GROUND-WATER DATA FOR MICHIGAN 1989

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

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CONVERSION FACTORS

Multiply	By	To obtain
inch (in.)	25.4	millimeter
feet (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

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Temperature in degrees Fahrenheit (°F) as follows:

$$°F = 1.8 \times °C + 32$$

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ABSTRACT

Water levels, locations, depths, and aquifers tapped are given for 108 observation wells. Tabulated data include a listing of ground-water reports in Michigan, extremes of water levels for calendar year 1989 and for the period of record, pumpage of most major ground-water users in the State, and water-quality data from selected wells. In 1989, 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 6.7 billion gallons from glacial deposits only.

INTRODUCTION

Purpose and Scope

This report provides records of water levels and related data collected during 1989 for the principal aquifers of Michigan. Data on yield of wells, pumpage, quality of water, and hydrographs of ground-water levels 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 1989 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 and future demands for water and to determine whether expansion of present supply systems for ground water is practical.

Water levels normally fluctuate annually and may exhibit long-term trends over a period of years. A knowledge of fluctuations is important when planning construction that requires excavation. For example, when construction is planned after several years of drought, the allowance for rising water levels should be greater. Test drilling may be needed at some sites to determine water levels. In an area where the water level is declining because of pumping, projection of future water levels indicates the depth below which well intakes should be installed.

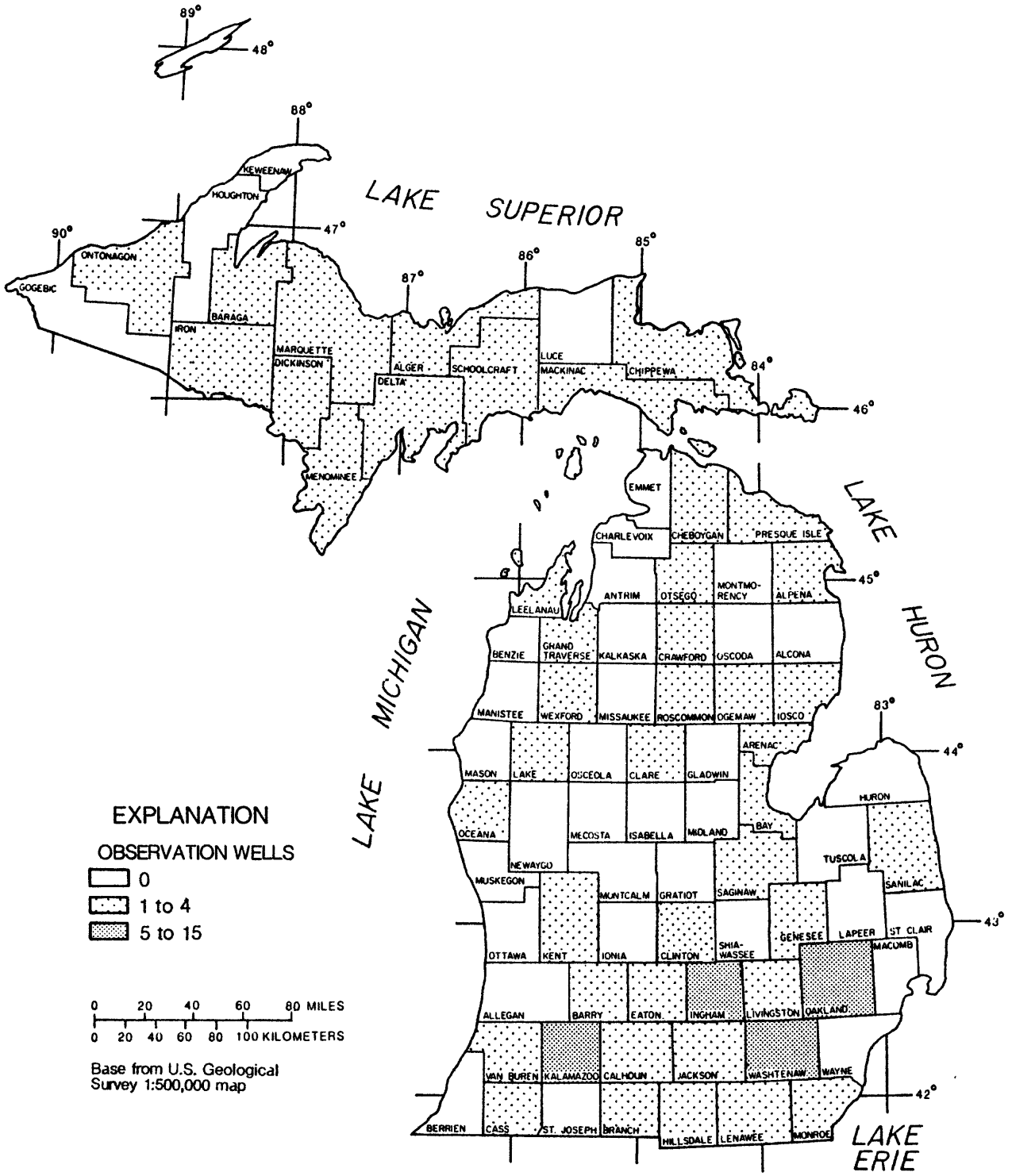


Figure 1.--Distribution of observation wells. (Water levels were monitored in 108 wells in 1989.)

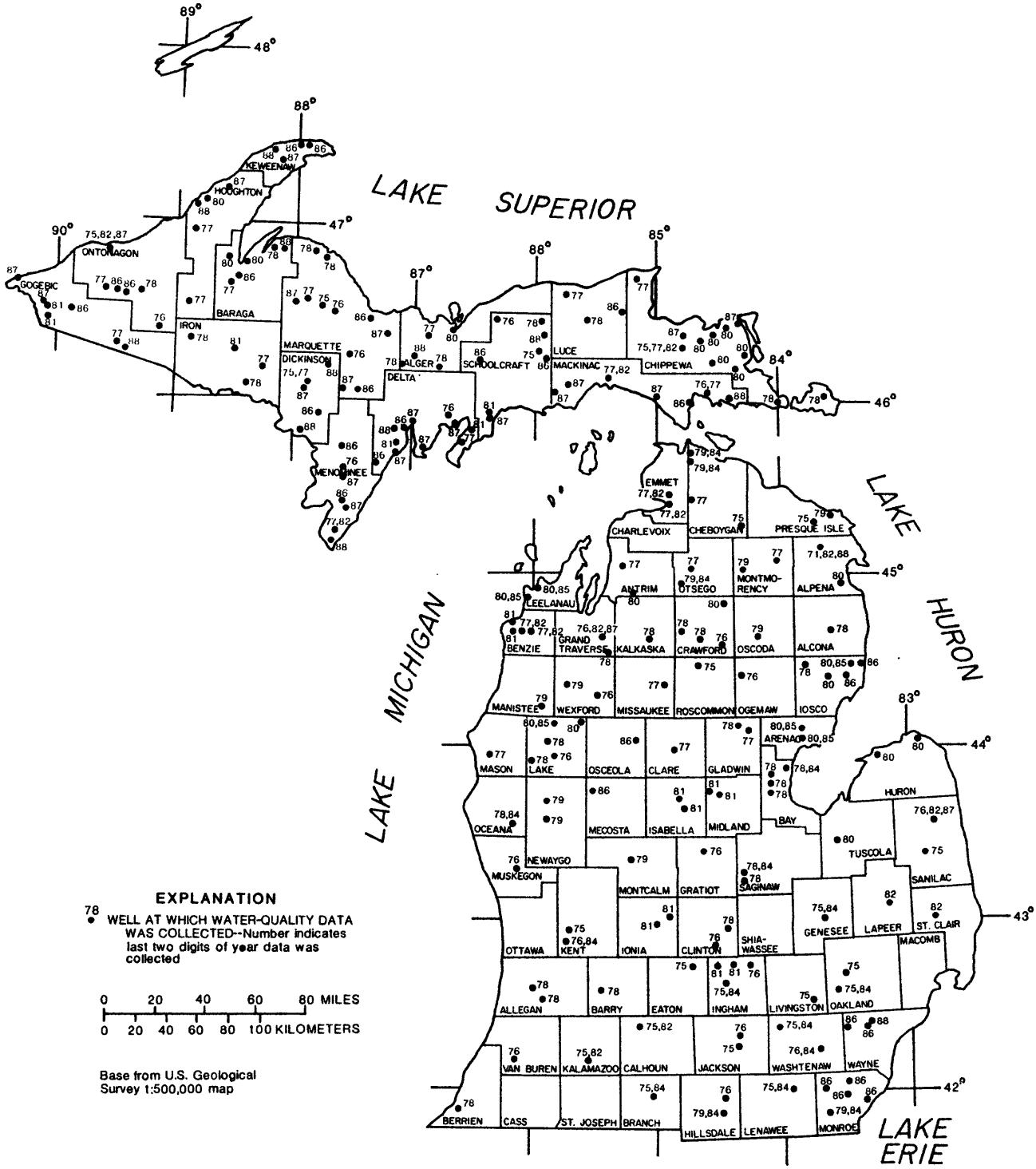


Figure 2.--Water-quality sampling sites and year sample was collected. (Water-quality data are given in the Michigan annual groundwater report for year in which sample was collectd. Data for the years 1975-76 are in the annual report for 1977.)

Ground-Water Records and Reports

Tabulations of water-level measurements, hydrographs of observation wells, 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 U.S. Geological Survey Office, State Office Building, Escanaba, Michigan 49829.

Ground-water levels from 1935-1974 are reported in U.S. Geological Survey Water-Supply Papers. Records since 1975 are 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 reports that describe ground water in Michigan are shown in figure 3 and listed in table 1. In addition, many publications dealing with ground water are listed in the references at the end of this report.

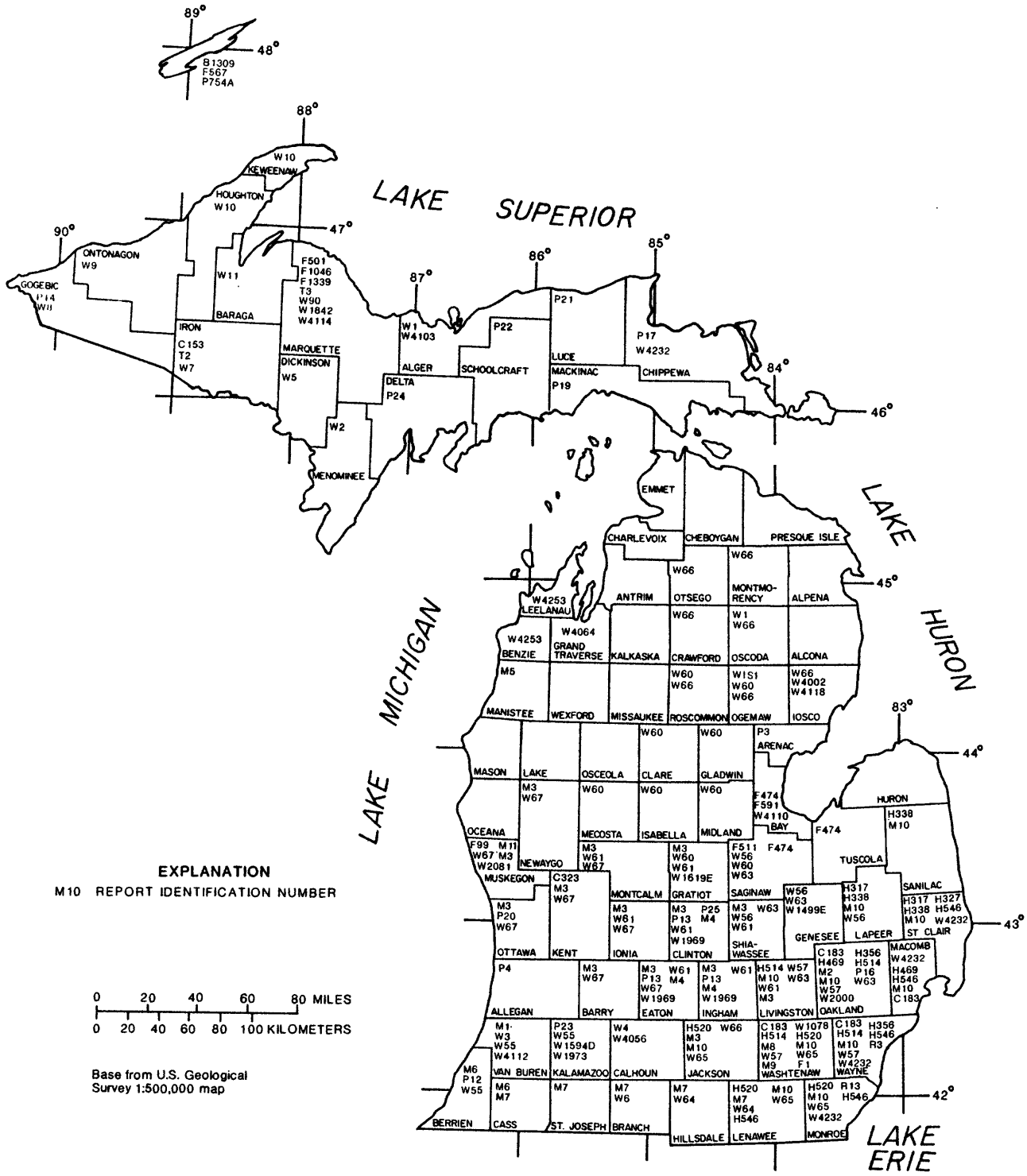


Figure 3.--Ground-water reports in Michigan.
(See table 1 for report title)

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

B1309 -- Huber, N.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 87-474.

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 Altas 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 geologial 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., Stoimenoff, 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. 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.

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 Holtschlag, 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.

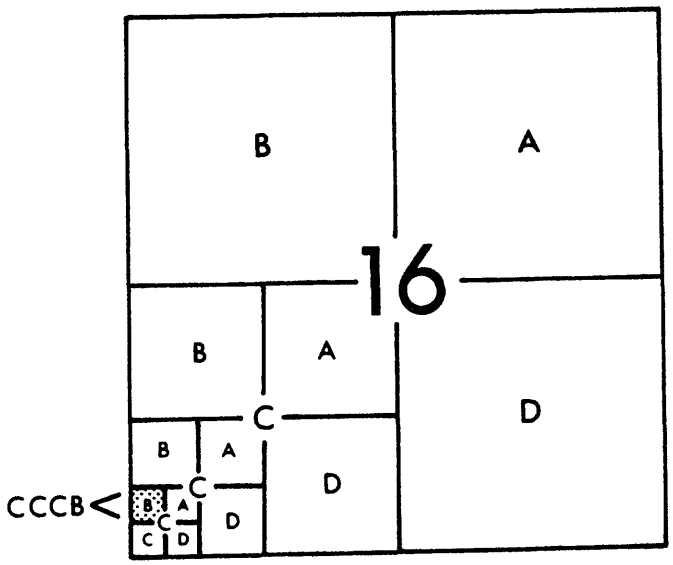
W4232 -- Gillespie, J.L., and Dumouchelle, D.H., 1989, Ground-water flow and quality near the upper Great Lakes connecting channels, Michigan: U.S. Geological Survey Water-Resources Investigations Report 88-4232.

