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*Public Groundwater Supplies
in Adams County*

by DOROTHY M. WOLLER

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PUBLIC GROUNDWATER SUPPLIES IN ADAMS COUNTY

by Dorothy M. Woller

Introduction

This publication presents all available information on production wells used for public groundwater supplies in Adams County. Bulletin 60, which is divided by county into separate publications, supersedes Bulletin 40 and its Supplements 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 descriptions for groundwater supplies of 8 municipalities, 2 subdivisions, and 1 state park in Adams County. These are preceded by brief summaries of the groundwater geology of the county and the development of groundwater sources for municipal use. An explanation of the format used in the descriptions is also given.

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Geology

The geology of Adams County in western Illinois is described generally in Illinois State Geological Survey Circular 232, *Groundwater Geology in Western Illinois, South Part*. The following brief discussion of geologic conditions in the county is taken largely from that publication. 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.

In Adams County thick permeable sand and gravel deposits suitable for high-capacity wells are present at many locations in the valley of the Mississippi River where the fill is as much as 125 ft thick. Drillers report mainly coarse material below 45 ft. Deposits of sand

and gravel are locally present along tributaries of the Mississippi such as Mill Creek, Ursa Creek, and Bear Creek. Deposits are not always confined to the valley along these tributaries, but in some cases also occur below the bordering upland. East of Quincy, portions of the Mill Creek bedrock valley underlie the upland and contain water-yielding deposits that are more than 150 ft below the surface.

Thin sand and gravel deposits containing considerable amounts of chert occur in the lower part of the drift on the upland in the west half of the county. These are suitable water sources for drilled or dug farm wells at some locations.

The Keokuk-Burlington limestone, present beneath

the entire upland in the county, is the main source of public and private water supplies. Water is generally obtained from wells penetrating the limestone for 120 to 140 ft, and ranging in depth from 200 to 350 ft. Almost all municipal wells obtain water from the Keokuk-Burlington limestone with wells ranging from 141 to 430 ft in depth. At some places the upper, weathered part of the formation, composed of well-creviced rock and pockets of loose chert, is a source of water. The limestone commonly yields water charged with some hydrogen sulfide.

Groundwater possibilities in deeper bedrock formations are fair to poor. The Devonian-Silurian limestone, which is absent near the southwestern corner and

is less than 50 ft thick in much of the county, is not highly creviced, and at some locations contains shows of gas associated with saline water. Similarly, the Kimmswick-Joachim dolomite is "tight" or yields water of poor quality.

The St. Peter sandstone, encountered at depths varying from 650 to more than 900 ft, yields water that is too salty for most purposes, according to analyses by the Illinois Geological Survey (Meents, *et al.*, *Illinois Petroleum* 66, 1952, p. 36). Analyses of water from the St. Peter sandstone from two wells in Section 11, T2S, R6W and Section 26, T2S, R8W, show 8210 mg/l total solids with 3876 mg/l chlorides and 12,258 mg/l total solids with 6398 mg/l chlorides, respectively.

Groundwater Development for Municipal Use

Unconsolidated sand and gravel deposits associated with a fairly narrow buried bedrock valley are tapped as a partial source of municipal water supply at one town, Camp Point, located in the northeastern part of the county. Four wells ranging in depth from 25 to 56 ft have been constructed in this aquifer during past years. Their reported yields range from 4 to 100 gpm depending primarily upon the type of well and the permeability, thickness, and areal extent of the sand and gravel unit tapped by each well. Production from the Camp Point municipal sand and gravel wells in 1970 was about 30,000 gpd. Their iron content ranges from 0.1 to 2.9 mg/l, and the hardness from 600 to 883 mg/l. Water from these wells is chlorinated, fluoridated, and the iron removed by filtration.

Consolidated bedrock aquifers, principally the Keokuk-Burlington limestone, are tapped as a primary source of both private and municipal supplies throughout much of the entire county. Relatively impermeable sandstone units in the upper part of the bedrock have been tapped at Golden with three wells as a partial source of supply. These wells, which individually produce less than 15 gpm, range in depth from

75 to 80 ft. The Keokuk-Burlington limestone is tapped as a source of water by all 11 public supplies utilizing 29 production wells. These wells range in depth from 141 to 430 ft and yield from 3 to 190 gpm depending primarily upon the number, size, and degree of interconnection of water-filled cracks and crevices within the rock that were penetrated by the well bore. Municipal wells at Mendon, Payson, and Ursa in the western part of the county are finished in the most productive part of the limestone thus far delineated. These wells yield from 75 to 190 gpm. On the other hand wells for Camp Point, Golden, Liberty, Loraine, Plainville, and Siloam Springs State Park in the eastern half of the county are capable of producing only from 3 to 25 gpm on a long-term basis. The estimated production of all municipal wells finished in limestone aquifers of the county was 250,000 gpd in 1970. Water from the limestone varies in iron content from 0.0 to 3.6 mg/l and from 68 to 348 mg/l in hardness. The towns of Golden and Liberty aerate to remove hydrogen sulfide; none of the towns remove iron or soften. Fluoridation is not required at Golden and Loraine because of natural fluoride content. Of the remaining nine supplies, six are currently fluoridating their water.

Format

In this publication the descriptions of public groundwater supplies are presented in alphabetical order by place name as follows: Camp Point, East Hickory Grove Subdivision, Golden, Liberty, Loraine, Mendon, Payson, Plainville, Siloam Springs State Park, West Hickory Grove Subdivision.

At the beginning of each description the U.S. Census of population for 1970 is given for incorporated places. For unincorporated places, the population is estimated on the basis of the number of services or residential units and an assumed number of 3.5 persons per service.

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 tapped, date drilled, depth, driller, legal location, elevation in feet above mean sea level, log, construction features,*

yield, pumping equipment, and chemical analyses.

The screen sizes given in this publication are for continuous slot type screens unless stated otherwise. 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 slots 0.100 in. wide. Approximate equivalent slot openings for other types of screens are given in parentheses after the screen designation.

Abbreviations Used

est.....	estimated
ft.....	foot (feet)
gal.....	gallon (s)
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)
R.....	range
rpm.....	revolutions per minute
T.....	township
TDH.....	total dynamic head
Tr.....	trace

CAMP POINT

The village of Camp Point (1143) installed a public water supply in 1942. Nine wells (Nos. 3-11) are in use and another well (No. 1) is available for emergency use. In 1952, there were 250 services, with all but 5 or 6 metered; the average daily pumpage was estimated to be 23,000 gpd. In 1971 there were 485 services, all metered; the average and maximum daily pumpages were 69,000 and 110,000 gpd, respectively. The water is filtered, chlorinated, and fluoridated.

In 1940, an attempt was made by the village to locate a water supply. Several electrical earth resistivity surveys were made by the State Geological Survey to assist the village. The site finally selected for test drilling lies on the west side of Figley Branch, about 1 mile south and 0.5 mile west of town. A pit, 4 ft wide and 6 ft long, was constructed to a depth of 11 ft and cribbed with 2-in. oak lumber. A clean coarse sand formation 4.5 ft thick was penetrated in the bottom and, by sounding-rod, the coarse sand was estimated to extend about 4.5 ft below the bottom of the pit, indicating a total thickness of the formation of about 9 ft. Artesian flow from the cribbed pit terminated after pumping began. During a 3-hr pumping test at a rate of 25 gpm, the drawdown was 8 ft below land surface. The average recovery rate was calculated to be 14 gpm.

The aquifer at this spot was not developed for village use until 1947. In the interim, an old well formerly owned by Producers Creamery, was the sole source of supply.

WELL NO. 1 (old Producers Creamery well), finished in sand and gravel, was dug and drilled to a depth of 51 ft. This well is maintained for emergency use. The well is located at the rear of the village water treatment plant at the southwest corner of Ohio and Wood Sts. (U.S. Highway 24), approximately 1980 ft N and 1300 ft E of the SW corner of Section 26, T1N, R6W. The land surface elevation at the well is approximately 720 ft.

A 24-ft diameter hole was dug to a depth of 12 ft, reduced to 12 ft between 12 and 23 ft, reduced to 8 ft between 23 and 41 ft, and drilled 6 in. in diameter from 41 to 51 ft. The well is lined with a 12-ft diameter brick wall from land surface to a depth of 20 ft and a 6-ft diameter brick wall from 20 to 41 ft.

A production test was conducted by the State Water Survey on June 18, 1940. After 3 hr of pumping at rates from 168 to 18.5 gpm, the drawdown was 28.6 ft from a nonpumping water level of 9.9 ft below the top of the well cover. One hr after pumping was stopped, the water level had recovered to 34.6 ft.

In 1945, it was reported that after about 3 weeks rest, the yield would decrease from about 12,000 gal the first day, to about 4000 gal the sixth day, after which a rest was required.

The pumping equipment presently installed consists of a 2-hp General Electric motor and a 6-stage

Pomona oil-lubricated turbine pump attached to 3-in. column pipe with the bottom of the pump set at 37 ft. A 2-ft strainer is attached below the pump.

A mineral analysis of a sample (Lab. No. 88129) collected June 18, 1940, showed the water to have a hardness of 873 mg/l, total dissolved minerals of 978 mg/l, and an iron content of 2.8 mg/l.

In 1945, the production from Well No. 1 was not sufficient to meet demands and part of the supply had to be obtained from the C. B. and Q. RR reservoir, located about 0.5 mile south of town. In 1947, combined production from the reservoir and Well No. 1 had to be supplemented with water hauled from Quincy by railroad tank cars. At this time three test wells were drilled and Well No. 2 was constructed.

WELL NO. 2, finished in sand and gravel, was completed in September 1947 to a depth of 34 ft by Henry Schuster, Golden. Because of insufficient production, this well was abandoned in December 1947, disconnected from the system about 1953, and is now sealed. The well is located at the east end of Jefferson St. about 1300 ft E and 250 ft N of Well No. 1, approximately 2600 ft E and 2230 ft N of the SW corner of Section 26, T1N, R6W. The land surface elevation at the well is approximately 725 ft.

The well is cased with 6-in. pipe from land surface to a depth of 31 ft followed by 3 ft of Johnson screen.

When the well was completed the static water level was 5 ft below the top of the well but after less than 4 months usage, at about 10,000 gpd, the nonpumping water level was only 2 ft above the bottom of the well.

WELL NO. 3, finished in sand and gravel, was completed in December 1947 to a depth of 24.8 ft by the Calhoun Drilling Co., Batchtown. The well is located at the site of the pit constructed in 1940 about 1 mile south and 0.5 mile west of the village, approximately 2600 ft N and 2500 ft W of the SE corner of Section 34, T1N, R6W. The land surface elevation at the well is approximately 680 ft.

A 20-in. diameter hole was drilled to a depth of 24.8 ft. The well is cased with 12-in. pipe from 1 ft above the pumphouse floor to a depth of 17.8 ft followed by 7 ft of 12-in. Johnson screen. The 4- by 6-ft pit was cleaned out and backfilled with gravel to within 2.5 ft of the top of the casing. Clay was backfilled on top of the gravel to the top of the well.

Upon completion, the well reportedly produced 100 gpm for 8 hr with a drawdown of 16.8 ft from a nonpumping water level of 2 ft below the top of the well. At a later date, water was pumped for 72 hr at 48 gpm but no water levels were reported.

In 1947, after 8 hr of pumping at a rate of 100 gpm, the drawdown was 16.8 ft from a nonpumping water level of 2.0 ft below the top of the well.

