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Groundwater Levels and Pumpage in the East St. Louis Area, Illinois, 19624966

by G. E. Reitz, Jr.

ILLINOIS STATE WATER SURVEY
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GROUNDWATER LEVELS AND PUMPAGE IN THE EAST ST. LOUIS AREA, ILLINOIS, 1962-1966

by G. E. Reitz, Jr.

SUMMARY

Groundwater levels and pumpage in the East St. Louis area from 1962 through 1966 are considered in this report. Large quantities of groundwater chiefly for industrial and municipal use are withdrawn from wells penetrating a sand and gravel aquifer along the valley lowlands of the Mississippi River.

Groundwater pumpage increased from 99.4 million gallons per day (mgd) in 1961 to 108.1 mgd in 1966. Of the total 1966 pumpage 89.8 percent was industrial; 7.4 percent was for public water supplies; 2.2 percent was for domestic use; and 0.6 percent was for irrigation. Pumpage in the East St. Louis area is concentrated in five major pumping centers: the Alton, Wood River, Granite City, National City, and Monsanto areas.

As the result of heavy pumping, below normal precipitation, and low Mississippi River stages, water levels declined 25 feet in the Monsanto area near the Mississippi River, 5 feet in the National City area, 10 feet in the Alton area near the Mississippi River, and 10 feet in the Wood River and Granite City areas. In localized areas away from the Mississippi River in the vicinity of Alton and Monsanto water levels rose in excess of 10 and 20 feet, respectively, as a result of reduced pumpage.

INTRODUCTION

The East St. Louis area (figure 1) is one of the most heavily populated and industrialized areas in Illinois. The groundwater resources of a sand and gravel aquifer underlying the area have been developed extensively. It is estimated that during 1966 an average of 108.1 mgd was withdrawn chiefly from industrial and municipal wells.

In 1965 the State Water Survey issued Report of Investigation 51 (Schicht, 1965) which described in detail the groundwater resources of the East St. Louis area. The geology and hydrology of the sand and gravel aquifer, the yields of

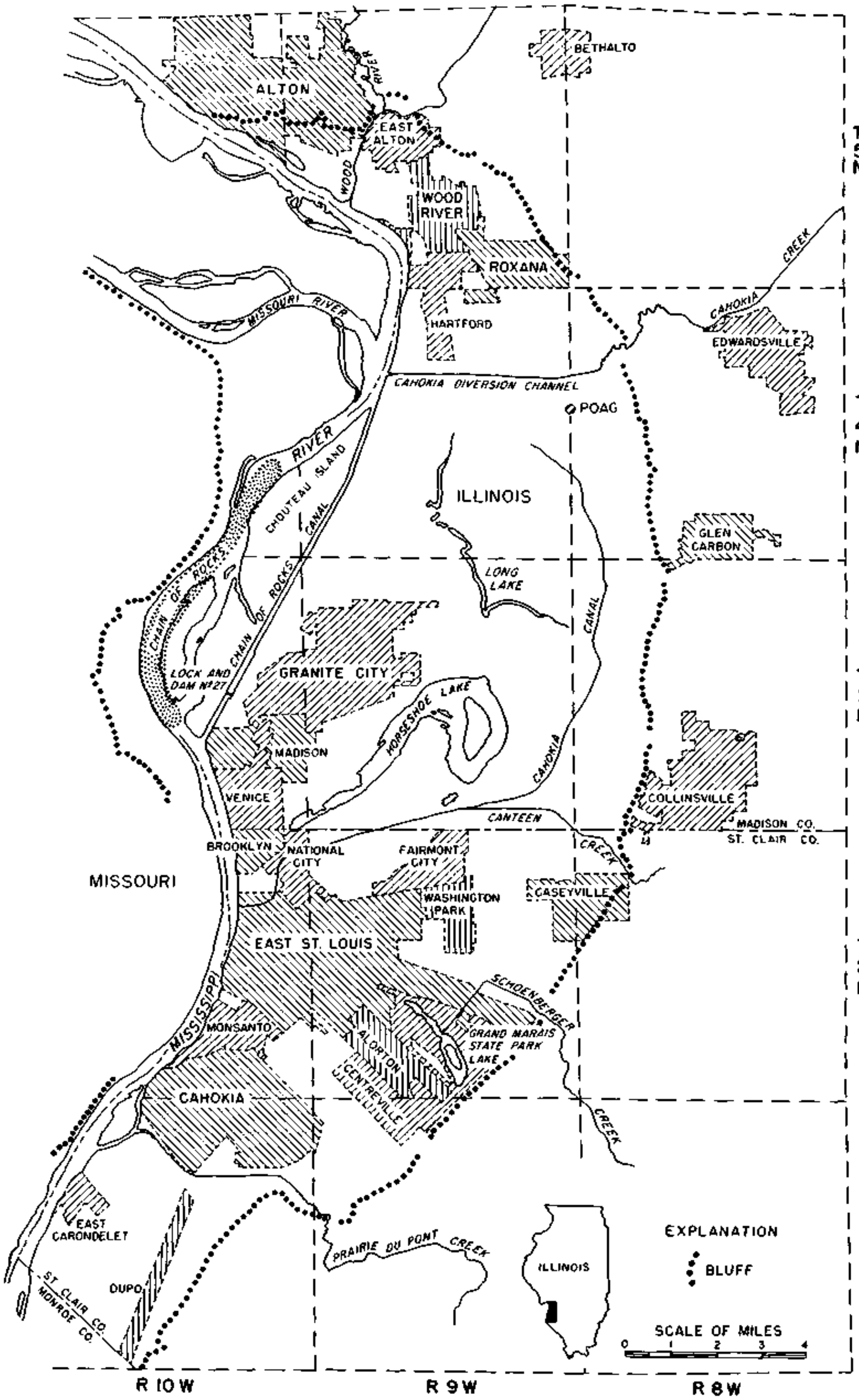

Figure 1. Location of the East St. Louis area

wells, and the possible consequences of future groundwater development were discussed in detail. The report was the culmination of a period of intensive data collection initiated in 1941 after alarming water-level recessions were observed by local industries. Previous reports which summarized water levels and pumpage and aided in the preparation of Report of Investigation 51 were issued in 1953 (Bruin and Smith) and 1962 (Schicht and Jones). The groundwater geology of the area had been described by the State Geological Survey (Bergstrom and Walker, 1956).

Studies described in Report of Investigation 51 indicated that the practical sustained yield of existing pumping centers exceeded withdrawals in 1962. However, extrapolation of past groundwater use indicated that pumpage would exceed the practical sustained yield in the Monsanto area within a few years. The practical sustained yield of the other major pumping centers probably would not be reached until after 1980. It was estimated that with the development of additional pumping centers the potential yield of the sand and gravel aquifer would exceed 188 mgd.

In order to validate the predictions of pumping center yields made in Report of Investigation 51 and to delineate problem areas data collection was continued on the previous scale. This report summarizes water levels and pumpage in the area for the period 1962 through 1966.

GEOLOGY AND HYDROLOGY

Large supplies of groundwater chiefly for industrial development are withdrawn from permeable sand and gravel in unconsolidated valley fill in the East St. Louis area. According to Bergstrom and Walker (1956), the valley fill is composed of recent alluvium and glacial valley-train material and is underlain by Mississippian and Pennsylvanian rocks consisting of limestone and dolomite with subordinate amounts of sandstone and shale. Because of the low permeability of the bedrock formations and poor water quality with depth, the rocks do not constitute an important aquifer in the area. The valley fill has an average thickness of 120 feet and ranges in thickness from a featheredge near the bluff boundaries of the area and along the Chain of Rocks Reach of the Mississippi River to more than 170 feet near the city of Wood River. The thickness of the valley fill is generally greatest and exceeds 120 feet in places near the center of a buried bedrock valley that bisects the area as shown in figure 2. The coarsest deposits most favorable for development are commonly encountered near bedrock and often average 30 to 40 feet in thickness.

Groundwater in the valley fill occurs under leaky artesian and water-table conditions. Because water occurs most commonly under leaky artesian conditions, the surface to which water rises, as defined by water levels in wells, is hereafter called the piezometric surface.

Recharge within the area is from precipitation, induced infiltration of surface water from the Mississippi River and small streams traversing the area,

