ISWS/CIR-170/88

Circular 170

STATE OF ILLINOIS

DEPARTMENT OF ENERGY AND NATURAL RESOURCES

Ground-Water Investigations for Siting the Superconducting Super Collider in Northeastern Illinois

by ADRIAN P. VISOCKY and MARCIA K. SCHULMEISTER

ILLINOIS STATE WATER SURVEY

CHAMPAIGN

1988

CIRCULAR 170

Ground-Water Investigations for Siting the Superconducting Super Collider in Northeastern Illinois

by ADRIAN P. VISOCKY and MARCIA K. SCHULMEISTER

Title: Ground-Water Investigations for Siting the Superconducting Super Collider in Northeastern Illinois.

Abstract: The Superconducting Super Collider (SSC) study area comprises 36 townships in Kane County and portions of Cook, De Kalb, Du Page, Kendall, and Will Counties. An inventory and mass measurement of water levels in 389 private domestic wells was conducted during the summer of 1986. Potentiometric surface maps constructed from these data indicate that the general direction of ground-water movement is to the southeast and toward cones of depression resulting from subdivision pumpage in north-central Kane County. Monthly water-level measurements have been made since December 1984 at 26 individual piezometers and at nine nested piezometers. The data show that vertical head gradients of from 0.14 to 3.35 feet per foot exist between various aquifers. An analysis of water samples collected during the mass measurement and a review of water analyses from public water supply wells indicate that the ground water likely to be encountered at the SSC site is a calcium-magnesium bicarbonate. The water is moderately mineralized and would require softening for domestic uses. Ground-water use projections for the study area indicate that total pumpage from the 36 townships will be nearly 72 mgd by the year 2025.

Reference: Visocky, Adrian P., and Marcia K. Schulmeister. Ground-Water Investigations for Siting the Superconducting Super Collider in Northeastern Illinois. Illinois State Water Survey, Champaign, Circular 170, 1988.

Indexing Terms: Bedrock aquifers, ground water, ground-water movement, head gradients, hydrogeology, Illinois, piezometers, potentiometric surface maps, Superconducting Super Collider, water chemistry, water levels, water quality, water use, wells.

STATE OF ILLINOIS
HON. JAMES R. THOMPSON, Governor

DEPARTMENT OF ENERGY AND NATURAL RESOURCES
DON ETCHISON, Ph.D., Director

STATE WATER SURVEY DIVISION
RICHARD G. SEMONIN, Chief

2204 GRIFFITH DRIVE
CHAMPAIGN, ILLINOIS 61820

1988

Printed by authority of the S??te of Illinois

(3-88-2000)

Funds derived from grants and contracts administered by
the University of Illinois were used to produce this report.

CONTENTS

Concluded on next page

GROUND-WATER INVESTIGATIONS FOR SITING THE SUPERCONDUCTING SUPER COLLIDER **IN NORTHEASTERN ILLINOIS**

by Adrian P. Visocky and Marcia K. Schulmeister

ABSTRACT

The Superconducting Super Collider (SSC) study area comprises 36 townships in Kane County and portions of Cook, De Kalb, Du Page, Kendall, and Will Counties. An inventory and mass measurement of water levels in 389 private domestic wells was conducted during the summer of 1986. Potentiometric surface maps constructed from these data indicate that the general direction of ground-water movement is to the southeast and toward cones of depression resulting from subdivision pumpage in north-central Kane County. Monthly water-level measurements have been made since December 1984 at 26 individual piezometers and at nine nested piezometers. The data show that vertical head gradients of from 0.14 to 3.35 feet per foot exist between various aquifers. An analysis of water samples collected during the mass measurement and a review of water analyses from public water supply wells indicate that the ground water likely to be encountered at the SSC site is a calcium-magnesium bicarbonate. The water is moderately mineralized and would require softening for domestic uses. Ground-water use projections for the study area indicate that total pumpage from the 36 townships will be nearly 72 mgd by the year 2025.

INTRODUCTION

In 1983 the U.S. Department of Energy proposed the construction of the Superconducting Super Collider (SSC) --an atomic particle accelerator whose innovative high-speed design would allow the United States to remain a world leader in high-energy physics research. In response to a call for suitable building sites for the SSC, the Illinois Department of Energy and Natural Resources was designated the lead agency to work, on a siting investigation. Consequently, the State Scientific Surveys and State Museum have examined the possibility of constructing the SSC in the vicinity of the Fermi National Accelerator Laboratory (Fermilab) at Batavia. Installing the SSC at the Fermi site would eliminate the expense of an "injector" (which already exists at Fermilab) from overall construction costs. A 36-township area west of Fermilab was chosen for the detailed siting study, which was to include careful evaluation of environmental and social constraints. The accelerator design calls for an elliptical-shaped ring, 53 miles in circumference, to be housed in an underground tunnel bored through the Galena dolomite.

This report is primarily a compilation of results of field work conducted by the State Water Survey for the SSC siting study. Although the collection of hydrologic data was initiated for engineering purposes, it is also important as a means of characterizing ground-water systems. Through water-level measurements, aquifer tests, and chemical analyses of water samples, relationships among the various aquifers typifying northeastern Illinois can be determined.

Most of the hydrologic data acquired by the State Water Survey for this study was obtained from water wells. Private wells were used for determining water-level elevations and collecting water samples for chemical analysis. Test holes, drilled especially for the study by the State Geological Survey, were also used for determining water-level elevations and conducting an aquifer test.

In addition to conducting field-based hydrologic studies, the Water Survey also assessed current ground-water pumpage in the study area and estimated future pumpages. Water required by an SSC facility for cooling and domestic uses would, in all probability, be supplied by local ground-water resources. For this reason, it is important from a resource-management perspective to understand both existing and projected pumpage volume and areal distribution. Data for this effort were obtained from the Illinois Water Inventory Program and the Illinois Bureau of the Budget.

Data from Private Wells

In the summer of 1986 Water Survey personnel inventoried and measured water levels in wells finished near the anticipated elevation of the proposed SSC tunnel. Water levels of wells at various other elevations were also measured. The diversity of the data that were collected affords an opportunity for studying and speculating about possible interrelationships among hydrostratigraphic units. The data are used in this report to define potentiometric surfaces of several of the major aquifers in the study area.

Water samples were obtained from one test well and ten private wells for complete inorganic mineral analysis. The variability in depth and casing records for the wells sampled was informative from a chemical standpoint, in that it allows for a better understanding of hydrochemical interactions among aquifers. The results of these analyses were supplemented with chemical analyses from selected municipal wells.

Significance and Construction of Test Holes

Test holes were drilled under the direction of the State Geological Survey for the purpose of providing both hydrologic and geologic information about the site. During the fall of 1984, nine test holes were drilled, and seven (F-1, F-2, F-3, F-5, F-6, F-7, and F-9) were completed as "piezometers" (see discussion below), with 1-inch PVC casing installed and the bottom 5 feet slotted. During the spring of 1985, an additional eight boreholes were drilled and completed as piezometers (F-10 through F-17). In these wells the bottom 20 feet of casings were slotted. Since at that time the target elevation of the proposed SSC tunnel was 400 feet (MSL), all but one of the piezometers were finished at an approximate elevation of 400 feet (F-13 was finished in the Maquoketa Group at an elevation of 713 feet). During the summer of 1986, piezometers S-18 through S-22 were constructed, and that fall, numbers S-23, S-24, S-26, S-27, S-28, and S-30 were added. These piezometers were constructed by using 1-1/2-inch PVC casing with 10 feet of screen at the bottom. The elevations of these piezometers ranged from 274 to 349 feet, because modifications of the proposed tunnel design called for new target elevations.

The final series of observation wells for the SSC study was completed in early 1987 with the construction of three 8-inch-diameter experimental boreholes near Kaneland (SSC-1), Fermilab (SSC-2), and Big Rock (SSC-3). An aquifer test conducted at the Kaneland test well is described elsewhere. Each well was completed with three nested piezometers installed within the borehole and was grouted so that the piezometers were open to three zones separated vertically by about 100 feet.

Table 1 summarizes the locations and construction features of the piezometers and indicates the geologic units in which the piezometers are set. The well-numbering system used in this report is described in Appendix 1. The geographical distribution of the piezometers is shown in figure 1.

Hydrologic data are obtained by the Water Survey through monthly measurements of water levels in these wells. The authors recognize that a strict definition of the term "piezometer" refers to a well open to a discrete point. This term, however, has been extended to the SSC wells, because the open interval of each well is small compared to the thickness of the geologic unit penetrated. In this report the authors have chosen to use the terms "piezometers" and "wells" interchangeably, since within the vertical scale of the geologic units, the distinction is not important. The monthly water levels are discussed thoroughly in this report, as they were used to construct hydrographs and some portions of potentiometric surfaces. The geologic information resulting from the drilling is presented in detail by Kempton et al. (1987a,b) and in unpublished State Geological Survey data.

Through a pressure-testing technique known as packer testing, hydraulic conductivities were measured by the State Geological Survey along 20-foot intervals in each of the boreholes. Packer test results are not presented here but are a useful interpretive tool in most hydrologic investigations. The reader is referred to Kempton et al. (1987a,b) and to unpublished Geological Survey data for detailed results of those tests and for other geological data.

Table 1. Locations and Construction Features of SSC Piezometers, and Geologic Units in Which They Are Set

Piezometer	Location	Measuring pt. elev. (MSL)	Piez. depth (ft)	Piez. elev. (ft) MSL	Diameter (in)	Screen or slot length (ft)*	Geologic unit	Remarks
F-1	DUP39N9E-20.4b	739.5	347	392.5	1.0	5	Maquoketa	
F-2	DUP40N9E-17.1d	785.5	382	403.5	1.0	5	Galena	
F-3	KNE40N8E-2.6b	702.2	311	391.2	1.0	5	Galena	Plugged
F-5	DEK39N5E-1.8b	865.6	465	400.6	1.0	5	Platteville	Plugged
F-6	KEN37N8E-23.3f	711.9	305	406.9	1.0	5	Maquoketa	
F-7	KNE39N6E-20.1h	796.3	394	402.3	1.0	5	Galena	
F-9	DEK41N5E-10.1a	916.9	490	426.9	1.0	5	Platteville	Plugged
F-10	KNE38N8E-25.4f	706.4	338	368.4	1.0	20	Galena	
F-11	DEK38N5E-14.5c	731.3	350	381.3	1.0	20	Platteville	
F-12	KNE40N6E-10.5b	872.0	466	406.0	1.0	20	Platteville	
F-13	KNE40N6E-10.5b	870.0	157	713.0	1.0	20	Maquoketa	
F-14	DEK40N4E-16.1b	870.8	478	392.8	1.0	20	Platteville	
F-15	KNE41N8E-30.8d	848.0	455	393.0	1.0	20	Galena	Plugged
F-16	KEN37N7E-3.6a	659.5	262	397.5	1.0	20	Galena	
F-17	DEK38N5E-27.5h	743.3	349	394.3	1.0	20	Platteville	Plugged
S-18	KEN37N8E-9.4a	656.0	355	301.0	1.5	10	Galena	
S-19	KEN37N7E-16.1h	646.0	297	349.0	1.5	10	Galena	
S-20	KEN37N8E-2.1f	717.0	416	301.0	1.5	10	Galena	
S-21	KEN37N8E-7.1h	648.0	304	344.0	1.5	10	Galena	
S-22	KNE38N6E-26.6d	663.0	371	292.0	1.5	10	Galena	
S-23	KNE39N6E-34.1f	754.0	474	280.0	1.5	10	Platteville	
S-24	KNE40N7E-22.6d	903.0	605	298.0	1.5	10	Platteville	
S-26	KNE39N6E-14.8c	815.0	503	312.0	1.5	10	Platteville	
S-27	KNE40N8E-20.2b	739.0	465	274.0	1.5	10	Platteville	
S-28	DUP38N9E-5.7a	731.0	435	296.0	1.5	10	Galena	
S-30	KNE40N6E-36.1c	883.0	545	338.0	1.5	10	Platteville	
Kaneland Nested Piezometers:								
SSC-1-1	KNE39N6E-3.4d	841.0	421	420.0	1.5	10	Galena	
SSC-1-2	KNE39N6E-3.4d	841.0	521	320.0	2.0	10	Platteville	
SSC-1-3	KNE39N6E-3.4d	841.0	640	201.0	1.5	10	Ancell	
Fermilab Nested Piezometers:								
SSC-2-1	DUP39N9E-32.8f	753.0	317	436.0	1.5	10	Maquoketa	
SSC-2-2	DUP39N9E-32.8f	753.0	417	336.0	2.0	10	Galena	
SSC-2-3	DUP39N9E-32.8f	753.0	571	182.0	1.5	10	Platteville	
Big Rock Nested Piezometers:								
SSC-3-1	KNE38N6E-23.2h	688.0	277	411.0	1.5	10	Galena	
SSC-3-2	KNE38N6E-23.2h	688.0	377	311.0	2.0	10	Platteville	
SSC-3-3	KNE38N6E-23.2h	688.0	477	211.0	1.5	10	Platteville	

Numbers F-1 through F-17 were installed with slotted pipe, rather than screen.

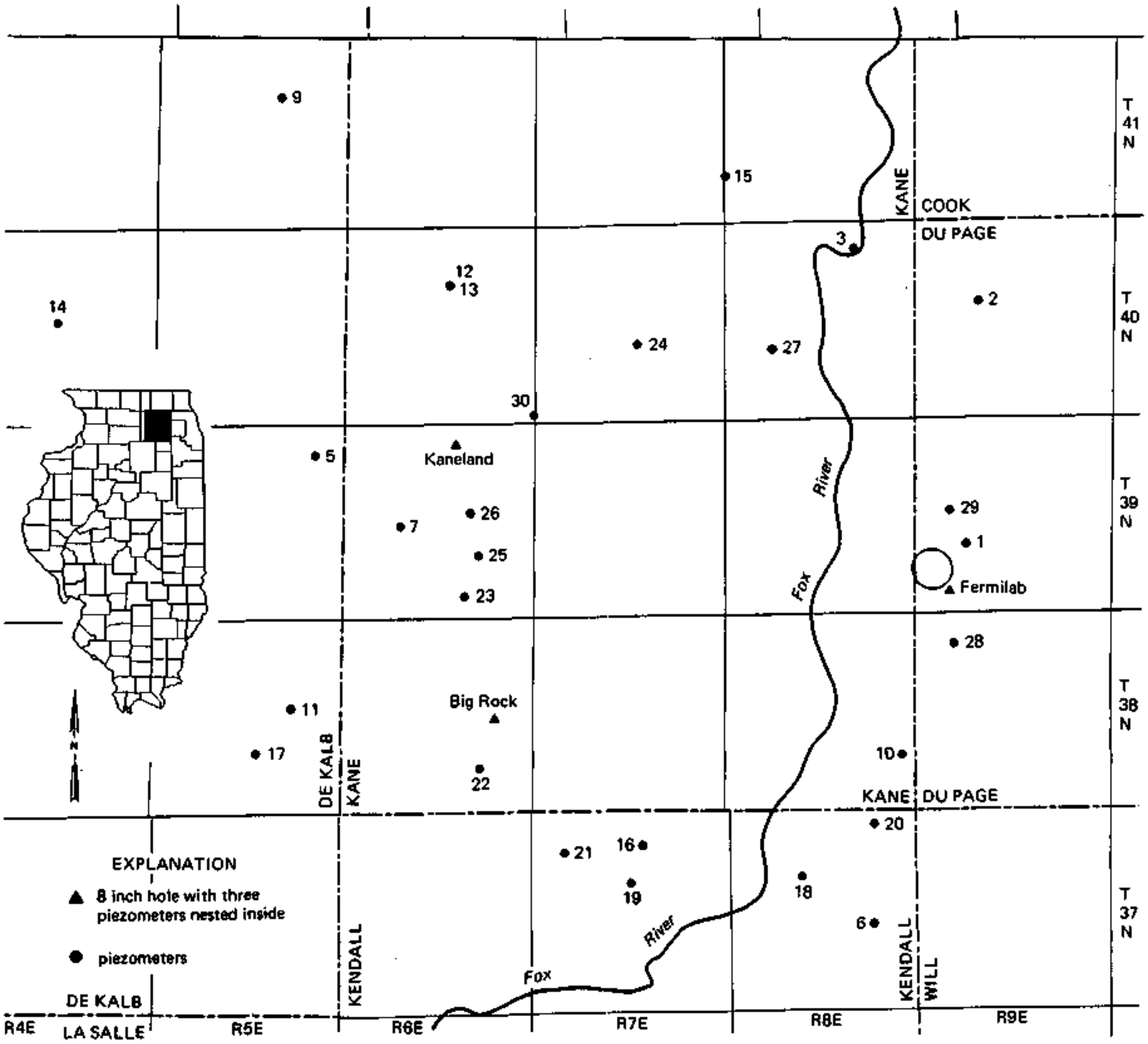


Figure 1. Locations of piezometers

Acknowledgments

This project was funded by the Illinois Department of Energy and Natural Resources. The authors wish to acknowledge the following individuals for their roles in this effort.

The project was conducted under the general supervision of Ellis W. Sanderson, Head of the Ground-Water Section at the State Water Survey, who also made a technical review of the final report. Robert Kay, employed at the time in the Northern Field Office of the State Water

Survey, assisted in the well inventory and mass measurement of water levels in the summer of 1986. Our deep appreciation also is extended to the many citizens of De Kalb, Du Page, Kane, and Kendall Counties who cooperated with us on that effort. Special thanks go to Robert Vaiden, Anne Graese, William Dixon, and Brandon Curry of the State Geological Survey, who were helpful in providing numerous cross sections and field data from their own investigations, and to John Kempton of that same agency for his continual encouragement and advice during the preparation of this report. Until David Schumacher was hired in February 1987 to conduct the monthly waterlevel measurements, this task was faithfully and consistently performed by Robert Sasman, Scott Ludwigs, and Curtis Benson of the Northern Field Office. Ludwigs and Sasman also collected the field data during the special aquifer test on the 8-inch test well at Kaneland.

This report was typed by Pamela Lovett and Patti Hill. Artwork was prepared by John Brother, Linda Riggin, and Lynn Weiss; and Gail Taylor edited the report.

HYDROGEOLOGY

Geologic Description of the Study Area

The geology of the SSC study area has been described by Willman et al. (1975) and in greater detail by Kempton et al. (1985, 1987a, 1987b). The following description is taken largely from those reports. Rocks of the Silurian and the upper half of the Ordovician Systems are most relevant to this study and are therefore discussed in greatest detail.

The site is characterized by glacially deposited material lying above Paleozoic bedrock and ranging in thickness from 0 to greater than 400 feet. The configuration of the bedrock units in the area is a result of ancient tectonic activity at the Wisconsin Arch to the north and west, and at the Sandwich Fault Zone to the southwest. The geology of the bedrock surface is shown in figure 2.

Glacial Drift

Glacially derived sediments of Quaternary age overlie an erosional topography on Paleozoic dolomites and shale. The drift thickness varies from 0 to greater than 400 feet throughout the area (figure 3), filling bedrock valleys in some places and supporting glacial landforms in others. The stratigraphic succession of these unconsolidated materials is described completely by Kempton et al. (1985). Borehole descriptions of the SSC test wells show that variations in lithologies and in their thicknesses exist throughout the drift.

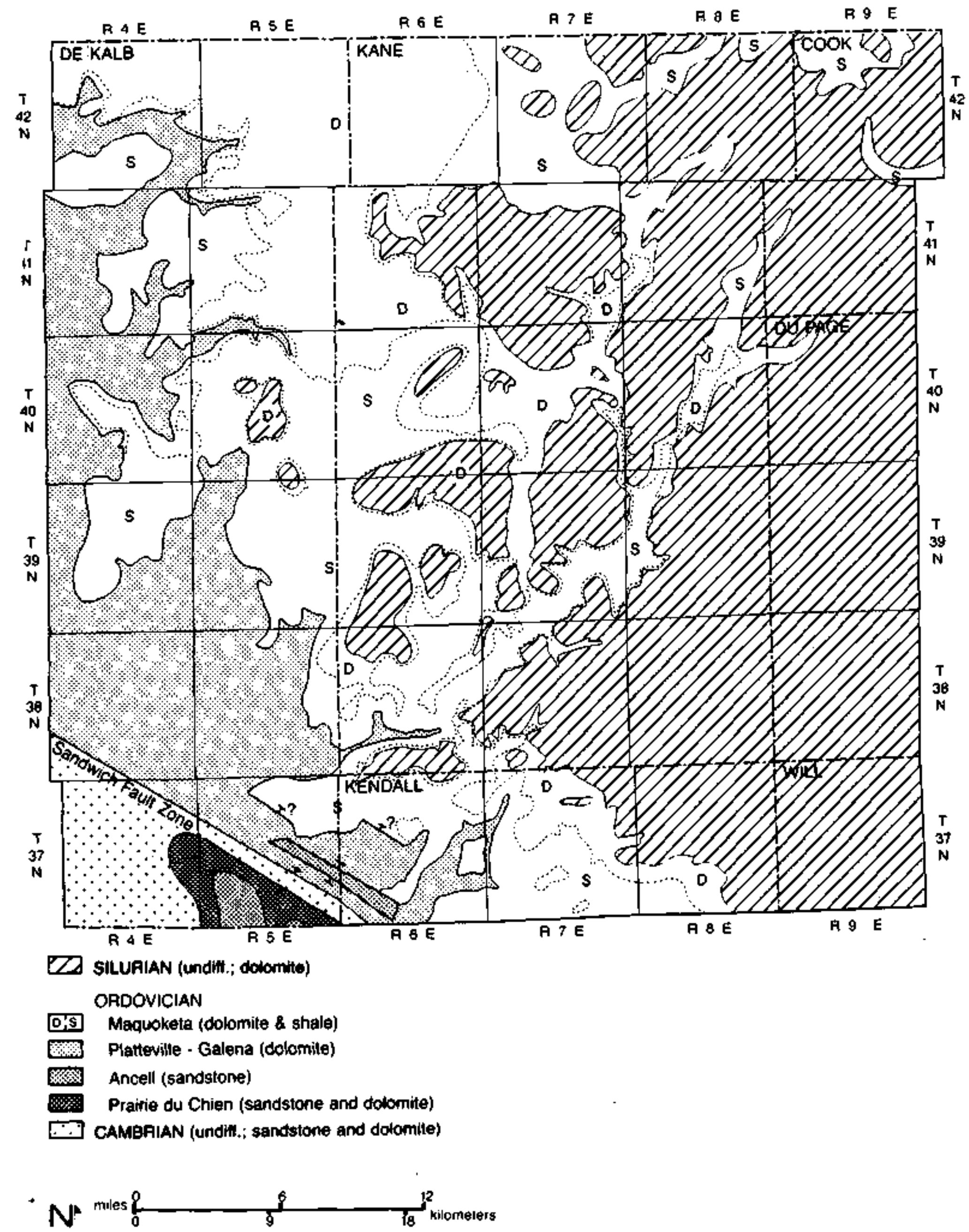


Figure 2. Areal geology of the bedrock surface in the study area (After Kempton et al., 1985)

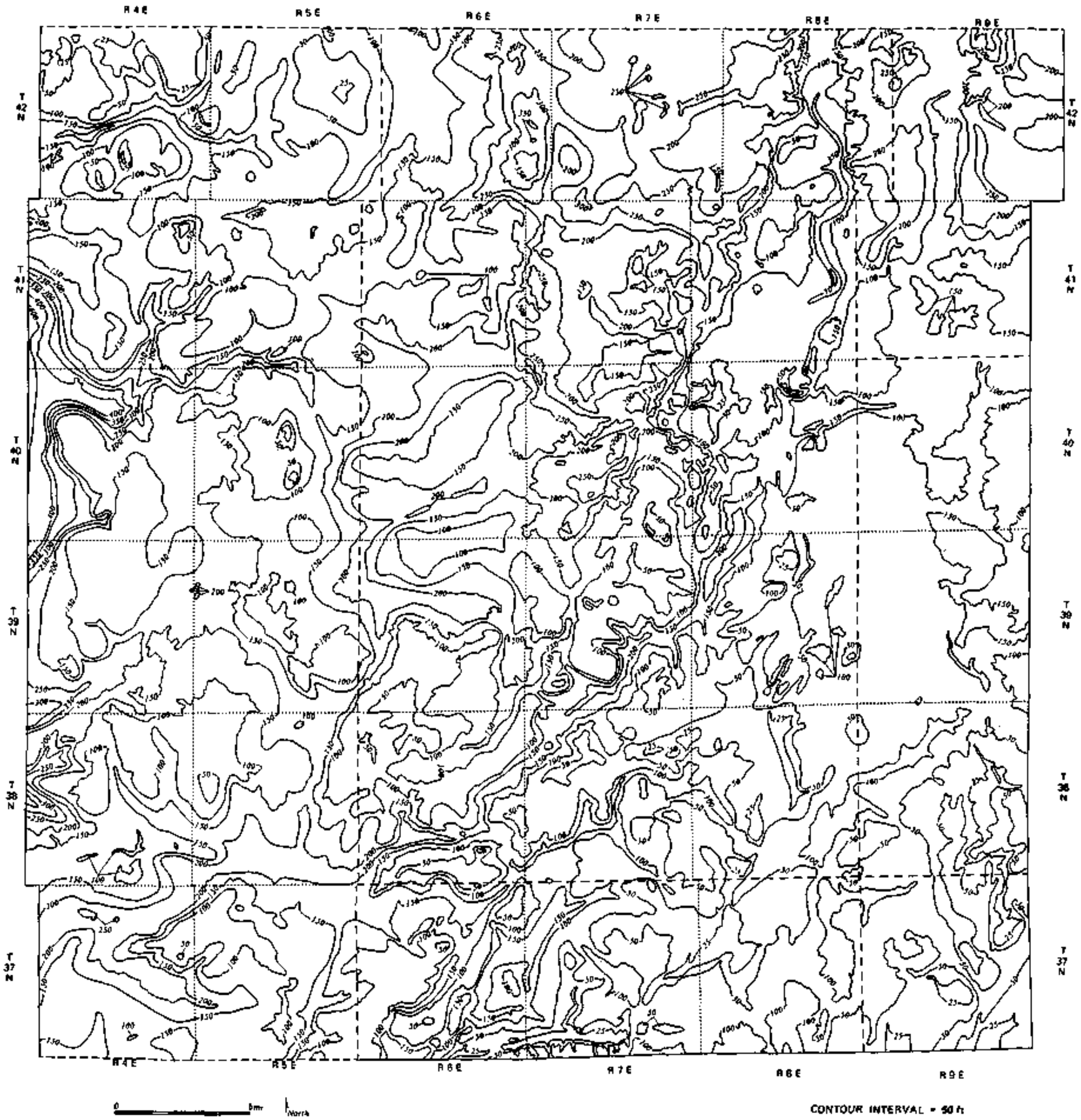


Figure 3. Thickness of glacial drift (Prepared by B. B. Curry and R. C. Vaiden, State Geological Survey, 1987)

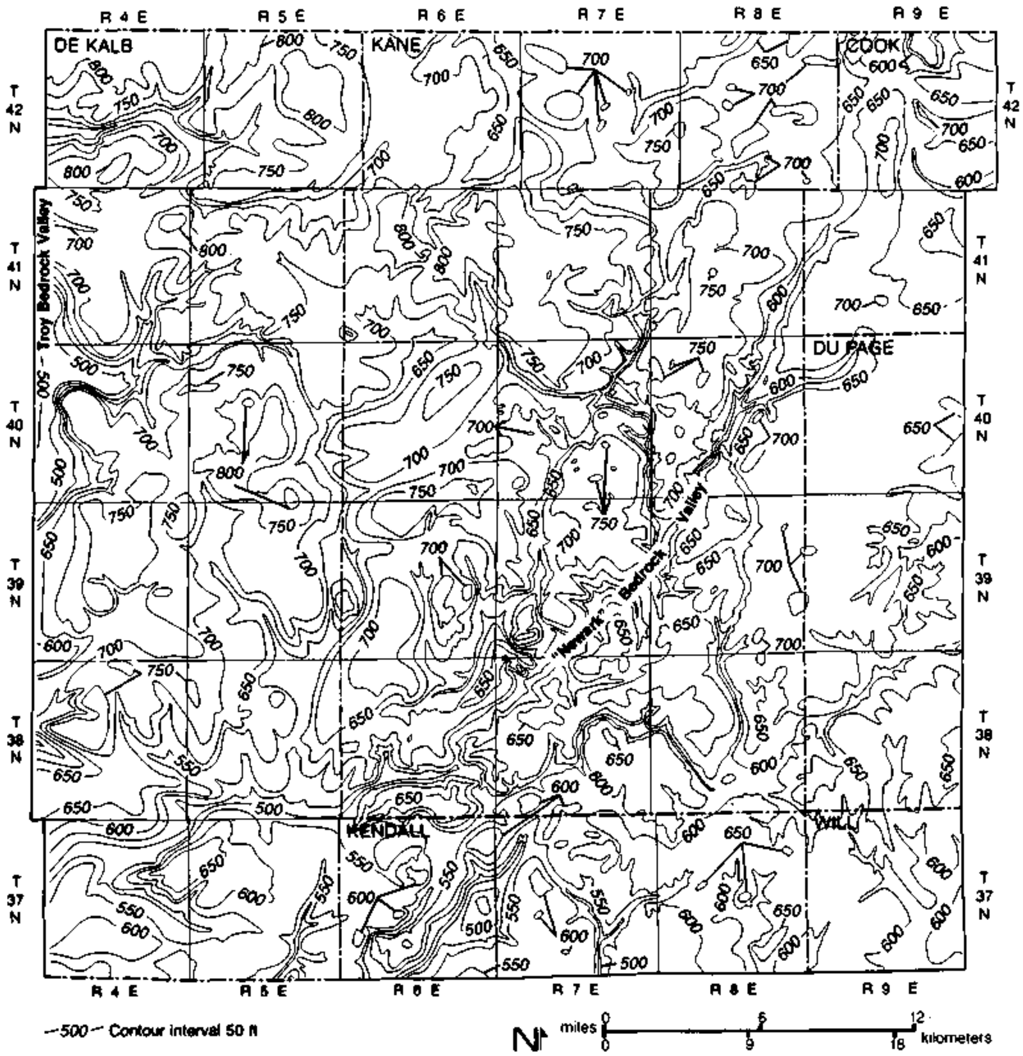


Figure 4. *Topography of bedrock surfaces (Prepared by R. C. Vaiden and B. B. Curry, State Geological Survey, 1987)*

Bedrock

The highly irregular bedrock surface (figure 4) is a result of pre-Pleistocene erosion. It is commonly dissected by pre-glacial river valleys, the largest of which extends along the eastern and southern boundaries of Kane County. Bedrock above the Pre-Cambrian basement consists of Cambrian, Ordovician, and Silurian sedimentary strata, with a combined thickness of approximately 4000 feet (figure 5). The rock units dip approximately 0.1 to 0.2 degree to the southeast, with the Ordovician Galena Group exposed at the bedrock surface in De Kalb and northwestern Kendall Counties. In western Kane County these dolomite units are over-

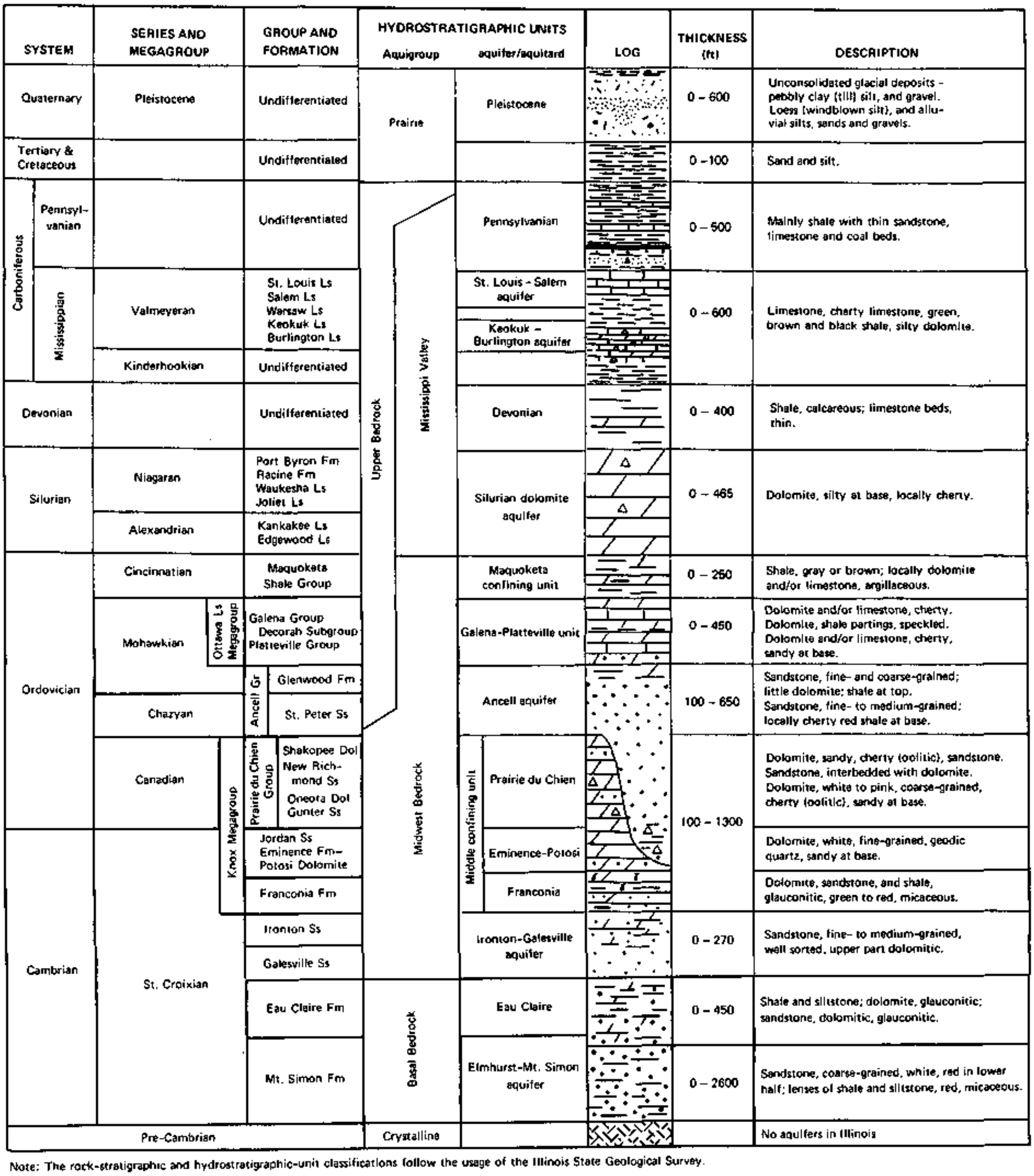


Figure 5. Stratigraphy and hydrostratigraphy of the rocks in the study area (From Visocky et al., 1985)

lain by interbedded shale and dolomite of the Ordovician Maquoketa Group, which, in turn, are overlain by dolomite formations of the Silurian System in eastern Kane and Du Page Counties. Complete lithologic descriptions of each of the SSC test holes are presented by Kempton et al. (1987a,b) and Curry et al. (in preparation).

