BULLETIN NO. 21 1938
SUPPLEMENT I

STATE OF ILLINOIS
HENRY HORNER, Governor

SUPPLEMENT I

TO

BULLETIN 21

DEPARTMENT OF REGISTRATION AND EDUCATION
J. J. HALLIHAN, Director

STATE WATER SURVEY DIVISION
A. M. BUSWELL, Chief

URBANA, ILLINOIS

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ISSUED BY

STATE WATER SURVEY DIVISION

A. M. BUSWELL, Chief

URBANA, ILLINOIS

ORGANIZATION

STATE OF ILLINOIS
HENRY HORNER, *Governor*

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STATE WATER SURVEY DIVISION

A. M. BUSWELL, *Chief*

(66590)

PREFACE.

In 1925 this division published a compilation and summary of data on water supplies which it had accumulated in its files over a period of thirty years. This publication was entitled "Bulletin 21, Public Ground Water Supplies in Illinois" and included data on wells. well yields, material penetrated in drilling and chemical analyses of water from the various sources. The report covered 398 municipal well water supplies and listed 99 municipalities that obtained water from surface sources. It comprised some 710 pages.

At the time of the issue of Bulletin 21 we planned to make subsequent additions in the form of supplements rather than to revise the entire publication to include the new data. With this plan in mind a large edition (2500 copies) of Bulletin 21 was issued. There are two reasons for adopting such a plan. First, there is no reason for eliminating data on abandoned supplies as would be done in a revision. In fact such data are always of importance in planning for increase or change in the existing supply. Second, the cost of revising and reprinting all the old material together with the new data would be about three times as great as that of printing supplements from time to time.

The page numbers in supplements are continuous with those of the original bulletin and water supplies are listed alphabetically under the name of the town or city. In looking up information on a given supply the reader will refer to the latest supplement. Following the name of the town will be the population as of 1930, next a page reference to the data on that supply given in earlier volumes in the series, then follows a summary of data collected on the supply since the last previous publication in the series.

In preparing Supplement I an attempt has been made to bring the information on all supplies up to date about July 1938. This has not been possible in all cases. We shall welcome corrections or additions. The number of municipalities with public water supplies at that time had increased to 625 and consisted of 453 well water supplies and 172 surface water supplies.

In checking changes and in extensions to public ground water supplies much assistance has been given by the Chief Sanitary Engineer of the Department of Public Health and his assistants. The publication "Data on Illinois Public Water Supplies" prepared by the State Department of Public Health has been freely used in preparing this material. Well logs and geologic data have been furnished by Mr. L. E. Workman of the State Geological Survey.

Municipal officials, employees of municipalities, well drillers, and engineers who have made investigation of water supplies have kindly given us much valuable information. There have been so many changes in personnel of officials and persons employed by them that it is impossible to give credit here to each one excepting in the case of well drillers. When data are given in regard to a well the name of the driller is given when known.

Every engineer employed by the State Water Survey since it was organized has had a part in the collection of data which appears in this bulletin, and every chemist of the Survey has had a part in the collection of data or in the analyses of waters.

A. M. BUSWELL, *Chief.*

ABINGDON (2771) (p. 13). In 1928 a new well was drilled by Thorpe Brothers of Des Moines, Iowa. It is located about 50 feet south of the 1350-foot well. It is 2580 feet deep and 8 inches in diameter at the bottom. It is cased with 16-inch pipe to a depth of 303 feet, with 10-inch pipe from 300 to 1441 feet, and with 8-inch pipe from 2410 to 2440 feet. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
No record	130	130
Coal measures	60	190
Limestone, Burlington	120	310
Shale, Kinderhook	270	580
Limestone, Devonian	50	630
Dolomite, Silurian	90	720
Shale, Maquoketa	180	900
Dolomite, Galena-Platteville	310	1210
Sandstone, St. Peter	200	1410
Dolomite, Shakopee	220	1630
Dolomite, New Richmond	100	1730
Dolomite, Oneota	210	1940
Dolomite, Jordan	10	1950
Dolomite, Trempealeau	290	2240
Dolomite, shale, Mazomanie	200	2440
Sandstone, Dresbach	140	2580

The elevation of the ground surface at the well is about 742 feet above sea level.

The water level was at a depth of 177 feet when not pumping and was lowered 17 feet by a pumping rate of 623 gallons per minute. The well was tested when only 1441 feet deep, and yielded about 216 gallons per minute with a draw down of 48 feet. At that time the temperature of the water was 70° F. After the well had been deepened the temperature of the water was 77° F.

The chemical quality of the water from the finished well was similar to that of the water pumped when the well was 1441 feet deen. The water had a total residue of 1333, a total hardness of 353.5. and a content of iron of 0.4 parts per million as shown by the analysis of sample number 71479, collected August 9, 1932.

Analysis of Sample Number 71479 from Well 2580 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.4	Sodium Nitrate	$NaNO_3$	2.6	.2
Manganese	Mn	0.0	Sodium Chloride	NaCl	235.6	13.7
Silica	SiO_2	12.0	Sodium Sulfate	Na_2SO_4	633.2	37.0
Turbidity		3.0	Ammonium Sulfate	$(NH_4)_2SO_4$	3.3	.2
Calcium	Ca	82.0	Magnesium Sulfate	$MgSO_4$	148.7	8.7
Magnesium	Mg	36.1	Magnesium Carbonate	$MgCO_3$	21.1	1.2
Ammonium	NH_4	1.0	Calcium Carbonate	$CaCO_3$	205.1	12.6
Sodium	Na	298.8	Iron Oxide	Fe_2O_3	.6	.1
Sulfate	SO_4	549.8	Silica	SiO_2	12.0	.7
Nitrate	NO_3	1.6				
Chloride	Cl	142.8	Total		1,262.2	73.8
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		230.0				
Residue		1,333.0				
Total Hardness		353.5				

The well is equipped with a Peerless turbine pump having 206 feet of 6-inch column pipe, 7 feet of bowls, and 20 feet of suction pipe. The pump is direct-connected to a 40-horsepower electric motor. Water is pumped to a concrete reservoir and thence, by means of centrifugal pumps, to an elevated tank connected to the distribution system.

ADDISON (916). Addison is situated in the northeastern part of DuPage County. Water for the public supply, installed by the village in 1925, is secured from a well and is pumped directly into the distribution system to which a 30,000-gallon steel elevated tank is connected.

The well, 152 feet deep, located in the business area on the south side of Lake Avenue, was drilled in 1924 by George A. Morris. Casing 10 inches in diameter extends from the surface to rock at a depth of 90 to 95 feet, the balance of the hole being in rock. It was reported, upon completion of the well, that static water level was 18 feet below ground surface, and at the end of 10 hours of pumping at a rate of 150 gallons per minute it was lowered only 2 feet.

The well is equipped with a Keystone Driller Company double-acting deep-well cylinder pump. The cylinder has an inside diameter of 5¾ inches and a stroke of 18 inches. It is set 75 feet below the top of the well. A length of suction pipe is attached to the bottom of the cylinder. The speed is 35 to 36 revolutions per minute.

The pump is powered by a 15-horsepower electric motor. The average total pumpage is about 30,000 gallons per day. There are 110 services, all of which are metered.

The water had a total residue of 421, a total hardness of 359, and an iron content of 0.5 parts per million as shown by the analysis of sample number 80168, collected January 16, 1934.

Analysis of Sample Number 80168 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.5	Sodium Nitrate	$NaNO_3$	.8	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	8.2	.48
Silica	SiO_2	11.0	Sodium Sulfate	Na_2SO_4	64.6	3.77
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.3	.08
Calcium	Ca	76.7	Magnesium Carbonate	$MgCO_3$	120.3	7.02
Magnesium	Mg	40.8	Magnesium Sulfate	$MgSO_4$	30.1	1.76
Ammonium	NH_4	.3	Calcium Carbonate	$CaCO_3$	191.5	11.18
Sodium	Na	24.4	Iron Oxide	Fe_2O_3	.7	.04
Sulfate	SO_4	68.7	Silica	SiO_2	11.0	.64
Nitrate	NO_3	.9				
Chloride	Cl	5.0	Total		428.5	25.02
Alkalinity as $CaCo_3$						
Phenolphthalein		0.0				
Methyl Orange		334.0				
Residue		421.0				
Total Hardness		359.0				

ALBION (1666). Water for the public supply of the city of Albion is obtained from Bonpas Creek. The water is treated before entering the distribution system.

ALEDO (2203) (p. 14). A new well was drilled in 1925 by the F. M. Gray Drilling Company of Milwaukee. It is 1172 feet deep and 8 inches in diameter at the bottom. It is located across the street from the old well. It is cased with 16-inch pipe to a depth of 259¾ feet, with 12-inch pipe from 541½ to 635 feet, with 10-inch pipe from 635 to 835 feet and with 8-inch pipe from 984 to 1109 feet. The lower part of the 8-inch casing is perforated. The elevation of the ground surface is about 736 feet above sea level. A record of material penetrated with classifications by P. T. Thwaites is as follows:

	Thickness in feet.	Depth in feet.
Drift	105	105
Coal measures	155	260
Devonian	168	428
Niagaran	132	560
Richmond	183	743
Galena-Black River	322	1065
St. Peter	45	1110
Magnesian	62	1172

The water level was reported to be at a depth of 146 feet when not pumping and was lowered 26½ feet by a pumping rate of 500 gallons per minute. In 1932 the water level was reported to be at a depth of 166 feet when not pumping.

The well is equipped with an 8-inch, 11-stage Layne turbine pump having 200 feet of column pipe and 10 feet of suction pipe.

The water had a total residue of 1244, a total hardness of 224, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 57791, collected November 29, 1926.

An analysis made in 1932 showed the total residue to be 1259, and the total hardness to be 290 parts per million.

Analysis of Sample Number 57791 from Well 1,172 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	0.3	0.02
Manganese	Mn	0.0	Potassium Chloride	KCl	44.0	2.57
Silica	SiO_2	8.6	Sodium Chloride	NaCl	215.7	12.61
Nonvolatile		3.0	Sodium Sulfate	Na_2SO_4	729.5	42.66
Alumina	Al_2O_3	1.7	Sodium Carbonate	Na_2CO_3	34.0	1.99
Calcium	Ca	50.3	Ammonium Carbonate	$(NH_4)_2CO_3$	1.1	0.06
Magnesium	Mg	24.0	Magnesium Carbonate	$MgCO_3$	82.3	4.81
Ammonium	NH_4	0.4	Calcium Carbonate	$CaCO_3$	124.3	7.26
Sodium	Na	339.7	Silica	SiO_2	8.6	0.50
Potassium	K	23.5	Iron Oxide	Fe_2O_3	0.1	0.01
Sulfate	SO_4	487.2	Alumina	Al_2O_3	1.7	0.10
Nitrate	NO_3	0.2	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	150.0	Nonvolatile		3.0	0.17
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		1,244.6	72.76
Methyl Orange		252.0				
Residue		1,244.0				
Total Hardness		224.0				

ALEXIS (786) (p. 16). No reported change has been made in the source of water supply at Alexis. Analysis of sample number 66662, collected on June 11, 1930, indicated an increase in the iron content

and total mineral content since 1923. The water had a total residue of 1118, a total hardness of 292, and an iron content of 2.6 parts per million as shown by this analysis.

Analysis of Sample Number 66662 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	2.6	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	222.7	13.00
Turbidity		20.0	Sodium Sulfate	Na_2SO_4	610.5	35.62
Silica	SiO_2	14.0	Ammonium Sulfate	$(NH_4)_2SO_4$	4.0	0.23
Calcium	Ca	67.4	Magnesium Sulfate	$MgSO_4$	36.2	2.11
Magnesium	Mg	29.9	Magnesium Carbonate	$MgCO_3$	78.8	4.60
Ammonium	NH_4	1.0	Calcium Carbonate	$CaCO_3$	168.6	9.84
Sodium	Na	285.5	Silica	SiO_2	14.0	0.82
Sulfate	SO_4	445.0	Iron Oxide	Fe_2O_3	3.7	0.22
Nitrate	NO_3	0.62	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	135.0				
Alkalinity as $CaCO_3$			Total		1,139.4	66.49
Phenolphthalein		0.0				
Methyl Orange		262.0				
Residue		1,118.0				
Total Hardness		292.0				

ALGONQUIN (866) (p. 17). No reported change.

ALPHA (403) (p. 18). The village of Alpha secures water from the 1364-foot well described on page 19. The deep-well pump was replaced by an air-lift system sometime between 1925 and 1928. This change eliminated the objectionable odors from the water.

The air lift consists of 530 feet of 3-inch discharge pipe and a 1-inch air line outside of the discharge pipe. In 1928 the starting pressure was about 135 pounds per square inch and the operating pressure was about 133 pounds per square inch. The air-lift delivered about 78 gallons per minute and the water level in the well was lowered 10 feet to a depth of 231 feet.

The air-lift discharges into a concrete reservoir located under the pumping station which holds approximately 20,000 gallons. Water is pumped from the reservoir to the elevated tank and distribution system by a single-stage Fairbanks-Morse centrifugal pump, rated at 125 gallons per minute, driven by a 7½-horsepower electric motor.

There are about 125 metered service connections. The daily use is between 10,000 and 13,000 gallons. The minimum water rate is $2.00 per quarter and includes 4000 gallons of water. All additional water is sold at a rate of 50 cents per 1000 gallons.

ALTAMONT (1225) (p. 20). The two wells which furnished the public supply in 1924 and described on page 22 have been abandoned. Also a well constructed by F. Thorpe in 1926 and four wells constructed by Earl C. Baker in 1931 have been abandoned.

Since 1935 the public water supply has been obtained from an impounding reservoir. The water is treated before entering the distribution system.

ALTON (30,151) (p. 708). The raw water supply of Alton is obtained from Mississippi River. The water is treated before entering the distribution system.

AMBOY (1972) (p. 24). Well number 2 was drilled in 1924 by E. Stephenson of Chicago. It is located 50 feet southeast of well number 1. It is reported to be 1100 feet deep and 6 inches in diameter at the bottom. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	21	21
Dolomite, Galena-Platteville	159	180
Sandstone, Glenwood	75	255
Sandstone, St. Peter	100	355
Dolomite, Shakopee	40	395
Sandstone, dolomite, New Richmond	70	465
Dolomite, Oneota	155	620
Dolomite, Jordan	5	625
Dolomite, sandstone, Trempealeau	200	825
Dolomite, sandstone, Franconia	120	945
Sandstone, Dresbach	155	1100

The elevation of the ground surface is about 750 feet above sea level.

In 1933 the water level was at a depth of 23.25 feet below the top of the casing and was lowered 12.75 feet by a pumping rate of 190 gallons per minute when delivering into the distribution system against 107-foot head. When delivering into the old reservoir at ground level a discharge of 480 gallons per minute was observed.

The well is equipped with a 6-stage American deep-well turbine pump set at a depth of 120 feet and driven by a 40-horsepower electric motor.

The water had a total residue of 405, a total hardness of 400, and a content of iron of 0.9 parts per million as shown by the analysis of sample number 73,392, collected August 15, 1933.

Analysis of Sample Number 73392 from Well 1100 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron....Fe	0.9	Sodium Nitrate....$NaNO_3$	0.9	0.05
Manganese..Mn	0.0	Sodium Chloride....NaCl	18.1	1.06
Silica....SiO_2	10.0	Sodium Sulfate....Na_2SO_4	7.8	0.46
Turbidity....	0.0	Ammonium Sulfate....$(NH_4)_2SO_4$	1.3	0.08
Calcium....Ca	88.0	Magnesium Sulfate....$MgSO_4$	28.3	1.65
Magnesium..Mg	43.8	Magnesium Carbonate..$MgCO_3$	132.0	7.70
Ammonium..NH_4	0.4	Calcium Carbonate....$CaCO_3$	203.5	11.88
Sodium....Na	9.9	Calcium Silicate....$CaSiO_3$	19.3	1.13
Sulfate....SO_4	29.0	Iron Oxide....Fe_2O_3	1.3	0.08
Nitrate....NO_3	0.3			
Chloride....Cl	11.0	Total....	412.5	24.09
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	360.0			
Residue....	405.0			
Total Hardness....	400.0			

Measurements made in 1932 indicated that well number 1 had filled up to a depth of 357½ feet or had become bridged at that depth. A recent report stated that this well was not in use.

ANNA (3436) (p. 26). A new well was drilled for the Central Illinois Public Service Company in 1929 by the Sewell Well Company of St. Louis. It is located about 300 feet west of the old well and is 650 feet deep. It is cased with 16-inch pipe to a depth of 123 feet, with 12-inch pipe from the surface to 174 feet, with 10-inch pipe from the surface to 167 feet, and with 8-inch pipe from 167 to 252 feet. A 4-foot hook-wall packer is used at the bottom of the 8-inch casing. The diameter at the bottom of the well is 10 inches. A record of material penetrated, with classifications by the State Geological Survey Division is as follows:

	Thickness in feet.	Depth in feet.
Clay, gravelly	100	100
Limestone, Ste. Genevieve	115	215
Limestone, St. Louis	365	580
Limestone, Salem	70	650

The water level was at a depth of 110 feet when not pumping and was lowered 80 feet by pumping at a rate of 300 gallons per minute. A large amount of mud was pumped from the well and several months elapsed before this condition was completely eliminated. It was necessary to clean the reservoir and elevated tank frequently.

The well is equipped with a 9-stage Fairbanks-Morse turbine pump with the bottom of the bowls at a depth of 195 feet. A 20-foot length of suction pipe is attached to the bowls.

The quality of water from this well was similiar to that of water from the old well.

In 1934 the city undertook to secure a supply of water from municipally-owned wells. Two wells were drilled near the city hospital in the western part of town. One of these was 745 feet deep. Neither well produced much water. Both wells were abandoned before being completed because of extremely bad drilling conditions.

A new location was selected and two wells, numbers 1A and 2A, were drilled in 1935-1936 by the Sewell Well Company of St. Louis. These wells are located in the northeastern part of the city and are about 1000 feet apart. Well number 1A is 1031 feet deep and is cased to a depth of 100 feet with 16-inch pipe. Well number 2A, located northwest of number 1A, is 1038 feet deep. The surface elevations of 1A and 2A are respectively 595.4 and 581.4 feet above sea level.

These two wells were tested simultaneously for a period of 33 hours. Well number 1A yielded 320 gallons per minute with a draw down of 294 feet from a static level of 71½ feet. Well number 2A yielded 80 gallons per minute with a draw down of 350 feet from a static level of 58 feet. Well number 1 of the Public Service Company was not being pumped during this test, but the water level was lowered 10½ feet by pumping the city wells. It is located about 2200 feet from the city wells.

Water from well number 1A had a mineral content of 332, a total hardness of 239, and a content of iron of 4.0 parts per million as shown by the analysis of sample number 78082, collected May 22, 1936. Water from well number 2A had a mineral content of 420, a total hardness of 332.5, and a content of iron of 20.0 parts per million as shown by the analysis of sample number 78083, collected May 22, 1936.

The city purchased the two wells owned by the Public Service Company. An attempt was made to ream and straighten the older well, but a shifting rock formation made it necessary to abandon the hole. An attempt was then made to drill a new well about 300 feet farther east, but similar conditions were encountered and the hole was abandoned. In 1938 another attempt was being made to drill a new well nearby. Drilling was reported to be very difficult.

Water is now obtained from the three successful wells described above and is treated in a softening plant which was constructed in 1937.

Well number 1A is equipped with a Pomona turbine pump rated at 375 gallons per minute and driven by a 50-horsepower electric motor. Well number 2A is equipped with a Pomona turbine pump rated at 75 gallons per minute and driven by a 25-horsepower electric motor. Water is pumped from the treatment plant by three Fairbanks-Morse centrifugal pumps driven by electric motors. The largest of these can also be driven by a 75-horsepower gasoline engine.

Analysis of Sample Number 78082 from Well 1031 Feet Deep.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	4.0
Manganese..Mn	0.0
Silica.....SiO_2	11.0
Turbidity.....	70.0
Odor.....	M 1
Calcium.....Ca	67.0
Magnesium..Mg	17.4
Sodium.....Na	30.4
Sulfate.....SO_4	22.8
Nitrate.....NO_3	4.9
Chloride.....Cl	19.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	250.0
Residue.....	332.0
Total Hardness....	239.0

Hypothetical Combinations.

	Pts. per million.	Grs. per gallon.
Sodium Nitrate.....$NaNO_3$	6.8	0.40
Sodium Chloride.....NaCl	31.5	1.84
Sodium Sulfate.....Na_2SO_4	34.1	1.99
Sodium Carbonate.....Na_2CO_3	11.7	0.68
Magnesium Carbonate..$MgCO_3$	60.3	3.52
Calcium Carbonate.....$CaCO_3$	167.5	9.75
Silica.....SiO_2	11.0	0.64
Total.....	322.9	18.82

Analysis of Sample Number 78083 from Well 1038 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe (filtered).....	0.0	Sodium Nitrate.....	$NaNO_3$	8.5	0.49
(unfiltered).....	20.0	Sodium Chloride.....	NaCl	29.8	1.74
Manganese..Mn	0.0	Magnesium Chloride....	$MgCl_2$	36.2	2.11
Silica.....SiO_2	10.0	Magnesium Sulfate.....	$MgSO_4$	56.0	3.26
Turbidity.....	300.0	Magnesium Carbonate..	$MgCO_3$	16.4	0.96
Odor.....	M 2	Calcium Carbonate.....	$CaCO_3$	228.5	13.32
Calcium.....Ca	91.4	Silica.....	SiO_2	10.0	0.58
Magnesium..Mg	25.3				
Sodium.....Na	14.0	Total.....		385.4	22.48
Sulfate.....SO_4	44.8				
Nitrate.....NO_3	6.2				
Chloride.....Cl	45.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	248.0				
Residue.....	420.0				
Total Hardness....	332.5				

ANTIOCH (1101) (p. 27). The source of the water supply remains as previously reported.

During 1932 the old Goulds deep-well pumping unit in well number 1 (north well) was replaced by a Sterling deep-well turbine pump. The assembly of this unit consists of 100 feet of 4-inch column pipe, five stages or 24 inches of 6-inch turbine and 30 feet of 4-inch suction pipe with strainer. The pump is direct connected to a U. S. Electric Company, overhead, 15-horsepower electric motor operating on 3-phase, 60-cycle, 220-volt current. The normal speed is 3600 revolutions per minute and the full load speed is 3450 revolutions per minute.

Static water level, at the time of the new installation, was 40 feet below station floor. The pump was designed to deliver 100 to 120 gallons per minute against 45 pounds pressure. Static and pumping water levels may be measured by means of a ¼-inch air-pipe line that extends to the top of the bowl assembly or 100 feet below the pump base.

During 1937 the village removed the old Luitwieler pump from well number 2 (south well) and replaced it with a Sterling deep-well turbine pump. The assembly consists of 100 feet of 5-inch column pipe, five stages or 8 feet of 6-inch turbine, and 20 feet of 4-inch suction pipe with a strainer one foot long on the bottom. The pump is designed to deliver 200 gallons per minute against a total head of 200 feet. The pump is direct connected to a 20-horsepower vertical motor requiring 3-phase, 60-cycle, 220-volt current. It has a normal speed of 3600 revolutions per minute.

AECOLA (1686) (p. 29). No record of change.

AELINGTON (258) (p. 32). No reported change.

The water has a total residue of 374, a total hardness of 310.5, and an iron content of 0.32 parts per million as shown by the partial analysis of sample number 83696, collected June 6, 1938.

ARLINGTON HEIGHTS (4997) (p. 33). In 1932 the water supply was obtained from five wells, four of which ranged in depths from 47 feet to 147 feet. The fifth well, number 4, had a depth of 251 feet. This well was deepened by Henry Boysen of Libertyville in 1934. Total depth is now 923 feet. It is 12 inches in diameter to 455 feet and 10 inches in diameter below that depth. From ground surface to 161 feet the casing is 12 inches in diameter. A 10-inch liner is set between depths of 243 and 455 feet, and an 8-inch liner between depths of 471 and 625 feet. Elevation of the ground surface at the well site is 725 feet above sea level.

A log of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Blue Clay	145	145
Sand and gravel	16	161
Limestone	84	245
No record	6	251
Shale, some dolomite	199	450
Limestone, Galena-Platteville	295	745
Limestone, Glenwood	10	755
Sandstone, Glenwood	60	815
Sandstone, St. Peter	108	923

After deepening, the water stood at a depth of 102 feet when not pumping. A pumping rate of 450 gallons per minute lowered the water level to a point 265 feet below the surface.

The well is equipped with a 10-inch Cook deep-well turbine pump with the bottom of the 20-foot suction pipe at a depth of 333 feet. The pump is driven by a 50-horsepower electric motor.

Water from this well had a total residue of 644, a total hardness of 271, and a content of iron of 1.5 parts per million as shown by the analysis of sample number 75438, collected December 4, 1934.

Analysis of Sample Number 75438 from Village Well Number 4.

Determinations Made.

	Pts. per million.
Iron....Fe	
(filtered).....	0.0
(unfiltered).....	1.5
Manganese..Mn	0.0
Silica.....SiO_2	7.0
Turbidity.....	75.0
Calcium.....Ca	49.8
Magnesium..Mg	35.6
Ammonium..NH_4	0.3
Sodium.....Na	107.9
Sulfate.....SO_4	340.0
Nitrate.....NO_3	1.9
Chloride.....Cl	11.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	136.0
Residue.....	644.0
Total Hardness....	271.0

Hypothetical Combinations.

		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	2.6	0.15
Sodium Chloride.....	NaCl	18.1	1.06
Sodium Sulfate.....	Na_2SO_4	309.0	18.01
Ammonium Sulfate.....	$(NH_4)_2SO_4$	1.3	0.08
Magnesium Sulfate.....	$MgSO_4$	162.5	9.48
Magnesium Carbonate..	$MgCO_3$	9.7	0.56
Calcium Carbonate.....	$CaCO_3$	124.6	7.27
Silica.....	SiO_2	7.0	0.41
Total.....		634.8	37.02

At times some water has been purchased from the American National Jockey Club. This club has a well, 320 feet deep, which is

seldom used, and also a well, 920 feet deep, which penetrates the St. Peter sandstone and is pumped at a rate of 350 gallons per minute.

ARTHUR (1361) (p. 35). Arthur obtains water from a well located at the east end of South Second Street. The well was drilled by A. D. Cook, Inc. of Lawrenceburg, Indiana in 1938. It is 88 feet deep and 10 inches in diameter. A 10-inch brass tube strainer with the top 7 feet cut with number 60 slots and the bottom 9 feet cut with number 10 slots is installed in the well. The well is equipped with an 8-inch Cook turbine pump rated at 120 gallons per minute against a head of 180 feet. The pump assembly consists of 50 feet of 5-inch column pipe, seven stages, and 15 feet of 5-inch suction pipe. The pump is driven by a 15-horsepower U. S. electric motor. The static water level was reported to be 16 feet from the top of the 10-inch pipe or 12 feet 10 inches below the ground surface. The draw down was reported to be 50 feet after pumping at an average rate of 198 gallons per minute for 24 hours. The well was drilled to a depth of 88 feet but the bottom 10 feet were through dry blue clay and the well was back-filled to a depth of 78 feet.

Water is pumped from the well to the distribution system and the 50,000-gallon elevated tank. There are about 250 service connections. The average daily consumption is about 17,500 gallons. The rates are as follows:

Minimum is 75 cents per month.
50 cents per 1000 gallons for less than 300 gallons per day.
42 cents per 1000 gallons from 300 to 1000 gallons per day.
55 cents per 1000 gallons from 1000 to 20,000 gallons per day.

The water had a total residue of 520, a total hardness of 264, and an iron content of 2.2 parts per million as shown by the analysis of sample number 84222, collected on September 6, 1938.

Analysis of Sample Number 84222 from Village Well Drilled in 1938.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.5	0.15
(filtered)		0.7	Sodium Chloride	NaCl	13.4	0.78
(unfiltered)		2.2	Sodium Carbonate	Na_2CO_3	198.2	11.56
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	4.8	0.28
Turbidity		8	Magnesium Carbonate	$MgCO_3$	105.4	6.14
Color		25	Calcium Carbonate	$CaCO_3$	139.1	8.11
Odor		Os-1	Iron Oxide	Fe_2O_3	1.0	0.06
Silica	SiO_2	19.0	Silica	SiO_2	19.0	1.11
Calcium	Ca	55.7				
Magnesium	Mg	30.4	Total		483.4	28.19
Ammonium	NH_4	1.9				
Sodium	Na	92.0				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.7				
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		456.0				
Residue		520.0				
Total Hardness		264.0				

The three wells described on page 35 are filled and abandoned. The reservoir is no longer used.

In 1928 Meister Bros of Tuscola drilled an 8-inch well 329 feet deep for the city. This well is located about 50 feet east of the original wells. A log of the well prepared by the State Geological Survey indicates 137 feet of glacial drift with sand and gravel between depths of 85 feet and 110 feet, and between 127 feet and 137 feet. Water is obtained from sandstone encountered between depths of 249 feet and 329 feet. This well is not equipped with a pump but the hole is open. It has not been used since 1933.

The water had a total residue of 2180, a total hardness of 20.1, and an iron content of 0.3 parts per million as shown by the analysis of sample number 63414, collected on January 21, 1929.

Analysis of Sample Number 63414 from 329-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.3	Sodium Nitrate	$NaNO_3$	0.8	.04
Manganese	Mn	0.1	Sodium Chloride	NaCl	1,428.0	83.49
Turbidity		5	Sodium Carbonate	Na_2CO_3	696.0	40.70
Silica	SiO_2	12.0	Ammonium Carbonate	$(NH_4)_2CO_3$	3.4	.20
Calcium	Ca	4.6	Magnesium Carbonate	$MgCO_3$	7.2	.42
Magnesium	Mg	2.1	Calcium Carbonate	$CaCO_3$	11.6	.68
Ammonium	NH_4	1.3	Silica	SiO_2	12.0	.70
Sodium	Na	863.8	Iron Oxide	Fe_2O_3	0.4	.02
Sulfate	SO_4	0.0	Manganese Oxide	MnO	0.1	.01
Nitrate	NO_3	0.5				
Chloride	Cl	866.0	Total		2,159.5	126.26
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		680.0				
Residue		2,180.0				
Total Hardness		20.1				

In 1933 Mike Ebert of Washington drilled an 8-inch well 85 feet deep at a point 15 feet north of the 329-foot well. Two 5-inch wells were drilled adjacent to the 8-inch well and 18 tons of screened gravel were introduced around the 8-inch well. A 10-foot length of screen is installed in the well. It is reported that the static water level was 12 feet below the ground and that the water was drawn down to a depth of 24 feet when pumping at a rate of 70 gallons per minute. The well is equipped with a size 7⅝-inch Cook turbine pump rated at 100 gallons per minute. The pump assembly consists of 60 feet of 4-inch column pipe, seven bowls measuring about 8 feet over-all and 10 feet of suction pipe. The pump is driven by a 10-horsepower U. S. electric motor. This well has not been used since the first of August, 1938. At that time the water was drawn down to the bottom of the pump suction pipe and the discharge was intermittent.

In 1936 R. E. Milaeger of Milwaukee, Wisconsin drilled a 20-inch by 8-inch gravel-packed well 85 feet deep for the city. A. D. Cook, Inc. was general contractor. The well is located in the east end of the old pumping station about 50 feet south of the 329-foot well. A 10-foot length of screen is installed in the well. The pump now installed in the South Second Street well was formerly installed in this well. The well was used for about 1½ years and was abandoned when the pump discharge became intermittent.

ASHLAND (1007). Ashland is located near the southeast corner of Cass County on the drainage area of Indiana Creek, a tributary of Illinois River. A public water supply was installed in 1936. Three wells about 50 feet apart were drilled in the valley of Little Indian Creek about two miles southwest of the village by C. O. Eobertson of Indiana.

Well number 1 was drilled in 1935. It is 26 feet deep, 18 inches in diameter, and is surrounded by a gravel wall 9 inches thick. A Cook screen, with slots 3/16-inch wide, is in place between depths of 12 and 21 feet. Water stood at a depth of 2 feet below the surface. Pumping at a rate of 88 gallons per minute lowered the water level to a point 12 feet 10 inches below the surface.

The other wells are of similar construction and of approximately the same depth. The three wells are connected with a common suction pipe and are pumped by either of two Fairbanks-Morse duplex piston pattern pumps having 4-inch pistons and 6-inch strokes. Each pump is connected by an enclosed chain drive to a 10-horsepower electric motor. In ease of emergency both pumps can be driven by a 4-cylinder gasoline engine. The pumping equipment is set below ground level and is housed by a small brick building near the wells.

Water is pumped from the wells to a treatment plant in the southwestern part of the city where it passes over an aerator into a collecting basin, then through a pressure filter and a zeolite softener. From the softener it is discharged into the distribution system, to which is connected a 60,000-gallon elevated steel tank. The service pump is a Fairbanks-Morse centrifugal pump driven by a 7½-horsepower electric motor.

The raw water had a total residue of 548, *a* total hardness of 524, and a content of iron of 1.3 parts per million as shown by the analysis of sample number 82362, collected November 13, 1937.

Analysis of Sample Number 82362 from City Wells.

Determinations Made.		Pts. per million	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	.10
(filtered)		0.0	Sodium Chloride	NaCl	18.1	1.05
(unfiltered)		1.3	Magnesium Chloride	$MgCl_2$	8.1	.47
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	105.4	6.14
Silica	SiO_2	14.0	Magnesium Carbonate	$MgCO_3$	112.2	6.54
Turbidity		10.0	Calcium Carbonate	$CaCO_3$	295.0	17.20
Color		0.0	Silica	SiO_2	14.0	.82
Odor		0.0				
Calcium	Ca	118.0	Total		554.5	32.32
Magnesium	Mg	55.6				
Ammonium	NH_4	trace				
Sodium	Na	7.6				
Sulfate	SO_4	84.1				
Nitrate	NO_3	1.1				
Chloride	Cl	17.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		428.0				
Residue		548.0				
Total Hardness		524.0				

ASHTON (868) (p. 36). No reported change.

ASSUMPTION (1554) (p. 38). The cluster of nine wells from which Assumption obtained its water supply in 1923, as described on page 39, were abandoned sometime prior to 1928 upon the completion of a new cluster of six wells located nearby but on higher ground.

These six wells were arranged in two rows 40 feet apart, with the wells 40 feet apart in each row. The wells were eased with 10-inch inside diameter pipe and had an average depth of 23 feet 9 inches to hardpan.

In three of the wells the screen consisted of a 4-foot length of the easing perforated with 1900 holes ⅝-inch in diameter, the bottom row of which was one foot above and the top row five feet above the bottom. In the three other wells the casing was slotted from a point one foot above the bottom with three rows of slots, ¼-inch by 10 inches, spaced 2 inches apart.

The water was drawn from the wells and delivered to the distribution system by 7 by 8-inch triplex pump driven by an electric motor, operating by direct suction through well connections to a suction manifold located midway between the rows.

This group of wells furnished the municipal supply until about 1936, at which time a large dug well 10 feet in diameter by 25 feet 4 inches deep was constructed at the site of the northeast well of the group. The other five wells are available but seldom used.

This large well is curbed with a circular concrete wall 6 inches thick by 25 feet 4 inches high into which was cast 744 ¾-inch pipe nipples spaced 6 inches apart in fourteen rows. The well curb extends above the normal ground level and supports a conical plate steel roof.

Water is drawn from this well by direct suction and delivered into the distribution system by a Worthington single-stage centrifugal pump powered by a General Electric 30-horsepower electric motor.

There is some seasonable variation in the water level but the normal water level, when not pumping, is about 8 feet below the top of the well curb, and when pumping at a rate of 190 gallons per minute there is a draw down of about 18 inches.

There are 319 services and the average daily usage is about 60,000 gallons.

The water from this dug well has a total residue of 580, a total hardness of 447, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 83712, collected June 16, 1938.

Analysis of Sample Number 83712 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	0.10
(filtered).....	.02	Sodium Chloride.....NaCl	8.2	0.48
(unfiltered).....	.6	Sodium Sulfate.....Na_2SO_4	19.9	1.16
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	204.0	11.89
Silica.....SiO_2	15.0	Calcium Sulfate.....$CaSO_4$	26.5	1.55
Turbidity.....	8.0	Calcium Carbonate.....$CaCO_3$	258.2	15.05
Color.....	0.0	Silica.....SiO_2	15.0	0.87
Odor.....	0.0			
Calcium.....Ca	111.1	Total.....	533.5	31.10
Magnesium..Mg	41.2			
Ammonium..NH_4	trace			
Sodium.....Na	10.1			
Sulfate.....SO_4	195.5			
Nitrate.....NO_3	1.0			
Chloride.....Cl	5.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	258.0			
Residue.....	580.0			
Total Hardness....	447.0			

ASTORIA (1189) (p. 40). Until the early part of 1925 the public water supply was obtained from a well as described on page 40. Since that time water has been obtained from an impounding reservoir on a branch of Otter Creek. The water is treated before entering the distribution system.

ATHENS (1019). Athens is located in the southeastern part of Menard County on the drainage area of Sangamon River. The development of a public water supply is in progress.

In 1936 the city of Athens drilled a number of test holes in an attempt to locate an adequate source of water for a municipal supply. Test wells in the northwest section of town indicated deposits of sand in the vicinity of Washington and Polk Streets. Test holes east of town did not penetrate any water-bearing material.

A short production test was made on test well number 1 located on the northeast corner of the intersection of Washington and Polk Streets. This well was 74 feet deep and was equipped with a 3-inch, 60-mesh well point 10 feet long. The water level when not pumping was 17 feet 7 inches below the top of the casing and was drawn down 44 feet 11 inches when pumping at a rate of 12 gallons per minute. Water from this well had a total residue of 683, a total hardness of 466.5, and an iron content of 2.6 parts per million as shown by the analysis of sample number 77943, collected on May 5, 1936. The temperature of the water was 54° F. Considerable fine sand was pumped from the well during this test.

Analysis of Sample Number 77943 from 74-Foot Well.

Determinations Made.		Hypothetical Combinations.			
	Pts. per million.			Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$		31.5	1.84
(unfiltered).....	2.6	Sodium Chloride.....NaCl		69.0	4.02
Manganese..Mn	1.4	Sodium Sulfate.....Na_2SO_4		33.4	1.95
Silica.....SiO_2	12.0	Magnesium Sulfate.....$MgSO_4$		123.4	7.19
Turbidity.....	70.0	Magnesium Carbonate..$MgCO_3$		78.0	4.55
Calcium.....Ca	108.6	Calcium Carbonate.....$CaCO_3$		271.5	15.83
Magnesium..Mg	47.5	Manganese Oxide.....MnO		1.8	0.10
Sodium.....Na	46.4	Silica.....SiO_2		12.0	0.70
Sulfate.....SO_4	120.8				
Nitrate.....NO_3	23.0	Total.....		620.6	36.18
Chloride.....Cl	42.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	364.0				
Residue.....	683.0				
Total Hardness....	466.5				

On November 9-10, 1936 a 2-hour production test of the finished city well was made. This well is located at the site of test well number 6 or about 175 feet north and 125 feet west of the intersection of Washington and Polk Streets. The well is of the gravel packed type, 77 feet deep with a 26-inch outer casing extending to a depth of 62 feet and a 12-inch inner casing. A 15-foot length of 12-inch, ⅛-inch slot Layne shutter screen is installed in the well. The water level was 32.3 feet below the top of the casing and at the end of the test the pump broke suction when pumping at a rate of 25 gallons per minute. A second test of this well was made on November 30, 1936. At this time the static water level was 43 feet below the top of the casing. At the end of 22 hours of pumping at a rate of 25 gallons per minute the draw down was 32 feet and the pump broke suction. The water had a total residue of 599, a total hardness of 219.5, and an iron content of 0.6 parts per million as shown by the analysis of sample number 79131, collected at the end of the test on December 1, 1936. This well was not considered adequate for a municipal supply.

Analysis of Sample Number 79131 from 77-Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	1.7	0.10
(unfiltered).....	0.6	Sodium Chloride.....NaCl	115.3	6.72
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	264.0	15.40
Silica.....SiO_2	12.0	Ammonium Carbonate..$(NH_4)_2CO_3$	1.4	0.08
Turbidity.....	2.0	Magnesium Carbonate..$MgCO_3$	63.3	3.69
Odor.....	M 1	Calcium Carbonate.....$CaCO_3$	144.6	8.43
Calcium.....Ca	57.8	Silica.....SiO_2	12.0	0.70
Magnesium..Mg	18.2			
Ammonium..NH_4	0.5	Total.....	602.3	35.12
Sodium.....Na	160.3			
Sulfate.....SO_4	none			
Nitrate.....NO_3	1.2			
Chloride.....Cl	70.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	470.0			
Residue.....	599.0			
Total Hardness....	219.5			

In February, 1937 an electrical earth resistivity survey was made in the vicinity of Athens. Areas of high resistivity were noted in the flood plain of Sangamon River. Additional test holes were drilled in this area.

Test hole number 15, located in the flood plain of Sangamon River about two miles west and one-half mile south of the center of the city, was tested on March 25, 1937. The well penetrates 11½ feet of gravel between depths of 48 and 59½ feet and is finished in blue clay at a depth of 61 feet. The water level was 10⅔ feet below the top of the casing when not pumping and was drawn down 22 feet when pumping at a rate of 88 gallons per minute.

The finished well located at the site of test hole number 15 was a gravel packed well with a 26-inch outer casing and a 12-inch inner casing. The well is equipped with a 12-inch Layne shutter screen 16 feet long with 15 feet of openings. The screen extends between depths of 45 feet and 61 feet below the ground surface. The 12-inch casing is to be extended to a point 15 feet 3 inches above the normal ground surface.

A 24-hour production test of the well was made on May 23 and 24, 1938. The water level was 8 feet below the ground surface when not pumping and after 20 hours of pumping at a rate varying from 148 to 155 gallons per minute the water was drawn down to a depth of 37 feet below the ground surface. The pumping rate was increased to 175 gallons per minute for 2 hours and to 185 gallons per minute for the remaining 2 hours. At the end of the test the draw down was 35½ feet when pumping at a rate of 185 gallons per minute. Fifteen minutes after the test was completed the water level stood at a depth of 18 feet below the ground surface.

The water had a total residue of 459, a total hardness of 186, and an iron content of 2.8 parts per million as shown by the analysis of

sample number 83542, collected at the end of the 24-hour production test on May 24, 1938. This well will be used as the source of the municipal supply. The temperature of the water was 54° F.

Analysis of Sample Number 83542 from 61-Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.6	0.15
(filtered).....	2.2	Sodium Chloride.....NaCl	69.0	4.02
(unfiltered).....	2.8	Sodium Carbonate.....Na_2CO_3	199.0	11.60
Manganese..Mn	0.0	Magnesium Carbonate..$MgCO_3$	66.2	3.86
Silica.....SiO_2	17.0	Calcium Carbonate.....$CaCO_3$	107.6	6.27
Turbidity.....	18.0	Iron Oxide.....Fe_2O_3	3.2	0.19
Color.....	2.0	Silica.....SiO_2	17.0	0.99
Odor.....	0.0			
Calcium.....Ca	43.0	Total.....	464.6	27.08
Magnesium..Mg	19.1			
Ammonium..NH_4	trace			
Sodium.....Na	114.0			
Sulfate.....SO_4	0.0			
Nitrate.....NO_3	1.6			
Chloride.....Cl	42.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	20.0			
Methyl Orange...	374.0			
Residue.....	459.0			
Total Hardness....	186.0			

On May 16, 1938 a short test was made before the well was completely developed. At this time the static water level was 12 feet below the ground level and was drawn down to a depth of 48½ feet when pumping at a rate of 56 gallons per minute. The fluctuation in static water level is probably due to the fluctuation of the level of Sangamon River. At the end of the test on May 24 the water level of the river was between 1 and 2 feet below the top of the casing.

ATKINSON (689) (p. 42). No reported change.

ATLANTA (1169) (p. 44). In 1930 the water in the mine shaft became contaminated and since that time has not been used.

A 10-inch well was drilled in the pump-house to a depth of 191 feet. It is located about 50 feet from the old 10-inch well which is 151 feet deep. Both of these wells are now used. The 191-foot well is equipped with a 14-foot length of Johnson screen and the same pump which was formerly used in the mine shaft. The water level was reported to be at a depth of 106 feet when not pumping.

The other wells have been abandoned and are sealed with concrete.

The water from the 191-foot well had a total residue of 511, a total hardness of 430, and a content of iron of 1.0 parts per million as shown bv the analysis of sample number 82572, collected December 8, 1937.

The analysis of a sample of water collected on the same date from the 10-inch well 151 feet deep indicates the quality is similar to the report given on page 45.

Analysis of Sample Number 82572 from Well 91 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	17.9	1.04
(filtered).....	0.0	Sodium Chloride.....NaCl	3.5	0.20
(unfiltered).....	1.0	Sodium Sulfate.....Na_2SO_4	2.1	0.12
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	63.5	3.70
Silica.....SiO_2	19.0	Magnesium Carbonate..$MgCO_3$	160.0	9.30
Turbidity.....	12.0	Calcium Carbonate.....$CaCO_3$	240.0	14.00
Color.....	10.0	Silica.....SiO_2	19.0	1.11
Odor.....	Bs			
Calcium.....Ca	96.0	Total.....	506.0	29.47
Magnesium..Mg	46.2			
Ammonium..NH_4	trace			
Sodium.....Na	34.5			
Sulfate.....SO_4	1.2			
Nitrate.....NO_3	13.3			
Chloride.....Cl	2.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	490.0			
Residue.....	511.0			
Total Hardness....	430.0			

ATWOOD (683). Atwood is located in Douglas and Piatt Counties on the drainage area of Lake Fork, a tributary of Kaskaskia River. A public water supply was installed by the village in 1935.

Water is secured from a well, 97 feet deep, drilled in 1935 by L. R. Burt. The well is located in the eastern part of town. It is of the gravel packed type, both the 24-inch outer casing and the 12-inch inner casing extending to a depth of 81½ feet. At the bottom of the 12-inch casing is a 17-foot section of 12-inch, number 187-slot Cook screen.

The water level was at a depth of 11½ feet when not pumping and was lowered 32½ feet by a pumping rate of 190 gallons per minute.

A record of material penetrated by the well is as follows:

	Thickness in feet.	Depth in feet.
Black soil	2	2
Clay, yellow, blue	33	35
Dirty yellow sand	2	37
Clay, brown, gray	16	53
Coarse gravel, little water	4	57
Hardpan	20	77
Sand and fine gravel, coarse at bottom	19	96
Hardpan	1	97

Water from a 97-foot test well at the site of the finished well had a mineral content of 465. a total hardness of 370.5, and a content of iron of 2.2 parts per million as shown by the analysis of sample number 75793, collected March 14, 1935. Water from the finished well was of similar chemical quality but had a much higher content of iron, 24.0 parts per million. It is reasonable to expect that this value will be reduced a great deal by continued pumping of the well.

Analysis of Sample Number 75793 from Test Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.5	0.15
(filtered)		0.0	Sodium Chloride	NaCl	8.2	0.48
(unfiltered)		2.2	Sodium Carbonate	Na_2CO_3	84.8	4.94
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	5.3	0.31
Silica	SiO_2	14.0	Magnesium Carbonate	$MgCO_3$	122.3	7.13
Turbidity		15.0	Calcium Carbonate	$CaCO_3$	225.8	13.16
Calcium	Ca	90.2	Silica	SiO_2	14.0	0.82
Magnesium	Mg	35.2				
Ammonium	NH_4	1.9	Total		462.9	26.99
Sodium	Na	40.7				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.9				
Chloride	Cl	5.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		456.0				
Residue		465.0				
Total Hardness		370.5				

The well is equipped with a 12-stage, 7-inch Fairbanks-Morse turbine pump having 85 feet of column pipe, rated at 140 gallons per minute, and driven by a 20-horsepower electric motor. Water is pumped from the well to a 60,000-gallon elevated steel tank connected to the distribution system. The pump is operated only a few hours weekly.

AUBURN (2242). Auburn purchases water from the city of Springfield. The distribution system was installed in 1935.

AUEOEA (46,589) (p. 46). Wells numbers 1-5 have been abandoned and plugged, and all water is now obtained from eight wells including wells numbers 6-10 which were described on pages 49-50. All of the wells, with the exception of number 12A, are equipped with American turbine pumps driven by electric motors. Number 12A is equipped with an Aurora turbine pump. No air lifts are in use. The larger Teservoir reported on page 46 is in use together with a new reservoir having a capacity of 4,000,000 gallons. A 1,000,000-gallon elevated steel tank located in the southeastern part of the city is connected to the mains. Water is pumped from wells numbers 11, 12 and 12A to the reservoirs, and from the reservoirs to the distribution system by five American centrifugal pumps. The capacities of these pumps range from 1390 to 2780 gallons per minute against a total head of 151 feet. Three of the pumps are driven by electric motors and two by 200-horsepower natural gas engines. These pumps are housed in a new pumping station located about 100 feet south of the old station.

Well number 11 was drilled in 1928 by S. B. Geiger of Chicago and is located at the north end of the old station. It is 2240 feet deep and is cased with 400 feet of 17-inch pipe. In 1929 the static water level was at a depth of 80 feet and in 1938 was at a depth of 130 feet. It is pumped 14 hours daily at a rate of 900 gallons per minute by a

9-stage, 17-inch pump consisting of 344 feet of 10-inch column pipe, the bowl assembly 10 feet long, and 30 feet of 10-inch suction, which is driven by a 200-horsepower electric motor.

Well number 12 was drilled in 1929 by William Cater of Chicago and is located about 100 feet east of the new station. It is 2230 feet deep and is cased with 400 feet of 18-inch pipe. In 1930 the water level was reported to be at a depth of 100 feet when not pumping and to be lowered 234 feet when pumping at rate of 1300 gallons per minute. This well is equipped with a pump exactly like the one in number 11 and is pumped 15 hours daily at a rate of 1150 gallons per minute.

Well number 12A was drilled in 1935 and 1936 by the Layne Western Company of Chicago and is located about 400 feet northeast of number 12. It is 2251 feet deep and 15 inches in diameter at the bottom. A 22-inch drive pipe extends to a depth of 31 feet 8 inches and an 18-inch casing to a depth of 450 feet below ground surface. A 16-inch liner hung by a hook-wall packer is placed between 771 and 838½ feet and another 16-inch liner is placed between 1333 and 1633 feet. The tops of the 22-inch and 18-inch pipes are at a depth of 6½ feet below ground surface.

A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	15	15
Dolomite, Silurian	85	100
Shale, dolomite, Maquoketa	158	258
Limestone, dolomite, Galena-Platteville	332	590
Dolomite, Glenwood	10	600
Sandstone, St. Peter	220	820
Dolomite, Oneota	100	920
Sandstone, dolomite, Jordan	60	980
Dolomite, Trempealeau	120	1100
Sandstone, shale, Franconia	100	1200
Sandstone, dolomitic, Galesville	165	1365
Shale, siltstone, dolomite, Eau Claire	365	1730
Sandstone, Mt. Simon	521	2251

The elevation of the ground surface at the well site is 668 feet above sea level.

The well was tested at a rate of 1300 gallons per minute in September, 1936. The static water level was 128 feet 8 inches below the top of the casing and the draw down was 132½ feet after pumping for 25 hours. The test was made with the permanent pump, a 13-stage, 14-inch Aurora turbine pump consisting of 390 feet of column pipe, the bowl assembly 14 feet long, and 30 feet of suction pipe. The pump is driven by a 200-horsepower electric motor and is operated 15 hours daily at a rate of approximately 1400 gallons per minute.

In 1938 there were about 12,000 service connections in use. The daily pumpage was very close to 4½ million gallons.

The temperature of water from well number 12A was 61° F. The water had a total residue of 763, a total hardness of 333.5, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 78757, collected September 25, 1936.

Analysis of Sample Number 78757 from Well Number 12A.

Determinations Made..	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.4	Sodium Nitrate.....$NaNO_3$	0.9	0.05
(unfiltered).....	0.6	Sodium Chloride.....NaCl	375.2	21.88
Manganese..Mn	0.0	Ammonium Chloride....NH_4Cl	1.1	0.06
Silica.....SiO_2	10.0	Magnesium Chloride....$MgCl_2$	52.4	3.05
Turbidity.....	5.0	Magnesium Sulfate.....$MgSO_4$	48.7	2.84
Calcium.....Ca	87.5	Magnesium Carbonate..$MgCO_3$	16.1	0.94
Magnesium..Mg	27.8	Calcium Carbonate.....$CaCO_3$	219.0	12.77
Ammonium..NH_4	0.3	Silica.....SiO_2	10.0	0.58
Sodium.....Na	147.8			
Sulfate.....SO_4	38.6	Total.....	723.4	42.17
Nitrate.....NO_3	0.7			
Chloride.....Cl	269.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	238.0			
Residue.....	763.0			
Total Hardness....	333.5			

AVON (799) (p. 51). A new well was drilled in 1929 by Thorpe Brothers of Des Moines, Iowa. It is located on the south side of Clinton Street about 100 feet east of the Chicago, Burlington & Quincy Eailroad tracks. It is 1170 feet deep and 8 inches in diameter at the bottom. It is cased with 12-inch pipe to a depth of 167 feet, with 10-inch pipe from 272½ feet to 580 feet, and with 8-inch pipe from 667 feet to 829 feet. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Clay	15	15
Lime	10	25
Sand	10	35
Shale, coal lime	130	165
Lime	90	255
Chert, quartz	30	285
Shale	285	570
Lime	102	672
Shale	138	810
Lime	325	1135
St. Peter sandstone, hard	35	1170

The elevation of the ground surface at the top of the well is about 641 feet above sea level.

The static water level was at a depth of 85 feet and the well was tested at a rate of 210 gallons per minute.

The well was equipped with a double-acting Cook deep-well pump with 8¾-inch cylinder and 18-inch stroke. The cylinder was set at a depth of 259 feet.

The temperature of the water was 67° F. The water had a total residue of 2708, a total hardness of 870.5 parts per million, and a trace of iron as shown by the analysis of sample number 71480, collected August 8, 1932.

The quality of the water was very unsatisfactory and in 1936 the well was plugged at a depth of 667 feet. This repair work had very little effect on the quality of the water.

Analysis of Sample Number 71480 from Well 1170 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Chloride	NaCl	438.2	25.6
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	1,003.4	58.5
Silica	SiO_2	13.0	Ammonium Sulfate	$(NH_4)_2SO_4$	4.6	.3
Turbidity		5.0	Magnesium Sulfate	$MgSO_4$	432.0	25.2
Calcium	Ca	204.8	Calcium Sulfate	$CaSO_4$	389.1	22.7
Magnesium	Mg	87.2	Calcium Carbonate	$CaCO_3$	226.2	13.2
Ammonium	NH_4	1.3	Silica	SiO_2	13.0	.8
Sodium	Na	497.5				
Sulfate	SO_4	1,300.0	Total		2,506.5	146.3
Nitrate	NO_3	.2				
Chloride	Cl	266.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		226.0				
Residue		2,708.0				
Total Hardness		870.5				

BANNOCKBURN (186). Bannockburn is located in the southeastern part of Lake County about four miles west of Lake Michigan. Many private wells are in use. Most of these obtain water from the Niagaran limestone. A private system owned by Lincoln Pettis serves several residences.

Water for this system is obtained from a well drilled in 1930 by Mr. Pettis. The well is 300 feet deep and 6 inches in diameter. It is cased to rock at a depth of 200 feet with 6-inch pipe. The elevation of the top of the well is 683 feet above sea level.

The well is equipped with a Deming deep-well plunger pump with a 4¼-inch cylinder and 14-inch stroke. The cylinder is set at a depth of 100 feet. The rate of pumping is about 25 gallons per minute.

Water from the 300-foot well had a total residue of 593, a total hardness of 277, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 67907, collected November 7, 1930.

Analysis of Sample Number 67907 from Well 300 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.3	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	.1	Sodium Chloride	NaCl	18.1	1.06
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	189.7	11.05
Turbidity		40.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Calcium	Ca	46.4	Magnesium Sulfate	$MgSO_4$	181.8	10.60
Magnesium	Mg	39.2	Magnesium Carbonate	$MgCO_3$	8.4	.49
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	116.0	6.76
Sodium	Na	68.8	Iron Oxide	Fe_2O_3	0.4	.02
Sulfate	SO_4	275.2	Manganese Oxide	MnO	0.1	.01
Nitrate	NO_3	0.7	Silica	SiO_2	9.0	.53
Chloride	Cl	11.0				
Alkalinity as $CaCO_3$			Total		526.4	30.69
Phenolphthalein		0.0				
Methyl Orange		126.0				
Residue		593.0				
Total Hardness		277.0				

BARRINGTON (3213) (p. 52). A new well (well number 2) was drilled in 1929 by the W. L. Thorne Company under the direction of the engineering firm of Suhr, Berryman, Peterson and Suhr, to a depth of 310 feet.

The well is located about 30 feet south of the south line of Station Street and 210 feet west of the west line of Hough Street and is about 130 feet distant in a northwest direction from well number 1. The ground elevation was about 815.5 feet above sea level.

The well was cased to a depth of 192 feet with 16-inch outside diameter casing. From 192 feet to 310 feet was 16-inch open hole. Between 210 feet and 310 feet the bore hole was filled with gravel and a seal placed over it. That portion of the bore between 192 feet and 210 feet was left uncased. In effect the well is but 210 feet deep. The following is a summarized log of the well taken from data furnished by the State Geological Survey.

	Thickness in feet.	Depth in feet.
Wisconsin drift	170	170
Niagaran dolomite	60	230
Maquoketa shale	80	310

When tested in October, 1929 upon its completion the water level, when not pumping, was found to be 61.4 feet below the top. When pumping at a rate of 540 gallons per minute a draw down of 13.75 feet was created representing a specific capacity of 39.3 gallons per minute per foot of draw down.

The operation of well number 1 produced a lowering of water levels in well number 2 of about 4.4 feet.

Well number 2 was equipped with an American Well Works 15-inch deep-well turbine pump, having three stages of bowls and 80 feet of column pipe, rated at 600 gallons per minute against a head of 91 feet. This well pump discharges into the new rectangular storage reservoir adjacent to and south of the pumping station. An air line for determining water levels extended to a depth of 80 feet below the pump base. As finally completed the pump-room floor is about 6 feet below the present ground level outside.

During a test of both wells in November, 1933 it was observed that at the end of a 4-hour and 25-minute operating period of the air lift in well number 1, when it operated alone, there was an average production of 350 gallons per minute, the draw down in well number 1 was 3.65 feet and in well number 2 it was 3.12 feet.

During a 3-hour and 25-minute period in which the turbine pump in well number 2 operated alone at an average production rate of 700 gallons per minute, the draw down in well number 2 was 11.73 feet and in well number 1 it was 6.9 feet.

During a 3-hour period when both pumps operated, well number 1 produced at the rate of 321 gallons per minute and a draw down of 9.95 feet occurred, while well number 2 produced at an average rate of 625 gallons per minute accompanied by a draw down of 14.6 feet.

The water from well number 1 had a total residue of 392, a total hardness of 310.5, and an iron content of 0.3 parts per million as shown by the analysis of sample number 73780, collected November 7, 1933 at the end of a test run. The water from well number 2 is similar to that from well number 1.

Analysis of Sample Number 73780 from Well Number 1, 305 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.3	Sodium Chloride	NaCl	3.5	.20
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	87.4	5.10
Silica	SiO_2	18.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Turbidity		0.	Magnesium Sulfate	$MgSO_4$	29.5	1.72
Calcium	Ca	57.0	Magnesium Carbonate	$MgCO_3$	121.0	7.05
Magnesium	Mg	40.9	Calcium Carbonate	$CaCO_3$	112.5	6.55
Ammonium	NH_4	0.5	Calcium Silicate	$CaSiO_3$	34.8	2.03
Sodium	Na	29.7	Iron Oxide	Fe_2O_3	0.4	.02
Sulfate	SO_4	84.0				
Nitrate	NO_3	0.2	Total		391.1	22.79
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.				
Methyl Orange		256.				
Residue		392.0				
Total Hardness		310.5				

BARRY (1506) (p. 53). In 1931 a dug well was constructed a few feet behind the pump-house. This well is 18 feet deep and 12 feet in diameter, but is not used at present.

Eight well points have been driven at a point about 150 feet north of the reservoir. Water is pumped from these points to the reservoir by means of a small Fairbanks-Morse centrifugal pump driven by a 1½-horsepower electric motor. This pump is operated for a few hours about once a week when the flow from the spring is not sufficient to meet the demand.

Since 1931 the water has been chlorinated before being pumped into the distribution system. The average daily pumpage is about 28,000 gallons.

BARTLETT (504) (p. 55). Bartlett is located in the northwestern part of Cook County on the drainage area of West Branch of DuPage River, a tributary of Des Plaines River. A public water supply was installed in 1925.

A well, 200 feet deep, was drilled in 1923 by W. L. Thorne. It is located on the west side of Main Street one block south of the railroad station. It penetrated 146 feet of glacial drift and is cased to rock with 8-inch pipe. The diameter at the bottom is 8 inches. Elevation of the ground surface is about 810 feet above sea level.

Water stood at a depth of 46 feet from the surface when not pumping and was lowered only 6 feet when pumping at a rate of 300 gallons per minute.

The well was first equipped with a Luitwieler double-stroke pump with an 18-inch stroke. Pump leathers measured 4¾ inches in diameter. The pump was driven by an electric motor. In 1936 a new 8-stage turbine pump was installed. It has 100 feet of column pipe and no suction pipe and is driven by a 20-horsepower electric motor. It is rated at 450 gallons per minute. When pumping at a rate of 263 gallons per minute the water level was lowered 4 feet. Water from the well is pumped directly into the distribution system to which an elevated tank of 40,000 gallons capacity is connected.

The water had a total residue of 434, a total hardness of 411, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 82394, collected November 17, 1937.

Analysis of Sample Number 82394 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.3	.02
(filtered)		0.0	Sodium Sulfate	Na_2SO_4	20.6	1.20
(unfiltered)		0.4	Ammonium Sulfate	$(NH_4)_2SO_4$	1.3	.08
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	27.7	1.61
Silica	SiO_2	12.0	Magnesium Carbonate	$MgCO_3$	160.3	9.34
Turbidity		2.0	Calcium Carbonate	$CaCO_3$	198.1	11.55
Color		0	Silica	SiO_2	12.0	.70
Odor		0				
Calcium	Ca	79.2	Total		420.3	24.50
Magnesium	Mg	51.6				
Ammonium	NH_4	0.3				
Sodium	Na	7.4				
Sulfate	SO_4	37.2				
Nitrate	NO_3	1.7				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		388.0				
Residue		434.0				
Total Hardness		411.0				

BARTONVILLE (1886) (p. 55). No reported change.

The State Hospital for the Insane has a well which was drilled by the J. P. Miller Artesian Well Company in 1903. It is 1864 feet deep and penetrates the St. Peter Sandstone. It is cased with 12-inch pipe to a depth of 60¾ feet, with 10-inch pipe from that point to 482 feet, and with 6-inch pipe to a depth of 1350½ feet. It is equipped with an air lift and yields about 250 gallons per minute.

The water had a total residue of 1665, a total hardness of 261 parts per million, and a trace of iron as shown by the analysis of sample number 80067, collected January 4, 1934.

Analysis of Sample Number 80067 from Well 1864 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Nitrate	$NaNO_3$	0.8	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	409.0	23.87
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	955.3	55.69
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	71.0	4.14
Calcium	Ca	66.1	Ammonium Carbonate	$(NH_4)_2CO_3$	2.9	0.17
Magnesium	Mg	23.4	Magnesium Carbonate	$MgCO_3$	81.0	4.72
Ammonium	NH_4	1.1	Calcium Carbonate	$CaCO_3$	150.0	8.74
Sodium	Na	501.4	Calcium Silicate	$CaSiO_3$	17.4	1.02
Sulfate	SO_4	647.3				
Nitrate	NO_3	0.89	Total		1,687.4	98.40
Chloride	Cl	248.5				
Alkalinity as $CaCO_3$						
Phenolphthalein		12.0				
Methyl Orange		316.0				
Residue		1,665.0				
Total Hardness		261.0				

BATAVIA (5045) (p. 55). The source of supply at Batavia is the same as described on pages 56 and 57. The recession of water levels noted at that time has continued. On March 26, 1936 the static water level was reported to be 85 feet and the pumping level 105 feet when pumping at a rate of 740 gallons per minute. During this test it was impossible to measure water levels in well number 2. The levels reported were measured in well number 1 located 50 feet away. The temperature of the water at that time was 58° F.

BEARDSTOWN (6344) (p. 57). No record of change.

BECKEMEYEE (850). Beckemeyer installed a water supply system in 1936. Filtered water is purchased from the city of Carlyle. There are 145 services. Bates are $1.50 per month for 2000 gallons of water. Few customers use more than the minimum quantity of water.

BEECHER (722) (p. 59). The well and pumping equipment reported on page 59 is maintained in operating condition but is seldom used.

Water for the public supply is generally obtained from well number 2, drilled about 1931, at a point 12 feet south of well number 1. It is equipped with a Pomona deep-well turbine pump, the assembly of which consists of 50 feet of 6-inch column pipe, 13 stages of 8-inch bowls having an over-all length of 6 feet 9¾ inches, and 10 feet of 5-inch suction pipe. It is powered by a 30-horsepower electric motor and is rated at 300 gallons per minute against a 220-foot head when operating at a speed of 1750 revolutions per minute.

BELLEVILLE (28,425) (p. 708). Belleville is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

BELLWOOD (4991) (p. 62). In 1929 a well 1960 feet deep was drilled by Wm. Cater near the corner of St. Charles Place and Eastern Ave. It is cased to a depth of 75 feet with 20-inch pipe. An 18-inch liner is set between depths of 260 and 500 feet, and a 12½-inch liner between depths of 975 and 1032 feet. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	66	66
Limestone, Niagaran	204	270
Shale	225	495
Limestone, Galena-Platteville	320	815
Sandstone, St. Peter	185	1000
Limestone	220	1220
Shale	85	1305
Limestone, sandy	105	1410
Sandstone, Dresbach	85	1495
Shale, streak of limestone	250	1745
Sandstone, Eau Claire	20	1765
Limestone Eau Claire	35	1800
Sandstone, Mt. Simon	160	1960

Elevation of the ground surface is about 631 feet above sea level.

The water had a total residue of 653, a total hardness of 462, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 63940, collected April 27, 1929.

Analysis of Sample Number 63940 from Well 1960 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0	Sodium Nitrate.....$NaNO_3$	0.6	.03
Manganese..Mn	0	Sodium Chloride.....NaCl	21.5	1.25
Silica.....SiO_2	9.0	Sodium Sulfate.....Na_2SO_4	30.8	1.80
Calcium.....Ca	100.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	1.9	.11
Magnesium..Mg	51.6	Magnesium Sulfate.....$MgSO_4$	207.6	12.14
Ammonium..NH_4	0.5	Magnesium Carbonate..$MgCO_3$	34.0	1.99
Sodium.....Na	18.6	Calcium Carbonate.....$CaCO_3$	250.0	14.62
Sulfate.....SO_4	188.0	Silica.....SiO_2	9.0	.52
Nitrate.....NO_3	0.4	Iron Oxide.....Fe_2O_3	0.0	.00
Chloride.....Cl	13.	Manganese Oxide.....MnO	0.0	.00
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.	Total.....	555.4	32.46
Methyl Orange...	290.			
Residue.....	653.			
Total Hardness....	462.			

The well drilled in 1913 to a depth of 1538 feet was deepened in 1935 by J. P. Miller Artesian Well Co. to 1956 feet. The water level stood at a depth of 250 feet when not pumping. The well is equipped with a 10-inch, 13-stage Cook deep-well turbine pump designed to pump 500 gallons per minute from 450 feet below ground surface. It is driven by a 100-horsepower electric motor. Water from this well was much softer than water from the 1960-foot well. The water had a total residue of 641, a total hardness of 293.5, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 75890, collected in 1935.

Analysis of Sample Number 75890 from Well 1956 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.6	0.15
(unfiltered).....	0.2	Sodium Chloride.....NaCl	125.6	7.32
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	201.8	11.76
Silica.....SiO_2	10.0	Magnesium Sulfate.....$MgSO_4$	24.1	1.40
Turbidity.....	10.0	Magnesium Carbonate..$MgCO_3$	106.7	6.22
Calcium.....Ca	59.0	Calcium Carbonate.....$CaCO_3$	147.6	8.60
Magnesium..Mg	35.5	Silica.....SiO_2	10.0	0.58
Ammonium..NH_4	0.0			
Sodium.....Na	115.5	Total.....	618.4	36.03
Sulfate.....SO_4	154.5			
Nitrate.....NO_3	1.9			
Chloride.....Cl	75.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	6.0			
Methyl Orange...	274.0			
Residue.....	641.0			
Total Hardness....	293.5			

BELVIDERE (8123) (p. 63). The three wells described on page 64 still furnish the water supply for the city, but they have all been made larger and new pumping equipment installed. A new water works pumping station has also been erected.

Well number 1 was reamed to a depth of 100 feet and 70 feet of 16-inch outside diameter casing installed in 1930. The well is equipped with an 8-inch Fairbanks-Morse deep-well turbine pump consisting of 70 feet of 6-inch column pipe, five stages of pump having an over-all length of 5 feet 6¼ inches, and 10 feet of suction pipe on the bottom of the bowls. It is driven by a 20-horsepower Fairbanks-Morse electric motor and is rated at 450 gallons per minute when operating at 1750 revolutions per minute.

Well number 2 was replaced in service in 1929 after being idle for seven years. It was reamed to a depth of 100 feet and 50 feet of 12-inch casing was installed in 1937. The well is equipped with an 8-inch American Well Works deep-well turbine pump consisting of 70 feet of 6-inch column pipe, seven stages of pump having an over-all length of 4 feet 6¼ inches, and 10 feet of suction pipe. The pump is driven by a 20-horsepower General Electric motor and is rated at 450 gallons per minute when operating at 1750 revolutions per minute.

Well number 3 was reamed to a depth of 100 feet and 70 feet of 16-inch outside diameter casing installed in 1930. The well is equipped with a 10-inch Fairbanks-Morse deep-well turbine pump consisting of 70 feet of 7-inch column pipe, three stages of pump having an over-all length of 3 feet 3 inches, and 10 feet of suction pipe. The pump is driven by a 20-horsepower Fairbanks-Morse electric motor and is rated at 600 gallons per minute when operating at 1750 revolutions per minute.

The deep-well pumps are all piped so that they may discharge into the 500,000-gallon ground storage reservoir or into the suction side of the centrifugal service pumps as occasion may demand.

One service pump is in the old pumping station beside well number 1. It is an American Well Works single-stage centrifugal pump rated at 600 gallons per minute against a 139-foot head at 1750 revolutions per minute. It is driven by a 30-horsepower General Electric motor.