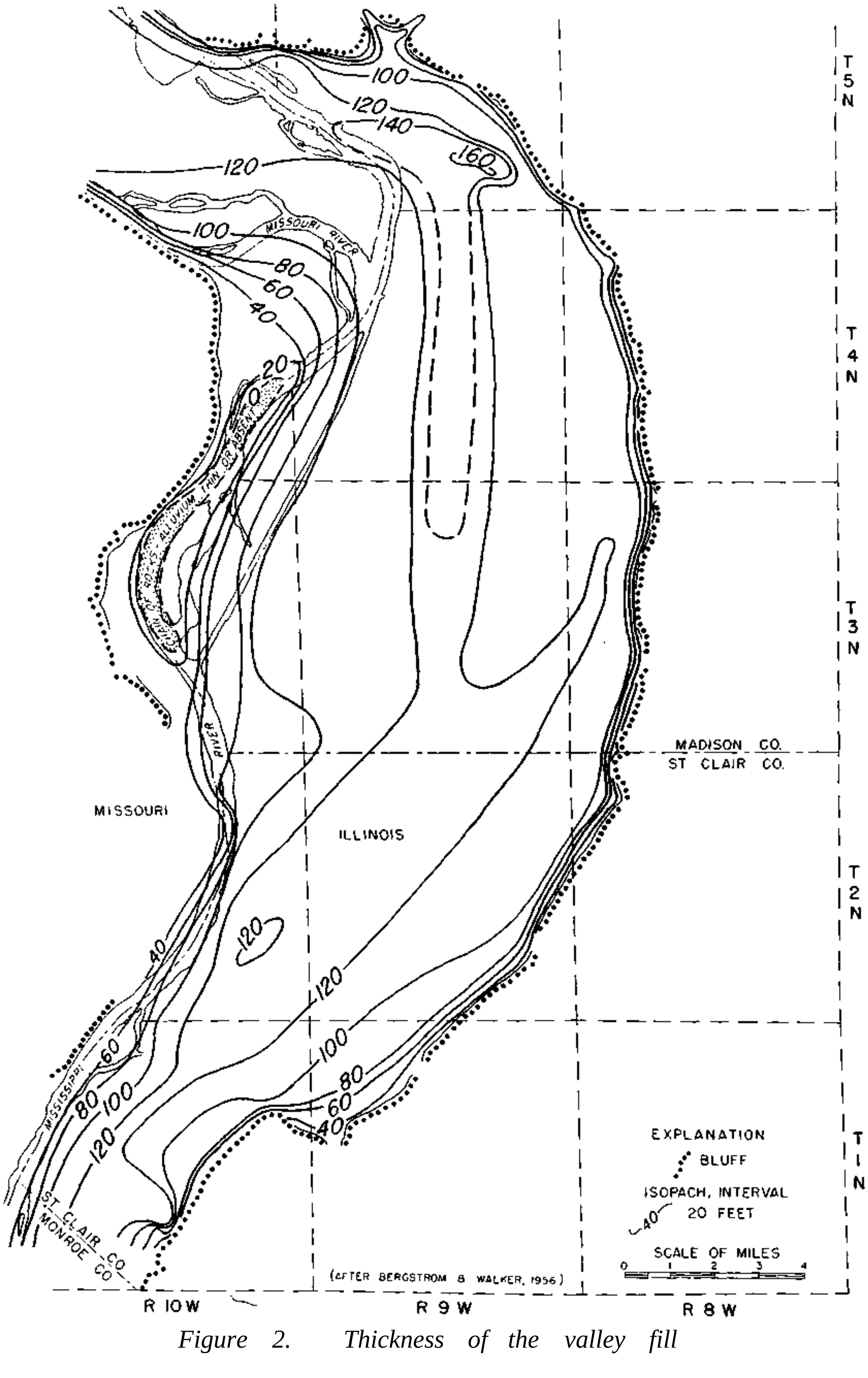

Figure 2. Thickness of the valley fill

and subsurface flow from the bluffs bordering the area. A fraction of the annual precipitation seeps downward through surface materials and into the valley-train deposits. Recharge by induced infiltration occurs at places where heavy pumping from wells has lowered the piezometric surface below stream level.

PUMPAGE FROM WELLS

The first significant withdrawal of groundwater in the East St. Louis area started in the late 1890s. Prior to 1900 groundwater was primarily used for domestic and farm supplies; since 1900 pumpage has been mostly for industrial use. Estimated pumpage from wells increased from 2.1 mgd in 1900 to 111.0 mgd in 1956 as shown in figure 3. Pumpage declined sharply from 111.0 mgd in 1956 to 92.0 mgd in 1958. By 1961 pumpage had increased to 99.4 mgd.

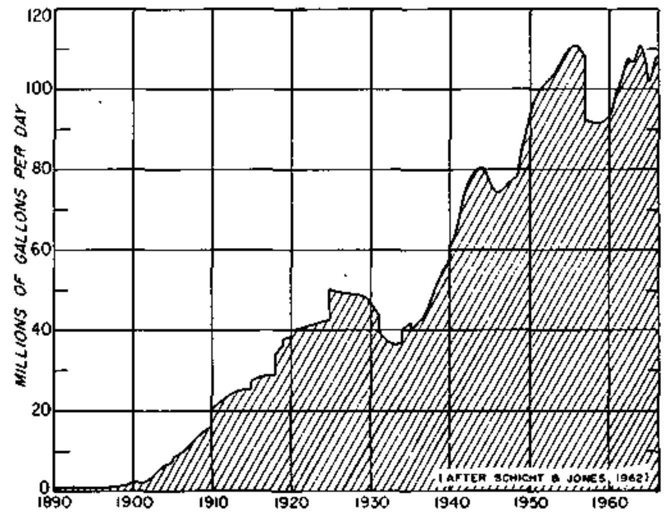

Figure 3. Estimated pumpage, 1890 through 1966

Pumpage use data are classified in this report according to four main categories: 1) *public,* including municipal and institutional; 2) *industrial;* 3) *domestic,* including rural farm nonirrigation and rural nonfarm; and 4) *irrigation,* including farms, golf courses, and cemeteries. Most water-supply systems furnish water for several types of uses. A public supply commonly includes water used for drinking and other domestic uses, manufacturing processes, and lawn sprinkling. Industrial supplies may also be used in part for drinking and other domestic uses. No attempt has been made to determine the final use of water within the public and domestic categories; for example, any water pumped by a municipality is called a public supply, regardless of the use of the water. However, the final use of water within the industrial category has been determined in part, and any water pumped by an industry and furnished to a municipality is included in the public supply category.

Pumpage, 1962 through 1966

Since 1961 pumpage from wells has increased erratically from 99.4 mgd to 108.1 mgd. Pumpage was greatest in 1964 when 110.2 mgd was withdrawn. Estimated pumpage for the period 1961-1966 is shown in figure 4.

Of the 1966 total estimated groundwater pumpage, public water-supply systems accounted for 7.4 percent or 8.0 mgd, industrial pumpage was 89.8 percent or

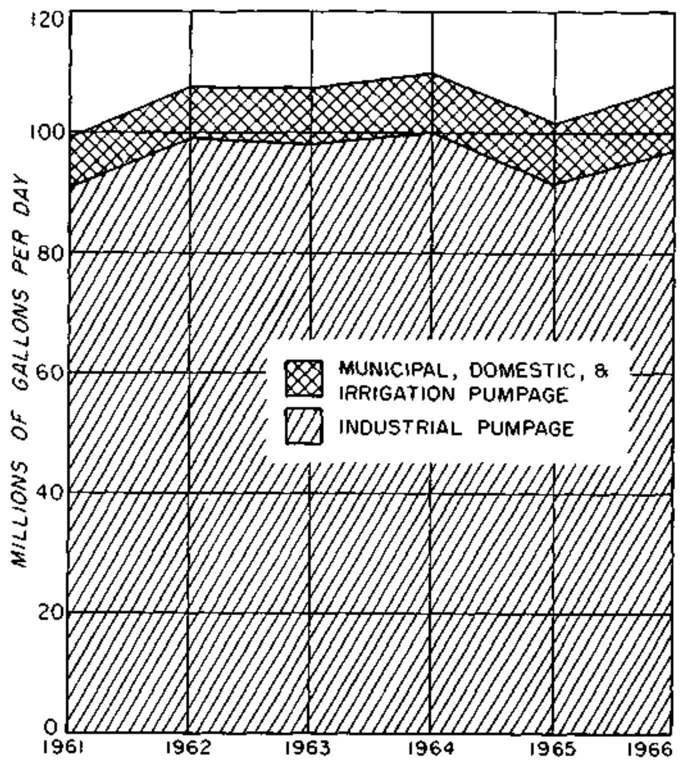

Figure 4. Estimated pumpage, 1961 through 1966, subdivided by use

97.0 mgd, domestic pumpage was 2.2 percent or 2.4 mgd, and irrigation pumpage was 0.6 percent or 0.7 mgd.

Pumpage in the East St. Louis area is concentrated in five major and five minor pumping centers. The major pumping centers are: the Alton, Wood River, Granite City, National City, and Monsanto areas. The minor pumping centers are: the Fairmont City, Caseyville, Troy, Glen Carbon, and Poag areas.

Public Supplies. Municipal and institutional uses are included in public supplies. In the East St. Louis area in 1966 estimated pumpage for 11 municipal supplies and 1 major institutional supply was 7.6 mgd. Other institutional pumpage, including hotels, hospitals, theaters, motels, and restaurants, averaged about 0.4 mgd in 1966.

Pumpage of public water supplies reflect seasonal variations to some extent. Municipal pumpage is generally 25 to 30 percent higher during the summer months than during the winter months. Institutional pumpage is primarily for air conditioning, and therefore is affected by seasonal changes in temperature.

Industrial Supplies. The major industries in the East St. Louis area using groundwater are oil refineries, chemical plants, ore refining plants, meat packing plants, and steel plants. Data on industrial pumpage were obtained from 60 plants. Most of the industrial plants do not meter their pumpage, and for these pumpage estimates were based on the number of hours the pump operated, the pump capacity, and in some cases on production data. Industrial pumpage generally is more uniform throughout the year than public pumpage unless large air-conditioning installations are used, or the industry is seasonal, or a change in operation occurs as a result of strikes or vacation shutdowns.

Industrial pumpage (figure 4) increased erratically from 90.8 mgd in 1961 to 100.1 mgd in 1964. The greatest increase, 8.0 mgd, occurred from 1961 to 1962. Estimated industrial pumpage declined from 100.0 mgd in 1964 to 91.3 mgd in 1965. The decrease in pumpage was due to a strike at one industry and the introduction of water conservation measures at another industry. Estimated pumpage increased to 97.0 mgd in 1966 primarily because of the strike settlement.

Domestic Supplies. Domestic pumpage, including rural farm nonirrigation and rural nonfarm use, was estimated by considering rural population as reported by the U. S. Bureau of the Census and per capita use of 50 gallons per day (gpd). Average domestic pumpage for the period 1961 to 1966 was estimated to be 2.4 mgd.

Irrigation Supplies. Irrigation pumpage is seasonal and varies considerably from year to year depending on climatic conditions. Irrigation pumpage increased at an average rate of approximately 160,000 gpd per year from 1961 to 1964. As shown in figure 5 irrigation pumpage increased from 50,000 gpd in 1961 to 540,000 gpd in 1964. Pumpage decreased to about 190,000 gpd in 1965 but increased to 680,000 gpd in 1966. The decrease in irrigation pumpage that occurred in 1965 can be related to precipitation. Precipitation as reported by the Weather Bureau station at Edwardsville was approximately 8 inches below normal in 1965, but 60 percent of the precipitation occurred just prior to or during the growing season (figure 6). In 1966 there were 35 irrigation well owners. Water withdrawn from wells was used primarily to irrigate horseradish and truck crops. Irrigation pumpage estimates were based on reported well yields, the number of hours of operation, acres irrigated, and the depth and number of water applications made.

