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Public Groundwater Supplies in Carroll County

by Dorothy M. Woller and Ellis W. Sanderson

ILLINOIS STATE WATER SURVEY

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PUBLIC GROUNDWATER SUPPLIES IN CARROLL COUNTY

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Introduction

This publication presents all available information on production wells used for public groundwater supplies in Carroll County. Bulletin 60, which is divided by county into separate publications, supersedes Bulletin 40 and its Supplements 1 and 2.

The definition of public water supply as contained in the Environmental Protection Act of 1970 was used to determine those water systems and wells to be included. Systems and wells described furnish water for drinking or general domestic use in: 1) incorporated municipalities; 2) unincorporated communities where 10 or more separate lots or properties are being served or are intended to be served; 3) state-owned parks and memorials; and 4) state-owned educational, charitable, or penal institutions.

This report includes separate descriptions for groundwater supplies of 7 municipalities and 1 state park in Carroll County. These are preceded by brief summaries of the groundwater geology of the county and the development of groundwater sources for public use. An explanation of the format used in the descriptions is also given.

Acknowledgments. This report was prepared under the general direction of Dr. William C. Ackermann, Chief of the Illinois State Water Survey, and Richard J. Schicht, Head of the Hydrology Section. Special thanks are given to R. T. Sasman, Hydrologist, who checked all of the data and reviewed the manuscript. Mrs. J. L. Ivens and Mrs. P. A. Motherway edited the manuscript, Mrs. Marilyn J. Innes typed the camera-copy, and John W. Brother, Jr., supervised the preparation of the illustrations. The chemical analyses, unless otherwise stated were made by personnel of the Water Survey Chemistry Section under the supervision of Laurel M. Henley. The analyses made by personnel of the Illinois Environmental Protection Agency were under the supervision of Ira M. Markwood. M. L. Sargent of the Illinois State Geological Survey prepared the generalized column of rock stratigraphic units and aquifers. R. D. Brower, Assistant Geologist, Illinois State Geological Survey, and M. L. Sargent reviewed the geological information in the manuscript. Grateful acknowledgment also is given to consulting engineers, well drillers, water superintendents, and municipal officials who have provided valuable information used in this report.

Groundwater Geology

The geology of Carroll County is described generally in Illinois State Geological Survey Circular 206, *Groundwater in Northwestern Illinois*, and Circular 491, *Plum River Fault Zone of Northwestern Illinois*. The following brief discussion of geologic conditions in the county is taken largely from these publications. For a more detailed definition of the geology in this portion of the state, the reader is referred to the State Geological Survey which is located on the University of Illinois campus, Urbana.

Glacial drift deposits, loess, and alluvium materials form the present day land surface in Carroll County and vary greatly in thickness and water-yielding character. Glacial outwash and alluvium consisting mostly of extensive, per-

meable deposits of sand and gravel 50 to 200 ft thick are associated with the Mississippi River valley along the western edge of the county. These sands and gravels offer excellent possibilities for developing large irrigation, municipal, and industrial supplies. Sand and gravel outwash and alluvial deposits favorable for development of small to moderate supplies may also be present in the valleys of the larger creeks. Glacial ice did not advance to the northwestern part of Carroll County but in the rest of the county the uplands are covered by less than 50 ft of glacial drift and loess with poor possibilities for the presence of water-bearing sands and gravels. Loess covers the entire upland to a depth of 25 ft at the bluff and thins to 10 ft along the eastern side of the county.

Beneath the glacial deposits, the upper bedrock formations consist principally of beds of dolomite (a limestone-like rock) and shale. The bedrock stratigraphy is complicated by the presence of the Plum River Fault Zone which extends from Leaf River (Ogle County), westward through Savanna, into Jackson County, Iowa. The bedrock formations in Carroll County range in geologic age from Silurian to Precambrian (see generalized stratigraphic sequence in figure 1).

Silurian dolomite underlies the glacial drift in most of the northern tier of townships and in the south-central area of the county (see figure 2). These rocks, known as the Silurian aquifer, are part of the geohydrologic unit referred to as the shallow dolomite aquifer system. They are encountered from near land surface to depths of about 100 ft, and have a maximum thickness of about 225 ft tapering to a feather-edge where they have been thinned by erosion. Where the Silurian has been removed by erosion, the underlying Maquoketa Group is exposed. The yield capability of the Silurian rocks depends primarily upon the number, size, and degree of interconnection of water-filled cracks and crevices within the rock that are penetrated by a well bore. In some areas the Silurian rocks directly underlie permeable deposits of water-bearing sand and gravel. Under such geohydrologic conditions formation of solution cracks and crevices and free exchange of water from the glacial drift to the bedrock is possible, thereby enhancing the yield capability of the Silurian aquifer.

The Maquoketa Group (Ordovician age) underlies the glacial drift in a portion of the southeastern and southwestern areas and is present beneath the glacial drift and alluvial deposits in the bottoms of deeply eroded stream valleys in the northern tier of townships north of the Plum River Fault Zone. The Maquoketa consists primarily of nonwater-bearing shales that separate the Silurian aquifer from deeper water-bearing units. These shales lie at depths of 20 ft (in the lowlands) near Savanna (Well No. 5) to as much as 260 ft beneath the bluff at Mississippi Palisades State Park. The Maquoketa rocks are absent in a large part of central and eastern Carroll County where they have been eroded away exposing the underlying Galena and Platteville Dolomite Groups, but are about 150 ft thick at Shannon and as much as 200 ft thick at Mississippi Palisades State Park. The Maquoketa Group generally is not considered as a source for water supplies.

Below the Maquoketa Group there is a thick sequence of hydrologically connected rocks that is referred to as the Cambrian-Ordovician aquifer system. This aquifer system consists in downward order of the Galena and Platteville Dolomite Groups, Glenwood-St. Peter Sandstone, Prairie du Chien Group, Eminence-Potosi Dolomite, Franconia Formation, and Ironton-Galesville Sandstone.

The Galena-Platteville (Ordovician age) directly underlies the drift in part of the central and eastern portions of Carroll

County (see figure 2). The top of this dolomite lies at depths from less than 50 ft in the central and southeast areas of the county to about 250 ft in the northeast and northwest areas. It usually varies in thickness from about 200 ft in the southwest to about 350 ft in the northern and eastern areas. Water from this dolomite is obtained from cracks and crevices, and where it lies directly beneath permeable sand and gravel deposits, its yield potential is enhanced.

The Glenwood-St. Peter Sandstone (Ancell Group of Ordovician age) lies below the Galena-Platteville. This sandstone aquifer is encountered at depths from about 300 ft in the southeast to about 600 ft beneath the bluffs in the western part of the county, and ranges in thickness from about 90 to 150 ft. The Glenwood-St. Peter is one of the principal water-yielding units of the Cambrian-Ordovician aquifer.

The Glenwood-St. Peter overlies various units in different parts of the county that include the Prairie du Chien Group, the Eminence-Potosi Dolomite, and the Franconia Formation that consists of interbedded sandstones, shales, and dolomites. The Prairie du Chien Group (Ordovician age) is present only along the western and southern edges of the county. It contains three formations; the Shakopee Dolomite, the New Richmond Sandstone, and the Oneota Dolomite. These units have a combined thickness up to 330 ft, but thin rapidly to zero toward the north. In most of Carroll County the Glenwood-St. Peter overlies the Eminence-Potosi Dolomite (Cambrian age) and the Franconia Formation (Cambrian age). These units are encountered at depths from about 800 ft in the southwest on the Mississippi River floodplain to about 1100 ft on the topographic high a few miles to the east and occur within this range in most of the county. They have total thicknesses varying from about 130 ft at Mt. Carroll to about 550 ft at Savanna and Milledgeville. The shales and dolomites yield small quantities of water, but the sandy parts of these formations may contribute moderate quantities of water to wells where they are not cased off by liners.

The Ironton-Galesville Sandstone (Cambrian age) is the most consistently permeable and productive unit of the Cambrian-Ordovician aquifer system in northern Illinois. In Carroll County it lies at depths from 1000 ft south of Shannon to as much as 1400 ft beneath the bluffs in the western part of the county and varies in thickness from about 100 to 150 ft. The Ironton-Galesville is the principal water-yielding unit of the Cambrian-Ordovician aquifer.

The Eau Claire Formation lies below the Ironton-Galesville Sandstone. The upper and middle parts of the Eau Claire contain many nonwater-bearing shales that separate the Cambrian-Ordovician aquifer from deeper water-bearing units. The Elmhurst Sandstone Member at the base of the Eau Claire Formation and the underlying Mt. Simon Sandstone are hydrologically connected and form the Elmhurst-Mt. Simon aquifer, the deepest fresh water aquifer in northern Illinois. In Carroll County this aquifer lies at depths of about 1500 to 1700 ft, and ranges in thickness from about 1150 ft

SYSTEM	SERIES	GROUP OR FORMATION	AQUIFER	LOG	THICKNESS (FT)	GENERALIZED DESCRIPTION	
QUATERNARY	PLEISTOCENE		Sands and Gravels		0-200	Till, gravel, sand, silt, peat, loess	
SILURIAN	NIAGARAN	Hunton	Silurian		0-225	Dolomite, crystalline, vesicular, white to gray, partly cherty	
	ALEXANDRIAN					Dolomite, dense to vesicular, silty and sandy in lower part	
ORDOVICIAN	CINCINNATIAN	Maquoketa			0-185	Shale, dolomitic, green to gray, some dolomite	
	CHAMPLAINIAN	Galena	Galena-Platteville		0-250	Dolomite and limestone, medium-grained, cherty in lower part	
		Platteville			0-100	Dolomite, fine-grained, cherty	
	CANADIAN	Prairie du Chien	Ancell	Glenwood-St. Peter		70-200	Sandstone, medium-grained, friable, mostly white
			Shakopee	Shakopee		0-100	Dolomite, light gray to light brown; very fine grained; some thin beds sandy, silty, argillaceous; some oolitic chert
			New Richmond	New Richmond		0-30	Sandstone, white to gray, fine to medium grained
			Oneota	Oneota		0-200	Dolomite, light gray to brownish gray, fine to coarse grained, cherty
	CAMBRIAN	CROIXAN	Eminence	Eminence-Potosi		0-210	Dolomite, light colored, sandy, thin sandstones Dolomite, fine-grained, gray to brown, drusy quartz
Potosi							
Franconia			Franconia	60-100		Dolomite, sandstone and shale, glauconitic, green to red, micaceous	
Ironton			Ironton-Galesville	115-150		Sandstone, fine to coarse grained, well sorted; upper part dolomitic	
Galesville							
Eau Claire				240-380		Shale and siltstone, dolomitic, glauconitic; sandstone, dolomitic, glauconitic	
Elmhurst Member			Elmhurst-Mt. Simon	1150-1500		Sandstone, coarse-grained, white, red in lower half; lenses of shale and siltstone, red, micaceous	
Mt. Simon							
PRE-CAMBRIAN						Granitic rocks	

Figure 1. Generalized column of rock stratigraphic units and aquifers in Carroll County
 (Prepared by M. L. Sargent, Illinois State Geological Survey)

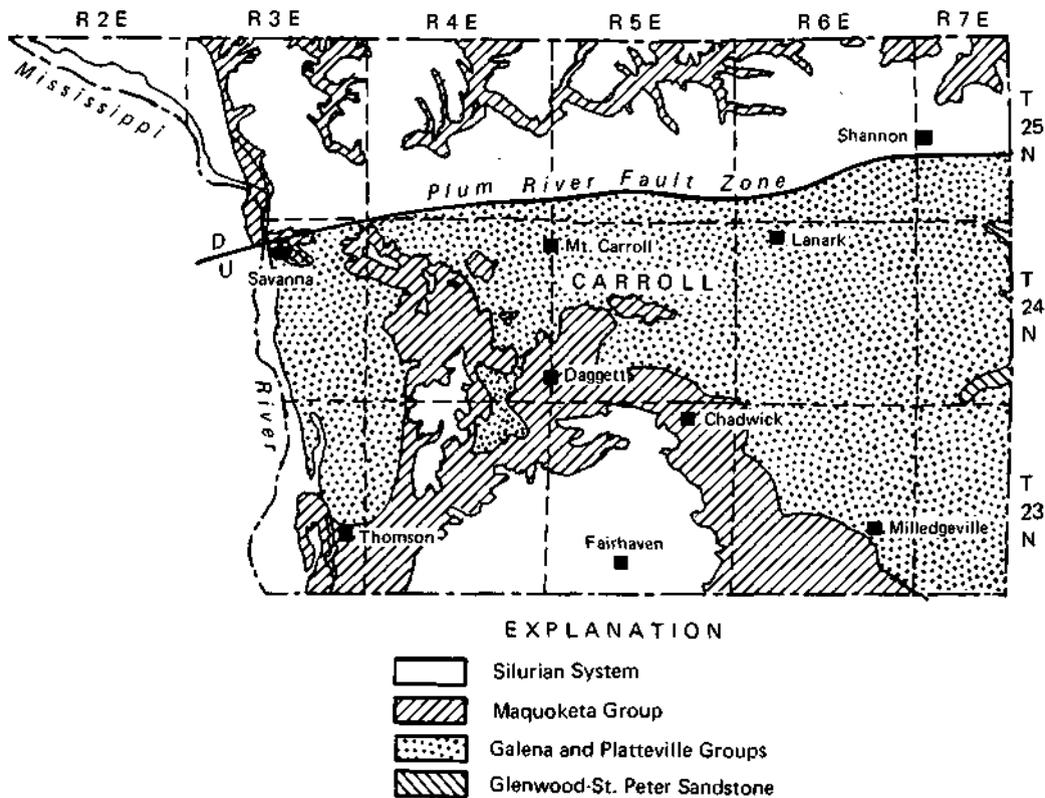


Figure 2. Areal geology of the bedrock surface
 (Modified from Geologic Map of Illinois, Willman and others, 1961, and
 figure 2, Illinois State Geological Survey Circular 491)

in the northwest corner to about 1500 ft in the southeast part of the county. Water wells usually penetrate only a few hundred feet into this aquifer because the mineral quality of the water deteriorates with depth.