In the new station there are three Fairbanks-Morse centrifugal pumps. One is rated at 600 gallons per minute and is powered by a 40-horsepower Fairbanks-Morse electric motor while the other two are rated at 450 gallons per minute and are powered by 25-horsepower Fairbanks-Morse electric motors.

Pressure in the system is maintained by direct pump pressure as there is no elevated storage. Power is generated in the station with a Diesel electric unit.

There are about 2800 service connections all of which are metered. The daily demand is more than 600,000 gallons. About two-thirds of this is obtained from well number 3.

The water has a total residue of 574. a total hardness of 417, and a content of iron of 0.12 parts per million as shown by the partial analysis of sample number 83757, collected from a tap in the pumping station on June 22, 1938.

A summary of the log of well number 3 as supplied by the State Geological Survey is as follows:

	Thickness in feet.	Depth in feet.
Glacial drift	46	46
Galena, gray dolomite	294	340
St. Peter, white sandstone	185	525
Prairie du Chien, dolomites and sandstones	120	645
Mazomanie, old shale	80	725
Dresbach, white sandstone	125	850
Eau Claire, red, gray and green shale sandstone	200	1050
Mt. Simon, layers of colored shales and sandstones	753	1803

The Chicago and Northwestern Railroad Company has a well 1241 feet deep in which is installed steam pumping equipment.

The Keene-Belvidere Canning Company has a well that is 10 inches in diameter for the full depth of 627 feet. The well is cased with 10-inch pipe from the surface to a depth of 62 feet. The formations penetrated according to a log furnished by the State Geological Survey were:

	Thickness in feet.	Depth in feet.
Drift and surface material	62	62
Galena-Platteville dolomite	258	320
Glenwood, dolomite and sandstone	50	370
St. Peter, sandstone	210	580
Trempealeau dolomite	47	627

Static water level is reported as 20 feet below pump base. The well is equipped with a Fairbanks-Morse 8-inch deep-well turbine pump consisting of 70 feet of column pipe, seven stages of bowls, and 10 feet of 8-inch suction pipe. The pump is rated at 550 gallons per minute when operated at a speed of 1800 revolutions per minute. It is direct connected to a 30-horsepower electric motor. The pumping equipment operates from 12 to 20 hours per day.

BEMENT (1517) (p. 65). The east well, one of the two drilled in 1894 at the pumping station, has been out of service for several years, but the west well was still in service in 1937.

The 208-foot well, originally drilled in 1924, was repaired and deepened in 1936. It is now 215 feet deep. It is equipped with a 10-foot length of 6-inch, 40-slot, Johnson screen. Above the screen is a 21-foot length of 4⅞-inch casing and above this is a 184-foot length of 6-inch casing. This well was in use in 1937. It was equipped with a Cook plunger pump driven by an electric motor.

The 275-foot well, originally drilled in 1917, was repaired in 1936 but was not placed in service.

A new well, known as number 4, was drilled in 1937 by the Layne Western Company. It is located near the intersection of Macon and Bond streets and is 139 feet deep. It is of the gravel packed type, having a 28-inch outer casing and an 18-inch inner casing. The lower half of the 30-foot Layne shutter screen has number 5 openings and the upper half has number 7 openings.

The water level was reported to be 32½ feet below the top of the inner easing when not pumping and was lowered 49 feet by a pumping rate of 550 gallons per minute. Water is obtained from a deposit of fine sand. During construction of the well, large clam shells and boulders as large as a man's head were removed from the well.

The well is equipped with a 6-stage, 18-inch Layne turbine pump having 114 feet of 7-inch column pipe and no suction pipe. The pump is rated at 500 gallons per minute against a total dynamic head of 158 feet and is driven by a 40-horsepower electric motor.

The water had a total residue of 472, a total hardness of 306, and a content of iron of 2.6 parts per million as shown by the analysis of sample number 81911, collected September 14, 1937. The temperature of the water was 55° F.

Analysis of Sample Number 81911 from Well Number 4.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	0.9	0.05
(filtered).....	0.0	Sodium Chloride.....NaCl	54.4	3.17
(unfiltered).....	2.6	Sodium Sulfate.....Na_2SO_4	1.4	0.08
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	82.6	4.81
Silica.....SiO_2	10.0	Ammonium Carbonate..$(NH_4)_2CO_3$	3.8	0.22
Turbidity.....	48.0	Magnesium Carbonate..$MgCO_3$	134.4	7.84
Color.....	0.0	Calcium Carbonate.....$CaCO_3$	146.5	8.54
Odor.....	C	Silica.....SiO_2	10.0	0.58
Calcium.....Ca	58.6			
Magnesium..Mg	38.7	Total.....	434.0	25.29
Ammonium..NH_4	1.4			
Sodium.....Na	58.0			
Sulfate.....SO_4	1.0			
Nitrate.....NO_3	0.7			
Chloride.....Cl	33.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	388.0			
Residue.....	472.0			
Total Hardness....	306.0			

BENLD (2980). Benld installed a distribution system in 1935. Filtered water is purchased from Gillespie.

BENSENVILLE (1680). Bensenville is located in the northwestern part of DuPage County on the drainage area of Salt Creek, a tributary of Des Plaines River. The population in 1920 was 650, and in 1930 it was 1680. A public water supply system was installed by the village in 1925. This included a deep well, pump, distribution system, and a 75,000-gallon elevated steel tank.

The well, located on Elm Street in the north part of the village, was drilled by the W. L. Thorne Company in 1924 to a final depth of 1445 feet. The log of the well on file with the State Geological Survey is as follows:

	Thickness in feet.	Depth in feet.
Drift	114½	114½
Limestone	101½	216
Shale	118	334
Limestone	11	345
Shale	34	379
Limestone	10	389
Shale	74	463
Limestone, hard, broken	157	620
Limestone, caving	110	730
Limestone, some water	55	785
Sandstone, St. Peter	222	1007
Sandstone, St. Peter	53	1060
Limestone	34	1094
Shale	16	1110
Lime shale, caving badly, sandy, red and blue	90	1200
Sandstone, first Potsdam	240	1440
Shale	5	1445

There was placed in the well 114½ feet of 12-inch casing from the surface to the top of the limestone, 118 feet of 10-inch liner between depths of 216 and 334 feet, 329 feet of 8-inch liner between depths of 456 and 785 feet, 103 feet of 7-inch liner between 1060 and 1163 feet and 106 feet of 6-inch liner between 1163 and 1269 feet.

The well was equipped with a McDonald's Johnson double-stroke deep-well cylinder pump consisting of 225 feet of drop pipe, a 7¾-inch diameter cylinder and 20 feet of suction pipe. The cylinder had a 24-inch stroke and an over-all length of about 9 feet. The pump was rated at 274 gallons per minute at 28 revolutions per minute. During regular operation the pump operated at 22 revolutions per minute.

The water had a total residue of 372, a total hardness of 227, and an iron content of 0.2 parts per million as shown by the analysis of sample number 56029, collected January 30, 1926.

About 1926 the well was equipped with an American Well Works deep-well turbine pump powered by a 30-horsepower electric motor.

In the early part of 1938 the well was cleaned by the J. P. Miller Artesian Well Company and in May of that year a production test was run using a new Peerless deep-well turbine pump for the test. The pump assembly consisted of 330 feet of 5-inch column pipe, 7 feet of bowls (13 stages of 7½-inch bowls) and 30 feet of 4-inch suction pipe. Static water level was found to be 234 feet below the pump base and after a 24-hour pumping period at a discharge rate of from 195 to 199 gallons per minute the draw down was 96 feet.

Well number 2, located about 100 feet east of well number 1, was completed in 1929 by the W. L. Thorne Company to a final depth of 1442 feet. The following is a summarized log of the drilling, taken from a blue-print log prepared by the State Geological Survey:

	Thickness in feet.	Depth in feet.
Pleistocene—		
Drift	110	110
Silurian—		
Niagaran dolomite	123	233
Ordovician—		
Maquoketa, shale rock, shale, limestone, shattered, cave	237	470
Galena-Platteville, dolomite	300	770
Glenwood	65	835
St. Peter sandstone	237	1072
Oneota	28	1100
Cambrian—		
Jordan, shale	5	1105
Trempealeau dolomite	30	1135
Mazomanie sandstone	135	1270
Dresbach sandstone	155	1425
Eau Claire	17	1442

The well is cased with 20-inch casing from the surface to a depth of 110 feet, 17-inch casing between depths of 98 and 322 feet, 12-inch casing between depths of 301 and 622 feet, 10-inch liner between depths of 1083 and 1165 feet, and 10-inch liner between depths of 1244 and 1300 feet. The well is finished with a 10-inch hole.

The well was equipped with a Byron-Jackson deep-well turbine pump powered by a 50-horsepower General Electric motor operating at a full load speed of 1720 revolutions per minute.

Shortly after the completion of well number 2 the village constructed a concrete ground storage reservoir having a capacity of 25,000 gallons. Water from either well is discharged into the concrete reservoir though well number 1 is seldom used. A single-stage Morris Machine Works centrifugal pump, direct connected to a 15-horsepower General Electric motor operating at a full load speed of 1750 revolutions per minute, pumps water from the concrete reservoir into the distribution system and the elevated tank.

The water had a total residue of 361, a total hardness of 246, and an iron content of 0.4 parts per million as shown by the analysis of sample number 82769, collected January 17, 1938.

Analysis of Sample Number 82769 from Village Well Number 2.

Determinations Made.		Pts. per million.
Iron	Fe	0.4
Manganese	Mn	0.0
Silica	SiO_2	11.0
Turbidity		0.0
Color		0.0
Odor		0.0
Calcium	Ca	69.5
Magnesium	Mg	17.5
Ammonium	NH_4	0.2
Sodium	Na	39.8
Sulfate	SO_4	54.2
Nitrate	NO_3	2.0
Chloride	Cl	12.0
Alkalinity as $CaCO_3$		
Phenolphthalein		0.0
Methyl Orange		258.0
Residue		361.0
Total Hardness		246.0

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate	$NaNO_3$	2.55	0.15
Sodium Chloride	NaCl	19.85	1.16
Sodium Sulfate	Na_2SO_4	79.3	4.62
Sodium Carbonate	Na_2CO_3	12.2	0.71
Ammonium Carbonate	$(NH_4)_2CO_3$	0.48	0.03
Magnesium Carbonate	$MgCO_3$	60.7	3.54
Calcium Carbonate	$CaCO_3$	175.1	10.05
Total		350.2	20.26

The Chicago, Milwaukee and St. Paul Eailroad has five wells at their Godfrey yards. These wells vary in depth from 2201 feet to 2290 feet. The 2290-foot well penetrated the salt water zone below 2250 feet.

BENSON (334) (p. 68). No reported changes in source of supply or pumping equipment.

In 1938 Barnes Bros of Metamora drilled three test wells at various points within the village limits. The village planned to have a new well drilled at the site of test well number 3.

BENTON (8219) (p. 708). The raw water supply of the city of Benton is secured from an impounding reservoir on a branch of Big Muddy River. The water is treated before entering the distribution system.

BERKELEY (779). Berkeley is located at the west border of Cook County in Proviso Township and adjacent on the east to the village of Elmhurst. A public water supply was installed in 1914. Water was secured from two wells located on lot. 36, block 2 and just north of the Chicago Great Western Railroad.

In 1933 only one of these wells remained in service. It was equipped with a Goulds deep-well cylinder pump connected by belt to a 5-horse-power induction motor. The well was reported to be 205 feet deep and was used only for emergency. The unit is housed in a combined village hall and fire department building, the ground floor of which has an elevation of about 685 feet above sea level.

The water had a total residue of 493, a total hardness of 330.0, and a content of iron of 3.1 parts per million as shown by the analysis of sample number 82464, collected November 30, 1937.

Analysis of Sample Number 82464 from Village Well 205 Feet Deep.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	3.1
Manganese..Mn	0.0
Silica.....SiO_2	16.0
Turbidity.....	25.0
Color.....0	
Odor.....	El
Calcium.....Ca	80.0
Magnesium..Mg	31.5
Ammonium..NH_4	0.1
Sodium.....Na	44.6
Sulfate.....SO_4	132.0
Nitrate.....NO_3	4.2
Chloride.....Cl	4.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	280.0
Residue.....	493.0
Total Hardness....	330.0

Hypothetical Combinations.

	Pts. per million.	Grs. per gallon.
Sodium Nitrate.....$NaNO_3$	5.9	0.35
Sodium Chloride.....NaCl	6.4	0.37
Sodium Sulfate.....Na_2SO_4	125.0	7.30
Magnesium Sulfate.....$MgSO_4$	60.2	3.50
Magnesium Carbonate..$MgCO_3$	67.0	3.90
Calcium Carbonate.....$CaCO_3$	200.0	11.67
Silica.....SiO_2	16.0	0.93
Total.....	480.5	28.02

Well number 2, constructed in 1930 to a depth of 151 feet, is located on lot 9, block 4, in the southwest part of the village close to the Illinois Central Railroad right-of-way. Ground surface at this point is about 685 feet above sea level. Ten-inch inside diameter casing extends through the drift to rock at a depth of 65 feet.

The well is equipped with a Cook deep-well turbine pump consisting of 80 feet of column pipe, 16 stages of 7-inch bowls having an over-all length of 6 feet 5 7/16 inches, and 20 feet of suction pipe. The rated capacity of the pump was 180 gallons per minute.

The water from the well had a total residue of 481, a total hardness of 405.0, and an iron content of 0.4 parts per million as shown by the analysis of sample number 82465, collected November 30, 1937.

Analysis of Sample Number 82465 from the Village Well 151 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	3.4	0.20
(filtered)		0.0	Sodium Chloride	NaCl	4.7	0.27
(unfiltered)		0.4	Sodium Sulfate	Na_2SO_4	87.5	5.10
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	56.5	3.29
Silica	SiO_2	15.0	Magnesium Carbonate	$MgCO_3$	131.1	7.65
Turbidity		0.0	Calcium Carbonate	$CaCO_3$	196.0	11.40
Color		0	Silica	SiO_2	15.0	0.88
Odor		E				
Calcium	Ca	78.5	Total		494.2	28.79
Magnesium	Mg	50.9				
Ammonium	NH_4	trace				
Sodium	Na	31.1				
Sulfate	SO_4	104.0				
Nitrate	NO_3	2.3				
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		358.0				
Residue		481.0				
Total Hardness		405.0				

BERWYN (47,027) (p. 69). No record of change.

BETHANY (802). Bethany is located in the western part of Moultrie County on the drainage area of West Okaw River, a tributary of Kaskaskia Biver. A public water supply was installed by the village in 1936. Previous to the drilling of the permanent well several test wells were drilled in and near the village limits. Most of these yielded less than 50 gallons per minute.

The permanent well was drilled in 1935 by C. S. Cumming of Gardner, Illinois. It is located at the site of test well number 11 at the west end of Robinson Street. It is 76 feet 3 inches deep and of the gravel-walled type. The 24-inch outer casing extends to a depth of 67 feet 7 inches and the 12-inch inner casing from 2 feet 4 inches above the surface to a depth of 66 feet 3 inches. The 10-foot length of 12-inch Cook screen has slots 3/16 inch wide. Much of the gravel penetrated between depths of 65½ and 76½ feet was either muddy or cemented.

The water level was at a depth of 29 feet 10 inches when not pumping and was lowered 40 feet by a pumping rate of 117 gallons per minute.

The well is equipped with an 8-stage, 7-inch Cook deep-well turbine pump having 69 feet of 5-inch column pipe and 10 inches of 4-inch suction pipe. The pump is rated at 120 gallons per minute at 200-foot head and is driven by a 15-horsepower electric motor.

Water is pumped from the well to the distribution system and elevated steel tank. There are about 85 service connections and the average daily pumpage is more than 10,000 gallons. The rates charged vary from 60 cents to 8 cents per 1000 gallons. A minimum charge of $1.50 per month is made.

The water from test well number 11 had a total residue of 461, a total hardness of 327, and a content of iron of 17.0 parts per million as shown by the analysis of sample number 76196, collected June 17, 1935. Water from the permanent well was of similar chemical quality.

Analysis of Sample Number 76196 from Test Well Number 11.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	17.0
Manganese..Mn	0.0
Silica.....SiO_2	10.0
Turbidity.....	1,500.0
Color.....	1.5
Odor.....	0.0
Calcium.....Ca	76.2
Magnesium..Mg	33.3
Ammonium..NH_4	3.2
Sodium.....Na	49.2
Sulfate.....SO_4	0.0
Nitrate.....NO_3	1.8
Chloride.....Cl	8.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	430.0
Residue.....	461.0
Total Hardness....	327.0

Hypothetical Combinations.

	Pts. per million.	Grs. per gallon.
Sodium Nitrate.....$NaNO_3$	2.5	0.15
Sodium Chloride.....NaCl.....	13.4	0.78
Sodium Carbonate.....Na_2CO_3	99.6	5.81
Ammonium Carbonate..$(NH_4)_2CO_3$	8.6	0.50
Magnesium Carbonate..$MgCO_3$	115.1	6.71
Calcium Carbonate.....$CaCO_3$	190.6	11.10
Iron Oxide.....Fe_2O_3	0.0	0.00
Manganese Oxide.....MnO	0.0	0.00
Silica.....SiO_2	10.0	0.58
Total.....	439.8	25.63

BIGGSVILLE (363) (p. 70). Between 1921 and 1932 the quality of the water from the village well changed appreciably. Sample number 73810, collected November 16, 1933, had a total residue of 593, a total hardness of 507, and a content of iron of 0.4 parts per million as shown by the analysis.

Analysis of Sample Number 73810 from Well 200 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Its. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	6.0	.35
Manganese	Mn	0.0	Sodium Chloride	NaCl	64.9	3.79
Silica	SiO_2	12.0	Ammonium Chloride	NH_4Cl	0.5	.03
Turbidity		0.0	Magnesium Chloride	$MgCl_2$	8.6	.50
Calcium	Ca	120.0	Magnesium Sulfate	$MgSO_4$	98.8	5.77
Magnesium	Mg	50.3	Magnesium Carbonate	$MgCO_3$	97.8	5.71
Ammonium	NH_4	.09	Calcium Carbonate	$CaCO_3$	280.0	16.34
Sodium	Na	27.1	Calcium Silicate	$CaSiO_3$	23.2	1.35
Sulfate	SO_4	78.8	Iron Oxide	Fe_2O_3	0.6	.04
Nitrate	NO_3	4.4				
Chloride	Cl	46.0	Total		580.4	33.88
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		396.0				
Residue		593.0				
Total Hardness		507.0				

In 1937 the old well was abandoned and a new well was drilled near the high school building by Ellis Jones of Burlington, Iowa. It is 891 feet deep, 8 inches in diameter to a depth of 775 feet, 6 inches in diameter at the bottom, and cased to a depth of 65 feet with 8-inch casing.

A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift, loess and till	57	57
Limestone, Keokuk	53	110
Limestone, Burlington	90	200
Shale, Kinderhook	260	460
Dolomite and limestone, Cedar Valley	107	567
Dolomite, Silurian	13	580
Shale and dolomite, Maquoketa	180	760
Dolomite, Galena	131	891

The well was tested at a rate estimated to be about 150 gallons per minute. However, the duration of the test was only about two hours and the amount of draw down is unknown. The water level was reported to be at a depth of 130 feet when not pumping.

The well is equipped with a 17-stage, 7-inch Cook deep-well turbine pump having 210 feet of 5-inch column pipe and no suction pipe. The pump is driven by a 15-horsepower electric motor.

Several consumers have complained about the taste and odor of the water from this well. The water causes staining of porcelain and enamel ware and of clothes laundered in it. It has a total residue of 1054, a total hardness of 485, and a content of iron of 0.4 parts per million as shown bv the analysis of sample number 81267, collected May 13, 1937.

Analysis of Sample Number 81267 from 891 Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$		2.6	0.15
(unfiltered).....	0.4	Sodium Chloride.....NaCl		105.7	6.17
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4		450.2	26.23
Silica.....SiO_2	11.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		4.0	0.23
Turbidity.....	4.0	Magnesium Sulfate.....$MgSO_4$		109.6	6.39
Odor.....	E1	Magnesium Carbonate..$MgCO_3$		89.0	5.18
Calcium.....Ca	115.3	Calcium Carbonate.....$CaCO_3$		288.5	16.82
Magnesium..Mg	47.8	Silica.....SiO_2		11.0	0.64
Ammonium..NH_4	1.1				
Sodium.....Na	188.1	Total.....		1,060.6	61.81
Sulfate.....SO_4	395.3				
Nitrate.....NO_3	1.7				
Chloride.....Cl	64.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	394.0				
Residue.....	1,054.0				
Total Hardness....	485.0				

BLANDINSVILLE (952). Blandinsville is located in the northwestern part of McDonough County on the drainage area of LaMoine River (Crooked Creek), a tributary of Illinois River.

An attempt to install a public water supply was made in 1936. A well was drilled in the southwestern part of the village in 1936 by Joseph Egerer of Milwaukee. It was 1205 feet deep and 6 inches in diameter at the bottom. It was cased with 10-inch pipe to a depth of 330 feet, with 8-inch pipe from 330 to 660 feet, and with 6-inch pipe from 660 to 1060 feet. All of the casing was copper-bearing steel pipe. The elevation of the top of the well was about 730 feet above sea level. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	60	60
Shale, Pennsylvanian	51	111
Limestone, Burlington-Keokuk	209	320
Shale, Kinderhook	288	608
Limestone, Niagaran	136	744
Shale, Maquoketa	31	775
Limestone, Galena-Platteville	267	1042
Sandstone, Glenwood, St. Peter	160	1202
Shale	3	1205

The water level was at a depth of 154 feet and was lowered 61 feet by a pumping rate of 27 gallons per minute.

The casing was then perforated between depths of 660 and 1060 feet and the yield increased to 65 gallons per minute with a draw down of 106 feet. The temperature of the water was 67° F.

Another attempt to increase the capacity of the well was made by discharging 10-pound shots of 80 per cent explosive gelatine at depths of 650, 620, 600, 580, 550, 330, 320, and 310 feet. The purpose of this shooting was to rip the casing without disturbing the surrounding formations. The yield increased to 168 gallons per minute with a draw down of 31½ feet. The temperature of the water was 67° F.

A pronounced odor of hydrogen sulfide was noticed during each of the production tests. Although the yield was increased by the various operations, the high temperature of the water indicated that most of the water was coming from the bottom part of the well. That this was true was shown by the fact that the chemical quality of the water did not change with increased yield. After the shooting had been completed the water had a total residue of 2382, a total hardness of 593, and a content of iron of 1.6 parts per million as shown by the analysis of sample number 78920, collected October 24, 1936.

Since the water was too highly mineralized to be acceptable for use as a public supply an attempt to shut out the undesirable water was made. It was found that the casing had collapsed at the 320-foot level and a shale stoppage had occurred at the 537-foot level. Sand and cement were placed above this shale until the well was plugged at a depth of 494 feet. After this operation the well was practically a dry hole and was abandoned.

At present the village has no public water system.

Analysis of Sample Number 78920 from Well 1205 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	3.4	0.20
(filtered).....	0.4	Sodium Chloride.....NaCl	886.5	51.74
(unfiltered).....	1.6	Sodium Sulfate.....Na_2SO_4	715.5	41.70
Manganese..Mn	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	5.3	0.31
Silica.....SiO_2	10.0	Magnesium Sulfate.....$MgSO_4$	314.0	18.30
Turbidity.....	20.0	Calcium Sulfate.....$CaSO_4$	122.5	7.14
Color.....	0.0	Calcium Carbonate.....$CaCO_3$	248.1	14.47
Odor.....	0.0	Silica.....SiO_2	10.0	0.58
Calcium.....Ca	135.6			
Magnesium..Mg	61.9*	Total.....	2,305.3	134.44
Ammonium..NH_4	1.4			
Sodium.....Na	581.0			
Sulfate.....SO_4	819.0			
Nitrate.....NO_3	2.5			
Chloride.....Cl	538.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	248.0			
Residue.....2,382.0				
Total Hardness....	593.0			

BLOOMINGTON (30,930) (p. 71). In 1930 an impounding reservoir was constructed on Money Creek several miles north of the city. Since that time the old wells have not been used. Eaw water from the reservoir is treated in a modern softening plant before being pumped to the city.

BLUE ISLAND (16,534) (p. 76). No record of change.

BLUE MOUND (817) (p. 77). At Blue Mound the east well of the two wells drilled in 1917 is still in use and is equipped as described previously. The west well was abandoned in 1935 and the casing was removed. It has not been filled.

In 1935 a 6-inch well 55 feet deep was drilled about 85 feet west of the old east well. This well is equipped with a 4-inch, 9-stage, Fairbanks-Morse turbine pump rated at 40 gallons per minute. The top of the bowls are set at a depth of 50 feet below the ground surface. Power is furnished by a 3-horsepower electric motor. This well supplies about 95 per cent of the water used in the village.

There are 150 services supplied at a flat rate of $1.00 per month for residences. The average daily usage is about 20,000 gallons in the winter and 40,000 gallons during the summer.

BLUFFS (953). Bluffs is located in the northwestern part of Scott County at the eastern edge of Illinois River flood plain. Shallow wells into the alluvium have been in use in the past.

Water for the public supply, installed by the village in 1936, is obtained from a well located a few hundred feet west of the village, constructed in 1936 by the Thorpe Concrete Well Company of Alton. It is 58 feet deep, is cased to a depth of 14 feet with solid concrete casing, and has a porous concrete screen between depths of 14 and 58 feet. The inside and outside diameters of both casing and screen are 26 and 36 inches respectively. The bottom of the well is sealed with a solid concrete plug.

A record of material penetrated by the well is as follows:

	Thickness in feet.	Depth in feet.
Clay and top-soil	20	20
Blue mud	8	28
Fine dirty sand	7	35
Fine sand	15	50
Coarse sand	8	58
Hardpan	1½	59½

The water level was at a depth of 15 feet when not pumping and was lowered 10 feet by a pumping rate of 178 gallons per minute.

The well is equipped with a 3-stage, 8-inch Johnston turbine pump having 50 feet of 4-inch column pipe and 3 feet of 4-inch suction pipe. The pump is direct connected to a 3-horsepower electric motor operating at a speed of 1720 revolutions per minute.

A treatment plant has been constructed at the well site. The lime-soda softening method is used. Two dry-feed machines add lime and soda ash with a small amount of alum to the water before it enters a settling basin outside the main building. Two pressure type filters, each about 6 feet high and 5½ feet in diameter, are housed in the building. Water is pumped through the filters into the distribution system and a large steel tank which is located on the bluff east of the village. The service pump is an American Marsh centrifugal pump rated at 100 gallons per minute against 220-foot head and driven by a 15-horsepower electric motor. The water is chlorinated before leaving the treatment plant.

In December, 1937 there were 158 service connections. The average daily pumpage was about 25,000 gallons.

Water from the well had a total residue of 775, a total hardness of 609. and a content of iron of 1.4 parts per million as shown by the analysis of sample number 77435, collected February 13, 1936.

Analysis of Sample Number 77435 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.6	0.15
(filtered).....	0.0	Sodium Chloride.....NaCl	33.4	1.95
(unfiltered).....	1.4	Ammonium Chloride....NH_4Cl	0.5	0.03
Manganese..Mn	0.6	Magnesium Chloride....$MgCl_2$	16.7	0.97
Silica.....SiO_2	12.0	Magnesium Sulfate.....$MgSO_4$	293.0	17.08
Turbidity.....	10.0	Calcium Sulfate.....$CaSO_4$	40.8	2.38
Calcium.....Ca	139.2	Calcium Carbonate.....$CaCO_3$	318.2	18.55
Magnesium..Mg	63.4	Manganese Oxide.....MnO	0.8	0.05
Ammonium..NH_4	0.1	Silica.....SiO_2	12.0	0.70
Sodium.....Na	13.8			
Sulfate.....SO_4	263.0	Total.....	718.0	41.86
Nitrate.....NO_3	1.9			
Chloride.....Cl	33.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	318.0			
Residue.....	775.0			
Total Hardness....	609.0			

BOURBONNAIS (685) (p. 78). No reported change.

BRADFORD (951) (p. 80). Well number 2 was drilled in 1936 by the Sewell Well Company of St. Louis, Missouri. It is located about 70 feet west of well number 1, one block north of the business district. It is 2052 feet deep and 8 inches in diameter at the bottom. It is cased with 12-inch pipe to a depth of 146½ feet, with 10-inch pipe from 131 to 526 feet, and with 8-inch pipe from 506 to 1439½ feet.

When the well was 1681 feet deep the water level was at a depth of 234 feet when not pumping and was lowered 85 feet by a pumping rate of 51 gallons per minute. At this time the well had penetrated the St. Peter sandstone.

Drilling was continued until the Galesville sandstone of the Dresbach formation had been penetrated at a depth of 2052 feet. The water level was then at a depth of 234 feet when not pumping and was lowered 51 feet by a pumping rate of 67 gallons per minute.

At this time only 94 gallons per minute could be pumped. Four months later the yield of the well had increased to 137 gallons per minute. Pumping level was not known but was estimated to be 300 feet below the pump base.

The well is equipped with a 12-stage Johnston turbine pump having 340 feet of column pipe and 35 feet of suction pipe. The pump is direct connected to a 20-horsepower electric motor.

Water from the St. Peter sandstone had a total residue of 1293, a total hardness of 159, and a content of iron of 0.6 parts per million. Water from the finished well had a total residue of 1388, a total hardness of 291.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 79458, collected February 1, 1937.

Analysis of Sample Number 79458 from Well Number 2.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe (unfiltered).....	0.4	Sodium Nitrate.....$NaNO_3$	3.4	0.20
Manganese..Mn	0.0	Sodium Chloride.....NaCl	778.0	45.37
Silica.....SiO_2	9.0	Sodium Sulfate.....Na_2SO_4	285.4	16.65
Turbidity.....	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	5.9	0.34
Calcium.....Ca	68.6	Magnesium Sulfate.....$MgSO_4$	64.4	3.76
Magnesium..Mg	29.1	Magnesium Carbonate..$MgCO_3$	56.1	3.27
Ammonium..NH_4	1.5	Calcium Carbonate.....$CaCO_3$	171.5	10.01
Sodium.....Na	399.1	Ferric Oxide.....Fe_2O_3	0.6	0.03
Sulfate.....SO_4	249.5	Silica.....SiO_2	9.0	0.52
Nitrate.....NO_3	2.2			
Chloride.....Cl	471.5	Total.....	1,374.3	80.15
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	238.0			
Residue.....	1,388.0			
Total Hardness....	291.5			
Free CO_2	2.0			

BRADLEY (3048) (p. 81). A new well was drilled in 1927 by the J. P. Miller Artesian Well Company. It is located north of Broadway on the east side of Prairie Avenue. It is 16 inches in diameter to a depth of 391 feet, 12 inches in diameter between depths of 391 and 547 feet and 10 inches in diameter below a depth of 547 feet. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	10	10
Lime	280	290
Shale	70	360
Lime	51	411
Shale	99	510
Lime	385	895
Sandstone	112	1007
Lime and sandstone	35	1042

The water level was reported to be at a depth of 35 feet when not pumping and was lowered 238 feet by a pumping rate of 190 gallons per minute.

The well is equipped with an American double-acting, deep-well pump with a 6¾-inch cylinder set at a depth of 375 feet. This pump discharges into the suction side of an American single-stage centrifugal pump which pumps the water into the distribution system.

The water had a total residue of 784, a total hardness of 464, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 62039, collected June 27, 1928.

Analysis of Sample Number 62039 from Well 1042 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	19.3	1.13
Manganese	Mn	0.0	Sodium Nitrate	$NaNO_3$	20.6	1.20
Turbidity		0.0	Sodium Chloride	NaCl	184.9	10.78
Silica	SiO_2	12.3	Sodium Sulfate	Na_2SO_4	40.9	2.38
Nonvolatile		0.8	Ammonium Sulfate	$(NH_4)_2SO_4$	.8	.05
Alumina	Al_2O_3	1.3	Magnesium Sulfate	$MgSO_4$	207.3	12.09
Calcium	Ca	93.8	Magnesium Carbonate	$MgCO_3$	46.9	2.74
Magnesium	Mg	56.0	Calcium Carbonate	$CaCO_3$	231.5	13.50
Ammonium	NH_4	0.2	Iron Oxide	Fe_2O_3	0.1	.01
Potassium	K	7.6	Alumina	Al_2O_3	1.3	.08
Sodium	Na	92.6	Silica	SiO_2	12.3	.72
Sulfate	SO_4	191.8	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	26.6	Nonvolatile		.8	.05
Chloride	Cl	111.0				
Alkalinity as $CaCO_3$			Total		766.7	44.73
Phenolphthalein		0.0				
Methyl Orange		284.0				
Residue		784.0				

The Kroehler Lounge Company has a well 212 feet deep that furnished an average of 50 gallons per minute for 24 hours per day during 1927.

Sears, Roebuck and Company has a well reported to be 400 feet deep that gave a production of about 160 gallons per minute for six hours per day during 1927.

BRAIDWOOD (1161) (p. 82). Water for the public supply is now obtained from seven of the nine 2-inch wells previously described. The dug well is used only in case of emergency. There have been no changes in pumping equipment.

A new well was drilled in 1936-1937. It was drilled to a depth of 1410 feet by C. W. Varner of Dubuque, Iowa. At this depth the diameter is 10 inches. In 1937 it was deepened to 1645 feet by the W. L. Thorne Company of Des Plaines. It is estimated that not all of the Galesville sandstone, which was very hard and compact, was penetrated. The well may be deepened at a later date in order to obtain more water.

The water level, when not pumping, was at a depth of 70 feet. Only 50 gallons per minute could be obtained with a pump setting of 200 feet. It is estimated that the lower part of the sandstone is more porous and would produce more water.

Due to the low yield the well has not been equipped with a pump. No analysis of the water is available.

BREESE (1957) (p. 708). The raw water supply of the city of Breese is obtained from Shoal Creek. The water is treated before entering the distribution system.

BRIDGEPORT (2315) (p. 83). Water for the public supply of the city of Bridgeport is obtained from the city of Lawrenceville.

BROADVIEW (2334) (p. 83). Water for a public supply is purchased from the city of Chicago and not from Haywood as was stated on page 83.

BROOKFIELD (10,035) (p. 84). An error occurred in the printing of the log of the Brookfield well (page 84). Corrected it reads as follows:

	Thickness in feet.	Depth in feet.
Clay and gravel	41	41
Limestone, Silurian system all or chiefly Niagaran.	314	355
Blue shale, Richmond	165	520
Limestone, Galena-Platteville	320	840
Sand and cavey formation, St. Peter	287	1127
Limestone with crevices, Prairie du Chien	118	1245
Shale, green, cavey, Prairie du Chien	20	1265
Limestone, Prairie du Chien	185	1450
Sandstone, Mazomanie-Dresbach Cambrian system..	200	1650
Shale, green and blue, Eau Claire Cambrian system.	200	1850
Sandstone, Mt. Simon Cambrian system	154	2004

The log of the casing is correct as previously printed.

In 1927 a new Byron-Jackson deep-well turbine pump was installed in the well. When pumping at a rate of about 900 gallons per minute the water level was lowered an unknown amount, but in excess of 129 feet.

In 1928 the discharge of the pump was 797 gallons per minute. In 1930 the pump discharge was 625 gallons per minute. Heasurements at this time indicated that the well was "bridged" at a depth of 1673 feet or had filled to that depth. In 1932 the water level was reported to be rising and the pump discharge was 700 gallons per minute. In 1936 the pump discharge was 575 gallons per minute. The water level was reported to be between depths of 70 and 75 feet when not pumping and about 100 feet lower when pumping. At this time it was proposed to drill a new well about two blocks east of the old well.

The Chicago Zoological Garden which is adjacent to the village of Brookfield has its own water supply system.

A well 2061 feet deep, located in the southwest portion of the park, was drilled in. 1927. The original equipment consisted of an American Well Works deep-well turbine so set that the top of the bowls was 304 feet below the base plate and the bottom of the suction pipe opening at a depth of 349 feet. The top of the pump foundation is about 4 feet below ground level. At the beginning the well delivered 350 gallons per minute but by 1933 a yield of only 250 gallons per minute could be obtained and even at that the pump drew air after only a short period of operation.

In the spring of 1934 the column pipe was lengthened to give a setting of 432 feet to the top of the bowls. As reset, the pump assembly was reported to consist of 432 feet of column, 12 feet of bowls (nine stages) and 30 feet of suction pipe. This gives a depth to the suction pipe opening below ground surface of 474 feet. A small air pipe for determining water levels was also installed, the bottom of which was at the top of the bowl assembly.

Water from this well had a total residue of 696, and a hardness of 362 parts per million as shown by analysis number 77681 of a sample collected March 27, 1936.

Analysis of Sample Number 77681 from Well Number 1 Chicago Zoological Park.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		trace	Sodium Chloride	NaCl	164.9	9.61
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	161.3	9.40
Silica	SiO_2	9.0	Magnesium Sulfate	$MgSO_4$	41.6	2.42
Turbidity		0.0	Magnesium Carbonate	$MgCO_3$	101.6	5.92
Calcium	Ca	83.0	Calcium Carbonate	$CaCO_3$	207.6	12.11
Magnesium	Mg	37.5	Silica	SiO_2	9.0	0.52
Sodium	Na	117.5				
Sulfate	SO_4	141.6	Total		687.7	40.08
Nitrate	NO_3	1.1				
Chloride	Cl	100.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		328.0				
Residue		696.0				
Total Hardness		362.0				

In December, 1937 the pump was again lowered by adding 64 feet of column, thus giving a depth to the top of the bowls below the base of pump of 496 feet. The air pipe was also lengthened a like amount.

Early in 1937 a contract was awarded to W. L. Thorne Company of Des Plaines for the drilling of a second well in the northeast corner of the park area. The well was finished at a depth of 2080 feet in January, 1938, and a 48-hour production test was run in February, 1938.

The test pump installation consisted of a Sterling deep-well turbine having an assembly of 480 feet of column, 6.5 feet of pump (six stages of 14-inch pump) and 20 feet of suction or a total depth from pump base to suction pipe opening of 506.5 feet. Power was furnished by a U. S. 150-horsepower electric motor direct connected to the pump shaft and having a speed of 1765 revolutions per minute at full load. At the conclusion of the 48-hour continuous pumping test a production of 725 gallons per minute with a draw down of 231 feet from a static water level of 249 feet was obtained.

At the end of the test the water from well number 2 had a total residue of 783, a hardness of 274, and a content of iron of 0.3 parts per million as shown by analysis number 82944 of a sample collected on February 14, 1938 just before the test was completed. The temperature of the water remained constant at 64½°F. after one hour of pumping.

Analysis of Sample Number 82944 from Well Number 2 of the Chicago Zoological Garden.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.32	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	376.0	21.9
Silica	SiO_2	11.3	Sodium Sulfate	Na_2SO_4	124.5	7.26
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	0.12
Color		0.0	Magnesium Sulfate	$MgSO_4$	12.0	0.70
Odor		C	Magnesium Carbonate	$MgCO_3$	82.5	4.8
Calcium	Ca	66.4	Calcium Carbonate	$CaCO_3$	166.2	9.71
Magnesium	Mg	21.2	Iron Oxide	Fe_2O_3	0.5	0.03
Ammonium	NH_4	.5	Silica	SiO_2	11.3	0.66
Sodium	Na	189.0				
Sulfate	SO_4	95.3	Total		775.9	45.23
Nitrate	NO_3	0.9				
Chloride	Cl	229.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		264.0				
Residue (180°C)		783.0				
(103°C)		805.0				
Total Hardness		274.0				

BROOKLYN (2063) (p. 708). Brooklyn is supplied with water by the Bast St. Louis and Interurban Water Company of East St. Louis.

BROOKPORT (1336) (p. 85). No reported change.

BUCKINGHAM (140). Buckingham is located in the southwest part of Kankakee County on the drainage area of Crane Creek, a tributary of Kankakee River.

A public water supply was installed by the village in 1902. At that time a well 4½ inches in diameter and 150 feet deep was drilled. The well penetrated 94 feet of drift which was cased off. This well has since been plugged. The well and pump-house are located about 500 feet southwest of the Illinois Central depot.

In 1935 George Berns of Chebanse drilled a new well for the village. It is located 25 feet west of the old well, is 150 feet deep and is 6 inches in diameter. It is cased with 6-inch pipe to a depth of 97 feet.

Water is pumped from the well to the distribution system at a rate of from 50 to 60 gallons per minute by an Eureka 6-inch cylinder wedged in the casing at a depth of 78 feet. Power is furnished by a 15-horsepower International Harvester Company mogul kerosene engine.

In 1938 there were 40 service connections and the daily use is about 12,000 gallons. Water is sold at a flat rate of 75 cents or $1.00 per month depending upon the plumbing installed in the residence.

An analysis of sample number 83361, collected April 21, 1938, shows a total residue of 418, a total hardness of 167.5, and an iron content of 0.22 parts per million.

Analysis of Sample Number 83361 from the Village Well 150 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	3.4	.20
(filtered).....	0.02	Sodium Chloride.....NaCl	36.8	2.15
(unfiltered).....	0.22	Sodium Sulfate.....Na_2SO_4	78.0	4.55
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	98.0	5.92
Silica.....SiO_2	21.0	Magnesium Carbonate..$MgCO_3$	70.8	4.13
Turbidity.....	14.0	Calcium Carbonate.....$CaCO_3$	82.5	4.81
Color.....	0.0	Silica.....SiO_2	21.0	1.22
Odor.....	0.0			
Calcium.....Ca	33.3	Total.....	390.5	22.98
Magnesium..Mg	20.2			
Ammonium..NH_4	trace			
Sodium.....Na	83.2			
Sulfate.....SO_4	52.0			
Nitrate.....NO_3	2.6			
Chloride.....Cl	22.5			
Alkalinity as $CaCO_3$				
Phenolphthalein..	18.0			
Methyl Orange...	260.0			
Residue.....	418.0			
Total Hardness....	167.5			

BUCKLEY (485) (p. 86). No record of change.

BUDA (794) (p. 88). A new well 21 feet northeast of the older well described on page 88 was placed in service in 1927.

In drilling the new well the following materials were encountered as shown by a report by F. T. Thwaites:

	Thickness in feet.	Depth in feet.
Pleistocene system—		
Drift	305	305
Pennsylvanian system-		
Shale, limestones	170	475
Silurian system—		
Niagaran dolomite	435	910
Ordovician system—		
Maquoketa shale	200	1110
Galena-Platteville dolomite	340	1450
Glenwood and St. Peter sandstones	181	1631

The well is cased with 12-inch cast iron casing, with screw joints, from the ground surface to a depth of 482½ feet. No casing was placed below this depth and the well was finished 10 inches in diameter at the bottom.

The well was equipped with a Keystone Driller Company 2-stroke deep-well cylinder pump. The cylinder had a diameter of 7⅞ inches and an 18-inch stroke. It was set at 240 feet below the ground surface.

After completion of the well, but before equipment had been installed, the static water level was 187 feet. It was observed at the same time that when well number 1 operated at a rate of 90 gallons per minute for an hour, the water level in well number 2 was lowered 11¾ inches. The well was tested for a short time at a rate of 300 gallons per minute.

It was reported in 1931 that the water level in well number 2 when not pumping was approximately 220 feet below ground surface. This represents a lowering of static water level of 33 feet within a period of four years.

In 1931 the new well furnished all the requirements which amounted to about 24,000 gallons per day. The older well was maintained for emergency but had been rarely used since the new well was completed.

The water had a total residue of 1251, a total hardness of 247, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 69595, collected August 17, 1931.

Analysis of Sample Number 69595 from Village Well 1631 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	.4	Sodium Nitrate.....$NaNO_3$	7.6	.44
Manganese..Mn	0.0	Sodium Chloride.....NaCl	764.1	44.55
Silica.....SiO_2	8.0	Sodium Sulfate.....Na_2SO_4	271.3	15.82
Turbidity.....	0.0	Magnesium Sulfate.....$MgSO_4$	42.1	2.46
Calcium.....Ca	53.6	Magnesium Carbonate..$MgCO_3$	65.7	3.84
Magnesium..Mg	27.4	Calcium Carbonate.....$CaCO_3$	134.0	7.81
Ammonium..NH_4	0.0	Iron Oxide.....Fe_2O_3	0.6	.04
Sodium.....Na	390.7	Manganese Oxide.....MnO	0.0	.00
Sulfate.....SO_4	217.2	Silica.....SiO_2	8.0	.47
Nitrate.....NO_3	5.7			
Chloride.....Cl	463.6	Total.....	1,293.4	75.43
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	212.0			
Residue.....	1,251.0			
Total Hardness....	247.0			

BULPITT (447). Bulpitt is located in the northwestern part of Christian County on the drainage area of South Fork of Sangamon River.

A public water supply was installed in 1930. Water is purchased from the village of Kincaid for fire protection only. Some individual service connections are in use. The consumers pay bills at the Kincaid office.

BUNKER HILL (947). Bunker Hill installed a water supply system in 1937. The raw water is obtained from an impounding reservoir on Wood River. The water is treated before entering the distribution system.

BUREAU (552) (p. 89). The public water supply is obtained from two flowing wells. One of these is the municipal well on Kansas Street and the other is a well acquired in 1934 from a Mr. Jensen which is located about 1¼ blocks east of the depot and adjacent to the north right-of-way line of the Chicago, Rock Island and Pacific Railroad. The well on the depot grounds described on page 89 has been

abandoned and now discharges into the sewer. An attempt to plug it met with failure.

The Kansas Street well was recased in 1934 with casing of the same size and length as had originally been installed. The Jensen well was recased in the same year with 2½-inch pipe to a depth of **310** feet and after repairs had been completed the shut-in pressure was 24 pounds.

A new pump of similar design and size has replaced the older one used to maintain pressure in the pressure tank for services on the hill. It was reported in 1938 that no reduction in flow has been observed.

BURNHAM (994) (p. 708). No record of change.

BUSHNELL (2850) (p. 90). Bushnell obtains water from two wells into the St. Peter sandstone. Well number 2 is described on page 91. The well was measured on October 12, 1931 and was found to have filled to a depth of 1306 feet. In a test made after a turbine pump had been installed the well produced 350 gallons per minute.

In 1932 well number 1 was reconstructed by John Millis. A 16-inch drive pipe was placed to a depth of 140 feet. The hole was then drilled 15½ inches in diameter to a depth of 434 feet, 13 inches from 434 feet to 1052½ feet, and 10 inches from 1052½ feet to 1509½ feet. The well is cased with 12½-inch wrought iron to a depth of 412 feet, and with 10-inch pipe from 412 feet to 1052 feet. St. Peter sandstone is encountered between depths of 1235 feet and 1509½ feet. The water level was reported to be at a depth of 93 feet when not pumping and at 257 feet when pumping at a rate of 200 gallons per minute.

In October, 1931 two identical Fairbanks-Morse water lubricated turbine pumping units were purchased. The pump assembly consisted of 13 stages of bowls measuring 8 feet over-all, 150 feet of 5-inch column pipe and 20 feet of 5-inch suction pipe. The electric motors are rated at 30 horsepower. The pump in well number 1 was ultimately installed at a depth of 250 feet using an oil lubricated column.

Water is pumped from the wells to two open reservoirs where it is aerated to remove hydrogen sulphide gas. The service pumps consist of, one Fairbanks-Morse single-stage centrifugal pump rated at 250 gallons per minute against a pressure of 52 pounds per square inch, driven by a 15-horsepower motor; one American Well Works centrifugal pump, size number 3, driven by a 15-horsepower Lincoln Electric Company motor; and one American Well Works 8-inch centrifugal pump rated at 1000 gallons against a pressure of 90 pounds per square inch, driven by a 100-horsepower Lincoln Electric Company motor.

BYRON (915) (p. 92). In 1929 P. E. Millis of Byron drilled a well for the city of Byron. It is 673 feet deep and 8 inches in diameter. The well is cased with 8-inch pipe to a depth of 212 feet.

A record of the materials penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	200	200
Sandstone, chert, St. Peter	240	440
Dolomite, chert, Trempealeau	55	495
Dolomite, shale, sandstone, Mazomanie	85	580
Sandstone, Dresbach	93	673

This well is located about 10 feet south of the 2000-foot well. It is equipped with a Fairbanks-Morse turbine pump. The pump is driven by a 5-horsepower Fairbanks-Morse electric motor.

Well number 1 (described on page 93) is now equipped with a Fairbanks-Morse turbine pump driven by a 20-horsepower Fairbanks-Morse electric motor.

The discharge pipe from the turbine pump in well number 1 is connected to the suction pipe of a 2½-inch Fairbanks-Morse centrifugal pump driven by a 10-horsepower electric motor.

The discharge pipe from the turbine pump in well number 2 is connected to the suction pipe of a Fairbanks-Morse centrifugal pump driven by a 15-horsepower electric motor. Both centrifugal pumps discharge into the pressure tanks described on page 93.

The water from well number 2 had a total residue of 269, a total hardness of 257, and an iron content of 1.4 parts per million as shown by the analysis of sample 82733, collected on January 7, 1938.

Analysis of Sample Number 82733 from Well 673 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Chloride	NaCl	7.6	0.44
(filtered)		0.02	Sodium Sulfate	Na_2SO_4	4.3	0.25
(unfiltered)		1.4	Magnesium Sulfate	$MgSO_4$	8.4	0.49
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	109.2	6.37
Silica	SiO_2	13.0	Calcium Carbonate	$CaCO_3$	121.0	7.05
Turbidity		8.0	Silica	SiO_2	13.0	0.76
Color		0				
Odor		0	Total		263.5	15.36
Calcium	Ca	48.2				
Magnesium	Mg	33.2				
Ammonium	NH_4	trace				
Sodium	Na	4.4				
Sulfate	SO_4	9.5				
Nitrate	NO_3	trace				
Chloride	Cl	4.5				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		250.0				
Residue		269.0				
Total Hardness		257.0				

CABERY (290) (p. 94). The well at Cabery was drilled by Lars Jenson of Clifton rather than by Chris Jenson as reported on page 94. No change reported in the water supply.

CAHOKIA (286). Water is supplied to Cahokia by the Bast St. Louis and Interurban Water Company of East St. Louis.

CAIRO (13,532) (p. 708). The raw water supply for the city of Cairo is obtained from Ohio River. The water is treated before entering the distribution system.

CALUMET CITY (12,298) (p. 708). No record of change.

CALUMET PARK (1429). The village of Calumet Park obtains Lake Michigan water from the city of Chicago.

CAMBRIDGE (1355) (p. 95). The static water level in two wells at Cambridge has dropped from 180 feet in 1921 to 242 feet in 1938. No changes have been made in the sources of supply or pumping equipment as described on page 95.

CAMPUS (160) (p. 96). No change had been made in the source of supply or pumping equipment at the time of the last visit on July 29, 1930. Analysis of sample number 67047 collected at that time indicates an increase in total hardness and iron content. The total residue is 687, the total hardness 230, and the iron content 0.8 parts per million.

Analysis of Sample Number 67047 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.8	Sodium Nitrate	$NaNO_3$	11.0	.64
Manganese	Mn	0.0	Sodium Chloride	NaCl	138.0	8.05
Silica	SiO_2	11.0	Sodium Sulfate	Na_2SO_4	302.3	17.79
Turbidity		10.0	Magnesium Sulfate	$MgSO_4$	3.0	.18
Calcium	Ca	53.2	Magnesium Carbonate	$MgCO_3$	80.1	4.68
Magnesium	Mg	23.7	Calcium Carbonate	$CaCO_3$	133.0	7.75
Ammonium	NH_4	0.0	Iron Oxide	Fe_2O_3	1.1	.06
Sodium	Na	175.6	Manganese Oxide	MnO	0.0	.00
Sulfate	SO_4	206.8	Silica	SiO_2	11.0	.64
Nitrate	NO_3	8.0				
Chloride	Cl	84.0	Total		679.5	39.79
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		228.0				
Residue		687.0				
Total Hardness		230.0				

CANTON (11,718) (p. 97). The city of Canton secures its water supply from the three wells described on page 98. However, well number 2, which was reported to be 2043 feet deep, has been filled to a depth of 1650 feet.

The plant was electrified in 1929 or 1930, and the air lifts were replaced by deep-well turbine pumps. A 150,000-gallon elevated tank was installed at the same time.

Well number 1 was reported to be equipped with a 7-stage Price deep-well turbine, set at a depth of 200 feet below the ground surface, and with 10 feet of 6-inch suction pipe attached to the bottom of the bowls. The pump is driven by a 30-horsepower Fairbanks-Morse electric

motor. Static water level was 95 feet below the ground surface on June 30, 1936.

Well number 2 is equipped with a 6-inch, 6-stage Price deep-well turbine, rated at 125 gallons per minute. The top of the bowls are set 150 feet below the ground surface and 10 feet of 5-inch suction pipe is attached to the bottom of the bowls. The pump is driven by a 35-horsepower Fairbanks-Morse electric motor.

Well number 3 is equipped with an 8-inch, 8-stage Price deep-well turbine, rated at 375 gallons per minute. The bowls are attached to 200 feet of 6-inch column pipe and 10 feet of suction pipe is attached to the bottom of the bowls. The pump is driven by a 35-horsepower Fairbanks-Morse electric motor.

Water from the wells is discharged into a large rectangular concrete surface reservoir that is open at the top. From the surface reservoir the water is pumped to the distribution system by either of two centrifugal pumps. One pump is rated at 650 gallons per minute against a pressure of 75 pounds per square inch and is driven by a 40-horsepower Fairbanks-Morse electric motor. The second pump is rated at 1000 gallons per minute against a pressure of 75 pounds per square inch, and is driven by a 100-horsepower Fairbanks-Morse electric motor.

During 1938, the city had plans prepared for a raw water supply from an impounding reservoir on the West Branch of Copperas Creek several miles east of the city. The water will be treated.

CAPRON (397) (p. 103). The public water supply is as reported on page 103. A new semi-diesel type of gas engine has recently been installed to drive the pump.

CARBONDALE (7528) (p. 105). Since 1926 the source of water for the public supply has been an impounding reservoir on Piles Fork. The water is treated before entering the distribution system.

CARBON HILL (165) (p. 104). No record of change.

CARLINVILLE (4144) (p. 708). The raw water supply of the city of Carlinville,. is obtained from Macoupin Creek. The water is treated before entering the distribution system.

CARLYLE (2078) (p. 708). The raw water supply of the city of Carlyle is obtained from Kaskaskia River. The water is treated before entering the distribution system.

CARMI (2932) (p. 708). The raw water supply of the city of Carmi is obtained from Little Wabash River. The water is treated before entering the distribution system.

CARPENTERSVILLE (1461) (p. 110). The source of water for the public supply is as reported on page 110. Most of the water is now

pumped by an American centrifugal pump rated at 500 gallons per minute and driven by a 40-horsepower electric motor. The old triplex pump is used part of the time.

In 1938 there were 334 service connections in use. None of these are metered and customers pay a flat rate of $1.50 per quarter. The average daily pumpage is about 100,000 gallons.

CAEEOLLTON (2075) (p. 111). No reported change.

An analysis of sample number 77169 collected on December 12, 1935 shows a total residue of 340, a total hardness of 314 parts per million and no iron.

Analysis of Sample Number 77169 from City Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	11.1	0.65
Manganese	Mn	0.0	Sodium Chloride	NaCl	3.5	0.20
Silica	SiO_2	12.0	Magnesium Chloride	$MgCl_2$	3.8	0.22
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	36.7	2.14
Color		0.0	Magnesium Carbonate	$MgCO_3$	73.3	4.27
Calcium	Ca	77.2	Calcium Carbonate	$CaCO_3$	173.1	10.11
Magnesium	Mg	29.6	Calcium Silicate	$CaSiO_3$	23.2	1.35
Sodium	Na	4.4				
Sulfate	SO_4	29.2	Total		324.7	18.94
Nitrate	NO_3	8.0				
Chloride	Cl	5.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		260.0				
Residue		340.0				
Total Hardness		314.5				

CAETEEVILLE (2866). The raw water supply of the city of Carterville is obtained from an impounding reservoir on Hurricane Creek. The water is treated before entering the distribution system.

CAETHAGE (2240) (p. 113). Since 1926 the source of water for the public supply has been an impounding reservoir on a branch of Long Creek near the northwestern limits of the city. The water is treated before entering the distribution system.

CAEY (731) (p. 115). The water supply at Cary is as described on page 115. The deep-well pump has been replaced by a size 6 American Well Works turbine pump rated at 180 gallons per minute against a head of 120 feet. The pump is driven by a 15-horsepower motor. There were 180 service connections in use during July, 1938. The average daily pumpage is about 90,000 gallons.

CASEY (2200) (p. 117). Casey drilled two additional wells sometime between 1923 and 1928. These wells are each 8 inches in diameter and 80 feet deep. The bottom 20 feet of casing is perforated with 14-inch holes. The wells are located on a line with the three wells drilled in 1916. One well is placed at each end of the line and about

15 feet distant from the older wells. The center well, 131 feet deep, is seldom used.

Water is pumped from the wells by a triplex pump with 8-inch cylinders and a 10-inch stroke driven by a 40-horsepower General Electric motor.

There are about 500 service connections. The average daily use is about 100,000 gallons. The rates are as follows:

75 cents per 1000 gallons for the first 1,000 gallons.
50 cents per 1000 gallons for the next 49,000 gallons.
30 cents per 1000 gallons for the next 50,000 gallons.
15 cents per 1000 gallons for all over 100,000 gallons.

CASEYVILLE (743). The village of Caseyville installed a distribution system in 1937. Water is obtained from the East St. Louis and Interurban Water Company of East St. Louis.

CATLIN (813). Catlin is located in the central part of Vermilion County on the drainage area of Vermilion River, a tributary of Wabash River. A public water supply was installed by the village in 1935.

Water for the public supply is obtained from four wells into shale. Wells numbers 1, 2 and 3 were drilled in 1934 by O. A. Musson of Hoopeston. Well number 4 was drilled in 1936 by W. C. LeRoy of Danville following the failure of well number 1 which was apparently due to clogging of the fissures in the shale.

Well number 1 is located near the intersection of Commercial and Sandusky Streets. It is 90 feet deep, 8 inches in diameter, and cased with 8-inch pipe to a depth of 33 feet. The water level was at a depth of 11 feet when not pumping and was lowered 70 feet by a pumping rate of 14 gallons per minute. This well has not been used since 1936.

Well number 2 is located about 600 feet northeast of well number 1 on Sandusky Street south of Vermilion Street. It is 106 feet deep, 8 inches in diameter, and cased with 8-inch pipe to a depth of 37½ feet. It yielded 9 gallons per minute with a draw down of about 50 feet from a static level of 10 feet.

Well number 3 is located about 1800 feet northwest of well number 2 near the intersection of Webster and Bryant Streets. It is 100 feet deep, 8 inches in diameter, and cased with 8-inch pipe to a depth of 31 feet. It yielded 7 gallons per minute with a draw down of 25½ feet from a static level of 15 feet.

Well number 4 is located on Jackson Street about midway between Vermilion and Buckingham Streets, or 850 feet west of well number 2. It is 91 feet deep, 8 inches in diameter, and cased with 8-inch casing to a depth of 41 feet. It yielded 12 gallons per minute with a draw down of 22 feet from a static level of 16 feet.

Thorough production tests indicated that each well is capable of yielding just a certain amount and that this amount cannot be increased by increasing the draw down. This seems to be fairly conclusive proof that practically all of the water is obtained from the upper part of the shale.

Each well is equipped with a deep-well cylinder pump driven by an electric motor. Pump number 1, rated at 840 gallons per hour, has a

3¼-inch cylinder, 9-inch stroke, and 80 feet of 3½-inch drop pipe. Pump number 3, rated at 510 gallons per hour, has a 2¼-inch cylinder, 9-inch stroke, and 90 feet of 2½-inch drop pipe. None of the pumps are equipped with suction pipes.

Wells numbers 1 and 4 yielded waters of similar quality. Wells numbers 2 and 3 yielded waters similar to each other, but much softer and more alkaline than water from either well number 1. or well number 4. Water from well number 4 had a total residue of 457, a total hardness of 302, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 79050, collected November 13, 1936. Water from well number 3 had a total residue of 664, a total hardness of 79.5 and a content of iron of 1.0 parts per million as shown by the analysis of sample number 75170, collected October 19, 1934.

Analysis of Sample Number 79050 from Well Number 4.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		4.2	0.24
(filtered).....	trace	Sodium Chloride.....NaCl		77.8	4.54
(unfiltered).....	0.4	Sodium Sulfate.....Na_2SO_4		16.4	0.96
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3		55.2	3.22
Silica.....SiO_2	12.0	Magnesium Carbonate..$MgCO_3$		99.1	5.78
Turbidity.....	5.0	Calcium Carbonate.....$CaCO_3$		184.5	10.76
Calcium.....Ca	73.9	Silica.....SiO_2		12.0	0.70
Magnesium..Mg	28.6				
Sodium.....Na	60.9	Total.....		449.2	26.20
Sulfate.....SO_4	10.9				
Nitrate.....NO_3	2.8				
Chloride.....Cl	47.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	8.0				
Methyl Orange...	354.0				
Residue.....	457.0				
Total Hardness....	302.0				

Analysis of Sample Number 75170 from Well Number 3.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		1.7	0.10
(filtered).....	0.2	Sodium Chloride.....NaCl		128.6	7.50
(unfiltered).....	1.0	Sodium Sulfate.....Na_2SO_4		32.0	1.92
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3		413.2	24.10
Silica.....SiO_2	12.0	Ammonium Carbonate..$(NH_4)_2CO_3$		0.5	0.03
Turbidity.....	50.0	Magnesium Carbonate..$MgCO_3$		25.7	1.50
Calcium.....Ca	19.6	Calcium Carbonate.....$CaCO_3$		49.1	2.86
Magnesium..Mg	7.2	Iron Oxide.....Fe_2O_3		0.3	0.02
Ammonium..NH_4	0.2	Silica.....SiO_2		12.0	0.70
Sodium.....Na	240.8				
Sulfate.....SO_4	21.3	Total.....		663.1	38.73
Nitrate.....NO_3	1.5				
Chloride.....Cl	78.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	470.0				
Residue.....	664.0				
Total Hardness....	79.5				

CEDAE POINT (266) (p. 120). No reported change.

CENTRAL CITY (1148) (p. 708). Central City obtains water from the city of Centralia.

CENTRALIA (13,583) (p. 708). The raw water supply of the city of Centralia is secured from an impounding reservoir on Martin's Branch. The water is treated before entering the distribution system.

CERRO GORDO (965) (p. 122). The wells in use in 1925 produced little water but considerable gas. In that year a number of test wells were drilled in and near the village. Very little water was found except in the northeast quarter of section 32 about 1½ miles west of the village. Two 8-inch wells were constructed at this location. The first well is 27 feet deep and equipped with a 12-foot Cook screen and a Goulds cylinder pump driven by a 10-horsepower electric motor. This well is seldom used.

The second well was drilled 15 feet west of the first. It is 25 feet deep and is equipped with a 4-stage Sterling turbine pump driven by a 7½-horsepower electric motor. The bottom of the bowls is 23 feet below the ground surface and the pumping rate is 90 gallons per minute. This well furnishes most of the water for the public supply. The old wells in town have been abandoned.

Water is pumped directly from the wells to the mains and elevated tank. There are about 200 service connections and the average daily pumpage is 30,000 gallons. A minimum charge of $2.00 per quarter entitles the user to 10,000 gallons of water. Additional quantities are sold at the same rate.

Water from the new supply has a total residue of 402, a total hardness of 352.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 72660, collected March 20, 1933. Another analysis indicates that the content of iron is 0.6 parts per million.

Analysis of Sample Number 72660 from Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	7.6	.44
Silica	SiO_2	8.0	Ammonium Chloride	NH_4Cl	.5	.03
Turbidity		30.0	Magnesium Chloride	$MgCl_2$	8.1	.47
Calcium	Ca	83.5	Magnesium Sulfate	$MgSO_4$	120.4	7.03
Magnesium	Mg	35.0	Magnesium Carbonate	$MgCO_3$	29.5	1.72
Ammonium	NH_4	.1	Calcium Carbonate	$CaCO_3$	209.0	12.20
Sodium	Na	3.5	Silica	SiO_2	8.0	.47
Sulfate	SO_4	96.0				
Nitrate	NO_3	1.2	Total		384.8	22.46
Chloride	Cl	11.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		244.0				
Residue		402.0				
Total Hardness		352.5				

CHADWICK (558) (p. 125). The public water supply is still obtained from the 600-foot well described on page 125, but the pumping equipment has been changed.

In November, 1935 the well was equipped with a Sterling 6-inch deep-well turbine pump consisting of 240 feet of 4-inch column pipe, six stages of bowls and 10 feet of 4-inch suction pipe. It is direct connected to a U. S. Electric Motor operating at 3600 revolutions per minute or full-load speed of 3490 revolutions per minute. The pump delivers 125 gallons per minute against a head of 260 feet.

The water has a total residue of 385, a total hardness of 353, and an iron content of 2.44 parts per million as shown by the analysis of sample number 83699, collected June 7, 1938.

Analysis of Sample Number 83699 from Well 600 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.00	Sodium Chloride	NaCl	3.5	0.20
(unfiltered)		2.44	Sodium Sulfate	Na_2SO_4	4.9	0.28
Manganese	Mn	0.00	Sodium Carbonate	Na_2CO_3	17.0	0.99
Silica	SiO_2	15.00	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	0.06
Turbidity		15.00	Magnesium Carbonate	$MgCO_3$	133.2	7.70
Color		0.00	Calcium Carbonate	$CaCO_3$	195.1	11.37
Odor		0.00	Silica	SiO_2	15.0	0.87
Calcium	Ca	78.00				
Magnesium	Mg	38.40	Total		371.4	21.57
Ammonium	NH_4	0.3				
Sodium	Na	10.8				
Sulfate	SO_4	3.5				
Nitrate	NO_3	1.4				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		370.0				
Residue		385.0				
Total Hardness		353.0				

CHAMPAIGN-URBANA (33,408) (p. 126). Since January 1, 1925 the Illinois Water Service Company has constructed five additional wells in their water production field northwest of Urbana.

Well number 38 was drilled in 1925 to a depth of 185.5 feet. It is of the gravel-packed type of construction and at the time of the initial test static water level was 111.6 feet below ground surface. When pumping at a rate of 420 gallons per minute draw down was 45 feet.

Well number 39 was completed in July, 1926 to a depth of 216 feet 2 inches. It is of the double-cased gravel-packed type of construction. The outside casing consists of 140 feet of 30-inch pipe, while the inner casing consists of 167 feet 4 inches of 21-inch pipe and 48 feet 10 inches of 21-inch shutter screen. At the time of the initial test, static water level was 126 feet below the surface and when pumping at a rate of 743 gallons per minute a draw down of 18 feet took place.

Well number 40 was finished in September, 1927 to a depth of 212 feet 3 inches. It is of the double-cased gravel-packed type of construction. The outer casing consists of 164 feet of 20-inch pipe and the inner

casing of 192 feet of 12-inch pipe, and 20 feet of 12-inch Ohio Bar screen. At the time of the initial test static water level stood at 130.5 feet below the surface and when pumping at a rate of 485 gallons per minute a draw down of 30 feet took place.

Well number 41 was finished in 1928 to a depth of 224 feet. It is of the double-cased gravel-packed type of construction. The outer casing consists of 139 feet of 24-inch pipe and the inner casing 172½ feet of 16-inch pipe and 52 feet of 16-inch Ohio Angle screen. At the time of the initial test static water level was 143.2 feet and when pumping at a rate of 800 gallons per minute a draw down of 22.4 feet took place.

More recently this well was reconditioned by Layne-Western Company. Upon completion of the work it was found that static water level had receded to 149.7 feet, but that at a pumpage rate of 700 gallons per minute a draw down of only 9.75 feet took place.

Well number 42 was completed in June, 1937 to a depth of 217.5 feet. It is of the double-cased, gravel-packed type of construction. The outer casing consists of 155 feet of 36-inch pipe and the inner casing of 169.5 feet of 26-inch pipe with 50 feet of 26-inch shutter screen. At the time of the initial test static water level was 139.5 and when pumping at a rate of 1000 gallons per minute a draw down of 10 feet took place.

During the fall of 1938 the construction of well number 43 was started by the Layne-Western Company.

The water from well number 41 had a total residue of 336. a total hardness of 279.5, and a content of iron of 1.4 parts per million as shown by analysis of sample number 80001, collected December 28, 1933. The water from the other wells is of a similar character.

Analysis of Sample Number 80001 from Well Number 41.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.4	Sodium Nitrate	$NaNO_3$	.8	.05
Manganese	Mn	0.	Sodium Chloride	$NaCl$	4.7	.27
Silica	SiO_2	11.	Sodium Carbonate	Na_2CO_3	84.8	4.94
Turbidity		6.	Ammonium Carbonate	$(NH_4)_2CO_3$	10.5	.61
Calcium	Ca	59.9	Magnesium Carbonate	$MgCO_3$	109.7	6.40
Magnesium	Mg	31.6	Calcium Carbonate	$CaCO_3$	131.0	7.64
Ammonium	NH_4	3.9	Calcium Silicate	$CaSiO_3$	21.5	1.25
Sodium	Na	38.9	Iron Oxide	Fe_2O_3	2.0	.12
Sulfate	SO_4	trace				
Nitrate	NO_3	.8	Total		365.0	21.28
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.				
Methyl Orange		352.				
Residue		336.				
Total Hardness		279.5				

The water from all wells is piped to the water-works pumping station and iron removal plant where the water is discharged through a perforated pipe (aerator) into an open settling tank. From the settling tank the water is pumped to sand filters and from there it flows by gravity to large ground storage reservoirs.

At the pumping station all the old steam equipment has been removed and service pressure is maintained by centrifugal pumps which take suction from the clear water storage reservoirs.

The pumping equipment consists of:

Two De Laval single-stage centrifugal units rated at 2200 gallons per minute, 3 million gallons per day, when operating at a speed of 1160 revolutions per minute against 127 foot head. These are direct connected on one side to General Electric 100-horsepower electric motors, and on the other side to Sterling 145-horsepower gas engines, as emergency power.

Two De Laval single-stage centrifugal units rated at 1050 gallons per minute, l½ million gallons per day, when operating at a speed of 1720 revolutions against 127-foot head. These are direct connected to Wagner Electric Company 50-horsepower motors.

One Aurora 2-stage centrifugal unit rated at 1450 gallons per minute, 2,000,000 gallons per day. It is direct connected to a Buffalo Gas Engine of 210 horsepower.

One American single-stage centrifugal unit rated at 1050 gallons per minute, 1½ million gallons per day. It is direct connected to an Electric Machinery Company 100-horsepower electric motor which operates at a nominal speed of 1800 revolutions per minute. This unit is used mainly for fire pressure service.

There are about 10,350 service connections and the average daily pumpage is about 3,000,000 gallons per day.