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 108 observation wells throughout the State (fig. 1 and table 2) in 1989, generally follow precipitation trends. Rising levels usually occur where precipitation has been above normal and declining levels where precipitation has been below normal. Hydrographs (fig. 4) show that water levels are generally highest in spring. During the spring, snowmelt and rain constitutes most of the annual recharge to ground-water reservoirs. However, if ice cover or frost in the ground persists during snowmelt, recharge will be impeded by decreased infiltration and increased overland flow. Generally, recharge is also impeded during the summer when most rainfall is evaporated, transpired, or flows overland, depending on rainfall intensity and duration. In the autumn, when evapotranspiration is minor, significant amounts of precipitation may cause water levels to rise. Little or no recharge occurs during winter due to persistent below-freezing temperatures and frost conditions.

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 affect the 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 wihdrawals can lower water levels appreciably. If withdrawals are greater than recharge, long-term water-level declines will occur.

Uniform pumping rates throughout the year may allow levels to follow precipitation trends.

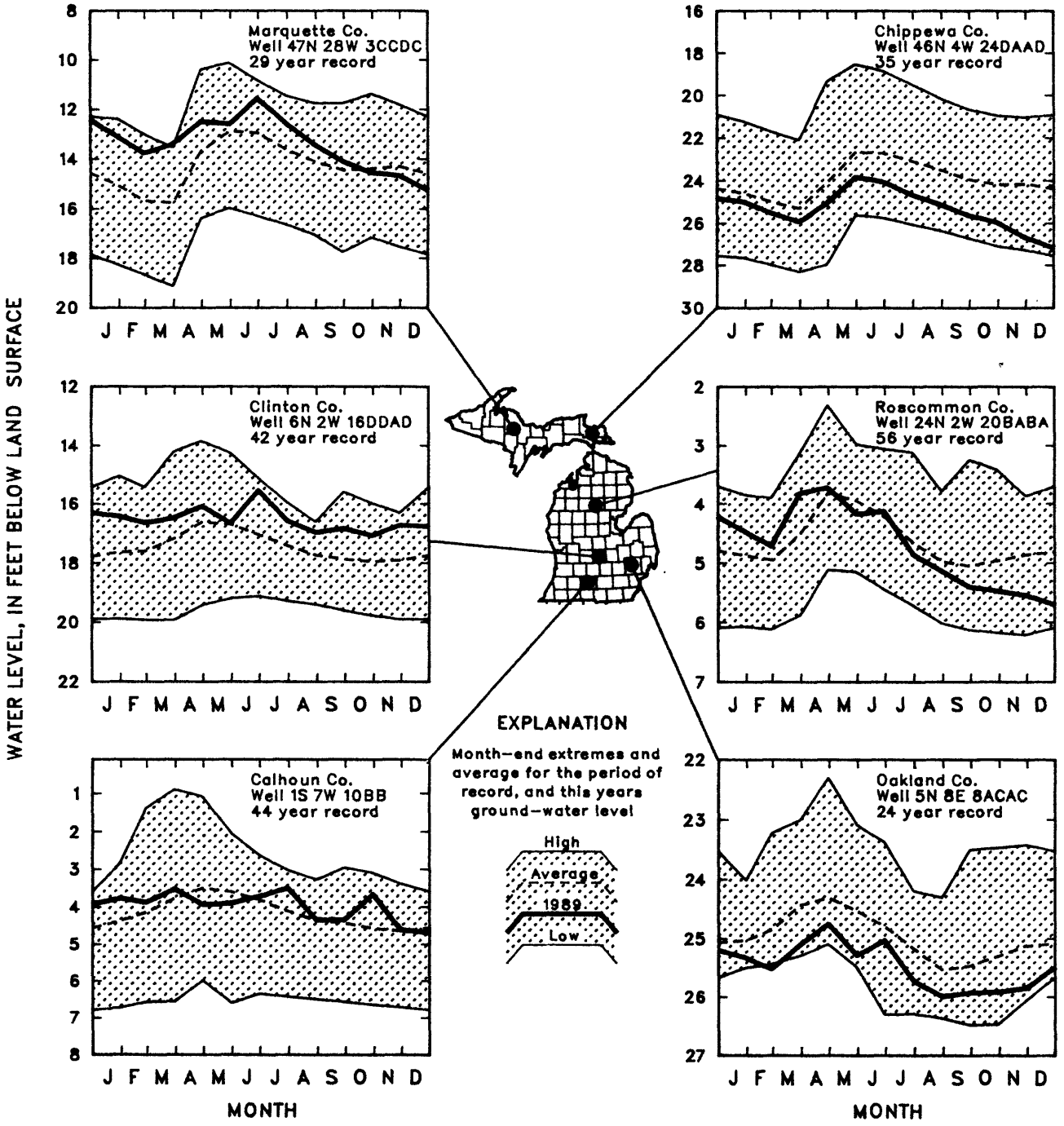
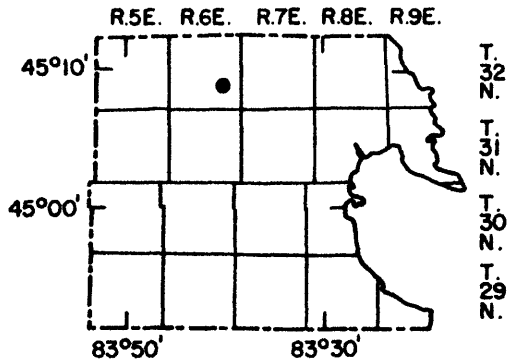


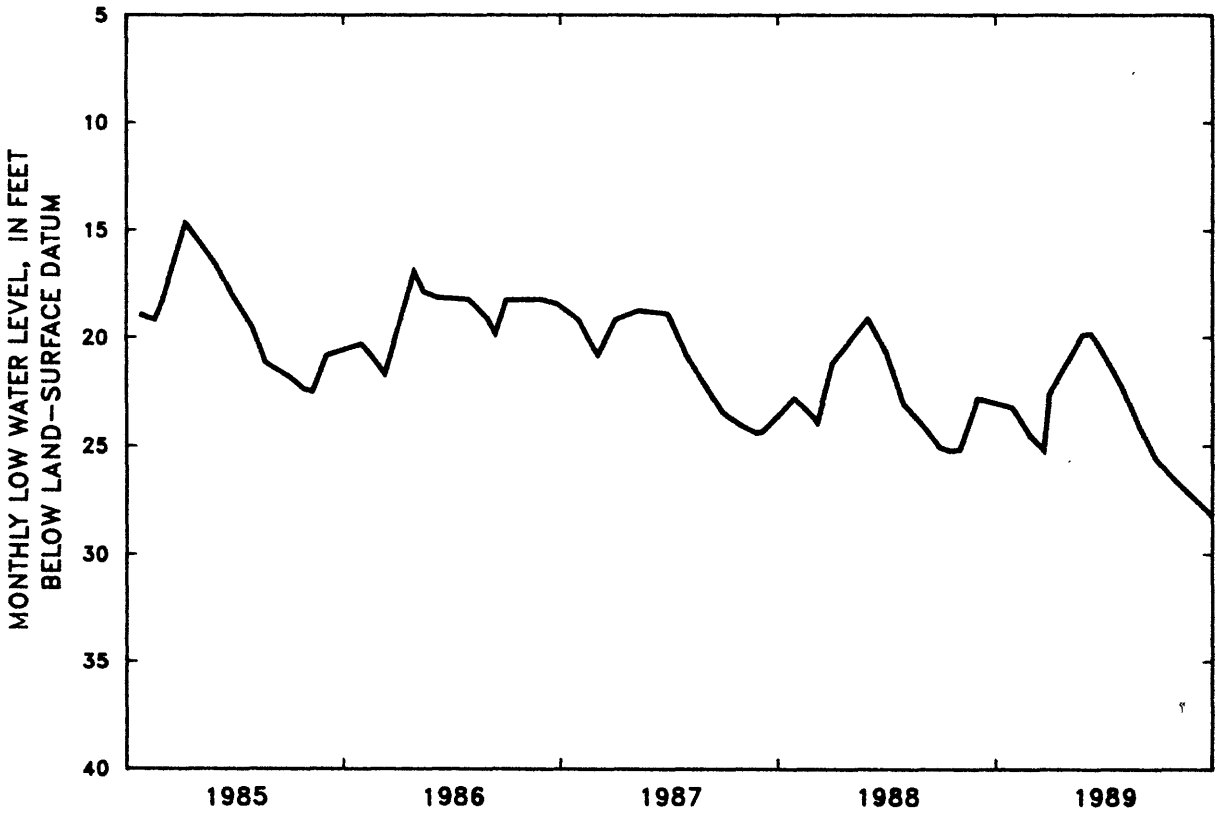
Figure 4.--Water levels in selected wells.

GROUND-WATER DATA, BY COUNTY

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

ALPENA COUNTY





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

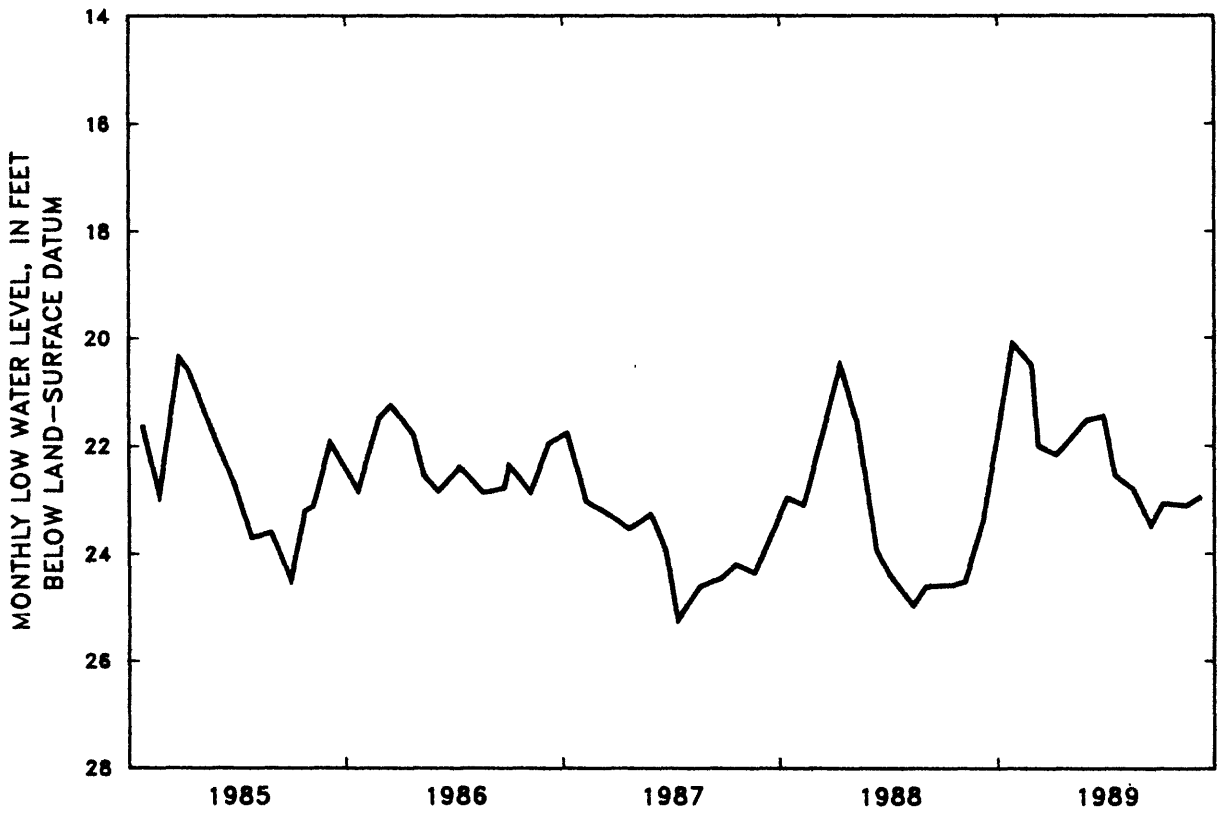
BRANCH COUNTY - CITY OF COLDWATER

SUPPLY AND SOURCE -- 4 wells, 117 to 129 feet 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.

1989 - 1,018
1988 - 1,167
1987 - 1,078
1986 - 1,183
1985 - 1,168



Water levels in well 6S 6W 22CABA1. Well is 113 feet deep and in glacial deposits.

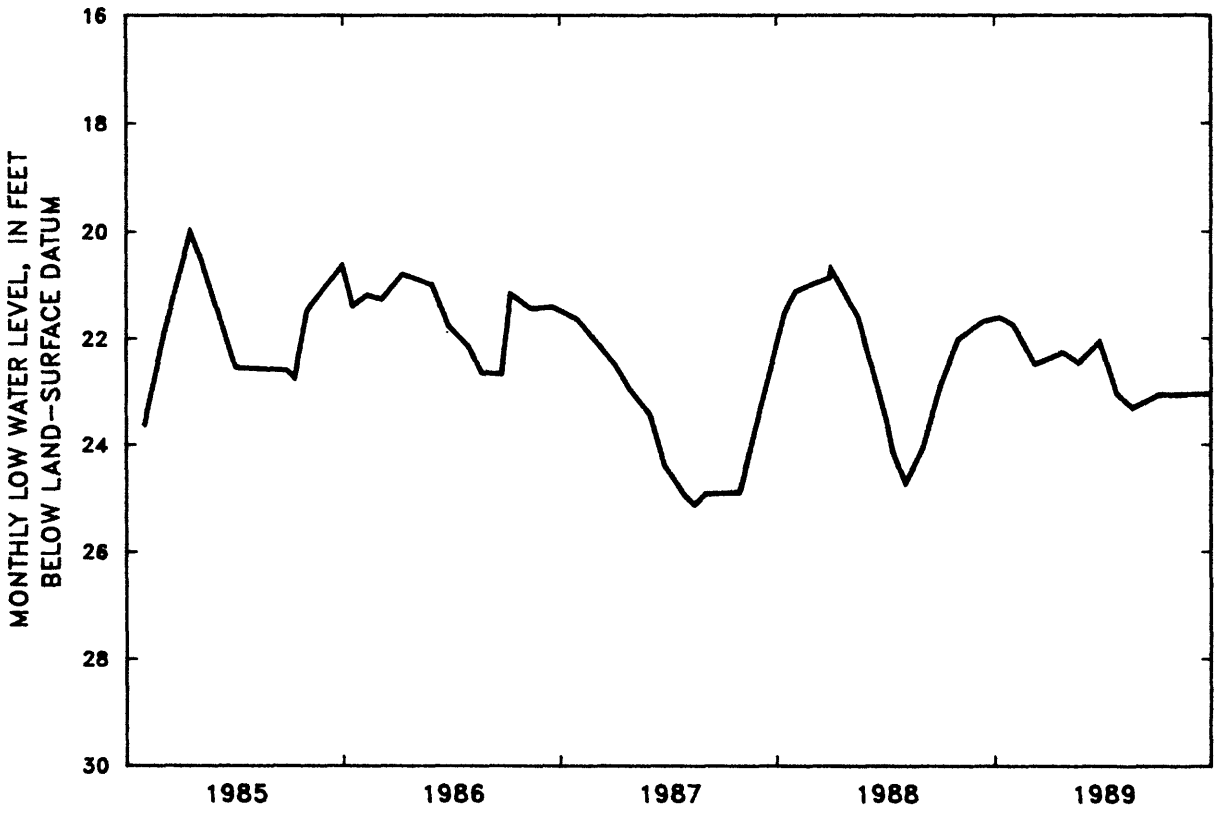
CALHOUN COUNTY - CITY OF BATTLE CREEK

SUPPLY AND SOURCE -- 38 wells, 110 to 180 feet 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.

