WATER SUPPLY REPORT NUMBER SEVEN

STATE OF MICHIGAN
DEPARTMENT OF CONSERVATION
GERALD E. EDDY, DIRECTOR
GEOLOGICAL SURVEY DIVISION
WILLIAM L. DAOUST, STATE GEOLOGIST

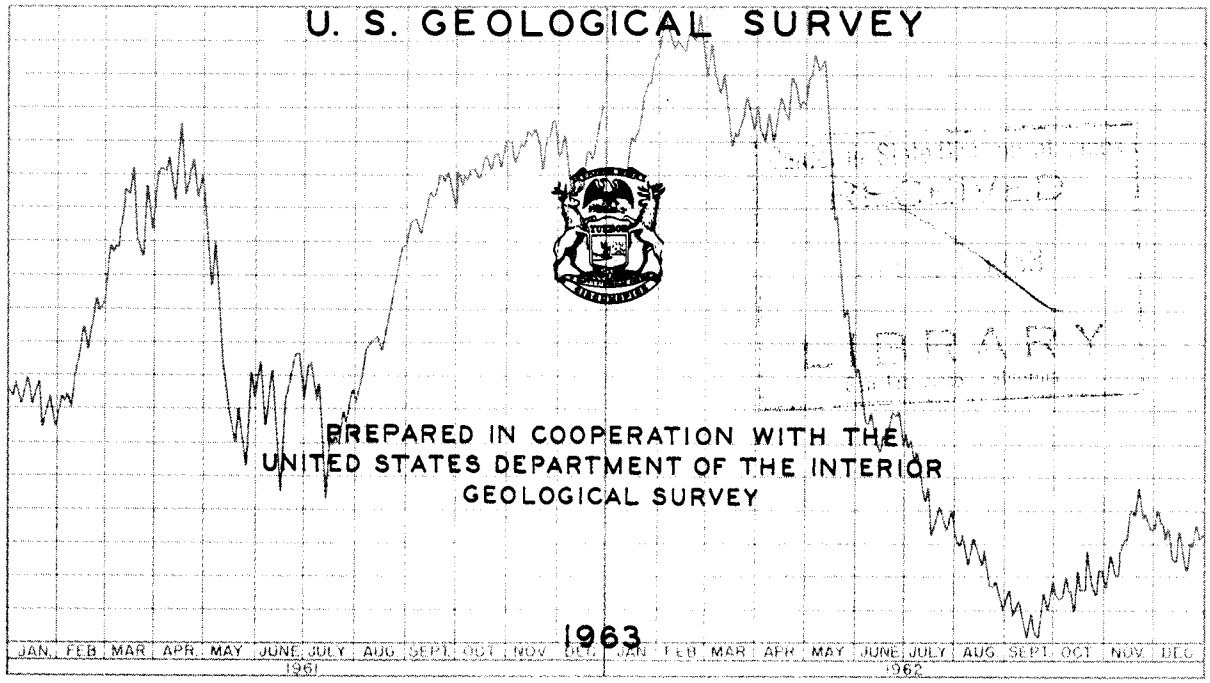
SUMMARY OF GROUND-WATER CONDITIONS IN MICHIGAN 1962

BY

P. R. GIROUX AND G. C. HUFFMAN
U. S. GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

1963



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SUMMARY OF GROUND WATER CONDITIONS IN MICHIGAN

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INTRODUCTION

This report is the seventh of a series covering ground-water levels in the State of Michigan. It summarizes and interprets, in part, the results of the program of measurement of ground-water levels and the collection of other pertinent hydrologic information by the U. S. Geological Survey. The program is a part of the overall water-resources investigation carried out in cooperation with the Michigan Geological Survey.

Cooperation

Ground-water investigations in Michigan are made by cooperative agreement with the Michigan Department of Conservation, G. E. Eddy, Director, G. A. Walker, Chief Deputy, through the Geological Survey Division.

The systematic collection of ground-water level records is aided by the following municipalities, institutions, and private organizations:

Cities and villages of Alma, Ann Arbor, Battle Creek, Beaverton, Cadillac, Coldwater, Dowagiac, Grand Ledge, Greenville, Hastings, Hillsdale, Holland, Ironwood, Jackson, Kalamazoo, Lansing, Lowell, Marshall, Mason, Ontonagon, Plymouth, Pontiac, Rochester, St. Johns, St. Louis, Wyoming; Ypsilanti; Cranbrook School, Michigan College of Mining and Technology, Oakland University; State Hospitals at Howell, Ionia, and Ypsilanti; Fisher Body Division of General Motors Corporation; and Wisconsin-Michigan Power Company.

Cooperative ground-water investigations by the U. S. Geological Survey in Michigan are directed jointly by O. M. Hackett, Chief of the Ground Water Branch, U. S. Geological Survey, Washington, D. C. and the State Geologist, Michigan Geological Survey, Lansing, and are supervised by G. E. Hendrickson, District Geologist.

Records and interpretations of water levels and artesian pressures from 1935 through 1955 have been published in the annual series of U. S. Geological Survey Water-Supply Papers entitled "Water Levels and Artesian Pressures in the United States". The following tabulation lists the papers containing water-level data for Michigan:

Year	No.	Year	No.	Year	No.
1935	777	1942	944	1949	1156
1936	817	1943	986	1950	1165
1937	840	1944	1016	1951	1191
1938	845	1945	1023	1952	1221
1939	886	1946	1071	1953	1265
1940	906	1947	1096	1954	1321
1941	936	1948	1126	1955	1404

Beginning in 1956, the U. S. Geological Survey discontinued publication of its series of annual reports and is now publishing, at 5-year intervals, a reduced number of water-level records without interpretive text or illustrations. The first of these series for the Northeastern States, which includes Michigan, has been published for the 2-year period 1956-57 as Water-Supply Paper No. 1537. The needs of the State, however, require more detailed and current ground-water information. As a result, publication of annual Water Supply Reports entitled "Summary of Ground-Water Conditions in Michigan" by the Michigan Geological Survey was started in 1956.

The first of six reports of this series published cover ground-water conditions in Michigan for the calendar years 1956 through 1961 as follows:

Water Supply Report	Year
1	1956
2	1957
3	1958
4	1959
5	1960
6	1961

The State Water Supply Reports are designed to supplement data contained in the Federal reports and also provide interpretive text and illustrations. By means of these ground-water summaries, basic information concerning ground-water conditions in Michigan are readily available to the public.

Ground-Water Supplies in Michigan

Large supplies of good-quality ground water are available throughout most of the State. However, in parts of the extreme southeast and the Thumb and Saginaw Bay areas of the Lower Peninsula, aquifers yield only small quantities of water. In addition, the underlying rock formations yield saline or high sulfate water.

Investigations of the ground-water resources of the State have so far been limited to detailed studies of a few urban areas and reconnaissance studies of some Upper Peninsula counties. There is a need for a comprehensive study of the State's entire water resources and problems as a guide to intelligent development of both surface and ground-water supplies.

Figure 1 generalizes the principal aquifers from which ground-water supplies are obtained for municipal or public use. This generalization does not imply that water can be obtained only from these specific aquifers in each area. In areas where the bedrock serves as the principal aquifer, the overlying drift may be an additional source of ground water; in some areas where the glacial drift is the principal aquifer, water can also be obtained from the bedrock.

Yields of ground water from individual public supply wells vary widely -- some yielding only 100 gallons per minute (gpm) while others can be safely pumped at rates up to 2,000 gpm. Highest reported yields of ground water generally are obtained from buried outwash channels in the glacial drift. Sandstones of the Marshall and Saginaw Formation yield as much as 1,000 gpm to wells in the southern part of the Lower Peninsula. Unfortunately, cities are not always located where high-yield aquifers are present. Water from these high-yield sites, however, can sometimes be piped into urban areas.

Objectives of the Observation Well Program

The observation-well program in Michigan is a part of a nationwide program, the purpose of which was summarized by Sayre (Water-Supply Paper 1404, p. 1, 1957) as follows:

"The objectives of the observation-well program are to provide a day-to-day evaluation of available ground-water supplies, to facilitate the prediction of trends in ground-water levels that will indicate the probable status of important ground-water supplies in the future, to delineate present or potential areas of detrimentally high or low ground-water levels, to aid in the prediction of the base flow of streams, to determine the several forces that act on a ground-water body, and to demonstrate the interplay of those forces in the ground-water regimen, to furnish information for use in basic research, and to provide long-term continuous records of fluctuations of water levels in representative wells. These selected records serve as a framework to which many short-term records collected during an intensive investigation may be related."

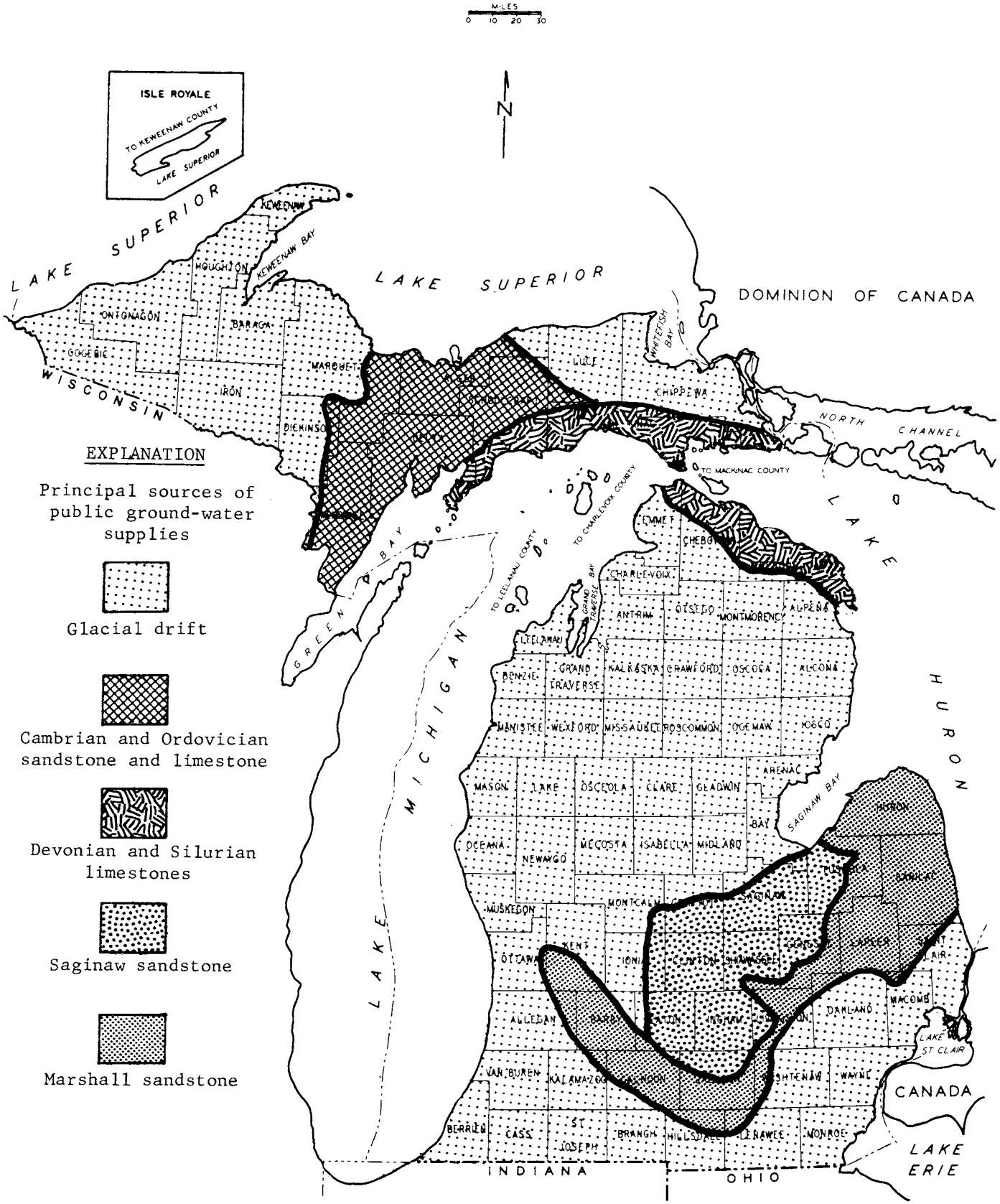


Figure 1. Areas of principal sources of public ground-water supplies.

Scope of this Report

This report is based on periodic measurements of water levels made during 1962 in 235 wells, of which 77 were equipped with continuous recording gages. The report summarizes water-level changes observed throughout the State, and analyzes these changes in selected areas. During 1962 the cooperative program was continued with the addition of 11 ground-water recording stations. One objective of this cooperative program is to observe and analyze the effects of pumping on water levels in areas of heavy ground-water withdrawals. This information is used to guide water-management practices in these areas.

The location of wells in which water levels were observed in 1962 is shown in figure 2.

Table 1 lists the basic information for each observation well, and the extremes of water-level fluctuations in 1962 and for the period of record. Fluctuations of water levels in representative wells are also shown by hydrographs, and in many cases graphic interpretations of the changes in water level are made possible by including records of precipitation and (or) pumpage. Several illustrations in this report include graphs showing the cumulative departures of annual precipitation from the long-term mean. These graphs were constructed by using the "zero" or "average" line to denote the average precipitation for the period of record preceding the period of the graph. Starting at this line the excess or deficiency of precipitation for each month or year is added algebraically. Thus, for each time unit, a line sloping downward indicates below-average precipitation, and a line sloping upward indicates above-average precipitation. In cumulative graphs such as these, the slope of the line is the important part -- that is, even where the graph is far below the zero line, if the slope is upward the period is one of above-average precipitation. The end point of the graph gives the total rainfall above or below the average for the entire period of the graph.

Table 2 lists the reported monthly and annual ground-water pumpage for many municipalities, institutions, and some industries in the State.

Open-File and Published Records

Complete tabulations of water-level measurements and the hydrographs for each observation well, records of chemical quality of ground-water, water-temperature measurements, well records including logs, aquifer tests, records of pumping for public supply and industrial use, and published and unpublished water-resource reports are on file for public inspection. They may be examined at the office of the Water Resources Section of the Michigan Geological Survey, Fourth Floor, Mason Building, Lansing, or at the Michigan district office of the U. S. Geological Survey, Ground Water Branch, 407 Capitol Savings and Loan Building, Lansing. Records for the Northern


ISLE ROYALE
TO KEWEENAW COUNTY
EXPLANATION
Observation well
Two or more observation wells
R.30W.
T. 49 N.
Diagram of geographical township
0 10 20 30 Miles
KEWEENAW
KEWEENAW BAY
HOUGHTON
ONTONAGON
BARAGA
GOGEBIC
MARQUETTE
ALGER
LUCE
WHITEFISH BAY
CHIPPEWA
MACKINAC
SCHOOLCRAFT
IRON
DICKINSON
DELTA
MENOMINEE
WISCONSIN
Menominee River
GREEN BAY
LAKE MICHIGAN
LAKE HURON
LAKE SUPERIOR
TO MACKINAC COUNTY

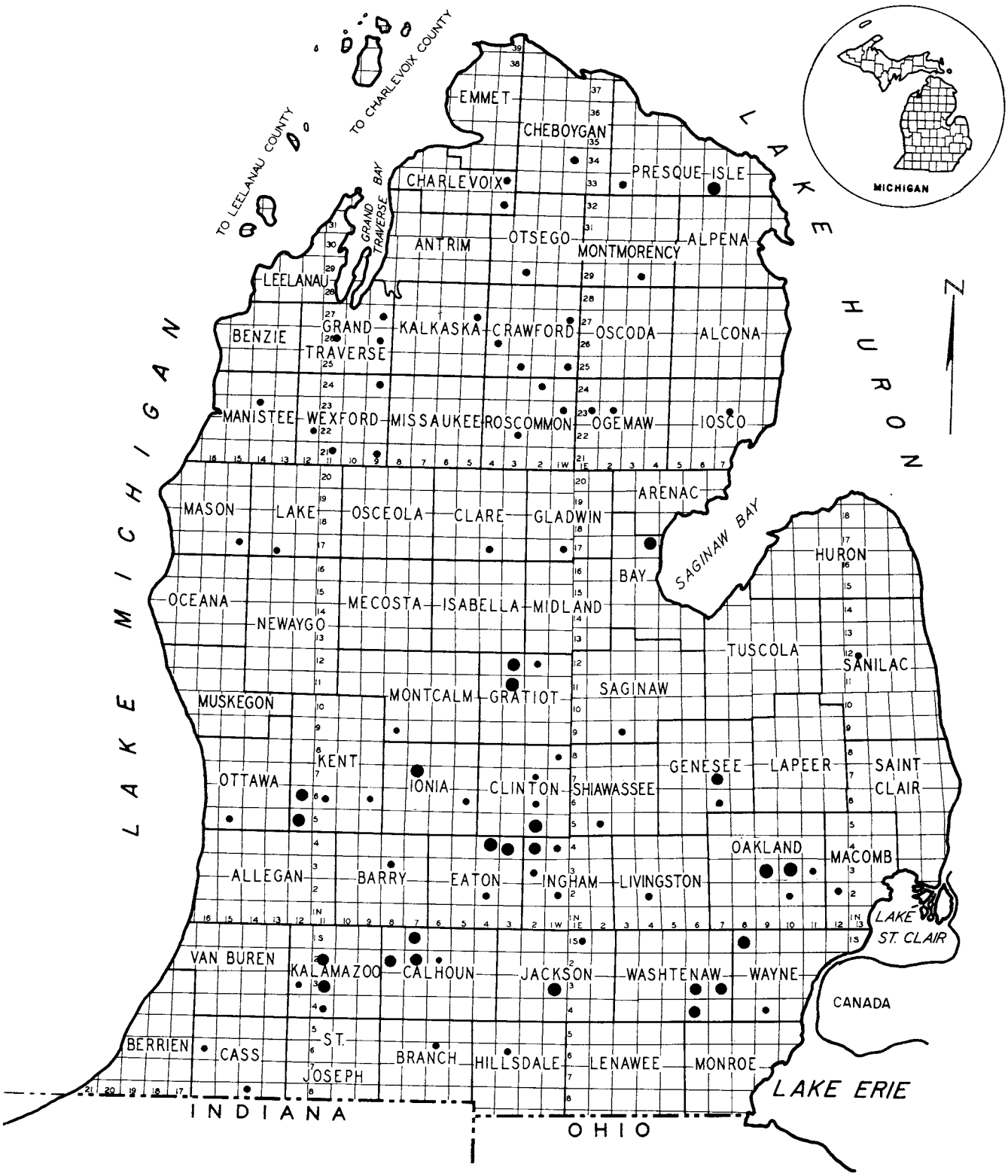


Figure 2. Location of observation wells in Michigan, 1962.

Peninsula are also kept on file in the office of the State and Federal Geological Surveys, 203 State Office Building, Escanaba.

U. S. Geological Survey Water-Supply Papers are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., or can be consulted at the offices listed above and in major university or municipal libraries.

The Federal Survey also issues a monthly publication entitled "Water Resources Review" which briefly summarizes ground-water levels and streamflow throughout the United States. The monthly issues plus spring and annual summaries can be obtained free of charge by application to the Director, U. S. Geological Survey, Washington 25, D. C.

Copies of annual "Summaries of Ground-Water Conditions in Michigan" are free on application, while other publications of the Michigan Geological Survey can be purchased from the Michigan Department of Conservation, Publications Room, Mason Building, Lansing 26, Michigan.

Reports of cooperative ground-water investigations covering specific areas of the State are also published by the Michigan Geological Survey or the U. S. Geological Survey. These reports are also available for inspection at the offices listed above.

Well-Numbering System

The well-numbering system used by the State and Federal Surveys in Michigan indicates the location of wells within the rectangular subdivision of the land with reference to the Michigan meridian and base line (fig. 2). The first two segments of a well number designate township and range; the third segment designates both the section and the well within the section. Thus, well number 32N 6E 16-1 is well number 1 in section 16, Township 32 North, Range 6 East.

Acknowledgments

Acknowledgment is made to personnel of Federal and State agencies, industrial concerns, well drillers, consultants, municipalities, and public utilities whose cooperation has contributed to the accumulation of the basic data presented in this report.

Appreciation is also extended to Messrs. J. G. Rulison and A. E. Slaughter of the Michigan Geological Survey, for their assistance in the editing of this series of reports.

PRECIPITATION AND TEMPERATURE

Precipitation and temperature are the major climatic factors affecting the ground-water regimen in any area. Recharge to aquifers is supplied directly or indirectly by precipitation. Ground-water levels are affected by the quantity of precipitation, the season of its occurrence, its intensity, and nature (rain or snow).

Hydrographs of natural fluctuations of water in wells (figs. 4 and 7) show that spring and fall are the seasons when most of the ground-water recharge occurs. In the spring before the growing season starts, snowmelt and rain normally result in large additions to the ground-water reservoirs. However, layers of ice, or frost in the ground, can impede infiltration when thaws occur. Under these conditions, water from snowmelt and early spring precipitation may be mostly lost by quick surface runoff. In the fall of the year, after the growing season ends and evapotranspiration demands are reduced by colder weather, substantial rises in water levels from rains usually occur.

According to the U. S. Weather Bureau, precipitation in 1962 was below average in all climatological divisions of the State. Departures ranged from 0.16 to 8.84 inches (fig. 3). Although precipitation was below average in all climatological divisions of the State, a few localities within these divisions had more than average precipitation. The deficiencies resulted in lower ground-water levels in the State, especially in the south-central lower area where precipitation has also been deficient in the previous two years.

Temperatures during the year were colder than average. Although May was much warmer than normal, the summer months were cooler and served to reduce evapotranspiration and irrigation demands for ground water.

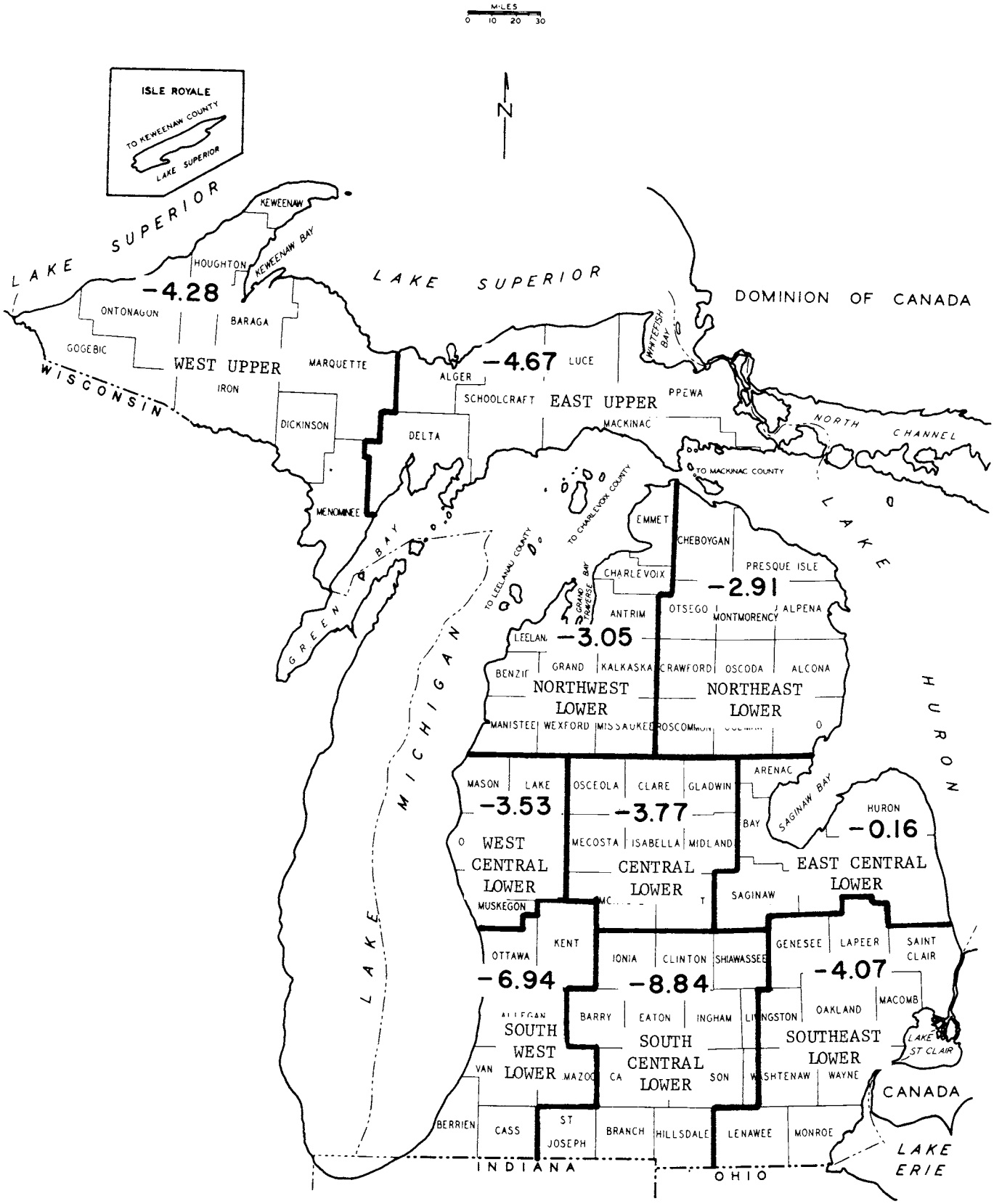


Figure 3. Annual regional departure of precipitation from average in 1962.

SUMMARIES OF GROUND-WATER CONDITIONS

Statewide Changes in Storage from Natural Influences

Northern Peninsula

Water levels in four key wells (fig. 4) were the lowest of the past several years. Below average levels prevailed during most of the year as the result of precipitation deficiencies of the past two years. Levels fell to record low in the Schoolcraft County well at the end of the year.

Water levels in two wells affected only by natural conditions continued to decline in 1962 (fig. 5) as the result of precipitation deficiencies. The seasonal patterns in water level are different in the two wells. Levels in both wells rise in the Spring, but only the Schoolcraft County well shows recovery in the fall.

Stages were slightly lower in 1962 as the result of deficient rainfall, in seven out of eight wells (fig.6). Note the similarity of fluctuations in each well for the 2-year superimposed record. These wells are finished in various aquifers in various parts of the Upper Peninsula and each has a distinctive pattern of fluctuations. For instance, Spring peaks of water level generally are higher in shallow than in deep wells.

Many observation wells in the western half of the Northern Peninsula are maintained and measured by the Wisconsin-Michigan Power Company (Table 1). They serve to evaluate ground-water storage and to aid in the prediction of streamflows in the Menominee River Basin. These wells are finished at shallow depth in glacial-drift deposits, and the levels reflect changes in natural storage in the shallow aquifers of that area. The Company issues monthly summaries of hydrologic conditions and annual summaries containing valuable information such as weather, evapotranspiration, and ground-water storage data. The 1962 annual Weather Bulletin of the Company (p. 1) states "as the year ended, the average water table was at elevation 1.83 feet compared to a normal year-end elevation of 2.09 feet". According to their report, water table elevations were above average the first 5 months of 1962 and then below average the remainder of the year.

Southern Peninsula

Figure 7 gives the month-end levels as compared to extremes and average of record for eight key wells affected primarily by natural conditions.

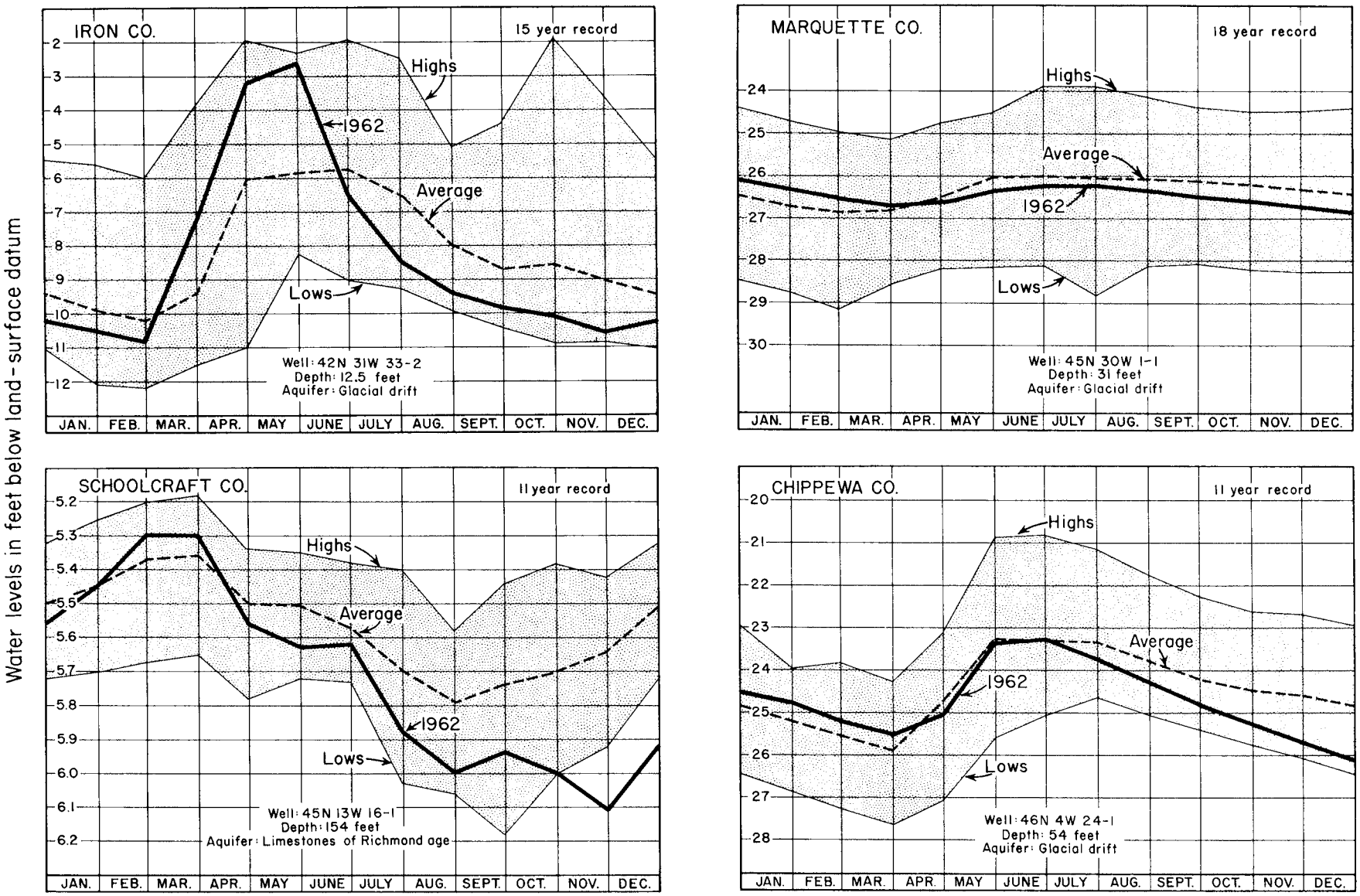


Figure 4. Month-end water levels in key observation wells in the Northern Peninsula, 1962.

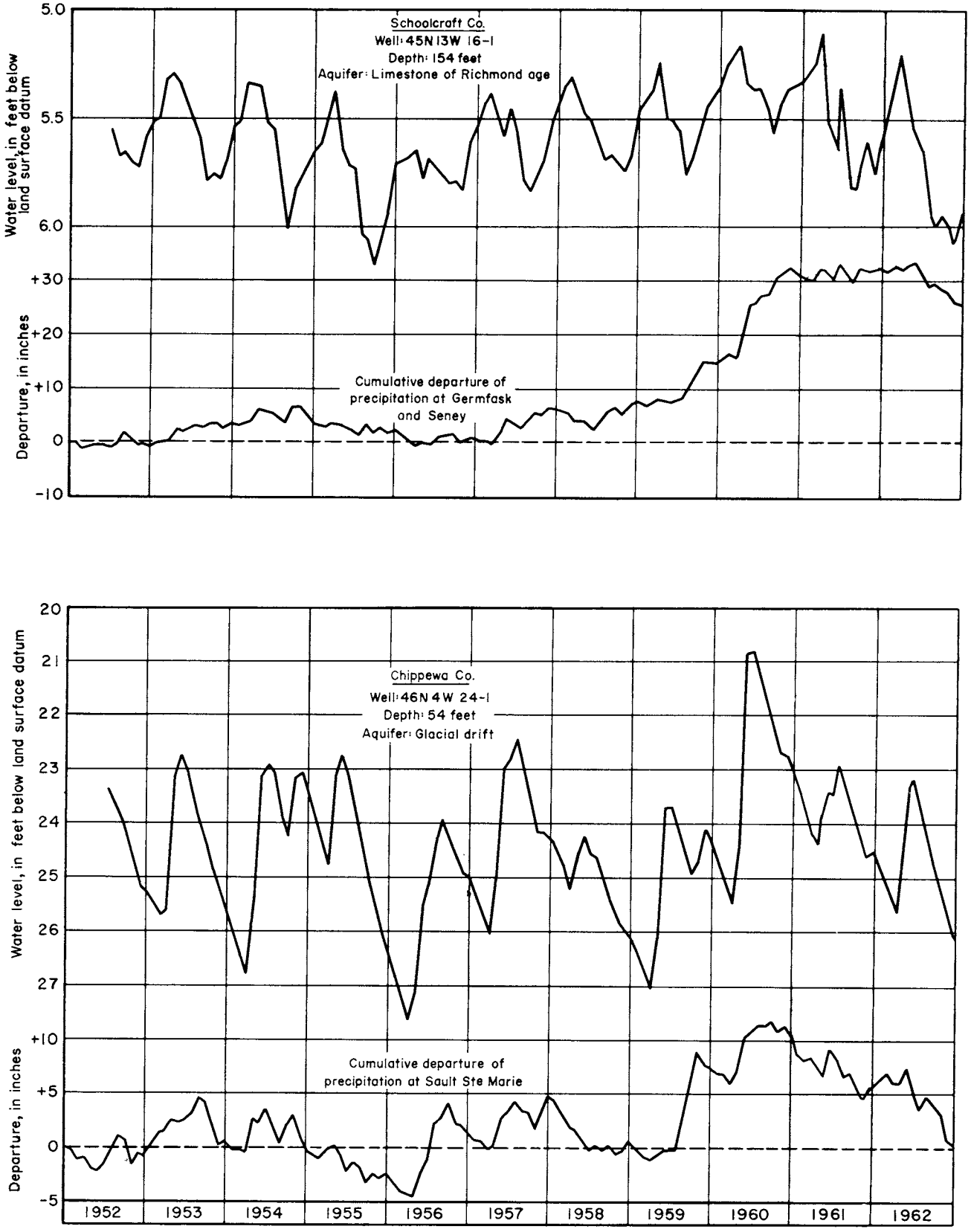


Figure 5. Hydrographs of two wells, and precipitation, in Chippewa and Schoolcraft Counties, 1952-62.