A production test was conducted on July 29, 1970, by representatives of the village, the State Water Survey,

and Wm. H. Klingner & Associates, Engineers. After 1 hr of pumping at a rate of 13 gpm, the drawdown was 2.16 ft from a nonpumping water level of 12.32 ft below land surface. A comparison between the specific capacity (yield per ft of drawdown) of this well during this test and the original test in 1948, indicates that the well has maintained its initial efficiency.

The pumping equipment presently installed is a Burks centrifugal pump rated at 10-12 gpm and powered by a 1-hp electric motor.

A partial analysis of a sample (Lab. No. 87365) collected from a shallow pit at this location on February 22, 1940, showed the water to have a hardness of 762 mg/l, total dissolved minerals of 993 mg/l, and an iron content of 1.2 mg/l.

A partial analysis of a sample (Lab. No. 183168) collected from the final production well on July 29, 1970, after pumping for 1 hr at 13 gpm, showed the water to have a hardness of 880 mg/l, total dissolved minerals of 1150 mg/l, and an iron content of 1.9 mg/l.

WELL NO. 4, finished in sand and gravel, was completed in July 1955 to a depth of 40 ft by the Calhoun Drilling Co., Batchtown. The well is located about 200 ft N of the old railroad reservoir, approximately 400 ft S and 75 ft E of the NW corner of Section 35, T1N, R6W. The land surface elevation at the well is approximately 725 ft.

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

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
Till, sand dirty; clay	34	34
Sand, coarse; gravel fine	6	40

An 8-in. diameter hole was drilled to a depth of 40 ft. The well is cased with 8-in. standard pipe from 0.3 ft above the pumphouse floor to a depth of 34 ft followed by 6 ft of 8-in. Cook Everdur screen.

Upon completion, the well reportedly produced 38 gpm for 4 hr with a drawdown of 28.81 ft from a nonpumping water level of 20.00 ft below land surface.

A recovery test using one observation well was conducted on July 28, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. Prior to the test the well reportedly had been pumping at a rate of 5 gpm for several days. One hr after pumping was stopped the water level had recovered 2.06 ft to a depth of 24.51 ft below land surface. A comparison of specific capacities calculated from the data gathered during this recovery test and the original pumping test in 1955 indicated the well had declined in yield to about one-half its original value.

The pumping equipment presently installed is a Burks horizontal centrifugal jet pump powered by a 1-hp 3500 rpm electric motor.

A partial analysis of a sample (Lab. No. 183166) collected July 28, 1970, after pumping for 1 hr at 5 gpm, showed the water to have a hardness of 700 mg/l,

total dissolved minerals of 934 mg/l, and an iron content of 0.4 mg/l.

WELL NO. 5, finished in sand and gravel, was constructed in July 1955 to a depth of 36 ft by the Calhoun Drilling Co., Batchtown, and deepened in September 1959 to a depth of 56 ft by Henry Schuster, Golden. The well is located 100 ft E of Well No. 4, approximately 400 ft S and 175 ft E of the NW corner of Section 35, T1N, R6W. The land surface elevation at the well is approximately 725 ft.

A 10-in. diameter hole was drilled to a depth of 56 ft. The well is cased with 6-in. pipe from 1.5 ft above the pumphouse floor to a depth of 26 ft, 6-in. screen from 26 to 44 ft, and 6-in. casing from 44 to 56 ft. The annulus between the casing and the wall of the hole is filled with grout from the top of the casing to 10 ft below land surface and with gravel from 10 to 56 ft.

A recovery test was conducted on July 28, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. The well reportedly had been pumping at a rate of 4 gpm when the pump was turned off. After 1 hr, the water level had recovered 0.44 ft to a depth of 28.64 ft below land surface. During this test, Well No. 4, 100 ft W, was pumping continuously. On the basis of available data, Well No. 5 was estimated to be capable of yielding about 4 gpm (5760 gpd) on a long-term basis without drawing water levels below the top of the screen.

The pumping equipment presently installed is a Burks horizontal centrifugal jet pump powered by a 1½-hp 3500 rpm electric motor.

The following mineral analysis (Lab. No. 185952) is for a water sample from the well collected June 23, 1971, after 24 days of pumping at 7 gpm.

WELL NO. 5, LABORATORY NO. 185952					
		mg/l	me/l		
Iron	Fe	0.1		Silica	SiO ₂ 20.4
Manganese	Mn	2.96		Boron	B 0.1
Ammonium	Tr			Fluoride	F 0.2
Sodium	NH ₄	33.9	1.47	Nitrate	NO ₃ 6.6 0.11
Potassium	Ka	2.2	0.06	Chloride	Cl 15 0.42
Calcium	Ca	164.8	8.22	Sulfate	SO ₄ 237.6 4.94
Magnesium	Mg	46.0	3.78	Alkalinity	(as CaCO ₃) 408 8.16
Strontium	Sr	0.28		Hardness	(asCaCO ₃) 600 12.00
Copper	Cu	0.02		Total dissolved minerals	792
Cadmium	Cd	0.00			
Chromium	Cr	0.00			
Lead	Pb	< 0.05			
Lithium	Li	0.01		Turbidity	0
Nickel	Ni	<0.05		Color	0
Zinc	Zn	0.05		Odor	0

WELL NO. 6, finished in limestone, was constructed in 1961 to a depth of 31 ft by Henry Schuster, Golden, and reportedly deepened in 1966 to 410 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located 100 ft S of Well No. 4 about 100 ft N of the old railroad reservoir, approximately 500 ft S and 75 ft E of the NW corner of Section 35, T1N, R6W. The land surface elevation at the well is approximately 725 ft.

A drillers log of Well No. 6 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	30	30
Clay and gravel	18	48
Limestone	6	54
Dark gray shale	68	122
Limestone	4	126
Light shale	42	168
Limestone	8	176
Shale and limestone streaks	87	263
Limestone	152	415

The well is cased with 10-in. outer pipe from 0.8 ft above the pumphouse floor to a depth of 48 ft and with 7-in. inner pipe from 1.7 ft above the pumphouse floor to a depth of 281 ft. Below the 7-in. casing, the hole in bedrock is finished 7 in. in diameter to the bottom. The annulus between the 10-in. and 7-in. casings was cement grouted to a depth of 48 ft.

A recovery test was conducted on August 18, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. Prior to the test the well reportedly had been pumping at a rate of 4 gpm for several days. One hr after pumping was stopped, the water level had recovered 109.10 ft to a depth of 277.20 ft.

The pumping equipment presently installed is a Red Jacket submersible pump (Model No. R500T1-N25CB) powered by a 5-hp electric motor.

A partial analysis of a sample (Lab. No. 183162) collected July 29, 1970, showed the water to have a hardness of 146 mg/l, total dissolved minerals of 499 mg/l, and an iron content of 0.0 mg/l.

WELL NO. 7, finished in limestone, was completed in 1962 to a depth of 350 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located 1.5 miles southwest of the village about 50 ft W of Well No. 3, approximately 2550 ft W and 2600 ft N of the SE corner of Section 34, T1N, R6W. The land surface elevation at the well is approximately 680 ft.

The well is cased with 10-in. outer pipe from 1 ft above the pumphouse floor to a depth of 30 ft and with 6-in. inner pipe from 1.5 ft above the pumphouse floor to a depth of 128 ft. Below the 6-in. casing, the hole in bedrock is finished 6 in. in diameter to the bottom. The annulus between the 10-in. and 6-in. casings was grouted with concrete.

The pumping equipment presently installed is a Reda submersible pump powered by a 15-hp electric motor.

WELL NO. 8, finished in limestone, was completed in 1963 to a depth of 410 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located 0.25 mile northeast of Well No. 7, approximately 1400 ft S and 1300 ft W of the NE corner of Section 34, T1N, R6W. The land surface elevation at the well is approximately 700 ft.

The well is cased with 10-in. outer pipe from 1 ft above the pumphouse floor to a depth of 28 ft and with 6-in. inner pipe from 1.5 ft above the pumphouse floor to a depth of 130 ft. Below the 6-in. casing,

the hole in bedrock is finished 6 in. in diameter to the bottom. The annulus between the 10-in. and 6-in. casings was grouted with concrete.

A recovery test was conducted on August 18, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. Prior to the test the well reportedly had been pumping at a rate of 4 gpm for several days. One hr after pumping was stopped, the water level had recovered 10.72 ft to a depth of 298.45 ft. The well was acidized in 1970 but no results are available.

The pumping equipment presently installed is a Reda submersible pump rated at 15 gpm powered by an electric motor.

A partial analysis of a sample (Lab. No. 183167) collected July 29, 1970, showed the water to have a hardness of 164 mg/l, total dissolved minerals of 492 mg/l, and an iron content of 1.5 mg/l.

WELL NO. 9, finished in limestone, was completed in 1964 to a depth of 385 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located about 300 ft S of Well No. 7, approximately 2300 ft N and 2600 ft W of the SE corner of Section 34, T1N, R6W. The land surface elevation at the well is approximately 680 ft.

The well is cased with 10-in. outer pipe from 0.7 ft above the pumphouse floor to a depth of 40 ft and with 6-in. inner pipe from 2.5 ft above the pumphouse floor to a depth of 200 ft. Below the 6-in. casing, the hole in bedrock is finished 6 in. in diameter to the bottom. The annulus between the 10-in. and 6-in. casings is grouted from the top of the casings to 10 ft and filled with clay from 10 to 40 ft.

A recovery test was conducted on August 19, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. The well reportedly had been pumping at a rate of 6.3 gpm for several days when the pump was turned off. After 30 min, the water level had recovered 78.95 ft to a depth of 274.42 ft.

The pumping equipment presently installed is a Red Jacket submersible pump rated at 18 gpm and powered by a 7-hp electric motor.

A partial analysis of a sample (Lab. No. 183165) collected July 29, 1970, showed the water to have a hardness of 158 mg/l, total dissolved minerals of 480 mg/l, and an iron content of 3.6 mg/l.

WELL NO. 10, finished in limestone, was completed in 1967 to a depth of 415 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located 600 ft S of Well No. 9 and 200 ft W of a creek, approximately 1700 ft N and 2500 ft W of the SE corner of Section 34, T1N, R6W. The land surface elevation at the well is approximately 680 ft.

The well is cased with 10-in. outer pipe from 0.7 ft above the concrete floor to a depth of 40 ft and with 7-in. inner pipe from 1.7 ft above the pumphouse floor to a depth of 280 ft. Below the 7-in. casing, the hole in bedrock is finished 7 in. in diameter to the bottom.

The annulus between the 10-in. and 7-in. casings was reported to be filled with cement grout.

A drillers log of Well No. 10 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil and clay	36	36
Gravel	4	40
Clay	8	48
Limestone	6	54
Shale	68	122
Limestone and shale	72	194
Shale	69	263
Limestone	152	415

A recovery test was conducted on August 19, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. Prior to the test the well reportedly had been pumping at a rate of 9.3 gpm for several days. One hr after pumping was stopped, the water level had recovered 106.26 ft to a depth of 238.74 ft.

The pumping equipment presently installed is a Red Jacket submersible pump (Model No. R500T4-M25CB) set at 400 ft, rated at 20 gpm, and powered by a 5-hp electric motor.

A partial analysis of a sample (Lab. No. 183163) collected July 29, 1970, showed the water to have a hardness of 196 mg/l, total dissolved minerals of 490 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 11, finished in limestone, was completed in 1969 to a depth of 420 ft by Mick Johnson, Plymouth. The well is located 0.5 mile south of the village on a country road, approximately 50 ft W and 1000 ft S of the NE corner of Section 34, T1N, R6W..The land surface elevation at the well is approximately 730 ft.