Groundwater Development for Public Use

Groundwater is used as a source for 8 public water supplies serving Chadwick, Lanark, Milledgeville, Mississippi Palisades State Park, Mt. Carroll, Savanna, Shannon, and Thomson. The locations of these supplies are shown in figure 3.

Unconsolidated sand and gravel deposits associated with the Mississippi valley are tapped as a source of water by the wells at Thomson. There are presently 3 municipal production and standby wells finished in these aquifers at depths of 58, 76.5, and 65 ft. Their reported yields range from 96 to 600 gpm depending primarily upon the type of well constructed and the permeability, thickness, and areal extent of the sand and gravel unit tapped by each well. Production from these wells in 1978 was estimated to be 54,000 gpd. Analyses of water from these wells indicate that the iron content ranges from a trace to 2.4 mg/l, and the hard-

ness from 167 to 223 mg/l. Water for Thomson is chlorinated and fluoridated.

Wells tapping combinations of formations within the Cambrian-Ordovician aquifer are used at 7 public water supply systems. The Galena-Platteville Dolomite, the uppermost unit of the Cambrian-Ordovician aquifer, is tapped at the Mississippi Palisades State Park and Shannon as a source of all or a portion of their water supplies. There are presently 4 production and standby wells finished in this unit at depths of 250, 350, 515, and 560 ft. Their reported yields range from 29 to 125 gpm. The yield of an individual well depends primarily on the thickness of the aquifer and the number, size, and degree of interconnection of the crevices intersected by the well bore. Withdrawals from this unit in 1978 were estimated to be about 11,000 gpd. Analyses of water from wells tapping only the Galena-Platteville indicate that the iron content ranges from 0.0 to 3.4 mg/l, and the hardness from 271 to 376 mg/l. Water for Shannon is fluoridated and chlorinated and part of the water for the state park is chlorinated.

The Glenwood-St. Peter Sandstone, the middle part of the Cambrian-Ordovician aquifer, and the overlying Galena-Platteville are tapped as a partial source of water for Milledgeville and Shannon. One standby well (675 ft deep) and one

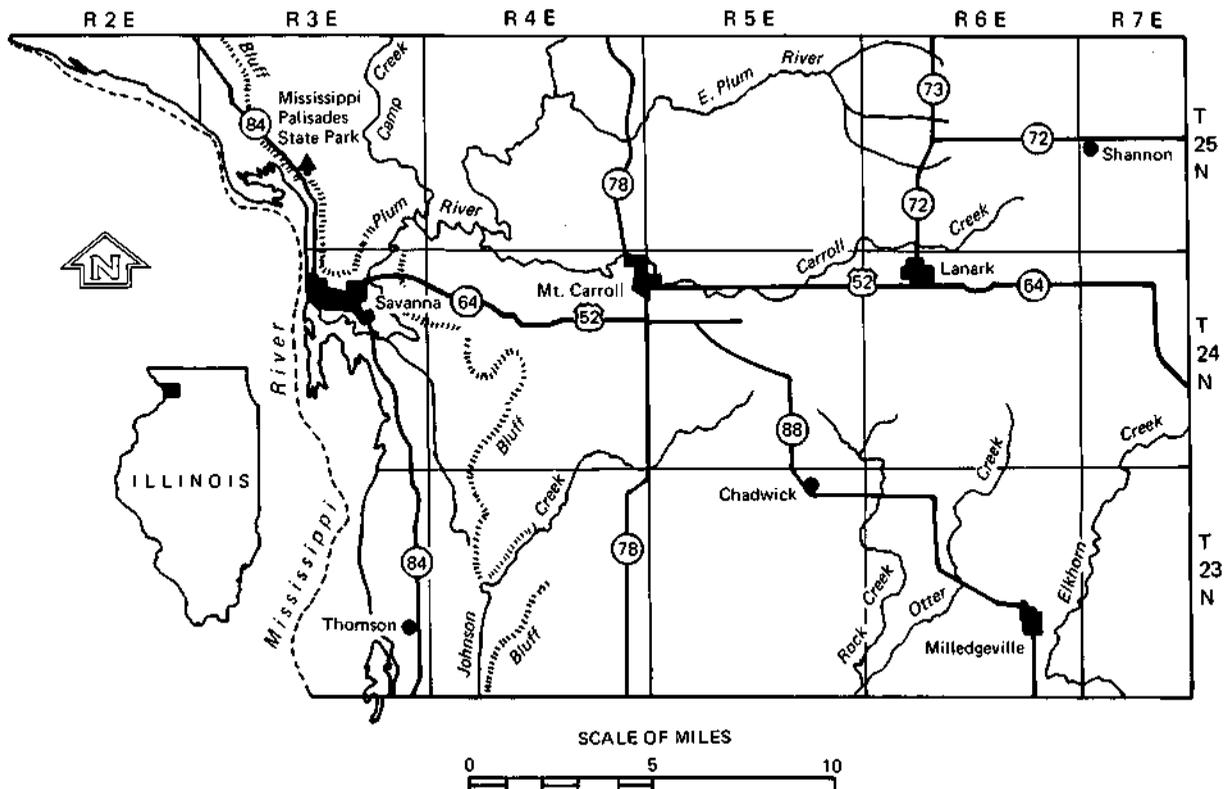


Figure 3. Location of public groundwater supplies in Carroll County

production well (704 ft deep) are in use. They are pumped at rates of about 140 and 165 gpm. Production from these wells in 1978 was estimated to be about 125,000 gpd. Analyses of water from these wells indicate that the iron content ranges from 0.05 to 0.8 mg/l, and the hardness from 308 to 390 mg/l. Water from the standby well at Milledgeville is not treated and the water from the active well at Shannon is fluoridated and chlorinated.

There are presently 7 other production and standby wells, ranging in depth from 1082 to 1208.5 ft, finished in the Ironton-Galesville Sandstone at the base of the Cambrian-Ordovician aquifer system. These wells are pumped at rates of about 150 to 1580 gpm. Production from these wells in 1978 was estimated to be 1,005,000 gpd. Analyses of water from these wells indicate that the iron content ranges from a trace to 2.9 mg/l, and the hardness from 274 to 389 mg/l. Water for Chadwick Well No. 3 is aerated to remove hydrogen sulfide, fluoridated, and chlorinated. Water for Lanark and Savanna is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution. Water from Well No. 4 at Milledgeville is fluoridated and chlorinated.

Wells tapping combinations of formations within the Cambrian-Ordovician aquifer and the deep-lying Elmhurst-Mt. Simon aquifer are used at Mt. Carroll and Savanna as a

source of all or part of their water supply. There are presently 4 production and standby wells, ranging in depth from 1453 to 1852 ft, finished within the Elmhurst-Mt. Simon aquifer system. These wells are pumped at rates of about 140 to 920 gpm. Production from these wells in 1978 was estimated to be about 397,000 gpd. The analyses of water from these wells show the iron content to range from 0.02 to 1.2 mg/l, and the hardness from 240 to 424 mg/l. The water for Mt. Carroll is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution; Well No. 2 water is also aerated. At Savanna, the water is chlorinated, fluoridated, and treated with polyphosphate.

The total public water supply pumpage in Carroll County for 1978 was about 1,592,000 gpd. Of this total approximately 3 percent (54,000 gpd) was obtained from sand and gravel aquifers, 72 percent (1,141,000 gpd) from formations of the Cambrian-Ordovician aquifer, and 25 percent (397,000 gpd) from combinations of formations within the Cambrian-Ordovician and the Elmhurst-Mt. Simon aquifers.

Format

In this publication the descriptions of public groundwater supplies are presented in alphabetical order by place name.

The U. S. Census of population for 1970 for incorporated places is given at the beginning of each description.

The number of services and quantity of water distributed at each supply are given where available for the earliest and the latest reported values.

Individual production wells for each supply are described in the order of their construction. The description for each well includes the *aquifer or aquifers tapped, date drilled, depth, driller, legal location, elevation in feet above mean sea level, log, construction features, yield, pumping equipment, and chemical analyses.*

When available, sample study logs prepared by the Illinois State Geological Survey are presented. When these are not available, drillers logs are used as reported. Commonly used drillers terms such as clay, silt, or pebbly clay generally are synonymous with the glacial tills tabulated by the State Geological Survey. Similarly, limestones or dolomites reported by drillers usually are calciferous rocks which in most of Illinois are dolomitic in composition. When stating the bedrock aquifers tapped by a well, the sample study log provided by the Geological Survey and the drillers casing record are used to determine the geohydrologic units open to the hole. If only a drillers log is available and the geohydrologic units cannot be readily determined, then the principal rock type usually is given (i.e., dolomite).

The screen sizes given in this publication are for continuous slot screens. The slot sizes given indicate the width of

the slot openings in thousandths of an inch. For example, a 20 slot screen has slot openings 0.020 in. wide and a 100 slot screen has openings 0.100 in. wide.

Abbreviations Used

ft	.....	foot (feet)
gpd	.....	gallons per day
gpm	.....	gallons per minute
hp	.....	horsepower
hr	.....	hour(s)
ID	.....	inside diameter
in.	.....	inch(es)
Lab.	.....	laboratory
lb	.....	pound(s)
me/l	.....	milliequivalents per liter
mg/l	.....	milligrams per liter
min	.....	minute(s)
No.(s)	.....	number(s)
OD	.....	outside diameter
pc/l	.....	picocuries per liter
R	.....	range
rpm	.....	revolutions per minute
T	.....	township
TDH	.....	total dynamic head

CHADWICK

The village of Chadwick (605) installed a public water supply in 1895. One well (No. 3) is in use and another well (No. 2) is available for emergency use. In 1952 there were 210 services; the estimated average daily pumpage was 40,000 gpd. In 1977 there were 250 services, none metered; the average and maximum daily pumpages were 54,100 and 90,000 gpd, respectively. The water from Well No. 3 is aerated to remove hydrogen sulfide, fluoridated, and chlorinated.

Initially, a 5.6-in. diameter well was completed in 1895 to a depth of 215 ft. The well was located in the village park on Main St. south of Third St., approximately 3900 ft N and 2130 ft E of the SW corner of Section 2, T23N, R5E. This well was reported to be dry in October 1920 and was abandoned.

WELL NO. 1, open to the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone, was completed in 1913 to a depth of 615 ft (reported to have filled in to 525 ft by 1945). This well was abandoned prior to 1955 and sealed prior to 1958. The well was located near the intersection of Third and Main Sts. about 10 ft east of the initial well, approximately 3900 ft N and 2140 ft E of the SW corner of Section 2, T23N, R5E. The land surface elevation at the well is approximately 800 ft.

The well was cased with 8-in. pipe from land surface to a depth of 200 ft.

In October 1913, the nonpumping water level was reported to be 100 ft below land surface.

A mineral analysis of a sample (Lab. No. 83699) collected June 7, 1938, showed the water to have a hardness of 353 mg/l, total dissolved minerals of 385 mg/l, and an iron content of 2.44 mg/l.

WELL NO. 2, open to the Cambrian-Ordovician aquifer except for the Glenwood-St. Peter Sandstone, was completed in November 1945 to a depth of 1215 ft by the Varner Well and Pump Co., Dubuque, Iowa. This well is available for emergency use. The well is located in the village square 50 ft east and 110 ft south of the intersection of Main and Third Sts., approximately 3850 ft N and 2130 ft E of the SW corner of Section 2, T23N, R5E. The land surface elevation at the well is approximately 800 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Clay and till	40	40
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale and dolomite	37	77
Galena and Platteville Groups		
Dolomite	343	420
Ancell Group		
Glenwood Formation		
Shale, dolomite, sandstone	20	440

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
St. Peter Sandstone		
Sandstone, silty, thin shale bed 495 to 500 ft	100	540
Conglomerate of sandstone, chert, and shale	25	565
Prairie du Chien Group		
Shakopee Dolomite	40	605
New Richmond Sandstone		
Sandstone and dolomite	25	630
Oneota Dolomite		
Dolomite and compact sandstone	198	828
CAMBRIAN SYSTEM		
Eminence-Potosi Dolomite	150	978
Franconia Formation		
Sandstone, shale, and dolomite	92	1070
Ironton-Galesville Sandstone		
Sandstone, incoherent	25	1095
Sandstone, partly dolomitic	40	1135
Sandstone, incoherent	65	1200
Eau Claire Formation		
Shale, sandstone, and dolomite	15	1215

A 16-in. diameter hole was drilled to a depth of 115 ft, reduced to 12 in. between 115 and 450 ft, and finished 10 in. in diameter from 450 to 1215 ft. The well is cased with 16-in. OD pipe from land surface to a depth of 77 ft, 12-in. ID pipe from land surface to a depth of 115 ft (cemented in), and 10-in. liner pipe from 450 ft to a depth of 610 ft.

During drilling when the St. Peter Sandstone had been penetrated, the well reportedly produced 143 gpm with a drawdown of 190 ft from a nonpumping water level of 60 ft below the top of the casing.