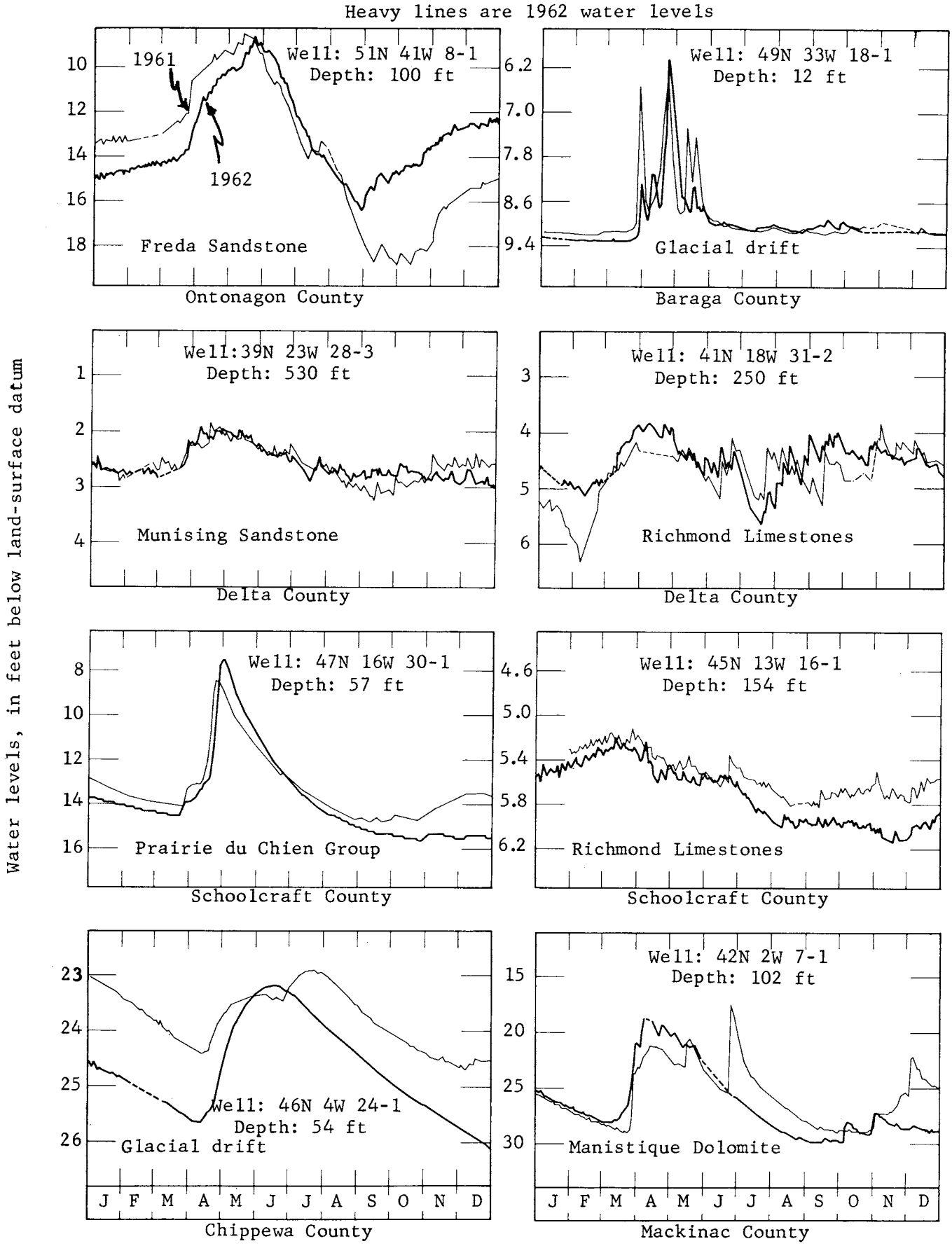
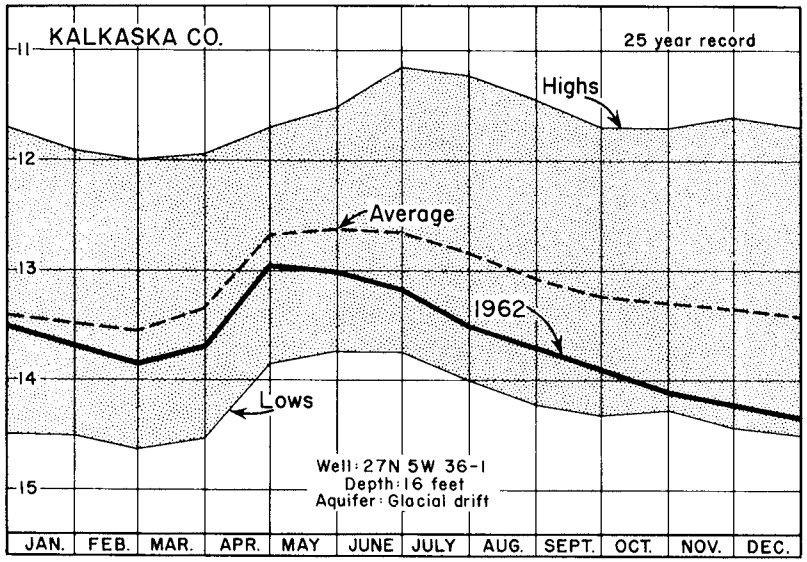
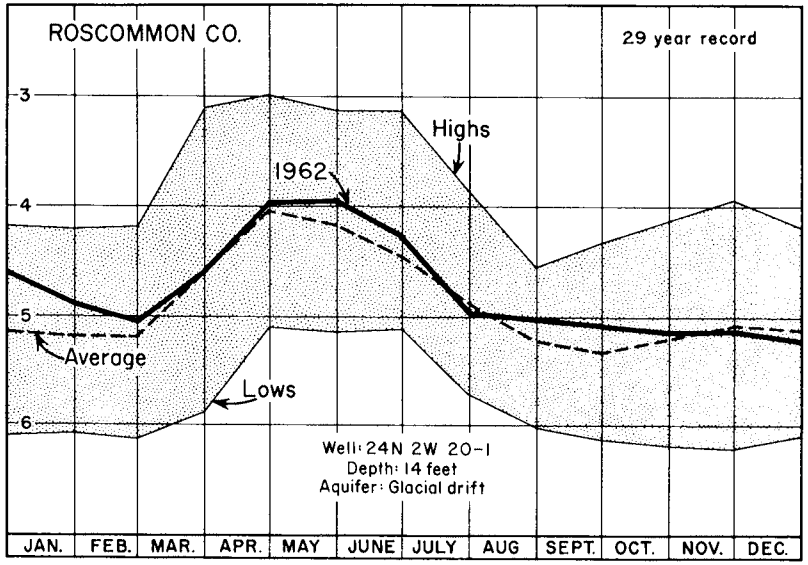
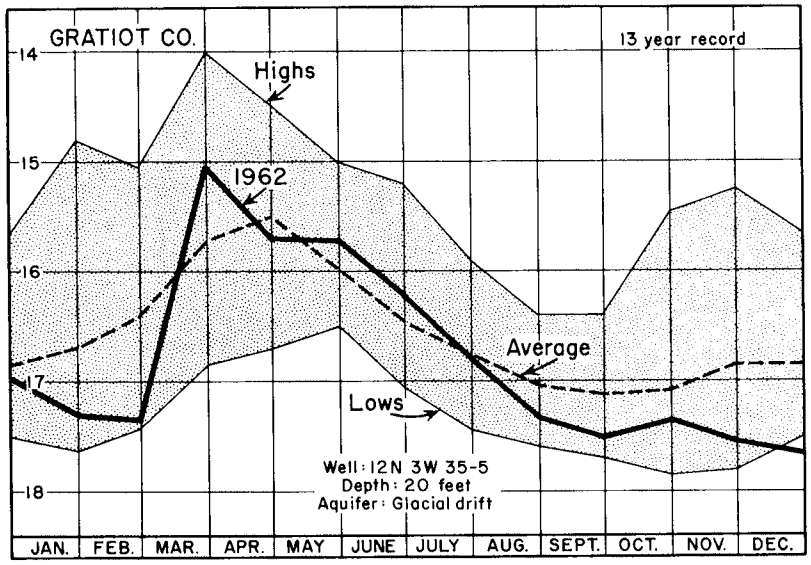


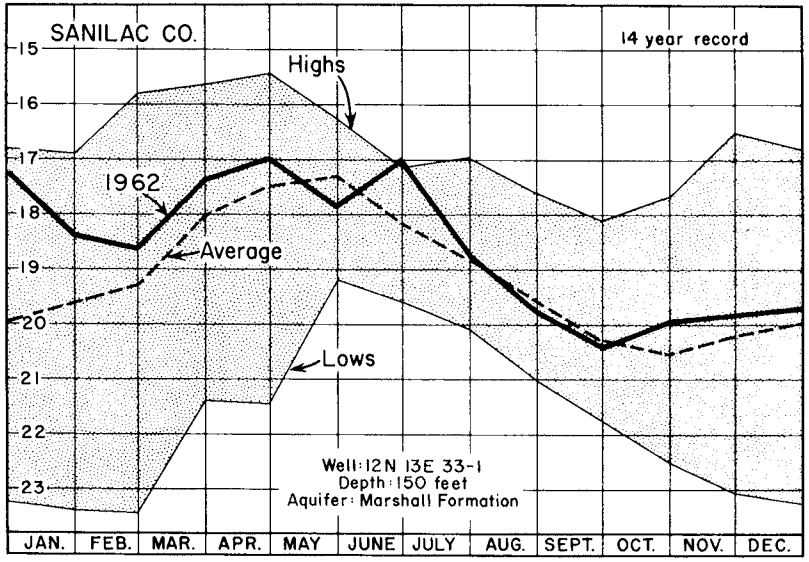
Figure 6. Hydrographs of eight selected wells in the Northern Peninsula, 1961-62.

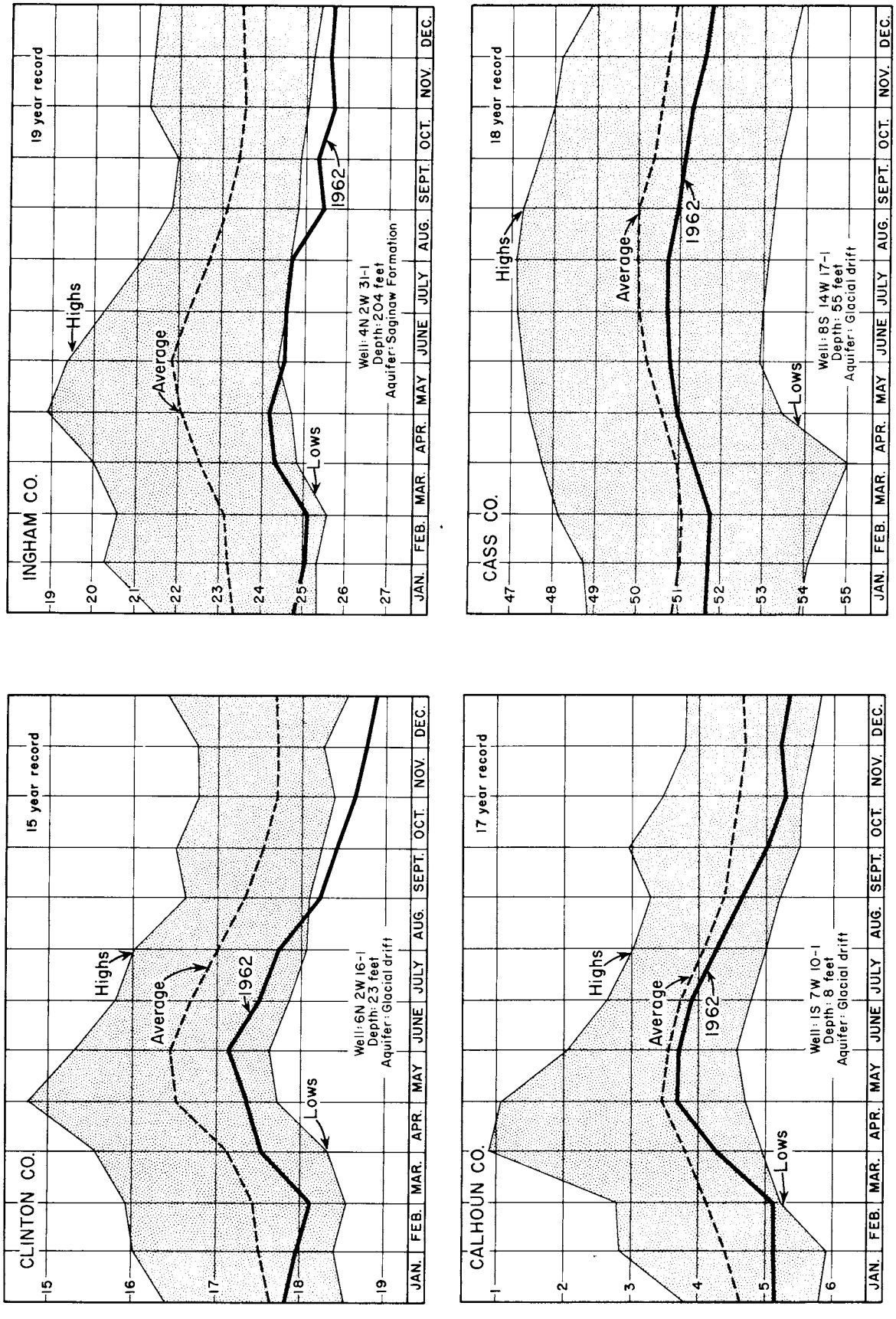
Water levels in feet below land-surface datum





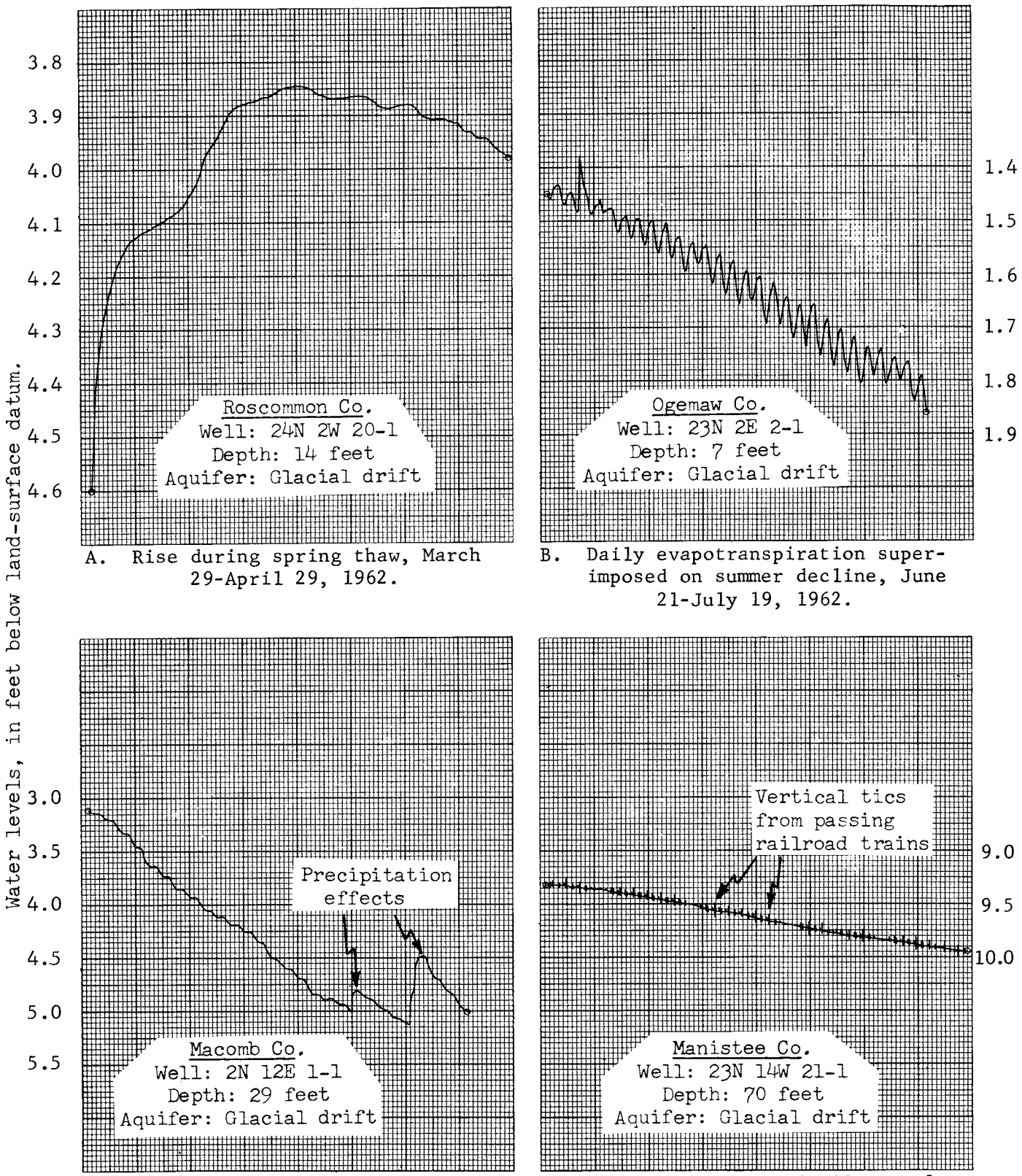






High, average, and low readings are for the period of record through 1961

Figure 7. Month-end water levels in key observation wells in the Southern Peninsula, 1962.



A. Rise during spring thaw, March 29-April 29, 1962.

B. Daily evapotranspiration superimposed on summer decline, June 21-July 19, 1962.

C. Daily evapotranspiration superimposed on summer decline, and effects of precipitation, May 12-June 9, 1962.

D. Summer decline and effects of passing railroad trains, May 9-June 11, 1962.

(Charts about one-third actual size)

Figure 8. Selected recorder charts showing effects of natural climatic conditions on water levels in observation wells.

Water levels in most of the wells, reflecting the large deficiencies of precipitation, fell to stages ranging from below average to record low by the end of the year.

In Kalkaska County, levels for 1962 were below average while in Roscommon and Sanilac Counties, 1962 levels remained about average. In the Gratiot County well stages were below average during most of the year. Water levels in the four wells in Clinton, Ingham, Calhoun, and Cass Counties remained below average during the entire year as the result of continuing general deficiencies in precipitation during the last three years.

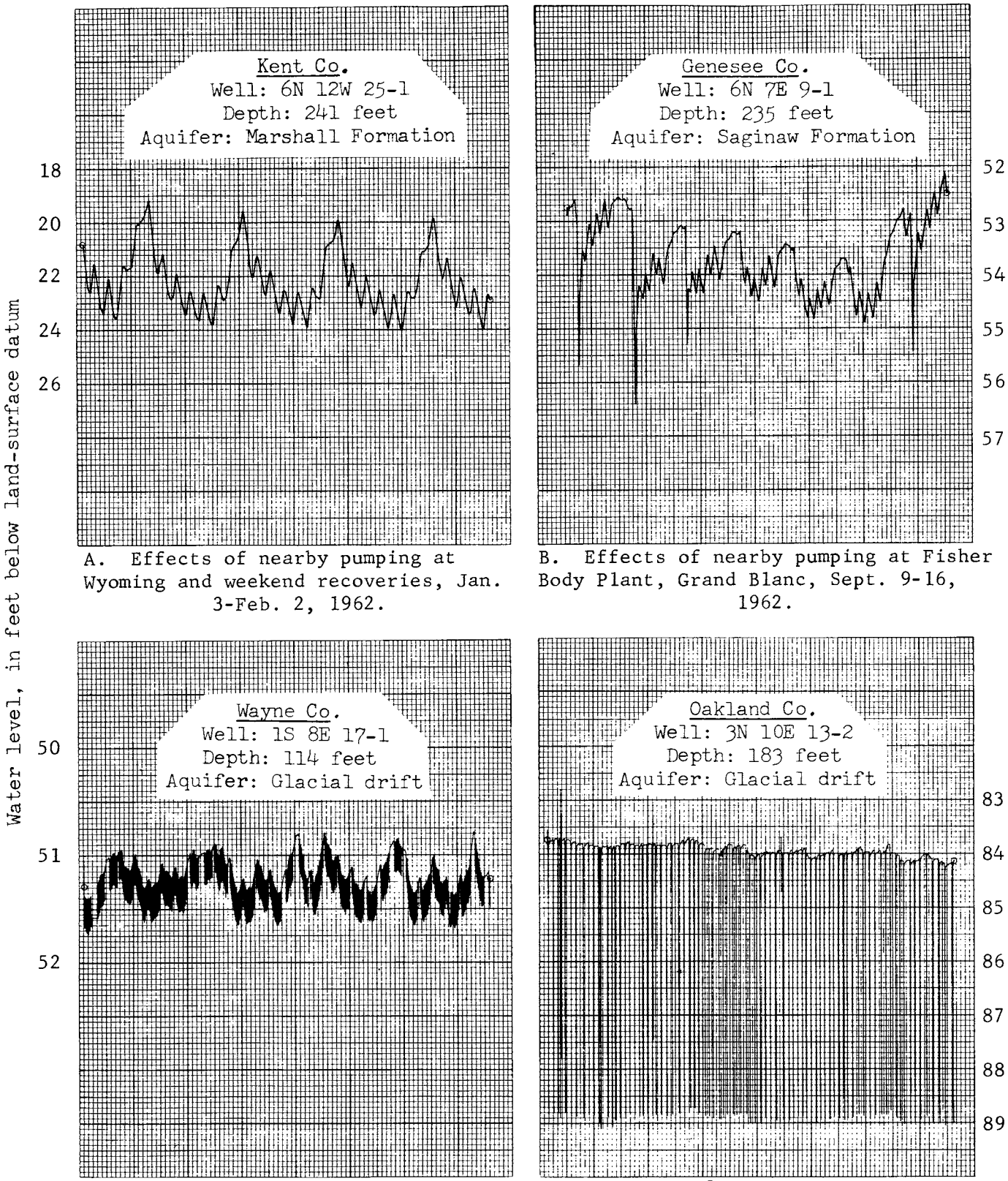
Reproductions of charts taken from recording gages in operation on four wells in which water levels respond to natural conditions are shown in figure 8. Each chart shows about a month's record. The vertical lines equal eight hours of pen travel or three lines to a day. Chart A is typical of rises in a shallow well, during the spring, from snowmelt and rainfall and before evapotranspiration begins. In Chart B evapotranspiration during the growing season and in the daylight hours causes daily fluctuations in water level. Chart C shows the seasonal decline, with evapotranspiration minimized owing to the greater depth of the well, and the temporary effect of periods of precipitation on the decline. Chart D shows the summer decline with slight vertical oscillations caused by passing of railroad trains nearby.

Statewide Changes in Storage from Pumping Influences

In areas where ground water is used for municipal or industrial supplies, hydrographs of water levels in observation wells are useful to show the relation between discharge from wells and natural, induced, and artificial recharge to aquifers. Declines, except as caused by precipitation deficiencies, indicate depletion of storage in the aquifers caused by pumping. An effective method of determining the amount of water available from an aquifer is the analysis of long-term records of water levels and pumpage.

A recording station provides for the continuous collection of basic water-level data, which serves to indicate both the day-to-day and also the long-term effects of pumping. This information can be especially valuable to municipalities, industries, institutions, and their consultants to estimate the capacity of aquifers to meet present and future demands for water, to determine the desirable separation between wells, and to indicate whether expansion of ground-water supply systems is feasible.

In 1962 many record near-or record lows were observed in heavily pumped areas of the State. The low water levels were partly the result of deficient precipitation, but in many cases increased withdrawals of ground



A. Effects of nearby pumping at Wyoming and weekend recoveries, Jan. 3-Feb. 2, 1962.

B. Effects of nearby pumping at Fisher Body Plant, Grand Blanc, Sept. 9-16, 1962.

C. Effects of nearby pumping at 6-Mile Road well field near Plymouth, Oct. 12-Nov. 11, 1962.

D. Effects of closeby pumping at Oakland University, Sept. 27-Oct. 27, 1962.

Figure 9. Selected recorder charts showing effects of nearby pumping on water levels in observation wells.

water due to population and industrial growth and the increased demand for water created by modern living was an important contributing factor.

Reproductions of four charts, taken from recording gages on observation wells, reflecting pumping influences on water levels are shown in figure 9. All are records for about a month except for the Genesee County graph which is for a week. The vertical lines are equivalent to eight hours, or one day for each three lines on the monthly charts, while on the weekly chart, vertical lines are equivalent to two hours each, or 12 lines a day. Chart A shows weekend, and the daily fluctuations of water levels from pumping, while Chart B shows the daily fluctuations from pumping by an industrial plant. Chart C is a monthly chart showing the effects of pumping by a municipal well about 500 feet away at the rate of over 2,000 gallons per minute. Chart D is a monthly chart, with effects on water levels of automatic controls turning a nearby pump on and off as needed. The pumping well in this case is only about 15 feet distant.

Northern Peninsula

Gogebic County

City of Ironwood.--The City obtains its municipal supply from wells finished in glacial drift aquifers at depths of from about 20 to 120 feet. Reported municipal withdrawals of ground water by the City totaled 324 million gallons for the year (table 2), about 10 percent less than in 1961. During periods of heavy precipitation some of the excess water from the nearby creek is diverted into a recharge channel to help maintain high ground-water levels by induced infiltration.

A recording gage has been in operation on well 34-3 since July, 1961. A second recording gage was installed in mid-1962 on an unused well to further observe effects of municipal pumping at well field SE Gp 3. The observation wells are at about equal distance from a nearby creek, but well 34-2 is further from pumping and as a result, its water levels are slightly higher (fig. 10). The sharp fluctuations in the hydrographs coincide with periods of rainfall and apparently are not the result of pumping from the field. The daily range is only about 1/10 of a foot (Fig. 8, Giroux, 1961). The decline in levels (well 34-3) during the 1961-62 winter indicates probable lack of recharge from surface sources as the result of frozen ground. Above freezing daytime temperatures from about mid-March resulted in several feet of rise from recharge owing to the melting of about three feet of snow cover. Despite a deficiency of four inches of precipitation for the period illustrated, water levels at the end of 1962 were a foot higher than at the end of 1961.

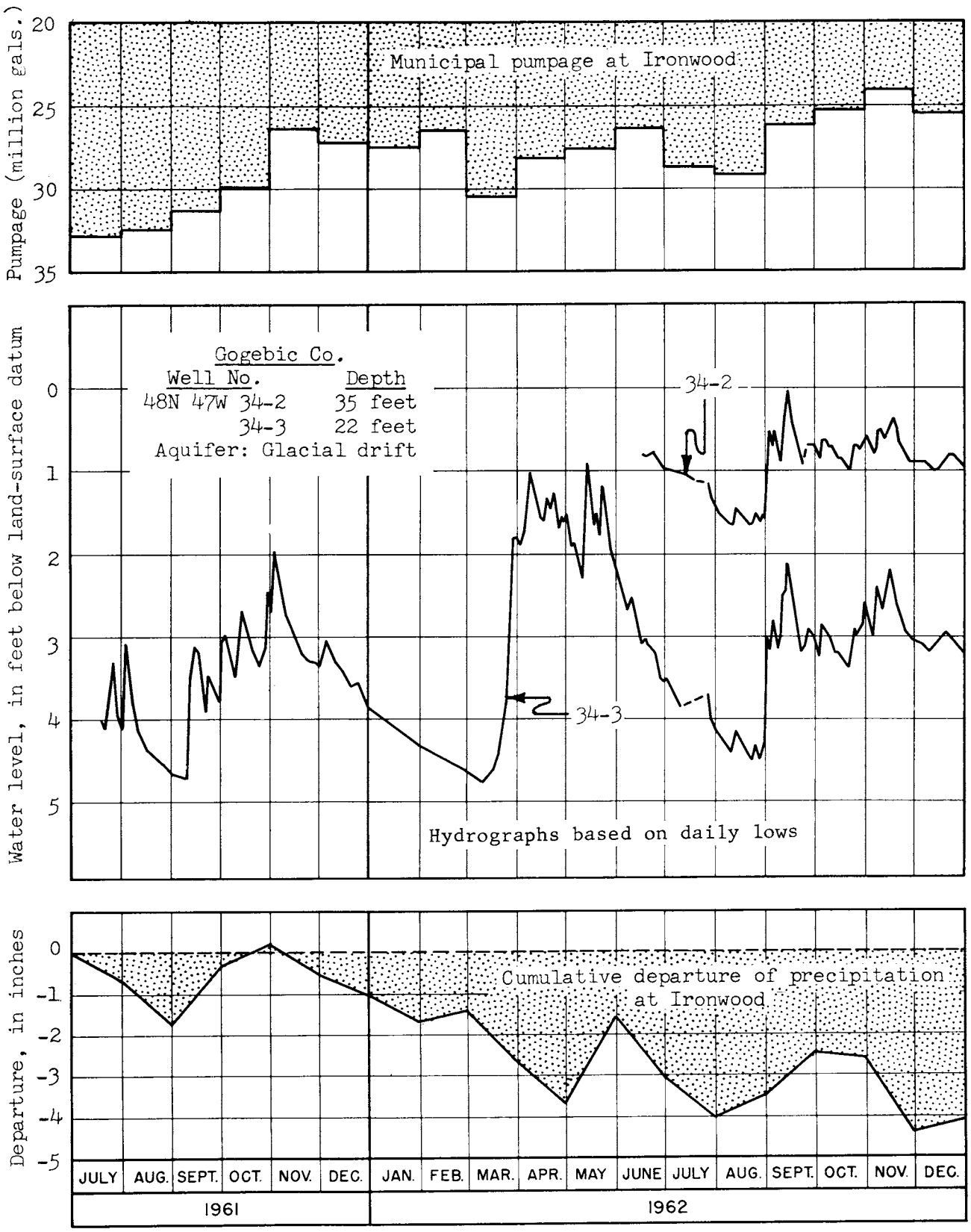


Figure 10. Hydrograph of two wells, pumpage, and precipitation, at Ironwood, 1961-62

Ontonagon County

Village of Ontonagon.--The Village obtains water for public supply from a tile infiltration gallery tapping the beach sand aquifer parallel to and near the shore of Lake Superior. When water is pumped, infiltration through the sand replenishes the gallery. Municipal withdrawal of water from the gallery by the Village was 175 million gallons in 1962 (table 2) or about 40 percent more than the 124 million gallons pumped in 1961.

A recording gage has been maintained since December 1960 in the gallery. Despite the 40 percent increase in pumping, water levels in the gallery showed little change in 1962 (fig. 11). The water levels principally reflect changes in recharge by infiltration from the Lake. Water levels in the gallery are lower in the winter as a result of colder and thus more viscous water (Giroux, 1961). In addition, lakeshore ice and lower lake levels reduce the area of infiltration. Pumping rates are controlled insofar as feasible to maintain water levels because the iron content of the water increases when levels in the gallery are drawn below about 14 feet.

Southern Peninsula

Barry County

City of Hastings.--Water supply is obtained from wells tapping the glacial drift aquifer at from 40-60 feet and from one well tapping sandstones of the Marshall Formation to a depth of 350 feet. Municipal withdrawals of ground water were reported as 396 million gallons (table 2), an increase of 48 mg over 1961 and only slightly less than the record 398 mg pumped in 1960.

The use of water from the deep well has allowed water levels to recover in the overlying drift aquifer (fig. 12) despite increased municipal pumpage and large deficiencies of precipitation totaling over 30 inches for the 1958-62 record. Water levels in the observation well were higher in 1962 than at any time during the period of record.

Bay County

Pinconning Township.--In August a recording gage was installed on an observation well finished in the Saginaw Formation in Pinconning Township to observe the effects in the area of pumping withdrawals of ground water and natural climatic effects on the ground-water levels(fig. 13)

The City of Pinconning nearby derives its water for municipal supply from an intake into Saginaw Bay, but in order to augment its supply began

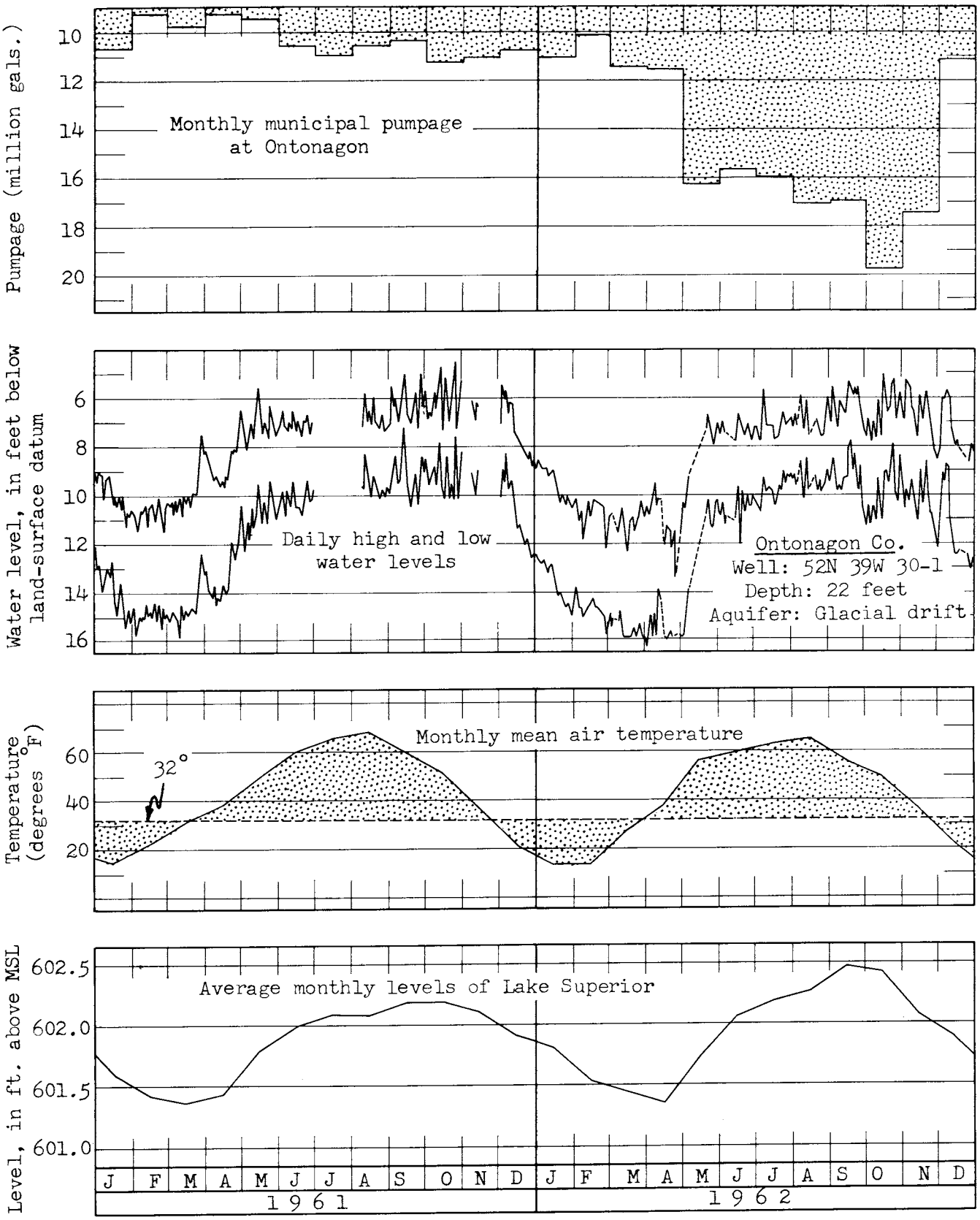


Figure 11. Hydrograph of gallery, pumpage, air temperature, and Lake Superior levels, at Ontonagon, 1961-62.

