Circular 79

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WILLIAM G. STRATTON, *Governor*
DEPARTMENT OF REGISTRATION AND EDUCATION
VERA M. BINKS, *Director*

Water Level Decline and Pumpage During 1959 in Deep Wells in the Chicago Region, Illinois

by W.C. WALTON. R.T. SASMAN , and R.R. RUSSELL

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WATER-LEVEL DECLINE AND PUMPAGE DURING 1959 IN DEEP WELLS IN THE CHICAGO REGION, ILLINOIS

by

W. C. Walton, R. T. Sasman, and R. R. Russell

SUMMARY

The water-level decline during 1959 in deep wells penetrating the Cambrian-Ordovician Aquifer, the most highly developed aquifer for large ground-water supplies in the Chicago region, is considered in this reporto The Cambrian-Ordovician Aquifer is encountered at an average depth of about 500 feet below the land surface at Chicago; it has an average thickness of 1000 feet and is composed chiefly of sandstones and dolomites.

Pumpage from deep wells has increased from 200,000 gallons per day (gpd) in 1864 to 78.3 million gallons per day (mgd) in 1958 (as reevaluated in 1960). As a result, artesian pressure in the Cambrian-Ordovician Aquifer at Chicago has declined 660 feet. Pumpage from deep wells is concentrated in six centers: Chicago area, Joliet area, Elmhurst area, Des Plaines area, Aurora area, and Elgin area.

In 1959, pumpage from deep wells was 88.0 mgd or 9.7 mgd more than in 1958. This annual increase in pumpage is record high and has resulted in excessive declines in water levels in deep wells. Water-level declines during 1959 ranged from 9 feet in the Joliet area to 41 feet in the Elmhurst area and averaged about 20 feet. The 1959 average decline is much greater than the average annual rate of decline (10 feet) for the period 1945-1958.

Withdrawals In 1959 exceed the practical sustained yield of the Cambrian-Ordovician Aquifer, with the result that ground-water users in the Chicago Region have started to mine water and to borrow water from future generations. If the distribution of pumpage remains the same as in 1959 and pumpage from the Cambrian-Ordovician Aquifer continues to increase in the future, the lowest and most permeable unit of the aquifer will be partially dewatered in many areas much sooner than previously anticipatedo Pumping levels exceeding 1000 feet below the surface will be common within 20 years.

INTRODUCTION

In May, 1959 the State Water Survey and the State Geological Survey issued Cooperative Ground-Water Report 1,entitled "Preliminary Report on Ground-Water Resources of the Chicago Region, Illinois."[1] Cooperative Report 1 discussed the geology and hydrology of the ground-water resources of the Chicago region, along with the history, present conditions, and effects of possible future development. Special emphasis was placed on the deep water-yielding aquifers which have been most widely used for large ground-water supplies. Studies described in Cooperative Report 1 indicated that pumpage from deep wells during 1958 approached the amount that could be continuously withdrawn without eventually dewatering the lowermost and most productive formation of the deep aquifer,,

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[1] Suter, Max, Bergstrom, R. E., Smith, H. F., Enrich, G. H., Walton, W. C., and Larson, T. E., 1959, Preliminary Report on Ground-Water Resources of the Chicago Region, Illinois: Cooperative Ground-Water Report 1, Illinois State Water Survey and State Geological Survey,

Future (1958-1980) water-level declines, ranging from 190 feet at Elgin to 300 feet at Chicago and Des Plaines, were predicted. It was recognized that actual water-level declines will vary from predicted declines given in the report if future distribution and rates of pumpage deviate from extrapolations of past ground-water use. As a result of the findings of Cooperative Report 1, the program of collection and reporting water-level and pumpage data for deep wells in the Chicago Region, which is one of the functions of the State Water Survey, was accelerated in 1959.

The objectives of the program are (1) to provide a year to year evaluation of trends in water levels and pumpage, (2) to delineate problem areas, (3) to recompute, if necessary, future declines in water levels on the basis of current data, (4) to provide long-term continuous records of fluctuations of water levels and pumpage, and (5) to collect and report all hydrologic information which will facilitate the planning and development of the water resources of the deep aquifer in the Chicago region,, The program is particularly urgent at this time due to the progressively increasing demands for water supplies and the continuing decline of water levels,, This report summarizes trends in water levels and pumpage for deep wells during 1959. A summary of the essential findings of Cooperative Report 1 regarding the deep aquifers is presented to serve as a background for interpretation of the records.

GEOLOGY AND HYDROLOGY OP CAMBRIAN-ORDOVICIAN AQUIFER

Ground-water resources in the Chicago region are developed from four aquifer systems: (1) sand and gravel deposits of the

glacial drift; (2) shallow dolomite formations, mainly of Silurian age; (3) the Cambrian-Ordovician Aquifer; and (4) the Mt. Simon Aquifer. This report Is concerned with the Cambrian-Ordovician Aquifer.

The Cambrian-Ordovician Aquifer consists in downward order of the Galena-Platteville Dolomite, Glenwood-St. Peter Sandstone, and Prairie du Chien Series of Ordovician Age; Trempealeau Dolomite, Franconia Formation, and Ironton-Galesville Sandstone of Cambrian age. The sequence, structure, and general characteristics of these rocks are shown in figure 1. The Cambrian-Ordovician Aquifer Is separated from the Mt. Simon Aquifer by shale beds of the Eau Claire Formation. The Maquoketa Formation above the Galena-Platteville Dolomite acts as a barrier between the shallow dolomite and deeper aquifers and confines the water in the deeper aquifers under artesian pressure. Available data indicate that on a regional basis the entire sequence of strata, from the top of the Galena-Platteville to the top of the shale beds of the Eau Claire Formation, behaves hydraulically as one aquifer.

The Ironton-Galesville Sandstone is the most productive formation of the Cambrian-Ordovician Aquifer. The Galena-Platteville Dolomite and Prairie du Chien Series generally are not well creviced and are not major contributors. The Trempealeau Dolomite is locally well creviced.

The Cambrian-Ordovician Aquifer receives water from overlying glacial deposits mostly in areas of Kane, McHenry, Kendall, Boone, and DeKalb Counties where the Galena-Platteville Dolomite is the uppermost bedrock formation below the glacial deposits.

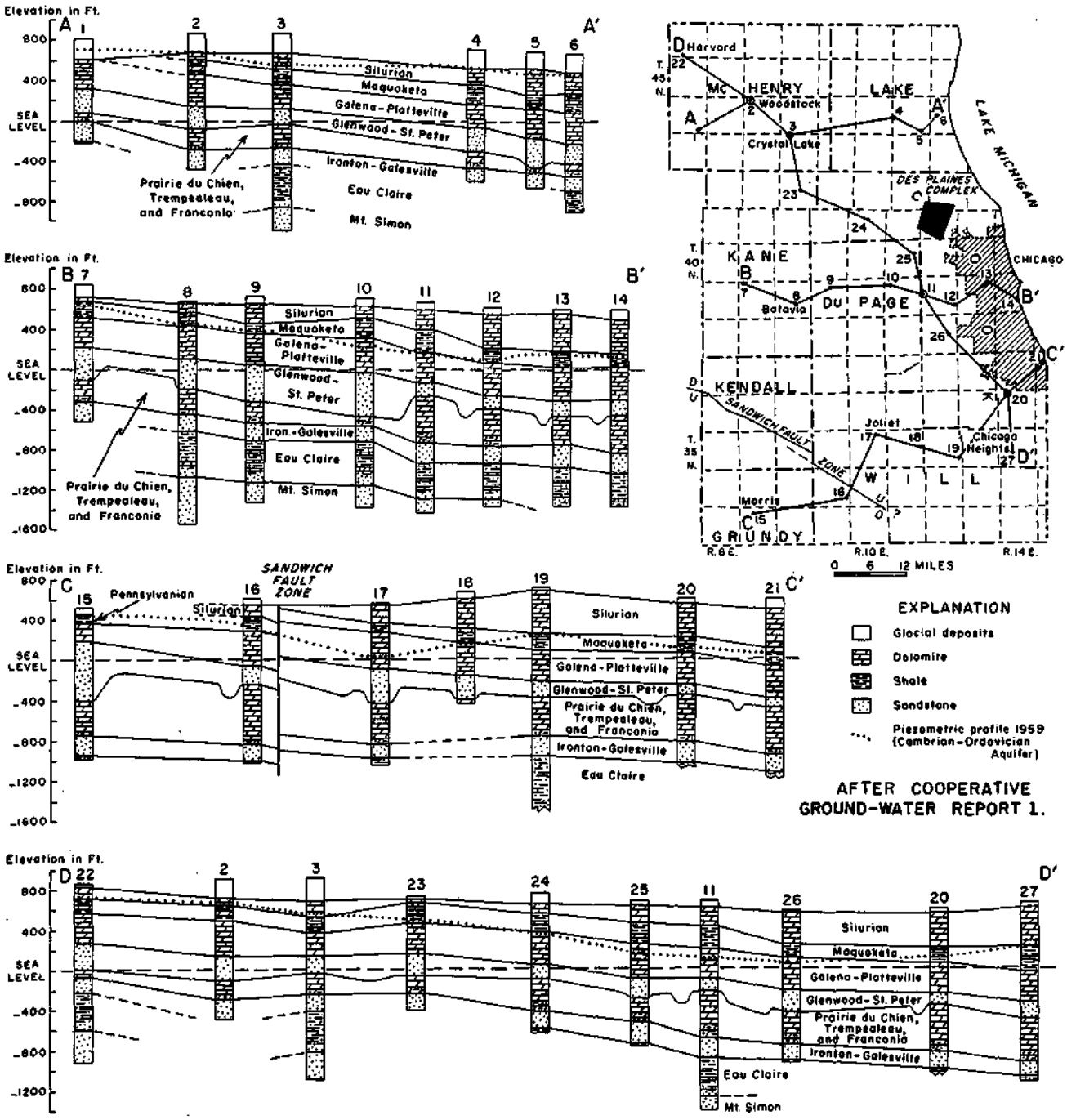


Figure 1. CROSS SECTIONS OF THE STRUCTURE AND STRATIGRAPHY OF THE BEDROCK AND PIEZOMETRIC PROFILES OF THE CAMBRIAN-ORDOVICIAN AQUIFER IN THE CHICAGO REGION

This is west of the border of the Maquoketa Formation. Recharge of the glacial deposits occurs from precipitation that falls locally. Vertical leakage of water through the Maquoketa Formation into the Cambrian-Ordovician Aquifer is becoming appreciable under the influence of large differentials in head between shallow deposits and the Cambrian-Ordovician Aquifer.

PUMPAGE FROM DEEP WELLS

The first deep well in Chicago, drilled at the corner of Chicago and Western Avenues in 1864, had an artesian flow estimated at about 150 gallons per minute (gpm) or about 200,000 gpd. The estimated pumpage from deep wells in the Chicago region increased gradually from 200,000 gpd in 1864 to more than 78 mgd in 1958 as shown in figure 2.