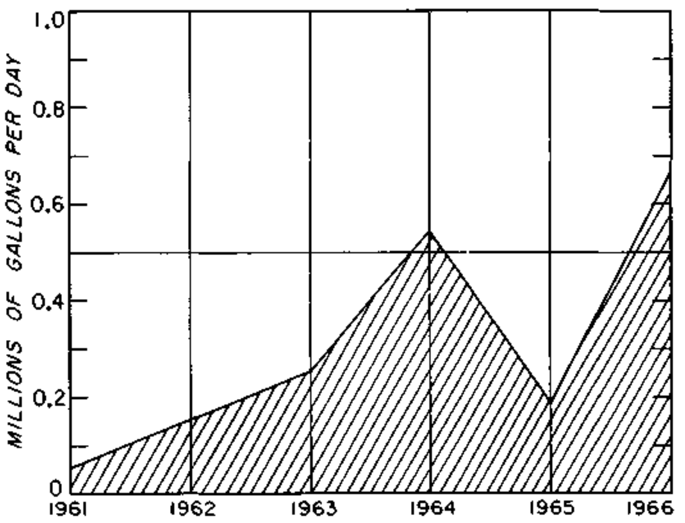

Figure 5. Estimated pumpage for irrigation

Distribution of Pumpage

Distribution of the 1966 pumpage and locations of pumping centers are shown in figure 7. Prior to 1953 pumpage from wells for the most part was concentrated in areas 1 mile or more from the Mississippi River. During and after 1953 pumpage from wells located a few hundred feet or less from the Mississippi River increased greatly. Table 1 shows the distribution of pumpage from wells near the river from 1961 to 1966. Figure 8 shows the distribution and location of pumpage

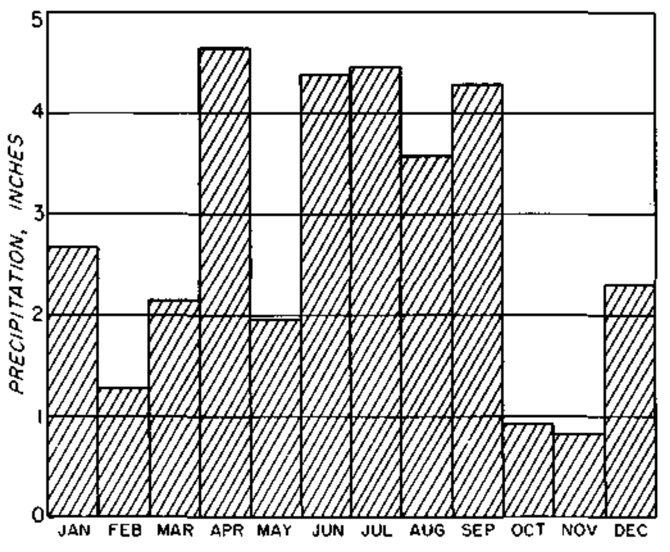

Figure 6. Monthly precipitation at Edwardsville, 1965

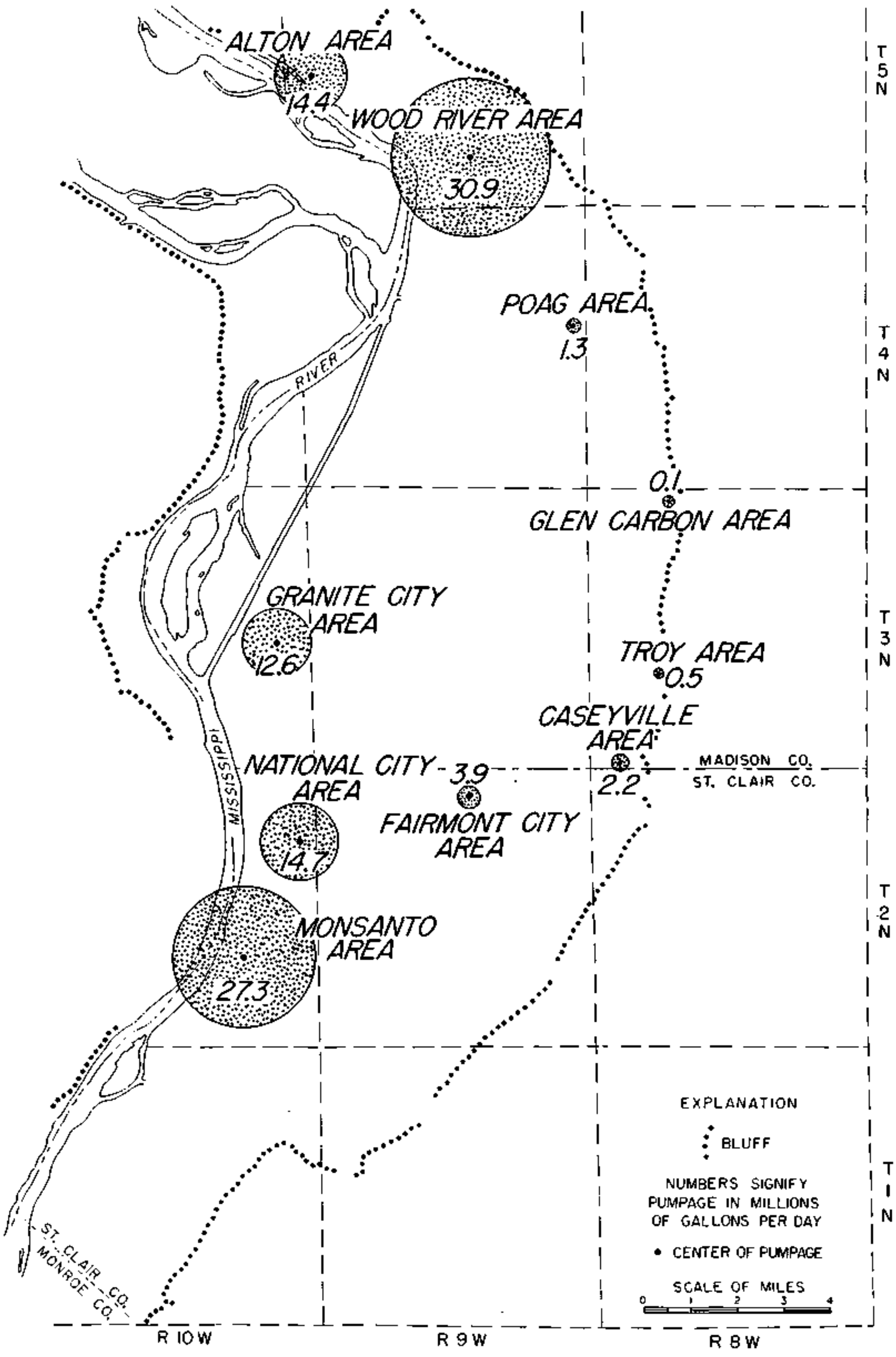

Figure 7. Distribution of estimated pumpage in 1966

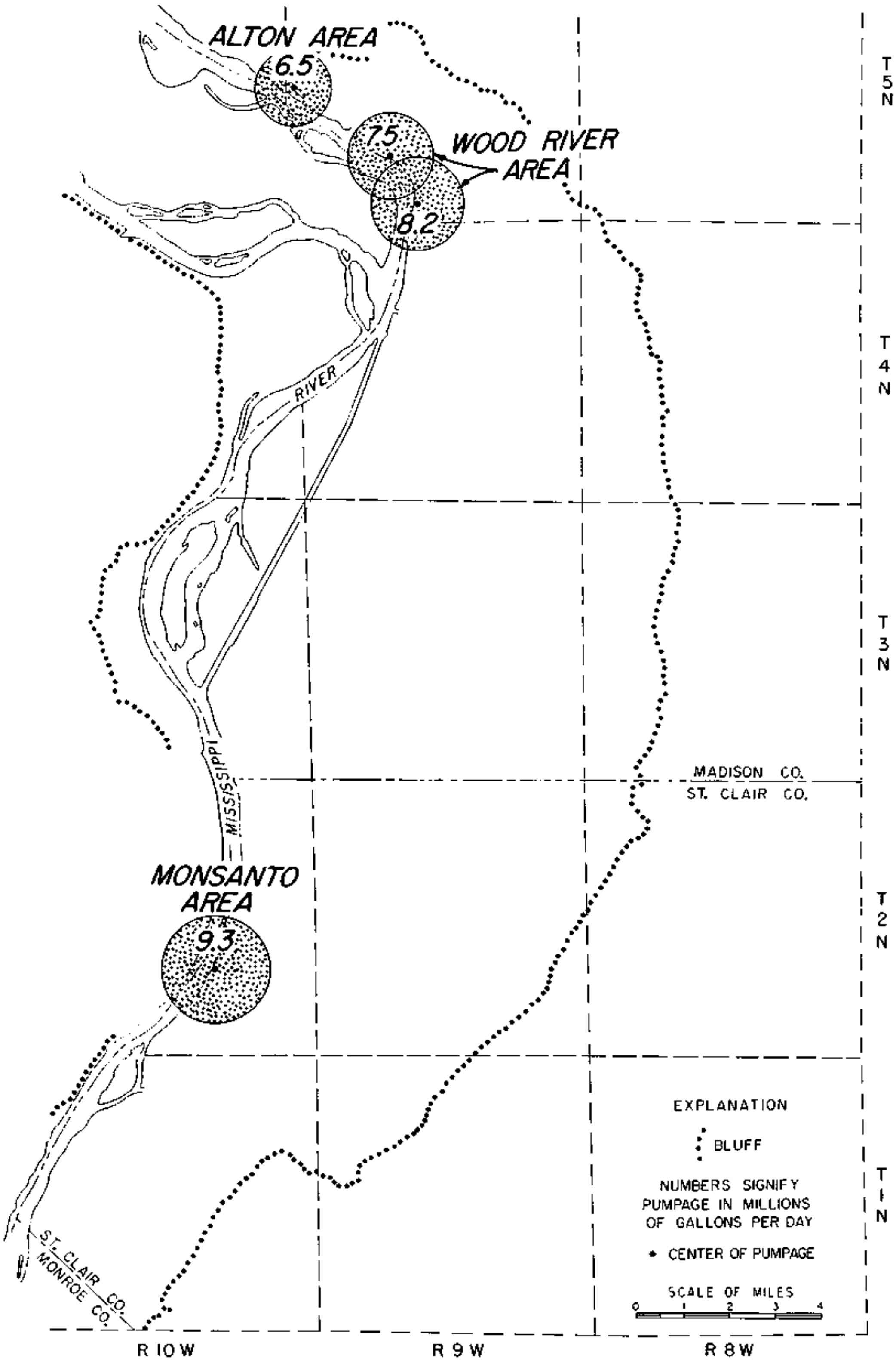

Figure 8. Distribution of estimated pumpage near the Mississippi River in 1966

Table 1. Distribution of Pumpage from Wells near Mississippi River
(Pumpage in million gallons per day)

Pumping center	1961 All wells	1961 Wells near river	1962 All wells	1962 Wells near river	1963 All wells	1963 Wells near river
Alton	12.3	7.2	13.9	7.6	14.6	7.2
Wood River	25.3	10.8	26.1	10.8	28.0	12.1
Monsanto	32.5	11.4	36.5	12.8	33.9	9.7

Pumping center	1964 All wells	1964 Wells near river	1965 All wells	1965 Wells near river	1966 All wells	1966 Wells near river
Alton	12.8	6.1	14.5	6.5	14.4	6.5
Wood River	28.7	13.5	27.6	13.4	30.9	15.7
Monsanto	31.0	7.6	26.8	8.6	27.3	9.3