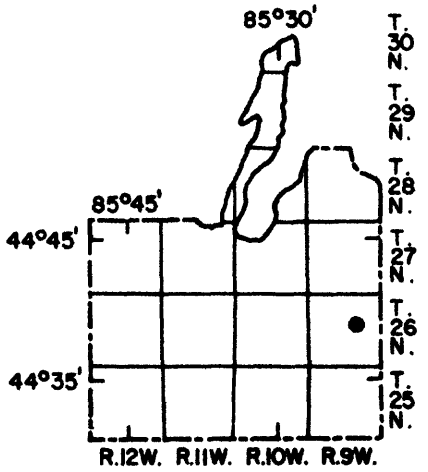
PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

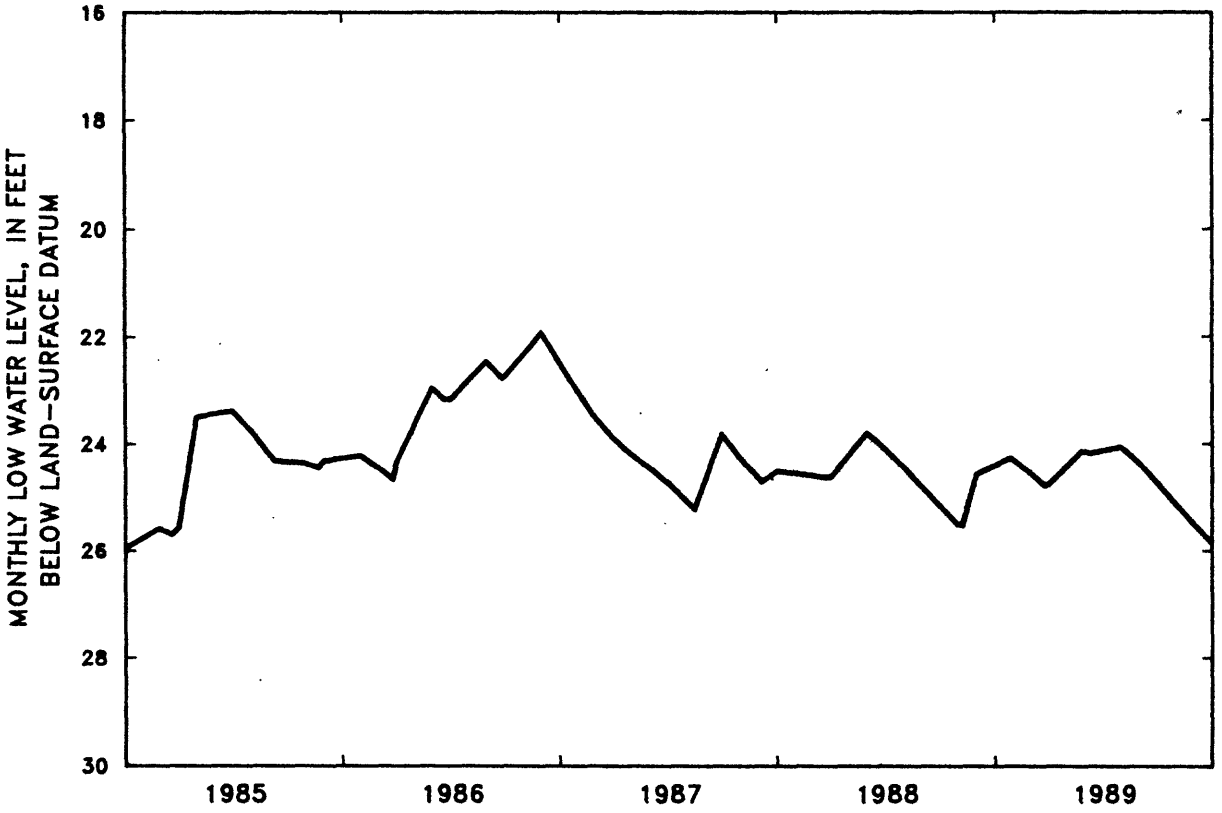
1989 - 4,057
1988 - 4,230
1987 - 3,697
1986 - 3,518
1985 - 2,950



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

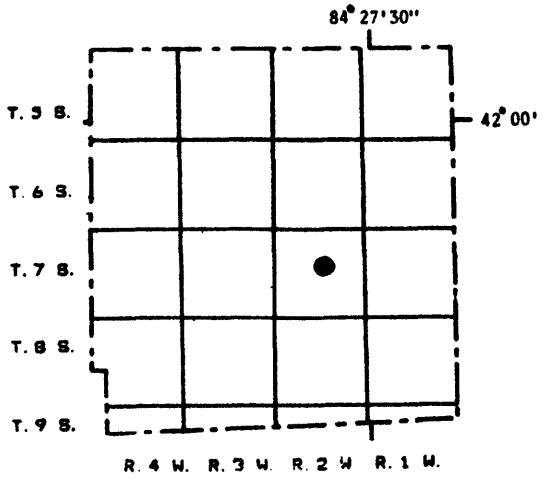
GRAND TRAVERSE COUNTY

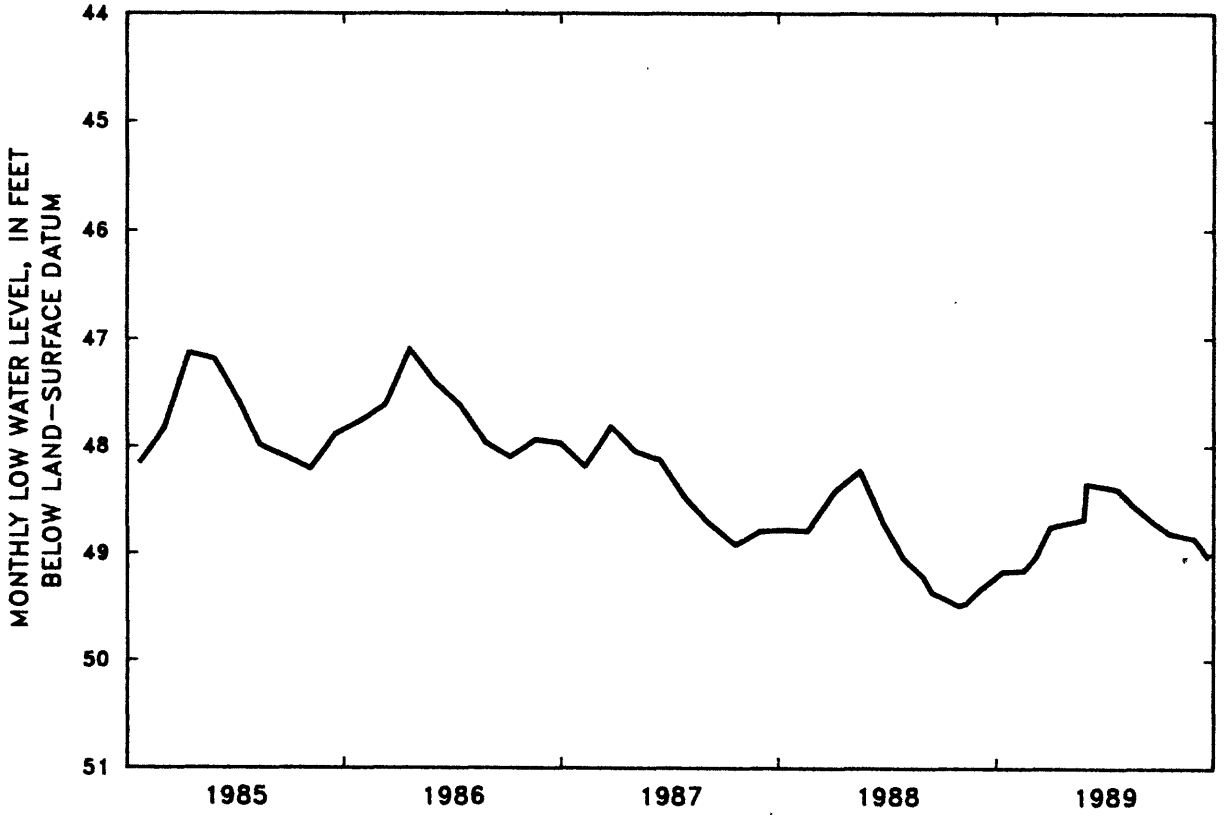




Water levels in well 26N 9W 14ABAA1. Well is 80 feet deep and in sand. Water-quality data in ground-water reports for 1977 and 1982 (Huffman, 1979, 1983).

HILLSDALE COUNTY





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

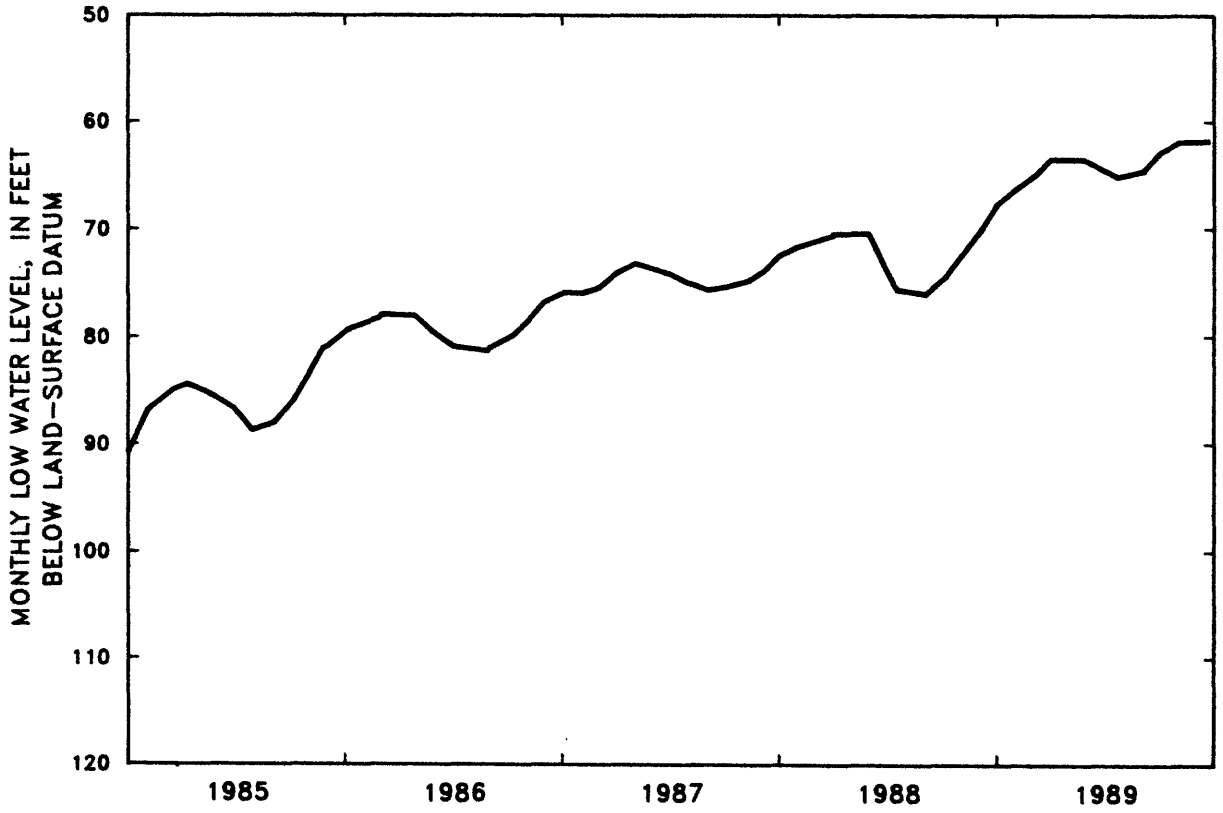
INGHAM COUNTY - CITY OF LANSING

SUPPLY AND SOURCE -- 125 wells, 400 to 425 feet deep, tap sandstones of Saginaw Formation; 3 wells, 85 to 105 feet 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.

1989 - 7,217
1988 - 7,754
1987 - 7,838
1986 - 7,690
1985 - 7,945



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

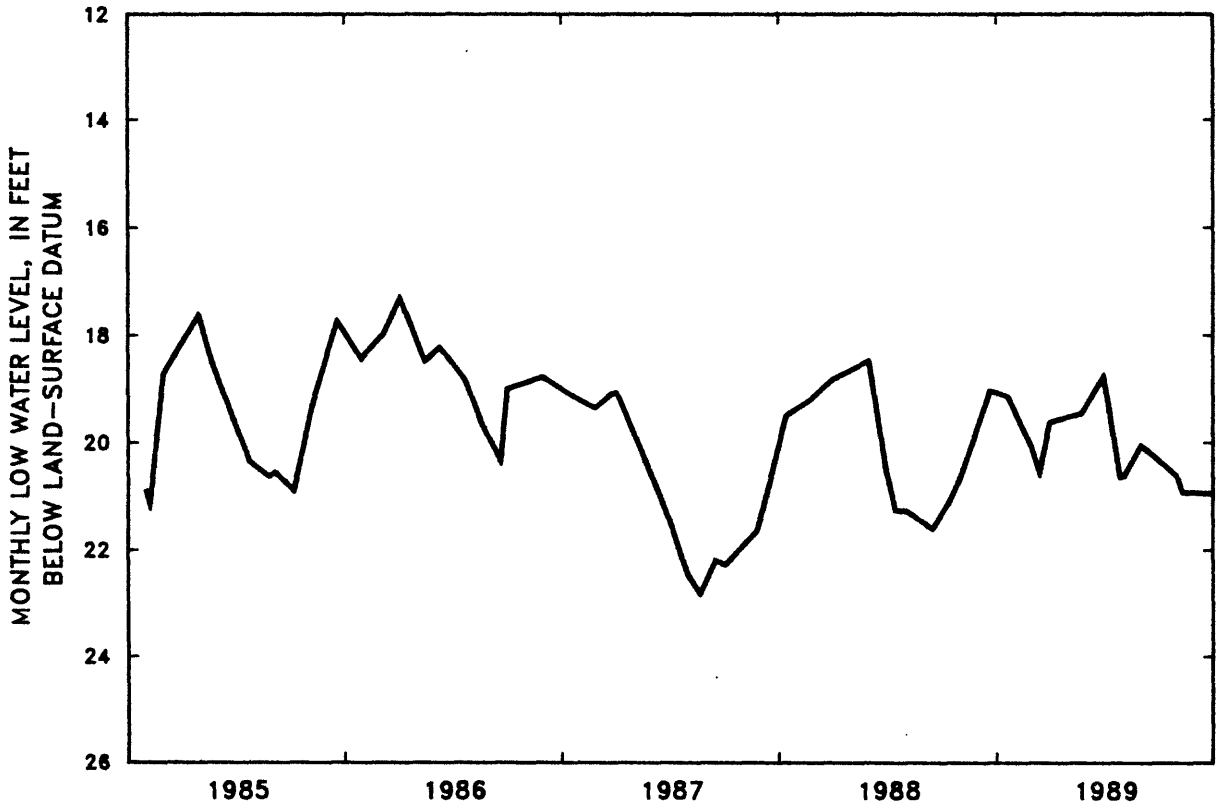
INGHAM COUNTY - CITY OF MASON

SUPPLY AND SOURCE -- 1 well, about 50 feet deep, taps glacial deposits; 2 wells, 218, 223 feet 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.