The well is cased with 10-in. pipe from land surface to a depth of 37 ft and with 7-in. pipe from land surface to a depth of 257 ft. Below the 7-in. casing, the hole in bedrock is finished 7 in. in diameter to the bottom.

A drillers log of Well No. 11 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	37	37
Gray mud	4	78
Coal	1	79
Dark shale	62	141
Limestone	11	152
Shale and limestone streaks	90	242
Limestone	193	435
Getting water at depths of 350-373 ft		

A recovery test was conducted on August 18, 1970, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. The well reportedly had been pumping at a rate of 5 gpm for several days when the pump was turned off. After 1 hr, the water level had recovered 68.66 ft to a depth of 293.02 ft.

The pumping equipment presently installed is a Red Jacket submersible pump powered by an electric motor.

The following mineral analysis (Lab. No. 185953) is for a water sample from the well collected June 23, 1971, after 24 days of pumping at 4 gpm.

WELL NO. 11. LABORATORY NO. 185953

	mg/l	me/l		mg/l	me/l
Iron	Fe	Tr	Silica	SiO ₂	7.0
Manganese	Mn	0.05	Boron	B	0.3
Ammonium	NH ₄	Tr	Fluoride	F	0.6
Sodium	Na	141.5	Nitrate	NO ₃	1.0
Potassium	K	1.8	Chloride	Cl	122
Calcium	Ca	25.6	Sulfate	SO ₄	31.9
Magnesium	Mg	19.9	Alkalinity (asCaCO ₃)		252
Strontium	Sr	0.49			5.04
			Hardness (as CaCO ₃)		146
Copper	Cu	0.03			2.92
Cadmium	Cd	0.00	Total dissolved minerals		493
Chromium	Cr	0.00			
Lead	Pb	< 0.05	Turbidity	0	
Lithium	Li	0.07	Color	0	
Nickel	Ni	< 0.05	Odor	0	
Zinc	Zn	0.05			

EAST HICKORY GROVE SUBDIVISION

East Hickory Grove Subdivision (est. 105), located 3 miles east of Quincy on Route 104, installed a public water supply in 1946. Three wells are in use. In 1959 there were 31 services, not metered; the average daily pumpage was estimated to be 3720 gpd. In 1972 there were 30 services, not metered; the average daily pumpage was estimated to be 5000 gpd. The water is chlorinated.

WELL NO. 1, finished in limestone, was completed in 1946 to a depth of 300 ft by the Quincy Well Drilling Co., Quincy. The well is located near the east drive of the subdivision inside the main pumping station, approximately 1090 ft E and 560 ft N of the SW corner of Section 34, T1S, R8W. The land surface elevation at the well is approximately 740 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Drift	99	99
Shale	86	185
Limestone (water at 285-297 ft)	115	300

The well is cased with 6-in. pipe from 2 ft above the water plant floor to an estimated depth of 99 ft.

Upon completion, the well was reportedly bailed at a rate of 8 gpm with a nonpumping water level of 100 ft.

The pumping equipment presently installed is a Jacuzzi submersible pump rated at 6 gpm and powered by a -hp electric motor.

WELL NO. 2, finished in limestone, was completed about 1948 to a depth of 285 ft by the Quincy Well Drilling Co., Quincy. The well is located 25 ft N of North

Drive about 200 ft N and 175 ft W of Well No. 1, approximately 925 ft E and 790 ft N of the SW corner of Section 34, T1S, R8W. The land surface elevation at the well is approximately 740 ft.

A drillers log of Well No. 2 follows:

Formation	Thickness (ft)	Depth (ft)
Drift	90	90
Shaley limestone	90	180
Limestone (water at 275-283 ft)	105	285

The well is cased with 6-in. pipe from 1.5 ft above land surface to an estimated depth of 85 ft.

The pumping equipment presently installed is a Jacuzzi submersible pump (Model No. PF05SR) set at 240 ft, rated at 6 gpm, and powered by a 1/2-hp electric motor.

WELL NO. 3, finished in limestone, was completed about 1962 to a depth of 285 ft by Brower and Seeland, Quincy. The well is located on the south side of North Drive of the subdivision about 260 ft W of Well No. 2, approximately 665 ft E and 725 ft N of the SW corner of Section 34, T1S, R8W. The land surface elevation at the well is approximately 740 ft.

The well is cased with 6-in. pipe from 1.5 ft above surrounding land surface to a depth of 88 ft.

The pumping equipment presently installed is a Jacuzzi submersible pump powered by a 1/2-hp electric motor.

The following mineral analysis (Lab. No. 186300) is for a water sample from the well collected July 23, 1971, after 5 min of pumping at 3 gpm.

WELL NO. 3, LABORATORY NO. 186300

	mg/l	me/l		mg/l	me/l	
Iron	Fe	0.2	Silica	SiO ₂	6.6	
Manganese	Mn	0.00	Boron	B	0.3	
Ammonium	NH ₄	Tr	Fluoride	F	0.3	
Sodium	Na	23.3	Nitrate	NO ₃	1.6	0.03
Potassium	K	1.1	Chloride	Cl	5	0.14
Calcium	Ca	85.6	Sulfate	SO ₄	11.7	0.24
Magnesium	Mg	30.8	Alkalinity (asCaCO ₃)		368	7.36
Strontium	Sr	0.27				
			Hardness (asCaCO ₃)		340	6.80
Copper	Cu	0.04				
Cadmium	Cd	0.00	Total dissolved minerals		386	
Chromium	Cr	0.00				
Lead	Pb	<0.05				
Lithium	Li	0.01	Turbidity		1	
Nickel	Ni	<0.05	Color		0	
Zinc	Zn	0.02	Odor		0	

GOLDEN

The village of Golden (571) installed a public water supply in 1949. Two wells (Nos. 7 and 8) are in use and three wells (Nos. 1, 2, and 6) are available for emergency use. In 1954 there were 143 services; the average and maximum daily pumpages were 10,000 and 16,000 gpd, respectively. In 1971 there were 230 services, all metered; the estimated average and maximum daily pumpages were 25,000 and 29,000 gpd, respectively. The water from Well Nos. 1 and 2 is not treated; Well No. 6 is chlorinated; and Well Nos. 7 and 8 are aerated (for hydrogen sulfide removal) and chlorinated. The natural fluoride concentration in the water is adequate to satisfy state requirements for this ingredient.

Seven test holes were drilled in the vicinity of Golden prior to the installation of a public water supply for the village. Four of these, drilled in 1948 by Henry Schuster, Golden, were located in Section 31, T2N, R5W; the remainder, drilled in 1949 by George Chadwick, Rushville, were located in this section and in Section 6, T1N, R5W.

WELL NO. 1 (originally known as No. 1-49), finished in sandstone, was completed in June 1949 to a depth of 80 ft by George Chadwick, Rushville. This well is maintained for emergency use. The well is located about 250 ft E of the C. B. & Q. RR and 200 ft S of Hanna St., approximately 1820 ft W and 345 ft N of the SE corner of Section 31, T2N, R5W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil	2	2
Clay	38	40
Yellow sandstone	10	50
Gray sandstone	30	80
Shale below		

The well is cased with 8-in. pipe from 3 ft above land surface to a depth of 44 ft. Below the 8-in. casing, the hole in bedrock is finished 8 in. in diameter to the bottom.

A production test using three observation wells was conducted on June 27-28, 1949, by representatives of the village, the driller, the State Water Survey, and Crenshaw and Jost, Consulting Engineers. For test purposes the well was equipped with a rig-operated plunger-type pump (a swab attached to the bottom of the stem, operating in the lowest section of the column pipe) with the bottom of the suction set at 81.5 ft below the top of the casing. After 8 hr of pumping at rates of 19.4 to 14.6 gpm, the final drawdown was 66.4 ft from a nonpumping water level of 11.7 ft below land surface. Fourteen hr after pumping was stopped, the water level had recovered to 13.7 ft.

The well was reported to be cleaned in 1966, but no results are available.

The pumping equipment presently installed is a Jacuzzi horizontal shaft centrifugal jet pump rated at

6.5 gpm and powered by a ¾-hp Fairbanks-Morse electric motor.

The following mineral analysis (Lab. No. 118658) is for a water sample from the well collected during the initial production test, after 8 hr of pumping at 14.6 gpm.

WELL NO. 1, LABORATORY NO. 118658

	<i>mg/l</i>	<i>me/l</i>		<i>mg/l</i>	<i>me/l</i>
Iron (total)	Fe	0.7	Silica	SiO ₂	35.5
Manganese	Mn	0.4	Fluoride	F	0.4
Calcium	Ca	84.3	Chloride	Cl	1.0
Magnesium	Mg	26.5	Nitrate	NO ₃	0.1
Ammonium	NH ₄	0.2	Sulfate	SO ₄	60.1
Sodium	Na	51.3	Alkalinity (asCaCO ₃)		368
			Hardness (asCaCO ₃)		320
Turbidity		1	Total dissolved minerals		487
Color		0	pH		6.8
Odor		0	Free CO ₂		147(calc.)
Temp		54 8F (reported)			

WELL NO. 2 (originally known as No. 2-49), finished in sandstone, was completed in June 1949 to a depth of 83 ft by George Chadwick, Rushville. This well is maintained for emergency use. The well is located about 510 ft SW of Well No. 1 near the intersection of the public road and Quincy St., about 50 ft W of the C. B. & Q. RR, approximately 50 ft N and 2250 ft W of the SE corner of Section 31, T2N, R5W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 2 follows:

<i>Formation</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Top soil	2	2
Clay	36	38
Yellow sandstone	12	50
Gray sandstone	33	83
Shale below		

The well is cased with 8-in. pipe from 1 ft above land surface to a depth of 44.7 ft. Below the 8-in. casing, the hole in bedrock is finished 8 in. in diameter to the bottom.

A production test using three observation wells was conducted on June 28, 1949, by representatives of the village, the driller, the State Water Survey, and Crenshaw and Jost, Consulting Engineers. At an initial pumping rate of 23.0 gpm, the pump broke suction after 12 min. The rate was then reduced and pumping continued at rates of 16.4 to 14.2 gpm for 6 hr with a final drawdown of 68.2 ft from a nonpumping water level of 11.3 ft below land surface. Forty-one min after pumping was stopped, the water level had recovered to 18.9 ft.

The well was reported to be cleaned in 1966, but no results are available.

The pumping equipment presently installed is a Jacuzzi horizontal shaft centrifugal jet pump rated at 6.5 gpm and powered by a 1-hp 3450 rpm Dayton electric motor.

A partial analysis of a sample (Lab. No. 118660) collected during the initial production test, showed the water to have a hardness of 396 mg/l, total dissolved minerals of 544 mg/l, and an iron content of 1.2 mg/l.

WELL NO. 3 (originally known as No. 3-49), finished in sandstone, was completed in September 1949 to a depth of 78 ft by Henry Schuster, Golden. This well was abandoned in 1968 and is now sealed. The well is located 260 ft SE of Well No. 2 on the east side of the C. B. & Q. RR, approximately 190 ft S and 2230 ft W of the NE corner of Section 6, T1N, R5W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 3 follows:

<i>Formation</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Till and rock	50	50
Dark broken sandstone	5	55
Sandrock	21	76
Blue shale	2	78

A 10-in. diameter hole was drilled to a depth of 78 ft. The well is cased with 10-in. pipe from 3 ft above land surface to a depth of 40 ft.