Many deep wells in the Chicago region are either uncased or faultily cased in the Silurian age dolomite and allow leakage,, The Mt. Simon Aquifer also Is penetrated by a large number of deep wells, particularly along the Fox River in Kane County. The artesian pressure of the Cambrian-Ordovician Aquifer is lower than that in the Silurian age dolomite and Mt„ Simon Aquifer. Ground water therefore moves downward from the dolomite and upward from the Mt. Simon into the Cambrian-Ordovician Aquifer through wells that are open in all three aquifers. Thus, water pumped from deep wells does not come from the Cambrian-Ordovician Aquifer alone. It is estimated that of the 78 mgd pumped from deep wells in 1958, 44 mgd came from the Cambrian-Ordovician Aquifer, 21 mgd came from the Silurian age dolomite, and 13 mgd came from the Mt. Simon Aquifer.

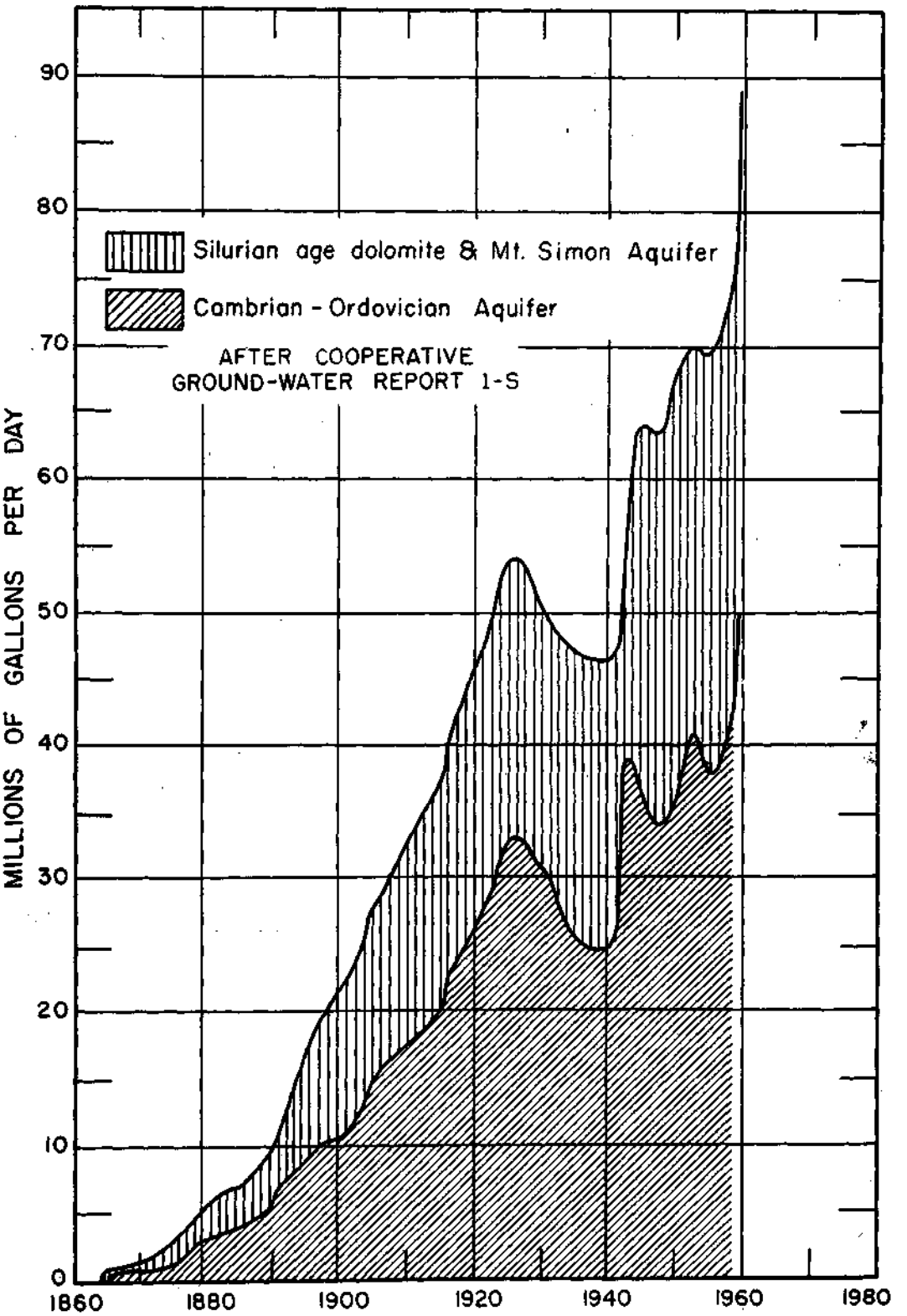


Figure 2. PUMPAGE FROM DEEP WELLS, 1864 THROUGH 1959, SUBDIVIDED BY SOURCE

Pumpage in 1959

During 1959 pumpage from deep wells increased from 78.3 mgd to 88.0 mgd. The rate of increase in withdrawal, 9.7 mgd per year, is record high. As shown in figure 2, prior to 1959 the maximum rate of increase was 8.1 mgd per year and was recorded for the period June 1942 to June 1943 during World War II. It is estimated that of the 88.0 mgd pumped from deep wells in 1959, 50.0 mgd came from the Cambrian-Ordovician Aquifer, and 38.0 mgd came from the Silurian age dolomite and Mt. Simon Aquifer.

Pumpage is concentrated in six centers; the Chicago, Joliet, Elmhurst, Des Plaines, Aurora, and Elgin areas. Distribution of pumpage from deep wells in 1958 and 1959 is shown in table 1. The greatest quantities of water were withdrawn from deep wells in the Chicago, Joliet, and Aurora areas.

Table 1 - Distribution of Pumpage from Deep Wells in 1958 and 1959

Pumping Center	1958 Total pumpage (mgd)	1959 Total pumpage (mgd)	1958-1959 Pumpage increase (mgd)
Chicago area	23.6	24.9	1.3
Joliet area	16.5	18.9	2.4
Elmhurst area	9.3	10.7	1.4
Des Plaines area	9.2	10.9	1.7
Elgin area	6.8	7.5	0.7
Aurora area	12.9	15.1	2.2
Total	78.3	88.0	9.7

Pumpage data for 1958 in table 1 differ in some cases from data given in Cooperative Report 1. Pumpage in 1958 was reevaluated

for the present report on the basis of additional and more complete data which were collected in 1959 to obtain greater accuracy in computing increases in pumpage.

The greatest increase in pumpage 1958-1959, 2.4 mgd, occurred in the Joliet area, Pumpage increases in all areas, except the Elgin area, exceed 1.0 mgd. Total pumpage in 1959 was about 12 percent greater than the total pumpage in 1958.

During 1959, 12 new deep wells were placed in operation. Of these wells, 6 were drilled to augment existing municipal wells or to develop new subdivision water-supply systems. A large number of deep wells and deep well pumps were rehabilitated to meet the great increase in demand.

The distribution of pumpage in 1959, subdivided by use is shown in figure 3 and in table 2. Public use includes municipal and institutional pumpage. No attempt has been made to determine the final use of water within categories. Any water pumped by a municipality is called a public supply, regardless of the use of the water.

Table 2 - Distribution of Pumpage from Deep Wells in 1959, Subdivided by Use

Pumping Center	Public Pumpage (mgd)	Industrial Pumpage (mgd)
Chicago area	4.7	20.2
Joliet area	7.4	11.5
Elmhurst area	9.0	1.7
Des Plaines area	10.2	0.7
Elgin area	6.6	0.9
Aurora area	13.1	2.0
Total	51.0	37.0

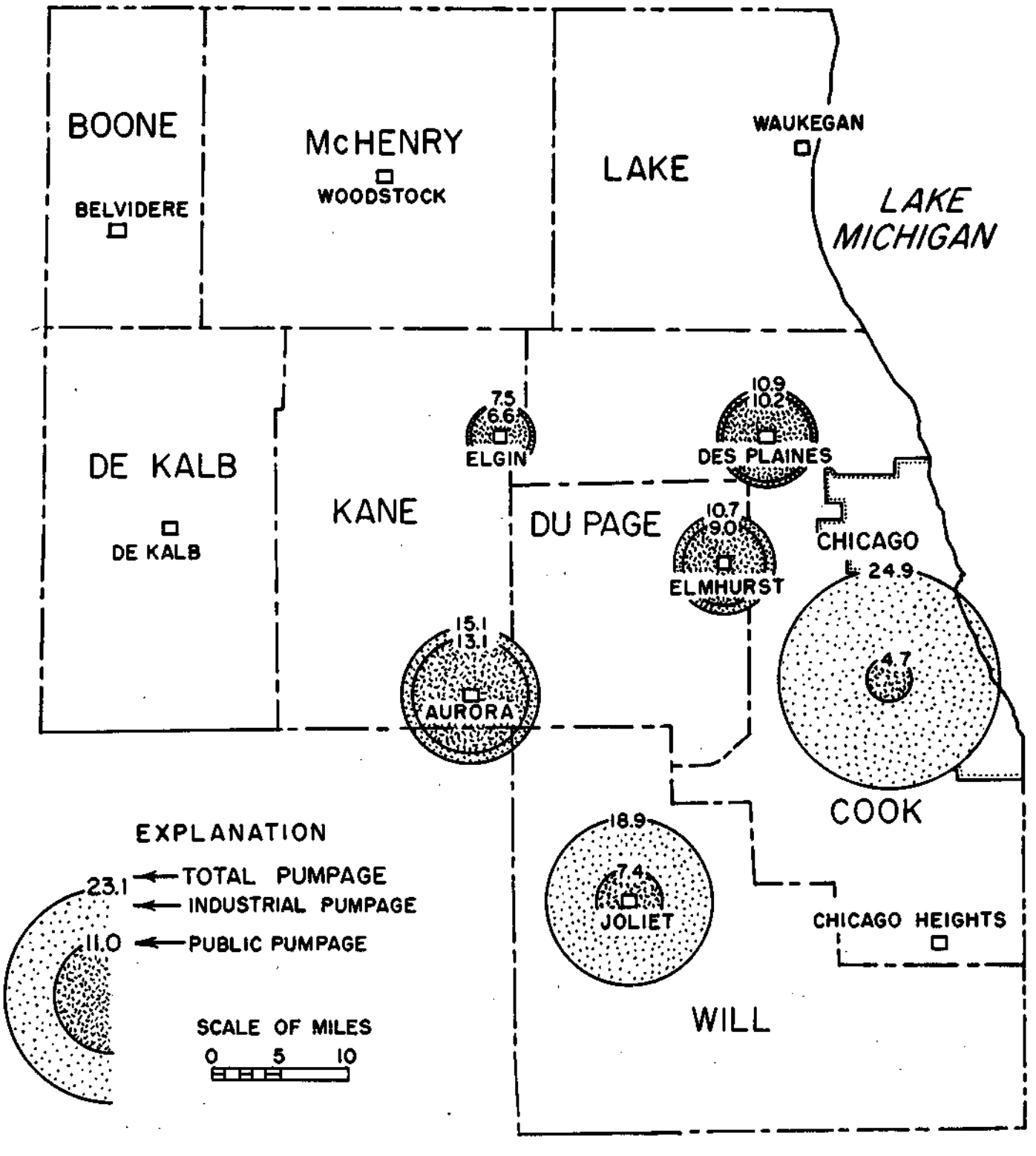


Figure 3. DISTRIBUTION OF ESTIMATED PUMPAGE FROM DEEP WELLS IN 1959

Withdrawals for public water-supply systems amounted to about 58 percent of the total pumpage; industrial pumpage was about 42 percent of the total. Municipal pumpage was 47.3 mgd or 93 percent of the total public pumpage. Municipal pumpage is by far the greatest use in the Elmhurst, Des Plaines, Elgin, and Aurora area pumping centers. Most industrial pumpage is concentrated in the Chicago and Joliet area pumping centers. Municipal pumpage in 1959 was 14.1 percent greater than 1958; industrial pumpage in 1959 was 10.1 percent greater than in 1958.