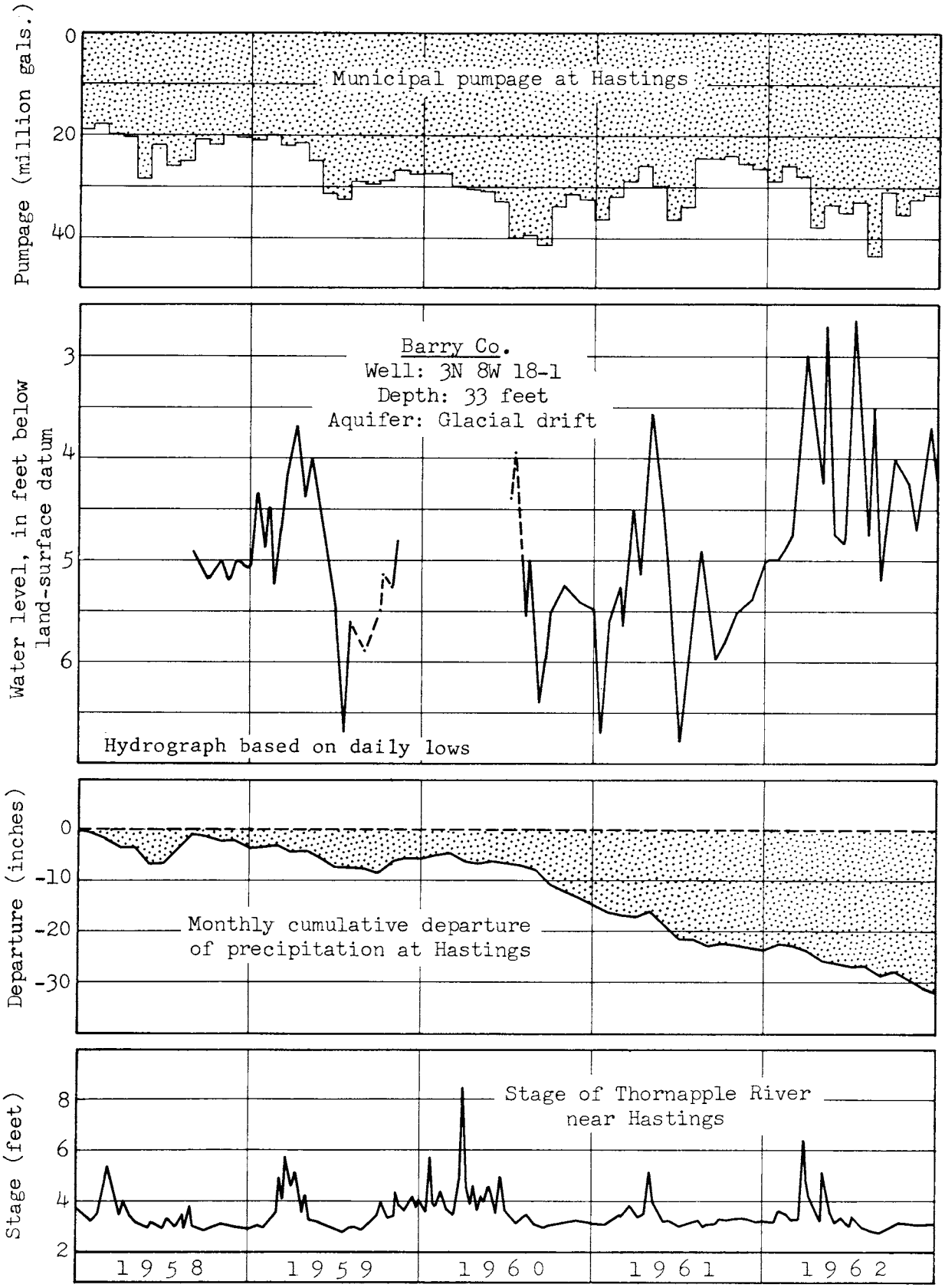


Figure 12. Hydrograph of well, pumpage, precipitation, and river stages, at Hastings, 1958-62.

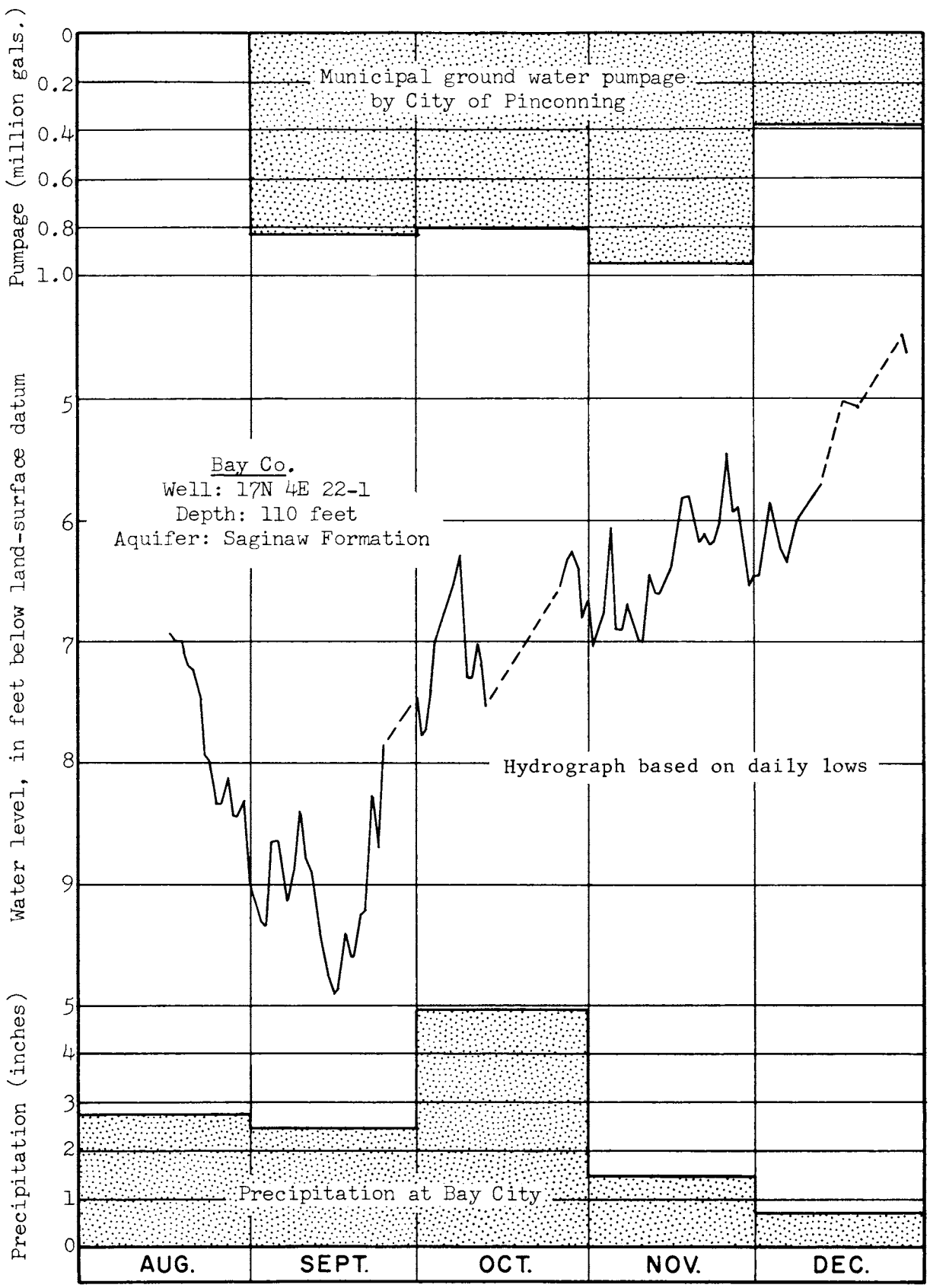


Figure 13. Hydrograph of well, pumpage, and precipitation, at Pinconning Township, 1962.

pumping in September 1962 from a well tapping the Saginaw Formation at the same depth and within a half mile of the observation well. The City pumped 2.9 million gallons of ground water (table 2) for municipal use in 1962.

Other wells measured periodically in the vicinity (table 1) showed the same general trend in ground-water levels.

Although pumping of the city well began in September, the water level in the township observation well generally rose from that time to the end of the year. The rising water level probably was caused by increased recharge after the end of the growing season. A longer period of record will be required to accurately evaluate the effects of pumping in this area.

Calhoun County

Battle Creek Metropolitan area.--Most municipal and industrial wells obtain water from sandstones of the Marshall Formation which underlies the glacial drift in the area. Water levels in the aquifer are generally within about 20 feet of land surface.

At Battle Creek's municipal well field -- Verona Station -- there are about 27 wells tapping the Marshall Formation to depths of 120-160 feet. A second station -- Goguac -- is supplied by wells finished in drift but is on a standby basis only. Total municipal pumpage reported by the City of Battle Creek was 3.5 billion gallons (table 2), a decrease of about 200 million gallons from 1961. In addition, the Township of Battle Creek pumped 345 million gallons for municipal use (table 2).

The effects of long-range municipal pumpage and precipitation variations are shown by figure 14. Despite heavy pumping and a deficiency of precipitation of nearly 30 inches in the 1955-62 period, water level trends in the observation well in the well field do not indicate any serious decline. The falling trend in the 1955-59 period was partly the result of precipitation deficiencies, for as evidenced by the graph, the subsequent relatively steady rate of pumping and near average precipitation of the past three years has resulted in water levels remaining at about the same height. It would thus appear that pumpage at the present rate could result in equilibrium between recharge to and discharge from the aquifer at the well field.

Figure 15 shows the effects of precipitation departures, and the deepening and lowering of the base level of the Kalamazoo River in mid-1958 below its confluence with the Battle Creek River. The new base level for ground water discharge has resulted in a lower range in water levels as evidenced by the two hydrographs in the center of the figure. The precipitation departures, as for example the 25 inches of deficiency in the 1955-58 period, indicate that precipitation has less effect than the base level of the Kalamazoo River, although it does appear to influence the levels in the shallow drift as shown by the hydrograph (3-1) at the top of figure 15.

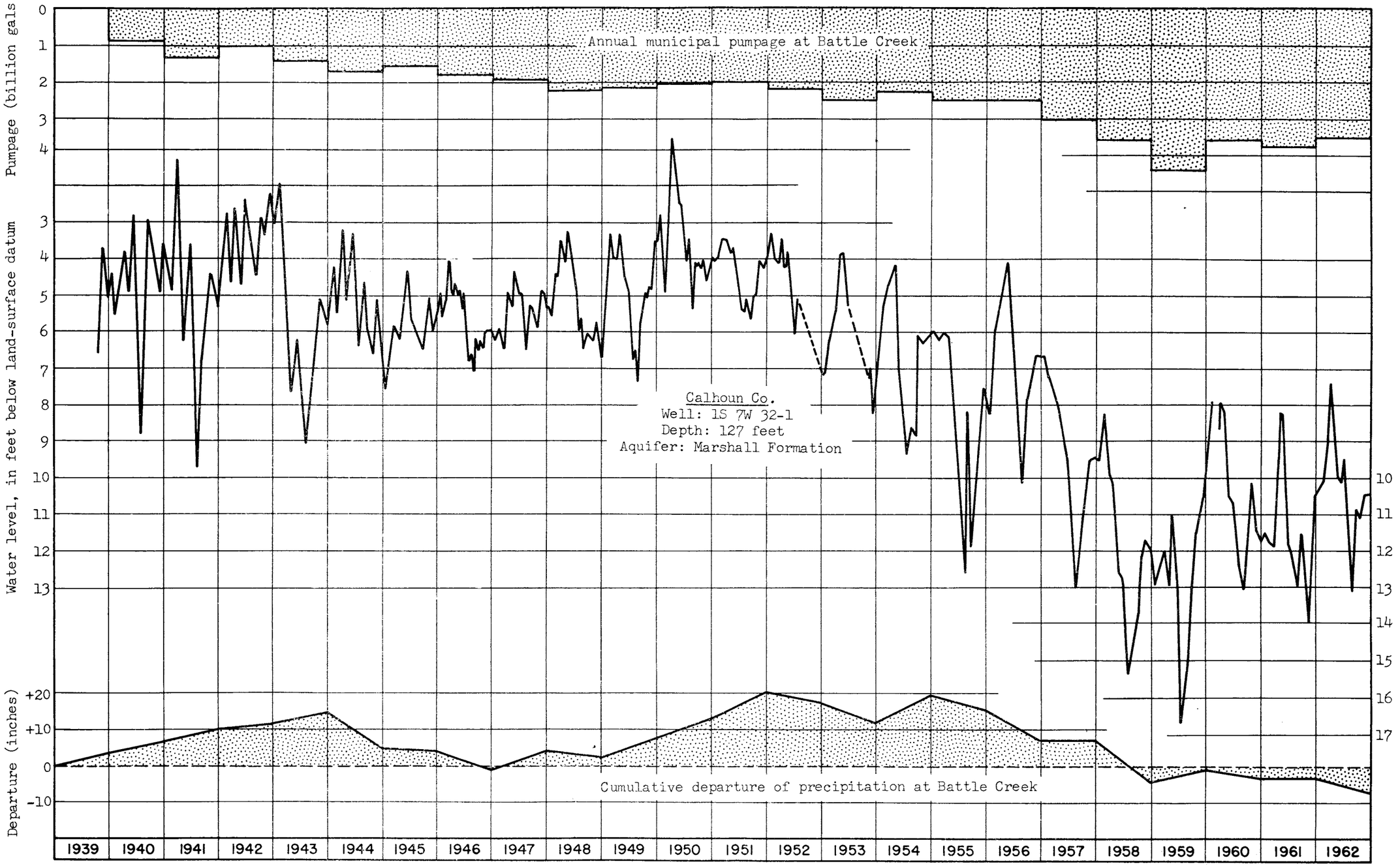


Figure 14. Hydrograph of well at Verona Station, pumpage, and precipitation, at Battle Creek, 1939-62.

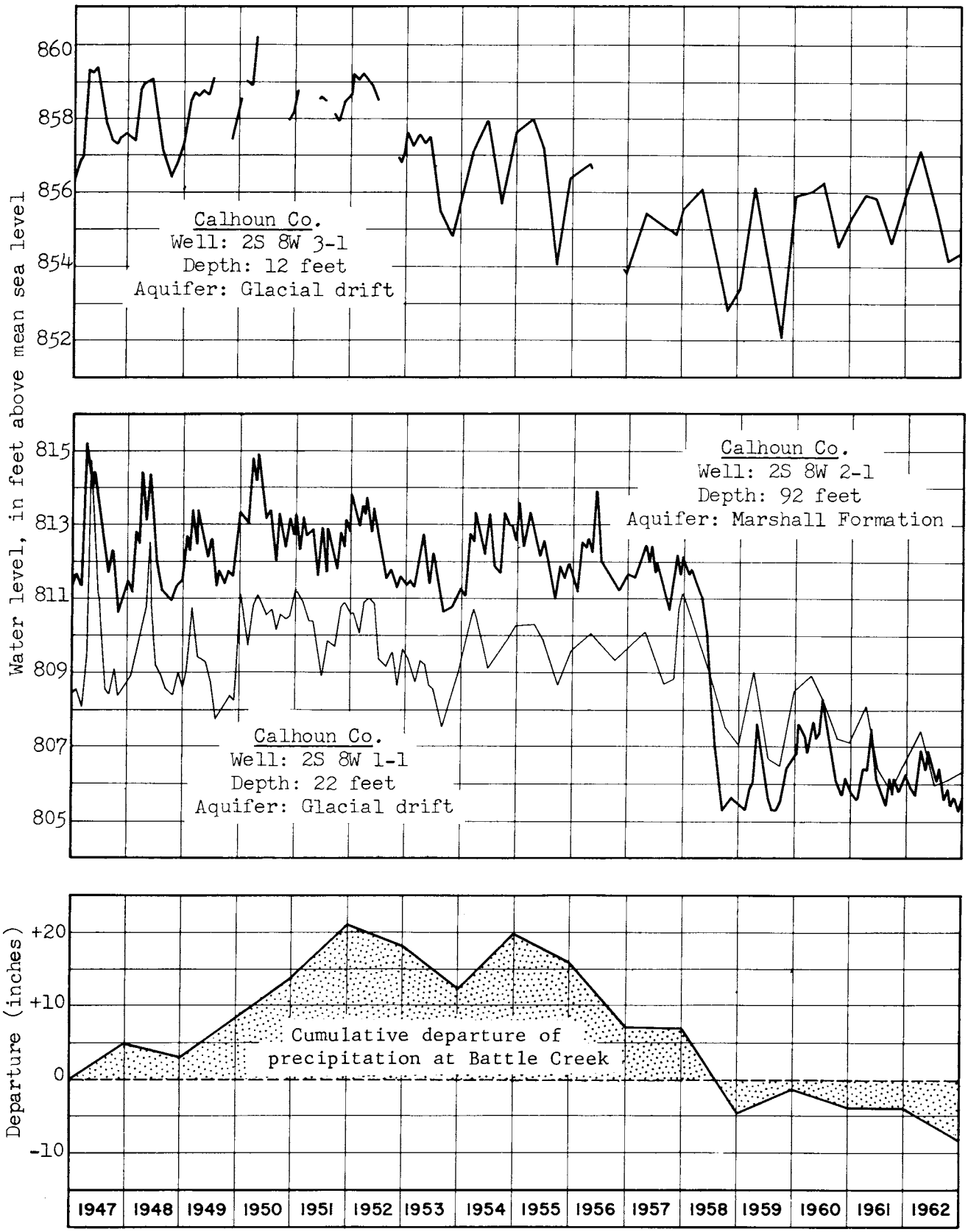


Figure 15. Hydrographs of three wells, and precipitation, at Battle Creek, 1947-62.

Although precipitation was deficient in 1962, area water levels (table 1) were somewhat higher than the record lows experienced in 1959.

Clinton County

City of St. Johns.--The City obtains water for municipal supply from four wells finished at depths of about 500 feet in the Saginaw Formation, consisting mostly of shales and sandstones. In 1962 pumpage amounted to 324 million gallons or three times the amount pumped in 1947.

In November, 1962, a recording gage was installed on an unused well at the municipal well field. Large fluctuations of water level occur as municipal pumps are turned on and off. Water levels in the observation well ranged from 72 to 112 feet below land surface in the November and December period of record (table 1). An example of a two-day period of water level changes is shown by figure 16. This is a copy of an actual chart as removed from the recording gage.

Although no conclusions of trends can be drawn from the short period of record in 1962, measurements made in 1947 in a nearby well show that ground-water levels ranged from 36 to 50 feet at that time. This would indicate a decline in water levels of about two feet a year since 1947.

Eaton County

City of Grand Ledge.--The three municipal wells and two observation wells are finished in the Saginaw Formation at depths of 190 to 400 feet. Total reported municipal pumpage by the City of Grand Ledge (table 2) was 153 million gallons, a slight decrease from the 156 mg reported in 1961.

Figure 17 is an extension of the illustration that appeared in the 1961 report of this series. Observation wells 2-1 and 11-1 are about one mile, and one-third of a mile respectively from municipal pumping well number 2. Water levels in observation well 11-1 are quickly affected by withdrawals of water from well 2. However, no persistent decline of water levels is indicated at the present rate of pumpage. Water levels in observation well 2-1 generally follows the same trends, but the fluctuations are minimized by the greater distance from pumpage. Precipitation changes do not seem to have a strong effect on the water levels in comparison to pumpage.

Genesee County

Flint Metropolitan Area.--The City of Flint obtains its municipal supply from the Flint River. Burton Township on the southern outskirts, Beecher Metropolitan Water District to the north, and some industries obtain water from the Saginaw Formation or the overlying glacial drift.

Observation wells in the area finished in the glacial drift (table 1) were at or near records lows reflecting dryness and pumpage from

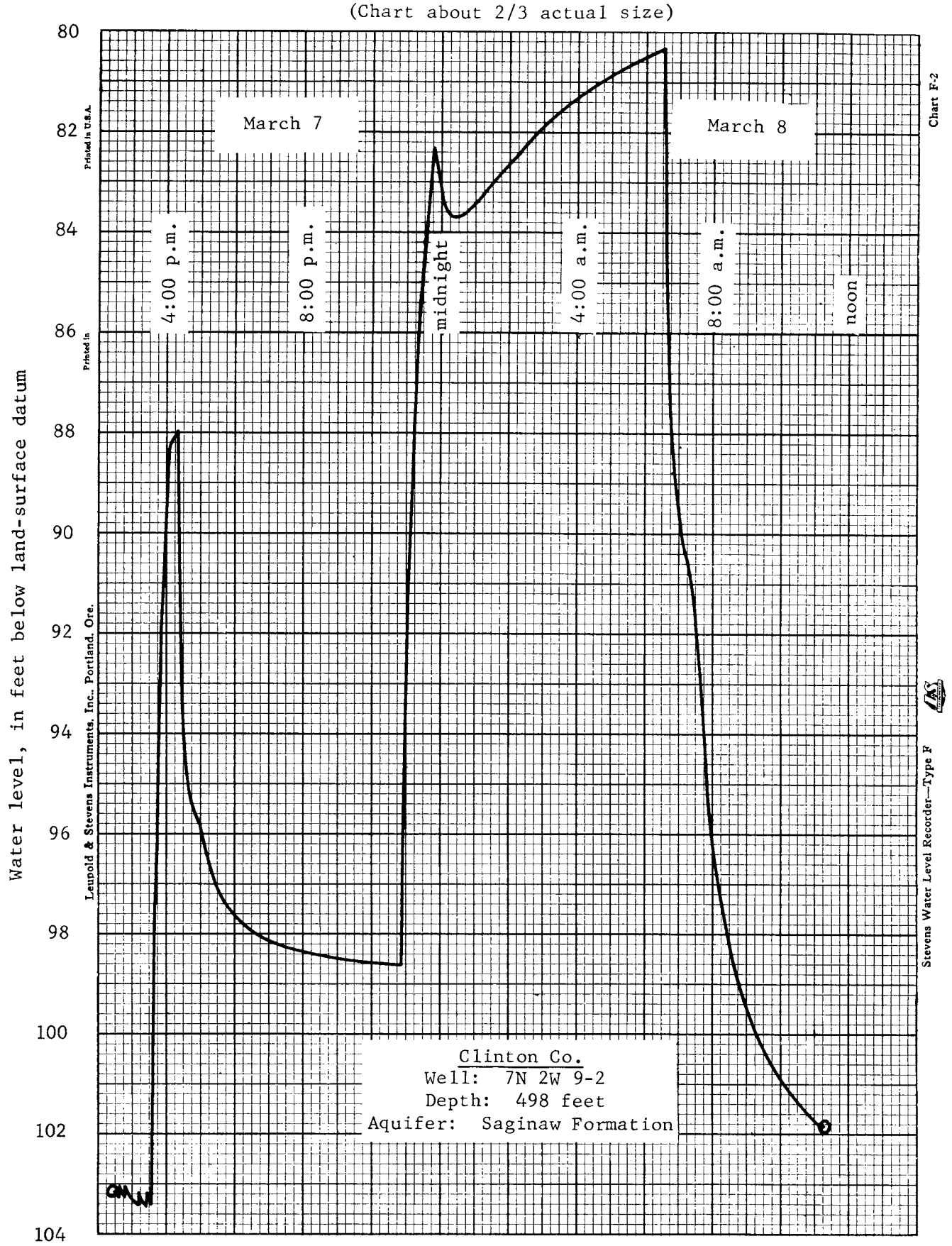


Figure 16. Hydrograph from continuous recording gage on well at St. Johns, March 7-8, 1963.

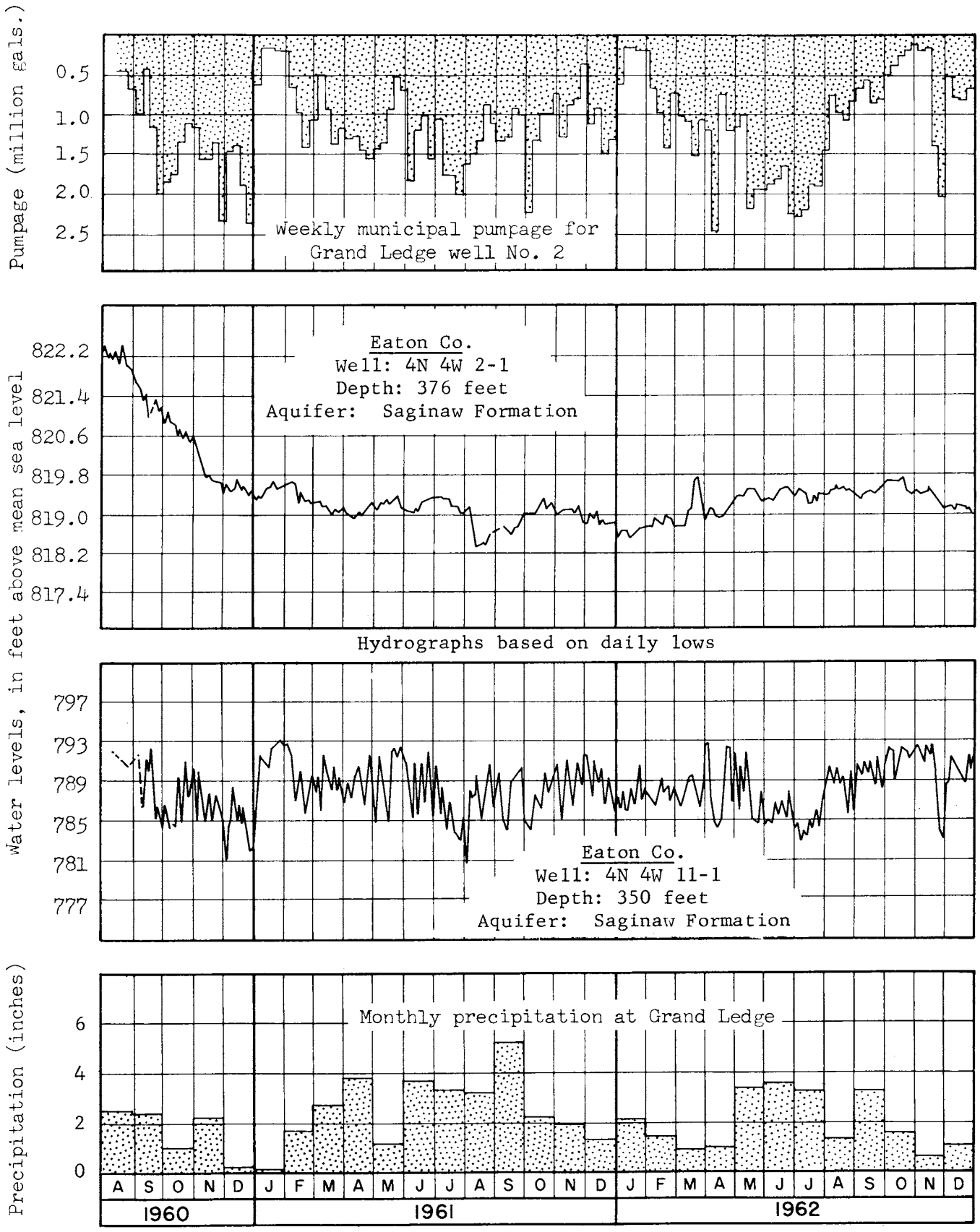


Figure 17. Hydrographs of two wells, pumpage, and precipitation, at Grand Ledge, 1960-62.

the drift. However, observation well 7N 7E 17-1 finished in the Saginaw Formation was more than six feet above the record low observed in 1955 probably reflecting the discontinuance of pumpage from the Saginaw Formation by Burton Township.

At Grand Blanc, an observation well is maintained at the Fisher Body Plant well field of General Motors Corporation. Reported pumpage at the Plant was 80.7 million gallons (table 2), slightly less than the record 82.9 mg withdrawn in 1961. A general trend of declining water levels from 1958 continued through the year 1962. The lowering was the result of relatively heavy pumping beginning in 1959 and was aggravated by a deficiency of about 15 inches in precipitation in the 1960-62 period (fig. 18). In 1962 this observation well was plugged back to 235 feet from its original depth of 375 feet so that it would be in the same horizon as the three pumping wells that are finished at depths of 230 to 275 feet.

Gratiot County

City of Alma.--The City obtains ground water for municipal use from five wells, 82 to 164 feet deep. These wells and a few industrial wells tap buried outwash deposits. A sixth municipal well, 550 feet deep, taps the underlying Saginaw Formation, but is seldom used because the water is of poor quality. Reported municipal pumpage by the City of Alma totaled 606 million gallons in 1962 (table 2) as compared to 604 in 1961 and 645 in 1960.

Water levels in TW 6 (fig. 19) reflect changes in pumpage patterns and rates by the City. Stages in 1962 were generally lower, mostly as the result of deficient precipitation inasmuch as total pumpage for the year was about the same as in 1961. A new low for the six-year period of record was established in July (table 1).

City of St. Louis.--As in Alma, municipal and industrial supplies are obtained from buried outwash deposits, but wells are finished at depths of from 213 to 223 feet. Reported municipal withdrawals of ground water at St. Louis totaled 232 million gallons (table 2) as compared to 218 and 262, in 1961 and 1960 respectively. Effects of pumping the city's six wells and some industrial wells are observed by means of a recording gage on unused city well no. 3. Despite deficient precipitation and some increase in municipal pumpage in 1962 (fig. 19) the rising trend in water levels continued.

Ingham County

Lansing Metropolitan area.--Most wells in the area obtain water from the Saginaw Formation. A few tap the overlying glacial drift for domestic supplies. Municipal, institutional, and township wells tap the Saginaw Formation and are finished at depths ranging from 300 to 500 feet. Total reported withdrawals of ground-water by municipal, industrial, and institutional wells in the metropolitan area (table 2) was a record 9.3 billion gallons or an increase of 1.2 billion gallons over 1961.

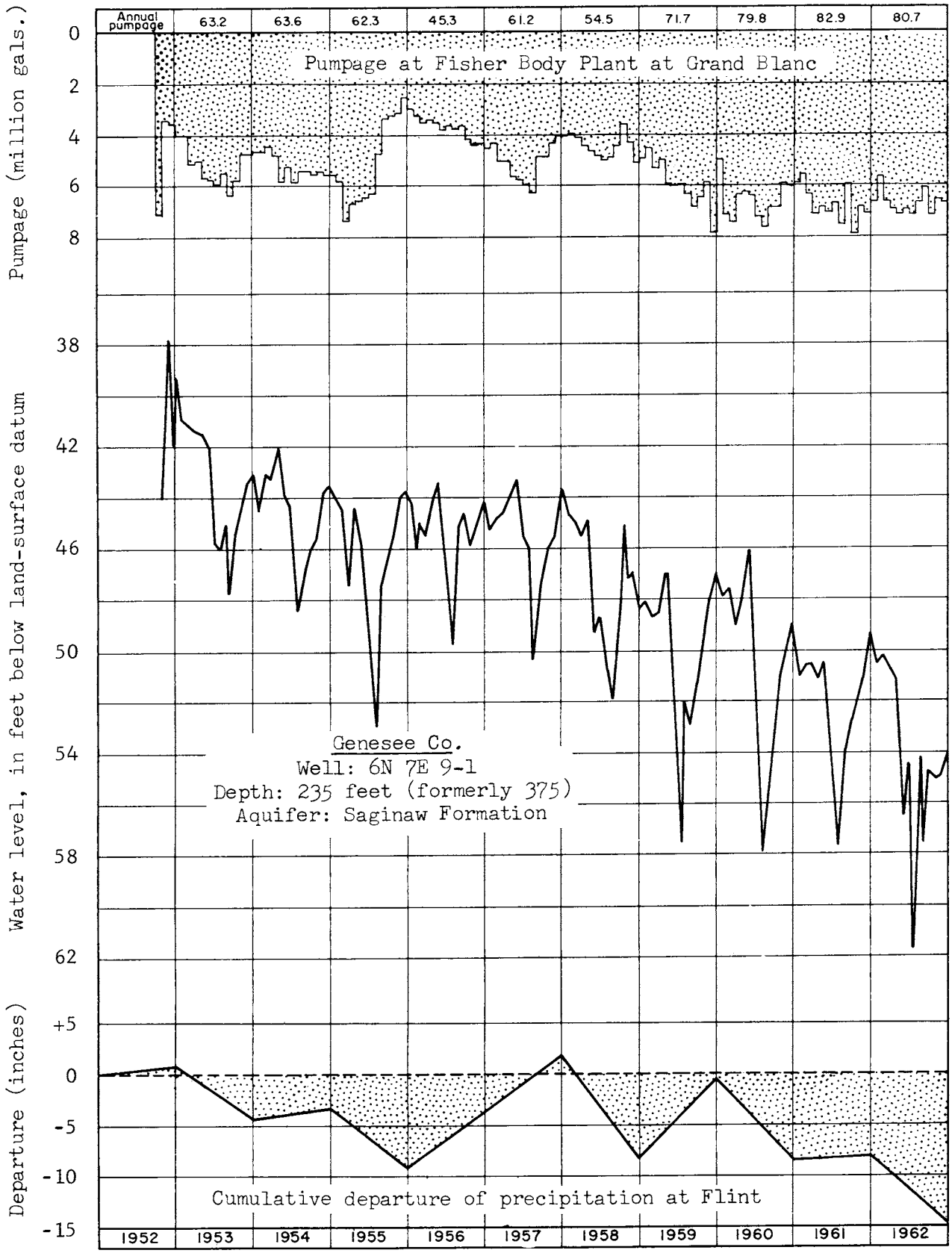


Figure 18. Hydrograph of well, pumpage, and precipitation, at Fisher Body Plant near Grand Blanc, 1952-62.