A production test using two observation wells was conducted on September 14, 1949, by representatives of the village, the driller, the State Water Survey, and Crenshaw and Jost, Consulting Engineers. For test purposes the well was equipped with a rig-operated plunger-type pump. After 6.8 hr of pumping at rates of 22.5 to 14 gpm, the drawdown was 65.8 ft from a nonpumping water level of 11.2 ft below land surface. Seventeen hr after pumping was stopped, the water level had recovered to 13.2 ft.

A second production test was conducted on January 19, 1950. The well was pumped at rates of 12.5 to 11 gpm for 2.5 hr with a drawdown of 29.2 ft from a nonpumping water level of 12.5 ft below land surface.

A mineral analysis of a sample (Lab. No. 119353) collected during the initial production test, after pumping for 6.5 hr, showed the water to have a hardness of 361 mg/l, total dissolved minerals of 471 mg/l, and an iron content of 0.4 mg/l.

WELL NO. 4 (originally known as No. 4-49), finished in sandstone, was completed in September 1949 to a depth of 80 ft by Henry Schuster, Golden. This well was abandoned in 1967 and is now sealed. The well is located 290 ft SW of Well No. 3 on the east side of the C. B. & Q. RR, approximately 375 ft S and 2380 ft W of the NE corner of Section 6, T1N, R5W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 4 follows:

<i>Formation</i>	<i>Thickness (ft)</i>	<i>Depth (ft)</i>
Till and rock	55	55
Dark brown sandstone	7	62
Blue shale and some sand	3	65
Blue sandrock	7	72
Brown sandrock	3	75
Black shale	5	80

An 8-in. diameter hole was drilled to a depth of 80 ft. The well is cased with 8-in. pipe from 1 ft above land surface to a depth of 42 ft.

A production test using two observation wells was conducted on September 15, 1949, by representatives of the village, the driller, the State Water Survey, and

Crenshaw and Jost, Consulting Engineers. The well was first pumped intermittently at rates of 13.0 to 28.2 gpm for 3.4 hr. After a recovery period of 6 min, the well was pumped at a rate of 13.7 gpm for 1.9 hr with a final pumping water level 60.2 ft below land surface. Thirty-five min after pumping was stopped, the water level had recovered to 25.4 ft.

On January 18-19, 1950, a supplementary production test was conducted in order to collect additional water-level yield data so that the most productive portion of the aquifer might be determined. After 17.8 hr of pumping at rates of 5.8 to 14 gpm, the drawdown was 66.2 ft from a nonpumping water level of 7.8 ft below land surface. Four hr after pumping was stopped, the water level had recovered to 15.9 ft.

A mineral analysis of a sample (Lab. No. 119355) collected during the initial production test, after 5 hr of intermittent pumping, showed the water to have a hardness of 419 mg/l, total dissolved minerals of 507 mg/l, and an iron content of 0.8 mg/l.

WELL NO. 5 (known as Mill Well), finished in limestone, was completed to a depth of 132 ft. This well was abandoned in 1963 and is now sealed. The well is located about 285 ft SW of Well No. 1 and 225 ft NE of Well No. 2, approximately 210 ft N and 2070 ft W of the SE corner of Section 31, T2N, R5W. The land surface elevation at the well is approximately 720 ft.

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

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE AND PENNSYLVANIAN SYSTEMS		
No record	95	95
PENNSYLVANIAN SYSTEM		
Shale, gray, brown, green, weak; little sandstone, silty, white, very fine, compact	20	115
Sandstone, silty, white fine to medium, few very coarse, incoherent	5	120
Shale, green, light gray, weak, sideritic	3	123
MISSISSIPPIAN SYSTEM		
St. Louis limestone		
Limestone, white, subliothographic	9	132

In October 1948 it was reported that this well was originally a dug well 25 ft deep by 10 ft diameter. The upper 4 ft of the dug portion was cemented, below which the wall was constructed of brick and stone. In the bottom of the dug portion and to one side of the center, there was another dug well 5.5 ft deep by 4 ft diameter. This was curbed with timber piling. Opposite this in the bottom of the 10-ft diameter dug portion was a 6-in. tubular well, which several years before had been drilled to 132 ft below the land surface. Prior to October 1948 the 6-in. well casing reportedly extended from 25 ft (bottom of dug portion) to 70 ft. In 1954, it was reported that the 6-in. casing had been extended to 2 ft above land surface and the dug portion of the well filled.

A production test using five observation wells was conducted on October 12-13, 1948, by representatives of the village, the Calhoun Drilling Co., and the State

Water Survey. After 16 hr of pumping at rates of 28 to 14 gpm, the drawdown was 82.6 ft from a nonpumping water level of 21.4 ft below the top of the concrete. The rate was further reduced and 3 hr later the yield was 11.2 gpm with a final drawdown of 40.8 ft. Fifty-five min after pumping was stopped, the water level had recovered to 29.6 ft.

A partial analysis of a sample (Lab. No. 116083) collected during the production test, showed the water to have a hardness of 453 mg/l, total dissolved minerals of 686 mg/l, and an iron content of 0.7 mg/l.

WELL NO. 6, finished in sandstone, was completed in April 1963 to a depth of 75 ft by Henry Schuster, Golden. This well is maintained for emergency use. The well is located 75 ft S of Hanna St. and 75 ft W of Fifth St. at the west edge of the village, approximately 700 ft E and 500 ft N of the SW corner of Section 31, T2N, R5W. The land surface elevation at the well is approximately 710 ft.

The well is cased with 8-in. steel pipe from 1.5 ft above land surface to a depth of 28 ft. Below the 8-in casing, the hole in bedrock is finished 8 in. in diameter to the bottom.

The pumping equipment presently installed is an 18-stage Universal submersible pump rated at 6.5 gpm at about 104 ft TDH and powered by a ½-hp electric motor.

WELL NO. 7, finished in limestone, was completed in 1967 to a depth of 380 ft by Henry Schuster, Golden. The well is located at the end of Fifth St., about 400 ft N of Well No. 6, approximately 700 ft E and 900 ft N of the SW corner of Section 31, T2N, R5W. The land surface elevation at the well is approximately 710 ft.

A drillers log of Well No. 7 follows:

Formation	Thickness (ft)	Depth (ft)
Alluvial soil	70	70
Shale and lime	50	120
Lime	30	150
Shale and lime	90	240
Lime	140	380

An 8-in. diameter hole was drilled to a depth of 243 ft and finished 6 in. in diameter from 243 to 380 ft. The well is cased with 8-in. steel pipe from 1.5 ft above land surface to a depth of 75 ft and with 6-in. pipe from 3.2 ft above land surface to a depth of 243 ft. The annulus between the 6-in. and 8-in. casings and the 8-in. drill hole is filled with neat cement grout to a depth of 243 ft.

The pumping equipment presently installed is a Jacuzzi submersible pump (Model No. 3S4C-S2/S-98) rated at 20 gpm and powered by a 3-hp 3450 rpm Franklin electric motor.

WELL NO. 8, finished in limestone, was completed in May 1970 to a depth of 420 ft by Henry Schuster, Golden. The well is located 600 ft W of Well No. 7, approximately 938 ft N and 100 ft E of the SW corner of Section 31, T2N, R5W. The land surface elevation at the well is 705 ft.

A drillers log of Well No. 8 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	42	42
Blue clay	26	68
Sandstone	28	96
Blue clay	24	120
Mississippian limestone	77	197
Blue clay	38	235
Burlington-Keokuk limestone	145	380
No record	40	420

A 10-in. diameter hole was drilled to a depth of 70 ft; reduced to 8 in. between 70 and 241 ft; and finished 6 in; in diameter from 241 to 420 ft. The well is cased with 10-in. pipe from land surface to a depth of 42 ft; 8-in. pipe from 1 ft above land surface to a depth of 70 ft; and 6-in. pipe from 1 ft above land surface to a depth of 241 ft.

On May 19, 1970, when the well was 380 ft deep, a production test using one observation well was conducted by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 3 hr of pumping at a rate of 10.3 gpm, the drawdown was 84 ft from a nonpumping water level of 191 ft below the top of the casing. Thirty min after pumping was stopped, the water level had recovered to 208 ft. On the basis of the production test data, it was estimated that this well would yield 7 gpm (10,000 gpd) on a long-term basis.

After deepening the well to 420 ft, a second pro-

duction test was conducted on May 29, 1970, by representatives of the driller and Wm. H. Klingner & Associates, Engineers. After 2 hr of pumping at a rate of 10 gpm, the drawdown was 58 ft from a nonpumping water level of 201 ft below the top of the casing. Thirty min after pumping was stopped, the water level had recovered to 213 ft.

The pumping equipment presently installed is a Jacuzzi submersible pump rated at 20 gpm and powered by a 3-hp Franklin electric motor.

The following mineral analysis (Lab. No. 185934) is for a water sample from the well collected June 18, 1971, after 24 hr of pumping at 18 gpm.

WELL NO. 8, LABORATORY NO. 185934

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.9		Silica	SiO ₂	7.4	
Manganese	Mn	0.04		Boron	B	0.6	
Ammonium	NH ₄	0.4	0.02	Fluoride	F	2.4	
Sodium	Na	363.0	15.79	Nitrate	.NO ₃	0.4	0.01
Potassium	K	3.1	0.08	Chloride	Cl	355	10.0
Calcium	Ca	15.2	0.76	Sulfate	SO ₄	17.5	0.36
Magnesium	Mg	7.3	0.60	Alkalinity (asCaCO ₃)		324	6.48
Strontium	Sr	6.37					
				Hardness (asCaCO ₃)		68	1.36
Copper	Cu	0.01					
Cadmium	Cd	0.00		Total dissolved minerals		959	
Chromium	Cr	0.00					
Lead	Pb	<0.05		Turbidity		6	
Lithium	Li	0.11		Color		0	
Nickel	Ni	<0.05		Odor		0	
Zinc	Zn	0.02					

LIBERTY

The village of Liberty (369) installed a public water supply in 1964. Three wells (Nos. 2, 3, and 4) are in use. In 1964 there were 107 services, all metered; the average daily pumpage was 12,500 gpd. In 1971 there were 154 services, all metered; the average and maximum daily pumpages were 28,000 and 35,000 gpd, respectively. The water is aerated, chlorinated, and fluoridated.

WELL NO. 1, finished in limestone, was completed in October 1963 to a depth of 305 ft by the Callihan Drilling Co., Pittsfield. This well was deepened to approximately 365 ft in 1971 with reportedly no further increase in production capacity and was taken out of service. The well is located in the southeast part of town at the south edge of the village park, approximately 1620 ft N and 155 ft E of the SW corner of Section 21, T2S, R6W. The land surface elevation at the well is approximately 755 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil	5	5
Yellow clay	62	67
Gray shale	33	100
Gray sandy shale	10	110
Sand	2	112
Gray shale	1	113
Gray to blue shale	12	125
Gray shale	25	150
Broken lime and shale	21	171
Burlington limestone	134	305

An 8-in. diameter hole was drilled to a depth of 171.3 ft and finished 6 in. in diameter from 171.3 to 305 ft. The well is cased with 6-in. standard pipe from 1.5 ft above land surface to a depth of 171.3 ft.

WELL NO. 2, finished in limestone, was completed in October 1963 to a depth of 295 ft by the Callihan Drilling Co., Pittsfield. The well is located in the water treatment plant in the southeast part of the village adjacent to the water tower, about 110 ft W and 300 ft S of Well No. 1, approximately 1320 ft N and 45 ft E of the SW corner of Section 21, T2S, R6W. The land surface elevation at the well is 759 ft.