Silurian System. The Silurian System unconformably overlies the formations of the Maquoketa Group and is the uppermost bedrock where it exists in the study area. Where the Maquoketa is deeply dissected by pre-Silurian erosion, the basal Silurian strata tend to be a very argillaceous dolomite. Where pre-Silurian erosion was minimal, the overlying Silurian strata tend to be a relatively pure, cherty dolomite. In the western part of the area, most of the Silurian has been removed, leaving only remnant outliers. It is 110 to 130 feet thick at Fermilab. The rocks of this system have been subdivided into three formations which appear to be hydraulically similar.

Ordovician System. The Maquoketa (youngest), Galena, Platteville, Ancell, and Prairie du Chien (oldest) Groups are included within this system.

Maquoketa Group. The Maquoketa consists of shale and argillaceous dolomite ranging from 130 to 210 feet thick in areas where it is overlain by Silurian units. In the unconfined regions its thickness diminishes to zero. Its subunits are not easily distinguishable, since they are highly variable laterally. In northern Kane and De Kalb Counties, the Maquoketa consists primarily of argillaceous dolomite, which grades into shale in Kendall County. This variation is reflected by the distribution of wells which tap the dolomitic portions of the Maquoketa.

Galena Group. The Galena Group is made up of pure, partially cherty dolomite. It is typically fine- to medium-grained, medium-bedded, and vuggy. Where the upper portions have not been eroded, the Galena attains 200 feet in thickness. The group has been divided into five formations, three of which have been delineated in the SSC study area. The uppermost, Wise Lake Dolomite, is a relatively pure dolomite, and the underlying Dunleith Dolomite is cherty and more vuggy. The basal Guttenburg Dolomite is characterized by reddish-brown shale partings. One would expect the lithologic variation among these formations to be reflected by variations in hydraulic conductivities. However, the localized nature of fracturing within those formations seems to suppress any such effects.

Platteville Group. The dolomitic Platteville Group is very similar to the Galena but is finer-grained, more thinly bedded, and less porous than that group. Its thickness averages 140 to 150 feet. Five formations have been named within the Platteville but have not as yet been differentiated in the study area. The hydraulic conductivities of the formations within the Platteville depend on local fracture patterns, as is the case with the Galena, and are not significantly different from those of the Galena.

Ancell Group. The Ancell consists of the St. Peter Sandstone and the Glenwood Formation. The St. Peter is a well-sorted, fine- to medium-grained sandstone, between 150 and 200 feet thick. It is overlain by the Glenwood, a highly variable formation consisting of poorly sorted sandstone, silty dolomite, and green shale, and attaining thicknesses locally of 75 feet. The sandstones of this unit are the primary source of water supplies for many municipalities and industries.

Prairie du Chien Group. This group consists primarily of cherty dolomite and interbedded sandstone but also contains some siltstone and shale.

Cambrian System. Cambrian rocks in the area include the Eminence Formation, Potosi Dolomite, Franconia Formation, Ironton-Galesville Sandstone, Eau Claire Formation, and the Mt. Simon Sandstone. The Mt. Simon is coarse-grained and poorly sorted and ranges in thickness from 1700 to 2600 feet. Eau Claire sandstones, siltstones, and shales rest unconformably above the Mt. Simon, reaching a combined thickness of 350 to 400 feet. The overlying Ironton-Galesville Sandstone is fine- to medium-grained, well-sorted, and up to 220 feet thick. Most of the high-capacity municipal and industrial wells in the region obtain a major part of their yield from the Ironton-Galesville Sandstone. The Franconia Formation consists of fine-grained, dolomitic sandstone whose surface shows little evidence of erosion. Above the Franconia is the Potosi Dolomite, a fine-grained dolomite, approximately 130 feet thick. The overlying Eminence Formation is a fine-grained dolomite, about 100 feet in thickness, and commonly containing sand and oolitic chert.

Pre-Cambrian Rock. Below the Mt. Simon Sandstone is the igneous Pre-Cambrian basement rock. The contact between these two units is abrupt, showing little evidence of weathering.

Hydrology of Study Area

The nomenclature and hydrologic division of the rock units used in this report are based on those suggested by Visocky et al. (1985) and are presented in figure 5. This terminology divides the hydrogeologic units into aquigroups which, in turn, are subdivided into aquifers and confining units. Such a classification is substantiated by water-level data described later in the report.

As noted earlier, much of the field effort for the SSC project was conducted for the purpose of providing both hydrologic and geotechnical information. As such, the SSC.siting reports of the State Geological Survey are generally written from the standpoint of tunneling considerations, and terminology related to selected bedrock units is appropriate to that concern. This report, however, is written from a water-resources perspective, and bedrock unit terminology and descriptions reflect this emphasis.

The uppermost aqulgroup in the study area is the Prairie Aquigroup, composed of glacial drift and alluvium, whose lithologic variability supports local and intermediate flow systems. Recharge to these flow systems is primarily from local precipitation. Significant sand and gravel deposits, often at the base of the drift, provide moderate to large ground-water supplies to communities in the area, especially in the eastern part of Kane County. In areas where basal sands and gravels exist, there is often a hydraulic connection between the Prairie Aquigroup and an underlying water-bearing unit referred to as the Upper Bedrock Aquigroup.

In the upper portion of the bedrock the hydrologic system is not affected by variations in bedrock surface lithology. Because the geologic strata are dipping to the east, the Silurian, the Maquoketa, and (in the western part of the study area) the Galena carbonates comprise the uppermost bedrock in the study area. Extended periods of weathering and the release of overburden pressures at this exposed surface produced a fractured, relatively permeable zone, which extends laterally across geologic boundaries and varies with depth, depending on the nature and extent of fractures and incipient joints.

For the purposes of this report, the depth of this weathered zone has been defined as 50 feet, a value arrived at by using data on fracture frequency from pressure tests on the SSC wells. Most of these data indicate a fractured zone occurring in the top 25 feet of the bedrock, which commonly extends to depths greater than 50 feet. The network of interconnected fractures delineates the Upper Bedrock Aquigroup. This aquigroup is extensively developed for water supplies in the eastern part of the study area where Silurian dolomites comprise the bedrock surface. Recharge to the Upper Bedrock Aquigroup is from the overlying Prairie Aquigroup, whose variability in thickness and lithology creates local and intermediate flow systems within the Upper Bedrock Aquigroup.

In the eastern part of the study area, the Upper Bedrock Aquigroup also includes that portion of the Silurian dolomite existing below a depth of 50 feet. Visocky et al. (1985) refer to the Silurian, where it is unconfined by Devonian strata, as the Upper Bedrock Aquigroup. In the study area, this description includes any bedrock overlying the Maquoketa Group.

The Midwest Bedrock Aquigroup is defined as including that portion of the bedrock that is not within the Upper Bedrock Aquigroup but is above the Eau Claire confining units of the Basal Bedrock Aquigroup (see figure 5). The hydrology of the Midwest Bedrock Aquigroup varies internally as a function of its different lithologic units. This report examines two of these units, the Maquoketa and Galena-Platteville Units. For reasons discussed later, the effects of the Ancell aquifer, the Middle Confining Unit, and the Ironton-Galesville aquifer are combined.

The Basal Bedrock Aquigroup includes the productive Elmhurst-Mt. Simon aquifer, with shales of the Eau Claire Formation acting as a confining unit. The Elmhurst-Mt. Simon rests on Pre-Cambrian crystalline rock, which has little hydrologic significance in the study area.

POTENTIOMETRIC SURFACES

The potentiometric surface maps presented in this report were derived by using computer contouring packages, in order to obtain statistically sound estimates of water-level elevations in areas where data are sparse. Contour lines have been drawn to include only those regions for which data exist. Data used to construct these maps were obtained from water levels measured in private domestic wells and in piezometers.

Mass Measurement Data

Water levels were measured during the summer of 1986 in 389 domestic wells open to various combinations of glacial drift, Silurian units, and the Maquoketa, Galena, and Platteville Groups, as these units were of interest in siting the SSC. Data collected for this study are based on an inventory of drillers logs in which wells open to only one geologic unit were sought. The number of wells meeting this criterion is limited, however, since the most productive water supply for domestic use is usually obtained by pumping from several hydrologic units. The data from single-unit wells, therefore, were supplemented by measurements in wells. open to several units. A complete list of wells and measurement data is presented in Appendix 2.

Casing records and drillers logs showed that the wells in which water levels had been measured were of three types: 1) those tapping only one hydrostratigraphic unit; 2) those finished at specific depths, independent of stratigraphic boundaries; and 3) those open to combinations of several units. The following sub-sections discuss potentiometric conditions of the hydrostratigraphic units to which the wells are open.

Prairie Aquigroup

Water levels were measured in 56 wells finished in the unconsolidated "Prairie Aquigroup, in an attempt to determine the hydrologic relationship between that unit and shallow bedrock aquifers. Where these wells are finished in basal sand and gravel deposits, water-level elevations approximate those observed in the Upper Bedrock Aquigroup, suggesting a close hydraulic connection between the two units. Wells finished in shallower parts of the drift, however, have water-level elevations quite different from those in the shallow bedrock. Such differences are a reflection of variations in lithology within the drift, which make the construction of a potentiometric surface for the Prairie Aquigroup inappropriate. Individual water levels in the Prairie Aquigroup are therefore presented in figure 6 without any attempt at constructing contours.

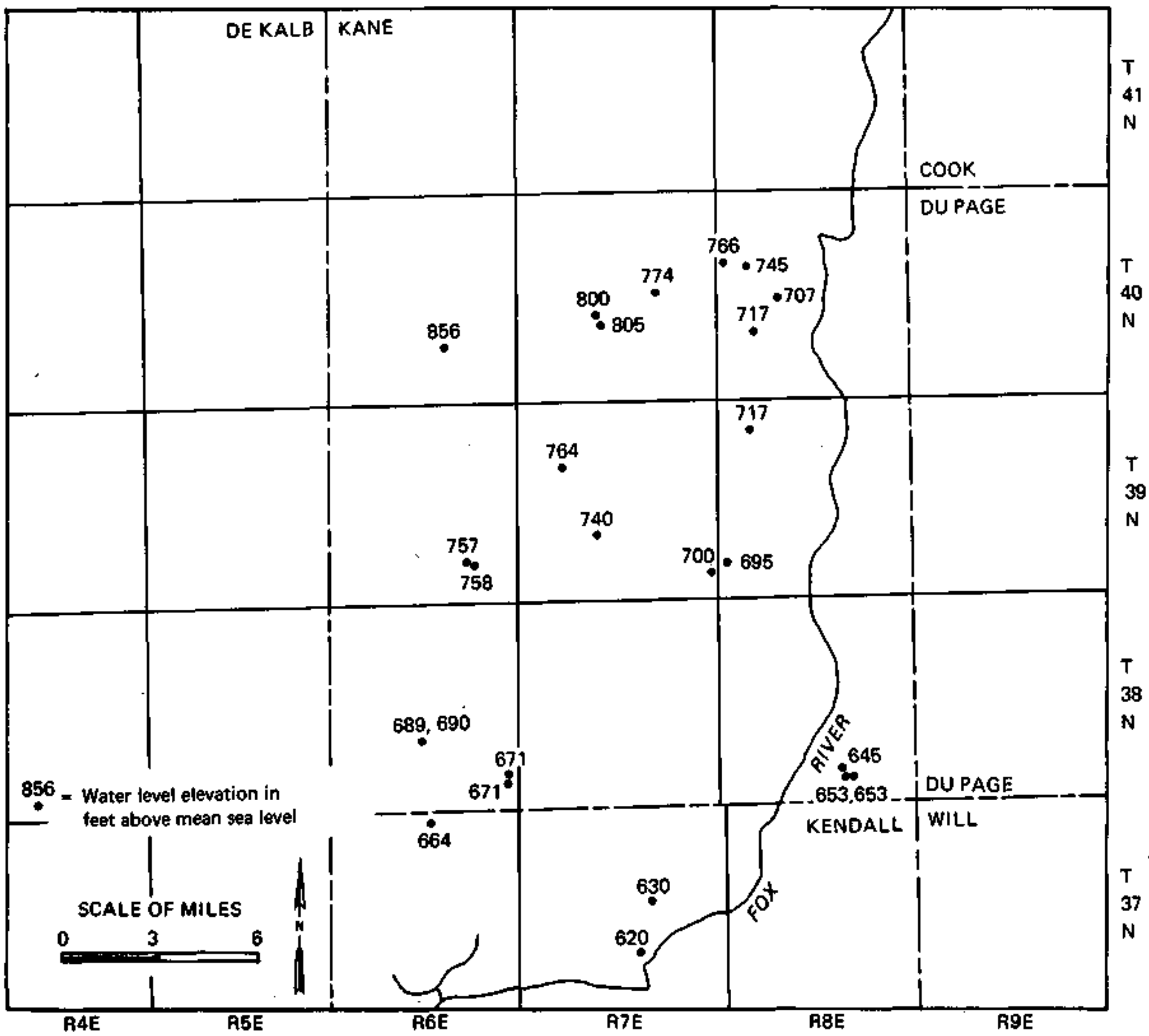


Figure 6. Water levels in wells finished in the Prairie Aquigroup

Upper Bedrock Aquigroup

Figure 7 describes the potentiometric surface of the Upper Bedrock Aquigroup, based on water levels measured in 173 wells finished in Silurian, Maquoketa, and Galena units. The general direction of ground-water movement, indicated by constructing flow lines perpendicular to the water-level contours, is to the southeast. This condition is caused in part by high regional pumpage within the Upper Bedrock Aquigroup in the eastern part of the study area, but it may also be a function of the eastward dip of the bedrock. The apparent cones of depression in the northeast region of the map reflect local increases in pumpage in newly developed subdivisions.

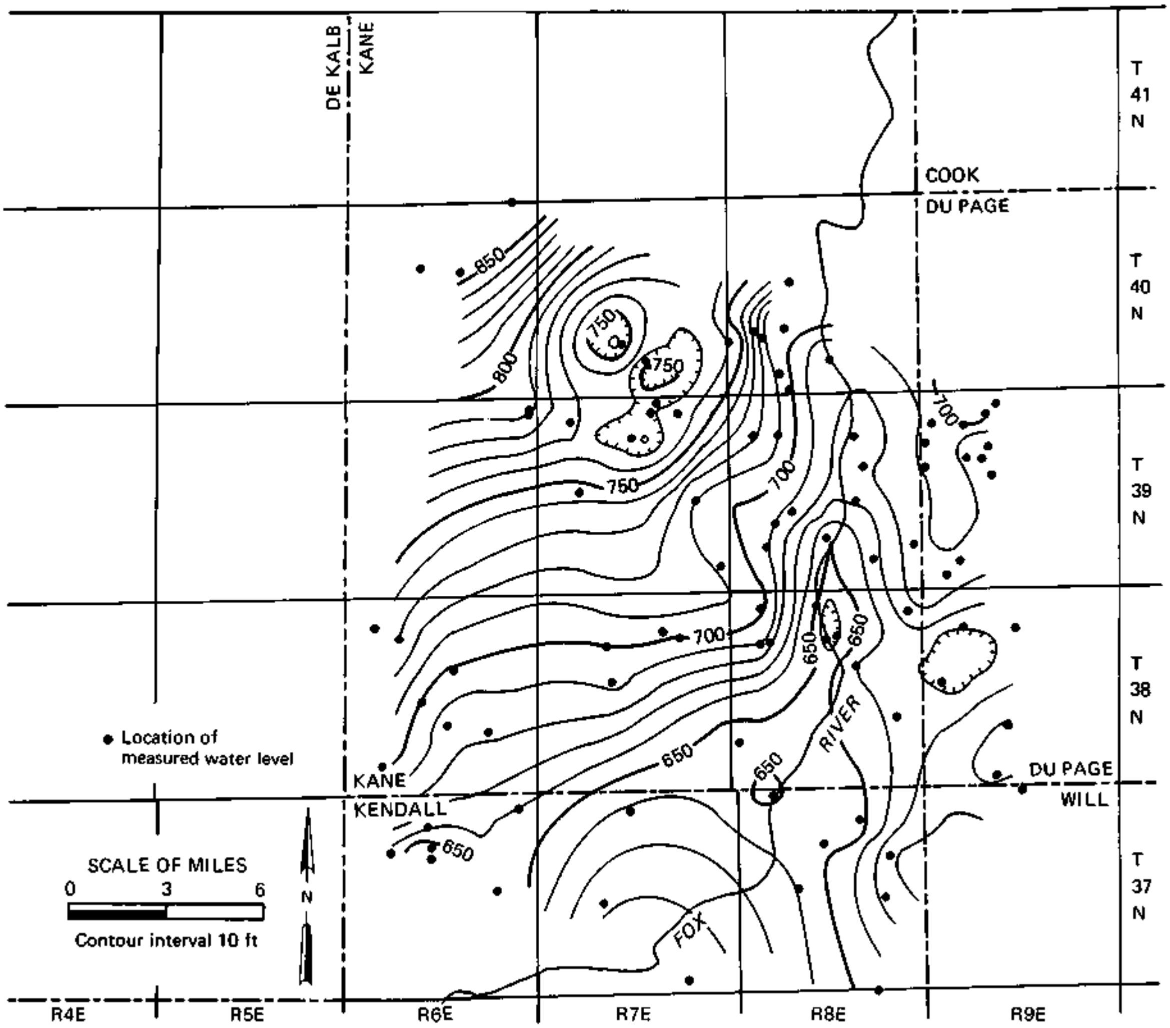


Figure 7. Potentiometric surface of the Upper Bedrock Aquigroup

Where the Fox River is known to be in direct connection with the bedrock, average river-stage elevations were included as part of the piezometric surface. As those elevations were lower than water levels in nearby wells, the resulting contours were strongly deflected upstream, indicating ground-water discharge to the river. This conclusion is not in agreement with accretionary baseflow values calculated by Broeren and Singh (1987); however, the discrepancy is believed to be attributable to variations in effluent trends discussed in their report.

Midwest Bedrock Aquigroup (Maquoketa and Galena-Platteville Units)

The interval of rock below the Upper Bedrock Aquigroup and above the Ancell aquifer consists of the lower part of the Maquoketa Group and the

Galena and Platteville Groups. Two different hydrostratigraphic units are recognized within this interval: the Maquoketa Confining Unit and the Galena-Platteville Unit.

The potentiometric surface of the Maquoketa Confining Unit cannot be determined from water levels in domestic wells, since the domestic wells tap only the uppermost, dolomitic portions of the Maquoketa, which is part of the Upper Bedrock Aquigroup. Dolomitic zones within the Maquoketa do underlie the Upper Bedrock Aquigroup but are rarely used for water supplies. These shales are generally thought to confine the Galena-Platteville Unit but, as will be discussed below, they possess some water-bearing zones.

Only seven domestic wells in the area are known to be open to the Galena-Platteville Unit. Water-level data obtained from these wells (figure 8) are significant in that they exhibit lower elevations than those observed in figure 7. The difference in water levels of the Upper Bedrock Aquigroup and the Galena-Platteville Unit suggests that the lowermost shaley portion of the Maquoketa acts to confine the Galena-Platteville Unit and consequently induces artesian conditions in that unit. This assumption is confirmed by the observation that all of the water levels in the domestic wells are at or above the Galena surface.

Multi-Aquifer Wells

Water-level measurements were made in 153 wells open to the Upper Bedrock Aquigroup and to the Maquoketa and Galena-Platteville Units in the Midwest Bedrock Aquigroup. A potentiometric surface map described by these water levels is presented in figure 9, for comparison with that of the Upper Bedrock Aquigroup (figure 7). The general water-level configuration and elevations in figure 9 closely agree with those of figure 7, suggesting that water levels in the multi-aquifer wells are more strongly influenced by the Upper Bedrock Aquigroup than by the Galena-Platteville Unit. In areas of heavy pumpage, however, the multiple-aquifer potentiometric surface is characterized by deeper cones of depression than are seen in the map for the Upper Bedrock Aquigroup. This suggests that in these heavily pumped areas, dewatering of both the upper and lower units has taken place.

Piezometer Data

The most useful information describing the hydrology below the Upper Bedrock Aquigroup has been that collected from the SSC piezometers (see table 1). Unlike the private domestic wells, which are open to entire formations or to more than one formation, the piezometers monitor specific 10- to 20-foot intervals of rock. Measurements from piezometers in service during the summer of 1986 are presented in figure 10 for comparison with figures 7-9, which are based on data from the mass measurement of wells. Because 20 additional piezometers were installed after the

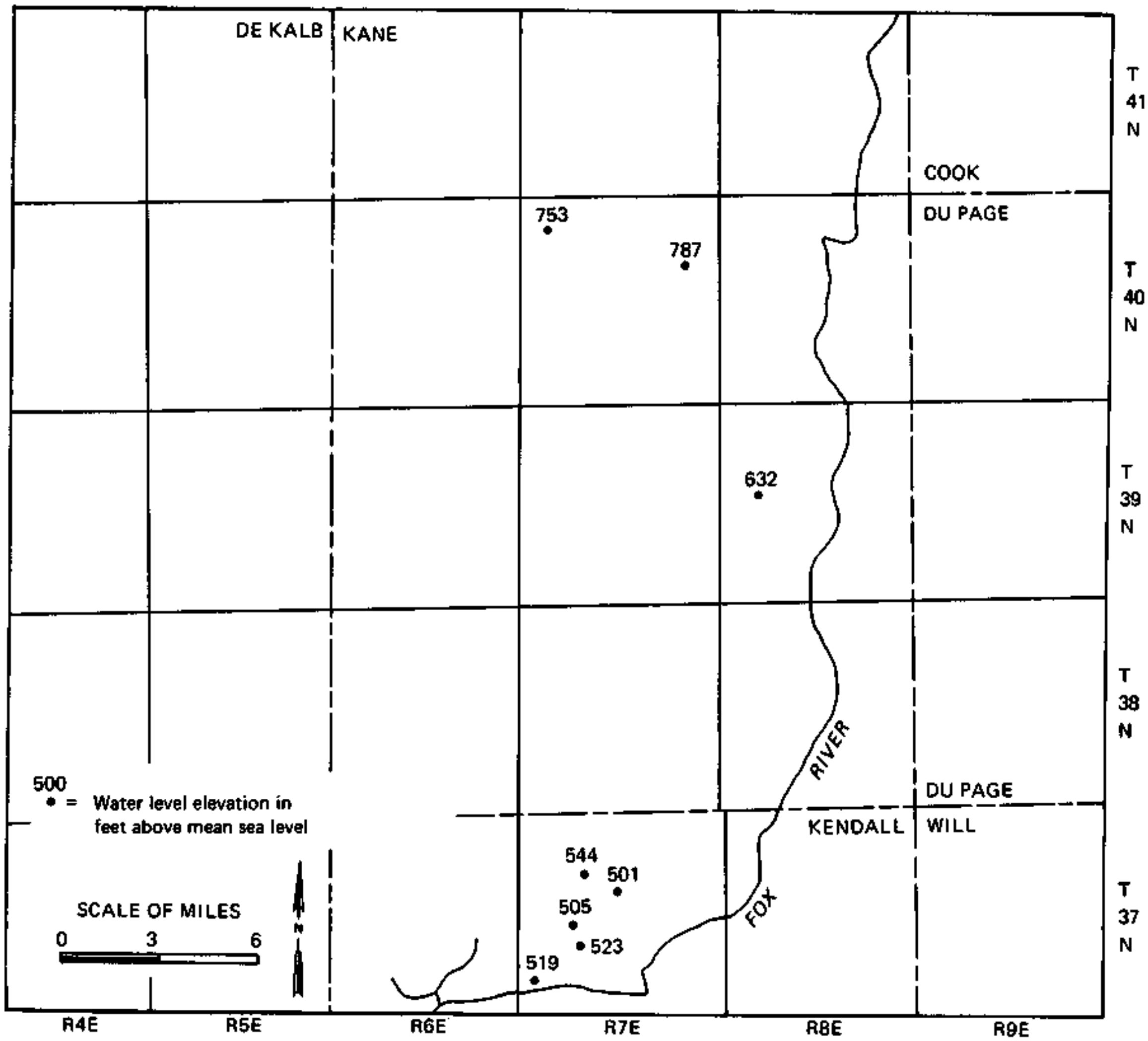


Figure 8. Water levels in wells open only to the Galena-Platteville Unit

mass measurement was conducted, a more complete set of data for May 1987 is also discussed below. Data from Maquoketa and Galena-Platteville piezometers are considered separately.

Maquoketa Confining Unit

Four piezometers (F-1, F-6, F-13, and SSC-2-1) were set in shaley portions of the Maquoketa Confining Unit, which has a very low hydraulic conductivity. Water levels in the Maquoketa piezometers appear to be intermediate to those of overlying and underlying aquifers, suggesting a natural vertical gradient (see the section on monthly water levels).

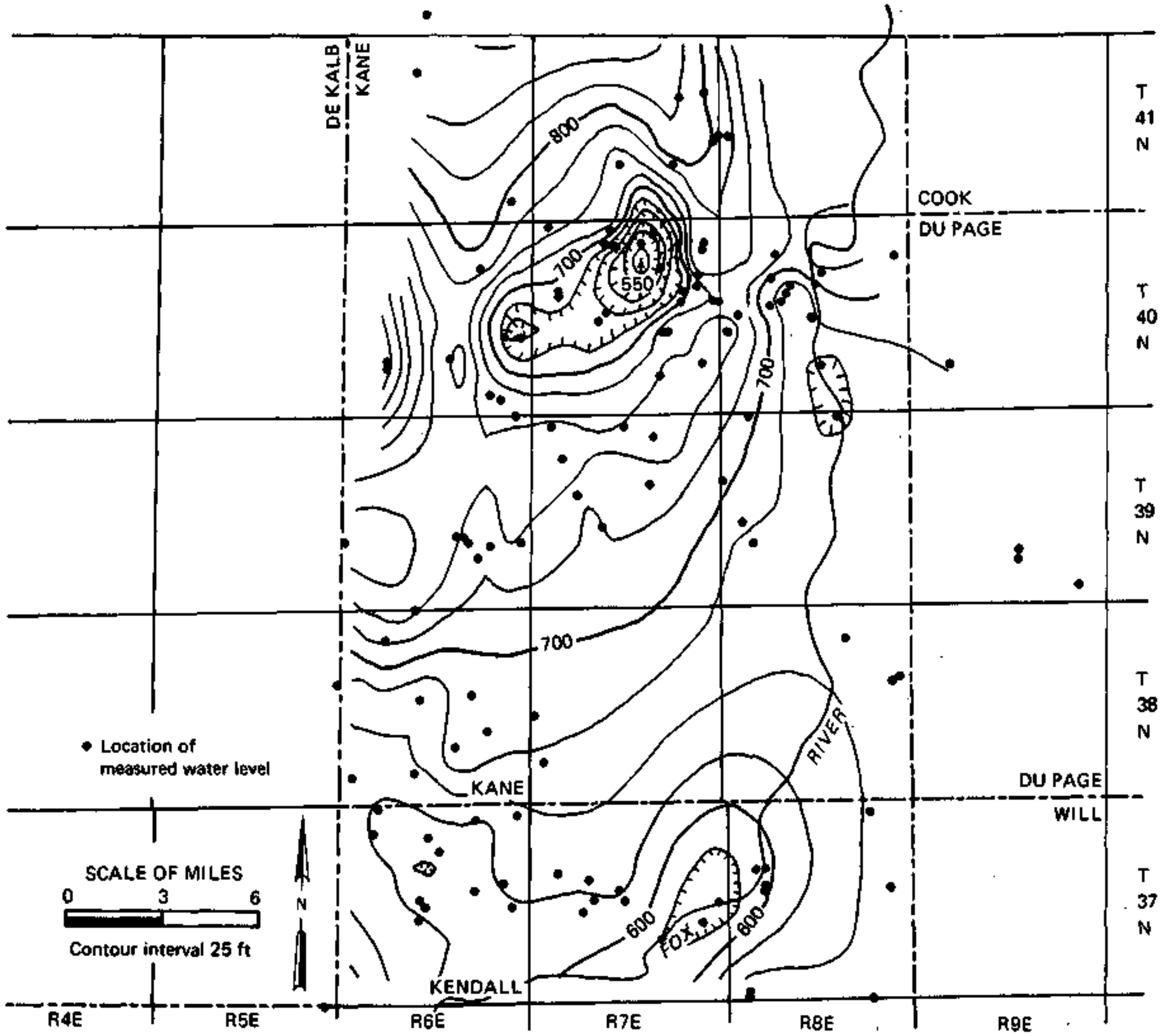


Figure 9. Potentiometric surface of combined Upper Bedrock and Midwest Bedrock Aquigroups

Galena-Platteville Unit

Although the SSC piezometers are finished at different elevations within the Galena-Platteville Unit (see table 1), their water-level elevations appear similar enough to be plotted as one potentiometric surface. A map of this surface, prepared from data from 31 piezometers for the month of May 1987, is presented in figure 11. The west-to-east slope of the contours in figure 11 compares well with that seen in the maps in figures 7 and 9.