The University of Illinois has its own water supply system. Between the years 1900 and 1936 there have been constructed eleven wells as follows:

Well No.	Date constructed	Diameter at top	Depth	Present condition
1	1900	8	138	Abandoned
2	1900-1901	8	140	Abandoned
3	1904	8	142	Standby
4	1906	12	143	Used for observing water levels
5	1911	12	175	Abandoned
6	1916	24 gravel pack	169	Abandoned and filled 1935
7	1925	24 gravel pack	172	Operating 250 G. P. M.
8	1924	16 gravel pack	232	Abandoned
9	1931	48	251	Operating 150 G. P. M.
10	1935	26 gravel pack	160	Operating 600 G. P. M.
11	1935	20 gravel pack	161'-5"	Operating 600 G. P. M.

Water is pumped from all wells to a coke-tray aerator constructed above an open settling and ground storage reservoir which receives the water after it passes through the aerator. The water is filtered before being discharged into the distribution system.

All the wells, pumping equipment, and filter plant are located in the northerly part of the university campus. On a knoll on the southern part of the campus some 3300 feet from the filter plant is a 500,000-gallon elevated storage tank that maintains pressure in that area. The daily average extraction from the wells is about 850,000 gallons.

Other wells for industrial use have been constructed at the following places:

Illinois Central Railroad roundhouse, three miles north of the city	8	wells
Near the freight house	4	"
Smith Ice Co. plant	2	"
Twin City Ice and Cold Storage Co	3	"
Illinois-Iowa Power Co.	1	"
Gas Plant	1	"
Clifford-Jacobs Forging Co	2	"
Producers Creamery	1	"
Swift Soybean Mill	1	"
Virginia Theater	1	"
Rialto Theater	1	"
Kresge Ten Cent Store	1	"

These wells all obtain water from the same sand and gravel zone from which the University of Illinois and the Illinois Water Service Company secure their water supply.

CHANDLERVILLE (824). Chandlerville is located in the northern part of Cass County about one mile south of Sangamon River. A public water supply consisting of a well, pumping equipment, treatment plant, distribution system, and an elevated tank was installed in 1936.

The well was constructed by the Thorpe Concrete Well Company of Alton, Illinois. It is 32 feet deep and is cased to a depth of 16 feet with solid concrete. Below the concrete casing are 16 feet of Thorpe porous concrete screen. Both casing and screen have inside diameters of 26 inches and outside diameters of 36 inches. An envelop of selected gravel 6½ inches thick was placed around the screen. Water level was 11½ feet below the surface when not pumping and was lowered 8 feet when pumping at 154 gallons per minute. The water temperature was 55½° F.

The well from which the water supply is obtained is located in the southwestern part of the village on the flood plain of Sangamon River and adjacent to the water-works station. Water is pumped by either of two Westco direct-suction centrifugal pumps set in a pit 10 feet deep. These pumps deliver the raw water to the treatment plant for the removal of iron and softening by lime and soda. From the treatment plant the water is delivered by a Westco centrifugal pump to the distribution system, to which is connected a 60,000-gallon elevated storage tank.

Shortly after the completion of the system it was reported there were 99 service connections and a daily consumption of from 12,000 to 14,000 gallons.

The raw well water had a total residue of 620, a total hardness of 507, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 78365, collected July 10, 1936.

Analysis of Sample Number 78365 of Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	62.0	3.62
(filtered)		0.3	Magnesium Nitrate	$Mg(NO_3)_2$	11.9	0.69
(unfiltered)		0.3	Magnesium Chloride	$MgCl_2$	34.8	2.03
Manganese	Mn	0.5	Magnesium Sulfate	$MgSO_4$	191.5	11.16
Silica	SiO_2	10.0	Calcium Sulfate	$CaSO_4$	29.3	1.71
Turbidity		0.0	Calcium Carbonate	$CaCO_3$	282.0	16.42
Calcium	Ca	121.5	Ferric Oxide	Fe_2O_3	0.4	0.02
Magnesium	Mg	49.5	Manganese Oxide	MnO	0.6	0.03
Sodium	Na	16.8	Silica	SiO_2	10.0	0.58
Sulfate	SO_4	173.5				
Nitrate	NO_3	55.3	Total		622.5	36.26
Chloride	Cl	26.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		620.0				
Total Hardness		507.0				

CHAELESTON (8012) (p. 708). The raw water supply for the city of Charleston is obtained from Embarrass River. The water is treated before entering the distribution system.

CHATHAM (883). Chatham purchases water from the city of Springfield. The distribution system was installed in 1935.

CHATSWORTH (981) (p. 130). No reported change.

CHENOA (1325) (p. 132). No changes have been made at the water works except the removal of the air lift and the installation of a Cook 2-stroke pump. The pump operates with an 18-inch stroke and has a 5¾-inch diameter cylinder 74 inches long. The bottom of the cylinder is set at a depth of 264½ feet. The pump is belt-driven by a 15-horsepower electric motor.

In 1938 the static water level in the well was 176 feet below the ground surface. There are 165 service connections and the well pump is operated 12 or 13 hours each day.

CHEEKY (636) (p. 13). Conditions regarding the public water supply still remain the same as reported on page 134.

The elevated tank is kept full for fire protection, but no distribution to provide service connections is attempted.

In 1937 interest was revived for a rehabilitation of the water supply system and a location for a new well recommended as to the old well had failed in 1930 due, it was reported, to mining operations.

CHESTER (3922) (p. 708). The raw water supply of the city of Chester is obtained from Mississippi River. The water is treated before entering the distribution system.

CHICAGO (3,376,438) (p. 708). No record of change.

CHICAGO-HEIGHTS (22,321) (p. 136). The source of the public water supply at Chicago Heights is the same as reported on pages 136-139. However, most of the water is now obtained from the wells in the vicinity of the water-works station. The deep well some distance away is seldom used.

CHILLICOTHE (1978) (p. 140). Water for the public supply is obtained from the wells previously described. There are three 4-inch and seven 6-inch wells located in an area about 8 feet wide by 30 to 35 feet long. The water is high enough in the wells to permit pumping by direct suction.

Water is generally pumped by a Jennings centrifugal pump, having a 5-inch suction, a 3-inch discharge, and rated at 210 gallons per minute against 76 pounds pressure per square inch when operating at 1750 revolutions per minute. It is direct connected to a General Electric 25-horsepower electric motor. Water is discharged directly into the distribution system.

Two additional pumps are available for emergency service. The older unit is the 7½ by 8-inch Vaile pump described on page 140. The newer unit is an 8 by 10-inch Smith Vaile triplex pump driven through reduction gears by a Westinghouse 30-horsepower Induction electric motor which operates at a full-load speed of 575 revolutions per minute.

The average daily pumpage in the summer is reported to be 100,000 gallons to 115,000 gallons and in winter from 75,000 gallons to 80,000 gallons.

The water has a total residue of 591.0, a total hardness of 467, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 84168, collected from a tap on the pump discharge pipe August 27, 1938.

Analysis of Sample Number 84168 from City Wells.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	34.0	1.98
(filtered)		0.0	Magnesium Nitrate	$Mg(NO_3)_2$	19.3	1.13
(unfiltered)		0.0	Magnesium Chloride	$MgCl_2$	26.7	1.56
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	189.0	11.02
Silica	SiO_2	20.0	Calcium Sulfate	$CaSO_4$	17.7	1.03
Turbidity		0	Calcium Carbonate	$CaCO_3$	256.2	14.94
Color		0	Silica	SiO_2	20.0	1.17
Odor		Ch-1				
Calcium	Ca	107.6	Total		562.9	32.83
Magnesium	Mg	48.3				
Ammonium	NH_4	trace				
Sodium	Na	9.2				
Sulfate	SO_4	162.9				
Nitrate	NO_3	41.1				
Chloride	Cl	20.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		256.0				
Residue		591.0				
Total Hardness		467.0				

CHRISMAN (1092) (p. 141). The public water supply of Chrisman is now obtained from two wells about 175 feet apart.

Well number 1 is as described on page 141 while well number 2, drilled in 1926 to a total depth of 165 feet, is the northerly one of the two. The new well is cased with 10-inch casing from the surface to the top of the rock at a depth of 132 feet, below this it is 8 inches in diameter to the bottom.

Water is obtained from fine sand on top of the rock. When first constructed well number 2 was equipped with a Cook well screen but as it clogged rapidly it was withdrawn and a length of casing perforated with ½-inch holes was substituted and installed between depths of 116 feet and 132 feet. In June, 1938 static water level in both wells was 128 feet below the surface.

Well number 2 is equipped with an air-lift pump. Air is supplied through a ¾-inch pipe and the water is discharged through a 3-inch eductor pipe, the lower end of which is close to the bottom of the well. Starting pressure is about 80 pounds and operating pressure about 65 pounds per square inch. Air is supplied by a 10-inch by 8-inch Ingersall Band compressor. It was reported that very little sand was pumped from either well.

Water from the wells is discharged into reservoirs as described on page 141. A Camden single-stage centrifugal pump draws water from the reservoirs and discharges it into the distribution system. A 40-horsepower General Electric Company electric motor supplies power for the operation of both of the air compressors and the service pump.

There are about 205 service connections. The high school is the largest customer. The average daily pumpage is about 18,000 gallons.

The minimum rate per month for 2,000 gallons is $1.00 and for each additional 1,000 gallons $0.50.

CHEISTOPHBE (4244) (p. 708). The raw water supply of the city of Christopher is obtained from an impounding reservoir on Brandy Creek. The water is treated before entering the distribution system.

CICEEO (66,602) (p. 708). No record of change.

CISSNA PARK (588) (p. 143). No reported change.

CLARENDON HILLS (933). Clarendon Hills is located in the eastern part of DuPage County on the drainage area of Flag Creek, a tributary of Des Plaines River. A public water supply was installed by a private company in 1923.

Water was secured from a well, 875 feet deep, drilled by F. M. Gray, Jr., in 1923. The well is cased to rock with 140 feet of 8-inch pipe, and through the shale with 202 feet of 6-inch pipe. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	140	140
Limestone, Niagaran	192	332
Shale, Maquoketa	174	506
Limestone, Galena-Platteville	312	818
Sandstone, St. Peter	57	875

Water was pumped from the well to a concrete reservoir by air lift. A Lea Courtenay centrifugal pump was used to pump water from the reservoir to an elevated steel tank connected to the distribution system. In 1932 the water level was at a depth of 95 feet when not pumping and was lowered 270 feet by a pumping rate of 75 gallons per minute.

A new well, 250 feet deep, was drilled by Henry Boysen, Jr., in 1932. It is located about 100 feet west of the old well and is cased 5 feet into rock with 145 feet of 12-inch pipe. The diameter at the bottom of the well is 12 inches. The water level was at a depth of 95 feet when not pumping and was lowered 11½ feet by a pumping rate of 150 gallons per minute.

The well was equipped with a 400-gallon per minute 3-stage Layne turbine pump which iischarged into the suction side of a Fairbanks-Morse centrifugal pump which discharged into the distribution system and an elevated steel tank.

Water from the 250-foot well had a total residue of 645, a total hardness of 531, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 73709, collected October 25, 1933.

Analysis of Sample Number 73709 from Well 250 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Sodium Nitrate	$NaNO_3$	3.4	.20
Manganese	Mn	0.0	Sodium Chloride	NaCl	1.8	.11
Silica	SiO_2	16.0	Sodium Sulfate	Na_2SO_4	78.2	4.56
Turbidity		5.0	Magnesium Sulfate	$MgSO_4$	166.8	9.73
Calcium	Ca	138.0	Magnesium Carbonate	$MgCO_3$	40.0	2.33
Magnesium	Mg	45.3	Calcium Carbonate	$CaCO_3$	318.5	18.58
Ammonium	NH_4	.005	Calcium Silicate	$CaSiO_3$	30.8	1.80
Sodium	Na	26.9	Iron Oxide	Fe_2O_3	1.4	.08
Sulfate	SO_4	186.0				
Nitrate	NO_3	2.7	Total		640.9	37.39
Chloride	Cl	1.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		366.0				
Residue		645.0				
Total Hardness		531.0				

In 1933 much trouble was caused by the growth of crenothrix in the mains which had been stimulated by the high iron content in the water. Since that time a treatment plant has been constructed. At present the water is filtered through two pressure filters and partially softened by passing part of the water through a zeolite softener.

CLINTON (5920) (p. 144). The water-works station has undergone considerable changes since last reported. The old pumping station has been removed and a new one erected on the same property.

Water is now obtained from three wells. Well number 1, located in the southeast corner of the new pumping station, is 12 inches in diameter by 332 feet deep. It is equipped with a Peerless deep-well turbine pump driven by a Westinghouse, 15-horsepower electric motor operating at a full load speed of 1,765 revolutions per minute. A produc-

tion rate of 250 gallons per minute is obtained with a draw down of 20 feet from a static water level of 150 feet below pump room floor.

Well number 2, located in a small building southwest of the main pumping station, is 12 inches in diameter by 360 feet deep. It is equipped with a Peerless deep-well turbine pump, rated at 250 gallons per minute, driven by a Westinghouse 15-horsepower electric motor operating at a full load speed of 1,765 revolutions per minute.

Well number 3, located west of the main pumping station about on the center line of Quincy Street extended and housed in a small building, is 14 inches in diameter by 360 feet deep. It is equipped with a Peerless deep-well turbine pump, rated at 500 gallons per minute, driven by a Westinghouse 30-horsepower electric motor operating at a full load speed of 1,770 revolutions per minute.

The water from all three wells is discharged over a coke-tray aerator from whence it flows to the ground storage reservoir. Three electric motor-driven centrifugal service pumps located in the basement of the pumping station take suction from the ground reservoir and discharge into the distribution system. The three pumps are, a single-stage centrifugal pump rated at 350 gallons per minute powered by a 30-horsepower electric motor, a single-stage centrifugal pump rated at 350 gallons per minute powered by a 40-horsepower electric motor, and a single-stage centrifugal pump rated at 1,000 gallons per minute powered by a 60-horsepower electric motor.

The water contains 7.4 cubic feet of methane gas per 1,000 gallons.

COAL CITY (1637) (p. 146). The 7-inch well 350 feet deep which furnished water for Coal City in 1924 was abandoned and filled in 1927. The pump pit in the old pumping station was converted into a ground storage reservoir.

In 1925 C. S. Cumming of Gardner drilled a well now known as number 1 for the city at a point 8 feet from the well in use at that time. This well passed through a mine working at a depth of 114 feet and entered fractured limestone at a depth of 215 feet. It is cased with 12-inch pipe to a depth of 40 or 45 feet and with 10-inch wrought iron pipe from the surface to a depth of 190 feet through Maquoketa shale. The hole was reduced to 8 inches at 215 feet and finished at about 265 feet. Six feet of 6-inch casing was placed to hold out a bit which was lost at a depth of approximately 256 feet.

The well was equipped with a 7½-inch double-acting American deep-well pump with the cylinder placed at a depth of 44 feet, and 20 feet of suction pipe below the cylinder. The pump discharges between 250 and 300 gallons per minute. Static water level in 1925 was reported to be 47 feet below the ground level.

During 1937 the W. L. Thorne Company of Des Plaines enlarged the well drilled in 1925 (well number 1) and drilled a second well about 30 feet east of it.

Well number 1 was reamed to the following dimensions: 30 inches to a depth of 30 feet; 20 inches to a depth of 214 feet; and 10 inches to 260 feet. A 20-inch and 10-inch casing were set from the surface to a depth of 214 feet and the annular space was filled with cement.

The well is not equipped with a pump, but a new American Well Works turbine will be installed.

Well number 2 is 360 feet deep and cased similarly to well number 1. The inner casing is 12 inches in diameter and 213 feet long. The outer casing is 20 inches in diameter and extends to a depth of 200 feet. The annular space between the two casings is filled with concrete. There is also a 30-foot length of 24-inch drive pipe which is not cemented. Static water level was 69 feet below the ground level and the draw down was 42 feet when pumping at a rate of 700 gallons per minute.

A 12-inch American turbine pump rated at 500 gallons per minute against a head of 240 feet is installed in the well. The pump is driven by a 50-horsepower U. S. electric motor.

Water is furnished to the village of Eileen, two clothing factories and the Atlas Wall Paper Mill. There are 700 service connections and the average daily use is 156,000 gallons. Water is sold at a flat rate of 50 cents per month to residences, $1.00 per month to garages, and proportionately higher rates to factories.

A blue-print log furnished by the State Geological Survey shows that the following strata were penetrated:

Glacial drift . . . . . 40 feet
Coal measures . . . . . 115 feet, sandstone, limestone and shale
Maquoketa . . . . . 60 feet, shale
Galena . . . . . 145 feet, limestone

Water from well number 2 had a total residue of 1614. a total hardness of 511, and a content of iron of 2.8 parts per million as shown by the analysis of sample number 83926, collected July 21, 1938.

Analysis of Sample Number 83926 from Well Number 2.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	.10
(filtered)		.06	Sodium Chloride	NaCl	426.8	24.88
(unfiltered)		2.8	Sodium Sulfate	Na_2SO_4	603.0	35.15
Manganese	Mn	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	5.9	.34
Silica	SiO_2	18.0	Magnesium Sulfate	$MgSO_4$	192.0	11.20
Turbidity		18.0	Magnesium Carbonate	$MgCO_3$	63.7	3.71
Color		0.0	Calcium Carbonate	$CaCO_3$	288.7	16.83
Odor		Cs-1	Iron Oxide	Fe_2O_3	0.1	.01
Calcium	Ca	115.5	Silica	SiO_2	18.0	1.05
Magnesium	Mg	57.2				
Ammonium	NH_4	1.7	Total		1,599.9	93.27
Sodium	Na	364.0				
Sulfate	SO_4	565.1				
Nitrate	NO_3	1.1				
Chloride	Cl	259.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		364.0				
Residue		1,614.0				
Total Hardness		511.0				

COAL VALLEY (306). Coal Valley is located in the eastern part of Eock Island County about three miles south of Eock River. A

public water supply was installed by the village in 1902. It consisted of a well, a deep-well pump driven by a one-cylinder semi-diesel engine, a 14,000-gallon elevated tank, and a distribution system.

Water for the public supply is obtained from a well located in the western part of the village about one block south of the railroad tracks. The well is 375 feet deep and 8 inches in diameter to a depth of 150 feet and 6 inches in diameter below that depth. The static water level in the well is about 50 feet below the top of the casing.

The well is equipped with a deep-well cylinder pump driven by a 5-horsepower electric motor. The 3¼-inch diameter cylinder is set at a depth of 100 feet and the pump operates with a 24-inch stroke at a rate of 32 strokes per minute.

There are only 15 or 16 service connections and daily pumping is necessary only during the summer.

Sample number 83365 was collected April 21, 1938 from a tap in a house near the well. Analysis of the sample shows the water to have a total residue of 425, a total hardness of 192.5, and a content of iron of 0.4 parts per million.

Analysis of Sample Number 83365 from Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.3	0.25
(filtered)		0.1	Sodium Chloride	NaCl	6.6	0.38
(unfiltered)		0.4	Sodium Sulfate	Na_2SO_4	48.8	2.73
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	181.8	10.60
Silica	SiO_2	11.0	Magnesium Carbonate	$MgCO_3$	70.7	4.12
Turbidity		4.0	Calcium Carbonate	$CaCO_3$	108.7	6.24
Color		0.0	Iron Oxide	Fe_2O_3	0.1	0.01
Odor		0.0	Silica	SiO_2	11.0	0.64
Calcium	Ca	43.4				
Magnesium	Mg	20.4	Total		432.0	24.97
Ammonium	NH_4	trace				
Sodium	Na	97.6				
Sulfate	SO_4	31.6				
Nitrate	NO_3	3.4				
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		364.0				
Residue		425.0				
Total Hardness		192.5				

COBDEN (1036). Cobden is located in the northern part of Union County on the drainage area of Cache River, a tributary of Ohio River.

Water for the public supply, installed by the village in 1934, is obtained from a well, in the southeastern part of the village, drilled in 1934 by C. W. Haverstick of DeSoto, Missouri. It is 227 feet deep and the 8-inch casing extends from 3¾ feet above to 146¼ feet below the ground surface. Bedrock was encountered six feet below the surface.

The water level was at a depth of 87 feet when not pumping and was lowered 14½ feet by a pumping rate of 190 gallons per minute.

The well is equipped with a 6-stage 8-inch Cook turbine pump having 175 feet of column pipe and 20 feet of suction pipe. The over-all length of the bowl assembly is about 4 feet. The pump is direct connected to a 10-horsepower electric motor operating at a speed of 1760 revolutions per minute. Water is pumped from the well to a small concrete storage reservoir. From here it passes through a pressure type zeolite softening plant before reaching the distribution system. A reinforced concrete reservoir of 124,000 gallons capacity is connected to the mains and is located on a hill in the northeastern part of the village. Two service pumps are available, each being a Goulds centrifugal pump rated at 100 gallons per minute. One of these is driven by a 10-horsepower electric motor and the other by a 4-cylinder gasoline engine.

Water from the well had a total residue of 281, a total hardness of 245.5 parts per million, and a trace of iron as shown by the analysis of sample number 74748, collected June 25, 1934.

Analysis of Sample Number 74748 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Nitrate	$NaNO_3$	2.6	0.15
Manganese	Mn	0.0	Sodium Chloride	NaCl	6.4	0.37
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	18.5	1.08
Turbidity		10.0	Magnesium Sulfate	$MgSO_4$	29.5	1.72
Calcium	Ca	68.0	Magnesium Carbonate	$MgCO_3$	43.0	2.51
Magnesium	Mg	18.3	Calcium Carbonate	$CaCO_3$	155.0	9.04
Ammonium	NH_4	0.7	Calcium Silicate	$CaSiO_2$	17.4	1.02
Sodium	Na	9.2				
Sulfate	SO_4	36.0	Total		272.4	15.89
Nitrate	NO_3	1.8				
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		206.0				
Residue		281.0				
Total Hardness		245.5				

COLCHESTER (1342). Colchester is located in the western part of McDonough County on the drainage area of LaMoine River (Crooked Creek), a tributary of Illinois River. A public water supply was installed by the city in 1935. Previous to that time a number of the business houses had been furnished with water from an abandoned mine shaft.

Water for the public supply is obtained from a dug well located at the intersection of Fulton and George Streets in the southeastern part of the city. The well is 75½ feet deep, measured from the pump base, and is 6 feet in diameter. The walls are of brick. Shale was found at a depth of 30 feet, coal at 40 feet, and more shale at 42 feet.

The water level was at a depth of 27 feet and was lowered 16½ feet by a pumping rate of 133 gallons per minute.

The well is equipped with a 5-stage Sterling turbine pump with the bottom of the bowls at a depth of 70 feet. The pump-house also

contains a coke-tray aerator with collecting basin and a pressure type zeolite softener.

The raw water had a total residue of 542, a total hardness of 398.5, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 76801, collected October 10, 1935.

Analysis of Sample Number 76801 from City Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(unfiltered).....	0.3	Sodium Nitrate.....$NaNO_3$	0.9	.05
Manganese..Mn	0.0	Sodium Chloride.....NaCl	18.1	1.05
Silica.....SiO_2	10.0	Sodium Sulfate.....Na_2SO_4	95.2	5.55
Turbidity.....	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	0.7	0.04
Calcium.....Ca	95.8	Magnesium Sulfate.....$MgSO_4$	12.7	0.74
Magnesium..Mg	38.6	Magnesium Carbonate..$MgCO_3$	125.2	7.30
Ammonium..NH_4	0.2	Calcium Carbonate.....$CaCO_3$	239.8	13.97
Sodium.....Na	38.2	Iron Oxide.....Fe_2O_3	0.4	0.02
Sulfate.....SO_4	75.0	Silica.....SiO_2	10.0	0.58
Nitrate.....NO_3	0.6			
Chloride.....Cl	11.0	Total.....	503.0	29.30
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	388.0			
Residue.....	542.0			
Total Hardness....	398.5			

COLFAX (803) (p. 148). The 6-inch well at Colfax has been abandoned and the pump removed. The 10-inch well was equipped in 1931 with a 6-inch, 5-stage, Pomona turbine pump attached to 70 feet of column pipe and with 12 feet of suction pipe below the bowls. The pump is driven by a 15-horsepower Westinghouse motor.

During July, 1938 there were 170 service connections in use. Five hours of pumping at a rate of about 100 gallons per minute is required to meet the demand during the summer months.

COLLINSVILLE (9235) (p. 149). The city water works is located in the S. E. ¼ of Section 31, T. 3 N., E. 8 W., south of State highway route 40 about 1500 feet west of its intersection with State highway route 157.

Water is obtained from three large diameter wells made by enlarging some of the 10-inch wells described on page 151. The 26-inch inside diameter well constructed by the Casing and Strainer Manufacturing Company, described on page 151, has been abandoned and the pump removed, but it has not been filled.

The wells now in service are located along a southeast, northwest line and are numbered consecutively from the southeast to the northwest. They were all installed between 1923 and 1928.

Well number 2 is the oldest well. It is 100 feet deep, 26 inches inside diameter and cased with concrete 5 inches thick. Water is ad-

mitted to the well through a porous concrete screen 30 feet long. This well was constructed by Parker of St. Louis.

Wells numbers 1 and 3 were constructed by Wise of St. Louis. They are 24 inches inside diameter, 100 feet deep and cased to a depth of 70 feet, below which depth is 30 feet of Cater screen.

Well number 1 is now equipped with an Aurora deep-well turbine pump-head fitted with a number 14 Johnson Pump Company 4-stage pump driven by a 50-horsepower Wagner electric motor. The top of the bowls is set at a depth of 70 feet, there being no suction pipe below the bowls. The reported rate of delivery of the installation is 1200 gallons per minute.

Well number 2 is equipped with a Byron-Jackson turbine pump, size 800. The pump assembly consists of 70 feet of column pipe, four bowls and no suction pipe. The pump was installed in 1926 and is reported to deliver 800 gallons per minute. It is driven by a 25-horsepower General Electric motor.

Well number 3 is equipped with a Byron-Jackson turbine pump-head originally installed in 1926. A new pump assembly consisting of 70 feet of column pipe and three bowls of a number 14 Johnson Pump Company pump with no suction pipe was installed in 1937. The pump is driven by a Wagner 40-horsepower electric motor and reported to deliver 1200 gallons per minute.

All the well pumps discharge to a ground storage reservoir with a capacity of 35,000 gallons. Water is pumped from the ground storage reservoir to the distribution system and 250,000-gallon elevated tank by any one of four pumps of the following descriptions:

A Dayton Dowd 2-stage, size 6 centrifugal pump rated at 1200 gallons per minute against a head of 370 feet, driven by a diesel engine. This is an emergency unit.

A Dayton Dowd 2-stage, size 5 centrifugal pump rated at 850 gallons per minute against a head of 350 feet, driven by a 100-horsepower Westinghouse electric motor.

A Worthington Duplex pump, size 8 by 12-inch, driven by a 75-horsepower Allis-Chalmers electric motor. This pump is reported to deliver 850 gallons per minute.

A Worthington Duplex pump, size 11¾ by 18-inch, driven by a 200-horsepower Wagner electric motor. This pump is reported to deliver 1350 gallons per minute.

There are 2400 service connections. The average daily usage is between 1½ and 2 million gallons. Water is sold at the rates given on page 150.

The water had a total residue of 415, a total hardness of 351, and an iron content of 0.7 parts per million as shown by the analysis of sample number 74365, collected on April 12, 1934.

Analysis of Sample Number 74365 from City Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.3	.25
(filtered)		trace	Sodium Chloride	NaCl	3.5	.20
(unfiltered)		0.7	Sodium Sulfate	Na_2SO_4	20.6	1.21
Manganese	Mn	0.45	Magnesium Sulfate	$MgSO_4$	83.1	4.84
Silica	SiO_2	9.0	Magnesium Carbonate	$MgCO_3$	55.7	3.25
Turbidity		5	Calcium Carbonate	$CaCO_3$	216.2	12.61
Calcium	Ca	86.5	Manganese Oxide	MnO	0.6	.03
Magnesium	Mg	32.8	Silica	SiO_2	9.0	.52
Ammonium	NH_4	trace				
Sodium	Na	9.2	Total		393.0	22.91
Sulfate	SO_4	80.1				
Nitrate	NO_3	3.0				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		415.0				
Total Hardness		351.0				

COLUMBIA (1791). Columbia is located in the northern part of Monroe County about 4 miles east of the Mississippi River. A public water supply was installed in 1928 after several years of contemplation and various attempts to secure an adequate supply of water.

In 1913 a test well 45 feet deep was drilled in the southwestern part of the city. This yielded about 10 gallons per minute. A year later an old mine shaft near the test well was cleaned out and prepared for a pumping test. It yielded about 42 gallons per minute.

When the system was completed in 1928 water was secured from two dug wells each 44 feet deep and 6 feet in diameter, located near the old mine shaft. The wells were pumped by suction. The combined yield was about 75 gallons per minute. The water had a total residue of 725, a total hardness of 483.5, and a content of iron of 2.8 parts per million as shown by the analysis of sample number 62819, collected October 17, 1928.

In 1937 the use of the wells was discontinued. Since that time all water for the public supply has been purchased from the village of Dupo, which buys water from the East St. Louis and Interurban Water Company.

Analysis of Sample Number 62819 from Wells 44 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	2.8	Potassium Nitrate	KNO_3	6.4	0.37
Manganese	Mn	0.0	Potassium Chloride	KCl	4.3	0.25
Turbidity		50.0	Sodium Chloride	NaCl	75.9	4.44
Silica	SiO_2	26.5	Sodium Sulfate	Na_2SO_4	46.8	2.74
Nonvolatile		4.1	Ammonium Sulfate	$(NH_4)_2SO_4$	0.5	0.03
Alumina	Al_2O_3	1.5	Magnesium Sulfate	$MgSO_4$	82.7	4.84
Calcium	Ca	127.5	Magnesium Carbonate	$MgCO_3$	84.1	4.92
Magnesium	Mg	40.2	Calcium Carbonate	$CaCO_3$	324.4	18.97
Ammonium	NH_4	0.1	Silica	SiO_2	26.5	1.54
Potassium	K	4.7	Iron Oxide	Fe_2O_3	4.0	0.23
Sodium	Na	44.2	Alumina	Al_2O_3	1.5	0.09
Sulfate	SO_4	100.0	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	4.0	Nonvolatile		4.1	0.24
Chloride	Cl	49.0				
Alkalinity as $CaCO_3$ Phenolphthalein			Total		661.2	38.66
Methyl Orange		432.0				
Residue		725.0				

COMPTON (277) (p. 152). No reported change.

CRESCENT CITY (304) (p. 153). In 1934 P. P. Campbell drilled a well for Crescent City. This well is 4 inches in diameter, 122 feet deep, and is located about 4 feet east of the old 120-foot well. The old well has been abandoned and plugged.

Water from the new well flows under artesian pressure into the ground storage reservoir. It is reported that when the water in the reservoir is low, water from the 4-inch pipe from the well shoots out about 2 feet horizontally.

Water is pumped from the reservoir into the distribution system and elevated tank by a Kewanee Private Utility Co. 4-inch triplex pump powered by a 7½-horsepower Imperial electric motor.

CRESTON (315) (p. 154). No reported change.

CRETE (1429) (p. 155). The wells previously described are still in use. In 1937 the old well, known as number 1 and 192 feet deep, was equipped with a 30-stage, 6-inch Pomona turbine pump having 90 feet of column pipe and 10 feet of suction pipe. The pump is rated at 175 gallons per minute against a 190-foot head and is driven by a 15-horsepower electric motor. Nearly all water for the public supply has been obtained from this well since the installation of the new pump.

Well number 2, which is 264 feet deep, is equipped with a Keystone Driller Company 2-stroke deep-well pump driven by a 15-horsepower electric motor. The cylinder is 7½ inches in diameter and is set at a depth of 90 feet. The pump operates with an 18-inch stroke at a rate of 25 revolutions per minute. This well is located about 70 feet south of well number 1, and furnished all water for the public supply from 1925 to 1937. At the present time it is seldom used.

CEEVE COEUR (350). Creve Coeur is located in the northwestern part of Tazewell County on the east bank of the Illinois River. A rapid growth in population occurred after 1934 and in 1938 the population was estimated to be about 4000. The installation of a public water supply by the village was completed in 1938.

Water is obtained from a well located on bottom land near the southwestern part of the village. The well was drilled in 1937 by Mike Ebert of Washington and is 91 feet deep, 15 inches in diameter, and equipped with 20 feet of Johnson screen. The upper half of the screen has number 20 slot openings and the lower half has number 25 slot openings. The water level was reported to be at a depth of 19 feet when not pumping and at a depth of 30 feet when pumping 200 gallons per minute.

The well is equipped with a 20-stage, 8-inch Fairbanks-Morse turbine pump having 30 feet of 6-inch column pipe and 10 feet of 6-inch suction pipe. The over-all length of the bowl assembly is 15 feet. The pump discharges 290 gallons per minute to the distribution system and is driven by a 40-horsepower electric motor.

A 100,000-gallon elevated steel tank, located on high ground near the center of the village, is connected to the distribution system. The system consists of 3000 feet of 8-inch mains, 30,000 feet of 6-inch mains, and 39,000 feet of 4-inch mains. All mains are Transite pipe.

In 1938 there were 750 service connections in use and the daily pumpage was about 75,000 gallons. None of the services are metered. A flat rate of $1.67 per month is charged, with 10 per cent discount for prompt payment.

Water from the well had a total residue of 647, a total hardness of 485.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 83853, collected July 21, 1938. The temperature of water from a test well at the same location was 53° F. on December 6, 1937.

Analysis of Sample Number 83853 from Village Well.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	0.0
Manganese..Mn	0.0
Silica.....SiO_2	22.0
Turbidity.....	0.0
Color.....	0.0
Odor.....	0.0
Calcium.....Ca	111.3
Magnesium..Mg	50.5
Ammonium..NH_4	trace
Sodium.....Na	22.5
Sulfate.....SO_4	198.6
Nitrate.....NO_3	5.7
Chloride.....Cl	11.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	308.0
Residue.....	647.0
Total Hardness....	485.5

Hypothetical Combinations.

		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	7.7	0.45
Sodium Chloride.....	NaCl	18.1	1.05
Sodium Sulfate.....	Na_2SO_4	41.2	2.40
Magnesium Sulfate.....	$MgSO_4$	214.0	12.48
Magnesium Carbonate..	$MgCO_3$	25.3	1.47
Calcium Carbonate.....	$CaCO_3$	278.1	16.22
Silica.....	SiO_2	22.0	1.28
Total.....		606.4	35.35

CEOTTY (SENECA) (1185). Crotty is located in the eastern part of LaSalle County on bottom land of Illinois River.

Water for the public supply, installed by the village in 1927, is obtained from a well located about one block east of the center of the business district, drilled in that year by Otis Heflin of Joliet. It is 700 feet deep and 10 inches in diameter. It is cased to a depth of 132 feet with 10-inch wrought iron pipe. The elevation at the top of the well is about 510 feet above sea level. A record of material penetrated is as follows:

	Thickness in feet	Depth in feet
Surface	25	25
Shale	22	47
Clay	15	62
Shale	28	90
Clay	12	102
Coal	3	105
Clay	12	117
Shale	11	128
Limestone	92	220
Sandstone	205	425
Chert	10	435
Dolomite	90	525
Sandstone	175	700

The natural flow at the top of the well was 30 gallons per minute. The water level was lowered to a depth of 47 feet by a pumping rate of 190 gallons per minute. No water was encountered above the limestone.

The well is equipped with a Keystone 2-stroke, deep-well pump having a 7¾-inch diameter cylinder and 18-inch stroke driven by a 20-horsepower electric motor.

The water had a total residue of 670, a total hardness of 342, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 61240, collected February 25, 1928.

Analysis of Sample Number 61240 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	1.0	.06
Manganese	Mn	0.0	Potassium Chloride	KCl	25.1	1.47
Turbidity		0.0	Sodium Chloride	NaCl	206.2	12.06
Silica	SiO_2	9.2	Sodium Sulfate	Na_2SO_4	105.5	6.18
Nonvolatile		1.5	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Alumina	Al_2O_3	0.7	Magnesium Sulfate	$MgSO_4$	65.3	3.82
Calcium	Ca	74.0	Magnesium Carbonate	$MgCO_3$	89.8	5.25
Magnesium	Mg	38.3	Calcium Carbonate	$CaCO_3$	188.9	11.05
Ammonium	NH_4	0.5	Silica	SiO_2	9.2	.54
Potassium	K	13.3	Iron Oxide	Fe_2O_3	0.1	.01
Sodium	Na	112.8	Alumina	Al_2O_3	0.7	.04
Sulfate	SO_4	127.8	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.6	Nonvolatile		1.5	.09
Chloride	Cl	140.0				
Alkalinity as $CaCO_3$			Total		695.3	40.69
Phenolphthalein		0.0				
Methyl Orange		302.0				
Residue		670.0				
Total Hardness		342.0				

An iron removal plant was built in 1935. Water is pumped over an aerator into a concrete storage reservoir. Prom the reservoir it is pumped through pressure filters into an elevated steel tank connected to the mains. An Allis-Chalmers centrifugal pump rated at 125 gallons per minute against a head of 150 feet and driven by a 7½-horsepower electric motor is used to pump the water through the filters.

CRYSTAL LAKE (3732) (p. 157). A new well was drilled in 1928 by the W. L. Thorne Company. It is located near the intersection of Franklin and College Streets and is 2000 feet deep. It is cased with 20-inch pipe to a depth of 234 feet, with 16-inch pipe from 205 to 242½ feet, with 10-inch pipe from 235 to 569 feet, and with 8-inch pipe from 748 to 964 feet. The diameter at the bottom of the well is 8 inches. The elevation of the ground surface is about 915 feet above sea level. A record of material penetrated is as follows :

	Thickness in feet.	Depth in feet.
Drift	231	231
Dolomite, Niagaran	124	355
Shale, Maquoketa	194	549
Dolomite, Galena-Platteville	226	775
Dolomite, sandstone, Glenwood	45	820
Sandstone, St. Peter	110	930
Dolomite, sandstone, Jordan	60	990
Dolomite, Trempealeau	70	1060
Dolomite, sandstone, Mazomanie	115	1175
Sandstone, Dresbach	155	1330
Shale, sandstone, dolomite, Eau Claire	395	1725
Sandstone, Mt. Simon	275	2000

The water level was at a depth of 200 feet when not pumping and was lowered 69 feet by a pumping rate of 318 gallons per minute. Very little water was obtainable from the St. Peter sandstone.

The water had a total residue of 331, a total hardness of 139, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 70266, collected February 1, 1932.

Analysis of Sample Number 70266 from Well 2000 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.2	Sodium Chloride	NaCl	6.4	.37
Manganese	Mn	.0	Sodium Carbonate	Na_2CO_3	153.2	8.93
Silica	SiO_2	13.0	Ammonium Carbonate	$(NH_4)_2CO_3$	6.2	.36
Calcium		25.8	Magnesium Carbonate	$MgCO_3$	62.8	3.66
Magnesium	Mg	18.1	Calcium Carbonate	$CaCO_3$	64.6	3.77
Ammonium	NH_4	.2	Iron Oxide	Fe_2O_3	.3	.02
Sodium	Na	69.0	Manganese Oxide	MnO	0.0	0.00
Sulfate	SO_4	0.0	Silica	SiO_2	13.0	.76
Nitrate	NO_3	0.0				
Chloride	Cl	4.0	Total		306.5	17.87
Alkalinity as $CaCO_3$						
Phenolphthalein		8.0				
Methyl Orange		290.0				
Residue		331.0				
Total Hardness		139.0				

CUBA (1479) (p. 159). No changes reported.

An analysis of sample number 68129 collected December 4, 1930 shows a total residue of 2467, a total hardness of 703, and an iron content of 1.2 parts per million.

CULLOM (489) (p. 161). The latest report indicates that the village well is 1670 feet deep and that prior to 1930 the pumping equipment was changed to an American Well Works double-acting deep-well pump having a 5¾-inch diameter cylinder and 24-inch stroke. The working barrel which is 60 inches long is attached to the bottom of nine lengths of 6-inch drop pipe, which approximates 180 feet. On the bottom of the cylinder is 20 feet of 5-inch suction pipe.

The water is much more highly mineralized than in 1916. Sample number 67046, collected July 29, 1930, had a total residue of 2267, a total hardness of 137, and a content of iron of 0.8 parts per million as shown by the analysis.

Analysis of Sample Number 67046 from Well 1670 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.8	Sodium Chloride	NaCl	1,776.6	103.60
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	73.1	4.27
Turbidity		10.0	Sodium Carbonate	Na_2CO_3	275.3	16.05
Silica	SiO_2	13.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.4	.08
Calcium	Ca	30.4	Magnesium Carbonate	$MgCO_3$	51.4	3.00
Magnesium	Mg	14.9	Calcium Carbonate	$CaCO_3$	76.0	4.43
Ammonium	NH_4	0.6	Iron Oxide	Fe_2O_3	1.1	.06
Sodium	Na	842.0	Manganese Oxide	MnO	0.0	.00
Sulfate	SO_4	49.4	Silica	SiO_2	10.0	.58
Nitrate	NO_3	0.0				
Chloride	Cl	1,077.0	Total		2,264.9	132.07
Alkalinity						
Phenolphthalein		0.0				
Methyl Orange		398.0				
Residue		2,267.0				
Total Hardness		137.0				

DALLAS CITY (1114) (p. 708). The raw water supply of the city of Dallas City is obtained from Mississippi River. The water is treated before entering the distribution system.

DANFORTH (369) (p. 162). Well number 1, 1250 feet deep, is still in use. Well number 2 is located one block north of number 1 and is 164 feet deep and 4 inches in diameter. It is cased to rock at a depth of about 125 feet with 4-inch pipe. Water from this well is pumped to the reservoir beside the old deep well. Well number 2 is equipped with a Deming deep-well cylinder pump driven by a 3-horsepower electric motor.

Well number 3 is located one block west of number 2 and is 100 feet deep and 4 inches in diameter. Although water is obtained from a gravel deposit the well is not equipped with a screen. A Deming deep-well cylinder pump driven by a 2-horsepower electric motor discharges into the distribution system.

Both shallow wells were drilled by Lars Jensen of Clifton.

Water from well number 2 had a total residue of 1125, a total hardness of 419, and a content of iron of 0.8 parts per million as shown by the partial analysis of sample number 82389, collected November 16, 1937. Water from well number 3 had a total residue of 607, a total hardness of 163, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 82388, collected the same day.

Analysis of Sample Number 82388 from Well 100 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	.10
(filtered).....	0.0	Sodium Chloride.....NaCl	303.0	17.66
(unfiltered).....	0.6	Sodium Sulfate.....Na_2SO_4	2.8	.16
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	134.2	7.82
Silica.....SiO_2	12.0	Ammonium Carbonate..$(NH_4)_2CO_3$	2.4	.14
Turbidity.....	3.0	Magnesium Carbonate..$MgCO_3$	62.8	3.66
Color.....	0.0	Calcium Carbonate.....$CaCO_3$	88.4	5.16
Odor.....	Bsl	Silica.....SiO_2	12.0	.70
Calcium.....Ca	35.3			
Magnesium..Mg	18.1	Total.....	607.3	35.40
Ammonium..NH_4	0.8			
Sodium.....Na	178.8			
Sulfate.....SO_4	2.1			
Nitrate.....NO_3	1.0			
Chloride.....Cl	184.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	292.0			
Residue.....	607.0			
Total Hardness....	163.0			

DANVEKS (601) (p. 164). No record of change.

DANVILLE (36,765) (p. 708). The raw water supply of the city of Danville is obtained from an impounding reservoir on North Fork of Vermilion River. The water is treated before entering the distribution system.

DE LAND (474) (p. 173). For many years the citizens of De Land have desired a public water supply. Several wells have been drilled but none of them were satisfactory. Another movement to secure a public water supply was started in 1933. Several test wells were drilled in and near the village and an electrical earth resistivity survey was conducted by the State Geological Survey Division. This work indicated the presence of a thin but fairly widespread deposit of sand and gravel at a depth of about 85 feet.

A permanent well was drilled in the southwestern part of the village near the high school in 1935. Test well number 7 located 15 feet south of the permanent well penetrated water-bearing sand between depths of 76½ and 84 feet. The permanent well is 83 feet deep and of the gravel-walled type. The 26-inch outer casing extends to a depth

of 75 feet. The 12-inch inner casing extends to a depth of 73½ feet. Below this point is a 12-inch, number 60 slot Cook screen.

The water level was at a depth of 18 feet when not pumping and was lowered 45½ feet by a pumping rate of 65 gallons per minute.

Water is pumped from this well with a 6-inch, 12-stage Aurora deep-well turbine pump. The bowl assembly measures 6 feet over-all and is attached to 75 feet of column pipe. One foot of suction pipe is added below the bowls. The pump will deliver 30 gallons per minute when pumping against a total head of 290 feet. The softening and iron removal plant was installed in 1937.

The plant will not be put into service until an aerator has been installed to remove the methane gas from the water. At the present time about 35 services are connected to the distribution system and the average daily consumption is about 10,000 gallons. No charge is made for the water and it is pumped directly from the well to the distribution system.

The water had a total residue of 794, a total hardness of 606, and a content of iron of 8.0 parts per million as shown by the analysis of sample number 76727, collected October 1, 1935 from test well number 7.

Analysis of Sample Number 76727 from Test Well Number 7.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		2.6	0.15
(filtered).....	0.2	Sodium Chloride.....NaCl		8.2	0.48
(settled 1 hr.)....	3.3	Sodium Sulfate.....Na_2SO_4		8.5	0.49
(unsettled).....	8.0	Sodium Carbonate.....Na_2CO_3		134.6	7.84
Manganese..Mn	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$		25.9	1.51
Silica.....SiO_2	20.0	Magnesium Carbonate..$MgCO_3$		238.5	13.90
Turbidity.....	60.0	Calcium Carbonate.....$CaCO_3$		323.3	18.85
Calcium.....Ca	129.2	Iron Oxide.....Fe_2O_3		0.3	0.02
Magnesium..Mg	68.7	Silica.....SiO_2		20.0	1.17
Ammonium..NH_4	9.8				
Sodium.....Na	65.1	Total.....		761.9	44.41
Sulfate.....SO_4	6.0				
Nitrate.....NO_3	1.8				
Chloride.....Cl	5.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	760.0				
Residue.....	794.0				
Total Hardness....	606.0				

The water contains 6.7 cubic feet of methane gas per 1000 gallons.

DECATUR (57,510) (p. 708). The raw water supply of the city of Decatur is obtained from an impounding reservoir on Sangamon River. The water is treated before entering the distribution system.

DEEE CREEK (290) (p. 172). The well and pump described on page 172 have been used very little since 1925, when a new well was drilled by Chris Ebert of Washington. The new well is located 25 feet west of the old well. It is 267 feet deep, 6 inches in diameter, and equipped with 10 feet of 6-inch Cook screen.

Water is pumped from the well to the steel pressure tank by a Goulds deep-well cylinder pump driven by a 10-horsepower oil engine. Nearly all water for the public supply is obtained from this well.

In 1938 there were 74 service connections, of which one-half were metered. The Goulds pump was operated about 3 hours daily, but the total pumpage was not known.

The water had a total residue of 307, a total hardness of 298.5, and an iron content of 1.4 parts per million as shown by the mineral analysis of sample number 84052, collected on August 6, 1938.

Analysis of Sample Number 84052 from Well Drilled in 1925.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	4.2	0.24
(filtered).....	0.0	Magnesium Carbonate..$MgCO_3$	110.0	6.41
(unfiltered).....	1.4	Calcium Carbonate.....$CaCO_3$	171.6	10.00
Manganese..Mn	0.0	Silica.....SiO_2	16.5	0.96
Silica.....SiO_2	16.5			
Turbidity.....	4	Total.....	302.3	17.61
Color.....	0			
Odor.....	0			
Calcium.....Ca	68.5			
Magnesium..Mg	31.7			
Ammonium..NH_4	trace			
Sodium.....Na	1.1			
Sulfate.....SO_4	0.0			
Nitrate.....NO_3	3.1			
Chloride.....Cl	0.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	302.0			
Residue.....	307.0			
Total Hardness....	298.5			

DEERFIELD (1852) (p. 708). Deerfield is supplied with filtered lake water from Highland Park.

DE KALB (8545) (p. 165). Prior to 1926 the water supply for the city of De Kalb was obtained from the three wells described on pages 165, 166 and 167. During that year the W. L. Thorne Company completed well number 4 at the corner of Eighth and Locust Streets to a depth of 1325 feet. The log of the well with classifications furnished by the State Geological Survey is as follows:

	Thickness in feet.	Depth in feet.
Pleistocene—		
Drift	223	223
Galena Platteville—		
Gray limestone	197	420
Blue limestone	15	435
Brown limestone	25	460
Light blue limestone	20	480
Gray limestone	75	555
St. Peter—		
Gray sandstone	15	570
Blue shale	15	585
Shale and lime	15	600
Gray limestone	23	623
St. Peter sandstone	247	870
Prairie du Chien—		
Reddish sandstone	15	885
Red limestone or soapstone	15	900
Reddish limestone	30	930
Gray limestone	15	945
Sandstone, brown	60	1005
Sand and white limestone	15	1020
Gray limestone	60	1080
Mazomanie—		
Brown shale	15	1095
Gray shale and sand	30	1125
Green shale	15	1140
Green shale and sandstone	15	1155
Brown sandstone	30	1185
Dresbach—		
White sandstone	30	1215
Reddish sandstone	15	1230
White sandstone	90	1320
Blue shale or clay	5	1325

The hole was drilled of sufficient size to permit setting 223 feet of 20-inch outside diameter casing from the surface into the top of the limestone. Below this depth the hole was of sufficient size to permit placing of 16-inch outside diameter pipe, a 60-foot length being placed with its bottom in limestone at a depth of 623 feet. Below this depth the hole was of sufficient size to permit placing of 12-inch inside diameter pipe, a 106-foot length being placed with its bottom at a depth of 1155 feet. Below this depth is open hole 12 inches in diameter. When tested, static or non-pumping water level was at a depth of 131 feet. The production of 585 gallons per minute created a draw down of 46.2 feet.

The well is now equipped with a Pomona 8-inch, 8-stage deep-well turbine pump set with the bottom of the lowest bowl at a depth of 271½ feet. There is attached to the bowls 30 feet of 6-inch suction pipe. The pump is powered by a 100-horsepower General Electric Company electric motor and under regular operating conditions delivered about 600 gallons per minute.

The water had a total residue of 304, a total hardness of 287.4 and an iron content of 0.2 parts per million as shown by the analysis of sample number 61711.

Analysis of Sample Number 61711 from Well Number 4.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	5.0	0.29
Turbidity		5.0	Sodium Carbonate	Na_2CO_3	7.9	0.46
Silica	SiO_2	10.0	Ammonium Carbonate	$(NH_4)_2CO_3$	0.8	0.05
Calcium	Ca	57.9	Magnesium Carbonate	$MgCO_3$	120.8	7.07
Magnesium	Mg	34.8	Calcium Carbonate	$CaCO_3$	144.5	8.46
Ammonium	NH_4	0.3	Silica	SiO_2	10.0	0.58
Sodium	Na	5.6	Iron Oxide	Fe_2O_3	0.3	0.02
Sulfate	SO_4	0.0	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.6				
Chloride	Cl	3.0	Total		290.2	16.98
Alkalinity as $CaCO_3$						
Phenolphthalein						
Methyl Orange		296.0				
Residue		304.0				
Total Hardness		287.4				

Well number 1 was reported to be 1331 feet deep in 1913. In 1935 it had filled up until it was only 990 feet deep. In 1936 it was repaired by reaming, shooting and cleaning by W. L. Thorne Company. The diameter is now 15 inches to a depth of 618 feet, 12 inches to 911 feet and 10 inches to 1331 feet. The well is cased as follows:

	From	To
15-inch outside diameter	0	161
14-inch outside diameter	348	368
12-inch inside diameter	479	620
10-inch inside diameter	811	911

It was shot at depths of 725, 1250 and 1300 feet.

The water level was at a depth of 143 feet when not pumping and was lowered 20 feet by a pumping rate of 390 gallons per minute. The well is now reported to be yielding about 800 gallons per minute.

Well number 1 is now equipped with a size 12, American turbine pump, rated at 800 gallons per minute against a head of 260 feet. The pump is driven by a 75-horsepower General Electric motor.

The quality of the water is similar to that shown by analysis numbers 3463 and 3464 on page 167.

Well number 2 is now equipped with a size 10, American turbine pump, rated at 500 gallons per minute against a head of 260 feet. The pump is driven by a 60-horsepower Westinghouse electric motor.

The air lift in well number 3 has been replaced with a size 8, American turbine pump, rated at 250 gallons per minute against a head of 357 feet. The pump is driven by a 30-horsepower U. S. electric motor.

The pumps in wells numbers 1 and 2 discharge to the reservoir on Pearl Street. The pumps in wells numbers 3 and 4 discharge into the distribution system.

Additional industrial wells have been constructed since 1925 as follows: At the Midwest Canning Company are two wells, 1343 and 1345 feet deep.

The 1321-foot well drilled by the W. L. Thorne Company in 1924 and which is mentioned on page 167 was not a city well but was drilled for the Illinois Power Company.

DELAVAN (1084) (p. 173). Water for the Delavan public supply is obtained from the two wells described on page 173. Either well is capable of furnishing enough water for the village. They are pumped alternately for periods of a month.

The west well is equipped with a 12-stage, 8-inch Worthington turbine pump haying 120 feet of 6-inch column pipe, 10 feet of 6-inch suction pipe, rated at 200 gallons per minute, and driven by a 20-horsepower electric motor. The east well is equipped with an 11-stage, 8-inch Worthington turbine pump having 120 feet of 6-inch column pipe, 10 feet of 6-inch suction pipe, rated at 300 gallons per minute, and driven by a 30-horsepower electric motor.

The partial analysis of sample number 82573, collected December 7, 1937, shows the water from the east well to have a total residue of 331, a total hardness of 309.8, and a content of iron of 0.6 parts per million.

DE PUE (2200) (p. 168). The 32-foot well described on page 169 has not been used for several years. In 1938 the use of the 1278-foot well described on page 168 was discontinued and the flow was shut off. This well was recased with 4½-inch pipe in 1928. The free flow from the well was about 100 gallons per minute in 1938.

All water is now obtained from a new well drilled in 1938 by the Sewell Well Company of St. Louis, Missouri. The flow from this well began at a depth of 460 feet and increased as drilling progressed. Salt water was encountered at 680 feet. When the well was 825 feet deep and cased with 10-inch pipe to a depth of 490 feet the flow was estimated to be 75 gallons per minute. At that time the water was very salty, had a total residue of 5501, a total hardness of 169.5, and a content of iron of 0.18 parts per million as shown by the analysis of sample number 83491, collected May 11, 1938. When a depth of 1330 feet had been reached and 1035 feet of 8-inch casing had been set, thereby casing off the salt water, the flow of fresh water was about 90 gallons per minute. The salt water was flowing between the 10-inch and 8-inch casings at a rate of 60 to 75 gallons per minute. When the depth was 1370 feet the flow of fresh water was about 90 gallons per minute and the temperature of the water was 63° F. Drilling was continued to a depth of 1487 feet or almost to the base of the St. Peter sandstone.

The finished well had a shut-in pressure of 38 pounds per square inch at a point 4 feet below the ground surface. The free flow was 147 gallons per minute at a point 4 feet above the surface.

Water from the well flows over an aerator to an 80,000-gallon concrete reservoir constructed in 1928, and is then pumped to the distribution system by one of the Deming triplex pumps described on page 169. Three elevated tanks provide a storage capacity of 181,000 gallons.

Water from the 1487-foot well had a total residue of 960, a total hardness of 218, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 84058, collected August 6, 1938.

Analysis of Sample Number 84058 from Well 1487 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	15.3	0.89
(filtered).....	trace	Sodium Chloride.....NaCl	532.0	31.01
(unfiltered).....	.3	Sodium Carbonate.....Na_2CO_3	101.8	5.93
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	99.5	5.80
Silica.....SiO_2	15.0	Magnesium Carbonate..$MgCO_3$	76.0	4.43
Turbidity.....	5.0	Calcium Carbonate.....$CaCO_3$	128.0	7.46
Color.....	0.0	Silica.....SiO_2	15.0	.87
Odor.....	0.0			
Calcium.....Ca	51.1	Total.....	967.6	56.39
Magnesium..Mg	22.0			
Ammonium..NH_4	trace			
Sodium.....Na	290.5			
Sulfate.....SO_4	67.3			
Nitrate.....NO_3	11.2			
Chloride.....Cl	323.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	314.0			
Residue.....	960.0			
Total Hardness....	218.0			

DES PLAINES (8798) (p. 174). In May, 1927 the capacities of the wells described on page 175 had receded to such an extent that the two shallow wells at the water works station were furnishing only about 5000 gallons per day.

The 1670-foot well, constructed by the W. L. Thorne Company in 1922 and 1923, had been abandoned; and an attempt on the part of the Layne-Bowler Company to develop three wells in sand and gravel had failed. Therefore, arrangements had been made by the village for the use of a well owned by the Chicago and Northwestern Eailroad.

This well is located on the east side of the tracks about 1000 feet south of Thacker Street at what is known as Norma Station on the west edge of the village. It was drilled by J. F. McCarthy of St. Paul in 1913 to a reported depth of 1890 feet deep and was 16 inches in diameter at the top and 8 inches in diameter at the bottom. The well is equipped with a deep-well turbine pump having 280 feet of column pipe and 20 feet of suction pipe. This unit was capable of producing water at a rate of 600 gallons per minute for 8 to 10 hours daily. The average daily production was about 310,000 gallons.

In 1927 a new deep well was completed by William H. Cater, as a private venture, at a site on the north side of Thacker Street about 1000 feet west of the Chicago and Northwestern Eailroad tracks. The ground surface is about elevation 652 and the well was reported to be 1735 feet deep. It is 20 inches in diameter at the top and 10 inches at the bottom. The well was equipped with a deep-well turbine having 300 feet of column pipe and 15 feet of suction pipe. A production of more than 1000 gallons per minute was reported on August 28 and 29, 1928. The water temperature was 62° F.

With the new Cater well in service the use of water from the Norma well was discontinued.

For a few years after the completion of the Cater well the gravel wells at the old water works station were used, but now these have been abandoned and all water for the municipal supply is obtained from the Cater well. The water is softened.

The water from this well had a total residue of 483, a total hardness of 262.0, and an iron content of 0.1 parts per million as shown by the analysis of sample number 62466 collected August 28, 1928.

Analysis of Sample Number 62466 of 1735-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	1.0	.06
Manganese	Mn	0.	Potassium Chloride	KCl	22.6	1.32
Silica	SiO_2	17.4	Sodium Chloride	NaCl	19.4	1.13
Nonvolatile		5.8	Sodium Sulfate	Na_2SO_4	180.4	10.55
Alumina	Al_2O_3	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.7	.10
Calcium	Ca	70.1	Magnesium Sulfate	$MgSO_4$	26.2	1.53
Magnesium	Mg	21.1	Magnesium Carbonate	$MgCO_3$	53.0	3.10
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	170.8	9.99
Potassium	K	12.5	Silica	SiO_2	17.4	1.01
Sodium	Na	67.7	Iron Oxide	Fe_2O_3	0.1	.01
Sulfate	SO_4	140.8	Alumina	Al_2O_3	0.0	.00
Nitrate	NO_3	0.6	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	22.	Nonvolatile		5.8	.34
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		498.4	29.14
Methyl Orange		228.				
Residue		483.				
Total Hardness		262.				

DIVERNON (1170). Divernon purchases water from the city of Springfield. The distribution system was installed in 1935.

DIXMOOE (944). The village of Dixmoor obtains Lake Michigan water from Chicago.

DIXON (9908) (p. 176). No reported change.

DOLTON (2923) (p. 708). No record of change.

DONGOLA (635). Dongola is located in the southern part of Union County on the drainage area of Cache River, a tributary of Ohio lliver.

Water for the public water supply, installed by the village in 1936, is obtained from a well located in the northeastern part of the village. It was drilled in 1935 by C. W. Haverstick of DeSoto, Missouri. It is 301 feet deep and 14 inches in diameter at the bottom. It is cased with 18-inch pipe to a depth of 101 feet.

The water level was at a depth of 26 feet when not pumping and was lowered 83½ feet by a pumping rate of 110 gallons per minute. A long period of pumping was required to clear the well.

The well is equipped with an 18-stage, 8-inch Pomona water-lubricated turbine pump having 200 feet of 6-inch column pipe. The pump is direct-connected to a 25-horsepower electric motor.

The water from the finished well was very similar to water from a test well at the same location which had a total residue of 340, a total hardness of 284, and a content of iron of 11.0 parts per million as shown by the analysis of sample number 76191, collected June 14, 1935. The analysis of a sample collected in 1937 showed the content of iron to be 0.8 parts per million.

Analysis of Sample Number 76191 from Test Well 330 Feet Deep.

Determinations Made.	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	11.0
Manganese..Mn	0.1
Silica.....SiO_2	10.0
Turbidity.....	4,000.0
Color.....	0.0
Odor.....	1 e
Calcium.....Ca	85.2
Magnesium..Mg	17.3
Ammonium..NH_4	0.0
Sodium.....Na	9.7
Sulfate.....SO_4	7.8
Nitrate.....NO_3	11.1
Chloride.....Cl	10.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	274.0
Residue.....	340.0
Total Hardness....	284.0

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	15.3	0.89
Sodium Chloride.....	NaCl	14.0	0.82
Magnesium Chloride....	$MgCl_2$	1.9	0.11
Magnesium Sulfate.....	$MgSO_4$	9.6	0.56
Magnesium Carbonate..	$MgCO_3$	51.4	3.00
Calcium Carbonate.....	$CaCO_3$	213.1	12.42
Iron Oxide.....	Fe_2O_3	0.0	0.00
Manganese Oxide.....	MnO	0.1	0.01
Silica.....	SiO_2	10.0	0.58
Total.....		315.4	18.39

DONOVAN (375). Donovan is located in the northeastern part of Iroquois County on the drainage area of Pike Creek, a tributary to Iroquois River.

In 1906 Mr. Eodiger drilled a well for the village. It is 6 inches in diameter, 130 feet deep, and located about 1800 feet north and 100 feet east of the southwest corner of section 28, township 28 north, range 11 west. Static water level was 40 feet below the ground level. This well was reconditioned in November, 1937 by Ira French of Fairbury.

The well is equipped with a Deming pump with a 4½-inch by 48-inch single acting cylinder. The stroke is 12 inches. The pump cylinder is attached to 84½ feet of drop pipe, and 21 feet of suction pipe is added below the cylinder. The pump delivers about 25 gallons per minute, but the pumping rate can be doubled without pumping air. The pump is driven by a 5-horsepower General Electric motor.

Water is pumped from the well to a steel pressure tank 8 feet in diameter and 40 feet long.

An analysis of sample number 83362, collected April 21, 1938, shows the water to have a total residue of 307, a total hardness of 160.5, and an iron content of 0.8 parts per million.

Analysis of Sample Number 83362 from 130-Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		2.5	.15
(filtered).....	0.06	Sodium Chloride.....NaCl		47.9	2.79
(unfiltered).....	0.8	Sodium Carbonate.....Na_2CO_3		86.4	5.04
Manganese..Mn	0.0	Magnesium Carbonate..$MgCO_3$		56.4	3.29
Silica.....SiO_2	14.0	Calcium Carbonate.....$CaCO_3$		93.5	5.51
Turbidity.....	9	Iron Oxide.....Fe_2O_3		.1	.01
Color.....	0	Silica.....SiO_2		14.0	.82
Odor.....	El				
Calcium.....Ca	37.4	Total.....		300.8	17.61
Magnesium..Mg	16.3				
Ammonium..NH_4	trace				
Sodium.....Na	57.1				
Sulfate.....SO_4	0.0				
Nitrate.....NO_3	1.8				
Chloride.....Cl	29.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	242.0				
Residue.....	307.0				
Total Hardness....	160.5				

DOWNERS GROVE (8977) (p. 178). The 24-inch well, 105 feet deep, drilled in 1925 by the Kelly Well Company and reported on page 179, furnished practically all the water needed by the village of Downers Grove until the summer of 1928. In the meantime a concrete reservoir 103 feet in diameter and a new well 100.6 feet deep were constructed on the same property.

The well was constructed by the American Water Corporation and equipped with an American Well Works deep-well turbine. Two American Well Works centrifugal pumps, each rated at 1000 gallons per minute, were housed in the pump-house with the well. One pump was driven by an electric motor and the other by a gasoline engine. They pumped water from the reservoir into the distribution system.

In 1928 the American Water Corporation completed a well at a site on the west side of Lee Avenue about 750 feet south of the Chicago, Burlington and Quincy Eailroad.

The well is cased with 68 feet of 30-inch casing extending from the ground surface to the top of the limestone. Below the casing the well is 24 inches in diameter to the top of the shale at a depth of 237.5 feet.

At the end of a 10-hour pumping test a discharge of 570 gallons per minute produced a draw down of 65 feet 4 inches from a static water level of 40 feet.

The well was equipped with an Aurora Pump Company deep-well turbine pump rated at 800 gallons per minute which discharged directly into the distribution system.

In 1930 the Layne North Central Company completed a well on city property at the northwest corner of the intersection of Park Avenue and. Summit Street. The well was cased through the unconsolidated material with 30-inch genuine wrought iron easing from the pump-

house floor level to the top of the limestone at a depth of 118 feet. The well continued as an open hole through the limestone to the top of the shale at a depth of 291 feet.

The well was equipped with a Layne deep-well turbine pump, consisting of 139 feet of 10-inch column pipe, four stages of 15-inch pump having an over-all length of 4.5 feet, 20 feet of 10-inch suction pipe, and a strainer 5 feet long. The small air-line for determining water levels extends to a depth of 156 feet below the base plate of the pump.

On acceptance test the well produced at an average rate of 1068 gallons per minute for 6 hours 24 minutes with a draw down of 27 feet from a static water level of 63 feet.

The pump was powered by a 50-horsepower General Electric motor operating at a full load speed of 1170 revolutions per minute and discharged into the concrete reservoir several hundred feet to the north.

The water had a total residue of 577, a total hardness of 493, and an iron content of 0.8 parts per million as shown by the analysis of sample number 68986, collected April 13, 1931.

Analysis of Sample Number 68986 from 291-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.8	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	8.2	.48
Silica	SiO_2	18.0	Sodium Sulfate	Na_2SO_4	1.4	.08
Turbidity		10.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.3	.08
Calcium	Ca	113.1	Magnesium Sulfate	$MgSO_4$	170.1	9.92
Magnesium	Mg	51.2	Magnesium Carbonate	$MgCO_3$	58.1	3.39
Ammonium	NH_4	0.4	Calcium Carbonate	$CaCO_3$	283.0	16.50
Sodium	Na	4.1	Iron Oxide	Fe_2O_3	1.1	.06
Sulfate	SO_4	138.0	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.2	Silica	SiO_2	18.0	1.05
Chloride	Cl	5.0				
Alkalinity as $CaCO_3$			Total		542.9	31.66
Phenolphthalein		0.0				
Methyl Orange		352.0				
Residue		577.0				
Total Hardness		493.0				

DUPO (2082). The raw water supply of the village of Dupo is obtained from East St. Louis. The village of Dupo installed a distribution system in 1932. Water is obtained from the East St. Louis and Interurban Water Company of East St. Louis.

DUQUOIN (7593) (p. 181). Only a limited amount of water could be pumped from the abandoned mines which served as a source of water for the public supply up to 1937. During dry summers the use of water had to be curtailed.

In 1937 the city constructed an impounding reservoir on Eeese Creek the dam and intake tower being some 2½ miles north of the city. The filter plant is located in the city.

DURAND (554). Durand is located in the northwestern part of Winnebago County on the drainage area of Pecatonica River, a tributary

of Rock River. A public water supply was installed in 1928, water being obtained from a well in the village hall on the south side of Howard Street east of Center Street.

This well was drilled in 1917 and was used by a creamery for a number of years before being repaired in 1928 and put into service as a source of water for the public supply. It is 576 feet deep and 10 inches in diameter. The top of the well is in the basement of the village hall. The static water level is reported to be at a depth of 5 or 6 feet and the well is equipped with a centrifugal pump rated at 320 gallons per minute and driven by a 25-horsepower electric motor.

The distribution system consists entirely of 8-inch and 6-inch mains. An elevated steel tank is connected to the mains.

The water had a total residue of 311.0, a total hardness of 321.0, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 84147, collected August 17, 1938.

Analysis of Sample Number 84147 from Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		trace	Sodium Sulfate	Na_2SO_4	0.7	0.04
(unfiltered)		0.4	Magnesium Sulfate	$MgSO_4$	10.8	0.63
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	132.5	7.72
Silica	SiO_2	13.0	Calcium Carbonate	$CaCO_3$	155.0	9.04
Turbidity		5.0	Silica	SiO_2	13.0	0.76
Color		0.0				
Odor		0.0	Total		313.7	18.29
Calcium	Ca	62.0				
Magnesium	Mg	40.5				
Ammonium	NH_4	trace				
Sodium	Na	0.7				
Sulfate	SO_4	9.1				
Nitrate	NO_3	1.0				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		312.0				
Residue		311.0				
Total Hardness		321.0				

DWIGHT (2534) (p. 183). Dwight obtains water from two wells. Well number 1 is described on page 184. It is referred to as the west well and is 10 inches in diameter and 140 feet deep. Well number 2, which is described on the same page, as being slightly north of a line between the other two wells, has been abandoned and filled. Well number 3, described on page 184 as the east well, is seldom used. Well number 4 was constructed about 1928 or 1929. It is 12 inches in diameter and 140 feet deep.

In 1937 well number 1 was equipped with a size 8 Deming turbine pump rated at 375 gallons per minute against a head of 100 feet. The pump assembly consists of 100 feet of 6-inch column pipe, 5 bowls measuring 3 feet 9 inches over-all, and 10 feet of suction pipe. The pump is driven by a 15-horsepower U. S. electric motor.

At the same time well number 4 was equipped with a size 10 Deming turbine pump rated at 450 gallons per minute against a head of 100 feet. The pump assembly consists of 100 feet of 6-inch column pipe, 4 stages measuring 3 feet 10 inches over-all, and 10 feet of suction pipe.. The pump is driven by a 20-horsepower U. S. electric motor.

Both pumps discharge into a 50,000-gallon ground storage reservoir. Water is pumped to the distribution system and 50,000-gallon elevated tank by a Fairbanks-Morse centrifugal pump. The pump is driven by a 30-horsepower Fairbanks-Morse electric motor.

There are 800 service connections. The average daily usage is about 41,000 gallons. Water is sold at the following rates:

30 cents per 1,000 gallons for the first 3,000 gallons.
25 cents per 1,000 gallons for the next 7,000 gallons.
16 cents per 1,000 gallons for all over 10,000 gallons.