A drillers log of Well No. 2 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil	4	4
Yellow clay	76	80
Greenish gray shale	5	85
Gray shale	19	104
Sandy shale	7	111
Black shale	5	116
Gray shale	35	151
Broken lime and shale	18	169
Burlington limestone	131	300
Picked up water from 275 to 300 ft.		

A 6-in. diameter hole was drilled to a depth of 295 ft. The well is cased with 6-in. standard wrought iron pipe from 1 ft above land surface to a depth of 180.2 ft.

A production test using one observation well was conducted on November 5, 1963, by representatives of

the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 4 hr of pumping at a rate of 25 gpm, the drawdown was 51.4 ft from a nonpumping water level of 116.3 ft below the top of the casing. One hr after pumping was stopped, the water level had recovered to 123.0 ft. On the basis of production test data, it was estimated that this well would yield 25 gpm (36,000 gpd) on a long-term basis.

On November 12, 1968, the nonpumping water level was 192 ft below the top of the casing. After 30 min of pumping at an average rate of 24.7 gpm, the drawdown was 49 ft.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump set at 281 ft, rated at 25 gpm at about 190 ft TDH, and powered by a 3-hp electric motor.

A partial analysis of a sample (Lab. No. 161614) collected during the initial production test after pumping for 4 hr at 25 gpm, showed the water to have a hardness of 312 mg/l, total dissolved minerals of 352 mg/l, and an iron content of 0.2 mg/l.

WELL NO. 3, finished in limestone, was completed in November 1968 to a depth of 308 ft by the Callihan Drilling Co., Pittsfield. The well is located at the southwest corner of Park and Pittsfield Sts., about 100 ft E and 300 ft S of Well No. 2, approximately 1020 ft N and 145 ft E of the SW corner of Section 21, T2S, R6W. The land surface elevation at the well is 758 ft.

A drillers log of Well No. 3 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	70	70
Clay to blue shale	120	190
Gray limestone	60	250
White limestone	58	308

An 8-in. diameter hole was drilled to a depth of 200 ft and finished 6 in. in diameter from 200 to 308 ft. The well is cased with 6-in. standard pipe from 1.5 ft above land surface to a depth of 200 ft and sealed in limestone with a drive shoe.

A production test was conducted on October 17, 1968, by representatives of the driller and Wm. H. Klingner & Associates, Engineers. The well reportedly produced 26 gpm for 2 hr with a drawdown of 6 ft from a nonpumping water level of 190 ft below the top of the casing.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump set at 290 ft, rated at 25 gpm at about 250 ft TDH, and powered by a 3-hp electric motor.

The following mineral analysis (Lab. No. 185908) is

for a water sample from the well collected June 15, 1971, after 30 min of pumping at 18.76 gpm.

WELL NO. 3, LABORATORY NO. 185908

	mg/l	me/l		mg/l	me/l	
Iron	Fe	Tr	Silica	SiO ₂	7.0	
Manganese	Mn	0.03	Boron	B	0.2	
Ammonium	NH ₄	0.1	Fluoride	F	0.2	
Sodium	Na	23.1	Nitrate	NO ₃	0.7	0.01
Potassium	K	1.4	Chloride	Cl	10	0.28
Calcium	Ca	58.4	Sulfate	SO ₄	13.8	0.29
Magnesium	Mg	42.4	Alkalinity (as CaCO ₃)		340	6.80
Strontium	Sr	0.19				
			Hardness (as CaCO ₃)		320	6.40
Copper	Cu	0.01				
Cadmium	Cd	0.00	Total dissolved minerals		358	
Chromium	Cr	0.00				
Lead	Pb	<0.05	Turbidity	Tr		
Lithium	Li	0.01	Color		0	
Nickel	Ni	<0.05	Odor		0	
Zinc	Zn	0.04				

WELL NO. 4, finished in limestone, was completed in December 1971 to a depth of 355 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located on the west edge of the village, approximately 1250 ft N and 700 ft W of the SE corner of Section 20, T2S, R6W. The land surface elevation at the well is approximately 745 ft.

A drillers log of Well No. 4 follows:

Formation	Thickness (ft)	Depth (ft)
Top soil	4	4
Yellow clay	58	62
Shale	94	156
Limestone	199	355

A 6-in. diameter hole was drilled to a depth of 355 ft. The well is cased with 6-in. pipe from 1 ft above land surface to a depth of 180 ft.

A production test was conducted on February 2, 1972, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. For test purposes the permanent pump described below was used. After 2 hr of pumping at a rate of 13.8 gpm, the drawdown was 69.32 ft from a nonpumping water level of 172.59 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 177.58 ft.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump set at 283 ft and powered by an electric motor.

A partial analysis of a sample (Lab. No. 187694) collected during the initial production test, after pumping for 2 hr at 13.8 gpm, showed the water to have a hardness of 306 mg/l, total dissolved minerals of 347 mg/l, and an iron content of 1.4 mg/l.

LORAINE

The village of Loraine (372) installed a public water supply in 1956. Two wells are in use. In 1957 there were 129 services, all metered. In 1971 there were 140 services, all metered; the average and maximum daily pumpages were 20,000 and 30,000 gpd, respectively. The water is chlorinated. The natural fluoride concentration in the water is adequate to satisfy state requirements for this ingredient.

WELL NO. 1 (North Well), finished in limestone, was completed in May 1956 to a depth of 300 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located at the northwest corner of the village on Oak St. at the intersection with Long St., approximately 1655 ft N and 334 ft E of the SW corner of Section 16, T2N, R7W. The land surface elevation at the well is 650.5 ft.

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

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
"Yellow Clay"	45	45
"Gray Clay"	50	95
MISSISSIPPIAN SYSTEM		
Warsaw formation		
Limestone, medium gray, silty	19	114
Shale, gray, silty	6	120
Limestone, gray	5	125
Shale, gray, greenish gray, silty	15	140
Limestone, gray brown, shale, gray and brown	5	145
Keokuk-Burlington formation		
Limestone, gray, medium gray, silty	18	163
Chert, white	7	170
Limestone, dolomitic, gray, brown	5	175
Chert, white, and limestone, gray	10	185
Limestone, gray, and chert, white	35	220
Chert, white, and limestone, gray	20	240
Limestone, light gray; chert, white	30	270
Chert, white and limestone, gray	10	280
Limestone, light gray, crystalline	20	300

An 8-in. diameter hole was drilled to a depth of 300 ft. The well is cased with 8-in. pipe from 1 ft above land surface to a depth of 162 ft.

A production test was conducted on May 15, 1956, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 5.7 hr of pumping at a rate of 21 gpm, the drawdown was 126 ft from a nonpumping water level of 98 ft below the top of the casing. Forty-eight min after pumping was stopped, the water level had recovered to 127 ft.

A production test to determine if the well had declined in yield was conducted on February 15, 1972, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 1.1 hr of pumping at a rate of 20 gpm, the drawdown was 132.22 ft from a nonpumping water level of 116.98 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 146.45

ft. The specific capacity (yield per ft of drawdown) of the well during the 1972 test is not appreciably less than the specific capacity during the original test in 1956.

The pumping equipment presently installed is a Reda submersible pump (type 645) rated at 25 gpm and powered by a 3-hp 3450 rpm electric motor.

A partial analysis of a sample (Lab. No. 187731) collected February 15, 1972, after pumping for 1 hr at 20 gpm, showed the water to have a hardness of 130 mg/l, total dissolved minerals of 808 mg/l, and an iron content of 0.6 mg/l. Hydrogen sulfide also was apparent when this sample was collected.

WELL NO. 2 (South Well), finished in limestone, was completed in May 1956 to a depth of 300 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located in the pumphouse at the northeast corner of the village at the end of Short St., 517 ft SE of Well No. 1, approximately 1460 ft N and 785 ft E of the SW corner of Section 16, T2N, R7W. The land surface elevation at the well is 650.3 ft.

A drillers log of Well No. 2 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	65	65
Gray clay	33	98
Gray sandy clay	4	102
Lime gray	17	119
Shale gray	9	128
Lime gray	5	133
Shale	13	146
Limestone	154	300

An 8-in. diameter hole was drilled to a depth of 300 ft. The well is cased with 8-in. pipe from 2.2 ft above land surface to a depth of 163.5 ft.

A production test was conducted on May 23, 1956, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 6 hr of pumping at a rate of 22 gpm, the drawdown was 98 ft from a nonpumping water level of 93 ft below the top of the casing. Forty min after pumping was stopped, the water level had recovered to 122 ft. A water level recorder installed in Well No. 1 during this production test showed a water level decline of 8.43 ft from a nonpumping water level of 93.15 ft.

Another production test to determine if the well had declined in yield was conducted on February 15, 1972, by representatives of the village, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 1.5 hr of pumping at a rate of 20 gpm, the drawdown was 120.98 ft from a nonpumping water level of 120.60 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 147.70 ft. These test data indicate that a marked decrease in well efficiency has occurred since 1956.

The pumping equipment presently installed is a Jacuzzi submersible pump powered by a 3-hp electric motor.

The following mineral analysis (Lab. No. 185924) is for a water sample from the well collected June 16, 1971, after 40 min of pumping at 22.5 gpm.

A partial analysis of a sample (Lab. No. 187730) collected February 15, 1972, after pumping for 1 hr at 20 gpm, showed the water to have a hardness of 144 mg/l, total dissolved minerals of 753 mg/l, and an iron content of 0.2 mg/l. Hydrogen sulfide also was apparent when this sample was collected.

WELL NO. 2, LABORATORY NO. 185924

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.7		Silica	SiO ₂	7.0	
Manganese	Mn	0.13		Boron	B	0.6	
Ammonium	NH ₄	1.1	0.06	Fluoride	F	1.3	
Sodium	Na	278.0	12.10	Nitrate	NO ₃	1.6	0.03
Potassium	K	2.7	0.07	Chloride	Cl	195	5.50
Calcium	Ca	28.8	1.44	Sulfate	SO ₄	4.5	0.09
Magnesium	Mg	13.6	1.12	Alkalinity (as CaCO ₃)		456	9.12
Strontium	Sr	0.28					
				Hardness (as CaCO ₃)		128	2.56
Copper	Cu	0.03					
Cadmium	Cd	0.00		Total dissolved minerals		803	
Chromium	Cr	0.00					
Lead	Pb	<0.05					
Lithium	Li	0.06		Turbidity		2	
Nickel	Ni	<0.05		Color		0	
Zinc	Zn	0.01		Odor		0	

MENDON

The village of Mendon (883) installed a public water supply in 1950. Altogether nine production wells have been constructed for this supply since that time, but only two of these wells (Nos. 8 and 9) located 4 miles west near the village of Ursa are in use. In 1954 there were 197 services, all metered; the average daily pumpage was 13,000 gpd. In 1971 there were 315 services, all metered; the average and maximum daily pumpages were reported to be 53,000 and 73,000 gpd, respectively. The water is chlorinated and fluoridated.

WELL NO. 1, finished in sand and gravel, was completed in 1950 to a depth of 46 ft by the Air-Made Well Co., Edwardsville, Kansas. This well was abandoned in 1964 and is now sealed. The well is located 1550 ft SW of the village filter plant, approximately 255 ft N and 1300 ft W of the SE corner of Section 11, T1N, R8W. The land surface elevation at the well is 714.9 ft.

A 16-in. diameter hole was drilled to a depth of 46 ft. The well is cased with 12-in. outer pipe from 1.2 ft above land surface to a depth of 12.8 ft (cemented in) and 6-in. inner pipe from 2 ft above land surface to a depth of 44.5 ft. The bottom 10 ft of the inner casing was perforated with 1/4-in. vertical slots. The annulus between the 6-in. casing and the bore hole and 12-in. casing was filled with washed river gravel.