In comparing figure 11 with figure 9, it is interesting to note that water levels in the piezometers are lower than those measured in domestic wells. The water levels in the piezometers are lower because piezometers

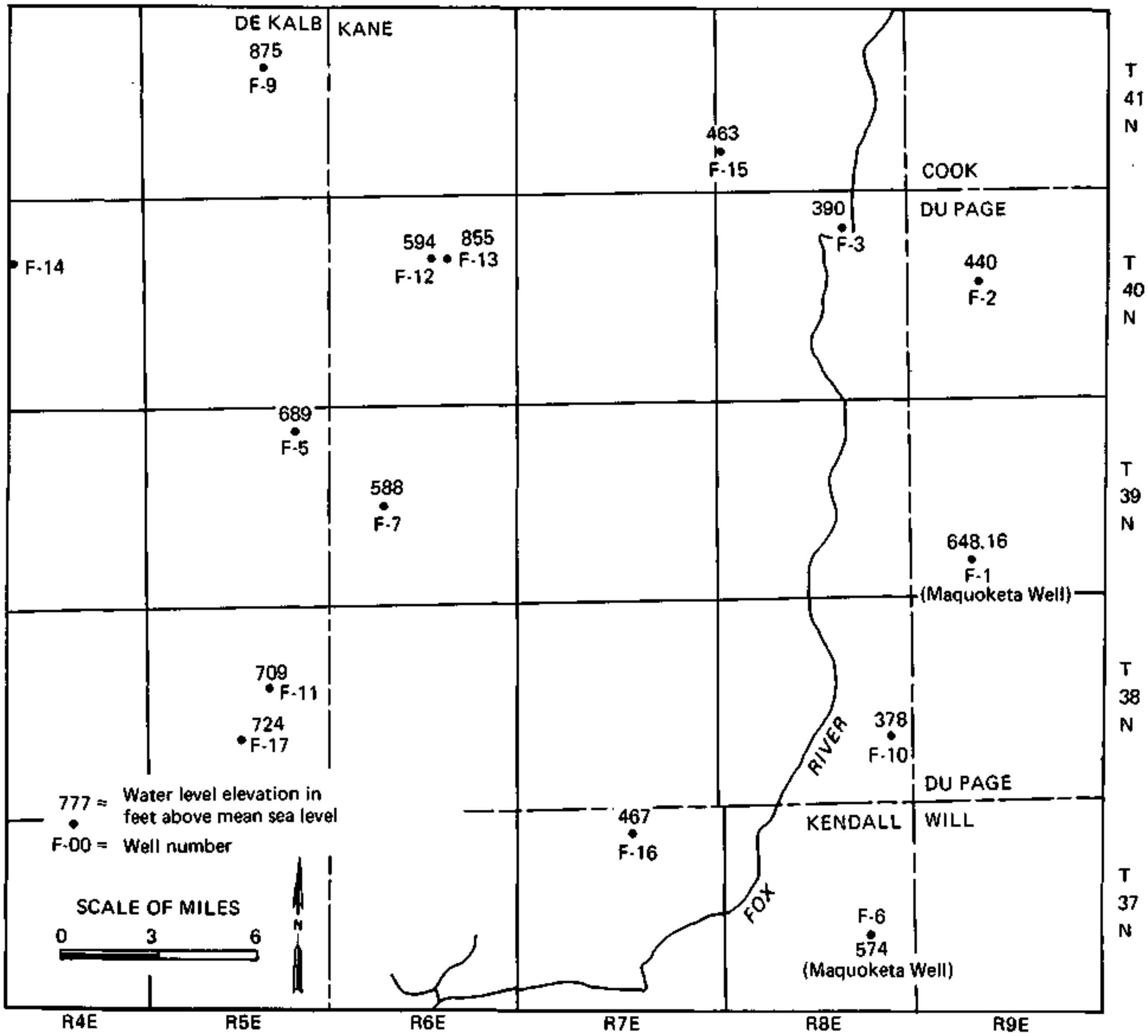


Figure 10. Water levels in piezometers existing in summer 1986

monitor only the lowest 10- to 20-foot interval at a given location. Water levels in the wells, on the other hand, incorporate the influence of a greater portion of the fractured dolomite units and reflect shallower conditions.

Midwest Bedrock Aquigroup (Units below the Galena-Platteville)

During the mass measurement in the summer of 1986, water levels were not measured in wells open to units of the Midwest Bedrock Aquigroup since the emphasis of the field study was on units likely to be tunneled

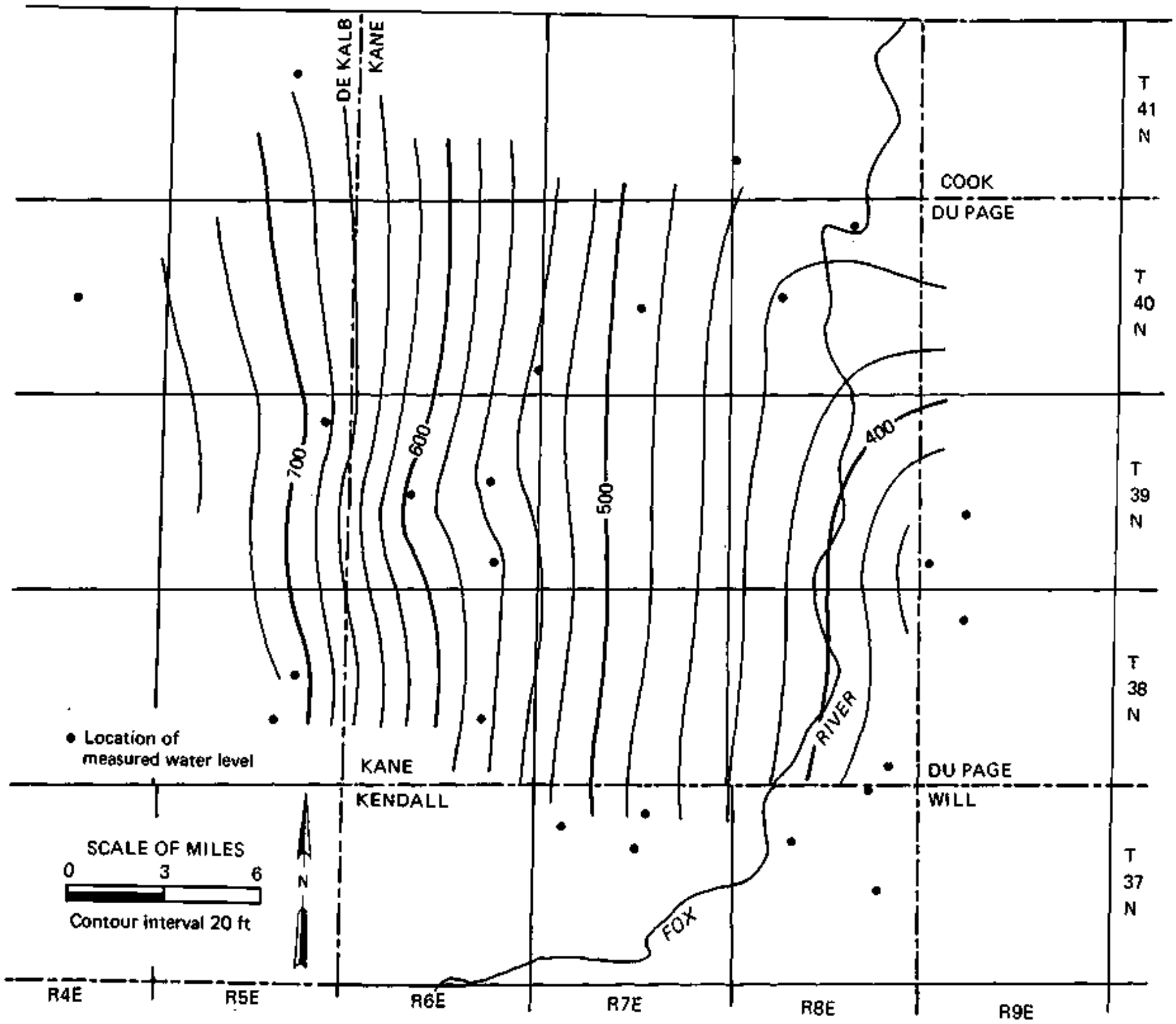


Figure 11. Potentiometric surface of Galena-Platteville Unit, May 1987

for the SSC ring. These units, however, are the most productive and heavily pumped portion of the Midwest Bedrock Aquigroup.

Sasman et al. (1986) presented a map of the potentiometric surface of the popularly described "Cambrian-Ordovician" aquifer system in the fall of 1985 (figure 12). Water levels included in that report were taken from wells open to any combination of Cambrian and Ordovician strata including the Galena-Platteville Unit and the Ancell, Ironton-Galesville, and Elmhurst-Mt. Simon aquifers. Although the water levels measured in these wells represent an integrated set of data, incorporating the influe of the various aquifers from the Basal Bedrock and Midwest Bedrock Aquigroups, water supplies are primarily derived from the high-yielding sandstone units within these aquigroups. Only a crude

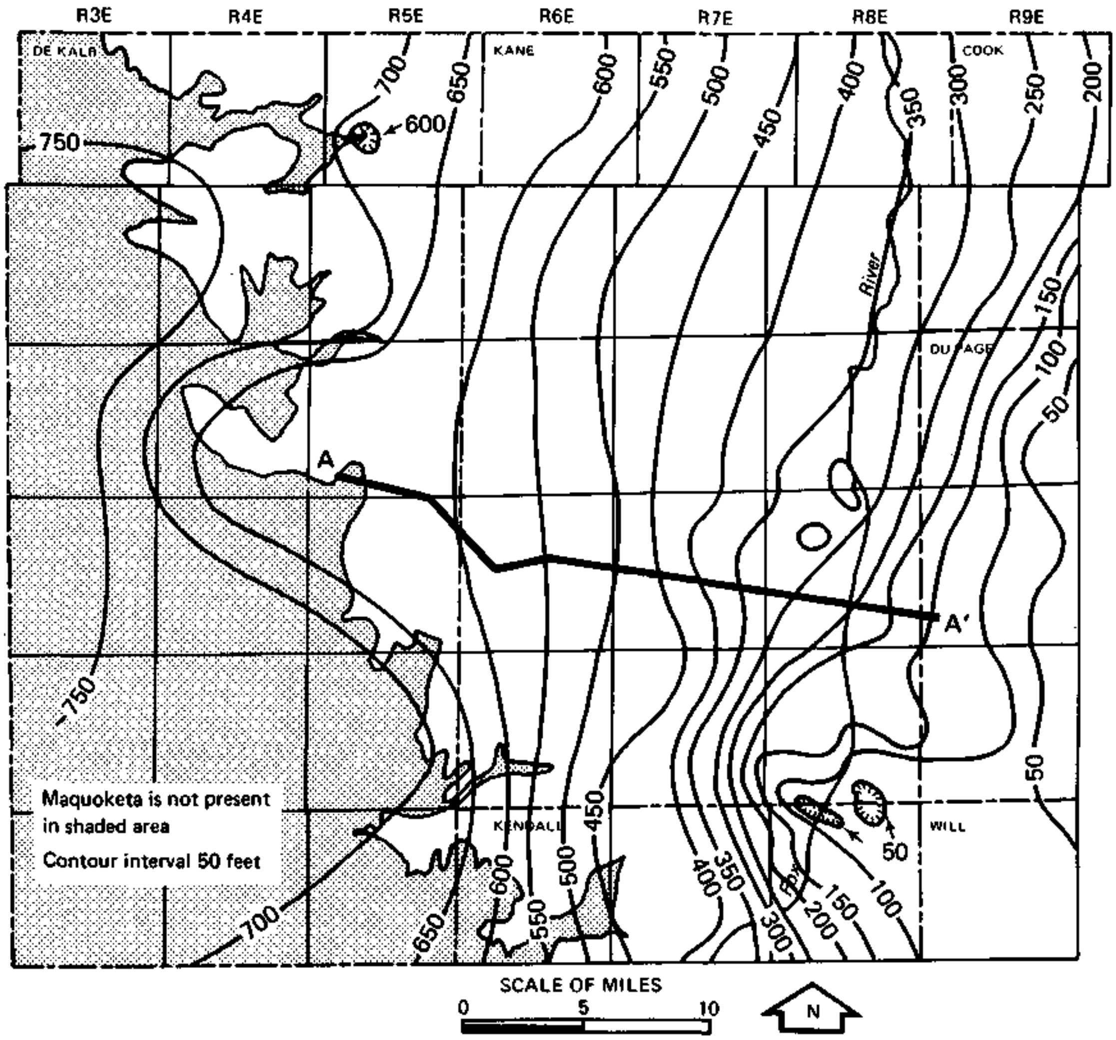


Figure 12. Potentiometric surface of the "Cambrian-Ordovician" aquifer (After Sasman et al., 1986)

comparison, therefore, can be made between the potentiometric surface of the Galena-Platteville Unit (figure 11) and that of the combined aquigroups (figure 12). Nevertheless, such a comparison is useful since it gives some insight into the effect of overpumpage in the sandstone aquifers on water levels in the Galena-Platteville portion of the aquigroup.

Potentiometric surfaces of both the "Cambrian-Ordovician" aquifer and the Galena-Platteville Unit slope eastward, as a function of dipping strata and heavy pumpage in that part of the area. In cross section, however, the slope of the "Cambrian-Ordovician" potentiometric surface is steeper than that of the Galena-Platteville (figure 13). It may also be

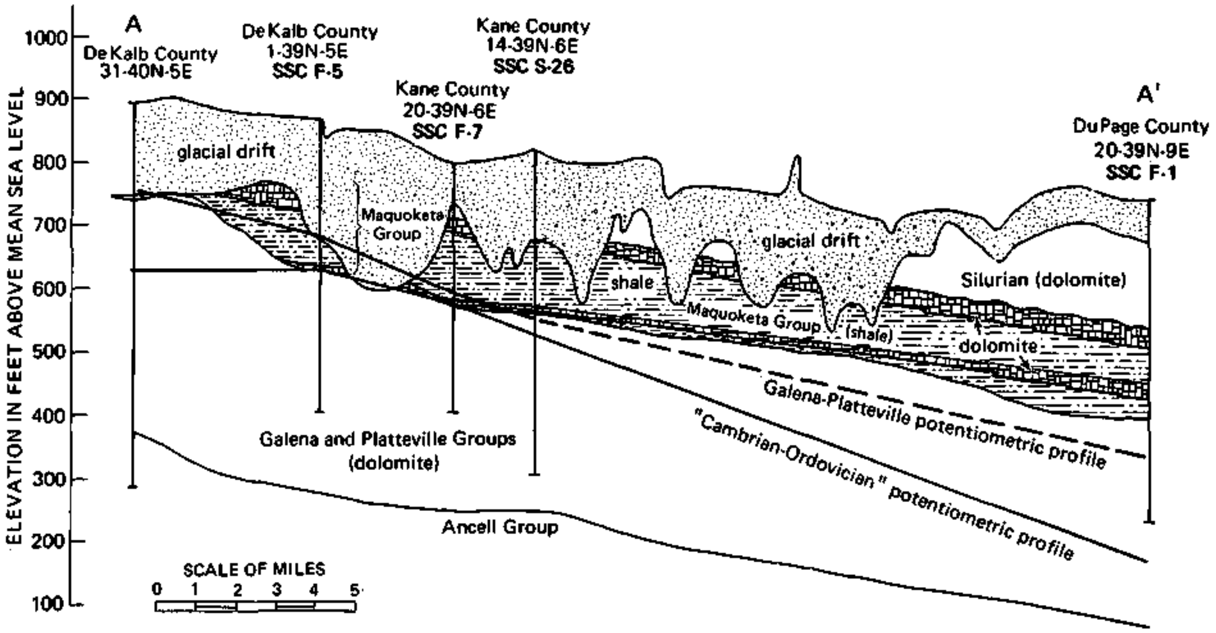


Figure 13. Cross-sectional view of potentiometric profiles for Galena-Platteville and "Cambrian-Ordovician" aquifers

noted that the water levels in the area where the Galena is confined rise above the top of the Galena in the western part of the study area and drop below the top of this unit toward the east, in the direction of the heavy withdrawals (figures 13 and 14). While the Galena-Platteville is not a productive unit in areas where it is confined by the Maquoketa Confining Unit, the relationship between water levels noted above suggests that some degree of vertical hydraulic continuity exists between the Galena-Platteville and the underlying, more productive units of the Midwest Bedrock Aquigroup.

Because the Upper Bedrock Aquigroup is effectively isolated from the Galena-Platteville by the Maquoketa Confining Unit, it is relatively unaffected by the heavy pumpage from the Midwest Bedrock Aquigroup.

MONTHLY WATER LEVELS

The first series of piezometers for the SSC study (F-1, F-2, F-3, F-5, F-6, F-7, and F-9) was completed in the fall of 1984. Since December of that year and up to the present, monthly water-level measurements have been made at these sites and at subsequently installed piezometers. A total of 26 piezometers were completed by the fall of 1986. In addition, nine nested piezometers at three sites have also been measured since February 1987. Five of the piezometers (F-3, F-5, F-9, F-15, and F-17) were eventually abandoned after various periods of monitoring, because they are remote from the redesigned SSC tunnel configuration.

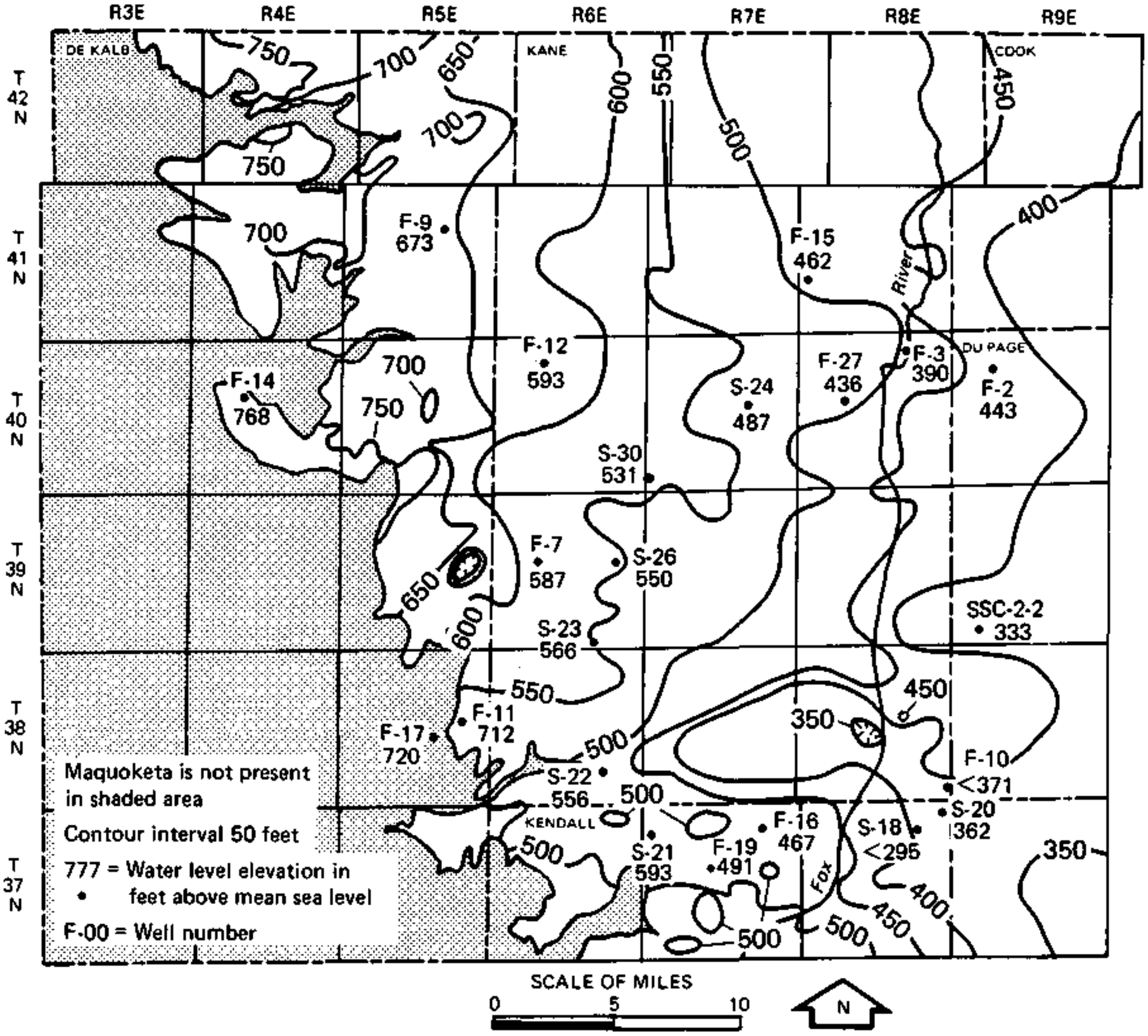


Figure 14. Elevation of Galena surface and water levels in piezometers

The piezometers are grouped for discussion purposes according to the geologic formation in which they are screened. The nested piezometers are treated separately, since they are open to various formations at one site. A complete tabulation of monthly water levels through July 1987 is presented in Appendix 3.

Maquoketa Levels

Figure 15 shows water-level hydrographs for the three non-nested piezometers completed within the Maquoketa Group (F-l, F-6, and F-13). At F-l and F-6, the hydrographs indicate a somewhat cyclic nature, wherein water levels appear to recover in the spring and decline during the rest of the year. Fluctuations are only a few feet each year. At F-13, the fluctuations are also small, but the seasonal character of the water-level changes is less apparent. One possible explanation for this

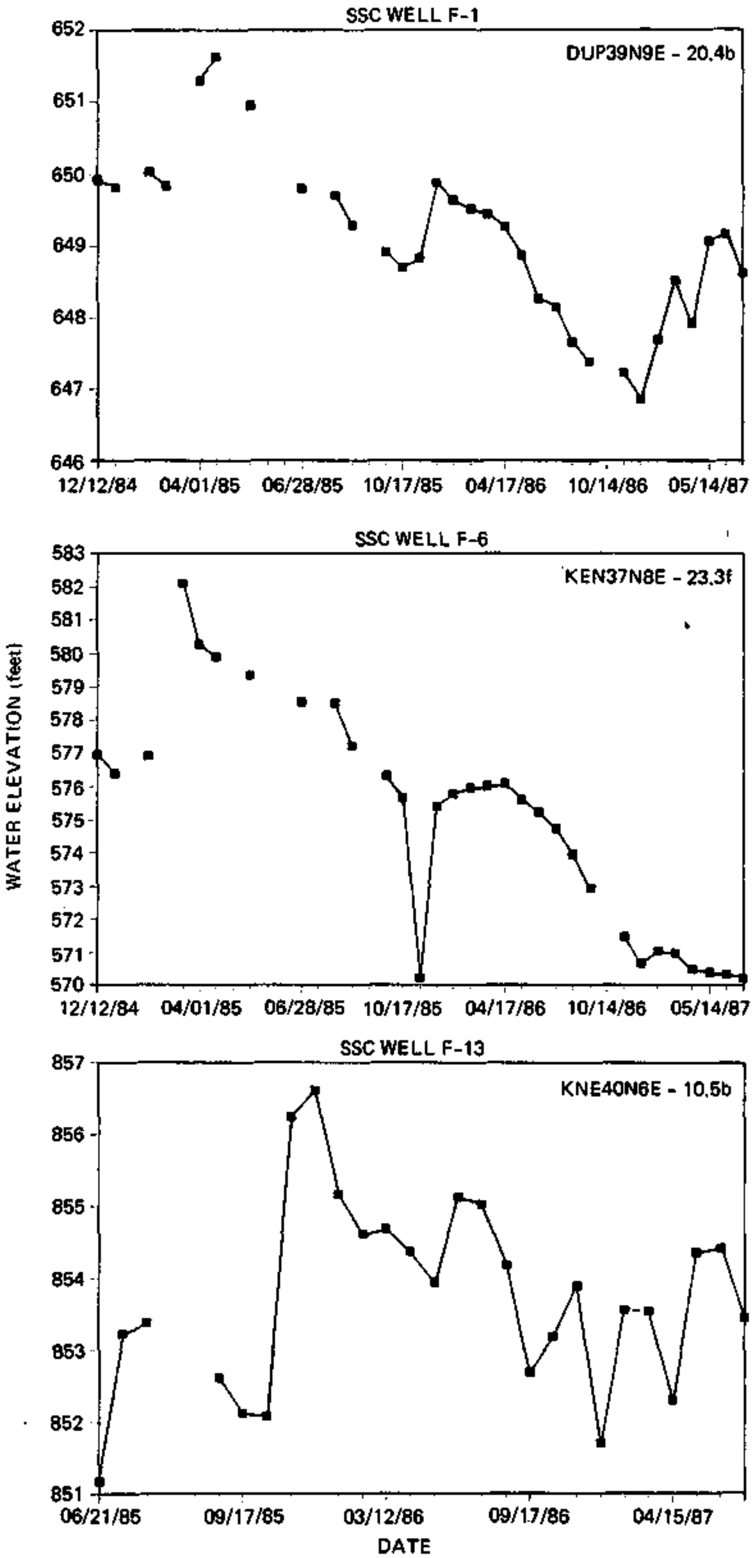


Figure 15. Hydrographs for Maquoketa piezometers F-1, F-6, and F-13

difference in response is that F-13 appears to be finished in a more permeable part of the Maquoketa than are F-1 and F-6. If this is the operative mechanism, then the more permeable zone acts to dampen the cyclic nature of yearly fluctuations.

Figure 16 shows all three hydrographs plotted together. At this scale, it is apparent that water levels at the three wells exhibit a very stable nature, relative both to time and to each other. Since measurements began, water levels at F-13 have remained at an elevation of approximately 855 feet, about 200 feet above those at F-l and about 280 feet above those at F-6. On the basis of these data and the relative locations of these wells, as shown in figure 1, the average horizontal flow gradient in the Maquoketa Group is approximately 17 feet per mile in a southeasterly direction.

Figure 17 shows water levels in F-13 plotted on the same graph with water levels measured in piezometer F-12, which was constructed at the same site (located at Virgil in Section 10, T40N, R6E) but was finished in the Platteville Group, more than 300 feet deeper. Once again, at this common scale, water levels in both wells are seen to be quite stable, with heads in the Maquoketa about 260 feet higher than those in the Platteville. The vertical head gradient at the site, calculated by dividing the head difference by the difference in the bottom-hole elevations of the wells, is about 0.85 foot per foot.

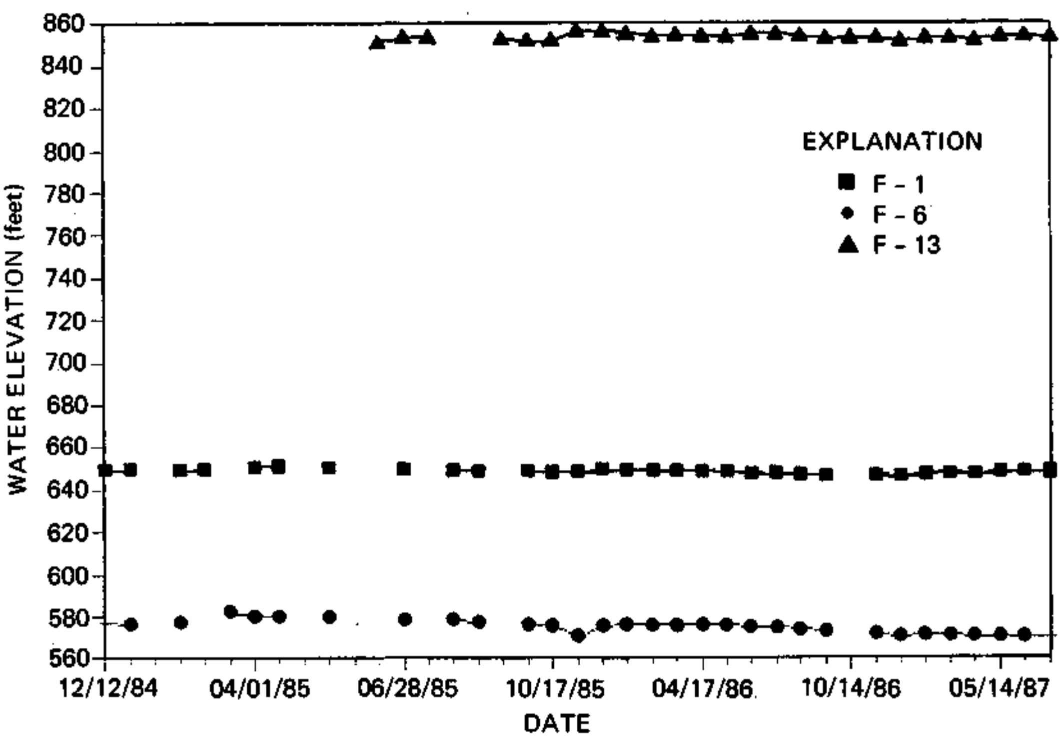


Figure 16. Comparison of hydrographs for F-l, F-6, and F-13

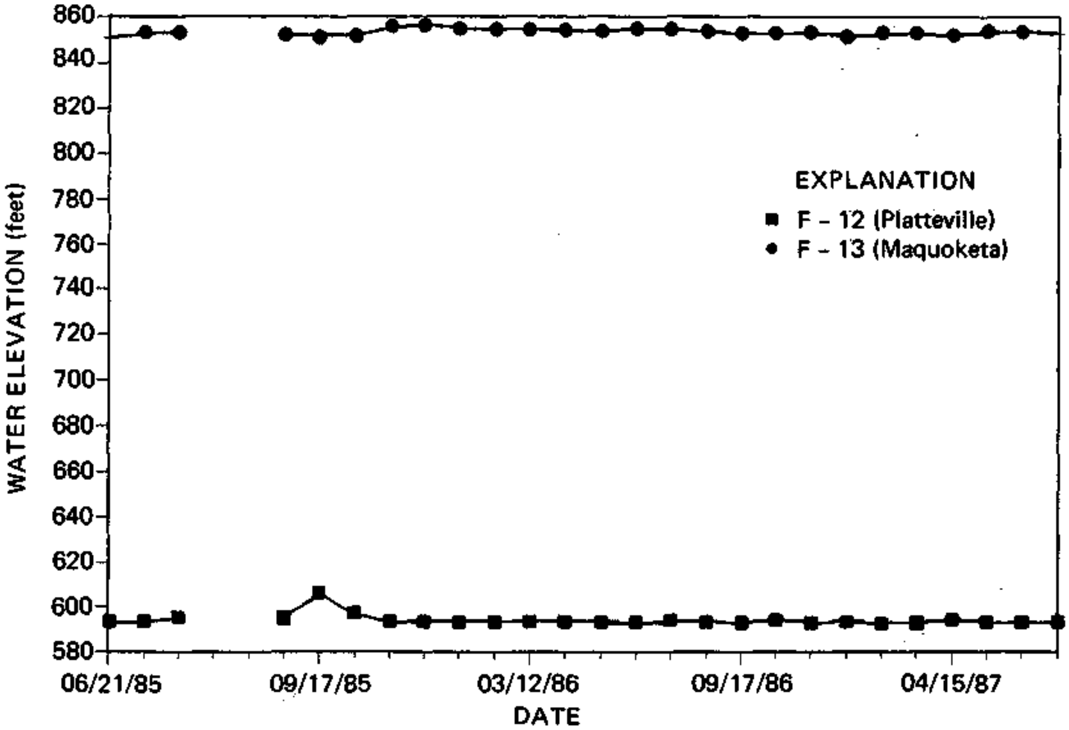


Figure 17. Comparison of Maquoketa and Platteville water levels at Virgil, Illinois

Galena Levels

During the drilling seasons of the fall of 1984 and the spring of 1985, piezometers were finished in the Galena Group at sites F-2, F-3, F-7, F-10, F-15, and F-16 (figure 1). Initially, water levels at F-3 stood only 3 to 4 feet above the bottom of the well, and by May 1985 they had dropped below the bottom of the well. When the target location for the SSC tunnel became better defined and the usefulness of data from these sites lessened, this well, along with F-15, was no longer monitored. By August 1986 these wells had been abandoned and plugged.