The minimum rate is $1.65 per quarter and permits the use of 6,000 gallons of water.

The water had a total residue of 1.082, a total hardness of 466.2 and an iron content of 1.66 parts per million as shown by the partial analysis of sample number 83954, collected from a tap in the pumping station on July 26, 1938.

EARLVILLE (1028) (p. 186). No reported change.

EAST ALTON (4502) (p. 187). Water for the public supply of the village of East Alton is furnished by the East Alton Public Service Corporation. Water is now obtained from four wells identified by numbers 7, 9, 10, 11, located on a tract of land at the northwest corner of the intersection of Monroe Street and St. Louis Eoad.

All wells have been constructed in a similar manner. They are 90 feet deep and are cased with concrete casing and porous concrete screens, 26 inches inside diameter and 5 inches thick. Water-bearing sand and gravel was encountered between depths of 50 feet and 90 feet.

The first of these wells is described on page 187. Since 1923 additional wells have been constructed at various times. Well number 11 was constructed in 1936 and placed in service in 1938.

Well number 7 is equipped with a size 12 American turbine pump driven by a 40-horsepower U. S. electric motor. The pump assembly consists of 70 feet of 7-inch column pipe, 4 bowls measuring 5 feet 5 inches over-all and no suction pipe. The pump is rated at 500 gallons per minute against a head of 204 feet.

Well number 9 is equipped with a size 12 American turbine pump driven by a 40-horsepower U. S. electric motor. The pump assembly consists of 70 feet of 7-inch column pipe, 4 bowls measuring 5 feet 1 inch over-all and no suction pipe. The pump is rated at 500 gallons per minute against a head of 204 feet.

Well number 10 is equipped with a size 12 American turbine pump driven by a 40-horsepower U. S. electric motor. The pump assembly consists of 70 feet of 8-inch column pipe, 4 bowls measuring 4 feet 8 inches over-all and no suction pipe. The pump is rated at 600 gallons per minute against a head of 180 feet.

Well number 11 is equipped with a size 12 American turbine pump driven by a 40-horsepower U. S. electric motor. The pump assembly consists of 70 feet of 7-inch column, 4 bowls measuring 5 feet 1 inch over-all and no suction pipe. The pump is rated at 500 gallons per minute against a head of 204 feet.

There are 1050 service connections. Most of the water is used **for** industrial purposes. The average week-day demand is between 2½ and 3 million gallons.

Water is sold at 35 cents per 1,000 gallons for the first 6,000 gallons; 32 cents per 1,000 gallons for the next 4,000 gallons; 30 cents per 1,000 gallons for the next 50,000 gallons; and 20 cents per 1,000 gallons for the next 60,000 gallons.

The water from well number 11 had a total residue of 466, a total hardness of 353 and an iron content of 0.8 parts per million as shown by the analysis of sample number 84061, collected August 12, 1938.

Analysis of Sample Number 84061 Collected from Well Number 11.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	trace
(unfiltered).....	0.8
Manganese..Mn	0.0
Silica.....SiO_2	22.0
Turbidity.....	10.0
Color.....	0.0
Odor.....	0.0
Calcium.....Ca	90.3
Magnesium..Mg	31.0
Ammonium..NH_4	trace
Sodium.....Na	16.6
Sulfate.....SO_4	130.0
Nitrate.....NO_3	1.5
Chloride.....Cl	43.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	192.0
Residue.....	466.0
Total Hardness....	353.0

Hypothetical Combinations.

		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	1.7	0.10
Sodium Chloride.....	NaCl	40.9	2.38
Magnesium Chloride....	$MgCl_2$	24.3	1.42
Magnesium Sulfate.....	$MgSO_4$	122.8	7.16
Calcium Sulfate.....	$CaSO_4$	45.6	2.66
Calcium Carbonate.....	$CaCO_3$	192.3	11.22
Silica.....	SiO_2	22.0	1.28
Total.....		449.6	26.22

EAST DUBUQUE (1395) (p. 188). The free flow of the 1343-foot well decreased from year to year until it ceased entirely during the summer of 1936. At that time a temporary air-lift was installed and used to pump the water to the collected reservoir. In March, 1937 the free flow had again started and was about 45 gallons per minute. A new well was drilled in 1937 by C. W. Varner of Dubuque, Iowa.

The new well is located about 60 feet southeast of the old well and is 1502 feet deep. It was drilled 23 inches in diameter to a depth of 259 feet, 19 inches to 412 feet, 17 inches to 930 feet, and 13 inches to 1502 feet. It is cased with a 20-inch pipe between depths of 198½ and 259 feet, 18-inch pipe from 249½ to 412 feet, and 12-inch pipe from 4½ to 425 feet.

A condensed tabulation of the formations penetrated as classified by the State Geological Survey is:

	Thickness in feet.	Depth in feet.
Surface fill sand	1	1
Ordovician system—		
Galena-Platteville lime	124	125
Glenwood lime, sandstone and shale	45	170
St. Peter sandstone	232	402
Oneota lime	48	450
Cambrian system—		
Jordan sandstone and lime	80	530
Trempealeau lime	79	609
Franconia shale and lime	111	720
Galesville sandstone	155	875
Eau Claire sandstone	355	1230
Mt. Simon sandstone	272	1502

As drilling proceeded, the water level gradually rose until it was 5 feet below the surface. A complete list of static levels for various depths of the well is available. After the 12-inch casing was cemented, in place, the static level was 8½ feet above the ground surface. Pumping levels were 23 feet 8 inches and 6 feet 8 inches below the surface when pumping at rates of 492 and 215 gallons per minute respectively.

The water from the well flows into the old collecting reservoir. The flow of the old well has been increased by the drilling of the new well.

The temperature of the water was 59° F. The mineral quality was very similar to that of the water from the old well. The water had a total residue of 280, a total hardness of 273.5 and a content of iron of 0.2 parts per million as shown by the analysis of sample number 84059, collected August 10, 1938.

Analysis of Sample Number 84059 from Well 1502 Feet Deep.

Determinations Made.

	Pts. per million.
Iron....Fe	
(filtered).....	trace
(unfiltered).....	0.2
Manganese..Mn	0.0
Silica.....SiO_2	13.5
Turbidity.....	3.0
Color.....	0.0
Odor.....	0.0
Calcium.....Ca	54.0
Magnesium..Mg	33.6
Ammonium..NH_4	0.1
Sodium.....Na	3.5
Sulfate.....SO_4	16.5
Nitrate.....NO_3	0.7
Chloride.....Cl	0.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	264.0
Residue.....	280.0
Total Hardness....	273.5

Hypothetical Combinations.

		Pts. per million.	Grs. per gallon.
Sodium Nitrate	$NaNO_3$	0.9	0.05
Sodium Sulfate	Na_2SO_4	10.0	0.58
Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Magnesium Sulfate	$MgSO_4$	11.4	0.66
Magnesium Carbonate	$MgCO_3$	108.8	6.34
Calcium Carbonate	$CaCO_3$	135.0	7.87
Silica	SiO_2	13.5	0.79
Total		280.3	16.33

EAST DUNDEE (1341) (p. 190). Most of the water for the public supply is now obtained from the springs described on page 190. The dug well has been abandoned and a new well has been drilled on the hillside near the reservoir. The new well is approximately 100 feet deep and is equipped with a 6-inch American turbine pump driven by a 7½-horsepower electric motor. The pump is rated at 125 gallons per minute against a total head of 120 feet and discharges to the reservoir.

The triplex pump described on page 190 has been replaced by an American centrifugal pump, rated at 400 gallons per minute against a head of 130 feet and driven by a 25-horsepower electric motor. A stand-by unit consists of an American centrifugal pump driven by a 6-cylinder gasoline engine.

In 1938 there were about 325 service connections in use. All water was being obtained from the springs and it was not necessary to use the well.

EAST MOLINE (10,107) (p. 191). Well number 3 was drilled in 1937 by Thorpe Brothers of Des Moines. It is located near well number 1 at the pumping station on Ninth Street. It is 1600 feet deep and 13 inches in diameter at the bottom. It is cased with 30-inch pipe from the surface to a depth of 34 feet, with 20-inch pipe from the surface to 150 feet, with 18-inch pipe from 420 feet to 656 feet, and with 14-inch pipe from 955 to 1150 feet. The liner through the St. Peter sandstone is perforated between depths of 1010 and 1070 feet.

A record of material penetrated by the well is as follows:

	Thickness in feet.	Depth in feet.
Drift	28	28
Lime, Niagaran	395	423
Shale, Maquoketa	218	641
Dolomite, Galena	310	951
Shale, sandstone	34	985
Sandstone, St. Peter	65	1050
Lime, Prairie du Chien	422	1472
Sandstone, Jordan	30	1502
Lime, shale, sandstone, St. Lawrence	98	1600

When the well was 1105 feet deep and uncased below a depth of 34 feet a production test was made. Static water level was 22 feet below ground surface. The water level was lowered 46 feet by a pumping rate of 524 gallons per minute, and 130 feet by a rate of 1045 gallons per minute. During this test, well number 1 was being pumped at a rate of 350 gallons per minute. The operating level in well number 1 was lowered from 61.4 to 64.7 feet by the test of well number 3, only 50 feet distant.

At this time the water had a total residue of 674, a total hardness of 277.5, a content of iron of 0.2, and a content of fluoride of 2.5 parts per million as shown by the analysis of sample number 79895, collected April 14, 1937.

The well was drilled deeper to a depth of 1600 feet, a continuous string of casing from the ground surface to 1087½ feet was installed,

and another test was made. The static level was then 35 feet below ground surface. The water level was lowered 91 feet by a pumping rate of 945 gallons per minute. At the same time the operating level in well number 1 was lowered 9.3 feet.

Sample number 81378 was collected at this time, May 23, 1937. The water had a total residue of 1131, a total hardness of 158, a content of iron of 0.0, and a content of fluoride of 1.1 parts per million as shown by the partial analysis.

After the permanent casing had been installed the well was again tested. The water level was approximately 38 feet below ground surface when not pumping. The draw-down at various pumping rates was as follows:

Pumping Rate G. P. M.	Draw-down Feet
1400	119
1300	110
1200	100
1000	75
800	52
600	33

Well number 1 was being pumped during this test.

Another test was made of the finished well when well number 1 was not being pumped. The water level was lowered 66 feet by a pumping rate of 1212 gallons per minute.

The water temperature increased from 55° F. at the start of the test to 58° at the finish.

Water from the finished well had a total residue of 810, a total hardness of 303.5, a content of iron of 0.2, and a content of fluoride of 0.8 parts per million as shown by the analysis of sample number 81629, collected July 16, 1937.

The well is equipped with a 4-stage, 12-inch Fairbanks-Morse deep-well turbine pump having 130 feet of 10-inch column pipe and 20 feet of 10-inch suction pipe. The pump is driven by a 50-horsepower electric motor.

Water from wells 2 or 3 is discharged into a new concrete reservoir equipped with a multiple spray aerator. Water from well number 1 is discharged into the old reservoir.

Well number 2 is now equipped with a 14-stage, 8-inch American turbine pump having 190 feet of column pipe and 20 feet of suction pipe. The pump is driven by a 40-horsepower electric motor and delivers approximately 450 gallons per minute.

Well number 1 is equipped with an airlift which delivers approximately 400 gallons per minute. A new air compressor and air receiver have been installed.

Water is pumped from the reservoirs to the distribution system by either of two centrifugal pumps, each rated at 1000 gallons per minute. Two elevated steel tanks, located in different parts of the city, are connected to the distribution system. In emergencies, water may be obtained from the cities of Silvis and Moline. All water is chlorinated before being pumped into the mains.

Analysis of Sample Number 79895 from Well When 1105 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....	$NaNO_3$	1.7	0.10
(unfiltered).....	0.2	Sodium Chloride.....	NaCl	195.8	11.42
Manganese..Mn	0.0	Sodium Sulfate.....	Na_2SO_4	176.0	10.26
Silica.....SiO_2	12.0	Sodium Carbonate.....	Na_2CO_3	30.2	1.76
Turbidity.....	30.0	Magnesium Carbonate..	$MgCO_3$	97.0	5.65
Odor.....	V1	Calcium Carbonate.....	$CaCO_3$	162.5	9.48
Calcium.....Ca	65.0	Silica.....	SiO_2	12.0	0.70
Magnesium..Mg	27.9				
Sodium.....Na	147.6	Total.....		675.2	39.37
Sulfate.....SO_4	118.9				
Nitrate.....NO_3	1.2				
Chloride.....Cl	119.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	8.0				
Methyl Orange...	306.0				
Residue.....	674.0				
Total Hardness....	277.5				
Fluoride.....F	2.5				

Analysis of Sample Number 81629 from Finished Well Number 3.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....	$NaNO_3$	6.8	0.40
(unfiltered).....	0.2	Sodium Chloride.....	NaCl	339.1	19.78
Manganese..Mn	0.0	Sodium Sulfate.....	Na_2SO_4	152.6	8.90
Silica.....SiO_2	10.0	Magnesium Sulfate.....	$MgSO_4$	37.9	2.21
Turbidity.....	5.0	Magnesium Carbonate..	$MgCO_3$	77.2	4.50
Calcium.....Ca	73.2	Calcium Carbonate.....	$CaCO_3$	180.5	10.53
Magnesium..Mg	29.9	Silica.....	SiO_2	10.0	0.58
Sodium.....Na	184.6				
Sulfate.....SO_4	133.5	Total.....		804.1	46.90
Nitrate.....NO_3	5.2				
Chloride.....Cl	206.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	272.0				
Residue.....	810.0				
Total Hardness	303.5				
Fluoride.....F					
(sanchis).....	0.8				

EAST PEORIA (5027) (p. 193). Water for the public supply is obtained from the eight wells previously described, and four 6-inch wells, 25 to 30 feet deep, drilled in 1927 by John Cumming. All the wells are located near the pumping station and are pumped simultaneously by suction. A "Kelley well", 30 feet deep, was constructed in 1930 but has been abandoned.

Three pumps are available. A Worthington triplex pump rated at 500 gallons per minute and driven by a 50-horsepower electric motor is seldom used. A Gardner-Denver centrifugal pump rated at 1200 gallons per minute and driven by a 95-horsepower diesel engine is

used six days weekly. A 5-stage Sterling turbine pump rated at 800 gallons per minute and driven by a 60-horsepower electric motor is used only on Sundays.

The old reservoir and standpipe have been abandoned. A new one million-gallon concrete tank was built in 1931 on top of the bluff about 3000 feet south of the pumping station.

There are 1500 service connections, all of which are metered. The average daily pumpage is approximately 350,000 gallons.

EAST ST. LOUIS (74,347). (p. 708). The raw water supply of the city of East St. Louis is obtained from Mississippi River. The water is treated before entering the distribution system. The system is owned by the East St. Louis and Interurban Water Company.

EDWARDSVILLE (6235) (p. 194). Edwardsville obtains water from two wells located at the site of the wells described on page 195. These wells have been cleaned and repaired a number of times.

Well number 1 is located in the southwest part of the pumping station and was formerly equipped with a Pomona 2-stroke deep-well pump. This well is reported to be 113½ feet deep with 42 feet of number 14 slot Johnson screen installed in the bottom. Water is pumped from the well by a size 24 American deep-well turbine pump rated at 1300 gallons per minute against a head of 80 feet. The pump assembly consists of 64 feet of 10-inch column pipe, one bowl measuring 3 feet 8 inches over-all and no suction pipe. The pump is driven by a 40-horsepower General Electric motor.

Well number 2 is located in the northeast part of the pumping station. This well is reported to be 114½ feet deep and is equipped with 42 feet of 18-inch number 14 slot Johnson screen. Water is pumped from the well by a size 20 American turbine pump. The pump assembly consists of 24 feet of 9-inch column pipe, one bowl measuring 5 feet over-all and no suction pipe. The pump is rated at 700 gallons per minute against a head of 60 feet. It is driven by a 20-horsepower General Electric motor.

Both pumps discharge into the 250,000-gallon ground storage reservoir. Water is pumped from the reservoir to the distribution system by either of two service pumps. One is an American 2-stage centrifugal pump driven by a 100-horsepower electric motor, is rated at 500 gallons per minute against a pressure of 135 pounds per square inch. The other pump is an American 2-stage centrifugal pump driven by a 200-horsepower electric motor and is. rated at 1250 gallons per. minute against a pressure of 195 pounds per square inch.

The average daily usage is between 700,000 and 750,000 gallons Most of the water is furnished by well number 2. Well number 1 is pumped occasionally. There are 2047 service connections.

EFFINGHAM (4978) (p. 708). The raw water supply of the city of Effingham is obtained from Little Wabash River. The water is treated before entering the distribution system.

EILEEN (312) (p. 196). The village of Eileen secures water from Coal City.

ELBURN (548) (p. 198). A new well was drilled in 1937 by M. L. Reichart of Batavia. It is located about one-half block north of the old village well and is 153 feet deep. The water-bearing formation at the bottom of the well is a deposit of coarse, angular sand which is screened with an eleven-foot length of 8-inch, number 8, Clayton Mark brass screen. The water level was at a depth of 85 feet when not pumping and was lowered 65 feet by a pumping rate of 40 gallons per minute.

The well is equipped with a 9-stage American turbine pump with the bottom of the bowls at a depth of 138 feet. Below the bowls is a 12-foot length of suction pipe.

The temperature of the water was 52° F. The water had a total residue of 359, a total hardness of 263, and a content of iron of 2.4 parts per million as shown by the analysis of sample number 79757, collected March 23, 1937.

Analysis of Sample Number 79757 from Well 153 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		2.0	Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		2.4	Sodium Chloride	NaCl	3.5	0.20
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	4.3	0.25
Silica	SiO_2	14.0	Sodium Carbonate	Na_2CO_3	73.6	4.29
Turbidity		30.0	Ammonium Carbonate	$(NH_4)_2CO_3$	7.2	0.42
Odor		E1	Magnesium Carbonate	$MgCO_3$	92.3	5.38
Calcium	Ca	61.4	Calcium Carbonate	$CaCO_3$	153.6	8.96
Magnesium	Mg	26.6	Silica	SiO_2	14.0	0.82
Ammonium	NH_4	2.7				
Sodium	Na	35.2	Total		350.1	20.42
Sulfate	SO_4	2.9				
Nitrate	NO_3	1.3				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		340.0				
Residue		359.0				
Total Hardness		263.0				

The water is pumped from the well at a rate of about 70 gallons per minute and is discharged over a coke-tray aerator into a detention basin. It is then pumped at a rate of 100 gallons per minute through two pressure sand filters.

Analysis of a sample of filtered water, Number 82309, collected November 11, 1937, shows that all of the soluble iron was removed by this treatment.

ELDOEADO (4482) (p. 709). The raw water of the city of Eldorado is obtained from an impounding reservoir on Wolf Creek. The water is treated before entering the distribution system.

ELGIN (35,929) (p. 199). The four deep wells, described on page 199, located near the pumping station are still in service. These

wells were reconditioned and equipped with deep-well turbine pumps in 1932. The pump settings are 250 feet below the surface and each is powered by an electric motor. The old shaft and tunnel system has been abandoned. In 1934 the average static water level was 94 feet below the ground surface and the pumping level 155 feet. The four wells when pumped together delivered about 3,000,000 gallons per day. It was reported that static water level was receding at a rate of about 2.7 feet per year.

Only one of the four shallow wells southwest of the station was in service in 1934. This apparently is the old dug well that originally was 19 feet deep. It has been deepened to 53 feet and walled with a concrete screen and casing. The electric motor-driven turbine pump with which the well is equipped has a setting of 40 feet and produced 300,000 gallons per day with a static water level of 18 feet and a pumping water level of 34 feet.

A well was dug in 1920 or 1921 at the northwest corner of the intersection of North State and Washington Streets. It was reported that the original depth was 42 feet and that a screen 10 inches in diameter was placed through the water-bearing sand. When first constructed a production of 540 gallons per minute was obtained. Later a fine screen replaced the original screen. This had the effect of greatly reducing the yield of the well.

In 1928 it was reported that a well, at this site, 48 feet deep was provided with a Kelly Well Company screen 25 inches in diameter, and that sand and gravel was encountered for the full depth of the well.

The well was equipped with an American Well Works, direct suction, centrifugal pump set in the bottom of a pit 12 feet deep. The pump was driven by a Westinghouse, 75-horsepower electric motor and was rated at 1,000,000 gallons per day. It was further reported that after a non pumping interval of 12 hours, the static water level was 15 2/6 feet below the floor level of the pit. This unit was used previously during peak demands in the summer.

The St. Charles Street well described on page 202 was abandoned and a new one constructed at the same location in 1933 by the Kelly Well Company. The new well is 100 feet deep and cased with Kelly concrete casing and screen having an inside diameter of 16 inches.

Static water level was reported at that time as 14 feet, and pumping water level as 42 feet below the ground surface. The well had a production of 300,000 gallons per day.

In 1934 a ground storage reservoir was constructed, having a storage capacity of 125,000 gallons.

It was reported in 1928 that a well had been constructed by the Kelly Well Company on the west side of Crighton Avenue about a half block north of West Chicago Street. This well was 53 feet deep and cased with Kelly concrete casing and screen. Sand was encountered at a depth of 12 feet.

The well was equipped with a Worthington deep-well turbine pump, driven by a General Electric 75-horsepower electric motor. The bottom of the suction pipe is at a depth of 43 feet. The pump was rated at

1,000,000 gallons per day but a yield of only 218 gallons per minute was obtained.

In 1934 it was reported that static water level was 19 feet and pumping water level was 42 feet below ground surface when the pump was producing at a rate of 300,000 gallon per day.

During the year 1928 the Kelly Well Company constructed a well 53 feet deep at the southwest corner of the intersection of Laurel Street and Illinois Avenue. The well was cased with 18 feet of concrete casing and 35 feet of Kelly screen, both casing and screen having an inside diameter of 25 inches.

The log of the well as reported to the city follows:

	Thickness in feet.	Depth in feet.
Soil	4	4
Sand	2	6
Gravel	47	53

At the time of a test in August, 1928 a production of 750 gallons per minute against a 172½-foot head, with a static water level of 3⅓ feet below the pump house floor and a pumping water level of 10 feet, was obtained.

A report made in 1935 states that the depth of the well was 59 feet, that static water level was 14 feet and pumping water level 23 feet below pump house floor when producing 700 gallons per minute. The well may have been reconstructed during the interval.

A well, 1940 feet deep, located on high ground near the southwest corner of the intersection of Commonwealth Avenue and Schuler Street was constructed by C. W. Varner of Dubuque, Iowa. The work was started in the fall of 1930 and completed in 1931.

The formations penetrated, as classified by the State Geological Survey, are as follows:

	Thickness in feet.	Depth in feet.
Pleistocene		
Drift	104	104
Silurian		
Alexandrian dolomite	36	140
Ordovician		
Maquoketa shale	200	340
Galena dolomite	190	530
Decorah dolomite	10	540
Platteville dolomite	120	660
Glenwood sandstone	100	760
St. Peter sandstone	190	950
Cambrian		
Trempealeau dolomite	100	1050
Franconia, sandstone with shale	50	1100
Trenton and Dresbach sandstone	200	1300
Eau Claire sandstone, dolomite and shale	380	1680
Mt. Simon	260	1940

The well is cased with 18-inch outside diameter casing from the surface to a depth of 210 feet. A 16-inch outside diameter liner was placed between depths of 890 feet and 955 feet and a 12-inch inside diameter liner between depths of 1280 feet and 1465 feet. The hole was finished 12 inches in diameter.

The test pump was of the deep-well turbine type, with a setting of 350 feet. With static water level at 180 feet below ground surface and a pumping level of 338 feet at the end of an 8-hour test period, a production rate of 800 gallons per minute was obtained.

The water from this Schuler Street well had a total residue of 361, a total hardness of 184 parts per million with no iron as shown by the analysis of sample number 69717, collected on October 5, 1931 after 48 hours of continuous pumping.

Analysis of Sample Number 69717 from the Schuler Street Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.0	Sodium Nitrate.....$NaNO_3$	0.9	0.05
Manganese..Mn	0.0	Sodium Chloride.....NaCl	8.2	0.48
Silica.....SiO_2	16.0	Sodium Sulfate.....Na_2SO_4	22.0	1.28
Turbidity.....	0.0	Sodium Carbonate.....Na_2CO_3	126.2	7.36
Calcium.....Ca	41.2	Ammonium Carbonate..$(NH_4)_2CO_3$	0.5	0.03
Magnesium..Mg	19.8	Magnesium Carbonate..$MgCO_3$	68.7	4.01
Ammonium..NH_4	0.2	Calcium Carbonate.....$CaCO_3$	103.0	6.01
Sodium.....Na	65.3	Iron Oxide.....Fe_2O_3	0.0	0.00
Sulfate.....SO_4	14.8	Manganese Oxide.....MnO	0.0	0.00
Nitrate.....NO_3	0.3	Silica.....SiO_2	16.0	0.93
Chloride.....Cl	5.0			
Alkalinity as $CaCO_3$		Total.....	345.5	20.15
Phenolphthalein..	0.0			
Methyl Orange...	304.0			
Residue.....	361.0			
Total Hardness....	184.0			

In 1931 the W. L. Thorne Company completed a 677½-foot well at the southeast corner of LaVoie Avenue and Elgin Street. The well was originally intended to be an 85-foot well in sand and gravel, but when this depth was reached and an insufficient amount of water found, the well was ordered deepened. At a depth of 365 feet a production of 500 gallons per minute with a draw down of 160 feet from a static water level of 2 feet was obtained.

The formations penetrated with classifications as given by the State Geological Survey follows:

	Thickness in feet.	Depth in feet.
Pleistocene		
Wisconsin Drift	85	85
Ordovician		
Richmond dolomite and shale	190	275
Galena-Platteville dolomite	295	570
Glenwood dolomite and sandstone	107½	677½

The well is cased with 16-inch outside diameter casing from the surface to a depth of 87 feet. When finished the static water level was 7 feet below the surface and at the end of an 18-hour production test, a rate of 700 gallons per minute was obtained with a draw down of 181 feet. The turbine pump had a setting of 247 feet.

It was reported in 1934 that at the end of a 15-hour pumping period, a production rate of 815 gallons per minute was obtained with a draw down of 190 feet from a static water level of 10 feet and with a pump setting of 250 feet.

Eecently the city has been engaged in a major reconstruction program which is still incomplete. This includes the construction of a plant for the removal of iron and hydrogen sulfide from the water from the four deep wells at the pumping station.

It is reported that the plant is so designed that water softening may be accomplished if and when found desirable.

In addition to the municipal wells there are a considerable number of industrial wells throughout the city.

Of these the Elgin National Watch Company has three. One drilled in 1936 to a depth of 1231 feet, produced 1250 gallons per minute with 160 feet of draw down from a static water level of 123 feet at the end of 48 hours of pumping.

A second well was finished in the same year to a depth of 1221 feet. The static water level, draw down, and production were reported the same as for the first well.

A third and older well located in the south part of the watch company grounds was reconditioned by reaming and shooting. The final depth was 516 feet and on test of 24-hour duration a production of 200 gallons per minute was obtained with a draw down of 75 feet from a static level of 100 feet below ground surface.

ELIZABETH (651) (p. 204). The village well described on page 204 continued to furnish the public water supply for Elizabeth until early in 1934 when it became inadequate because of the increased demand which had taken place since the municipal sewer system was installed four years previous. By 1934 the number of service connections had increased to 225.

The Chicago Great Western Railroad Company had a well that had not been in use for a number of *years.* The village leased this and after rehabilitation it proved adequate for all the needs of the village and the old municipal well was abandoned.

The present well is located on the west side of the railroad tracks near the depot. It was drilled in 1900 by W. H.. Grau and Bros. It is 317 feet deep and 12 inches in diameter. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Blue Clay	25	25
Shale	10	35
Limestone	282	317

The elevation of the ground surface at the well is about 790 feet above sea level.

The water level is at a depth of 130 feet when not pumping and is lowered ten feet by a pumping rate of 100 gallons per minute.

The well is equipped with a Pomona deep-well turbine pump having 280 feet of column pipe and 10 feet of suction pipe. The pump is driven by a 15-horsepower electric motor.

The water had a total residue of 352, a total hardness of 338, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 81705, collected August 2, 1937.

Analysis of Sample Number 81705 from Chicago Great Western Railroad Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	1.7	0.10
(unfiltered).....	0.3	Sodium Chloride.....NaCl	1.8	0.10
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	10.7	0.63
Silica.....SiO_2	10.0	Magnesium Sulfate.....$MgSO_4$	36.1	2.10
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	102.4	5.97
Calcium.....Ca	74.6	Calcium Carbonate.....$CaCO_3$	186.5	10.87
Magnesium..Mg	36.8	Ferric Oxide.....Fe_2O_3	0.4	0.02
Sodium.....Na	4.6	Silica.....SiO_2	10.0	0.58
Sulfate.....SO_4	35.8			
Nitrate.....NO_3	1.3	Total.....	349.6	20.37
Chloride.....Cl	1.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	308.0			
Residue.....	352.0			
Total Hardness....	338.0			

ELIZABETHTOWN (488). The village of Elizabethtown obtains water from the village of Rosiclare.

ELKVILLE (1133). A public water supply system for the village of Elkville was installed in 1936. The raw water supply is obtained from Hallidayboro Lake. The water is treated before entering the distribution system.

ELMHURST (14,055) (p. 205). In 1925 the yield of the city wells was much less than in 1923. The water level had dropped to a depth of 300 or more feet and it was necessary to drill a new well.

Well number 3 was drilled by S. B. Geiger in 1925. It is located on the east side of Larch Avenue two blocks west of the older wells. It is 18 inches in diameter to a depth of 450 feet, 12 inches to 1105 feet and 10 inches to the bottom at a depth of 2077 feet. It was cased with 18-inch pipe to a depth of 79 feet, 16-inch pipe from 226 feet 9 inches to 455 feet, and 10-inch pipe from 947 to 1110 feet. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Black soil and clay	40	40
Sand and gravel	39	79
Limestone	146	225
Shale	90	315
Limestone	10	325
Shale	125	450
Limestone	350	800
Sandstone, St. Peter	189	989
Limestone	4	993
Shale	37	1030
Limestone	70	1100
Shale	10	1110
Limestone	150	1260
Sandstone	240	1500
Limestone	285	1785
Sandstone	5	1790
Limestone	10	1800
Sandstone	50	1850
Limestone	10	1860
Sandstone, Mt. Simon	217	2077

Elevation of the ground surface is about 690 feet above sea level.

The water level was at a depth of 138 feet when not pumping and was lowered 242 feet by a pumping rate of 800 gallons per minute.

The well was equipped with an American deep-well turbine pump with the bowls 356 feet below the ground surface.

Water from this well had a total residue of 403, a total hardness of 231, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 57924, collected December 16, 1926.

Analysis of Sample Number 57924 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	2.0	.12
Manganese	Mn	0.0	Potassium Chloride	KCl	22.5	1.32
Silica	SiO_2	11.2	Sodium Chloride	NaCl	11.2	.66
Nonvolatile		0.5	Sodium Sulfate	Na_2SO_4	112.1	6.56
Alumina	Al_2O_3	0.5	Sodium Carbonate	Na_2CO_3	36.0	2.11
Calcium	Ca	55.1	Ammonium Carbonate	$(NH_4)_2CO_3$	0.8	.05
Magnesium	Mg	22.7	Magnesium Carbonate	$MgCO_3$	81.0	4.74
Ammonium	NH_4	0.3	Calcium Carbonate	$CaCO_3$	141.5	8.27
Potassium	K	12.2	Silica	SiO_2	11.2	.65
Sodium	Na	54.9	Iron Oxide	Fe_2O_3	0.1	.01
Sulfate	SO_4	78.0	Alumina	Al_2O_3	0.5	.03
Nitrate	NO_3	1.2	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	18.0	Nonvolatile		0.5	.03
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0	Total		419.4	24.55
Methyl Orange		280.0				
Residue		403.0				
Total Hardness		231.0				

The well was deepened in 1933 by W. L. Thorne Company. It is now 2221 feet deep. The water after deepening had a total residue of 635, a total hardness of 273, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 78500, collected August 3, 1936.

Analysis of Sample Number 78500 from Well 2221 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe (unfiltered).....	0.2	Sodium Nitrate.....	$NaNO_3$	4.3	0.25
Manganese..Mn	0.0	Sodium Chloride.....	NaCl	245.7	14.31
Silica.....SiO_2	8.0	Sodium Sulfate.....	Na_2SO_4	124.3	7.24
Turbidity.....	0.0	Sodium Carbonate.....	Na_2CO_3	1.6	0.09
Calcium.....Ca	77.3	Ammonium Carbonate..	$(NH_4)_2CO_3$	1.4	0.08
Magnesium..Mg	19.3	Magnesium Carbonate..	$MgCO_3$	67.0	3.91
Ammonium..NH_4	0.5	Calcium Carbonate.....	$CaCO_3$	193.5	11.28
Sodium.....Na	138.7	Ferric Oxide.....	Fe_2O_3	0.3	0.02
Sulfate.....SO_4	83.8	Silica.....	SiO_2	8.0	0.47
Nitrate.....NO_3	3.3				
Chloride.....Cl	149.0	Total.....		646.1	37.65
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	276.0				
Residue.....	635.0				
Total Hardness....	273.0				

Well number 2 was deepened in 1926-1927 by S. B. Geiger. It is now 2222 feet deep. Below 2077 feet (the depth of well number 3 when first drilled) drilling was continued in red sand to a depth of 2218 feet. At that depth there was a 5-foot thickness of soft white sand. Below that depth red sand was again entered and drilling was stopped. The red sand in this well was soft and in well number 3 was hard. When in the. red sand the water level rose from a depth of 130 feet to a depth of 80 feet. When in the white sand- it rose 10 feet higher. Elevation of the ground surface is about 685 feet above sea level.

Water from well number 2 had a total residue of 681, a total hardness of 350.5, and a content of iron of 0.0 as shown by the analysis of sample number 78499, collected August 3, 1936.

Well number 4 was drilled in 1927 by S. B. Geiger. It is located at St. Charles Road and Scott Street and is 2219 feet deep. Elevation of the ground surface is about 665 feet above sea level. . The well is 20. inches in diameter to rock, 18 inches in diameter to a depth of 1000 feet, and 12 inches in diameter below a depth of 1000 feet. The water level was at a depth of 135 feet when not pumping and was lowered 185 feet by a pumping rate reported to have been 1310 gallons per minute. Water is pumped from the well into the distribution system by a Peerless turbine pump and a Fairbanks-Morse centrifugal pump connected in series. The temperature of the water is 61° F.

Water from well number 4 had a total residue of 1428, a total hardness of 389, and a content of iron of 0.7 parts per million as shown by the analysis of sample number 78501, collected August 3, 1936.

Analysis of Sample Number 78501 from Well Number 4.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	1.7	0.10
(unfiltered).....	0.7	Sodium Chloride.....NaCl	980.0	57.10
Manganese..Mn	0.0	Ammonium Chloride....$(NH_4)Cl$	1.6	0.09
Silica.....SiO_2	8.0	Magnesium Chloride....$MgCl_2$	55.4	3.23
Turbidity.....	15.0	Magnesium Sulfate.....$MgSO_4$	50.3	2.93
Calcium.....Ca	115.3	Calcium Sulfate.....$CaSO_4$	44.2	2.58
Magnesium..Mg	24.4	Calcium Carbonate.....$CaCO_3$	256.1	14.94
Ammonium..NH_4	0.5	Silica.....SiO_2	8.0	0.47
Sodium.....Na	386.0			
Sulfate.....SO_4	71.6	Total.....	1,397.3	81.44
Nitrate.....NO_3	1.0			
Chloride.....Cl	637.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	256.0			
Residue.....	1,428.0			
Total Hardness....	389.0			

In 1937 all four wells were in use at least part of the time, but plans were being made to plug the lower portion of well number 4 in order to reduce the high sodium chloride content.

ELHWOOD (1166) (p. 207). No reported change.

ELMWOOD PARK (11,270). Elmwood Park obtains Lake Michigan water from the city of Chicago.

EL PASO (1578) (p. 196). The well and its equipment at El Paso, described on page 196, is maintained as a stand-by unit.

In 1927 a new pumping station and well were constructed by the city. The well is located about 30 feet west of the old well. It is 8 inches in diameter and 120 feet deep. A 10-foot length of screen is installed in the well.

Water is pumped from the well by an American Well Works turbine pump belt driven by a 20-horsepower Fairbanks-Morse diesel engine. The pump assembly consists of 90 feet of 6-inch column pipe, 10 bowls measuring 5 feet 7 inches over-all and 20 feet of 5-inch suction pipe. It is rated at 200 gallons per minute against a head of 240 feet.

There are about 560 service connections. The minimum rate is $2.00 for six months, and permits the use of 5700 gallons of water. All additional water is sold at a rate of 35 cents per 1000 gallons.

ERIE (888) (p. 209). No reported change has been made in the source of water supply or pumping equipment at Erie. The analysis of sample number 73229, collected on July 10, 1933 indicated that the quality of the water was similar to sample number 49848, collected on August 3, 1923. The water had a total residue of 308, a total hardness of 281.5, and an iron content of 1.0 parts per million.

EUREKA (1534) (p. 210). The wells, pumping equipment, reservoir, and pressure tank described on pages 210-211 have been abandoned. Water is now obtained from two wells and is pumped directly to the distribution system, to which is connected a 100,000-gallon elevated steel tank located just south of the old pumping station at Major and Mill Streets.

One well is 27 feet deep and is located north of First Street and 600 feet west of Meek Street. It was drilled in 1926 by E. H. Johnson of Bloomington. The screen was cleaned in 1936. A test well at this location penetrated blue sharp gravel between depths of 17 and 26 feet and entered shale at 193 feet. Using a perforated 10-inch pipe for a screen the test well was pumped at a rate reported to be more than 250 gallons per minute. The bottom of the pipe was at a depth of 21 feet.

The second well in use in 1938 is 175 feet deep, 12 inches in diameter, and equipped with 6 feet of Johnson screen. It was drilled in 1936 by E. W. Johnson of Bloomington and is located about 85 feet northeast of the mine shaft described on page 211.

Another well drilled about 1926 is located 10 feet east of the mine shaft. Use of this well was discontinued in 1937, but was to be resumed in 1938. It is 172 feet deep, 8 inches in diameter, and equipped with 5 feet of screen.

The 27-foot well is equipped with an American centrifugal pump, driven by a 20-horsepower electric motor, which is operated about three hours daily.

The 175-foot well is equipped with a 17-stage, 7-inch Sterling turbine pump having 170 feet of 4-inch column pipe and no suction pipe. The pump, rated at 125 gallons per minute and driven by a 15-horsepower electric motor, is operated about twelve hours daily.

The 172-foot well is equipped with a 16-stage, 7-inch Sterling turbine pump having 150 feet of 4-inch column pipe and 24 feet of 4-inch suction pipe. The pump is rated at 75 gallons per minute at 312-foot head and is driven by a 10-horsepower electric motor.

Several test wells have been drilled at various points in the city. These have indicated that sand and gravel deposits in the drift are sporadic in occurrence and limited in extent.

Water from the 27-foot well had a total residue of 790, a total hardness of 662, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 83923, collected July 22, 1938. Water from the 175-foot well had a total residue of 550, a total hardness of 389, and a content of iron of 2.2 parts per million as shown by the analysis of sample number 83924 collected July 22, 1938. Water from this well contains a large amount of inflammable gas.

Analysis of Sample Number 83923 from Well 27 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	28.1	1.64
(filtered)		0.0	Magnesium Nitrate	$Mg(NO_3)_2$	28.0	1.63
(unfiltered)		0.2	Magnesium Chloride	$MgCl_2$	40.5	2.36
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	273.5	15.95
Silica	SiO_2	15.0	Calcium Sulfate	$CaSO_4$	21.1	1.23
Turbidity		2.0	Calcium Carbonate	$CaCO_3$	358.0	20.87
Color		0.0	Silica	SiO_2	15.0	0.87
Odor		0.0				
Calcium	Ca	149.5	Total		764.2	44.55
Magnesium	Mg	70.3				
Ammonium	NH_4	trace				
Sodium	Na	7.6				
Sulfate	SO_4	233.0				
Nitrate	NO_3	44.7				
Chloride	Cl	30.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		358.0				
Residue		790.0				
Total Hardness		662.0				

Analysis of Sample Number 83924 from Well 175 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.5	0.15
(filtered)		0.06	Sodium Chloride	NaCl	11.7	0.68
(unfiltered)		2.2	Sodium Carbonate	Na_2CO_3	108.8	6.34
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	17.8	1.04
Silica	SiO_2	7.5	Magnesium Carbonate	$MgCO_3$	187.6	10.95
Turbidity		15.0	Calcium Carbonate	$CaCO_3$	166.5	9.71
Color		0.0	Iron Oxide	Fe_2O_3	0.1	0.01
Odor		0.0	Silica	SiO_2	7.5	0.44
Calcium	Ca	66.7				
Magnesium	Mg	54.1	Total		502.5	29.32
Ammonium	NH_4	6.7				
Sodium	Na	52.4				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.8				
Chloride	Cl	7.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		510.0				
Residue		550.0				
Total Hardness		389.0				

EVANSTON (63,338) (p. 709). No record of change.

EVERGREEN PAEK (1594). The village of Evergreen Park has obtained Lake Michigan water from the city of Chicago since 1926.

FAIRBURY (2310) (p. 213). A well 1586 feet deep was drilled in 1926 by Ira French, a local driller. It was located about 75 feet west of the 2172-foot well. The logs of these two wells are similar. The 1586-foot well was cased with 8-inch pipe to a depth of 381 feet and

with 6-inch pipe from 745 feet to 955 feet. It was shot with 300 pounds of 100 per cent gelatin. This split the 8-inch casing and loosened the packer at the bottom of the casing. In 1928 the well yielded about 57 gallons per minute. The temperature of the water was 67° F. The quality of the water was very similar to that of the water from the 2172-foot well. Since 1935 the deep wells have not been used.

Two shallow wells, drilled in 1935 by John Bolliger and Sons of Fairbury, are located south of the city in the valley of Indian Creek. Well number 1 is 39 feet deep and 12 inches in diameter. It penetrates 35 feet of water-bearing sand and gravel and is equipped with a 15-foot length of 12-inch Johnson screen. The bottom 12 feet has number 125 slots. This is followed by one-foot sections of number 100, number 60, and number 40 slots in ascending order. The water level was at a depth of 5½ feet when not pumping and was lowered 7½ feet when pumping at a rate of 360 gallons per minute.

Well number 2 is located 100 feet north of well number 1. It is 40 feet deep and 12 inches in diameter. It is equipped with a 15-foot length of 12-inch Cook screen, with the upper 6 feet cut with number 60 slots, and the lower 9 feet cut with number 125 slots. The water level was 6 feet below the surface when not pumping arid was lowered 17.8 feet when pumping at a rate of 330 gallons per minute.

Well number 1 is used most of the time. Water from this well had a total residue of 450, a total hardness of 356.5, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 76133, collected May 21, 1935. Water from well number 2 was of similar quality.

Analysis of Sample Number 76133 from Shallow Well Number 1.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		10.2	0.59
(filtered).....	0.0	Sodium Chloride.....NaCl		22.2	1.18
(unfiltered).....	0.6	Magnesium Chloride....$MgCl_2$		6.2	0.36
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$		159.4	9.30
Silica.....SiO_2	6.0	Calcium Sulfate.....$CaSO_4$		12.9	0.75
Turbidity.....	5.0	Calcium Carbonate.....$CaCO_3$		208.2	12.14
Color.....	0.0	Iron Oxide.....Fe_2O_3		0.0	0.00
Odor.....	2e	Manganese Oxide.....MnO		0.0	0.00
Calcium.....Ca	87.0	Silica.....SiO_2		6.0	0.35
Magnesium..Mg	339.0				
Ammonium..NH_4	trace	Total.....		425.1	24.67
Sodium.....Na	11.5				
Sulfate.....SO_4	136.4				
Nitrate.....NO_3	7.4				
Chloride.....Cl	18.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	208.0				
Residue.....	450.0				
Total Hardness....	356.5				

Each shallow well is equipped with a 3-stage, 8-inch Fairbanks-Morse turbine pump having 30 feet of 6-inch column pipe and driven by a 7½-horsepower electric motor. Each pump delivers about 300 gallons per minute, but the pump in well number 2 was seldom used.

A water treatment plant was built in 1935. Treatment consists of coke-tray aeration, lime-soda softening and filtration. The plant is located about 300 feet north of well number 2. Two Fairbanks-Morse centrifugal pumps, located in the plant building, pump the treated water to the distribution system. One is rated at 500 gallons per minute and is driven by a 30-horsepower electric motor. The other is rated at 350 gallons per minute and is driven by a 20-horseppwer electric motor.

FAIRFIELD (3280) (p. 709). The raw water supply of the city of Fairfield is obtained from Little Wabash River. The water is treated before entering the distribution system.

FAIRMONT CITY (1827). Fairmont City is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

FAEMEE CITY (1621) (p. 216). The public water supply for Farmer City was obtained from the two wells described on page 216 until 1925. In that year Chris Ebert of Washington drilled a well 173½ feet deep at a location 22 feet north and 80 feet west of the old north well that had been constructed in 1907. This third well was cased with 12-inch casing to a depth of 159.5 feet, below which was set 14 feet of Cook screen having number 10 slots.

The well was equipped with a steam-head deep-well cylinder pump having a 9¾ cylinder and a 36-inch stroke. The cylinder, which had an over-all length of 5½ feet, was attached to 136¼ feet of 10-inch drop-pipe, with 20 feet 5 inches of 8-inch suction pipe attached to the bottom of the cylinder. Shortly after this third well was placed. in regular service, the equipment and casing was removed from the old south well (drilled in 1910) and the hole filled up. At the time of a visit in April, 1928. the new well was operating about 4 hours per day, The old north well was operated a few hours per day when the demand was not heavy.

During the latter part of 1928, the steam-head deep-well pump in the well Mr. Ebert drilled in 1925 was replaced by a Fairbanks-Morse 5-inch deep-well turbine pump consisting of 130 feet of 5-inch column pipe, 14 stages of bowls and 20 feet of 4-inch suction pipe. It is direct connected to a Fairbanks-Morse electric motor of 25-horsepower which operates at a full-load speed of 1755 revolutions per minute. The pump delivers about 250 gallons per minute.

In 1931, a fourth well was drilled by E. W. Johnson of Bloomington at a location adjacent to the east side of the pumping station. This well was 174 feet deep and was cased with 12-inch casing to a depth of 159 feet below which was set 15 feet of Cook screen having number 10 slots. Static water level was reported to be 25 feet below the surface. The following log was furnished by Mr. Johnson:

	Thickness in feet.	Depth in feet.
Soil	2	2
Yellow clay	13	15
Soft blue clay	38	53
Streak of gravel	...	53
Hard blue clay	22	75
Water, sand, medium to coarse	4	79
Hard blue clay	26	105
Streak of sand	...	105
Blue clay, not hard	40	145
Green clay	10	155
Brown and blue clay mixed	5	160
Sand, fine muddy	12	172
Blue clay	2	174

This well did not prove satisfactory, and Mr. Johnson drilled another one just north of the pumping station which, likewise, was not up to expectations. Neither well was ever equipped and they were soon filled in.

In 1932, Chris Ebert drilled a sixth well at a site 25 feet southwest of the well he constructed in 1925. It is 173 feet deep and is cased with 12-inch casing to a depth of 156 feet below which is exposed 17 feet of a 20-foot length of Cook number 16-slot screen.

The well was equipped with a Fairbanks-Morse 7-inch deep-well turbine pump consisting of 130 feet of 5-inch column pipe, and 16 stages of bowls. It is direct connected to a Fairbanks-Morse 25-horsepower electric motor operating at a speed of 1800 revolutions per minute. The pump is rated at 250 gallons per minute.

Soon after this well was placed in service the old north well (drilled in 1907) was abandoned and the wells renumbered. The well drilled by Mr. Ebert in 1925 is now known as well number 1 and the well he drilled in 1932 is known as well number 2. These two wells supply all the water for the municipal supply. The average daily demand is about 75,000 gallons. The water from the well number 2 has a total residue of 702.0, a total hardness of 255.5 and a content of iron of 1.2 parts per million as shown by the analysis of sample number 83940, collected June 22, 1938.

Analysis of Sample Number 83940 from Village Well Number 2.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. pr million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		4.2	0.24
(filtered).....	0.0	Sodium Chloride.....NaCl		173.0	10.09
(unfiltered).....	1.2	Sodium Carbonate.....Na_2CO_3		216.1	12.60
Manganese..Mn	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$		19.7	1.15
Silica.....SiO_2	19.0	Magnesium Carbonate..$MgCO_3$		88.2	5.14
Turbidity.....	14.0	Calcium Carbonate.....$CaCO_3$		151.1	8.81
Color.....	10.0	Silica.....SiO_2		19.0	1.11
Odor.....	DF-4				
Calcium.....Ca	60.3	Total.....		671.3	39.14
Magnesium..Mg	25.5				
Ammonium..NH_4	7.5				
Sodium.....Na	163.1				
Sulfate.....SO_4	0.0				
Nitrate.....NO_3	2.9				
Chloride.....Cl	105.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	480.0				
Residue.....	702.0				
Total Hardness....	255.5				

FARMERSVILLE (553). Farmersville is located in the northwestern part of Montgomery County on the drainage area of Macoupin Creek, a tributary of Illinois River. An attempt to install a public water supply was made in 1936. A number of test wells were drilled in and near the village. Most of these were dry holes. The most promising was located northwest of the village. It was 89 feet deep and penetrated some thin sandstones of the Pennsylvanian system. The water level was at a depth of 5 feet when not pumping and was lowered 68 feet by a pumping rate of 15 gallons per minute. The water had a total residue of 235, a total hardness of 182, and a content of iron of 0.7 parts per million as shown by the analysis of sample number 78446, collected July 22, 1936.

Analysis of Sample Number 78446 from Test Well 89 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.3	Sodium Nitrate.....$NaNO_3$		2.6	0.15
(unfiltered).....	0.7	Sodium Chloride.....NaCl		16.4	0.96
Manganese..Mn	0.1	Sodium Sulfate.....Na_2SO_4		2.1	0.12
Silica.....SiO_2	13.0	Sodium Carbonate.....Na_2CO_3		31.8	1.85
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$		58.2	3.39
Calcium.....Ca	45.2	Calcium Carbonate.....$CaCO_3$		113.1	6.59
Magnesium..Mg	16.8	Ferric Oxide.....Fe_2O_3		0.4	0.02
Sodium.....Na	21.6	Manganese Oxide.....MnO		0.1	0.01
Sulfate.....SO_4	1.2	Silica.....SiO_2		13.0	0.76
Nitrate.....NO_3	1.8				
Chloride.....Cl	10.0	Total.....		237.7	13.85
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	212.0				
Residue.....	235.0				
Total Hardness....	182.0				

At the present time the village does not have a public water supply.

FARMINGTON (2269) (p. 217). The city of Farmington replaced the Keystone Driller Company deep-well pump with a Pomona turbine pump in November, 1931. The pump is rated at 150 gallons per minute. The bowls are suspended at a depth of 290 feet. There is 10 feet of suction pipe below the bowls. On June 18, 1933 the static water level was reported to. be about 249 feet below the ground level. The draw down was about 47 feet when the pump was operating.

Analysis number 73441 showed the water to have a total residue of 1670, a total hardness of .275, and an iron content of 0.8 parts per million.

Analysis of Sample Number 73441 from Well 1700 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.8	Sodium Nitrate	$NaNO_3$	.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	486.5	28.39
Silica	SiO_2	11.0	Sodium Sulfate	Na_2SO_4	915.0	53.30
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	5.3	.31
Calcium	Ca	70.0	Ammonium Carbonate	$(NH_4)_2CO_3$	4.3	.25
Magnesium	Mg	24.4	Magnesium Carbonate	$MgCO_3$	84.3	4.91
Ammonium	NH_4	1.7	Calcium Carbonate	$CaCO_3$	156.5	9.13
Sodium	Na	490.0	Calcium Silicate	$CaSiO_3$	21.5	1.25
Sulfate	SO_4	618.0	Iron Oxide	Fe_2O_3	1.1	.06
Nitrate	NO_3	.2				
Chloride	Cl	295.0	Total		1,675.4	97.65
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		266.0				
Residue		1,670.0				
Total Hardness		275.0				

FINDLAY (682). Findlay is located in the northern part of Shelby County on the drainage area of Kaskaskia River, a tributary of Mississippi River. A public water supply was installed by the village in 1935.

Water for the public supply is obtained from a well near the railroad tracks in the southeastern part of the village at the site of test well number 3. The well was drilled in 1935 by L. E. Burt of Elwin. It is 154 feet deep, of the gravel-walled type, and is equipped with a 25-foot length of 12-inch, number 187-slot Cook screen. The diameters of the inner and outer casings are 12 and 26 inches respectively. A test well at the same location penetrated water-bearing sand and gravel between depths of 122 feet and 171 feet.

The water level was at a depth of 96 feet when not pumping and was lowered 14.3 feet when pumping at a rate of 150 gallons per minute.

The well is equipped with an 11-stage, 7-inch Cook deep-well turbine pump having 120 feet of 6-inch column pipe and 10 feet- of 6-inch suction pipe. The pump is rated at 150 gallons per minute against a 240-foot head and is driven by a 20-horsepower electric motor. Water is pumped from the well to the distribution system and elevated steel tank.

There are 75 to 80 service connections. Average daily pumpage is about 10,000 gallons. A minimum charge of $1.50 per month is made for each connection.

Water from the finished well was very similar in chemical quality to water from test well number 3 which had a total residue of 705, a total hardness of 224, and a content of iron of 4.0 parts per million as shown by the analysis of sample number 75860, collected March 29, 1935.

Analysis of Sample Number 75860 from Test Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million:	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.0	Sodium Chloride	NaCl	159.6	9.30
(unfiltered)		4.0	Sodium Sulfate	Na_2SO_4	18.5	1.08
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	253.9	14.80
Silica	SiO_2	12.0	Ammonium Carbonate	$(NH_4)_2CO_3$	25.4	1.48
Turbidity		38.0	Magnesium Carbonate	$MgCO_3$	91.0	5.31
Calcium	Ca	46.4	Calcium Carbonate	$CaCO_3$	116.1	6.76
Magnesium	Mg	26.2	Silica	SiO_2	12.0	0.70
Ammonium	NH_4	9.5				
Sodium	Na	179.4	Total		678.2	39.53
Sulfate	SO_4	12.3				
Nitrate	NO_3	1.3				
Chloride	Cl	97.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		490.0				
Residue		705.0				
Total Hardness		224.0				

FISHER (709). Fisher is located in the northwest part of Champaign County on the drainage of Sangamon River. A public water supply was installed by the village in 1936. The installation consists of a well, pumping equipment, an iron removal and water softening unit, distribution mains and an elevated storage tank.

Water is obtained from a well located in the fire station on the north side of Front Street, west of Third Street in the central part of the village. The well is cased with 8-inch casing to a depth of 186 feet. Below the casing 18 feet of a 20-foot length of Johnson screen is exposed to the water-bearing sand. The lower 10 feet of the screen is cut with number 12 slots and the upper 10 feet is cut with number 10 slots. The water-bearing sand extends between depths of 152 feet and 207 feet and is a rather fine gray sand.

The well is equipped with a Fairbanks-Morse deep-well turbine pump consisting of 9 stages of 7-inch bowls set 80 feet below floor level. The pump is direct connected to an overhead Fairbanks-Morse electric motor of 15-horsepower operating on 220 volt, 3 phase, 60 cycle current at full load speed of 1740 revolutions per minute. At the time of the official test a production of 182 gallons per minute was maintained for a period of 8 hours with a draw down of 26 feet from static level of 30 feet. The water is pumped through two Elgin Zeolite softeners capable of passing 18,000 gallons between regenerations. An elevated steel tank having a capacity of 50,000 gallons is connected to the distribution system.

The raw water from the well has a total residue of 384, a total hardness of 365.5, and an iron content of 0.9 parts per million as shown by the analysis of sample number 77757 collected April 10, 1936.

Analysis of Sample Number 77757 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	0.9	0.05
(filtered).....	0.0	Sodium Chloride.....NaCl	3.5	0.20
(unfiltered).....	0.9	Ammonium Chloride....NH_4Cl	1.0	0.06
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	6.0	0.35
Silica.....SiO_2	16.0	Magnesium Carbonate..$MgCO_3$	130.6	7.62
Turbidity.....	5.0	Calcium Carbonate.....$CaCO_3$	179.0	10.45
Calcium.....Ca	82.2	Calcium Silicate.....$CaSiO_3$	30.7	1.79
Magnesium..Mg	38.8			
Ammonium..NH_4	0.4	Total.....	351.7	20.52
Sodium.....Na	1.6			
Nitrate.....NO_3	1.0			
Sulfate.....SO_4	5.0			
Chloride.....Cl	3.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	334.0			
Residue.....	384.0			
Total Hardness....	365.5			

FLANAGAN (631) (p. 220). The water supply of Flanagan was obtained from two similar wells in July, 1930. The second well is located very close to the well described on page 220. Both wells are interconnected so that they are both pumped at once. In July, 1930 the wells were flowing at a rate of about one gallon per minute when not pumping.

FLORA (4393) (p. 221). In 1932-1933 a filter plant was constructed. Since that time all water for the public supply has been obtained from Little Wabash River.

FLOSSMOOR (808). Flossmoor is located in the southern part of Cook County about 3 miles northwest of Chicago Heights. The village was incorporated in 1925. Part of the territory now included in the corporation had been and is supplied with water from wells owned by the Illinois Central Railroad and part with water from a well owned by the Merrick Construction Company.

The Illinois Central Railroad formerly had two wells on the west side of its right-of-way, north of the depot. The south well (well number 1) was drilled in 1892 and abandoned in 1926. The north well (well number 2) was drilled in 1922 and is 152 feet deep. It is 10 inches in diameter and is cased to rock with 85 feet of 10-inch pipe. It is equipped with an American double-acting deep-well pump and yields 150 gallons per minute. Elevation of the ground surface is about 682 feet above sea level.

A well (well number 3) 160 feet deep was drilled in 1926 by Layne-Bowler Company. It is 16 inches in diameter and is cased with 16-inch

pipe to a depth of 88 feet. It is located about 200 feet northwest of the other well (number 2) and is equipped with a similar pump. When the pump in well number 2 was operating alone the water level in well number 3 stood at a depth of 46 feet. With both pumps operating the water was lowered to a depth of 94 feet. When the east pump was stopped the water rose to 89 feet.

Water from well number 2 had a mineral content of 741, a total hardness of 503, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 57160, collected August 27, 1926.

Analysis of Sample Number 57160 from Well 152 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Potassium Nitrate	KNO_3	0.3	.02
Manganese	Mn	0.0	Potassium Chloride	KCl	7.6	.44
Silica	SiO_2	19.9	Potassium Sulfate	K_2SO_4	9.7	.57
Nonvolatile		0.5	Sodium Sulfate	Na_2SO_4	114.8	6.71
Alumina	Al_2O_3	2.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.6	.09
Calcium	Ca	115.0	Magnesium Sulfate	$MgSO_4$	156.2	9.13
Magnesium	Mg	52.5	Magnesium Carbonate	$MgCO_3$	67.4	3.94
Ammonium	NH_4	0.4	Calcium Carbonate	$CaCO_3$	278.7	16.30
Potassium	K	8.7	Silica	SiO_2	19.9	1.16
Sodium	Na	38.4	Iron Oxide	Fe_2O_3	1.4	.08
Sulfate	SO_4	203.0	Alumina	Al_2O_3	2.0	.12
Nitrate	NO_3	0.2	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	3.5	Nonvolatile		0.5	.03
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		660.1	38.59
Methyl Orange		348.0				
Residue		741.0				
Total Hardness		503.0				

A well 351 feet deep was drilled for the Merrick Construction Company. It is 12 inches in diameter to rock which was entered at a depth of 105 feet and is 10 inches in diameter at the bottom. The depth to water was about 60 feet when not pumping. The well was reported to have been pumped at a rate of 250 gallons per minute. The well is equipped with a Pomona pump of 200 gallons per minute capacity.

FORREST PARK (14,555) (p. 223). In 1932 the village discontinued the use of wells as a source of water. Since that time all water has been obtained from Chicago.

FOREST VIEW (125). The village of Forest View obtains Lake Michigan water from Chicago through the village of Stickney.

FORREST (915) (p. 226). The mine shafts, from which water for the public supply was formerly obtained, have been abandoned.

A well drilled in 1935 by Layne North Central Company, is located near the Vermilion River about one-half mile south of the village limits. It is 114 feet deep and is equipped with a 25-foot length of 18-inch Layne screen having openings 3/16 inches in width. The well is gravel-walled with selected gravel. The outer casing is 30 inches in diameter.

The water level was 36½ feet below the base of the pump on May 25, 1935. It was lowered 8¼ 13½, and 17 feet when pumping at rates of 143, 200, and 250 gallons per minute, respectively.

The well is equipped with an 8-stage, 8-inch Layne turbine pump having 99 feet of column pipe and 6 feet of suction pipe.

The water had a total residue of 336, a total hardness of 281, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 75915 collected April 8, 1935.

Analysis of Sample Number 75915 from Well 114 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Sodium Nitrate	$NaNO_3$	.8	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	3.5	.20
Silica	SiO_2	8.0	Sodium Carbonate	Na_2CO_3	63.0	3.73
Turbidity		15.0	Ammonium Carbonate	$(NH_4)_2CO_3$	7.2	.42
Calcium	Ca	61.0	Magnesium Carbonate	$MgCO_3$	108.3	6.32
Magnesium	Mg	31.3	Calcium Carbonate	$CaCO_3$	152.6	8.90
Ammonium	NH_4	2.7	Iron Oxide	Fe_2O_3	1.4	.08
Sodium	Na	29.0	Silica	SiO_2	8.0	.47
Sulfate	SO_4	0.0				
Nitrate	NO_3	0.9	Total		344.8	20.17
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		348.0				
Residue		336.0				
Total Hardness		281.0				

FORRESTON (908) (p. 227). No reported change.

FOX LAKE (880). Fox Lake is located in the northwestern part of Lake County on the shores of Fox, Nippersink, and Pistakee Lakes.

Water for the public supply, installed by the village in 1928, is obtained from a well drilled in 1928 by W. L. Thorne Company of Des Plaines. It is 945 feet deep and 10 inches in diameter at the bottom. It is cased with 12-inch pipe to a depth of 255 feet and with 10-inch pipe from 237 feet to 545 feet. The elevation of the ground surface at the well is approximately 770 feet above sea level. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	245	245
Limestone, Niagaran	60	305
Shale, Maquoketa	190	495
Limestone, Galena-Platteville	315	810
Sandstone, St. Peter	135	945

The well was equipped with a Keystone two-stroke deep-well pump with a 5¾-inch diameter cylinder and an 18-inch stroke. The displacement was about 165 gallons per minute. During 1937 the original deep-well cylinder pump was replaced by a Sterling deep-well turbine pump the assembly of which consisted of 200 feet of 5-inch column pipe, 12 stages (6 feet 10 inches) of 8-inch turbine pump, and 10 feet of 5-inch suction pipe on the bottom of which is a 13-inch tapered strainer.

The pump is direct connected to a vertical electric motor of 25-horsepower operating on 3 phase, 60 cycle, 220 volt electric current at a normal speed of 1800 revolutions per minute. The pump was designed for 200 gallons per minute against a total head of 325 feet.

The water had a total residue of 336, a total hardness of 317, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 62540, collected September 11, 1928.

Analysis of Sample Number 62540 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.6	Potassium Nitrate	KNO_3	0.6	0.04
Manganese	Mn	0.0	Potassium Chloride	KCl	4.3	0.25
Turbidity		10.0	Sodium Chloride	NaCl	1.9	0.11
Silica	SiO_2	28.3	Sodium Sulfate	Na_2SO_4	3.2	0.19
Nonvolatile		7.9	Sodium Carbonate	Na_2CO_3	32.0	1.87
Alumina	Al_2O_3	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	0.03
Calcium	Ca	57.8	Magnesium Carbonate	$MgCO_3$	139.1	8.14
Magnesium	Mg	42.1	Calcium Carbonate	$CaCO_3$	137.4	8.04
Ammonium	NH_4	0.2	Silica	SiO_2	28.3	1.65
Sodium	Na	16.4	Iron Oxide	Fe_2O_3	0.9	0.05
Potassium	K	2.6	Alumina	Al_2O_3	0.0	0.00
Sulfate	SO_4	2.1	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.4	Nonvolatile		7.9	0.46
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$			Total		356.1	20.83
Phenolphthalein						
Methyl Orange		318.0				
Residue		336.0				
Total Hardness		317.0				

FOX RIVER GROVE (641). Pox River Grove is located in the southeastern part of McHenry County on the east bank of Fox River, a tributary of Illinois River.

Water for the public supply, installed by the village in 1928, is obtained from a well located in the public park surrounded by Beach Way and River Way. It was drilled in 1928 by the W. L. Thorne Company of Des Plaines to a depth of 145 feet. It is cased with 12-inch pipe to rock at a depth of 102 feet and is 12 inches in diameter at the bottom. The elevation at the top of the well is about 738 feet above sea level. The water level was at a depth of 6 feet and was lowered 23 feet when pumping at a rate of 210 gallons per minute.

The well is equipped with a 2-stroke Keystone deep-well pump having a 7¾-inch diameter cylinder, an 18-inch stroke and driven by a 25-horsepower electric motor.

The water had a total residue of 373,. a total hardness of 370, and a content of iron of 0.5 parts per million as shown by the analysis of sample number 63413, collected January 19, 1929.

Analysis of Sample Number 63413 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.5	Ammonium Chloride....NH_4Cl	0.3	0.02
Manganese..Mn	0.0	Magnesium Chloride....$MgCl_2$	10.8	0.63
Turbidity.....	5.0	Magnesium Sulfate.....$MgSO_4$	48.9	2.86
Silica.....SiO_2	13.0	Magnesium Carbonate..$MgCO_3$	133.8	7.24
Calcium.....Ca	66.5	Calcium Carbonate.....$CaCO_3$	161.4	9.44
Magnesium..Mg	49.7	Silica.....SiO_2	13.0	0.76
Ammonium..NH_4	0.1	Iron Oxide.....Fe_2O_3	0.7	0.04
Sulfate.....SO_4	38.1	Manganese Oxide.....MnO	0.0	0.00
Nitrate.....NO_3	0.0			
Chloride.....Cl	8.0	Total.....	358.9	20.99
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	300.0			
Residue.....	373.0			
Total Hardness....	370.0			

FEANKFORT (590) (p. 228). The 165-foot well described on page 229 was furnishing water for Frankfort on July 13, 1938. The single-acting deep-well pump was replaced in 1931 by a size 8 Deming turbine pump rated at 240 gallons per minute against a head of 210 feet. The pump is driven by a 20-horsepower U. S. electric motor. The top of the bowls are 96 feet below the ground level. On December 22, 1931 the static water level was reported to be 64 feet below the ground level.

The analysis of sample number 83850, collected on July 13, 1938 shows it to be similar to the analysis of sample number 49185 given on page 229.

FEANKLIN GEOVE (625) (p. 230). Franklin Grove secures water from the well described on page 230.

In 1923 or 1924 a second well was drilled about 50 feet north of the original well. This well is 150 feet deep and 10 inches in diameter. Water is pumped from this well with an American Well Works double-acting pump. The cylinder is 7½ inches in diameter, 5 feet 8 inches long, and is attached to 83 feet of 8-inch drop-pipe. A 6-inch suction pipe, 11 feet 5 inches long, is attached below the cylinder. The stroke is 24 inches long. The pump is driven by a 20-horsepower Fairbanks-Morse gasoline engine. The static water level is about 31 feet below the ground surface. The well, drilled in 1923, is maintained as a stand-by unit.

There are about 120 service connections. The rates are as follows:

Minimum $1.00 per quarter
30 cents per 100 cu. ft. for the first 3,000 cu. ft.
20 cents per 100 cu. ft. for the next 10,000 cu. ft.
15 cents per 100 cu. ft. for all over 13,000 cu. ft.

The water had a total residue of 514, a total hardness of 478 and an iron content of 1.08 parts per million as shown by the analysis of

sample No. 83973, collected on July 26, 1938. The sample was collected from the pressure tank after the 150-foot well drilled in 1923 or 1924 had been in use exclusively for one week.

Analysis of Sample No. 83973 Collected from Pressure Tank.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		trace	Sodium Chloride	NaCl	12.8	0.75
(unfiltered)		1.08	Magnesium Chloride	$MgCl_2$	17.6	1.03
Manganese	Mn	0.00	Magnesium Sulfate	$MgSO_4$	117.4	6.84
Silica	SiO_2	16.00	Magnesium Carbonate	$MgCO_3$	79.3	4.62
Turbidity		18	Calcium Carbonate	$CaCO_3$	268.2	15.63
Color		0	Silica	SiO_2	16.0	.93
Odor		0				
Calcium	Ca	107.2	Total		513.0	29.90
Magnesium	Mg	51.1				
Ammonium	NH_4	trace				
Sodium	Na	5.5				
Sulfate	SO_4	93.8				
Nitrate	NO_3	1.3				
Chloride	Cl	21.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		362.0				
Residue		514.0				
Total Hardness		478.0				

FRANKLIN PARK (2425) (p. 231). The well drilled in 1917 which was reported to be 1242 feet deep has since been reported to be 1485 feet deep.

The well being drilled in 1923 was finished at a depth of 1405 feet. It was cased to limestone at a depth of 75 feet. A leak between the casing and its seat on the rock allowed large quantities of surface water to enter the well. Pear of contaminated water and high cost of pumping caused this well to be temporarily abandoned. In 1931 the well was reamed to a depth of 500 feet and deepened to a depth of 1949 feet.

Part of the log of this well is as follows:

	Thickness in feet.	Depth in feet.
Sandstone, Dresbach	50	1455
Lime, sand, shale, Eau Claire	280	1735
Sandstone	10	1745
Limestone	90	1835
Sandstone, Mt. Simon	114	1949

Elevation of the ground surface is about 640 feet above sea level.

Water from this well had a total residue of 527, a total hardness of 224, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 69087, collected May 1, 1931.

Analysis of Sample Number 69087 from Village Well 1949 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	59.0	3.44
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	182.5	10.64
Turbidity		10.0	Sodium Carbonate	Na_2CO_3	37.1	2.16
Calcium	Ca	54.4	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	.06
Magnesium	Mg	21.4	Magnesium Carbonate	$MgCO_3$	74.2	4.32
Ammonium	NH_4	0.4	Calcium Carbonate	$CaCO_3$	136.0	7.94
Sodium	Na	99.0	Iron Oxide	Fe_2O_3	1.4	.08
Sulfate	SO_4	123.7	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.1	Silica	SiO_2	9.0	.53
Chloride	Cl	36.0				
Alkalinity as $CaCO_3$			Total		501.9	29.27
Phenolphthalein		0.0				
Methyl Orange		260.0				
Residue		527.0				
Total Hardness		224.0				

FREEBURG (1,434) (p. 709). The raw water supply of the village of Freeburg is obtained from Silver Creek. . The water is treated before entering the distribution system.