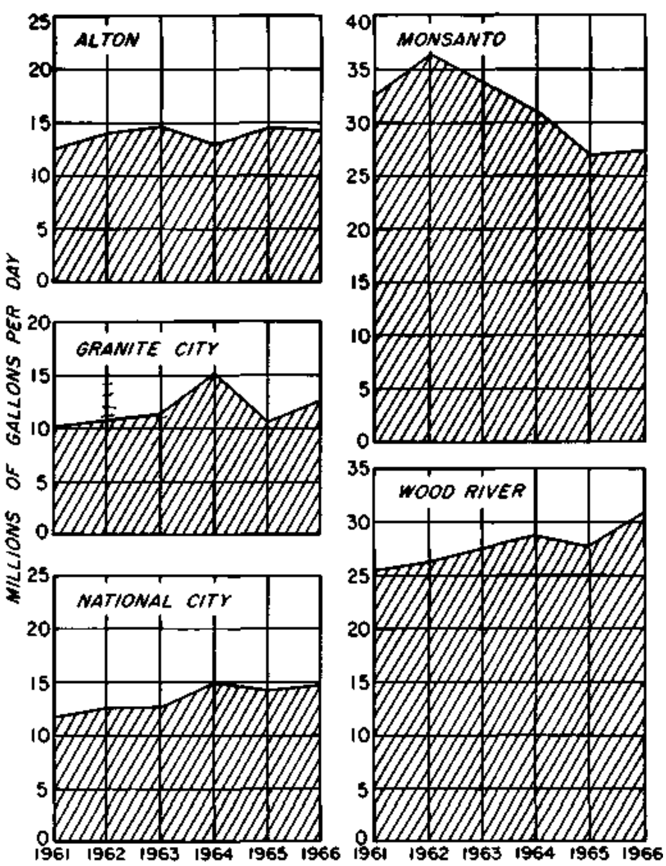

Figure 9. Estimated pumpage, major pumping centers, 1961-1966

withdrawn from wells near the Mississippi River in 1966.

Estimated pumpage in major pumping centers from 1961 through 1966 is shown in figure 9. Pumpage in the *Alton area* increased from 12.3 mgd in 1962 to 14.6 mgd in 1963. Estimated pumpage declined to 12.8 mgd in 1964 but increased to 14.5 mgd in 1965 and remained fairly uniform at 14.4 mgd in 1966. Groundwater withdrawals are chiefly from wells owned by five industries; the greatest use of water is for boxboard manufacturing.

Estimated groundwater pumpage from 1961 to 1966 in the *Wood River area* increased at an average rate of about 1.0 mgd per year. Pumpage increased from 25.3 mgd in 1961 to 30.9 mgd in 1966. Groundwater withdrawals are primarily from wells owned by eight industries and five municipalities; the greatest use of water is by oil refineries.

Pumpage in the *Granite City area* increased from 10.1 mgd in 1961 to 15.3 mgd in 1964. Pumpage declined from 14.6 mgd in 1964 to 10.6 mgd in 1965 because of a strike at one industry and reduced groundwater usage at another. Pumpage increased to 12.6 mgd in 1966 because of settlement of the strike early in 1966. Groundwater withdrawals are chiefly from wells owned by seven industries.

Groundwater pumpage in the *National City area* increased erratically from 11.8 mgd in 1961 to 14.7 mgd in 1966. The peak withdrawal, 15.0 mgd, occurred in 1964. Groundwater withdrawals are primarily from wells owned by 14 industries; the greatest use of water is by meat packing plants.

Estimated groundwater withdrawals in the *Monsanto area* increased 4.0 mgd from 1961 to 1962. From 1962 to 1965 groundwater pumpage decreased from 36.5 mgd to 26.8 mgd as a result of increased conservation of water at one industry by recirculating instead of pumping to waste after the initial use. Groundwater withdrawals are for the most part from wells owned by 14 industries; the greatest use of water is by chemical plants.

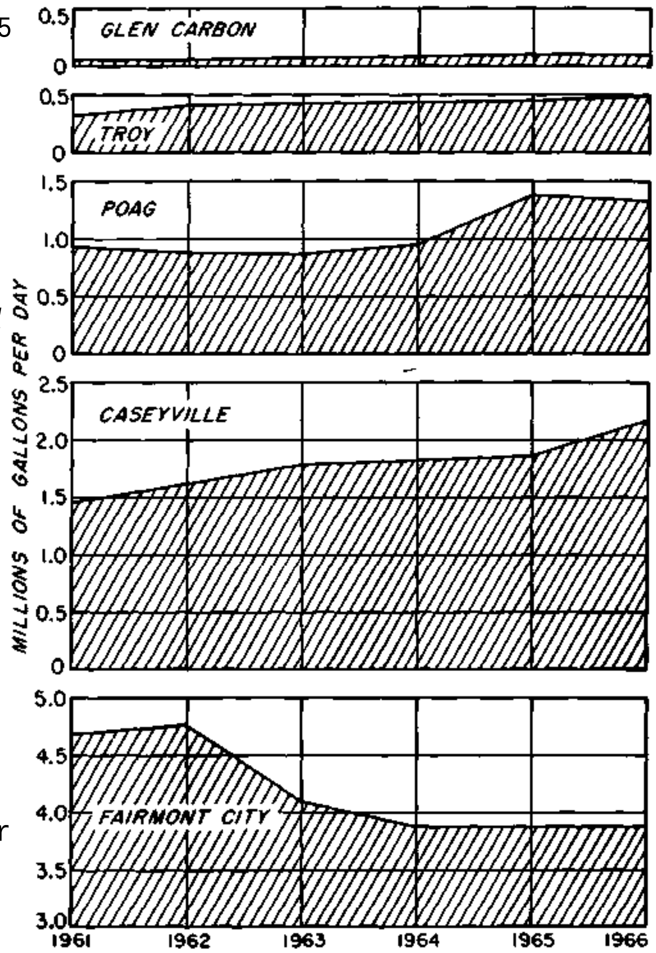

Figure 10. Estimated pumpage, minor Pumping centers, 1961-1966

Groundwater withdrawals in the minor pumping centers are principally for municipal supplies, with the exception of the Fairmont City area where pumpage is for industrial use. Pumpage for the period 1961 to 1966 increased uniformly in the Glen Carbon, Troy, Poag, and Caseyville areas as shown in figure 10. Pumpage totals for 1961 and 1966 show increases from 50,000 to 105,000 gpd in the Glen Carbon area, from 320,000 to 510,000 gpd in the Troy area, from 0.9 to 1.3 mgd in the Poag area, and from 1.5 to 2.2 mgd in the Caseyville area. Pumpage in the Fairmont City area decreased from 4.7 mgd in 1961 to 3.9 mgd in 1966. The decrease of pumpage was the result of the complete shut down of one industry and a gradual decrease in production at another.

WATER LEVELS IN WELLS

Water levels in wells have been measured periodically for more than 20 years by the State Water Survey and by industries and municipalities in the area. The locations of current observation wells are given in figure 11. (See Schicht and Jones, 1962, and Schicht, 1965, for descriptive records of wells.)

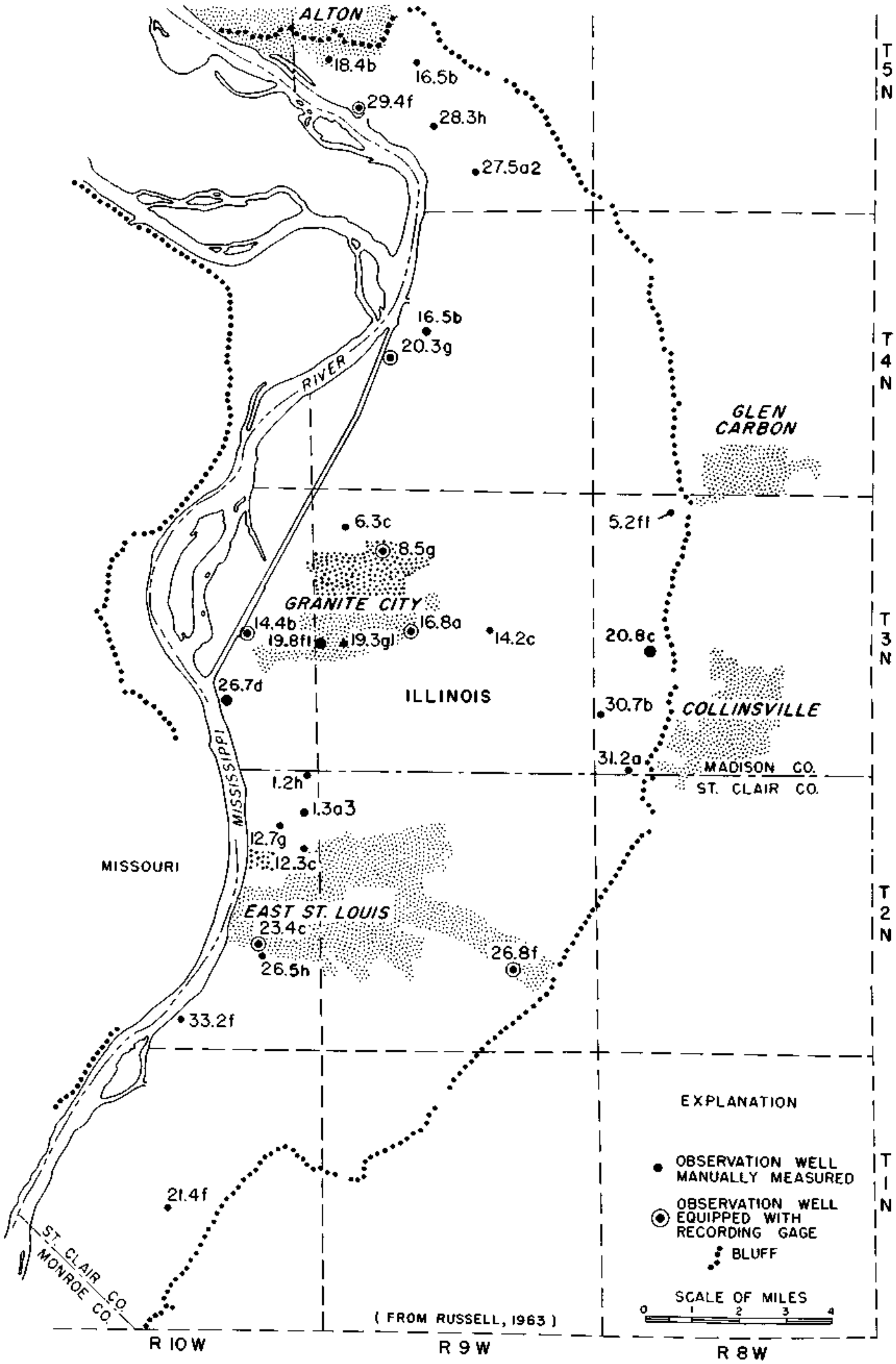

Figure 11. Location of observation wells

Water levels in the area generally recede in the late spring, summer, and early fall when discharge from the groundwater reservoir by evapotranspiration, groundwater runoff to streams, and pumping from wells is greater than recharge from precipitation and induced infiltration of surface water from the Mississippi River and other streams. Water levels generally recover in the early winter when conditions are favorable for the infiltration of rainfall to the water table. The recovery of water levels is especially pronounced during the spring months when the groundwater reservoir receives most of its annual recharge. Water levels are frequently highest in May and lowest in December depending upon climatic conditions, pumping rates, and stages of the Mississippi River.