On June 16, 1964, the nonpumping water level was reported to be 175 ft.

The pumping equipment presently installed consists of a 25-hp Westinghouse electric motor (Serial No. 1544), an 8-in., 15-stage American Well Works turbine pump (No. 707552) set at 250 ft, rated at 200 gpm at about 338 ft head, and has 250 ft of 5-in. column pipe. A 30-ft section of 5-in. suction pipe is attached to the pump intake. The well is equipped with 250 ft of airline.

A partial analysis of a sample (Lab. No. 113906) collected March 17, 1948, after pumping for 21 min, showed the water to have a hardness of 353 mg/l, total dissolved minerals of 379 mg/l, and an iron content of 0.4 mg/l.

WELL NO. 3, open to the Cambrian-Ordovician aquifer, was constructed in November 1955 to a depth of 561 ft by the Allabaugh Well Co., Rockford, and reportedly deepened in August 1967 to a depth of 1210 ft by the Layne-Western Co., Aurora. The well is located at the southeast corner of Third and Main Sts., approximately 3923 ft N and 2165 ft E of the SW corner of Section 2, T23N, R5E. The land surface elevation at the well is approximately 790 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil, black	4	4
Clay, yellow	16	20
Clay, greenish to gray	15	35

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Clay, yellow with stones	15	50
Shale, gray	23	73
Limestone, buff to gray	107	180
Limestone, buff	125	305
Limestone, gray	25	330
Limestone, buff	65	395
Limestone, gray	9	404
Shale, gray	1	405
Limestone, buff	15	420
Shale, green	5	425
Limestone, gray	3	428
Shale, gray	10	438
Sandstone, white	52	490
Shale, gray sticky	6	496
Sandstone, white	36	532
Sandstone with shale, red to gray	29	561
Lime, gray, hard	69	630
Sandy lime, hard	15	645
Lime, white, hard	10	655
Lime, white, medium hard	55	710
Lime, gray, medium hard	40	750
Lime, gray, fine and hard	115	865
Lime, sandy, hard	35	900
Lime, gray, hard	40	940
Lime, brown, hard	10	950
Lime and shale lenses, gray, hard	50	1000
Shale and lime, hard	25	1025
Sandy shale, hard	25	1050
Sand, gray, hard	20	1070
Sand, white, hard	20	1090
Sand, hard	30	1120
Sand, white, medium	68	1188
Sandy lime and shale, hard	6	1194
Shale and lime shells, dark gray, hard	6	1200
Muddy shale, gray	10	1210

A partial record shows that a 12-in. diameter hole was drilled between the depths of 95 and 561 ft and finished 10 in. in diameter from 561 to 1210 ft. The well is cased with 18-in. OD steel pipe from 2 ft above land surface to a depth of 50 ft and 12-in. ID steel pipe from 2 ft above land surface to a depth of 93 ft (cemented in).

Upon completion at the depth of 561 ft, the well reportedly produced 80 gpm for 6 hr with a drawdown of 75 ft from a nonpumping water level of 95 ft below land surface.

LANARK

The city of Lanark (1495) installed a public water supply in 1888. Two wells (Nos. 3 and 4) are in use. In 1950 there were about 412 services; the estimated average and maximum daily pumpages were 150,000 and 220,000 gpd, respectively. In 1977 there were 800 services, 4 percent metered; the average and maximum daily pumpages were 227,000 and 400,000 gpd, respectively. The water is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution.

Initially, a large-diameter well was constructed 20 ft in diameter to a depth of 60 ft. Because of an inadequate water level, two wells were drilled in the bottom, one to a depth of 400 ft and the other to a depth somewhat less than 400 ft, and the lower 40 ft of the large-diameter hole filled

After the well was deepened, a production test was conducted by the driller on August 24-25, 1967. After 6 hr of pumping at a rate of 153 gpm, the drawdown was 88 ft from a nonpumping water level of 120 ft below land surface. Pumping was continued for 6 hr at a rate of 250 gpm with a drawdown of 113 ft. Pumping was continued for another 6 hr at rates ranging from 346 to 357 gpm with a drawdown of 143 ft. After an additional 6 hr of pumping at a rate of 402 gpm, the final drawdown was 168 ft. During the last 2.8 hr of this test, Well No. 2 was pumping continuously.

The pumping equipment presently installed is a Layne & Bowler vertical turbine pump (Serial No. 58311) set at 310 ft, rated at 400 gpm, and powered by a 50-hp 1800 rpm U. S. Holloshaft electric motor (Serial No. R1784-01-168).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B47449) is for a water sample from the well collected May 15, 1978, after 30 min of pumping at 400 gpm.

WELL NO. 3, LABORATORY NO. B47449

		<i>mg/l</i>	<i>me/l</i>			<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.2		Silica	SiO ₂	9.4	
Manganese	Mn	0.01		Fluoride	F	0.2	0.01
Ammonium	NH ₄	0.1	0.01	Boron	B	0.0	
Sodium	Na	3	0.13	Nitrate	NO ₃	0.0	0.00
Potassium	K	2.5	0.06	Chloride	Cl	0.8	0.02
Calcium	Ca	64	3.19	Sulfate	SO ₄	23	0.48
Magnesium	Mg	40	3.29	Alkalinity (as CaCO ₃)		308	6.16
Arsenic	As	0.00					
Barium	Ba	0.1		Hardness (as CaCO ₃)		331	6.62
Copper	Cu	0.00					
Cadmium	Cd	0.00					
Chromium	Cr	0.00		Total dissolved minerals		348	
Lead	Pb	0.00					
Mercury	Hg	<0.0004					
Nickel	Ni	0.0					
Selenium	Se	0.00					
Silver	Ag	0.00					
Cyanide	CN	0.00					
Zinc	Zn	0.0		pH (as rec'd)		7.2	

in. Water was obtained from the 400-ft deep well until 1895 when the water supply became inadequate and the installation was abandoned.

WELL NO. 1, open to the St. Peter Sandstone, was completed in 1895 to a depth of 600 ft (sounded in January 1946 and found to be 510 ft). This well was abandoned in 1957 and sealed in August 1962. The well was located on North Boyd St. about 125 ft north of the center of the Chicago, Milwaukee, and St. Paul RR tracks, approximately 2940 ft N and 2900 ft W of the SE corner of Section 5, T24N, R6E. The land surface elevation at the well is approximately 885 ft.

A drillers log of Well No. 1 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Glacial drift	40	40
Galena-Platteville limestone	160	200
St. Peter sandstone	400	600

A 10-in. diameter hole was drilled to a depth of about 200 ft and finished 6 in. in diameter from about 200 to 600 ft. The well was cased with 10-in. pipe from land surface to a depth of 200 ft. In 1952, it was reported that the hole was reamed to 10 in. in diameter to a depth of 430 ft.

In 1913 and 1924, the nonpumping water level was reported to be 80 ft below land surface.

A production test was conducted by the State Water Survey on June 13, 1940. After 1.1 hr of pumping at rates of 190 to 160 gpm, with a nonpumping water level of 60 ft below land surface, the water was drawn down more than 123 ft and the pump broke suction.

In January 1946, when the depth was found to be 510 ft, the nonpumping water level was 64 ft below the pump base after an idle period of 5 days.

A mineral analysis of a sample (Lab. No. 108670) collected December 16, 1946, after pumping for 1 hr at 100 gpm, showed the water to have a hardness of 331 mg/l, total dissolved minerals of 341 mg/l, and an iron content of 1.5 mg/l.

WELL NO. 2, open to the St. Peter Sandstone, was completed in 1936 to a depth of 447 ft by the Varner Well and Pump Co., Dubuque, Iowa. This well was abandoned and sealed in 1972. The well was located 15 ft north of Locust St. and 15 ft west of Bruce St., approximately 2350 ft N and 3800 ft W of the SE corner of Section 5, T24N, R6E. The land surface elevation at the well is approximately 860 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Till	15	15
Gravel, very fine, sandy	12	27
Till	73	100
ORDOVICIAN SYSTEM		
Galena-Platteville dolomites	197	297
Glenwood Formation		
Sandstone, dolomite, and some shale	23	320
St. Peter Sandstone	127	447

A 10-in. diameter hole was drilled to a depth of 447 ft. The well was cased with 10-in. pipe from 1 ft above land surface to a depth of 315 ft.

On March 12, 1937, the well reportedly produced 225 gpm with a drawdown of 30 ft from a nonpumping water level of 135 ft.

On June 13, 1940, the nonpumping water level was reported to be 132 ft.

In June 1945, the pump broke suction after 6 weeks of

continuous operation when the pumping water level reached the 180-ft pump setting. The pump was then lowered 50 ft.

A production test was conducted by the Lyons Well Drilling Co., Stockton, on October 11, 1961. After 6.8 hr of pumping at rates of 77 to 350 gpm, the final drawdown was 109 ft from a nonpumping water level of 140 ft.

A partial analysis of a sample (Lab. No. 167652) collected in December 1965, showed the water to have a hardness of 316 mg/l, total dissolved minerals of 358 mg/l, and an iron content of 2.3 mg/l.

WELL NO. 3, open to the Cambrian-Ordovician aquifer, was completed in February 1957 to a depth of 1101 ft by the Allabaugh Well Co., Rockford. The well is located south of Claremont St. between Broad and Boyd Sts., approximately 2300 ft S and 2300 ft E of the NW corner of Section 5, T24N, R6E. The land surface elevation at the well is approximately 880 ft.

A sample study summary log of Well No. 3 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Till, silty, sandy, brownish yellow	80	80
ORDOVICIAN SYSTEM		
Champlainian Series		
Galena Group		
Dolomite, yellowish brown to buff, very fine to medium, crystalline	125	205
Dolomite, light gray to brown, very fine to medium	40	245
Platteville Group		
Dolomite, buff to grayish buff, extra fine to fine, crystalline	70	315
Ansell Group		
Glenwood Formation		
Sandstone, white, light gray to buff, coarse to very fine	70	385
St. Peter Sandstone		
Sandstone, white to light gray, white to light red at base, very fine to coarse, incoherent; shale, reddish brown, weak, brittle from 598 to 610 ft, 622 to 630 ft, 635 to 647 ft, and 710 to 718 ft	333	718
CAMBRIAN SYSTEM		
Croixan Series		
Eminence-Potosi Dolomite		
Dolomite, light buff to buff, very fine to fine; shale reddish brown, weak brittle; sandstone, pinkish, buff, very fine to coarse	37	755
Dolomite, light gray to light pinkish-buff, fine, crystalline	72	827
Sandstone, reddish-brown to purple, very fine to fine, compact	13	840
Franconia Formation		
Sandstone, light gray to light grayish-brown, very fine to coarse, incoherent; shale, greenish-gray, weak, little brittle	70	910
Ironton Sandstone		
Sandstone, light gray to light buff, very fine to very coarse, rounded, incoherent	100	1010
Galesville Sandstone		
Sandstone, white to light buff, very fine to medium, little coarse, rounded, incoherent	45	1055
Eau Claire Formation		
Sandstone, light grayish buff, gray, very fine to fine, compact, incoherent	45	1100

An 18-in. diameter hole was drilled to a depth of 340 ft and finished 14 in. in diameter from 340 to 1101 ft. The well is cased with 18-in. steel pipe from land surface to a depth of 91 ft and 14-in. steel pipe from 2 ft above land surface to a depth of 340 ft (cemented in).

A production test using one observation well was conducted on February 20, 1957, by representatives of the driller, the city, the State Water Survey, and Mr. G. E. DeJong, Consulting Engineer. After 24 hr of pumping at rates of 270 to 616 gpm, the final drawdown was 89.4 ft from a nonpumping water level of 174.7 ft below the pump base. Thirty-three min after pumping was stopped, the water level had recovered to 191.0 ft. During this test, Well Nos. 1 and 2 were pumping intermittently.

On October 6, 1960, the well reportedly produced 500 gpm for 15 min with a pumping water level of 273.5 ft.

The pumping equipment presently installed consists of a 50-hp 1770 rpm Fairbanks-Morse electric motor (Serial No. F1 30544), a 10-in., 9-stage Fairbanks-Morse submersible pump set at 280 ft, rated at 400 gpm at about 305 ft head, and has 280 ft of 8-in. column pipe. A 20-ft section of 8-in. suction pipe is attached to the pump intake.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B50658) of a sample collected June 21, 1976, after pumping for 2 hr at 500 gpm, showed the water to have a hardness of 294 mg/l, total dissolved minerals of 294 mg/l, and an iron content of 0.4 mg/l.

WELL NO. 4, open to the Cambrian-Ordovician aquifer, was completed in June 1971 to a depth of 1082 ft by the Henry Boysen Co., Libertyville. The well is located north of West Locust St. on the west side of Bruce St., approximately 2400 ft N and 1420 ft E of the SW corner of Section 5, T24N, R6E. The land surface elevation at the well is approximately 860 ft.

A drillers log of Well No. 4 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sandy clay, gray	96	96
Limestone	202	298
Shale, sandstone, limestone	17	315
Sandstone, white	145	460
Sandstone, pink	22	482

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sandstone, white	52	534
Shale, limestone, crevice	154	688
Limestone	119	807
Shale, limestone	91	898
Sandstone, white	135	1033
Sandstone, shale, limestone	49	1082

An 18-in. diameter hole was drilled to a depth of 315 ft and finished 14 in. in diameter from 315 to 1082 ft. The well is cased with 18-in. pipe from land surface to a depth of 101 ft and 14-in. OD pipe from land surface to a depth of 315 ft (cemented in).