FREEPORT (22,045) (p. 232). The water-works was purchased by the city from the Illinois Water Service Company in 1937. A number of changes have been made since 1925.

Prior to 1931 the 25 wells into sand and gravel and the 265-foot rock well, number 1, were abandoned. All of these wells have been plugged.. Since that year all water has been obtained from the 303-foot well known as number 2, the 503-foot well known as number 3, and a new 100-foot well drilled by the Ohio Drilling Company and known as number 4. In 1938 the water was aerated and filtered, but the use of chemicals had been abandoned.

Well number 2 is equipped with a 2-stage, 16-inch Sterling turbine pump having 60 feet of 10-inch column pipe and 21 feet of 10-inch suction pipe. The pump is driven by a 30-horsepower electric motor. The well has been pumped at a rate of 1383 gallons per minute.

Well number 3 is pumped by air-lift. Well number 4 is equipped with a 2-stage, 14-inch Sterling turbine pump having 55 feet of column pipe and 20 feet of suction pipe. The pump delivers 873 gallons per minute and is driven by a. 20-horsepower electric motor. .

Water from all the wells is pumped to an aerator, from which it flows by gravity to the filters and then to the reservoirs. It is pumped from the reservoirs to the distribution system by the Epping-Carpenter pump or the Holly pump, both described on page 233, or by a Cameron centrifugal pump driven by a 250-horsepower steam turbine. This latter pump is rated at 2400 gallons per minute against a head of 264 feet.

In 1936 a new elevated steel tank was erected on high ground in the southern part of the city. It has a capacity of one million gallons and is connected to the distribution system. The average daily pumpage is about 1,400,000 gallons.

Recent analyses of water samples from the three wells now in use show the chemical quality to be essentially the same as that shown on page 235.

. PULTON (2656) (p. 236). A new well, number 3, was drilled in 1931 by Joseph Egerer of Milwaukee. It is located at the pumping station about 300 feet from the old 1500-foot well, number 2, and is 1943 feet deep. It is cased to a depth of 192 feet with 16-inch pipe, from 179 to 345 feet with 12½-inch pipe, and. from 654½ to 760 feet with 10-inch pipe. It was drilled 15 inches in diameter from 192 to 345 feet, 12 inches in diameter from 345 to 760 feet, and 10 inches in diameter from 760 to 1943 feet.

A record of material penetrated, with classifications by the Geology Department of the University of Wisconsin, is as follows:

	Thickness in feet.	Depth in feet.
Drift	190	190
Dolomite, shale, Richmond	152	342
Dolomite, Galena-Black River	348	690
Sandstone, shale, St. Peter	70	760
Dolomite, Lower Magnesian	370	1130
Sandstone, Jordan	10	1140
Dolomite, Trempealeau	170	1310
Dolomite, sandstone, Mazomanie-Franconia	90	1400
Sandstone, Ironton	40	1440
Sandstone, Dresbach	90	1530
Sandstone, Eau Claire	180	1710
Sandstone, Mt. Simon	233	1943

The static water level was 15 feet above ground surface and the free flow at the surface was 160 gallons per minute in 1931. In 1938 the static level was about 40 feet below the surface.

The well is equipped with an air-lift and is pumped at a rate of 600 gallons per minute. Air is admitted through 168 feet of 2-inch pipe.

Well number 2 is pumped at a rate of 750 gallons per minute by air-lift. Well number 1 has been abandoned and filled.

There are 700 service connections, of which only 30 are metered. The average daily pumpage is approximately 400,000 gallons.

Water from well number 3 had a total residue of 333, a total hardness of 279, and a content of iron of 0.44 parts per million as shown by the analysis of sample number 83702, collected June 7, 1938.

Analysis of Sample Number 83702 from Well 1943 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.3	0.25
(filtered)		0.0	Sodium Chloride	NaCl	18.1	1.05
(unfiltered)		0.44	Sodium Sulfate	Na_2SO_4	22.7	1.32
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	10.9	0.64
Silica	SiO_2	13.0	Magnesium Carbonate	$MgCO_3$	101.7	5.93
Turbidity		4.0	Calcium Carbonate	$CaCO_3$	149.9	8.74
Color		0.0	Silica	SiO_2	13.0	0.76
Odor		0.0				
Calcium	Ca	59.8	Total		320.6	18.69
Magnesium	Mg	31.5				
Ammonium	NH_4	trace				
Sodium	Na	15.6				
Sulfate	SO_4	23.9				
Nitrate	NO_3	3.0				
Chloride	Cl	11.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		270.0				
Residue		333.0				
Total Hardness		279.0				

GALATIA (933). The raw water supply of the village of Galatia is obtained from Gassaway Creek and from a supplemental raw water storage reservoir constructed in 1937. The water is treated before entering the distribution system.

GALENA (3878) (p. 238). There has been no change in the source of supply or pumping equipment.

Well number 1 was recased in 1928 with pipe which had been treated with "No-Oxide". In 1933 this easing was removed, and reinstalled after being again treated. At that time very little corrosion was noticed. The casing consists of 265½ feet of 6-inch pipe connected by a reducer to 245 feet of 5-inch pipe.

Well number 2 was recased in 1933. A 448-foot length of new 8-inch casing was cemented inside the old 10-inch pipe.

Well number 3 was being drilled in 1938 by C. W. Varner of Dubuque, Iowa. It is located about 20 feet from well number 1, and is to be 1500 feet deep with a diameter of 12 inches at the bottom. As soon as it is completed well number 1 will be abandoned and plugged.

In 1938 static pressure at the top of the old wells was 17½ pounds per square inch. The chemical quality of the water was similar to that of sample number 46743, shown on page 239.

GALESBURG (28,830) (p. 241). The Brooks Street and Central Station wells described on pages 242 and 243 are maintained as stand-by units. Both wells are pumped by air.

The 2414-foot well described on page 242, now known as well number 1, is operated more or less regularly.

At the time of a production test made May 8, 1936 the well was

equipped with an American Well Works 12-inch deep-well turbine pump. The assembly consisted of 4.4 feet of discharge tee, 264 feet of 8-inch column pipe, 14 bowls having an over-all length of 13 feet, and 20 feet of 8-inch suction pipe. This represents an over-all length of 301.4 feet from top of bed plate at floor level to bottom of suction pipe. A 14-inch air line for measuring water levels extends to a depth of 276 feet below the top of the bed plate. Static water level was found to be 205.5 feet below top of bed plate. The pump which had been out for repairs for some time was replaced in service at 4:00 p. m. April 11, 1936 and had been in constant operation from that date to the date of the test, at which time the pump was delivering 810 gallons per minute with a 67-foot draw down. Temperature of the water was 70° F.

A second deep-well (2408 feet deep) was completed in June, 1928 by Thorpe Bros of Des Moines, Iowa at a location on the west side of South Henderson Street, about 275 feet south of the south line of Main Street. This well is now known as well number 2 and is 533 feet northeast of well number 1.

A log of the material penetrated with classification by the State Geological Survey is as follows:

	Thickness in feet.	Depth in feet.
Drift	85	85
Coal measures, Pennsylvanian	145	230
Shale, Kinderhook	125	355
Limestone, Devonian	90	445
Dolomite, Silurian	125	570
Shale, Maquoketa	200	770
Dolomite, Galena-Platteville	300	1070
Sandstone, St. Peter	140	1210
Dolomite, Shakopee	270	1480
Sandstone, dolomite, New Richmond	40	1520
Dolomite, Oneota	295	1815
Dolomite, Trempealeau	205	2020
Dolomite, sandstone, Franconia	195	2215
Sandstone, Dresbach	120	2335
Sandstone, shale, Eau Claire	73	2408

The well is cased with 22-inch outside diameter pipe from the surface to a depth of 412 feet, and with 14-inch outside diameter pipe between depths of 406 feet and 1479 feet. The well was finished as a 12-inch hole.

The well is equipped with an American Well Works 20-inch deep-well turbine pump consisting of 4 feet of discharge tee, 264 feet of 10-inch column pipe, four bowls having an over-all length of 6 feet and 20 feet of 10-inch suction pipe, making an over-all length from top face of bed plate (pump house floor) to bottom of suction pipe of 294 feet. A 14-inch air pipe extends to a depth of 273 feet 7¾ inches below floor level.

At the time of a test on June 22, 1933 the production was 1580 gallons per minute with a draw down of 39 feet from a static water level of 202 feet below floor level.

The water from well number 2 has a total residue of 1020, a total hardness of 242.5 and a content of iron of 0.4 parts per million as shown by the analysis of sample number 77978, collected May 8, 1936. Temperature 71° F.

. Analysis of Sample Number 77978 from Well Number 2.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	297.0	17.32
Silica	SiO_2	12.0	Sodium Sulfate	Na_2SO_4	464.0	27.05
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.6	0.15
Color		0.	Magnesium Sulfate	$MgSO_4$	17.5	1.08
Odor		0.	Magnesium Carbonate	$MgCO_3$	75.0	4.37
Calcium	Ca	55.8	Calcium Carbonate	$CaCO_3$	139.0	8.10
Magnesium	Mg	25.3	Iron Oxide	Fe_2O_3	.6	.03
Ammonium	NH_4	.7	Silica	SiO_2	12.0	.70
Sodium	Na	267.4				
Sulfate	SO_4	329.5	Total		1,009.4	58.90
Nitrate	NO_3	1.5				
Chloride	Cl	180.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		228.0				
Residue		1,020.0				
Total Hardness		242.5				

GALVA (2875) (p. 245). In 1933 Thorpe Brothers of Des Moines, Iowa drilled a new well, known as number 4, for Galva. This well is located about 150 feet east and 50 feet north of the old wells. It is 1687 feet deep and cased with 24-inch pipe from the ground surface to 64½ feet, 20-inch pipe from the ground surface to 359 feet, 16-inch pipe from 320 to 502 feet, and 12-inch pipe from 840 to 1040 feet. A log prepared by the State Geological Survey shows the material penetrated as follows:

	Thickness in feet.	Depth in feet.
Drift	50	50
Pennsylvanian, shales	300	350
Mississippian, shales	100	450
Devonian Limestone	80	530
Silurian, Niagaran Dolomite	280	810
Alexandrian Dolomite	50	860
Ordovician, Maquoketa Shale	165	1025
Galena Dolomite	195	1220
Decorah Dolomite	40	1260
Platteville Dolomite	90	1350
Glenwood Dolomite	10	1360
St. Peter Sandstone	150	1510
Shakopee Dolomite	177	1687

During an 8-hour test on October 12, 1933 the static water level was reported to be about 288 feet below the ground surface, and the draw down to be 60 feet when pumping at a rate of 490 gallons per minute. At the time of the final test on January 23, 1934 static water level was reported to be 285.6 feet and the pumping level was 335.1 feet below the pump base when pumping at a rate of 490 gallons per minute.

During the test on January 23, 1934 the pumping level in well number 3 had receded two feet, 2½ hours after pumping was started at well number 4. After well number 3 was shut down the pumping level in well number 4 raised 1.1 feet.

Water is pumped from well number 4 by a 13-stage, 12-inch American Well Works deep-well turbine pump driven by a 60-horsepower General Electric motor. The bowls are attached to 350 feet of 8-inch column pipe and a 20-foot length of 8-inch suction pipe extends to a total depth of 380 feet 6 inches below the pump base.

Well number 3 is pumped by air lift and is only used about four hours per week. A 4½-inch Sullivan foot-piece attached to 545 feet of air pipe was installed in 1922. At that time the static water level was reported to be 293 feet and the pumping level 339 feet below the ground level when pumping 247 gallons per minute. The operating pressure is 107 pounds per square inch. Air. is furnished by a Sullivan Angle Compound Compressor driven by a 100-horsepower Fairbanks-Morse Type Y oil engine.

On January 23, 1934 the. starting pressure on the air lift was 107 and the operating pressure 92 pounds per square inch. This would indicate a static water level of 294 and a pumping level of 328 feet below the ground surface when pumping 207 gallons per minute.

Wells numbers 1 and 2 have been abandoned.

Water is pumped from the ground storage reservoirs to the mains; by either an Economy centrifugal pump rated at 350 gallons per minute and driven by a 20-horsepower General Electric motor or an American Well Works centrifugal pump rated at 500 gallons per minute and driven by a 25-horsepower General Electric motor. An Allis-Chalmers centrifugal pump rated at 1200 gallons per minute and driven by a 50-horsepower Allis-Chalmers motor is available but seldom used.

There are about 1000 services, and the average daily usage is about 175,000 gallons. The rates are as follows:

Minimum $1.95 per quarter includes 300 cubic feet.
45 cents per 100 cubic feet for the next 700 cubic feet.
18 cents per 100 cubic feet for all over 5000 cubic feet.

The analysis of sample number 73928, collected December 9, 1933 from well number 3 showed a total residue of 906, a total hardness of 150, a trace of iron and a fluoride content of 1.7 to 2.0 parts per million.

The water in well number 4 has a total residue of 908, a total hardness of 74, and a content of iron of 0.6 parts per million as shown, by the analysis of sample number 83364, collected April 19, 1938. The temperature of the water was 66° F.

Analysis of Sample Number 83364 from Well Number 4.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.06	Sodium Nitrate	$NaNO_3$	7.7	0.45
(unfiltered)		0.6	Sodium Chloride	NaCl	257.5	15.10
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	376.2	21.60
Silica	SiO_2	14.0	Magnesium Carbonate	$MgCO_3$	49.3	2.87
Turbidity		4.0	Sodium Carbonate	Na_2CO_3	182.4	10.65
Color		0	Calcium Carbonate	$CaCO_3$	15.5	0.09
Odor		0	Iron Oxide	Fe_2O_3	0.1	0.01
Calcium	Ca	6.2	Silica	SiO_2	14.0	0.82
Magnesium	Mg	14.2				
Ammonium	NH_4	trace	Total		902.7	51.59
Sodium	Na	307.0				
Sulfate	SO_4	255.0				
Nitrate	NO_3	5.3				
Chloride	Cl	156.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		16.0				
Methyl Orange		246.0				
Residue		908.0				
Total Hardness		74.0				

GENESEO (3406) (p. 247). Water for the public supply is obtained from the two wells described on page 248, supplemented by five other wells. The five wells which were constructed first are from 15 to 19 feet in depth. The other two wells are about 24 feet deep and of greater diameter. They were constructed in 1932. The greatest distance between any two of the wells is probably less than 600 feet.

Water is siphoned from the wells to the large reservoir (page 247), and is then pumped to the city by an American 2-stage centrifugal pump, rated at 450 gallons per minute against a head of 254 feet and driven by a 60-horsepower electric motor. In case of emergency, water can be pumped by a Fairbanks-Morse 2-stage centrifugal pump, rated at 400 gallons per minute against a head of 254 feet and driven by a 60-horsepower diesel engine. A total of seven million gallons is pumped each month.

Water from one of the 24-foot wells had a total residue of 456, a total hardness of 364, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 70953, collected May 16, 1932. Water from the other 24-foot well had a total residue of 634, a total hardness of 491, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 71215, collected June 27, 1932.

Analysis of Sample Number 70953 from Well Number 6.

Determinations made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.6	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	29.8	1.74
Silica	SiO_2	14.0	Sodium Sulfate	Na_2SO_4	24.9	1.45
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Calcium	Ca	77.5	Magnesium Sulfate	$MgSO_4$	97.0	5.65
Magnesium	Mg	41.5	Magnesium Carbonate	$MgCO_3$	76.7	4.47
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	194.0	11.30
Sodium	Na	20.0	Iron Oxide	Fe_2O_3	0.9	0.05
Sulfate	SO_4	95.0	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.1	Silica	SiO_2	14.0	0.82
Chloride	Cl	18.0				
Alkalinity as $CaCO_3$			Total		438.9	25.57
Phenolphthalein		0.0				
Methyl Orange		284.0				
Residue		456.0				
Total Hardness		364.0				

Analysis of Sample Number 71215 from Well Number 7.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.1	Sodium Chloride	NaCl	46.8	2.73
Silica	SiO_2	14.0	Ammonium Chloride	NH_4Cl	0.5	0.03
Turbidity		0.0	Magnesium Chloride	$MgCl_2$	7.1	0.41
Calcium	Ca	106.6	Magnesium Sulfate	$MgSO_4$	214.3	12.50
Magnesium	Mg	54.8	Magnesium Carbonate	$MgCO_3$	33.3	1.94
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	266.5	15.55
Sodium	Na	18.6	Iron Oxide	Fe_2O_3	0.3	0.02
Sulfate	SO_4	171.1	Manganese Oxide	MnO	0.1	0.01
Nitrate	NO_3	0.8	Silica	SiO_2	14.0	0.82
Chloride	Cl	34.0				
Alkalinity as $CaCO_3$			Total		583.8	34.06
Phenolphthalein		0.0				
Methyl Orange		306.0				
Residue		634.0				
Total Hardness		491.0				

Station Number 10 of the Natural Gas Pipeline Company of America is located about four miles south of Geneseo. In 1931 the Sewell Well Company completed two wells for this company. These wells are located on the grounds of Station Number 10 in the south 30 acres of the S. E. ¼ of the N. E. ¼ of section 8, T. 16 N., E. 3 E.

Well number 1 was drilled to a total depth of 1307 feet terminating in the St. Peter sandstone. Ten-inch casing was set between the surface and 318 feet, and 8-inch casing between 314 feet and 763 feet. A lead seal filled the annular space between the casings.

Static water level was reported as 151 feet when the acceptance test was made. The draw down was 88 feet when pumping at a rate of 180 gallons per minute.

Well number 2 is 80 feet north of number 1. It was finished in the St. Peter sandstone at a depth of 1314 feet. Ten-inch casing was placed between the surface and a depth of 319 feet, and 8-inch casing between depths of 310 and 1192 feet. Sixty-nine feet of 6-inch liner, the lower

20 feet of which was perforated, was set between depths of 1241 feet and 1310 feet. The annular space between the 10-inch and 8-inch casings was filled with a seal.

Static water level was reported as the same as in well number 1. The water had a pronounced odor of hydrogen sulfide. The water from well number 1 had a total residue of 1506, and a total hardness of 466 as shown by the analysis of sample number 69808. collected October 21, 1931.

Analysis of Sample Number 69808 from Well Number 1 at Station Number 10 of the Natural Gas Pipeline Company of America.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	910.2	53.09
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	97.2	5.66
Turbidity		45.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Calcium	Ca	99.9	Magnesium Sulfate	$MgSO_4$	260.6	15.15
Magnesium	Mg	52.6	Magnesium Carbonate	$MgCO_3$	0.4	0.02
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	249.5	14.56
Sodium	Na	390.1	Iron Oxide	Fe_2O_3	0.0	0.00
Sulfate	SO_4	274.7	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.9	Silica	SiO_2	10.0	0.58
Chloride	Cl	552.3				
Alkalinity as $CaCO_3$			Total		1,529.5	89.15
Phenolphthalein		0.0				
Methyl Orange		250.0				
Residue		1,506.0				
Total Hardness		466.0				

GENEVA (4607) (p. 249). Well number 1 described on page 249 was not in use in 1937 and the pumping equipment had been removed.

Well number 2 described on page 250 is located slightly more than 100 feet south of number 1. In 1927 it was drilled deeper by the J. P. Miller Artesian Well Company, being 10 inches in diameter from 1156 feet to the bottom at a depth of 2217 feet. It is cased with a 12-inch pipe to a depth of 225 feet.

A condensed record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
No sample	4	4
Dolomite, shale, Kankakee	76	80
Dolomite, Edgewood	60	140
Dolomite, shale, Maquoketa	80	220
Dolomite, Galena	112	332
Shale, Decorah	9	341
No sample	49	390
Dolomite, Platteville	140	530
Sandstone, shale, St. Peter	320	850
Dolomite, Prairie Du Chien	150	1000
Shale, sandstone, Mazomanie	70	1070
Sandstone, Dresbach	150	1220
Sandstone, shale, dolomite, Eau Claire	410	1630
Sandstone, Mt. Simon	587	2217

The elevation of the ground surface at the well is about 675 feet above sea level.

In 1926 the water level was at a depth of 66 feet when not pumping and the draw down was 142 feet when pumping at a rate of 130 gallons per minute. In 1928 after the well was deepened the water level was at a depth of 50 feet and was lowered 78 feet when pumping at a rate of 525 gallons per minute. In 1938 the water level was reported to be at a depth of 66 feet when not pumping. In 1938 this well was pumped about 6 hours daily, the water discharging over an aerator to the concrete reservoir described on page 249. The well is equipped with a 10-stage, 10-inch American turbine pump with 210 feet of column pipe. The pump is rated at 800 gallons per minute against a head of 236 feet and is driven by a 75-horsepower electric motor.

Well number 3 was drilled in 1930 by William Cater of Chicago and is located on Logan Avenue near Center Street in the northwestern part of the city. It is 985 feet deep and 19 inches in diameter at the top. It was originally cased to rock at a depth of 65 feet, but a late report indicates that the casing has been extended to a depth of 302 feet.

In March, 1930 the static water level was 48 feet 9 inches below the ground surface. In November of the same year it had receded to a depth of 62 feet and the draw down was 224 feet when pumping at a rate of 500 gallons per minute. In 1937 the static level was reported to be 127 feet below the ground surface.

The well is equipped with a 15-stage, 14-inch Byron Jackson turbine pump consisting of 298 feet 8 inches of 8-inch column pipe, 14 feet 4 inches of bowl assembly, and 20 feet of 8-inch suction pipe. The pump is driven by a 100-horsepower electric motor and discharges 500 gallons per minute over a coke-tray aerator to a collecting basin. Water is pumped from the basin through pressure filters to the distribution system by an American centrifugal pump rated at 500 gallons per minute against a head of 160 feet and driven by a 30-horsepower electric motor.

Water is pumped from the main reservoir to the distribution system by two American centrifugal pumps, each rated at 350 gallons per minute and driven by a 30-horsepower electric motor, or by a 6-inch American centrifugal pump which can be driven by a 100-horsepower electric motor or a 100-horsepower gasoline engine.

In 1938 there were 1400 service connections in use and the average daily pumpage was about 450,000 gallons.

Water from the 2217-foot well had a total residue of 313, a total hardness of 232, and a content of iron of 0.7 parts per million as shown by the analysis of sample number 61315, collected March 12, 1928. The temperature of this water is 68° F. Water from the 985-foot well had a total residue of 369, a total hardness of 363, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 68183, collected December 11, 1930. A recent analysis shows the iron content to be 0.8 parts per million. The temperature of this water is 67° F.

Analysis of Sample Number 61315 from Well Number 2.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.7	Sodium Nitrate	$NaNO_3$	10.9	.64
Manganese	Mn	0.0	Sodium Chloride	NaCl	37.9	2.22
Silica	SiO_2	12.0	Sodium Sulfate	Na_2SO_4	25.9	1.51
Calcium	Ca	54.7	Ammonium Sulfate	$(NH_4)_2SO_4$	0.9	.05
Magnesium	Mg	23.2	Magnesium Sulfate	$MgSO_4$	2.0	.12
Ammonium	NH_4	0.3	Magnesium Carbonate	$MgCO_3$	78.9	4.61
Sodium	Na	26.2	Calcium Carbonate	$CaCO_3$	136.6	7.99
Sulfate	SO_4	19.8	Silica	SiO_2	12.0	.70
Nitrate	NO_3	8.0	Iron Oxide	Fe_2O_3	1.0	.06
Chloride	Cl	23.0	Manganese Oxide	MnO	0.0	.00
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0	Total		306.1	17.90
Methyl Orange		230.0				
Residue		313.0				
Total Hardness		232.0				

Analysis of Sample Number 68183 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	1.8	.10
Silica	SiO_2	12.0	Sodium Sulfate	Na_2SO_4	9.9	.58
Turbidity		30.0	Sodium Carbonate	Na_2CO_3	4.2	.24
Calcium	Ca	73.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.9	.17
Magnesium	Mg	44.0	Magnesium Carbonate	$MgCO_3$	152.2	8.87
Ammonium	NH_4	1.0	Calcium Carbonate	$CaCO_3$	182.6	10.64
Sodium	Na	6.2	Iron Oxide	Fe_2O_3	0.0	.00
Sulfate	SO_4	6.6	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.2	Silica	SiO_2	12.0	.70
Chloride	Cl	1.0				
Alkalinity as $CaCO_3$			Total		367.3	21.40
Phenolphthalein		0.0				
Methyl Orange		370.0				
Residue		369.0				
Total Hardness		363.0				

GENOA (1168) (p. 251). The two wells described on pages 251 and 252 still furnish the water supply for the city. Changes in pumping equipment, however, were made in 1936 when the south well was equipped with an 8-inch American Well Works deep-well turbine pump rated at 300 gallons per minute against a head of 270 feet at 1750 revolutions per minute. It is powered by a U. S. 30-horsepower electric motor.

In the same year the north well was equipped with an 8-inch Fairbanks-Morse 15-stage deep-well turbine with a 150-foot setting. This pump can be operated by either a Fairbanks-Morse 30-horsepower electric motor or a Fairbanks-Morse 6-cylinder 50-horsepower gas engine.

There are now 365 service connections, all of which are metered. A charge of $2.50 per quarter for 5000 gallons is made, less a discount of 50 cents if paid promptly.

GEORGETOWN (3407). The raw water supply of the city of Georgetown is secured from Little Vermilion River. A channel dam and treatment plant were constructed in 1934.

GERMANTOWN (776). Germantown is located in the southwestern part of Clinton County on the drainage area of Shoal Creek, a tributary of Kaskaskia River. A public water supply was installed in 1909.

Water was secured from a dug well 10 feet in diameter and 16 feet deep located about 2½ blocks south and ½ block east of the railroad station. It was pumped at a rate of 70 gallons per minute for about ¾ of an hour daily. At the end of this time the well was about dry.

Water was pumped from the well to an elevated tank connected to the mains by a 4 by 6 duplex double-acting pump. In case of emergency water could be pumped from a pond.

The water was not generally used for drinking. There are 16 service connections, and the average daily use is about 2000 gallons.

Temperature of the water was 58½° F. The water had a total residue of 1195, a hardness of 658, and a content of iron of 0.0 parts per million, as shown by the analysis of sample number 62920, collected October 24, 1928.

Analysis of Sample Number 62920 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	60.7	3.55
Manganese	Mn	0.2	Sodium Chloride	NaCl	102.2	5.98
Turbidity		0.0	Sodium Sulfate	Na_2SO_4	145.5	8.51
Silica	SiO_2	16.0	Magnesium Sulfate	$MgSO_4$	318.3	18.61
Calcium	Ca	157.6	Calcium Sulfate	$CaSO_4$	86.1	5.04
Magnesium	Mg	64.3	Calcium Carbonate	$CaCO_3$	330.2	19.32
Ammonium	NH_4	0.0	Silica	SiO_2	16.0	.93
Sodium	Na	103.8	Iron Oxide	Fe_2O_3	0.0	.00
Sulfate	SO_4	413.5	Manganese Oxide	MnO	0.3	.02
Nitrate	NO_3	44.3				
Chloride	Cl	62.0	Total		1,059.3	61.96
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		330.0				
Residue		1,195.0				
Total Hardness		658.0				

The Hanover Star Milling Company had a well 217 feet deep. No log of this well is available, but the log of a coal mine ½ mile west of the village is as follows:

	Thickness in feet.	Depth in feet.
Surface material	10	10
Sand and gravel	19	29
Slate	8	37
Coal	1½	38½
Clay	½	39
Slate	82	121
Sandstone and sandy shale	48½	169½
Sandstone	68½	238
Slate	78½	316½
Limestone	6	322½
Slate	23½	346
Flint and limestone	4	350
Slate	8½	358½
Coal	5	363½
Slate	1	364½

Surface elevation at both the mill and the mine is about 430 feet above sea level.

Water from the well at the mill has a total residue of 857, a total hardness of 10 and a content of iron of 0.0 parts per million, as shown by the analysis of sample number 62921, collected October 24, 1928.

Analysis of Sample Number 62921 from Mill Well 217 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	1.1	.06
Manganese	Mn	0.0	Sodium Chloride	NaCl	362.6	21.20
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	502.4	29.39
Silica	SiO_2	10.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.6	.10
Calcium	Ca	1.8	Magnesium Carbonate	$MgCO_3$	4.9	.29
Magnesium	Mg	1.4	Calcium Carbonate	$CaCO_3$	4.5	.26
Ammonium	NH_4	0.6	Silica	SiO_2	10.0	.58
Sodium	Na	361.0	Iron Oxide	Fe_2O_3	0.0	.00
Sulfate	SO_4	0.0	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.8				
Chloride	Cl	220.0	Total		887.1	51.86
Alkalinity as $CaCO_3$						
Phenolphthalein		18.0				
Methyl Orange		486.0				
Residue		857.0				
Total Hardness		10.0				

GIBSON CITY (21G3) (p. 253). Gibson City obtains water from a well located about 20 feet west of the pumping station. It was originally drilled about 1916. In 1930 the well was cleaned and rebuilt. It is 55 feet deep and 15 inches in diameter. A 10-foot length of No. 6 slot Johnson screen is installed in the well.

Water is pumped from the well to the distribution system by either a Western Pump and Engineering Company triplex pump described on page 253 or by a 10 by 10-inch Deming triplex pump driven by a 40-horsepower Venn Severin oil engine.

The water from this well has a total residue of 313, a total hardness of 281 and an iron content of 1.0 parts per million as shown by the analysis of sample number 80150, collected on January 16, 1934.

In 1927 the American Water Corporation drilled a well for the city. It is located south of 13th Street between Lott Boulevard and Church Street. The well is of the gravel packed type 58 feet deep. The outer casing is 38 inches in diameter and extends to a depth of 38 feet. The inner casing and screen are both 24 inches in diameter. The hole penetrated 6 feet of soil, 32 feet of blue clay and 20 feet of fine sand.

The well is equipped with an American deep-well turbine pump driven by a 40-horsepower General Electric motor. The pump assembly consists of 40 feet of 8-inch column pipe, 5 feet 5 inches of bowls, and 10 feet of suction pipe. The American Water Corporation tested the well on April 12, 1927, at which time the static water level was 13 feet below the ground surface, and after 10 hours of pumping at a rate of 422 gallons per minute the water level was 33½ feet below the ground surface. For several years this well furnished most of the water used by the city, but at present it is only pumped at times of peak demand.

This water has a total residue of 324, a total hardness of 322.5 and an iron content of 0.8 parts per million as shown by the analysis of sample number 84155, collected August 25, 1938.

The other wells described on page 253 are available, but they are seldom used. The old 45,000-gallon elevated tank supported on a brick tower at the old pumping station was removed in 1927 and a new 100,000-gallon elevated tank supported on a steel tower was erected behind the city hall.

There are 500 service connections. The average daily usage is about 200,000 gallons.

Analysis of Sample Number 80150 from 55-Foot Well at Pumping Station.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Sodium Nitrate	$NaNO_3$	0.8	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	4.7	0.27
Silica	SiO_2	12.0	Sodium Sulfate	Na_2SO_4	22.7	1.32
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	39.7	2.32
Calcium	Ca	64.9	Ammonium Carbonate	$(NH_4)_2CO_3$	1.4	0.08
Magnesium	Mg	28.9	Magnesium Carbonate	$MgCO_3$	100.5	5.86
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	162.0	9.44
Sodium	Na	26.7	Iron Oxide	Fe_2O_3	1.4	0.08
Sulfate	SO_4	15.4	Silica	SiO_2	12.0	0.70
Nitrate	NO_3	0.4				
Chloride	Cl	3.0	Total		345.2	20.12
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		320.0				
Residue		313.0				
Total Hardness		281.0				

Analysis of Sample Number 84155 from 58-Foot Well on 13th Street.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.6	0.15
(filtered)		trace	Sodium Chloride	NaCl	3.5	0.20
(unfiltered)		0.8	Sodium Sulfate	Na_2SO_4	9.2	0.54
Manganese	Mn	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.3	0.08
Silica	SiO_2	14.5	Magnesium Sulfate	$MgSO_4$	19.9	1.16
Turbidity		10.0	Magnesium Carbonate	$MgCO_3$	121.0	7.05
Color		0.0	Calcium Carbonate	$CaCO_3$	162.5	9.47
Odor		0.0	Silica	SiO_2	14.5	0.85
Calcium	Ca	65.0				
Magnesium	Mg	38.9	Total		334.5	19.50
Ammonium	NH_4	0.3				
Sodium	Na	5.1				
Sulfate	SO_4	23.2				
Nitrate	NO_3	2.0				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		306.0				
Residue		324.0				
Total Hardness		322.5				

GILLESPIE (5111). The raw water supply of the city of Gillespie is obtained from an impounding reservoir on Rocky Branch Creek. The water is treated before entering the distribution system.

GILMAN (1620) (p. 254). No reported change.

An analysis of sample number 83641, collected June 1, 1938, shows a total residue of 1032, a total hardness of 583, and an iron content of 2.0 parts per million.

GIEAED (1760). Girard installed a distribution system in 1935. Water is purchased from the city of Springfield.

GLASFORD (671) (p. 256). Water for the public supply is obtained from the 1685-foot well described on page 257. The air-lift pump was removed in 1936 and replaced by a Worthington deep-well turbine pump.

The pump is direct connected to a General Electric 15-horsepower electric motor which operates at a full load speed of 1750 revolutions per minute.

Because of the pronounced odor of hydrogen sulfide it was necessary to arrange to discharge the water at the top of the elevated tank over a cascade aerator. The total pumping reported by the water superintendent for the year 1937 was 1,775,300 gallons or an average daily demand of 4590 gallons.

The water has a total residue of 1861, a total hardness of 270, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 84167, collected from a tap on the pump discharge August 27, 1938.

Analysis of Sample Number 84167 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	11.0	0.64
(filtered).....	0.0	Sodium Chloride.....NaCl	743.0	43.38
(unfiltered).....	0.4	Sodium Sulfate.....Na_2SO_4	854.5	49.82
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	8.5	0.49
Silica.....SiO_2	12.0	Magnesium Carbonate..$MgCO_3$	100.3	5.85
Turbidity.....	5	Calcium Carbonate.....$CaCO_3$	150.1	8.75
Color.....	0	Silica.....SiO_2	12.0	0.70
Odor.....	0			
Calcium.....Ca	60.5	Total.....	1,879.9	109.63
Magnesium..Mg	28.9			
Ammonium..NH_4	trace			
Sodium.....Na	575.4			
Sulfate.....SO_4	577.4			
Nitrate.....NO_3	7.9			
Chloride.....Cl	451.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	278.0			
Residue.....	1,861.0			
Total Hardness....	270.0			

GLENCOE (6295) (p. 709). The village of Glencoe obtains its water supply from Lake Michigan. The village constructed its own filtration plant and pumping station in 1927 and 1928.

GLEN ELLYN (7680) (p. 258). No recent changes of importance have been made in the public water supply system. The wells mentioned previously are still in use. The 360-foot well is now equipped with an 8-stage Layne turbine pump rated at 750 gallons per minute. The bottom of the suction pipe is at a depth of 252 feet.

A third centrifugal pump, rated at 1200 gallons per minute and driven by a 75-horsepower electric motor, has been added to the high-lift pumping equipment.

In 1936 a well was drilled by W. L. Thorne Company for the Glen Ellyn Park Commissioners. It is located in the northeastern part of town on the north bank of Lake Ellyn. It is 325 feet deep, and is cased with 10-inch pipe to depth of 78 feet and with 8-inch pipe from 78 to 144 feet.

The water level was at a depth of 17 feet when not pumping and was lowered 33 feet by a pumping rate of 352 gallons per minute.

The water had a total residue of 823, a total hardness of 44, and a content of iron of 1.6 parts per million as shown by the analysis of sample number 78906, collected October 21, 1936.

GLENVIEW (1886) (p. 260). In 1925 a new well, well number 2, 1431 feet deep was drilled by S. B. Geiger. It has an inside diameter of 15¼ inches at the top and 8 inches at the bottom.

The well is located at a site on the east side of Shermer Avenue some 600 feet south of the center of Glenview Eoad and has a ground surface elevation of 655 feet above sea level. This well is about 4200 feet west of well number 1.

At the time of the acceptance test static water level was 117 feet below the top of the casing and when pumping at a rate of 350 gallons per minute a draw down of 49 feet took place.

The well was equipped with a Layne-Bowler deep-well turbine rated at 420 gallons per minute.

The water had a total residue of 501, a total hardness of 293.5 and an iron content of 0.0 parts per million as shown by the analysis of sample number 71759, collected September 29, 1932.

Analysis of Sample Number 71759 from Well Number 2, 1431 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	1.7	.09
Manganese	Mn	0.0	Sodium Chloride	NaCl	46.2	2.69
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	122.2	7.13
Turbidity		2.0	Magnesium Sulfate	$MgSO_4$	88.4	5.16
Calcium	Ca	79.4	Magnesium Carbonate	$MgCO_3$	18.1	1.06
Magnesium	Mg	23.2	Calcium Carbonate	$CaCO_3$	198.5	11.60
Ammonium	NH_4	.02	Silica	SiO_2	10.0	.58
Sodium	Na	58.2				
Sulfate	SO_4	153.5	Total		485.1	28.31
Nitrate	NO_3	1.1				
Chloride	Cl	28.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		220.0				
Residue		501.0				
Total Hardness		293.5				

GOLCONDA (1184). The raw water supply of the town of Golconda is obtained from Ohio River. A treatment plant and a distribution system were installed in 1935.

GOLF (112). The village of Golf purchases Lake Michigan water from Morton Grove.

A public water supply system under private ownership was installed in 1923, consisting of 4600 feet of 4-inch and 6-inch cast iron pipe distribution mains, and a 30,000-gallon elevated tank on a steel tower having an over-all height of 104.75 feet. Until the spring of 1938, water was obtained from an 8-inch well, 260 feet 8 inches deep, in which was placed 95 feet 8 inches of wrought iron pipe. The top of the casing extends 8 inches above ground level.

Static water level was 60 feet below ground level and at a pumping rate of 17 gallons per minute a draw down of 4 feet took place. The well was equipped with an American Marsh double-stroke deep-well cylinder pump. The cylinder which had an inside diameter of 2¾ inches was set 100 feet below ground surface. The length of stroke was 12 inches.

The pump was powered by a General Electric 3-horsepower electric motor.

The water had a total residue of 412, a total hardness of 198 parts per million and but a trace of iron as shown by the analysis of sample number 70808, collected April 27, 1932.

Analysis of Sample Number 70808 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Nitrate	$NaNO_3$	2.6	0.15
Manganese	Mn	0.0	Sodium Chloride	NaCl	64.3	3.75
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	139.0	8.11
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Calcium	Ca	43.2	Magnesium Sulfate	$MgSO_4$	19.9	1.16
Magnesium	Mg	22.0	Magnesium Carbonate	$MgCO_3$	62.4	3.64
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	108.0	6.30
Sodium	Na	71.1	Iron Oxide	Fe_2O_3	trace	trace
Sulfate	SO_4	110.6	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	1.7	Silica	SiO_2	9.0	0.52
Chloride	Cl	39.0				
Alkalinity as $CaCO_3$			Total		405.9	23.67
Phenolphthalein		0.0				
Methyl Orange		182.0				
Residue		412.0				
Total Hardness		198.0				

GRAFTON (1026). A public water supply system for the city of Grafton was installed in 1936. The raw water supply is obtained from the Mississippi and Illinois Rivers. The water is treated before entering the distribution system.

GRAND RIDGE (367) (p. 261). Grand Ridge secures water from two wells into sand and gravel. Well number 1 is described on pages 261 and 262. Well number 2 is located 10 feet east of well number 1. It is 10 inches in diameter by 159 feet deep, and six feet of an 11-

foot screen is exposed to the aquifer. It was drilled by John Sehomas of Ottawa in 1926.

The well is equipped with a Keystone Driller Company 2-stroke pump with a 5¾-inch diameter cylinder, and an 18-inch stroke. The speed is 32 strokes per minute. Static water level in July, 1922 was 122 feet below the ground level.

The material penetrated as recorded by the State Geological Survey is as follows:

	Thickness in feet.	Depth in feet.
Soil	3	3
Clay, yellow	12	15
Clay, blue	45	60
Clay, gravelly	20	80
Soapstone	26	106
Coarse sand the size of peas, not much gravel	54	160

GRANITE CITY (25,130) (p. 709). Granite City is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

GRAFT PARK (508) (p. 262). No record of change.

GRANVILLE (949) (p. 264). The well drilled in 1909-1910 is still in use, but the deep-well pump was replaced in 1922 by an air lift consisting of 443 feet of 4-inch eductor pipe and the same length of 1¼-inch air pipe. Air is supplied by an 8-inch and 4¼ by 8-inch Pennsylvania compound compressor. In 1927 the starting pressure was 140 pounds per square inch, the operating pressure was 114 pounds per square inch, and the pumping rate was 104 gallons per minute.

The triplex pump has been replaced by a Fairbanks-Morse centrifugal pump. The pump and compressor are now driven by a 50-horsepower diesel engine.

Water is no longer sold at a flat rate. All service connections are metered. Water purchased by the village of Mark is measured by a master meter and all service connections in Mark are metered.

GRAYS LAKE (1120) (p. 265). In 1924 F. M. Gray, Jr. of Milwaukee, Wisconsin drilled an additional well for Grays Lake. The well is 1323 feet deep and. located about 20 feet east of the 1039-foot well described on page 265. The well is equipped with a pump similar to the one described on page 266.

The materials penetrated were similar to those penetrated in well number 1 to a depth of 1040 feet. Below that depth the following materials were penetrated, according to a classification prepared by the Department of Geology, University of Wisconsin:

	Thickness in feet.	Depth in feet.
Sandstone, St. Peter	50	1090
Sandstone, Mazomanie	110	1200
Sandstone, Dresbach	60	1260
Sandstone, Eau Claire	63	1323

The water had a total residue of 341, a total hardness of 257.5, and an iron content of 0.2 parts per million as shown by the analysis of sample number 62539, collected September 11, 1928.

Analysis of Sample Number 62539 from 1323-Foot Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Potassium Nitrate	KNO_3	0.9	.05
Manganese	Mn	0.0	Potassium Chloride	KCl	17.5	1.02
Turbidity		5.0	Potassium Sulfate	K_2SO_4	2.7	.16
Silica	SiO_2	12.4	Sodium Sulfate	Na_2SO_4	66.5	3.89
Nonvolatile		0.6	Sodium Carbonate	Na_2CO_3	9.9	.58
Alumina	Al_2O_3	1.5	Ammonium Carbonate	$(NH_4)_2CO_3$	0.6	.04
Calcium	Ca	71.5	Magnesium Carbonate	$MgCO_3$	64.2	3.75
Magnesium	Mg	19.2	Calcium Carbonate	$CaCO_3$	172.6	10.09
Ammonium	NH_4	0.2	Silica	SiO_2	12.4	.72
Potassium	K	11.1	Iron Oxide	Fe_2O_3	0.3	.02
Sodium	Na	26.8	Alumina	Al_2O_3	1.5	.09
Sulfate	SO_4	44.9	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.5	Nonvolatile		0.6	.04
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$			Total		349.7	20.45
Phenolphthalein		0.0				
Methyl Orange		250.0				
Residue		341.0				
Total Hardness		257.5				

GRAYVILLE (1904) (p. 709). The city of Grayville changed its source of water for the public supply from Wabash River to wells in 1928. In the spring of that year Mr. P. Thorpe completed two wells into the sand and gravel deposits of Wabash River bottoms. Well number 1 was 68 feet deep and number 2, which was 100 feet north of the first, was 72½ feet deep.

The material penetrated in constructing a test well near which the two permanent wells were drilled is as follows:

	Thickness in feet.	Depth in feet.
Soil and silt	14	14
Fine sand	8	22
Moderately coarse sand	16	38
Fine sand	21	59
Moderately coarse sand	5	64
Fine sand	5	69
Gravel	1	70
Fine gravel and coarse sand	2½	72½

Each well is curbed in the lower part with 55 feet of porous concrete screen set on a cast iron shoe, and plain concrete casing in the upper part. The concrete casing and screen was 5 inches thick with an inside diameter of 26 inches.

Well number 1 gave a production of 377 gallons per minute with a draw down of 3.6 feet from a static water level 9 feet 2 inches below the top of the casing. At a production rate of 584 gallons per minute the draw down was 5 feet 4 inches at the end of a 15-hour test.

Well number 2 gave a production of 502 gallons per minute with a draw down of 5 feet 9 inches from a static water level 9 feet 4 inches below the top of the well casing.

Each well was equipped with a Cook 2-stroke deep-well cylinder pump driven by a General Electric 24-horsepower electric motor. The cylinders, which had an inside diameter of 8¾ inches, were set with the bottoms at a depth of 65 feet. The pumps were set to operate with a 20-inch stroke and at a speed of 27 revolutions per minute. They were purchased under a guarantee to deliver 250 gallons per minute against a 275-foot head.

The temperature of the water was reported to be 54° F.

The water from well number 1 had a total residue of 319, a total hardness of 298 and a content of iron of 0.4 parts per million as shown by the analysis of sample 62138, collected July 12, 1928.

Analysis of Sample Number 62138 from Well Number 1.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.4	Potassium Nitrate.....KNO_3	3.5	0.21
Manganese..Mn	0.0	Sodium Nitrate.....$NaNO_3$	2.7	0.16
Turbidity.....	0.0	Sodium Chloride.....NaCl	13.7	0.80
Silica.....SiO_2	13.6	Sodium Sulfate.....Na_2SO_4	7.7	0.45
Nonvolatile.....	0.3	Ammonium Sulfate.....$(NH_4)_2SO_4$	0.1	0.01
Alumina.....Al_2O_3	0.5	Magnesium Sulfate.....$MgSO_4$	41.4	2.41
Calcium.....Ca	82.8	Magnesium Carbonate..$MgCO_3$	44.9	2.62
Magnesium..Mg	22.2	Calcium Carbonate.....$CaCO_3$	198.5	11.57
Ammonium..NH_4	0.01	Iron Oxide.....Fe_2O_3	0.5	0.03
Potassium...K	1.4	Alumina.....Al_2O_3	0.5	0.03
Sodium.....Na	9.0	Silica.....SiO_2	13.6	0.79
Sulfate.....SO_4	36.9	Nonvolatile.....	0.3	0.02
Nitrate.....NO_3	4.0			
Chloride.....Cl	8.0	Total.....	327.4	19.10
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	242.0			
Residue.....	319.0			
Total Hardness....	298.0			

GREENFIELD (1038). Greenfield is located in the southeastern part of Green County on a tributary drainage area of Macoupin Creek, a tributary of Illinois River. Many private dug wells ranging from 12 to 40 feet in depth are in use, but none of these furnish much water. A public water supply was installed by the city in 1936.

Water for the public supply is obtained from a well located on the west bank of Rubicon Creek in the eastern part of the city. It was constructed by the Thorpe Concrete Well Company in 1936 and is 32 feet deep. It is cased to a depth of 16 feet with solid concrete. Below this depth is a 16-foot section of porous concrete screen. Casing and screen are of the Thorpe type, inside diameter being 26 inches and outside diameter, 36 inches. This well was the climax of an intensive campaign of test drilling. A total of 24 test wells were drilled before the site of the permanent well was selected. This test drilling revealed the fact that, in this vicinity, the glacial drift is thin and contains little sand and gravel.

The water level was at a depth of 10 feet below the top of the casing which is approximately 2 feet above the ground surface. A pumping rate of 43 gallons per minute lowered the water level 11 feet.

The well is equipped with a 7-stage, 6-inch Fairbanks-Morse turbine pump having 30 feet of column pipe and driven by a 2-horsepower electric motor. The pump is rated at 50 gallons per minute.

Water is pumped from the well to a treatment plant consisting of a coke-tray aerator with collecting basin, a pressure filter, a chlorinator, and a pressure type zeolite softener. The service pump is a 1¼-inch Fairbanks-Morse centrifugal pump driven by a 7½-horsepower electric motor. This pump is rated at 50 gallons per minute at a total dynamic head of 190 feet. A 60,000-gallon elevated steel tank located in the business district is connected to the distribution system.

The water had a total residue of 614, a total hardness of 492, and a content of iron of 3.2 parts per million as shown by the partial analysis of sample number 77450, collected February 17, 1936. The quality was very similar to that of the water from test well number 20, located at the same spot. Several months later the quality of the water had changed a great deal. Sample number 82356, collected November 12, 1937, had a total residue of 1384, a total hardness of 781, and a content of iron of 3.3 parts per million as shown by the analysis.

Analysis of Sample Number 76968 from Test Well Number 20.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$		2.6	0.15
(unfiltered).....	0.0	Sodium Chloride.....NaCl		27.5	1.60
Manganese..Mn	0.0	Ammonium Chloride....NH_4Cl		1.6	0.09
Silica.....SiO_2	13.0	Magnesium Chloride....$MgCl_2$		13.8	0.80
Turbidity.....	40.0	Magnesium Sulfate.....$MgSO_4$		238.0	13.90
Calcium.....Ca	113.4	Magnesium Carbonate..$MgCO_3$		5.5	0.32
Magnesium..Mg	53.2	Calcium Carbonate.....$CaCO_3$		283.8	16.55
Ammonium..NH_4	0.6	Silica.....SiO_2		13.0	0.76
Sodium.....Na	12.5				
Sulfate.....SO_4	190.0	Total.....		585.8	34.27
Nitrate.....NO_3	2.0				
Chloride.....Cl	28.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	290.0				
Residue.....	615.0				
Total Hardness....	502.5				

Analysis of Sample Number 82356 from City Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.0	Sodium Nitrate	$NaNO_3$	5.1	0.30
(unfiltered)		3.33	Sodium Chloride	NaCl	449.1	26.18
Manganese	Mn	0.0	Magnesium Chloride	$MgCl_2$	246.8	14.40
Silica	SiO_2	16.0	Magnesium Sulfate	$MgSO_4$	111.3	6.49
Turbidity		35.0	Calcium Sulfate	$CaSO_4$	210.3	12.30
Calcium	Ca	172.3	Calcium Carbonate	$CaCO_3$	276.1	16.10
Magnesium	Mg	8.52	Silica	SiO_2	16.0	0.93
Ammonium	NH_4	trace				
Sodium	Na	178.0	Total		1,314.7	76.70
Sulfate	SO_4	237.5				
Nitrate	NO_3	3.9				
Chloride	Cl	455.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		276.0				
Residue		1,384.0				
Total Hardness		781.0				

GREENUP (1062). Greenup is located in the southern part of Cumberland County on Embarrass River. A public water supply system was installed in 1897, water being obtained from the river. The pumping station was located on the east bank of the river about 600 feet northerly of State Highway number 121. In addition to the pumping station there was constructed a circular intake well of brick and concrete about 16 feet in diameter, the bottom of which was well below the river bottom. From this intake well an 8-inch pipe extended to midstream and river water flowed by gravity to the well. This river water connection was abandoned when the new infiltration well on the northerly side of the river was completed.

In 1924 an infiltration well was constructed across the river northerly from the pumping station. This well was about 10 feet in diameter and 14 feet deep. The lower 6 feet penetrates water-bearing gravel and below this is shale. The masonry walls were extended above ground sufficiently to prevent flooding at times of high water in the river. From this infiltration well a gravity pipe line was laid into the old intake well which was transformed into a storage reservoir and suction well. In 1925 a second reservoir 16 feet in diameter was constructed close to the old suction well and connected to it with a pipe line.

Water is pumped from the collecting reservoir or suction well to the distribution system by a Deane triplex pump with 8½-inch cylinders and an 8-inch stroke. The pump is operated by a 20-horsepower Westinghouse electric motor. An old Deane duplex, double-acting pump with 8-inch cylinders and a 10-inch stroke is available for emergency use. This pump is driven by a 40-horsepower Springfield gasoline engine.

There are about 200 services in use. Eates are as follows:

50 cents per 1000 gallons for the first 1000 gallons.
35 cents per 1000 gallons for the next 1000 gallons.
25 cents per 1000 gallons for all additional water.

The minimum is 50 cents per month.

The water from the infiltration well had a total residue of 354, a total hardness of 278 and a content of iron of 1.4 parts per million as shown by the analysis of sample number 55030, collected September 10, 1925.

Analysis of Sample Number 55030 from Village Well.

Determinations Made.		Hypothetical Combinations.			
	Pts. per million.			Pts. per million.	Grs. per gallon.
Iron.....Fe	1.4	Potassium Nitrate.....KNO_3		0.6	0.04
Manganese..Mn	0.7	Potassium Chloride.....KCl		7.1	0.41
Silica.....SiO_2	11.5	Sodium Chloride.....NaCl		44.5	2.60
Nonvolatile.....	1.1	Sodium Sulfate.....Na_2SO_4		11.7	0.69
Alumina.....Al_2O_3	0.4	Ammonium Sulfate.....$(NH_4)_2SO_4$		0.6	0.04
Calcium.....Ca	65.7	Magnesium Sulfate.....$MgSO_4$		27.7	1.62
Magnesium..Mg	27.7	Magnesium Carbonate..$MgCO_3$		75.3	4.40
Ammonium..NH_4	0.2	Calcium Carbonate.....$CaCO_3$		162.0	9.48
Potassium...K	3.9	Silica.....SiO_2		11.5	0.67
Sodium.....Na	21.6	Iron Oxide.....Fe_2O_3		2.0	0.12
Sulfate.....SO_4	30.1	Alumina.....Al_2O_3		0.4	0.02
Nitrate.....NO_3	0.4	Nonvolatile.....		1.1	0.06
Chloride.....Cl	30.0	Manganese Oxide.....MnO		0.9	0.05
Alkalinity as $CaCO_3$					
Phenolphthalein..		Total.....		345.4	20.20
Methyl Orange...	248.0				
Residue.....	354.0				
Total Hardness....	278.0				

GREENVIEW (720) (p. 267). The 10-inch well 153 feet deep which furnished water to the village in April, 1925 has been abandoned. The quality of the water obtained from this source was no better than that obtained from the dug well 37 feet deep and it was only used for a short time.

In April, 1938 the village was obtaining water from the original dug well 37 feet deep. The pumping equipment is the same as that previously described.

GREENVILLE (3233) (p. 268). Seven new wells were drilled just north of the stockyards in 1927. Average depth was about 62 feet. The water was a little harder and had a slightly higher sulfate content than the old supply. The wells did not yield much water and are no longer in use.

Water is now secured from two wells penetrating sand and gravel and located about one-quarter of a mile southwest of the pumping station. They were constructed in 1932 and are alike in construction. The east well is 68 feet deep and of the gravel-pack type. The 17-foot length of 18-inch strainer is surrounded by a 9-inch jacket of gravel. The west well is 65 feet deep and has a 10-foot length of 24-inch strainer surrounded by a 6-inch jacket of gravel. Each well is reported to yield 250 gallons per minute with a draw down of only one foot from a static water level of 42 feet. Each well is equipped with a 3-stage Sterling water lubricated turbine pump with 50 feet of 5-inch column pipe and a suction pipe extending to within a few feet of the bottom of the well.

The water from the public supply had a total residue of 703, a total hardness of 479, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 71806, collected October 7, 1932.

Analysis of Sample Number 71806 from the City Supply.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.0	Sodium Nitrate.....$NaNO_3$	64.7	3.77
Manganese..Mn	0.0	Sodium Chloride.....NaCl	83.0	4.84
Silica.....SiO_2	22.0	Magnesium Chloride....$MgCl_2$	7.6	.44
Turbidity.....	0	Magnesium Sulfate.....$MgSO_4$	147.5	8.60
Calcium.....Ca	122.2	Magnesium Carbonate..$MgCO_3$	35.8	2.09
Magnesium..Mg	42.1	Calcium Carbonate.....$CaCO_3$	305.5	17.82
Ammonium..NH_4	trace	Silica.....SiO_2	22.0	1.28
Sodium.....Na	50.2			
Sulfate.....SO_4	117.6	Total.....	666.1	38.84
Nitrate.....NO_3	46.9			
Chloride.....Cl	56.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	348.0			
Residue.....	703.0			
Total Hardness....	478.5			

GRIDLEY (709) (p. 270). No record of change.

GRIGGSVILLE (1184). Griggsville is located in the northeastern part of Pike County about four miles west of Illinois River.

Water for the public supply, installed by the city in **1935,** is obtained from three wells in the valley of McGee Creek about three miles north of the city. They were constructed in 1935 by the Thorpe Concrete Well Company of Alton. Each well has a 26-inch inside diameter porous concrete screen 5 inches thick. Around each screen is a gravel wall 9 inches thick. Above each screen is a solid concrete casing of the same diameter and thickness as the screen.

Well number 1 is 43 feet deep and has 18 feet of screen. The water level was at a depth of 1 foot when not pumping and was lowered 34 feet by a pumping rate of 56 gallons per minute.

Well number 2 was located about 250 feet east and 200 feet north of number 1. The yield of this well was reported to be very low.

Well number 3 is about 250 feet east of number 1. It is 41½ feet deep and has 28 feet of screen. The water level was at a depth of 1 foot when not pumping and was lowered 26½ feet by a pumping rate of 50 gallons per minute. During this test the water level in well number 2 was lowered 3 feet.

Each well is equipped with a single-stage, 8-inch Westco turbine pump driven by a 1½-horsepower electric motor. The pump in well number 2 has 30 feet of column pipe while the other pumps have 40 feet of column pipe. Each pump is rated at 30 gallons per minute and discharges into a concrete reservoir near well number 1. From this reservoir the water is pumped to the city by a 14-stage, 8-inch Byron Jackson turbine pump driven by a 15-horsepower electric motor. The pump is rated at 100 gallons per minute against a head of 368 feet.

Water from well number 1 had a total residue of 430, a total hardness of 362, and a content of iron of 0.8 parts per million as shown by the analysis of sample number 75781, collected May 12, 1935.

Analysis of Sample Number 75781 from Well Number 1.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		4.25	0.25
(filtered).....	0.0	Sodium Chloride.....NaCl		13.5	0.79
(unfiltered).....	0.8	Sodium Sulfate.....Na_2SO_4		17.05	0.99
Manganese..Mn	1.0	Sodium Carbonate.....Na_2CO_3		42.4	2.47
Silica.....SiO_2	10.0	Magnesium Carbonate..$MgCO_3$		93.9	5.48
Turbidity.....	60.0	Calcium Carbonate.....$CaCO_3$		247.4	14.43
Calcium.....Ca	99.0	Iron Oxide.....Fe_2O_3		0.0	0.0
Magnesium..Mg	27.7	Manganese Oxide.....MnO		1.1	0.06
Sodium.....Na	30.4	Silica.....SiO_2		10.0	0.58
Sulfate.....SO_4	11.5				
Nitrate.....NO_3	3.5	Total.....		429.6	25.05
Chloride.....Cl	8.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	402.0				
Residue.....	430.0				
Total Hardness....	362.0				

Analysis of Sample Number 76067 from Well Number 3.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		9.4	0.55
(filtered).....	0.0	Sodium Chloride.....NaCl		9.9	0.58
(unfiltered).....	6.0	Magnesium Sulfate.....$MgSO_4$		20.5	1.20
Manganese..Mn	0.7	Magnesium Carbonate..$MgCO_3$		81.0	4.72
Silica.....SiO_2	10.0	Calcium Carbonate.....$CaCO_3$		182.2	10.62
Turbidity.....	400.0	Manganese Oxide.....MnO		0.9	0.05
Color.....	0.0	Silica.....SiO_2		10.0	0.58
Odor.....	2e				
Calcium.....Ca	72.8	Total.....		313.9	18.30
Magnesium..Mg	27.4				
Ammonium..NH_4	trace				
Sodium.....Na	6.4				
Sulfate.....SO_4	16.4				
Nitrate.....NO_3	6.6				
Chloride.....Cl	6.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	278.0				
Residue.....	333.0				
Total Hardness....	295.0				

HAMILTON (1687) (p. 709). The raw water supply of the city of Hamilton is obtained from Mississippi River. The water is treated before entering the distribution system.

HAMMOND (470). Hammond is located in the extreme southern part of Piatt County on the drainage area of Kaskaskia River, a tributary of Mississippi River.

Water for the public supply, installed by the village in 1935, is secured from a well near the center of the village. The well was drilled

in 1934 by L. E. Burt of Elwin. It is 87 feet deep and of the gravel-walled type. The 26-inch outer casing extends to a depth of 70½ feet and the 12-inch inner casing extends to a depth of 71½ feet. Below the inner casing is a 12-inch Cook screen having 3/16-inch slots.

The water level was at a depth of 11 feet when not pumping and was lowered, 8.0, 11.0, 17.2, 21.8, and 44.8 feet when pumping at rates of 175, 210, 278, 295, and 390 gallons per minute, respectively.

The well is equipped with a 10-stage, 7-inch Fairbanks-Morse deep-well turbine pump having 80 feet of 6-inch column pipe and driven by a 15-horsepower electric motor. The rate of discharge and total discharge are measured by a flow meter.

A treatment plant consisting of a coke-tray aerator, pressure filter, and pressure-type zeolite softener was constructed in 1937. The service pump is a Fairbanks-Morse single-stage centrifugal pump rated at 100 gallons per minute and driven by a 5-horsepower electric motor. A 50,000-gallon elevated steel tank is connected to the distribution system.

There are 55 service connections, 20 of which were added after the treatment plant was built. The average daily pumpage, for April, 1938, was more than 13,000 gallons. The rates charged are a minimum of $1.00 per month for 1000 gallons, 60 cents for the next 1000 gallons, and 35 cents for each additional 1000 gallons.

The water had a total residue of 510, a total hardness of 387.5, and a content of iron of 5.0 parts per million as shown by the analysis of sample number 75396, collected November 27, 1934. The water had a pronounced odor of hydrogen sulfide.

Analysis of Sample Number 75396 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.0	Sodium Chloride	NaCl	29.8	1.74
(unfiltered)		5.0	Sodium Sulfate	Na_2SO_4	30.6	1.78
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	71.5	4.17
Silica	SiO_2	10.0	Ammonium Carbonate	$(NH_4)_2CO_3$	24.0	1.40
Turbidity		85.0	Magnesium Carbonate	$MgCO_3$	148.4	8.64
Calcium	Ca	84.6	Calcium Carbonate	$CaCO_3$	211.6	12.33
Magnesium	Mg	42.8	Silica	SiO_2	10.0	0.58
Ammonium	NH_4	9.0				
Sodium	Na	53.1	Total		527.6	30.74
Sulfate	SO_4	20.6				
Nitrate	NO_3	1.1				
Chloride	Cl	18.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		480.0				
Residue		510.0				
Total Hardness		387.5				

HAMPSHIRE (G56) (p. 271). The 1178-foot well drilled in 1924 has been plugged at a depth of 400 feet and shot at a depth of 300 feet. All water for the public supply is now obtained from this well. The static water level is reported to be about 25 feet below the ground surface.

The well is now equipped with a 6-stage, 6-inch American turbine pump having 110 feet of column pipe and 11 feet of suction pipe. The pump is rated at 150 gallons per minute and discharges into the pressure tank described on page 271.

After the well was plugged, the water had a total residue of 291, a total hardness of 245.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 84157, collected August 24, 1938.

Analysis of Sample Number 84157 from Well 400 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.6	0.15
(filtered).....	0.0	Sodium Chloride.....NaCl	1.8	0.10
(unfiltered).....	0.4	Sodium Carbonate.....Na_2CO_3	40.2	2.34
Manganese..Mn	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$	2.4	0.14
Silica.....SiO_2	15.0	Magnesium Carbonate..$MgCO_3$	111.5	6.50
Turbidity.....	7	Calcium Carbonate.....$CaCO_3$	113.2	6.60
Color.....	0	Silica.....SiO_2	15.0	0.87
Odor.....	V-2			
Calcium.....Ca	45.2	Total.....	286.7	16.70
Magnesium..Mg	32.2			
Ammonium..NH_4	1.0			
Sodium.....Na	18.9			
Sulfate.....SO_4	0.0			
Nitrate.....NO_3	1.9			
Chloride.....Cl	1.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	286.0			
Residue.....	291.0			
Total Hardness....	245.5			

HANOVER (806) (p. 273). No reported change.

HARDIN (733). Hardin is located on the west bank of Illinois River near the center of Calhoun County. A public water supply was installed in 1934. It included a well and pump, an elevated storage tank, 15,511 feet of water mains, and 24 fire hydrants. The well is located in the east part of the city. It is 8¼ inches in diameter and 70 feet deep. The log of the well, as reported by the driller, is as follows:

	Thickness in feet	Depth in feet
Top soil	5	5
Yellow river clay	5	10
Red pipe clay	10	20
Blue river silt	15	35
Fine gravel mixed with sand	5	40
Fine gravel	5	45
Medium sand, silt and gravel	5	50
Fine muddy sand	5	55
Medium sand	12½	67½
Rock (lime)	2½	70

The well is cased with 8¼-inch inside diameter casing to a depth of 55 feet below which is 15 feet of 7½-inch number 20-slot well screen.

Static water level at the time of test was reported to be 24 feet and when pumping at a rate of 205 gallons per minute for three hours a draw down of four feet occurred. The well is equipped with a Peerless deep-well turbine pump consisting of 48 feet of 5-inch column, nine stages of 8-inch pump, and 10 feet of 5-inch suction pipe. The unit is rated at 125 gallons per minute against 75 pounds of pressure.

Water from a tap in the pumping station had a total residue of 829, a total hardness of 656, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 82363, collected November 1, 1937.

Analysis of Sample Number 82363 from City Well 70 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	30.6	1.78
(filtered)		0.0	Sodium Chloride	NaCl	61.4	3.58
(unfiltered)		0.0	Magnesium Chloride	$MgCl_2$	64.3	3.75
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	186.0	10.85
Silica	SiO_2	14.0	Magnesium Carbonate	$MgCO_3$	11.8	.68
Turbidity		0.0	Calcium Carbonate	$CaCO_3$	420.0	24.49
Color		0.0	Silica	SiO_2	14.0	.82
Odor		0.0				
Calcium	Ca	168.0	Total		788.1	45.95
Magnesium	Mg	57.4				
Ammonium	NH_4	trace				
Sodium	Na	32.4				
Sulfate	SO_4	148.5				
Nitrate	NO_3	22.1				
Chloride	Cl	85.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		434.0				
Residue		829.0				
Total Hardness		656.0				

HARMON (209) (p. 275). Harmon now secures water from eight driven wells about 32 feet deep. The original well, 532 feet deep, has not been used much since 1923.

The wells are 4 feet apart arranged in two north-south lines about 4 feet apart. The west line is about 8 feet east of the deep well. The drive-pipes are 1¼ inches in diameter, and a well point 2½ feet long is installed at the bottom of each drive-pipe. All of the wells are connected to the suction of an P. E. Meyers Bros. pump. The pump stroke is 5 inches, the cylinder is 5 inches in diameter and the pump is run at a rate of 40 revolutions per minute. Power is furnished by a 3-horsepower General Electric motor. The estimated rate of discharge is about 35 gallons per minute and 10 hours pumping per week is usually sufficient to supply the needs of the town.

There are 12 service connections. Eates are 75 cents per month for residences and business buildings.

The water had a total residue of 611, a total hardness of 498, and an iron content of 1.8 parts per million as shown by the analysis of sample number 83965, collected on July 26, 1938.

Analysis of Sample Number 83965 from 8 Village Wells 32 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.6	0.15
(filtered).....	.06	Sodium Chloride.....NaCl	42.0	2.45
(unfiltered).....	1.8	Magnesium Chloride....$MgCl_2$	6.2	0.36
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	240.0	13.99
Silica.....SiO_2	17.0	Magnesium Carbonate..$MgCO_3$	10.1	0.59
Turbidity.....	20.0	Calcium Carbonate.....$CaCO_3$	270.8	15.79
Color.....	0.0	Iron Oxide.....Fe_2O_3	0.1	0.01
Odor.....	0.0	Silica.....SiO_2	17.0	0.99
Calcium.....Ca	107.9			
Magnesium..Mg	53.0	Total.....	588.8	34.33
Ammonium..NH_4	trace			
Sodium.....Na	17.2			
Sulfate.....SO_4	192.0			
Nitrate.....NO_3	1.9			
Chloride.....Cl	30.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	282.0			
Residue.....	611.0			
Total Hardness....	498.0			

HARRISBURG (11,625) (p. 709). The raw water supply of the city of Harrisburg is obtained from an impounding reservoir on Middle Fork of Saline River. The water is treated before entering the distribution system.

HARTFORD (1566). Hartford is located in the western part of Madison County on the east bank of Mississippi River.

Water for the public supply, installed by the village in 1926, was first obtained from two wells about 100 feet apart. These wells were constructed by F. Thorpe in 1926 and were alike in construction. Each was 67 feet deep and was equipped with a porous concrete screen 16 inches inside diameter and 3 inches thick, and a Chippewa 2-stroke, deep-well pump with 8¾-inch diameter cylinder, and 24-inch stroke. Each well yielded 325 gallons per minute with a draw down of 7.8 feet. The water had a mineral content of 448, a total hardness of 384, and a content of iron of 16.0 parts per million.

In 1934 the use of the old wells was discontinued and a new well, number 3, was drilled, at a point 18 feet west of the old south well, by the Thorpe Concrete Well Company. It is 115 feet deep and has a porous concrete screen 26 inches inside diameter and 5 inches thick. It is equipped with a Pomona turbine pump, rated at 200 gallons per minute, driven by a 7½-horsepower electric motor.

In 1936 a treatment plant was built near the well. It consists of a coke-tray aerator, a softener, and a rapid sand filter. The water had a total residue of 397, a total hardness of 329.5, and an iron content of 4.8 parts per million as shown by the analysis of sample number 81506, collected June 23. 1937. The average amount of water treated is about 33,000 gallons per day.

Analysis of Sample Number 81506 from Well Number 3.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....	$NaNO_3$	1.7	0.10
(unfiltered).....	4.8	Sodium Chloride.....	NaCl	6.4	0.37
Manganese..Mn	0.7	Sodium Sulfate.....	Na_2SO_4	6.4	0.37
Silica.....SiO_2	16.0	Ammonium Sulfate.....	$(NH_4)_2SO_4$	0.7	0.04
Turbidity.....	48.0	Magnesium Sulfate.....	$MgSO_4$	57.2	3.33
Calcium.....Ca	93.1	Magnesium Carbonate..	$MgCO_3$	41.3	2.41
Magnesium..Mg	23.5	Calcium Carbonate.....	$CaCO_3$	233.1	13.59
Ammonium..NH_4	1.2	Manganese Oxide.....	MnO	0.9	0.05
Sodium.....Na	5.1	Silica.....	SiO_2	16.0	0.93
Sulfate.....SO_4	50.4				
Nitrate.....NO_3	1.2	Total.....		363.7	21.19
Chloride.....Cl	4.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	282.0				
Residue.....	397.0				
Total Hardness....	329.5				

HARVAED (2988) (p. 276). Part of the water supply for the city of Harvard is obtained from well number 1 described on page 277 and part from a gravel-packed well constructed in 1929.