Figure 18 shows hydrographs of water levels at F-2, F-7, F-10, F-15, and F-16. Water levels at F-2 initially stood at an elevation of about 592.5 feet. The pattern of slow but gradual decline at this well suggests that the initial water level was perched, perhaps because of muddy borehole conditions after completion. By February 1986, water levels had fallen to an elevation of about 446 feet. Since that time, water levels at F-2 have exhibited an apparent cyclic pattern, as shown by the partial hydrograph for this well. A similar decline in water levels occurred at F-10, where, by the end of 1986, levels fell below the bottom of the well. A partial hydrograph is also presented for this well in figure 18. The hydrographs for F-7, F-15, and F-16 generally show

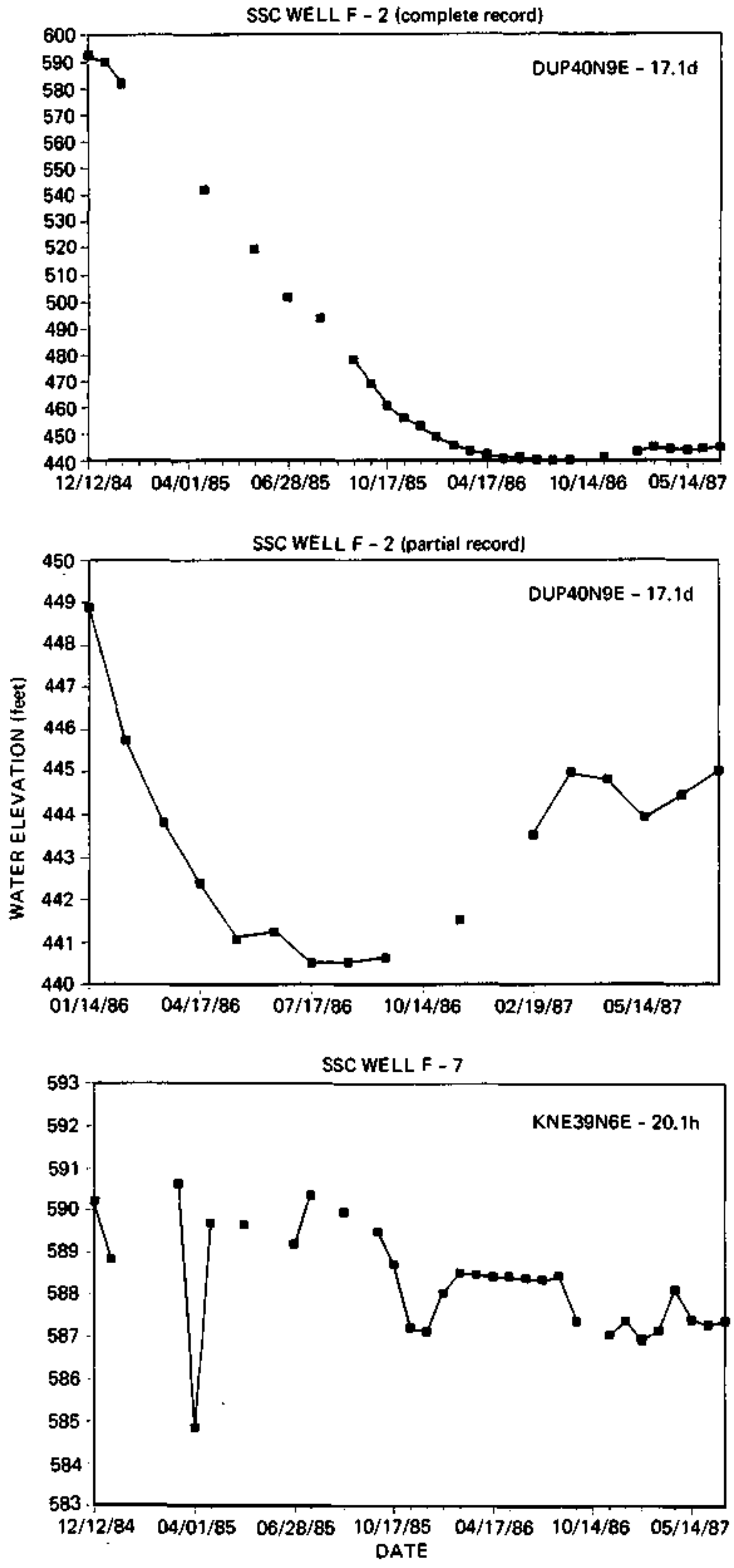


Figure 18. Hydrographs for F-2, F-7, F-10, F-15, and F-16

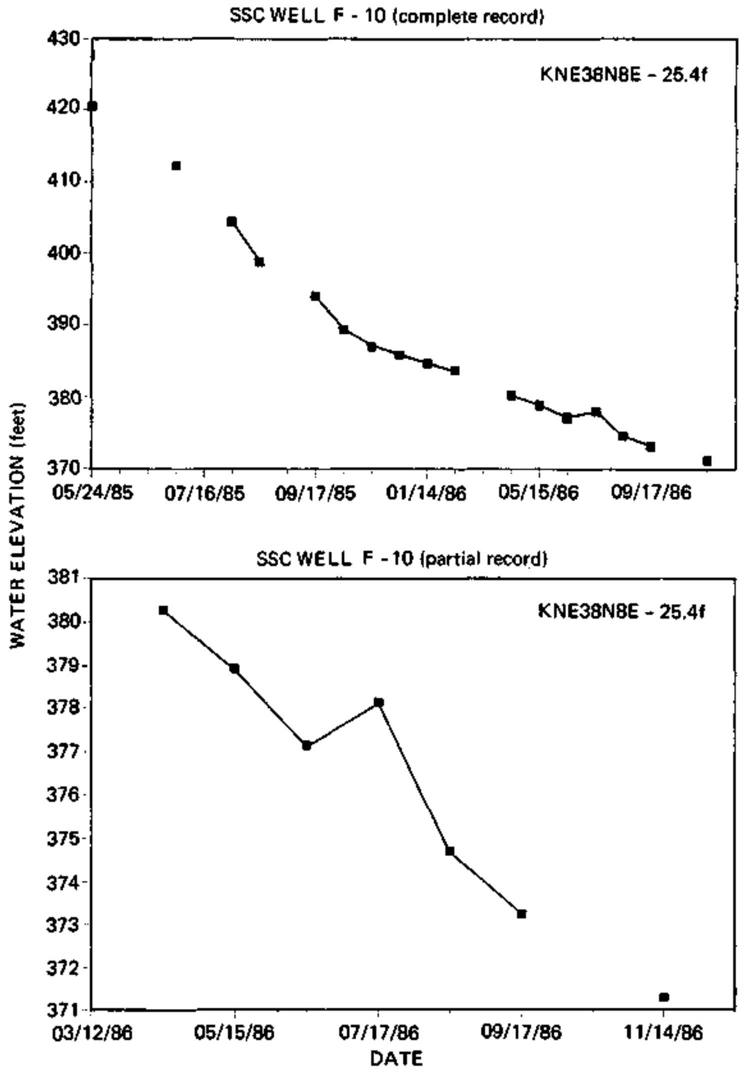


Figure 18. Continued

fluctuations of only a few feet, suggesting a subdued seasonal cyclic response.

A comparison of hydrographs plotted on the same graph (figure 19) shows that after water levels at F-2 and F-10 approached near-steady conditions in the late summer of 1986, a relatively stable west-east head relationship could be seen. Heads at the westernmost well (F-7) stood at approximately 590 feet, abovit 120 feet higher than at F-15 and F-16, 145 feet higher than at F-2, and 215 feet higher than at F-10. The resultant horizontal flow gradient is southeasterly at about 12.5 feet per mile.

During the summer and fall of 1986, as the target location of the SSC tunnel became better defined, additional piezometers were constructed

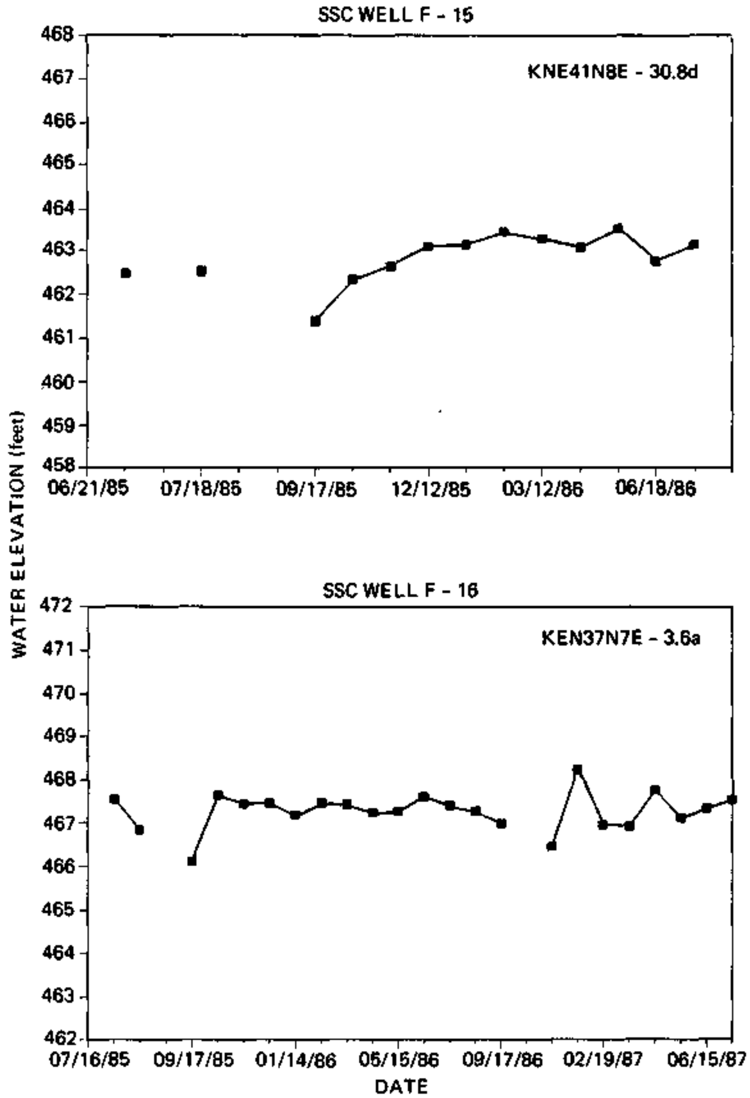


Figure 18. Concluded

in the Galena Group at sites S-18 to S-22 and S-28 (figure 1). Bottom-hole elevations of these wells ranged from 292 to 349 feet MSL, or an average of about 75 feet deeper than the earlier Galena wells. Water levels at S-18 and S-28 dropped below the bottoms of the wells very soon after construction and have not recovered. After an initial short period of adjustment, however, water levels at the remaining wells have fluctuated only a few feet and appear to have stabilized (figure 20). Hydrographs from these wells for the period of record were combined with that from piezometer F-16 for the same period, in order to compare heads in the Galena Group along the corridor of the proposed southern end of the ring-shaped tunnel (figure 21). With the exception of those at S-22, heads exhibit a west-to-east gradient. Water levels at S-22 are appar-

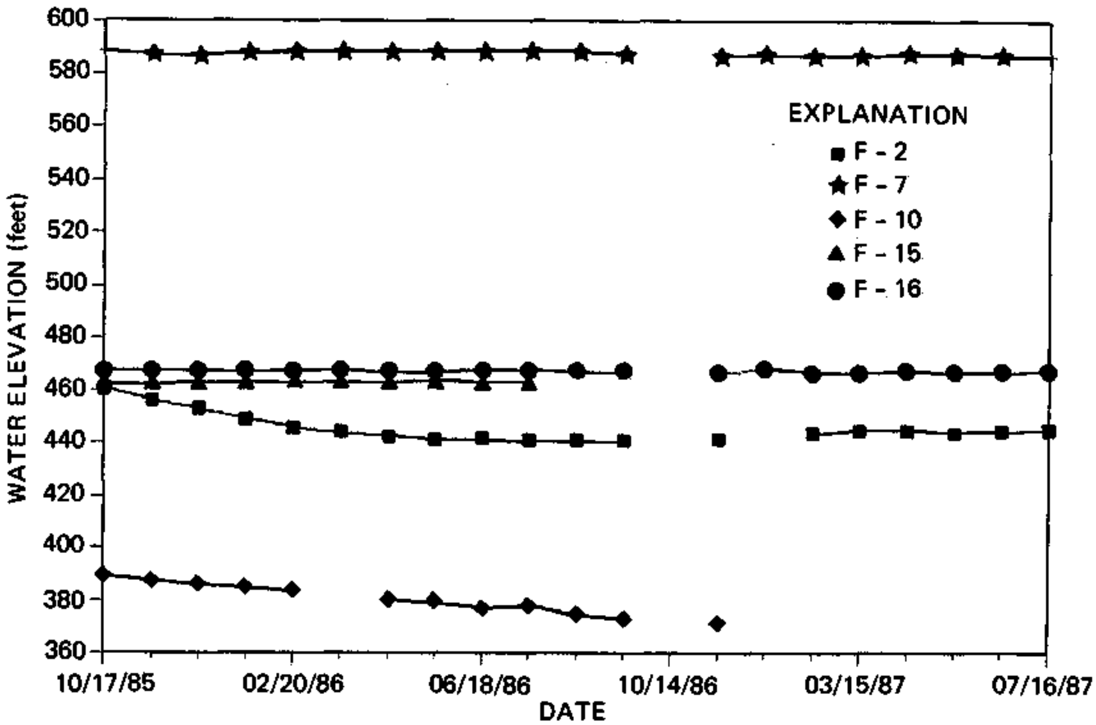


Figure 19. Comparison of hydrographs for five Galena wells

ently affected by dewatering operations in a stone quarry less than 100 feet away. Water levels at S-21, at the southwestern corner of the ring site, appear to have stabilized at an elevation of approximately 590 feet, about 100 feet above levels at S-19, 125 feet above levels at F-16, and about 230 feet above those at S-20, at the southeastern corner. It is also interesting to note that, although the bottom-hole elevation of F-16 is 50 to 100 feet higher than those for the later Galena piezometers, the west-to-east head relationship noted above shows no significant distortion, suggesting that good vertical hydraulic connection exists within this interval of the Galena.

Plattevllle Levels

As in the case of piezometers finished in the Galena Group, the discussion of water levels in the Platteville Group is divided into two parts: those for piezometers drilled in the early part of the study (F-5, F-9, F-11, F-12, F-14, and F-17), when the SSC ring target location had been only generally defined, and those drilled in 1986 (S-23, S-24, S-26, S-27, and S-30), when the location was more precisely defined. Locations of these wells are shown in figure 1.

Figure 22 shows hydrographs for piezometers F-5, F-9, F-ll, F-12, F-14, and F-17 for their periods of record. F-5, F-9, and F-17 were

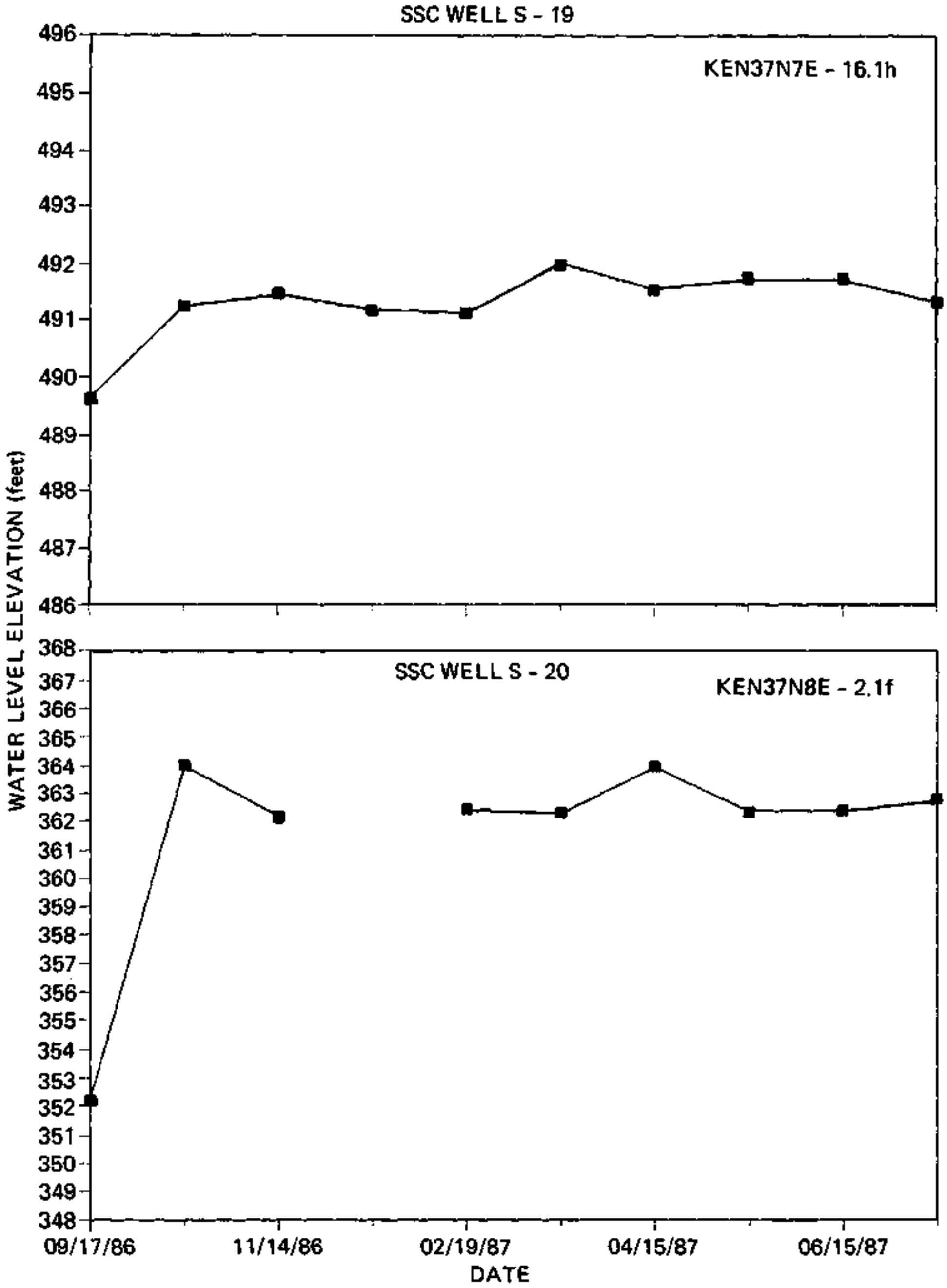


Figure 20. Hydrographs for S-19, S-20, S-21, and S-22

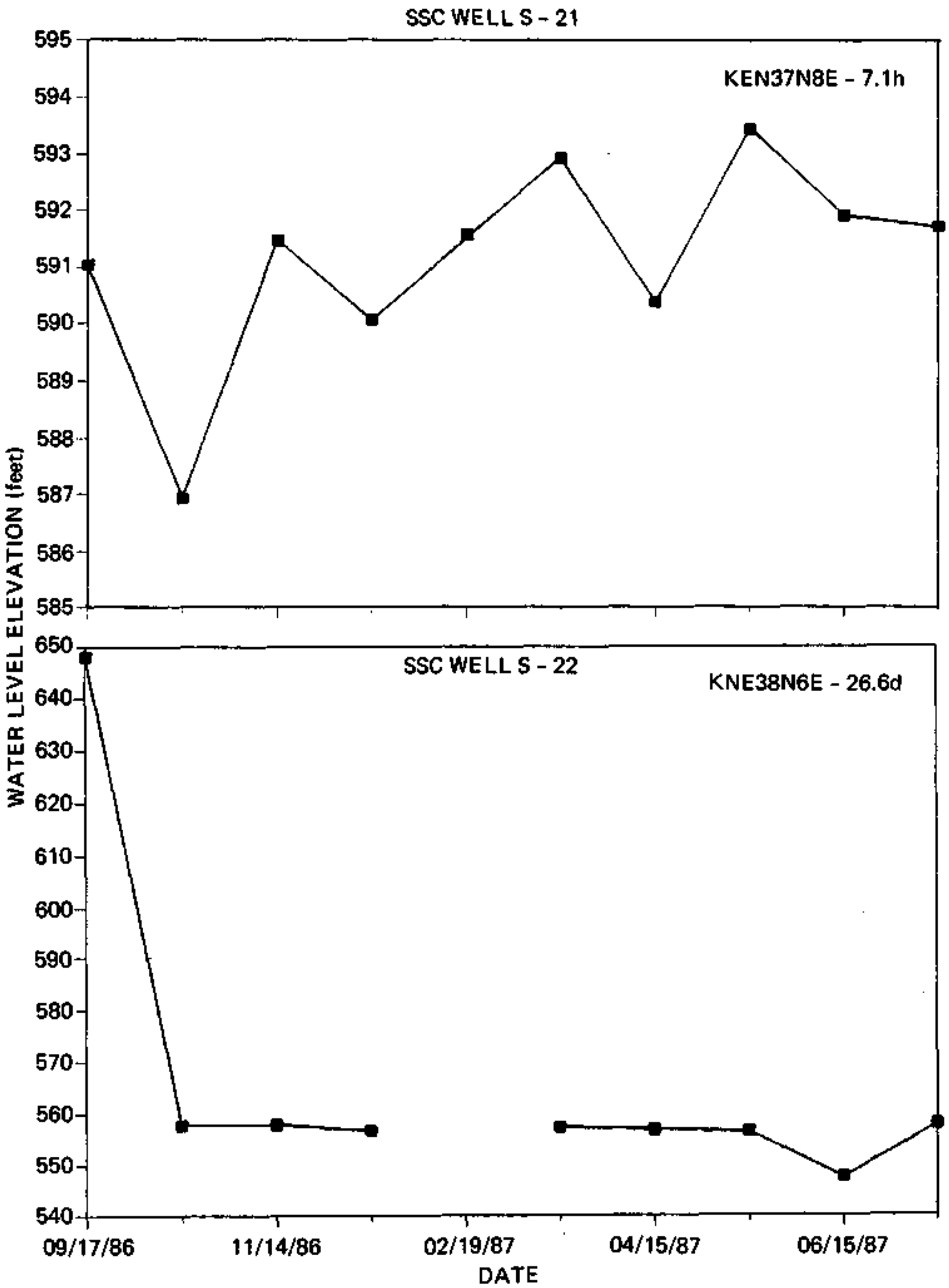


Figure 20. Concluded

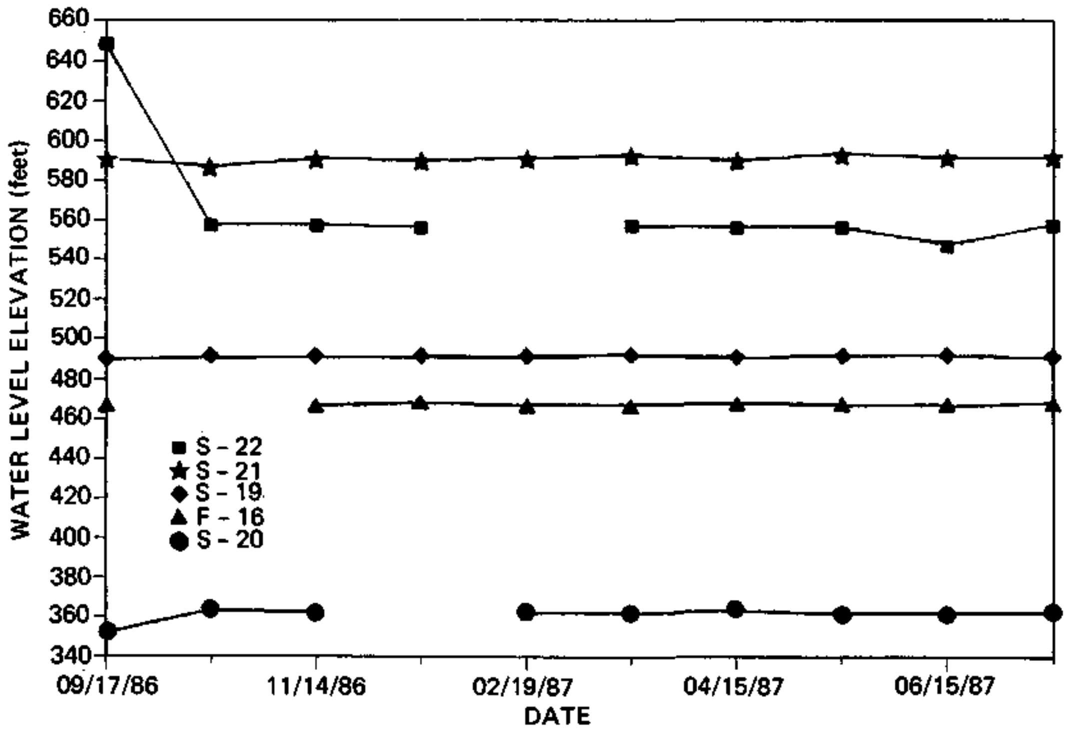


Figure 21. Comparison of hydrographs for five Galena wells in the ring corridor

abandoned and plugged in August 1986. Perhaps unique among the hydrographs for these piezometers (as well as for the rest of the SSC wells) is that for F-14. This well is located at De Kalb and is at the westernmost site of all the SSC wells. The hydrograph clearly reveals a yearly cyclic pattern, rising through the winter, spring, and early summer and falling during the rest of the year. The total fluctuation observed thus far has been about 9 feet. By contrast, hydrographs at the other five Platteville wells show much smaller fluctuations and exhibit only a subdued cyclic pattern, if any. The most reasonable explanation for the clear difference between F-14 and the other piezometers is that the Maquoketa Group at that site is thin, and the overlying glacial drift apparently does not act as a confining layer. Under these conditions, the shallow bedrock receives recharge from precipitation infiltration at a more rapid rate than at the remaining sites and is therefore more sensitive to rainfall.

Figure 23 shows the hydrographs for wells F-5, F-9, F-11, F-12, F-14, and F-17, plotted on the same graph. Water levels at F-14 are relatively stable at about 770 feet MSL, which is about 45 to 50 feet higher than levels at F-17, about 65 feet higher than levels at F-ll, 80 feet higher than at F-5, 90 feet higher than at F-9, and 175 feet higher than at F-12. A generally west-to-east head gradient exists with an average value of 14 feet per mile.

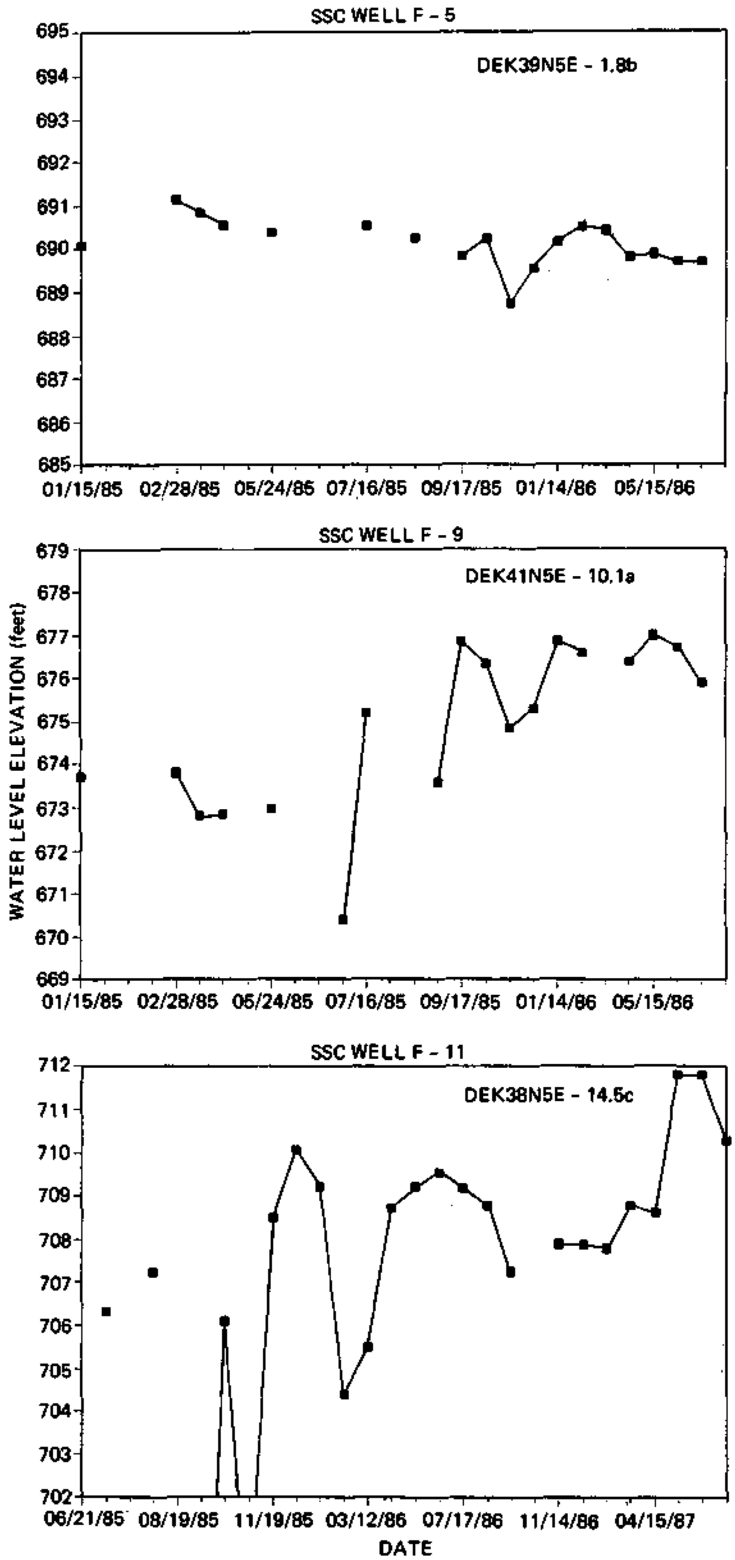


Figure 22. Hydrographs for F-5, F-9, F-11, F-12, F-14, and F-17

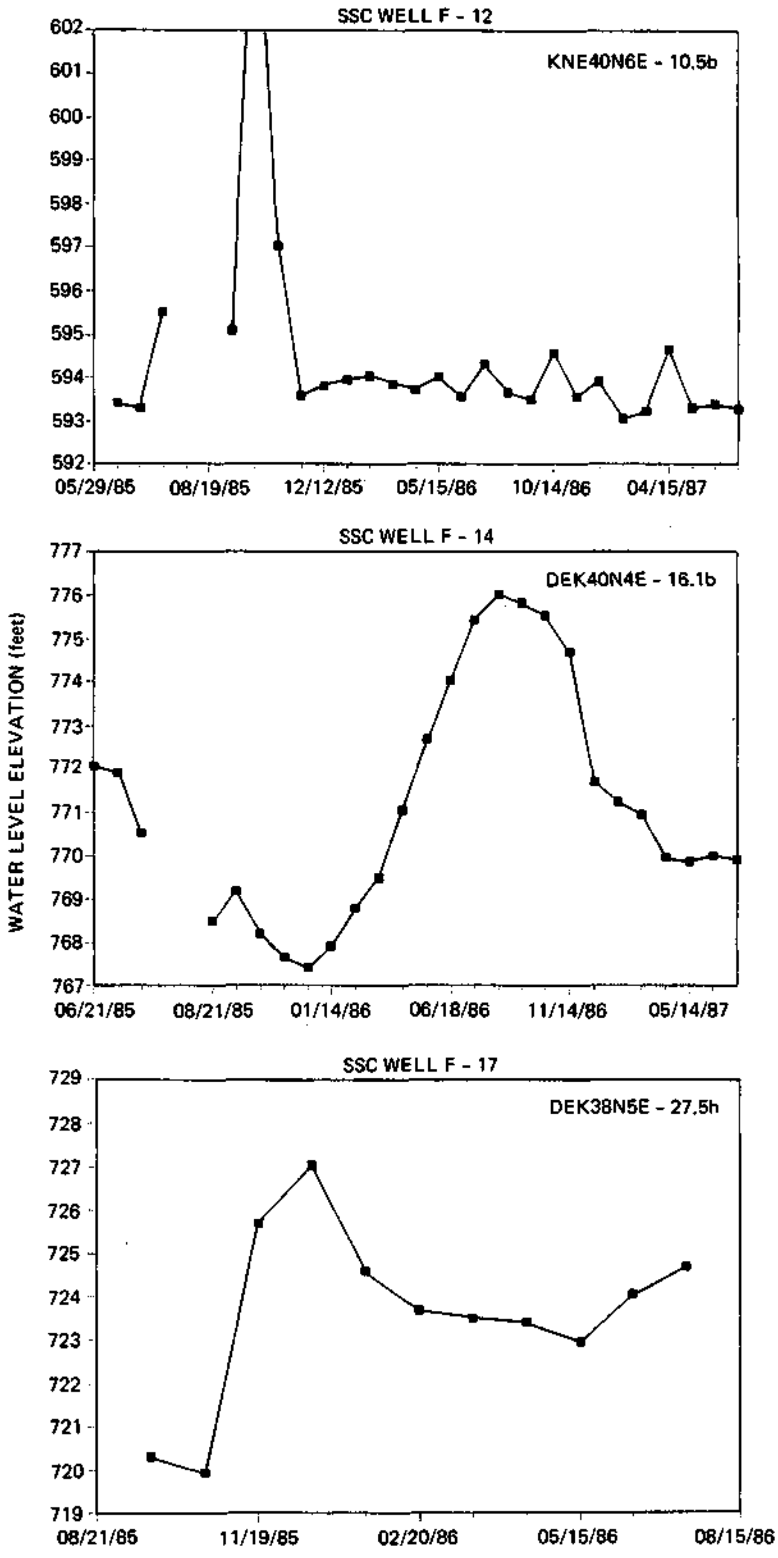


Figure 22. Concluded

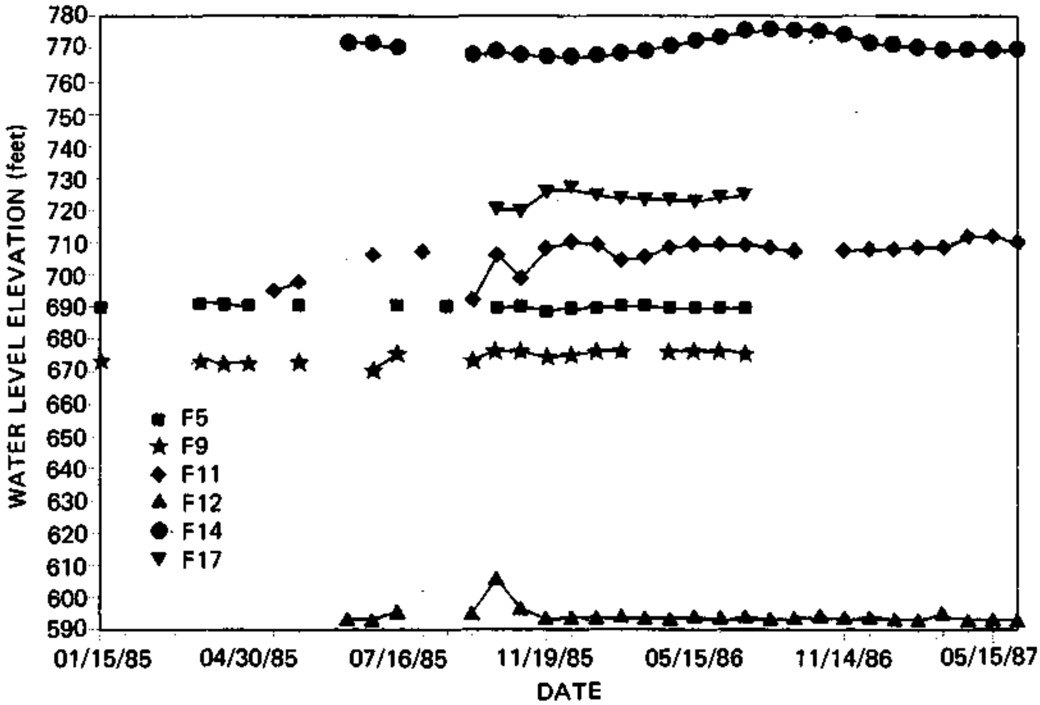


Figure 23. Comparison of hydrographs for six Platteville wells

A comparison of hydrographs for the most recently constructed piezometers in the Platteville Group (S-23, S-24, S-26, S-27, and S-30) is shown in figure 24. These wells were placed in close proximity to the final target location of the SSC tunnel. Even at this compressed vertical scale it is apparent that, during the relatively brief period of record for these wells, water levels have not fluctuated significantly. Figure 24 indicates that a west-east head gradient exists within the Platteville Group at these well sites, and that their relative head differences are stable. Water levels at the southernmost and westernmost well, S-23, are at an elevation of about 565 feet, which is approximately 15 feet above water levels at S-26 (its nearest neighbor), about 35 feet above levels at S-30, 80 feet above levels at S-24, and 130 feet above those at S-27, the northernmost and easternmost well.