A production test using one observation well was conducted on June 28, 1950, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 2 hr of pumping at a rate of about 25 gpm, the drawdown was 12.3 ft from a non-pumping water level of 18.5 ft below land surface. Pumping was continued for an additional 3 hr at a reduced rate of about 16 gpm with a final drawdown of 12.1 ft. Twenty-nine min after pumping was stopped, the water level had recovered to 22.2 ft.

The following mineral analysis (Lab. No. 144579) is for a water sample from the well collected September 25, 1957.

WELL NO. 1, LABORATORY NO. 144579

		mg/l	me/l			mg/l	me/l
Iron (total)	Fe	0.3		Silica	SiO ₂	17.0	
Manganese	Mn	0.0		Fluoride	F	0.2	
Calcium	Ca	45.0	2.25	Boron	B	0.0	
Magnesium	Mg	8.7	0.72	Chloride	Cl	9	0.25
Ammonium	NH ₄	Tr	Tr	Nitrate	NO ₃	5.8	0.09
Sodium	Na	3	0.15	Sulfate	SO ₄	5.6	0.12
				Alkalinity (as CaCO ₃)		136	2.72
Turbidity		0					
Color		0		Hardness (as CaCO ₃)		149	2.97
Odor		0					
Temp.		58.9F (reported)		Total dissolved minerals		181	

WELL NO. 2, finished in sand and gravel, was completed in 1950 to a depth of 42.5 ft by the Air-Made Well Co., Edwardsville, Kansas. This well was abandoned in 1964 and is now sealed. The well is located about 165 ft S of Well No. 1, approximately 90 ft N and 1300 ft W of the SE corner of Section 11, T1N, R8W. The land surface elevation at the well is 710.6 ft.

A 16-in. diameter hole was drilled to a depth of 42.5 ft. The well is cased with 12-in. outer pipe from 1.2 ft above land surface to a depth of 12.8 ft (cemented in) and 6-in. inner pipe from 2 ft above land surface to a depth of 40.5 ft. The bottom 10 ft of the inner casing was perforated with 1/4-in. vertical slots. The annulus between the 6-in. casing and the bore hole and 12-in. casing was filled with washed river gravel.

A production test using one observation well was conducted on June 26, 1950, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 9 hr of pumping at a rate of 23.2 gpm, the drawdown was 14.3 ft from a non-pumping water level of 14.0 ft below land surface. Twenty-four min after pumping was stopped, the water level had recovered to 21.7 ft.

A mineral analysis of a sample (Lab. No. 122211) collected June 26, 1950, after pumping for 8.5 hr at a rate of 23.2 gpm, showed the water to have a hardness of 163 mg/l, total dissolved minerals of 205 mg/l, and an iron content of 1.5 mg/l.

WELL NO. 3, finished in limestone, was completed in January 1951 to a depth of 275 ft by the Air-Made Well Co., Edwardsville, Kansas. This well was abandoned in 1964 and is now sealed. The well is located in the southwest corner of the filter plant building east of State St., approximately 1160 ft N and 50 ft W of the SE corner of Section 11, T1N, R8W. The land surface elevation at the well is 755.5 ft.

A 10-in. diameter hole was drilled to a depth of 91.5 ft and finished 8 in. in diameter from 91.5 to 275 ft. The well is cased with 8-in. pipe from 1.5 ft above land surface to a depth of 91.5 ft. From 78 to 90 ft the casing was perforated with vertical slots 3 in. by $\frac{1}{2}$ in. The slot rows were spaced 1 ft apart vertically with 8 slots per row.

A production test using one observation well was conducted on January 19, 1951. For test purposes the well was equipped with an air-lift pump and 210 ft of 3-in. ejector pipe. After 2.5 hr of pumping at rates from 12.7 to 22 gpm, the final drawdown was 105.3 ft from a nonpumping water level of 36.9 ft below the top of the casing. Two hr after pumping was stopped, the water level had recovered to 42.6 ft.

WELL NO. 4, finished in limestone, was completed in January 1951 to a depth of 226 ft by the Air-Made Well Co., Edwardsville, Kansas. This well was abandoned in 1952 and sealed in 1958. The well is located about 675 ft W from Well No. 3 and about 1185 ft NE of Well No. 1, approximately 1280 ft N and 710 ft W of the SE corner of Section 11, T1N, R8W. The land surface elevation at the well is 747.5 ft.

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

Formation	Thickness (ft)	Depth (ft)
PLEISTOCENE SERIES		
Silt, yellowish brown	9	9
Sand, fine to medium, yellow, mainly quartz. clean, well sorted	61	70
No samples	8	78
MISSISSIPPIAN SYSTEM		
Warsaw formation		
Limestone, light gray to gray, fine to coarse. sandy	36	114
Shale, light olive green, silty, weak	8	122
Shale, dark gray, silty weak	58	180
Limestone, very cherty, light brownish gray	35	215
Keokuk-Burlington formation		
Limestone, light gray, very fine to medium	11	226

A 10-in. diameter hole was drilled to a depth of 83 ft and finished 8 in. in diameter from 83 to 226 ft. The well is cased with 8-in. pipe from 1.8 ft above land surface to a depth of 81.2 ft. The lower 25 ft of the casing was perforated with vertical slots 3 in. by $\frac{1}{2}$ in. The slot rows were spaced 1 ft apart vertically with 8 slots per row. Another row of slots was cut at 45 ft below the top of the casing. The annulus outside the casing was filled with approximately 120 tons of gravel.

Upon completion the well was pumped intermittently at rates of 5.8 to 6.6 gpm for 24.8 hr with a final pumping level of 91.2 ft below the top of the casing. After pumping was stopped, the water level had recovered to 36.9 ft in 2.2 hr.

WELL NO. 5, finished in sand and gravel, was completed in May 1958 to a depth of 42.6 ft by the J. P. Miller Artesian Well Co., Brookfield. This well was abandoned in 1964 and is now sealed. The well is located about 1650 ft SW of the village filter plant, approximately 160 ft N and 1300 ft W of the SE corner of Section 11, T1N, R8W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 5 follows:

Formation	Thickness (ft)	Depth (ft)
Clay	11	11
Sand and clay	3	14
White sand	6	20
Clay, sticky	6	26
White sand	10	36
Clay	2	38
Sand	2	40
Gravel and broken limestone	2.5	42.5

A 60-in. diameter hole was drilled to a depth of 42.6 ft. The well is cased with 8-in. pipe from 0.5 ft above land surface to a depth of 37.6 ft followed by a 5-ft length of 8-in. No. 30 slot Cook stainless steel screen. The annulus is filled with clay from 0 to 5 ft, with 36 tons of torpedo sand from 5 to 31 ft, and with 10 tons of No. 1 gravel from 31 to 42.6 ft.

A production test using one observation well was conducted on May 22, 1958, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. The initial pumping rate was 13 gpm, but the pump broke suction after 11 min and the pumping rate was reduced to 6 gpm. After 4.1 hr of pumping, the drawdown was 9.4 ft from a nonpumping water level of 32.0 ft below the pump base. One hr after pumping was stopped, the water level had recovered to 34.2 ft. During the test, Well No. 1, 95 ft N, and Well No. 2, 71 ft S, were pumping continuously.

WELL NO. 6, finished in sand and gravel, was completed in September 1960 to a depth of 63.5 ft by Charles Hayes, Champaign. This well was abandoned in 1964 and is now sealed. The well is located approximately 700 ft E and 1310 ft S of the NW corner of Section 13, T1N, R8W. The land surface elevation at the well is approximately 730 ft.

A drillers log of Well No. 6 follows:

Formation	Thickness (ft)	Depth (ft)
Clay	19	19
Sand	9	28
Clay with sand streaks	21.5	49.5
Sand	14	63.5
Ended on bedrock		

The well is cased with 4-in. steel pipe from 1.5 ft above land surface to a depth of 55.6 ft followed by an 8.5-ft length of 4-in. No. 18 slot Johnson Red Brass screen.

Upon completion, the well reportedly produced 10 gpm for 8 hr with a drawdown of 36.7 ft from a nonpumping water level of 26.7 ft.

WELL NO. 7, finished in sand and gravel, was completed in October 1960 to a depth of 49.5 ft by Charles Hayes, Champaign. This well was abandoned in 1964 and is now sealed. The well is located 282 ft W of Well No. 6, approximately 1310 ft S and 418 ft E of

the NW corner of Section 13, T1N, R8W. The land surface elevation at the well is approximately 720 ft.

A drillers log of Well No. 7 follows:

Formation	Thickness (ft)	Depth (ft)
Clay	15	15
Sand	7	22
Clay	10	32
Clay and sand	3	35
Sand	10	45
Sand and small gravel mixed with clay	4.5	49.5
Ended on bedrock		

The well is cased with 4-in. steel pipe from 1.5 ft above land surface to a depth of 41.8 ft followed by an 8.5-ft length of 4-in. No. 18 slot Johnson Red Brass screen.

Upon completion, the well reportedly produced 2.5 gpm for 8 hr with a drawdown of 20.3 ft from a non-pumping water level of 18.3 ft.

WELL NO. 8, finished in limestone, was completed in August 1960 to a depth of 176 ft by Henry Schuster, Golden. The well is located 4 miles west of Mendon on the north edge of Ursa about 100 ft W of Route 96 and 1500 ft N of the intersection of Routes 96 and 61, approximately 130 ft S and 2800 ft W of the NE corner of Section 18, T1N, R8W. This was originally known as the Chester Tripp well. The land surface elevation at the well is approximately 615 ft.

A drillers log of Well No. 8 follows:

Formation	Thickness (ft)	Depth (ft)
Drift	59	59
Limestone	117	176

An 8-in. diameter hole was drilled to a depth of 59 ft and finished 6 in. in diameter from 59 to 176 ft. The well is cased with 6-in. wrought iron pipe from 2 ft above the pumphouse floor to a depth of 59 ft.

A production test was conducted on October 9, 1962, by representatives of the J. B. Bushnell Well Drilling Co., the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 2.5 hr of

pumping at a rate of 189 gpm, the drawdown was 26.0 ft from a nonpumping water level of 14.0 ft below land surface. Thirty min after pumping was stopped, the water level had recovered to 17 ft.

The pumping equipment presently installed is a Fairbanks-Morse Pomona deep well water-lubricated vertical turbine pump rated at 100 gpm and powered by a 15-hp General Electric motor.

WELL NO. 9, finished in limestone, was completed in 1963 to a depth of 180 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located 10 ft N of Well No. 8, approximately 2800 ft W and 120 ft S of the NE corner of Section 18, T1N, R8W. The land surface elevation at the well is approximately 615 ft.

The well is cased with 8-in. wrought iron pipe from 2 ft above the pumphouse floor to a depth of 59 ft. Below the 8-in. casing, the hole in bedrock is finished 8 in. in diameter to the bottom.

The pumping equipment presently installed is a Fairbanks-Morse Pomona water-lubricated deep well turbine pump rated at 100 gpm and powered by a 15-hp U.S. electric motor.

The following mineral analysis (Lab. No. 186006) is for a water sample from the well collected June 28, 1971, after 45 min of pumping at 90 gpm.