Well number 1 is pumped with an air lift as previously described and is operated from four to five hours per day, the water being discharged into the surface storage reservoirs.

Well number 2 has been abandoned since well number 3 was constructed.

Well number 3 is located about 40 feet south of the water works pumping station and together with the pump and motor is housed in a small brick pump-house. The well is 71 feet deep and was constructed in 1929. It was dug and lined with a 48-inch steel tube to a depth of 30 feet, a 45-inch steel tube extends between depths of 30 feet and 43 feet, and a 42-inch steel tube between 43 feet and rock at 71 feet. Inside the center of the 42-inch tube and seated on the rock was installed a porcelain enameled cast-iron screen 16 inches in diameter by 15 feet long, above which was a 14-inch easing extending to the ground surface. The annular space between the 16-inch screen and 14-inch casing and the 42-inch and 45-inch tubes was filled with selected and washed pea gravel. As the gravel filling progressed the steel tubes were withdrawn. When the gravel filling had reached a point 32 feet below the ground surface and two feet below the bottom of the 48-inch tube, a 32-inch steel tube was centered around the 14-inch pipe and the annular space between it and the 48-inch tube was filled with concrete. The space between the 32-inch tube and 14-inch casing was then filled with gravel to the ground surface. Water-bearing gravel extended between depths of 43 feet and 71 feet. Static water level was 15 feet below ground surface.

The well is equipped with a Fairbanks-Morse, four stage deep-well turbine pump consisting of 60 feet of 8-inch column, four stages of pump having an over-all length of five feet and three feet of 8-inch

suction plus a cone-shaped strainer on the bottom of the suction pipe. The pump is powered by a 15-horsepower Fairbanks-Morse electric motor, and is rated at 800 gallons per minute when operating at a full load speed of 1150 revolutions per minute. A small air line extends to the bottom of the bowls. The pump operates about 5½ hours per day under normal conditions, but in summer when the demand is heavy it operates 11 to 12 hours per day.

When the well was first completed the test gave a production of 550 gallons per minute, but this has slowly increased to 600 gallons per minute at the present time. Water is drawn down to the bottom of the suction pipe within fifteen minutes after starting the pump. Prom then on some air is discharged with the water.

It was reported at the time of a visit in May, 1938 that well number 1 was cased with 5⅝-inch casing to a depth of 300 feet and with 5-inch casing between depths of 300 feet and 600 feet. The two sizes of casing are connected with a swedge nipple. The air pipe consists of 600 feet of 2-inch pipe with an upturned elbow. The yield is about 250 gallons per minute. The starting pressure is 260 pounds and the running pressure is 165 pounds. Air is supplied by an Ingersol-Eand 6 x 12-inch and 11½ x 12-inch air compressor driven through a belt connection by 120-horsepower Fairbanks-Morse diesel engine. The speed of the compresser is 150 revolutions per minute and the engine 257 revolutions per minute. The engine also supplies power for the operation of the electric generator, the energy from which is used to operate the centrifugal service pump in the station. The service pump takes suction from the surface storage reservoirs and discharges water directly into the distribution system and 85,000-gallon elevated **tank** which is connected to the mains.

The water from the 71-foot well had a total residue of 634, a total hardness of 528, and a content of iron of 0.20 parts per million as shown by the analysis of sample number 83548, collected May **19, 1938.**

Analysis of Sample Number 83548 from 71-Foot Well.

Determinations Made.	Pts. per million.
Iron.....Fe	
(filtered).....	0.02
(unfiltered).....	0.20
Manganese..Mn	0.00
Silica.....SiO_2	17.00
Turbidity.....	3.00
Color.....	0.00
Odor.....	0.00
Calcium.....Ca	117.3
Magnesium..Mg	57.2
Ammonium..NH_4	0.0
Sodium.....Na	22.6
Sulfate.....SO_4	133.0
Nitrate.....NO_3	11.5
Chloride.....Cl	41.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	352.0
Residue.....	634.0
Total Hardness.....	528.0

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	15.3	0.89
Sodium Chloride.....	NaCl	46.8	2.73
Magnesium Chloride....	$MgCl_2$	17.1	1.00
Magnesium Sulfate.....	$MgSO_4$	166.0	9.68
Magnesium Carbonate..	$MgCO_3$	66.5	3.88
Calcium Carbonate.....	$CaCO_3$	293.0	17.10
Silica.....	SiO_2	17.0	1.34
Total.....		621.7	36.62

The Chicago and Northwestern Eailroad has two wells, but it buys some city water at times.

The Bowman Dairy Company has two wells. The large well is reported to be cased with 12-inch casing at the top and to be 800 feet deep. It is equipped with a Keystone Driller deep-well cylinder pump having a cylinder 6¾ inches in diameter by 18-inch stroke. The smaller well is cased with 6-inch casing at the top and is reported to be 636 feet deep. It is equipped with a Goulds single-acting deep-well cylinder pump having a cylinder 4 inches in diameter by a 24-inch stroke.

HARVEY (16,374) (p. 278). Since 1926 all water for the public supply has been obtained from Chicago.

HAVANA (3451) (p. 280). Havana has abandoned the wells and pumping equipment described on page 281. The water supply is now obtained from a well 85 feet deep constructed by the Thorpe Concrete Well Company of Alton in 1930. It is cased with a porous concrete screen and waterproof concrete casing 26 inches inside diameter and 36 inches outside diameter. The well is located at the pumping station a few feet from the abandoned wells. Static water level was reported to be 33 feet below the ground surface.

Water is pumped by either of two similar, size 3 Fairbanks-Morse, pumping units rated at 500 gallons per minute and driven by 25-horsepower electric motors. These units were installed in 1931 in a pump pit 16 feet deep.

HAZEL CEEST (1162). A public water supply system was installed in 1927. Lake Michigan water is obtained from Harvey. A well supply was first contemplated but before a well was drilled it was decided to purchase and use lake water.

HEBRON (608) (p. 281). The public water supply is obtained from the well described on page 282. The pumping equipment, however, has been changed.

The well is equipped with an 8-stage, 7-inch Fairbanks-Morse deep-well turbine pump direct connected to a Fairbanks-Morse 15-horsepower electric motor operating at 1800 revolutions per minute. Water from the well is discharged into a 60,000-gallon ground storage reservoir just outside the pumping station building.

An American Well Works centrifugal pump direct connected to a Westinghouse 10-horsepower electric motor operating at 3475 revolutions per minute takes suction from the ground reservoir and discharges the water into the distribution system. A steel pressure and storage tank 8 feet in diameter by 30 feet long is connected to the distribution system within the pumping station. Both the deep-well pump and the service pump are automatically controlled.

A Worthington 8 by 8 inch triplex pump provides auxiliary service pressure when needed. This pump is powered by a Worthington 20-horsepower gas engine.

The well formerly used at the Borden-Wieland Milk Company has been abandoned and all water is purchased from the village.

HENNEPIN (312) (p. 283). There has been no change in the source of water for the public supply.

HENRY (1658) (p. 284). Henry obtains water from three wells located near the pumping station in a park bounded by Water, Main and Edward Streets and Illinois River.

The dug well described on page 284, and reported in 1938 to be 22 feet deep instead of 40 feet deep, is seldom used. Water is pumped from this well by a 2-stage American centrifugal pump rated at 500 gallons per minute. The pump is driven by a 40-horsepower, 6-cylinder Wisconsin gasoline engine.

The water had a total residue of 522.0, a total hardness of 399.0, and an iron content of 0.12 parts per million as shown by the analysis of sample number 83957, collected on July 27, 1938.

In 1930 Fred Bickerman of Henry drilled a well for the city. It is 8 inches in diameter and 62 feet deep. The well is located about 20 feet southeast of the southerly corner of the pumping station. A number 60-slot screen 14 feet long is installed in the well. When not pumping the water level stands about 18 feet below the ground surface. Water is pumped from the well by a 7⅝-inch American Well Works turbine pump rated at 300 gallons per minute against a head of 200 feet. The pump assembly consists of 40 feet of 6-inch column pipe, nine bowls measuring 5 feet 1½ inches over-all, and 10 feet of 5-inch suction pipe. The pump is driven by a 25-horsepower U. S. electric motor. This well furnishes most of the water used in the city.

The water had a total residue of 454.0, a total hardness of 376.5. and an iron content of 0.09 parts per million as shown by the analysis of sample number 83956, collected on July 27, 1938.

The third well was drilled in 1936 by Mike Schwiderski of Henry. It is located about 30 feet northeast of the northeast side of the pumping station. It is 12 inches in diameter and 62 feet deep. The lower 14 feet are screened with number 60-slot screen. Water is pumped from the well by a 11½-inch American Well Works turbine rated at 500 gallons per minute against a head of 200 feet. The pump assembly consists of 40 feet of 6-inch column pipe, four bowls measuring 4½ feet over-all, and 10 feet of 8-inch suction pipe. A 40-horsepower U. S. electric motor drives the pump. The water level when not pumping is about 18 feet below the ground surface and is drawn down to a depth of 42 feet when pumping at a rate of 550 gallons per minute.

There are about 600 service connections. Water is sold at a flat rate of 50 cents per month to residences. The pump, rated at 300 gallons per minute, operates about 25 minutes out of each hour to supply the summer demand. Two new pressure tanks 36 feet long by 8 feet in diameter were installed during 1937.

Analysis of Sample Number 83957 from Dug Well 22 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		44.2	2.58
(filtered).....	0.02	Sodium Chloride.....NaCl		22.2	1.29
(unfiltered).....	0.12	Calcium Chloride.....$CaCl_2$		35.5	2.07
Manganese..Mn	0.00	Calcium Sulfate.....$CaSO_4$		115.8	6.75
Silica.....SiO_2	19.0	Calcium Carbonate ....$CaCO_3$		282.1	16.44
Turbidity.....	4.0	Silica.....SiO_2		19.0	1.11
Color.....	0.0				
Odor.....	0.0	Total.....		518.8	30.24
Calcium.....Ca	159.7				
Magnesium..Mg	0.0				
Ammonium..NH_4	trace				
Sodium.....Na	20.7				
Sulfate.....SO_4	81.8				
Nitrate.....NO_3	32.1				
Chloride.....Cl	36.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	282.0				
Residue.....	522.0				
Total Hardness....	399.0				

Analysis of Sample Number 83956 from 8-Inch Well 62 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		54.5	3.18
(filtered).....	.08	Sodium Chloride.....NaCl		6.4	0.37
(unfiltered).....	.09	Magnesium Chloride....$MgCl_2$		35.3	2.06
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$		78.9	4.60
Silica.....SiO_2	19.0	Magnesium Carbonate..$MgCO_3$		45.2	2.64
Turbidity.....	1.0	Calcium Carbonate.....$CaCO_3$		221.0	12.88
Color.....	0.0	Iron Oxide.....Fe_2O_3		0.1	0.01
Odor.....	0.0	Silica.....SiO_2		19.0	1.11
Calcium.....Ca	88.3				
Magnesium..Mg	37.9	Total.....		460.4	26.85
Ammonium..NH_4	0.0				
Sodium.....Na	17.3				
Sulfate.....SO_4	63.0				
Nitrate.....NO_3	39.8				
Chloride.....Cl	30.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	274.0				
Residue.....	454.0				
Total Hardness....	376.5				

HEREIN (9708) (p. 709). The raw water of the city of Herrin is obtained from impounding reservoirs on Hurricane and Wolf Creeks. The water is treated before entering the distribution system.

HEESCHER (426). Herscher is located in the southwest part of Kankakee County on the drainage area of Horse Creek, a tributary of Kankakee River.

The village installed a public water supply about 1895. The original well was 5 inches in diameter and 165 feet deep. It was located about ½ block west of Main Street and ½ block south of Kankakee Avenue. Water was pumped from the well to a 13,000-gallon elevated

tank by a deep-well pump driven by a windmill. The distribution system was limited to the business district. This well is now sealed at a point about 3 feet below the ground surface.

The well now in use is located about 30 feet west of the original well. It is 10 inches in diameter and 165 feet deep. The casing is reported to extend a short distance into the rock which is encountered at a depth of about 48 feet. A small quantity of water containing oil and gas is encountered in the drift just above the top of the rock. According to local reports this well was drilled about 1895. The water level is about 40 feet below the ground surface when no water is being withdrawn from the well.

In 1925 the elevated tank was replaced by a cylindrical pressure tank 8 feet in diameter and 36 feet long. At the same time the old cylinder pump was replaced by a Fairbanks-Morse single-acting cylinder pump rated at 20 gallons per minute. The 3¾-inch diameter cylinder is attached to 120 feet of 4-inch drop pipe and 8 feet of suction pipe is attached to the bottom of the cylinder. The pump operates at a speed of 28 strokes per minute. The stroke is 16 inches long. The pump is driven by a 5-horsepower Fairbanks-Morse electric motor.

A single-stage Fairbanks-Morse centrifugal pump driven by a 20-horsepower Fairbanks-Morse electric motor is installed to increase the pressure.

The distribution system was not extended beyond the business district until 1928. It was again extended in 1931. In July, 1938 there were 60 service connections. The minimum rate for water is $5.00 per year. Water is sold at a rate of 75 cents per 1000 gallons for the first 75,000 gallons, 50 cents per 1000 gallons for the next 75,000 gallons and 25 cents per 1000 gallons for all additional water.

The water had a total residue of 349.0, a total hardness of 275.5, and an iron content of 0.04 parts per million as shown by the analysis of sample number 83961, collected on July 26, 1938.

Analysis of Sample Number 83961 from Village Well.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	0.04
Manganese..Mn	0.0
Silica.....SiO_2	19.0
Turbidity.....	5.0
Color.....	0.0
Calcium.....Ca	56.6
Odor.....	0.0
Magnesium..Mg	32.6
Ammonium..NH_4	0.3
Sodium.....Na	33.4
Sulfate.....SO_4	4.9
Nitrate.....NO_3	2.3
Chloride.....Cl	3.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	0.0
Methyl Orange...	338.0
Residue.....	349.0
Total Hardness....	275.5

Hypothetical Combinations.

	Pts. per million.	Grs. per gallon.
Sodium Nitrate.....$NaNO_3$	3.4	0.20
Sodium Chloride.....NaCl	4.7	0.27
Sodium Sulfate.....Na_2SO_4	7.1	0.41
Sodium Carbonate.....Na_2CO_3	65.2	3.80
Ammonium Carbonate..$(NH_4)_2CO_3$	1.0	0.06
Magnesium Carbonate..$MgCO_3$	113.0	6.59
Calcium Carbonate.....$CaCO_3$	141.7	8.26
Silica.....SiO_2	19.0	1.11
Total.....	355.1	20.70

HEYWORTH (959). Heyworth is located in the southern part of McLean County on the drainage area of Kickapoo Creek, a branch of the Sangamon River drainage system.

Water for the public supply, installed by the village in 1936, is obtained from a well in the valley of Kickapoo Creek about two miles west of the village. Before selecting the site for the permanent well several test wells were drilled in and near the village. With the exception of test well number 8, located near the permanent well, none of these revealed a satisfactory water-bearing formation.

The permanent well is 12 inches in diameter and is equipped with a 20-foot section of number 100-slot Johnson screen. It penetrates clean coarse gravel between a depth of 4 feet and the bottom of the well at 61 feet 8 inches. It was drilled in 1935 by L. R. Burt of Elwin.

The water level was at a depth of 20 feet and was lowered 3.2 feet when pumping at a rate of 325 gallons per minute. The temperature of the water was 53½° F.

The well is equipped with a 12-stage Fairbanks-Morse turbine pump having 40 feet of column pipe. Water is pumped to an elevated steel tank in the village.

The water had a total residue of 392, a total hardness of 398, and a content of iron of 1.4 parts per million as shown by the analysis of sample number 78835, collected October 13, 1936.

Analysis of Sample Number 78835 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.6	Magnesium Nitrate.....$Mg(NO_3)_2$	3.0	0.18
(unfiltered).....	1.4	Magnesium Chloride....$MgCl_2$	8.1	0.47
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	65.2	3.80
Silica.....SiO_2	10.0	Magnesium Carbonate..$MgCO_3$	85.2	4.97
Turbidity.....	10.0	Calcium Carbonate.....$CaCO_3$	215.2	12.55
Calcium.....Ca	92.8	Calcium Silicate.....$CaSiO_3$	19.2	1.12
Magnesium..Mg	40.5			
Sulfate.....SO_4	52.8	Total.....	395.9	23.09
Nitrate.....NO_3	2.4			
Chloride.....Cl	6.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	316.0			
Residue.....	392.0			
Total Hardness....	398.0			

HIGHLAND (3319). Highland obtains water from an impounding reservoir constructed in 1924 on a branch of Silver Creek, and from Silver Creek. The water is treated before entering the distribution system.

HIGHLAND PARK (12,203) (p. 709). The city of Highland Park obtains its water supply from Lake Michigan. The water is treated before entering the distribution system.

HIGHWOOD (3590) (p. 709). The city of Highwood obtains filtered lake water from Highland Park.

HILLSBOEO (4435) (p. 709). The raw water supply of the city of Hillsboro is obtained from an impounding reservoir on Brush Creek. The water is treated before entering the distribution system.

HILLSIDE (1004). A water supply system was installed about 1927. Water was first obtained from a well drilled by William Cater to a reported depth of 600 feet. This well has never been very strong and in January, 1937 was capable of yielding only 100 gallons per minute.

Later that same year an American Well Works deep-well turbine pump was installed. This pump was set at a depth of 250 feet and was rated at 100 gallons per minute when operating at a speed of 1750 revolutions per minute.

The water from this well had a total residue of 558, a total hardness of 424.5, and an iron content of 0.4 parts per million as shown by the analysis of sample number 82462, collected November 30, 1937.

Analysis of Sample Number 82462 from the 600-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.5	0.15
(filtered)		0.0	Sodium Chloride	NaCl	11.7	0.68
(unfiltered)		0.4	Sodium Sulfate	Na_2SO_4	114.2	6.65
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	89.5	5.22
Silica	SiO_2	13.0	Magnesium Carbonate	$MgCO_3$	126.3	7.35
Turbidity		2.0	Calcium Carbonate	$CaCO_3$	200.0	11.69
Color		0	Silica	SiO_2	13.0	0.76
Odor		E				
Calcium	Ca	80.0	Total		557.2	32.50
Magnesium	Mg	54.5				
Ammonium	NH_4	0.1				
Sodium	Na	42.3				
Sulfate	SO_4	149.0				
Nitrate	NO_3	1.8				
Chloride	Cl	7.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		350.0				
Residue		558.0				
Total Hardness		424.5				

During the year 1937 the village also took over the operation of the 180-foot well at the Mater Dolorosa Seminary. This well is now known as village well number 2 and has been equipped with an American Well Works deep-well turbine pump having an over-all length of 160 feet. It is rated at 100 gallons per minute when operating at 1750 revolutions per minute.

The water has a pronounced hydrogen sulfide odor, a total residue of 569, a total hardness of 434.5, and an iron content of 1.12 parts per million as shown by the analysis of sample number 82463, collected September 26, 1937.

Analysis of Sample Number 82463 from 180-Foot Well at the Mater Dolorosa Seminary.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.0	Sodium Chloride	NaCl	4.7	0.27
(unfiltered)		1.12	Sodium Sulfate	Na_2SO_4	120.8	7.05
Manganese	Mn	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	0.12
Silica	SiO_2	14.0	Magnesium Sulfate	$MgSO_4$	104.0	6.05
Turbidity		2.0	Magnesium Carbonate	$MgCO_3$	111.0	6.48
Color		0	Calcium Carbonate	$CaCO_3$	216.0	12.60
Odor		0	Silica	SiO_2	14.0	0.82
Calcium	Ca	86.5				
Magnesium	Mg	53.2	Total		574.2	33.49
Ammonium	NH_4	0.5				
Sodium	Na	41.5				
Sulfate	SO_4	165.5				
Nitrate	NO_3	1.4				
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		348.0				
Residue		569.0				
Total Hardness		434.5				

HINCKLEY (626) (p. 285). The well described on page 286 still furnishes all the supply for the village. Static water level stays sufficiently high in the well to permit the use of direct suction pumps. A pumping rate of 450 gallons per minute does not cause a break in suction. A few years ago the centrifugal pump, rated at 200 gallons per minute, and its gas engine were replaced by a new centrifugal pump, rated at 225 gallons per minute, powered by a 15-horsepower electric motor. This unit is operated by automatic control. The pumps are in a pit 15 feet deep.

HINSDALE (6923) (p. 287). The 200-foot well (well number 1) described on page 287 continued to supply all the water for the village until the latter part of 1924. At this time the 271-foot well (well number 2) drilled by M. T. Peterson of Madison, Wisconsin was placed in service. It was equipped with a deep-well turbine pump powered by an electric motor.

A new water treatment plant was constructed about 1926 and soon after all water for the village supply was obtained from well number *2*. In May, 1927 this well produced an average of about 560,000 gallons per day at a rate of about 1690 gallons per minute.

The water had a total residue of 600, a total hardness of 474, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 61903, collected May 29, 1928.

Analysis of Sample Number 61903 from Well Number 2.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Potassium Nitrate	KNO_3	1.7	.10
Manganese	Mn	0.0	Potassium Chloride	KCl	6.8	.40
Turbidity		15.0	Sodium Chloride	NaCl	1.5	.09
Silica	SiO_2	14.0	Sodium Sulfate	Na_2SO_4	101.3	5.92
Nonvolatile		2.1	Ammonium Sulfate	$(NH_4)_2SO_4$	2.3	.14
Alumina	Al_2O_3	0.0	Magnesium Sulfate	$MgSO_4$	105.8	6.19
Calcium	Ca	129.5	Magnesium Carbonate	$MgCO_3$	49.6	2.90
Magnesium	Mg	36.7	Calcium Carbonate	$CaCO_3$	314.2	18.37
Ammonium	NH_4	0.6	Silica	SiO_2	14.0	.82
Sodium	Na	34.4	Iron Oxide	Fe_2O_3	1.4	.08
Potassium	K	4.4	Alumina	Al_2O_3	0.0	.00
Sulfate	SO_4	150.4	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.1	Nonvolatile		2.1	.12
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$			Total		600.7	35.13
Phenolphthalein		0.0				
Methyl Orange		362.0				
Residue		600.0				

In the early part of 1928 the Gray Drilling Company of Milwaukee, Wisconsin completed well number 3 at a site a block east of well number 2. This new well had a total depth of 210 feet and upon test produced 1120 gallons per minute with a draw down of 5 feet from a static level of 45 feet below well top.

In November, 1937 wells numbers 2 and 3 were supplying all the water needed which was about 666,000 gallons per day, each well being pumped from 10 to 11 hours per day.

The raw water from well number 2 had a total residue of 542, a total hardness of 426, and a content of iron of 0.8 parts per million as shown by the analysis of sample number 82401, collected November 16, 1937.

The raw water from well number 3 had a total residue of 516, a total hardness of 406.5, and an iron content of 0.2 parts per million as shown by the analysis of sample number 82402, collected November 16, 1937.

Analysis of Sample Number 82402 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.2	0.24
(filtered)		0.0	Sodium Chloride	NaCl	6.4	0.37
(unfiltered)		0.2	Sodium Sulfate	Na_2SO_4	7.8	0.45
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	198.0	11.49
Silica	SiO_2	16.0	Magnesium Carbonate	$MgCO_3$	49.3	2.87
Turbidity		5.0	Calcium Carbonate	$CaCO_3$	183.5	10.70
Color		0.0	Silica	SiO_2	16.0	0.93
Odor		0.0				
Calcium	Ca	73.4	Total		465.2	27.05
Magnesium	Mg	54.3				
Ammonium	NH_4	trace				
Sodium	Na	6.2				
Sulfate	SO_4	163.5				
Nitrate	NO_3	2.8				
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		242.0				
Residue		516.0				
Total Hardness		406.5				

HOMEWOOD (3227) (p. 289). In 1933 well number 2 (360 feet deep) was deepened by S. B. Geiger to a depth of 1350 feet. The water level then was at a depth of 240 feet when not pumping and was lowered 45 feet when pumping at a rate of 508 gallons per minute. It is equipped with an 8-stage Pomona deep-well turbine pump with the top of the bowls at a depth of 300 feet. A 300-foot air line was installed for measuring water levels.

A rather incomplete log of this well indicates that the St. Peter sandstone was entered at a depth of 930 feet, that it was 140 feet thick, and that drilling was stopped after penetrating 145 feet of the Trempealeau dolomite. Elevation of the ground surface is about 650 feet above sea level.

A treatment plant consisting of aerator, filter and zeolite softener was installed in 1935.

Water from the 1350-foot well was quite similar in chemical quality to that from the 252-foot well.

Analysis of Sample Number 75891 from Village Well, 252 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	6.7	0.39
Silica	SiO_2	8.0	Sodium Sulfate	Na_2SO_4	154.9	9.03
Turbidity		2.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.9	0.11
Calcium	Ca	111.0	Magnesium Sulfate	$MgSO_4$	196.1	11.44
Magnesium	Mg	54.8	Magnesium Carbonate	$MgCO_3$	52.7	3.06
Ammonium	NH_4	0.6	Calcium Carbonate	$CaCO_3$	277.8	16.19
Sodium	Na	52.9	Iron Oxide	Fe_2O_3	0.2	0.01
Sulfate	SO_4	263.1	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.8	Silica	SiO_2	8.0	0.47
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$			Total		699.2	40.75
Phenolphthalein		0.0				
Methyl Orange		340.0				
Residue		721.0				
Total Hardness		503.0				

HOOPESTON (5613) (p. 290). Hoopeston obtains water from four wells about 110 feet deep. Three of the wells are 10 inches in diameter and are described on page 291.

The fourth well was drilled about 1927 by a driller from LaFayette, Indiana. It is 12 inches in diameter and 110 feet deep. A 14-foot length of screen is installed in the well. It is located 50 feet south of well number 3 which is outside of the main pumping station. Water is pumped from well number 4 by a Pomona deep-well turbine pump rated at 700 gallons per minute. In 1932 the pump was delivering about 600 gallons per minute. The pump is driven by a 15-horsepower electric motor.

The air lift in well number 3 has been replaced by a Pomona deep-well turbine pump rated at 600 gallons per minute.

HOPEDALE (498) (p. 292). No reported change.

HULL (554). Hull is located in the northwestern part of Pike County on the flood plain of Mississippi River. A public water supply was installed in 1903. Little information is available concerning the early years of this system's existence. Water was secured from a shallow well and pumped to an elevated tank on a brick tower.

A new well, drilled in 1936 by E. W. Franke of Batchtown, is located in the southwestern part of town near the Wabash Eailway station. It is 51¼ feet deep by 8 inches in diameter and is cased with 41¼ feet of 8-inch pipe below which is a 10-foot section of 8-inch Cook screen. Below a depth of 22 feet the well penetrated coarse, water-bearing sand.

The water level was at a depth of 12.9 feet below ground surface when not pumping and was lowered 5.9 feet by a pumping rate of 142 gallons per minute.

The well is equipped with a 3-stage Cook turbine pump having 40 feet of 4½-inch column pipe and 7 feet of suction pipe. The pump is direct-connected to a 3-horsepower electric motor.

A treatment plant is located at the well site. Water from the well is pumped over a coke-tray aerator to a collecting basin, thence through two pressure filters to the distribution system.

The service pump is a single-stage Goulds centrifugal pump, rated at 100 gallons per minute against 150-foot head, driven by a 10-horsepower electric motor.

All equipment is housed in a brick building at the well site. An elevated steel tank located beside the building is connected to the distribution system. In December of 1937 there were 46 service connections and the average daily pumpage was about 5500 gallons.

The temperature of the water was 57° F. The raw water had a distinct odor of hydrogen sulfide and had a total residue of 353, a total hardness of 230.5 and a content of iron of 3.0 parts per million as shown by the analysis of sample number 78245, collected June 18, 1936.

Analysis of Sample Number 78245 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	3.0	Sodium Nitrate.....$NaNO_3$		4.3	0.25
(unfiltered).....	3.0	Sodium Chloride.....NaCl		54.4	3.17
Manganese..Mn	4.0	Sodium Sulfate.....Na_2SO_4		32.6	1.90
Silica.....SiO_2	14.0	Magnesium Sulfate.....$MgSO_4$		72.8	4.24
Turbidity.....	50.0	Magnesium Carbonate..$MgCO_3$		8.8	0.51
Odor.....	S1	Calcium Carbonate.....$CaCO_3$		159.5	9.30
Calcium.....Ca	63.9	Ferric Oxide.....Fe_2O_3		4.3	0.25
Magnesium..Mg	17.3	Manganese Oxide.....MnO		5.2	0.30
Sodium.....Na	33.1	Silica.....SiO_2		14.0	0.82
Sulfate.....SO_4	80.0				
Nitrate.....NO_3	3.1	Total.....		355.9	20.74
Chloride.....Cl	33.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	170.0				
Residue.....	353.0				
Total Hardness....	230.5				

HUNTLEY (670) (p. 294). The water supply at Huntley is as described on page 294 except that the southeast well, 74 feet deep, had been abandoned prior to July, 1938.

HUTSONVILLE (604). Hutsonville is located in the northeastern part of Crawford County on the west bank of Wabash River. A public water supply was installed in 1936. In addition many private wells are in use. These are usually well points driven into sand below the river level.

Water is secured from a well drilled by C. A. Cramer in 1936. It is located on the river bank at the end of Dover Street. It is 35 feet deep and 10 inches in diameter. The water-bearing formation is screened with a number 125-slot Cook screen between depths of 22½ and 29½ feet. On March 31, 1936 the water level was at a depth of 9½ feet and was lowered 9¾ feet when pumping at a rate of 155 gallons per minute. The driller reported that below a depth of 5 feet the material penetrated by the well varied from gravel to coarse sand to fine sand.

The well is equipped with an 11-stage Fairbanks-Morse turbine pump having 30 feet of column pipe and driven at a speed of 1740 revolutions per minute by a 15-horsepower electric motor.

Water is pumped directly into the distribution system. An elevated steel tank located on high ground in the western part of the village is connected to the mains.

The water had a total residue of 361, a total hardness of 298.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 77712, collected March 31, 1936.

Analysis of Sample Number 77712 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	12.8	0.75
Manganese	Mn	0.0	Magnesium Nitrate	$Mg(NO_3)_2$	23.0	1.34
Silica	SiO_2	8.0	Magnesium Chloride	$MgCl_2$	16.2	0.95
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	68.6	4.00
Calcium	Ca	83.6	Calcium Sulfate	$CaSO_4$	12.9	0.75
Magnesium	Mg	21.7	Calcium Carbonate	$CaCO_3$	186.1	10.86
Sodium	Na	3.5	Calcium Silicate	$CaSiO_3$	15.7	0.92
Sulfate	SO_4	63.9				
Nitrate	NO_3	28.8	Total		335.3	19.57
Chloride	Cl	12.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		186.0				
Residue		361.0				
Total Hardness		298.5				

The analysis of sample number 82498, collected December 1, 1937 showed the water had a total residue of 459, a total hardness of 358 and an iron content of 0.2 parts per million.

Analysis of Sample Number 84298 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	54.5	3.18
(unfiltered)		0.2	Sodium Chloride	NaCl	1.7	0.10
Manganese	Mn	0.0	Magnesium Chloride	$MgCl_2$	29.5	1.72
Silica	SiO_2	15.0	Magnesium Sulfate	$MgSO_4$	75.7	4.42
Turbidity		0	Calcium Sulfate	$CaSO_4$	13.6	0.79
Color		0	Calcium Carbonate	$CaCO_3$	254.0	14.92
Odor		0	Silica	SiO_2	15.0	0.87
Calcium	Ca	105.5				
Magnesium	Mg	22.9	Total		444.0	26.00
Ammonium	NH_4	trace				
Sodium	Na	15.4				
Sulfate	SO_4	70.0				
Nitrate	NO_3	39.6				
Chloride	Cl	23.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		254.0				
Residue		459.0				
Total Hardness		358.0				

ILLIOPOLIS (715). Illiopolis is located in the eastern part of Sangamon County on the drainage area of Sangamon River, a tributary of Illinois River. Many private wells of the shallow dug type have been used, but none of these were capable of furnishing much water.

Water for the public supply, installed by the village in 1937, is obtained from a well about two blocks north of the business district. An electrical earth resistivity survey followed by a program of test drilling was completed before selecting the site for the permanent well. It is 45 feet deep, of the gravel-walled type, is cased with 35 feet of pipe below which is a 10-foot length of 12-inch, number 187-slot Cook wire-wound screen. The diameters of the inner and outer casings are 12 and 26 inches, respectively. The well was drilled by C. O. Robertson of Campbellsburg, Indiana.

The water level was 15 feet below the pump base or 13 feet below ground surface when not pumping and was lowered 24.7 feet by a pumping rate of 86 gallons per minute.

The well is equipped with a 12-stage Fairbanks-Morse, size 6, turbine pump having 35 feet of 4-inch column pipe and driven by a 5-horsepower electric motor.

The temperature of the water was 55° F. The water had a total residue of 497, a total hardness of 426.5, and a content of iron of 6.0 parts per million as shown by the analysis of sample number 79239, collected December 16, 1936.

Analysis of Sample Number 79239 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	2.8	Sodium Nitrate.....$NaNO_3$	1.7	0.10
(unfiltered).....	6.0	Sodium Chloride.....NaCl	21.6	1.26
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	7.1	0.41
Silica.....SiO_2	14.0	Sodium Carbonate.....Na_2CO_3	33.4	1.95
Turbidity.....	40.0	Ammonium Carbonate..$(NH_4)_2CO_3$	5.8	0.34
Color.....	1.0	Magnesium Carbonate..$MgCO_3$	141.9	8.26
Calcium.....Ca	103.2	Calcium Carbonate.....$CaCO_3$	258.2	15.06
Magnesium..Mg	40.9	Silica.....SiO_2	14.0	0.82
Ammonium..NH_3	2.2			
Sodium.....Na	25.8	Total.....	483.7	28.20
Sulfate.....SO_4	5.0			
Nitrate.....NO_3	1.1			
Chloride.....Cl	13.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	464.0			
Residue.....	497.0			
Total Hardness....	426.5			

The water is aerated and filtered before being pumped to an elevated tank connected to the distribution system.

IPAVA (635) (p. 295). No reported change.

ITASCA (594). Itasca is located in the northeastern part of DuPage County on the drainage area of Salt Fork, a tributary of Des Plaines River. Water for the public supply, installed by the village in

1926, is obtained from two wells. Well number 1, drilled by the W. L. Thorne Company in 1925 to a depth of 800 feet, is located in the western part of the village near the intersection of Center and Willow Streets. It is 6 inches in diameter at the bottom and is probably finished in the St. Peter sandstone. It is cased with 10-inch pipe to a depth of 86 feet and with 8-inch pipe between 86 and 430 feet. The water level was reported to be at a depth of 20 feet when not pumping.

The well is equipped with a Cook 2-stroke deep-well pump having a 5¼-inch diameter cylinder and 18-inch stroke. The pumping rate is about 50 gallons per minute. The pump did not operate smoothly when the cylinder was installed at a depth of 204 feet. Operation was smooth after the cylinder was lowered 105 feet.

The temperature of the water in 1926 was reported to be 50° F. The water had a mineral content of 491, a total hardness of 327, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 57920, collected December 15, 1926.

Analysis of Sample Number 57920 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Potassium Nitrate	KNO_3	2.4	.14
Manganese	Mn	0.0	Potassium Chloride	KCl	6.4	.38
Silica	SiO_2	24.0	Sodium Sulfate	Na_2SO_4	125.0	7.31
Nonvolatile		7.2	Ammonium Sulfate	$(NH_4)_2SO_4$	1.1	.06
Alumina	Al_2O_3	0.0	Magnesium Sulfate	$MgSO_4$	123.2	7.20
Calcium	Ca	69.1	Magnesium Carbonate	$MgCO_3$	43.2	2.53
Magnesium	Mg	37.7	Calcium Carbonate	$CaCO_3$	171.0	10.00
Ammonium	NH_4	0.3	Silica	SiO_2	24.0	1.40
Potassium	K	4.4	Iron Oxide	Fe_2O_3	0.3	.02
Sodium	Na	40.9	Alumina	Al_2O_3	0.0	0.00
Sulfate	SO_4	182.1	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	1.5	Nonvolatile		7.2	.42
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$			Total		503.8	29.46
Phenolphthalein		0.0				
Methyl Orange		220.0				
Residue		491.0				
Total Hardness		327.0				

Well number 2 was drilled in 1936 by Wayman and Wayman of Arlington Heights to a depth of 184 feet. It is cased with 85 feet of 8-inch pipe which entered the limestone five feet.

The well is equipped with a Pomona deep-well turbine pump powered by a 15-horsepower electric motor and operates at a rate of 80 gallons per minute for about 4 hours per day.

The water had a total residue of 475.0, a total hardness of 348, and a content of iron of 0.10 parts per million as shown by the analysis of sample number 82397, collected November 17, 1937.

There are about 135 metered customers.

Analysis of Sample Number 82397 from Well 184 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron (unfiltered)	Fe	0.10	Sodium Nitrate	$NaNO_3$	4.3	0.25
Manganese	Mn	0.0	Sodium Chloride	NaCl	3.5	0.20
Silica	SiO_2	16.0	Sodium Sulfate	Na_2SO_4	71.6	4.18
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	166.0	9.70
Color		0.0	Calcium Sulfate	$CaSO_4$	8.2	0.48
Odor		0.0	Calcium Carbonate	$CaCO_3$	204.0	11.90
Calcium	Ca	84.0	Silica	SiO_2	16.0	0.93
Magnesium	Mg	33.5				
Ammonium	NH_4	0.1	Total		473.6	27.64
Sodium	Na	25.8				
Sulfate	SO_4	186.5				
Nitrate	NO_3	2.8				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		204.0				
Residue		475.0				
Total Hardness		348.0				

JACKSONVILLE (17,747) (p. 296 and 709). All water for the public supply is obtained from an impounding **reservoir on Mauvaise** Terre Creek. The water is treated before entering **the distribution** system.

A new reservoir having an estimated storage capacity of 2.25 billion gallons is to be constructed in the fall of 1938 on Big Sandy Creek south of the city.

JEESEYVILLE (4309) (p. 299). No reported change.

JOHNSTON CITY (5955) (p. 709). The raw water of the city of Johnston City is obtained from an impounding reservoir on Lake Creek. The water is treated before entering the distribution system.

JOLIET (42,993) (p. 303). Several changes have occurred in the water system since 1925. A general recession of water levels and a decline in production of all wells has been noted. Some changes in pumping equipment have been made. The Canal Street and Spruce Slip wells have been abandoned since 1931, and the Van Buren Street well has not been used since 1935. The Des Plaines Street well can be used but is not in use at present. Some wells have been repaired.

The Jasper Street well was shot with nitroglycerine in 1933. It is cased to a depth of 303 feet with 17-inch casing. In 1937 this well was cleaned out and is reported to yield 1000 gallons per minute with the water level lowered to a depth of 440 feet. It is equipped with a Cook turbine pump attached to 450 feet of column pipe. The pump is rated at 1000 gallons per minute against a total head of 450 feet and is driven by a 150-horsepower electric motor. It discharges to the suction side of an Economy centrifugal pump which is connected to the mains and is driven by a 60-horsepower electric motor.

The Ottawa Street well was shot with nitroglycerine in 1932. In 1937 the yield had decreased very much because of caving sand. It was not possible to clean out the well until a 100-foot length of 5-inch perforated pipe had been set at the bottom. Total depth was then reported to be 1600 feet. The well yielded 835 gallons per minute with a draw down of 87 feet from a static level of 236 feet. The temperature of the water was 62° F. The well is equipped with a 19-stage, 10-inch Cook turbine pump having 430 feet of column pipe and 30 feet of suction pipe and driven by a 125-horsepower electric motor. This pump discharges to the suction side of an Economy centrifugal pump which is connected to the mains and is driven by a 40-horsepower electric motor.

The Ruby Street well was repaired in 1931. It was necessary to remove the old easing which was in very bad condition. More than a year was spent in repairing this well. The final depth was 1565 feet. The well is cased with 12-inch pipe to a depth of 410 feet, with 10-inch pipe from 410 to 1237½ feet, and with 8-inch perforated pipe from 1237½ to 1438 feet. In 1933 the static water level was 210 feet below the surface. This is a rise of 50 feet since 1932 and a rise of 93 feet since 1931. This well has been used but little since the repair work was completed.

The Williamson Avenue well was repaired in 1929. It was shot with two 750-pound charges of dynamite. In 1933 the yield was reported to be 904 gallons per minute. The well is equipped with a 10-stage, 15-inch Layne turbine consisting of 367 feet of 10-inch column pipe, the bowl assembly 11 feet long, and 40 feet of 10-inch suction pipe. This well is used at infrequent intervals.

At the Washington Street station the only wells used regularly are number 5 and a new well drilled in 1937. Well number 5 was repaired in 1937 and is now known as number 2. It was shot with 50 pounds of dynamite at a depth of 1540 feet. Total depth is now thought to be 1704 feet.. The well yielded 450 gallons per minute with a draw down of 114 feet from a static level of 242 feet. It is equipped with a 7-stage, 10-inch Peerless turbine pump having 400 feet of column pipe, 10 feet of bowls and 20 feet of suction pipe. The temperature of the water was 61° F.

The new well, to be known as number 1, was drilled by C. W. Varner of Dubuque, Iowa. It is 1608 feet deep and yielded 1050 gallons per minute with a draw down of 125 feet from a static level of 270 feet. It is cased to a depth of 39 feet with 24-inch pipe, from the surface to 68¼ feet with 18-inch pipe, from 239 feet to 350 feet with 18-inch pipe, from 917½ feet to 980 feet with 12-inch pipe and from 1076½ feet to 1134 feet with 10-inch pipe. Between depths of 1134 feet and 1608 feet the diameter of the open hole is 10 inches. It is equipped with a 9-stage, 12-inch Peerless turbine pump driven by a 150-horsepower electric motor. The pump bowl assembly is set at a depth of 450 feet and is rated at 1000 gallons per minute against a total head of 450 feet. The temperature of the water was 59° F. The water had a total residue of 554, a total hardness of 392, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 81613, collected July 13, 1937.

The other wells at the Washington Street station have been abandoned and are not equipped with pumps. Water from wells numbers 1 and 2 is pumped to two collecting reservoirs described on page 303, and is then pumped to the mains by three Economy centrifugal pumps driven by electric motors.

Analysis of Sample Number 81613 from Washington Street Well Number 1.

Determinations Made.		Hypothetical Combinations.			
	Pts. per million.			Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$		1.7	0.10
(unfiltered).....	0.0	Sodium Chloride.....NaCl		40.9	2.38
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4		86.6	5.05
Silica.....SiO_2	10.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		1.3	0.08
Turbidity.....	0	Magnesium Sulfate.....$MgSO_4$		125.2	7.30
Odor.....	Chl	Magnesium Carbonate..$MgCO_3$		41.7	2.43
Calcium.....Ca	95.3	Calcium Carbonate.....$CaCO_3$		238.5	13.90
Magnesium..Mg	36.9	Silica.....SiO_2		10.0	0.58
Ammonium..NH_4	0.4				
Sodium.....Na	44.6	Total.....		545.9	31.82
Sulfate.....SO_4	159.5				
Nitrate.....NO_3	1.5				
Chloride.....Cl	25.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	288.0				
Residue.....	554.0				
Total Hardness....	392.0				

There are a number of industrial wells in the city which obtain water from the St. Peter and lower sandstones.

The Stateville Penitentiary is located north of the city and obtains water from four wells ranging in depth from 1100 to 2007 feet. Well number 4 is the deepest and is located south of the penitentiary walls. It is cased with 12-inch pipe to a depth of 1413 feet and with 10-inch pipe from 1587 feet to 1909 feet. After the Mt. Simon sandstone was entered at a depth of 1965 feet the static water level rose from about 300 feet to 70 feet below the surface. The water level was lowered more than 300 feet by pumping at a rate of 240 gallons per minute. A condensed record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Lime	245	245
Shale and lime	115	360
Lime	340	700
Sand	125	825
Shale	10	835
Lime, some shale	560	1395
Sandstone	163	1558
Lime, some sand and shale	407	1965
Sandstone	42	2007

The water had a total residue of 1256, a total hardness of 119.5, and a content of iron of 17.5 parts per million as shown by the analysis of sample number 79972, collected April 27, 1937.

Analysis of Sample Number 79972 from Penitentiary Well Number 4.

Determinations Made.		Hypothetical Combinations.			
	Pts. per million.			Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	3.2	Sodium Nitrate.....$NaNO_3$		1.7	0.10
(unfiltered).....	17.5	Sodium Chloride.....NaCl		828.0	48.25
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4		86.6	5.04
Silica.....SiO_2	8.0	Sodium Carbonate.....Na_2CO_3		214.5	12.51
Turbidity.....	800.0	Ammonium Carbonate..$(NH_4)_2CO_3$		1.9	0.11
Calcium.....Ca	43.1	Magnesium Carbonate..$MgCO_3$		9.7	0.56
Magnesium..Mg	2.8	Calcium Carbonate.....$CaCO_3$		108.1	6.30
Ammonium..NH_4	0.6	Silica.....SiO_2		8.0	0.47
Sodium.....Na	447.1				
Sulfate.....SO_4	58.6	Total.....		1,258.5	73.34
Nitrate.....NO_3	1.0				
Chloride.....Cl	502.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	10.0				
Methyl Orange...	324.0				
Residue.....	1,256.0				
Total Hardness....	119.5				

JONESBORO (1241) (p. 308). The well described on page 308 furnished the entire water supply for Jonesboro until 1938. An A. D. Cook single-acting deep-well plunger pump was installed at a depth of 100 feet. In 1925 the pump cylinder was lowered 40 feet. The well pump discharged into a 30,000-gallon ground storage reservoir. A Dayton-Dowd centrifugal pump, rated at 300 gallons per minute against a head of 190 feet, pumped water from the ground storage reservoir to the distribution system and elevated tank. The deep-well pump was driven by a 5-horsepower electric motor and the centrifugal pump was driven by a 30-horsepower electric motor. In 1926 the static water level was 13½ feet below the ground surface.

A few years after the system was installed the Cook pump was replaced by an 8-inch Byron-Jackson turbine pump rated at 100 gallons per minute against a head of 140 feet. The pump assembly consists of 132 feet of 5-inch column pipe, ten bowls, and no suction pipe. It is driven by a 7½-horsepower General Electric motor. In 1935 the water level stood at a depth of 25 feet 8 inches below the ground surface and was lowered 57 feet when pumping at a rate of 53 gallons per minute.

Water from well number 1 had a total residue of 446, and a total hardness of 361 parts per million, and a trace of iron as shown by the analysis of sample number 76511, collected August 15, 1935.

Analysis of Sample Number 76511 from City Well 267 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Nitrate	$NaNO_3$	36.6	2.13
Manganese	Mn	0.0	Sodium Chloride	NaCl	11.7	0.68
Silica	SiO_2	10.0	Magnesium Chloride	$MgCl_2$	21.4	1.24
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	49.9	2.91
Color		0.0	Calcium Sulfate	$CaSO_4$	9.5	0.55
Odor		0.0	Calcium Carbonate	$CaCO_3$	290.2	16.92
Calcium	Ca	118.8	Silica	SiO_2	10.0	0.58
Magnesium	Mg	15.5				
Ammonium	NH_4		Total		429.3	25.01
Sodium	Na	14.5				
Sulfate	SO_4	46.5				
Nitrate	NO_3	26.5				
Chloride	Cl	23.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		290.0				
Residue		446.0				
Total Hardness		361.0				

Well number 2 is located in the southern part of the city near the Mobile and Ohio depot about ¼ mile south of well number 1. It was drilled by A. C. Wise of St. Louis in 1937. The well is cased with 22-inch pipe from the surface to a depth of 11 feet and with 10-inch pipe from the surface to a depth of 78 feet. It is drilled 10 inches in diameter below the casing to a total depth of 302 feet. The annular space between the 10-inch and 22-inch casings is filled with concrete.

The static water level was 7½ feet below the top of the casing on April 22, 1937. The draw down was 92½ feet when pumping at a rate of 55 gallons per minute. The temperature of the water was 58° F.

The pump installed in well number 2 is a Fairbanks-Morse turbine pump driven by a 5-horsepower electric motor. The bowl assembly installed in well number 1 is an 11-stage Fairbanks-Morse unit.

Both well pumps discharge water over a coke-tray aerator into a 30,000-gallon settling basin. The water is pumped through Permutit pressure filters and zeolite softeners to a 100,000-gallon clear well by a centrifugal pump rated at 150 gallons per minute, driven by an electric motor. A 4-inch Fairbanks-Morse centrifugal pump rated at 500 gallons per minute against a head of 185 feet pumps the water from the clear well to the distribution system. The service pump is driven by either a 50-horsepower Fairbanks-Morse electric motor or a G-cylinder Continental gasoline engine. The Dayton-Dowd centrifugal pump is available but seldom used.

The water from well number 2 had a total residue of 323, a total hardness of 288, and an iron content of 24 parts per million as shown by the analysis of sample number 79946, collected at the end of a 24-hour production test on May 8, 1937.

Analysis of Sample Number 79946 from Well Number 2
302 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	2.8	Sodium Nitrate.....$NaNO_3$	9.4	0.55
(unfiltered).....	24.0	Sodium Chloride.....NaCl	11.7	0.68
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	2.1	0.12
Silica.....SiO_2	14.0	Magnesium Sulfate.....$MgSO_4$	9.6	0.56
Turbidity.....	1,000.0	Magnesium Carbonate..$MgCO_3$	62.4	3.64
Calcium.....Ca	82.4	Calcium Carbonate.....$CaCO_3$	206.0	12.01
Magnesium..Mg	19.9	Silica.....SiO_2	14.0	0.82
Sodium.....Na	7.8			
Sulfate.....SO_4	9.2	Total.....	315.2	18.38
Nitrate.....NO_3	7.1			
Chloride.....Cl	7.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	280.0			
Residue.....	323.0			
Total Hardness....	288.0			

The treatment plant was placed in operation in January, 1938.

JOY (524) (p. 309). No reported change.

KANKAKEE (20,620) (p. 709). The raw water supply of the city of Kankakee is obtained from Kankakee River. The water is treated before entering the distribution system.

Wells in Kankakee vary in depth from 20 feet to 1892 feet. Most of the wells take water from the limestone above a depth of 340 feet. The St. Peter sandstone is encountered at about 900 feet, is about 170 feet thick, and a number of wells terminate in this aquifer. The mineral content of wells in this area increases with depth and the water from the 1892-foot well is unsatisfactory for both domestic and industrial uses. The upper limestone has become contaminated with gas-house waste.

KANSAS (900) (p. 310). The well described on page 310 continued to supply all the water needed until 1925. In that year a new well was drilled at the west end of Maple Street about 15 feet west of the 80-foot well drilled in 1914. The new well was drilled to a depth of 76 feet and was cased with 8-inch casing to a reported depth of 67 feet below which was 9 feet of Cook screen.

The well was equipped with a Cook double-acting deep-well cylinder pump having a cylinder 6 inches in diameter and an over-all length of 81½ inches. The length of stroke was 18 inches and the pump operated at a speed of 29 strokes per minute. The cylinder had a reported setting of 52 feet and a 15-foot length of 4-inch suction pipe attached to the bottom of it. This gave a depth of 73 feet 9½ inches to bottom of the suction pipe below the surface.

The pump was driven by a Wagner 10-horsepower electric motor and was reported to deliver 125 gallons per minute.

On August 28, 1927 static water level was reported to be 13 feet below ground surface.

The water had a total residue of 453, a total hardness of 379, and a content of iron of 3.4 parts per million as shown by the partial analysis of sample 83710, collected June 13, 1938.

In 1932 a third well was drilled by E. W. Johnson of Bloomington at a site 20 feet west and 15 feet north of the well drilled in 1925. This well is 85 feet deep and is cased with 10-inch casing to a depth of 73 feet below which was placed a 12-foot length of Johnson screen.

The well is equipped with a Sterling deep-well turbine pump rated at 100 gallons per minute. The pump is powered by a U. S. 10-horse-power electric motor.

Water is pumped directly into the distribution system and the elevated tank, each well being pumped on alternate days. There are 128 service connections and the daily demand averages about 10,000 gallons. The service rate is 35 cents per 1000 gallons with a minimum charge of $1.50 per quarter.

KEITHSBURG (1081) (p. 311). No reported change.

KEMPTON (289) (p. 312). The well and pump described on pages 312 and 313 are still in service and furnish practically all of the water demanded.

A second well was completed by E. W. Johnson of Bloomington in January, 1931, to a depth of 238 feet at a site 20 feet west of the older well.

The log of the well reported in the records of the village clerk is as follows:

	Thickness in feet.	Depth in feet.
Soil	2	2
Yellow clay	13	15
Blue clay	135	150
Hard blue clay	38	188
Streak of sand at 188 feet; some water 5 to 10 gallons per minute.		
Streak of hard and soft clay	15	203
Hard clay	20	223
Streak of sand at 223 feet; some water, about 2 gallons per minute. Water raised to a static level of 100 feet.		
Hard blue clay	5	228
Fine sand	7	235
Sand and some gravel	3	238
Hard blue clay	2	240

The well is cased with 8-inch pipe to a depth of 228 feet below which is placed a 10-foot length of 8-inch Johnson screen, the upper 7 feet of which has number 20 slots and the lower 3 feet number 30 slots.

When completed the well was pumped for four days at a rate of 110 gallons per minute with a draw down of 100 feet from a static level of 90 feet.

The well is equipped with a Sterling 6-inch deep-well turbine pump consisting of 210 feet of 4½-inch column pipe, 8 stages of bowls having

an over-all length of 3 feet 9 inches, and 20 feet of 4½-inch suction pipe. The pump is direct connected to a U. S. 15-horsepower electric motor.

The water from the 238-foot well has a total residue of 1809, a total hardness of 785 and an iron content of 2.8 parts per million as shown by the analysis of sample number 83928, collected July 21, 1938. The water from the 404-foot well has a total residue of 801, a total hardness of 8.0 and an iron content of 0.0 parts per million as shown by the analysis of sample number 72733, collected April 4, 1933.

Analysis of Sample Number 83928 from 238-Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		0.9	0.05
(filtered).....	trace	Sodium Chloride.....NaCl		41.5	2.42
(unfiltered).....	2.8	Sodium Sulfate.....Na_2SO_4		743.7	43.36
Manganese..Mn	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		5.9	0.34
Silica.....SiO_2	11.0	Magnesium Sulfate.....$MgSO_4$		446.0	26.00
Turbidity.....	30	Calcium Sulfate.....$CaSO_4$		390.2	22.75
Color.....	0	Calcium Carbonate.....$CaCO_3$		128.0	7.46
Odor.....	0	Silica.....SiO_2		11.0	0.64
Calcium.....Ca	165.9				
Magnesium..Mg	90.2	Total.....		1,767.2	103.02
Ammonium..NH_4	1.5				
Sodium.....Na	257.4				
Sulfate.....SO_4	1,140.0				
Nitrate.....NO_3	0.9				
Chloride.....Cl	25.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	128.0				
Residue.....	1,809.0				
Total Hardness....	785.0				
pH-7.3					

Analysis of Sample Number 72733 from 404-Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe	0.0	Sodium Nitrate.....$NaNO_3$		.9	.05
Manganese..Mn	0.0	Sodium Chloride.....NaCl		77.8	4.53
Silica.....SiO_2	7.0	Sodium Carbonate.....Na_2CO_3		668.5	39.00
Turbidity.....	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$		1.0	.06
Calcium.....Ca	2.0	Magnesium Carbonate..$MgCO_3$		2.5	.15
Magnesium..Mg	.8	Calcium Carbonate.....$CaCO_3$		5.0	.29
Ammonium..NH_4	.3	Silica.....SiO_2		7.0	.41
Sodium.....Na	321.0				
Sulfate.....SO_4	none	Total.....		762.7	44.49
Nitrate.....NO_3	.5				
Chloride.....Cl	47.0	Fluoride (F-) content=3.66-3.80 ppm.			
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	640.0				
Residue.....	801.0				
Total Hardness....	8.0				

Because of the lower hardness the water from the 404-foot well is used most of the time to supply the municipal demand.

KENILWORTH (2501) (p. 709). No record of change. The village constructed a new filtration plant and pumping station in 1928.

KEWANEE (17,093) (p. 313). Kewanee secures water from two wells into the Cambrian sandstone. The two wells into the St. Peter sandstone were abandoned in 1925, but the west well was maintained to provide boiler feed water until 1931.

Water is pumped from well number 1 (drilled in 1919) by a 12-inch, 19-stage Cook turbine pump. The top of the bowls are set 390 feet below the pump base. Power is supplied by a 100-horsepower U. S. electric motor. Static water level was reported to be about 273 feet and the pumping level 319 feet below the pump base when pumping at a rate of 700 gallons per minute.

Well number 2 was drilled by Thorpe Brothers of Des Moines, Iowa in 1927. It is located about 400 feet north and 150 feet east of well number 1. The well is 2438 feet deep and is cased with 20-inch pipe from the surface to 439 feet, and with 14-inch pipe from 439 feet to 1488 feet. Below a depth of 1488 feet the well is 12 inches in diameter and uncased. A log prepared by the State Geological Survey indicates the materials penetrated are as follows:

	Thickness in feet.	Depth in feet.
Clay, sand and till	30	30
Pennsylvanian, shales	362	392
Devonian(?), shale	38	430
Silurian, Niagaran dolomite	350	780
Maquoketa shale	190	970
Galena dolomite	220	1190
Platteville dolomite	110	1300
St. Peter sandstone	147	1447
Shakopee dolomite	223	1670
New Richmond sandstone	30	1700
Oneota dolomite	230	1930
Jordan (?) dolomite and sandstone	50	1980
Trempealeau dolomite	210	2190
Franconia sandstone	150	2340
Dresbach sandstone	70	2410
Eau Claire sandstone	28	2438

Water is pumped from the well by a 14-inch, 11-stage Cook deep-well turbine pump assembly attached to an American Well Works column and pump base. The top of the bowls are 320 feet below the pump base. Power is furnished by a 150-horsepower electric motor. The pump is rated at 900 gallons per minute.

On July 21, 1927 the well was tested for six hours. The average discharge was 968 gallons per minute, the maximum discharge 1225 gallons per minute, and the draw down 108 feet. Static water level was 270 feet 6 inches below the pump base.

On May 12, 1927 the drilling had proceeded to a depth of 1480 feet and a production test was made. At that time static water level was 300 feet and the pumping level was 450 feet below the ground surface. An air line 600 feet long was installed and the well was pumped for four hours. Water discharged about one-half minute and then stopped for about a minute. The average discharge was at a rate of 176 gallons per minute.

The city plans to construct a new well into the St. Peter sandstone during 1938. The specifications call for a well 1450 feet deep, 12 inches in diameter, and uncased from 450 feet to the bottom. The top 450 feet will be cased with 16-inch pipe. The desired capacity is between 600 and 800 gallons per minute, to be obtained by shooting if necessary.

Two identical American Well Works centrifugal pumps rated at 700 gallons per minute and driven by 50-horsepower Fairbanks-Morse electric motors pump water from the ground storage reservoir into the distribution system.

There are about 3200 services and the average daily usage is about 500,000 gallons. The rates are as follows:

27 cents per 100 cubic feet for the first 2,000 cubic feet per month.
17½ cents per 100 cubic feet for the next 10,000 cubic feet per month.
10 cents per 100 cubic feet for all over 12,000 cubic feet per month.

The analysis of sample number 62543, collected September 14, 1928, indicates a total residue of 1923, a total hardness of 452, and an iron content of 0.6 parts per million.

KINCAID (1583). When the village of Kincaid was first established in 1914, a temporary water supply was developed from a small reservoir on the southerly side of the Chicago and Illinois Midland Eailroad and easterly of the depot.

The water was not filtered, but equipment for applying a hypochlorite of lime solution was installed in the pumping station. While this treatment made the water safe, it did not improve the appearance and most of the water for household use was obtained from private wells.

In December, 1917 it was reported there were 75 service connections and a daily use of about 20,000 gallons mostly for flushing and laundering.

At about the time the reservoir was developed a number of test wells were put down in an attempt to locate a site for the installation of a well water supply, but with no success. Additional test wells were put down in 1922 with like results.

The plant was acquired by the Central Illinois Public Service Company about 1927 and in the latter months of that year twenty-two additional test holes were started but only twelve were finished to bed rock. The results of all these tests, together with other information, did not indicate a very encouraging situation within the village.

However, in 1928 a program of additional test drilling was undertaken and as a result a well, having an inside diameter of 26 inches and a depth of 58 feet, was constructed at a site on the east bank of the Sangamon River and south of the railroad track.

This well was lined with a concrete casing, porous concrete sections being placed opposite the two layers of sand and gravel which were encountered between depths of 20 feet and 31 feet and between 55 feet and 61 feet.

On test a production of 87 gallons per minute was obtained with a draw down of 42 feet from a static water level of 13 feet.

Water from this large test well had a total residue of 700, a total hardness of 344 and an iron content of 4.8 parts per million as shown by the analysis of sample number 62719, collected October 6, 1928.

Analysis of Sample Number 62719 from 26-Inch Test Well.

Determinations Made.		Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
	Pts. per million.				
Iron.....Fe					
(filtered).....	0.5	Sodium Nitrate.....$NaNO_3$		1.1	0.06
(unfiltered).....	4.8	Sodium Chloride.....NaCl		206.1	12.05
Manganese..Mn	0.3	Sodium Sulfate.....Na_2SO_4		15.2	0.89
Silica.....SiO_2	16.0	Sodium Carbonate.....Na_2CO_3		80.9	4.72
Turbidity.....	60.0	Ammonium Carbonate..$(NH_4)_2CO_3$		9.6	0.56
Calcium.....Ca	87.5	Magnesium Carbonate..$MgCO_3$		105.6	6.18
Magnesium..Mg	30.5	Calcium Carbonate.....$CaCO_3$		218.6	12.78
Ammonium..NH_4	3.6	Silica.....SiO_2		16.0	0.93
Sodium.....Na	121.4	Iron Oxide.....Fe_2O_3		6.9	0.40
Sulfate.....SO_4	10.3	Manganese Oxide.....MnO		0.4	0.02
Nitrate.....NO_3	0.8				
Chloride.....Cl	125.0	Total.....		660.4	38.59
Alkalinity as $CaCO_3$					
Phenolphthalein..					
Methyl Orange...	430.0				
Residue.....	700.0				
Total Hardness....	344.0				

At the present time water is obtained from a group of sand-point wells located in the vicinity of the large test well. Water is pumped by direct suction into the distribution system and to an elevated tank connected with it.

KINGSTON (242). A public water supply system was installed in the village in 1911. Water is pumped from a well into the distribution system and a steel pressure tank by an electric motor powered deep-well cylinder pump. The tank is 8 feet in diameter and 36 feet long. Water is sold at a flat rate.

The water for the public supply is obtained from a well 10 inches in diameter at the top and 202½ feet deep.

In 1928 the distance to water level when not pumping was 35 feet below ground surface and when pumping at a rate of about 30 gallons per minute the draw down was about 25 feet.

The well is now equipped with an American Well Works single-acting deep-well cylinder pump set with 140 feet of 5-inch drop pipe. The pump has an 18-inch stroke and is powered by a 10-horsepower General Electric Company electric motor.

The water has a total residue of 401, a total hardness of 367.5, and a content of iron of 1.8 parts per million as shown by analysis of sample number 82685, collected December 31, 1937.

Analysis of Sample Number 82685 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	0.10
(filtered).....	0.12	Sodium Chloride.....NaCl	13.4	0.78
(unfiltered).....	1.8	Sodium Sulfate.....Na_2SO_4	25.6	1.49
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	31.9	1.86
Silica.....SiO_2	22.0	Magnesium Carbonate..$MgCO_3$	130.0	7.58
Turbidity.....	18.0	Calcium Carbonate.....$CaCO_3$	149.5	8.71
Color.....	0.0	Calcium Silicate.....$CaSiO_3$	43.0	2.51
Odor.....	0.0	Iron Oxide.....Fe_2O_3	0.2	0.01
Calcium.....Ca	74.6			
Magnesium..Mg	44.0	Total.....	395.3	23.04
Ammonium..$\ddot{N}H_4$	trace			
Sodium.....Na	13.8			
Sulfate.....SO_4	42.4			
Nitrate.....NO_3	1.5			
Chloride.....Cl	8.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	304.0			
Residue.....	401.0			
Total Hardness....	367.5			

KINSMAN (150) (p. 319). The village of Kinsman was without a public water supply for about a year while a new well was being drilled. Caving material filled the 710-foot well drilled in 1895, and the well was abandoned in 1936.

A new well, drilled by J. Otis Heflin of Joliet, located about 40 feet east and 10 feet north of the old well, is 700 feet deep. The hole is 8 inches in diameter to a depth of 335 feet and 6 inches in diameter from 355 feet to 700 feet. The casing is 8 inches in diameter to 143 feet and 6 inches in diameter from 137 feet to 335 feet. The driller reported 143 feet of drift, broken shale between depths of 143 feet and 335 feet, and broken limestone of unknown thickness on top of the St. Peter sandstone.

A 6-inch, 17-stage Peerless turbine pump rated at 27½ gallons per minute against a head of 275 feet was installed in the well on January 21, 1937. The column pipe is 4 inches in diameter and 200 feet long. The suction pipe is 3 inches in diameter and 30 feet long.

A sample was collected from the pressure tank on November 24, 1937. Analysis number 82439 shows a total residue of 854, a total hardness of 307.5, and an iron content of 1.0 parts per million.

Analysis of Sample Number 82439 from Village Supply.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.5	0.15
(filtered).....	0.0	Sodium Chloride.....NaCl	295.0	17.20
(unfiltered).....	1.0	Sodium Sulfate.....Na_2SO_4	252.0	14.70
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	9.0	0.52
Silica.....SiO_2	15.0	Magnesium Carbonate..$MgCO_3$	129.8	7.56
Turbidity.....	8.0	Calcium Carbonate.....$CaCO_3$	153.5	8.95
Color.....	5	Silica.....SiO_2	15.0	0.88
Odor.....	0			
Calcium.....Ca	61.4	Total.....	856.8	49.96
Magnesium..Mg	37.4			
Ammonium..NH_4	0.1			
Sodium.....Na	202.0			
Sulfate.....SO_4	170.0			
Nitrate.....NO_3	1.9			
Chloride.....Cl	179.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	316.0			
Residue.....	854.0			
Total Hardness....	307.5			

KIRKLAND (526). Kirkland is located in the northwestern part of DeKalb County on the drainage area of South Branch of Kishwaukee River, a tributary of Rock River. A public water supply system was installed in 1928.

Water is obtained from a well 7 inches in diameter at the top and 737 feet deep owned by the Chicago, Milwaukee, St. Paul and Pacific Eailroad Company, constructed in 1896. It is pumped into the distribution system and an elevated tank by a triplex pump powered by an electric motor. The well is cased with 7-inch pipe to a depth of 88 feet.

Static water level was reported in 1934 to be 6 feet below the ground surface and when pumping at a rate of 200 gallons per minute a draw down of 14 feet took place. The average daily pumpage is 85,000 gallons of which the village uses about 15,000 gallons.

The well is equipped with a Goulds 8-inch by 10-inch triplex pump, belt connected to an Allis-Chalmers 15-horsepower electric motor. All water is pumped into the village distribution system and elevated tank. The railroad water tank is filled from the village system. A master meter measures all water pumped from the well and a second meter measures all water taken by the railroad company. The difference is the amount paid for by the village.

The water has a total residue of 276, a total hardness of 259.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 82G86, collected December 17, 1937.

Analysis of Sample Number 82686 from Village Supply.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.4	Sodium Nitrate.....$NaNO_3$	1.7	0.10
Manganese..Mn	0.0	Sodium Chloride.....NaCl	1.8	0.10
Silica.....SiO_2	20.0	Sodium Sulfate.....Na_2SO_4	2.8	0.16
Turbidity.....	0.0	Sodium Carbonate.....Na_2CO_3	0.5	0.03
Color.....	0.0	Magnesium Carbonate..$MgCO_3$	135.5	7.90
Odor.....	0.0	Calcium Carbonate.....$CaCO_3$	98.5	5.75
Calcium.....Ca	39.7	Manganese Oxide.....MnO	0.6	0.03
Magnesium..Mg	38.6	Silica.....SiO_2	20.0	1.17
Sodium.....Na	2.3			
Sulfate.....SO_4	2.1	Total.....	261.4	15.24
Nitrate.....NO_3	1.2			
Chloride.....Cl	1.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	260.0			
Residue.....	276.0			
Total Hardness....	259.5			

KIRKWOOD (693) (p. 320). Well number 1, 216 feet deep, has not been used for many years. Well number 2 has been drilled and abandoned since 1921. It was located near the north limits of the village and was about 145 feet deep. It was equipped with a cylinder pump.

Water for the public supply is now obtained from well number 3, located south of Walnut Street in the southwestern part of the village, drilled in 1931, by E. W. Johnson of Bloomington. It is 145 feet deep, 8 inches in diameter, and cased to rock with 8-inch casing.

The water level was at a depth of 30 feet when not pumping and was lowered 50 feet by a pumping rate of 50 gallons per minute maintained for 24 hours.

The well is equipped with a 12-stage, 4-inch Sterling turbine pump having 100 feet of 3-inch column pipe and 20 feet of suction pipe. The pump is rated at 40 gallons per minute and is driven by a 5-horsepower electric motor.

The temperature of the water is 54° F. The water had a total residue of 525, a total hardness of 335, and a content of iron of 2.3 parts per million as shown by the analysis of sample number 82902, collected February 8, 1938.

Analysis of Sample Number 82902 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.3	0.25
(filtered)		0.02	Sodium Chloride	NaCl	3.5	0.20
(unfiltered)		2.3	Sodium Sulfate	Na_2SO_4	12.1	0.70
Manganese	Mn	0.22	Sodium Carbonate	Na_2CO_3	137.9	8.04
Silica	SiO_2	17.5	Magnesium Carbonate	$MgCO_3$	77.6	4.53
Turbidity		15.0	Calcium Carbonate	$CaCO_3$	243.0	14.20
Color		0.0	Manganese Oxide	MnO	0.3	0.02
Odor		Al	Silica	SiO_2	17.5	1.02
Calcium	Ca	97.2				
Magnesium	Mg	22.4	Total		496.2	28.96
Ammonium	NH_4	trace				
Sodium	Na	66.3				
Sulfate	SO_4	8.0				
Nitrate	NO_3	2.9				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		465.0				
Residue		525.0				
Total Hardness		335.0				

KNOXVILLE (1867) (p. 321). Well number 2 was drilled in 1934 by C. W. Varner of Dubuque, Iowa. It is located on the same lot as well number 1, and is 2498 feet deep. It is cased with 16-inch pipe to a depth of 90 feet, with 10-inch pipe from the surface to 480 feet, with 8-inch pipe from 459 to 900 feet, and with 6-inch pipe from 1383 to 1485 feet. The diameter at the bottom of the well is 6 inches. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	20	20
Coal measures, Pennsylvanian	240	260
Shale, Sweetland Creek	200	460
Limestone, Devonian	90	550
Dolomite, Silurian	155	705
Shale, Maquoketa	180	885
Dolomite, Galena-Platteville	315	1200
Sandstone, Glenwood	105	1305
Sandstone, St. Peter	95	1400
Dolomite, Ordovician	485	1885
Dolomite, Cambrian	325	2210
Dolomite, sandstone, shale, Franconia	190	2400
Sandstone, Dresbach	98	2498

The elevation of the ground surface at the well is between 770 and 775 feet above sea level.