1989 - 253
1988 - 299
1987 - 256
1986 - 232
1985 - 240



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

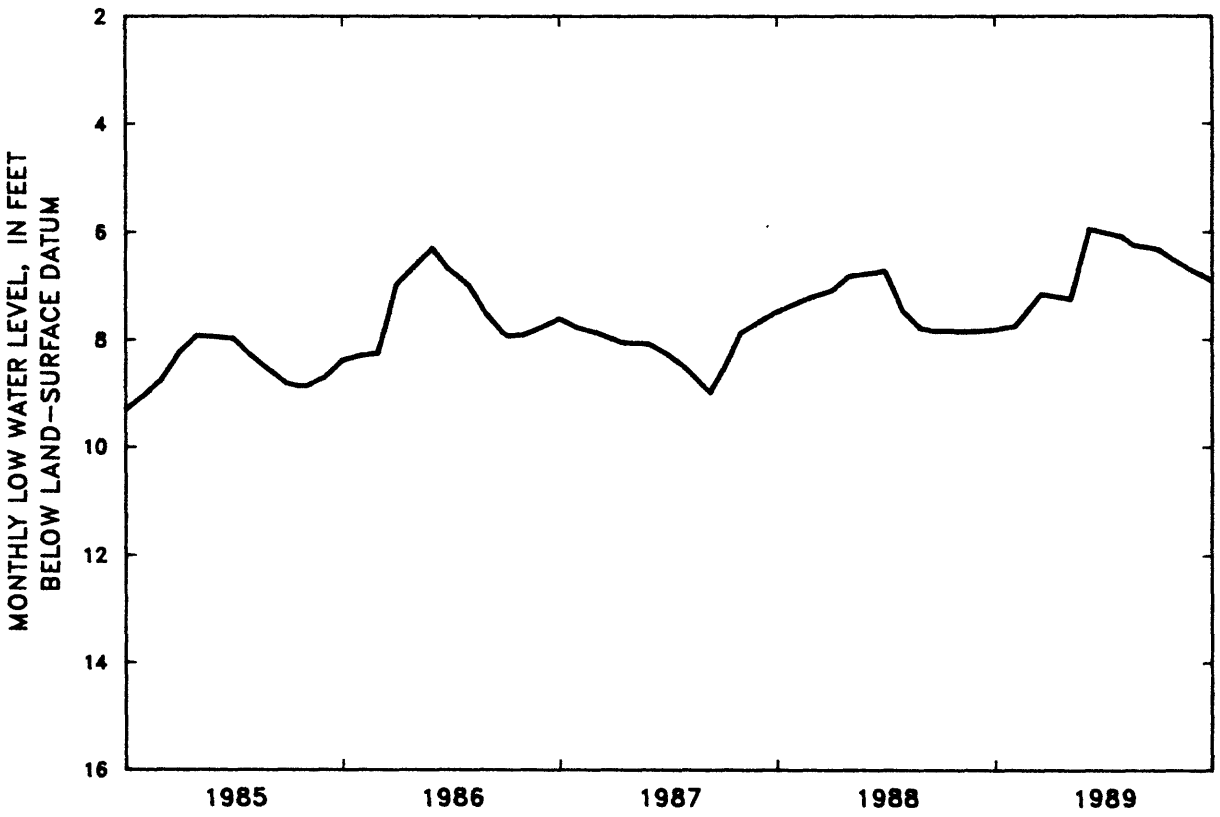
KALAMAZOO COUNTY - CITY OF KALAMAZOO

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

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

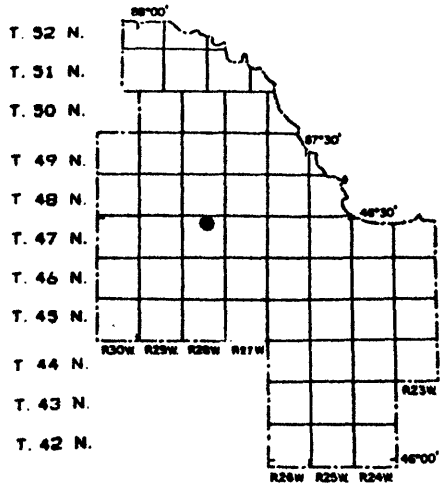
PUMPAGE -- Total annual pumpage, in million gallons, for past 5 years.

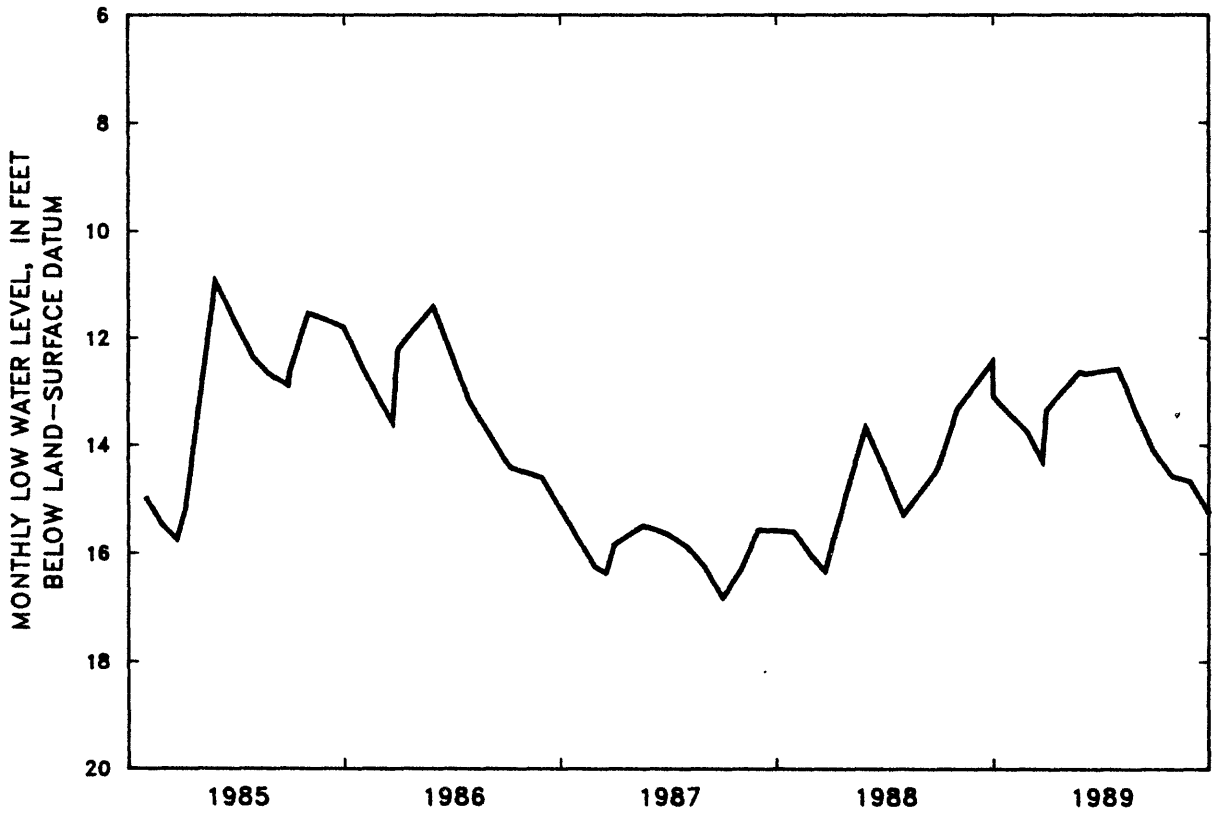
1989 - 6,749
1988 - 7,422
1987 - 6,450
1986 - 6,638
1985 - 6,736



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

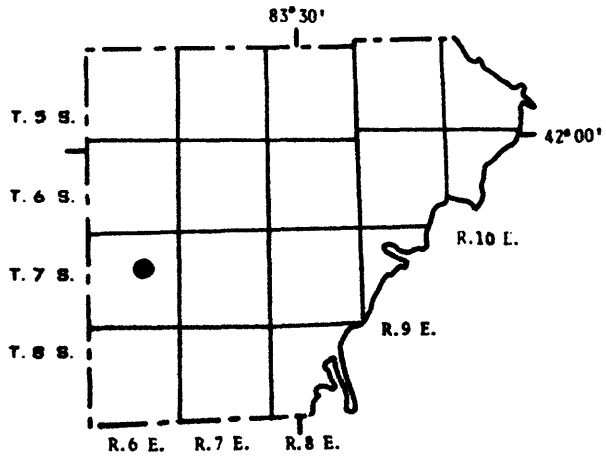
MARQUETTE COUNTY - IRON RANGE AREA

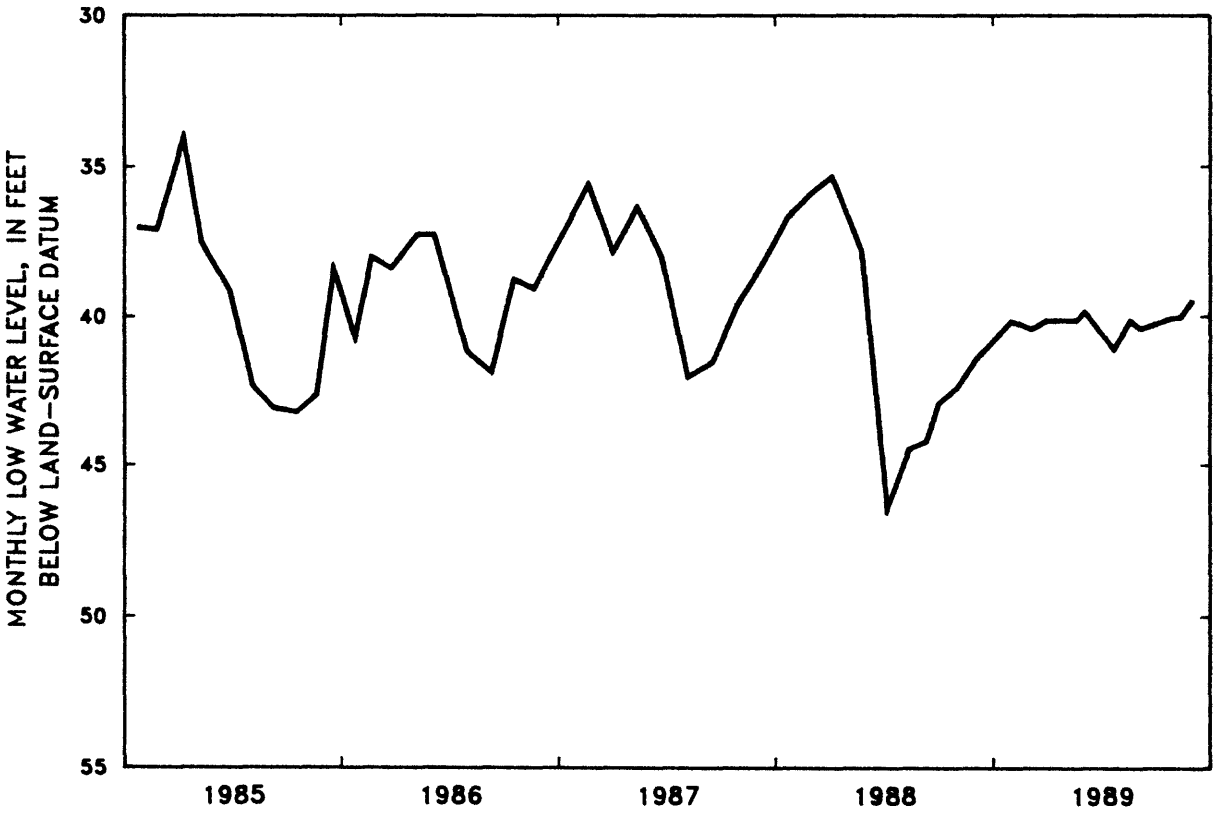




Water levels in well 47N 28W 3CCDC1. Well is 75 feet deep and in outwash. Levels are typical of observation wells in Marquette Iron Range. Water-quality data in ground-water report for 1977 (Huffman, 1979).