WELL NO. 9, LABORATORY NO. 186006

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.1		Silica	SiO ₂	16.5	
Manganese	Mn	0.04		Boron	B	0.1	
Ammonium	NH ₄	0.2	0.01	Fluoride	F	0.5	
Sodium	Na	8.2	0.36	Nitrate	NO ₃	8.7	0.14
Potassium	K	0.6	0.02	Chloride	Cl	8	0.23
Calcium	Ca	72.0	3.59	Sulfate	SO ₄	25.9	0.54
Magnesium	Mg	25.9	2.13	Alkalinity (as CaCO ₃)		260	5.20
Strontium	Sr	0.13					
				Hardness (as CaCO ₃)		286	5.72
Copper	Cu	0.01					
Cadmium	Cd	0.00		Total dissolved minerals		329	
Chromium	Cr	0.00					
Lead	Pb	<0.05		Turbidity		2	
Lithium	Li	0.01		Color		0	
Nickel	Ni	<0.05		Odor		0	
Zinc	Zn	0.05					

PAYSON

The village of Payson (589) installed a public water supply in 1910. Two wells are in use. In 1953 there were approximately 155 services; the average and maximum daily pumpages were 25,000 and 50,000 gpd, respectively. In 1971 there were 215 services, all metered; the average and maximum daily pumpages were reported to be 50,000 and 60,000 gpd, respectively. The water is chlorinated and fluoridated.

WELL NO. 1, finished in limestone, was completed in 1910 to a depth of 330 ft. The well is located inside the service building on the northwest corner of the village square about 75 ft from the elevated storage tank, approximately 1000 ft N and 100 ft E of the SW

corner of Section 8, T3S, R7W. The land surface elevation at the well is approximately 763 ft.

In November 1966, Wm. H. Klingner & Associates, Engineers, reported that the well was cased with 5-in. pipe to a depth of approximately 60 ft and is apparently 4 in. in diameter to a depth of 194.7 ft, where an obstruction was encountered. In 1940 it was reported that a 60-ft length of 2-in. pump column had been dropped into the well.

A production test was conducted by the State Water Survey on August 7, 1940. For test purposes the permanent pump described below was used. Before the test the nonpumping water level was reported to be 75 ft

below land surface. The well was pumped for 7 hr at a rate of 74 gpm, but no pumping water level measurements were reported. From the pump characteristics, it was estimated that the drawdown was 67 ft.

The pumping equipment presently installed consists of a 7½-hp 3600 rpm Fairbanks-Morse electric motor (No. 366940), a 4-in., 15-stage Fairbanks-Morse water-lubricated turbine pump (No. 8565), rated at 50 gpm at about 284 ft TDH, having 5.5 ft overall length and 160 ft of 3-in. column pipe. A 20-ft section of 3-in. suction pipe is attached to the pump intake. The pump base is about 1 ft above floor level, which is at land surface.

A mineral analysis of a sample (Lab. No. 113934) collected March 25, 1948, after pumping for 7 hr at 74 gpm, showed the water to have a hardness of 239 mg/l, total dissolved minerals of 296 mg/l, and an iron content of 0.1 mg/l.

WELL NO. 2, finished in limestone, was completed in September 1967 to a depth of 304 ft by the Callihan Drilling Co., Pittsfield. The well is located at the southeast corner of Main and Edwards Sts., 20 ft N of Well No. 1, approximately 1020 ft N and 100 ft E of the SW corner of Section 8, T3S, R7W. The land surface elevation at the well is approximately 762 ft.

A drillers log of Well No. 2 follows:

Formation	Thickness (ft)	Depth (ft)
Drift	40	40
Sand	30	70
Shale	66	136
Broken lime	19	155
Light gray lime	30	185
Dark gray lime	10	195
Yellow flint rock	25	220
White lime	79	299
Shale	5	304

An 8-in. diameter hole was drilled to a depth of 304 ft. The well is equipped with a Monitor pitless adapter from 1.7 ft above land surface to 4 ft, and cased

with 8-in. pipe to a depth of 159 ft. The annulus between the casing and the wall of the hole is filled with compacted earth from 0 to 4 ft and cement grout from 4 ft to a 10-15 ft depth.

A production test was conducted on September 14, 1967, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 2 hr of pumping at a rate of 133 gpm, the drawdown was 0.23 ft from a nonpumping water level of 127.20 ft below land surface; full recovery was observed 10 min after pumping was stopped.

The pumping equipment presently installed is a Jacuzzi submersible pump rated at 50 gpm at about 284 ft TDH and powered by a 7½-hp electric motor.

A partial analysis of a sample (Lab. No. 172991) collected during the initial production test after pumping for 2 hr at 133 gpm, showed the water to have a hardness of 230 mg/l, total dissolved minerals of 296 mg/l, and an iron content of 0.1 mg/l.

The following mineral analysis (Lab. No. 185933) is for a water sample from the well collected June 21, 1971, after 30 min of pumping at 65 gpm.

WELL NO. 2, LABORATORY NO. 185933

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.4		Silica	SiO ₂	12.3	
Manganese	Mn	0.05		Boron	B	0.1	
Ammonium	NH ₄	Tr		Fluoride	F	0.2	
Sodium	Na	22.6	0.98	Nitrate	NO ₃	41.5	0.67
Potassium	K	1.4	0.04	Chloride	Cl	27	0.76
Calcium	Ca	80.8	4.03	Sulfate	SO ₄	39.5	0.82
Magnesium	Mg	14.2	1.17	Alkalinity(asCaCO ₃)		208	4.16
Strontium	Sr	0.09					
				Hardness (as CaCO ₃)		260	5.20
Copper	Cu	0.02					
Cadmium	Cd	0.00		Total dissolved minerals		376	
Chromium	Cr	0.00					
Lead	Pb	<0.05		Turbidity	1		
Lithium	Li	0.01		Color	0		
Nickel	Ni	<0.05		Odor	0		
Zinc	Zn	0.50					

PLAINVILLE

The village of Plainville (289) installed a public water supply in 1964. Two wells are in use. In 1964 there were 99 services; the average daily pumpage was 13,000 gpd. In 1971 there were 105 services, of which 87 are metered; the average and maximum daily pumpages were reported to be 15,000 and 20,000 gpd, respectively. The water is chlorinated and fluoridated.

WELL NO. 1, finished in limestone, was completed in August 1962 to a depth of 141 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located in the service building in the east central part of the village on the north edge of the park, approximately 359 ft S and 1250 ft E of the NW corner of Section 26, T3S,R7W. The land surface elevation at the well is approxi-

mately 700 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Clay (yellow)	35	35
Sandy clay with a little gravel (rusty)	11	46
Clay sandy fine (yellow)	2	48
Clay with gravel (yellow)	18	66
Broken at 78 ft, water brown, 1 gpm	12	78
Rock hard (near solid)	4	82
Rock broken (brown mud)	10	92
Sand fine	5	97
Broken rock (brown mud)	18	115
Broken rock and sand-tested, no more water than above	3	118
Very sandy	1	119
Sand and lime	2	121
Lime (brown)	3	124
Lime (coarse cut) (white chert)	9	133
Lime (light brown)	8	141

A 10-in. diameter hole was drilled to a depth of

141 ft. The well is cased with 10-in. pipe from 1.3 ft above the pumphouse floor to a depth of 121 ft. The annulus between the casing and hole was sealed with cement grout to a depth of 15 ft.

A production test was conducted on August 10, 1962, by representatives of the driller and Wm. H. Klingner & Associates, Engineers. During 8.4 hr of pumping at rates of 52 to 35 gpm, the maximum drawdown was 70.58 ft from a nonpumping water level of 48.12 ft below land surface. Three and one-half hr after pumping was stopped, the water level had recovered to 59.09 ft. Based on the production test data, the State Water Survey estimated that this well would yield approximately 20 gpm (30,000 gpd) on a long-term basis.

The pumping equipment presently installed is a Fairbanks-Morse Pomona water-lubricated deep well turbine pump set at 117 ft, rated at 25 gpm, and powered by a 3-hp 1715 rpm electric motor.

A mineral analysis of a sample (Lab. No. 186595) collected August 20, 1971, after pumping for 15 min at 25 gpm, showed the water to have a hardness of 256 mg/l, total dissolved minerals of 288 mg/l, and an iron content of 0.0 mg/l.

WELL NO. 2, finished in limestone, was completed in September 1962 to a depth of 188 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located approximately 165 ft SE of Well No. 1, approximately 403 ft S and 1412 ft E of the NW corner of Section 26, T3S, R7W. The land surface elevation at the well is 702.1 ft.

A drillers log of Well No. 2 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	33	33
Broken lime and yellow clay	33	66
Lime (hard)	122	188

An 8-in. diameter hole was drilled to a depth of 188 ft. The well is equipped with a pitless adapter

placed at a depth of 4.5 ft, and cased with 8-in. pipe to a depth of 79 ft. The annulus was sealed with cement grout to a depth of 15 ft.

A production test using one observation well was conducted on September 12, 1962, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 7 hr of pumping at a rate of 15 gpm, the drawdown was 90.98 ft from a nonpumping water level of 53.05 ft below land surface. Ten hr after pumping was stopped, the water level had recovered to 53.37 ft. Based on the production test data, it was estimated that this well should yield 5 gpm (7000 gpd) on a long-term basis.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump set at 168 ft, rated at 8 gpm, and powered by a 1-hp electric motor. The well is equipped with 166 ft of airline.

The following mineral analysis (Lab. No. 186596) is for a water sample from the well collected August 20, 1971, after 15 min of pumping at 8 gpm.

WELL NO. 2. LABORATORY NO. 186596

	mg/l	me/l		mg/l	me/l	
Iron	Fe	Tr	Silica	SiO ₂	8.4	
Manganese	Mn	0.00	Boron	B	0.1	
Ammonium	NH ₄	Tr	Fluoride	F	0.3	
Sodium	Na	8.8	Nitrate	NO ₃	14.7	0.24
Potassium	K	1.3	Chloride	Cl	7	0.20
Calcium	Ca	56.8	Sulfate	SO ₄	20.4	0.42
Magnesium	Mg	30.8	Alkalinity(as CaCO ₃)		244	4.88
Strontium	Sr	0.10				
			Hardness(as CaCO ₃)		268	5.36
Copper	Cu	0.02				
Cadmium	Cd	0.00	Total dissolved minerals		291	
Chromium	Cr	0.00				
Lead	Pb	< 0.05				
Lithium	Li	0.00	Turbidity	Tr		
Nickel	Ni	< 0.05	Color	0		
Zinc	Zn	0.07	Odor	0		
Barium	Ba	<0.1				

SILOAM SPRINGS STATE PARK

Siloam Springs State Park, located 3 miles south of Kellerville, installed a public water supply in 1948. Although a portion of the park extends into Brown County, all of the wells are in Adams County. A large-diameter augered well serves the maintenance area and custodian's home; three drilled wells serve the park area. The average pumpage during the summer months is estimated to be about 1000 gpd. The water is chlorinated.

MAINTENANCE AREA WELL, finished in drift above bedrock, is 40-ft deep, 18 in. in diameter and cased with tile. This well is located 200 ft S of the custodian's house, approximately 1870 ft N and 1370 ft E of the SW corner of Section 13, T2S, R5W. The land surface elevation at the well is approximately 760 ft.

A Fairbanks-Morse jet pump is presently installed.

PARK WELL NO. 1, finished in limestone, was completed in August 1948 to a depth of 363 ft by the Quincy Well Drilling Co., Quincy. The well is located about 250 ft from the new shelter house, approximately 1100 ft N and 25 ft E of the SW corner of Section 13, T2S, R5W. The land surface elevation at the well is approximately 700 ft.