Figure 25 shows a west-east profile of hydrographs from selected Platteville Group piezometers. The profile confirms the head gradient in the west-east direction observed in the ring corridor wells (figure 24). The gradient between wells F-14 and F-12, located approximately 12.5 miles apart, is about 14 feet per mile, and from F-12 to S-27 (9.5 miles to the east) the gradient is 16.5 feet per mile. The steepening of the gradient might be caused by the influence of pumpage in that direction, in both the Galena and Platteville Groups and in the deeper units of the Cambrian and Ordovician Systems. It is also likely that the hydraulic conductivities of the Galena and Platteville Groups decrease in an easterly direction because of their confinement beneath the Maquoketa Group.

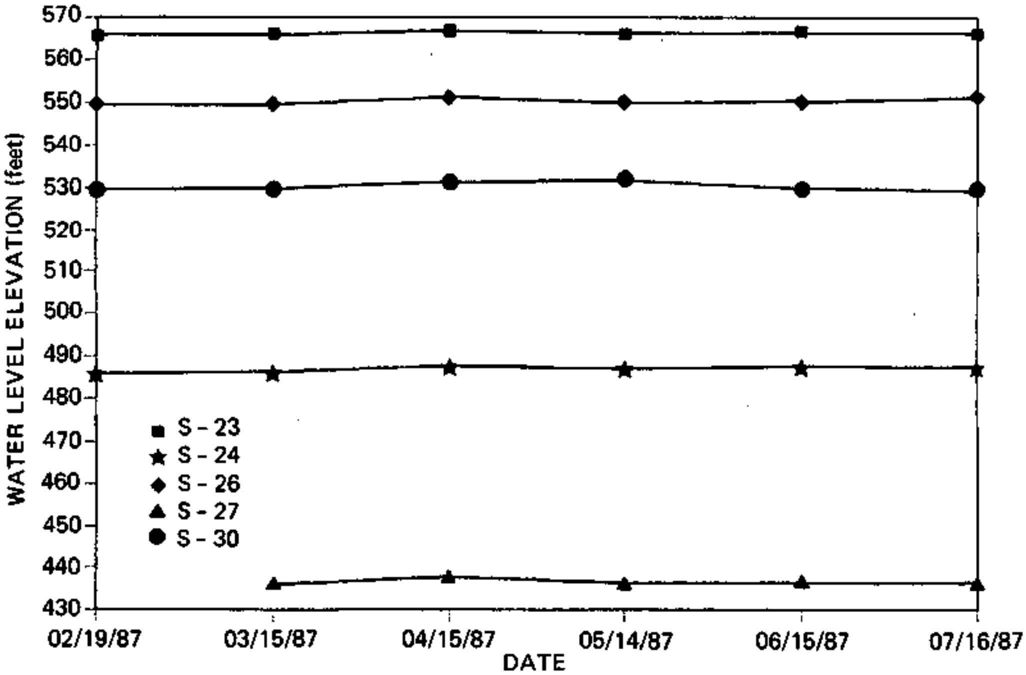


Figure 24. Comparison of hydrographs for five Platteville wells in the ring corridor

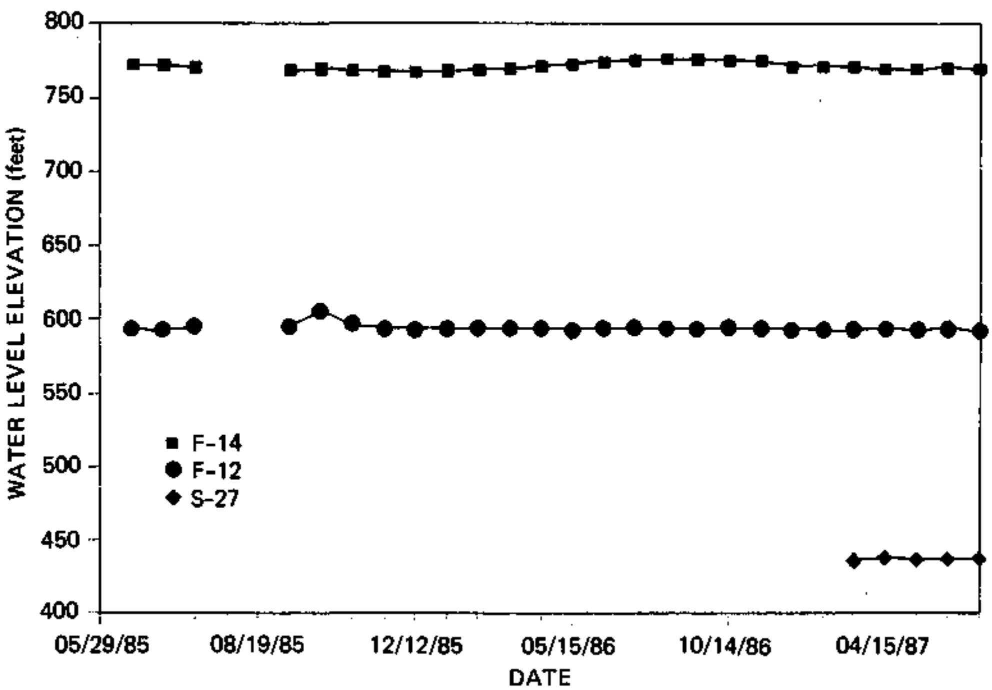


Figure 25. Comparison of hydrographs for three Platteville wells along a west-to-east profile

Nested Piezometers

As summarized in table 1, nested piezometers were installed at a vertical spacing of about 100 feet within three 8-inch test wells at Kaneland, Fermilab, and Big Rock. The bottom-hole elevations of these piezometers were approximately 400 feet, 300 feet, and 200 feet. At the Kaneland well, three major units were monitored, as piezometers were set in the Galena, Platteville, and Ancell Groups. At Big Rock the upper piezometer was completed in the Galena and the lower two in the Platteville. At Fermilab, three major units were monitored: the Maquoketa, Galena, and Platteville Groups. Figures 26 to 28 show the combined hydrographs for the three nested piezometers at each of the three test well sites.

As shown in figure 26, the hydrographs for the three nested piezometers at Kaneland are virtually identical, even though the bottom-hole elevations of the piezometers have a vertical spacing of about 100 feet. It is unlikely that this extremely close correspondence among the monthly water levels could be explained by anything other than vertical communication between the screened portions of the piezometers. Typically, this is the result of a loss of integrity and/or continuity in the grout material separating the individual screens. Total fluctuation of the water levels for the period of record has been only about 2 feet.

At the Fermilab piezometers (figure 27), water levels have stabilized and show head differences of 335 feet between the upper and middle piezometers (Maquoketa and Galena Groups) and nearly 40 feet between the middle and lower piezometers (Galena and Platteville Groups). The high head within the Maquoketa Group agrees with that at F-1, three miles to the north.

At Big Rock (figure 28), heads measured by the piezometers are much closer together than at Fermilab. A head difference of about 14 feet exists between the upper and middle piezometers (Galena and Platteville Groups), and only about a foot of head difference is typically observed between the middle and lower piezometers (both finished in the Platteville Group but separated by 100 feet). Perhaps the lower vertical head gradient at Big Rock exists because this site is located farther from significant pumpages than Fermilab is.

Summary

Of the original test holes drilled for coring and testing purposes, 21 are presently being used for water-level measurements. In addition, three sets of three nested piezometers are also being monitored. Thus far, hydrographs of these data have shown a fairly stable water-level pattern, with yearly fluctuations of only a few feet. The fluctuations appear to follow seasonal patterns in the shallower wells and in those wells closest to the recharge area to the west. A vertical head gradient of 0.85 foot per foot has been observed between the Maquoketa and Platteville Groups at Virgil in T40N, R6E. Horizontal gradients have been

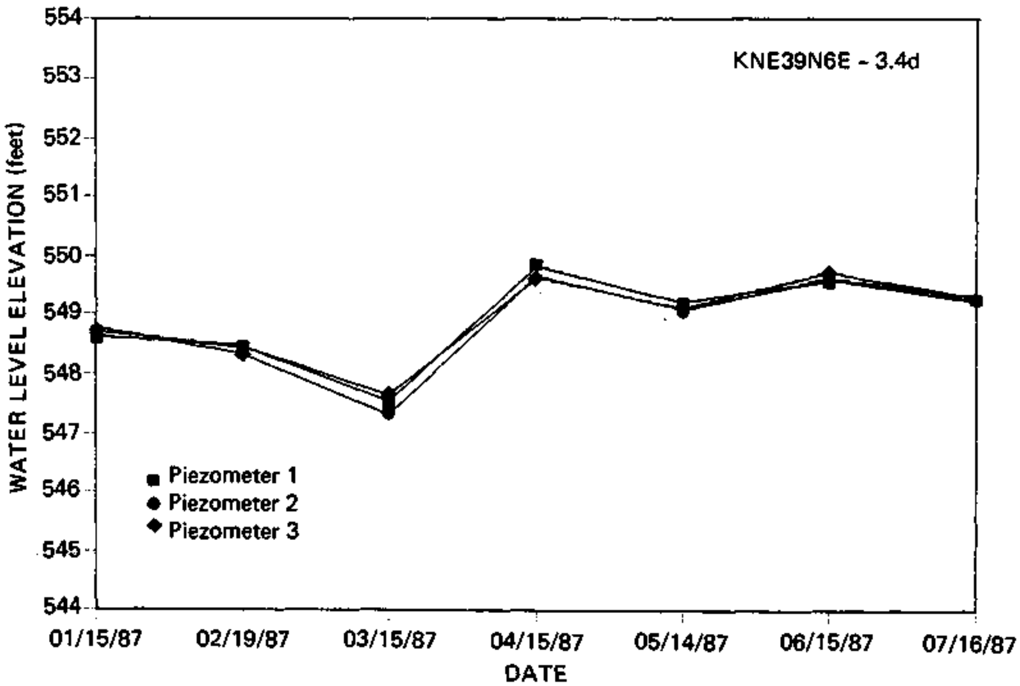


Figure 26. Comparison of hydrographs for nested piezometers at Kaneland

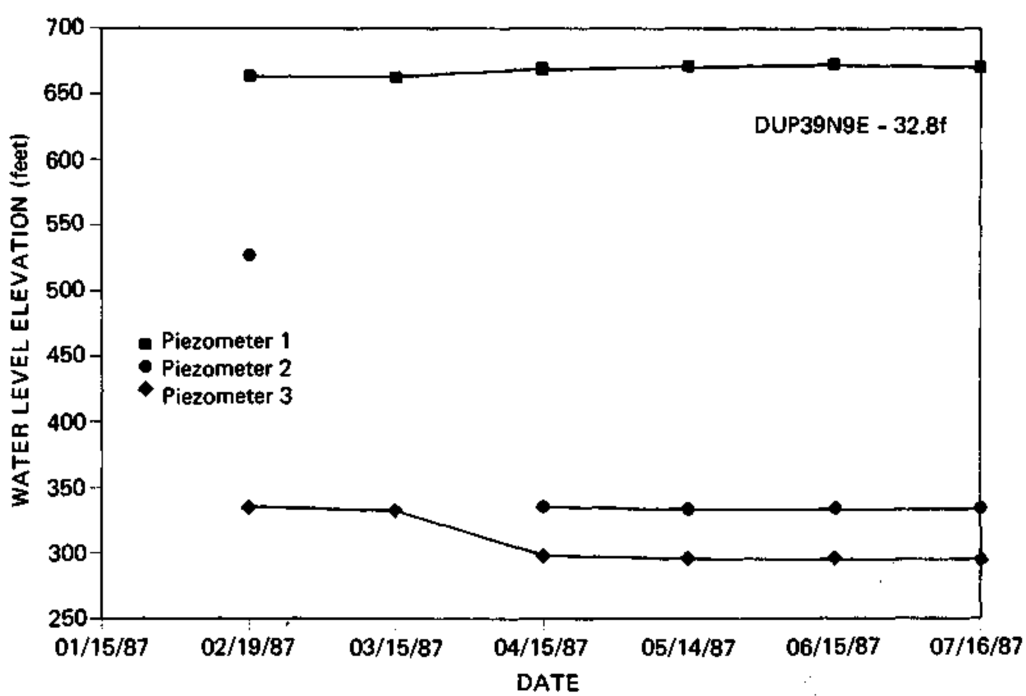


Figure 27. Comparison of hydrographs for nested piezometers at Fermilab

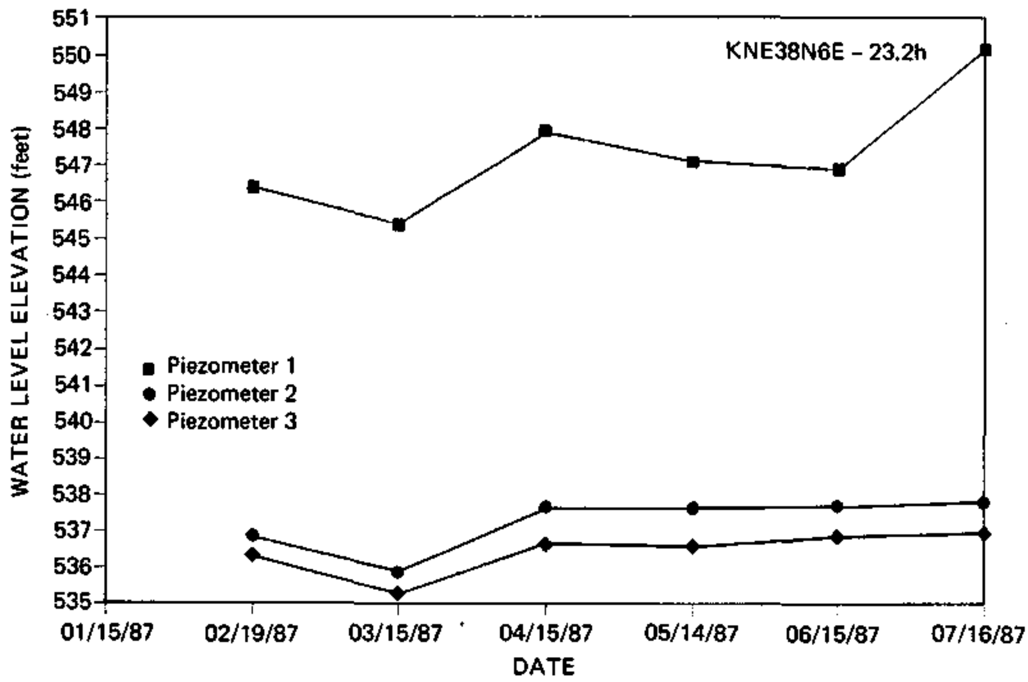


Figure 28. Comparison of hydrographs for nested piezometers at Big Rock

calculated for the Maquoketa Group (17 feet per mile SE), the Galena Group (12.5 feet per mile SE), and the Platteville Group (14 feet per mile E). Nested piezometers at Fermilab indicate a vertical gradient between the Maquoketa and Galena Groups of 3.35 feet per foot and between the Galena and Platteville Groups of 0.26 foot per foot. At Big Rock, a gradient of only 0.14 foot per foot has been measured between the Galena and Platteville Groups.

KANELAND SCHOOL AQUIFER TEST

To aid the geotechnical investigation in the final corridor selected for the SSC, several large-diameter (8-inch) test holes were constructed (see figure 1). During the fall of 1986 and the early part of 1987, three such test holes were drilled by contractors for the State Geological Survey to support the geophysical program and to obtain additional water-level data and water samples (the latter for the radioactive background study). At each of the 8-inch boreholes, geophysical logging was conducted, and three nested piezometers were later set in place within the hole.

The construction of the first of these test holes (SSC-1) into the St. Peter Sandstone at the Kaneland Middle School, about 3-1/2 miles west of Elburn, afforded the unique opportunity of conducting an aquifer test in this important aquifer. Although many water wells in northern

Illinois tap the St. Peter, a??ifer tests in this unit that employ one or more observation wells are rare. Through the cooperation of school officials, one of two wells at the school was used as an observation well in a test of Well SSC-1.

After completion of drilling to a depth of 994 feet, reaming, geophysical logging, and partial backfilling of the test hole to a depth of 946 feet, the drilling contractor set a packer near the top of the St. Peter Sandstone and set a pump below the packer to a position approximately one-third of the way into the formation. Figure 29a shows the preliminary geologic log and construction details of SSC-1, after logging had been completed but prior to the emplacement of the nested piezometers. Airlines with altitude gages were set so as to allow monitoring of water levels above and below the packer. Presumably, water levels measured above the packer would reflect conditions in the overlying Platteville Group, while those measured below the packer would monitor the St. Peter Sandstone. Water levels in Kaneland School Well 1, 900 feet SSE of the test hole (figure 29b), were measured during the test with an electric dropline.

The test pump was turned on at 8:44 a.m. on November 2, 1986, and was operated at a rate of 222 gallons per minute. Discharge was measured at a 4" x 3" orifice. At 4:00 p.m., after 436 minutes of pumping, the pump was shut off, and recovery data were collected for 60 minutes. Before the pump was shut off, a water sample was collected. The water temperature at the time of the sampling was 54°F, and an odor of hydrogen sulfide was noted in the water. The data from the test are summarized in Appendix 4.

It is important to recognize, when one examines these data, that there is a significant difference in accuracy between the altitude gages (accurate to about 1 foot of depth) installed in the test well and the electric dropline (accurate to about 0.01-0.02 foot) used in the observation well. Given these constraints, the results were nonetheless fairly interesting.

At the test well, the nonpumping water levels observed above and below the packer were 294 feet and 308 feet, respectively, below land surface (or elevations 553 feet and 539 feet MSL), indicating a head difference of -14 feet between the St. Peter Sandstone and the Platteville Group. This apparent downward gradient suggests either that a natural flow gradient exists in this area, allowing recharge to the St. Peter to occur, or that the lower head in the St. Peter merely reflects the stress created by the large pumping centers in the Cambrian and Ordovician aquifers to the east in Du Page and Cook Counties. The observed drawdown in the St. Peter after 436 minutes of pumping was about 49 feet, while water levels in the upper airline declined only about 1 foot.

The specific capacity of the test well was approximately 4.5 gallons per minute per foot. This is several times higher than that typically observed in St. Peter wells in northern Illinois (Walton and Csallany,

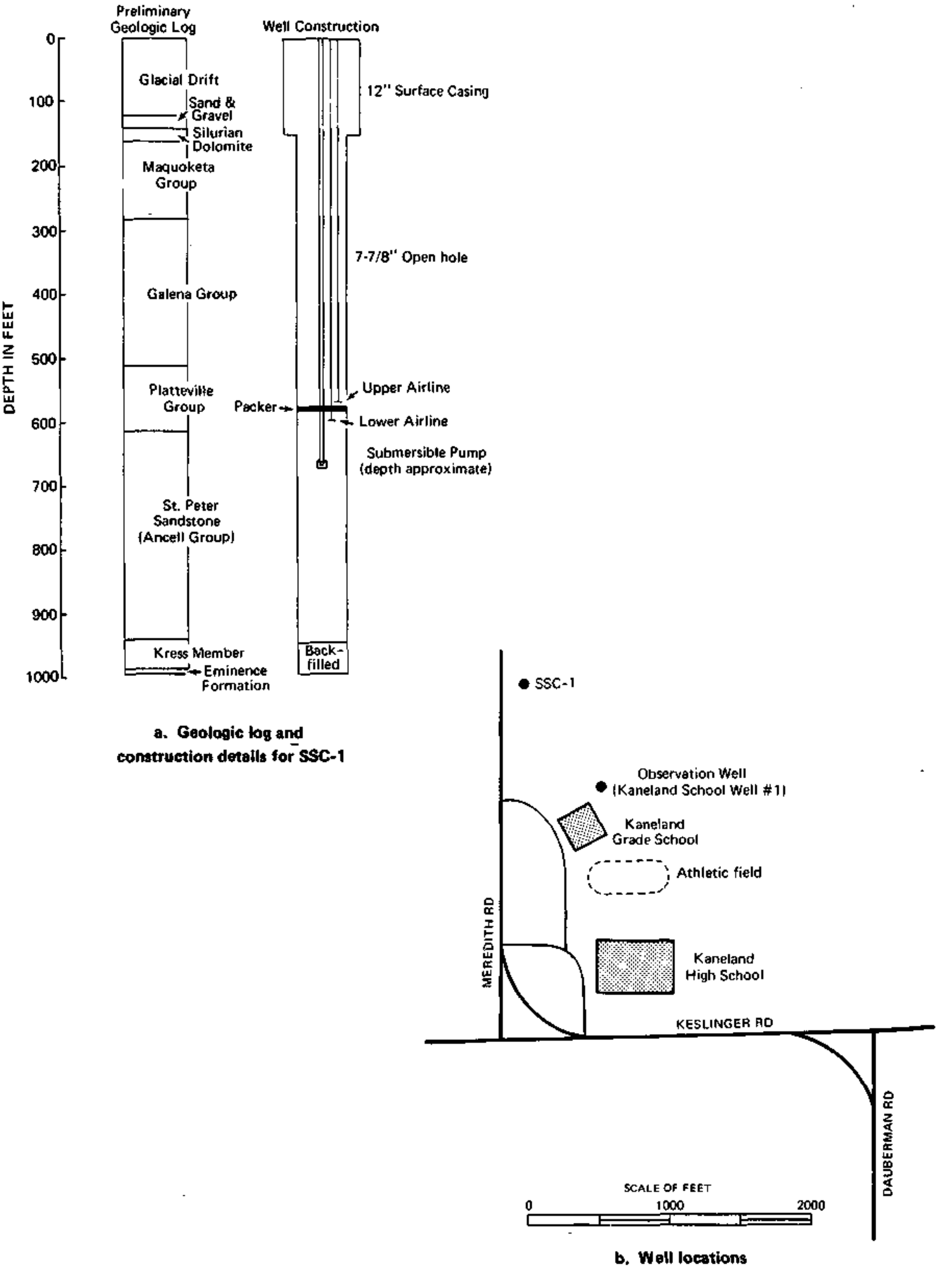


Figure 29. Geologic and construction information for test well SSC-1, and locations of wells used in aquifer test at Kaneland School

1962), but it is in agreement with the value from an 8-hour test in 1956 at the Kaneland School well. The pumping rate during that test was 127 gpm. As discussed below, the hydraulic properties of the St. Peter in this area appear to be enhanced by fracturing in the overlying formations.

The final drawdown at the observation well was 2.83 feet. A log-log graphical analysis of the time-drawdown and recovery data was made, as shown in figure 30. The results were as follows:

Transmissivity (T) = 21,200 gpd/ft

Hydraulic conductivity (K) = 62 gpd/sq ft

Storage coefficient (S) = 0.00022

Aquifer thickness (m) = 344 ft

The hydraulic conductivity was estimated by dividing the transmissivity by the thickness of the St. Peter Sandstone at the observation well (358 feet). The resultant value is nearly four times the values typically found by Walton and Csallany (1962) for northern Illinois. While the data exhibited no indication of leakage from overlying forma-

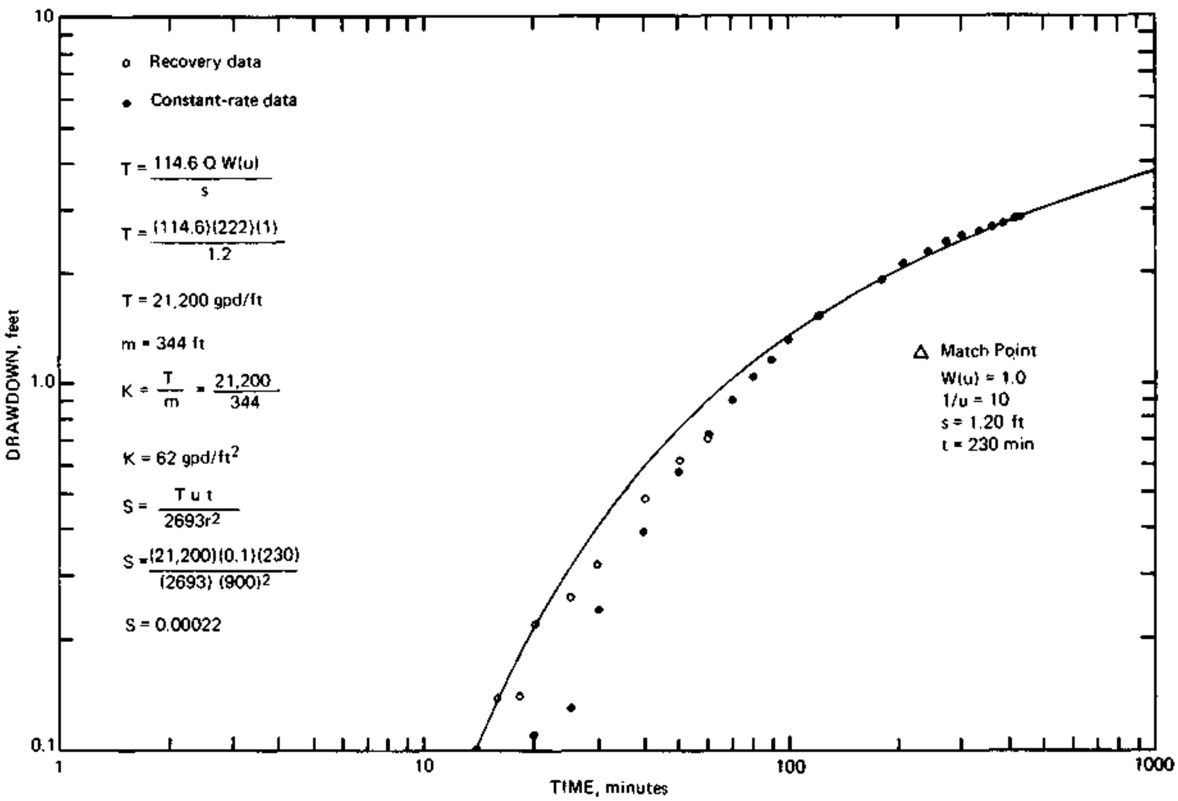


Figure 30. Graphical analysis of time-drawdown data for observation well during Kaneland test

tions, they did suggest that some contribution to the well discharge was possibly coming out of storage from above the St. Peter during the early portion of the test (up to about 100 minutes). During this period of time, drawdowns fell below the nonleaky (Theis) type curve. After about 100 minutes, the data points fell on the type curve for the remainder of the test.

The conjecture concerning water from storage above the St. Peter is certainly plausible in light of the significant fracturing observed by a downhole TV camera during the logging work at the test hole. While additional data would be needed in order to more adequately test the hypothesis, data from both the 1956 test at the school well and the 1986 test at the SSC well suggest that the hydraulic properties of the St. Peter Sandstone are significantly higher than normal and are apparently enhanced by hydraulic connection with overlying fractured formations.

WATER QUALITY

Introduction

During the mass water-level measurement in the summer of 1986, ten water samples were collected from selected domestic wells finished in bedrock formations throughout the SSC study area. An additional water sample was collected during the aquifer test at the Kaneland test well (SSC-1) on November 2, 1986. The locations of these sampling sites are shown in figure 31.

The purpose of collecting water samples was to test the quality of water in the upper bedrock (Silurian Dolomite through the Ancell Group) in the vicinity of the SSC tunnel corridor. Two of the eleven wells sampled were open to the Silurian and to the Maquoketa Group, five were open to both the Maquoketa and Galena Groups, two were open only to the Galena Group, one was open from the Galena through the Ancell Group, and one was open only to the Ancell. Well depths ranged from 200 to 946 feet. Table 2 is a summary of the major chemical constituents found in the eleven samples. With one exception, iron content was less than or equal to 0.70 mg/L, and total dissolved minerals ranged from 311 to 487 mg/L.

Water Chemistry

Water samples can be compared in a variety of ways. The most useful procedure is to categorize water samples by type according to their major cationic and anionic constituents. These constituents can then be analyzed either graphically or quantitatively to determine similarities or differences.