Public pumpage increases 1958-1959 were greatest in the Aurora area (1.9 mgd) and least in the Chicago area (0.4 mgd). Most of the increase in public pumpage was recorded for deep wells owned by large municipalities such as Aurora, Joliet, Elmhurst, Des Plaines, Arlington Heights, Bellwood, and Villa Park. Municipal pumpage increases exceeding 1.0 mgd occurred in the Des Plaines and Joliet areas. The greatest industrial pumpage increase (1.2 mgd) was recorded for deep wells in the northern and southern parts of the Joliet area. Industrial pumpage increases exceeding 0.5 mgd occurred in the Chicago and Elmhurst area pumping centers.

The number of municipalities obtaining water from deep wells increased from 44 in 1958 to 48 in 1959. During 1958 and 1959 three municipalities developed shallow ground-water supplies to supplement the existing deep well supply or to provide the primary supply.

Data on industrial pumpage were obtained at 113 plants. Each year a few industries abandon their deep wells and convert to municipal systems or reduce their pumpage by conservation measures. However, each year a few industries begin pumping deep wells, and overall industrial pumpage continues to show a steady increase.

Practical Sustained Yield of Cambrian-Ordovician Aquifer in Relation to Pumpage in 1959

In Cooperative Report 1 it was estimated that the practical sustained yield of the Cambrian-Ordovician Aquifer is about 46 mgd and will be developed when the total pumpage from deep wells is about 81 mgd. The practical sustained yield of the aquifer is the maximum amount of water that can be withdrawn without eventually dewatering the most productive water-yielding formation, the Ironton-Galesville Sandstone,, The practical sustained yield is largely limited by the rate at which water can move eastward through the aquifer from recharge areas.

Based on past records of pumpage and water levels, it was estimated in Cooperative Report 1 that the practical sustained yield would be exceeded by 1965. However, total pumpage from deep wells in 1959 actually exceeded the withdrawal rate anticipated for 1965. Thus, the practical sustained yield of the aquifer was exceeded in 1959 and ground-water users in the Chicago region started to mine water and to borrow water from future generations. Continual pumping at the 1959 rate will result in the dewatering of the Ironton-Galesville Sandstone in many parts of the Chicago region much sooner than anticipated in Cooperative Report 1 with a great and continual reduction in yields of wells.

WATER LEVELS IN DEEP WELLS

In 1864 the artesian pressure in the Cambrian-Ordovician Aquifer was sufficient to cause wells to flow in many parts of the Chicago region. The average elevation of water levels in deep

wells at Chicago and at Jollet was probably about 700 feet. As a result of continued heavy pumping, the nonpumping water levels in deep wells declined in 1958 to elevations of 50 feet at Summit southwest of Chicago and 25 feet; at Jollet. From 1864-1958, the artesian pressure at Chicago declined about 660 feet. The average rate of decline, 1864-1958, was, about 7 feet per year. The greatest water-level declines in the Chicago Region, amounting to more than 650 feet, have occurred in areas of heavy pumpage at Summit and at Joliet. The total decline has been 10 feet or less in recharge areas in Boone and DeKalb Counties.

Examples of long-term fluctuations in water levels in the Chicago region are shown in figures 4-7. Hydrographs of observation wells in the Cambrian-Ordoviclan Aquifer show a steady decline of water levels largely as a result of the continued increase of withdrawals by municipalities, industries, institutions, and commercial establishments, as shown in figure 2. The location of the observation wells for which hydrographs are available are given in figure 8.

From 1945 through 1958, the decline in water levels ranged from about 220 feet in wells in the Des Plaines and Elmhurst areas to about 70 feet in wells near the center of Joliet. The average annual rates of decline for the period 1945 through 1958 in pumping centers, as indicated by the hydrographs of observation wells are given in table 3.