Since 1900 water levels have lowered appreciably in the five major and five minor pumping centers. According to Schicht and Jones (1962) the greatest water-level declines for the period 1900 to November 1961 occurred in the five major pumping centers: 50 feet in the Monsanto area, 40 feet in the Wood River area, 20 feet in the Alton area, 15 feet in the National City area, and 10 feet in the Granite City area. Part of the decline, 2 to 12 feet, was attributed to the construction of levees and drainage ditches (Bruin and Smith, 1953)-

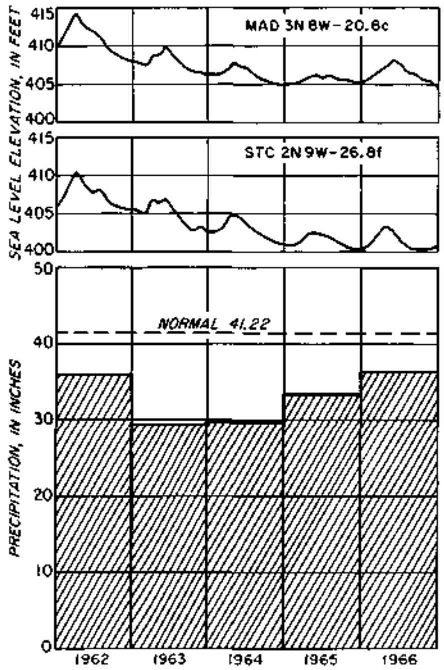

Figure 12. Water levels in wells remote from pumping centers and annual precipitation at Edwardsville, 1962-1966

During the period 1962-1966 water levels in wells in areas remote from pumping centers and the Mississippi River declined as the result of below normal precipitation. Weather Bureau records at Edwardsville indicate an average yearly rainfall of 33.0 inches for 1962 through 1966, about 8.2 inches per year below normal. The effects of below normal precipitation are shown in figure 12 by the hydrographs of wells MAD 3N8W-20.8c and STC 2N9W-26.8f and the graph of annual precipitation at Edwardsville. Water levels in the wells declined about 5 feet during the period.

Examples of water-level hydrographs within major pumping centers for the period 1962-1966 are shown in figures 13-15. Water levels within the major pumping centers fluctuate in response to changes in precipitation, river stage, and pumpage. The effects of below normal precipitation on water levels in wells located away from the Mississippi River are apparent.

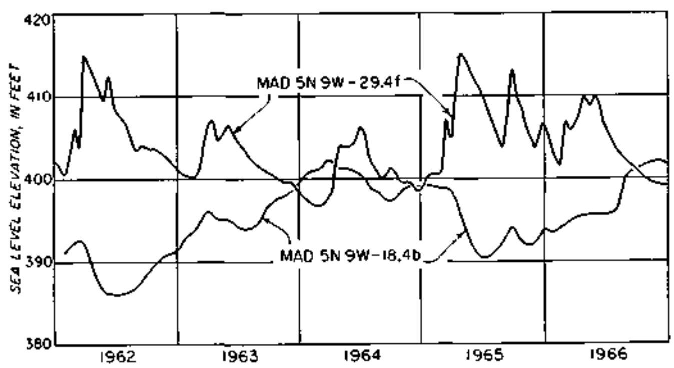

Figure 13. Water levels in the Alton area

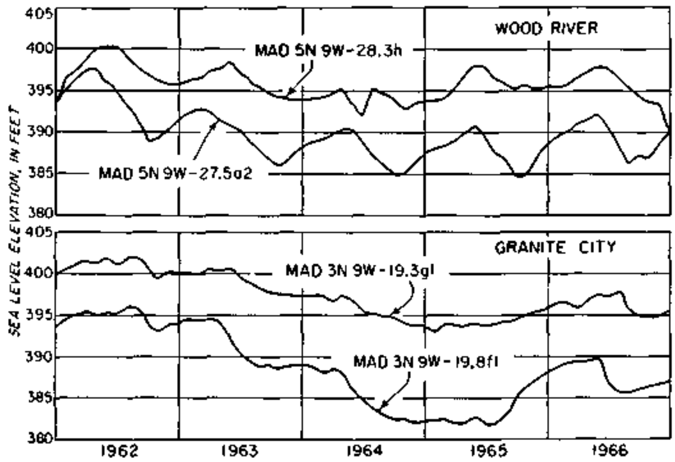

Figure 14. Water levels in the Wood River and Granite City areas

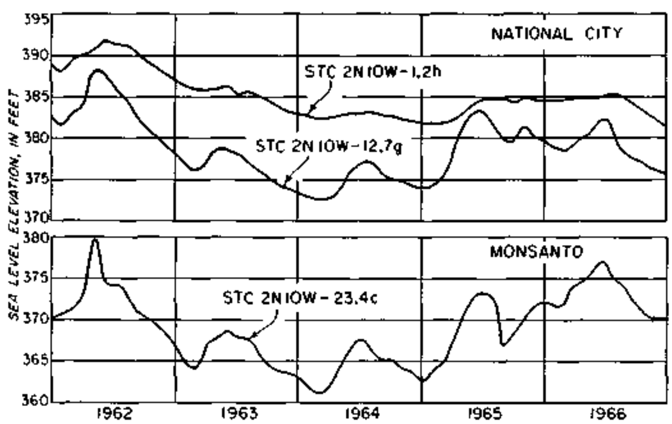

Figure 15. Water levels in the National City and Monsanto areas

Water levels in wells near the Mississippi River fluctuated several feet in response to large changes in river stage. Month-end river stages at St. Louis for the period are shown in figure 16.

Water levels in the major pumping centers, with the exception of the Granite City area and well 5N9W-18.4b in the Alton area, declined an average of 7 feet from early 1962 to early in 1964. The decline was attributed primarily to below normal precipitation and declining river stages. From early 1964 to the early summer of 1966 water levels recovered an average of 5 feet as river stages rose and conditions for recharge from precipitation became more favorable.

Water levels in the Granite City area (figure 14) from 1962 to 1965 declined as the result of below normal precipitation and an average increase in pumpage of 1.5 mgd per year. Water levels recovered late in 1965 because of a reduction in pumpage of 4.7 mgd, but then declined late in 1966 as pumpage increased 2.0 mgd.

Water levels in well 5N9W-18.4b in the Alton area recovered 16 feet from 1962 to 1964 largely as the result of a reduction in pumpage in the immediate vicinity.

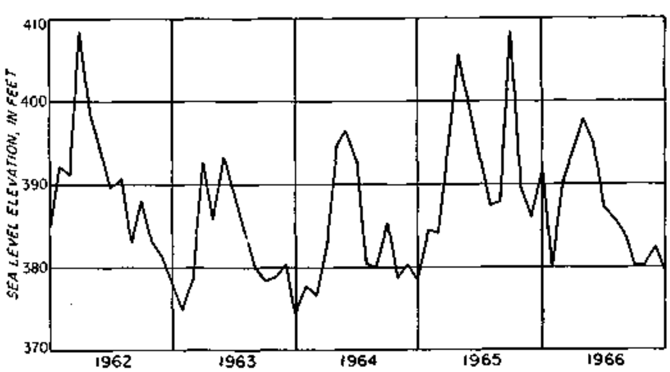

Figure 16. Month-end Mississippi River stages at St. Louis, 1962-1966

PIEZOMETRIC SURFACE

The water levels in 197 wells were measured during the third week in November 1966 when water levels were near minimum stages. Groundwater and surface-water level data collected are given in tables 2 and 3 and in the appendix. A piezometric surface map for November 1966 (figure 17) was prepared from the water-level data.

Table 2. Lake and Stream Elevations

Gage number	Location of gage	Elevation of measuring point (*feet above msl)*	Water-surface elevation (*feet above msl*) Nov. 1961	Nov. 1966
1	Highway bridge 1, NE cor, sec 16, T4N, R9W	444.36		413.81
2	Highway bridge 2, NW cor, sec 14, T4N, R9W	440.42	414.05	413.89
3	Highway bridge 3, NE cor, sec 14, T4N, R9W	441.38	414.11	413.98
4	Highway bridge 4, SE cor, sec 12, T4N, R9W	442.95	414.14	414.05
1	111. Route 203 bridge, NW cor, sec 5, T2N, R9W	415.30	393.04	394.50
2	Sand Prairie Road bridge, Canteen Creek, near center sec 35, T3N, R9W	418.04	400.39	401.44
3	Sand Prairie Road bridge, NW cor, sec 35, T3N, R9W	418.55	399.79	400.85
4	Hadley bridge, NW cor, sec 19, T3N, R8W	416.40	404.30	403.90
5	Black Lane bridge, Canteen Creek, near center sec 36, T3N, R9W	420.80	401.87	402.10
1	Mollenbrock bridge, Horseshoe Lake, SW cor, sec 14, T3N, R9W	414.24	404.30	403.74
	Chain of Rocks Canal (upper) SW cor, sec 14, T3N, R10W			398.97
	Chain of Rocks Canal (lower) NW cor, sec 23, T3N, R10W			382.10