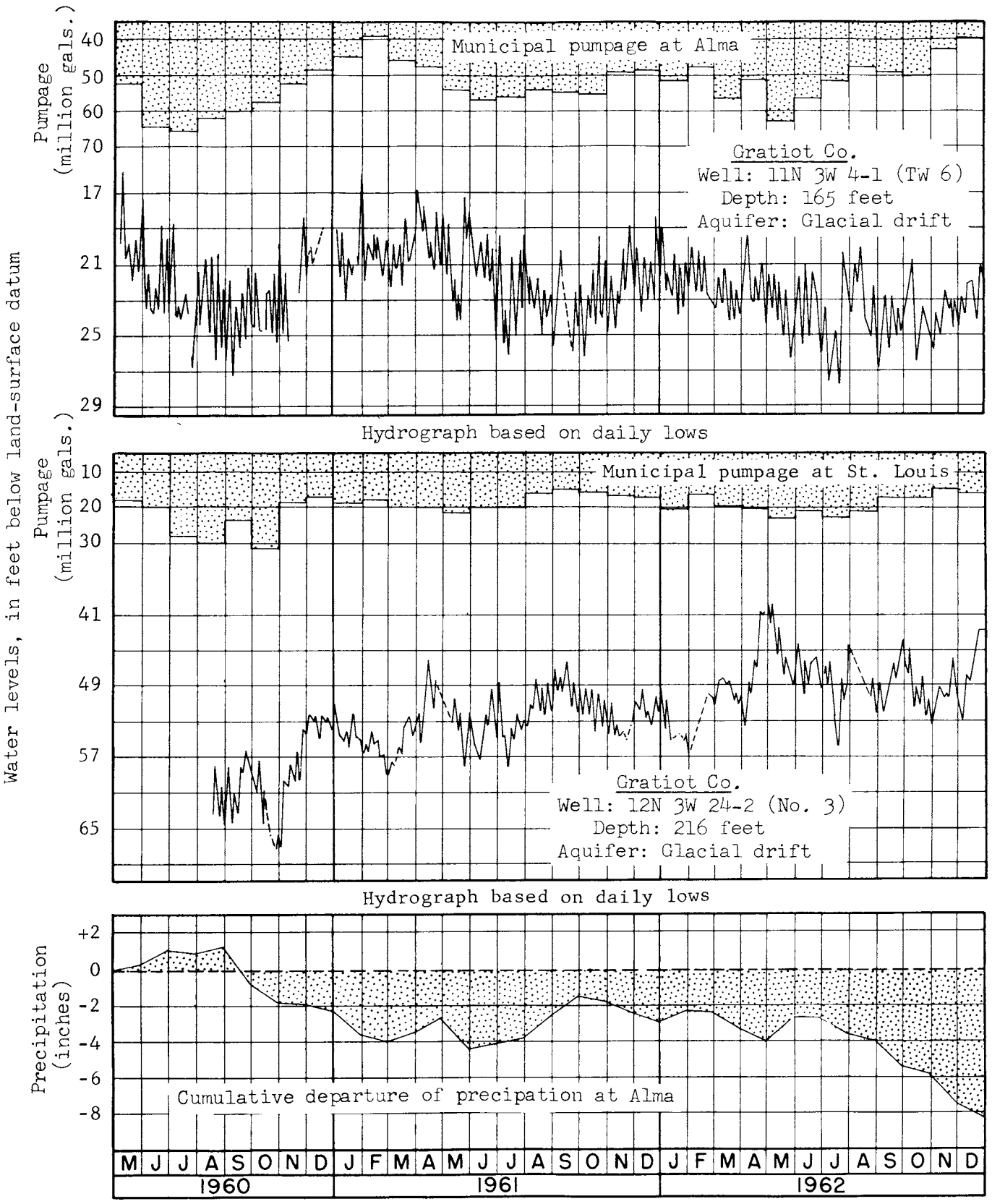


Figure 19. Hydrographs of wells, municipal pumpage, and precipitation, at Alma and St. Louis, 1960-62

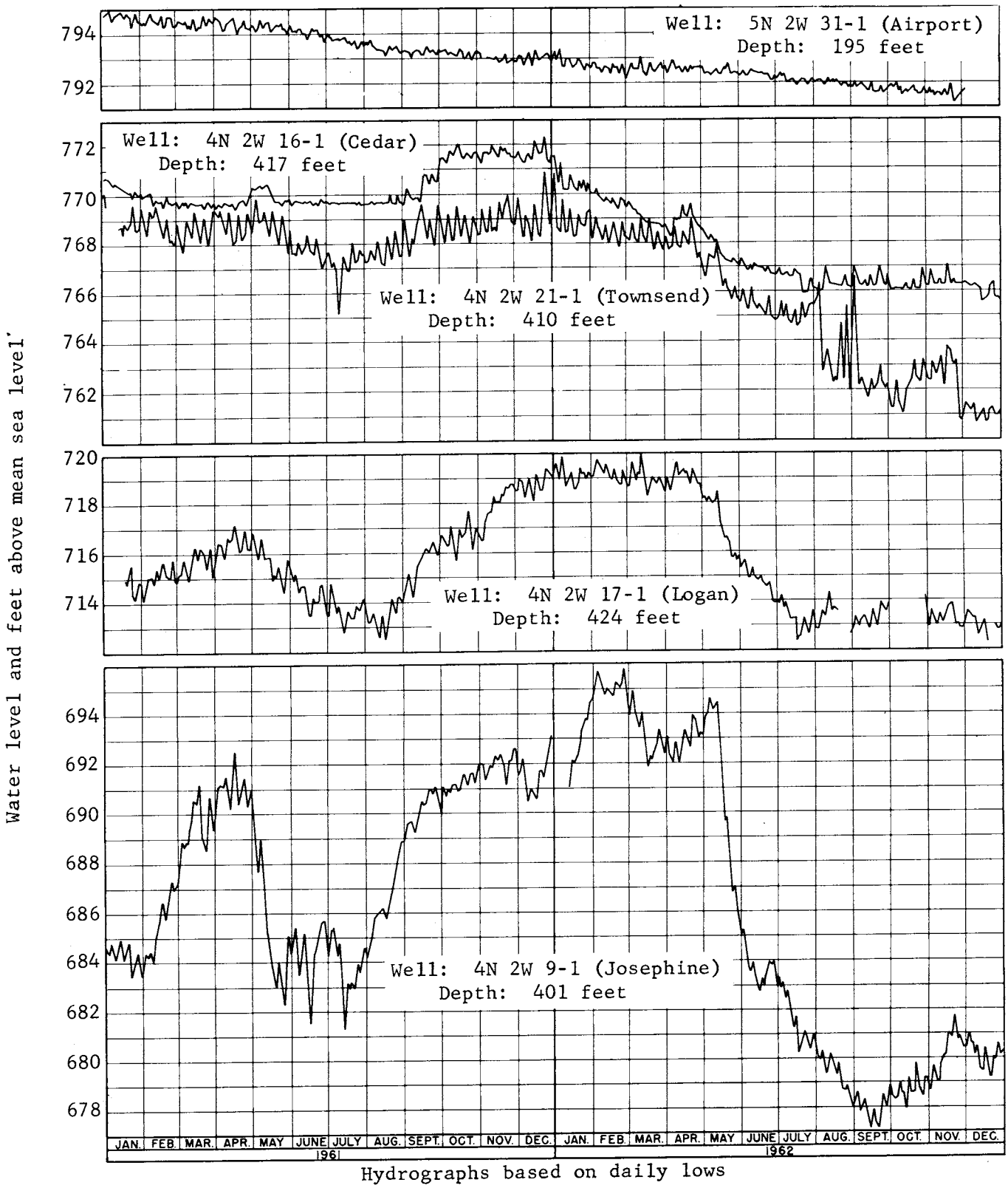


Figure 20. Hydrographs of five wells tapping the Saginaw Formation in the Greater Lansing area, 1961-62.

Most observation wells in the Lansing area, that includes parts of Ingham, Eaton, and Clinton Counties, reflect the large withdrawals of ground water from the Saginaw aquifer. In 1962, ten of the nineteen observation wells in the area fell to new lows of record (table 1) as the result of increased pumping and large deficiencies of precipitation. In the 1958-62 period a deficiency of about 27 inches or nearly a year's normal rainfall has been recorded.

Hydrographs for the period 1961-62, based on records from five of the eight recording gages maintained in the area, are shown by figure 20. Owing to changes in pumpage distribution patterns in the area, only the Clinton County (Airport) well of the five illustrated was at a low of record.

The long-term record of five observation wells in Lansing (fig. 21) shows among other things the effect of changes in pumpage distribution on wells 9-1 and 17-1 after they had fallen to record lows in early 1956. Despite the increased overall pumpage and general dryness since 1956, levels have been maintained so that no further decline has occurred in these areas. In addition, stages in wells 21-1 and 22-1 have also remained within a 10-foot range during the last four years.

Most of the record low levels observed in the environs of the City of Lansing were the result of dryness and pumping in the rapidly expanding suburban areas that require more water for irrigation of lawns and other uses.

Jackson County

City of Jackson.--The City and most large industrial water users obtain supplies from wells finished in the Saginaw, Parma, and Marshall Formations to depths of 380 to 400 feet. Eleven of the 14 municipal wells are located at the Belden Road Well field. Reported municipal pumpage of ground water at Jackson totaled 4.2 billion gallons in 1962 (table 2), or 100 million gallons more than in 1961. In addition, wells at the State Prison at Jackson pumped a reported 531 million gallons in 1962.

Water levels in two observation wells (fig. 22) show the effects of withdrawals of water from the sandstone stratas. Well 2-1 is located 1.1 miles, and well 10-1, 1.7 miles from the Belden Well field. Despite large drawdowns water levels quickly recover when pumping decreases. Although water levels fell to record lows during 1962 as a result of heavy municipal pumping, stages by year's end were about the same as at the end of 1961. For the period illustrated a precipitation deficiency of 16 inches or about a half-year's rainfall has been recorded.

Additional recording gages were installed in 1962 on an observation well finished in glacial drift, and on the Grand River nearby to observe whether hydraulic connection exists between the sandstone aquifer, the drift, and the Grand River (fig. 23). Some correlation is evident between the stages of the Grand River and the water levels in the drift well. No short-term correlation with pumping of the sandstone aquifer is apparent.

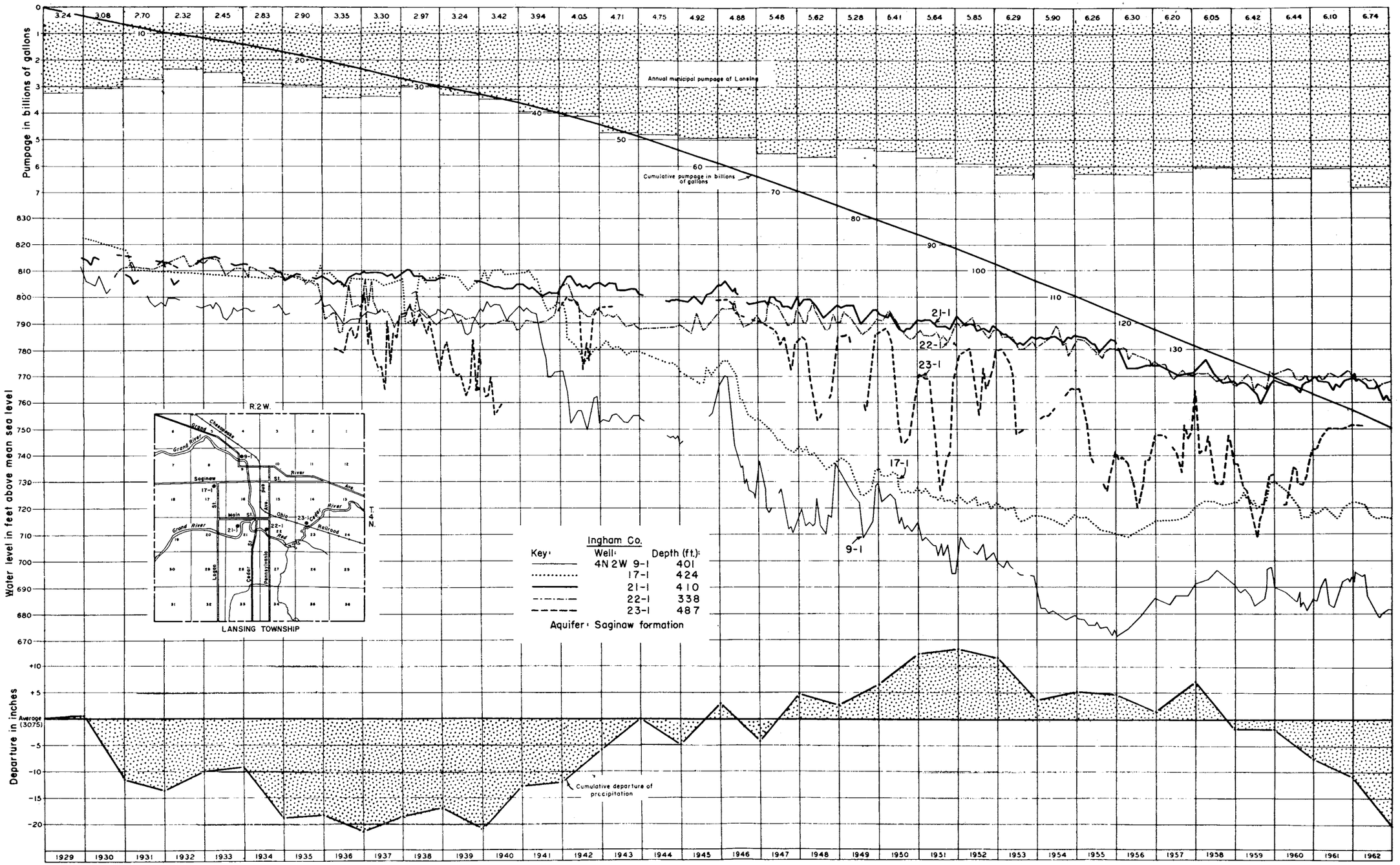


Figure 21. Hydrographs of five wells, pumpage, and precipitation, at Lansing, 1929-62.

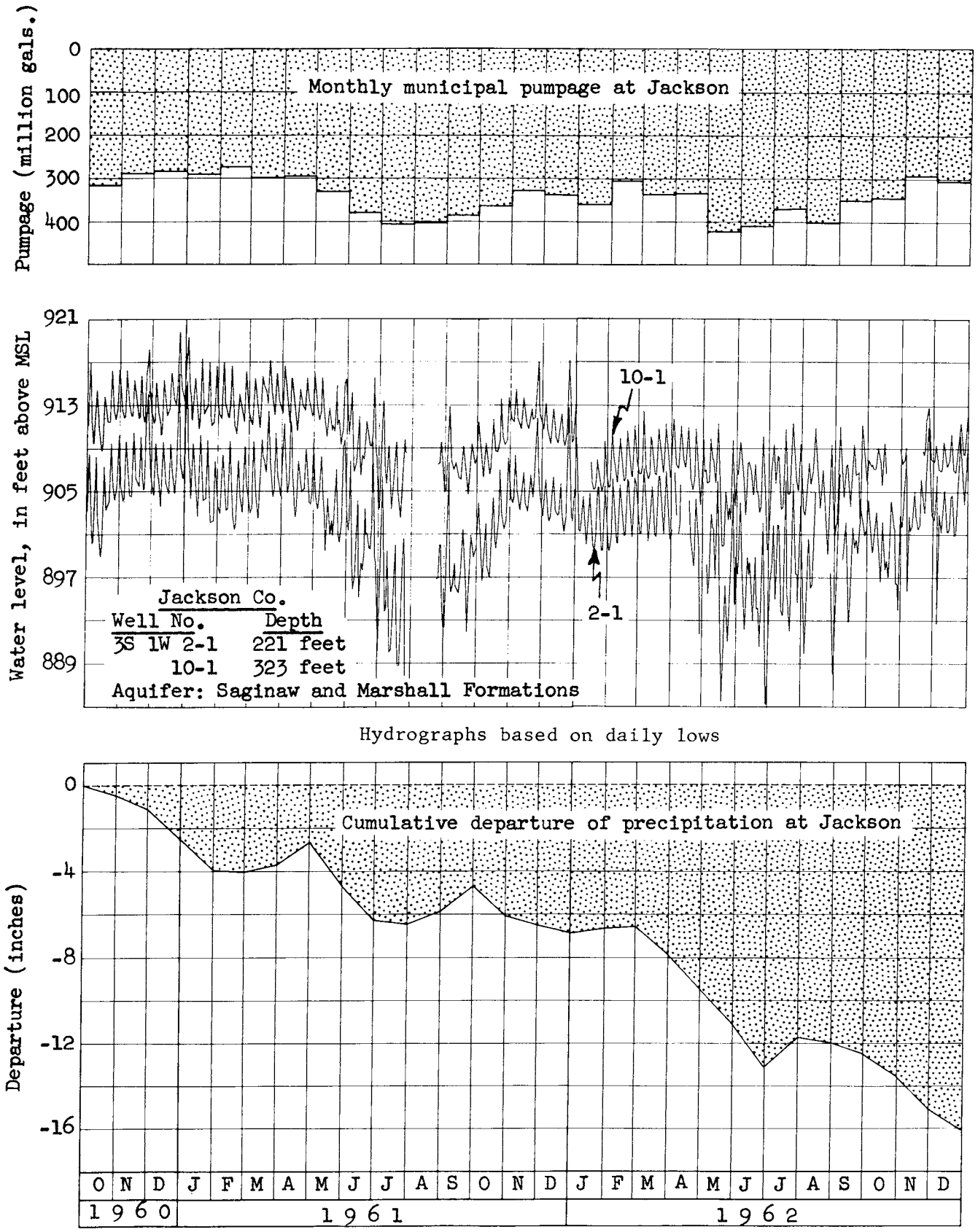


Figure 22. Hydrograph of two wells, pumpage, and precipitation, at Jackson, 1960-62.

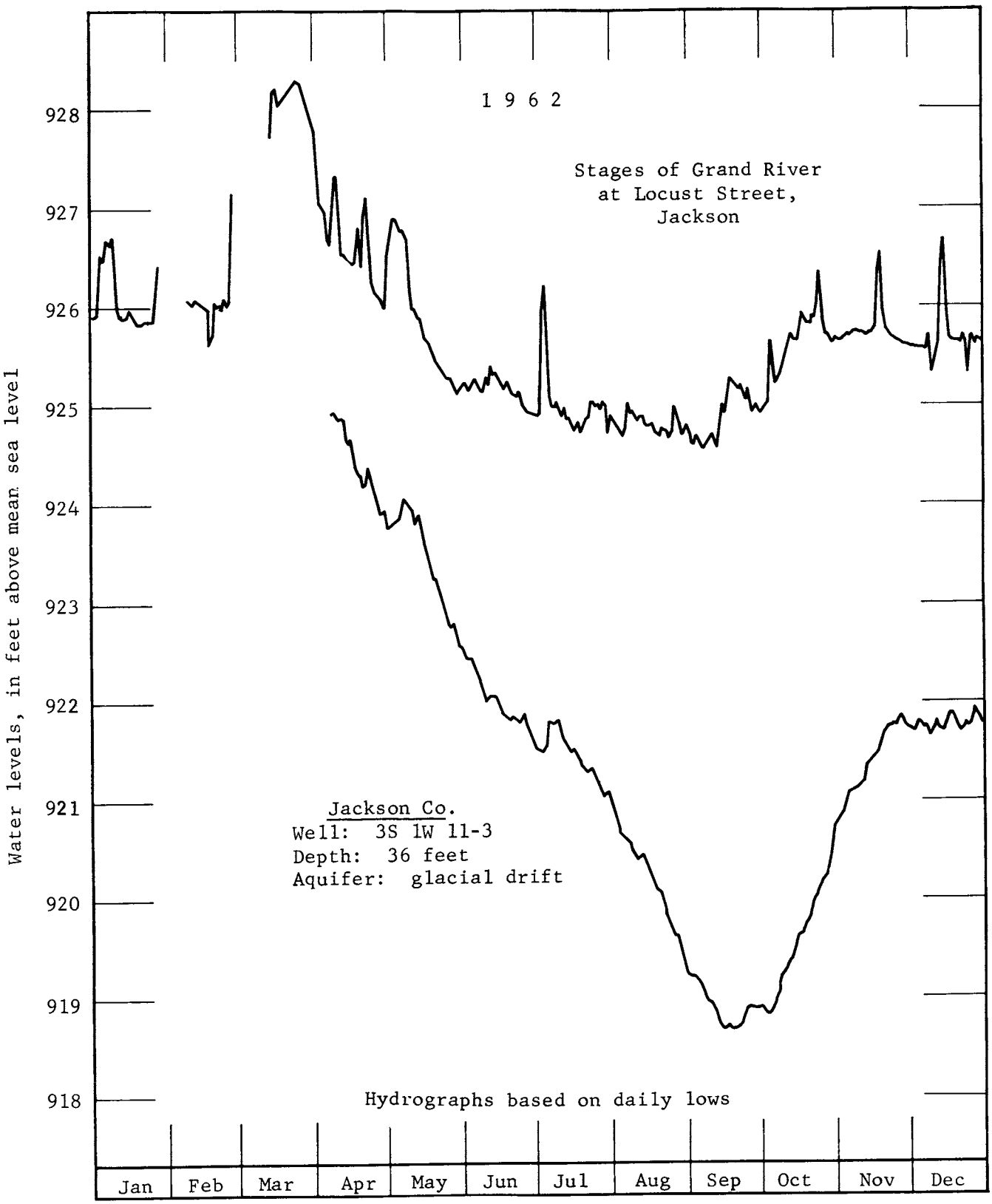


Figure 23. Hydrograph of well, and river stage at Belden Road well field, Jackson, 1962.

However, the water levels in the drift well are lower than the stage of the nearby Grand River. This reversal of expected water-table gradient, which normally would be toward the river, suggests some long-term discharge of water from the drift to the sandstone.

Kalamazoo County

City of Kalamazoo.--The glacial drift consitutes the only source of potable ground water in the area. About 75 municipal and many industrial wells pump large amounts from the drift aquifers. Municipal pumpage was reported as 4.7 billion gallons for 1962 (table 2), about 200 million gallons less than in 1961.

Four recording gages are maintained in the area, and periodic measurements are made in several wells (table 2).

Municipal well fields are generally located in areas where recharge from surface ponds or streams can be induced into the aquifer by pumping. As a result, ground-water levels in the well fields have been maintained at relatively high stages for many years by controlled withdrawals to balance recharge with discharge by municipal wells. For example, the Axtell Creek area well fields have been used for over 90 years. The average pumpage from Axtell area for the period illustrated (fig. 24) has been about three billion gallons annually and no significant dewatering has occurred except as a result of precipitation deficiencies. Since 1952 a total deficiency in rainfall of 40 inches has accumulated at Kalamazoo. This amounts to a total loss of over a year's annual precipitation. However, despite this loss, water levels have recovered since the record low in 1959. This rising trend has resulted mostly from reduced municipal withdrawals in the Axtell area. Pumpage was less in the fall of 1961 and in 1962 when a drop of 500 million gallons of pumpage was reported.

Levels in observation wells A and A-s (fig. 25) reflect changes in pumping withdrawals by municipal wells at Station 9. Here, water has been diverted into a pond from Portage Creek and when withdrawals are made from the artesian aquifer levels are lowered in both this aquifer (Well A) and the water table aquifer (Well A-s). The correlation between the daily pumping rates and the water levels in the aquifer is quite evident. In the winter and early spring, water levels remained high as a result of the low and steady pumping. The subsequent heavier pumping resulted in low water levels during most of the remainder of the year. Stages quickly recovered when pumping was stopped, as in the latter part of October. The heavy pumping and precipitation deficiencies resulted in slightly lower levels at the end of the year.

Other wells in the area were in the low range or at lows for the period of record (table 1) principally as the result of the accumulated deficiencies in precipitation.

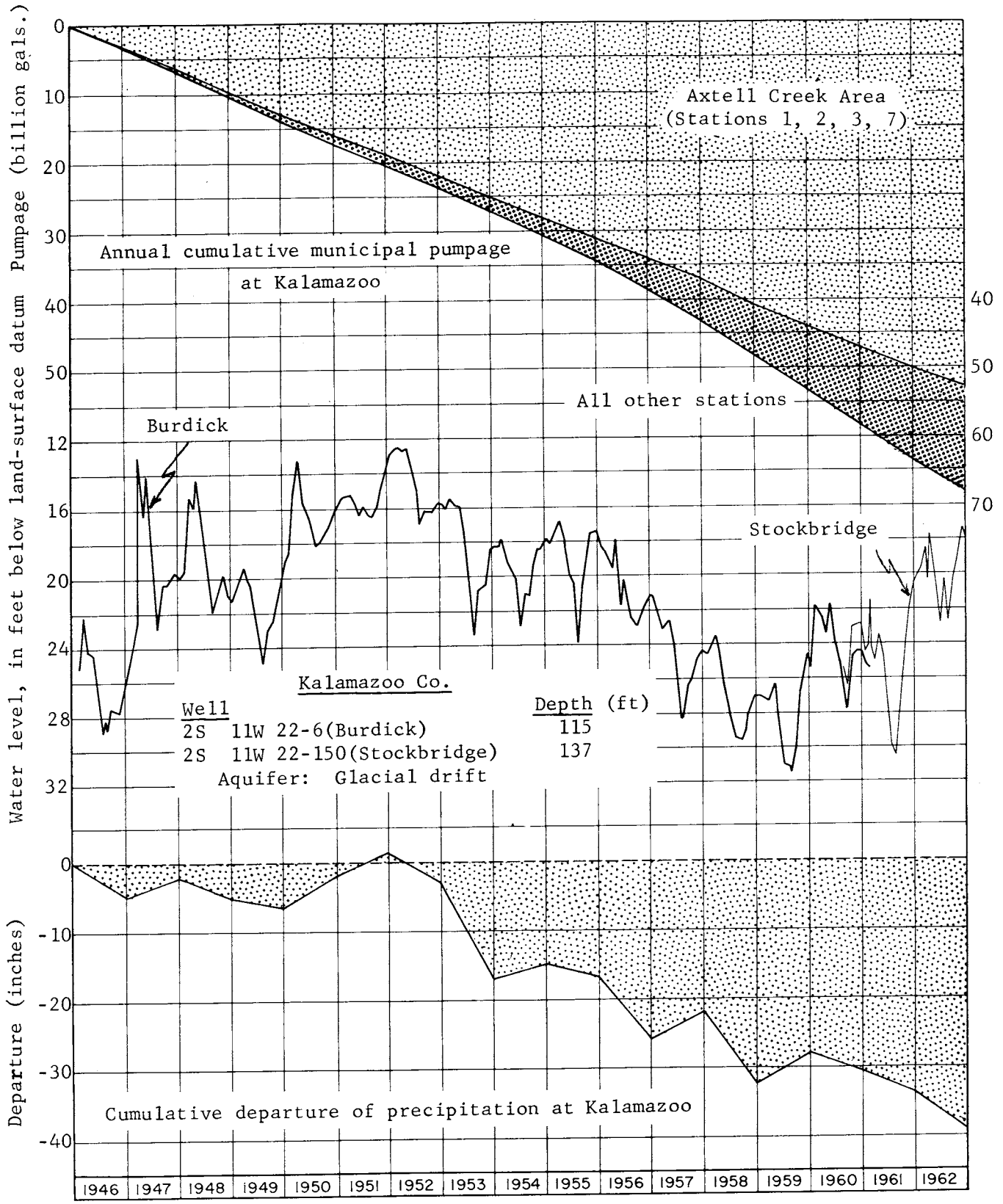


Figure 24. Hydrographs of two wells, pumpage, and precipitation, at Kalamazoo, 1946-62.

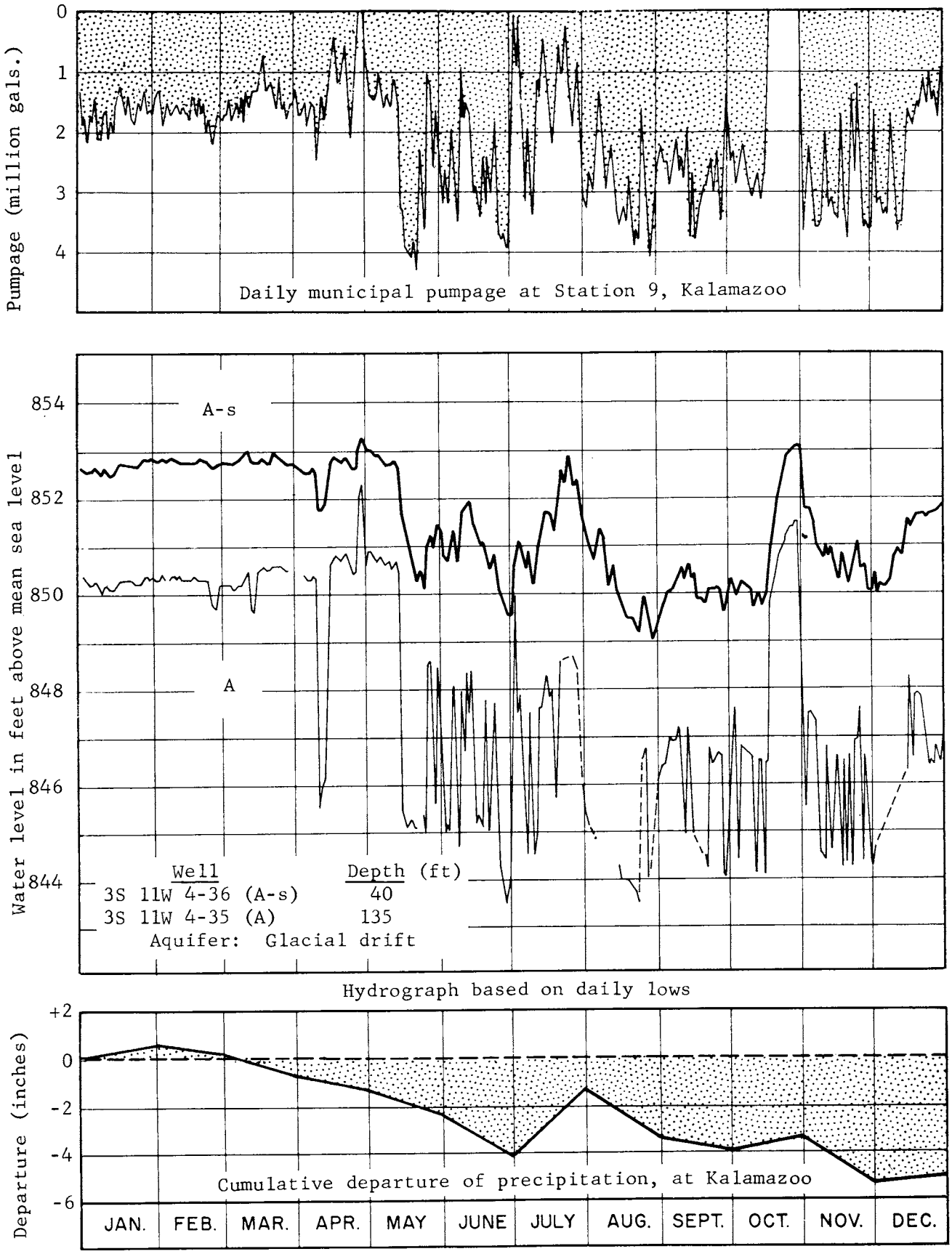


Figure 25. Hydrographs of two wells, pumpage, and precipitation, at Kalamazoo, 1962.

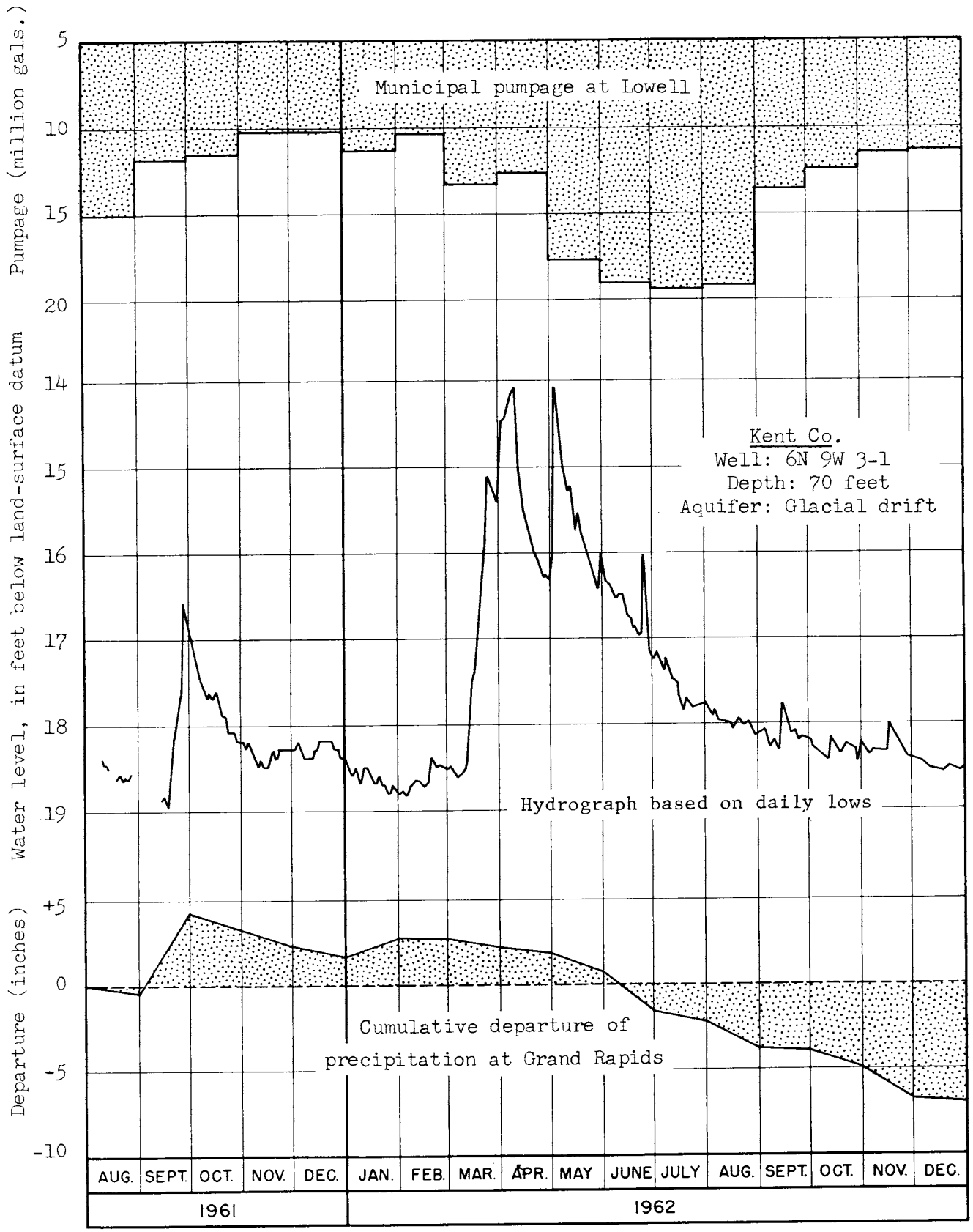


Figure 26. Hydrograph of well, pumpage, and precipitation, at Lowell, 1961-62.

Kent County

City of Lowell.--The City's municipal supply is obtained from four wells finished in the glacial drift aquifers at depths of 50 to 70 feet. Municipal pumpage for the year (table 2) was reported as 172 million gallons, or an increase of 29 mg over 1961.

A recording gage is maintained on an unused municipal well.

Pumping of three nearby wells and precipitation variations seem to have only temporary effects (fig. 26). Despite about eight inches of deficiency in rainfall in 1962 ground-water levels were about the same as at the end of the previous year. Water-levels may be affected by stages of nearby streams. Ground-water levels rise and fall sharply at about the same time as the nearby surface streams. Variations in base levels for ground-water discharge are probably created by the changes in stage of the streams.

City of Wyoming.--The City obtains water for municipal supply from 24 wells -- eight finished in the Marshall Formation at an average of about 225 feet and 16 in the overlying glacial drift at depths averaging 50 feet. Municipal pumpage was reported as 2,131 million gallons for 1962 (table 2). This was 320 mg more than in 1961 and 602 mg more than in 1960.

Despite the large increases in pumping and deficient precipitation, water levels in two observation wells in the Marshall Formation (fig. 27) showed no significant long-term declines in stage. Short-term fluctuations in water levels in these wells correlate with pumping of municipal wells.

In late 1962, four additional recording gages were installed to observe water levels in the drift and rock aquifers at greater distances from the effects of pumping by the City (fig. 28). Water levels shown in the first three hydrographs varied only slightly during the year and showed little change from the effects of municipal pumping. The lower hydrograph in the figure reflects pumping from Well Field No. 6 about a mile away. Fluctuations are small, however, and within about a half-foot range. It should be noted that all these graphs cover only a short period and the record from a period of the year when pumpage was low.

The location of municipal well fields in relation to observation wells is shown by fig. 29. Listed below are the municipal well fields and the number of wells in the drift or bedrock at each location.