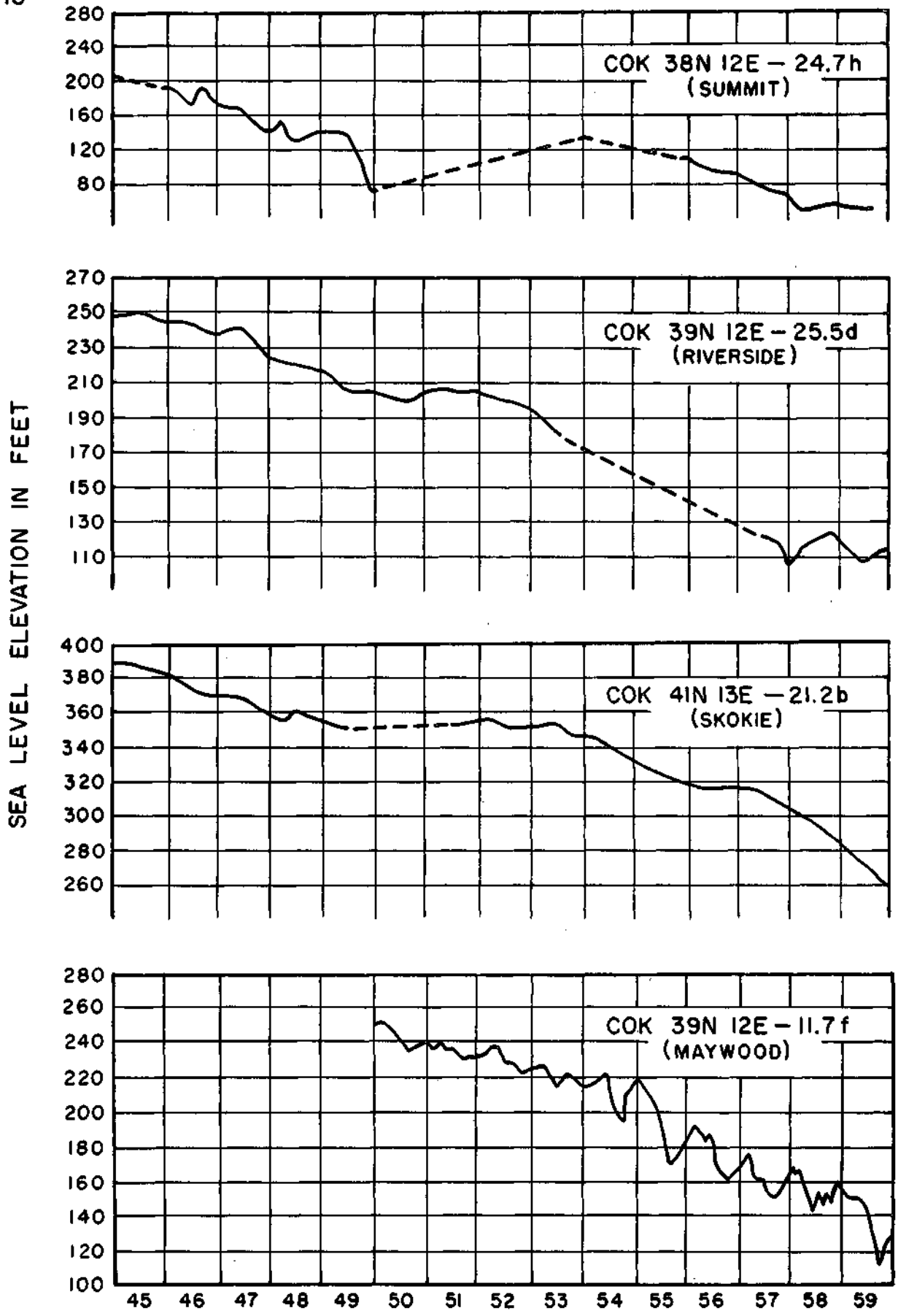


Figure 4. WATER LEVELS IN DEEP WELLS IN THE CHICAGO AREA PUMPING CENTER, 1945-1959

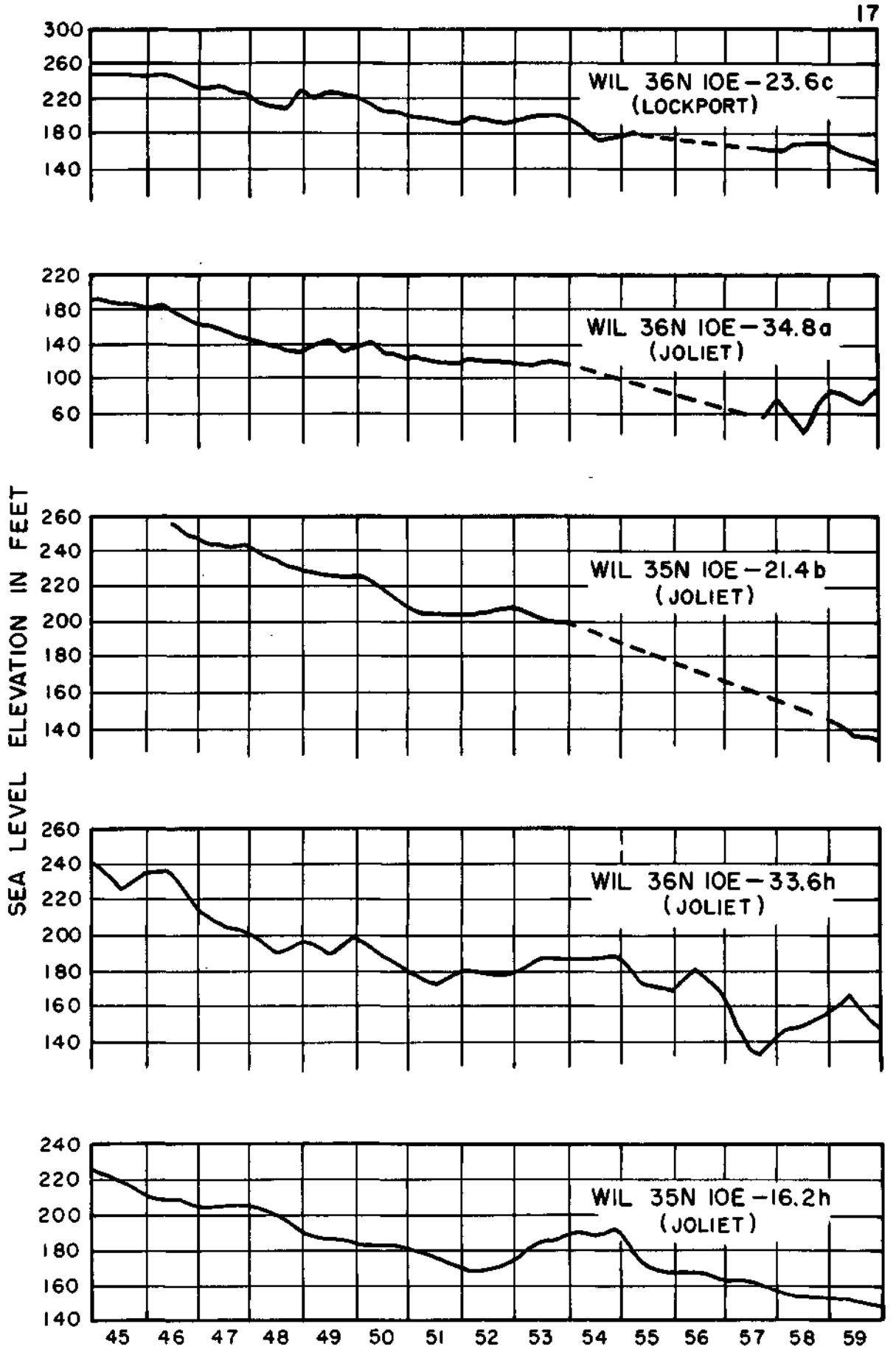


Figure 5. WATER LEVELS IN DEEP WELLS IN THE JOLIET AREA PUMPING CENTER, 1945-1959

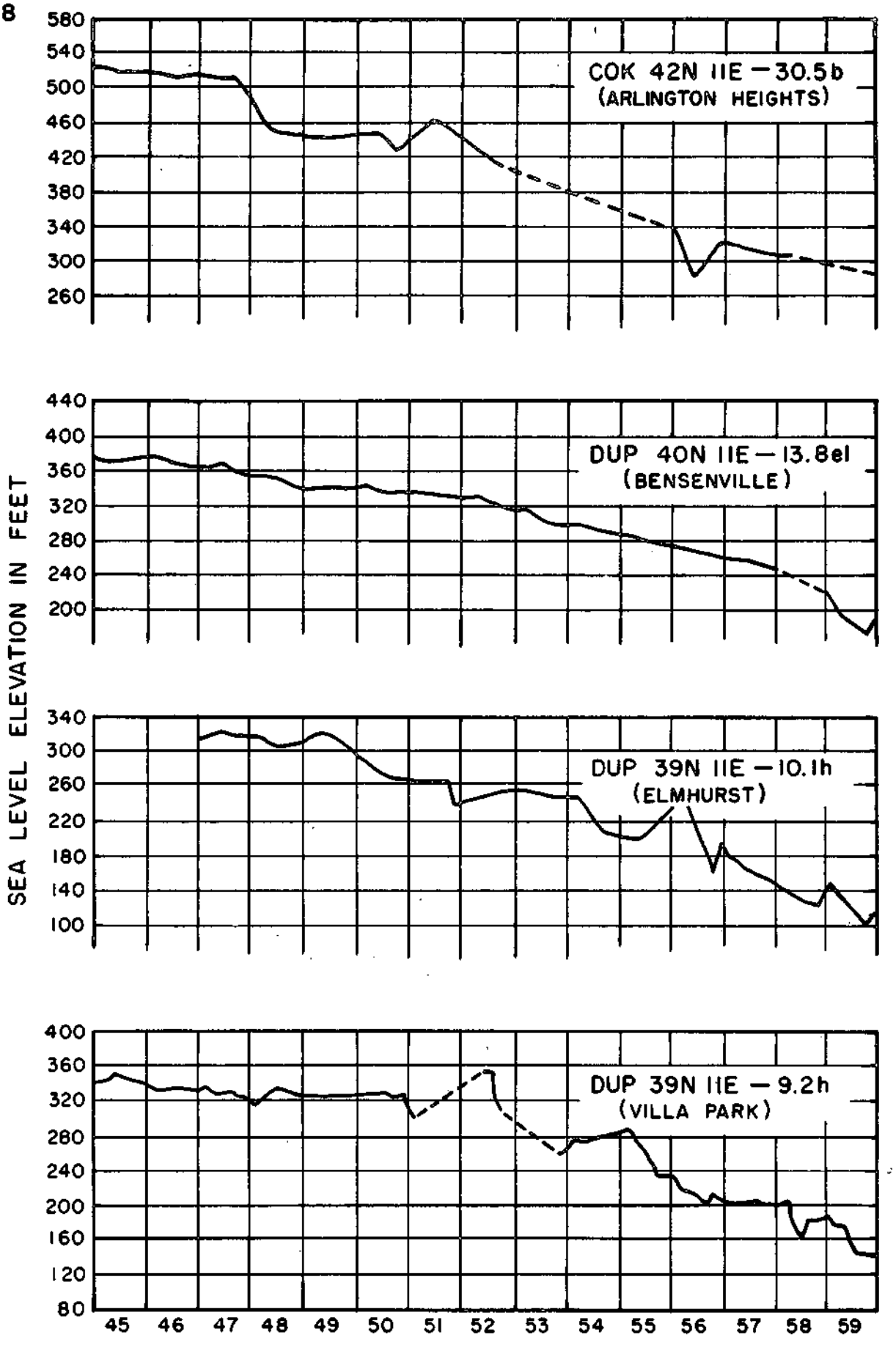


Figure 6. WATER LEVELS IN DEEP WELLS IN THE ELMHURST AND DES PLAINES AREA PUMPING CENTERS, 1945-1959

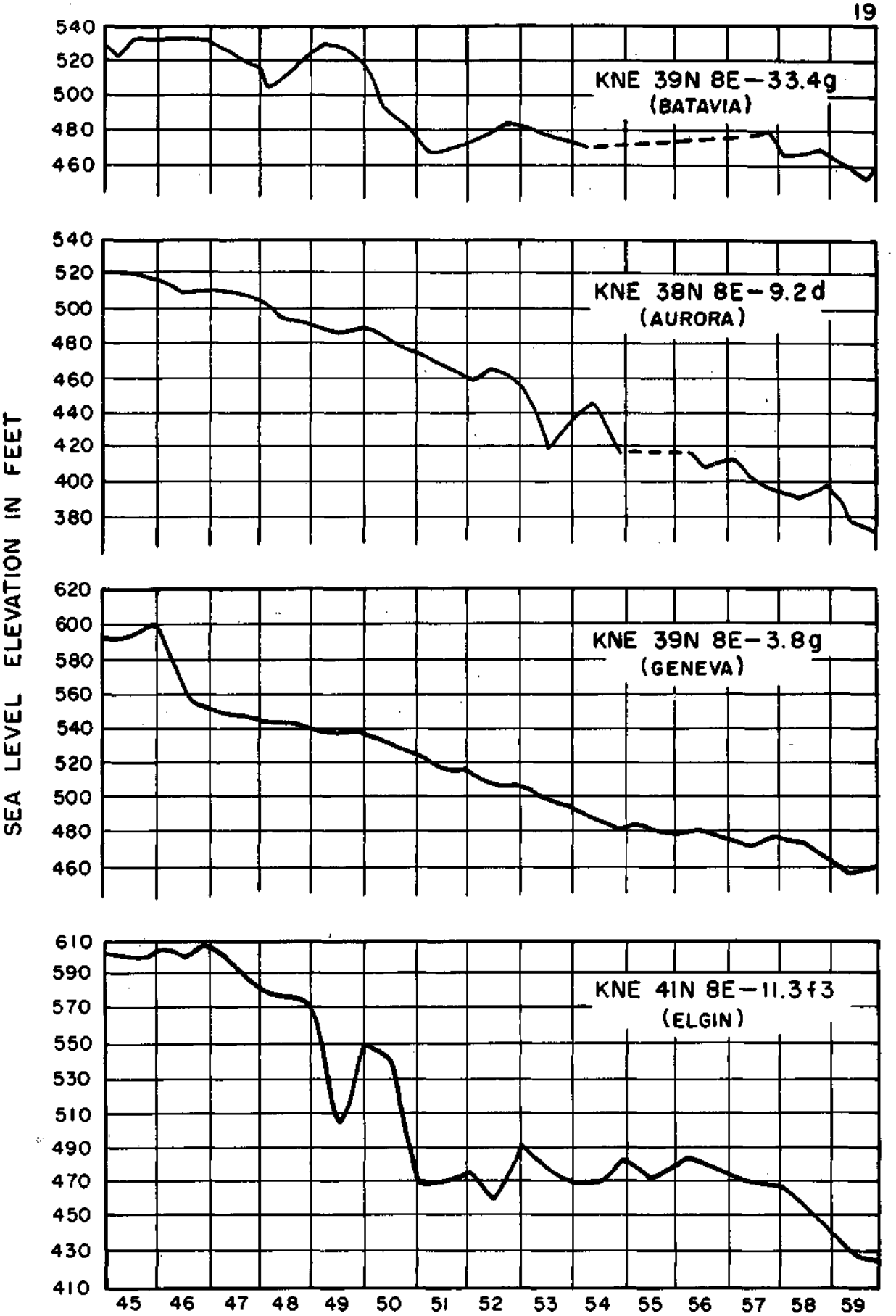


Figure 7. WATER LEVELS IN DEEP WELLS IN THE ELGIN AND AURORA AREA PUMPING CENTERS, 1945-1959

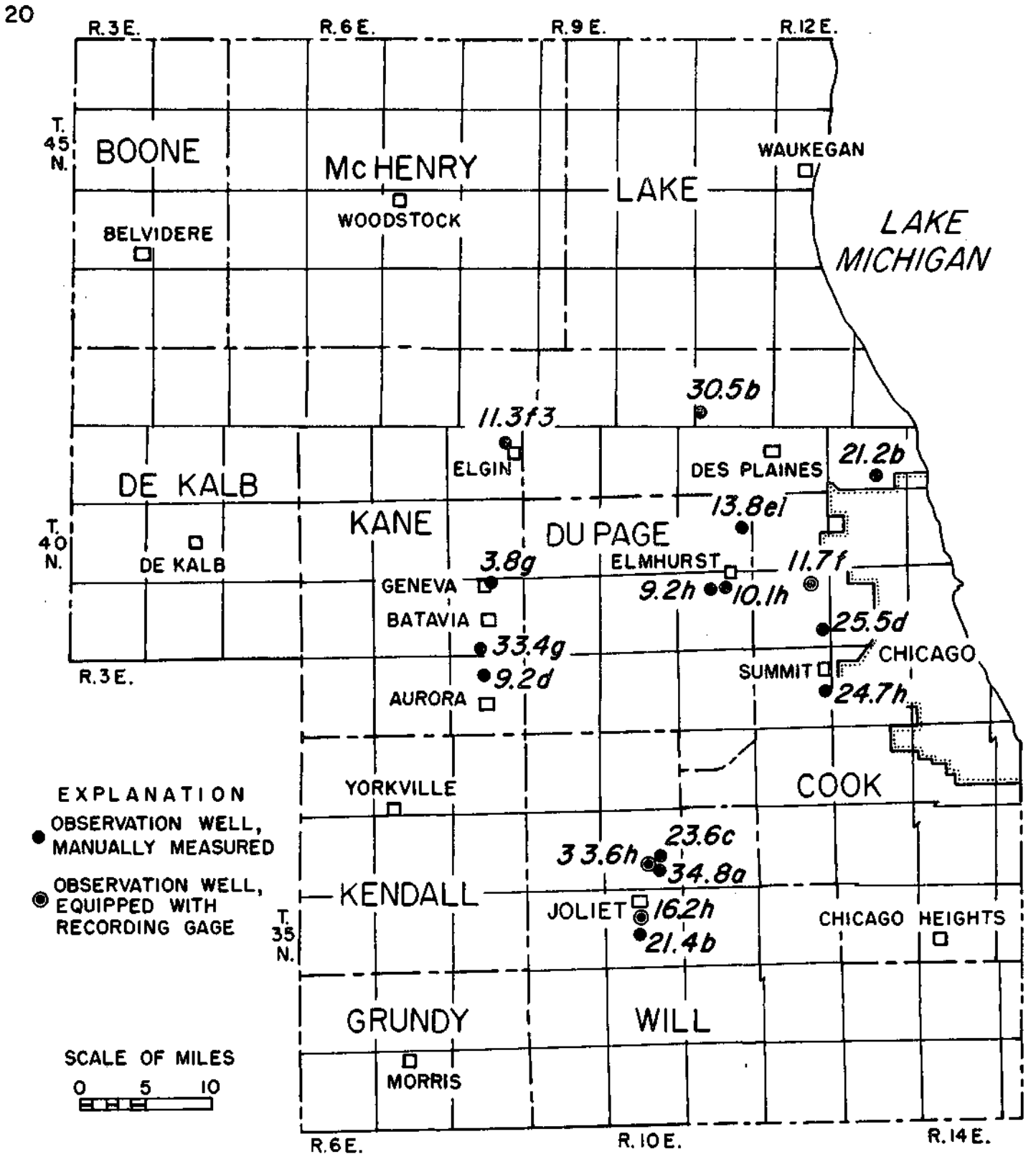


Figure 8. MAP SHOWING LOCATION OF SELECTED OBSERVATION WELLS

Table 3 - Decline in Nonpumping Water Levels, 1945-1958

Pumping Center	Average Decline, 1945-1958, (feet per year)
Chicago area	8
Joliet area	7
Elmhurst area	12
Des Plaines area	12
Elgin area	11
Aurora area	8

Water-Level Decline, October 1958 to October 1959

The water levels in 209 deep wells in the Chicago region were measured during the last week in October and the first week in November, 1959. Data for the wells are given in table 4. Water levels in 51 of these wells were also measured during 1958. Available water-level data for 1958 were compared with data for 1959; computed declines are given in table 5, The average decline in nonpumping water levels, October 1958 to October 1959, for each pumping center were estimated based on data in table 5 and on the hydrographs in figures 4-7. The fact that water levels given in table 5 were not measured during the same month in 1958 and 1959 was taken into consideration. Estimated average water-level declines for pumping centers are given in table 6.

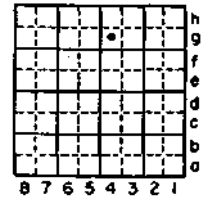
Table 4 - Water Levels in Deep Wells in Northeastern Illinois in 1959
Elevations in Feet Above Mean Sea Level

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
*BNE 44N3E-35.1e2	City of Belvidere	610	800	64	736	10/27
BNE 44N3E-24.8a	City of Belvidere	870	780	60	720	10/27
COK 42N12E-2.5b	Green Acre Country Club	1362	655	273	382	11/6
×COK 42N12E-5.7c	Lonetree Subdivision	1404	686	338	348	11/6
COK 42N12E-14.2c1	Sunset Ridge Country Club	1385	655	334	321	11/6
COK 42N12E-28.7e	Signode Steel Strapping Co.	1452	670	279	391	11/6
COK 42N12E-29.1a	Glenview Countryside Subdivision	1405	677	360	317	11/6

The well numbering system used in this report is based on the location of the well, and uses the township, range, and section for identification.

The well number consists of five parts: county abbreviation, township, range, section, and coordinate within the section. Sections are divided into rows of one-eighth mile squares. Each one-eighth mile square contains 10 acres and corresponds to a quarter of a quarter of a quarter section. A normal section of one square mile contains eight rows of eighth-mile squares; an odd-size section contains more or fewer rows. Rows are numbered from east to west and lettered from south to north as shown below.

Cook County
T.41N., R. 11E.
sec.25



The number of the well shown in sec. 25 above is as follows:

COK 41N11E-25.4g

Where there is more than one well in a 10-acre square they are identified by arabic numbers after the lower case letter in the well number.

Table 4 (continued)

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
COK 42N11E-11.6e	Village of Wheeling	1370	645	320	325	11/5
COK 42N11E-11.8b2	Ekco Foil Container Corp.	1320	650	327	323	11/19
COK 42N11E-16.7a	Arlington Vista Subdivision	900	687	437	250	10/26