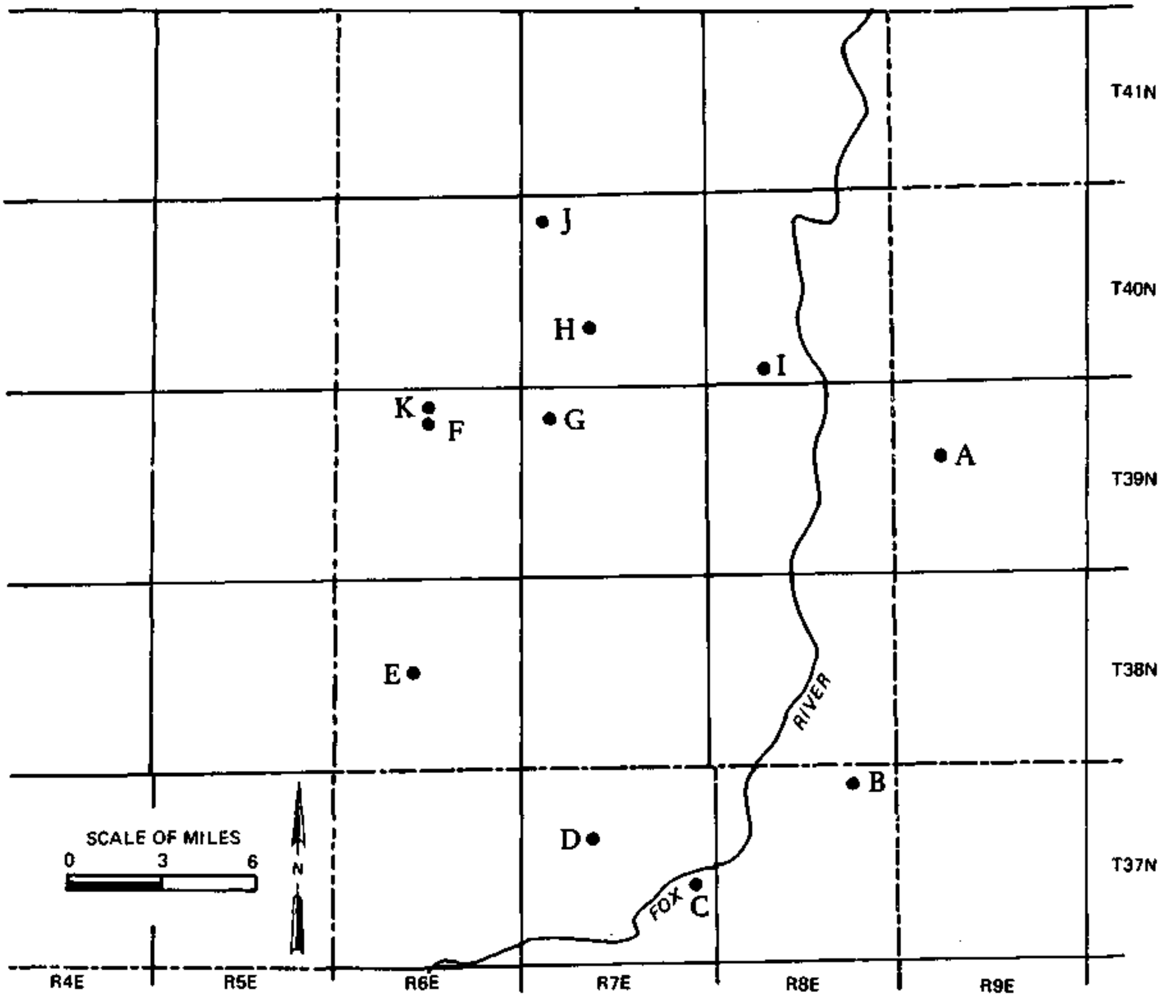


Figure 31. Locations of water sampling sites

One graphical approach considers the values of the major anions and cations expressed as percentages of their total milliequivalents per liter. In this way, the composition of the water can be represented conveniently by a trilinear plot (Hem, 1985). The simplest of these plots uses two equilateral triangles, one for anions and one for cations. Each vertex represents 100 percent of a particular major ion or combination of ions (such as sodium plus potassium). The composition of the water with respect to the major cations is indicated by a point plotted in the cation triangle at the coordinates corresponding to the percentage values of the three cations. The coordinates at each point add up to 100 percent. A similar relationship exists in the anion triangle.

Hill (1940) and Piper (1944) independently introduced an extension of the trilinear plotting technique, whereby the cation and anion tri-

Table 2. Results of Analyses of Water Samples from SSC Study Area

Sample	Well depth (ft)	Aquifer	Concentrations* Fe	Ca	Mg	Na+ K	Cl	SO4	Alk. (CaCO3)	Total diss. min.
A	216	Sil/Maq	0.61	2.52	2.50	1.85	0.23	1.04	5.76	381
B	305	Sil/Maq	0.37	3.09	2.63	0.99	0.14	0.83	6.08	373
C	282	Maq/Gal	0.05	2.64	2.06	4.03	0.99	1.87	5.60	486
D	200	Maq/Gal	6.77	4.49	3.70	0.27	0.23	2.08	6.56	487
E	305	Maq/Gal	0.55	3.14	2.79	0.99	0.23	<0.21	7.06	363
F	930	Gal/Anc	0.03	2.79	2.16	1.01	0.03	<0.28	6.08	318
G	420	Galena	0.02	2.49	1.70	1.98	0.25	0.21	5.76	336
H	600	Maq/Gal	0.01	1.56	1.24	4.61	0.31	1.04	6.16	414
I	440	Maq/Gal	0.31	2.39	3.21	0.75	0.03	<0.21	6.48	331
J	530	Galena	0.70	2.03	1.77	2.52	0.17	<0.21	6.24	343
K	946	Ancell	0.12	2.59	2.24	0.91	0.06	0.06	6.10	311

*All in meq/L except for iron and total dissolved minerals (mg/L)

angles are combined. Their procedure is to place the two triangles at the bottom of a graph such that their bases align vertically. The upper central portion of the graph is diamond-shaped. In using this graph the points in each triangle are extended upwards into the central field by projecting them along lines parallel to the upper edges of the central field. The intersection of these projections represents the composition of a particular water with respect to the combination of cations and anions. The form of trilinear diagram suggested by Piper is used in this report and is shown in figure 32. In the hypothetical samples shown, sample A projects into the central field as a calcium-magnesium bicarbonate type of water, while sample B projects as a sodium chloride type.

Another graphical technique, described by Schoeller (1935, 1955, 1962), plots ionic concentrations, in milliequivalents per liter, on semi-logarithmic graph paper. Waters of similar composition plot as near-parallel lines and exhibit patterns unique to that type. Figure 33 shows a Schoeller plot of the same hypothetical samples depicted in the Piper plot.

In addition to graphical methods, the expression of the relationship of individual ions to one another or to a group in terms of a ratio may make resemblances or differences among waters more apparent. When related to one another, ratios are usually calculated with concentrations in milliequivalents per liter; however, when ionic concentrations are com-

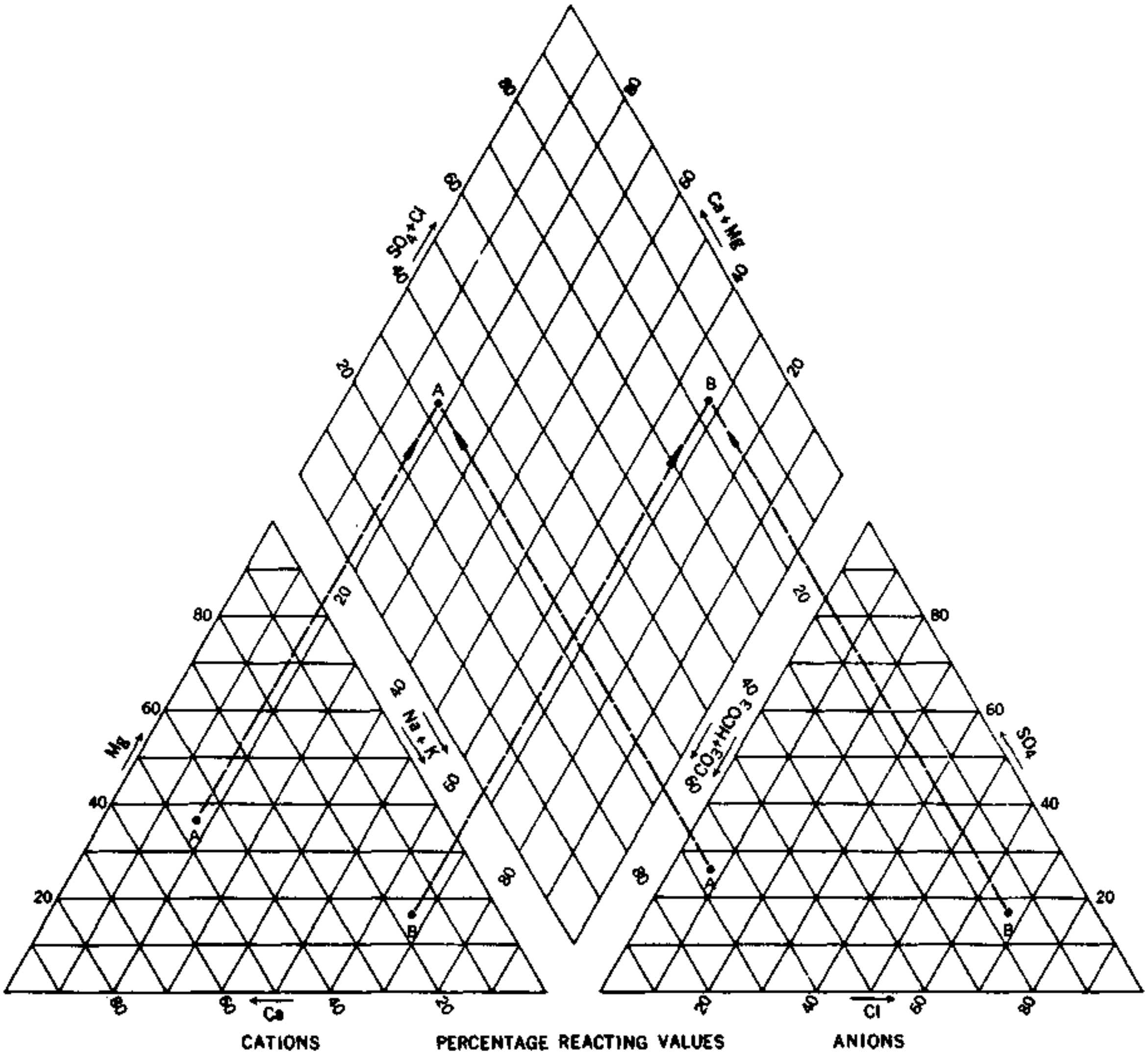


Figure 32. Example of Piper trilinear diagram with hypothetical analyses

pared with total dissolved minerals, the concentrations are given in milligrams per liter.

To facilitate an interpretation of the chemistry of the 11 water samples (A-K) collected during the summer and fall of 1986, graphical and quantitative analyses, as described above, were applied to these data. For comparison, similar studies were applied to chemical analyses from 38 selected municipal wells in the study area. The construction features of these wells are such that they are open to a variety of glacial drift and bedrock aquifers, from the Silurian dolomite to the Ironton-Galesville Sandstone. Table 3 lists the locations and depths of these wells, and the aquifers to which they are open.

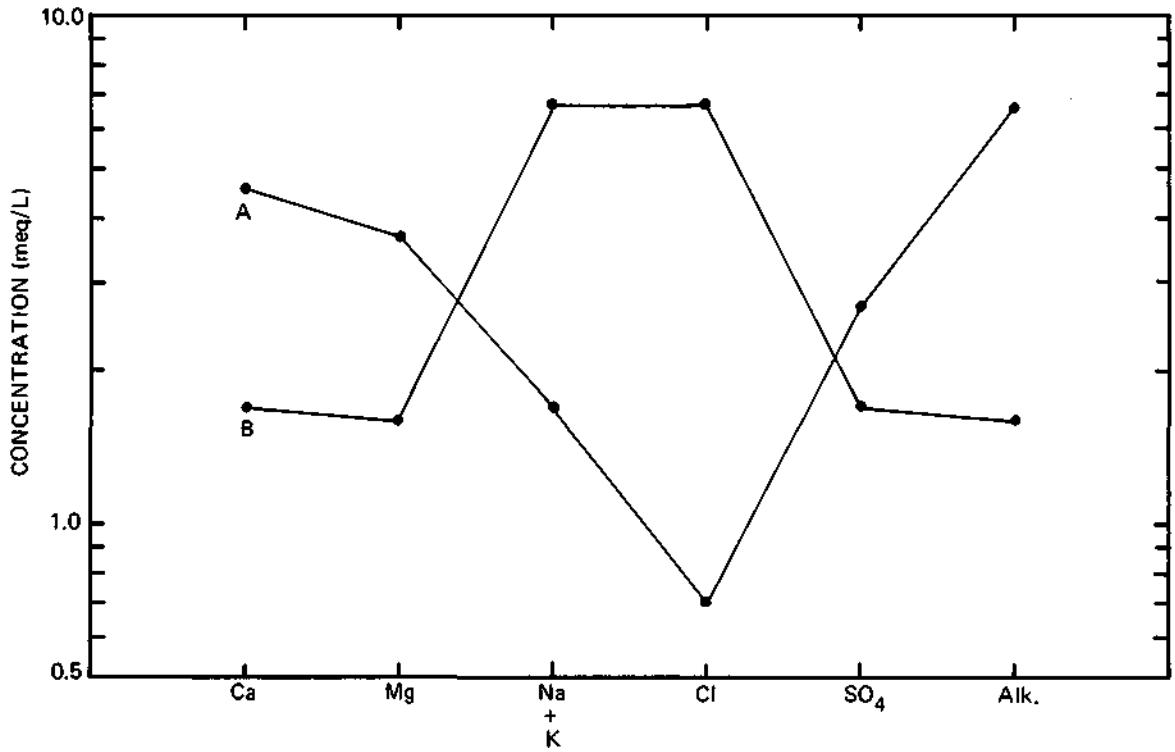


Figure 33. Example of Schoeller graphical plot of hypothetical analyses

Analyses

Samples A and B

Figure 34 shows a Piper plot of samples A and B (from wells open to both the Silurian Dolomite and the Maquoketa Group). The figure also shows the water quality of glacial sand and gravel deposits, the Silurian, and the Maquoketa, depicted as envelopes. Data from wells listed in table 3 were used to define the outlines of the envelopes.

For the most part, the central field plots of both samples A and B and the envelopes for wells from table 3 show water types which can be characterized as calcium-magnesium bicarbonates. If one draws a straight line from the sodium apex of the cation triangle of figure 34 through both the envelopes and points, a fairly close fit is obtained, suggesting that a stable ratio of calcium to magnesium exists for all these waters. The intersection of this line with the calcium/magnesium base line (52.5% calcium, 47.5% magnesium) allows one to calculate an average Ca/Mg ratio of about 1.1. The average Ca/Mg ratios for glacial, Silurian, and Maquoketa waters were calculated independently to be 1.18, 1.06, and 1.12, respectively, thereby providing close agreement with the graphical slope value. Alkalinity for these groups constituted an average of 76,

Table 3. Wells Selected for Interpretation of Regional Water Quality

Location	Well	Depth (ft)	Aquifer*
COK41N9E-34.1b	Bartlett #3	97	S&G
DEK37N5E-32.1c	Somonauk #2	502	Anc/Fran
DEK37N5E-36.8g	Sandwich #2	600	E-P/I-G
DEK38N4E-15.8d	Waterman #3	400	Gal/Plt
DEK38N5E-15.2d	Hinckley #2	708	Gal/Anc
DEK40N4E-33.1h	De Kalb #12	1200	Gal/I-G
DEK41N5E-32.7g	Sycamore #6	1214	Anc/I-G
DEK42N5E-20.7a	Genoa #4	770	Gal/Anc
DUP39N9E-5.4d	West Chicago #6	325	Silurian
KNE38N7E-10.2b	Prestbury Sbd. #1	200	Maquoketa
KNE38N7E-21.5e	Sugar Grove #2	107	S&G
KNE38N8E-8.3e	Aurora #25	1340	Anc/I-G
KNE38N8E-18.8b	Aurora TW10-84	123	S&G
KNE38N8E-24.4e	Ogden Gardens #3	185	Silurian
KNE38N8E-25.8g	Wermes Sbd. #2	253	Silurian
KNE38N8E-26.2h	Moecherville Sbd.#3	196	Silurian
KNE38N8E-32.3c	Montgomery #2	718	Gal/Anc
KNE38N8E-33.4h	Montgomery #10	82	S&G
KNE38N8E-34.2g	Bangs-Union-Parker#1	260	Maquoketa
KNE39N7E-5.8f	Elburn #2	153	S&G
KNE39N8E-5.8a	Geneva #8	150	S&G
KNE39N8E-25.1e	Fermilab FNAL-1	224	Silurian
KNE40N6E-30.7a	Maple Park #3	182	S&G
KNE40N7E-16.4c	Ferson Cr. Sbd. #2	186	S&G
KNE40N7E-16.6e	Ferson Cr. Sbd. #1	1409	Gal/I-G
KNE40N8E-15.4a	Highland Sbd. #1	152	Maquoketa
KNE40N8E-28.8a	St. Charles #7	173	S&G
KNE40N8E-31.7f	Ill.Youth Ctr. #5	1292	Anc/I-G
KNE40N8E-34.6f	St. Charles #6	1502	Gal/I-G
KNE41N8E-16.4d	Elgin #3A	1378	Gal/I-G
KNE41N8E-34.1h	South Elgin #4	109	S&G
KNE42N8E-11.6d	Lk. Marian Wds. Sbd#2	251	Maquoketa
KNE42N8E-23.8c	E. Dundee Spring	-	S&G
KEN37N6E-19.5b	Hollis Park Sbd. #1	200	Gal/Plt
KEN37N6E-23.8c	Plano #5	41	S&G
KEN37N7E-32.1e	Yorkville #3	1335	Anc/I-G
KEN37N8E-7.1h	Marina Village Sbd#2	700	Maquoketa
KEN37N8E-17.2e	Oswego #4	1396	Anc/I-G

*Anc: Ancell Grp; E-P: Eminence-Potosi dol.; Fran: Franconia Fm.; Gal: Galena Grp; I-G: Ironton-Galesville Ss.; Maquoketa: Maquoketa dol.; Plt: Platteville Grp; S&G: Glacial sand & gravel; Silurian: Silurian dol.

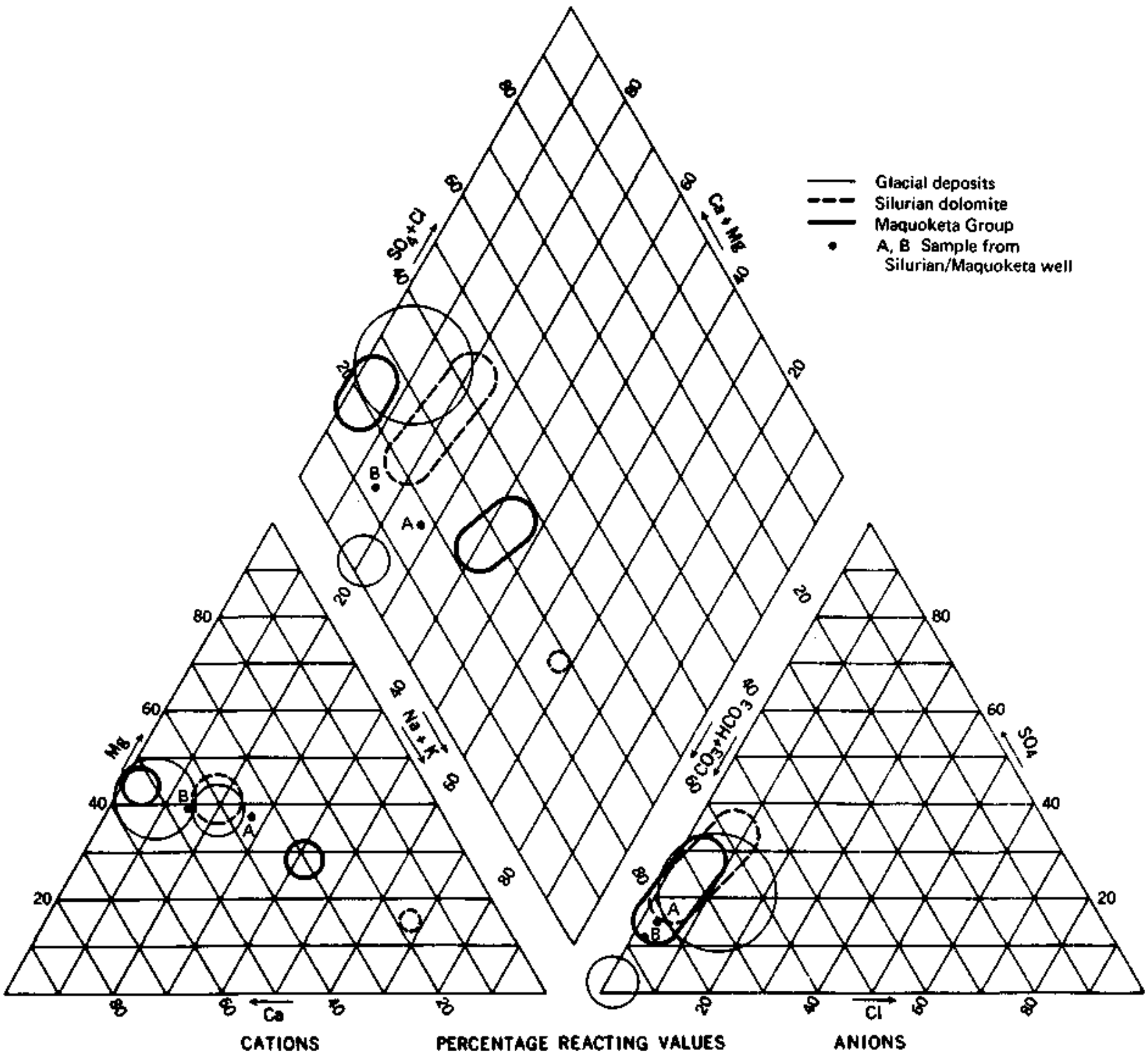


Figure 34. *Piper plot of samples A and B as well as envelopes of data from glacial, Silurian, and Maquoketa wells*

70, and 74%, respectively, of their total anionic equivalents, while for samples A and B, alkalinity amounted to 82% and 86%, respectively, of the total anion equivalents.

For comparison, Schoeller plots were also constructed for samples A and B as well as for chemical data from selected wells open to the Silurian and the Maquoketa (figure 35). The plots are all quite similar in shape, especially those for the anions, which corroborates the evidence of similarity of water type shown in the Piper graph of figure 34.

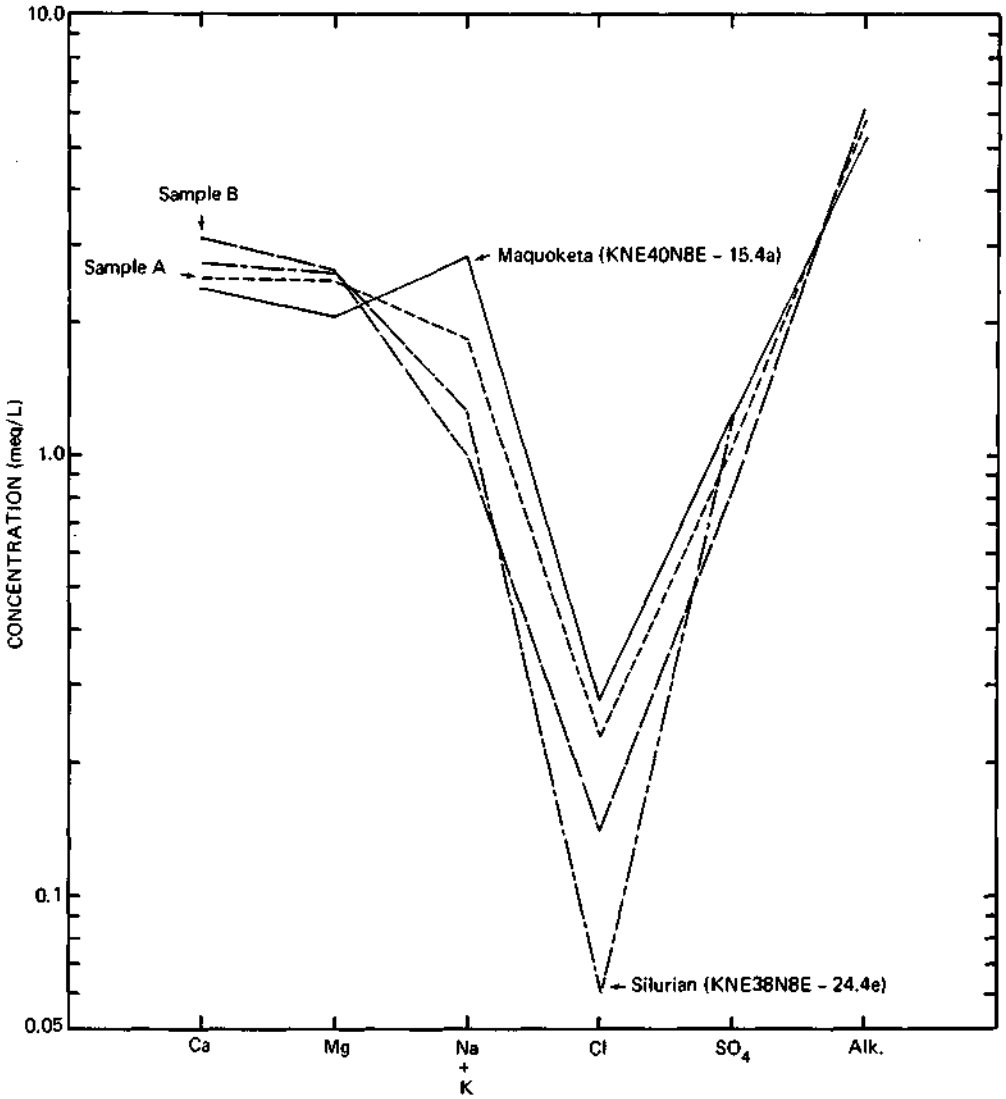


Figure 35. Schoeller plots of samples A and B and of data from selected Silurian and Maquoketa wells

Samples C, D, E, G, H, I, and J

Figure 36 shows a Piper plot of samples C, D, E, H, and I (open to both the Maquoketa and Galena Groups) and samples G and J (open to the Galena Group alone). Also shown are envelopes of water quality data for wells open to the Maquoketa, Galena, and Platteville Groups, and the Galena through Ancell Groups. As was the case in figure 34, data for the envelopes were obtained from water analyses for wells listed in table 3.

Plots of three of the samples from Maqubketa/Galena wells (samples D, E, and I) fall into or very close to the Maquoketa or the Galena-Platteville/Ancell envelopes. Water from these aquifers is very similar

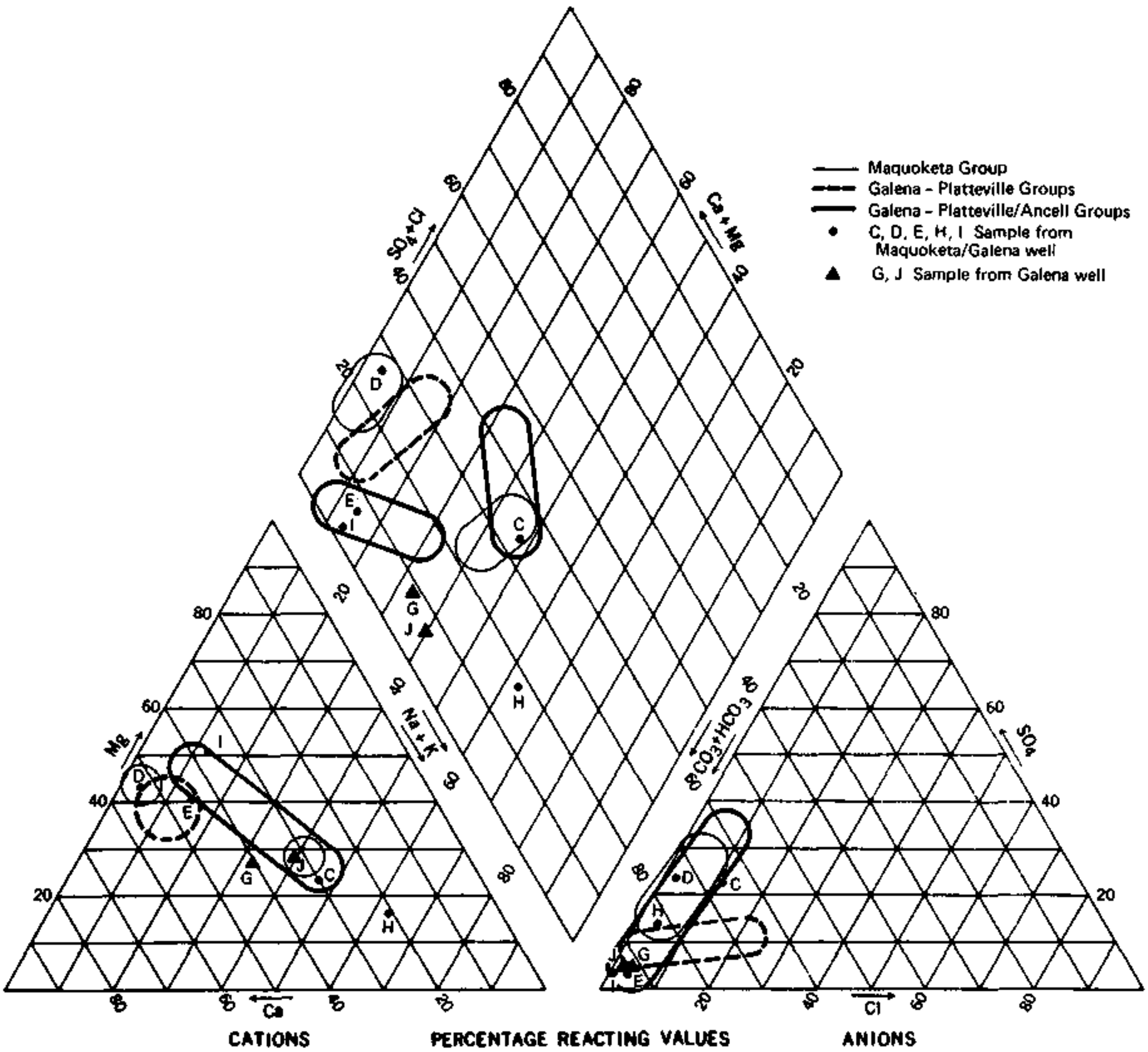


Figure 36. Piper plot of samples C, D, E, G, H, I, and J and of data from wells in the Maquoketa, Galena-Platteville, and Galena-Platteville/Ancell Groups

in type to that observed for the glacial and Silurian waters represented in figure 34 -- a calcium-magnesium bicarbonate. Schoeller plots of these waters also bear a strong resemblance to those in figure 35 and are therefore not shown. Their average Ca/Mg ratio is 1.02, which agrees with the slope of a best-fit line from the sodium apex through these points, while alkalinity accounts for between 74 and 96% of their total anionic equivalents.

Samples C and H can more accurately be categorized as sodium-calcium bicarbonates, with sodium plus potassium accounting for 46% and 62%, respectively, of their cationic equivalents, and alkalinity being 66% and 82%, respectively, of their anionic equivalents. Their average

Ca/Mg ratio of 1.27 is nearly 25% higher than that for samples D, E, and I. The central field location of sample H indicates that it is somewhat different from the typical waters of these aquifers and is closer to resembling some of the Silurian waters plotted in figure 34.

Samples G and J (Galena Group only) are strongly bicarbonate waters; alkalinity accounts for 93% and 94%, respectively, of their anions. Although their Ca/Mg ratio is relatively high (1.30) compared to that of samples D, E, and I, their cation equivalents are within a few percentage points of being equally distributed. This can be seen graphically by noting their location with respect to the center of the cation triangle in figure 36.

Samples F, G, J, and K

Figure 37 shows Piper plots of samples F (Galena through Ancell Groups) and K (Ancell Group alone), along with plots of samples G and J (Galena Group alone) again. Samples G and J were included once more in figure 37 to see whether their central field coordinates would have any greater correspondence with the aquifer envelopes in this figure than with those in figure 36. Envelopes were constructed for Galena through Ancell, Galena through Ironton-Galesville, and Ancell through Ironton-Galesville combinations of aquifers taken from table 3.