Well field	Drift	Rock
1	4	2
2	2	1
3	5	1
4	4	-
5	1	-
6	-	3
7	-	1

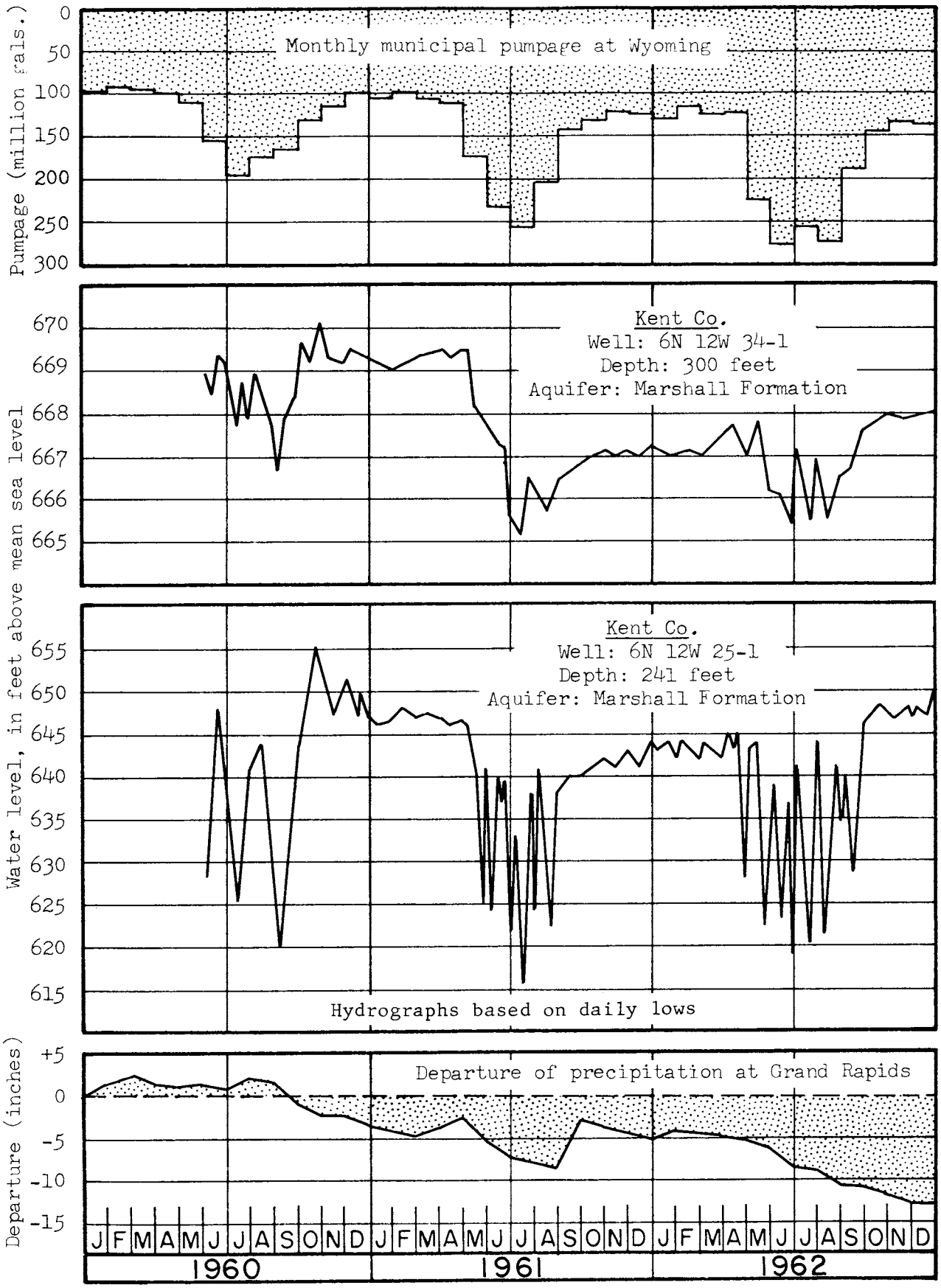


Figure 27. Hydrographs of two wells, pumpage, and precipitation, at Wyoming, 1960-62.

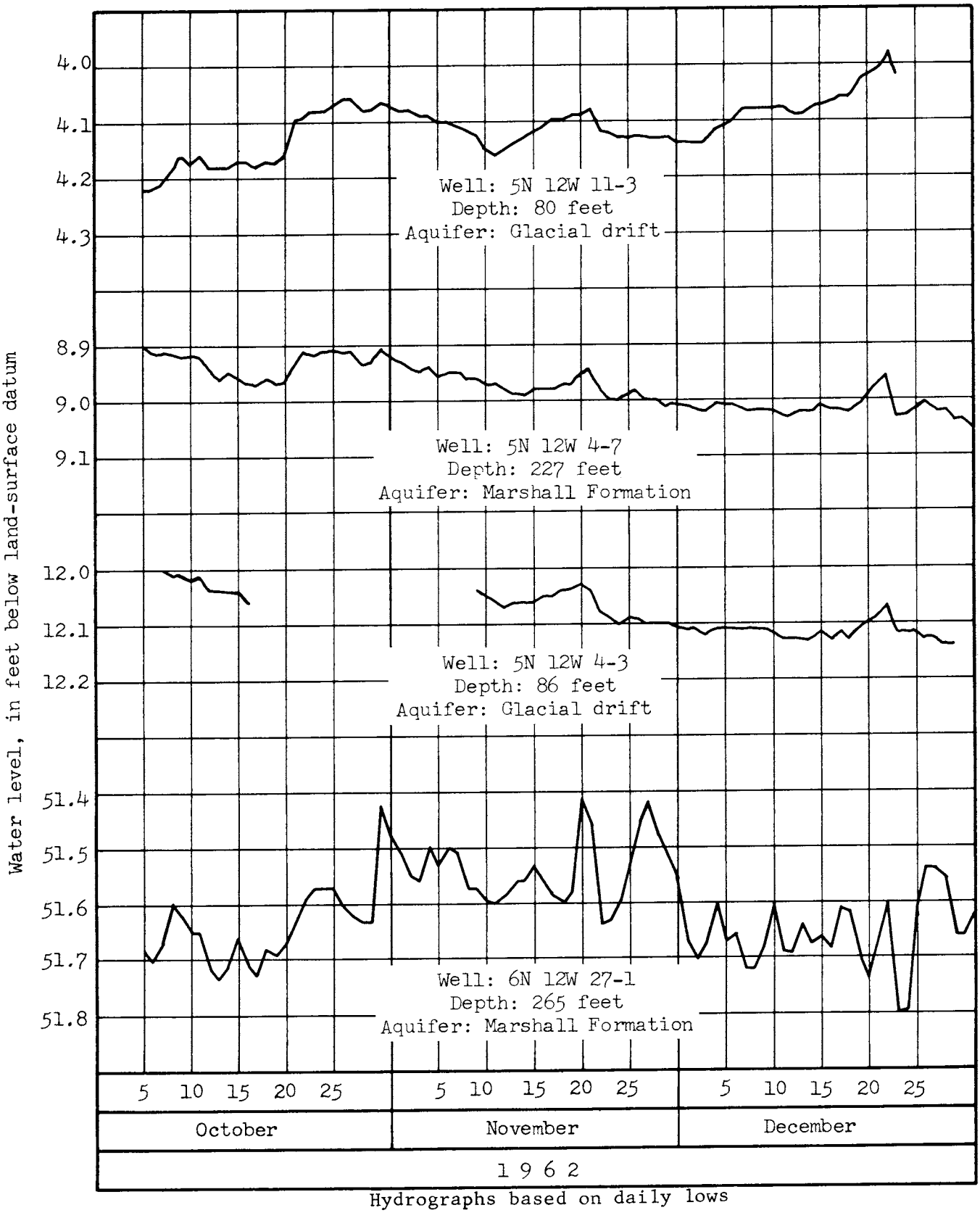


Figure 28. Hydrographs of four wells at Wyoming, for months October to December, 1962.

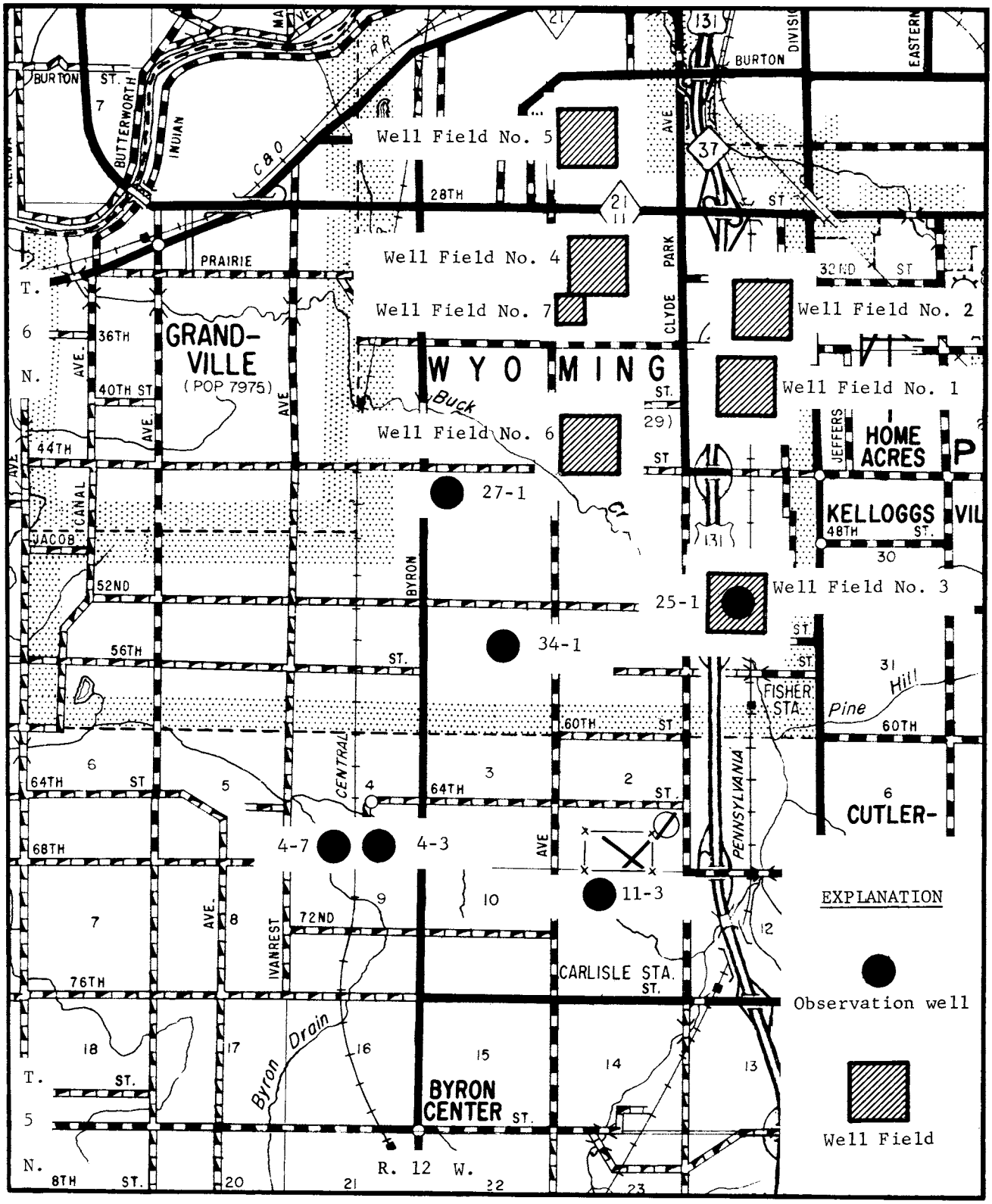


Figure 29. Location of well fields and observation wells in Wyoming area, 1962.

Oakland County

Oakland University.--Public supplies of water were obtained from a well tapping the glacial drift at 150 feet until April 1962, when a second well 183 feet, also in the drift, was put into service. The University pumped 22 million gallons in 1962 (table 2) as compared to 11 million gallons in 1961.

The new production well is located close to the observation well, and sharp fluctuations occur when pumping begins. Water levels quickly recover when pumping stops. A reproduction of a chart from the recording gage on the observation well is shown in figure 9B.

Both the daily low stages and a hyphenated line showing static water levels are shown in fig. 30. Static water levels have declined six feet since the beginning of record. This decline is the result of increased pumping combined with a precipitation deficiency of eight inches for the two-year period.

City of Pontiac.--In 1962, the City obtained water from about 23 wells finished in glacial drift at depths of from 100 to 280 feet. Reported municipal pumpage in 1962 totaled 4,329 million gallons (table 2) or 800 million gallons more than was reported for 1961.

Water levels in an observation well at the Walnut Street station (fig. 31) were four feet lower at the end of 1962. This drop was the result of heavy pumping in May through July and deficient precipitation, especially in the spring and fall, when conditions are usually favorable for groundwater recharge. Stages in another observation well (Orchard Lake - table 1) follow closely the fluctuations of water level in the Walnut well.

The long-term hydrograph of the Walnut Street observation well is shown in figure 32. After the long declining trend was reversed in late 1955, water levels recovered somewhat for several years as the result of changes in pumpage patterns by the City to control the declining levels in that area. However, greatly increased pumpage and an overall deficiency of precipitation of about 18 inches since 1959 have caused a resumption of the declining trend. Stages are now near 1955 lows.

Village of Rochester.--The Village obtains water from wells finished in glacial drift at depths of 65 to 120 feet. Municipal pumpage was reported as 457 million gallons in 1962 (table 2), or 29 million gallons less than was reported for 1961.

Water levels in the observation well (fig. 33) at the well field fluctuate sharply from the effects of pumping of nearby wells. Heavier pumping in late spring and summer resulted in low ground-water levels by mid-year. Levels at the end of 1962, however, were about the same as at the beginning of the year, despite the deficiency of more than four inches of precipitation for the year.

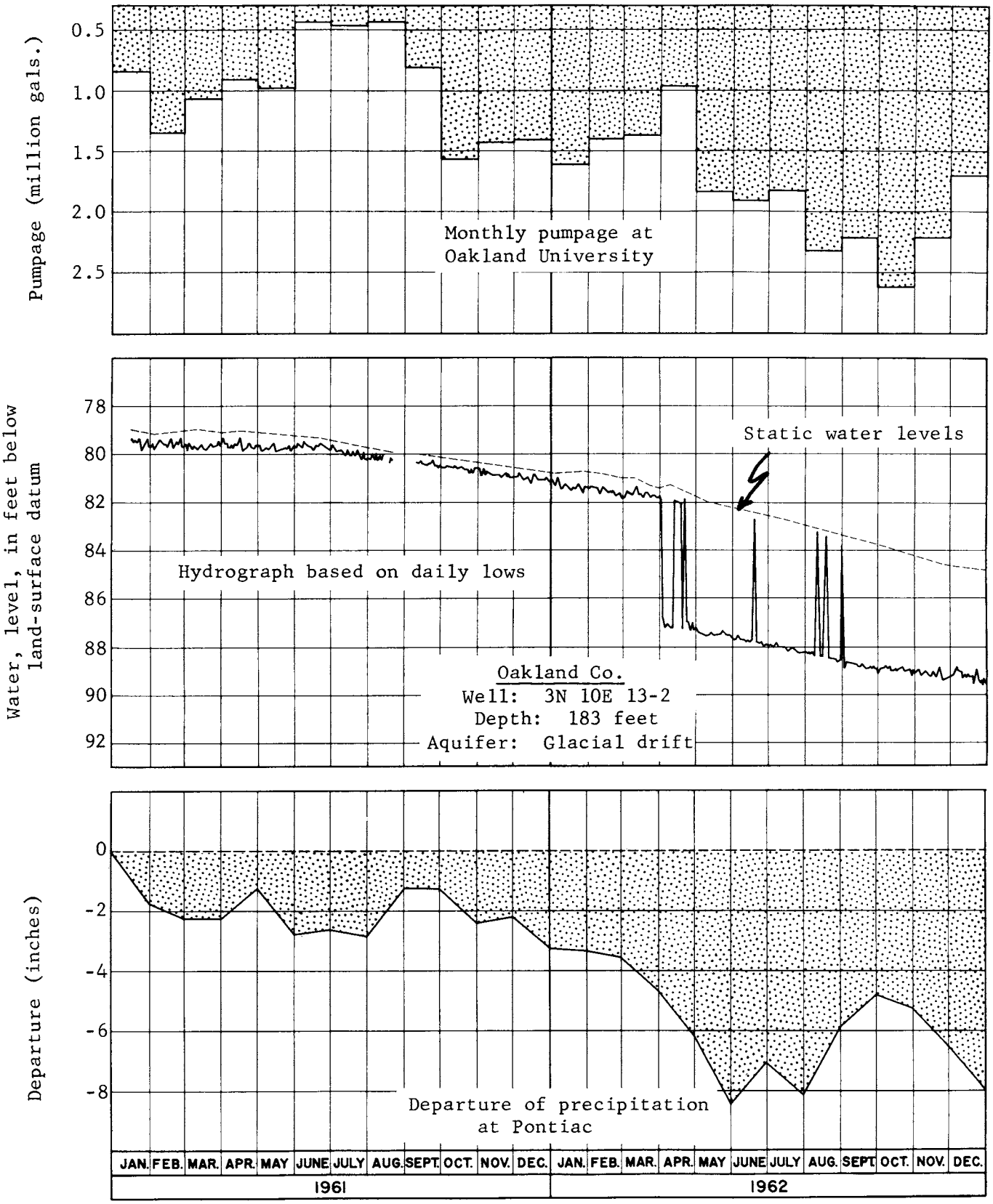


Figure 30. Hydrograph of well, pumpage, and precipitation, at Oakland University, near Rochester, 1961-62.

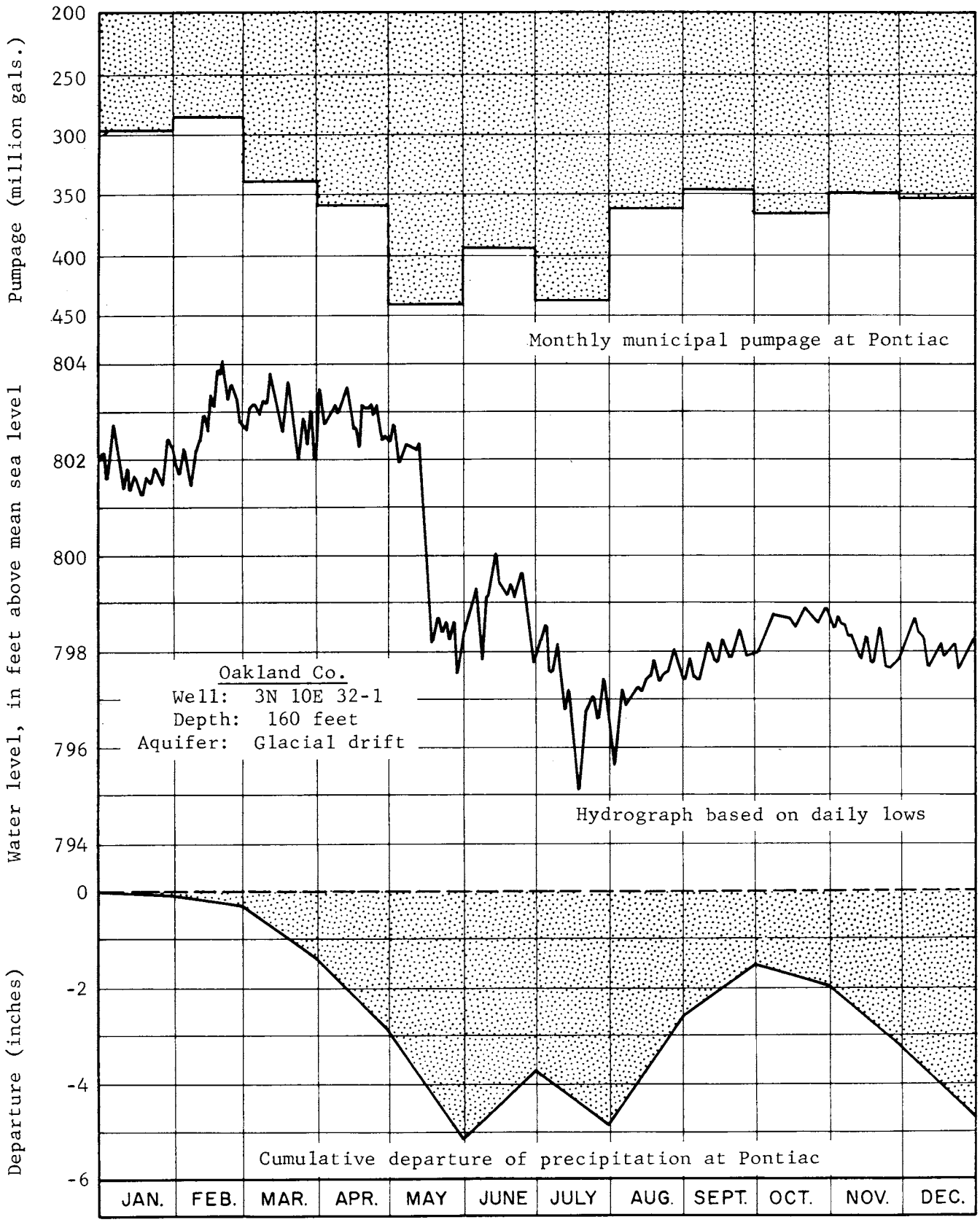


Figure 31. Hydrograph of well, pumpage, and precipitation, at Pontiac, 1962.

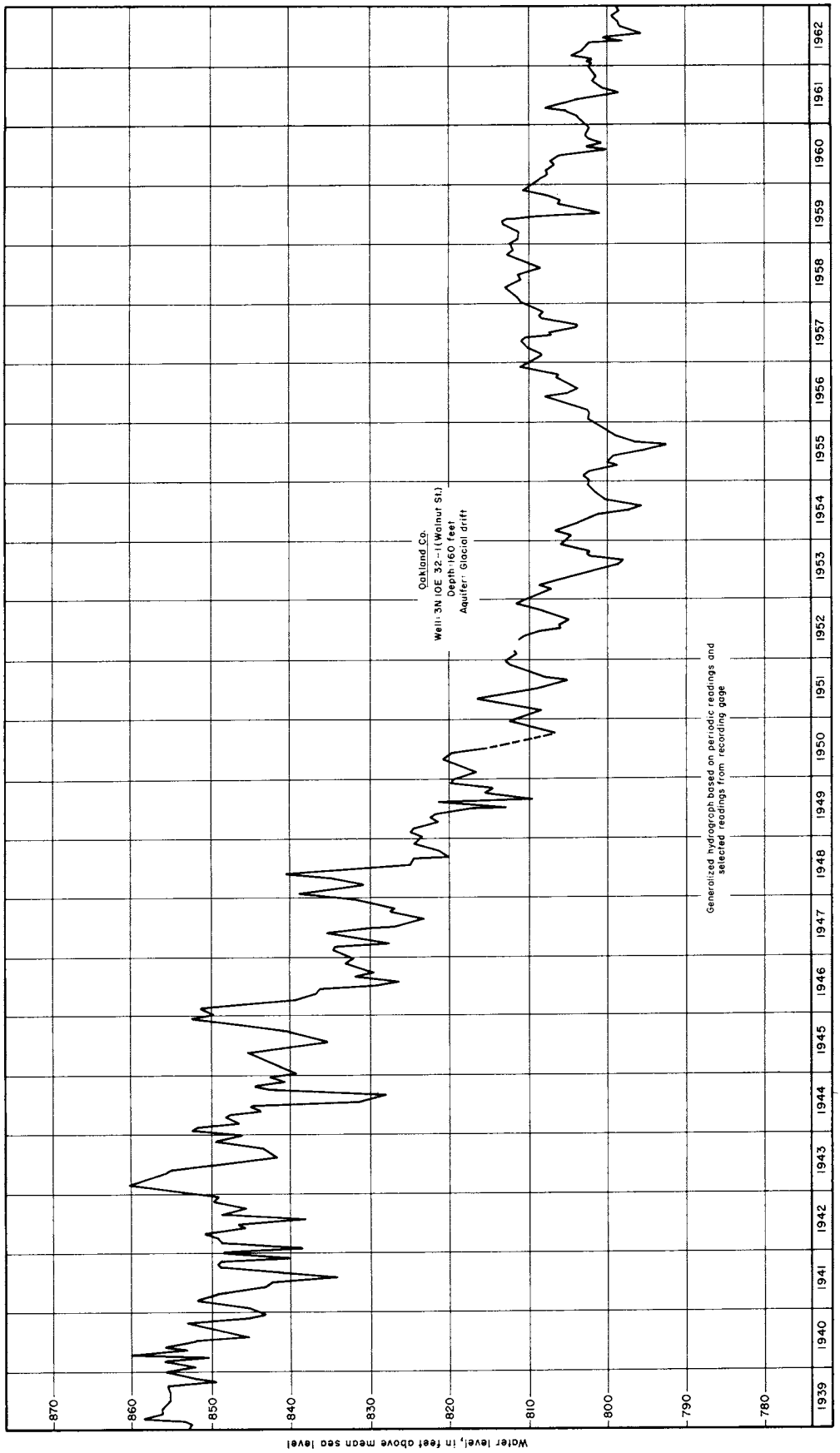


Figure 32. Hydrograph of well at Pontiac, 1939-62.

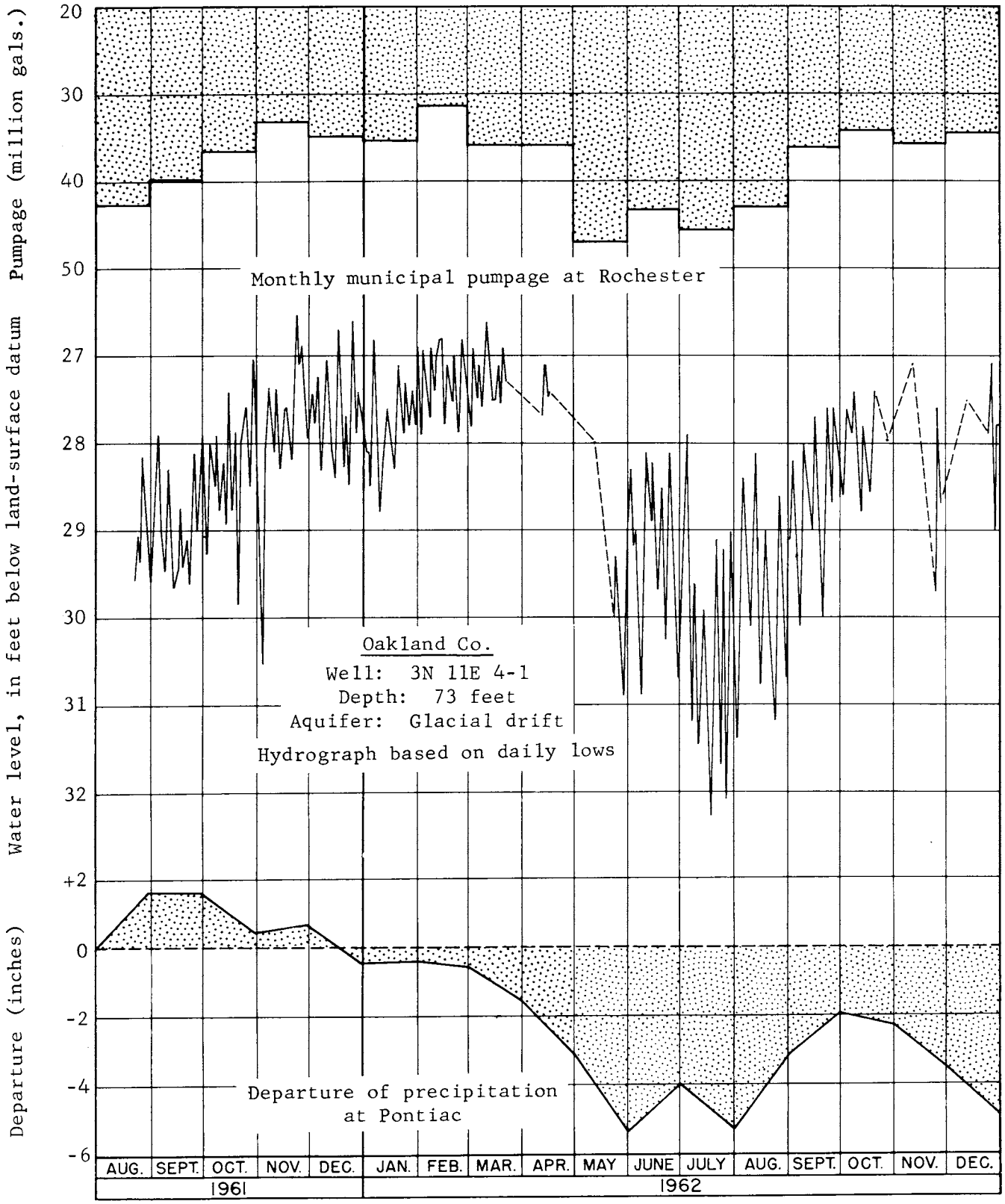


Figure 33. Hydrograph of well, pumpage, and precipitation, at Rochester, 1961-62.

Waterford Township.--The glacial drift is the only source of potable water to wells in the Township. Municipal wells are finished at depths of 200 to 300 feet while about 10 subdivisions obtain their public supply from wells finished at depths of from 40 to 179 feet. Reported municipal pumpage by the Township in 1962 totaled 382 million gallons (table 2) or 68 million gallons more than in 1961.

Recording gages are maintained on two observation wells in the Township. The Garfield Estates well is at some distance from pumping while the Josephine well reflects nearby pumping. Both wells followed a general declining trend of water levels as a result of increased pumpage and large deficiencies of precipitation that have accumulated to about 19 inches, or more than half a year's normal rainfall in the 1960-62 period (fig. 34). Despite these factors stages have fallen only about $2\frac{1}{2}$ feet in the Josephine well since the start of record in mid-1960.

Washtenaw County

City of Ann Arbor.--The City obtains its water supply from the Huron River and from wells finished in glacial drift. Most of the wells are located at the Steere Farm Well Field south of the City. Reported ground-water withdrawals for municipal supply totaled 985 million gallons (table 2) or essentially the same as was reported pumped in 1961.

A recording gage was installed in July, 1962, on an unused well at the Steere Farm field. Stages in the observation well (fig. 35) are affected by pumping at this field.

During the summer, pumpage was heavy and water levels declined steadily despite above average rainfall. No pumping for municipal supply was made at the Steere Farm well field from late September to the end of the year, and water levels rose in the observation well despite deficient precipitation. The sharp fluctuations of water level superimposed on the rising trend in the fall were the results of intermittent test pumping of new wells being constructed nearby. For example, a new production well was test pumped at rates of up to 3,000 gallons per minute in late November.

City of Ypsilanti.--The City obtains its municipal supply from wells finished in glacial drift at depths of 87 to 102 feet. Reported withdrawals of ground water for municipal supply totaled 1,150 million gallons (table 2) for 1962 or 120 million gallons more than in 1961.

Stages continued to decline in observation wells 9-2 and 9-3 (fig. 36) as the result of increased pumpage and deficient precipitation in 1962. Water levels in well 9-3 dropped about three feet to a new record low. Periodic measurements of water levels made in well 9-2 show the same general trend as in well 9-3. In July, 1962, a second recording gage was installed on a test well (5-1) at a greater distance from municipal pumping wells. Stages in this well (upper right-hand corner of fig. 36) are near land surface, but also show effects of pumping by the City.

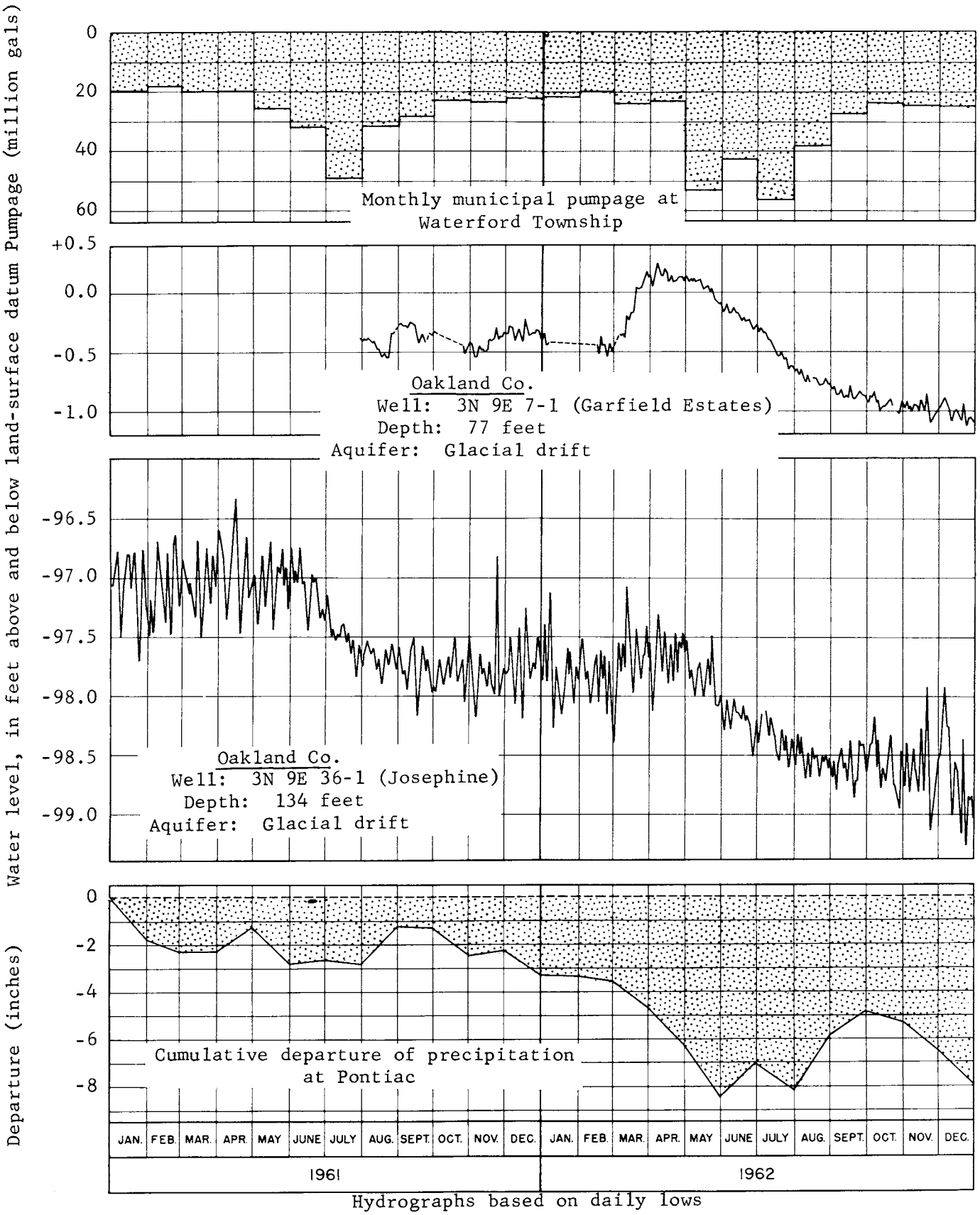


Figure 34. Hydrographs of two wells, pumpage, and precipitation, at Waterford Township, 1961-62.