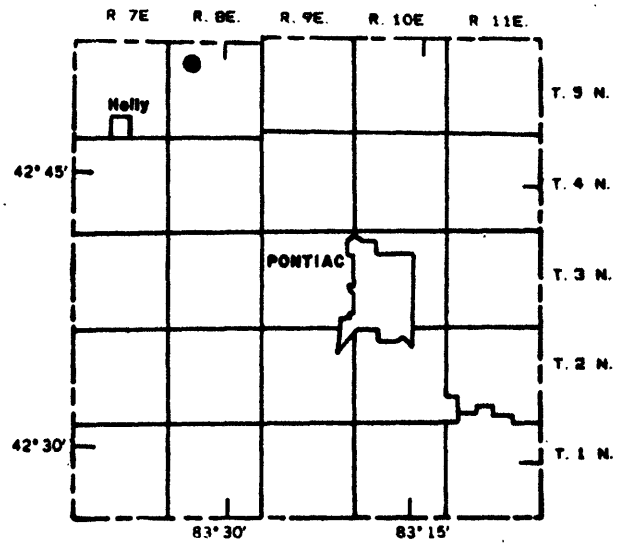
MONROE COUNTY

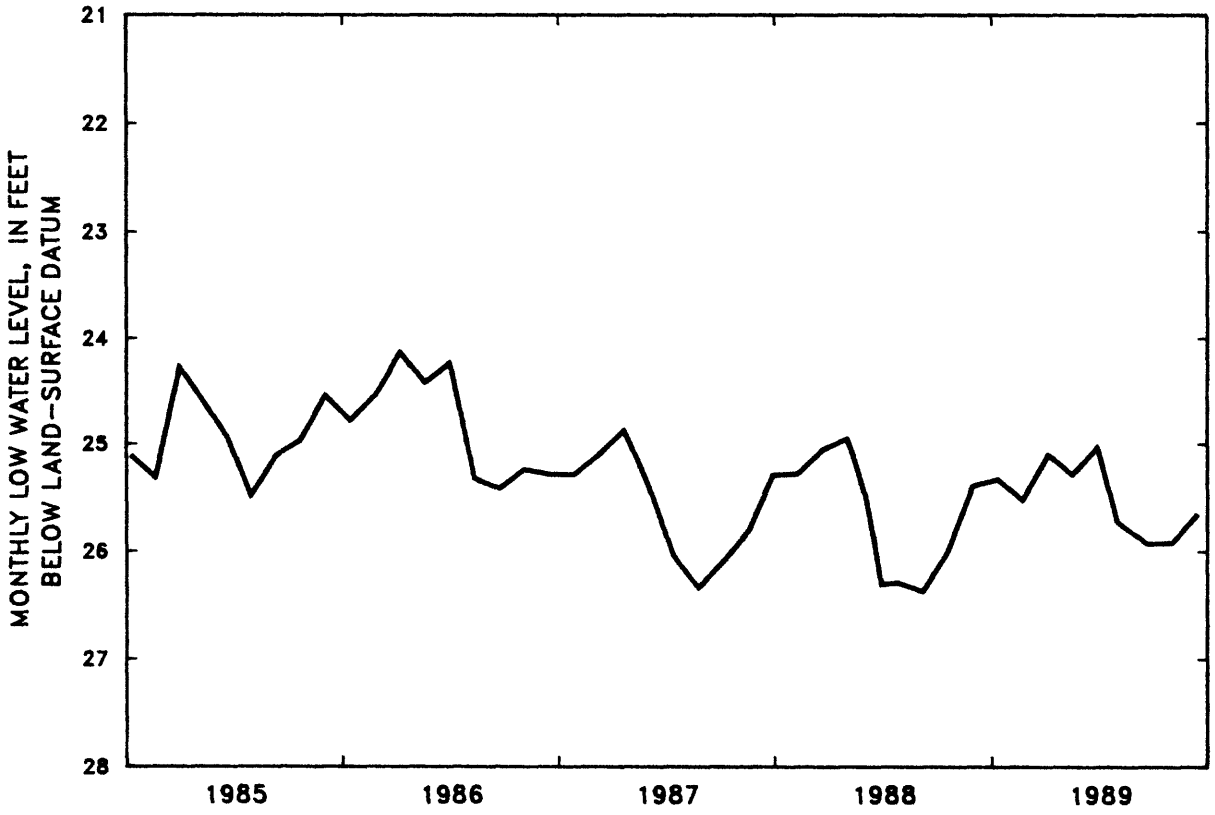




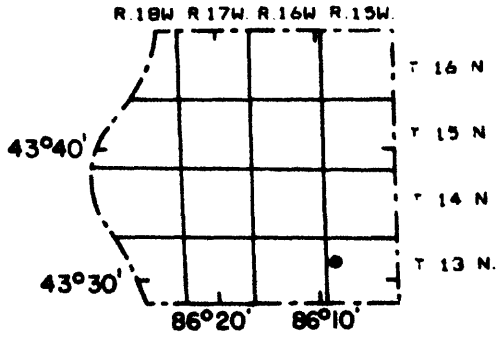
Water levels in well 7S 6E 15ACAA1. Well is 73 feet deep and in the Detroit River Group. Water-quality data in ground-water reports for 1979 and 1984 (Huffman, 1980, 1985).

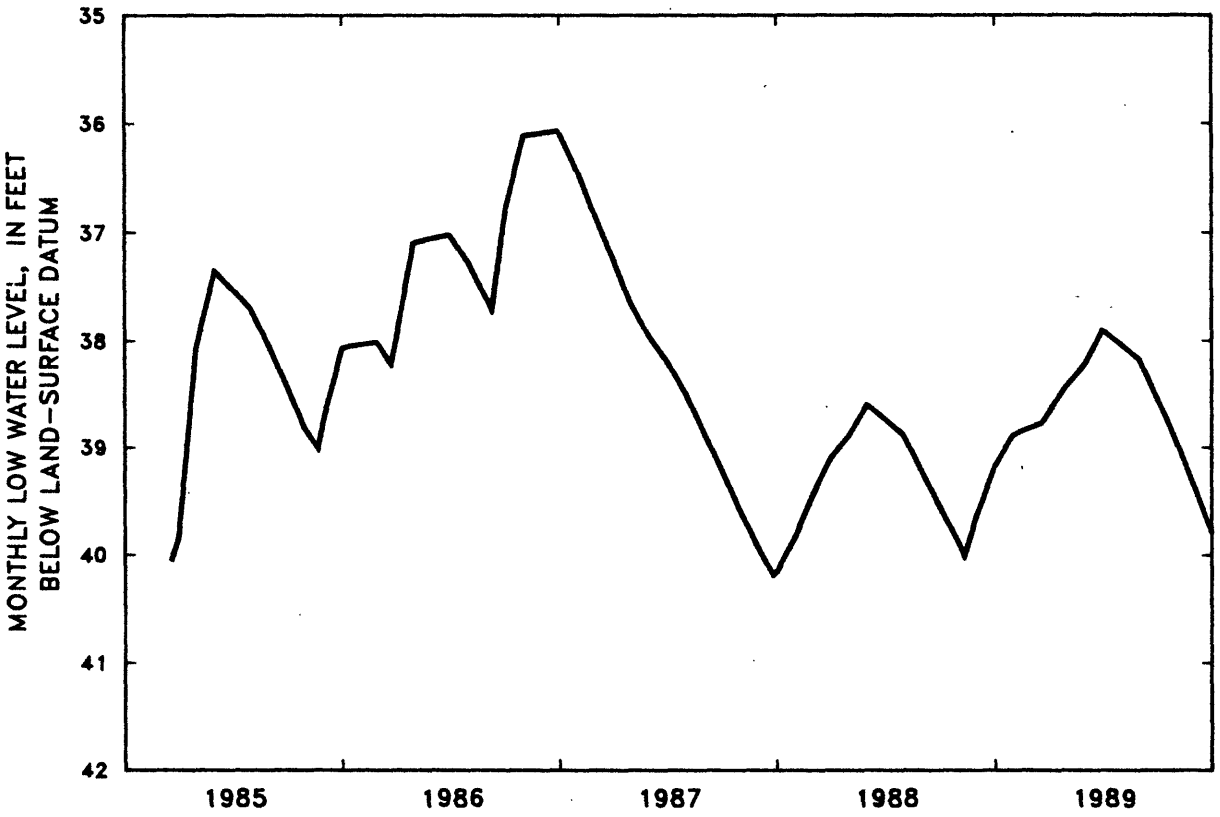
OAKLAND COUNTY





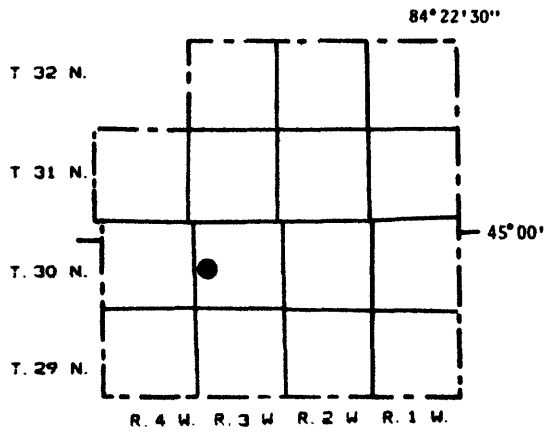
Water levels in well 5N 8E 8ACAC1. Well is 42 feet deep and in glacial deposits.

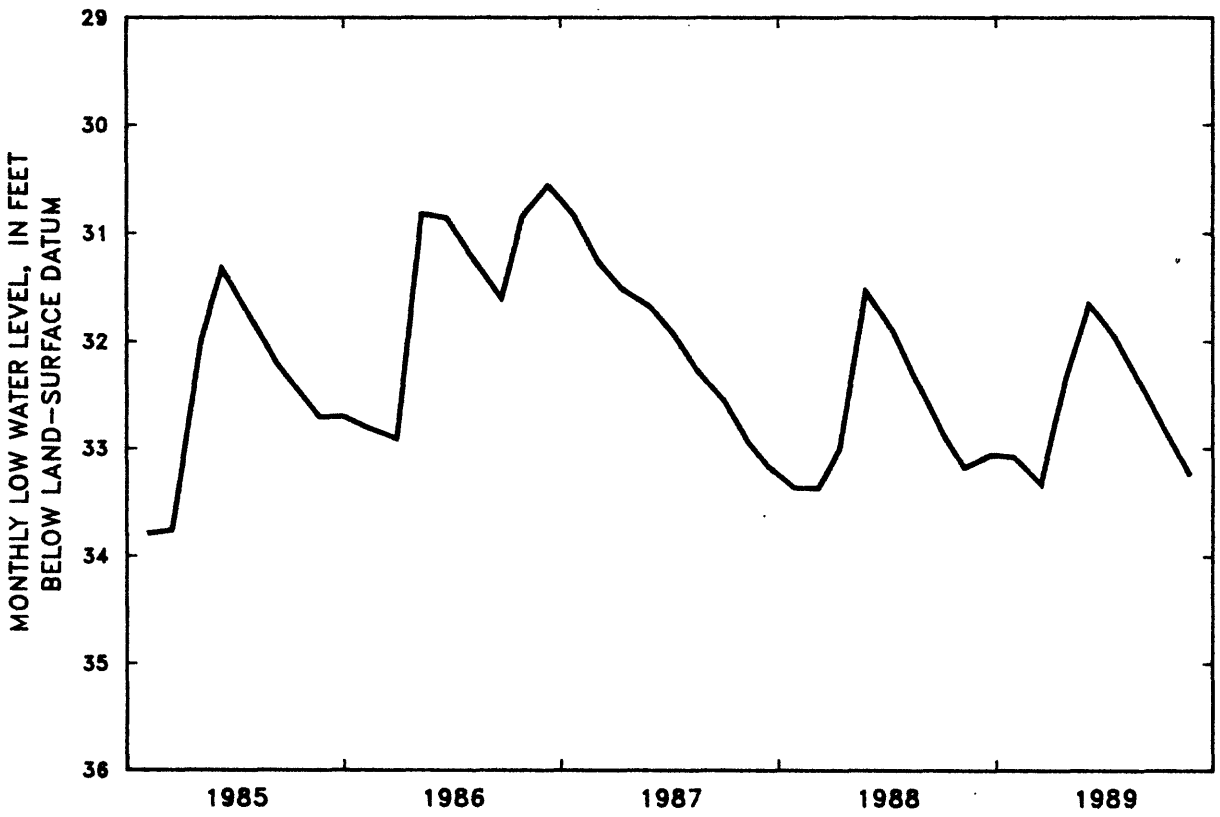




Water levels in well 13N 15W 18AAAA1. Well is 79 feet deep and in outwash. Water-quality data in ground-water reports for 1978 and 1984 (Huffman, 1979, 1985).

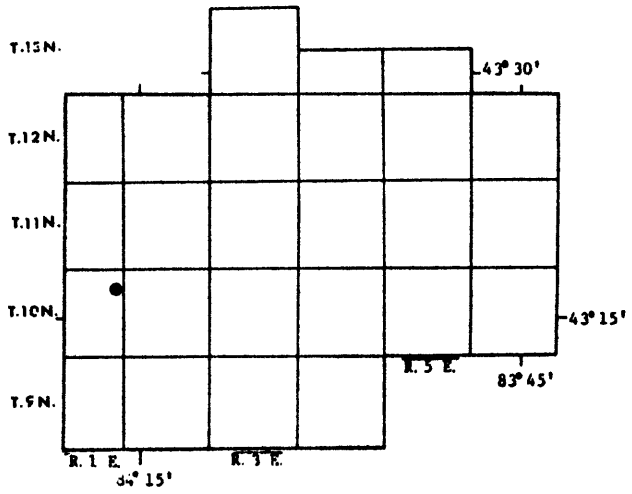
OTSEGO COUNTY

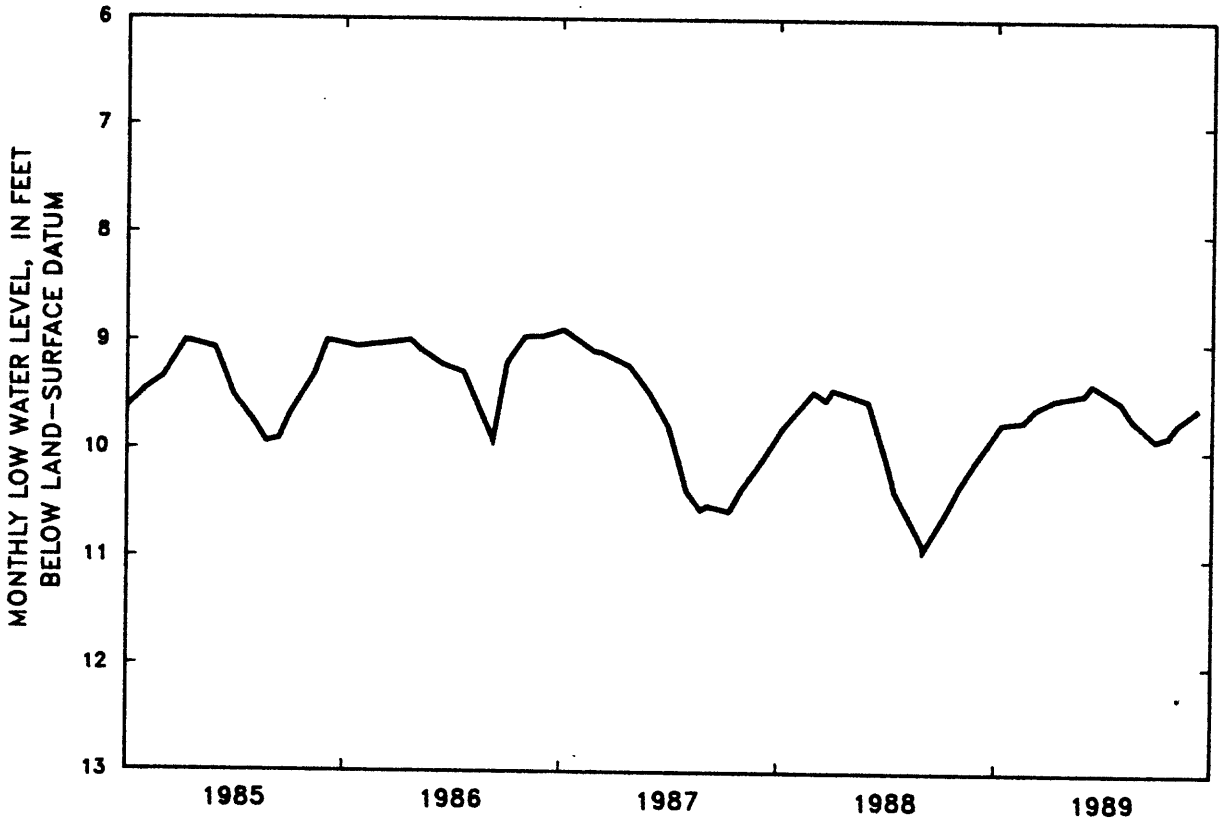




Water levels in well 30N 3W 19ABBB1. Well is 90 feet deep and in glacial outwash. Water-quality data in ground-water reports for 1979 and 1984 (Huffman, 1980, 1985).