Sample F (Galena/Ancell) falls within the Galena/Ancell envelope in the central field, indicating good agreement with the regional data, and sample K (Ancell) is very close to both the Galena/Ancell and the Ancell/Ironton-Galesville envelopes. All four samples are strongly bicarbonate in their anionic type, averaging 95% alkalinity among the anion equivalents. Their Ca/Mg ratio ranges from 1.15 to 1.46, averaging 1.26. Samples F and K were observed to exceed the drinking water standard of 1.0 mg/L for barium, with concentrations of 2.40 and 2.29 mg/L, respectively.

Samples G and J (Galena) fall within or close to the Galena/Ironton-Galesville envelope and show a closer correspondence to this grouping than to either the various Galena groupings in figure 36 or the Silurian groupings of figure 34, speculated about earlier.

One of the noticeable characteristics of water from wells open from the Galena through the Ironton-Galesville is that a northwest-southeast trend exists among several of the ionic constituents as related to total anions or cations. For example, alkalinity decreases from 96% of the anion equivalents in northwestern Kane County to about 64% in northeast Kendall County. At the same time, sulfates increase from 4% to 28% of the anion equivalents. Among the cation equivalents, sodium plus potassium increases from 8% in the northwest to 45% in Kendall County. These trends probably reflect the mineralization activity that takes place as water slowly percolates over this lengthy flow path (Visocky et al., 1985).

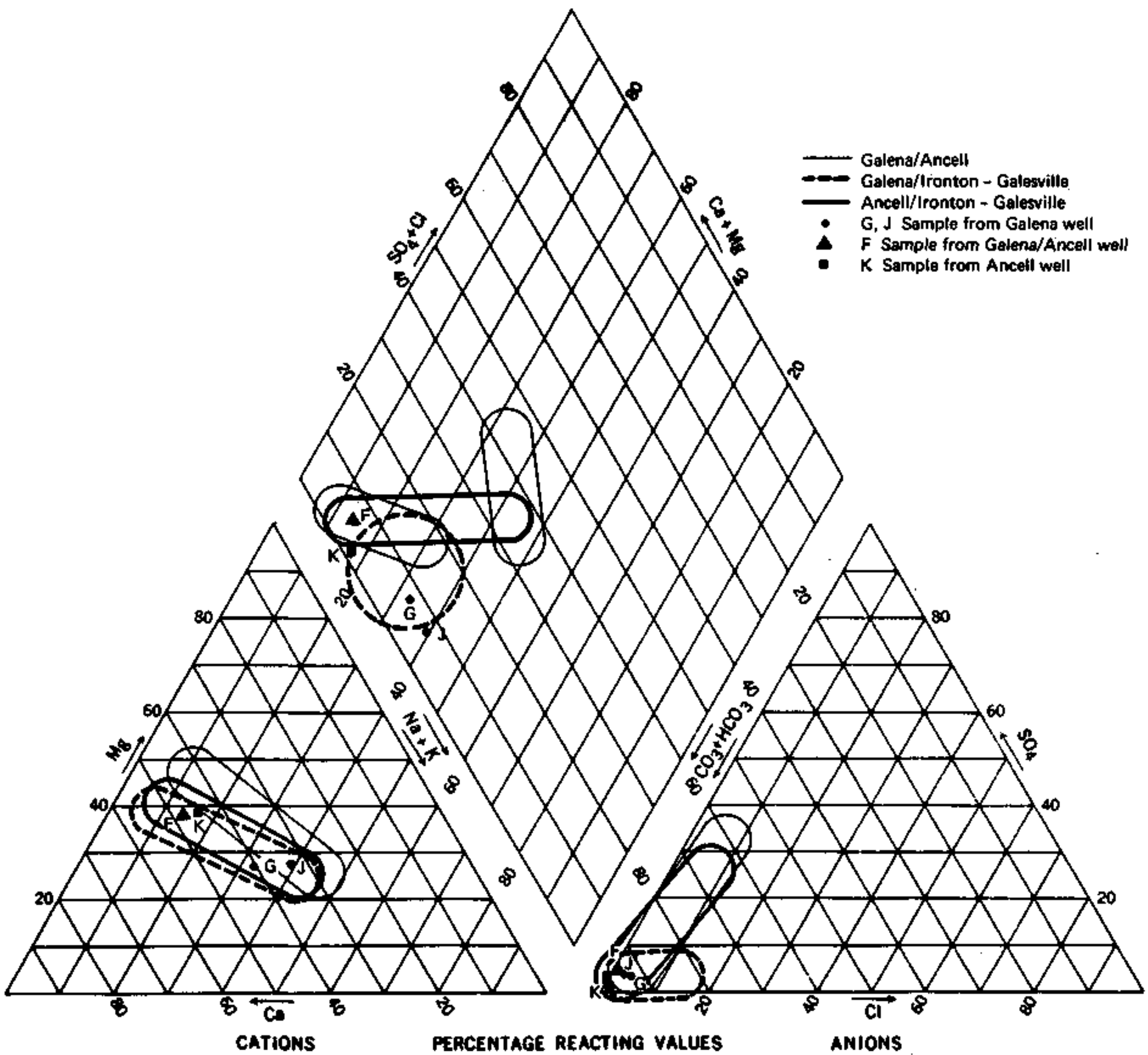


Figure 37. Piper plot of samples F, G, J, and K as well as envelopes of data from Galena/'Ancell, Galena/Ironton-Galesville, and Ancell/Ironton-Galesville Units

Conclusions

Graphical and quantitative analyses of the chemical data from water samples collected at selected sites in the SSC study indicate that, for the most part, these waters are typical of waters found in the various aquifers and aquifer groupings penetrated by water-supply wells. As a type, these waters are usually characterized as calcium-magnesium bicarbonates, with moderate amounts of mineralization, normally requiring some softening for household use.

CURRENT AND PROJECTED GROUND-WATER USE

Introduction

This portion of the report summarizes current and projected pumpage for each of the 36 townships in the original SSC study area and for each of the three primary aquifer systems in northeastern Illinois: 1) glacial sands and gravels, 2) shallow dolomite, and 3) Cambrian and Ordovician aquifers.

Initial Projections

Current water use was summarized from the Illinois Water Inventory Program (IWIP) at the State Water Survey. The projection analysis was begun in late 1985, in order to use population figures which were available in five-year increments; but because 1985 pumpage figures were not as yet available, they were projected from 1980 withdrawal data. Projected water use was estimated primarily from anticipated population figures from the State of Illinois, Bureau of the Budget (1984) and took into account present conditions, such as aquifer sources, and anticipated conditions, such as the Lake Michigan allocations (Visocky, 1982) and Elgin's Fox River withdrawals. The projection analysis in most cases was based on an assumption of no changes in per capita consumption. The tabulated summaries were reviewed by the Illinois Department of Transportation, Division of Water Resources, and were submitted as part of the state's SSC Siting Parameters Document.

The summary showed that the two townships within the study area in Cook County (41N9E and 42N9E) were expected to experience a 17% decrease in ground-water use between 1980 and 2025 and that ground-water use in the three western townships of Du Page County (38N9E, 39N9E, and 40N9E) would decrease about 70%, both decreases reflecting the impact of Lake Michigan allocations. The remaining townships within the SSC area in De Kalb (12), Kane (all 15), Kendall (3), and Will (1) Counties would likely experience increases in ground-water consumption of about 25, 19, 86, and 85%, respectively. Overall, the Cambrian and Ordovician aquifers would remain the most important ground-water source.

Revised Projections

After the completion of the original projection analysis, pumpage figures for 1985 became available from the IWIP. This new information permitted comparisons between the actual withdrawals and those projected in the initial analysis, as a test of its accuracy. It thus also provided a basis for refining the original estimates, and it is these new projections that are presented in this report.

Current Pumpage

The Illinois Water Use Inventory (Kirk et al., 1979, 1982, 1984, 1985) was begun in 1978, and updates of water use in the state have been published every other year (for even years) since its inception. During the preparation of this report, data for 1986 were not yet available, but unpublished figures for 1985 (Kirk, personal communication) provide a reasonably close estimate of current ground-water withdrawals. Pumpage data in the inventory are typically available in several forms. One tabulation lists pumpage in each county by use (public systems, self-supplied industry, rural, and fish and wildlife). Another listing shows combined withdrawals (excluding rural totals) from individual major aquifers. This information allows one to see for each county what the ground-water usage was in 1985 by **source.** In the 1980 inventory an additional table gave a listing by **township** of the source of water use for both public water systems and self-supplied industry. This information was provided for 11 counties in northeastern Illinois, including all of the SSC study area. While these data did not include rural pumpages, they were nonetheless valuable for interpreting pumpage within individual townships. This information was also available, although not published, for 1985. Rural withdrawals were estimated on a township basis by proportioning county totals with township population figures. Pumpages for 1985 are included in table 4.

Projected Pumpages

Ground-water withdrawals for 1980 were divided by county population figures, published by the Illinois Bureau of the Budget, to determine per capita consumption for each county. This number was then multiplied by the projected township population for each five-year period from 1985 through 2025 in order to estimate ground-water pumpage for those years. Adjustments to these projections were made after the actual 1985 pumpages became available from the IWIP. This procedure formed the basis for projections in most of the townships.

In some areas, however, other factors were also taken into consideration and adjustments were made to the per-capita-based projections. For example, the two Cook County townships within the study area (41N9E and 42N9E) have allocations for Lake Michigan water. On the basis of anticipated pipeline completion schedules, water demands in these townships will be partially met by lake allocations beginning about 1990. The remainder of the projected water demand after that date is expected to be satisfied by ground water. Likewise, in Kane County, projected ground-water demands in township 41N8E are affected by the withdrawal of water from the Fox River by the City of Elgin. In other areas, rural ground-water pumpage is significant and must be added to projected public water supply and self-supplied industry withdrawals. In Kane County, it was assumed that rural pumpage was spread over the townships west of the Fox River and proportioned by population. Similar proportioning by population was employed for the townships of De Kalb, Du Page, Kendall, and

Will Counties that are within the SSC area. Projected pumpages from 1990 to 2025 are given in table 4.

The projections indicate that total ground-water demand will be nearly 72 mgd by the year 2025, with the majority of the pumpage continuing to come from the deep sandstone aquifers of the Midwest Bedrock Aquigroup. The Aurora area (township 38N8E) will continue to be the largest individual ground-water consumer. The overall total is about 7% lower than the total predicted originally, with 1980 pumpages used as a basis for projection.

Table 4. Current and Projected Ground-Water Use in SSC Area

Cook Co.
Pumpage in mgd

Twp	1985	1990	1995	2000	2005	2010	2015	2020	2025
41N9E	3.99	3.21	3.25	3.35	3.36	3.37	3.42	3.46	3.50
42N9E	1.43	1.40	1.38	1.40	1.40	1.40	1.41	1.42	1.43
Total	5.42	4.61	4.63	4.75	4.76	4.77	4.83	4.88	4.93

The estimated proportion of pumpage from various aquifers after 1990 is:

T41N9E: Sand & Gravel, 60%; Dolomite, 17%; Deep Sandstone, 24% (rounding off causes total to exceed 100%)

T42N9E: Sand & Gravel, 2%; Dolomite, 96%; Deep Sandstone, 2%

De Kalb Co.
Pumpage in mgd

Twp	1985	1990	1995	2000	2005	2010	2015	2020	2025
37N4E	0.06	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07
38N4E	0.18	0.19	0.20	0.20	0.21	0.21	0.22	0.22	0.22
39N4E	0.08	0.08	0.08	0.08	0.09	0.09	0.09	0.09	0.09
40N4E	4.68	4.78	4.95	5.13	5.20	5.31	5.42	5.52	5.60
41N4E	0.10	0.10	0.10	0.11	0.11	0.11	0.12	0.12	0.12
42N4E	0.23	0.24	0.25	0.26	0.26	0.26	0.27	0.28	0.28
37N5E	0.92	0.95	0.98	1.04	1.05	1.07	1.10	1.12	1.13
38N5E	0.27	0.29	0.30	0.31	0.31	0.32	0.32	0.33	0.34
39N5E	0.06	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08
40N5E	0.54	0.57	0.58	0.61	0.61	0.63	0.64	0.65	0.66
41N5E	1.08	1.12	1.16	1.20	1.22	1.25	1.27	1.30	1.32
42N5E	0.53	0.55	0.58	0.59	0.60	0.61	0.62	0.64	0.65
Total	8.73	9.00	9.31	9.66	9.79	10.00	10.22	10.42	10.56

In 1985 virtually all water pumped from public water supply and industrial wells came from the deep sandstone aquifers of the Midwest Bedrock Aquigroup. It is assumed that domestic pumpage (approximately 20% of the total withdrawal) is derived from dolomite and glacial drift wells and that the projected pumpages from all wells will maintain the current proportions of sources.

Continued on next page

Table 4. Continued

Du Page Co.
Pumpage in mgd

Twp	1985	1990	1995	2000	2005	2010	2015	2020	2025
38N9E	6.72	0.63	0.67	0.72	0.76	0.78	0.82	0.86	0.89
39N9E	3.80	0.87	0.93	1.00	1.04	1.08	1.13	1.18	1.23
40N9E	3.26	0.90	0.91	0.94	0.98	1.01	1.04	1.09	1.12
Total	13.78	2.40	2.51	2.66	2.78	2.87	2.99	3.13	3.24

It is assumed that by 1990 Lake Michigan allocations will be in effect. In townships 38N9E and 39N9E virtually all future pumpage will be from dolomite wells. In township 40N9E approximately 85% will come from the dolomite.

Kane Co.
Pumpage in mgd

Twp	1985	1990	1995	2000	2005	2010	2015	2020	2025
38N6E	0.16	0.17	0.18	0.18	0.20	0.21	0.21	0.22	0.22
39N6E	0.11	0.11	0.12	0.12	0.13	0.14	0.14	0.14	0.14
40N6E	0.21	0.22	0.23	0.24	0.26	0.27	0.27	0.28	0.29
41N6E	0.18	0.19	0.20	0.20	0.20	0.22	0.23	0.23	0.24
42N6E	0.44	0.46	0.48	0.49	0.54	0.56	0.56	0.58	0.59
38N7E	2.66	2.83	2.95	3.00	3.29	3.39	3.41	3.54	3.63
39N7E	0.33	0.35	0.37	0.37	0.41	0.42	0.43	0.44	0.45
40N7E	0.64	0.68	0.71	0.72	0.79	0.82	0.82	0.85	0.87
41N7E	0.18	0.19	0.20	0.20	0.22	0.23	0.23	0.24	0.24
42N7E	0.16	0.17	0.18	0.18	0.20	0.20	0.20	0.21	0.22
38N8E	11.05	11.74	12.25	12.45	13.64	14.08	14.16	14.69	15.05
39N8E	4.41	4.69	4.89	4.97	5.45	5.62	5.66	5.86	6.01
40N8E	3.69	3.92	4.09	4.16	4.55	4.70	4.73	4.90	5.02
41N8E	4.53	4.81	5.02	5.10	5.59	5.77	5.80	6.02	6.17
42N8E	3.82	4.05	4.23	4.30	4.71	4.86	4.89	5.07	5.19
Total	32.67	34.58	36.10	36.68	40.18	41.49	41.74	43.27	44.33

Table 4. Concluded

In 1985 the following proportions of pumpage from various aquifers were noted for public water supply and industrial wells in Kane County:

Twp	Proportion of Pumpage (mgd) S&G	Dol	Deep Ss
38N6E	-	-	-
39N6E	-	-	-
40N6E	-	-	100
41N6E	-	-	100
42N6E	-	-	100
38N7E	8	-	92
39N7E	-	-	100
40N7E	34	-	66
41N7E	-	-	-
42N7E	100	-	-
38N8E	-	13	87
39N8E	-	3	97
40N8E	46	-	54
41N8E	16	3	81
42N8E	98	1.5	0.5

It is anticipated that these approximate proportions will be maintained for the foreseeable future.

Kendall Co.
Pumpage in mgd

Twp	1985	1990	1995	2000	2005	2010	2015	2020	2025
37N6E	1.55	1.80	2.00	2.18	2.36	2.63	2.68	2.86	3.04
37N7E	0.80	0.96	1.04	1.13	1.22	1.32	1.39	1.46	1.54
37N8E	2.58	2.50	2.68	2.86	3.03	3.28	3.34	3.52	3.70
Total	4.93	5.26	5.72	6.17	6.61	7.23	7.41	7.84	8.28

The estimated proportion of pumpage from various aquifers after 1990 is:

T36N6E: Sand & Gravel, 2/3; Dolomite, 1/3
T37N6E: Dolomite, 1/2; Deep Sandstone, 1/2
T38N6E: Dolomite, 2/3; Deep Sandstone, 1/3

Will Co.
Pumpage in mgd

Twp	1985	1990	1995	2000	2005	2010	2015	2020	2025
37N9E	0.28	0.30	0.32	0.36	0.39	0.41	0.42	0.45	0.48

It is estimated that virtually all pumpage from this township will be from the shallow dolomite.

REFERENCES

Broeren, S., and K.P. Singh. 1987. Baseflow accretions, low flows, and water quality in the Fox River in Kane County, Illinois: Present conditions and projections based on public water supply trends. Illinois State Water Survey Contract Report 418, 54 p.

Curry, Brandon B., et al. (In preparation.) Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: Results of the Spring 1985 test drilling program.

Hem, John D. 1985. Study and interpretation of the chemical characteristics of natural water. Third Edition. U.S. Geological Survey Water-Supply Paper 2254, pp. 176-180.

Hill, R.A. 1940. Geochemical patterns in Coachella Valley, California. American Geophysical Union Transactions, Vol. 21, pp. 46-49.

Kempton, J.P., R.C. Vaiden, D.R. Kolata, P.B. DuMontelle, M.M. Killey, and R.A. Bauer. 1985. Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: Preliminary geological feasibility report. Illinois Geological Survey Environmental Geology Notes 111, 63 p.

Kempton, J.P., R.A. Bauer, B.B. Curry, W.G. Dixon, A.M. Graese, P.C. Reed, M.L. Sargent, and R.C. Vaiden. 1987a. Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: Results of the Fall 1984 test drilling program. Illinois State Geological Survey Environmental Geology Notes 117, 102 p.

Kempton, J.P., R.A. Bauer, B.B. Curry, W.G. Dixon, A.M. Graese, P.C. Reed, and R.C. Vaiden. 1987b. Geological-geotechnical studies for siting the Superconducting Super Collider in Illinois: Results of the Spring 1985 test drilling program. Illinois State Geological Survey Environmental Geology Notes 120, 88 p.

Kirk, James R., Kenneth J. Hlinka, Robert T. Sasman, and Ellis W. Sanderson. 1985. Water withdrawals in Illinois, 1984. Illinois State Water Survey Circular 163.

Kirk, James R., Jacquelyn Jarboe, Ellis W. Sanderson, Robert T. Sasman, and Carl Lonnquist. 1982. Water withdrawals in Illinois, 1980. Illinois State Water Survey Circular 152.

Kirk, James R., Jacquelyn Jarboe, Ellis W. Sanderson, Robert T. Sasman, and Robert A. Sinclair. 1979. Water withdrawals in Illinois, 1978. Illinois State Water Survey Circular 140.

Kirk, James R., Ellis W. Sanderson, and Robert D. Sasman. 1984. Water withdrawals in Illinois, 1982. Illinois State Water Survey Circular 161.

Piper, A.M. 1944. A graphic procedure in the geochemical interpretation of water analyses. American Geophysical Union Transactions, Vol. 25, pp. 914-923.

Sasman, R. T., R. S. Ludwigs, C. R. Benson, and J. R. Kirk. 1986. Water-level trends and pumpage in the Cambrian and Ordovician aquifers in the Chicago region, 1980-1985. Illinois State Water Survey Circular 166.

Schoeller, Henri. 1935. Utilite de la notion des exchanges de bases pour la comparison des eaux souterraines. France, Societe Geologie Comptes rendus Sommaire et Bulletin Serie 5, Vol. 5, pp. 651-657.

Schoeller, Henri. 1955. Geochemie des eaux souterraines. Revue de L'Institute Francais du Petrole, Vol. 10, pp. 230-244.

Schoeller, Henri. 1962. Les eaux souterraines. Paris, France, Massio et Cie.

State of Illinois, Bureau of the Budget. 1984. Illinois population trends from 1970-2025. Springfield.

Visocky, Adrian P. 1982. Impact of Lake Michigan allocations on the Cambrian-Ordovician aquifer system. Illinois State Water Survey Contract Report 292.

Visocky, A.P., M.G. Sherrill, and K. Cartwright. 1985. Geology, hydrology, and water quality of the Cambrian and Ordovician Systems in northern Illinois. Illinois State Geological Survey and Illinois State Water Survey Cooperative Groundwater Report 10, 136 p.

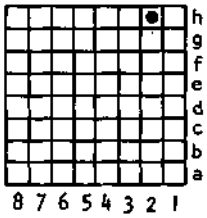
Walton, W.C., and Sandor Csallany. 1962. Yields of deep sandstone wells in northern Illinois. Illinois State Water Survey Report of Investigation 43, 47 p.

Willman, H.S., et al. 1975. Handbook of Illinois stratigraphy. Illinois State Geological Survey Bulletin 95, 261 p.

Appendix 1: Well-Numbering System

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 coordinates 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 one square mile contains eight 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 below.

The number of the well shown in Sec. 25 at the right is as follows:
COK 41N11E-25.2h



In Appendix 2, three-letter codes are used for the following counties:

De Kalb	DEK	Kane	KNE
Du Page	DUP	Kendall	KEN

Appendix 2: Mass Measurement Data, Summer 1986

The aquifer coding system used in Appendix 2 is taken from an unpublished State Water Survey intra-office memorandum and uses a four-digit number to describe uppermost and lowermost aquifers pumped by each well. The first two digits of each number describe the upper aquifer to which the well is open, and the last two digits denote the lowest unit. Code numbers have been assigned to the various aquifers as follows:

01 Prairie Aquigroup
56 Silurian Dolomite aquifer
61 Maquoketa Confining Unit
63 Galena part of Galena-Platteville Unit
65 Platteville part of Galena-Platteville Unit
66 Ancell aquifer

Missing data are denoted by the symbol (?) in Appendix 2. Forty-three of the wells included in the study were located in the field but are not documented by drillers logs. Thus their depths and consequently their well-bottom elevations and aquifer codes are unknown. In some instances, records exist that do not fully describe the cased interval of the borehole. Partial aquifer codes have been assigned for these wells in which the upper aquifer is unknown.

Appendix 2. Mass Measurement Data

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
DEK	38N05E-13.1f	200	538	738	723	6165
DEK	39N05E-01.8b	462	404	866	690	6565
DEK	40N04E-16.1b	478	393	871	774	6565
DEK	41N05E-10.1a	490	427	917	677	6565
DUP	38N09E-02.5f	300	390	690	632	5661
DUP	38N09E-03.5e	242	473	715	667	5661
DUP	38N09E-04.5a	?	?	719	654	?
DUP	38N09E-05.4a	200	541	741	656	5656
DUP	38N09E-06.6e	?	?	730	686	?
DUP	38N09E-07.1f	?	?	736	675	?
DUP	38N09E-08.4g	?	?	724	654	?
DUP	38N09E-08.7h	?	?	730	683	?
DUP	38N09E-10.5h	145	555	700	663	5656
DUP	38N09E-17.4h	?	?	720	656	?
DUP	38N09E-17.8c	216	494	710	649	5656
DUP	38N09E-20.8f	?	?	719	661	?
DUP	38N09E-31.1d	?	?	707	682	?
DUP	38N09E-21.1a	100	609	709	684	5656
DUP	38N09E-32.3e	?	?	710	681	?
DUP	38N09E-33.3d	163	539	702	685	5661
DUP	38N09E-34.2c	334	336	670	526	5663
DUP	38N09E-34.3c	240	450	690	670	5661
DUP	39N09E-04.7f	108	652	760	711	5656
DUP	39N09E-05.1f	180	573	753	705	5656
DUP	39N09E-05.5d	325	426	751	681	5661
DUP	39N09E-06.4d	?	?	746	690	?
DUP	39N09E-07.5g	?	?	756	693	?
DUP	39N09E-08.3b	150	600	750	689	5656
DUP	39N09E-09.3e	200	550	750	676	5656
DUP	39N09E-09.6e	330	428	758	669	5661
DUP	39N09E-09.7c	305	445	750	658	5661
DUP	39N09E-09.7c	353	399	752	622	5661
DUP	39N09E-16.5f	150	583	733	686	5656
DUP	39N09E-18.1h	127	619	746	690	5656
DUP	39N09E-20.4b	342	398	740	649	6161
DUP	39N09E-27.6c	335	395	730	658	5663
DUP	39N09E-29.5a	?	?	739	690	?
DUP	39N09E-30.8d	?	?	744	688	?
DUP	39N09E-34.5h	365	340	705	660	5663
DUP	39N09E-35.1a	273	430	703	669	5661
DUP	39N09E-35.4b	256	439	695	643	5661
DUP	39N09E-36.7a	354	376	730	676	5663
DUP	40N09E-17.1c	377	409	786	442	6363
DUP	40N09E-32.5g	270	484	754	676	5663
DUP	40N09E-32.5g	271	484	755	703	5656
DUP	40N09E-33.5a	350	420	770	689	5661
KNE	37N08E-13.6c	280	485	765	665	6163
KNE	38N06E-03.7a	180	555	735	722	6161
KNE	38N06E-05.7h	225	547	772	765	6163
KNE	38N06E-06.1a	130	642	772	752	5656
KNE	38N06E-08.2g	300	442	742	730	6163
KNE	38N06E-08.3f	120	620	740	725	6161
KNE	38N06E-14.5b	305	397	702	692	6163
KNE	38N06E-14.7g	180	530	710	656	6161
KNE	38N06E-15.2a	240	467	707	697	6161
KNE	38N06E-15.4h	160	553	713	703	6161
KNE	38N06E-16.2a	260	445	705	640	6163
KNE	38N06E-16.2a	305	407	712	580	6163
KNE	38N06E-16.2a	240	470	710	596	6163
KNE	38N06E-16.2a	305	407	712	580	6163
KNE	38N06E-18.7e	325	405	730	652	6163
KNE	38N06E-20.5h	93	631	724	701	0101
KNE	38N06E-21.3d	180	527	707	689	0101

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
KNE	38N06E-21.5d	122	582	704	690	0101
KNE	38N06E-21.5h	160	554	714	698	6161
KNE	38N06E-22.7d	?	?	700	596	?
KNE	38N06E-22.8c	185	515	700	680	6161
KNE	38N06E-22.7e	?	?	703	683	?
KNE	38N06E-23.1b	375	320	695	677	6163
KNE	38N06E-23.6e	120	581	701	691	0101
KNE	38N06E-25.4c	?	?	685	670	?
KNE	38N06E-31.3h	425	287	712	639	6163
KNE	38N06E-32.7e	300	404	704	644	6163
KNE	38N06E-32.7h	160	552	712	704	6161
KNE	38N06E-32.7h	140	570	710	706	0101
KNE	38N06E-32.7h	140	569	709	702	0101
KNE	38N06E-33.3h	340	410	750	636	6163
KNE	38N07E-02.3a	230	485	715	700	5661
KNE	38N07E-02.5b	75	643	718	698	0101
KNE	38N07E-02.7b	110	578	688	688	5656
KNE	38N07E-02.7b	75	630	705	702	0101
KNE	38N07E-05.4h	271	439	710	600	6163
KNE	38N07E-06.1g	120	668	788	738	0101
KNE	38N07E-09.2b	110	577	687	686	0156
KNE	38N07E-09.4e	100	608	708	698	5656
KNE	38N07E-16.4d	100	610	710	694	5656
KNE	38N07E-19.5d	150	535	685	683	6163
KNE	38N07E-19.7d	?	?	685	678	?
KNE	38N07E-25.1d	76	634	710	670	5656
KNE	38N07E-30.2c	300	413	713	674	??63
KNE	38N08E-01.3f	120	612	732	684	5661
KNE	38N08E-05.7f	112	608	720	707	6161
KNE	38N08E-08.3f	100	600	700	690	5661
KNE	38N08E-08.6f	50	650	700	685	5656
KNE	38N08E-10.1g	150	606	756	673	5661
KNE	38N08E-10.3h	200	540	740	676	5661
KNE	38N08E-11.3e	137	538	675	615	6161
KNE	38N08E-11.8a	265	465	730	661	5661
KNE	38N08E-11.8c	200	662	748	662	5663
KNE	38N08E-11.8f	500	259	759	656	5663
KNE	38N08E-13.2e	320	400	720	645	5663
KNE	38N08E-13.4e	?	?	721	653	?
KNE	38N08E-13.6e	?	?	712	624	?
KNE	38N08E-13.5e	320	398	718	658	5663
KNE	38N08E-24.5d	185	538	723	662	5661
KNE	38N08E-25.4d	110	600	710	655	??61
KNE	38N08E-25.5g	338	368	706	377	6363
KNE	38N08E-26.1f	160	552	712	660	??61
KNE	38N08E-28.3g	220	430	650	650	
KNE	38N08E-29.3e	120	535	655	595	5656
KNE	38N08E-30.4e	90	620	710	660	5656
KNE	38N08E-30.4e	120	553	673	643	5656
KNE	38N08E-34.1d	105	555	660	645	0101
KNE	38N08E-34.1f	100	569	669	653	0101
KNE	38N08E-34.1f	90	578	668	653	0101
KNE	38N08E-35.8f	95	585	680	657	0101
KNE	39N06E-01.3h	260	592	852	797	5661
KNE	39N06E-01.3h	180	680	860	795	5656
KNE	39N06E-01.4e	110	625	735	725	5656
KNE	39N06E-02.5e	218	652	870	833	5656
KNE	39N06E-08.8e	?	?	850	837	?
KNE	39N06E-19.7b	136	662	798	743	0101
KNE	39N06E-20.1h	206	590	796	588	6363
KNE	39N06E-20.2h	345	458	803	722	5663
KNE	39N06E-20.4h	460	343	803	703	5663
KNE	39N06E-23.8a	320	472	792	681	6163

Appendix 2. Continued

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
KNE	39N06E-24.1h	140	660	800	760	6161
KNE	39N06E-26.6e	?	?	785	761	?
KNE	39N06E-26.5e	?	?	784	684	?
KNE	39N06E-26.5e	365	419	784	698	6163
KNE	39N06E-26.5e	50	735	785	756	0101
KNE	39N06E-26.5e	65	721	786	757	0101
KNE	39N06E-26.6h	400	390	790	752	6163
KNE	39N06E-26.8g	340	444	784	702	5663
KNE	39N06E-26.8f	365	420	785	758	6163
KNE	39N06E-28.1c	200	585	785	765	5661
KNE	39N06E-30.3g	488	307	795	655	6165
KNE	39N06E-30.5h	188	786	792	786	6163
KNE	39N07E-02.6h	183	612	795	768	5661
KNE	39N07E-02.7g	200	595	795	705	5661
KNE	39N07E-03.4g	150	663	813	765	5661
KNE	39N07E-03.7a	148	674	822	756	6163
KNE	39N07E-05.6e	?	?	850	774	?
KNE	39N07E-05.6f	215	625	840	771	5661
KNE	39N07E-06.1c	306	536	842	766	6163
KNE	39N07E-06.4a	200	625	825	804	??61
KNE	39N07E-06.4a	260	572	832	804	??61
KNE	39N07E-06.5a	420	404	824	510	6363
KNE	39N07E-08.5d	160	660	820	764	0101
KNE	39N07E-08.6d	280	530	810	765	6163
KNE	39N07E-08.7e	170	635	805	790	5661
KNE	39N07E-09.4h	300	512	812	767	5663
KNE	39N07E-13.8a	183	565	748	703	5656
KNE	39N07E-13.8a	150	598	748	712	5656
KNE	39N07E-14.5e	390	410	800	735	??63
KNE	39N07E-14.5e	390	410	800	735	??63
KNE	39N07E-17.2b	320	425	745	722	6163
KNE	39N07E-17.2b	320	425	745	722	6163
KNE	39N07E-17.5d	355	440	795	742	5663
KNE	39N07E-20.4c	320	452	772	731	6163
KNE	39N07E-21.7a	68	692	760	740	0101
KNE	39N07E-25.2a	100	607	707	700	0101
KNE	39N07E-29.8h	160	577	737	627	6161
KNE	39N07E-32.5a	307	398	705	515	6163
KNE	39N07E-32.5a	290	415	705	625	6363
KNE	39N07E-32.8d	300	410	710	580	5663
KNE	39N07E-33.7g	250	475	725	705	5661
KNE	39N08E-03.2d	252	448	700	652	6163
KNE	39N08E-05.8a	153	612	765	717	0101
KNE	39N08E-05.8e	440	315	755	708	6163
KNE	39N08E-06.1a	207	558	765	720	6161
KNE	39N08E-07.4h	60	664	724	715	0101
KNE	39N08E-08.3h	226	529	755	715	5661
KNE	39N08E-11.5a	120	600	720	680	5656
KNE	39N08E-12.4a	180	530	710	685	6561
KNE	39N08E-17.6b	400	301	701	632	6363
KNE	39N08E-17.6c	130	575	705	635	5656
KNE	39N08E-17.7a	260	470	730	700	6163
KNE	39N08E-18.3a	500	210	710	440	??63
KNE	39N08E-18.3c	400	301	701	460	??66
KNE	39N08E-18.4c	82	613	695	680	0101
KNE	39N08E-18.4d	380	320	700	500	6163
KNE	39N08E-18.5e	310	400	710	500	6161
KNE	39N08E-19.1d	350	390	740	690	5663
KNE	39N08E-20.2f	133	587	720	700	5656
KNE	39N08E-21.7f	133	557	690	690	5656
KNE	39N08E-26.2c	198	574	772	669	5656
KNE	39N08E-29.5f	140	592	732	692	5656
KNE	39N08E-30.5d	?	?	722	695	?