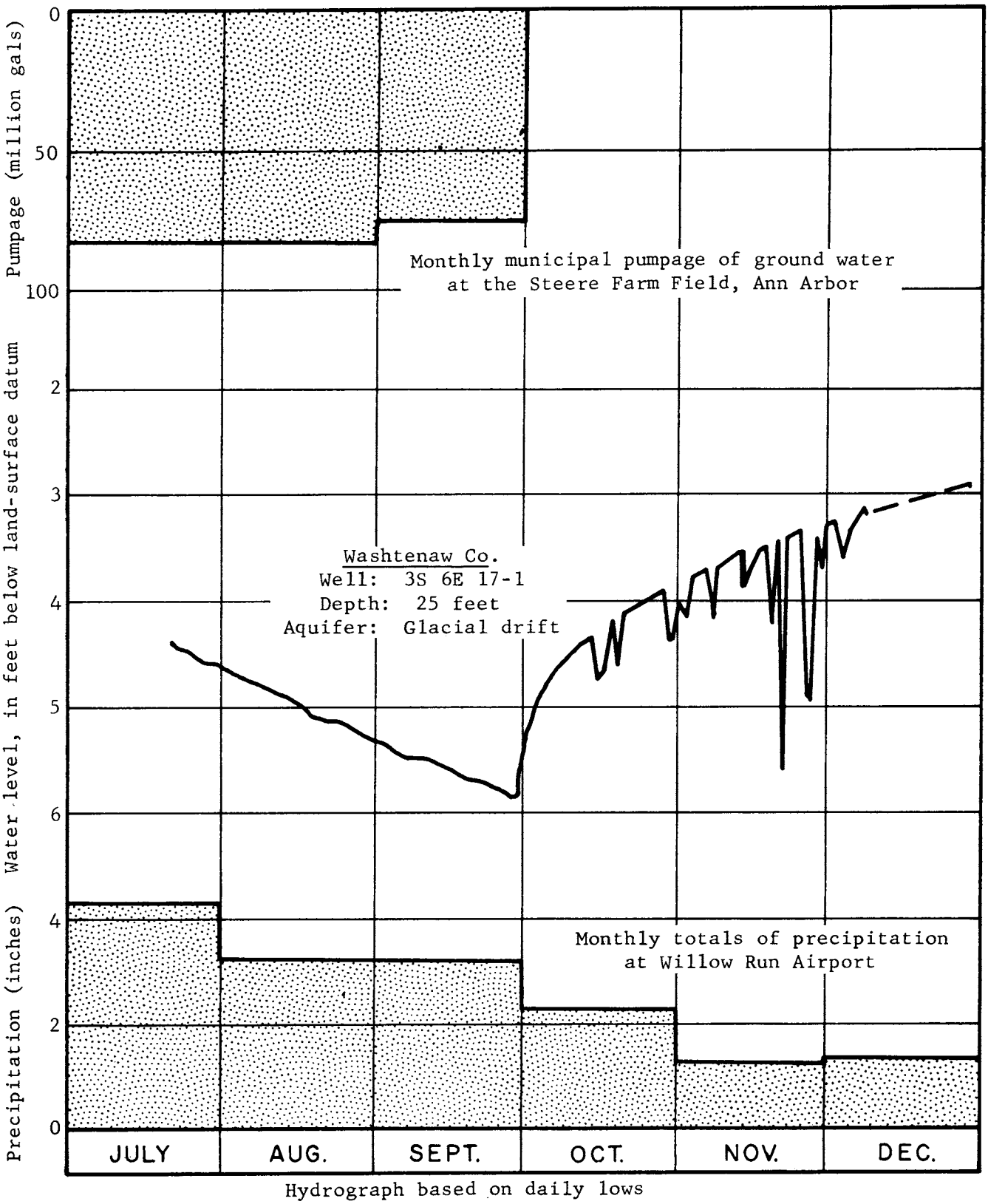


Figure 35. Hydrograph of well, pumpage, and precipitation, at Ann Arbor, July-December, 1962.

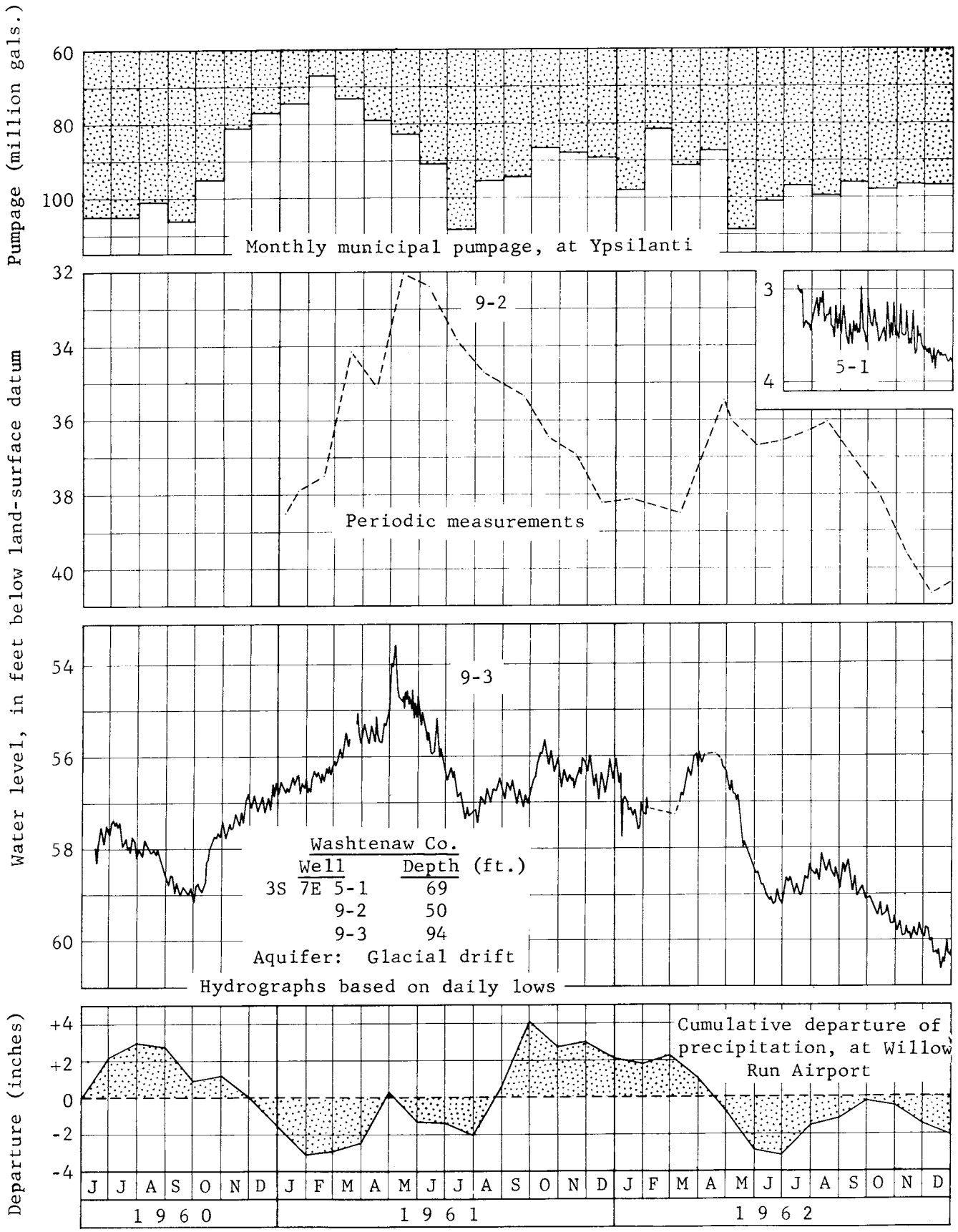


Figure 36. Hydrographs of three wells, pumpage, and precipitation, at Ypsilanti, 1960-62.

Water levels in observation wells in this area dropped about 30 feet during the period 1945 through 1962, (table 1).

Ypsilanti Township.--The Township obtains its water from wells finished in glacial drift at depths of 50 to 90 feet. Total reported municipal pumpage by the Township well field for 1962 was 2,130 million gallons (table 2) or 45 million gallons more than in 1961.

Water levels in three of the five observation wells fell to lows of record in 1962 (table 1). Hydrographs based on records from two recording gages show the effects of nearby pumping from the well field (fig. 37). Periodic measurements had been made in well 24-2 until July 1962, when a recording gage was installed. The long-term hydrograph (bottom of figure 37) shows a general lowering of water levels attributed to the effects of pumping, inasmuch as precipitation for the period as a whole was above average. Relatively uniform pumpage during the period 1960 through 1962 resulted in a general leveling off of water levels. The continued decline in well 24-1 is attributed to increased pumpage in a nearby well.

Wayne County

City of Plymouth.--The City obtains its municipal supply from wells finished in glacial drift at depths of 20 to 100 feet located in three well fields. Reported municipal pumpage by Plymouth was 711 million gallons in 1962 (table 2) or 26 million gallons more than in 1961.

Water levels in well 9-1, equipped with a recording gage, reflect conditions at the Beck Road well field (fig. 38). Here pumping is held at a relatively steady rate of about a million gallons daily. The sharp short-term fluctuations indicate the stop and start of pumps at this field. Large amounts of precipitation in September, 1961, and recharge from rainfall and thawing of the heavy snow cover in the spring of 1962, resulted in high stages during those periods. Major trends in water levels at this field apparently relate to natural climatic conditions rather than the pumping variations. After the spring high in 1962, the summer decline began, and levels continued to fall until the end of the year, owing to deficient precipitation during the last three months, notwithstanding the decline in pumping during this period.

A second recording gage was installed in August 1962, at the 6-Mile Road well field, to assess the effects of pumping by a large-capacity (about 2,600 gpm) municipal well about 500 feet from the observation well. Based on the short period of record the effects of pumping are small (fig. 38) and trends in water level are about the same as at the Beck Road observation well.

Water levels in both wells are plotted on an estimated mean-sea level datum in the illustration to allow comparison.

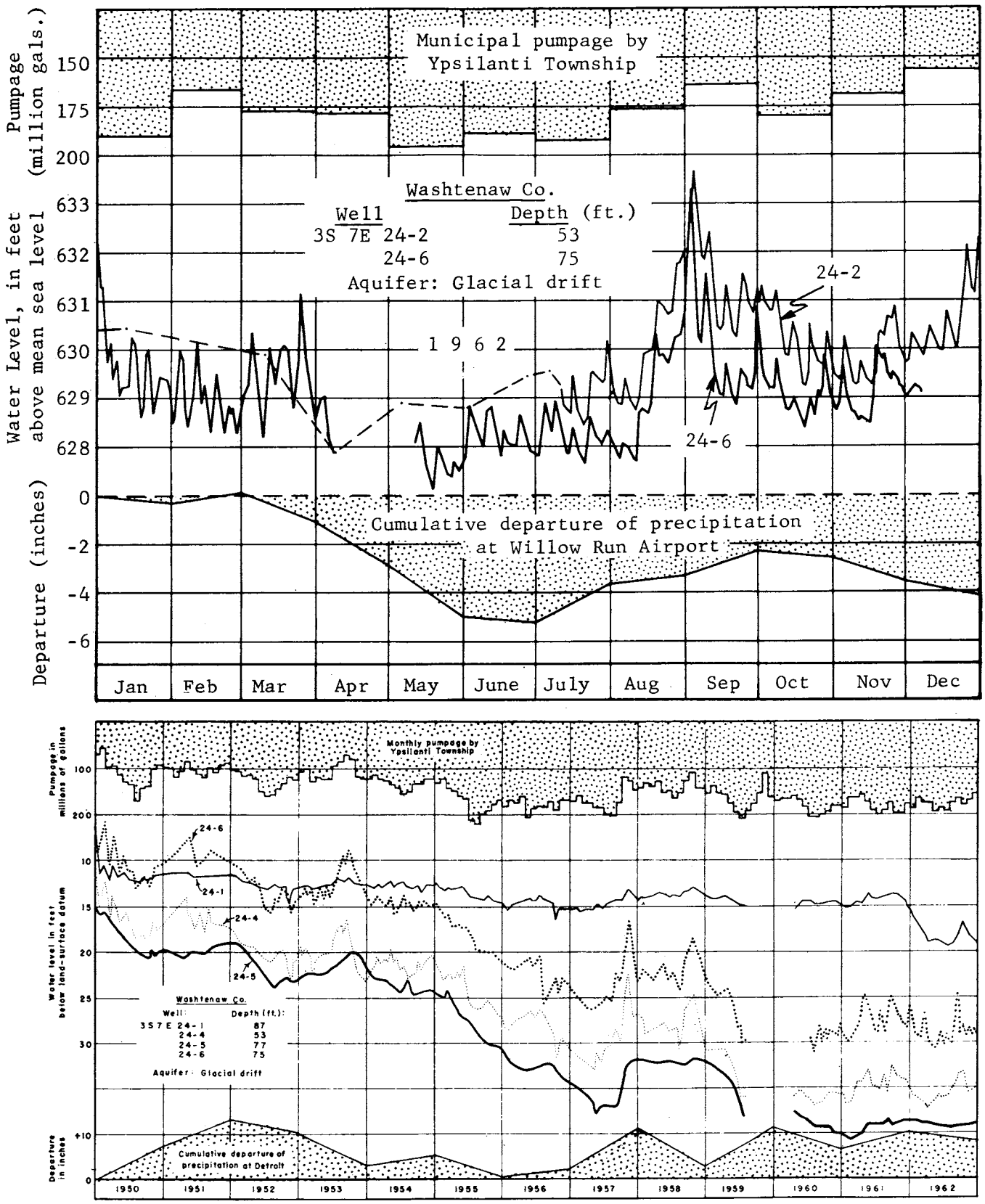


Figure 37. Hydrographs of 5 wells, pumpage, and precipitation, at Ypsilanti Township well field, 1962, and 1950-62.

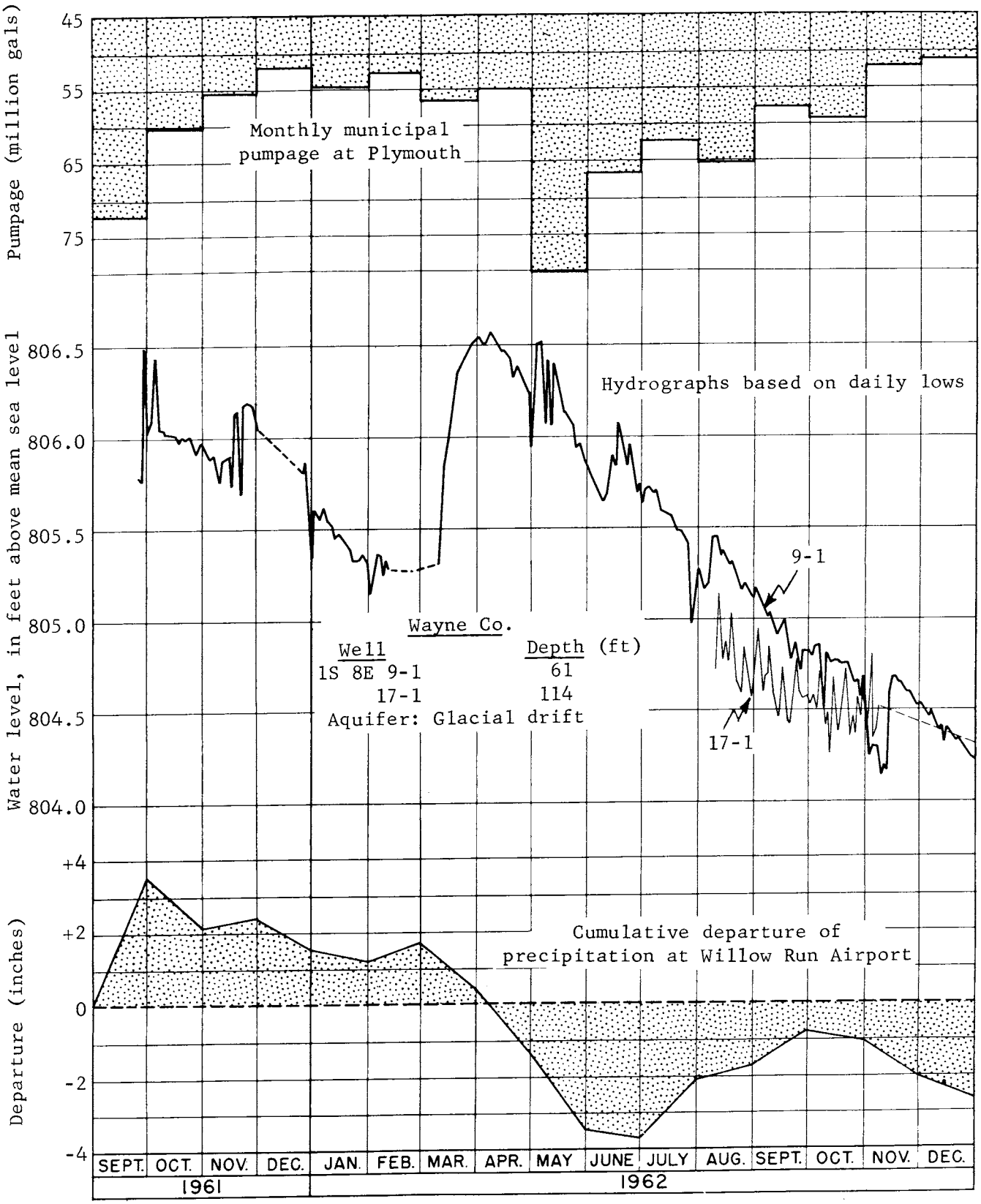


Figure 38. Hydrographs of two wells, pumpage, and precipitation, at Plymouth, 1961-62.

Wexford County

City of Cadillac.--The City obtains its municipal water supply from six wells finished in glacial drift at depths averaging 300 feet. These wells were put into operation on October 26, 1961 and prior to that time the City obtained its water from surface-water sources. Reported municipal pumpage in 1962 was 528 million gallons (table 2) or 124 million gallons more than the combined surface and ground water pumped in 1961.

A recording gage was installed in mid-1961 on a well used for observation since 1949, to closely observe changes in ground-water levels from the effects of pumping the new municipal wells. The short-term hydrograph of the well (fig. 39) shows the effect of pumping of the new system on ground-water levels over the past 17 months. Sharp changes in water level occur during the summer months when pumping is heavy. Some overall decline in water level has occurred, but part of this decline has probably resulted from the more than five inches of deficiency in precipitation at Cadillac in 1962. The lower part of the figure is a long-term hydrograph of the same well since 1949, showing the effects of mostly only natural climatic conditions prior to the start of municipal pumping.

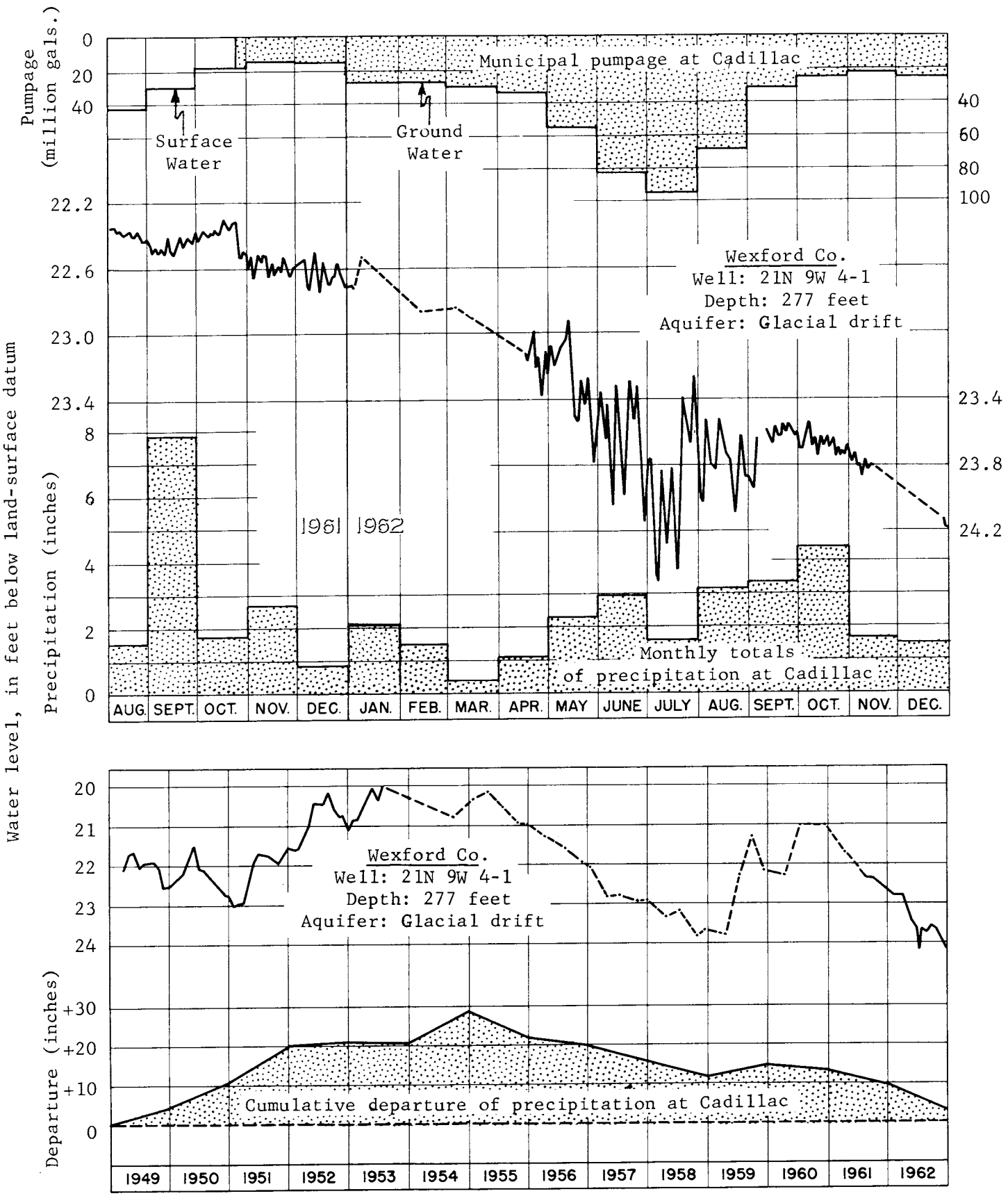


Figure 39. Hydrographs of well, pumpage, and precipitation, at Cadillac, 1949-62.

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Table 1.--Records of Michigan observation wells and extremes in water levels observed in 1962 and for the period of record.

Owner: MDC - Mich. Dept. of Conservation; WMP - Wisconsin-Michigan Power Co.; MSHD - Mich. State Highway Dept.; USFS - U. S. Forest Service

Chief Aquifer:

Qgd - Glacial drift deposits of Pleistocene (Quaternary) age
Ps - Saginaw Formation of Pennsylvanian age
Mb - Bayport Limestone of Mississippian age
Mm - Marshall Formation of Mississippian age
Dt - Traverse Group of Middle and Late Devonian age
Dtb - Thunder Bay Limestone of Middle and Late (?) Devonian age
Ds - Sylvania Sandstone of Middle Devonian age
Ss - Salina Formation of Late Silurian age
Sm - Manistique Dolomite of Middle Silurian age
Or - Limestones of Richmond age (Late Ordovician)
Otb - Black River and Trenton Limestones of Middle Ordovician age
Op - Prairie du Chien Group of Early Ordovician age (previously designated as Au Train Formation)
Cm - Munising Sandstone of Cambrian age
pC - Rocks of Precambrian age (undifferentiated)
pCf - Freda Sandstone of Keweenawan age (Precambrian)

Altitude: Land-surface datum in feet above mean-sea level

F - 62: Frequency of measurement in 1962. R - Continuous recorder; D - Daily; W - Weekly; M - Monthly; Q - Quarterly; S - Semiannual

Observed water-level extremes: 1962 measurements underscored are new extremes for entire period of record (in feet below or above (+) land surface).

Remarks: P - water level affected by pumping. Water-level measurements are made by the U. S. Geological Survey unless otherwise noted.

Well number	Location in section ¼ ¼	Owner	Depth (ft)	Dia. (in)	Chief aquifer	Altitude	Years of record	F 62	Observed water level extremes: Through 1961 Highest	Date	Lowest	Date	In 1962 Highest	Date	Lowest	Date	Remarks
							NORTHERN PENINSULA										
							Alger County										
45N 19W 25-1	SW NE	USFS	66	6	Qgd		1959-62	M	6.35	6-29-60	12.66	8-26-59	11.20	5-23	12.60	10-22	
							Baraga County										
49N 33W 18-1	NE SW	Mich. College of Mining and Tech.	12	16	Qgd		1958-62	R	e4.90	4-25-60	9.40	2-9-59	6.03	4-23	9.26	2-12	Meas. by owner
48N 32W 12-1	SE SE	MSHD (WMP14)	10	1¼	Qgd		1948-62	M	4.19	5- 3-51	6.72	3-15-49	4.93	5-1	7.33	2-28	Meas. by WMP
							Chippewa County										
46N 4W 24-1	NE SE	USFS (Raco CCC Camp)	54	6	Qgd		1952-62	R	20.70	7- 3-60	27.77	4-12-56	23.18	6-17	26.14	12-31	
							Delta County										
43N 19W 24-3	NW NW	Harry Clarage	405	4	Otb		1958-62	M	77.02	7-29-60	80.06	4- 9-59	79.31	7-6	79.87	4-5	
42N 19W 20-3	NE NE	USFS	134	6	Or		1958-62	M	23.76	6-27-60	25.85	3-31-59	25.26	5-23	25.70	10-22	
42N 18W 17-2	SW NE	USFS	60	6	Qgd		1958-62	M	21.20	5-25-60	24.97	3-31-59	23.54	5-23	24.89	10-22	
41N 19W 17-1	NE SW	USFS	58	6	Or	635±	1958-62	M	0.50	4-29-60	4.01	9-29-61	0.30	4-30	3.74	7-31	
41N 18W 31-2	SE SW	Charles Thompson	250	4	Or		1958-62	R	3.77	5- 7-60	6.31	2- 7-61	3.83	4-8	5.64	7-19	
40N 22W 4-4	NE NW	USFS	34	5	Qgd		1959-62	M	14.87	7-29-60	17.10	4-29-60	16.24	7-16	16.90	3-8	
39N 23W 28-3	SW NE	Marshall and Sherman Blake	530	5	Cm	680±	1958-62	R	1.32	5- 6-60	3.86	9-28-58	1.90	4-28	3.06	12-31	
38N 22W 24-1	NW SE	USFS (3)	36	6	Or	585±	1958-62	M	1.10	4-29-60	5.53	10-27-58	0.75	4-30	4.70	12-4	
							Dickinson County										
43N 29W 32-1	NW NE	Dickinson Co. (WMP 11)	12	1¼	Qgd		1948-62	M	5.12	4-18-51	dry	10-12-48	6.85	5-1	10.42	8-31	Meas. by WMP

								Dickinson County (Continued)													
42N 27W 33-1	NE	NW	E. W. La Freniere (WMP 10)	12	36	Qgd		1945-46, 58-62	M	2.74	5-3-60	10.75	10-3-55	3.40	4-30	8.82	8-1	Meas. by WMP
41N 30W 25-1	NE	SW	Dickinson Co. (WMP 1)	20	1¼	Qgd		1948-62	M	2.66	5-3-60	dry	10-3-55	4.74	4-30	dry	1-30	Do.
25-2	NW	SE	Wm. Carrola (WMP 2)	16	36	Qgd		1945-46, 48-62	M	1.69	5-3-60	dry	1-30-59	2.84	4-30	9.76	3-2	Do.
25-3	SE	NE	Oscar Martinson (WMP3)	12	48	Qgd		1945-46, 48-62	M	1.57	5-3-60	dry	11- -48	1.60	4-30	7.93	3-2	Do.
								Gogebic County													
48N 47W 34-2	NE	SE	City of Ironwood (SE Well, Gp2)	35	6	Qgd		1962	R					0.00	9-14	1.69	8-22	P, Record started 6-15-62.
34-3	NE	SE	City of Ironwood (SE Well, Gp 3)	22	6	Qgd		1961-62	R	1.73	11-4-61	4.71	9-9-61	+0.14	5-13	4.61	3-13	P
								Iron County													
46N 34W 14-1	NE	NW	Oliver Iron Mining Co. (WMP 18)	12	1¼	Qgd		1945-62	M	3.65	6-2-54	8.60	3-15-49	5.70	6-1	7.70	2-28	Meas. by WMP
46N 33W 18-1	SW	NW	MSHD (WMP 17)	12	1¼	Qgd		1948-62	M	2.80	4-18-49	dry	2-28-56	5.55	5-1	7.84	12-27	Do.
45N 37W 23-1	SW	NE	USFS (WMP 28)	8	1¼	Qgd		1948-62	M	0.73	8-31-51	4.72	9-11-48	1.51	4-30	2.84	1-30	Do.
45N 35W 33-1	SE	NW	MSHD (WMP 34)	12	1¼	Qgd		1948-62	M	1.93	7-6-53	8.44	3-15-49	3.43	5-31	6.07	3-28	Do.
45N 33W 8-1	SW	SW	Basilio Prandi (WMP 20)	33	36	Qgd		1945-62	M	22.71	5-3-60	32.16	3-15-49	25.61	7-3	28.11	3-29	Do.
44N 37W 14-1	NW	NW	USFS (Former James Lake CCC Camp)	102	6	Qgd		1959-62	R	93.8	11-29-60	95.75	10-22-59	94.05	1-7	95.24	10-29	
44N 35W 6-1	SW	SW	USFS (Paint River Profile 1)	6	1¼	Qgd	1468.15	1948-62	M	+0.10	5-2-51	2.32	8-31-61	0.42	4-30	2.02	7-31	Meas. by WMP
6-2	SW	SW	USFS (Paint River Profile 2)	13	1¼	Qgd	1475.14	1948-62	M	5.08	7-6-53	8.92	11-15-48	6.35	4-30	8.52	10-1	Do.
6-3	NW	SW	USFS (Paint River Profile 3)	12	1¼	Qgd	1476.35	1948-62	M	4.03	7-6-53	9.20	11-15-48	6.08	4-30	8.92	3-1	Do.
7-1	NW	NW	USFS (Paint River Profile 4)	4	1¼	Qgd	1469.28	1948-62	M	1.12	5-2-51	3.73	8-1-47	1.49	4-30	3.31	7-31	Do.
7-2	NW	NW	USFS (Paint River Profile 5)	13	1¼	Qgd	1471.25	1948-62	M	2.30	7-6-53	9.44	10-26-48	3.45	4-30	5.18	11-29	Do.
7-3	NW	NW	USFS (Paint River Profile 6)	17	1¼	Qgd	1475.83	1948-62	M	8.48	5-2-51	13.40	10-26-48	10.69	4-30	12.70	11-29	Do.
44N 33W 10-1	SW	SW	Iron Co. (WMP 21)	8	1¼	Qgd		1948-62	M	1.95	4-29-54	7.94	1-12-51	2.26	5-1	7.03	2-28	Do.
43N 36W 1-1	SW	NE	Iron Co. (WMP 27)	9	1¼	Qgd		1948-62	M	6.48	5-2-60	9.02	6-30-52	7.42	4-30	8.46	3-1	P, Meas. by WMP
43N 35W 11-1	SE	NE	J. J. Javoroski (WMP 23)	47	36	Qgd		1945-62	M	38.61	9-1-60	47.08	8-15-49	41.69	10-31	42.80	4-30	Do.
13-1	SW	SE	F. V. Gendzwill (5)	65	36	pG		1945-62	S	47.90	9-11-46	63.68	11-30-46	52.11	10-1	53.10	5-9	Mine drainage study
13-2	SW	SE	Boyington (hole 4-44)	?	?	?		1945, 47-62	S	66.39	1-14-52	71.56	3-24-49	68.98	10-1	69.12	5-9	Do.
20-1	SW	SE	Mrs. B. Hendrikson (WMP 25)	48	1¼	Qgd		1945-62	M	41.66	6-20-53	48.29	8-15-49	43.57	7-2	44.37	3-1	Meas. by WMP
24-1	SE	NE	Spies-Johnson No. 73 (7)	?	3	Qgd?		1945-62	S	67.20	10-5-61	86.05	1-19-49	68.07	10-1	68.34	5-9	Mine drainage study
26-1	SW	NE	City of Iron River (1)	130	2	Qgd		1945-62	S	18.52	5-9-61	44.58	3-24-50	26.25	10-1	27.51	5-9	P
43N 34W 19-1	NW	SW	Spies-Johnson No. 3004 (8)	?	3	Qgd?		1945-62	S	59.87	10-5-61	89.5	10-20-45	60.92	10-1	61.24	5-9	Mine drainage study
19-2	NE	SW	Spies-Johnson No. 3c (9)	?	3	Qgd?		1945-62	S	66.23	10-5-61	84.10	12-21-48	67.14	10-1	67.39	5-9	Do.
29-1	SW	NE	Rogers Mine (11)	?	48	Qgd		1947-53, 56-62	S	10.31	8-15-53	20.69	3-24-50	14.71	5-9	15.12	10-1	Do.
43N 32W 26-3	SW	NE	Caya Mine	200+	4	?		1959-62	M	29.79	5-2-60	37.50	2-24-61	32.11	5-31	37.41	2-26	Do.
42N 36W 15-1	NE	SW	MSHD (Brule River Profile No. 1)	6	1¼	Qgd	1543.92	1948-62	M	0.81	4-29-54	3.17	10-26-48	1.35	4-30	2.87	12-28	Meas. by WMP
15-2	NE	SW	MSHD (Brule River Profile No. 2)	7	1¼	Qgd	1545.60	1948-62	M	0.46	7-6-53	3.10	10-26-48	0.30	4-30	2.32	12-28	Do.
15-3	NW	SW	W. Young Estate (Brule Riv. Profile No. 3)	14	1¼	Qgd	1554.36	1948-62	M	3.67	4-29-54	8.29	10-26-48	4.65	4-30	7.68	8-30	Meas. by WMP
42N 34W 7-1	SW	NE	Zimmerman No. 1 (13)	171	12	Qgd	1165.32	1945-62	S	128.22	10-5-61	153.27	4-21-50	102.10	10-1	109.99	5-9	P, Mine drainage study
42N 31W 33-1	NW	SE	Iron Co. (WMP 7)	11	1¼	Qgd		1948-62	M	+0.20	5-2-60	6.28	10-13-48	0.38	4-30	4.04	2-28	Meas. by WMP

Table 1.--Records of Michigan observation wells and extremes in water levels observed in 1962 and for the period of record.--Continued