A production test was conducted by the driller on July 13-14, 1971. After 23.3 hr of pumping at rates of 330 to 732 gpm, the final drawdown was 82 ft from a nonpumping water level of 167 ft below land surface. Five min after pumping was stopped, the water level had recovered to 189 ft.

The pumping equipment presently installed is a Reda submersible pump set at 280 ft, rated at 295 gpm, and powered by a 60-hp Reda electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B47452) is for a water sample from the well collected May 15, 1978, after 1 hr of pumping.

WELL NO. 4, LABORATORY NO. B47452

		<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.5		Silica	SiO ₂	13
Manganese	Mn	0.03		Fluoride	F	0.2 0.01
Ammonium	NH ₄	0.0	0.00	Boron	B	0.0
Sodium	Na	4	0.17	Nitrate	NO ₃	0.0 0.00
Potassium	K	0.9	0.02	Chloride	Cl	1.2 0.03
Calcium	Ca	55	2.74	Sulfate	SO ₄	24 0.50
Magnesium	Mg	34	2.80	Alkalinity (as CaCO ₃)		257 5.14
Arsenic	As	0.00		Hardness (as CaCO ₃)		282 5.64
Barium	Ba	0.1		Total dissolved minerals		307
Copper	Cu	0.00				
Cadmium	Cd	0.00				
Chromium	Cr	0.00				
Lead	Pb	0.00				
Mercury	Hg	<0.0003				
Nickel	Ni	0.0				
Selenium	Se	0.00				
Silver	Ag	0.00				
Cyanide	CN	0.00				
Zinc	Zn	0.0		pH (as rec'd)		7.3

MILLEDGEVILLE

The village of Milledgeville (1130) installed a public water supply in 1896. One well (No. 4) is in use and another well (No. 3) is available for emergency use. This supply is cross connected with the Kraft Foods, Inc. wells. In 1950 there were 315 services, 99 percent metered; the estimated average daily pumpage was 60,000 gpd. In 1977 there were 486 services, all metered; the average and maximum daily

pumpages were 117,000 and 180,000 gpd, respectively. The water from Well No. 4 is fluoridated and chlorinated.

WELL NO. 1 (old West Well), completed in 1897 by the Davis Drilling Co., Preston, Iowa, was originally reported to be 250 ft deep but in 1923 it was reported to be 475 ft deep. This well was abandoned prior to 1945 and sealed in 1954. The well was located 1 block west of the business

district within the pumping station building, approximately 1200 ft N and 1890 ft E of the SW corner of Section 23, T23N, R6E. The land surface elevation at the well is approximately 759 ft.

The well was cased with 8-in. pipe from above the bottom of a 6-ft deep pit to a depth of 15 ft.

WELL NO. 2 (old East Well), completed in 1897 by the Davis Drilling Co., Preston, Iowa, was originally reported to be 300 ft deep but in 1923 it was reported to be 518 ft deep. This well was abandoned in 1939 and sealed in 1954. The well was located within the pumping station building 10 ft east of Well No. 1, approximately 1200 ft N and 1900 ft E of the SW corner of Section 23, T23N, R6E. The land surface elevation at the well is approximately 759 ft.

The well was cased with 8-in. pipe from above the bottom of a 6-ft deep pit to a depth of 15 ft.

A partial analysis of a sample (Lab. No. 83698) collected June 7, 1938, showed the water to have a hardness of 300 mg/l, total dissolved minerals of 338 mg/l, and an iron content of 0.64 mg/l.

WELL NO. 3, open to the Galena-Platteville dolomite, Glenwood-St. Peter Sandstone, and the Prairie du Chien Group, was constructed in April 1939 to a depth of 437 ft by Davis & Lingle, Preston, Iowa, and deepened in January 1954 to a depth of 675 ft by the Varner Well and Pump Co., Dubuque, Iowa. This well is available for emergency use. The well is located 10 ft east of Well No. 2, approximately 1200 ft N and 1910 ft E of the SW corner of Section 23, T23N, R6E. The land surface elevation at the well is approximately 759 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Gray lime	155	155
A little shale break, some caving	25	180
Brown lime	25	205
Gray lime, a little harder	40	245
Gray lime, hard	45	290
Gray lime and iron cuttings	20	310
Light gray lime and rock caving	20	330
Gray lime	5	335
Real fine hard gray lime	3	338
Gray and brown mixed lime	10	348
Shale, sand and lime	10	358
Shale and lime	15	373
St. Peter sandstone	2	375
Sand and lime	11	386
Hard fine sand and lime	2	388
Sand and yellow lime	24	412
Sand and gravel	12	424
Lime and iron cuttings	14	438
Gray shale and iron	2	440
Sand, gravel and iron	3	443
Shale and sand	4	447
Sand and gravel, caving in	13	460
Solid gray limestone	2.5	462.5
Gray lime	2.5	465
Gray lime, traces of sand	2.5	467.5
Brown lime	2.5	470
Brown and gray lime	5	475
Very hard gray lime	25	500
Gray lime, traces of shale	5	505
Very hard gray lime	25	530
Gray lime and shale	15	545

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Richmond sand	10	555
Hard sand	5	560
Hard gray lime	23	583
Gray lime, considerable flint	4	587
Hard gray lime	8	595
Hard white lime	8	603
White and gray mixed lime	10	613
Solid white lime	5	618
Hard white and gray lime	2	620
Hard lime, heavy brown flint	3	623
Gray lime	2	625
White lime, a lot of flint	5	630
Gray hard lime	10	640
Gray and white lime, some shale	10	650
Hard white lime with flint	10	660
White lime	5	665
Hard white and gray lime	6	671
Softer gray lime	4	675

Originally, a 12-in. diameter hole was drilled to a depth of 32 ft and finished 10 in. in diameter from 32 to 437 ft. The well was cased with 12-in. outer pipe from land surface to a depth of 20 ft and 10-in. pipe from land surface to a depth of 32 ft (cemented in). In 1954 when this well was enlarged and deepened, a 15-in. diameter hole was drilled to a depth of 375 ft and finished 12 in. in diameter from 375 to 675 ft. The well is cased with 16-in. drive pipe from land surface to a depth of 41 ft, 10-in. pipe from land surface to a depth of 238.6 ft (cemented in), and a 12-in. liner from 341 ft to a depth of 380 ft.

Upon completion in 1939, the nonpumping water level was reported to be about 115 ft. There are no recorded water levels and production tests available after the well was deepened in 1954.

The pumping equipment presently installed is a Peerless turbine pump (Serial No. 107545) set at 270 ft, rated at 150 gpm, and powered by a 20-hp U. S. electric motor (Serial No. 967239).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B124056) is for a water sample from the well collected February 3, 1975, after 1 hr of pumping at 100 gpm.

WELL NO. 3, LABORATORY NO. B124056						
	<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>	
Iron	Fe	0.1	Silica	SiO ₂	8	
Manganese	Mn	0.0	Fluoride	F	0.2	0.01
Ammonium	NH ₄	0.0	Boron	B	0.1	
Sodium	Na	2	Nitrate	NO ₃	0.0	0.00
Potassium	K	3.2	Chloride	Cl	1.4	0.04
Calcium	Ca	62	Sulfate	SO ₄	22	0.46
Magnesium	Mg	38	Alkalinity (as CaCO ₃)	300	6.00	
Arsenic	As	0.00	Hardness (as CaCO ₃)	311	6.22	
Barium	Ba	0.1	Total dissolved minerals	305		
Copper	Cu	0.00				
Cadmium	Cd	0.00				
Chromium	Cr	0.00				
Lead	Pb	0.00				
Mercury	Hg	0.0000	pH (as rec'd)	7.7		
Nickel	Ni	0.0	Radioactivity			
Selenium	Se	0.00	Alpha <i>pc/l</i>	5.6		
Silver	Ag	0.00	± deviation	2.6		
Cyanide	CN	0.00	Beta <i>pc/l</i>	6.2		
Zinc	Zn	0.0	± deviation	6.1		

WELL NO. 4, open to the Cambrian-Ordovician aquifer (except for the Galena-Platteville dolomite), was completed in September 1948 to a depth of 1146 ft by C. W. Varner, Dubuque, Iowa. The well is located 50 ft east of Well No. 3, approximately 1215 ft N and 1960 ft E of the SW corner of Section 23, T23N, R6E. The land surface elevation at the well is approximately 759 ft.

A correlated drillers log of Well No. 4 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
ORDOVICIAN SYSTEM		
Galena and Platteville Groups		
Brown and gray lime	100	100
Shale (probably cavern deposit)	10	110
Lime	236	346
Ancell Group		
Glenwood Formation		
Blue shale	8	354
Sandy shale	14	368
St. Peter Sandstone		
Sandstone	4	372
Sand	63	435
ORDOVICIAN AND CAMBRIAN SYSTEMS		
Shakopee, New Richmond, Oneota Formations		
Lime	478	913
Franconia Formation		
Lime, sand, and shale	7	920
Sandy shale	70	990
Ironton-Galesville Sandstone		
Sand, some lime	5	995
Sand	129	1124
Eau Claire Formation		
Coarse sandy lime	6	1130
Blue sandy shale	4	1134
Blue shale	12	1146

An 18-in. diameter hole was drilled to a depth of 17 ft, reduced to 16.8 in. between 17 and 374 ft, reduced to 12 in. between 374 and 1015 ft, and finished 10 in. in diameter from 1015 to 1146 ft. The well is cased with 18-in. OD drive pipe from land surface to a depth of 17 ft and 12-in. pipe from land surface to a depth of 374 ft (cemented in).

A production test was conducted by Mr. M. W. Hurdle on September 23, 1948. After 2.9 hr of pumping at a rate of 200 gpm, the drawdown was 22 ft from a nonpumping water level of 83 ft below land surface. Pumping was continued for 2 hr at a rate of 400 gpm with a drawdown of 72 ft. Pumping was gradually increased to a rate of 565 gpm in 3.2 hr with a final drawdown of 121 ft. Thirty min after pumping was stopped, the water level had recovered to 88 ft. During this test, Well No. 3 was pumping intermittently.

The pumping equipment presently installed is a 9-stage Peerless turbine pump (Serial No. 51163) rated at 350 gpm at about 300 ft head, and powered by a 30-hp 1800 rpm U. S. electric motor (Serial No. 731526).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B48203) is for a water sample from the well collected May 17, 1978.

WELL NO. 4, LABORATORY NO. B48203

		<i>mg/l</i>	<i>me/l</i>			<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.1		Silica	SiO ₂	7.5	
Manganese	Mn	0.02		Fluoride	F	0.2	0.01
Ammonium	NH ₄	0.1	0.01	Boron	B	0.0	
Sodium	Na	1.0	0.04	Nitrate	NO ₃	0.0	0.00
Potassium	K	3.2	0.08	Chloride	Cl	1.1	0.03
Calcium	Ca	58	2.89	Sulfate	SO ₄	30	0.62
Magnesium	Mg	45	3.70	Alkalinity (as CaCO ₃)		301	6.02
Arsenic	As	0.00		Hardness (as CaCO ₃)		328	6.56
Barium	Ba	0.1		Total dissolved			
Copper	Cu	0.02		minerals		332	
Cadmium	Cd	0.00					
Chromium	Cr	0.00					
Lead	Pb	0.00					
Mercury	Hg	<0.0003					
Nickel	Ni	0.0					
Selenium	Se	0.00					
Silver	Ag	0.00					
Cyanide	CN	0.00					
Zinc	Zn	0.0		pH (as rec'd)		7.5	

MISSISSIPPI PALISADES STATE PARK

Mississippi Palisades State Park, located just north of Savanna along the Mississippi River, installed a public water supply in 1948. Three wells (Nos. 2, 3, and 4) and one spring (No. 1) are in use, which serve separate systems including two elevated tanks and various fountains throughout the park. In 1978 the average and maximum daily pumpages were 4180 and 50,000 gpd, respectively. The water from Well Nos. 2 and 3 is chlorinated.

Eight springs have been constructed in the past for a partial source of water supply for the park. Seven of these springs (Nos. 2-8) are either abandoned or not used. Spring No. 1 is located near the south entrance of the park, approximately 1050 ft N and 900 ft W of the SE corner of Section 28, T25N, R3E.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B48411) is for

a water sample from Spring No. 1 collected June 7, 1976.

SPRING NO. 1, LABORATORY NO. B48411

	mg/l	me/l		mg/l	me/l
Iron	Fe	0.0	Silica	SiO ₂	16
Manganese	Mn	0.00	Fluoride	F	0.3
Ammonium	NH ₄	0.00	Boron	B	0.1
Sodium	Na	4.3	Nitrate	NO ₃	2.2
Potassium	K	0.7	Chloride	Cl	3.4
Calcium	Ca	77	Sulfate	SO ₄	43
Magnesium	Mg	42	Alkalinity (as CaCO ₃)		326
Arsenic	As	0.00	Hardness (as CaCO ₃)		365
Barium	Ba	0.1			7.30
Copper	Cu	0.00	Total dissolved minerals		391
Cadmium	Cd	0.00			
Chromium	Cr	0.00			
Lead	Pb	0.00			
Mercury	Hg	0.0000			
Nickel	Ni	0.0			
Selenium	Se	0.00			
Silver	Ag	0.00			
Cyanide	CN	0.01			
Zinc	Zn	0.0	pH (as rec'd)		7.6

WELL NO. 1, open to the Maquoketa Group and the Galena dolomite, was completed in 1933 to a depth of 285 ft by Davis and Blackman, Preston, Iowa. This well was abandoned and sealed in 1951. The well was located in the main section of the park, approximately 1050 ft N and 430 ft E of the SW corner of Section 27, T25N, R3E. The land surface elevation at the well is approximately 650 ft.