COK 42N11E-34.4g	Village of Mt. Prospect	1822	673	378	295	10/26
COK 42N11E-26.7d	Brickman Manor Subdivision	1468	661	365	296	10/2
× COK 42N10E-14.2b	Village of Palatine	1290	738	400	338	10/22
× COK 42N10E-24.3h	Village of Palatine	1350	732	440	292	10/26
COK 42N10E-24.8a1	Arlington Heights Jockey Club	1825	730	411	319	10/26
COK 42N10E-25.6b	City of Rolling Meadow	1530	720	398	322	10/29
COK 41N13E-8.6d	Glenview Club	1546	643	368	275	11/6
COK 41N13E-20.7e	Baxter Laboratory	1700	627	376	251	11/9
COK 41N13E-21.2b	G. D. Searle & Co.	1470	614	350	264	11/9
× COK 41N13E-29.8d	Croname Inc.	1465	624	410	214	8/8
COK 41N12E-12.8b	Eugenia Subdivision	1414	666	380	286	11/6
× COK 41N12E-18.6a	City of Des Plaines	1735	652	410	242	11/5
× COK 41N12E-18.7a	City of Des Plaines	1813	653	358	295	11/5
× COK 41N11E-8.2g	U. S. Army	1353	695	456	239	11/6
COK 41N11E-10.3f	Hatlen Heights Subdivision	1765	680	466	214	10/9
COK 41N11E-21.3b	Village of Elk Grove	1415	717	480	237	11/5
COK 41N11E-24.1g2	Waycinden Park Subdivision	1601	660	370	290	10/23
COK 41N11E-26.8a	Village of Elk Grove	1395	682	520	162	11/5
× COK 41N10E-15.1f2	Hoffman Estates	1391	750	405	345	10/16
COK 40N13E-34.7d4	N'western Malt & Grain Co.	1548	612	438	174	11/21
COK 40N12E-18.6c	J. B. Clow & Sons, Inc.	1457	663	490	173	11/5
COK 40N12E-31.4c	Automatic Electric Co.	1900	655	569	86	11/17
COK 40N12E-31.4d	Automatic Electric Co.	1410	655	515	140	11/17
COK 39N14E-21.7b2	Joanna Western Mills Co.	1603	593	482	111	9/10
× COK 39N13E-11.2e1	Bunte Candy Co.	1959	600	417	183	11/18
COK 39N13E-11.2e2	Bunte Candy Co.	1951	600	428	172	11/18
COK 39N13E-13.3c	Superior Sleeprite Corp.	1607	590	476	114	11/3

Table 4 (continued)

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
COK 39N13E-21.6g	Kropp Forge Co.	1635	608	523	85	11/4
COK 39N13E-21.8f3	Chicago Vitreous Enamel Co.	1608	608	454	154	11/4
COK 39N13E-25.2g	Ideal Roller & Mfg. Co.	1147	598	484	114	11/3
COK 39N13E-35.1h	Liquid Carbonic Corp.	1512	594	466	128	10/19
COK 39N12E-12.3e	Bowman Dairy Co.	2072	631	467	164	11/4
COK 39N12E-13.7g	Altenheim-German Home	1661	626	508	118	11/11
COK 39N12E-25.5d	Village of Riverside	1980	620	507	113	10/27
COK 39N12E-36.8d	Village of Riverside	2047	618	515	103	10/27
COK 39N12E-11.7f	Village of Maywood	1615	630	512	118	10/23
COK 38N14E-7.6c	Fleischmann Malting Co.	1900	594	478	116	11/3
×COK 38N14E-7.6d	Fleischmann Malting Co.	1964	594	485	109	11/3
COK 38N13E-11.1h	Bradshaw-Praeger & Co.	1224	597	485	112	11/3
×COK 38N13E-12.8e	International Rolling Mill Products Co.	1617	600	497	103	11/3
COK 38N13E-19.4e1	Visking Corp.	1509	619	545	74	10/28
COK 38N13E-21.1f	Cracker Jack Co.	1500	620	500	120	10/19
COK 38N12E-5.8d2	Village of Western Springs	1600	678	528	150	10/28
COK 38N12E-11.3a	Universal Oil Co.	1564	608	510	98	10/28
COK 38N12E-18.8f3	Suburban Cook Co. T.B. Sanitarium	1540	689	535	154	10/28
COK 38N12E-24.7h	Corn Products Co.	1481	597	538	59	10/30
COK 38N12E-28.7d	Fisher Body Co.	1542	605	480	125	11/2
COK 38N12E-29.1d	Fisher Body Co.	1517	605	470	135	11/2
COK 37N15E-8.1b2	Columbia Malting Co.	1400	587	447	140	10/27
×COK 37N13E-2.1h	Evergreen Cemetery	1656	627	392	235	11/24
COK 37N13E-26.1g2	Oak Hill Cemetery	1637	667	428	239	11/24
COK 37N11E-20.4d	Village of Lemont	1665	596	400	196	11/5
COK 36N14E-3.1g	Metro Glass Co.	1704	592	430	162	10/27
×COK 36N14E-17.3e	Allis-Chalmers Mfg. Co.	1347	606	393	213	10/27
× COK 36N14E-34.5d2	Village of Thornton	1724	612	348	264	10/27

Table 4 (continued)