Appendix 2. Continued

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
KNE	39N08E-30.6a	185	535	720	709	6161
KNE	40N06E-10.5b	157	713	870	855	6161
KNE	40N06E-10.5b	466	406	872	594	6365
KNE	40N06E-21.2b	502	361	863	843	6363
KNE	40N06E-22.3a	48	822	870	856	0101
KNE	40N06E-22.4h	?	?	870	853	?
KNE	40N06E-22.4h	283	578	861	813	6163
KNE	40N06E-24.1a	409	485	894	673	5663
KNE	40N06E-24.1a	?	?	896	661	?
KNE	40N06E-25.6h	474	398	872	622	6163
KNE	40N06E-29.3a	310	570	880	630	6163
KNE	40N06E-29.3a	355	520	875	605	6163
KNE	40N06E-29.6c	58	807	865	853	0101
KNE	40N06E-32.1a	87	793	880	840	0101
KNE	40N06E-35.1c	495	395	890	723	6163
KNE	40N06E-36.8c	320	567	887	744	5663
KNE	40N07E-04.4a	535	391	926	713	5663
KNE	40N07E-06.3d	530	421	951	753	6363
KNE	40N07E-07.8h	900	45	945	575	??66
KNE	40N07E-10.1h	505	373	878	532	6163
KNE	40N07E-10.3g	520	362	882	546	6163
KNE	40N07E-11.8h	527	333	860	802	6163
KNE	40N07E-11.3a	310	505	815	787	6363
KNE	40N07E-11.4a	320	505	825	797	6163
KNE	40N07E-11.6a	497	333	830	575	6163
KNE	40N07E-12.4f	355	530	885	747	6163
KNE	40N07E-12.7g	355	510	865	745	6163
KNE	40N07E-13.1a	350	465	815	766	6163
KNE	40N07E-13.1a	375	429	804	733	6163
KNE	40N07E-13.6e	425	390	815	637	6163
KNE	40N07E-13.7d	445	375	820	698	6163
KNE	40N07E-14.1b	430	397	827	663	6163
KNE	40N07E-14.1d	430	388	818	647	6163
KNE	40N07E-14.6e	181	651	832	774	0101
KNE	40N07E-16.2h	505	407	912	636	6163
KNE	40N07E-17.7d	605	330	935	654	6163
KNE	40N07E-17.8c	520	390	910	695	6163
KNE	40N07E-20.2d	535	404	939	679	6165
KNE	40N07E-21.1c	540	375	915	650	6163
KNE	40N07E-21.3d	224	672	896	805	0101
KNE	40N07E-21.5h	231	680	911	800	0101
KNE	40N07E-21.6d	?	?	908	638	?
KNE	40N07E-21.7d	520	392	912	452	6163
KNE	40N07E-21.8e	550	358	908	584	6165
KNE	40N07E-22.2a	560	295	855	455	5665
KNE	40N07E-22.6e	?	?	898	804	?
KNE	40N07E-23.6a	440	370	810	748	5663
KNE	40N07E-23.6a	600	208	808	755	6165
KNE	40N07E-23.6a	350	455	805	770	5663
KNE	40N07E-24.2h	460	380	840	634	6163
KNE	40N07E-24.2h	480	350	830	718	6163
KNE	40N07E-24.3h	440	375	815	770	6163
KNE	40N07E-24.4e	560	225	785	515	6163
KNE	40N07E-24.4h	440	375	815	744	6163
KNE	40N07E-25.5c	495	333	828	748	5663
KNE	40N07E-25.6c	175	690	865	805	5661
KNE	40N07E-27.6e	240	690	930	792	5661
KNE	40N07E-28.3h	200	711	911	770	0101
KNE	40N07E-28.3b	265	646	911	733	5656
KNE	40N07E-30.5e	459	440	899	867	6165
KNE	40N07E-34.2c	210	615	825	771	5661
KNE	40N07E-35.7h	375	435	810	750	??63
KNE	40N08E-02.7e	205	545	750	660	5661

Appendix 2. Continued

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
KNE	40N08E-03.3a	260	482	742	687	5661
KNE	40N08E-04.1b	95	587	682	662	5656
KNE	40N08E-06.8a	500	323	823	583	5663
KNE	40N08E-07.1c	460	303	763	649	??63
KNE	40N08E-07.2c	200	575	775	733	5661
KNE	40N08E-07.4b	50	734	784	766	0101
KNE	40N08E-07.4d	?	?	811	750	?
KNE	40N08E-07.6d	?	?	800	758	?
KNE	40N08E-08.8b	370	386	756	739	6163
KNE	40N08E-08.8a	44	712	756	745	0101
KNE	40N08E-11.3g	150	600	750	676	0101
KNE	40N08E-12.4a	220	570	790	715	5663
KNE	40N08E-14.1e	209	574	783	671	5661
KNE	40N08E-15.3f	360	370	730	730	6163
KNE	40N08E-15.3d	130	657	750	682	0101
KNE	40N08E-15.4f	93	635	715	690	0101
KNE	40N08E-15.7a	685	41	726	529	6166
KNE	40N08E-15.7c	260	482	742	694	6163
KNE	40N08E-16.2b	?	?	762	680	?
KNE	40N08E-16.6c	500	299	799	648	5663
KNE	40N08E-16.7b	103	687	790	707	0101
KNE	40N08E-16.7d	460	338	798	681	6163
KNE	40N08E-16.8g	165	638	803	751	5661
KNE	40N08E-16.8h	245	562	807	793	5661
KNE	40N08E-17.4h	341	429	770	760	5663
KNE	40N08E-19.1a	460	305	765	505	6166
KNE	40N08E-19.3a	152	645	797	767	5656
KNE	40N08E-19.3c	320	390	770	767	5663
KNE	40N08E-19.4c	320	450	770	768	5663
KNE	40N08E-19.5b	130	652	782	774	0101
KNE	40N08E-19.7c	143	642	785	775	0101
KNE	40N08E-19.8a	220	610	830	770	5666
KNE	40N08E-20.1e	116	634	750	675	5656
KNE	40N08E-20.2g	500	292	792	665	5663
KNE	40N08E-20.3h	500	298	798	666	5663
KNE	40N08E-20.5c	?	?	750	712	?
KNE	40N08E-20.5c	158	590	748	717	0101
KNE	40N08E-21.1d	375	346	721	690	??63
KNE	40N08E-21.8h	400	390	790	690	5663
KNE	40N08E-21.8h	500	287	787	689	6163
KNE	40N08E-21.8h	440	350	790	662	5663
KNE	40N08E-27.6a	317	373	690	640	5663
KNE	40N08E-28.4f	230	501	731	670	5661
KNE	40N08E-28.7h	105	645	750	710	5661
KNE	40N08E-28.8e	105	655	760	714	0101
KNE	40N08E-29.2a	245	540	785	705	5656
KNE	40N08E-32.1f	242	543	785	699	5661
KNE	41N06E-04.1g	356	552	908	868	6163
KNE	41N06E-09.4a	320	628	948	876	6163
KNE	41N06E-12.2e	320	658	978	835	6161
KNE	41N06E-24.4d	375	595	970	925	5663
KNE	41N06E-24.4f	360	590	950	825	6161
KNE	41N06E-36.4a	355	570	925	789	6163
KNE	41N06E-36.8d	305	635	940	878	6161
KNE	41N07E-01.1g	230	695	925	805	0101
KNE	41N07E-08.7h	370	598	968	695	5661
KNE	41N07E-12.1b	?	?	900	804	?
KNE	41N07E-12.6a	375	525	900	805	6161
KNE	41N07E-13.1c	380	515	895	802	5663
KNE	41N07E-13.4b	338	548	886	799	5663
KNE	41N07E-14.2b	325	587	912	834	6163
KNE	41N07E-14.2b	325	587	912	834	6161
KNE	41N07E-26.3a	350	530	880	810	6163

Appendix 2. Continued

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
KNE	41N07E-26.7f	?	?	880	869	?
KNE	41N07E-27.7b	565	358	923	721	??63
KNE	41N07E-29.1d	580	363	943	478	5663
KNE	41N08E-30.5h	500	345	845	643	6163
KNE	41N08E-30.6h	375	480	855	808	5663
KNE	41N08E-30.7d	455	393	848	463	6363
KNE	42N07E-36.5a	410	510	920	699	6163
KEN	36N08E-06.1h	214	528	742	684	6163
KEN	37N06E-01.2f	200	470	670	639	6163
KEN	37N06E-01.5f	160	515	675	658	6161
KEN	37N06E-02.2f	90	596	686	650	0101
KEN	37N06E-02.3f	387	299	686	586	6163
KEN	37N06E-02.7g	110	575	685	668	5661
KEN	37N06E-03.7a	100	576	676	664	0101
KEN	37N06E-03.7h	295	403	698	610	6163
KEN	37N06E-03.8b	?	?	686	649	?
KEN	37N06E-04.4b	80	612	692	665	6161
KEN	37N06E-05.4h	305	407	712	621	6163
KEN	37N06E-05.4h	305	407	712	621	6163
KEN	37N06E-08.2c	260	421	681	629	6363
KEN	37N06E-08.3d	154	525	679	658	6161
KEN	37N06E-08.4d	?	?	717	698	?
KEN	37N06E-09.2b	200	574	674	649	6163
KEN	37N06E-09.2b	160	507	667	655	6161
KEN	37N06E-09.2d	200	472	672	672	6363
KEN	37N06E-09.2e	140	531	671	635	6161
KEN	37N06E-09.2e	150	515	665	638	6161
KEN	37N06E-10.6g	250				
KEN	37N06E-10.6h	125	554	679	646	6161
KEN	37N06E-10.8g	205	479	684	643	6163
KEN	37N06E-10.8f	13	562	682	595	0101
KEN	37N06E-11.1a	?	?	662	622	?
KEN	37N06E-12.1a	?	?	661	635	?
KEN	37N06E-12.8e	420	245	665	566	6165
KEN	37N06E-13.1a	300	351	651	605	6365
KEN	37N06E-13.4a	243	409	652	621	6163
KEN	37N06E-14.5e	140	517	657	609	6163
KEN	37N06E-14.5e	365	289	654	611	6163
KEN	37N06E-14.5f	200	461	661	610	6163
KEN	37N06E-16.1d	?	?	658	610	?
KEN	37N06E-16.2c	200	466	666	610	6163
KEN	37N06E-16.2d	90	564	654	608	6161
KEN	37N06E-16.3d	200	448	648	608	6161
KEN	37N06E-24.1e	85	565	650	627	0101
KEN	37N06E-25.7b	515	115	630	567	6166
KEN	37N06E-26.4b	200	435	635	635	6363
KEN	37N06E-29.8a	100	540	640	615	0101
KEN	37N07E-03.6a	264	395	659	467	6363
KEN	37N07E-07.4h	260	414	674	640	6163
KEN	37N07E-08.3a	325	319	644	544	6363
KEN	37N07E-15.5d	98	546	644	630	0101
KEN	37N07E-15.3e	82	562	644	629	0101
KEN	37N07E-15.6e	245	396	641	624	6163
KEN	37N07E-15.8d	14	626	640	632	0101
KEN	37N07E-15.8d	360	284	644	629	6163
KEN	37N07E-15.8h	?	?	640	630	?
KEN	37N07E-16.1d	160	478	638	629	6163
KEN	37N07E-16.1d	?	?	642	634	?
KEN	37N07E-16.2c	260	378	638	501	6363
KEN	37N07E-16.2g	75	570	645	630	0161
KEN	37N07E-16.2a	400	243	643	411	
KEN	37N07E-16.8g	201	442	643	513	6163
KEN	37N07E-17.1g	160	483	643	632	--63

Appendix 2. Concluded

County code	Location	Depth of well (ft.)	Well bottom elevation (msl)	Land surface elevation (msl)	Water level elevation (msl)	Aquifer code
KEN	37N07E-17.1g	200	442	642	631	6363
KEN	37N07E-17.8h	200	451	651	631	??63
KEN	37N07E-19.7g	155	490	645	623	6365
KEN	37N07E-20.1g	250	381	631	610	6163
KEN	37N07E-20.1g	100	541	641	621	6161
KEN	37N07E-20.2e	200	443	643	617	6163
KEN	37N07E-20.3d	380	261	641	505	6363
KEN	37N07E-20.3e	123	517	640	620	??61
KEN	37N07E-21.1h	?	?	641	624	?
KEN	37N07E-22.7g	125	513	638	627	??61
KEN	37N07E-22.6f	326	316	642	619	6363
KEN	37N07E-23.2g	405	220	625	405	6165
KEN	37N07E-24.1h	247	352	599	544	6163
KEN	37N07E-24.5e	282	358	640	570	6163
KEN	37N07E-26.4c	355	285	640	575	6163
KEN	37N07E-26.8h	470	120	590	590	??66
KEN	37N07E-26.8h	275	315	590	388	??63
KEN	37N07E-27.8f	80	560	640	620	0101
KEN	37N07E-28.3a	245	386	631	608	6363
KEN	37N07E-29.3g	300	310	610	525	6363
KEN	37N07E-31.5h	305	328	633	519	6363
KEN	37N07E-34.3e	360	263	623	483	6166
KEN	37N07E-35.7g	102	540	642	611	6161
KEN	37N07E-36.8a	535	170	705	300	6166
KEN	37N08E-01.7g	365	320	685	655	5661
KEN	37N08E-02.4e	305	390	695	654	6163
KEN	37N08E-02.7c	100	575	675	640	5656
KEN	37N08E-05.4g	175	490	665	655	6161
KEN	37N08E-08.6c	245	375	620	540	5663
KEN	37N08E-10.6d	100	560	660	648	5656
KEN	37N08E-12.7a	165	575	740	680	5661
KEN	37N08E-13.3a	300	440	740	617	5661
KEN	37N08E-13.6a	257	516	773	669	5661
KEN	37N08E-13.6c	360	402	762	667	5661
KEN	37N08E-16.3e	85	575	660	640	5661
KEN	37N08E-17.4h	?	?	604	574	?
KEN	37N08E-17.5f	250	400	650	593	5663
KEN	37N08E-17.5h	110	494	604	585	5661
KEN	37N08E-17.6h	350	256	606	594	5663
KEN	37N08E-16.8f	225	426	651	629	5663
KEN	37N08E-16.8f	205	446	651	599	6163
KEN	37N08E-16.8f	565	83	648	602	6166
KEN	37N08E-18.5d	540	110	650	522	??66
KEN	37N08E-23.3f	300	412	712	575	6363
KEN	37N08E-24.5e	300	457	757	619	5661
KEN	37N08E-27.5a	142	578	720	670	0101
KEN	37N08E-27.5c	140	630	770	705	5656
KEN	37N08E-28.2c	230	478	708	649	6161
KEN	37N08E-31.1b	242	488	730	647	??63
KEN	37N08E-32.2b	256	450	706	648	6163
KEN	37N08E-35.3a	120	550	670	655	5663

Appendix 3. Monthly Water-Level Data, December 1984 - July 1987

SSC OBSERVATION WELL DATA DISTANCE TO WATER (FEET)

Date		SSC-F1	SSC-F2	SSC-F3	SSC-F5	SSC-F6	SSC-F7	SSC-F9	SSC-F10	SSC-F11	SSC-F12	SSC-F13	SSC-F14	SSC-F15	SSC-F16	SSC-F17	SSC-S18	SSC-S19
	Depth:	342	377	312	462	300	389	490	337.7	350	466	157	478	455	264.5	349	355.2	388.6
	Elev.:	739.50	785.54	702.22	865.57	711.93	796.29	916.86	706.39	731.33	871.97	870	870.76	847.96	659.49	743.33	656	646
12-Dec-84		89.57	192.97	308.70	139.83	134.95	206.07	77.83										
15-Jan-85		89.67	195.65	310.70	175.40	135.57	207.43	243.17										
21-Feb-85			203.65															
22-Feb-85		89.47				135.00												
27-Feb-85		69.66																
28-Feb-85					174.43	129.83	205.63	243.04										
01-Apr-85		88.21		310.70	174.72	131.63	211.42	244.04										
30-Apr-85		87.88	243.69	310.70	175.91	132.04	206.60	244.02										
10-May-85				>312						36.15								
24-May-85		88.55		>312	175.17	132.59	206.62	243.89	285.75	33.40								
29-May-85			265.96	>312														
21-Jun-85				>312							278.54	18.82	98.71					
28-Jun-85		89.69	283.96	>312		133.41	207.09	246.44	294.08	25.01	278.66	16.77	98.85	385.49				
16-Jul-85				>312	175.00		205.93	241.64			276.43	16.61	100.23					
18-Jul-85		89.80	291.53	>312		133.43			301.95	24.09				385.44	191.93			
19-Aug-85		90.21		>312	175.31	134.72	206.33		307.57						192.65			
21-Aug-85			307.30	>312				243.30		39.01	276.85	17.38	102.26					
17-Sep-85		90.58	316.16	>312	175.73	135.60	206.78	240.03	312.33	25.23	265.88	17.87	101.58	384.58	193.37	23.01		
17-Oct-85		90.79	324.52	>312	175.33	136.28	207.58	240.55	316.97	32.64	274.94	17.90	102.55	385.62	191.85	23.40		
19-Nov-85		90.66	329.54	>312	176.83	141.70	209.08	242.00	319.30	22.83	278.38	13.75	103.10	385.31	192.03	17.63		
12-Dec-85		89.62	332.67	>312	176.02	136.55	209.17	241.55	320.55	21.25	278.15	13.38	103.35	384.86	192.03	16.30		
14-Jan-86		89.85	336.65	>312	175.40	136.15	208.25	240.00	321.70	22.10	278.00	14.83	102.85	384.81	192.30	18.75		
20-Feb-86		89.98	339.78	>312	175.05	136.00	207.76	240.27	322.70	26.96	277.93	15.38	101.95	384.51	192.01	19.63		
12-Mar-86		90.04	341.72	>312	175.13	135.92	207.81			25.83	278.10	15.31	101.26	384.68	192.05	19.82		
17-Apr-86		90.23	343.17	310.58	175.76	135.87	207.86	240.48	326.12	22.61	278.24	15.62	99.70	384.88	192.23	19.92		
15-May-86		90.61	344.45	>312	175.69	136.32	207.85	239.87	327.49	22.12	277.96	16.05	98.08	384.41	192.21	20.38		
18-Jun-86		91.22	344.30	>312	175.88	136.71	207.91	240.14	329.25	21.77	278.41	14.87	96.73	385.18	191.86	19.28		
17-Jul-86		91.34	345.02	>312	175.88	137.20	207.94	240.98	328.27	22.15	277.66	14.97	95.32	384.81	192.08	18.64		
15-Aug-86		91.83	345.00	Plugged	Plugged	137.96	207.84	Plugged	331.70	22.55	278.30	15.80	94.73	Plugged	192.20	Plugged		
17-Sep-86		92.11	344.88			139.01	208.90		333.16	24.09	278.47	17.30	94.94		192.50		>355	156.37
14-Oct-86											277.38	16.81	95.23				>355	154.74
14-Nov-86		92.27	344.00			140.45	209.24		335.10	23.43	278.40	16.10	96.08		193.00		352.15	154.51
15-Jan-87		92.63				141.26	208.91		Dry	23.44	278.03	18.30	99.05		191.24		Dry	154.81
19-Feb-87		91.80	342.00			140.87	209.35		Dry	23.53	278.90	16.43	99.50		192.52		Dry	154.86
15-Mar-87		90.98	340.55			140.97	209.14		Dry	22.52	278.74	16.46	99.80		192.55		Dry	154.01
15-Apr-87		91.57	340.71			141.43	208.17		Dry	22.70	277.29	17.69	100.79		191.71		Dry	154.43
14-May-87		90.43	341.59			141.53	208.87		Dry	19.53	278.65	15.64	100.89		192.35		Dry	154.26
15-Jun-87		90.33	341.08			141.59	208.99		Dry	19.53	278.57	15.57	100.75		192.14		Dry	154.26
16-Jul-87		90.87	340.50			141.72	208.91		Dry	21.05	278.67	16.55	100.86		191.92		Dry	154.66

SSC OBSERVATION WELL DATA DISTANCE TO WATER (FEET)

Date		SSC-S20	SSC-S21	SSC-S22	SSC-S23	SSC-S24	SSC-S26	SSC-S27	SSC-S28	SSC-S30	SSC-K1	SSC-K2	SSC-K3	SSC-L1	SSC-L2	SSC-L3	SSC-B1	SSC-B2	SSC-B3
	Depth:	416.2	303.5	371	474	605	502	465	435	545	421	521	640	317	417	571	277	377	477
	Elev.:	717	648	663	754	903	815	739	731	883	841	841	841	753	753	753	688	688	688
17-Sep-86		364.80	56.96	14.81															
14-Oct-86		353.00	61.07	105.37															
14-Nov-86		354.85	56.53	105.22															
15-Jan-87			57.95	106.37							292.39	292.20	292.28						
19-Feb-87		354.57	56.43		187.90	416.96	265.30	203.11	427.45	353.51	292.55	292.67	292.54	88.82	225.43	417.08	141.63	151.14	151.65
15-Mar-87		354.70	55.08	105.63	187.81	416.64	265.20	302.65	Dry	353.29	293.46	293.67	293.35	89.40		419.73	142.63	152.10	152.70
15-Apr-87		353.07	57.62	106.33	186.98	415.19	263.61	301.06	Dry	351.68	291.15	291.33	291.35	83.16	417.40	453.95	140.10	150.36	151.33
14-May-87		354.69	54.56	106.47	187.56	415.69	264.84	302.36	Dry	351.17	291.79	291.92	291.87	81.68	419.10	456.23	140.90	150.37	151.40
15-Jun-87		354.63	56.09	115.52	187.34	415.13	264.60	302.23	Dry	353.11	291.41	291.37	291.27	79.53	418.21	456.57	141.11	150.30	151.12
16-Jul-87		354.24	56.28	105.06	187.62	415.42	263.40	302.44	Dry	353.42	291.74	291.68	291.76	81.18	418.15	457.11	137.85	150.22	151.04

Appendix 4. Kaneland Aquifer Test Data

WELL PRODUCTION TEST
SSC PROJECT, WELL NO. KANELAND SSC-1 (8" SERIES)
KANE COUNTY, ILLINOIS

By

R. S. Ludwigs & R. T. Sasman

Well Owner:	State of Illinois, Department of Energy and Natural Resources
Consulting Engineers:	
Well Location:	2540' N. and 2490' W. of SE corner, Section 3. T.39N., R.6E., Kane County
Date Well Completed:	October 1986
Date of Production Test:	November 2, 1986
Length of Production Test:	436 min., constant rate
No. of Observation Wells:	1
Aquifer:	St. Peter Formation

PUMPED WELL DATA

Well No.:	Kaneland #1 (8" series)
Depth:	946'
Drilling Contractor:	Layne-Western Co., Inc., Aurora, IL
Drill Cuttings:	to ISGS
Drilling Method:	12" rotary, 0-150'; 5 7/8" dual-wall, 150-990'; 7 7/8" reamed, 150-994'
Hole Record:	12", 0-150'; 7 7/8" 150-994', backfilled to 946'
Casing Record:	Surface casing, +1 1/2 - 150'; open hole, 150-946' — bottom of packer at 579'
Ground Elevation at Well:	843'

Measuring Point:	2 1/2' above top of casing (V above land surface)
Nonpumping Water Level:	312 ft. below MP
Measuring Equipment:	Layne airlines and air gages set above and below the packer. Lower airline, 595'; upper airline, 567'; 4"x3" discharge orifice
Test Pump and Power:	Submersible pump
Time Water Sample Collected:	After 7 hours of pumping
Temperature of Water:	54° F — H_2S odor

Remarks:

After all drilling and reaming was completed, the hole was backfilled with grout to a depth of 946'. A packer was installed near the top of the St. Peter (bottom set at 579'), and a test pump installed through the packer.

PRELIMINARY FORMATION LOG (SGS)

Formation	From	To
Glacial drift	0	120 ft
Sand and gravel,	120	140
Silurian dolomite	140	150
Maquoketa shale	150	280
Galena Group	280	501
Platteville Group	501	611
St. Peter Sandstone	611	940
Kress member, St. Peter Sandstone	940	955
Oneota Dolomite?	955	974
Gunter Sandstone?	974	985
Eminence Formation?	985	990

SSC Project
Well No. Kaneland 1

Pumped Well

MEASUREMENTS

Date	Hour	Time (min)	Depth to water (ft)	Draw-down (ft)	Piez. tube (in.)	Pump rate (gpm)	Remarks
11/2/86	8:17 AM		312				Upper gage: 269 ft
	8:44	0	312	-			Pump on
	8:45	1	350	38			
	8:46	2	352	40	32	224	
	8:47	3	353	41			
	8:48	4	354	42	32	224	Upper gage: 268.5
	8:49	5	354	42			
	8:50	6	354	42	32	224	Upper gage: 268
	8:51	7	355	43			
	8:52	8	355	43			
	8:53	9	356	44			
	8:54	10	356	44			
	8:56	12	356	44	32	224	Upper gage: 268
	8:58	14	357	45			
	9:00	16	357	45	32	224	
	9:02	18	358	46			
	9:04	20	358	46			
	9:09	25	358	46	32	224	Clear
	9:14	30	359	47			
	9:24	40	359	47			Upper gage: 268
	9:34	50	360	48	32	224	" " "
	9:44	60	360	48			" " "
	9:54	70	360	48			" " "
	10:04	80	360	48			" " "
	10:14	90	360	48	32	224	53° F
	10:24	100	360	48			
	10:44	120	361	49			Upper gage: 268
	11:14	150	361	49			
	11:44	180	361	49	31.5	222	Upper gage: 268
	12:14 PM	210	361	49			" " "
	12:44	240	361	49	31.5	222	" " "
	1:14	270	361	49	31.5	222	" " "
	1:44	300	361	49	31.5	222	" " "
	2:14	330	361	49	31.5	222	" " "; Temp. = 53° F
	2:44	360	361	49	31.5	222	Upper gage: 268
	3:14	390	361	49	31.5	222	" " "; T = 54° F; H_2S
	3:44	420	361	49			Upper gage: 268

SSC Project
Well No. Kaneland 1

Pumped Well

MEASUREMENTS
(Continued)

Date	Hour	Time (min)	Depth to water (ft)	Draw-down (ft)	Piez. tube (in.)	Pump rate (gpm)	Remarks
	4:00	436	361	49			Pump off
	4:01	1	313				Recovery
	4:02	2	316				Upper gage: 265
	4:03	3	318				" " "
	4:04	4	320				
	4:05	5	320				Upper gage: 265
	4:06	6	319				
	4:07	7	319				Upper gage: 267
	4:08	8	319				" " "
	4:09	9	318				" " "
	4:10	10	318				" " "
	4:12	12	318				" " "
	4:14	14	318				" " "
	4:16	16	318				" " "
	4:18	18	317				" " "
	4:20	20	317				Upper gage: 267
	4:25	25	316				" " "
	4:30	30	316				" " "
	4:40	40	315				" " "
	4:50	50	315				" " "
	5:00	60	315				" " "
							End of test

Appendix 4. Continued

OBSERVATION WELL DATA

Observation Well No.:	Kaneland Middle School Well No. 1
Depth:	980'
Hole Record:	8", 0-980'
Casing Record:	8", +2-315'
Screen Record:	Open borehole
Measuring Equipment:	Electric dropline
Ground Elevation: 840'	est. (topo map)
Measuring Point:	Top of casing
Nonpumping Water Level:	296.07' ft. below MP
Distance and Direction from Pumped Well:	900' SSE

DRILLERS LOG

Formation	From	To
Brown clay	0	10
Gray clay	10	45
Gray clay and sand	45	52
Sand (gray)	52	70
Blue clay	70	81
Sand (gray)	81	120
Broken limestone and clay	120	135
Shale and dolomite	135	265
Dolomite (Galena)	265	607
Sandstone, brown with shale	607	650
Sandstone with dolomite and shale	650	965
Red shale	965	980

Appendix 4. Continued

SSC Project
Well No. Kaneland Middle School 1 Observation Well

MEASUREMENTS

Date	Hour	Time (min)	Depth to water (ft)	Draw-down (ft)	Piez. tube (in.)	Pump rate (gpm)	Remarks
10/31/86	12:30 PM		296.14				
11/2/86	8:07 AM		296.07				
	8:26		296.07				
	8:36		296.07				
	8:44	0	296.07	--			Pump on in 8" well
	8:45	1	296.07	--			
	8:46	2	296.03	--			
	8:47	3	296.00	--			
	8:48	4	296.09	.02			
	8:49	5	296.12	.05			
	8:50	6	296.09	.02			
	8:51	7	296.09	.02			
	8:52	8	296.01	--			
	8:53	9	296.10	.03			
	8:54	10	296.10	.03			
	8:56	12	296.10	.03			
	8:58	14	296.09	.02			
	9:00	16	296.12	.05			
	9:02	18	296.16	.09			
	9:04	20	296.18	.11			
	9:09	25	296.20	.13			
	9:14	30	296.31	.24			
	9:24	40	296.46	.39			
	9:34	50	296.64	.57			
	9:44	60	296.80	.73			
	9:54	70	296.97	.90			
	10:04	80	297.10	1.03			
	10:14	90	297.23	1.16			
	10:24	100	297.38	1.31			
	10:44	120	297.58	1.51			
	11:44	180	297.97	1.90			
	12:09 PM	205	298.18	2.11			
	12:44	240	298.34	2.27			
	1:14	270	298.50	2.43			
	1:44	300	298.60	2.53			
	2:14	330	298.67	2.60			
	2:44	360	198.73	2.66			
	3:14	390	298.80	2.73			
	3:44	420	298.89	2.82			
	4:00	436	298.90	2.83			Pump off

Appendix 4. Concluded

SSC Project
Well No. Kaneland Middle School 1 Observation Well

MEASUREMENTS
(Continued)

Date	Hour	Time (min)	Depth to water (ft)	Draw-down (ft)	Piez. tube (in.)	Pump rate (gpm)	Remarks
	4:01	1	298.92				Recovery
	4:02	2	298.90				
	4:03	3	298.85				
	4:04	4	298.90				
	4:05	5	298.81				
	4:06	6	298.90				
	4:07	7	298.78				
	4:08	8	298.82				
	4:09	9	298.80				
	4:10	10	298.77				
	4:12	12	298.86				
	4:14	14	298.80				
	4:16	16	298.76				
	4:18	18	298.76				
	4:20	20	298.68				
	4:25	25	298.64				
	4:30	30	298.58				
	4:40	40	298.42				
	4:50	50	298.28				
	5:00	60	298.19				End of test