The water level was at a depth of 214 feet when not pumping and was lowered 16½ feet by a pumping rate of 232 gallons per minute and 24 feet by a pumping rate of 300 gallons per minute. When the well was only 1376 feet deep the static water level was 224 feet below the ground surface and the draw down was 76 feet when pumping 92 gallons per minute.

The water had a total residue of 1111, a total hardness of 225.5, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 75636, collected January 30, 1935.

Analysis of Sample Number 75636 from Well 2498 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.6	Sodium Nitrate	$NaNO_3$	0.8	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	316.2	18.44
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	539.3	31.45
Turbidity		5.0	Sodium Carbonate	Na_2CO_3	18.6	1.08
Calcium	Ca	57.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.9	0.17
Magnesium	Mg	20.1	Magnesium Carbonate	$MgCO_3$	70.0	4.08
Ammonium	NH_4	1.2	Calcium Carbonate	$CaCO_3$	142.6	8.31
Sodium	Na	307.3	Iron Oxide	Fe_2O_3	0.9	0.05
Sulfate	SO_4	364.5	Silica	SiO_2	9.0	0.52
Nitrate	NO_3	0.4				
Chloride	Cl	192.0	Total		1,100.3	64.14
Alkalinity as $CaCO_3$						
Phenolphthalein		12.0				
Methyl Orange		246.0				
Residue		1,111.0				
Total Hardness		225.5				

Analysis of sample number 66666, collected June 12, 1930 from well number 1, shows that water to have changed in chemical quality since 1921. The water had a total residue of 717, a total hardness of 301 parts per million, and a trace of iron.

Analysis of Sample Number 66666 from City Well Number 1.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Nitrate	$NaNO_3$	5.1	.30
Manganese	Mn	0.0	Sodium Chloride	NaCl	77.8	4.54
Turbidity		5.0	Sodium Sulfate	Na_2SO_4	194.2	11.32
Silica	SiO_2	18.0	Sodium Carbonate	Na_2CO_3	135.7	7.92
Calcium	Ca	49.6	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	0.06
Magnesium	Mg	42.9	Magnesium Carbonate	$MgCO_3$	149.2	8.70
Ammonium	NH_4	.4	Calcium Carbonate	$CaCO_3$	124.0	7.24
Sodium	Na	153.7	Silica	SiO_2	18.0	1.05
Sulfate	SO_4	133.0	Iron Oxide	Fe_2O_3	trace	trace
Nitrate	NO_3	4.0	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	47.0				
Alkalinity as $CaCO_3$			Total		705.0	41.13
Phenolphthalein		0.0				
Methyl Orange		430.0				
Residue		717.0				
Total Hardness		301.0				

LACON (1548) (p. 329). The wells and pumps described on page 330 are still in use. A new well was drilled in 1931 by Mr. Ebert of Washington. It is about 12 feet south of the old wells, 39 feet deep, and 10 inches in diameter. A 12-foot length of Cook screen is installed in the well.

The new well is equipped with a 12-stage, 8-inch Worthington turbine pump having 20 feet of 6-inch column pipe and no suction pipe. The pump is rated at 500 gallons per minute against a head of 130 feet and is driven by a 40-horsepower electric motor.

Water from the 39-foot well had a total residue of 444, a total hardness of 358.5, and a content of iron of 0.02 parts per million as shown by the analysis of sample number 83958, collected July 27, 1938.

Analysis of Sample Number 83958 from 39-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	39.1	2.28
(filtered)		0.0	Magnesium Nitrate	$Mg(NO_3)_2$	7.4	0.43
(unfiltered)		.02	Magnesium Chloride	$MgCl_2$	20.0	1.17
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	60.8	3.54
Silica	SiO_2	19.0	Magnesium Carbonate	$MgCO_3$	64.0	3.73
Turbidity		1.0	Calcium Carbonate	$CaCO_3$	206.0	12.01
Color		0.0	Silica	SiO_2	19.0	1.11
Odor		0.0				
Calcium	Ca	82.5	Total		416.3	24.27
Magnesium	Mg	37.1				
Ammonium	NH_4	trace				
Sodium	Na	10.6				
Sulfate	SO_4	48.5				
Nitrate	NO_3	34.5				
Chloride	Cl	15.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		444.0				
Total Hardness		358.5				

LADD (1318) (p. 331). No reported change.

At the time of a visit on June 6, 1938 it was reported that the pump operated on an average of ten hours per day and the discharge was at a rate of 160 gallons per minute.

A typographical error appears on page 332,, line 3 of the text. The figure 185½ should read 158½.

LAKE BLUFF (1452) (p. 333). The water supply at Lake Bluff is as described on page 334. Most of the water is obtained from the well 1804 feet deep. The Layne and Bowler deep-well turbine pump in the 1804-foot well was replaced in 1936 by a size 10, 6-stage Fairbanks-Morse turbine pump rated at 500 gallons per minute. The bowls are attached to 190 feet of 6-inch column pipe. The pump is driven by a 30-horsepower motor.

The village has an arrangement with Lake Forest so that Lake Michigan water can be obtained in case of emergency.

The water from the 1804-foot well had a total residue of 552, a total hardness of 369, and an iron content of 0.5 parts per million as shown by the analysis of sample number 83846, collected on July 11, 1938.

Analysis of Sample Number 83846 from 1804-Foot Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	.10
(filtered)		0.0	Sodium Chloride	NaCl	24.5	1.43
(unfiltered)		0.5	Sodium Sulfate	Na_2SO_4	83.8	4.88
Manganese	Mn	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	.7	.04
Silica	SiO_2	11.0	Magnesium Sulfate	$MgSO_4$	99.9	5.83
Turbidity		7.0	Calcium Sulfate	$CaSO_4$	40.8	2.38
Color		0.0	Calcium Carbonate	$CaCO_3$	256.2	14.94
Odor		0.0	Silica	SiO_2	11.0	.64
Calcium	Ca	114.4				
Magnesium	Mg	20.2	Total		518.6	30.24
Ammonium	NH_4	0.2				
Sodium	Na	37.3				
Sulfate	SO_4	165.5				
Nitrate	NO_3	1.2				
Chloride	Cl	15.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		256.0				
Residue		552.0				
Total Hardness		369.0				

LAKE FOREST (6554) (p. 709). The water supply of Lake Forest is obtained from Lake Michigan. The water is treated before entering the distribution system.

LA GRANGE (10,103) (p. 323). During the year 1928 a fourth well was completed for the Public Service Company of Northern Illinois by William Cater. The site is at the northeast corner of the intersection of Tilden and Cossitt Streets, the ground surface being about 630 feet above sea level.

The log of the well as given by the State Geological Survey Division is as follows:

	Thickness in feet.	Depth in feet.
Pleistocene, top earth materials	20	20
Silurian system, Niagaran dolomite	345	365
Ordovician system, Maquoketa shale	100	465
Galena-Platteville dolomite	320	785
St. Peter sandstone	488	1273
Cambrian system, Mazomanie	82	1355
Dresbach sandstone	180	1535
Eau Claire, shales and sandstones	305	1840
Mt. Simon sandstone	168	2008

The water from well number 4 had a total residue of 831, a total hardness of 557, and an iron content of 0.4 parts per million as shown by the analysis of sample number 68994, collected April 14, 1931.

Analysis of Sample Number 68994 from Well Number 4, 2008 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	95.4	5.56
Silica	SiO_2	12.0	Sodium Sulfate	Na_2SO_4	93.8	5.47
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.3	.08
Calcium	Ca	132.1	Magnesium Sulfate	$MgSO_4$	250.0	14.59
Magnesium	Mg	55.3	Magnesium Carbonate	$MgCO_3$	16.9	.99
Ammonium	NH_4	0.3	Calcium Carbonate	$CaCO_3$	330.0	19.25
Sodium	Na	68.4	Iron Oxide	Fe_2O_3	0.6	.04
Sulfate	SO_4	264.4	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.2	Silica	SiO_2	12.0	.70
Chloride	Cl	58.0				
Alkalinity as $CaCO_3$			Total		801.7	46.78
Phenolphthalein		0.0				
Methyl Orange		350.0				
Residue		831.0				
Total Hardness		557.0				

LA GRANGE PAEK (2339). The village of La Grange Park now obtains Lake Michigan water from the city of Chicago. Water for the public supply formerly was obtained from the village of La Grange.

LA HARPE (1175) (p. 325). No reported change in the source of the supply, however, between 1923 and 1932 the quality of the water changed appreciably. Sample number 71841, collected October 12, 1932, had a total residue of 592, a total hardness of 501.5, and a content of iron of 2.4 parts per million as shown by the analysis.

Analysis of Sample Number 71841 from City Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	3.4	.20
(filtered)		trace	Sodium Chloride	NaCl	20.5	1.20
(unfiltered)		2.40	Ammonium Chloride	NH_4Cl	.5	.03
Manganese	Mn	0.3	Magnesium Chloride	$MgCl_2$	20.5	1.20
Silica	SiO_2	18.0	Magnesium Sulfate	$MgSO_4$	103.6	6.05
Turbidity		25.0	Magnesium Carbonate	$MgCO_3$	60.6	3.54
Calcium	Ca	128.7	Calcium Carbonate	$CaCO_3$	322.0	18.80
Magnesium	Mg	43.7	Iron Oxide	Fe_2O_3	3.4	.20
Ammonium	NH_4	.24	Manganese Oxide	MnO	.4	.02
Sodium	Na	9.0	Silica	SiO_2	18.0	1.05
Sulfate	SO_4	82.7				
Nitrate	NO_3	2.84	Total		552.9	32.29
Chloride	Cl	28.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		394.0				
Residue		592.0				
Total Hardness		501.5				

LAKE VILLA (487). Lake Villa is located in the heart of the lake region of northwestern Lake County and is adjacent to the south shore of Cedar Lake, a body of water having an area of about 320 acres. A public water supply was installed by the village in 1938.

The water supply is obtained from a well located at a point 150 feet north and 225 feet east of the southwest corner of Section 33, T. 46 N.,

E. 10 E., the ground surface elevation of which is about 798 feet above sea level.

The well is 167 feet deep, terminating in sand and gravel. It is cased from the surface to a depth of 131 feet with 12-inch pipe and between 131 and 141 feet with 10-inch pipe, a lead seal being placed between the 10-inch and 12-inch pipes.

The material penetrated consisted of glacial till with sand from the surface to about 130 feet, below which was fine to medium sand.

The screen consists of 26 feet of 8-inch Cook brass strainer made up as follows:

Upper 11 feet, number 20-slot opening;
next 2 feet, blank;
next 11 feet, number 20-slot opening;
lower 2-foot section, blank.

The pump installation consists of an American Well Works deep-well turbine pump made up of 120 feet of 5-inch column pipe, 10 stages of 8-inch turbine, and 10 feet of 5-inch suction pipe. It is rated at 150 gallons per minute against a head of 237 feet at a speed of 1750 revolutions per minute. The pump is direct connected to a U. S. electric motor of the vertical type.

An 8-hour production test made on the completed well following the installation of the pumping equipment indicated a production of 154 gallons per minute with a draw down of 60 feet from a static water level of 57½ feet. At the end of the 8-hour pumping test period the temperature of the water was 52° F.

The water is delivered by the well pump directly into the distribution system. An elevated tank having a capacity of 60,000 gallons is connected to the distribution system.

The water has a total residue of 384, a hardness of 293, and an iron content of 0.4 parts per million as it comes from the well as shown by analysis of sample number 83090, collected March 9, 1938.

Analysis of Sample Number 83090 from Village Well 167 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	.10
(filtered)		.3	Sodium Sulfate	Na_2SO_4	50.5	2.94
(unfiltered)		.4	Sodium Carbonate	Na_2CO_3	8.5	.49
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	.06
Silica	SiO_2	19.0	Magnesium Carbonate	$MgCO_3$	157.2	9.16
Turbidity		1.0	Calcium Carbonate	$CaCO_3$	106.7	6.22
Color		0.0	Iron Oxide	Fe_2O_3	0.4	.02
Odor		0.0	Silica	SiO_2	19.0	1.11
Calcium	Ca	42.6				
Magnesium	Mg	45.4	Total		345.0	20.10
Ammonium	NH_4	.3				
Sodium	Na	20.5				
Sulfate	SO_4	34.2				
Nitrate	NO_3	.9				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		302.0				
Residue		384.0				
Total Hardness		293.0				

LAKE ZURICH (368) (p. 336). No reported change.

LA MOILLE (504) (p. 326). A new well, 331 feet deep, was drilled by Layne-Western Company in 1936. It is located on the west side of the principal north and south street in the south part of town. It is cased to a depth of 305 feet with 10-inch casing. Below this is a 26-foot length of 8-inch number 30-slot, Layne screen.

A record of material penetrated, furnished by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Clay	10	10
Till	35	45
Sand	10	55
Till	100	155
Silt	15	170
Gravel	15	185
Till	30	215
Sand	45	260
Till	15	275
Gravel	10	285
Till	5	290
Clay	10	300
Gravel and coarse sand	5	305
Sand	26	331

The water level was at a depth of 137 feet when the well was completed. An extended pumping test at a rate of 190 gallons per minute lowered the water level 18 feet.

The water had a total residue of 335, a total hardness of 211, and a content of iron of 0.9 parts per million as shown by the analysis of sample number 78550, collected August 7, 1936.

Analysis of Sample Number 78550 from City Well 331 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	1.7	0.10
(unfiltered).....	0.9	Sodium Chloride.....NaCl	6.4	0.37
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	85.3	4.98
Silica.....SiO_2	14.0	Ammonium Carbonate..$(NH_4)_2CO_3$	2.4	0.14
Turbidity.....	15.0	Magnesium Carbonate..$MgCO_3$	72.5	4.23
Calcium.....Ca	50.0	Calcium Carbonate.....$CaCO_3$	125.0	7.28
Magnesium..Mg	20.9	Silica.....SiO_2	14.0	0.82
Ammonium..NH_4	0.9			
Sodium.....Na	40.0	Total.....	307.3	17.92
Sulfate.....SO_4	0.0			
Nitrate.....NO_3	1.1			
Chloride.....Cl	4.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	294.0			
Residue.....	335.0			
Total Hardness....	211.0			

A treatment plant consisting of a coke-tray aerator, detention basin, softener, and pressure sand filters was built during the same year. During the winter of 1937-1938 the softening process was discontinued.

LANARK (1208) (p. 337). The 600-foot well described on page 338 and its equipment is maintained as a standby unit. The municipal water supply is obtained from a well located in the northwest corner of the intersection of Locust and Bruce Streets. It was drilled in 1936 by C. W. Varner of Dubuque, Iowa to a depth of 447 feet. Ten-inch casing extends to a depth of 315 feet below which the hole is 10 inches in diameter to the bottom.

When the well was completed, the water level was 135 feet below the surface when not pumping and was lowered 30 feet to a depth of 165 feet when pumping at a rate of 225 gallons per minute.

The well is equipped with an American Well Works 10-inch deep-well turbine, pump, consisting of 180 feet of column pipe, 9 stages of bowls, and 10 feet of tail pipe, direct connected to a 25-horsepower U. S. Electric Motor operating at a full load speed of 1750 revolutions per minute. The pumps are rated at 200 gallons per minute against a 310-foot head and discharge directly into the distribution system.

The older well has been equipped for a number of years with an American Well Works deep-well cylinder pump having a 10-inch cylinder and a 36-inch stroke. It is planned to replace this unit with a deep-well turbine pump at an early date.

The old ground storage reservoir has been discontinued.

There are about 350 service connections and the daily demand amounts to about 100,000 gallons.

When the new sewage system and treatment plant is completed, the operation will be combined with the waterworks and the following rates for the two services will be charged, effective November 1, 1938.

Combined water and sewage:

City	$1000.00	per year
Dwelling water, bath toilet	24.00	" "
Dwelling water only	15.00	" "
Consumer water, toilet	15.00	" "
Business water, no bath or toilet	12.00	" "

Water rates when property is not connected to sewers:

Dwelling water, bath, toilet	$12.00	per year
Dwelling water and toilet	7.50	" "
Dwelling water only	7.50	" "
Business water only	6.00	" "

The water from the new 447-foot well had a total residue of 324, a total hardness of 324, and an iron content of 2.4 parts per million as shown by the analysis of sample number 79693, collected March 12, 1937.

Analysis of Sample Number 79693 from Well 447 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Magnesium Nitrate.....$Mg(NO_3)_2$	0.7	0.04
(unfiltered).....	2.4	Magnesium Chloride....MgCl	5.2	0.30
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	16.9	0.99
Silica.....SiO_2	12.0	Magnesium Carbonate..$MgCO_3$	102.1	5.96
Turbidity.....	15.0	Calcium Carbonate.....$CaCO_3$	182.9	10.67
Calcium.....Ca	73.1	Silica.....SiO_2	12.0	0.70
Magnesium..Mg	34.2			
Sulfate.....SO_4	13.6	Total.....	319.8	18.66
Nitrate.....NO_3	0.4			
Chloride.....Cl	4.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	304.0			
Residue.....	324.0			
Total Hardness....	324.0			

LANSING (3378) (p. 339). An analysis of water from a well 1632 feet deep as given on page 339 showed the water to have a total residue of 386, a total hardness of 20, and a content of iron of 0.0 parts per million on June 19, 1922.

Four years later the quality of this water had changed to the extent that the total residue was 1768, the hardness was 650, and the content of iron was 2.0 parts per million.

In 1932 water from this well had a total residue of 1953, a total hardness of 765.5, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 70463, collected March 1, 1932.

Analysis of Sample Number 70463 from Well 1632 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.6	Sodium Chloride.....NaCl	516.2	30.09
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	396.3	23.10
Silica.....SiO_2	12.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	2.0	.12
Calcium.....Ca	206.8	Magnesium Sulfate.....$MgSO_4$	299.1	17.41
Magnesium..Mg	60.7	Calcium Sulfate.....$CaSO_4$	396.2	23.06
Ammonium..NH_4	.5	Calcium Carbonate.....$CaCO_3$	226.2	13.16
Sodium.....Na	331.4	Iron Oxide.....Fe_2O_3	.9	.05
Sulfate.....SO_4	786.4	Silica.....SiO_2	12.0	.70
Nitrate.....NO_3	0.0			
Chloride.....Cl	313.3	Total.....	1,848.9	107.69
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	226.0			
Residue.....	1,953.0			
Total Hardness....	765.5			

In addition to this pronounced change in chemical quality the temperature of the water had increased from 54° F. in 1922 to more than 58° F. in 1926. Shallow wells located nearby had either been pumped dry or had experienced a pronounced lowering of water levels. It was evident that the village well had formerly drawn colder water of better chemical quality from the upper formations, but that as these

formations were drained the water was being drawn from deeper formations. In 1932 this well was used only at the time of peak summer demand. Most of the water was obtained from another well.

In 1926 a well 1800 feet deep was drilled by Layne-Bowler. It is cased with 125 feet of 16-inch pipe, a 190-foot liner of 12-inch pipe is set between depths of 533 and 723 feet, and a 64-foot liner of 10-inch pipe is set between depths of 1476 and 1540 feet. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet
Sand	15	15
Clay	96	111
Limestone	464	575
Shale	145	720
Limestone	326	1046
Sandstone	142	1188
Limestone	307	1495
Shale	40	1535
Limestone	115	1650
Sandstone	150	1800

Elevation of the ground surface at the well is about 623 feet above mean sea level.

This well is equipped with a Layne turbine pump with the bottom of the bowls at a depth of 400 feet. The water level was at a depth of 375 feet when pumping at a rate of 500 gallons per minute.

Water from this well had a total residue of 368, a total hardness of 81.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 70457, collected March 1, 1932. This well furnished all the water for the public supply except at the time of peak summer demand until 1937.

Analysis of Sample Number 70457 from Well 1800 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Chloride	NaCl	24.6	1.43
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	14.9	.87
Silica	SiO_2	14.0	Sodium Carbonate	Na_2CO_3	212.5	12.40
Calcium	Ca	23.7	Magnesium Carbonate	$MgCO_3$	19.0	1.11
Magnesium	Mg	5.5	Calcium Carbonate	$CaCO_3$	59.0	3.44
Ammonium	NH_4	0.0	Iron Oxide	Fe_2O_3	14.0	.82
Sodium	Na	106.7				
Sulfate	SO_4	10.3	Total		344.0	20.07
Nitrate	NO_3	0.0				
Chloride	Cl	15.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		8.0				
Methyl Orange		282.0				
Residue		368.0				
Total Hardness		81.5				

Since 1937 Lake Michigan water has been obtained from Hammond, Indiana.

LA SALLE (13,149) (p. 328). No reported change.

The diameter of the steel cylinder in two wells reported on page 329 as 7 feet 6 inches in diameter should be corrected to read 9 feet.

LAWRENCEVILLE (6303) (p. 340). The water supply for Lawrenceville is obtained from the well (number 1) described on page 342 and from a well (number 3) drilled about 1932 by J. A. Rue of the Central Illinois Public Service Company. In December, 1937 the yield of well number 1 was reported to be 150 gallons per minute instead of 700 gallons per minute as reported on page 342.

Well number 3 is located about 90 feet south and, 50 feet east of well number 1. It is 10 inches in diameter and 75 feet deep. The lower 10 feet of casing is perforated. Water is siphoned from this well into well number 1.

Well number 2 was constructed about 1927 by Thorpe Concrete Well Company of Alton. The well was 30 inches inside diameter and 60 feet deep. The concrete casing was 5 inches thick. A porous concrete screen 5 inches thick was installed in the well between depths of 10 feet and 50 feet. Well number 2 was located about 25 feet southeast of well number 1. The water level was 10 feet to 12 feet below the ground surface when not pumping and was drawn down to a depth of 15 feet to 18 feet when pumping. Well number 3 was originally siphoned into well number 2. The combined yield of the two wells was reported to be about 350,000 gallons per day. On November 15, 1937 the walls of well number 2 collapsed and the well has been abandoned.

The pumping equipment is as described on page 341.

LEAP RIVER (382) (p. 345). No reported change.

LEBANON (1828). Lebanon is located in the northeastern part of St. Clair County on the drainage area of Silver Creek, a tributary of Kaskaskia River. A public water supply was installed by the city in 1925. Private cisterns and shallow dug wells had been used extensively before that time.

Water for the public supply is obtained from two large diameter wells in the valley of Silver Creek about 1½ miles southwest of the business district. Both wells were constructed by the Thorpe Concrete Well Company of Alton and both have porous concrete screens.

The first well was completed in 1925. It is 46 feet deep, 16 inches inside diameter, and 22 inches outside diameter. The water level was lowered from a depth of 11 feet to a depth of about 29 feet when pumping at a rate of 175 gallons per minute. In 1934 the yield had dropped to about 90 gallons per minute. A new well was constructed about 20 feet west of the old well, and the latter is now used only in case of emergency.

Well number 2 is 47 feet deep, 24 inches inside diameter, and 34 inches outside diameter. The water level was lowered from 26 feet to 33½ feet when pumping at a rate of 150 gallons per minute.

The old well is equipped with a Keystone 2-stroke deep-well pump driven by a 15-horsepower electric motor. The new well is equipped with a Cook turbine pump driven by an electric motor.

A water treatment plant consisting of lime softening and filtration was built in 1929. The raw water from the old well had a total residue of 507, a total hardness of 368, and a content of iron of 4.0 parts per

million as shown by the analysis of sample number 66841, collected July 7, 1930. Water from the new well is similar in quality to that from the old well.

Analysis of Sample Number 66841 from Old Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	4.0	Sodium Nitrate.....$NaNO_3$	2.6	0.15
Manganese..Mn	0.6	Sodium Chloride.....NaCl	24.5	1.43
Turbidity.....	30.0	Sodium Sulfate.....Na_2SO_4	92.3	5.38
Silica.....SiO_2	19.0	Ammonium Carbonate..$(NH_4)_2CO_3$	0.5	0.03
Calcium.....Ca	105.7	Magnesium Carbonate..$MgCO_3$	89.0	5.19
Magnesium..Mg	25.5	Calcium Carbonate.....$CaCO_3$	264.3	15.43
Ammonium..NH_4	0.2	Silica.....SiO_2	19.0	1.11
Sodium.....Na	40.3	Iron Oxide.....Fe_2O_3	5.7	0.33
Sulfate.....SO_4	62.5	Manganese Oxide.....MnO	0.8	0.05
Nitrate.....NO_3	2.0			
Chloride.....Cl	15.0	Total.....	498.7	29.10
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	370.0			
Residue.....	507.0			
Total Hardness....	368.0			

LEE (269) (p. 346). No record of change.

The water had a total residue of 269, a total hardness of 143 and an iron content of 0.86 parts per million as shown by a partial mineral analysis of sample number 83760, collected on June 22, 1938.

LELAND (548) (p. 347). Leland secures water from two wells. Well number 1 drilled in 1915 is described on page 347. Well number 2 was drilled in 1922. It is located about 15 feet south and 10 feet west of well number 1. It is 220 feet deep and cased with 10-inch pipe to rock at a depth of 100 feet.

Water is pumped from the well by an A. Y. McDonald Manufacturing Company double-acting cylinder pump. The cylinder is 6 inches in diameter and set at a depth of 100 feet. The pump operates at a rate of 26 revolutions per minute with a 24-inch stroke. The rated discharge is about 150 gallons per minute.

In 1922 a single-acting McDonald Manufacturing Company cylinder set at a depth of 100 feet was substituted for the double-acting Goulds cylinder that was in the old well.

Static water level is about 20 feet below the ground surface in both wells.

Most of the water is supplied by well number 2.

There are about 120 metered services and 40 flat rate services. The rates are as follows:

50 cents per 1000 gallons for the first 4,000 gallons.
40 cents per 1000 gallons for the next 6,000 gallons.
35 cents per 1000 gallons for the next 5,000 gallons.
30 cents per 1000 gallons for the next 5,000 gallons.
25 cents per 1000 gallons for all over 20,000 gallons.

The minimum charge is $1.50 per quarter.

The average daily usage is about 50,000 gallons.

LEMONT (2582) (p. 348). The water supply from the stone quarry, as mentioned on page 348, served the village from October, 1924 until April 1, 1927. A year or two prior to the latter date a well was drilled on high ground in the south part of the city on the same lot on which is located the stand-pipe. This well was not successful and repairs were made to the well from which water had been obtained prior to October, 1924. This old well which had originally been drilled to a depth of 2000 feet was cleaned out to a depth of 1700 feet and equipped with an air-lift pump, the air-pipe outlet being set at a depth of 496 feet. Following the completion of the repairs, static water level was 175 feet below the ground surface and a production of 210 gallons per minute produced a draw down of 55 feet. It was also estimated that with a production of 320 gallons per minute the draw down was 84 feet.

Apparently this well has improved in the quality of the water produced since it was repaired. The analysis of a sample collected on October 26, 1927 (sample number 60572) shows a total residue of 911, a total hardness of 256, and an iron content of 0.4 parts per million. The analysis of sample number 82436 collected November 15, 1937 shows a total residue of 486, a total hardness of 261, and an iron content of 0.3 parts per million.

Analysis of Sample Number 82436 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.9	.05
(filtered)		0.0	Sodium Chloride	NaCl	112.3	6.55
(unfiltered)		0.3	Sodium Sulfate	Na_2SO_4	95.9	5.59
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	21.7	1.27
Silica	SiO_2	10.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.4	.14
Turbidity		0.0	Magnesium Carbonate	$MgCO_3$	72.1	4.20
Color		0.0	Calcium Carbonate	$CaCO_3$	175.6	10.24
Odor		0.0	Silica	SiO_2	10.0	.58
Calcium	Ca	70.2				
Magnesium	Mg	20.7	Total		490.9	28.62
Ammonium	NH_4	0.8				
Sodium	Na	85.0				
Sulfate	SO_4	64.6				
Nitrate	NO_3	0.9				
Chloride	Cl	68.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		284.0				
Residue		486.0				
Total Hardness		261.0				

LENA (1145) (p. 350). The well described on page 351 and known as well number 1 continued to furnish all the water for the municipality until 1931. The air-lift equipment was replaced in 1924 by a deep-well cylinder pump. At the time of a visit in March, 1937, it was found that this well and pump were seldom used except in case of an emergency.

Well number 2 was drilled in 1931 by C. W. Varner of Dubuque, Iowa. It is located in the area bounded by Freedom, Vernon, and South Railroad Streets. It is 998 feet deep and 12 inches in diameter at the

bottom. It is cased with 12-inch pipe to a depth of 106 feet. A record of material penetrated, with classifications by the State Geological Survey, is as follows:

	Thickness in feet.	Depth in feet.
Drift	20	20
Dolomite, Galena-Platteville	310	330
Dolomite, Glenwood	20	350
Sandstone, St. Peter	380	730
Dolomite, Trempealeau	40	770
Shale, sandstone, Mazomanie	100	870
Sandstone, Dresbach	128	998

When the well was new the water level was at a depth of 180 feet when not pumping and was lowered 35 feet when pumping at a rate of 330 gallons per minute. In 1937 the water level when not pumping was at a depth of 195 feet and was lowered to about 230 feet when pumped at a rate between 250 and 300 gallons per minute.

The well is equipped with a Pomona turbine pump with the top of the bowls set at a depth of 230 feet. The pump is driven by a 30-horsepower electric motor.

Water is pumped from the well into the concrete reservoir from which it is pumped to the distribution system and to the elevated steel tank. The service pump is an American centrifugal pump rated at 500 gallons per minute and driven by a 25-horsepower electric motor.

Water from well number 2 had a mineral content of 488, a total hardness of 467 and a content of iron of 0.0 parts per million as shown by the analysis of sample number 79691, collected March 11, 1937.

Analysis of Sample Number 79691 from 998-Foot Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe (unfiltered).....	0.0	Sodium Nitrate.....$NaNO_3$		1.7	0.10
Manganese..Mn	0.0	Sodium Chloride.....NaCl		4.1	0.24
Silica.....SiO_2	8.0	Magnesium Chloride....$MgCl_2$		22.4	1.31
Turbidity.....	0.0	Magnesium Sulfate.....$MgSO_4$		86.0	5.01
Calcium.....Ca	102.7	Magnesium Carbonate..$MgCO_3$		97.0	5.65
Magnesium..Mg	51.6	Calcium Carbonate.....$CaCO_3$		257.0	14.98
Sodium.....Na	2.1	Silica.....SiO_2		8.0	0.47
Sulfate.....SO_4	68.4				
Nitrate.....NO_3	1.1	Total.....		476.2	27.76
Chloride.....Cl	19.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	372.0				
Residue.....	488.0				
Total Hardness....	467.0				

LEONORE (173) (p. 352). No reported change.

LEROY (1,595) (p. 343). The wells and deep-well pumps at Leroy are as described on page 343. The deep-well pumps now discharge into a ground storage reservoir adjacent to the pumping station. Water is pumped from the reservoir to the distribution system by a 2-stage American Well Works size 3 centrifugal pump. All four pumps

are operated together. Power is furnished through a belt and shaft arrangement by a 40-horsepower Fairbanks-Morse diesel engine.

LEWISTOWN (2349) (p. 353). Lewistown secures water from two wells located in the bottom lands of Spoon River about 2½ miles southwest of the city. These wells are located near the old wells described on page 353. The old wells have been abandoned and the entire supply is furnished by the new wells.

One well was drilled in 1927 by the Thorpe Concrete Well Company of Alton. This well is equipped with 12 feet of porous concrete screen having a wall thickness of 5 inches and an inside diameter of 26 inches. The yield is about 500 gallons per minute.

The second well was drilled at a later date. It is 41½ feet deep, and 12 inches in diameter. A 14-foot length of 12-inch Johnson screen is installed in the well.

Water is pumped from the wells by either of two centrifugal pumps placed in a pit 10 or 12 feet below the ground surface. One pump is a 3-stage Fairbanks-Morse pump rated at 450 gallons per minute against a head of 260 feet. This pump is driven by a 75-horsepower Fairbanks-Morse electric motor. The other is a Worthington centrifugal pump rated at 250 gallons per minute against a head of 260 feet. This pump is driven by a 40-horsepower Fairbanks-Morse electric motor.

About 300,000 gallons of water are used per day. During periods of high river stage the water is chlorinated.

An analysis of sample number 82584 collected December 10, 1937 shows a total residue of 432, a total hardness of 365 and an iron content of 4.0 parts per million.

Analysis of Sample Number 82584 from the City Wells.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.2	Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		4.0	Sodium Chloride	NaCl	8.2	0.48
Manganese	Mn	0.2	Magnesium Chloride	$MgCl_2$	4.3	0.25
Silica	SiO_2	14.0	Magnesium Sulfate	$MgSO_4$	135.0	27.87
Turbidity		20.0	Magnesium Carbonate	$MgCO_3$	32.1	1.87
Color		0	Calcium Carbonate	$CaCO_3$	210.0	12.24
Odor		E1	Iron Oxide	Fe_2O_3	0.3	.02
Calcium	Ca	84.0	Manganese Oxide	MnO	0.3	.02
Magnesium	Mg	37.6	Silica	SiO_2	14.0	.82
Ammonium	NH_4	trace				
Sodium	Na	3.7	Total		405.9	23.67
Sulfate	SO_4	107.5				
Nitrate	NO_3	1.5				
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		248.0				
Residue		432.0				
Total Hardness		364.5				

LEXINGTON (1292) (p. 355). No reported change.

LIBERTYVILLE (3791) (p. 356). Some extensive improvements were completed at the water-works in 1928. These included the construction of a 500,000-gallon concrete reservoir at Cook Avenue and First Street, the installation of some new pumps, the extension of mains, and the drilling of a new well on the west side of Second Street midway between Cook and North Avenues. Since that time all of the wells at the old Cook Avenue Station have been abandoned. Water is now obtained from a well on Second Street and a well on Garfield Avenue.

The well on Second Street, drilled by Wm. Cater, is 250 feet deep and 16 inches in diameter. Original specifications called for a gravel-packed well with 24-inch and 16-inch casings and a 16-inch cater screen, but the well was finished in rock and it is thought that no screen was used in the drift above the rock.

In 1925 the static water level was estimated to be one foot above the top of the well. The water level was lowered to a depth of 129 feet by a pumping rate of 442 gallons per minute.

The well is equipped with an 8-stage, 10-inch Byron-Jackson deep-well turbine pump with 198 feet of 6-inch column pipe. The pump is rated at 350 gallons per minute at 220-foot head and is driven by a 40-horsepower electric motor. This pump is operated infrequently, the wafer being discharged into the reservoir at Cook and First Street a block away. When the water level in the reservoir is below the inlet pipe, water flows from the well to the reservoir under artesian pressure.

In 1926 a test well was drilled 200 feet southwest of Dawes Street and Crane Boulevard. It penetrated sand with streaks of clay and hardpan between depths of 76 and 111 feet and entered limestone at 162 feet. The total depth was 185 feet. The water contained an objectionable amount of hydrogen sulfide gas and some crude oil. Due to the undesirable quality of the water a permanent well was not constructed there.

About 1935 a new well was constructed in the southwestern part of the village by the Kelly Well Company of Grand Island, Nebraska. It is located on the east side of Garfield Avenue near Lincoln Avenue, and has a concrete casing and a 30-foot concrete screen. The well is 83 feet deep and penetrates 53 feet of clay and 30 feet of sand and gravel.

This well is equipped with a 6-stage, 10-inch Pomona turbine pump having 50 feet of 7-inch column pipe and 20 feet of 7-inch suction pipe. The pump is rated at 400 gallons per minute against a 188-foot head and is driven by a 30-horsepower electric motor. The pump discharges directly into the distribution system and is operated every day during the day time only.

During the night water is pumped from the reservoir to the distribution system by either of two De Laval centrifugal pumps. One is rated at 500 gallons per minute against a 180-foot head and is driven by a 30-horsepower electric motor; the other pump is rated at 1000 gallons per minute against a 150-foot head and is driven by a 60-horsepower electric motor or by a 50-horsepower gasoline engine. The larger pump is used only in case of emergency.

The temperature of the water from the Garfield Avenue well was 51½° F. The water had a total residue of 494, a total hardness of

351.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 83847, collected July 11, 1938.

Analysis of Sample Number 83847 from Garfield Avenue Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Chloride.....NaCl		6.4	0.37
(filtered).....	0.0	Sodium Sulfate.....Na_2SO_4		90.3	5.26
(unfiltered).....	0.4	Ammonium Sulfate.....$(NH_4)_2SO_4$		1.3	0.08
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$		199.0	11.60
Silica.....SiO_2	20.2	Magnesium Carbonate..$MgCO_3$		1.7	0.10
Turbidity.....	4.0	Calcium Carbonate.....$CaCO_3$		184.2	10.74
Color.....	0.0	Silica.....SiO_2		20.2	1.18
Odor.....	M1				
Calcium.....Ca	73.6	Total.....		503.1	29.33
Magnesium..Mg	40.8				
Ammonium..NH_4	0.3				
Sodium.....Na	31.7				
Sulfate.....SO_4	221.0				
Nitrate.....NO_3	trace				
Chloride.....Cl	4.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	186.0				
Residue.....	494.0				
Total Hardness....	351.5				

LINCOLN (12,855) (p. 359). A new infiltration well was constructed in 1932 in the bottoms of Salt Creek. It is of unique design.

A cylinder 12 feet in diameter was made by riveting together six sheets of boiler plate. At each of the splice points a wedge-shaped reinforced concrete column was constructed. The outside thickness next to the cylinder was about 24 inches, the depth about the same, and the inside thickness a little less than 24 inches. Near the inside face of these columns were anchored hoops of ½-inch metal spaced about ½-inch apart. The boiler plate was perforated with 2-inch round holes and the inside face was covered with ¼-inch galvanized wire screen.

This cylindrical screen was anchored on top of a reinforced concrete shoe. The space between the hoops and the galvanized wire screen was filled with graded gravel. The completed screen was 10 feet high.

Gravel was excavated from the inside of the screen with an orange peel bucket. As the screen settled a concrete cylinder was built up on top of it until the bottom of the screen was at a depth of 46 feet and the top of the easing was 3 feet above the ground surface.

Water-bearing gravel was found between depths of 6 and 46 feet. The screen rests upon solid rock. When the well was completed the water level was at a depth of 8 feet when not pumping and was lowered 5 or 6 feet when pumping at a rate of 870 gallons per minute.

The water had a total residue of 315, a total hardness of 292.5, and an iron content of 0.0 parts per million as shown by the analysis of sample number 84247, collected September 8, 1938.

Analysis of Sample Number 84247 from Well 46 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		4.2	0.24
(filtered).....	0.0	Sodium Chloride.....NaCl		1.7	0.10
(unfiltered).....	0.0	Magnesium Chloride....$MgCl_2$		8.1	0.47
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$		60.2	3.51
Silica.....SiO_2	9.0	Magnesium Carbonate..$MgCO_3$		56.1	3.27
Turbidity.....	5	Calcium Carbonate.....$CaCO_3$		167.6	9.77
Color.....	0	Silica.....SiO_2		9.0	0.52
Odor.....	0				
Calcium.....Ca	67.0	Total.....		306.9	17.88
Magnesium..Mg	30.4				
Ammonium..NH_4	trace				
Sodium.....Na	1.8				
Sulfate.....SO_4	47.8				
Nitrate.....NO_3	3.1				
Chloride.....Cl	7.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	234.0				
Residue.....	315.0				
Total Hardness....	292.5				

LINCOLNWOOD (473). The village of Lincolnwood was formerly known as Tessville. The change in name became effective in February, 1936.

The public water supply system was installed in 1926. Water is obtained from the city of Chicago.

LISLE. Lisle is an unincorporated community in the southern part of DuPage County on the Chicago, Burlington and Quincy Eailroad at DuPage River. It is about half-way between Downers Grove and Naperville.

The major part of the subdivided portion of the community was developed by the Arthur T. Mcintosh Company. They also installed a well and distribution system in portions of their subdivisions.

The water system is operated under the name of The Suburban Water Company.

The well, 12 inches in diameter, and 231 feet deep, was constructed in 1926. It was cased with genuine wrought-iron pipe from the ground surface to the top of the limestone at a depth of 44 feet, the hole being continued 12 inches in diameter to the bottom. The bottom of the hole is in a limestone which is separated from the upper limestone formation by a bed of shale. This shale is cased off by a 10-inch liner 43 feet 7 inches long set with its bottom at the bottom of the well and extending above the base of the top limestone. When completed static water level was 10 feet below the top of the well and upon test the well was pumped by direct suction at rates between 500 and 600 gallons per minute.

The well is equipped with a 12-inch American Well Works deep-well turbine rated at 400 gallons per minute and powered by a 10-horsepower electric motor operating at 1060 revolutions per minute. An American

Well Works centrifugal booster pump powered by a 25-horsepower electric motor takes water from the well pump and delivers it into the distribution system and elevated tank.

This system serves 220 metered service connections and the pump operates about two hours per day.

South of the railroad in the business area is a small well and distribution system owned by Mrs. J. L. Reedy. The well is 6 inches in diameter and 110 to 115 feet deep. It is equipped with a single acting Challenger deep-well cylinder pump, the cylinder of which is 3 inches in diameter and is set at 80 feet below the surface. The pump stroke is 18 inches long. This well pump is powered by a ½-horsepower Delco electric motor and operates all day. A small wooden elevated tank on a windmill tower provides pressure. The distribution system consists of about 2000 feet of 2-inch and 400 feet of 1-inch pipe and serves 15 customers.

In addition, the Lisle plant of the Pure Milk Association has a well reported to be 300 feet deep. It is equipped with a single stage Wesco centrifugal pump powered by a 5-horsepower electric motor. The pump operates on direct suction.

LITCHFIELD (6612) (p. 709). The raw water supply of the city of Litchfield is obtained from Shoal Creek and from an impounding reservoir on a small tributary of Shoal Creek. The water is treated before entering the distribution system.

LITTLE YORK (314) (p. 361). The 326-foot well described on page 361 furnishes most of the water for the public supply. A new well was drilled in 1933, but is pumped only once a week.

The new well is located about 10 feet north of the old well and is 142 feet deep. It has 6-inch casing to a depth of 135 feet, 4-inch casing from 135 to 138 feet, and 3-inch screen from 138 to 142 feet.

The new well is equipped with a Crocker-Wheeler deep-well pump with a 3¼-inch cylinder set at a depth of 90 feet. The length of stroke is 24 inches. The pump is driven by a 7-horsepower electric motor.

The water from the well 142-feet deep has a total residue of 532, a total hardness of 383 and an iron content of 2.8 parts per million as shown bv the analysis of sample number 83974, collected on July 28, 1938.

Analysis of Sample Number 83974 from Well 142-Feet Deep.

Determinations Made.		Hypothetical Combinations.			
	Pts. per million.			Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		23.8	1.39
(filtered).....	trace	Sodium Chloride.....NaCl		32.7	1.91
(unfiltered).....	2.8	Sodium Sulfate.....Na_2SO_4		1.4	0.08
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3		109.1	6.36
Silica.....SiO_2	12.5	Magnesium Carbonate..$MgCO_3$		122.7	7.15
Calcium.....Ca	95.0	Calcium Carbonate.....$CaCO_3$		238.0	13.88
Magnesium..Mg	35.4	Silica.....SiO_2		12.5	0.73
Ammonium..NH_4	trace				
Sodium.....Na	67.2	Total.....		540.2	31.50
Sulfate.....SO_4	0.8				
Nitrate.....NO_3	17.3				
Chloride.....Cl	20.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	486.0				
Residue.....	532.0				
Total Hardness....	383.0				

LOCKPOET (3383) (p. 362). The well described on page 363 has been abandoned and all water for the public supply is now obtained from a new well which was drilled for the city in 1927 by the J. P. Miller Artesian Well Company. It is located near the intersection of Ninth and Commerce Streets and has been reported to be 1475 feet deep. A record of material penetrated is similar to the log of the 1922-foot well as given on page 363. The elevation of the pump house floor is about 581 feet above mean sea level. The well is cased with 24-inch pipe to a depth of 9 feet, with 16-inch pipe from the surface to 365 feet, and with 10-inch pipe from 843 to 913½ feet. In 1928 the well was reported to be 1429 feet deep. These measurements are from the pump house floor.

In April, 1927 the static water level was 27¾ feet below the floor and it was found that polluted water was entering the well. An attempt was made to seal out this water by pouring marbles and sand around the outside of the 16-inch casing which is set in a 19-inch hole. There was some doubt as to the effectiveness of this seal. In May, 1928 the static level was at a depth of 205½ feet. It is thought that later a 12-inch pipe was set at a depth of 406 feet and extending up into the 16-inch pipe. The upper part of the well has been reported to be quite crooked. In 1935 the static level was at a depth of 207 feet and the draw down was 90 feet when pumping 375 gallons per minute.

The well was first equipped with a Keystone two-stroke deep-well pump with 7¾-inch cylinder and 18-inch stroke. This pump was replaced by a 16-stage, 12-inch Peerless turbine pump driven by a 60-horsepower electric motor. The pump was lowered 20 feet in 1935 and now consists of 320 feet of 8-inch column pipe, a bowl assembly 10 feet long, and 30 feet of 8-inch suction pipe. It discharges 330 gallons per minute to the distribution system to which is connected an elevated steel tank. Water may be pumped from this tank to the mains by a single-stage centrifugal pump rated at 1000 gallons per minute and driven by a .20-horsepower electric motor, or by a single-stage centrifugal

pump rated at 300 gallons per minute and driven by a 7½-horsepower electric motor. These two pumps are used only when high pressure in the mains is needed.

In 1938 there were 800 service connections in use and the average daily pumpage was about 250,000 gallons.

The temperature of the water was reported to be 53° F. The water had a mineral content of 668, a total hardness of 436, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 61785, collected May 14, 1928.

Analysis of Sample Number 61785 from Well 1475 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	0.5	.03
Manganese	Mn	0.0	Sodium Chloride	NaCl	107.2	6.27
Turbidity		5.0	Sodium Sulfate	Na_2SO_4	55.6	3.25
Silica	SiO_2	10.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.1	.07
Calcium	Ca	104.3	Magnesium Sulfate	$MgSO_4$	143.1	8.37
Magnesium	Mg	42.9	Magnesium Carbonate	$MgCO_3$	48.6	2.84
Ammonium	NH_4	0.3	Calcium Carbonate	$CaCO_3$	260.6	15.24
Sodium	Na	60.3	Silica	SiO_2	10.0	.58
Sulfate	SO_4	152.7	Iron Oxide	Fe_2O_3	0.6	.03
Nitrate	NO_3	0.4	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	65.0				
Alkalinity as $CaCO_3$			Total		627.3	36.68
Phenolphthalein		0.0				
Methyl Orange		318.0				
Residue		668.0				
Total Hardness		436.0				

LOMBARD (6197) (p. 364). A well, 2028 feet deep, was drilled in 1926 by the Gray Well Drilling Company. It is cased with 18-inch steel drive pipe to a depth of 67 feet, with 15-inch steel pipe from ground surface to 264 feet, 12-inch pipe from 245 to 500 feet, and 8-inch pipe from 500 to 1200 feet. At the bottom of the 8-inch pipe is a Larkin disk wall packer. From 1175 to 2000 feet the well bore is 10 inches. Below 2000 feet the bore is 8 inches.

A record of material penetrated, with the classification by F. T. Thwaites, Geologist of the University of Wisconsin, is as follows:

	Thickness in feet.	Depth in feet.
Drift	60	60
Niagaran, dolomite	115	175
Richmond, shale, dolomite	205	380
Galena-Black River, dolomite	350	730
St. Peter, sandstone	440	1170
Mazomanie, sandstone	80	1250
Dresbach, sandstone	125	1375
Eau Claire, shale, sandstone	415	1790
Mt. Simon, sandstone	238	2028

The water level was at a depth of 136 feet when not pumping and was lowered 52 feet when pumping at a rate of 95 gallons per minute.

The well is equipped with an American deep-well turbine pump which discharges into an American centrifugal booster pump. The rate of pumping varies from 525 to 580 gallons per minute.

Water from the well had a total residue of 451, a total hardness of 161.5, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 61710, collected April 30, 1928.

Analysis of Sample Number 61710 from Well 2028 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.6	Potassium Nitrate	KNO_3	0.6	.04
Manganese	Mn	0.0	Potassium Chloride	KCl	23.9	1.40
Turbidity		5.0	Sodium Chloride	NaCl	44.4	2.59
Silica	SiO_2	12.5	Sodium Sulfate	Na_2SO_4	55.8	3.27
Nonvolatile		0.7	Sodium Carbonate	Na_2CO_3	149.6	8.75
Alumina	Al_2O_3	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	.06
Calcium	Ca	43.9	Magnesium Carbonate	$MgCO_3$	43.2	2.53
Magnesium	Mg	12.6	Calcium Carbonate	$CaCO_3$	108.8	6.37
Ammonium	NH_4	0.4	Silica	SiO_2	12.5	.73
Potassium	K	12.9	Iron Oxide	Fe_2O_3	0.9	.05
Sodium	Na	101.3	Alumina	Al_2O_3	0.0	.00
Sulfate	SO_4	37.5	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.4	Nonvolatile		0.7	.04
Chloride	Cl	38.0				
Alkalinity as $CaCO_3$			Total		441.4	25.83
Phenolphthalein		0.0				
Methyl Orange		300.0				
Residue		451.0				

LONDON MILLS (432) (p. 709). The raw water supply of the village of London Mills is the same as the railroad supply and is obtained from Spoon River. The water is not used for domestic purposes.

LOEAINE (382). Loraine is located in the north central part of Adams County in Keene Township and on the watershed of Bear Creek, a tributary of Mississippi Kiver.

The public water supply is obtained from a well drilled in 1900 and thought to be 266 feet deep and 6 inches in diameter.

The well is equipped with a Stover deep-well cylinder pump with a 16-inch stroke. The cylinder has an inside diameter of 3¼ inches. It is attached to the bottom of 230 feet of drop pipe. Power is obtained from a single cylinder gas engine which is belt-connected to the pump.

The water is used only for fire protection, there being no private service connection. Fire pressure is furnished the five fire hydrants from a steel stand-pipe adjacent to the pumping station.

The water has a total residue of 713 parts per million and a hardness of 563.0 parts per million as is given in analysis number 81612 of a sample of water collected from the village well July 12, 1937.

Analysis of Sample Number 81612 from the Village Well 266 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	5.9	0.34
(unfiltered).....	4.0	Sodium Chloride.....NaCl	11.7	0.68
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	92.3	5.38
Silica.....SiO_2	10.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	1.3	0.08
Turbidity.....	25.0	Magnesium Sulfate.....$MgSO_4$	140.8	8.22
Odor.....	E1	Magnesium Carbonate..$MgCO_3$	74.2	4.34
Calcium.....Ca	143.1	Calcium Carbonate.....$CaCO_3$	358.0	20.88
Magnesium..Mg	49.3	Silica.....SiO_2	10.0	0.58
Ammonium..NH_4	0.4			
Sodium.....Na	36.1	Total.....	694.2	40.50
Sulfate.....SO_4	175.7			
Nitrate.....NO_3	4.2			
Chloride.....Cl	7.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	446.0			
Residue.....	713.0			
Total Hardness....	563.0			

LOSTANT (413) (p. 365). No reported change.

LOUISVILLE (803) (p. 709). The raw water supply for the village of Louisville is obtained from Little Wabash River. The water works was originally installed in 1899-1900 to supply water for fire protection and street sprinkling in the business area. A water treatment plant was completed late in 1937.

In January 1938 there were 120 service connections and the consumption varied from 15,000 to 20,000 gallons per day.

LOVINGTON (1121) (p. 367). Both 6-inch wells previously used have been abandoned since 1926. Another 8-inch well was drilled in 1926 by M. S. Burt and Son of Elwin. It is located about 20 feet west of the 129-foot well and is 131 feet deep. It is equipped with a 12-foot length of number 25-slot Cook screen.

Each 8-inch well was originally equipped with a Cook single-acting deep-well pump which discharged into the concrete reservoir. Later these pumps were replaced with Cook turbine pumps having ten 8-inch bowls, 80 feet of 5-inch column pipe, and 20 feet of 4-inch suction pipe. Each pump is driven by a 15-horsepower electric motor, and discharges into the elevated steel tank.

Water from the 129-foot well had a total residue of 517, a total hardness of 402.5 and a content of iron of 0.2 parts per million as shown by the analysis of sample number 82643, collected December 22, 1937.

Analysis of Sample Number 82643 from Well 129 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	30.6	1.79
(filtered)		0.0	Sodium Chloride	NaCl	6.4	0.37
(unfiltered)		0.2	Sodium Sulfate	Na_2SO_4	8.5	0.50
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	41.9	2.44
Silica	SiO_2	20.0	Magnesium Carbonate	$MgCO_3$	148.5	8.66
Turbidity		30.0	Calcium Carbonate	$CaCO_3$	226.0	13.20
Color		25.0	Silica	SiO_2	20.0	1.17
Odor		D1				
Calcium	Ca	90.5	Total		481.9	28.13
Magnesium	Mg	42.9				
Ammonium	NH_4	trace				
Sodium	Na	32.8				
Sulfate	SO_4	5.7				
Nitrate	NO_3	22.2				
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		442.0				
Residue		517.0				
Total Hardness		402.5				

LYONS (4787) (p. 368). In 1928 and at various other times water has been purchased from the city of Berwyn.

In 1929 a well, 2020 feet deep, was drilled near Collins and Joliet Avenues by Wm. Cater. It is 22 inches in diameter to a depth of 524 feet, 15 inches in diameter from 524 to 1300 feet, and 12 inches in diameter from 1300 to 2020 feet. A 9-foot length of 24-inch drive pipe and a 183-foot length of 18-inch liner set between depths of 341 and 524 feet is the only casing used in the construction of the well. A record of formations penetrated is as follows:

	Thickness in feet.	Depth in feet.
Niagaran	335	335
Maquoketa	165	500
Galena-Platteville	320	820
St. Peter	80	900
Prairie du Chien	380	1280
Mazomanie	75	1355
Dresbach	185	1540
Eau Claire	300	1840
Mt. Simon	180	2020

Elevation of the ground surface is about 618 feet above sea level.

The water level was at a depth of 298 feet when not pumping and was lowered 34 feet when pumping at a rate of 1090 gallons per minute.

The well was equipped with a 10-inch 3-stage Byron-Jackson turbine pump, set approximately 400 feet below the base plate and driven by a 150-horsepower Ideal electric motor. This pump became locked in 1936 and an investigation revealed that the oil tubing was badly corroded, two holes allowed water to reach the shaft and bearings. A new pump was purchased and installed.

The water had a total residue of 787, a total hardness of 264, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 67110, collected August 5, 1930.

Analysis of Sample Number 67110 from Well 2020 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	293.0	17.10
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	194.0	11.32
Turbidity		10.0	Sodium Carbonate	Na_2CO_3	38.7	2.26
Calcium	Ca	64.6	Ammonium Carbonate	$(NH_4)_2CO_3$	1.4	.08
Magnesium	Mg	24.9	Magnesium Carbonate	$MgCO_3$	86.5	5.05
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	161.5	9.43
Sodium	Na	195.0	Iron Oxide	Fe_2O_3	0.6	.04
Sulfate	SO_4	131.0	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.2	Silica	SiO_2	9.0	.53
Chloride	Cl	180.0				
Alkalinity as $CaCO_3$			Total		785.6	45.86
Phenolphthalein		0.0				
Methyl Orange		302.0				
Residue		787.0				
Total Hardness		264.0				

McHENRY (1354) (p. 369). The two wells described on page 370 are still in use, together with an 8-inch well, number 4, drilled about 1925 and located 15 feet east of the original well in the reservoir. The 6-inch well, or number 2, is located about 15 feet west of the original well. Well number 3 is a 6-inch well located about 35 feet southwest of the original well. It was drilled about 1925, but yielded very little water and was never used. Well number 4 was first equipped with a deep-well cylinder pump which was later removed. At present, water from wells 1, 2 and 4 flows into the reservoir and is then pumped to the distribution system by the centrifugal pump described on page 369. All of these wells are about 70 feet deep.

Well number 5 is located about 35 feet northwest of the original well. It was drilled in 1938 by Joseph H. Huemann and Sons of McHenry. A 6-inch test well was drilled here to rock at a depth of about 85 feet and was cased to that depth. It yielded about 250 gallons per minute when pumped. Then a 12-inch well was drilled at the same location. It was about 160 feet deep and cased to a depth of about 96 feet, but yielded only about 100 gallons per minute when pumped.

The partial analysis of sample number 83849, collected from the discharge of the service pump on July 12, 1938 shows the water to be similar to analysis of sample number 40039 given on page 370.

McLEAN (676). McLean is located in the southwestern part of McLean County on the drainage area of Sugar Creek, a branch of Sangamon River drainage system.

Water for the public supply, installed by the village in 1935, is obtained from a well drilled in 1934 by Chris Ebert of Washington. The well is located near the center of the village and is 353 feet deep. It is cased to a depth of 200 feet with 10-inch pipe and from ground surface to 353 feet with 8-inch pipe. At the bottom of the well is an 18-foot length of 8-inch Cook screen, the upper 10 feet being number 16-slot and the lower 8 feet being number 20-slot.

The water level was at a depth of 108 feet when not pumping and was lowered 138 feet by a pumping rate of 115 gallons per minute.

The well is equipped with a 20-stage, 7-inch Fairbanks-Morse-Price turbine pump having 220 feet of 5-inch column pipe and driven by a 15-horsepower electric motor.

In December of 1937 there were 131 service connections and the daily pumpage sometimes exceeded 8000 gallons.

The water had a total residue of 557, a total hardness of 278.5, and a content of iron of 2.0 parts per million as shown by the analysis of sample number 75111, collected October 8, 1934.

Analysis of Sample Number 75111 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	2.0	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	140.3	8.18
Silica	SiO_2	12.0	Sodium Carbonate	Na_2CO_3	88.6	5.16
Turbidity		20.0	Ammonium Carbonate	$(NH_4)_2CO_3$	17.3	1.00
Calcium	Ca	64.0	Magnesium Carbonate	$MgCO_3$	99.9	5.82
Magnesium	Mg	28.7	Calcium Carbonate	$CaCO_3$	160.2	9.34
Ammonium	NH_4	7.4	Iron Oxide	Fe_2O_3	2.8	0.16
Sodium	Na	93.8	Manganese Oxide	MnO	0.0	0.00
Sulfate	SO_4	0.0	Silica	SiO_2	12.0	0.70
Nitrate	NO_3	0.9				
Chloride	Cl	85.0	Total		522.0	30.41
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		380.0				
Residue		557.0				
Total Hardness		278.5				

McLEANSBORO (2162). The raw water supply of the city of McLeansboro is obtained from an impounding reservoir on a branch of Big Creek. The water is treated before entering the distribution system.

MACKINAW (760) (p. 371). The 5-inch well and the 4-inch well, described on page 372, have been abandoned. The old 8-inch well was deepened and recased in 1936 by E. W. Johnson of Bloomington. It is now 171 feet deep and is cased with 6-inch pipe and has a 6-inch screen.

The well is equipped with a 7-stage, 5-inch Sterling turbine pump, having 160 feet of 3-inch column pipe and 15 feet of 3-inch suction pipe, rated at 50 gallons per minute at 260-foot head, and driven by a 7½-horsepower electric motor.

A new 8-inch well was drilled by E. W. Johnson in 1935 at a point 10 feet southeast of the old 8-inch well. It is 178 feet deep, and there is installed in the bottom a 15-foot length of Cook screen thought to have slots 1/16-inch wide. This well yielded only about 100 gallons per minute in 1938 although it had originally produced more than 200 gallons per minute.

It is equipped with a 13-stage, 7-inch Sterling turbine pump, having 150 feet of 4-inch column pipe and 17 feet of 4-inch suction pipe, rated at 250 gallons per minute against a 160-foot head, and driven by a 15-horsepower electric motor.

The quality of the water is similar to that shown on page 372.

MACOMB (8509) (p. 373). A change from well water supply to surface water supply was made in 1911 but the wells were held in reserve for several years. The surface water supply was first obtained from Crooked Creek at a point about a mile north of the city where a low channel dam, filter plant and pumping station were constructeed.

In 1927 a new reservoir was developed in Spring Creek about four miles northwest of the city.

MACON (800). Macon is located in the southern part of Macon County on the drainage area of Sangamon River, a tributary of Illinois River.

Water for the public supply, installed by the city in 1935, is obtained from a well located in the northern part of the city, drilled in 1935 by the W. L. Thorne Company of Des Plaines. It is a gravel-packed well, 131 feet 9 inches deep, equipped with a 20-foot length of Armco iron screen having ¼ by 1½-inch slots spaced ⅜ inch apart. The diameter of the inner casing is 12 inches. The outer casing is 26 inches in diameter and extends to a depth of 122 feet. All depth measurements were made from the top of the inner casing which is approximately 3 feet above ground surface.

The water level was at a depth of 62 feet and was lowered more than 59 but less than 64 feet by a pumping rate of 195 gallons per minute.

The well is equipped with a 7-stage, 10-inch Pomona deep-well turbine pump with 120 feet of column pipe. Water is pumped to an elevated steel tank connected to the distribution system. In 1937 a contract was awarded for the construction of a water softening and iron removal plant.

The water had a total residue of 693, a total hardness of 506.5, and a content of iron of 4.0 parts per million as shown by the analysis of sample number 75112, collected October 9, 1934 from test well number 3, 134 feet deep located at the site of the permanent well. An appreciable amount of methane gas is produced by the well. After one minor explosion had occurred the gas was vented by a small pipe extending from the well casing to the top of the pump house.

Analysis of Sample Number 75112 from Test Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	4.0	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	32.7	1.91
Silica	SiO_2	15.0	Sodium Carbonate	Na_2CO_3	127.1	7.43
Turbidity		30.0	Ammonium Carbonate	$(NH_4)_2CO_3$	68.6	4.00
Calcium	Ca	123.0	Magnesium Carbonate	$MgCO_3$	166.0	9.68
Magnesium	Mg	47.9	Calcium Carbonate	$CaCO_3$	307.8	17.93
Ammonium	NH_4	25.8	Iron Oxide	Fe_2O_3	0.0	0.00
Sodium	Na	68.3	Manganese Oxide	MnO	0.0	0.00
Sulfate	SO_4	0.0	Silica	SiO_2	15.0	0.87
Nitrate	NO_3	0.9				
Chloride	Cl	20.0	Total		718.1	41.87
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		696.0				
Residue		693.0				
Total Hardness		506.5				

MADISON (7661) (p. 709). Madison is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

MALTA (383) (p. 374). The public water supply at Malta is obtained from the same well reported on page 374. The well is now equipped with a 6-inch Fairbanks-Morse 10-stage deep-well turbine pump having 200 feet of 4-inch column pipe and 20 feet of suction pipe on bottom of the bowls. The pump is powered by a 15-horsepower Fairbanks-Morse electric motor.

MANHATTAN (628) (p. 375). The well described on page 375 is now equipped with a size 6 Deming turbine pump rated at 80 gallons per minute against a head of 194 feet. The pump is driven by a 7½-horsepower IT. S. electric motor. The pump and a 50,000-gallon elevated tank were installed in 1937.

MANITO (711). Manito is located in the northern part of Mason County about 6 miles east of Illinois River. The entire village is underlain by sand deposits. Most of the residences obtain water from well points driven into this sand. A public water supply was installed in 1937.

Water for the public supply is obtained from an 81-foot well located about one block north of the business district. The well was drilled in 1937 by Chris Ebert of Washington, Illinois. It has a 20-foot length of 10-inch Johnson brass screen, the top 4 feet and the bottom 9 feet of which is number 25 slot, and the remaining 7 feet is number 12 slot.

The water level was at a depth of 33½ feet when not pumping and was lowered 7 feet by a pumping rate of 255 gallons per minute.

The well is equipped with a 7-stage, 6-inch Fairbanks-Morse deep-well turbine pump having 30 feet of 5-inch column pipe and driven by a 7½-horsepower electric motor.

The temperature of the water was 57° F. The water had a mineral content of 302, a total hardness of 249, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 81632, collected July 16, 1937.

Analysis of Sample Number 81632 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	10.2	0.59
(unfiltered).....	0.0	Magnesium Nitrate.....$Mg(NO_3)_2$	2.2	0.13
Manganese..Mn	0.0	Magnesium Chloride....$MgCl_2$	5.2	0.30
Silica.....SiO_2	10.0	Magnesium Sulfate.....$MgSO_4$	89.0	5.19
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	8.9	9.52
Calcium.....Ca	63.0	Calcium Carbonate.....$CaCO_3$	157.5	9.18
Magnesium..Mg	22.3	Silica.....SiO_2	10.0	0.58
Sodium.....Na	2.8			
Sulfate.....SO_4	71.0	Total.....	283.0	16.49
Nitrate.....NO_3	9.3			
Chloride.....Cl	4.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	168.0			
Residue.....	302.0			
Total Hardness....	249.0			

A pressure type zeolite softener was installed as part of the original equipment. About one-fourth to one-third of the water is by-passed. A 60,000-gallon elevated tank is connected to the distribution system.

MANLIUS (299). Manlius is located in the northwestern part of Bureau County on the drainage area of Hickory Creek, a tributary of Green River. Many private wells are in use. Some are shallow dug wells and others are drilled wells from 175 to 200 feet deep. The Chicago and Northwestern Eailway has a well 265 feet deep located about one-quarter mile north of the village well.

Water for the public supply, installed in 1926-1927, is obtained from a well 225 feet deep, drilled near the center of the village in 1926 by A. J. Pierson. It was cased to a depth of 210 feet below which 15 feet of. 6-inch Cook screen was set. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Sandy loam	4	4
Yellow clay	10	14
Blue clay	161	175
Water-bearing sand	50	225

Surface elevation is slightly more than 700 feet above sea level.

The well is equipped with a two-stroke Cook pump with 5¾-inch diameter cylinder and 18-inch stroke, driven by a 10-horsepower electric motor. Water level in the well was reported to stand at a depth of 98 feet when not pumping. The well is reported to have yielded 100 gallons per minute for several hours. An elevated tank of 30,000-gallon capacity is located on the same lot as the pumping station and is connected to the mains.

The Chicago and Northwestern Eailway Company is the largest single customer. About 28 service connections were in use in 1928 and about 7000 gallons were pumped daily. In 1938 there were 63 service connections, all of which were metered. A minimum rate of $2.00 for three months allows the use of 5000 gallons of water. Additional water is sold at a rate of 30 cents per 1000 gallons. Rates are not subject to discount.

The water had a total residue of 416, a total hardness of 367, and a content of iron of 8.0 parts per million as shown by the analysis of sample number 62346, collected August 7, 1928.

Analysis of Sample Number 62346 from the City Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	8.0	Potassium Nitrate	KNO_3	1.0	.06
Manganese	Mn	0.3	Potassium Chloride	KCl	4.8	.28
Silica	SiO_2	24.5	Sodium Chloride	NaCl	1.2	.07
Turbidity		30.0	Sodium Carbonate	Na_2CO_3	49.0	2.87
Nonvolatile		1.6	Ammonium Carbonate	$(NH_4)_2CO_3$	6.5	.38
Alumina	Al_2O_3	0.0	Magnesium Carbonate	$MgCO_3$	126.5	7.40
Calcium	Ca	85.8	Calcium Carbonate	$CaCO_3$	210.4	12.30
Magnesium	Mg	37.1	Silica	SiO_2	24.5	1.43
Ammonium	NH_4	2.5	Iron Oxide	Fe_2O_3	11.4	.66
Potassium	K	3.0	Alumina	Al_2O_3	0.0	.00
Sodium	Na	22.2	Manganese Oxide	MnO	0.4	.02
Sulfate	SO_4	0.0	Nonvolatile		1.6	.09
Nitrate	NO_3	0.6				
Chloride	Cl	3.0	Total		437.3	25.56
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		406.0				
Residue		416.0				
Hardness		367.0				

MANTENO (1149) (p. 376). Well number 4 was deepened in 1926 by the Ohio Drilling Company. It is now 1292 feet deep and 8 inches in diameter at the bottom. It is cased to a depth of 625 feet.

In 1933 the water level was reported to be at a depth of 175 feet when not pumping and was lowered 125 feet by pumping at a rate of 125 gallons per minute for five minutes.

The well is equipped with a Pomona deep-well turbine pump with the top of the bowls set at a depth of 300 feet.

This well now furnishes most of the water for the public supply.

The water had a total residue of 838, a total hardness of 601, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 56833, collected June 26, 1926.

Analysis of Sample Number 56833 from Well 1292 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	17.2	1.01
Manganese	Mn	0.0	Sodium Nitrate	$NaNO_3$	10.2	.60
Silica	SiO_2	13.3	Sodium Chloride	NaCl	80.3	4.70
Nonvolatile		0.5	Sodium Sulfate	Na_2SO_4	13.8	.81
Alumina	Al_2O_3	0.8	Ammonium Sulfate	$(NH_4)_2SO_4$	0.2	.01
Calcium	Ca	120.3	Magnesium Sulfate	$MgSO_4$	307.7	18.00
Magnesium	Mg	73.2	Magnesium Carbonate	$MgCO_3$	34.5	2.02
Ammonium	NH_4	.05	Calcium Carbonate	$CaCO_3$	296.2	17.32
Potassium	K	6.8	Silica	SiO_2	13.3	.78
Sodium	Na	39.4	Iron Oxide	Fe_2O_3	0.1	.01
Sulfate	NO_4	251.6	Alumina	Al_2O_3	0.8	.05
Nitrate	NO_3	17.7	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	48.0	Nonvolatile		0.5	.03
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0	Total		774.8	45.34
Methyl Orange		332.0				
Residue		838.0				
Hardness		601.0				

The State Hospital at Manteno secures water from three wells of the following depths: 155 feet, 227 feet and 1760 feet. The wells produce 205, 268 and 500 gallons per minute respectively.

MAPLE PARK (389) (p. 378). No reported change.

MARENGO (1948) (p. 379). The well 20 feet in diameter by 15 feet deep reported on page 379 is still in regular service. A second well having a diameter of 25 feet and a depth of 21 feet was constructed in 1925. It is connected to the older well by a 4-inch pipe near the bottom.

