	1986	MI-86-1
1979	MI-79-1	1987	MI-87-1
1980	MI-80-1	1988	MI-88-1
1981	MI-81-1	1989	MI-89-1
1982	MI-82-1	1990	MI-90-1