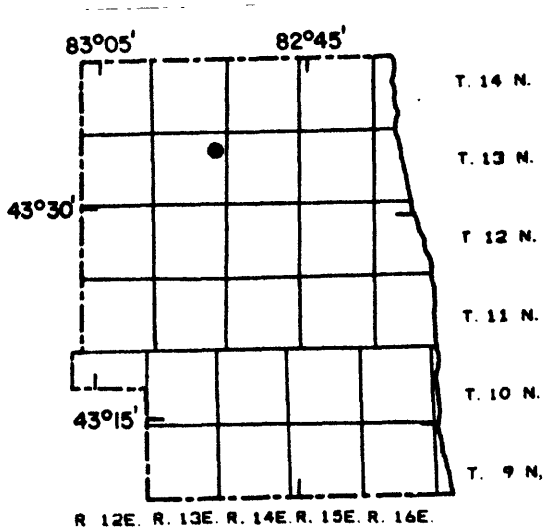
SAGINAW COUNTY

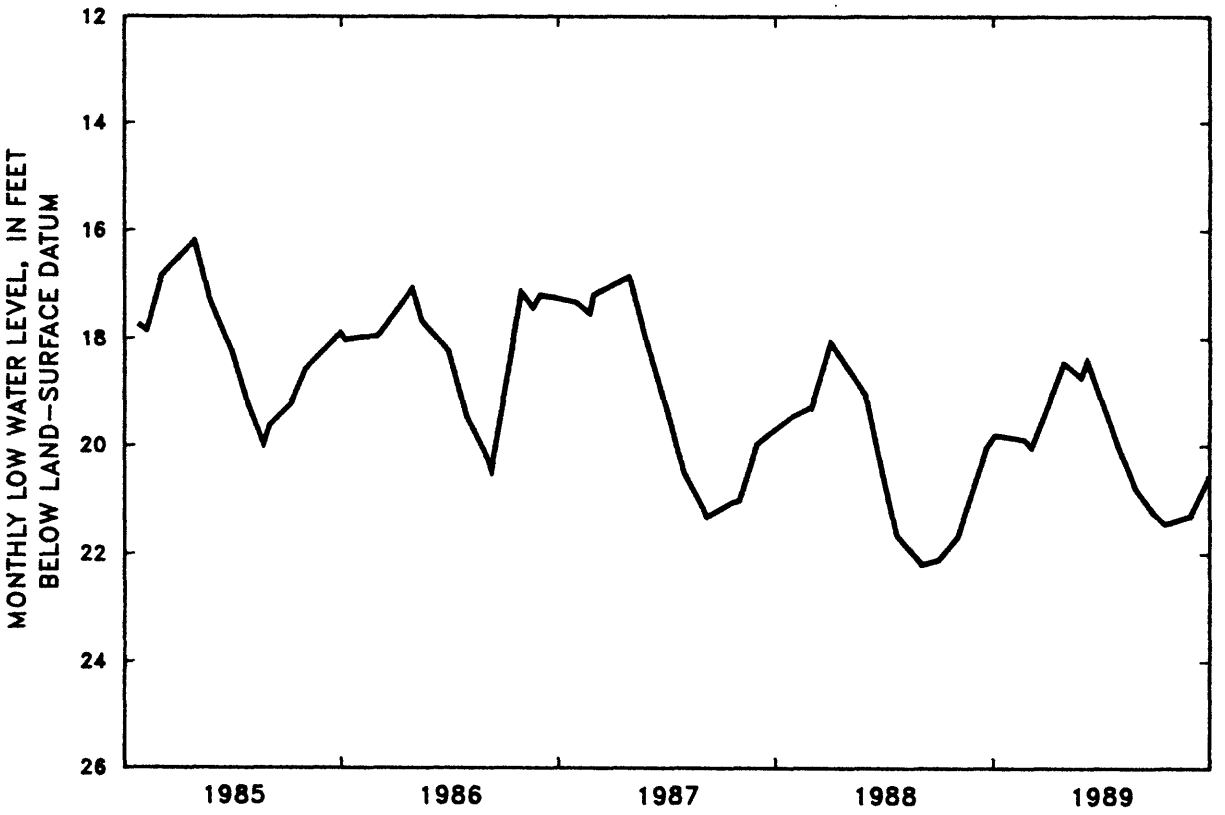




Water levels in well 10N 1E 22DADA1. Well is 210 feet deep and in Saginaw Formation. Water-quality data in ground-water reports for 1977 and 1984.

SANILAC COUNTY





Water levels in well 13N 13E 12ADAA1. Well is 130 feet deep and in the Marshall Formation. Water-quality data in ground-water reports for 1977 and 1982 (Huffman, 1979, 1983).

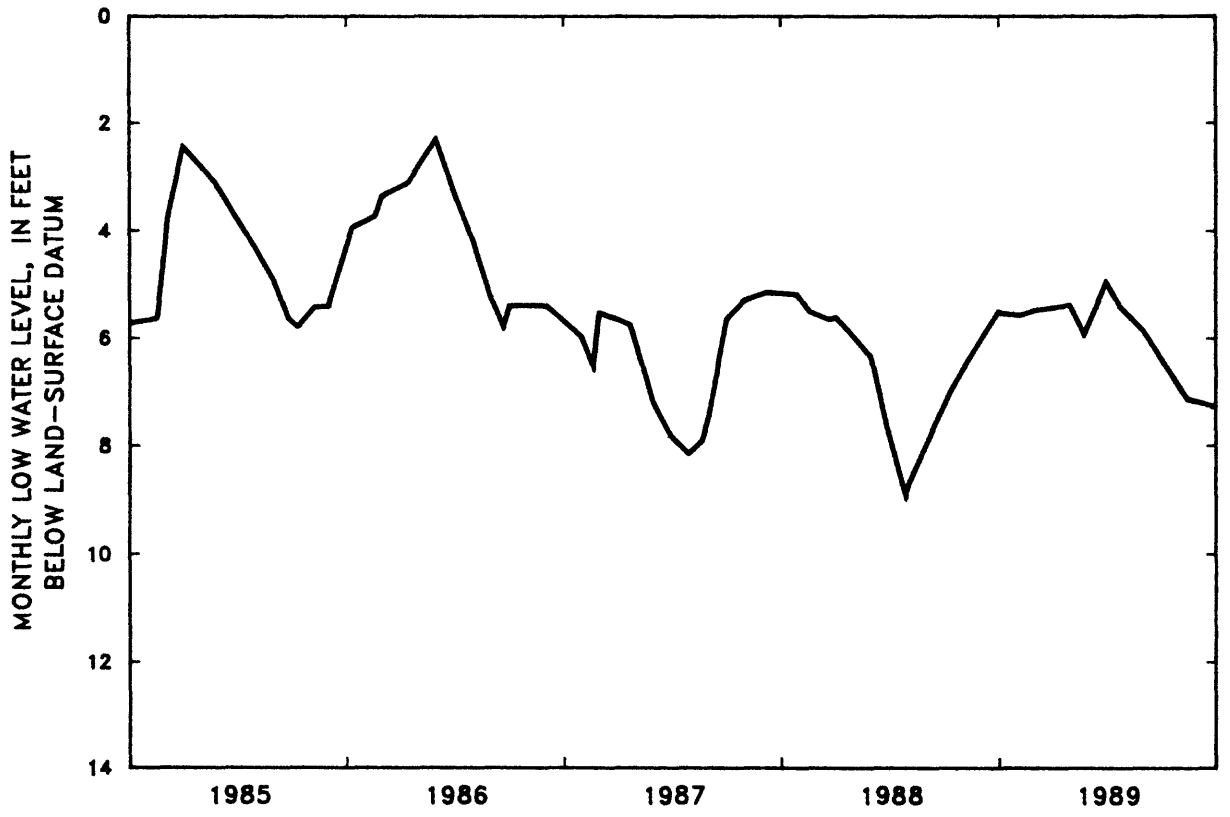
WASHTENAW COUNTY - CITY OF ANN ARBOR

SUPPLY AND SOURCE -- 3 wells, 91 to 196 feet 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).

1989 - 1,240
1988 - 1,136
1987 - 957
1986 - 1,044
1985 - 1,177



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

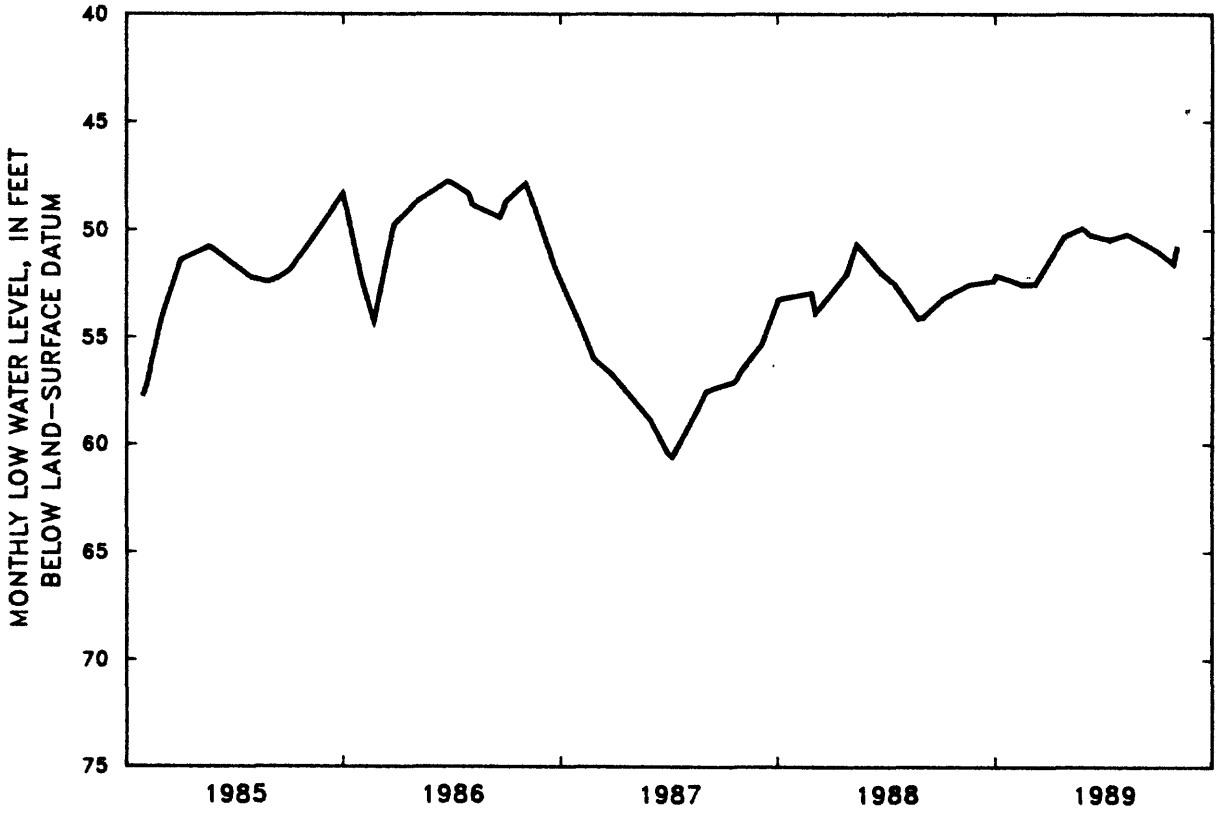
WASHTENAW COUNTY - CITY OF YPSILANTI

SUPPLY AND SOURCE -- 6 wells, 87 to 102 feet 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.

1989 -	960
1988 -	1,275
1987 -	1,220
1986 -	925
1985 -	906



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

Table 2.--Records of observation 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	420FRED	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. 1989 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 (Twsp,range,section)	Name	Depth (feet)	Diam. (inches)	Aquifer	Elev.	Yrs. record	Meas. freq.	Observed water-level extremes: Through 1988 Highest	Through 1988 Lowest	1989 Highest	1989 Lowest
ALGER											
45N 19W 25BDCD1	CCC	66	6	112GLCL	850	31	Q	6.4 Jun 1960	14.2 Apr 1964	10.9 May	12.0 Oct
ALPENA											
32N 6E 23DDDA1	Alpena State Forest	88	6	112SAND	713	13	R	13.6 May 1983	30.0 Mar 1982	17.8 Apr	28.2 Dec
ARENAC											
19N 5E 7DABA1	Omer, D	185	6	324SGNW	667	10	M	8.3 Jul 1980	11.8 Aug 1988	10.5 Jun	11.8 Dec
7DABA2	Omer, S	21	6	112GLCL	667	10	M	2.3 May 1983	7.0 Oct 1987	4.0 Apr	6.2 Nov
BARAGA											
48N 32W 12DD	[1]WEP14	10	1	112GLCL	1,630	42	M	3.3 Apr 1965	9.9 Jan 1987	5.5 Apr	7.4 Feb
BARRY											
4N 9W 5DA	Solomon Road	131	2	112GLCL	860	26	Q	111.5 Mar 1978	122.0 Mar 1965	115.9 Jul	116.4 Apr
BAY											
17N 4E 22DCAA1	Pinconning Twsp	110	6	324SGNW	620	28	M	0.0 Mar 1976	10.5 Aug 1963	1.2 Nov	5.0 Aug
BRANCH											
6S 6W 18CCCD1	Coldwater Twsp	56	6	112OTSH	950	26	M	18.3 Mar 1976	28.3 Jul 1964	22.0 Jul	23.4 Dec
22CABA1	[2]Coldwater Test 4	113	6	112GLCL	970	26	R	9.0 May 1975	25.9 May 1977	8.8 Jun	23.5 Sep
CALHOUN											
1S 7W 10BB	[3]Sabin	12	1	112GLCL	908	44	W	0.9 Mar 1950	7.2 Dec 1964	3.5 Aug	4.7 Dec
32BDCC1	[2]Pennfield Twsp	95	6	337MRSL	845	26	R	15.6 Apr 1974	27.0 Aug 1964	20.1 Apr	23.3 Aug
32DABD	[2,3]Battle Creek	127	8	337MRSL	830.8	51	D	0.7 Apr 1950	16.8 Jul 1959	7.7 Dec	10.4 May
2S 6W 25AA	[2,3]Marshall	59	6	337MRSL	904.8	40	M	5.5 May 1950	9.7 Aug 1964	5.1 Mar	8.2 Nov
CASS											
8S 14W 17BA	[3]Little	55	28	112GLCL	840	45	M	46.2 Jul 1950	55.0 Mar 1957	51.4 Feb	53.2 Jan