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
COK 36N13E-1.2c	Miller Pre-Pared Potato Co.	1651	600	395	205	10/27
COK 35N14E-21.2h2	Victor Chemical Co.	1800	640	350	290	10/27
COK 35N14E-21.3h	Calumet Steel Co.	1805	640	390	250	10/24
DEK 42N5E-19.4b	City of Genoa	732	830	85	745	10/27
DEK 42N5E-19.6b2	City of Genoa	730	820	75	745	10/27
DEK 42N4E-22.7a3	Village of Kingston	717	827	112	715	10/27
DEK 42N3E-26.3h1	Village of Kirkland	737	775	12	763	10/27
DEK 42N3E-26.3h2	Village of Kirkland	636	775	16	759	10/27
DEK 41N5E-32.6c	City of Sycamore	1290	855	94	761	11/18
DEK 40N4E-15.7a	City of DeKalb	1291	855	168	687	10/28
DEK 40N4E-22.3e1	City of DeKalb	1306	860	167	693	10/28
DEK 40N4E-23.2e	City of DeKalb	1330	890	187	703	10/28
DEK 40N4E-23.4d	City of DeKalb	1178	885	191	694	10/6
DEK 40N3E-23.6e	Village of Malta	1254	915	164	751	10/28
DEK 40N3E-23.7e	Village of Malta	853	915	148	767	10/28
DEK 40N3E-23.8e1	Chicago & Northwestern Railroad	1007	910	124	786	11/11
DEK 38N5E-15.2d	Village of Hinckley	708	740	23	717	10/29
DEK 37N5E-32.1c1	Village of Somonauk	190	685	17	668	10/28
DEK 37N5E-32.1c2	Village of Somonauk	502	685	15	670	10/28
DEK 37N5E-36.7h1	Village of Sandwich	600	661	20	641	10/28
DEK 37N5E-36.7h2	Village of Sandwich	600	667	30	637	10/28
DUP 40N11E-13.8e1	Village of Bensenville	1445	~~670~~ 677	~~501~~ 491	~~169~~ 186	11/5
DUP 40N11E-13.8e2	Village of Bensenville	1442	676	507	169	10/6
DUP 40N11E-14.4e	Village of Bensenville	1445	670	488	182	10/5
DUP 40N11E-31.5b	Village of Lombard	1793	738	524	214	11/5
DUP 40N11E-35.5e	City of Elmhurst	1476	703	588	115	10/30

Table 4 (continued)

	Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
	DUP 39N11E-10.1h	City of Elmhurst	1360	669	574	95	10/23
	DUP 39N11E-9.2h	Village of Villa Park	2125	699	558	141	11/2
	DUP 39N10E-1.4d	Public Service Co.of N.Ill.	1464	740	518	222	11/9
	DUP 38N9E-13.2b3	City of Naperville	1445	680	425	255	10/28
	GRY 34N8E-35.1e	Dresden Nuclear Power Sta.	1500	515	97	418	11/2
	GRY 34N8E-35.1g	Dresden Nuclear Power Sta.	788	519	106	413	11/2
	GRY 33N8E-36.5a	Village of Diamond	723	565	126	439	12/10
	GRY 33N7E-4.2a	City of Morris	865	523	59	464	10/22
	GRY 33N7E-4.4c	City of Morris	1462	506	66	440	10/22
	GRY 33N7E-9.3h	City of Morris	1501	519	66	453	10/22
	GRY 33N7E-4.4a	Brown Milling Co.	613	522	38	484	10/22
	GRY 31N6E-6.2e3	Village of Kinsman	710	658	222	436	10/28
	GRY 31N8E-4.2b	Village of Gardner	976	586	184	402	8/18
	KNE 42N8E-22.4g	Village of Carpentersville	1140	728	233	495	10/29
	KNE 42N8E-27.1e	Village of West Dundee	1200	725	267	458	10/29
	KNE 42N6E-3.1e	Ill.Toll Highway Comm.M-6	962	910	245	665	10/27
	KNE 41N8E-11.3f2	City of Elgin	1965	743	306	437	10/29
	KNE 41N8E-11.3f3	City of Elgin	1880	745	310	435	10/25
	KNE 41N8E-11.3f4	City of Elgin	1880	740	365	375	10/29
	KNE 40N8E-27.6b	City of St. Charles	2200	692	225	467	10/29
	KNE 40N8E-34.6e1	City of St. Charles	2200	764	312	452	10/29
×	KNE 40N8E-34.6e2	City of St. Charles	2249	755	335	420	10/29
	KNE 40N8E-31.6h	Ill.State Training School for Boys	1322	790	252	538	10/29
×	KNE 40N7E-23.4g	Wasco School	670	820	265	555	10/27
	KNE 39N8E-3.1b2	City of Geneva	2217	678	193	485	10/27
×	KNE 39N8E-3.2b	City of Geneva	2267	719	318	401	10/27
	KNE 39N8E-22.3e1	City of Batavia	2201	667	202	465	10/27
	KNE 39N8E-22.3e2	City of Batavia	2200	667	195	472	10/27

Table 4 (continued)

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
KNE 39N8E-23.8f	City of Batavia	1357	721	264	457	10/27
KNE 39N8E-33.4g	Mooseheart	2200	694	242	452	10/27
KNE 39N8E-33.5g	Mooseheart	1508	704	216	488	10/27
KNE 39N7E-5.8f	Village of Elburn	1350	850	233	617	10/29
KNE 38N8E-9.2d	Mercyville	1411	697	332	365	10/27
KNE 38N8E-15.3h	City of Aurora	2251	669	253	416	10/27
× KNE 38N8E-28.4e	City of Aurora	2262	619	164	455	10/27
KNK 30N9E-6.8a	Village of Reddick	1188	612	157	455	10/22
KEN 37N8E-5.9f	Caterpillar Tractor Co.	1384	661	280	381	10/29
KEN 37N8E-6.2f	Caterpillar Tractor Co.	1346	660	278	382	10/29
KEN 37N8E-6.2d	Caterpillar Tractor Co.	1352	661	246	415	10/29
KEN 37N8E-17.6b	Village of Oswego	728	654	201	453	10/29
KEN 37N7E-32.1ei	Village of Yorkville	590	584	40	544	10/26
× LKE 46N12E-21.1b	City of Zion	1025	630	124	506	10/20
LKE 46N12E-21.3d	Shiloh Park	1575	642	92	550	10/20
LKE 46N12E-35.8h	Ill. Beach State Park	1002	585	65	520	10/20
LKE 46N11E-27.3a	Central Fur-Food Coop.	1230	672	125	547	10/20
LKE 45N11E-15.8f	Ill.Toll Highway Comm.M-4	1045	740	211	529	10/20
LKE 45N11E-29.8a	Wildwood Subdivision	1310	810	247	563	3/3
LKE 45N10E-26.8b	Village of Grays Lake	1039	785	167	618	10/26
LKE 45N10E-26.7b	Village of Grays Lake	1323	785	218	567	10/26
× LKE 44N12E-18.3f1	Goodyear Tire & Rubber Co.	1631	680	205	475	9/4
LKE 44N12E-21.8f2	Village of Lake Bluff	1804	680	221	459	10/30
LKE 44N11E-18.4a	St. Marys of the Lake Seminary	1919	755	156	599	10/30
LKE 44N11E-35.4h	Dillon Subdivision	1600	710	231	479	11/6
× MCHLKE 44N9E-20.1b	Village of Island Lake	1223	775	230	545	11/17
LKE 43N12E-31.5f	Ill.Toll Highway Comm.TP-8	1055	680	312	368	10/20
× LKE 43N11E-23.5g	Lincolnshire Subdivision	1305	645	164	481	11/6

Table 4 (continued)

	Well No.	Owner	Depth of Well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
	LAS 36N4E-8.5h1	Village of Leland	230	701	53	648	10/28
	LAS 36N4E-8.5h2	Village of Leland	220	700	16	684	10/28
	LAS 36N3E-18.4d3	City of Earlville	625	703	35	668	10/28
	LAS 36N1E-32.1a	City of Mendota	1450	740	100	640	6/25
	LAS 35N5E-8.6b	Ill.State Industrial School	885	590	15	575	10/28
	LAS 33N5E-25.4e	U.S. Government (Civil Defense Agency)	654	505	101	404	11/3
	LAS 33N4E-13.3c	City of Marseilles	850	498	100	398	11/3
	LEE 37N2E-10.2b	Village of Paw Paw	1018	928	194	734	10/29
	LEE 37N1E-8.8e3	Village of West Brooklyn	650	945	252	693	10/29
	LIV 30N8E-26.8h	Cardiff	1785	638	120	518	10/22
	LIV 30N6E-1.1a	Ill.State Reformatory for Women	1201	648	193	455	10/22
×	LIV 29N6E-10.8e	Village of Odell	1941	720	194	526	10/30
	MCH 46N5E-33.8a	Dean Milk Co.	1610	890	179	711	10/28
	MCH 45N8E-10.8d	Morton Chemical Co.	1161	850	232	618	10/29
	MCH 44N8E-33.5a	City of Crystal Lake	1555	930	319	611	10/29
	MCH 44N5E-35.3g	City of Marengo	1028	817	118	699	10/28
	MCH 43N8E-5.4g	City of Crystal Lake	1218	917	324	593	10/29
	OGL 40N2E-23.1f	Village of Creston	737	905	128	777	10/28
	OGL 40N1E-24.7a1	City of Rochelle	1484	793	61	732	10/28
×	WIL 37N10E-33.2h	Hampton Park Subdivision	1520	640	425	215	10/27
	WIL 36N10E-2.8f	Public Service Co. of N.Ill. Sta. 18	1507	590	392	198	10/26
	WIL 36N10E-2.8h	Public Service Co. of N.Ill. Sta. 18	1536	590	388	202	10/26
	WIL 36N10E-16.4d	Revere Copper & Brass Co.	1523	666	477	189	9/11
	WIL 36N10E-23.2f	City of Lockport	1572	650	492	158	10/2

Table 4(continued)

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
WIL 36N10E-23.5a	City of Lockport	1571	662	476	186	10/1
WIL 36N10E-23.6c	City of Lockport	1446	589	435	154	10/1
WIL 36N10E-27.6b	U.S.Army Lockport Locks	815	581	432	149	11/12
WIL 36N10E-28.6f2	Ill.State Penitentiary, Stateville	2007	642	504	138	11/1
WIL 36N10E-28.6g	Ill.State Penitentiary, Stateville	1600	645	502	143	10/15
WIL 36N10E-28.6h	Ill.State Penitentiary, Stateville	1600	645	480	165	10/15
WIL 36N10E-29.2g	Ill.State Penitentiary, Stateville	1665	646	490	156	10/1
WIL 36N10E-32.1a	Lidice Subdivision	1652	659	497	162	11/17
WIL 36N10E-33.6h	Public Service Co. of N.Ill., Sta. 55	1558	593	445	148	11/16
WIL 36N10E-34.8a	Ruberoid Co.	776	551	480	71	11/3
WIL 36N9E-10.8d	Village of Plainfield	1481	622	346	276	10/26
WIL 35N11E-~~5.8~~a 8.8	City of Joliet(Hadley Valley)	1701	674	533	141	11/11
× WIL 35N10E-2.8b	City of Joliet	1608	558	426	132	11/10
WIL 35N10E-16.2h	City of Joliet	1575	~~535~~ 531	382	~~153~~ 149	11/16
WIL 35N10E-9.1d	City of Joliet	1621	536	414	122	10/20
WIL 35N10E-3.4e	Ill.State Penitentiary	1518	560	464	96	11/1
WIL 35N10E-3.5e	Ill.State Penitentiary	1660	549	422	127	11/3
WIL 35N10E-4.2h	Phoenix Mfg. Co.	1595	553	436	117	11/17
WIL 35N10E-10.1a	Wm. E. Pratt Mfg. Co.	1505	551	463	88	11/10
WIL 35N10E-10.6a	Joliet Twp. High School	881	535	430	105	11/17
WIL 35N10E-11.6g	E.J.& E. R. R.	1589	560	458	102	11/4
WIL 35N10E-20.2f	U.S.Army Brandon Locks	854	521	320	201	11/4
WIL 35N10E-20.6a	Public Service Co.of N.Ill. Sta. 9	1487	536	408	128	10/14
WIL 35N10E-20.7g	Village of Rockdale	1586	556	437	119	11/17
WIL 35N10E-21.4b	American Cyanamid Co.	1612	583	439	144	11/16