A drillers log of Park Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Soil	6	6
Clay yellow	34	40
Clay and sand	22	62
Shale	170	232
Shale and limestone	18	250
Limestone	113	363

The well is cased with 6-in. wrought iron pipe

from land surface to a depth of 63 ft. Below the 6-in. casing, the hole in bedrock is finished 5.6 in. in diameter to the bottom.

Upon completion, the well reportedly produced 10 gpm for 1 hr with a drawdown of 155 ft from a non-pumping water level of 108 ft below land surface.

The pumping equipment presently installed is a Red Jacket submersible pump set at 336 ft, rated at 45 gpm, and powered by a 3-hp electric motor.

PARK WELL NO. 2, finished in limestone, was completed in July 1958 to a depth of 335 ft by the Quincy Well Drilling Co., Quincy. The well is located at the camping area, approximately 1100 ft S and 350 ft W of the NE corner of Section 23, T2S, R5W. The land surface elevation at the well is approximately 700 ft.

A 6-in. diameter hole was drilled to a depth of 335 ft. The well is cased with 6-in. ID pipe from land surface to a depth of 139 ft.

A production test was conducted on July 23, 1958, by representatives of the driller, the State Water Survey, and the Department of Conservation. After 4 hr of pumping at a rate of 4 gpm, the drawdown was 135.8 ft from a nonpumping water level of 104.7 ft below the top of the casing. One hr after pumping was stopped, the water level had recovered to 159.0 ft.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump rated at 5 gpm and powered by a 1-hp electric motor.

PARK WELL NO. 3, finished in limestone, was completed in November 1968 to a depth of 430 ft by the Callihan Drilling Co., Pittsfield. The well is located 50 ft W of the new maintenance building, approximately 1870 ft N and 1520 ft E of the SW corner of Section 13, T2S, R5W. The land surface elevation at the well is approximately 750 ft.

An 8-in. diameter hole was drilled to a depth of 334 ft and finished 5 in. in diameter from 334 to 430 ft. The well is cased with 6-in. steel pipe from 1.5 ft

above land surface to a depth of 252 ft and with 5-in. steel pipe from 252 ft to 334 ft.

A drillers log of Park Well No. 3 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	180	180
Blue clay and lime	54	234
Sand and gravel	8	242
Blue shale	10	252
Warsaw lime and shale	50	302
Warsaw lime	32	334
Burlington lime	96	430

Upon completion the well reportedly produced 4.5 gpm for 2 hr with a drawdown of 162 ft from a nonpumping water level of 218 ft below the top of the casing. Forty-eight min after pumping was stopped, the water level had recovered to 249 ft.

The pumping equipment presently installed is a Fairbanks-Morse submersible pump set at 400 ft, rated at 5 gpm, and powered by a 1½-hp electric motor.

A partial analysis of a sample (Lab. No. 181688) collected May 19, 1970, showed the water to have a hardness of 148 mg/l, total dissolved minerals of 354 mg/l, and an iron content of 0.4 mg/l. Hydrogen sulfide also was apparent when this sample was collected.

The following mineral analysis (Lab. No. 186437) is for a water sample from the well collected August 17, 1971, after 20 min of pumping at 5 gpm.

PARK WELL NO. 3, LABORATORY NO. 186437

	mg/l	me/l		mg/l	me/l	
Iron	Fe	Tr	Silica	SiO ₂	6.7	
Manganese	Mn	0.00	Boron	B	0.3	
Ammonium	NH ₄	0.2	Fluoride	F	1.4	
Sodium	Na	97.0	Nitrate	NO ₃	0.2	0.00
Potassium	K	1.2	Chloride	Cl	58	1.64
Calcium	Ca	22.0	Sulfate	SO ₄	6.4	0.13
Magnesium	Mg	21.1	Alkalinity (as CaCO ₃)		264	5.28
Strontium	Sr	0.31				
			Hardness(as CaCO ₃)		142	2.84
Copper	Cu	0.00				
Cadmium	Cd	0.00	Total dissolved minerals		374	
Chromium	Cr	0.00				
Lead	Pb	<0.05				
Lithium	Li	0.02	Turbidity	0		
Nickel	Ni	<0.05	Color	0		
Zinc	Zr	0.23	0.01	Odor	0	

URSA

The village of Ursa (423) installed a public water supply in 1968. One well is in use. In 1968 there were 85 services, all metered; the average and maximum daily pumpages were 12,000 and 17,000 gpd, respectively. In 1971 there were 140 services, all metered; the average and maximum daily pumpages were 25,000 and 50,000 gpd, respectively. The water is chlorinated and fluoridated.

WELL NO. 1, finished in limestone, was completed in June 1966 to a depth of 200 ft by the J. B. Bushnell Well Drilling Co., Plymouth. The well is located adjacent

to the elevated tower about 260 ft W of Route 96 and 0.5 mile north of the village, approximately 166 ft S and 2911 ft W of the NE corner of Section 18, T1N, R8W. The land surface elevation at the well is approximately 610 ft.

A drillers log of Well No. 1 follows:

Formation	Thickness (ft)	Depth (ft)
Yellow clay	62	62
Limestone	138	200

A 10-in. diameter hole was drilled to a depth of 200

ft. The well is cased with 10-in. outer pipe from land surface to a depth of 64 ft and an 8-in. steel liner is installed from 1 ft above land surface to a depth of 95 ft. The annulus between the 10- and 8-in. casings and the 10-in. casing and bore hole was cement grouted.

A production test using two observation wells was conducted on June 21, 1966, by representatives of the driller, the State Water Survey, and Wm. H. Klingner & Associates, Engineers. After 1.6 hr of pumping at a rate of 80 gpm, the drawdown was 30.22 ft from a non-pumping water level of 15.55 ft below the top of the casing. Thirty min after pumping was stopped, the water level had recovered to 15.67 ft. Based on the production test data, it was estimated that this well would yield 60 gpm (86,500 gpd) on a long-term basis.

The pumping equipment presently installed is a Red Jacket submersible pump set at 70 ft, rated at 70 gpm (observed output), and powered by a 5-hp electric motor.

The following mineral analysis (Lab. No. 185939) is for a water sample from the well collected June 22, 1971, after 40 min of pumping at 80 gpm.

WELL NO. 1. LABORATORY NO. 185939

		mg/l	me/l			mg/l	me/l
Iron	Fe	Tr		Silica	SiO ₂	15.4	
Manganese	Mn	0.09		Boron	B	0.0	
Ammonium	NH ₄	Tr		Fluoride	F	0.5	
Sodium	Na	8.8	0.38	Nitrate	NO ₃	6.2	0.10
Potassium	K	0.5	0.01	Chloride	Cl	7	0.20
Calcium	Ca	73.2	3.65	Sulfate	SO ₄	22.6	0.47
Magnesium	Mg	26.1	2.15	Alkalinity (as CaCO ₃)		276	5.52
Strontium	Sr	0.14					
				Hardness(as; CaCO ₃)		290	5.80
Copper	Cu	0.01					
Cadmium	Cd	0.00		Total dissolved minerals		321	
Chromium	Cr	0.00					
Lead	Pb	<0.05		Turbidity		0	
Lithium	Li	0.00		Color		0	
Nickel	Ni	<0.05		Odor		0	
Zinc	Zn	0.01					

WEST HICKORY GROVE SUBDIVISION

West Hickory Grove Subdivision (est. 100), located 2 miles east of Quincy on Route 104, installed a public water supply in 1946. Three wells are in use. In 1959 there were 28 services, not metered; the average daily pumpage was estimated to be 3400 gpd. In 1972 there were 24 services, not metered; the average and maximum daily pumpages were reported to be 4000 and 5000 gpd, respectively. The water is not treated.

WELL NO. 1, finished in limestone, was completed in 1948 to a depth of 245 ft by Neiderhoff and Stevens, Quincy. The well is located 5 ft W of the new pump station at the west drive of the subdivision, approximately 1345 ft N and 270 ft E of the SW corner of Section 34, T1S, R8W. The land surface elevation at the well is approximately 740 ft.

The well is equipped with a pitless adapter from 1.5 ft above land surface to 4 ft and cased with 6-in. pipe to an estimated depth of 100 ft.

Because of loss of capacity in 1965, 80 lb of Calgon was added in an effort to regenerate the well; reportedly very little benefit resulted. In 1967 the well was acidized by local volunteer help and was reportedly restored to near original capacity.

The pumping equipment presently installed is a Jacuzzi submersible pump rated at 7 gpm at about 92 ft TDH and powered by a ¾-hp electric motor.

WELL NO. 2, finished in limestone, was completed in 1960 to a depth of 250 ft. The well is located about

300 ft N and 50 ft E of Well No. 1 on private property, approximately 1645 ft N and 320 ft E of the SW corner of Section 34, T1S, R8W. The land surface elevation at the well is approximately 745 ft.

The well is equipped with a pitless adapter from 1.5 ft above land surface to 4 ft and cased with 6-in. pipe to an estimated depth of 100 ft.

The pumping equipment presently installed is a Jacuzzi submersible pump rated at 10 gpm at about 92 ft TDH and powered by a ¾-hp electric motor.

WELL NO. 3, finished in limestone, was completed in April 1967 to a depth of 260 ft by the Callihan Drilling Co., Pittsfield. The well is located 250 ft W and 75 ft N of Well No. 1 on private property, approximately 20 ft E and 1420 ft N of the SW corner of Section 34, T1S, R8W. The land surface elevation at the well is approximately 745 ft.

A drillers log of Well No. 3 follows:

Formation	Thickness (ft)	Depth (ft)
Drift	90	90
Limestone	160	250
Keokuk-Burlington lime and shale	10	260

An 8-in. diameter hole was drilled to a depth of 92 ft and finished 6 in. in diameter from 92 to 260 ft. The well is equipped with a 6-in. pitless adapter from 0.8 ft above land surface to 3 ft, and cased with 6-in. pipe to a depth of 92 ft. At 92 ft a drive shoe was placed to seal off the annulus between the 10-in. bore hole and 6-in.

casing. The upper 15 ft of the annulus between the 6-in. casing and bore hole is filled with cement grout.

Upon completion the well reportedly produced 10 gpm for 2 hr with a drawdown of 130 ft from a nonpumping water level of 100 ft below the top of the casing.

The pumping equipment presently installed is a 14-stage Jacuzzi submersible pump set at 250 ft, rated at 8.9 gpm at about 92 ft TDH, and powered by a ¾-hp 3450 rpm electric motor.

The following mineral analysis (Lab. No. 186228) is for a water sample from the well collected July 19, 1971, after 30 min of pumping at 6 gpm.

WELL NO. 3, LABORATORY NO. 186228

		mg/l	me/l			mg/l	me/l
Iron	Fe	0.9		Silica	SiO ₂	6.7	
Manganese	Mn	0.00		Boron	B	0.1	
Ammonium	NH ₄	Tr	Tr	Fluoride	F	0.4	
Sodium	Na	19.3	0.84	Nitrate	NO ₃	1.3	0.02
Potassium	K	0.9	0.02	Chloride	Cl	3	0.08
Calcium	Ca	85.6	4.27	Sulfate	SO ₄	14.8	0.31
Magnesium	Mg	32.7	2.69	Alkalinity (asCaCO ₃)		368	7.36
Strontium	Sr	0.31	0.01				
				Hardness (as CaCO ₃)		348	6.96
Copper	Cu	0.01					
Cadmium	Cd	0.00		Total dissolved minerals		373	
Chromium	Cr	0.00					
Lead	Pb	<0.05					
Lithium	Li	0.01		Turbidity		3	
Nickel	Ni	<0.05		Color		0	
Zinc	Zn	0.24	0.01	Odor		0	