Table 2.--Records of observation wells in Michigan--Continued

County and well number (Twsp,range,section)	Name	Depth (feet)	Diam. (inches)	Aquifer	Elev.	Yrs. record	Meas. freq.	Observed water-level extremes: Through 1988 Highest	Through 1988 Lowest	1989 Highest	1989 Lowest
CHEBOYGAN											
33N 1W 26DABA1	Pigeon River CCC	164	6	112SAND	933	24	R	55.2 May 1985	60.2 Jul 1982	58.4 May	59.8 Mar
39N 3W 29CBCB1	Mackinaw, D	125	6	344DUND	705	11	M	4.7 Apr 1986	11.7 Feb 1981	5.3 Apr	10.4 Oct
29CBCB2	Mackinaw, S	55	6	112SDGV	705	11	M	1.8 Apr 1986	6.5 Feb 1981	2.2 Apr	6.0 Oct
CHIPPEWA											
46N 4W 24DAAD1	Raco	54	6	112OTSH	850	35	R	18.4 Jun 1971	28.4 Apr 1964	23.8 Jun	27.2 Dec
CLARE											
17N 4W 34DCAD	Clare	91	4	112GLCL	850	15	R	7.9 Mar 1976	24.9 May 1977	9.7 Jun	15.3 Aug
CLINTON											
5N 2W 32DC	[2]Quarantine Farm	135	4	324SGNW	849.2	46	M	42.0 Sep 1944	99.2 May 1966	63.9 May	71.6 Jul
6N 1W 3BB2	Sleepy Hollow 5	62	1	112GLCL	814.0	20	A	37.6 Apr 1983	43.5 Nov 1966	38.8 May	
2W 16DDAD1	[4]MDOT, U.S. 27	23	14	112GLCL	803.3	42	M	13.8 Apr 1974	19.9 Feb 1964	15.5 Jun	17.1 Oct
7N 1W 34CC	Sleepy Hollow 7	32	1	112OTSH	785.3	23	A	16.5 Apr 1983	20.3 Oct 1973	17.8 May	
CRAWFORD											
25N 1W 15DDCD1	Eldorado	56	6	112GLCL	1,190	42	R	25.6 Nov 1986	36.0 Apr 1951	27.8 May	29.8 Dec
DELTA											
39N 23W 28AC	Schemmel	530	5	372MNSG	680	32	R	1.3 May 1960	8.7 Jul 1988	5.3 Jun	8.4 Sep
41N 18W 31CD	Isabella	250	5	361ODVCU	615	32	M	3.3 Sep 1979	6.9 Jul 1987	4.4 Apr	6.4 Oct
42N 19W 20AA	Pollack CCC	134	6	112GLCL	740	32	Q	23.4 Jul 1982	28.1 Feb 1977	25.5 Aug	26.0 Mar
43N 19W 24BB	Clarage	405	4	365TBRV	860	32	Q	77.0 Jul 1960	88.8 Oct 1966	79.7 Aug	80.2 Mar
DICKINSON											
43N 28W 32ADAB1	Felch	31	1	112SAND	1,160	24	M	13.0 Apr 1986	16.8 May 1968	14.4 Jul	15.7 Dec
EATON											
3N 3W 2BA	[2]Lansing, Stiefel	66	1	112GLCL	839	26	R	3.0 Jun 1986	18.0 Nov 1968	4.0 May	6.3 Mar
4N 3W 12CD	[2]Robins Road	381	6	324SGNW	861.9	37	R	66.7 Jan 1988	103.6 Aug 1969	64.5 Oct	85.6 Jul
GENESEE											
6N 7E 9DCCC1	[2]Fisher Body No. 2	385	10	324SGNW	837.0	17	R	52.3 Dec 1975	87.7 Jul 1988	60.2 Feb	70.3 May
GRAND TRAVERSE											
26N 9W 14ABAA1	Fife Lake State Forest	80	6	112SAND	960	13	R	21.3 Oct 1986	28.0 Mar 1982	24.0 Jul	25.8 Dec
HILLSDALE											
7S 2W 10BDDD1	Pittsford Game Area	20	1	112SAND	1,070	24	M	5.8 Apr 1982	11.1 Sep 1967	7.6 Apr	8.8 Aug
2W 15BCBA1	Osseo	150	6	112OTSH	1,095	11	R	46.1 Apr 1982	49.5 Oct 1988	48.0 Jun	49.2 Jan

Table 2.--Records of observation wells in Michigan--Continued

County and well number (Twsp,range,section)	Name	Depth (feet)	Diam. (inches)	Aquifer	Elev.	Yrs. record	Meas. freq.	Observed water-level extremes: Through 1988 Highest	Through 1988 Lowest	1989 Highest	1989 Lowest
INGHAM											
2N 1E 34DB	Dansville Game Area	87	2	112GLCL	930	26	Q	22.4 Apr 1974	29.3 Oct 1964	23.1 Jun	24.1 Sep
1W 5BCAB1	[2] Mason	210	8	324SGNW	890	26	R	14.7 Mar 1973	23.8 Nov 1964	17.8 Jun	21.0 Dec
3N 1E 7DDCA1	Lotte	184	3	324SGNW	900	26	M	+2.4 Apr 1974	7.0 Nov 1964	1.2 Jun	3.6 Sep
2W 23BC8D	[2] Holt	188	8	324SGNW	895	8	R	18.3 May 1983	25.5 Oct 1985	21.2 Dec	23.2 Mar
4N 1W 16DA	[2] Meridian Twsp	398	4	324SGNW	841.2	22	M	6.3 Mar 1976	28.1 Jul 1988	17.6 Mar	22.4 Jul
28BCAD1	[2] Okemos	125	4	324SGNW	865	14	R	17.6 Apr 1985	24.2 Sep 1978	20.3 Jun	22.0 Aug
2W 9BD	[2] Lansing, Seymour	401	14	324SGNW	828.8	56	R	15.6 Mar 1931	179.4 Apr 1968	35.0 Nov	47.7 Jul
16DA	[2] Lansing, Cedar	417	12	324SGNW	829.1	45	R	28.3 Apr 1987	67.0 Aug 1949	33.3 Jan	26.4 Nov
17AB	[2] Lansing, Logan	424	20	324SGNW	858.7	59	R	34.3 Dec 1929	168.3 May 1968	60.6 Dec	67.7 Jan
22BC	[2] Lansing, P-5	338	12	324SGNW	823.6	60	M	7.1 Jul 1932	80.5 Feb 1979	25.3 Nov	30.1 Feb
24CA	[2] Spartan Village	453	10	324SGNW	853.4	45	R	25.5 Mar 1946	105.5 May 1972	59.8 Dec	75.4 May
27BB	[2] Fenner Arboretum	215	6	324SGNW	835	22	R	35.9 May 1986	89.5 Oct 1972	34.1 Nov	56.0 Jan
31CC	[2] Maybel Street	204	3	324SGNW	880.2	46	M	18.9 Apr 1952	45.9 Jul 1980	31.2 May	35.3 Feb
IOSCO											
24N 7E 13ADAD1	Oscoda	69	6	112SAND	760	10	M	27.3 Nov 1986	32.7 Mar 1982	30.2 Jun	31.6 Dec
IRON											
43N 35W 11AD	[1] WEP 23	47	36	112GLCL	1,565	45	M	35.3 Aug 1983	47.1 Aug 1949	39.7 Sep	40.9 Mar
20DC	[1] WEP 25	48	1	112GLCL	1,560	45	M	40.7 Jun 1973	48.3 Aug 1949	44.0 Jun	46.2 May
44N 37W 14BB	CCC Camp	102	6	112GLCL	1,730	31	Q	90.6 Sep 1986	97.1 Aug 1982	92.9 Aug	93.1 Nov
JACKSON											
3S 1W 11AA1	[2,3] Jackson, 4a Belden	360	6	324SGNW, 337MRSL	935	32	D	18.6 Jan 1961	122.0 Jul 1988	48.2 May	87.3 Aug
KALAMAZOO											
2S 10W 4D	[2] Kalamazoo, Campbell	13	4	112OTSH	836.5	21	R	1.9 Apr 1974	6.7 Sep 1988	4.0 Jun	5.3 Dec
26BBCC	[2] Kalamazoo, Morrow	46	4	112OTSH	790	3	R	5.9 Apr 1988	13.1 Sep 1988	9.4 Jun	12.8 Dec
11W 20BB2	[2] Kalamazoo, Kendall	106	4	112OTSH	880	22	R	12.5 Feb 1976	48.4 Jun 1971	16.7 Jul	37.1 Mar
22CD	[2] Kalamazoo, Stockbridge	137	4	112OTSH	764.7	30	R	4.8 Feb 1975	31.1 Aug 1961	5.7 Jun	7.8 Jan
28AA	[2] Kalamazoo, Maple	245	4	112OTSH	820	21	R	29.0 May 1988	73.1 Jul 1985	38.7 Dec	58.9 Jun
31CD	[2] Kalamazoo, Colony	226	4	112OTSH	910	21	R	41.4 Sep 1982	71.8 May 1978	50.4 Jun	65.1 Sep
36CB	[2] Kalamazoo, Emerald	226	4	112OTSH	860	21	R	25.4 Apr 1985	50.4 Jun 1971	26.1 Jun	38.7 Apr
3S 11W 4ABAD1	[2] Kalamazoo, K32S	36	4	112OTSH	860	2	R	9.9 Dec 1988	15.9 Sep 1988	9.6 Mar	12.0 Dec
4ABAD2	[2] Kalamazoo, K32D	144	4	112OTSH	860	2	R	11.5 Dec 1988	18.6 Sep 1988	11.1 Mar	15.0 Dec
14AA	[2] Upjohn 28	233	16	112OTSH	870	23	R	23.5 Aug 1982	45.2 Jul 1977	32.1 Nov	42.0 Aug

Table 2.--Records of observation wells in Michigan--Continued

County and well number (Twsp,range,section)	Name	Depth (feet)	Diam. (inches)	Aquifer	Elev.	Yrs. record	Meas. freq.	Observed water-level extremes: Through 1988 Highest	Through 1988 Lowest	1989 Highest	1989 Lowest
KALAMAZOO--Continued											
3S 11W 22BBCD	[2]Portage	102	12	112GLCL	877	8	R	24.8 Apr 1985	28.6 Aug 1988	26.3 Jul	28.5 Dec
12W 11BD	[2]Kalamazoo, Atwater	248	3	112OTSH	880	29	R	+3.0 Sep 1969	1.1 Jul 1988	+1.0 Sep	0.3 Aug
11AD1	[2]Kalamazoo, Sabo-D	300	4	112OTSH	877	17	R	4.5 Jul 1973	16.6 Jul 1984	9.6 Apr	14.5 Aug
11AD2	[2]Kalamazoo, Sabo-S	38	6	112OTSH	877	17	R	9.1 Aug 1975	12.8 Aug 1984	10.2 Sep	11.7 Sep
4S 11W 3CDDA1	[2]Prairie View Park	190	4	112OTSH	870	21	R	18.0 Apr 1985	20.6 Dec 1977	18.7 Jun	20.0 Dec
KENT											
5N 12W 4DCCD1	Wyoming, Wobma	86	6	112GRVL	868.0	28	M	7.8 Oct 1978	12.9 Aug 1964	9.8 Apr	10.8 Jul
10N 12W 13DD	Rogue River Game Area	30	1	112GLCL	785	24	Q	0.8 Jan 1975	9.2 Oct 1969	5.3 Jan	7.0 Oct
LAKE											
20N 13W 13ACAC1	Irons	57	6	112OTSH	945	10	M	9.1 Oct 1986	18.0 Mar 1982	10.7 Jun	13.4 Dec
LEELANAU											
28N 14W 8DDCA1	Sleeping Bear,D	128	6	112SAND	750	10	M	111.2 Apr 1987	114.5 Jun 1984	112.2 Mar	112.6 Jul
18BABB1	Sleeping Bear,S	60	6	112SAND	625	10	R	20.8 Oct 1986	24.9 Nov 1982	22.9 Apr	24.4 Dec
LENAWEE											
5S 1E 12DDBD1	Onsted Game Area	39	1	112GLCL	1,000	24	M	15.9 Mar 1982	19.3 Sep 1971	16.4 Jun	17.4 Oct
6S 4E 8DDBA1	[5]Fisher Body	81	8	112OTSH	800	25	R	9.9 Apr 1982	18.4 Feb 1965	14.1 Aug	15.3 Jan
LIVINGSTON											
1N 6E 13DBAB1	American Aggregate	29	2	112OTSH	930	20	R	12.1 Apr 1974	21.6 Oct 1979	14.8 Jun	16.4 Dec
MACKINAC											
41N 5W 23BC	Round Lake CCC	47	6	355SLINH	610	34	Q	2.9 Apr 1985	17.8 Feb 1981	6.1 Apr	15.6 Oct
42N 2W 7AABB1	Pontchartrain CCC	102	6	355MNSQ	680	34	R	12.5 Apr 1985	32.3 Feb 1977	16.2 Apr	30.8 Nov
MARQUETTE											
47N 28W 3CCDC1	[4]Ely Twsp	75	8	112OTSH	1,572.0	29	R	9.4 Apr 1985	19.3 Apr 1964	11.3 Jun	15.2 Dec
49N 30W 22AC	[1]WEP 13	17	1	112GLCL	1,680	42	M	0.6 May 1951	13.3 Sep 1948	7.0 Apr	10.6 Oct
MENOMINEE											
37N 26W 19DADA1	Carney	17	4	365TBRV	800	31	Q	3.3 Mar 1986	8.6 Jan 1977	4.8 May	6.5 Oct
MONROE											
7S 6E 15ACAA1	Petersburg, Rock	73	6	348DRRV	860	11	R	32.3 Mar 1982	43.2 Oct 1985	39.1 Jun	41.1 Jul
15ADBB1	Petersburg Game Area	17	1	112GLCL	675	24	M	3.0 Feb 1966	7.6 Oct 1988	5.9 Sep	7.2 Mar
OAKLAND											
2N 7E 5BA	Honeywell Lake Road	44	2	112GLCL	1,020	22	R	23.9 Apr 1976	28.9 Dec 1971	26.8 Jul	27.9 Nov
8E 18DBAD1	[2]Proud Lake Park	45	6	112OTSH	910	21	R	2.8 May 1974	6.4 Sep 1971	4.7 Jun	5.6 Oct
3N 7E 5DA	Fish Lake Road	49	2	112GLCL	1,055	21	R	29.5 Jun 1976	38.7 Dec 1972	35.0 Aug	35.5 Jan