Table 4 (continued)

Well No.	Owner	Depth of well (feet)	Surface elevation	Depth to water (feet)	Water level elevation	Date 1959
WIL 35N10E-22.7g	American Institute of Laundering	1608	569	391	178	11/17
WIL 35N10E-29.8g	Public Service Co. of N.Ill., Sta.9	1608	518	421	97	10/1
WIL 35N10E-30.1e1	Blockson Chemical Co.	1520	548	592	-44*	8/15
WIL 35N10E-30.7e	Caterpillar Tractor Co.	1543	546	400	146	9/18
WIL 35N10E-30.7f	Caterpillar Tractor Co.	1510	544	422	122	9/18
WIL 34N9E-10.1h	American Oil Co.	1422	568	320	248	9/8
WIL 34N9E-11.2e	Stepan Chemical Co.	1407	525	305	220	11/18
× WIL 33N10E-9.1f	Joliet Arsenal, Elwood	1672	646	359	287	10/1
WIL 33N10E-9.4h	Joliet Arsenal, Elwood	1645	641	366	275	10/1
WIL 33N9E-1.5e1	Joliet Arsenal, Kankakee	935	572	347	225	10/16
WIN 44N2E-23.1c	Ill.Toll Highway Comm. M-7	371	770	43	727	10/27
WIN 44N1E-23.6d?	City of Rockford	1530	~~720~~ 721	40	~~680~~ 681	10/27
WIN 44N2E-32.4a1	City of Rockford	1313	840	146	694	10/27

* - indicates elevation below sea level.

Table 5 - Decline in Water Levels in Deep Wells, 1958 and 1959

Well No.	Owner	Water Level Elevation 1958	Water Level Elevation 1959	Date of Measurements	Decline in Water Level Elevation (feet)
COK 42N10E-24.8a1	Arlington Heights Jockey Club	357	319	2/58-10/59	38
COK 42N10E-25.6b	City of Rolling Meadows	346	322	4/58-10/59	24
COK 42N13E-8.6d	Glenview Club	305	275	7/58-11/59	30
COK 41N13E-20.7e	Baxter Laboratory	279	251	7/58-11/59	28
COK 41N13E-21.2b	G. D. Searle & Co.	294	264	7/58-11/59	30
COK 41N12E-12.8b	Eugenia Subdivision	325	286	6/58-11/59	39
COK 41N10E-15.1f2	Hoffman Estates	372	345	4/58-10/59	27
COK 39N13E-25.2g	Ideal Roller & Mfg. Co.	134	114	1/58-11/59	20
COK 39N13E-35.1h	Liquid Carbonic Corp.	138	128	1/58-10/59	10
COK 39N12E-12.3e	Bowman Dairy Co.	173	164	2/58-11/59	9
COK 39N12E-36.8d	Village of Riverside	105	103	5/58-10/59	2
COK 39N12E-11.7f	Village of Maywood	148	118	7/58-10/59	30
COK 38N13E-12.8e	International Rolling Mill Products Co.	112	103	7/58-11/59	9
COK 38N13E-19.4e1	Visking Corp.	63	74	4/58-10/59	+11*
COK 38N13E-21.1f	Cracker Jack Co.	103	120	4/58-10/59	+17*
COK 38N12E-5.8d2	Village of Western Springs	153	150	4/58-10/59	3
COK 38N12E-11.3a	Universal Oil Co.	118	98	4/58-10/59	20
COK 38N12E-18.8f3	Suburban Cook Co. T.B.Sanitarium	197	154	6/58-10/59	43
COK 38N12E-24.7h	Corn Products Co.	52	59	3/58-10/59	+7*
COK 36N14E-3.1g	Metro Glass Co.	160	162	6/58-10/59	+2*
COK 36N13E-1.2c	Miller Pre-Pared Potato Co.	208	205	3/58-10/59	3
COK 35N14E-21.3h	Calumet Steel Co.	270	250	1/58-10/59	20
DUP 40N11E-13.8e1	Village of Bensenville	239	~~176~~ 186	5/58-11/59	~~63~~ 53
DUP 40N11E-13.8e2	Village of Bensenville	228	169	5/58-10/59	59
DUP 40N11E-31.5b	Village of Lombard	286	214	1/58-11/59	72
DUP 39N11E-10.1h	City of Elmhurst	131	95	6/58-10/59	36
DUP 39N11E-9.2h	Village of Villa Park	195	141	2/58-11/59	54

Table 5 (continued)

Well No.	Owner	Water Level Elevation 1958	Water Level Elevation 1959	Date of Measurements	Decline in Water Level Elevation (feet)
KNE 42N8E-22.4g	Village of Carpentersville	514	495	2/58-10/59	19
KNE 41N8E-11.3f2	City of Elgin	466	437	6/58-10/59	29
KNE 40N8E-27.6b	City of St. Charles	479	467	4/58-10/59	12
KNE 39N8E-3.2b	City of Geneva	414	401	2/58-10/59	13
KNE 39N8E-22.3e2	City of Batavia	490	472	4/58-10/59	18
KNE 39N8E-33.4g	Mooseheart	459	452	3/58-10/59	7
KEN 37N8E-5.9f	Caterpillar Tractor Co.	405	381	7/58-10/59	24
KEN 37N8E-6.2f	Caterpillar Tractor Co.	415	382	7/58-10/59	33
KEN 37N8E-6.2d	Caterpillar Tractor Co.	425	415	7/58-10/59	10
MCH 46N5E-33.8a	Dean Milk Co.	731	711	7/58-10/59	20
WIL 36N10E-23.2f	City of Lockport	142	158	1/58-10/59	+16*
WIL 36N10E-23.5a	City of Lockport	177	186	1/58-10/59	+9*
WIL 36N10E-27.6b	U. S. Army Lockport Locks	138	149	5/58-11/59	+11*
WIL 36N10E-34.8a	Ruberoid Co.	39	71	6/58-11/59	+32*
WIL 36N9E-10.8d	Village of Plainfield	306	276	5/58-10/59	30
WIL 35N10E-2.8b	City of Joliet	156	153	3/58-11/59	3
WIL 35N10E-4.2h	Phoenix Mfg. Co.	112	117	6/58-11/59	+5*
WIL 35N10E-10.1a	W. E. Pratt Mfg. Co.	93	88	6/58-11/59	5
WIL 35N10E-10.6a	Joliet Twp. High School	112	105	6/58-11/59	7
WIL 35N10E-22.7g	Amer. Inst. of Laundering	186	178	6/58-11/59	8
WIL 35N10E-30.1e1	Blockson Chem. Co.	25	-44	1/58-8/59	69
WIL 34N9E-11.2e	Stepan Chem. Co.	263	220	5/58-11/59	43
WIL 35N10E-16.2h	City of Joliet	~~157~~ 156	~~150~~ 149	10/58-10/59	7
WIL 36N10E-33.6h	Public Service Co. of No. Ill.,Sta.55	~~155~~ 157	~~146~~ 148	10/58-10/59	9

* + indicates rise in water level.

Table 6 - Decline in Nonpumping Water Levels, October 1958 to October 1959

Pumping Center	Estimated Average Decline Oct. 1958-Oct. 1959 (feet)
Chicago area	13
Joliet area	9
Elmhurst area	41
Des Plaines area	26
Elgin area	15
Aurora area	16

The water-level decline varies from place to place within pumping centers. For example, water levels in deep wells in some places in the Chicago area pumping center recovered; however, on an average water levels declined about 13 feet. The greatest declines occurred in the Elmhurst and Des Plaines area pumping centers. The least decline was recorded for the Jollet area pumping center where the pumpage increase was greatest. The decline was small because the pumpage increase was widely distributed within the pumping center.

The decline in water levels, October 1958 to October 1959 in the Elmhurst, Des Plaines, and Aurora area pumping centers is at least twice the rate of water-level declines for the period 1945-1958. The large increase in pumpage in 1959 (about 10 mgd) as compared to the average annual increase in pumpage (about 1.0 mgd) 1945-1958, resulted in a large increase in the time-rate of water-level decline. The full effects on water levels of the large

increase in pumpage during 1959 are not yet recorded. For example, water levels in the Elmhurst area pumping center were not measurably affected during 1959 by increased withdrawals in the Elgin, Aurora, and Joliet area pumping centers. These pumping centers are on the average about 25 miles away from Elmhurst. Pumpage increases in the Des Plaines area, which Is about 10 miles from Elmhurst, will affect the Elmhurst area for. many years in the future.

The hydrograph of the observation well at Maywood, in figure 4, illustrates the unusual and pronounced decline in water levels during 1959. Water levels started to decline at a rapid rate in June and reached record lows in September.

The cessation of pumping from the city of Zion deep wells in 1957 and from the village of Grays Lake deep wells in 1958 resulted in a rapid recovery in water levels in parts of Lake County. The greatest recorded rise (86 feet) in water level since October 1957 occurred in a municipal well at Zion.