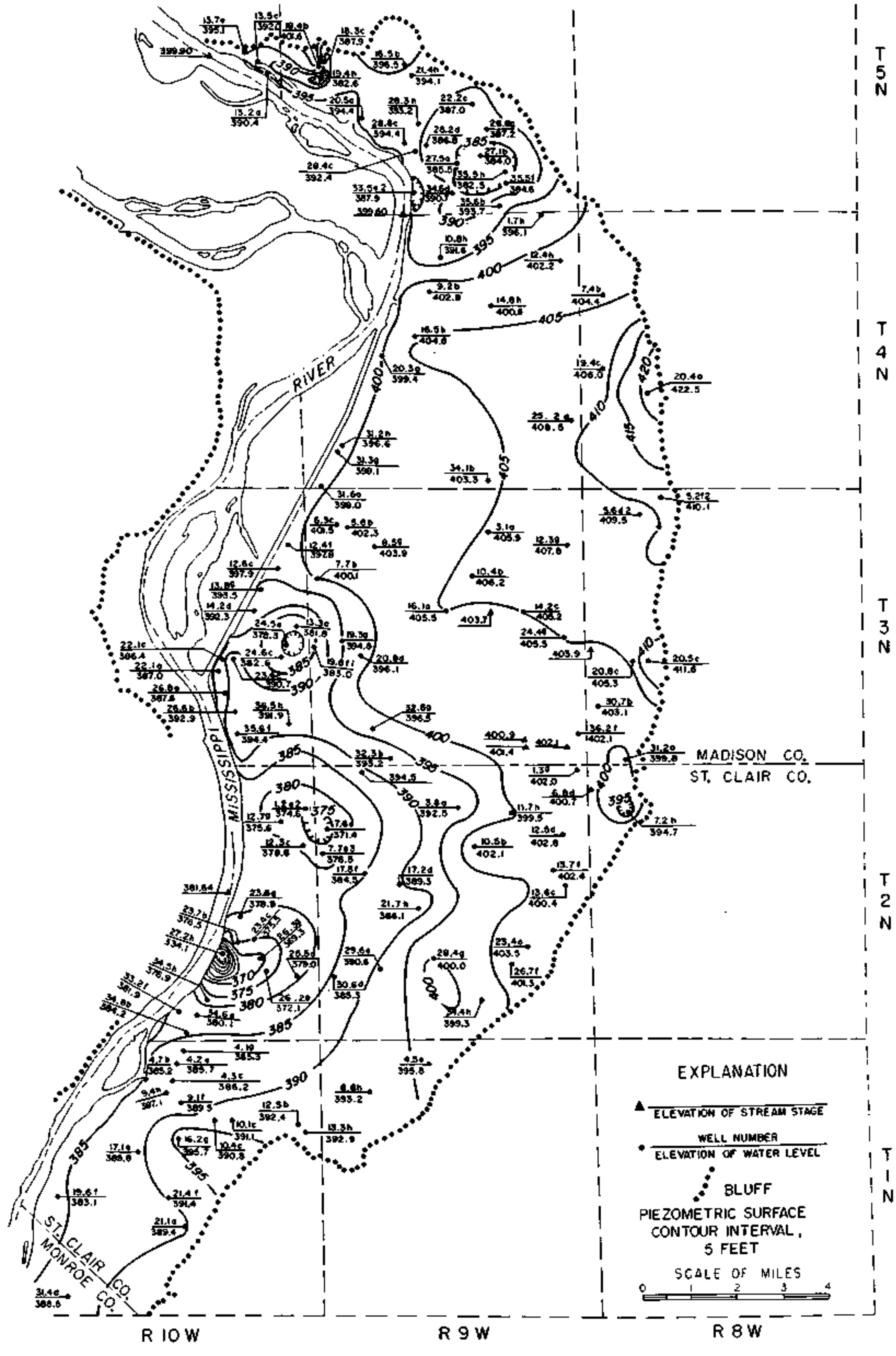

Figure 17. Approximate elevation of piezometric surface, November 1966

Table 3. Mississippi River Stages

Gage description	Mississippi River mile number	Water-surface elevations (feet) Nov. 30, 1961	Nov. 11, 1966
Lock and Dam No. 26 Alton, 111. (lower)	202.7	405.52	399.90
Hartford, 111.	196.8	404.26	399.60
Chain of Rocks, Mo.	190.4	399.00	396.41
Bissell Point, Mo.	183.3	394.20	*
St. Louis, Mo.	179.6	393.00	381.64
Engineer Depot, Mo.	176.8	392.40	379.68

*Discontinued l/l/65

The features of the November 1961 (figure 18) and November 1966 maps were compared. Except in the vicinity of the Monsanto area features of the two maps are similar. In November 1961 two cones of depression were located in the Monsanto area. Water levels were at elevations of 360 feet in the cone adjacent to the Mississippi River and 350 feet in the cone approximately 1.5 miles east. In 1966 a reduction in pumpage caused water levels away from the river to recover. Water levels in the cone adjacent to the river declined to an elevation of 335 feet primarily as the result of below normal precipitation and lower river stages.

The general pattern of flow of water in 1961 and 1966 was slow movement from all directions toward the cones of depression or the Mississippi River and other streams. The lowering of water levels in the Alton, Wood River, National City, and Monsanto areas that has accompanied withdrawals of groundwater has established hydraulic gradients from the Mississippi River toward pumping centers. Groundwater levels were below the surface of the river at places, and appreciable quantities of water were diverted from the river into the aquifer by the process of induced infiltration. However, the piezometric surface was above the river at other places. For example, southwest of the Granite City cone of depression water levels adjacent to the river were higher than the normal river stage and there was discharge of groundwater into the river.

The average slope of the piezometric surface in areas remote from pumping centers was 5 feet per mile in 1961 and 3.5 feet per mile in 1966. Gradients were steeper in the immediate vicinity of major pumping centers. The average slope of the piezometric surface in the immediate vicinity of the Monsanto cone of depression exceeded 30 feet per mile in 1961 and 1966. Gradients averaged 10

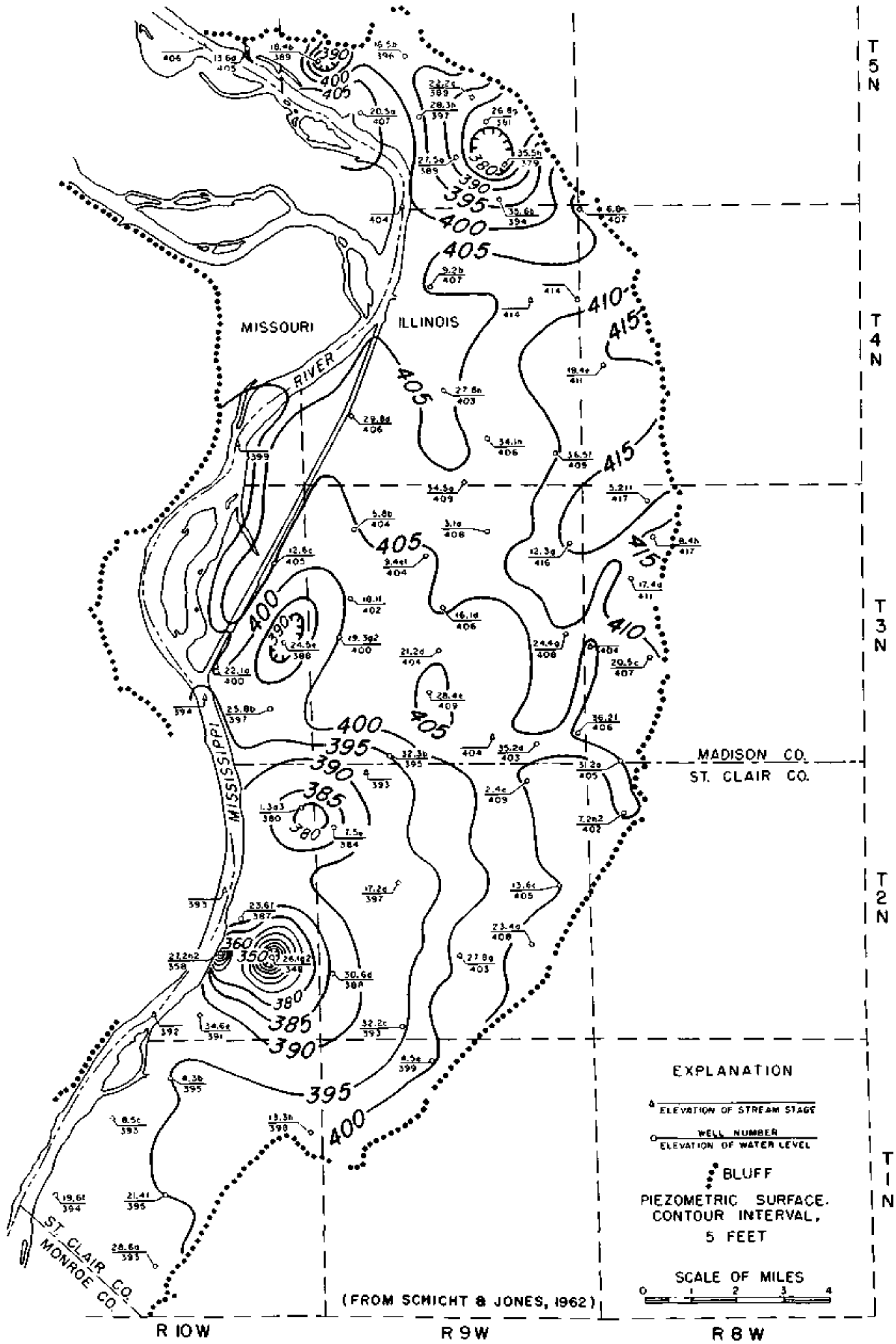

Figure 18. Approximate elevation of piezometric surface, November 1961

feet per mile in 1961 and 20 feet per mile in 1966 in the Alton cone of depression. Gradients averaged 10 feet per mile in the Wood River, Granite City, and National City cones of depression.

Along Canteen Creek and Cahokia Canal east of Horseshoe Lake, around the north and east sides of Horseshoe Lake, Long Lake, and Grand Marias State Park Lake, the piezometric surface in 1961 was higher than the surface-water elevation, and groundwater was discharged into these streams and lakes. In 1966 the piezometric surface was very near the same elevation as the water surfaces at these same locations. Below the confluence of Canteen Creek and Cahokia Canal south of Horseshoe Lake and the lower end of Horseshoe Lake, the piezometric surface in 1961 and 1966 was lower than the surface-water elevations at places where groundwater levels have declined as a result of heavy pumping. The surface of the water in the Cahokia Diversion Channel south of Wood River is kept above the piezometric surface at an elevation of 413 feet by a low water dam near the outlet of the channel. Surface-water levels are also controlled in the Chain of Rocks Canal by Lock No. 27 near Granite City and were higher in 1961 and 1966 than the piezometric surface adjacent to the canal.

In 1961 and 1966 the piezometric surface in the vicinity of Wood River near Alton and in the area of Prairie Du Pont Creek south of Monsanto was slightly higher than the surface of the streams. South of Prairie Du Pont Creek groundwater normally flows toward the Mississippi River.

In 1961 groundwater in the vicinity of Long Lake flowed northwest toward the Mississippi River between the northern end of the Chain of Rocks Canal and the outlet of the Cahokia Diversion Channel. In 1966 groundwater from the Long Lake area flowed west and southwest toward the Chain of Rocks Canal and the Granite City area.