A sample study summary log of Well No. 1 furnished by the State Geological Survey follows:

Strata	Thickness (ft)	Depth (ft)
RECENT AND PLEISTOCENE SERIES		
"Soil and yellow clay"	20	20
Clay, silty, buff and pink, flaky, weak	5	25
Silt to very fine sand, brown, noncalcareous, dolomite boulders at 30-35 ft	25	50
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale, slightly dolomitic, brownish, pinkish, and bluish gray, weak; limestone, dolomitic, part argillaceous, buff and greenish buff, very fine, weathered	20	70
Shale, dolomitic, bluish gray, weak; dolomite, argillaceous, bluish gray and light brown, very fine to coarse	12	82
Dolomite, light brown, fine to coarse; dolomite speckled light and dark gray, medium to coarse bryozoa; shale, dolomitic, bluish gray at base	18	100
Dolomite, argillaceous, bluish gray, very fine shale, dolomitic, bluish gray, weak	5	105
Shale, dolomitic, gray, weak; dolomite, argillaceous, gray, very fine	30	135
Shale, dolomitic, gray, weak; little dolomite, argillaceous, gray, very fine; brown phosphatized and pyritized gastropods, bryozoa, and pelecypods below 145 ft	30	165
Shale, dolomitic, brown, firm, grading to dolomite, argillaceous, brown, very fine, compact	20	185
Shale, dolomitic, brown, firm; few layers dolomite, argillaceous, brown, light brown, and gray, very fine to medium	20	205
Shale, dolomitic, brown to brownish gray,		

Strata (continued)	Thickness (ft)	Depth (ft)
firm little dolomite, argillaceous, brown to brownish gray, at top	20	225
Shale, slightly dolomitic, dark brown, tough, few pyritized gastropods	5	230
Galena Group		
Dolomite, brown, fine to coarse, crinoidal	5	235
Dolomite, light brown, medium crystalline, compact, partly vesicular at bottom	35	270
Dolomite, light brown, medium to coarse, vesicular, pyritic; coatings and chips of clay, dolomitic, blue, weak; water at 275 ft	15	285

The well was cased with 6-in. pipe from 1 ft above land surface to a depth of 84.8 ft. The hole was 6 in. in diameter below the casing.

A partial analysis of a sample (Lab. No. 88745) collected August 22, 1940, after pumping for a few min, showed the water to have a hardness of 304 mg/l, total dissolved minerals of 316 mg/l, and an iron content of 0.5 mg/l.

WELL NO. 2, finished in Galena dolomite, was completed in 1934 to a depth of 515 ft by C. H. Coad & Son, Apple River. The well is located in the east part of the main section of the park on a hill, approximately 2150 ft N and 150 ft W of the SE corner of Section 33, T25N, R3E. The land surface elevation at the well is approximately 830 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

Strata	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
No record	26	26
Loess	7	33
SILURIAN SYSTEM		
Niagaran-Alexandrian dolomites	227	260
ORDOVICIAN SYSTEM		
Maquoketa shale, some dolomite	198	458
Galena dolomite	57	515

A 6-in. diameter hole was drilled to a depth of 515 ft. The well is cased with 6-in. pipe from 1 ft above the bottom of a 10-ft deep pit to an unknown depth.

The pumping equipment presently installed is a submersible pump rated at 20 gpm, and powered by an electric motor.

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B5688) of a sample collected July 26, 1972, showed the water to have a hardness of 284 mg/l, total dissolved minerals of 305 mg/l, and an iron content of 0.0 mg/l.

WELL NO. 3, open to the Galena-Platteville dolomite, was completed in October 1951 to a depth of 560 ft by the Varner Well and Pump Co., Dubuque, Iowa. The well is located about 20 ft east of Well No. 1 in the main section of the park, approximately 1050 ft N and 450 ft E of the SW corner of Section 27, T25N, R3E. The land surface elevation at the well is approximately 655 ft.

A sample study summary log of Well No. 3 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Silt, sandy, yellowish orange	40	40
ORDOVICIAN SYSTEM		
Maquoketa Group		
Shale, grayish green, some pink, weak; dolomite, dark yellowish gray, green, fine to medium	195	235
Galena Group		
Dolomite, yellowish brown, fine	220	455
Dolomite, sandy, gray to pale yellowish brown, fine to coarse	35	490
Plattville Group		
Dolomite, pale grayish brown, fine to coarse	70	560

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B48681) is for a water sample from the well collected May 22, 1978, after 30 min of pumping at 33 gpm.

WELL NO. 3, LABORATORY NO. B48681

	<i>me/l</i>	<i>me/l</i>	<i>mg/l</i>	<i>me/l</i>		
Iron	Fe	0.1	Silica	SiO ₂	7.8	
Manganese	Mn	0.01	Fluoride	F	0.6	0.03
Ammonium	NH ₄	0.1	Boron	B	0.1	
Sodium	Na	6	Nitrate	NO ₃	0.0	0.00
Potassium	K	4.6	Chloride	Cl	1.6	0.04
Calcium	Ca	52	Sulfate	SO ₄	1	0.02
Magnesium	Mg	35	Alkalinity(as CaCO ₃)	281	5.62	
Arsenic	As	0.00	Hardness (as CaCO ₃)	280	5.60	
Barium	Ba	0.4				
Copper	Cu	0.01				
Cadmium	Cd	0.00	Total dissolved minerals	288		
Chromium	Cr	0.00				
Lead	Pb	0.00				
Mercury	Hg	<0.0002				
Nickel	Ni	0.0				
Selenium	Se	0.00				
Silver	Ag	0.00				
Cyanide	CN	0.00				
Zinc	Zn	0.0	pH (as rec'd)	7.7		

A 12-in. diameter hole was drilled to a depth of 45 ft, reduced to 10 in. between 45 and 97 ft, reduced to 8.8 in. between 97 and 265 ft, and finished 6 in. in diameter from 265 to 560 ft. The well is cased with 10-in. pipe from 1 ft above land surface to a depth of 52 ft and 6-in. pipe from 1.2 ft above land surface to a depth of 265 ft. The annulus between the casings is filled with cement grout from 1 ft above land surface to a depth of 70 ft, with sand from 70 to 263 ft, and with cement grout from 263 to 265 ft.

A production test was conducted on October 22-23, 1951, by representatives of the driller, the State Water Survey, and the State Department of Architecture and Engineering. After 24 hr of pumping at a rate of 40 gpm, the drawdown

was 24 ft from a nonpumping water level of 49 ft below land surface. Fifty-one min after pumping was stopped, the water level had recovered to 68 ft.

A second production test was conducted on November 5-6, 1951, by representatives of the driller, the State Water Survey, the State Department of Architecture and Engineering, and Jenkins, Merchant & Nankivil, Consulting Engineers. After 24 hr of pumping at rates of 60 to 76 gpm, the drawdown was 31 ft from a nonpumping water level of 51 ft below land surface. Five min after pumping was stopped, the water level had recovered to 72 ft.

The pumping equipment presently installed is a Peerless turbine pump (Serial No. 50173) rated at 31 gpm at about 390 ft TDH, and powered by a 7½-hp 1800 rpm U. S. electric motor (Serial No. 619976).

WELL NO. 4 (formerly a privately owned well), finished in the Galena dolomite, was completed in 1968 to a depth of 350 ft. The well is located north of the park office, approximately 1700 ft S and 50 ft E of the NW corner of Section 21, T25N, R3E. The land surface elevation at the well is approximately 595 ft.

The well is cased with 8-in. pipe from 3 ft above land surface to a reported depth of 245 ft.

The pumping equipment presently installed is an A. Y. McDonald submersible pump set at 240 ft, rated at 29 gpm, and powered by a 2-hp electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B48684) is for a water sample from the well collected May 22, 1978, after 30 min of pumping at 25 gpm.

WELL NO. 4, LABORATORY NO. B48684

	<i>mg/l</i>	<i>me/l</i>	<i>mg/l</i>	<i>me/l</i>		
Iron	Fe	0.2	Silica	SiO ₂	7.8	
Manganese	Mn	0.01	Fluoride	F	0.5	0.03
Ammonium	NH ₄	0.3	Boron	B	0.1	
Sodium	Na	5	Nitrate	NO ₃	0.0	0.00
Potassium	K	4.8	Chloride	Cl	1.5	0.04
Calcium	Ca	52	Sulfate	SO ₄	2	0.04
Magnesium	Mg	35	Alkalinity(as CaCO ₃)	292	5.84	
Arsenic	As	0.00	Hardness (as CaCO ₃)	277	5.54	
Barium	Ba	0.5				
Copper	Cu	0.01				
Cadmium	Cd	0.00	Total dissolved minerals	293		
Chromium	Cr	0.00				
Lead	Pb	0.00				
Mercury	Hg	<0.0003				
Nickel	Ni	0.0				
Selenium	Se	0.00				
Silver	Ag	0.00				
Cyanide	CN	0.08				
Zinc	Zn	0.0	pH (as rec'd)	7.6		

MT. CARROLL

The city of Mt. Carroll (2143) installed a public water supply in 1888. Two wells (Nos. 2 and 3) are in use. In 1950 there were 630 services, 80 metered. In 1978 there were 805 services, 99 percent metered; the estimated average and maximum daily pumpages were 192,000 and 570,000 gpd, respectively. The water is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution; the water from Well No. 2 is also aerated.

Initially, water was obtained from a 20-ft diameter dug well, 20 ft deep, located near the pump station building and elevated tank on South Mill St. In the bottom of the dug well, two 6-in. diameter and two 8-in. diameter wells were drilled, each to a depth of 80 ft. A brick wall, extending above land surface, surrounded the dug portion in an attempt to prevent possible contamination. In 1920, after pumping for 1.5 to 2 hr a day at an estimated rate of 400 gpm, the drawdown was 10 ft from a nonpumping water level of 8 ft below land surface. This well was abandoned in 1920 because of suspicion of causing a typhoid fever epidemic.

WELL NO. 1, open to the Cambrian-Ordovician and the Elmhurst-Mt. Simon aquifers, was completed in April 1895 to a depth of 2501 ft by the J. P. Miller Artesian Well Co., Brookfield. This well was abandoned and sealed in 1960. The well was located about 35 ft south of the initial well on South Mill St., approximately 400 ft S and 1450 ft W of the NE corner of Section 12, T24N, R4E. The land surface elevation at the well is approximately 725 ft.

A drillers log of Well No. 1 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Surface material	59	59
Limestone	221	280
Shale	80	360
Sandstone, probably also contains shale	180	540
Sandy limestone	85	625
Limestone	285	910
"Caving" material	215	1125
Shale	80	1205
Sandstone	10	1215
Limestone	5	1220
Sandstone	510	1730
Sandy red marl	100	1830
Sandstone	402	2232
Limestone, sandy	269	2501

A 10-in. diameter hole was drilled to a depth of 90 ft, reduced to 8 in. between 90 and 140 ft, reduced to 6 in. between 140 and 2000 ft, and finished 5 in. in diameter from 2000 to 2501 ft. The well was cased with 10-in. pipe from land surface to a depth of 90 ft and 8-in. pipe from 90 ft to a depth of 140 ft.

A production test was conducted by the State Water Survey on June 28, 1934. After 2.8 hr of pumping at rates ranging from 115 to 110 gpm, the drawdown was 56.8 ft from a nonpumping water level of 62.2 ft.

On October 15, 1946, after a 10-day idle period, the nonpumping water level was reported to be 72 ft below

the top of the casing.

A mineral analysis of a sample (Lab. No. 52213) collected August 20, 1924, showed the water to have a hardness of 282 mg/l, total dissolved minerals of 353 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 2, open to the Cambrian-Ordovician (except for the Galena-Platteville dolomite) and the Elmhurst-Mt. Simon aquifers, was completed in 1935 to a depth of 1457 ft by the Varner Well and Pump Co., Dubuque, Iowa. The well is located in a wellhouse about 105 ft south of the main pumping station, approximately 500 ft S and 1440 ft W of the NE corner of Section 12, T24N, R4E. The land surface elevation at the well is approximately 718 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Glacial Drift	60	60
ORDOVICIAN SYSTEM		
Galena and Platteville Groups		
Dolomite	202	262
Ansell Group		
Glenwood Formation		
Shale, dolomite, and sandstone	15	277
St. Peter Sandstone		
Sandstone, incoherent	383	660
Shale, sandstone, and pebbles	97	757
CAMBRIAN SYSTEM		
Potosi Dolomite		
Dolomite, some sandstone	43	800
Franconia Formation		
Sandstone, thin shale beds	90	890
Ironton-Galesville Sandstone		
Sandstone, partly dolomitic	125	1015
Eau Claire Formation		
Sandstone, dolomite, thin shale beds	360	1375
Mt. Simon Sandstone	82	1457

A 20-in. diameter hole was drilled to a depth of 83 ft, reduced to 19 in. between 83 and 367 ft, reduced to 15 in. between 367 and 737 ft, and finished 12 in. in diameter from 737 to 1457 ft. The well is cased with 20-in. drive pipe from land surface to a depth of 83 ft, 16-in. pipe from 1.3 ft above land surface to a depth of 367 ft (cemented in), and a 12-in. liner from 657 ft to a depth of 737 ft.