Superimposed upon the long-term trend of water-level fluctuations in deep wells are seasonal fluctuations caused chiefly by changes in the rate of pumping from nearby wells. Water levels in deep wells in many parts of the Chicago region generally recede during the summer and early fall months, when pumpage is the greatest. Water levels start to recover during the late fall, when pumpage is reduced. Minimum annual water levels are usually recorded during September and Octobers maximum annual water levels occur during late winter and spring months. Seasonal fluctuations in water levels are Illustrated by the hydrograph of a well at Maywood, in figure 9. The well is equipped with a recording gage. Short-term

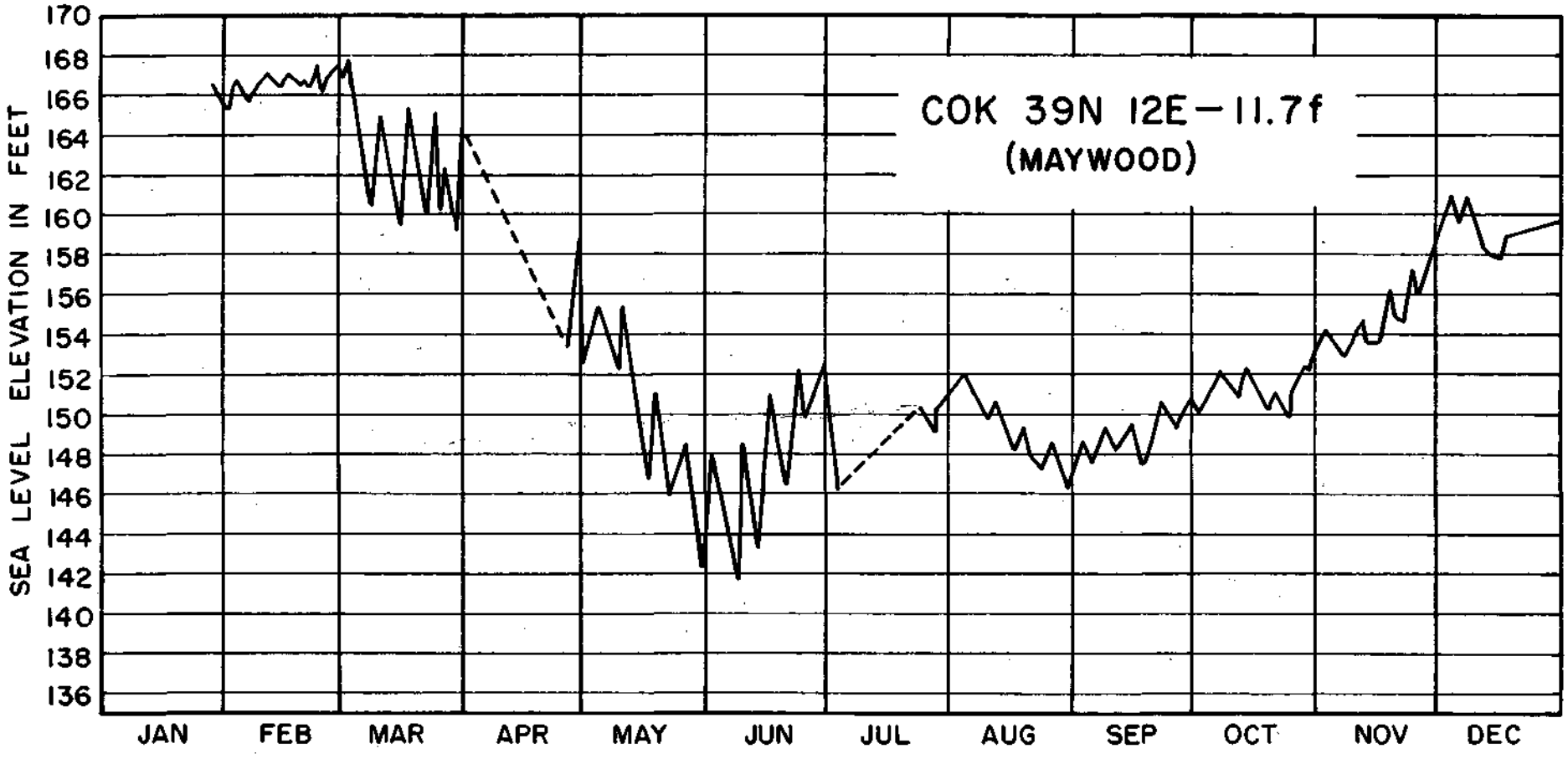


Figure 9. WATER LEVELS AT MAYWOOD DURING 1958

fluctuations reflect intermittent pumping, day-to-day variations in nearby pumping, or changes in atmospheric pressure.

Piezometric Surface of Cambrian-Ordovician Aquifer

The piezometric surface is an imaginary surface to which water will rise in artesian wells. Figure 10 shows the piezometric surface of the Cambrian-Ordovician Aquifer in October, 1959. Data on nonpumping water levels in table 4 were used to prepare the map. The general features of the piezometric surface map for 1959 differ but little from those of the piezometric surface map for 1958 as shown in Cooperative Report 1.

During 1959 the area of lowest water levels in the Chicago area continued to advance in a northwesterly direction from Summit towards the Elmhurst and Des Plaines area pumping centers. The 150-foot piezometric surface contour migrated in a northwesterly direction about six miles from Its estimated position in 1958. In 1959 the deepest cone of depression in Cook County (about 59 feet above sea level) was in the vicinity of Summit.

A pronounced cone of depression Is centered in the southwest part of Joliet where water levels declined to a position 44 feet below sea level in October 1959. The average elevation of water levels in deep wells within the corporate limits of Joliet was about 100 feet.

The general rise of water levels in the Zion area changed the piezometric surface in parts of Lake County. The 450-foot contour migrated several miles in a southeasterly direction as the result of continued decreases in pumpage.

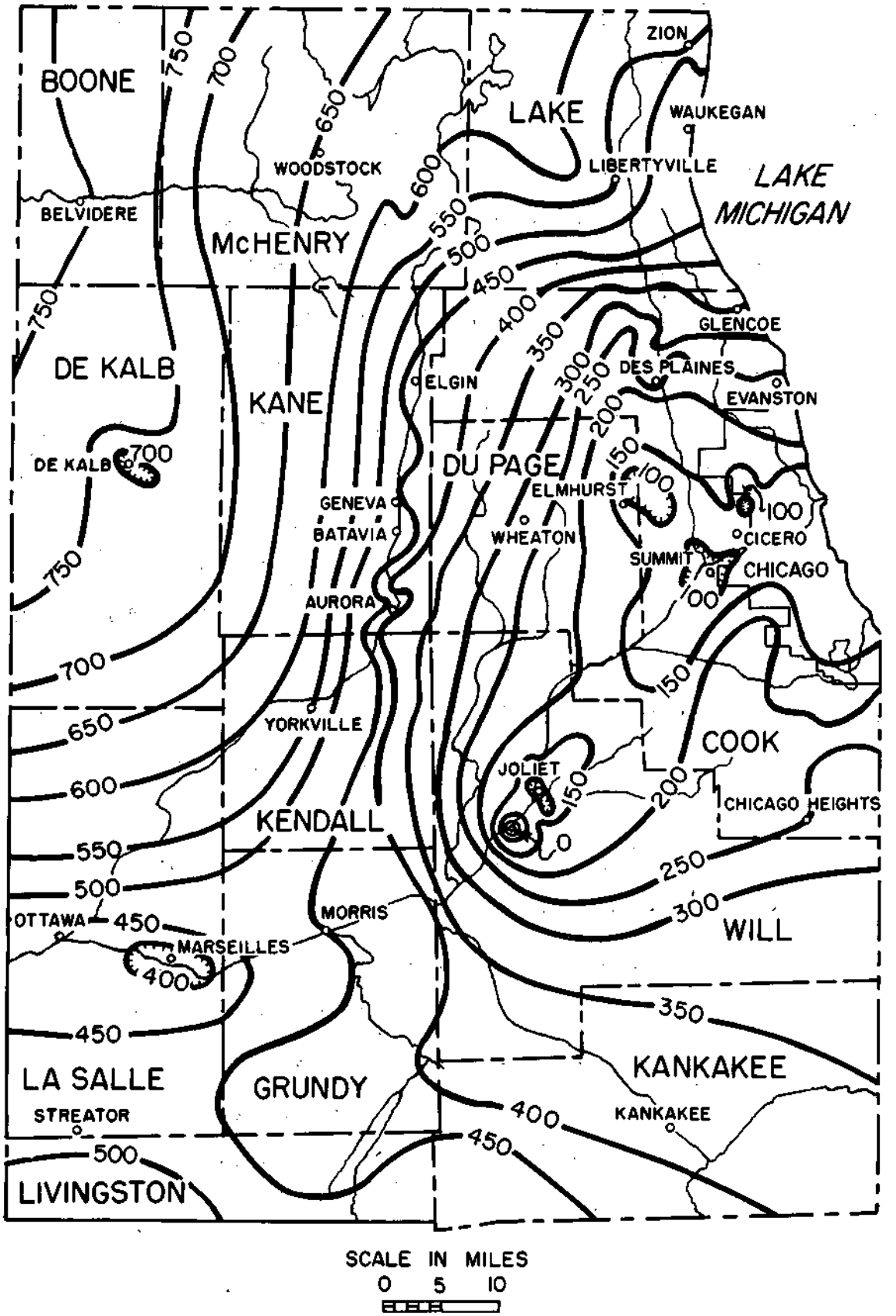


Figure 10. PIEZOMETRIC SURFACE OF CAMBRIAN-ORDOVICIAN AQUIFER IN OCT., 1959.

The piezometric surface in McHenry County receded appreciably during 1959. The 650-foot contour moved northwestward about five miles to a position west of Woodstock„

The 450-foot contour in the southern part of the Chicago region was north of Livingston County in 1958. During 1959 that contour moved in a southwesterly direction into Livingston County. Depressions in the piezometric surface are apparent at Elgin, Geneva, Batavia, Aurora, DeKalb, and Marseilles, The piezometric surface was below the top of the Galena-Platteville Dolomite in the deepest parts of the cones of depression at Chicago, Elmhurst, Des Plaines and Joliet,

The general pattern of flow of water in the Cambrian-Ordovician Aquifer in 1959 was slow movement from all directions toward the deep cones of depression centered west of Chicago at Summit and at Joliet, Some of the water flowing toward Chicago and Joliet is intercepted by cones of depression developed locally within the large cones in the Aurora, Elgin, Des Plaines, and Elmhurst areas.

The lowering of the water levels accompanying the withdrawals of ground water has established steep hydraulic gradients west and north of Chicago, and large quantities of water are at present being transmitted from recharge areas in northern Illinois and minor quantities from southern Wisconsin toward centers of pumping. Large amounts of water derived from storage within the Cambrian-Ordovician Aquifer and from vertical leakage of water through the Maquoketa Formation move toward Chicago and Joliet from the east in Indiana, from the south in Illinois, from the west in Illinois, and from the northeast beneath Lake Michigan.

Future Water-Level Decline

Estimates of future nonpumping water-level decline, 1958-1980, based on reasonable extrapolation of past pumpage data, were given in Cooperative Report 1. Average declines ranged from about 14 feet per year in the Chicago and Des Plaines area pumping centers to about 9 feet per year in the Elgin area pumping center. The measured declines during 1959 exceed the predicted declines because of the unexpected, accelerated rate of increase in pumpage. Pumpage increases vary from year to year in an erratic and unpredictable manner. Judging from past records it is unlikely that pumpage will increase indefinitely at the rate observed during 1959. By the same token, it is unlikely that water-level declines will persist indefinitely at the rate observed during 1959. However, declines during 1959 are so much in excess of predicted declines that, barring appreciable reductions in pumpage in some future years, water-level declines will exceed predicted declines given in Cooperative Report 1. Future declines in water level cannot be computed from the data collected in 1959o It is important that collection of data be continued so that potential ground-water development and its effects can be reevaluated within five years.