Changes in Water Levels

The piezometric surface map for November 1961 was compared with the piezometric surface map for November 1966, and water-level changes were computed (Figure 19). The greatest water-level changes occurred in the five major pumping centers. Water levels in the Alton area declined 10 feet in an area near the Mississippi River because of low river stages and below normal precipitation. About 0.5 mile to the northeast of this area water levels rose in excess of 10 feet because of a reduction in pumpage. Water levels in the Wood River, Granite City, National City, and Caseyville areas declined 10 feet. Near the Mississippi River in the Monsanto area water levels declined 25 feet primarily because of low river stages and below normal precipitation. Approximately 1 mile east of this area water levels rose as a result of a reduction in pumpage. Water levels declined an average of 5 feet in areas generally unaffected by heavy pumpage.

Areas of Diversion

Areas of diversion of pumping centers in November 1961 and November 1966 are shown in figure 20. The boundaries of areas of diversion delimit areas within

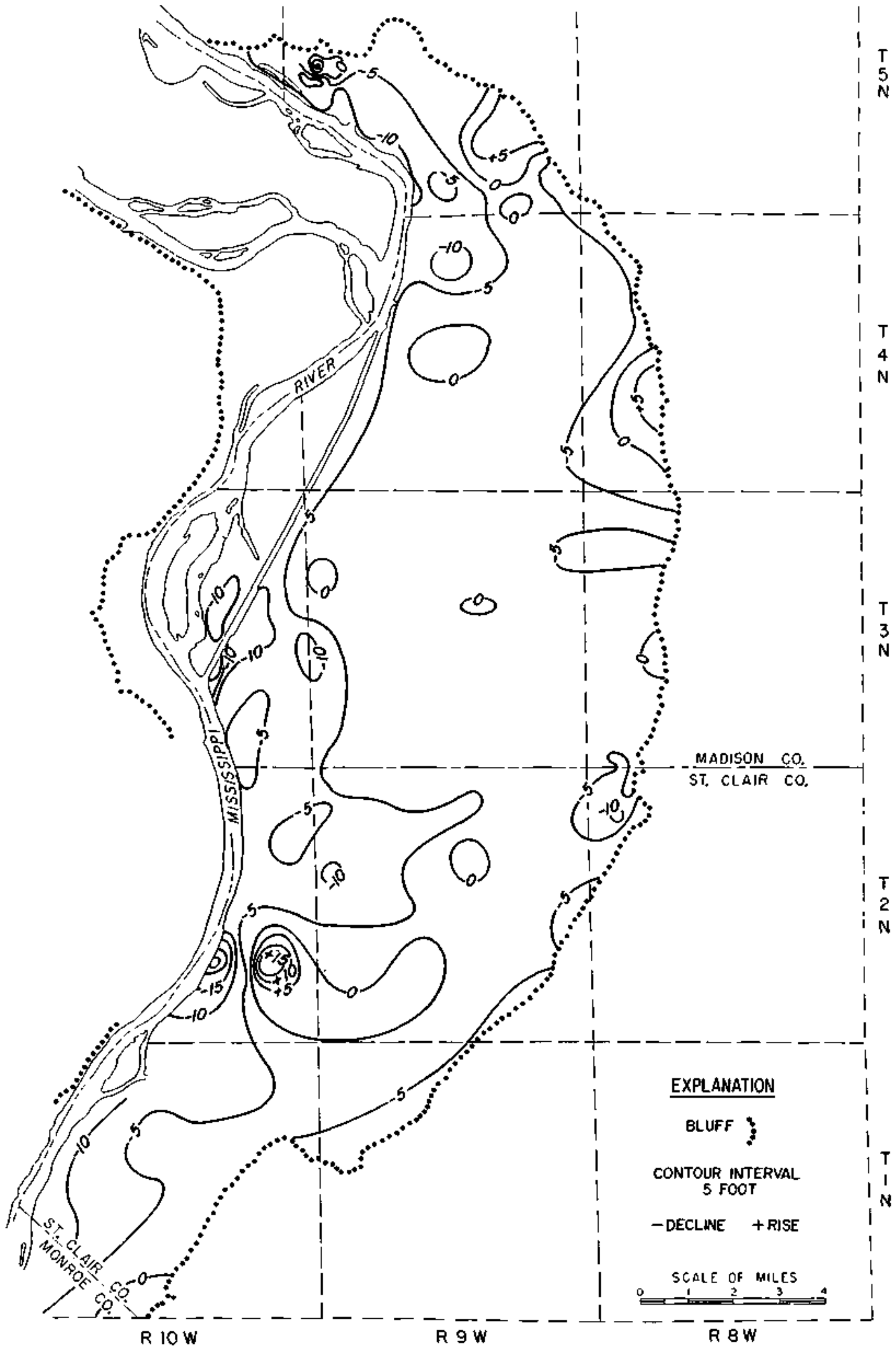

Figure 19. Estimated change in water levels, November 1961 to November 1966

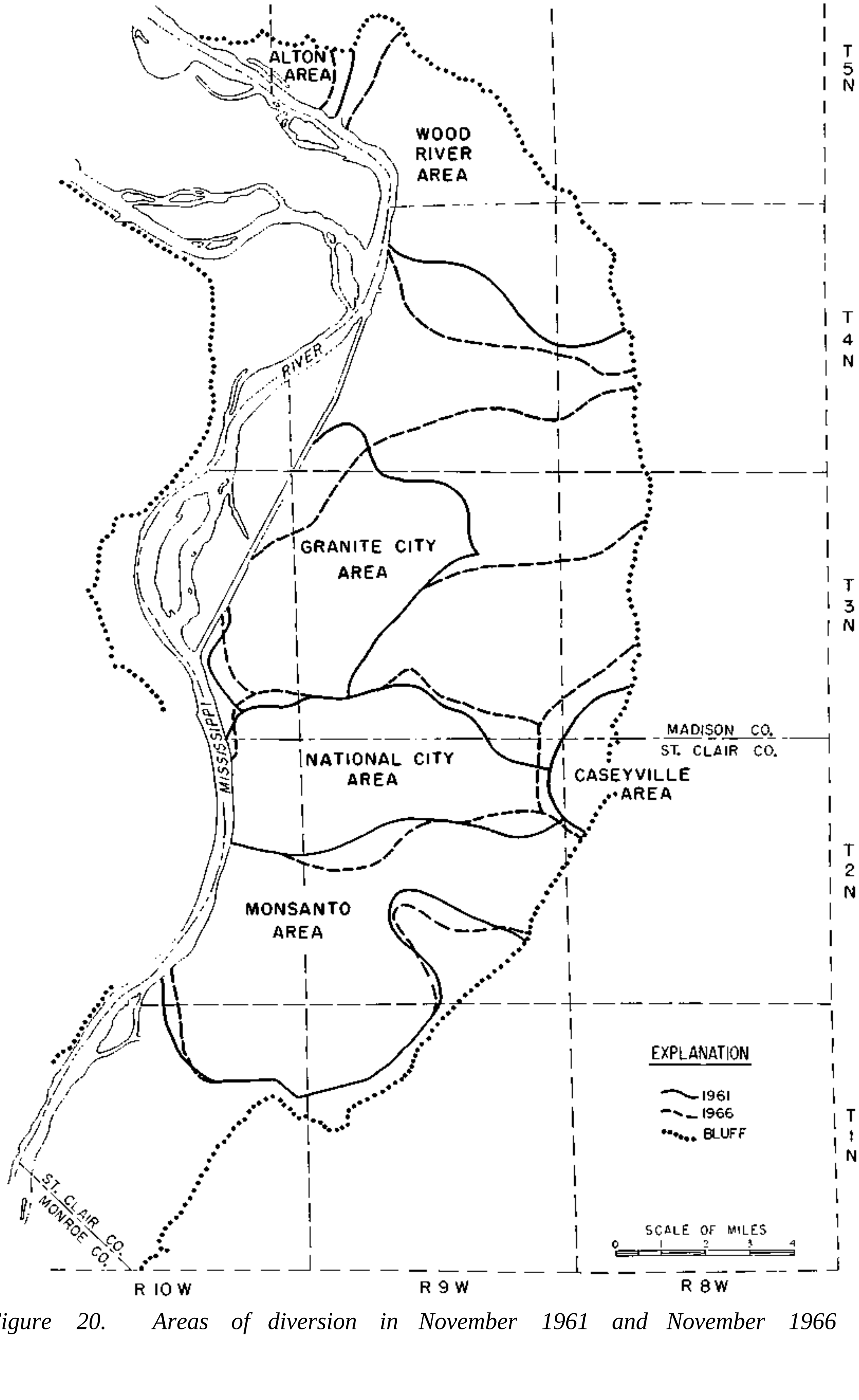

Figure 20. Areas of diversion in November 1961 and November 1966

which the general movement of groundwater is toward pumping centers. Diversion boundaries in all five major pumping centers and in the minor pumping center of Caseyville enlarged from 1961 to 1966 as shown in table 4 and figure 20. Increases in groundwater withdrawals and insufficient precipitation to recharge the groundwater aquifer caused cones of depression to deepen and enlarge in areal extent.

Table 4. Areas of Diversion

Pumping center	Diversion area (square miles) 1961	1966
Alton	2.07	2.54
Wood River	22.46	24.02
Granite City	21.95	39.93
National City	20.53	22.60
Monsanto	33.16	34.61
Caseyville	3.23	5.33

REFERENCES

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Schicht, R. J., and E. G. Jones. 1962. Ground-water levels and pumpage in East St. Louis area, Illinois, 1890-1961. Illinois State Water Survey Report of Investigation 44.

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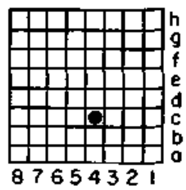
APPENDIX

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 1/8-mile squares. Each 1/8-mile square contains 10 acres and corresponds to a quarter of a quarter of a quarter section. A normal section of 1 square mile contains 8 rows of 1/8-mile squares; an odd-sized section contains more or fewer rows. Rows are numbered from east to west and lettered from south to north as shown in the diagram.



St. Clair County
T2N, R10W
sec. 23

The number of the well shown above is STC 2N10W-23.4c. 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. Any number assigned to the well by the owner is shown in parentheses after the location well number. The abbreviations for counties discussed in this report are:

Madison	MAD	Monroe	MON	St. Clair	STC

There are parts of the East St. Louis area where section lines have not been surveyed. For convenience in locating observation wells, normal section lines were assumed to exist in areas not surveyed.