A production test was conducted by the State Water Survey on May 14-15, 1935. After 22 hr of pumping at a rate of 225 gpm, the drawdown was 95 ft from a nonpumping water level of 52 ft. Because of the low capacity revealed by this test, charges of dynamite were exploded as follows: 60 lb at 900 ft, 60 lb at 950 ft, 60 lb at 1300 ft, 80 lb at 1350 ft, and 80 lb at 1400 ft.

A second production test conducted by the State Water Survey on June 10-11, 1935, showed that the specific capacity (yield per foot of drawdown) had been increased significantly and it was estimated that the well could be pumped at a rate of 600 gpm with a drawdown of about 100 ft after a 24-hr pumping period.

On November 20, 1946, the nonpumping water level was reported to be 57 ft below the pump base.

The pumping equipment presently installed is a Peerless turbine pump (Serial No. 320451) set at 200 ft, rated at 700 gpm at about 200 ft head, and powered by a 50-hp U. S. electric motor (Serial No. R-1784-01-262 R-201-14421).

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B49154) of a sample collected May 23, 1978, after pumping for 45 min at 630 gpm, showed the water to have a hardness of 315 mg/l, total dissolved minerals of 328 mg/l, and an iron content of 0.2 mg/l.

Prior to the construction of Well No. 3, three test holes located in Sections 1 and 12, T24N, R4E, were drilled in 1952 by the Layne-Western Co., Aurora, to depths of 13, 44, and 58 ft.

WELL NO. 3, open to the Cambrian-Ordovician (except for the Galena-Platteville dolomite) and the Elmhurst-Mt. Simon aquifers, was completed in December 1955 to a depth of 1453 ft by the Milaeger Well and Pump Co., Brookfield, Wis. The well is located in a wellhouse about 130 ft east of the pumping station, approximately 300 ft S and 1300 ft W of the NE corner of Section 12, T24N, R4E. The land surface elevation at the well is approximately 740 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sand and gravel	35	35
Blue shale	40	75
Gravel	10	85
Limestone	194	279
Shale	31	310
Sandstone	332	642
Red shale and sandstone	108	750
Limestone	85	835
Shale and lime	63	898
Sandstone	130	1028
Red shale	141	1169
Sandstone	284	1453

A 20-in. diameter hole was drilled to a depth of 85 ft, reduced to 19 in. between 85 and 303 ft, reduced to 15 in. between 303 and 730 ft, and finished 12 in. in diameter from 730 to 1453 ft. The well is cased with 20-in. drive

pipe from land surface to a depth of 85 ft, 16-in. pipe from 1.8 ft above land surface to a depth of 300 ft (cemented in), and a 12-in. liner from 642 ft to a depth of 730 ft.

A production test was conducted on December 20-22, 1955, by representatives of the driller, the city, the State Water Survey, and Baxter & Woodman, Consulting Engineers. After 24 hr of pumping at rates of 490 to 600 gpm, the final drawdown was 123.5 ft from a nonpumping water level of 120.5 ft below the pump base. Thirty-seven min after pumping was stopped, the water level had recovered to 131.0 ft. Durnig this test, Well No. 2 was pumping intermittently.

The pumping equipment presently installed consists of a 60-hp 1800 rpm U. S. electric motor (Serial No. 1074076), a Layne turbine pump (Serial No. C30104) set at 270 ft, rated at 425 gpm, and has 270 ft of 6-in. column pipe. A 10-ft section of 6-in. suction pipe is attached to the pump intake. The well is equipped with 270 ft of airline.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B49157) is for a water sample from the well collected May 23, 1978, after 30 min of pumping.

WELL NO. 3, LABORATORY NO. B49157

	<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.5	Silica	SiO ₂	11
Manganese	Mn	0.01	Fluoride	F	0.3
Ammonium	NH ₄	0.1	Boron	B	0.1
Sodium	Na	3	Nitrate	NO ₃	0.0
Potassium	K	1.8	Chloride	Cl	4.1
Calcium	Ca	75	Sulfate	SO ₄	29
Magnesium	Mg	44	Alkalinity (as CaCO ₃)		327
Arsenic	As	0.00	Hardness (as CaCO ₃)		363
Barium	Ba	0.0			7.26
Copper	Cu	0.01			
Cadmium	Cd	0.00	Total dissolved minerals		376
Chromium	Cr	0.00			
Lead	Pb	0.00			
Mercury	Hg	<0.0004			
Nickel	Ni	0.0			
Selenium	Se	0.00			
Silver	Ag	0.00			
Cyanide	CN	0.00			
Zinc	Zn	0.0	pH (as rec'd)		7.0

SAVANNA

The city of Savanna (4942) installed a public water supply in 1890. Three wells (Nos. 4, 5, and 6) are in use and another well (No. 3) is available for emergency use. In 1950 there were 1695 services, all metered; the average and maximum daily pumpages were 600,000 and 1,500,000 gpd, respectively. In 1979 there were 1987 services, 99 percent metered; the average and maximum daily pumpages in 1978 were 782,351 and 2,300,000 gpd, respectively. The water

is chlorinated, fluoridated, and treated with polyphosphate to keep iron in solution.

WELL NO. 1, open to the Cambrian-Ordovician aquifer, was completed in 1890 to a depth of 1432 ft by the J. P. Miller Artesian Well Co., Brookfield. This well was abandoned prior to 1949 and sealed in 1953. The well was located at the foot of Washington St. on the west side of Main St., approximately 1560 ft S and 310 ft W of the NE corner of

Section 9, T24N, R3E. The land surface elevation at the well is approximately 595 ft.

An 8-in. diameter hole was drilled to a depth of 400 ft and finished 5 in. in diameter from 400 to 1432 ft. The well was cased with 6-in. pipe to a depth of 35 ft.

In 1908, water flowed from the well at a rate of 260 gpm, and in 1945 the flow was negligible.

WELL NO. 2, open to the Cambrian-Ordovician aquifer, was completed in 1908 to a depth of 1443 ft. This well was abandoned prior to 1949 and sealed in 1953. The well was located at Murray and Third Sts., approximately 150 ft S and 300 ft W of the NE corner of Section 9, T24N, R3E. The land surface elevation at the well is approximately 605 ft.

A drillers log of Well No. 2 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Drift	3	3
Limestone	345	348
White sandstone	120	468
Shale	5	473
Limestone	55	528
Red marl	8	536
Limestone with pockets of coarse sandstone about 5 ft thick	367	903
Blue shale	80	983
White sandstone	110	1093
Blue shale	30	1123
White sandstone	40	1163
Limestone	100	1263
Red marl	10	1273
White sandstone	170	1443

A 13-in. diameter hole was drilled to a depth of 225 ft, reduced to 10 in. between 225 and 455 ft, and finished 8 in. in diameter from 455 to 1443 ft. The well was cased with 10-in. galvanized pipe from land surface to a depth of 225 ft, 8-in. galvanized pipe from 225 ft to a depth of 360 ft, and an 8-in. liner from 445 ft to a depth of 527 ft.

Upon completion of the well, water flowed from the well at a rate of 500 gpm, and in 1945, the flow was estimated to be at 75 gpm.

A mineral analysis of a sample (Lab. No. 43968) collected October 7, 1920, showed the water to have a hardness of 257 mg/l, total dissolved minerals of 308 mg/l, and an iron content of 0.20 mg/l.

WELL NO. 3, open to the Cambrian-Ordovician (except for the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone) and the Elmhurst-Mt. Simon aquifers, was completed in 1917 to a depth of 1852 ft (cleaned to 1780 ft in 1941 and reported in 1964 to be 1335 ft deep) by C. P. Brant & Co. This well is available for emergency use. The well is located at the northwest corner of Chicago Ave. and Main St., approximately 1775 ft S and 150 ft W of the NE corner of Section 9, T24N, R3E. The land surface elevation at the well is approximately 595 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Yellow clay and gravel	30	30
Hard gray limestone	310	340
Blue slate and lead ore	9	349
White water sand	151	500
Yellow sand	5	505
Red sand	165	670
White sand	30	700
Red sand	20	720
Red shale (caved badly)	10	730
Red sand	15	745
Broken limestone (caved)	55	800
Red sand	15	815
Limestone	95	910
Soft gray limestone	70	980
White sharp sand	130	1110
Gray sand	5	1115
Black sand	15	1130
White sand	80	1210
Limestone	50	1260
Black stone	2	1262
Red limestone	8	1270
White sand	230	1500
Pink sand	352	1852

A 16-in. diameter hole was drilled to a depth of 30 ft, reduced to 12 in. between 30 and 760 ft, reduced to 10 in. between 760 and 880 ft, and finished 8 in. in diameter from 880 to 1852 ft. Originally, the well was cased with 16-in. pipe from land surface to a depth of 30 ft, 12-in. pipe from land surface to a depth of 80 ft (cemented in), and an 8-in. pipe from land surface to a depth of 880 ft. When the well was cleaned in 1941, the 8-in. pipe was removed and a 10-in. pipe was installed from 2 ft above land surface to a depth of 234 ft and 8-in. pipe was then placed from 234 ft to a depth of 845 ft.

Upon completion of the well, the water flowed from the well at a rate of 312 gpm.

In 1972, it was reported that this well had been shot at depths of 1050, 1260, and 1560 ft in 1934, and was shot at depths of 1180, 1450, and 1780 ft in 1941. The well was cleaned to a depth of 1780 ft and recased in 1941.

A production test was conducted by the Varner Well and Pump Co., Dubuque, Iowa, on April 22-24, 1964. After 30 hr of pumping at rates ranging from 143 to 460 gpm, the drawdown was 163 ft from a nonpumping water level of 2 ft. One hr after pumping was stopped, the water level had recovered to 27 ft.

The pumping equipment presently installed is a Johnston vertical turbine pump (Serial No. JX1278) set at 200 ft, rated at 350 gpm at about 200 ft head, and powered by a 50-hp 1800 rpm U. S. Holloshaft electric motor (Serial No. NRR3715017).

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B00143) of a sample collected June 28, 1976, after pumping for 30 min at 450 gpm, showed the water to have a hardness of 283 mg/l, total dissolved minerals of 323 mg/l, and an iron content of 0.5 mg/l.

WELL NO. 4, open to the Cambrian-Ordovician aquifer (except for the Galena-Platteville dolomite), was completed

in February 1935 to a depth of 1308.5 ft by C. W. Varner, Dubuque, Iowa. The well is located at the northeast corner of Pike and Bowen Sts., approximately 2450 ft S and 1300 ft W of the NE corner of Section 10, T24N, R3E. The land surface elevation at the well is approximately 600 ft.

A sample study log of Well No. 4 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Soil	5	5
ORDOVICIAN SYSTEM		
Galena and Platteville Groups		
Dolomite	245	250
Dolomite, limestone, and thin shale beds	80	330
Ancell Group		
Glenwood Formation, shale, dolomite, some sandstone	40	370
St. Peter Sandstone	50	420
Prairie du Chien Group		
Shakopee Dolomite, some shale	110	530
Oneota Dolomite, thin sandstone beds at base	230	760
CAMBRIAN SYSTEM		
Potosi Dolomite	160	920
Franconia Formation, shale, sandstone, thin dolomite bed	80	1000
Ironton-Galesville Sandstone, partly dolomitic	100	1100
Eau Claire Formation, sandstone, shale, and dolomite	208.5	1308.5

A 23-in. diameter hole was drilled to a depth of 31 ft, reduced to 19 in. between 31 and 318 ft, reduced to 15 in. between 318 and 542 ft, and finished 12 in. in diameter from 542 to 1308.5 ft. The well is cased with 20-in steel pipe from land surface to a depth of 31 ft, 15.2-in. wrought iron pipe from land surface to a depth of 318 ft, and a 12-in. wrought iron liner from 893 ft to a depth of 975 ft.

A production test was conducted on March 6, 1935, by representatives of the driller and Consoer, Townserid & Quinlan, Consulting Engineers. It was reported that the water flowed at 405 gpm when the center line of the discharge pipe was 0.5 ft above the pumphouse floor. The drawdown was 2.4 ft below the top of the casing when pumping at a rate of 500 gpm and 6.0 ft when pumping at 660 gpm.

On June 11, 1935, a measurement of the flow from the well by the State Water Survey showed the rate to be 353 gpm when the center line of the 4-in. discharge pipe was 1.7 ft above the pumphouse floor.

The pumping equipment presently installed is a Peerless turbine pump set at 150 ft, rated at 550 gpm, and powered by a 50-hp 1765 rpm U. S. electric motor (Model No. R-2680-01-270-D, Serial No. R2029741).

A mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B00142) of a sample collected June 28, 1976, after pumping for 24 hr at 450 gpm, showed the water to have a hardness of 274 mg/l, total dissolved minerals of 297 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 5, open to the Cambrian-Ordovician (except for the Galena-Platteville dolomite) and the Elmhurst-Mt. Simon aquifers, was constructed in December 1952 to a depth of 1504 ft and deepened in April 1953 to a depth of 1835 ft by the Milaeger Well and Pump Co., Brookfield, Wis. The well is located at the north end of Main St. about 1 block south of the Mississippi River bridge, approximately 2875 ft N and 1000 ft W of the SE corner of Section 4, T24N, R3E. The land surface elevation at the well is approximately 600 ft.