Table 2.--Records of observation wells in Michigan--Continued

County and well number (Twsp,range,section)	Name	Depth (feet)	Diam. (inches)	Aquifer	Elev.	Yrs. record	Meas. freq.	Observed water-level extremes: Through 1988 Highest	Through 1988 Lowest	1989 Highest	1989 Lowest
OAKLAND--Continued											
3N 10E 13AC	Oakland University	183	6	112GLCL	940	9	R	55.4 Apr 1987	93.5 Jul 1963	55.0 Nov	57.0 Jul
5N 8E 8ACAC1	Holly Recreation Area	42	1	112GLCL	930	24	M	22.3 Apr 1974	26.5 Sep 1966	25.0 Jun	25.9 Sep
OCEANA											
13N 15W 18AAAA1	Hesperia	79	6	112OTSH	703	12	R	35.8 Dec 1986	41.0 Mar 1982	37.8 Jul	39.8 Dec
OGEMAW											
23N 1E 2BAAA1	Rose City Road, D	105	1	112GLCL	1,265	22	Q	73.3 Apr 1987	78.2 Apr 1969	74.3 Dec	75.0 Jul
2BAAA2	Rose City Road, S	20	1	112SAND	1,265	22	Q	7.6 Apr 1976	13.6 Dec 1972	10.5 May	12.9 Dec
ONTONAGON											
51N 41W 8BDBC1	Silver City	100	6	420FRED	620	32	Q	8.2 Apr 1959	21.8 Dec 1976	9.3 May	17.9 Nov
OTSEGO											
30N 3W 19ABBB1	Gaylord	90	6	112OTSH	1,308	11	M	30.6 Dec 1986	35.8 Apr 1982	31.6 Jun	33.3 Mar
PRESQUE ISLE											
33N 6E 8BBBB1	Styma	61	6	341TRVR	800	31	Q	4.8 Mar 1984	18.8 Mar 1963	8.2 May	15.3 Nov
ROSCOMMON											
24N 2W 20BABA1	[4]Exp. Station	14	8	112OTSH	1,145.3	56	R	2.1 Apr 1976	6.2 Dec 1949	3.4 Apr	5.7 Dec
SAGINAW											
10N 1E 22DADA1	Marion Springs, D	210	6	324SGNW	657	12	R	7.9 Feb 1981	10.9 Sep 1988	9.1 Jun	9.9 Sep
SANILAC											
13N 13E 12ADAA1	Minden Game Area	130	6	337MRSL	805	13	R	15.5 Apr 1985	22.7 Oct 1979	17.5 Jun	21.4 Oct
SCHOOLCRAFT											
45N 13W 16CCCB1	Seney	154	4	361ODVCU	710	38	R	4.6 Apr 1971	6.5 Oct 1963	4.9 Mar	5.8 Oct
47N 16W 30BBBB1	Cusino CCC	57	6	368PRDC	900	33	R	5.6 Apr 1985	16.4 Feb 1977	7.6 Apr	15.4 Dec
VAN BUREN											
2S 13W 2BBCB1	Almena, D	108	4	112GLCL	737	9	M	4.7 Oct 1986	10.7 Aug 1981	5.7 Jun	7.2 Aug
2BBCB2	Almena, S	44	4	112GLCL	737	9	M	8.4 Oct 1986	12.6 Sep 1984	10.2 Jun	12.1 Aug
WASHTENAW											
2S 3E 9DAA82	[2]Waterloo Park	48	6	112SDGV	970	21	R	4.1 May 1974	7.0 Aug 1971	4.5 Jun	6.1 Jul
3S 6E 16BCCD1	[2]Ann Arbor	55	10	112GLCL	821.5	27	R	0.7 Mar 1974	15.9 Oct 1964	4.1 Jun	7.3 Dec
7E 5BB	[2]Ypsilanti, Superior	69	8	112GLCL	720	28	R	1.8 Feb 1965	21.4 Dec 1965	2.1 Jun	3.6 Feb
9ADBC1	[2]Ypsilanti, Gilbert	94	6	112GLCL	710	39	R	29.1 Nov 1945	78.8 Oct 1974	47.2 Jun	52.5 Feb
24CA1	[2]Ypsilanti Twsp, 104	87	4	112GLCL	665.6	44	R	5.8 Jan 1950	22.7 Feb 1971	13.0 Dec	14.6 Feb

Table 2.--Records of observation wells in Michigan--Continued

County and well number (Twsp,range,section)	Name	Depth (feet)	Diam. (inches)	Aquifer	Elev.	Yrs. record	Meas. freq.	Observed water-level extremes: Through 1988 Highest	Through 1988 Lowest	1989 Highest	1989 Lowest
WASHTENAW--Continued											
3S 7E 24CD	[2]Ypsilanti Twsp, 117	75	6	112GLCL	657.8	43	R	4.7 Oct 1981	63.2 Feb 1970	8.4 Dec	29.1 Jul
WEXFORD											
22N 12W 13BA	[2]Harrietta Fish	141	4	112GLCL	1,060	29	R	+13.8 Mar 1970	1.6 Jan 1981	+7.1 Sep	+2.4 Feb

FOOTNOTES

[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 1989

(in millions of gallons)

County and water user	Total	Maximum day	Minimum day
ALCONA			
Harrisville	33.1	0.250	0.062
ALGER			
Chatham	9.3	[a]--	--
ALLEGAN			
Allegan	340.0	1.678	.458
Douglas	3.6	--	--
Otsego	382.5	1.413	.655
Plainwell	213.4	1.157	.329
Saugatuck	184.1	--	--
ANTRIM			
Bellaire	82.4	.452	.147
Central Lake	25.6	.291	.040
Mancelona	137.0	.820	.163
BARRY			
Middleville	107.0	.406	.185
Nashville	49.6	.216	.054
BENZIE			
Beulah	22.5	.146	.027
Frankfort	90.6	--	--
BERRIEN			
Coloma	97.9	.434	.169
Niles	866.4	4.110	1.080
Niles Township	93.2	1.283	.025
Watervliet	89.6	.522	.000
BRANCH			
Bronson	122.3	.607	.129
Coldwater	1,018.4	4.881	1.585
Coldwater Regional Center	103.0	.771	.060
Quincy	119.3	.744	.094
CALHOUN			
Albion	976.3	3.658	1.400
Athens	34.2	.224	.012
Battle Creek	4,057.0	15.470	6.140
Battle Creek Township	590.5	3.110	.000
Homer	72.1	.356	.139
Marshall	667.5	2.500	.868
CASS			
Cassopolis	77.4	.501	.130
Dowagiac	350.9	2.020	.524
CHARLEVOIX			
Boyne City	299.4	1.698	--
East Jordan	312.9	1.440	.390
CHEBOYGAN			
Mackinaw City	113.1	--	--
CHIPPEWA			
Kinross Township	242.9	1.622	.382
CLARE			
Clare	186.5	1.384	.260
Farwell	53.6	--	--
Harrison	84.6	1.351	.105
CLINTON			
Fowler	27.5	0.233	0.024
Maple Rapids	31.8	.177	.037
Westphalia	26.7	.240	.030
DICKINSON			
Breitung Township	46.3	--	--
EATON			
Bellevue	58.7	.386	.035
Charlotte	370.1	2.085	.746
Delta Township	1,139.7	4.850	--
Eaton Rapids	232.6	1.082	.417
Sunfield	28.3	--	--
EMMET			
Harbor Springs	197.8	2.290	.250
GENESEE			
Beecher Metro District	509.2	1.922	1.097
Burton	262.7	1.982	.274
Davison	244.7	1.798	.035
Fenton	337.5	1.362	.634
Grand Blanc	392.6	1.823	.785
Grand Blanc Township	252.3	--	--
Linden	74.3	.479	.106
GLADWIN			
Beaverton	51.2	--	--
GOGEBIC			
Ironwood	525.1	--	--
Marenisco Township	38.1	.180	.078
Wakefield	135.8	.755	.126
GRAND TRAVERSE			
Kingsley	39.1	--	--
GRATIOT			
Alma	24.9	--	--
Breckenridge	45.1	.245	.118
Ithaca	98.2	--	--
St. Louis	149.9	.728	.285
HILLSDALE			
Hillsdale	342.8	1.629	.524
Jonesville	155.7	.796	.164
Litchfield	71.2	.814	.096
Waldron	30.5	--	--
HOUGHTON			
Adams Township - South Range Water Authority	400.3	--	--
Chassell Township	41.0	.186	.069
Houghton	393.5	1.952	.654
[b]Northern Michigan Water	399.4	1.398	.715
HURON			
Elkton	35.7	.201	.069
Pigeon	56.0	.313	.041

Table 3.--Reported ground-water pumpage in 1989-Continued

(in millions of gallons)

County and water user	Total	Maximum day	Minimum day
INGHAM			
East Lansing-Meridian Township	2,510.2	11.280	4.990
Lansing	7,216.7	28.800	14.000
Mason	253.0	--	--
Michigan State University	1,474.5	4.828	1.846
Stockbridge	46.9	.224	.140
Webberville	54.7	.260	.119
Williamston	100.1	.483	.000
IONIA			
Ionia	636.0	2.641	1.163
Michigan Training Unit, Ionia	54.6	.256	.111
[c]Muir	61.2	.368	.107
Pewamo	21.6	--	.030
Portland	165.3	.653	.326
Saranac	65.5	.573	.066
IOSCO			
Oscoda Township	279.1	1.774	.383
Wurtsmith AFB	587.3	2.485	.504
IRON			
Alpha	9.6	--	--
Caspian	113.0	.503	.221
Crystal Falls	169.9	.856	.328
Crystal Falls Township	75.6	.285	.093
Iron River	134.2	.848	.151
Stambaugh	59.9	.317	.041
ISABELLA			
Mt. Pleasant	962.0	4.737	1.340
JACKSON			
Concord	55.6	.679	.046
Grass Lake	223.8	1.373	.205
Jackson	3,299.3	12.000	5.657
Springport	49.2	.466	.003
State Prison, Jackson	555.1	--	--
KALAMAZOO			
Augusta	28.0	.393	.038
Galesburg	91.1	.715	.116
Kalamazoo	6,748.7	33.382	11.907
Parchment	167.1	1.077	.115
Portage	1,278.0	7.612	1.943
Upjohn Company	8,284.5	28.500	8.264
Vicksburg	96.3	.605	.155
KALKASKA			
Kalkaska	178.6	1.274	.141
KENT			
Cedar Springs	110.4	.690	--
Kent County Airport	[e]12.0	--	--
Plainfield Township	967.5	7.300	1.480
LAKE			
Baldwin	80.2	1.024	.130
LAPEER			
Columbiaville	24.7	.125	.044
Dryden	17.3	.159	.020
LEELANAU			
Northport	29.6	--	--
LENAWEE			
Clinton	123.0	0.450	0.260
Hudson	129.7	.542	.094
Morenci	97.0	.579	.081
Onsted	36.0	.183	.056
Tecumseh	309.0	1.783	.295
LIVINGSTON			
Brighton	340.3	1.580	.460
Fowlerville	108.0	.444	.203
Green Oak Township	75.7	--	--
Howell	535.0	2.238	.895
LUCE			
Newberry	132.2	.763	.162
Newberry Health Center	27.5	--	--
MACOMB			
Armada	38.3	--	--
Richmond	146.0	.693	.322
MANISTEE			
Filer Township	56.5	.576	.045
Manistee	423.7	2.430	.818
MARQUETTE			
Ishpeming Township	114.4	.494	.199
K.I. Sawyer AFB	515.9	3.494	.753
Powell Township	12.4	.120	.014
MENOMINEE			
Stephenson	40.0	.242	.071
MISSAUKEE			
Lake City	65.6	.600	.049
MONROE			
Petersburg	43.3	.224	.015
MONTCALM			
Carson City	111.5	.670	.190
Edmore	58.5	.657	.010
Greenville	961.1	4.436	1.136
Howard City	52.5	--	--
Sheridan	35.0	--	--
MUSKEGON			
Montague	127.9	.972	.129
NEWAYGO			
Freemont	541.6	2.802	.157
Hesperia	28.0	--	--
Newaygo	58.4	.398	.062
White Cloud	68.9	.295	.116
OAKLAND			
Holly	179.4	.683	.353
Independence Township	268.9	--	--
Milford	259.7	1.139	.292
Oxford	211.6	1.061	.212

Table 3.--Reported ground-water pumpage in 1989-Continued

(in millions of gallons)

County and water user	Total	Maximum day	Minimum day
OAKLAND (Continued)			
Rochester	741.5	3.620	0.979
South Lyon	513.9	1.279	.409
Southfield	5.4	--	--
Sylvan Lake	78.2	--	--
Waterford Township	2,319.3	--	--
Wolverine Lake	64.7	--	--
OCEANA			
Hart	[e]195.4	--	--
Shelby	17.5	--	--
OGEMAW			
West Branch	94.3	.507	.000
ONTONAGON			
Bergland Township	[e]9.6	--	--
Rockland Township	10.6	.051	.016
OSCEOLA			
Evart	584.4	3.000	.287
OTSEGO			
Gaylord	234.4	--	--
OTTAWA			
Spring Lake	140.3	.800	.226
PRESQUE ISLE			
Onaway	66.5	.448	.035
Rogers City	163.8	1.195	.243
ROSCOMMON			
Roscommon	52.6	.181	.032
ST. CLAIR			
Capac	42.8	.424	.051
Yale	67.8	--	--
ST. JOSEPH			
Sturgis	861.2	3.518	1.367
SAGINAW			
Chesaning	107.5	0.522	0.171
SANILAC			
Deckerville	47.7	.398	.017
Marlette	88.0	.448	.122
Peck	18.4	.103	.030
Port Sanilac	60.9	--	--
Sandusky	121.8	--	--
SHIAWASSEE			
Bancroft	17.6	--	--
Byron	32.6	--	.035
Durand	135.9	.501	.266
Perry	63.6	.332	.114
TUSCOLA			
Akron	1.4	--	--
Caro	232.0	1.078	.343
Cass City	100.0	.656	.220
Kingston	14.7	.071	.030
Mayville	30.2	--	--
State Hospital, Caro	51.7	.250	.090
Vassar	172.9	.951	.370
VAN BUREN			
Bangor	66.4	.435	.093
Decatur	77.4	--	--
Gobles	23.2	--	--
Lawrence	34.4	.498	.035
Lawton	379.4	1.868	.285
Paw Paw	225.8	--	--
WASHTENAW			
Ann Arbor	[d]1,239.8	--	--
Chelsea	192.5	.874	.360
Dexter	101.8	.449	.001
Milan	342.3	1.910	.691
Saline	368.5	1.792	.644
Webster Township	40.2	.474	.002
Ypsilanti	960.2	4.346	.500
Ypsilanti Township	1,451.7	9.480	.621
WEXFORD			
Cadillac	891.0	4.768	1.297

FOOTNOTES

[a] Indicates data not available.

[b] Amount pumped to supply Calumet, Calumet Township, Copper City, Lake Linden, Laurium, Osceola Township, Torch Lake Township, Ahmeek, and Allouez Township.

[c] Supplies water to Lyons.

[d] Also diverted 4,429 million gallons from Huron River.

[e] Wholly or partly estimated.

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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

Year	WDR Number	Year	WDR Number
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		