Water-Level Data for Wells

Well number	Water-level elevation (*feet above msl*) Nov. 1961	Nov. 1966	Water-level change (*feet*) Nov. 1961 to Nov. 1966
MAD--			
5N10W-			
13.2a	402.77	390.4	-12.37
13.5c	404.80	392.0	-12.80
13.6d	405.43	392.4	-13.03
13.7e	408.74	395.1	-13.64
14.1e	409.81		
24.1h	402.43	391.4	-11.03
5N9W			
16.3a		392.87	
16.5b	396.45	396.47	+ 0.02
18.3c	384.40	387.94	+ 3.54
18.4b	389.00	401.60	+12.60
19.3c	405.60	395.5	-10.10
19.4h	392.46	382.58	- 9.88
19.6e	405.16	394.4	-10.76
19.6h		389.0	
19.7f	403.83	393.7	-10.13
19.8g	403.48	392.3	-11.18
20.5a	407.09	394.37	-12.72
21.4h		394.12	
22.2c	389.15	387.04	- 2.11
26.8g	381.39	387.18	+ 5.79
27.1b		383.98	
27.5a(1)	388.66	385.52	- 3.14
27.5a(2)		386.10	
28.2d	394.57	386.76	- 7.81
28.3h	396.58	393.22	- 3.36
28.4c	400.99	392.40	- 8.59
28.6d		395.32	
28.8e	406.62	394.40	-12.22
29.1e	407.18	396.70	-10.48
29.4f	407.07	395.39	-11.68
29.4g	406.27	394.75	-11.52
29.5g	407.43	392.48	-14.95
33.5e(1)	397.44	387.44	-10.00
33.5e(2)	400.89	387.89	-13.00
34.3d		384.50	
34.6a(1)		374.49	
34.6d	392.58	390.74	- 1.84
35.5f	381.55	384.55	+ 3.00
35.5h	378.53	382.53	+ 4.00
35.6b	394.48	393.69	- 0.79

Water-Level Data (Continued)

Well number	Water-level elevation (feet above msl) Nov. 1961	Nov. 1966	Water-level change (feet) Nov. 1961 to Nov. 1966
4N8W-			
6.8h	407.48		
7.4b	406.92	404.37	- 2.55
18.2e	412.99		
19.4e	41 1.23	406.04	- 5.19
20.3c	410.70		
20.4a		422.50	
20.4g	449.41	448.20	- 1.21
30.1f	410.05		
4N9W-			
1.7h	396.52	396.05	- 0.47
9.2b	407.23	402.94	- 4.29
10.8h	404.77	391.57	-13.20
12.4h		402.21	
13.1c(1)		406.93	
13.1c(2)	411.76		
14.8h	403.05	400.59	- 2.46
16.5b		404.60	
19.3b	403.05	396.04	- 7.01
20.3g	407.74	399.42	- 8.32
21.5h		408.03	
25.2d	411.95	408.52	- 3.43
25.8a		417.04	
27.8h	402.54	402.30	- 0.24
29.7b	406.06		
29.8d	405.79	399.62	- 6.17
30.1b	405.92		
31.2h	405.81	396.55	- 9.26
31.3g	405.90	399.07	- 6.83
31.6a	405.32	399.02	- 6.30
34.1h	406.29	403.30	- 2.99
34.5a	408.77		
4N10W-			
36.5f	408.75		
3N8W-			
5.2f(1)	416.65		
5.2f(2)	415.75	410.14	- 5.61
5.6d(2)		409.5	
6.1e	416.24		
8.4h(1)	417.40	411.73	- 5.67

Water-Level Data (Continued)

Well number	Water-level elevation (*feet above msl*) Nov. 1961	Nov. 1966	Water-level change (*feet*) Nov. 1961 to Nov. 1966
3N8W- (Continued)			
8.4h(2)		408.0	
8.8a	410.68		
17.4d	411.28	407.06	- 4.22
20.5c	407.44	411.61	+4.17
20.8c	409.26	405.25	- 4.01
29.3h		414.20	
30.7b	406.57	403.06	- 3.51
31.2a	404.74	399.83	- 4.91
3N9W-			
3. la	408.14	405.86	- 2.28
5.8b	404.47	402.31	- 2.16
6.3c	404.31	401.46	- 2.85
7.7b	397.98	400.08	+ 2.10
8.5g	405.53	403.93	- 1.60
9.4e	403.86	402.05	- 1.81
10.4b	408.34	406.17	- 2.17
12.3g	416.29	407.80	- 8.49
14.2c	408.50	405.20	- 3.30
16.1d	405.95	405.47	- 0.48
16.8a	404.12	404.12	0
17.2a		403.18	
18.1f	401 .60	399.44	- 2.16
19.3g(2)	399.57	394.75	- 4.82
19.8f(1)	393.22	382.98	-10.24
19.8f(2)	395.43		
20.2h	404.31	404.36	+ 0.05
20.7e(1)		398.42	
20.7e(2)	402.29	399.38	- 2.91
20.8d(1)	401.01	397.85	-3.16
20.8d(2)	400.96	396.06	- 4.90
20.8e(1)	401.48		
20.8e(2)	400.69	396.97	- 3.72
21.2d	403.84		
23.5g	402.30		
24.4g	408.20	405.48	- 2.72
28.4e	409.35	409.37	+ 0.02
32.3b	394.64	393.17	- 1.47
32.6g		396.51	
35.2d	403.28	399.62	- 3.66
35.5g	405.90		
36.2f	405.90	402.06	- 3.84

Water-Level Data (Continued)

Well number	Water-level elevation (*feet above msl*) Nov. 1961	Nov. 1966	Water-level change (*feet*) Nov. 1961 to Nov. 1966
3N10W-			
1.1c	405.06	398.71	- 6.35
12.4f	405.0	397.78	- 7.22
12.6c	404.83	397.01	- 7.82
13.3a	388.90	381.78	- 7.12
13.8g	401.13	393.53	- 7.60
14.1f	400.83	392.78	- 8.05
14.2d	401.17	392.26	- 8.91
14.3c	401.17	392.13	- 9.04
14.4b	401.01	392.20	- 8.81
22.1a	400.44	387.00	-13.44
22.1c	399.06	386.40	-12.66
23.6c	399.42	390.70	- 8.72
23.7c	398.70	387.70	-11.00
24.1c(1)	395.64		
24.1c(2)	395.43		
24.5e	387.61	378.25	- 9.36
24.6c	388.75	382.55	- 6.20
25.8b	397.45		
26.6b	398.77	392.90	- 5.87
26.7d	399.38	389.80	- 9.58
26.8e	399.13	388.30	-10.83
26.8h	399.24	387.60	-11.64
35.6f	401.98	394.40	- 7.58
36.5h	397.15	391.92	- 5.23
STC--			
2N8W-			
6.1d	403.52	399.40	- 4.12
6.8d	407.27	400.72	- 6.55
7.2h(1)		394.71	
7.2h(2)	401.65		
2N9W-			
1.3g		402.0	
2.4e	408.60	405.60	- 3.00
3.4g	403.31		
3.8a	398.32	392.50	- 5.82
7.5e	383.84	375.49	- 8.35
7.6e		371.35	
7.7a(1)		377.20	

Well number	Water-level elevation (*feet above msl*) Nov. 1961	Nov. 1966	Water-level change (*feet*) Nov. 1961 to Nov. 1966
2N9W- (Continued)			
7.7a(2)		376.54	
7.7a(3)		376.53	
10.5b		402.10	
11.7h	403.62	399.53	- 4.09
12.5d	407.46	402.84	- 4.62
13.6c	405.37	400.42	- 4.95
13.7f	407.18	402.37	- 4.81
14.5c	403.23	399.43	- 3.80
15.3b	400.10		
15.7a	398.71		
17.2d	396.52	389.29	- 7.23
17.8f	391.72	384.50	- 7.22
18.3a	392.49		
19.8e	386.73		
21.7h	392.68	386.12	- 6.56
23.4a	408.01	403.52	- 4.49
24.6e	407.44	402.15	- 5.29
26.7f	406.08	401.31	- 4.77
26.8f	405.77		
27.8g	403.20		
28.4g		400.00	
29.6e	392.63	390.64	- 1.99
30.6d	387.53	385.27	- 2.26
32.2c	393.14		
34.4h	402.76	399.32	- 3.44
2N10W-			
1.2h	388.47		
1.2a(1)		374.63	
1.2a(2)		374.55	
1.3a(3)	380.06		
12.3c	382.00	379.76	- 2.24
12.3g		375.60	
12.7g	383.68	375.73	- 7.95
23.4c	378.35	375.50	- 2.85
23.6f	386.84	378.30	- 8.54
23.6g	392.09	378.90	-13.19
23.7a	381.19	373.50	- 7.69
23.7b	385.60	376.50	- 9.10
25.5d		379.00	
25.6e	369.40	377.00	+ 7.60
26.1g(1)		372.04	

Well number	Water-level elevation (feet above msl) Nov. 1961	Nov. 1966	Water-level change (feet) Nov. 1961 to Nov. 1966
2NI0W- (Continued)			
26.1g(2)	347.64	371.24	+23.60
26.2e	351.20	372.12	+20.92
26.3g		369.33	
26.5h	374.31	372.48	- 1.83
27.2g		330.98	
27.2h(1)		336.00	
27.2h(2)	357.75	334.11	-23.64
33.2f	393.90	381.85	-12.05
34.5h	389.68	376.90	-12.78
34.6e	390.61	380.10	-10.51
34.7c	391.33	383.60	- 7.73
34.8b	391.82	384.20	- 7.62
1N9W-			
4.5e	399.09	395.80	- 3.29
6.2a	395.37		
8.8h		393.17	
1N10W-			
4.1g	392.86	385.30	- 7.56
4.2e	393.60	385.70	- 7.90
4.3b	394.57	386.70	- 7.87
4.3c	394.33	386.20	- 8.13
4.7b	394.08	385.20	- 8.88
8.2h	393.93	383.0	-10.93
8.5c	393.19	383.8	- 9.39
8.7a	394.41	385.6	- 8.81
9.1f	396.01	389.53	- 6.48
9.2h	395.93	388.85	- 7.08
9.4h	394.14	387.1	- 7.04
10.1c	396.21	391.09	- 5.12
10.4c	396.12	390.84	- 5.28
12.5b	397.70	392.44	- 5.26
13.3h	398.14	392.85	- 5.29
16.2g	397.28	395.74	- 1.54
17.1e	392.58	389.82	- 2.76
19.6f	393.67	383.10	-10.57
21. la	392.99	389.44	- 3.55
21.4f	395.24	391.38	- 3.86
28.6a	392.53		
30.6h	393.46	382.40	-11.06
32.3e	390.81	390.86	+ 0.05

Water-Level Data (Concluded)

Well number	Water-level elevation (*feet above msl*) Nov. 1961	Nov. 1966	Water-level change (*feet*) Nov. 1961 to Nov. 1966
MON--			
1N10W-			
30.8b	393.67	382.90	-10.77
31.4d	393.15	388.45	- 4.70