A sample study summary log of Well No. 5 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Silt, sandy, gravelly, yellowish brown	20	20
ORDOVICIAN SYSTEM		
Maquoketa Group		
Dolomite, grayish brown, fine to medium; shale, green, streaks	160	180
Galena Group		
Dolomite, pale grayish brown, fine to coarse	255	435
Dolomite, grayish brown, fine to coarse; little dolomite at base	30	465
Platteville Group		
Dolomite, grayish brown to gray, fine	70	535
Ancell Group		
Glenwood Formation		
Sandstone, yellowish gray, fine to coarse, incoherent; dolomite, gray to pale grayish brown, fine to medium	25	560
St. Peter Sandstone		
Sandstone, gray, yellowish gray, fine to coarse, incoherent; shale streaks; little dolomite at base	95	655
Prairie du Chien Group		
Shakopee Formation		
Dolomite, sandy, light gray, fine to medium	55	710
New Richmond Formation		
Sandstone, light gray, fine to coarse, dolomite, cherty, sandy at top	20	730
Oneota Formation		
Dolomite, light gray, fine to coarse; little sandstone and shale	170	900
CAMBRIAN SYSTEM		
Jordan Sandstone		
Dolomite, grayish brown, fine to medium; sandstone, light gray, medium to very coarse, incoherent, compact	50	950
Potosi Dolomite		
Dolomite, light gray to light yellow, pink, fine to medium; little sandstone, light gray, medium to coarse, incoherent to compact at base	160	1110
Franconia Formation		
Sandstone, clayey, green, very fine	60	1170
Ironton-Galesville Sandstone		
Sandstone, white, very fine to coarse, hard to friable	115	1285
Eau Claire Formation		
Sandstone, cemented, very fine to coarse; shale, dark gray; dolomite, gray at top	40	1325
Sandstone, white, pink at base, fine to very coarse, mostly medium to coarse, friable, incoherent	200	1525
Mt. Simon Sandstone		
Sandstone, mostly silty, pink, white, very fine to very coarse, incoherent; some maroon shale at base	250	1775

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sandstone, very clean, white, very fine to coarse, well sorted incoherent	35	1810
Sandstone, very silty, pinkish white, fine to coarse	20	1830
Sandstone, clean, fine to coarse, mainly medium grained, well sorted, incoherent; little maroon shale	5	1835

A 26-in. diameter hole was drilled to a depth of 155 ft, reduced to 25 in. between 155 and 555 ft, reduced to 19 in. between 555 and 893 ft, reduced to 15 in. between 893 and 1277 ft, and finished 12 in. in diameter from 1277 to 1835 ft. The well is cased with 26-in. ID pipe from land surface to a depth of 155 ft and 20-in. ID pipe from land surface to a depth of 555 ft (cemented in). Originally, a 16-in. ID liner extended from 632 ft to a depth of 783 ft and a 12-in. ID liner extended from 1096 ft to a depth of 1172 ft. In November 1960, the Varner Well and Pump Co., Dubuque, Iowa, cleaned out the bottom 400 ft of this well and reportedly installed about 20 ft of 16-in. liner pipe and about 23 ft of 12-in. liner pipe.

Before deepening the well, a production test was conducted on December 10, 1952, by representatives of the driller, the State Water Survey, and Beling Engineering Consultants. After 6.1 hr of pumping at rates ranging from 295 to 305 gpm, the drawdown was 64.0 ft from a non-pumping water level of 3.0 ft. Following this test, the well was deepened and shot with 450 lb of explosives as follows: 50 lb at 1692 ft, 100 lb at 1590 ft, 100 lb at 1515 ft, 50 lb at 1327 ft, 50 lb at 1290 ft, 50 lb at 1250 ft, and 50 lb at 1240 ft.

After deepening and shooting the well, a production test was conducted on April 29-30, 1953, by representatives of the driller, the city, the State Water Survey, and Beling, Engineering Consultants. After 24 hr of pumping at rates of 350 to 920 gpm, the final drawdown was 191 ft from a nonpumping water level of 1.5 ft below land surface. The water level recovered to 46.5 ft after pumping had been stopped for 1.5 hr.

On January 3, 1964, the well reportedly produced 585 gpm with a drawdown of 150 ft from a nonpumping water level of 15 ft below land surface.

In September 1966, the well reportedly produced 650 gpm with a drawdown of 104 ft from a nonpumping water level of 12 ft.

The pumping equipment presently installed is a Fairbanks-Morse Pomona turbine pump (Serial No. AN4107) set at 300 ft, rated at 535 gpm at about 300 ft head, and powered by a 60-hp 1800 rpm U. S. electric motor (Serial No. 888271). A 30-ft section of 8.6-in. suction pipe is attached to the pump intake.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B53288) is for a water sample from the well collected June 12, 1978, after 24 hr of pumping at 350 gpm.

WELL NO. 5, LABORATORY NO. B53288

		<i>mg/l</i>	<i>me/l</i>			<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.2		Silica	SiO ₂	9.5	
Manganese	Mn	0.00		Fluoride	F	0.3	0.02
Ammonium	NH ₄	0.0	0.00	Boron	B	0.1	
Sodium	Na	3	0.13	Nitrate	NO ₃	0.0	0.00
Potassium	K	4.6	0.12	Chloride	Cl	2.9	0.08
Calcium	Ca	52	2.60	Sulfate	SO ₄	24	0.50
Magnesium	Mg	36	2.96	Alkalinity (as CaCO ₃)		252	5.04
Arsenic	As	0.00		Hardness (as CaCO ₃)		267	5.34
Barium	Ba	0.2					
Copper	Cu	0.00					
Cadmium	Cd	0.00		Total dissolved minerals		280	
Chromium	Cr	0.00					
Lead	Pb	0.00					
Mercury	Hg	<0.0002					
Nickel	Ni	0.0					
Selenium	Se	0.00					
Silver	Ag	0.00					
Cyanide	CN	0.02					
Zinc	Zn	0.0		pH (as rec'd)		7.8	

In an attempt to locate sand and gravel deposits, a test hole, located in the northeast corner of Section 14, T24N, R3E, was constructed by the Layne-Western Co., Aurora, in April 1964 to a depth of 120 ft.

WELL NO. 6, open to the Cambrian-Ordovician aquifer (except for the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone), was completed in March 1965 to a depth of 1300 ft by L. Cliff Neely, Batavia. The well is located north of Wacker Road and east of Cedar St., approximately 60 ft N and 620 ft W of the SE corner of Section 11, T24N, R3E. The land surface elevation at the well is approximately 625 ft.

A drillers log of Well No. 6 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sand	63	63
Clay	6	69
Clay and brown sand	6	75
Clay and sand	17	92
Sandy lime, tan	25	117
Sandy lime, yellow	31	148
Lime	32	180
Lime, gray	40	220
Lime, gray very hard	15	234
Brown, fine and hard	26	260
Brown lime, coarse not so hard	12	272
Lime, gray	16	288
Lime, brown	22	310
Lime, gray, brown	21	331
Lime, gray	3	334
Lime, brown	21	355
Shale	10	365
White sand	35	400
Sand, some shale	3	403
Sand	17	420
White and green shale	10	430
Sandy lime, broken	11	441
Lime	4	445
Red shale and lime shells	22	467
Red rock	29	496
Lime	29	525
Sandy lime	55	580
Sand	14	594
Sandy lime	81	675
Lime	35	710
Sand	8	718

<i>Strata (continued)</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Sandy lime	20	738
Sand	20	758
Sandy lime	42	800
Dolomite	22	822
Sandy lime	30	852
Lime	23	875
Sandy and lime	21	896
Shale, light red	16	912
Shale, brown	24	936
Sandy shale	34	970
Shale, green, and gray	19	989
Sandy lime	5	994
White sand	124	1118
Dolomite	17	1135
Gray shale	15	1150
White sand	70	1220
Dolomite	23	1243
Sandy shale	12	1255
Brown dolomite	21	1276
Red rock	11	1287
Dolomite, sandy	2	1289
White sand	11	1300

The well is cased with 20-in. pipe from land surface to a depth of 92 ft, 16-in. pipe from land surface to a depth of 396 ft (cemented in), 12-in. pipe from 392 ft to a depth of 661 ft, and 10-in. pipe from 887 ft to a depth of 1003 ft. The well was shot with 326 lb of 100 percent gelatin from 1200 to 1210 ft and from 1080 to 1110 ft.

A production test was conducted by the driller on March 15-16, 1965. After 24 hr of pumping at rates ranging from 1491 to 1580 gpm, the final drawdown was 209 ft from a nonpumping water level of 65 ft below the top of the casing.

The pumping equipment presently installed is a Peerless turbine pump (Serial No. 313525) rated at 1200 gpm at about 180 ft head, and powered by a 150-hp 1770 rpm General Electric motor (Model No. 5KG277XC509A, Serial No. LAJ1110146).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B53287) is for a water sample from the well collected June 12, 1978, after 30 min of pumping.

WELL NO. 6, LABORATORY NO. B53287

		<i>mg/l</i>	<i>me/l</i>			<i>mg/l</i>	<i>me/l</i>
Iron	Fe	0.3		Silica	SiO ₂	8.9	
Manganese	Mn	0.00		Fluoride	F	0.3	0.02
Ammonium	NH ₄	0.0	0.00	Boron	B	0.1	
Sodium	Na	4	0.17	Nitrate	NO ₃	0.0	0.00
Potassium	K	5.2	0.13	Chloride	Cl	5.6	0.16
Calcium	Ca	58	2.89	Sulfate	SO ₄	30	0.62
Magnesium	Mg	38	3.13	Alkalinity (as CaCO ₃)		263	5.26
Arsenic	As	0.00		Hardness (as CaCO ₃)		290	5.80
Barium	Ba	0.1		Total dissolved minerals		305	
Copper	Cu	0.00					
Cadmium	Cd	0.00					
Chromium	Cr	0.00					
Lead	Pb	0.00					
Mercury	Hg	<0.0002					
Nickel	Ni	0.0					
Selenium	Se	0.00					
Silver	Ag	0.00					
Cyanide	CN	0.01					
Zinc	Zn	0.0		pH (as rec'd)		7.7	

SHANNON

The village of Shannon (848) installed a public water supply in 1894. One well (No. 2) is in use and another well (No. 1) is available for emergency use. In 1950 there were 153 services, none metered; the average daily pumpage was 21,000 gpd. In 1977 there were 360 services, none metered; the estimated average and maximum daily pumpages were 115,000 and 180,000 gpd, respectively. The water is fluoridated and chlorinated.

WELL NO. 1, finished in the Galena dolomite, was constructed in April 1894 to a depth of 215 ft by G. W. Whitmore, Shannon, and reportedly deepened in September 1945 to a depth of 250 ft (sounded in 1957 to be 244 ft) by George A. Lyons, Stockton. This well is available for emergency use. The well is located in the central part of the village just east of the grade school, approximately 1900 ft S and 1750 ft E of the NW corner of Section 19, T25N, R7E. The land surface elevation at the well is approximately 945 ft.

A correlated drillers log of Well No. 1 furnished by the State Geological Survey follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
PLEISTOCENE SERIES		
Soil	10	10
SILURIAN AND ORDOVICIAN SYSTEMS		
Alexandrian Series and Maquoketa Group		
Limestone	80	90
ORDOVICIAN SYSTEM		
Maquoketa Group		
Scales Shale		
Slate rock	100	190
Galena Group		
Hard gray rock	26	216
Interval not studied	35	250

The well is cased with 6-in. iron pipe from 1 ft above land surface to an unknown depth, and finished as a 5.8-in. diameter hole to a depth of 250 ft.

Upon completion of the well in 1894, the nonpumping water level was reported to be 80 ft.

In September 1945, after the well was rehabilitated and deepened by George A. Lyons, the nonpumping water level was reported to be 48 ft.

A production test was conducted on March 13, 1957, by

representatives of the Allabaugh Well Drilling Co., Rockford, and the State Water Survey. After 24.4 hr of pumping at a rate of 48 gpm, the drawdown was 7.22 ft from a nonpumping water level of 57.70 ft below the pumphouse floor. The water level recovered to 58.00 ft after pumping had been stopped for 1.3 hr.

On March 4, 1975, the well reportedly produced 125 gpm with a drawdown of 25 ft from a nonpumping water level of 55 ft.

The pumping equipment presently installed is a Fairbanks-Morse Pomona turbine pump (Serial No. AW5554) set at 140 ft, rated at 100 gpm, and powered by a 10-hp U. S. electric motor.

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. 01062) is for a water sample from the well collected August 24, 1971.

WELL NO. 1, LABORATORY NO. 01062

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.0		Silica	SiO ₂	19	
Manganese	Mn	0.05		Fluoride	F	0.1	0.00
Ammonium	NH ₄	0.0		Nitrate	NO ₃	32.1	0.52
Sodium	Na	10.2	0.44	Chloride	Cl	9.0	0.25
Potassium	K	1.6	0.04	Sulfate	SO ₄	45	0.94
Calcium	Ca	80	3.99	Alkalinity (as CaCO ₃)		284	5.68
Magnesium	Mg	39.5	3.25	Hardness (as CaCO ₃)		358	
Barium	Ba	0.0		Total dissolved minerals		420	
Copper	Cu	0.0		pH (as rec'd)		7.3	
Cadmium	Cd	0.00		Radioactivity			
Chromium	Cr	0.0		Alpha pc/l		0	
Lead	Pb	0.00		± deviation		0	
Mercury	Hg	<0.0005		Beta pc/l		0	
Nickel	Ni	0.0		± deviation		0	
Silver	Ag	0.0					
Zinc	Zn	0.0					

WELL NO. 2, open to the Galena-Platteville dolomite and the Glenwood-St. Peter Sandstone, was constructed in June 1949 to a depth of 698 ft, and deepened in 1971 to a depth of 704 ft by the Lyons Well Drilling Co., Stockton. The well is located 15 ft east of Well No. 1, approximately 1900 ft S and 1765 ft E of the NW corner of Section 19, T25N, R7E. The land surface elevation at the well is approximately 945 ft.