Well number	Location in section ¼ ¼	Owner	Depth (ft)	Dia. (in)	Chief aquifer	Altitude	Years of record	F 62	Observed water level extremes: Through 1961 Highest	Date	Lowest	Date	In 1962 Highest	Date	Lowest	Date	Remarks
							Iron County (Continued)										
42N 31W 33-2	NW SE	Joseph Giachino (WMP 8)	12	15	Qgd		1945-62	M	1.89	10-30-51	12.22	2-25-53	2.65	5-31	10.81	2-28	Meas. by WMP
41N 31W 10-1	SW NE	Iron Co. (WMP 5)	17	1¼	Qgd		1948-62	M	8.47	1- 3-52	dry	12-15-48	12.00	7-2	15.95	3-28	Do.
							Luce County										
49N 11W 2-5	NW NE	State (5)	7	1¼	Qgd		1959-62	M	+0.40	5-26-60	6.34	7-30-59	0.29	5-28	5.35	11-30	Lake Hdr. Study
49N 10W 6-6	SW SW	State (6)	8	1¼	Qgd		1959-62	M	1.98	5-31-60	8.02	8-26-59	2.76	5-28	8.00	11-30	Do.
							Mackinac County										
42N 2W 7-1	NE NE	USFS (Pontchartrain)	102	6	Sm		1956-62	R	13.1	5-11-60	29.35	11-5-57	18.70	4-8	29.83	9-15	
9-1	NE NW	Kenneth Kerr	84	2	Sm		1956, 59-62	M	+1.0		4.52	9-28-61	+1.08	5-29	5.49	9-25	Often flows-freezes in winter
41N 5W 23-1	SW NW	MDC (Round Lake)	47	6	Ss		1956-62	M	4.30	5-7-59	17.48	3-19-59	7.19	4-27	15.73	8-24	
							Marquette County										
49N 30W 22-1	SW NE	Marquette Co. (WMP 13)	17	1¼	Qgd		1948-62	M	0.64	5-3-51	13.32	9-2-48	7.78	5-1	10.82	1-31	Meas. by WMP
48N 26W 28-1	NW NW	Marquette Co. Airport	55	6	Qgd	1416.1	1962	M					16.74	6-29	17.99	5-16	Record started 5-16
47N 29W 3-1	NE SW	Bill Koski	28	6	Qgd		1962	M					11.98	6-26	12.64	8-13	Record started 5-16
47N 28W 1-1	NW SE	Inland Steel Co. (Morris Mine No. 1)	216	38	Qgd		1961-62	R	e62.5	12-31-61	70.99	10-26-61	27.10	12-23	55.46	1-10	P-recovery
3-1	SW SW	Ely Township	75	8	Qgd		1961-62	R	13.60	8-22-61	14.87	12-2-61	13.72	5-24	16.67	3-27	
4-1	NE NE	Inland Steel Co. (Blueberry Mine 8B)	68	8	Qgd	1577	1961-62	R	17.27	10-17-61	18.03	12-31-61	15.71	5-24	19.60	12-27	
10-1	NW NW	Clarance Carlson	17	6	Qgd		1961-62	M	8.35	9-27-61	10.18	12-22-61	9.54	5-16	12.82	2-14	
47N 28W 10-3	NE NW	Greenwood Cabins	65	6	Qgd		1962	M					11.99	5-16	15.16	10-19	Record started 5-16
47N 25W 15-1	SW SW	Frank Bollero	245	6	Qgd		1962	M					92.09	10-19	99.09	6-26	Record started 5-16
46N 30W 13-1	NW NE	Arolas Bottling Co.	47	6	Qgd		1962	M					10.47	5-16	15.76	11-15	Record started 5-16
46N 29W 18-2	NE SW	Republic Township	39	1¼	Qgd		1962	M					11.36	5-16	14.05	10-19	Record started 1-22
30-1	NE NE	Kountry Kitchen	42	6	Qgd		1962	M					19.69	6-26	21.96	8-13	Record started 5-16
46N 28W 1-1	SE NW	Clarance Carlson	96	6	Qgd		1961-62	M	35.59	8-22-61	37.05	11-14-61	35.61	1-22	39.79	10-19	
12-2	NW SW	USGS	16	1¼	Qgd		1962	M					2.29	9-18	2.70	10-15	Record started 9-18
12-3	NW SW	USGS	19.5	1¼	Qgd		1962	M					2.35	9-18	2.71	11-15	Record started 9-18
46N 27W 2-1	SW NE	Cleveland Cliffs Iron Co.	180	1½	Qgd		1962	M					58.62	8-16	49.82	11-27	Record started 6-5
46N 25W 11-1	NW SW	Pine Ridge Trailer Court	193	6	Qgd		1962	M					135.04	10-19	139.96	2-14	Record started 1-22
36-4	SE NW	U. S. Air Force	82	12	Qgd		1962	R					82.10	1-11	82.82	12-29	Record started 1-11

										Marquette County (Continued)										
45N 30W 1-1	SW	NW	Arnold Janofski (WMP 4)	31	36	Qgd		1945-62	R	23.82	7-18-60	29.28	3-15-49	26.12	1-1	26.89	12-31	Fed. key well
45N 25W 23-1	NW	SE	USGS	65	1¼	Qgd		1962	M					19.42	11-27	20.83	10-30	Record started 10-30
28-3	NW	NE	Forsyth Twp.	39	1¼	Qgd		1961-62	W	14.74	7-24-61	16.63	8-30-61	16.26	6-26	16.79	5-28	P
28-4	NE	NW	Village of Gwinn	40	6	Qgd		1962	M					13.37	9-25	13.52	10-19	Record started 9-25
44N 26W 28-1	NE	SE	MDC (Esc. Riv. CCC)	31	6	Qgd		1953-62	M	1.90	5-17-60	2.83	8-30-57	2.06	4-24	2.65	7-19	Meas. by MDC
								Menominee County										
37N 26W 19-1	NE	SE	MSHD	16+	4	Otb		1959-62	M	3.70	5-2-60	6.77	2-24-61	4.33	4-25	6.15	8-28	
								Ontonagon County										
52N 39W 30-1	NW	NW	Village of Ontonagon	22	240	Qgd		1960-62	R	2.0	10-26-61	13.4	3-11-61	5.0	10-16	16.6	4-3	P
51N 41W 8-1	SE	NW	Mich. Corrections Dept.	100	6	pef		1958-62	R	8.18	4-15-59	18.12	10-13-60	8.6	5-23	16.4	8-29	
								Schoolcraft County										
47N 16W 30-1	NW	NW	MDC (Cusino CCC Camp)	57	6	Op		1957-62	R	5.7	5-10-60	15.51	11-7-57	7.5	5-1	15.6	10-25	
45N 18W 31-1	NE	SW	USFS	229	5	Otb		1958-62	M	13.71	6-29-60	16.69	1-27-59	15.15	5-23	16.40	10-22	
45N 13W 16-1	SW	SW	U.S. Fish and Wildlife Service	154	4	Or		1952-62	R	4.80	5-8-60	6.28	9-26-55	5.20	3-12	6.14	11-18	
								SOUTHERN PENINSULA										
								Barry County										
3N 8W 18-1	SE	NE	City of Hastings	33	6	Qgd		1958-62	R	2.32	4-5-59	6.81	7-12-61	2.48	5-8	5.25	1-23	P
								Bay County										
17N 4E 15-1	SW	SE	Pinconning Twp.	61	2	Ps		1962	M					2.38	12-3	5.00	8-16	Record started 8-62
22-1	SW	SE	Pinconning Twp.	110	6	Ps		1962	R					4.09	12-26	9.90	9-15	P
22-2	SE	NE	Sterling Tube Co.	170	6	Ps		1962	M					9.72	12-3	12.97	9-14	Record started 8-62
27-1	SW	SE	Walter Wolan	72	2	Ps		1962	M					1.74	12-3	4.14	9-14	Do.
								Branch County										
6S 6W 22-1	NE	SW	City of Coldwater (3)	130	6	Qgd		1949-62	W	10.08	4-8-50	16.67	1-15-54	11.35	4-6	16.91	8-24	P, Meas. by owner
								Calhoun County										
1S 7W 10-1	NW	NW	K. N. Sabin	8	15	Qgd	907.99	1946-62	W	0.89	3-28-50	5.98	2-11-59	3.70	4-25	5.35	12-23	
32-1	NE	SE	City of Battle Creek (Verona 22)	127	8	Mm	830.79	1939-62	D	0.7	4-26-50	16.75	7-16-59	7.40	4-15	13.15	8-30	P, Meas. by owner
32-2	NE	NW	Mrs. Harriett Rice	43	2	Mm	842.88	1946-62	Q	8.98	4-25-50	18.93	9-23-59	15.89	4-3	17.67	10-5	P
2S 8W 1-1	SW	SE	Sherman Mfg. Co.	22	2	Qgd	825.19	1946-62	Q	10.49	4-11-47	19.47	9-18-61	17.77	4-3	19.26	7-3	
2-1	NW	SE	Oliver Elec. Mfg. Co.	92	10	Mm	819.99	1946-62	R	4.75	4-9-47	14.95	9-11-59	12.93	5-15	14.78	12-7	P
3-1	SE	SE	Dominic Conto	12	2	Qgd	862.02	1946-62	Q	1.75	4-28-50	9.89	9-23-59	4.89	4-3	7.84	10-5	
3-2	SE	NE	Eaton Mfg. Co.	80	10	Mm	833.39	1946-62	Q	13.43	4-25-50	25.41	9-23-59	20.75	4-3	23.03	12-20	P
14-1	NE	SE	City of Battle Creek	62	2	Qgd	916.05	1939-62	Q	9.10	5-31-52	32.76	3-26-41	11.48	10-5	12.22	4-3	
14-2	SE	SE	City of Battle Creek (TW 1)	89	26	Qgd	914.97	1945-62	Q	6.22	5-29-50	12.86	10-18-46	8.27	7-3	9.04	12-20	

Table 1.--Records of Michigan Observation wells and extremes in water levels observed in 1962 and for the period of record.--Continued

Well number	Location in section ¼ ¼	Owner	Depth (ft)	Dia. (in)	Chief aquifer	Altitude	Years of record	F 62	Observed water level extremes								Remarks
									Through 1961				In 1962				
									Highest	Date	Lowest	Date	Highest	Date	Lowest	Date	
Calhoun County (Continued)																	
2S 7W 7-1	SW NE	Oliver Farm Implement Company	74	6	Mm	834.30	1946-62	Q	15.00	4-11-47	24.68	9-23-59	18.74	4-3	22.33	10-5	P
17-1	NW SW	City of Battle Creek	87	2	Mm	841.78	1945-62	Q	6.57	4-25-50	11.38	9-23-59	8.57	4-3	10.67	10-5	P
18-1	SW SW	City of Battle Creek	87	2	Mm	832.49	1945-62	Q	+0.50	4-25-50	3.24	9-21-49	0.24	4-3	1.88	10-5	P
2S 6W 25-1	NE NE	City of Marshall (Ferguson)	59	6	Mm	904.85	1950-62	M	5.46	5- 9-50	9.59	10- 6-58	7.90	4-30	8.80	12-21	P, Meas. by owner
Cass County																	
6S 16W 1-1	SW NE	City of Dowagiac	159	10	Qgd	750.19	1949-62	W	+5.20	2-20-60	-5.97	7-24-53	+1.12	5-11	-4.46	12-21	P, Meas. by owner
8S 14W 17-1	NE NW	Ted Little	55	28	Qgd		1945-62	W	46.20	7-16-50	55.03	3-10-57	50.65	7-8	51.77	12-26	
Charlevoix County																	
33N 4W 2-1	SW NE	MDC	94	6	Qgd		1948-62	Q	69.49	7-14-60	75.85	4-16-56	70.58	7-16	73.74	4-18	
32N 4W 10-1	NE SE	MDC (33)	17	2	Qgd		1934-41, 48-62	M	1.19	3-30-58	7.42	2-12-59	2.09	5-14	5.07	3-12	
Cheboygan County																	
34N 1W 1-1	NW SW	MDC (7)	11	2	Qgd		1938-41, 48-52, 55-62	Q	2.75	3-28-38	5.55	10-13-55	3.58	4-16	4.65	12-16	
Clare County																	
17N 4W 33-1	NW NW	Watervliet Paper Co.	15	1¼	Qgd		1958-62	M	8.52	5- 2-60	10.56	2-27-59	8.18	3-31	9.84	1-31	Well destroyed 6-30
Clinton County																	
8N 1W 13-1	SW NW	Village of Elsie	298	12	Pps	699.68	1947-62	M	+3.78	6- 3-50	37.55	10-15-57	1.15	2-27	12.78	12-27	P, Resumed meas. 2-62
7N 2W 9-2	SW NW	City of St. Johns	498	10	Pps	746.93	1962 (fr 11-19)	R					72.3	12-30	112.1	12-13	
6N 2W 16-1	SE SE	MSHD	23	14	Qgd	803.32	1948-62	M	14.59	4-19-52	18.55	2-27-61	17.15	5-28	18.89	12-27	Fed. Key well
5N 2W 31-1	NW SW	Mich. Dept. of Aeronautics	195	6	Pps	e850	1949, 55, 60-62	R	45.0	3-21-49	57.33	12-15-61	56.25	1-7	58.80	11-24	P
32-1	SW SE	Mich. Health Dept.	135	4	Pps	849.21	1944-62	M	42.02	9-14-44	90.80	11-27-61	88.64	5-29	94.80	3-31	P
Crawford County																	
27N 1W 20-1	SW SW	MDC (22)	15	2	Qgd		1934-57, 60-62	Q	1.55	7-11-43	5.92	10-12-55	3.41	4-16	4.93	12-5	
26N 4W 11-1	NW SW	MDC	12	15	Qgd	1147.59	1942-62	R	4.03	6- 1-43	9.85	9- 3-58	5.81	4-9	9.36	9-8	
25N 3W 28-1	SW SW	MDC (8)	13	1¼	Qgd	1175.14	1934-37, 39-62	Q	8.60	7-28-60	11.28	10-22-58	9.57	4-23	10.02	7-18	
25N 1W 15-1	SE SE	USFS	56	6	Qgd		1948-62	R	29.36	7-27-60	35.97	4- 4-51	29.89	7-8	31.86	4-3	
Eaton County																	
4N 4W 2-1	SW SW	City of Grand Ledge	376	12	Pps	846.59	1948-62	R	21.34	5- 5-50	29.72	9-14-59	26.06	5-4	28.08	1-14	P
11-1	NW NE	City of Grand Ledge	350	8	Pps	788.9	1960-62	R	+3.8	9-19-60	-8.3	12- 4-60	+3.9	4-5	-6.8	7-7	P
4N 3W 10-1	SE NE	John Schneeberger	121	3	Pps	855.99	1944-62	M	31.28	5-27-48	39.36	11-27-61	39.26	4-27	40.54	10-29	P
12-1	SE SW	F. A. Wheeler	381	6	Pps	861.91	1953-62	R	67.51	11-23-53	79.8	8-19-61	74.4	1-1	82.2	7-20	P
2N 4W 19-1	NW SW	City of Charlotte	25	240	Qgd	889.44	1947-62	Q	8.04	4- 7-47	16.48	9-23-59	11.72	4-3	16.70	10-5	P

										Genessee County									
7N	7E	17-1	SE	NE	Consumers Power Co.	222	12	Pps	757.83	1946-62	R	24.23	2-12-50	37.99	8-24-55	24.30	4-13	31.13	7-19	P
		20-2	SW	SW	City of Flint	169	2	Qgd	749.48	1947-62	Q	1.09	4-26-50	9.07	9-15-55	4.77	4-2	9.10	9-18	
		29-1	SE	SW	C. F. Crain	14	1¼	Qgd	776.63	1946-62	Q	1.69	12-22-49	10.66	10-10-60	4.06	5-1	10.62	9-18	
		29-2	SW	SE	Jack Palmer	8	18	Qgd	779.86	1946-62	Q	+0.20	6-29-48	dry	10-10-60	1.60	5-1	dry	9-18	Meas. Discontinued 12-62
		32-1	SW	SW	A. W. Arndt	140	2	Qgd	792.27	1946-62	Q	18.51	6- 2-47	35.36	9- 2-59	34.14	5-1	37.76	9-18	P
6N	7E	9-1	SW	SE	Fisher Body Div., GMC	375	6	Pps	841.71	1952-62	R	37.79	11-24-52	59.9	8- 9-60	46.9	1-1	64.1	8-1	P
										Gladwin County									
17N	1W	7-1	SW	NW	City of Beaverton	93	12	Qgd	721.50	1950-62	W	27.94	4-6-59	49.35	6-26-50	30.20	3-26	33.62	7-25	P, Meas. by owner
										Grand Traverse County									
27N	9W	4-1	NW	NE	MDC (18)	15	2	Qgd	687.01	1934-37, 41-44, 48-52, 55-62	M	0.74	5-19-60	2.54	7-26-35	0.84	4-18	1.45	11-14	
26N	11W	27-1	NW	SW	MDC (2)	14	2	Qgd	914.25	1935-37, 41-44, 48-62	Q	1.20	4-14-59	4.02	8-18-36	1.12	4-17	2.68	9-20	
26N	9W	13-1	SW	SW	MDC (2)	14	2	Qgd	961.78	1934-37, 41-44 48-62	M	4.66	5-19-61	7.87	10-11-49	4.63	5-14	6.76	9-20	
										Gratiot County									
12N	3W	24-2	NE	SE	City of St. Louis (3)	216	16	Qgd		1960-62	R	44.6	4-17-61	67.6	10-28-60	41.2	6-25	56.0	7-18	P
		34-1	SW	SE	S. J. Brown	55	2	Qgd	727.12	1947-62	M	6.08	4-26-48	40.87	6-28-50	22.05	2-27	26.19	9-28	P
		35-3	NW	SW	Walter Stone	26	2	Qgd	732.62	1947-62	M	10.07	5-3-48	24.30	8-27-58	20.24	4-27	22.16	9-28	P
		35-5	SW	NW	Reed Excavating Co.	20	36	Qgd	738.78	1950-62	M	13.74	4-7-50	17.91	11-12-53	15.05	3-30	17.66	12-27	
12N	2W	18-1	NE	NW	Mich. Chemical Co.	1350	5½	Mm		1957-62	R	195.71	12-31-61	267.7	8-30-57	e175.50	12-31	197.08	1-1	
11N	3W	3-6	NW	NW	E. H. Waber	49	2	Qgd	733.20	1946-62	M	4.99	2-27-59	32.98	12-16-55	17.95	3-30	31.72	10-29	P
		4-1	SW	NE	City of Alma (TW 6)	165	8	Qgd	732.31	1955-58, 60-62	R	12.06	6-14-55	27.3	9-9-60	15.8	1-2	27.8	7-19	P
		36-1	SE	SE	Village of Ithaca	785	8	Pps	804.50	1947-62	M	78.25	1-22-52	83.96	9- 4-49	79.87	4-27	81.14	11-30	Meas. Resumed 2-62
										Hillsdale County									
6S	3W	23-2	NW	NW	City of Hillsdale (TW 6)	26	6	Qgd		1957-62	W	1.62	6-27-60	12.96	9-18-57	1.97	3-19	11.30	9-24	P
										Ingham County									
4N	2W	4-1	NW	SW	C & O R. R. (East 1)	38	12	Qgd	842.19	1953-62	M	25.98	3- 3-53	34.38	12-28-59	34.36	1-30	35.39	12-28	P
		9-1	SE	NW	City of Lansing (Seymour 1)	401	14	Pps	828.81	1929-62	R	15.63	3-26-31	154.77	4-10-56	132.5	2-26	151.7	9-14	P
		16-1	NE	SE	City of Lansing (Cedar)	417	12	Pps	829.11	1945-62	R	42.01	3-11-46	67.0	8-22-49	57.31	1-1	63.50	12-17	P
		17-1	NW	NE	City of Lansing (Logan)	424	20	Pps	858.72	1929, 31, 33-62	R	34.34	12- ?-29	149.64	4-11-56	138.4	2-5	146.4	12-20	P
		17-2	NW	NW	Olds Drop Forge (4)	417	12	Pps	872.55	1946-62	Q	104.86	12-10-46	149.47	9-26-61	146.75	3-29	151.70	12-20	P
		19-1	SW	SW	Waverly Hills Assoc.	87	2	Pps	833.94	1947-62	Q	0.00	3-29-50	8.74	12-29-60	5.75	7-3	8.04	12-20	P
		21-1	NE	NW	City of Lansing (Townsend)	410	14	Pps	834.10	1906, 19, 29-62	R	2.0	5-9-06	74.33	8-21-59	62.78	1-7	73.47	12-20	P
		22-1	SW	NW	City of Lansing (P-5)	338	12	Pps	823.64	1930-62	M	7.1	7-?-32	58.68	10-16-59	53.95	4-27	57.43	8-30	P
		23-1	NE	NW	City of Lansing (RS-7)	467	12	Pps	824.86	1930-32, 36-62	M	7.55	11-17-30	116.28	7-23-59	73.61	2-28	73.86	1-26	P, Meas. suspended 3-62
		24-1	NE	SW	Mich. State University	453	10	Pps	853.45	1945-62	R	25.47	3-25-46	e80.0	7-17-59	55.5	1-2	85.2	6-2	P
		28-1	NE	NW	Atlas Drop Forge (2)	425	8	Pps	849.20	1944-45, 48-62	Q	30.28	4-23-48	54.57	6-27-61	53.63	7-3	59.69	12-20	P
		31-1	SW	SW	C. A. Weber	204	3	Pps	880.15	1944-62	M	18.92	4-26-52	25.57	2-27-59	24.19	4-27	25.69	10-29	P
4N	1W	18-1	SE	NE	Marble School	175	3	Pps	847.85	1952-62	M	20.09	4-27-53	36.63	7-27-61	35.76	4-27	38.47	8-30	P
3N	2W	23-2	SE	NE	Delhi Twp.	268	8	Pps	e880	1959-62	R	2.07	3-31-60	6.09	8-17-61	3.60	3-21	6.75	10-13	P
2N	1W	5-1	SE	SE	City of Mason (old 2)	150	6	Pps		1948-62	W	0.08	6-29-49	8.96	9-10-60	3.31	5-26	7.64	2-10	P, Meas. by owner
										Ionia County									
7N	7W	23-1	NW	NW	Michigan Tng. Unit at Ionia	127	6	Qgd	741.65	1960-62	R	28.36	4-28-61	34.12	10-13-61	28.78	5-4	31.89	9-13	P
		25-1	SW	NE	Ionia State Hospital	23	6	Qgd	635.76	1960-62	R	9.34	4-28-61	17.42	10-28-61	4.23	3-22	18.07	9-13	P

Table 1.--Records of Michigan observation wells and extremes of water levels observed in 1962 and for the period of record.--Continued

Well number	Location in section ¼ ¼	Owner	Depth (ft)	Dia. (in)	Chief aquifer	Altitude	Years of record	F 62	Observed water level extremes: Through 1961 Highest	Date	Lowest	Date	In 1962 Highest	Date	Lowest	Date	Remarks
Ionia County (Continued)																	
6N 5W 33-1	- NE	Barley-Earhart Co.	15	180	Qgd		1957-62	M	4.55	4- 1-60	10.25	7-17-59	6.73	3-29	10.45	9-13	
Iosco County																	
23N 7E 7-1	NE SE	USFS	341	6	Qgd		1948-62	Q	25.13	8- 3-52	28.10	4-27-59	26.70	4-9	26.72	7-18	Meas. discontinued 7/62
Jackson County																	
1S 1E 36-9	SE SE	MDC (9)	9	1¼	Qgd	920.28	1956-62	W	0.42	5-10-56	6.80	12-30-58	1.68	4-3	5.76	9-8	Meas. by owner
3S 1W 2-1	SE NW	City of Jackson	221	8	Ips, Mm	e935	1960-62	R	17.5	11-28-60	46.0	7-27-61	20.8	11-25	49.8	6-29	P
10-1	SW SE	Summit Township	323	12	Ips,Mm	e935	1960-62	R	14.3	1- 2-61	32.4	7-20-61	20.3	4-23	35.9	8-19	P
11-2	NE NE	City of Jackson (4a)	360	6	Ips,Mm		1957-62	D	18.6	1- 2-61	93.0	8-26-59	25.8	11-4	84.4	6-29	P, Meas. by owner
11-3	NE NE	Do.	36	3	Qgd	928.82	1962	R					3.68	4-9	10.13	9-19	Record began 4-6-62
Kalamazoo County																	
2S 11W 3-60	NE NE	KVP Co. (61)	36	6	Qgd	763.18	1956-62	W	9.61	4- 4-60	12.90	7-17-61	9.75	3-26	12.75	9-17	P
15-18	NE SE	Consumers Power Co.	64	12	Qgd	766.17	1946-62	Q,M	9.20	3-28-50	18.20	9-15-61	13.52	4-4	17.72	12-14	P
20-7	SW SE	Western Mich. Univ.	78	8	Qgd	868.68	1946-62	Q,M	33.44	6-19-50	38.15	9-17-59	36.00	4-4	36.68	10-19	
22-150	SE SW	City of Kalamazoo (Stockbridge)	137	4	Qgd	764.7	1960-62	R	18.97	12-26-61	31.08	8-19-61	17.27	12-13	22.76	8-25	P
27-52	NE NE	Allied Paper Co. (7)	113	12	Qgd	802.59	1946-62	M	34.46	5- 5-50	64.37	9- 1-46	42.87	6-1	44.75	1-9	P
29-3	SW SE	Oakwood, Inc.	47	2	Qgd	880.72	1946-62	Q,M	26.12	8- 1-52	30.59	11-13-61	30.18	5-17	30.80	12-14	
3S 12W 11-1	SE NW	City of Kalamazoo (Atwater)	248	3	Qgd		1961-62	R	+1.96	3-27-61	+1.41	9- 8-61	+1.65	7-22	+1.19	12-23	
3S 11W 4-35	SE NE	City of Kalamazoo (A-D)	135	3	Qgd	854.03	1959-62	R	1.34	10-30-61	12.89	11- 3-59	1.5	4-30	10.5	6-28	P
4-36	SE NE	City of Kalamazoo (A-S)	40	3	Qgd	854.01	1959-62	R	0.04	10-30-61	9.12	11- 4-59	0.45	3-12	5.02	8-30	P
4S 11W 21-2	NW SW	Willis Chamberlain	19	1¼	Qgd		1957-62	Q	10.77	7-20-60	15.12	2- 8-59	12.62	4-25	15.24	2-7	
Kalkaska County																	
27N 5W 36-1	SE NW	MDC (100)	16	1¼	Qgd		1939-62	W	11.12	7-11-43	13.80	9- 8-61	12.93	5-4	14.32	12-21	
Kent County																	
6N 12W 17-1	SE NE	Jervis Corp (1)	30	12	Qgd		1950-62	M	6.88	6- 8-56	16.45	2-12-54	8.32	6-25	11.33	2-13	P, Meas. by owner
17-2	SE NE	Do.	26	6	Qgd	606.05	1950-62	M	7.34	6- 1-56	16.32	2-12-54	6.85	4-10	11.35	11-20	P, Do.
25-1	SW SW	City of Wyoming	241	12	Mm	e666	1960-62	R	10.0	10-24-60	50.4	7-12-61	14.4	12-26	47.4	6-29	P
27-1	NW NW	City of Wyoming (44th)	265	14	Mm		1962	R					51.3	10-30	51.80	12-23	Recorder installed 10/4/62
34-1	SE NE	City of Wyoming	300	8	Mm	e735	1960-62	R	64.82	10-26-60	69.85	7-12-61	66.75	12-27	69.67	6-30	P
6N 11W 19-1	SE	Lear Mfg. Co.	301	8	Mm		1960-62	R	34.3	12- 5-60	e75.2	7- 1-61	40.7	1-8	48.0	1-5	P, well destroyed 4-62
6N 9W 3-1	SW NE	City of Lowell	70	12	Qgd		1961-62	R	13.52	9-29-61	18.98	9-18-61	11.22	5-4	18.83	2-5	
5N 12W 4-3	SW SE	City of Wyoming (Wobma)	86	6	Qgd		1962	R					11.98	10-22	12.14	12-28	Recorder installed 10-4-62
4-7	SE SW	City of Wyoming (DeHaan)	227	8	Mm		1962	R					8.88	10-22	9.05	12-31	Do.
11-3	NE NW	Do. (DeJager)	80	8	Qgd		1962	R					3.97	10-23	4.24	10-24	Do.

									Lake County										
17N	13W	4-1	SE	NE	C & O R. R. (West Well)	83	8	Qgd		1957-62	Q	17.17	7- 6-60	20.36	5-23-58	17.86	4-10	19.34	12-12	
									Livingston County										
2N	4E	3-1	NW	SW	Howell State Sanitarium	148	8	Tps	916.13	1958-62	R	10.2	4-30-59	27.8	12-13-58	11.32	3-20	27.02	5-29	P
									Macomb County										
2N	12E	1-1	SE	NE	B. H. Tolley	29	48	Qgd		1959-62	R	0.50	1-13-60	7.45	10-31-60	0.86	3-12	6.98	8-6	
									Manistee County										
23N	14W	21-1	NE	SW	Village of Kaleva	70	8	Qgd		1959-62	R	8.49	5-15-60	11.19	8-25-61	8.25	4-1	10.59	8-8	P, Record discontinued 8/62
									Mason County										
17N	15W	3-1	SE	SW	USFS	32	6	Qgd	737.37	1948-62	M	13.90	6-30-60	19.45	8-24-58	15.19	5-31	16.43	12-1	
									Montcalm County										
9N	8W	15-1	SW	NW	City of Greenville (9)	65	12	Qgd		1950-62	M	11.40	4- 1-50	17.40	8- 1-58	12.40	4-2	16.08	11-1	P, Meas. by owner
									Montmorency County										
29N	3E	21-1	NW	NE	MDC (32)	14	2	Qgd		1945-62	Q	2.54	7- 6-60	5.91	1-27-56	2.85	7-2	4.50	12-3	
									Oakland County										
3N	9E	7-1	NE	SW	Garfield Estates	77	6	Qgd		1961-62	R	+0.05	8- 5-61	0.55	11- 4-61	+0.31	4-8	-1.13	12-24	
		36-1	NW	NE	Waterford Twp. (Josephine St.)	134	12	Qgd		1960-62	R	95.92	4-16-61	98.26	12-16-61	96.61	1-7	99.26	12-24	P
3N	10E	13-2	SW	NE	Oakland University (formerly MSU-O)	183	6	Qgd		1961-62	R	78.84	2-25-61	81.3	12-15-61	80.3	1-6	89.6	12-20	P
		31-1	NE	SW	City of Pontiac (Orchard Lake Road)	173	12	Qgd	926.4	1952-62	R	107.7	2-16-59	128.0	8-16-55	117.5	3-4	126.0	7-19	P
		32-1	SE	NW	City of Pontiac (6)	160	8	Qgd	921.88	1939-62	R	59.55	4-22-40	129.5	8- 5-55	116.6	3-12	126.8	7-19	P
3N	11E	4-1	SE	NW	Village of Rochester	73	6	Qgd		1961-62	R	23.2	12-25-61	30.6	11- 3-61	22.8	2-14	32.3	7-19	
2N	10E	22-1	NE	NW	Cranbrook School (3)	65	6	Qgd		1950-62	W	11.00	4-30-56	17.60	9-26-55	11.79	4-23	16.55	10-22	P, Meas. by owner
									Ogemaw County										
23N	1E	4-1	SE	NE	MDC (15)	21	4	Qgd		1934, 55-62	Q	1.14	4-27-60	4.26	10-10-55	1.34	4-23	3.09	12-21	
23N	2E	2-1	NE	NW	Charles Hudson	7	36	Qgd		1951-62	R	0.37	5- 5-52	4.30	3- 5-59	0.94	5-3	2.83	12-31	
									Otsego County										
29N	3W	29-1	SW	SE	MDC (106)	15	2	Qgd		1933-62	Q	5.56	5-14-47	9.74	10- 7-58	7.31	4-16	8.77	12-21	
									Ottawa County										
5N	15W	28-71	SE	SE	City of Holland	108	1¼	Qgd		1946-55, 57-62	M	56.44	8- 8-46	dry	9-14-54	64.94	12-3	69.60	1-16	Meas. by owner
									Presque Isle County										
33N	2E	30-1	NE	SE	MDC (19)	14	2	Qgd		1934-44, 48-62	Q	0.61	7-12-60	5.69	1-27-56	1.97	7-16	3.74	12-4	
33N	6E	8-1	NW	NW	Albert Styma	61	6	Dt		1959-62	M	5.66	4- 4-60	15.92	12- 1-60	6.27	4-4	16.24	12-4	
		15-1	NW	NW	Harley Ennest	31	5	Dt		1959-62	R	2.8	5-10-60	11.6	8-26-60	3.28	5-3	11.55	8-31	P
		21-1	NE	NE	Mike Ardycan	43	5	Dt		1959-62	M	4.27	4- 4-61	7.20	8- 6-59	2.47	4-4	7.04	2-2	

Table 1.--Records of Michigan observation wells and extremes of water levels observed in 1962 and for the period of record.--Continued

Well number	Location in section (¼ ¼)	Owner	Depth (ft)	Dia. (in)	Chief aquifer	Altitude	Years of Record	F 62	Observed water level extremes: Through 1961 Highest	Date	Lowest	Date	In 1962 Highest	Date	Lowest	Date	Remarks
							Roscommon County										
24N 2W 20-1	NE NW	MDC (1)	14	8	Qgd	1145.30	1934-62	R	2.78	5- 3-51	6.23	12- 6-49	3.52	4-5	5.26	12-31	Fed. key well
23N 1W 3-1	SE SE	MDC (50)	12	2	Qgd	1188.95	1939-62	Q	1.62	6-15-43	7.31	12-14-49	3.85	4-23	5.51	12-21	
22N 3W 22-1	SE NE	MDC (7)	14	2	Qgd	1170.58	1934-62	Q	2.56	4-27-60	5.70	12-20-61	4.38	4-23	6.60	12-21	
							Saginaw County										
9N 3E 16-2	SE NW	Ray Ellis	129	3	Ps		1958-62	W	35.41	1-27-59	53.84	9- 8-59	36.79	1-23	50.19	8-28	P
							Sanilac County										
12N 13E 33-1	SE SE	MSHD	150	3	Mm		1948-62	W	15.45	4-25-51	23.60	2-11-59	16.50	5-9	20.78	10-10	
							Shiawassee County										
5N 2E 16-1	NE SE	A. B. Cobb	26	1½	Qgd	896.00	1948-62	Q	17.28	5- 3-50	22.18	2-27-59	20.38	4-2	22.40	12-12	
							Washtenaw County										
3S 6E 16-1	SW NW	City of Ann Arbor	23	2	Qgd	817.43	1920-62	W	e+2.5	2- ?-30	e10.0	11- ?-27	2.41	1-10	7.90	8-29	P, Meas. by owner
16-2	SE NW	City of Ann Arbor	23	192	Qgd		1948-62	W	+2.00	6-30-51	15.50	8-21-57	7.97	1-10	16.79	8-22	P, Do.
17-1	NE SE	City of Ann Arbor	25	12	Qgd	e825	1962	R					2.9	12-28	5.84	9-28	P, recorder installed 7/62
3S 7E 5-1	NW NW	City of Ypsilanti	69	8	Qgd		1962	R					2.71	7-20	3.87	12-12	Do.
9-2	SW NE	City of Ypsilanti (NR)	50	6	Qgd		1944-46, 48-53, 60-62	M	29.12	11- 5-45	40.8	7- 2-49	35.44	4-27	40.71	12-8	P
9-3	SE NE	City of Ypsilanti (GP)	94	6	Qgd		1944-46, 48-53, 60-62	R	29.12	11- 5-45	59.15	10- 1-60	55.30	4-	60.62	12-20	P
24-1	NE SW	Ford Motor Co. (104)	87	4	Qgd	665.56	1943-45, 49-62	M	5.79	1- 5-50	16.43	10-16-56	16.39	1-13	19.44	7-27	P
24-2	NE SW	Ford Motor Co. (106)	53	4	Qgd	664.51	1943-45, 49-62	M,R	11.81	7-13-43	36.33	1-21-61	30.58	9-4	36.58	4-7	P
24-4	NE SW	Ford Motor Co. (107)	53	4	Qgd	664.05	1943-45, 49-62	M	11.55	1- 5-50	36.93	8- 5-60	33.55	9-16	37.12	4-7	P
24-5	NW SW	Ford Motor Co. (109)	77	4	Qgd	665.56	1943-45, 49-62	M	15.15	6- 6-45	40.70	2-18-61	38.58	1-13	39.39	8-17	P
24-6	SW SW	Federal Works Agency (117)	75	6	Qgd	657.83	1944-45, 49-62	R	5.69	2-15-50	e31.25	8- 5-60	23.67	9-4	30.70	5-19	P
4S 6E 9-1	NW NW	Ypsilanti State Hosp. (TW 20)	184	6	Qgd		1946-62	W	51.22	5-15-48	88.14	6-17-49	67.15	5-1	72.47	11-30	P, Meas. by owner
10-1	SW NW	Ypsilanti State Hosp. (TW 22)	173	6	Qgd		1946-62	W	56.77	10- 9-61	88.27	7- 8-55	56.64	10-1	76.64	6-29	P, Do.
							Wayne County										
1S 8E 9-1	SW NW	City of Plymouth	61	6	Qgd	820	1961-62	R	e11.0	9-28-61	e16.9	9-11-61	10.98	6-17	15.86	11-10	P
17-1	NE NE	City of Plymouth	114	6	Qgd	856	1962	R					50.45	8-12	51.88	12-?	P, recorder installed 8-62
4S 9E 32-1	SW SE	Village of Waltz Improvement Assoc.	190	6	Ds		1959-62	R	6.75	2-10-60	13.94	7-19-61	8.32	1-6	10.91	9-3	P
							Wexford County										
24N 9W 19-1	SW NW	MDC (38)	11	2	Qgd	944.16	1935-37, 41-44, 49-62	Q	0.49	4- 6-59	3.74	8-19-36	1.16	4-17	2.63	9-10	
22N 12W 13-1	NW	Harrietta State Fish Hatchery	141	4	Qgd		1961-62	R	+13.55	2- 7-61	+6.85	1-25-61	+12.03	12-21	+6.75	3-1	P, Record started 1-61
21N 11W 13-1	NW NE	USFS	62	6	Qgd		1948-62	M	46.28	6- 5-52	51.13	11- 1-58	48.60	7-9	49.91	4-9	Destroyed 8-62
21N 9W 4-1	NW NE	City of Cadillac	277	6	Qgd		1949-62	R	19.99	7- 6-53	23.83	10- 6-58	22.53	1-8	24.51	7-7	P

e - estimated

Table 2.--Reported ground-water pumpage by some Michigan municipalities, institutions, and industries (in million gallons).