A sample study log of Well No. 2 furnished by the State Geological Survey follows:

Strata	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
Soil, silty, dark brown	5	5
Loess, silty, tan	5	10
SILURIAN SYSTEM		
Niagaran-Alexandrian Series		
Dolomite, yellow, very fine	10	20
Dolomite, cherty, yellow, very fine	35	55
Dolomite, glauconitic, yellow, very fine	5	60
Dolomite, cherty, yellow, very fine	10	70
Mosalem Formation		
Dolomite, clayey, brownish-gray, fine	35	105
ORDOVICIAN SYSTEM		

Strata (continued)	Thickness (ft)	Depth (ft)
Maquoketa Group		
Dolomite, gray to buff; shale lenses	25	130
Shale, buff to gray; dolomite lenses	115	245
Shale, brown, phosphatic nodules at base	7	252
Galena Group		
Dolomite, buff, partly speckled, fine	38	290
Dolomite, buff, fine, dense to vesicular	75	365
Dolomite, partly cherty, buff, fine	100	465
Dolomite, buff to slightly gray, fine	5	470
Decorah Subgroup		
Dolomite, buff to gray, medium	20	490
Dolomite, buff, fine, red speckled	10	500
Platteville Group		
Dolomite, buff, fine, orange speckled	20	520
Dolomite, slightly cherty, buff, fine	25	545
Dolomite, grayish-buff, very fine	10	555
Dolomite, buff to brownish-gray, fine	44	599
Ancell Group		
Glenwood Formation		
Shale, sandy, green, hard, pyritic	1	600
Sandstone, shaly, gray, fine to coarse	10	610
St. Peter Sandstone		
Sandstone, gray to yellow, fine to medium	60	670
Sandstone, white; siltstone, gray; chert	10	680
Sandstone, white, coarse; dolomite pebbles	10	690
Shale, silty, gray	5	695

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B48449) is for a water sample from the well collected June 7, 1976, after 2 hr of pumping at 148 gpm.

WELL NO. 2, LABORATORY NO. B48449

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.1		Silica	SiO ₂	9	
Manganese	Mn	0.00		Fluoride	F	0.2	0.01
Ammonium	NH ₄	0.19	0.01	Boron	B	0.1	
Sodium	Na	5.2	0.23	Nitrate	NO ₃	0.0	0.00
Potassium	K	2.4	0.06	Chloride	Cl	1.1	0.03
Calcium	Ca	82	4.09	Sulfate	SO ₄	3.6	0.08
Magnesium	Mg	45	3.70	Alkalinity (as CaCO ₃)		388	7.76
Arsenic	As	0.00		Hardness (as CaCO ₃)		390	7.80
Barium	Ba	3.0		Total dissolved minerals		406	
Copper	Cu	0.00					
Cadmium	Cd	0.00					
Chromium	Cr	0.00					
Lead	Pb	0.00					
Mercury	Hg	0.0000					
Nickel	Ni	0.0					
Selenium	Se	0.00					
Silver	Ag	0.00					
Cyanide	CN	0.00					
Zinc	Zn	0.0		pH (as rec'd)		7.3	

A 12-in. diameter hole was drilled to a depth of 256 ft and finished 8 in. in diameter from 256 to 698 ft. The well is cased with 8-in. iron pipe from 1.5 ft above land surface to a depth of 256 ft (cemented in).

Upon completion in 1949, the well reportedly produced 140 gpm for 1.8 hr with a drawdown of 158 ft from a nonpumping water level of 157 ft.

This well was shot between 600 and 660 ft and cleaned in 1970 by the Lyons Well Drilling Co. In 1971, after the well started to pump sand, the pump was pulled and repaired,

and the well was recleaned.

On March 4, 1975, it was reported that the well produced 165 gpm with a drawdown of 155 ft from a nonpumping water level of 190 ft.

The pumping equipment presently installed is a Deming turbine pump (Model No. 4700, Serial No. T-70131) rated at 185 gpm, and powered by a 40-hp 1750 rpm U. S. electric motor (Serial No. R-1773-01-170 R-201-9565).

THOMSON

The village of Thomson (617) installed a public water supply in 1903. One well (No. 4) is in use and two wells (Nos. 2 and 3) are available for emergency use. In 1950 there were 121 services, 98 percent metered; the estimated average daily pumpage was 12,000 gpd. In 1979 there were 160 services, 85 percent metered; the average daily pumpage in 1978 was 54,000 gpd. The water from Well Nos. 3 and 4 is fluoridated and chlorinated.

Water was initially obtained from a 3-in. diameter well 37 ft deep. The top of the well was in a pit 5 ft below land surface; 5 ft of 3-in. diameter U. S. Wind Engine & Pump Co. screen was set in fine sand. This well was abandoned after the next well was drilled in 1918.

WELL NO. 1, finished in sand and gravel, was completed in 1918 to a depth of 40 ft by Mr. Warfield, Savanna. This well was abandoned in 1954 and sealed in 1956. The well was located on Market St. about 100 ft east of the Chicago, Burlington & Quincy RR tracks, approximately 385 ft N and 1800 ft W of the SE corner of Section 24, T23N, R3E. The land surface elevation at the well is approximately 600 ft.

An 8-in. diameter hole was drilled to a depth of 40 ft. The well was cased with 8-in. pipe from 1.5 ft above the pumphouse floor to a depth of 30 ft followed by 10 ft of 8-in. screen.

In 1924, the nonpumping water level was reported to be 25 ft below land surface.

A mineral analysis of a sample (Lab. No. 40032) collected August 20, 1918, showed the water to have a hardness of 132 mg/l, total dissolved minerals of 239 mg/l, and a trace of iron.

WELL NO. 2, finished in sand and gravel, was completed in November 1938 to a depth of 58 ft by D. E. Edwards, West Branch, Iowa. This well is available for emergency use. The well is located about 13 ft northeast of Well No. 1 at the northwest corner of Walnut and Market Sts., approximately 398 ft N and 1790 ft W of the SE corner of Section 24, T23N, R3E. The land surface elevation at the well is approximately 600 ft.

A 6-in. diameter hole was drilled to a depth of 58 ft. The well is cased with 6-in. pipe from 1.2 ft above land surface to a depth of 48 ft followed by 10 ft of 6-in. copper screen.

The well is reported to have penetrated hardpan at the bottom, but blue muck flowed into the well after it was drilled, which was shut off by backfilling the well with gravel.

The pumping equipment presently installed is a 6-in.,

14-stage Pomona turbine pump (No. SR1381) set at 46 ft, rated at 70 gpm at about 140 ft TDH, and powered by a 5-hp 1735 rpm Westinghouse electric motor (No. 10037).

A mineral analysis of a sample (Lab. No. 108673) collected December 14, 1946, after pumping for 10 min at 82 gpm, showed the water to have a hardness of 167 mg/l, total dissolved minerals of 233 mg/l, and an iron content of 0.9 mg/l.

WELL NO. 3, finished in sand and gravel, was completed in September 1954 to a depth of 76.5 ft by the J. P. Miller Artesian Well Co., Brookfield. This well is available for emergency use. The well is located about 300 ft west of Well No. 1, approximately 400 ft N and 2100 ft W of the SE corner of Section 24, T23N, R3E. The land surface elevation at the well is approximately 600 ft.

A drillers log of Well No. 3 follows:

<i>Strata</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Fine sand	20	20
Fine to medium sand	30	50
Medium gravel	20	70
Fine sand	11	81

A 30-in. diameter hole was drilled to a depth of 81 ft. The well is cased with 10-in. pipe from 1.5 ft above land surface to a depth of about 41.5 ft followed by 35 ft of 10-in. No. 80 slot Houston screen. The annulus between the bore hole and casing-screen assembly is filled with concrete from 0 to 20 ft, with sand and bentonite from 20 to 30 ft, and with gravel from 30 to 81 ft.

A production test was conducted on September 13-14, 1954, by representatives of the driller, the village, the State Water Survey, and Ernest D. Middaugh & Associates, Consulting Engineers. After 1.5 hr of pumping at a rate of 96 gpm, the drawdown was 2.0 ft from a nonpumping water level of 13.5 ft below land surface. Pumping was continued for 5 hr at a rate of 160 gpm with a drawdown of 4.0 ft. After an additional 17.5 hr of pumping at 215 gpm, the final drawdown was 4.7 ft. Thirty-five min after pumping was stopped, the water level had recovered to 14.0 ft.

This well was acidized in 1969 by the Varner Well and Pump Co., Dubuque, Iowa. The yield was reported to be 200 gpm with a drawdown of about 3 ft after this work.

The well was again acidized in May 1972 by this company, and the yield was reported to be 200 gpm with a drawdown of 4 ft after this work.

The pumping equipment presently installed is a Peerless

vertical turbine pump (No. 123373) set at 40 ft, rated at 150 gpm, and powered by a 7½-hp 1800 rpm Fairbanks-Morse electric motor (Serial No. 254202).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B108406) is for a water sample from the well collected February 20, 1974, after 30 min of pumping at 160 gpm.

WELL NO. 3, LABORATORY NO. B108406

		mg/l	me/l		mg/l	me/l
Iron	Fe	1.1		Silica	SiO ₂	28
Manganese	Mn	0.21		Fluoride	F	0.4 0.02
Ammonium	NH ₄	0.0	0.00	Boron	B	0.2
Sodium	Na	10	0.44	Nitrate	NO ₃	18 0.29
Potassium	K	4.3	0.11	Chloride	Cl	45 1.27
Calcium	Ca	56	2.79	Sulfate	SO ₄	34 0.71
Magnesium	Mg	20	1.65	Alkalinity(as CaCO ₃)		132 2.64
Arsenic	As	0.00		Hardness (as CaCO ₃)		223 4.46
Barium	Ba	0.1		Total dissolved minerals		293
Copper	Cu	0.00				
Cadmium	Cd	0.00				
Chromium	Cr	0.00				
Lead	Pb	0.00		pH (as rec'd)		7.4
Mercury	Hg	0.0000		Radioactivity		
Nickel	Ni	0.0		Alpha pc/l		0.0
Selenium	Se	0.00		± deviation		0.6
Silver	Ag	0.00		Beta pc/l		3.2
Zinc	Zn	0.02		± deviation		1.7

WELL NO. 4, finished in sand and gravel, was completed in September 1975 to a depth of 65 ft by the Varner Well and Pump Co., Dubuque, Iowa. The well is located about 50 ft south of North Ave. west of Market St., approximately 585 ft N and 2000 ft W of the SE corner of Section 24, T23N, R3E. The land surface elevation at the well is approximately 600 ft.

A drillers log of Well No. 4 follows:

Strata	Thickness (ft)	Depth (ft)
Sandy soil	3	3
Fine sand	47	50
Sand and gravel	5	55
Medium sand	10	65

A 30-in. diameter hole was drilled to a depth of 65 ft. The well is cased with 10-in. steel pipe from 3 ft above land surface to a depth of 50 ft followed by 15 ft of 10-in. No. 60 slot Cook stainless steel screen. The annulus between the bore hole and casing-screen assembly is filled with cement from 0 to 20 ft, with sand and bentonite from 20 to 29 ft, and with No. 2 Muscatine gravel from 29 to 65 ft.

A production test was conducted by the driller on September 5, 1975. After 2 hr of pumping at rates of 350 to 300 gpm, the drawdown was 9.1 ft from a nonpumping water level of 16.0 ft below land surface. Pumping was continued at a rate of 400 gpm for 3.5 hr with a drawdown of 12.2 ft. After an additional 2.5 hr of pumping at rates of 510 to 600 gpm, the final drawdown was 19.5 ft.

The pumping equipment presently installed is a 9-in., 4-stage Peerless turbine pump (Serial No. 232092) set at 40 ft, rated at 400 gpm at about 140 ft TDH, and powered by a 20-hp 1750 rpm Westinghouse electric motor (Serial No. 7503).

The following mineral analysis made by the Illinois Environmental Protection Agency (Lab. No. B07526) is for a water sample from the well collected August 8, 1978, after 45 min of pumping at 400 gpm.

WELL NO. 4, LABORATORY NO. B07526

		mg/l	me/l		mg/l	me/l
Iron	Fe	2.5		Silica	SiO ₂	22
Manganese	Mn	0.28		Fluoride	F	0.2 0.01
Ammonium	NH ₄	0.0	0.00	Boron	B	0.0
Sodium	Na	17	0.74	Nitrate	NO ₃	22 0.35
Potassium	K	3.2	0.08	Chloride	Cl	36 1.02
Calcium	Ca	56	2.79	Sulfate	SO ₄	40 0.83
Magnesium	Mg	20	1.65	Alkalinity(as CaCO ₃)		151 3.02
Arsenic	As	0.00		Hardness (as CaCO ₃)		221 4.42
Barium	Ba	0.1		Total dissolved minerals		310
Copper	Cu	0.04				
Cadmium	Cd	0.00				
Chromium	Cr	0.00				
Lead	Pb	0.00				
Mercury	Hg	<0.00001				
Nickel	Ni	0.0				
Selenium	Se	0.00				
Silver	Ag	0.00				
Cyanide	CN	0.00				
Zinc	Zn	0.0		pH (as rec'd)		7.4