Water User	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1962 Total	Max. Day	Min. Day
						NORTHERN	PENINSULA								
ALGER COUNTY															
Burt Township	1.66	1.20	1.79	1.59	1.87	2.09	2.48	1.63	1.37	1.71	1.33	1.51	20.23	.142	.030
CHIPPEWA COUNTY															
Kincheloe Air Force Base near Kinross	16.3	14.6	16.4	17.1	20.6	27.5	41.3	34.0	19.4	17.5	16.3	17.9	258.9	----	----
GOGEBIC COUNTY															
City of Bessemer	11.11	10.52	11.85	9.91	10.48	10.09	10.50	10.75	9.63	8.98	9.32	9.43	122.57	.375	.300
City of Ironwood	27.4	26.4	30.4	28.1	27.5	26.3	28.6	29.1	26.1	25.2	24.0	25.4	324.5	1.373	.464
City of Wakefield	6.60	5.25	3.35	4.10	6.20	6.51	6.38	6.38	6.17	6.07	5.79	6.45	69.25	----	----
HOUGHTON COUNTY															
City of Hancock	13.8	12.9	15.0	14.7	15.2	14.7	15.3	16.1	14.4	14.8	14.3	13.5	174.7	.575	.412
City of Houghton	26.0	24.8	27.6	26.8	29.8	25.6	25.5	25.9	22.6	24.8	e17.0	23.7	e300.1	1.136	.589
IRON COUNTY															
City of Caspian	7.42	6.61	7.57	7.36	7.60	8.01	9.11	9.00	8.91	7.71	7.30	7.40	94.00	.325	.225
City of Crystal Falls	18.3	17.6	18.4	19.1	19.7	19.5	22.2	19.0	15.7	15.4	13.6	14.7	213.2	.930	.543
City of Iron River	11.38	11.56	12.69	11.78	11.92	11.48	12.72	10.19	12.39	10.12	9.55	9.12	134.90	----	----
City of Stambaugh	7.14	6.60	7.28	6.78	7.93	7.58	8.29	8.39	6.78	6.98	6.19	6.06	86.00	.415	.136
Stambaugh Township	e.524	e.420	e.520	e.525	e.530	e.645	e.650	e.650	e.524	e.600	e.500	e.578	e6.666	e.026	e.016
LUCE COUNTY															
City of Newberry	e10.90	e10.27	e11.00	e10.00	e10.20	e11.00	e12.00	e12.00	e10.00	e9.50	e9.00	e9.00	e124.87	----	----
State Hospital at Newberry	9.69	9.67	15.38	10.01	11.42	11.81	13.48	15.37	10.54	10.50	12.39	13.71	143.97	----	----
MARQUETTE COUNTY															
State House of Corr. and Br. Prison at Marquette	7.86	6.72	7.54	7.32	8.00	7.60	8.71	8.76	8.57	8.09	7.67	7.36	94.20	.240	.180
KI Sawyer Air Force Base near Gwinn	21.3	22.7	23.8	25.0	37.1	36.3	52.1	39.2	24.6	27.3	27.1	28.5	365.0	----	----
ONTONAGON COUNTY															
Village of Ontonagon	11.1	10.2	11.5	11.6	16.3	15.7	16.0	17.1	17.0	19.8	17.5	11.2	175.0	.777	.250
						SOUTHERN	PENINSULA								
ALCONA COUNTY															
City of Harrisville	1.17	1.21	1.07	.89	1.07	1.17	1.90	1.88	1.32	1.07	.91	.93	14.59	.160	.024
ALLEGAN COUNTY															
City of Allegan	22.9	25.1	26.0	26.5	22.5	39.6	39.3	42.1	40.2	24.4	26.0	22.7	357.3	2.256	.503
City of Plainwell	8.74	7.88	9.22	10.25	15.11	17.55	16.67	17.66	11.48	11.50	9.26	9.50	144.82	.912	.127
City of Otsego	13.5	12.2	14.2	13.3	18.1	20.8	21.8	23.3	15.4	15.1	15.9	15.4	199.0	1.076	.282
ANTRIM COUNTY															
Village of Mancelona	11.16	9.42	10.28	11.65	13.82	14.36	14.55	12.16	12.24	12.81	12.39	11.97	146.81	.586	.214
BARRY COUNTY															
City of Hastings	28.8	26.1	27.7	38.0	33.4	35.0	32.9	43.5	31.2	35.3	32.4	31.6	395.9	1.710	.590
Village of Middleville	17.6	15.0	16.3	15.3	17.4	18.3	19.1	18.9	18.9	19.8	17.4	16.5	210.5	----	----
BAY COUNTY															
City of Pinconning	----	----	----	----	----	----	----	----	e.81	e.80	e .92	e.37	ce2.90	----	----
BENZIE COUNTY															
City of Frankfort	6.75	8.87	8.57	7.83	7.85	9.47	13.34	9.80	6.31	5.80	8.81	5.74	99.14	.630	.137
BERRIEN COUNTY															
Village of Berrien Springs	6.26	5.83	6.64	7.00	8.75	9.76	9.25	10.98	13.27	7.22	6.36	6.29	97.61	.493	.205
City of Buchanan	38.8	38.8	46.2	48.0	57.1	63.4	57.9	59.8	50.3	47.6	47.5	46.0	601.4	3.208	.873
City of Coloma	4.54	4.06	4.54	4.76	5.03	5.19	5.52	5.68	5.35	5.03	4.54	5.03	59.27	e.185	e.144
City of Niles	86.2	76.4	83.6	76.2	86.0	96.2	79.6	102.7	82.8	81.2	73.9	77.7	1002.5	4.79	1.4
BRANCH COUNTY															
City of Bronson	17.2	18.4	22.7	25.4	27.6	29.9	23.5	24.0	22.3	25.3	19.6	17.7	273.6	1.267	.160
City of Coldwater	42.2	36.0	33.7	45.7	59.2	64.0	58.6	75.0	52.1	51.5	46.6	48.2	612.8	3.809	.807
State Home and Tng. School at Coldwater	13.0	11.8	13.0	12.1	15.6	12.2	15.8	13.6	13.1	13.1	12.5	12.8	158.6	.824	.257
CALHOUN COUNTY															
City of Albion	127.	122.	136.	121.	145.	146.	130.	146.	128.	134.	119.	121.	1575.	6.204	----
American Legion Hosp. at Battle Creek	.542	.544	.501	.498	.498	.500	.476	.381	.339	.466	.422	.485	5.668	----	----
Village of Athens	.39	.39	.39	.57	.58	2.67	2.67	2.67	2.67	2.67	2.67	5.97	24.31	----	----
City of Battle Creek	254.	240.	270.	277.	344.	343.	316.	356.	293.	294.	261.	267.	3515.	15.05	6.36
Battle Creek Twp.	20.4	20.3	22.8	20.0	39.8	45.9	34.4	46.2	27.0	23.4	21.6	23.3	345.1	----	----
City of Marshall	27.4	20.9	23.8	30.9	41.9	43.5	39.0	44.4	34.5	34.7	30.9	28.1	400.0	1.959	.500

Table 2.--Reported ground-water pumpage by some Michigan municipalities, institutions, and industries (in million gallons).--Continued

Water User	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1962 Total	Max. Day	Min. Day
CASS COUNTY															
City of Dowagiac	24.0	22.6	20.9	15.8	21.0	31.2	29.5	28.5	25.2	23.4	23.2	14.2	279.5	----	----
Village of Marcellus	1.76	1.75	1.93	1.66	2.55	2.80	2.46	4.00	1.99	1.93	1.45	1.65	25.93	.263	.035
CHARLEVOIX COUNTY															
City of East Jordan	7.62	6.95	8.13	7.22	11.15	12.90	19.12	12.91	8.43	8.20	6.58	6.51	115.72	1.010	.120
CHEBOYGAN COUNTY															
City of Cheboygan	e10.0	e12.3	e11.0	e12.2	e12.0	e13.0	e14.5	e15.0	e12.2	15.7	14.2	19.3	e161.4	.727	.364
Village of Mackinac City	3.17	3.52	5.33	3.28	3.67	5.32	9.03	7.26	4.45	3.01	1.93	1.81	51.78	.395	.042
CLARE COUNTY															
City of Clare	17.6	18.2	16.0	16.0	22.9	37.0	29.5	19.4	16.6	14.2	15.2	15.0	237.6	----	----
City of Harrison	2.92	2.97	3.37	2.76	3.34	3.53	4.07	3.64	4.52	2.67	2.11	1.83	37.73	.197	.044
CLINTON COUNTY															
Village of Elsie	e1.44	e1.38	e1.41	e1.41	e1.47	e1.56	e1.89	e1.86	e1.80	e1.77	e1.77	e1.62	e19.38	----	----
Village of Ovid	1.71	1.51	2.01	2.16	2.90	2.63	3.87	3.00	2.10	2.22	1.62	2.78	28.51	.290	.058
City of St. Johns	28.3	25.9	28.8	27.3	31.4	32.4	29.0	25.4	23.6	25.9	23.1	23.0	324.1	1.286	.454
EATON COUNTY															
Village of Bellevue	e2.0	e2.0	e2.0	e2.0	e2.0	e2.0	e2.5	e2.5	e2.5	e2.0	e2.0	e2.0	e25.5	----	----
City of Olivet	----	----	----	----	----	----	----	----	----	----	----	----	e21.3	----	----
City of Charlotte	33.9	27.6	33.0	35.1	38.3	37.8	34.3	40.3	35.3	34.0	29.7	30.0	409.3	1.46	----
City of Eaton Rapids	31.5	28.5	25.2	29.1	24.5	35.0	34.5	32.1	32.3	25.1	24.3	25.9	348.0	1.117	.760
City of Grand Ledge	11.3	10.3	11.3	11.0	14.3	14.9	16.4	16.1	13.1	12.1	11.0	11.6	153.4	.847	.237
EMMET COUNTY															
City of Harbor Springs	7.40	7.63	6.99	8.51	8.34	21.51	29.98	25.62	16.36	8.53	8.59	7.77	157.23	1.693	.133
GENESEE COUNTY															
Beecher Metr. Dist.	27.8	25.9	27.3	25.2	31.1	26.6	31.7	29.6	26.2	25.8	23.8	25.5	326.5	1.410	.581
Village of Clio	3.54	7.32	4.11	4.73	4.20	5.04	4.64	4.14	5.02	4.00	3.66	3.19	53.59	.120	.082
City of Davison	9.04	7.76	9.50	11.62	9.14	11.62	10.05	11.02	9.75	9.77	8.71	9.21	117.19	.730	.162
Village of Fenton	16.0	14.8	17.8	15.9	20.6	19.7	21.7	19.2	18.0	17.7	15.7	16.8	213.9	1.404	.267
Fisher Body Div., at Grand Blanc	6.70	5.73	6.68	6.98	7.24	6.97	7.19	6.71	6.07	7.16	6.58	6.68	80.69	----	----
Village of Flushing	6.83	6.15	7.01	7.28	10.02	9.02	9.38	7.11	6.96	7.24	7.15	6.98	91.13	----	----
Village of Linden	.276	.111	.200	.163	.450	.926	.467	.456	.192	e.150	e.150	e.150	e3.691	----	----
Village of Montrose	1.56	1.73	1.96	1.93	2.86	2.83	3.62	2.73	2.20	2.55	2.39	1.07	27.43	.214	.055
City of Mt. Morris	6.11	5.28	6.35	5.92	6.94	6.54	7.04	7.63	6.65	6.71	6.44	6.76	78.37	.351	.152
Village of Otisville	1.03	1.11	1.23	1.09	1.11	1.30	2.03	2.05	1.01	1.05	.93	1.02	14.96	.060	.030
GLADWIN COUNTY															
City of Beaverton	2.52	2.42	2.91	3.32	3.11	1.87	3.30	1.32	1.89	2.55	2.01	2.19	29.41	----	----
GRATIOT COUNTY															
City of Alma	51.3	47.4	56.1	50.9	63.1	56.6	51.4	47.8	48.8	50.1	43.1	39.4	606.0	2.590	.900
Village of Breckenridge	2.70	2.46	2.70	2.65	2.70	2.99	3.64	3.10	2.76	2.84	2.58	2.81	33.93	.180	.062
City of Ithaca	5.23	5.00	5.01	5.44	5.32	5.48	5.74	5.47	5.32	5.60	5.06	5.45	64.12	.265	.113
City of St. Louis	20.6	16.4	20.1	20.4	23.0	21.1	22.9	20.9	17.6	17.7	14.9	16.6	232.2	1.043	.428
HILLSDALE COUNTY															
Village of Jonesville	6.99	6.65	6.72	9.77	10.11	10.78	9.92	8.54	8.66	9.45	8.63	8.15	104.37	.523	.207
City of Hillsdale	----	----	----	----	----	9.99	33.47	33.80	29.96	----	----	----	107.22b/c	----	----
HURON COUNTY															
Village of Pigeon	e2.90	e2.60	e2.90	e2.80	e3.10	e3.40	e4.46	e4.56	e4.10	e3.50	e2.90	e2.90	e40.12	.145	.090
Village of Sebewaing	9.54	10.15	10.58	15.03	10.03	10.70	13.47	12.65	10.73	10.78	10.08	7.15	130.89	----	----
INGHAM COUNTY															
City of East Lansing	34.5	38.0	41.9	39.1	56.8	52.1	52.3	53.3	53.8	55.2	52.1	51.2	580.3		
City of Lansing	525.	467.	522.	515.	628.	629.	623.	631.	553.	569.	531.	548.	6741.	27.16	----
Lansing Twp.	51.2	28.7	37.8	38.6	52.7	47.8	60.7	44.9	49.8	50.2	35.4	47.1	544.9	----	----
Village of Leslie	4.75	3.74	4.46	4.66	7.68	7.21	6.68	7.90	4.98	4.69	4.02	4.42	65.19	.460	.109
City of Mason	11.5	10.3	11.7	12.1	14.1	14.2	13.6	13.6	12.8	11.8	10.1	11.4	147.2	.741	.264
Meridian Twp.	14.86	14.27	15.03	15.58	23.02	16.96	19.43	20.96	2.76	2.32	2.26	2.46	149.91	----	----
Mich. State Univ. at East Lansing	88.1	86.4	90.0	91.8	111.3	97.0	94.0	90.9	81.8	95.1	86.4	75.6	1088.4	3.9	1.2
Oldsmobile Forge Plant at Lansing	12.9	14.3	12.3	13.8	14.9	13.7	13.5	11.7	13.8	11.9	12.0	13.2	158.0	----	----
Village of Stockbridge	1.95	1.69	1.85	1.97	2.24	2.34	2.52	2.68	2.40	2.34	2.05	1.99	26.02	----	----
IONIA COUNTY															
City of Ionia	34.7	32.4	36.3	35.4	40.1	35.7	31.7	31.3	27.9	26.8	23.4	26.5	382.2	----	----
State Hosp. at Ionia	10.24	9.58	10.12	9.84	10.50	11.35	12.27	12.48	10.47	10.72	10.01	10.19	127.77	.435	.329
Mich. Reform. at Ionia	17.1	14.0	15.8	14.8	17.8	19.6	23.3	22.3	20.0	26.6	13.9	13.9	219.1	1.000	.450
Mich. Tng. Unit at Ionia	1.51	1.29	1.17	1.44	2.56	2.67	3.62	5.57	2.72	2.26	1.96	1.57	28.34	e.232	e.039
City of Portland	9.02	8.41	8.80	9.08	11.92	13.72	13.48	13.09	10.30	9.97	8.42	8.98	125.19	.457	.281
Village of Saranac	7.57	7.48	8.07	7.47	9.86	10.92	10.40	10.96	10.13	10.85	9.73	10.52	113.96	.551	.070
IOSCO COUNTY															
Wurtsmith Air Force Base	21.3	21.8	26.6	30.9	34.7	41.2	41.2	35.6	26.9	24.0	23.8	23.6	351.6	1.741	.492
ISABELLA COUNTY															
City of Mt. Pleasant	42.9	39.7	50.3	47.3	58.6	55.4	58.5	45.4	49.0	50.4	46.0	44.4	587.9	2.67	0.96
Village of Shepherd	g	g	g	g	2.29	2.26	2.44	2.50	1.64	2.09	2.06	1.67			

Table 2.--Reported ground-water pumpage by some Michigan municipalities, institutions, and industries (in million gallons).--Continued

Water User	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1962 Total	Max. Day	Min. Day
JACKSON COUNTY															
Village of Concord	1.60	1.28	1.96	1.45	1.81	1.90	2.42	2.13	1.76	1.72	1.71	1.61	21.35	.108	.040
Village of Grass Lake	e.93	e.83	e1.08	e1.09	e1.03	e1.00	e1.50	e1.51	e1.44	e1.03	e1.00	e1.08	e13.52	----	----
City of Jackson	359.	306.	338.	335.	423.	411.	371.	402.	349.	344.	292.	306.	4236.	19.3	5.7
State Prison of S. Mich., at Jackson	43.6	37.0	37.7	35.8	51.8	44.9	55.2	48.7	47.1	51.9	39.7	38.1	531.5	2.294	1.074
KALAMAZOO COUNTY															
Village of Augusta	1.17	1.51	1.73	1.90	1.71	e1.05	1.88	3.52	1.81	1.84	1.42	1.82	e21.36	.657	----
City of Galesburg	2.39	2.19	2.50	2.33	3.72	3.83	3.83	4.73	3.36	3.41	3.11	3.17	38.57	----	----
City of Kalamazoo	308.	265.	356.	324.	475.	562.	467.	567.	380.	370.	325.	326.	4725.	28.4	6.9
State Hosp. at Kalamazoo	20.2	17.2	16.8	15.2	16.5	16.7	17.8	17.8	17.2	19.6	18.2	17.9	211.1	.750	.425
Village of Vicksburg	6.10	5.72	6.10	5.25	10.99	11.79	9.43	12.76	6.97	6.79	6.05	5.77	93.72	.401	.200
Upjohn Co. near Kal.	241.	218.	225.	243.	326.	308.	304.	310.	286.	288.	234.	214.	3197.	13.0	5.0
KVP-Sutherland Paper Co. at Parchment	e71.0	e82.3	e85.9	e118.1	e101.8	e106.0	e125.7	e101.8	e103.9	e49.8	e17.8	e9.8	e973.9	----	----
KALKASKA COUNTY															
Village of Kalkaska	3.62	3.97	4.35	3.89	3.88	4.66	4.96	4.51	3.96	3.90	3.27	3.17	48.14	.246	.073
KENT COUNTY															
City of Grandville	11.9	11.4	13.5	15.3	27.8	40.4	37.7	42.0	23.3	17.7	13.8	14.1	268.9	2.194	.278
Jervis Corp. at Grandville	13.06	10.23	9.32	9.02	9.42	5.89	7.45	6.19	5.38	6.94	5.65	7.51	96.06	----	----
City of Lowell	e11.3	e10.3	e13.3	e12.6	e17.7	e19.1	e19.4	e19.2	e13.6	e12.5	e11.5	e11.4	e171.9	1.069	.229
Paris Twp.	24.4	19.8	22.5	23.0	40.4	e55.3	e37.5	45.4	29.8	20.8	20.3	18.8	e358.0	1.513	..291
Village of Sparta	11.4	10.4	12.8	12.6	14.6	15.4	14.8	15.1	13.6	13.5	12.1	13.6	159.9	.800	.200
City of Wyoming	130.	116.	127.	125.	224.	279.	257.	273.	188.	144.	133.	135.	2131.	15.3	2.10
LAPEER COUNTY															
Village of Imlay City	10.83	7.00	9.58	9.72	8.95	11.69	14.55	11.27	8.38	9.68	6.60	5.59	113.84	----	----
City of Lapeer	17.7	15.2	19.3	17.6	19.8	17.3	18.7	19.4	16.3	16.3	14.3	14.5	206.4	----	----
State Home and Trng. School at Lapeer	21.1	21.0	24.0	22.9	23.4	21.7	20.4	21.5	21.3	23.1	22.1	20.6	263.1	----	----
LENAWEE COUNTY															
Village of Clinton	----	----	a16.9	----	----	a17.5	----	----	a16.9	----	----	a15.6	66.9	.195	.110
City of Hudson	7.88	7.26	8.12	6.87	8.39	9.04	8.63	10.03	8.13	8.53	8.11	8.05	99.04	.484	.125
City of Morenci	4.54	4.23	5.37	4.83	5.54	5.29	5.18	6.26	5.52	5.14	4.76	5.23	61.89	.315	.115
City of Tecumseh	76.3	66.6	73.4	71.0	74.6	68.0	76.5	70.2	72.3	74.6	64.7	68.4	856.6	3.075	1.474
LIVINGSTON COUNTY															
City of Brighton	6.61	6.29	6.87	8.68	12.86	13.50	12.43	10.88	8.84	6.62	5.24	8.22	107.04	----	----
City of Howell	19.7	19.3	21.6	21.2	24.5	23.6	25.1	23.9	26.3	20.1	19.7	19.5	264.5	----	----
State Hosp. at Howell	2.24	1.93	2.50	2.49	6.64	3.40	4.49	4.41	3.05	2.89	2.31	2.77	39.12	.475	.041
MACOMB COUNTY															
City of Fraser	13.8	12.3	14.8	16.3	28.6	21.3	25.9	20.2	16.4	16.4	14.8	15.2	216.0	1.500	.355
Village of Richmond	6.94	6.21	8.09	7.21	7.95	8.18	9.00	8.41	8.24	8.25	6.52	8.04	93.04	.385	.189
Village of Romeo	10.8	10.3	11.0	10.9	11.2	12.8	15.0	14.3	13.1	11.3	11.2	11.0	142.9	.475	.334
MANISTEE COUNTY															
City of Manistee	36.9	34.8	34.7	36.3	47.1	56.2	56.1	44.9	36.3	37.6	32.3	33.7	486.9	2.923	.863
MASON COUNTY															
City of Scottville	4.21	4.39	5.55	4.87	6.46	8.01	8.95	8.81	6.55	6.67	7.00	5.61	77.08	----	----
MONROE COUNTY															
Village of Carleton	2.71	2.28	2.53	2.77	3.26	3.10	3.09	3.27	2.79	2.94	2.60	3.15	34.49	.150	.062
MONTCALM COUNTY															
City of Carson City	10.73	7.55	6.56	8.83	8.63	8.71	8.42	8.40	7.95	8.50	9.23	7.55	101.06	.498	.133
City of Greenville	23.4	25.8	23.9	23.1	28.8	32.3	30.5	30.4	25.1	26.5	23.9	e23.0	e316.7	1.76	.29
Village of Howard City	.97	.78	1.00	.92	1.28	1.78	2.00	1.75	1.33	1.37	1.18	1.17	15.53	.062	.014
Village of Lakeview	----	----	ae4.0	----	----	ae5.0	----	----	ae7.0	----	----	ae4.0	e20.0	----	----
Village of Sheridan	1.16	1.07	1.36	1.15	2.51	2.45	4.32	3.20	2.25	1.24	1.41	1.24	23.36	.310	.035
MUSKEGON COUNTY															
City of Montague	4.36	3.14	5.29	6.81	10.59	11.51	9.71	6.34	5.65	4.54	4.10	4.57	76.61	.625	.150
City of Whitehall	9.49	8.94	9.70	7.66	15.94	22.48	18.04	15.24	12.77	11.80	11.02	11.16	154.24	1.642	.262
NEWAYGO COUNTY															
City of Fremont	22.2	15.0	15.5	18.0	28.8	27.3	26.6	24.2	26.9	18.6	16.6	14.7	254.4	2.588	.203
OAKLAND COUNTY															
City of Birmingham	7.96	6.59	5.71	4.88	14.02	7.45	9.08	10.48	0.44	10.02	4.87	4.32	f85.81	----	----
Cranbrook School	8.75	8.15	8.55	7.96	18.47	10.92	11.15	9.06	9.62	10.00	7.23	3.75	113.61	----	----
Oakland University	1.61	1.40	1.37	.959	1.84	1.91	1.82	2.33	2.21	2.62	2.21	1.70	22.0	.220	.016
Village of Oxford	5.58	4.15	5.56	4.38	6.85	7.02	5.65	5.30	4.12	4.67	5.73	5.08	64.09	----	----
City of Pontiac	297.	286.	339.	359.	441.	394.	438.	361.	346.	366.	349.	353.	4329.	20.89	6.45
Village of Rochester	35.3	31.3	35.8	35.8	46.9	43.2	45.5	42.9	36.0	34.1	35.6	34.4	456.8	2.278	.803
City of South Lyon	48.2	44.0	48.4	42.0	49.4	43.3	34.0	52.4	39.6	41.6	39.9	40.2	523.0	1.5	.9
City of Sylvan Lake	4.15	3.13	3.33	3.87	5.10	3.86	5.33	5.34	4.32	4.24	4.14	3.79	50.60	----	----
City of Troy	29.2	25.7	29.7	29.3	48.9	39.0	52.6	42.6	37.9	38.5	33.6	36.4	443.4	----	----
Waterford Twp.	22.0	20.1	24.1	23.3	53.3	42.9	56.4	38.3	27.8	24.0	24.8	25.0	382.0	----	----
OCEANA COUNTY															
City of Hart	10.06	9.57	9.96	9.49	15.29	27.48	48.40	20.94	17.29	19.13	13.49	11.18	212.28	2.730	.259
OGEMAW COUNTY															
City of West Branch	6.07	6.22	6.94	5.68	7.40	5.36	8.92	7.76	12.01	7.18	6.80	5.96	86.30	----	----

Table 2.--Reported ground-water pumpage by some Michigan municipalities, institutions, and industries (in million gallons).--Continued

Water User	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	1962 Total	Max. Day	Min. Day
OSCEOLA COUNTY															
City of Evart	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	e37.0	444.0 eh	----	----
OTSEGO COUNTY															
City of Gaylord	18.99	8.62	9.54	9.17	9.38	9.75	11.27	10.98	9.61	10.05	9.13	10.04	126.53	.396	.179
N.Mich. T.B. San. at Gaylord	1.35	1.35	1.43	1.40	1.40	1.34	1.55	1.41	1.35	1.44	1.35	1.48	16.85	.062	.028
OTTAWA COUNTY															
City of Grand Haven															
Lake Infil. Wells	52.0	52.1	50.8	50.3	79.9	121.6	110.3	108.3	69.8	67.3	54.3	50.1	866.8	6.400	.626
Drift Wells	17.6	15.4	17.4	16.9	17.1	15.5	14.9	15.3	13.9	17.6	16.5	16.2	194.3	.735	----
City of Hudsonville	----	----	a11.0	----	----	a14.8	----	----	a36.1	----	----	a12.8	74.7	----	----
Village of Spring Lake	7.58	6.14	9.62	8.87	14.76	22.82	19.21	21.83	11.41	8.47	7.00	7.07	144.78	1.078	.110
City of Zeeland	23.9	19.7	23.8	23.0	29.1	31.4	28.1	34.5	30.8	30.6	28.1	25.0	328.0	1.495	.428
Village of Coopersville	3.15	3.19	3.89	4.18	4.19	3.40	4.81	4.83	3.61	3.29	3.42	3.85	45.8	.156	.129
PRESQUE ISLE COUNTY															
City of Onaway	e2.0	e2.0	e2.0	e2.0	e2.0	e2.4	e3.0	e3.5	e3.2	e2.5	e2.0	e2.0	e28.6	e.085	e.035
City of Rogers City	6.23	6.01	7.26	6.48	7.27	7.96	13.23	8.38	6.29	6.40	6.18	6.28	87.97	.764	.145
SAGINAW COUNTY															
Bridgeport Twp.	6.34	4.96	6.22	6.10	8.00	7.83	9.97	9.71	8.27	8.06	6.24	5.55	87.25	----	----
Village of St. Charles	5.08	3.30	2.54	3.11	4.74	4.47	5.06	6.39	3.93	5.92	4.15	4.41	53.10	.211	.112
Thomas Twp.	3.57	3.27	3.50	3.43	4.72	4.74	5.18	5.14	4.26	4.83	3.72	3.53	49.89	.200	.116
ST. CLAIR COUNTY															
Village of Capac	3.19	1.50	1.54	1.12	2.82	2.40	3.83	3.39	2.67	2.55	2.78	2.17	29.96	.123	.036
City of Yale	5.18	4.99	5.33	5.46	6.41	6.56	6.95	7.08	6.51	6.05	5.20	3.63	69.35	----	----
ST.JOSEPH COUNTY															
Village of Constantine	----	----	a6.00	----	----	a6.84	----	----	a8.02	----	----	a6.93	27.79	----	----
City of Sturgis	48.9	43.2	46.6	46.5	58.7	60.5	56.4	70.9	54.1	55.3	48.6	48.1	637.7	3.525	.715
City of Three Rivers	24.7	24.4	25.0	24.9	33.8	39.7	34.7	39.0	28.8	27.5	13.0	12.1	327.6	1.898	.138
SANILAC COUNTY															
City of Croswell	10.23	9.54	9.95	13.07	14.90	14.75	24.61	34.32	19.81	18.78	17.33	17.94	205.23	1.360	.151
Village of Deckerville	4.74	4.70	4.92	4.90	5.70	5.72	6.71	6.85	9.01	6.85	5.70	4.97	70.77	----	----
City of Sandusky	e9.5	e9.4	e9.8	e9.9	e10.2	e10.4	e13.6	e12.3	e10.7	e10.6	e9.9	e11.0	e127.3	e.695	e.225
SHIAWASSEE COUNTY															
City of Corunna	5.98	4.69	5.44	5.28	6.05	5.71	6.73	6.33	5.62	5.63	5.38	5.03	67.51	.265	.115
City of Durand	9.70	9.46	11.11	10.09	11.41	11.65	9.59	9.39	9.13	9.13	8.65	9.30	118.61	.450	.300
City of Owosso	78.3	71.1	84.3	78.3	95.0	95.7	98.8	91.7	81.6	82.5	75.7	73.5	1006.5	3.987	2.099
Village of Perry	1.76	1.52	1.69	1.61	2.46	2.51	2.51	2.28	2.07	2.01	1.70	1.84	23.96	----	----
TUSCOLA COUNTY															
State Hosp. at Caro	9.34	8.94	9.72	10.53	12.11	12.11	12.63	9.69	9.29	8.48	9.11	8.99	120.94	.481	.216
Village of Cass City	6.40	5.31	5.92	5.41	6.33	6.41	9.23	7.01	6.36	5.86	5.05	5.06	74.35	.393	.111
VAN BUREN COUNTY															
Village of Bangor	19.1	17.1	18.3	13.0	16.3	16.1	17.9	22.9	e18.2	17.1	16.3	14.3	206.6	----	----
Village of Hartford	5.36	4.79	5.92	5.43	8.02	11.60	9.91	11.94	5.85	5.02	5.17	5.13	84.14	.960	.228
Village of Lawton	14.8	12.0	12.1	24.0	29.2	26.4	32.9	32.7	39.2	41.9	19.0	16.7	310.9	1.9	.45
WASHTENAW COUNTY															
City of Ann Arbor	61.4	58.6	81.0	83.7	103.7	109.5	100.4	114.5	100.8	61.8	54.7	54.6	c984.7	----	----
Boys Tng. School at Whitmore Lake	e.725	e.649	e.744	e.718	e.740	e.722	e.698	e.826	e.914	e.827	e.717	e.770	e9.05	----	----
Cassidy Lake Technical School	e1.2	e1.2	e1.3	e1.4	e1.4	e1.5	e1.5	1.4	1.3	1.1	1.2	1.2	e15.7	----	----
Village of Dexter	4.02	4.01	3.93	3.27	4.45	3.62	6.75	4.93	5.89	5.01	4.39	3.74	54.01	.299	.110
City of Saline	7.86	4.68	5.28	6.01	8.12	8.06	7.56	7.25	6.60	6.08	5.39	5.51	78.40	.508	.102
City of Ypsilanti	97.9	81.5	91.2	87.3	108.6	100.9	96.8	99.5	95.9	97.7	96.5	96.7	1150.5	5.255	1.830
Ypsilanti Twp.	189.	166.	177.	178.	195.	188.	192.	176.	164.	180.	169.	156.	2130.	7.869	2.704
State Hosp. at Ypsilanti	13.9	13.4	14.6	13.8	17.5	18.0	18.5	19.4	15.8	15.9	14.8	15.1	190.7	.701	.317
Village of Manchester	4.34	4.21	4.71	4.39	5.16	5.13	5.41	5.23	4.45	4.45	4.04	4.16	55.68	.332	.088
WAYNE COUNTY															
City of Belleville	4.58	----	a16.34	----	----	a17.21	----	----	a16.54	----	5.65	4.03	64.35	----	----
State Hosp. at Northville	22.3	18.3	18.7	19.3	20.4	18.8	19.0	19.5	18.9	18.9	20.5	21.5	236.1	----	----
City of Plymouth	e54.4	e52.6	e56.4	e54.9	e79.8	e66.4	e62.0	e65.0	e57.4	e59.1	e51.9	e51.1	e711.0	3.50.	1.30
Ply. State Home and Tng. School at Northville	2.69	2.16	2.33	2.77	3.16	2.61	2.61	3.08	2.78	2.80	2.45	2.99	32.93	.313	.043
WEXFORD COUNTY															
City of Cadillac	27.5	28.0	30.5	33.8	55.4	83.0	94.7	69.3	31.8	25.4	22.7	26.2	528.3	6.0	.60

a) Meters read quarterly
b) Pumped in summer months only
c) Also use surface water
d) Water purchased from Copper Range Co., Painesdale
e) Estimated wholly or in part
f) 84.9 MG of this total sold to City of Troy (Birmingham uses Detroit water)
g) No meters on pumps during these months
h) One industry used 383 MG of this total