The pumping equipment now consists of three American Well Works centrifugal pumps. One pump rated at 150 gallons per minute against a pressure of 85 pounds takes suction from the older or south well and delivers the water directly into the distribution system. It is direct connected to a 15-horsepower electric motor operating at a full load speed of 1750 revolutions per minute.

Both of the other pumps are rated at 450 gallons per minute against a pressure of 85 pounds and take suction from the north or newer well. One of these is direct connected to a 40-horsepower electric motor operating at a full load speed of 1750 revolutions per minute, while the other is powered by a 50-horsepower gas engine which operates at a full load speed of 1300 revolutions per minute. It is held in reserve as an emergency or stand-by unit.

At the Borden-Wieland Milk Company plant (formerly the Borden Milk Company) the double-acting cylinder pump has been replaced by an 8-inch American Well Works deep-well turbine pump rated at 250 gallons per minute against a head of 235 feet when operating at 1750 revolutions per minute. Water is discharged by the pump into an 8000-gallon steel pressure tank. Automatic control maintains a pressure of between 55 and 60 pounds. The daily demand is estimated at 60,000 gallons.

The water has a total residue of 409, a total hardness of 373.5, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 83546, collected May 19, 1938.

Analysis of Sample Number 83546 from Well 796 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	.9	.05
(filtered)		0.6	Sodium Chloride	NaCl	18.1	1.05
(unfiltered)		1.0	Sodium Sulfate	Na_2SO_4	0.7	.04
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	6.9	.40
Silica	SiO_2	19.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.9	.17
Turbidity		10.0	Magnesium Carbonate	$MgCO_3$	157.5	9.18
Color		0.0	Calcium Carbonate	$CaCO_3$	187.0	10.90
Odor		0.0	Iron Oxide	Fe_2O_3	.1	.01
Calcium	Ca	74.5	Silica	SiO_2	19.0	1.11
Magnesium	Mg	45.5				
Ammonium	NH_4	1.0	Total		393.1	22.91
Sodium	Na	10.6				
Sulfate	SO_4	0.4				
Nitrate	NO_3	0.9				
Chloride	Cl	11.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		4.0				
Methyl Orange		383.0				
Residue		409.0				
Total Hardness		373.5				

MAEION (9033) (p. 381 and 709). The raw water supply of the city of Marion is obtained from an impounding reservoir on Branch of Crab Orchard Creek. The water is treated before entering the distribution system.

MAEISSA (1630). Marissa is located in the southeastern part of St. Clair County on the drainage area of Kaskaskia River, a tributary of Mississippi River. Shallow dug wells are in general use throughout the village. The yield of these wells is limited although usually sufficient for private use. Several oil test wells have been drilled in the vicinity, but these indicated salt water at depths of 250 feet or more.

In 1935-1936 an attempt was made to locate a satisfactory source of ground water for a public supply. Three test wells were drilled near the village. None of these yielded enough water to justify the construction of a permanent well.

Local residents were of the opinion that fresh water had been obtained from an oil test well on the Dunn farm about 2 miles south of the village. A test well was drilled at this location to a depth of 371 feet. The water was very salty and the well and plans for a ground water supply were abandoned.

The water had a total residue of 5850, a total hardness of 81.5, and a content of iron of 175 parts per million as shown by the analysis of sample number 78533, collected August 3, 1936.

Analysis of Sample Number 78533 from a Test Well 371 Feet Deep on the Dunn Farm.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.2	Sodium Nitrate	$NaNO_3$	3.4	0.20
(unfiltered)		175.0	Sodium Chloride	NaCl	5,044.0	294.20
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	15.6	0.91
Silica	SiO_2	10.0	Sodium Carbonate	Na_2CO_3	675.0	39.35
Turbidity over		10,000.0	Ammonium Carbonate	$(NH_4)_2CO_3$	7.2	0.42
Color		0.0	Magnesium Carbonate	$MgCO_3$	26.9	1.57
Odor		BS	Calcium Carbonate	$CaCO_3$	49.5	2.89
Calcium	Ca	19.8	Ferric Oxide	Fe_2O_3	0.3	0.02
Magnesium	Mg	7.9	Silica	SiO_2	10.0	0.58
Ammonium	NH_4	2.7				
Sodium	Na	2,278.0	Total		5,831.9	340.14
Sulfate	SO_4	10.1				
Nitrate	NO_3	2.6				
Chloride	Cl	3,058.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		20.0				
Methyl Orange		726.0				
Residue		5,850.0				
Total Hardness		81.5				

In 1937 a surface water supply was developed on Mud Creek north of the village. The water is treated before entering the distribution system.

MARK (472) (p. 382). Water for the public supply is still purchased from the village of Granville.

MARKHAM (349). This village began the installation of a water-pipe distribution system in 1926. Lake Michigan water is obtained from the city of Chicago through the city of Harvey.

MAEOA (1154) (p. 382). Maroa secures water from two wells located at the pumping station. Well number 1, drilled in 1892, is located in the north end of the pumping station. It was recased with 6-inch casing in 1917. All of the other wells described on pages 383 and 384 have been abandoned and filled.

Well number 2, drilled in January, 1931, is located 85 feet south of well number 1. It is a 24 by 12-inch gravel-packed well. The 24-inch casing extends to a depth of 60 feet and a 20-inch casing extends from 60 feet to 76 feet. The inner casing is 12 inches in diameter and extends to a depth of 76 feet. A 5-foot length of Continental well screen extends below the 12-inch casing. A packer 2 feet long is installed in the bottom of the well and only 3 feet of the screen is exposed to the aquifer. The water level stood at 33 feet when not pumping and was lowered to 69 feet when pumping at a rate of 250 gallons per minute.

Water is pumped from well number 1 by a 3-stage, size 6, Fairbanks-Morse deep-well turbine pump rated at 75 gallons per minute. The top of the bowls are 70 feet below the ground surface. The pump is driven by a 5-horsepower Fairbanks-Morse electric motor.

Well number 2 is equipped with a 12-stage, size 7, 150 gallons per minute, Fairbanks-Morse deep-well turbine pump driven by a 15-horsepower electric motor. The top of the pump bowls are 70 feet below the ground surface. This pump discharges directly into the distribution system.

The pump discharge from well number 1 is connected to the suction of a 2-inch, 200-gallon per minute Fairbanks-Morse centrifugal pump driven by a 10-horsepower electric motor. This pump, however, is throttled to deliver only 75 gallons per minute.

The ground storage reservoir under the pumping station has been abandoned.

There were 235 service connections in April, 1938 and the average daily use was about 15,000 gallons per day. The city is planning to install a water softening and iron removal plant during 1938.

Gas analyses of samples number 83715 and 83716, taken from wells number 1 and 2 respectively on June 22, 1938, indicate 2.8 cubic feet of free methane per 1000 gallons of water from well number 1 and 0.1 cubic feet per 1000 gallons of water from well number 2.

MARSEILLES (4292) (p. 384). W. L. Thorne Company drilled a well 850 feet deep for Marseilles in 1931. It is located 100 feet north of the Chicago, Eock Island and Pacific Eailroad tracks and 1½ blocks west of Bridge Street. The well was drilled 16 inches in diameter to a depth of 365 feet and 12 inches in diameter to the bottom. It is cased to a depth of 365 feet with 12-inch casing. At the time the well was finished the static water level was about 12.8 feet above the ground surface and was lowered to 24.4 feet below the ground surface when pumping at a rate of 386 gallons per minute.

A blue-print log prepared by the State Geological Survey shows the materials penetrated as follows:

	Thickness in feet.	Depth in feet.
Cpalmeasures	67	67
Glenwood, dolomite	3	70
St. Peter sandstone	240	310
Shakopee, dolomite	50	360
New Richmond, sandstone and dolomite	85	445
Oneota, dolomite	210	655
Jordan, sandstone and dolomite	35	690
Trempealeau, dolomite	160	850

The well is equipped with an air lift pump. The 6-inch eductor pipe extends to a depth of 90 feet, the lower 60 inches of which is perforated with 120 holes each 3/16 inch in diameter. This perforated section is enclosed in a cylindrical drum made of a piece of 10-inch pipe 60 inches long which serves as a foot piece. The 1½-inch air pipe is welded into the 10-inch drum.

An analysis of sample number 68969, collected April 10, 1931, shows a total residue of 469, a total hardness of 319, and an iron content of 0.2 parts per million.

Analysis of Sample Number 68969 from the City Well 850 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.2	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	92.4	5.39
Silica	SiO_2	11.0	Sodium Sulfate	Na_2SO_4	53.2	3.11
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Calcium	Ca	71.0	Magnesium Sulfate	$MgSO_4$	28.3	1.65
Magnesium	Mg	34.5	Magnesium Carbonate	$MgCO_3$	100.0	5.83
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	177.5	10.35
Sodium	Na	54.1	Iron Oxide	Fe_2O_3	0.3	.02
Sulfate	SO_4	60.0	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.2	Silica	SiO_2	11.0	.64
Chloride	Cl	56.0				
Alkalinity as $CaCO_3$			Total		466.4	27.21
Phenolphthalein		0.0				
Methyl Orange		296.0				
Residue		469.0				
Total Hardness		319.0				

MARSHALL (2368) (p. 386). The 6-foot wells described on page 387 are used exclusively at Marshall, but the depth was reported to be between 30 and 35 feet on June 13, 1938. The capacity of these wells has been increased by drilling a 6-inch well in the center of each well and by jacking out radially 8 perforated pipes from the east well and 6 perforated pipes from the west well. Some of the Tadial pipes extend 15 or 20 feet beyond the circumference of the original well.

The pumping equipment consists of two identical 7½-inch by 10-inch Worthington triplex pumps each driven by a 40-horsepower General Electric motor. The pumps deliver about 300 gallons per minute to the distribution system.

There are about 650 services and the daily usage is about 180,000 gallons.

The water had a total residue of 347, a total hardness of 259.4 and a content of iron of 0.01 parts per million as shown by the partial analysis of sample number 83709, collected June 13, 1938.

MARTINSVILLE (1206). Martinsville is located in the western part of Clark County on the drainage area of the North Pork of Embarrass River, a tributary of Wabash River. A public water supply was installed by the city in 1923. Water is secured from wells in a stream valley in the southwestern part of the city.

Well number 1 was a dug well 17 feet in diameter lined with concrete. Depth of the well is not known. It was equipped with a centrifugal pump driven by an electric motor.

Well number 2 Avas an 8-inch well drilled by Mr. Leatherman of Martinsville and located about 30 feet south of the dug well.

Well number 3 was drilled by Mr. Leatherman. It is an 8-inch well located about 75 feet southwest of the dug well. In 1927 it furnished most of the water used. It was equipped with a Chippewa two-stroke deep-well pump.

Water from well number 3 had a total residue of 528, a total hardness of 269 and a content of iron of 2.0 parts per million as shown by the analysis of sample number 60000, collected August 30, 1927.

Analysis of Sample Number 60000 from City Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	2.0	Potassium Nitrate	KNO_3	3.6	0.21
Manganese	Mn	0.0	Potassium Chloride	KCl	4.5	0.27
Silica	SiO_2	14.1	Sodium Chloride	NaCl	86.2	5.04
Nonvolatile		1.3	Sodium Sulfate	Na_2SO_4	13.4	0.78
Alumina	Al_2O_3	2.0	Sodium Carbonate	Na_2CO_3	86.5	5.06
Calcium	Ca	61.9	Ammonium Carbonate	$(NH_4)_2CO_3$	13.0	0.76
Magnesium	Mg	27.8	Magnesium Carbonate	$MgCO_3$	96.3	5.63
Ammonium	NH_4	4.9	Calcium Carbonate	$CaCO_3$	154.6	9.04
Potassium	K	3.8	Silica	SiO_2	14.1	0.82
Sodium	Na	75.7	Iron Oxide	Fe_2O_3	2.3	0.13
Sulfate	SO_4	9.1	Alumina	Al_2O_3	2.0	0.12
Nitrate	NO_3	2.2	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	54.5	Nonvolatile		1.3	0.08
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		477.8	27.94
Methyl Orange		364.0				
Residue		528.0				
Hardness		269.0				

MASCOUTAH (2311) (p. 388). In 1935 a filter plant was constructed by the city on the bank of Silver Creek about 2½ miles west of the city. Since that time water for the public supply has been obtained from Silver Creek.

MASON CITY (1941) (p. 390). The two wells described on page 391 have been abandoned; however, the north well, constructed in 1889, still has a pump in it. The south well, constructed in 1916, has been filled.

The public water supply is now obtained from two newer wells.

A well drilled in 1924, located 30 feet south of the well constructed in 1889, is 12 inches in diameter by 195½ feet deep. Information on length and slot size of the screen is not available.

The well is equipped with a Cook steam-head single-acting deep-well cylinder pump. The cylinder has an inside diameter of 11 inches and a 36-inch stroke. The cylinder which is 60 inches long is attached to 90 feet of discharge pipe. There is about 5 feet of suction pipe on the bottom of the cylinder. This unit is rated at 15 gallons per stroke.

A well drilled in 1928, located about 20 feet northeast of the well drilled in 1888, is reported to be 12 inches in diameter by 222 feet deep with 12 feet of Cook 12-inch screen in the bottom and 12-inch casing above.

The well is equipped with a Cook steam-head single-acting deep-well cylinder pump. The cylinder has an inside diameter of 11 inches and a 36-inch stroke. The cylinder which is 60 inches long is attached to 90 feet of discharge pipe. There is 31 feet of suction pipe attached

to the bottom of the cylinder. This unit is also rated at 15 gallons per stroke.

The water from the 222-foot well has a total residue of 290, a total hardness of 267, and a content of iron of 0.06 parts per million as shown by the analysis of sample number 83959, collected July 28, 1938. The water from the 195½-foot well is similar.

Analysis of Sample Number 83959 from 222-Foot City Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	5.1	0.30
(filtered)		0.0	Sodium Carbonate	Na_2CO_3	20.1	1.17
(unfiltered)		.06	Magnesium Carbonate	$MgCO_3$	92.0	5.36
Manganese	Mn	.034	Calcium Carbonate	$CaCO_3$	158.0	9.21
Silica	SiO_2	20.0	Manganese Oxide	MnO	trace	
Turbidity		8.0	Silica	SiO_2	20.0	1.17
Color		0.0				
Odor		0.0	Total		295.2	17.21
Calcium	Ca	63.2				
Magnesium	Mg	26.5				
Ammonium	NH_4	trace				
Sodium	Na	10.1				
Sulfate	SO_4	0.0				
Nitrate	NO_3	3.8				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		286.0				
Residue		290.0				
Total Hardness		267.0				

MATTESON (736) (p. 392). No reported change in either source of supply or pumping equipment. The pump operates about 3 hours a day with a displacement of about 200 gallons per minute. There are about 100 service connections all of which are metered.

MATTOON (14,631) (p. 393). In 1929 an intensive search for deposits of water-bearing sand and gravel was conducted by the Central Illinois Public Service Company. A large number of test wells were drilled in the vicinity of Mattoon. These showed the most promising deposit of sand and gravel to be near Dorans. Two permanent wells about 1000 feet apart were constructed near the Illinois Central tracks about four miles north of Mattoon. Both are 42 feet deep and of similar construction. They consist of four 4-foot sections of concrete screen with a steel plate on the top and bottom of the 16-foot cylinder thus formed. To the top plate a 12-inch pipe is welded.

Each well was equipped with a Pomona deep-well turbine pump which discharged about 240 gallons per minute. The bottom of the pump bowls was set within 10 inches of the bottom of the well. Average daily pumpage was 320,000 gallons.

The yield of these wells gradually decreased until in 1937 neither well yielded as much as 65 gallons per minute unless pumped under vacuum. In that year two new wells were constructed near the wells

installed in 1928. The construction was similar to that of the old wells. It is reported that the yield was not as high as the original yield of the old wells.

The wells and distribution system were purchased by the city in 1936 and a new softening plant was built in the southeastern part of the city. The well water is treated before being pumped into the distribution system.

Water for industrial purposes is still obtained from an impounding reservoir. In case of emergency, it can be completely treated and pumped into the domestic system.

Water from the south well had a total residue of 417, a total hardness of 351 and a content of iron of 3.5 parts per million as shown by the analysis of sample number 68281, collected December 31, 1930.

Analysis of Sample Number 68281 from Well 42 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		1.7	0.10
(filtered).....	0.0	Sodium Chloride.....NaCl		1.8	0.10
(unfiltered).....	3.5	Sodium Carbonate.....Na_2CO_3		14.3	0.83
Manganese..Mn	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$		20.7	1.21
Silica.....SiO_2	24.0	Magnesium Carbonate $MgCO_3$		113.6	6.62
Turbidity.....	30.0	Calcium Carbonate.....$CaCO_3$		216.4	12.62
Calcium.....Ca	86.6	Iron Oxide.....Fe_2O_3		5.0	0.29
Magnesium..Mg	32.8	Manganese Oxide.....MnO		0.0	0.00
Ammonium..NH_4	7.7	Silica.....SiO_2		24.0	1.40
Sodium.....Na	7.4				
Sulfate.....SO_4	0.0	Total.....		397.5	23.17
Nitrate.....NO_3	1.4				
Chloride.....Cl	1.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	386.0				
Residue.....	417.0				
Total Hardness....	351.0				

MAYWOOD (25,829) (p. 396). Well number 6, completed by S. B. Geiger in 1924, mention of which was made on page 399, located at 9th Avenue and the Chicago and Great Western Eailroad, was finished at a depth of 2090 feet. The well was drilled 22 inches in diameter from the surface to 556 feet, 17 inches between 556 feet and 580 feet, 15 inches between 580 feet to 1065 feet and 12 inches from 1065 feet to the bottom. The casing installed consisted of 80 feet of 22-inch outside diameter drive-pipe at the top, and 555¼ feet of 18-inch outside diameter Genuine Wrought Iron casing from the top down.

The log of the well as reported by the State Geological Survey Division is as follows:

	Thickness in feet.	Depth in feet.
Surface material	45	45
Broken lime	20	65
Lime	295	360
Shale, black	180	540
Lime	343	883
St. Peter sandstone	102	985
Limestone	10	995
Shale	35	1030
Limestone	235	1265
Sand, shale	15	1280
Green sand	20	1300
Broken limestone	60	1360
Shaly limestone	30	1390
Potsdam sandstone	160	1550
Limestone	10	1560
Shale, blue	90	1650
Red rock	35	1685
Shale, blue	55	1740
Limestone	35	1775
Green shale	5	1780
Limestone	35	1815
Sandstone	20	1835
Limestone	10	1845
Hard sandstone	75	1920
Shale, blue	10	1930
Sand, hard	40	1970
Sand, soft, white	100	2070
Sand, soft, red	20	2090

The bottom of the well was shot and casing was placed at the bottom, the lower 164 feet of which was perforated. A yield of 1000 gallons per minute was obtained but it was expected that 1500 gallons would be obtained upon completion of the entire improvement.

Well number 1 was abandoned about the time well number 4 was completed and well number 2 was abandoned about 1923.

Water levels at the St. Charles Street pumping station receded steadily from a depth of 80 feet in 1907 to 228 feet in 1919, and to 303 feet in 1931.

In 1927 it was reported that the capacities available from the four wells then in service were:

	Gallons per minute
Well number 3	250
Well number 4	1000
Well number 5	1200
Well number 6	1500

A deep well turbine of 1000 gallons per minute capacity was to be installed in well number 4 with a setting of 360 feet. The pump in well number 5 was as reported on page 399. An 8-stage deep-well turbine with a setting of 330 feet had been installed in well number 6, the depth to water in April of that year being 259½ feet. The temperature of the water from well number 5 was 60° F. and from well number 6 it was 63.5° F.

Water from well number 4 had a total residue of 684, a total hardness of 323, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 62779, collected October 11, 1928.

The water from well number 5 had a total residue of 822, a total hardness of 441, and a content of iron of 0.8 parts per million as shown by analysis of sample number 62780, collected October 11, 1928. Water from well number 6 had a total residue of 983, a total hardness of 350, and a content of iron of 0.2 parts per million as shown by analysis of sample number 62781, collected October 11, 1928.

Analysis of Sample Number 62781 from Village Well No. 6, 2090 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.2	Potassium Nitrate.....KNO_3	0.3	.02
Manganese..Mn	0.0	Potassium Chloride.....KCl	33.8	1.98
Turbidity.....	0.0	Sodium Chloride.....NaCl	428.3	25.04
Silica.....SiO_2	9.4	Sodium Sulfate.....Na_2SO_4	53.3	3.12
Alumina.....Al_2O_3	2.8	Ammonium Sulfate.....$(NH_4)_2SO_4$	1.9	.11
Calcium.....Ca	96.3	Magnesium Sulfate.....$MgSO_4$	102.9	6.02
Magnesium..Mg	26.7	Magnesium Carbonate..$MgCO_3$	21.8	1.28
Ammonium..NH_4	0.5	Calcium Carbonate.....$CaCO_3$	244.2	14.28
Potassium...K	17.6	Silica.....SiO_2	9.4	.55
Sodium.....Na	183.0	Iron Oxide.....Fe_2O_3	0.3	.02
Sulfate.....SO_4	121.4	Alumina.....Al_2O_3	2.8	.16
Nitrate.....NO_3	0.2	Manganese Oxide.....MnO	0.0	.00
Chloride.....Cl	280.0			
Alkalinity as $CaCO_3$		Total.....	899.0	52.58
Phenolphthalein..				
Methyl Orange...	274.0			
Residue.....	983.0			
Total Hardness....	350.0			

During 1931 S. B. Geiger undertook the repair of well number 3. A charge of 1000 pounds of dynamite in a metal container 60 feet long was exploded between depths of 1490 feet and 1550 feet and a second shot of 250 pounds was used to shake down the loose material. This well was about 1600 feet deep, hence the bottom of the 1000-pound charge was within 50 to 55 feet of the bottom.

The repair program included the placing of 528 feet of 12-inch casing cemented in place for its entire length and the reaming of the balance of the hole to 10 inches. Upon completion of the work static water level was found to be 303 feet below the surface. It was reported that upon test a production of 1200 gallons per minute was obtained with a 35-foot draw down.

During 1937 reconditioning of wells 5 and 6 were undertaken and a water-softening plant was started.

MELEOSE PAKE (10,741) (p. 400). Well number 2 was equipped with a 7-stage American Well Works deep-well turbine pump in 1925. The bottom of the bowls is at a depth of 201 feet, below this is 40 feet of suction pipe. In 1927 it was reported that the well yielded 713 gallons per minute but there were times when the pump drew air.

During this same year well number 1 was discontinued and a new well placed under construction by William Cater at the northeast corner of 24th Avenue and Division Street. In September, 1927 the column pipe of the turbine pump in well number 2 was lengthened to 256 feet.

This plus the 14 feet of pump and 40 feet of suction pipe on the bottom gave an over-all depth to the bottom of the suction pipe of 310 feet. The average pumpage after the pump was reset was from 650,000 to 700,000 gallons per day. The temperature of the water was 52°F. indicating that a considerable part of the production was obtained from the upper portion of the well. Static water level was reported as 174 feet.

Well number 3 was completed in the early part of 1928 to a depth of 2117 feet. An analysis of the water indicated a NaCl content of 1256 parts per million and a temperature of 62°F. The well was equipped with a Byron-Jackson deep-well turbine pump consisting of 360 feet of column, 15 stages (15 feet) of pump, and. 30 feet of suction pipe. The pump was rated at 1000 gallons per minute when discharging to waste at the ground surface. Static water level was reported as 152.5 feet and when pumping at a rate of 1062 gallons per minute a draw down of 109.5 feet took place. Because of the high salt content the contractor was directed to plug the well. This was done by placing 180 feet of concrete in the bottom. The analysis of a sample of water collected in April, 1929 showed only 25 parts per million of NaCl.

During 1936 well number 1 was repaired and deepened to a final depth of 1965 feet. It was equipped with a Cook 13-stage deep-well turbine. Static water level was 157 feet below the surface.

MELVIN (499) (p. 402). Well number 1, located at a site on the east side of Center Street a little north of the railroad, was drilled in 1908 to a depth of 242 feet. It is still maintained as a stand-by unit, but is used mainly for the watering of stock.

Well number 2, drilled in 1913 at a location on the west side of Center Street about opposite well number 1, has been abandoned.

Well number 3 was drilled in 1923 by E. W. Johnson of Bloomington, Illinois at a site about 10 feet south of well number 2. The original depth was 259 feet and the well was cased with 8-inch pipe to a depth of 243 feet, below which 15 feet 11 inches of a 19-foot length of Cook screen with number 12 slots was exposed to the water-bearing sand. The casing and screen were removed from well number 2. About 1928 Mr. Johnson repaired the well and installed a 6-inch diameter screen 30 feet long in place of the 8-inch screen. It appears that the well was deepened some at this time.

In 1935 John Bolliger and Sons of Fairbury made additional repairs to the well. The 6-inch screen was removed and sent back to the makers, Edward E. Johnson, Inc. at St. Paul, Minnesota, for cleaning and repairs. When reinstated the bottom of the screen was set at a depth of 265 feet and the bottom of the casing at a depth of 240 feet, thus exposing 25 feet to the water-bearing material and permitting 5 feet to project into the larger portion of the casing.

The well is equipped with a Pomona, 6-inch deep-well turbine pump consisting of 220 feet of column pipe, and 31 stages of bowls having an over-all length of 11 feet. The pump is direct connected to a Westinghouse 10-horsepower electric motor and is rated at 60 gallons per minute when operating at a speed of 1750 revolutions per minute.

Static level was reported in 1938 to be 156 feet below the surface. The pump is operated about 6 hours per day in winter and 9 hours in summer. There are 175 service connections all of which are metered.

MENDOTA (4008) (p. 403). The air lift in the well located on the north side of the pumping station at Mendota was replaced by an American deep-well turbine pump about 1929. The pump has a rated capacity of 500 gallons per minute.

The service pumps are two electric motor driven American centrifugal pumps each rated at 500 gallons per minute and one 2-stage American centrifugal pump rated at 750 gallons per minute and driven by a 30-horsepower Buda gasoline engine.

There has been no change in the source of supply.

METAMORA (707) (p. 408). The well in the public park is no longer used as a source of water for the public supply. Since 1926 all water has been obtained from a well located behind the high school building in the northern part of the village. The well was drilled in 1926 by Chris Ebert of Washington and is 122 feet deep, by 8 inches in diameter. The well was cased with 106 feet of 8-inch casing, below which is a 16-foot length of 8-inch Cook screen.

The new well was first equipped with the Meyers pump described on page 408, but in 1936 a new pump was installed. It is a 5-stage, 6-inch Fairbanks-Morse turbine pump having 110 feet of 3½-inch column pipe. It discharges about 40 gallons per minute and is driven by a 5-horsepower electric motor.

In 1938 there were 70 service connections in use and the daily pumpage was nearly 30,000 gallons. A few of the services are metered and are charged 40 cents per 1000 gallons. The others are charged a flat rate of 75 cents monthly.

Water from the 122-foot well had a total residue of 542.0, a total hardness of 448.0, and a content of iron of 8.0 parts per million as shown by the analysis of sample number 83854, collected July 22, 1938. The water contains a large amount of methane. Accumulation of this gas in the pump house has resulted in more than one serious explosion.

Analysis of Sample Number 83854 from Well 122 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	3.4	0.20
(filtered)		0.0	Sodium Chloride	NaCl	1.8	0.10
(unfiltered)		8.0	Sodium Carbonate	Na_2CO_3	69.0	4.02
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	37.4	2.18
Silica	SiO_2	25.0	Magnesium Carbonate	$MgCO_3$	175.4	10.22
Turbidity		65.0	Calcium Carbonate	$CaCO_3$	240.1	14.00
Color		0.0	Silica	SiO_2	25.0	1.46
Odor		Csl				
Calcium	Ca	95.9	Total		552.1	32.18
Magnesium	Mg	50.6				
Ammonium	NH_4	14.0				
Sodium	Na	31.5				
Sulfate	SO_4	0.0				
Nitrate	NO_3	2.3				
Chloride	Cl	1.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		552.0				
Residue		542.0				
Total Hardness		448.0				

METROPOLIS (5573) (p. 409). The well drilled in 1906 was erroneously reported on page 410 as 125 feet deep. This well is 160 feet deep. The well is now equipped with a Worthington deep-well turbine pump set at a depth of 100 feet and rated at 500 gallons per minute. The pump is driven by a 25-horsepower electric motor. The static and pumping water levels were reported on November 30, 1937 to be about 11 feet and 25 feet below the ground surface respectively.

In 1924, Fred M. Luth of St. Louis drilled a well 14 inches in diameter and 300 feet deep. It is located 50 feet east of the old well. The well penetrated drift to a depth of 229 feet, then about 4 feet of shelly rock, then coarse gravel to a depth of 290 feet. Prom 290 feet to 396 feet the hole was in a hard limestone formation. The well was cased with 12½-inch casing to a depth of 290 feet and finished 10 inches in diameter. Since no water was obtained in the limestone the driller ripped six or eight slots in the casing between depths of 229 feet and 290 feet. Water stood 11 feet below the ground surface when the well was completed. A 10-inch casing and a 4-inch air-line were installed in the well and the engineers estimated a yield of 1000 gallons per minute. This well is used to supply the peak demand.

Air is supplied at a pressure of 40 pounds per square inch by a Worthington 13-inch by 14-inch compressor driven by a 75-horsepower electric motor. Both wells discharge into a covered concrete reservoir with a capacity of 140,000 gallons. Water is supplied to the distribution system by two 700-gallon per minute Worthington centrifugal pumps each driven by a 50-horsepower Westinghouse electric motor.

MIDLOTHIAN (1775). Prior to 1936 the village was supplied with water from a well 810 feet deep owned by the Arthur T. Mcintosh Company. In 1938 a change was reported in the quality of the water

which made it unpleasant to use. Arrangements were then made to obtain Lake Michigan water from the city of Chicago through the city of Blue Island.

MILAN (888) (p. 410). A new weU was drilled in 1937. It is 320 feet deep and is located 55 feet east of the old 1157-foot well. It is cased with 10-inch pipe from ground surface to a depth of 10 feet and with 8-inch pipe from ground surface to a depth of 140 feet. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Top soil, quicksand	7	7
Limestone, shale bands	120	127
Shale, very cavey	7	134
Limestone, solid	50	184
Limestone, porous	2	186
Limestone	9	195
Shale, loose cobblestones	5	200
Limestone, shale banks	113	313
Shale, cavey	7	320

The porous limestone at 184 feet is reported to be the source of the water. The shale at 127 feet is said to have yielded more than 25 gallons per minute, but the water had a strong sulfur odor.

The water level was at a depth of 14 feet when not pumping and was lowered 76 feet by a pumping rate of 180 gallons per minute.

The well is equipped with an 8-inch American turbine pump rated at 150 gallons per minute against a lead of 172 feet and driven by a 10-horsepower electric motor. The pump is set at a depth of 100 feet and has 10 feet of suction pipe.

The water had a total residue of 1045, a total hardness of 227, and an iron content of 0.3 parts per million as shown by the analysis of sample number 83363, collected on April 19, 1938.

Analysis of Sample Number 83363 from Village Well 320 Feet Deep.

Determinations Made.

	Pts. per million.
Iron.....Fe	
(filtered).....	0.06
(unfiltered).....	0.3
Manganese..Mn	0.0
Silica.....SiO_2	20.0
Turbidity.....	4.0
Color.....	0.0
Odor.....	0.0
Calcium.....Ca	54.5
Magnesium..Mg	23.6
Ammonium..NH_4	0.0
Sodium.....Na	279.0
Sulfate.....SO_4	313.0
Nitrate.....NO_3	2.6
Chloride.....Cl	172.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	10.0
Methyl Orange...	264.0
Residue.....	1,045.0
Total Hardness....	227.0

Hypothetical Combinations.

	Pts. per million.	Grs. per gallon.
Sodium Nitrate.....$NaNO_3$	3.4	0.20
Sodium Chloride.....NaCl	283.0	16.50
Sodium Sulfate.....Na_2SO_4	463.0	27.00
Sodium Carbonate.....Na_2CO_3	39.2	2.28
Magnesium Carbonate..$MgCO_3$	80.5	4.70
Calcium Carbonate.....$CaCO_3$	131.5	7.68
Iron Oxide.....Fe_2O_3	0.1	0.01
Silica.....SiO_2	20.0	0.12
Total.....	1,020.7	58.49

MILFORD (1442) (p. 412). The two wells described on page 413 have been abandoned and the pump pit has been made over into a ground storage reservoir. Two additional wells, constructed about 1925 or shortly thereafter, have also been abandoned.

The public water supply is now obtained from a well drilled by the Layne-Western Company in 1931 or 1932. It is located on the Water Works lot and is of the gravel-packed type 70 feet deep. The outer casing was 36 inches in diameter. The well is equipped with a Layne deep-well turbine pump rated at 65 gallons per minute. The pump is driven by a General Electric Company, 5-horsepower electric motor.

Water from the well is discharged into the surface reservoir, which formerly served as a pump pit, and from the reservoir into the distribution system by either an American single-stage centrifugal pump rated at 65 gallons per minute or by the Goulds triplex pump that originally was installed in the pump pit. Both pumps are electric motor driven.

There are 450 service connections and the average daily demand is about 50,000 gallons.

MILLEDGEVILLE (807) (p. 414). In 1936 the Cook two-stroke pump in the east well pumped air and the cylinder was lowered 50 feet to a depth of 300 feet. This pump is operated about 18 hours daily. The pump in the west well operates about three hours daily.

The water from the east well has a total residue of 338, a total hardness of 300, and a content of iron of 0.64 parts per million as shown by the partial analysis of sample number 83698, collected June 7, 1938.

The Kraft Cheese Company plant has two wells. The older well is 8 inches in diameter by 200 feet deep and was drilled in 1925. The first 25 feet was through soil and the balance in limestone. In 1929 the well was equipped with a 6-inch Layne-Bowler deep-well turbine pump with a setting of 90 feet and a reported discharge of 300 gallons per minute, when operated at a speed of 1750 revolutions per minute.

The newer well was drilled in 1931 to a depth of 400 feet. According to a log furnished by the State Geological Survey the well penetrated the following materials:

	Thickness in feet.	Depth in feet.
Pleistocene—		
soil clays, sandy clays	15	15
Galena—		
dolomite	170	185
Decorah—		
dolomite	5	190
Platteville—		
dolomite	115	305
Glenwood—		
shale, dolomite	20	325
St. Peter-		
sandstone	75	400

MILLSTADT (1014). Millstadt is located in the west central part of St. Clair County on the drainage areas of Prairie du Pont Creek

and Kaskaskia River, tributaries of Mississippi River. A public water supply was installed in 1932.

Water is obtained from a well near the business district. It is 8 inches in diameter and 610 feet deep. Because it was drilled many years ago no exact record of casing or formations penetrated is available. The water level is reported to be at a depth of 173 feet when not pumping. In October of 1934 the pumping rate was 51 gallons per minute.

The well is equipped with a Sterling turbine pump consisting of 300 feet of 4-inch column, 17 stages of 7-inch turbine having an overall length of 7-feet 1 inch, and 30 feet of 3½-inch suction pipe. It is driven by a 15-horsepower electric motor. Water from the well is delivered into a concrete storage reservoir and from there it is pumped to an elevated tank and to the distribution system by a Goulds centrifugal pump rated at 250 gallons per minute.

The water had a total residue of 348, a total hardness of 302.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 75171, collected October 15, 1934.

Analysis of Sample Number 75171 from Well 610 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	1.7	0.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	11.7	0.68
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	17.7	1.03
Turbidity		5.0	Sodium Carbonate	Na_2CO_3	17.5	1.02
Calcium	Ca	75.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.9	0.17
Magnesium	Mg	28.0	Magnesium Carbonate	$MgCO_3$	97.0	5.65
Ammonium	NH_4	10.3	Calcium Carbonate	$CaCO_3$	187.6	10.94
Sodium	Na	21.6	Iron Oxide	Fe_2O_3	0.6	0.03
Sulfate	SO_4	18.5	Silica	SiO_2	10.0	0.58
Nitrate	NO_3	1.4				
Chloride	Cl	7.0	Total		346.7	20.20
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		322.0				
Residue		348.0				
Total Hardness		302.5				

MINIER (726) (p. 415). One of the two wells described on page 415 has been abandoned. The other was deepened in 1929 and is now 193 feet deep. It is cased to a depth of 160 feet with 8-inch pipe, followed by a length of 7-inch pipe and a 16-foot length of number 20-slot Johnson screen.

This well is equipped with a 5-stage, 6-inch Pomona turbine pump having 120 feet of 4½-inch column pipe and 10 feet of 3½-inch suction pipe. The pump is rated at 130 gallons per minute at 220-foot head and is driven by a 15-horsepower electric motor.

A new well was drilled in 1928 about 20 feet from the old well. It is 193 feet deep, cased to 179 feet with 8-inch pipe, and equipped with a 14-foot length of number 30-slot Cook screen.

This well is equipped with a 14-stage, 7-inch Fairbanks-Morse, Price turbine pump having 120 feet of 5-inch column pipe and fitted

with a combination motor and belt head. The pump is usually driven by a 15-horsepower vertical electric motor.

The quality of the water is similar to that reported on page 416.

MINONK (1910) (p. 416). Minonk obtains water from the two wells described on page 417.

In 1938 a size 8 S. C. American Well Works turbine pump rated at 130 gallons per minute against a head of 340 feet was installed in well number 1 which is 1850 feet deep. The pump assembly consists of 340 feet of 5-inch column pipe, 13 bowls measuring 7 feet 9½ inches over-all, and 20 feet of 5-inch suction pipe. The pump is driven by a 15-horsepower U. S. electric motor. The static water level was reported to be about 218 feet below the ground surface.

In 1937 well number 2, which is 2005 feet deep, was equipped with a size 8 S. C. American Well Works turbine pump rated at 100 gallons per minute against a head of 355 feet. The pump assembly consists of 350 feet of 5-inch column pipe, 14 bowls measuring 8 feet 3½ inches over-all and 20 feet of 5-inch suction pipe. The pump is driven by a 15-horsepower U. S. electric motor. The static water level is about 218 feet below the ground surface.

The well pumps discharge into a ground storage reservoir which has a capacity of 150,000 gallons. The water is pumped from the ground storage reservoir into the distribution system and the 96,000-gallon elevated tank by either of two Ameican Well Works 2-stage, size 2 centrifugal pumps.

There are 580 service connections. The average daily usage is between 105,000 and 120,000 gallons. Water is sold at a rate of ½ cent per cubic foot. The minimum rate is $1.50 per quarter.

The water from well number 1 had a total residue of 2211, a total hardness of 35, and an iron content of 0.3 parts per million as shown by the analysis of sample number 66476, collected on May 13, 1930. The water from well number 2 had a total residue of 1609, a total hardness of 260, and an iron content of 0.3 parts per million as shown by the analysis of sample number 66477, collected on May 13, 1930.

Analysis of Sample Number 66476 from Well 1850 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.3	Sodium Nitrate	$NaNO_3$	.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	1,615.0	94.20
Turbidity		5	Sodium Sulfate	Na_2SO_4	153.8	8.97
Silica	SiO_2	12.0	Sodium Carbonate	Na_2CO_3	271.0	15.80
Calcium	Ca	10.1	Ammonium Carbonate	$(NH_4)_2CO_3$	8.0	.47
Magnesium	Mg	2.3	Magnesium Carbonate	$MgCO_3$	1.9	.11
Ammonium	NH_4	.8	Calcium Carbonate	$CaCO_3$	25.0	1.46
Sodium	Na	803.0	Silica	SiO_2	12.0	.70
Sulfate	SO_4	104.1	Iron Oxide	Fe_2O_3	.4	.02
Nitrate	NO_3	.9	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	981.0				
Alkalinity as $CaCO_3$			Total		2,088.0	121.78
Phenolphthalein		0.0				
Methyl Orange		292.0				
Residue		2,211.0				
Total Hardness		35.0				

Analysis of Sample Number 66477 from Well 2005 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.3	Sodium Nitrate	$NaNO_3$	.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	977.5	57.10
Turbidity		5.0	Sodium Sulfate	Na_2SO_4	319.5	18.67
Silica	SiO_2	14.0	Sodium Carbonate	Na_2CO_3	12.19	.71
Calcium	Ca	60.5	Ammonium Carbonate	$(NH_4)_2CO_3$	4.3	.25
Magnesium	Mg	26.4	Magnesium Carbonate	$MgCO_3$	91.8	5.36
Ammonium	NH_4	1.5	Calcium Carbonate	$CaCO_3$	151.1	8.82
Sodium	Na	495.0	Silica	SiO_2	14.0	.82
Sulfate	SO_4	216.4	Iron Oxide	Fe_2O_3	.4	.02
Nitrate	NO_3	.9	Manganese Oxide	MnO	.0	.00
Chloride	Cl	593.0				
Alkalinity as $CaCO_3$			Total		1,571.69	91.80
Phenolphthalein		0.0				
Methyl Orange		276.0				
Residue		1,609.0				
Total Hardness		260.0				

MINOOKA (346) (p. 419). The static water level in the 620-foot well has continued to recede. On May 3, 1938 the static water level was reported to be 92 feet below the ground surface. The draw down was 19 feet when pumping at a rate of 70 gallons per minute. The cylinder is now set 151 feet below the ground level and 20 feet of suction pipe is attached to the cylinder.

The old 2100-foot flowing well is flowing at an estimated rate of 4 gallons per minute.

MOKENA (562) (p. 421). No reported change.

MOLINE (32,236) (p. 709). The raw water supply of the city of Moline is obtained from Mississippi River. The water is treated before entering the distribution system.

MOMENCE (2236) (p. 423). W. L. Thorne Company of Des Plaines drilled two wells for Momence in 1936. The first well was about 200 feet deep and is located about 10 feet north and 8 feet west of the northeast corner of the pumping station. The yield was 150 gallons per minute and the well was never equipped.

The second well was drilled at a point 50 feet east of Pine Street and 50 feet north of Kankakee River. It is 125 feet deep and produced 600 gallons per minute. The well is equipped with a Pomona turbine driven by a 30-horsepower motor. Since this well is located at the opposite end of the distribution system from the elevated tank the pumping cost is high and it is not generally used.

There are 500 services. The average daily use is about 75,800 gallons.

Two dairies secure from 125 to 150 gallons per minute from wells about 55 feet deep.

MONEE (383) (p. 424). No reported change in source of supply or pumping equipment. The water had a total residue of 902, a total

hardness of 658.5, and an iron content of 0.1 parts per million as shown by the analysis of sample number 83842, collected July 13, 1938.

Analysis of Sample Number 83842 from Village Well.

Determinations Made.		Pts. per million.
Iron	Fe	
(filtered)		0.0
(unfiltered)		0.1
Manganese	Mn	0.14
Silica	SiO_2	13.0
Turbidity		10.0
Color		0.0
Odor		0.0
Calcium	Ca	178.7
Magnesium	Mg	51.5
Ammonium	NH_4	trace
Sodium	Na	39.8
Sulfate	SO_4	362.2
Nitrate	NO_3	4.8
Chloride	Cl	0.0
Alkalinity as $CaCO_3$		
Phenolphthalein		0.0
Methyl Orange		364.0
Residue		902.0
Total Hardness		658.5

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate	$NaNO_3$	6.8	0.40
Sodium Sulfate	Na_2SO_4	117.2	6.83
Magnesium Sulfate	$MgSO_4$	255.0	14.87
Calcium Sulfate	$CaSO_4$	112.1	6.53
Calcium Carbonate	$CaCO_3$	364.0	21.22
Iron Oxide	Fe_2O_3	0.1	0.01
Manganese Oxide	MnO	0.2	0.01
Silica	SiO_2	13.0	0.76
Total		868.4	50.63

MONMOUTH (8666) (p. 426). The well being drilled in 1925 by S. B. Geiger was completed in 1926. It is located 25 feet east of the well completed in 1925. Both wells are located near the intersection of A Street and Fifth Avenue. The old wells have been abandoned.

A record of material penetrated by the east well, with classifications by the State Geological Survey Division is as follows:

	Thickness in feet.	Depth in feet.
Drift	95	95
Coal, shale, Pottsville	15	110
Limestone, Burlington	80	190
Shale, Hannibal, Sweetland Creek	285	475
Limestone, Cedar Valley, Wapsipinicon	95	570
Limestone, Niagaran	40	610
Shale, limestone, Maquoketa	170	780
Limestone, Galena-Platteville	320	1100
Sandstone, shale, St. Peter	175	1275
Limestone, Ordovician and Cambrian	1020	2295
Sandstone, Mazomanie-Franconia	35	2330
Sandstone, Dresbach	115	2445

The elevation at the top of the well is 768.63 feet above sea level.

The east well is cased with 24-inch pipe to a depth of 85 feet, with 19-inch pipe from the surface to a depth of 485 feet, with 14-inch pipe from 443½ to 1044 feet, and with 10-inch pipe from 1225 to 1285 feet.

It is equipped with a 6-stage American deep-well turbine pump having 228 feet of 10-inch column pipe and 20 feet of 10-inch suction pipe.

The west well is equipped with a 6-stage American deep-well turbine pump having 232 feet of 10-inch column pipe and 20 feet of 10-inch suction pipe.

Each pump is driven by an electric motor and delivers about 850 gallons per minute.

In 1932 the water level in either well was at a depth of 201 feet when not pumping and was lowered 20 feet by the above pumping rate.

The water from the west well had a total residue of 1007, a total hardness of 271, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 57730, collected November 18, 1926.

Analysis of Sample Number 57730 from Well 2425 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Potassium Nitrate	KNO_3	2.0	0.12
Manganese	Mn	0.0	Potassium Chloride	KCl	38.3	2.24
Silica	SiO_2	17.7	Sodium Chloride	NaCl	154.4	9.03
Nonvolatile		1.1	Sodium Sulfate	Na_2SO_4	533.5	31.20
Alumina	Al_2O_3	0.5	Ammonium Sulfate	$(NH_4)_2SO_4$	2.6	0.15
Calcium	Ca	60.5	Magnesium Sulfate	$MgSO_4$	31.8	1.86
Magnesium	Mg	29.3	Magnesium Carbonate	$MgCO_3$	77.4	4.53
Ammonium	NH_4	0.7	Calcium Carbonate	$CaCO_3$	148.5	8.68
Sodium	Na	237.6	Silica	SiO_2	17.7	1.03
Potassium	K	21.2	Iron Oxide	Fe_2O_3	0.3	0.02
Sulfate	SO_4	381.9	Alumina	Al_2O_3	0.5	0.03
Nitrate	NO_3	1.2	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	110.0	Nonvolatile		1.1	0.06
Alkalinity as $CaCO_3$			Total		1,008.1	58.95
Phenolphthalein						
Methyl Orange		236.0				
Residue		1,007.0				
Hardness		271.0				

MONSANTO (304). Water is supplied to Monsanto by the East St. Louis and Interurban Water Company of East St. Louis.

MONTGOMERY (546). Montgomery is located in the southeastern part of Kane County near the southern limits of Aurora and on the west bank of Pox River, a tributary of Illinois River.

Water for the public supply, installed by the village in 1928, is obtained from a well, 175 feet deep, drilled in 1927 by B. L. Palmer and Sons of Aurora. The well is cased with 10-inch pipe from the ground surface to a depth of 34 feet, and with 8-inch pipe from the surface to a depth of 85 feet. Below this depth the diameter of the well is 8 inches. Between depths of 40 and 45 feet the casing is perforated. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	32	32
Limestone	28	60
Shale	115	175

The water level was at a depth of 24 feet when not pumping and was lowered 10 feet by a pumping rate of 100 gallons per minute.

The well is equipped with an American double-acting deep-well pump with a 4¾-inch diameter cylinder and 24-inch stroke. A 50,000-

gallon elevated steel tank located close to the well is connected to the mains.

The water had a total residue of 620, a total hardness of 333, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 64120, collected May 29, 1929.

Analysis of Sample Number 64120 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	28.0	1.64
Turbidity		5.0	Sodium Sulfate	Na_2SO_4	244.5	14.30
Silica	SiO_2	10.0	Sodium Carbonate	Na_2CO_3	17.0	.99
Calcium	Ca	69.0	Ammonium Carbonate	$(NH_4)_2CO_3$	0.7	.04
Magnesium	Mg	39.2	Magnesium Carbonate	$MgCO_3$	135.9	7.95
Ammonium	NH_4	0.3	Calcium Carbonate	$CaCO_3$	172.3	10.07
Sodium	Na	97.8	Silica	SiO_2	10.0	.58
Sulfate	SO_4	165.4	Iron Oxide	Fe_2O_3	0.0	.00
Nitrate	NO_3	0.6	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	17.0				
Alkalinity as $CaCO_3$			Total		609.3	35.62
Phenolphthalein		0.0				
Methyl Orange		350.0				
Residue		620.0				
Total Hardness		333.0				

MONTICELLO (2378) (p. 429). The 8-inch well, 212 feet deep, and the 10-inch well, 194 feet deep, have been abandoned. The 212-foot well drilled in 1916, now known as number 1, is 12 inches in diameter to 112 feet and 10 inches in diameter below that depth. It is pumped every other day and is equipped with a 6-stage, 10-inch Worthington turbine pump having 100 feet of 6-inch column pipe and 10 feet of 6-inch suction pipe. The pump is rated at 350 gallons per minute and is driven by a 25-horsepower electric motor.

A new well, known as number 2, was drilled in 1927 by Mike Ebert of Washington. It is located 60 feet north and 15 feet west of number 1, is 212 feet deep and 12 inches in diameter, and has a 20-foot length of Cook screen, of which 16 feet are exposed. This well was originally equipped with an air lift, but is now equipped with a Worthington turbine pump exactly like the pump in well number 1. This well is pumped on days when well number 1 is not in use.

Water from the wells is pumped to a treatment plant constructed in 1936 and located in the old boiler room of the pumping station. Treatment consists of pressure aeration, settling, filtration, and zeolite softening. The water is pumped from the treatment plant to the distribution system and an elevated steel tank of 150,000 gallons capacity by either of two identical single-stage Worthington centrifugal pumps, each rated at 350 gallons per minute and driven by a 25-horsepower electric motor. A single-stage Worthington centrifugal pump, rated at 700 gallons per minute and driven by a gasoline engine, is maintained as a stand-by unit.

The quality of the raw water is similar to that previously reported.

The water from well number 1 contains 6.3 cubic feet of gas per 1000 gallons, of which Methane constitutes 62 per cent. Aeration reduces the methane content to 0.1 cubic feet per 1000 gallons.

MORRIS (5568) (p. 431). No reported change.

MORRISON (3067) (p. 433). The source of water for the public supply is the same as reported on page 433. Most of the water is obtained from the spring, but both wells which are equipped with air lifts can be used. Water is usually pumped from the reservoir to the distribution system by a Fairbanks-Morse centrifugal pump rated at 200 gallons per minute against a head of 160 feet and driven by a 12-horsepower electric motor. The steam-driven pumps can be used but serve only as stand-by units.

No repairs have been made on the 2048-foot well, but the well drilled in 1897 was reamed and cleaned in 1938 by C. W. Varner of Dubuque, Iowa. It is now 1595 feet deep and is cased with 17-inch pipe to a depth of 21 feet, with 10-inch pipe from the surface to 136 feet 7 inches, and with 8-inch pipe from 111 feet to 435 feet. The 10-inch pipe is cemented in place and the 8-inch pipe has a lead packer at the top and a drive shoe at the bottom. An open hole between 435 and 1595 feet is 8 inches in diameter. A 50-pound charge of dynamite was exploded at a depth of 1500 feet.

After repairs were completed the water level was at a depth of 6½ feet when not pumping and was lowered 60 feet by pumping at a rate of 500 gallons per minute.

The water had a total residue of 375, a total hardness of 347.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 84056, collected July 27, 1938.

Water from the spring had a total residue of 436, a total hardness of 396, and a content of iron of 0.7 parts per million as shown by the analysis of sample number 83967. collected July 27, 1938. The temperature of the spring water was 56° F.

Analysis of Sample Number 84056 from Well 1595 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	22.1	1.29
(filtered)		trace	Magnesium Nitrate	$Mg(NO_3)_2$	1.5	0.09
(unfiltered)		0.4	Magnesium Chloride	$MgCl_2$	17.6	1.03
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	33.7	1.96
Silica	SiO_2	17.5	Magnesium Carbonate	$MgCO_3$	99.9	5.82
Turbidity		15.0	Calcium Carbonate	$CaCO_3$	181.6	10.59
Color		0.0	Silica	SiO_2	17.5	1.02
Odor		Cn–1				
Calcium	Ca	72.6	Total		373.9	21.80
Magnesium	Mg	40.4				
Ammonium	NH_4	trace				
Sodium	Na	5.9				
Sulfate	SO_4	26.8				
Nitrate	NO_3	17.3				
Chloride	Cl	13.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		300.0				
Residue		375.0				
Total Hardness		347.5				

Analysis of Sample Number 83967 from Spring.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	11.9	0.69
(filtered)		0.0	Sodium Chloride	NaCl	5.3	0.31
(unfiltered)		0.7	Magnesium Chloride	$MgCl_2$	13.4	0.78
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	38.5	2.24
Silica	SiO_2	17.5	Magnesium Carbonate	$MgCO_3$	118.9	6.93
Turbidity		5.0	Calcium Carbonate	$CaCO_3$	209.2	12.20
Color		0.0	Silica	SiO_2	17.5	1.02
Odor		0.0				
Calcium	Ca	83.7	Total		414.7	24.17
Magnesium	Mg	45.6				
Ammonium	NH_4	trace				
Sodium	Na	5.3				
Sulfate	SO_4	30.9				
Nitrate	NO_3	8.9				
Chloride	Cl	13.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		350.0				
Residue		436.0				
Total Hardness		396.0				

MORRISONVILLE (968) (p. 436). Morrisonville secures water from a well located northwest of town. This is the well formerly used by the Southern Illinois Light and Power Company to furnish part of the village water supply.

During 1934 the village rebuilt the well. It is now 14 feet deep and 10 feet in diameter. The walls are made of brick laid in mortar and are carried six feet above the normal ground level. Thus the well is 20 feet deep measured from the top of the well curb. The elevation of the ground surface around the well has been raised about five feet.

Water is pumped from the well to the distribution system by a Fairbanks-Morse duplex piston type pump, size 5 by 6 inches, rated at 6000 gallons per hour. The pumping rate has been reduced to 3900 gallons per hour. Power is furnished by a 5-horsepower Fairbanks-Morse electric motor.

On June 16, 1938 the water level was about 10 feet below the top of the well curb. During dry seasons the water level is kept close to the bottom of the well.

The two wells in the village are available but they are seldom used.

There are 135 service connections and the daily usage is about 30,000 gallons.

The rates are as follows:

60 cents per 1000 gallons for the first 3,000 gallons per month.
55 cents per 1000 gallons for the next 5,000 gallons per month.
50 cents per 1000 gallons for the next 5,000 gallons per month.
45 cents per 1000 gallons for the next 5,000 gallons per month.
40 cents per 1000 gallons for the next 10,000 gallons per month.
35 cents per 1000 gallons for the next 10,000 gallons per month.
30 cents per 1000 gallons for the next 10,000 gallons per month.
25 cents per 1000 gallons for the next 10,000 gallons per month.
20 cents per 1000 gallons for the next 30,000 gallons per month.
15 cents per 1000 gallons for the next 120,000 gallons per month.
10 cents per 1000 gallons for the next 400,000 gallons per month.
8 cents per 1000 gallons for all over 500,000 gallons per month.

The minimum rate is $1.00 per month.

The water had a total residue of 350, a total hardness of 256.0, and an iron content of 0.0 parts per million as shown by the analysis of sample number 75840, collected March 26, 1935.

Analysis of Sample Number 75840 from the Well Located Northwest of the Village.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	14.5	0.85
Manganese	Mn	0.0	Sodium Chloride	NaCl	9.9	0.58
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	29.1	1.70
Turbidity		5.0	Sodium Carbonate	Na_2CO_3	40.3	2.35
Calcium	Ca	60.2	Magnesium Carbonate	$MgCO_3$	88.9	5.18
Magnesium	Mg	25.5	Calcium Carbonate	$CaCO_3$	150.6	8.78
Sodium	Na	34.7	Silica	SiO_2	10.0	0.58
Sulfate	SO_4	19.7				
Nitrate	NO_3	10.6	Total		343.3	20.02
Chloride	Cl	6.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		294.0				
Residue		350.0				
Total Hardness		256.0				

MORTON (1501) (p. 438). The source of supply and the pump in well number 2 are as described on page 438. In 1930 an American turbine pump rated at 200 gallons per minute at 225-foot head was installed in well number 1, which is 45 feet south of number 2. The pump consists of 10 stages of 7⅝-inch bowls measuring 5 feet 7 inches over-all, 200 feet of 6-inch column pipe, and no suction pipe. It is direct connected to a 20-horsepower electric motor. The discharge side of the turbine pump is connected to the suction side of an American centrifugal pump driven by a 10-horsepower electric motor. The latter pump discharges to the distribution system.

In 1938 there were 500 metered service connections in use. Well number 2 was seldom used, but well number 1 was pumped from 12 to 14 hours daily.

MOKTON GROVE (1974) (p. 439). Since May 23, 1932 all water for the public supply has been obtained from the city of Chicago.

MOUND CITY (2548) (p. 441). No change has been made in the source of the water supply at Mound City.

MOUNDS (2129) (p. 442). Mounds obtains water from the two wells drilled in 1921 by Meister Bros of Tuscola and described on page 443. The air lift equipment has been abandoned.

The south well was equipped in 1927 with a 10-inch Layne-Bowler turbine pump rated at 750 gallons per minute. The pump assembly consists of 65½ feet of column pipe, two bowls measuring 4 feet 9 inches over-all, and 21 feet 7 inches of suction pipe. The pump is driven by a 50-horsepower Fairbanks-Morse electric motor.

A pump and motor similar to the one in the south well is installed in the north well. The column pipe is 78 feet long and 20½ feet of suction pipe is attached to the bottom of the bowls.

Under ordinary operating conditions the well pumps discharge directly into the distribution system, but they may also discharge into the concrete storage reservoir when so desired.

A centrifugal pump rated at 500 gallons per minute against a head of 100 pounds per square inch is available to either increase the pressure in the mains or to pump from the ground storage reservoir into the distribution system.

The analysis of a sample of water collected January 7, 1938 indicates that the quality of the water is similar to that shown by the analysis of sample number 51943, page 444.

MOUNT CAEMEL (7132) (p. 709). The raw water supply of the city of Mount Carmel is obtained from Wabash River. The water is treated before entering the distribution system.

MOUNT CAEEOLL (1775) (p. 444). Until 1934 the same well and reservoir described on page 444 were in regular service. Changes had been made in the pumping station, however, which included the installation of a new electric motor powered Worthington air compressor to replace the steam powered compressor previously in service. This latter unit was being maintained as stand-by equipment. Also the steam powered service pump had been replaced by a new electric motor powered Worthington single-stage centrifugal pump rated at 400 gallons per minute against 75 pounds pressure when operating at 1750 revolutions per minute. The steam pump was retained for stand-by service.

During the previous year there had been a gradual reduction in the production of the well and improvements in the source of supply became necessary.

In June, 1934 a test of the well revealed that the steady production was at a rate of 110 gallons per minute with a draw down of 55 to 56 feet representing a specific capacity of about 1.95 gallons per minute per foot of draw down.

A new well was urgently needed and sometime later a contract was awarded to C. W. Varner of Dubuque for a new deep well. This well was completed to a depth of 1457 feet in May, 1935. It is located about 100 feet southeast of the old 2501-foot well. It is cased to a depth of 367 feet with 16-inch casing. The well is 15 inches in diameter between 367 and 737 feet. A 12-inch liner is in place between 657 and 737 feet. The well is 12 inches in diameter between 737 feet and the bottom of the well. The water level was at a depth of 52 feet when not pumping, and at a depth of 147 feet when pumping at a rate of 225 gallons per minute. The well was shot at depths of 900, 950, 1300, 1350 and 1400 feet, after which a yield of 600 gallons per minute was obtained with the pumping water level at a depth of 152 feet. The temperature of the water was 58° F.

A record of material penetrated, with part of the classification as furnished by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Glacial drift	60	60
Dolomite, Galena-Platteville	202	262
Shale, dolomite, Glenwood	8	270
Sandstone, Glenwood	120	390
Shale, St. Peter	330	720
Sandstone, St. Peter	35	755
Sandstone, Franconia and Galesville	260	1015
Shale, Eau Claire	10	1025
Sandstone, some dolomite, Eau Claire	345	1370
Sandstone, Mt. Simon	87	1457

The water had a mineral content of 332, a total hardness of 342, and a content of iron of 0.8 parts per million as shown by the analysis of sample number 76099, collected May 15, 1935.

Analysis of Sample Number 76099 from Well 1457 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		0.8	Sodium Chloride	NaCl	9.9	0.58
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	0.7	0.04
Silica	SiO_2	8.0	Magnesium Sulfate	$MgSO_4$	23.5	1.37
Turbidity		10.0	Magnesium Carbonate	$MgCO_3$	112.2	6.55
Color		3.5	Calcium Carbonate	$CaCO_3$	173.1	10.10
Odor		0	Calcium Silicate	$CaSiO_3$	19.2	1.12
Calcium	Ca	75.8	Iron Oxide	Fe_2O_3	1.1	0.06
Magnesium	Mg	37.1				
Ammonium	NH_4		Total		341.4	19.92
Sodium	Na	4.6				
Sulfate	SO_4	18.9				
Nitrate	NO_3	1.2				
Chloride	Cl	6.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		306.0				
Residue		332.0				
Total Hardness		342.0				

MOUNT MORRIS (1902) (p. 447). The 500-foot well drilled in 1895 had been abandoned, but the 878-foot well drilled in 1920 is in use. It is now equipped with a 16-stage, 7-inch Fairbanks-Morse turbine pump having 260 feet of 5-inch column pipe, and driven by a 25-horsepower electric motor. This pump discharges into the reservoir at the pumping station.

In 1926 a new well, known as number 3, was drilled on First Street west of McKendrie Street by P. E. Millis. It is 905 feet deep, and is cased with 20-inch pipe to 28 feet and with 16-inch pipe to 175 feet.

A record of material penetrated furnished by the State Geological Survey Division is as follows:

	Thickness in feet.	Depth in feet.
Yellow clay	19	19
Galena-Platteville limestone	156	175
St. Peter sandstone	65	240
Prairie du Chien limestone	457	697
Galesville sandstone	193	890
Eau Claire limestone	15	905

The static water level is reported to be 240 feet below the ground surface.

This well is equipped with an 8-inch American Well Works pump. The pump is rated at 240 gallons per minute against a head of 390 feet and is driven by a 40-horsepower electric motor. It discharges directly into the distribution system.

The old triplex pumps at the pumping station have been replaced by centrifugal pumps. One is a single-stage American Well Works pump rated at 300 gallons per minute against a head of 120 feet and driven by a 15-horsepower electric motor. The other is a product of Advance Pump and Compressor Company and is rated at 370 gallons per minute against a head of 138 feet. It is driven by a 25-horsepower electric motor, but is seldom used.

Water from well number 3 had a total residue of 291.0, a total hardness of 301.0, and a content of iron of 0.01 parts per million as shown by the analysis of sample number 83838, collected July 5, 1938.

Analysis of Sample Number 83838 from Well Number 3.

Determinations Made.		Pts. per million.
Iron	Fe	
(filtered)		0.0
(unfiltered)		.01
Manganese	Mn	0.0
Silica	SiO_2	14.0
Turbidity		6.0
Color		0.0
Odor		0.0
Calcium	Ca	61.6
Magnesium	Mg	35.8
Ammonium	NH_4	trace
Sodium	Na	0.7
Sulfate	SO_4	12.1
Nitrate	NO_3	5.3
Chloride	Cl	4.0
Alkalinity as $CaCO_3$		
Phenolphthalein		0.0
Methyl Orange		280.0
Residue		291.0
Total Hardness		301.0

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate	$NaNO_3$	2.6	0.15
Magnesium Nitrate	$Mg(NO_3)_2$	4.5	0.26
Magnesium Chloride	$MgCl_2$	5.2	0.30
Magnesium Sulfate	$MgSO_4$	15.0	0.87
Magnesium Carbonate	$MgCO_3$	106.2	6.19
Calcium Carbonate	$CaCO_3$	154.0	8.98
Silica	SiO_2	14.0	0.82
Total		301.5	17.57

MOUNT OLIVE (3079). The raw water supply of Mount Olive is obtained from two impounding reservoirs. The older reservoir is located on Sugar Creek and the new reservoir, constructed in 1936, is located on Panther Creek. Both of these streams are tributaries of Cahokia Creek. The water is treated before entering the distribution system.

MOUNT PROSPECT (1225) (p. 449). A Pomona deep-well turbine pump was installed in 1937. With static water level at 36 feet a production of 160 gallons per minute was obtained with a draw down of 103 feet. The bottom of the pump suction was at 150 feet.

MOUNT PULASKI (1445) (p. 450). No reported change.

MOUNT STEELING (1724) (p. 454). Since 1935 the source of water for the public supply has been an impounding reservoir on a tributary of the South Pork of Shelby Creek. The water is treated before entering the distribution system.

MOUNT VEENON (12,375) (p. 709). The raw water supply of the city of Mount Vernon is obtained from an impounding reservoir on Casey Fork. The water is treated before entering the distribution system.

MOWEAQUA (1478) (p. 457). No reported change.

MUNDELEIN (1011) (p. 458). In August, 1929 the village was still obtaining all its water from the one well described on page 458.

It was reported at that time that the pump was a single stroke double-acting American Well Works deep-well cylinder pump. The assembly consisted of 120 feet of discharge pipe and a 4-inch cylinder with a 24-inch stroke. At 29 strokes per minute the pump was delivering 50 gallons per minute. Power was supplied through a 10-horsepower electric motor.

The water had a total residue of 422, a hardness of 144 parts per million and a trace of iron as shown by the partial analysis of sample number 64642, collected August 7, 1929. The water had a slight odor of hydrogen sulfide as it came from the well.

In January, 1930 Henry E. Luebbe completed a new well having a diameter of 12 inches at the top and a depth of 285 feet. On test the well delivered about 125 gallons per minute.

The new well is only a short distance from the older one and the distance to rock was approximately the same, namely, 235 feet.

The well is equipped with a Sterling deep-well turbine pump designed to deliver 125 gallons per minute against a total head of 280 feet.

The water had a total residue of 405, a total hardness of 124 and a content of iron of 0.0 parts per million as shown by analysis of sample number 65822, collected February 1, 1930.

Analysis of Sample Number 65822 from Village Well 285 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	13.4	.78
Turbidity		0.0	Sodium Sulfate	Na_2SO_4	226.0	13.18
Silica	SiO_2	12.0	Sodium Carbonate	Na_2CO_3	16.4	.96
Calcium	Ca	21.7	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	.03
Magnesium	Mg	17.0	Magnesium Carbonate	$MgCO_3$	59.0	3.44
Ammonium	NH_4	0.2	Calcium Carbonate	$CaCO_3$	54.0	3.15
Sodium	Na	85.7	Silica	SiO_2	12.0	.70
Sulfate	SO_4	153.0	Iron Oxide	Fe_2O_3	0.0	.00
Nitrate	NO_3	0.6	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$			Total		382.2	22.29
Phenolphthalein		0.0				
Methyl Orange		140.0				
Residue		405.0				
Total Hardness		124.0				

MURPHYSBORO (8182) (p. 709). The raw water supply of the city of Murphysboro is obtained from Big Muddy River. The water is treated before entering the distribution system.

NAMEOKI (2257). Nameoki installed a distribution system in 1930. Water is supplied by the East St. Louis and Interurban Water Company of East St. Louis.

NAPERVILLE (5118) (p. 459). Well number 4 was drilled in 1928 by the American Water Corporation. It is located in the northern part of the city near the intersection of Eagle Street and Eighth Avenue. It is 178 feet deep and is cased to a depth of 44 feet with 30-inch pipe. Below the casing the diameter of the well is 24 inches. This casing was originally perforated between depths of 6 and 16 feet in order to allow water from a gravel formation to enter the well. In May, 1928 the static water level was at a depth of 8½ feet and the well yielded 570 gallons per minute with a draw down of 8 feet. In September, 1929 the yield of the well began to decrease. In July, 1930 the yield was 370 gallons per minute, and in October, 1931 only 270 gallons per minute. At this time the perforations in the casing were sealed with cement and the yield decreased to 250 gallons per minute with a draw down of 48 feet from a static level of 14 feet. In April, 1932 it was reported that the yield of this well had increased to 348 gallons per minute with the pumping level at a depth of 51 feet. The quality of water from the well was not appreciably changed by sealing the perforations in the casing. The well is equipped with an American deep-well turbine pump driven by a 40-horsepower electric motor.

Well number 5 was drilled in 1930 by the Layne-Western Company. It is located near the intersection of School Avenue and Hoffman Street and is 189½ feet deep. It is cased with 30-inch wrought iron pipe to a depth of 31½ feet and is 24 inches in diameter at the bottom. The glacial drift at the well site has a thickness of 31 feet. Below the drift the well penetrates Niagaran dolomite. The water level was at a depth of 8 feet when not pumping and was lowered 43 feet by pumping at a rate of 630 gallons per minute. In 1937 the yield of the well had decreased to 460 gallons per minute with a draw down of 96½ feet from a static level of 10 feet. The well is equipped with a 10-stage Layne deep-well turbine pump having 79 feet of 8-inch column pipe and 20 feet of 6-inch suction pipe. The pump is driven by a direct-connected 60-horsepower vertical electric motor.

Well number 6 was drilled in 1937 by the Layne-Western Company and is located at a point 160 feet southwest of well number 5. It is 202 feet deep and 24 inches in diameter at the bottom, being cased with 27-inch pipe to a depth of 30 feet. The water level was at a depth of 10 feet when not pumping and was lowered 143 feet by pumping at a rate of 400 gallons per minute. The well is equipped with a 5-stage turbine pump having 20 feet of suction pipe. The over-all length of the pump is 187 feet. The pump is driven by a direct-connected electric motor.

The water from wells 4, 5 and 6 is of similar chemical quality. In 1936 a water treatment plant was installed in a building erected as an addition to the pump house at well number 5.

Water from well number 6 had a total residue of 405 and a total hardness of 392 parts per million and a trace of iron as shown by the analysis of sample number 82400, collected November 15, 1937. The analysis of sample number 82404 from the treatment plant shows that the iron was completely removed by aeration and filtration.

Analysis of Sample Number 82400 from Well 202 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron*	Fe		Sodium Nitrate	$NaNO_3$	4.2	0.25
(unfiltered)		trace	Sodium Chloride	NaCl	2.9	0.17
Manganese	Mn	0.0	Magnesium Chloride	$MgCl_2$	1.4	0.08
Silica	SiO_2	16.0	Magnesium Sulfate	$MgSO_4$	129.0	7.50
Turbidity		0.0	Magnesium Carbonate	$MgCO_3$	64.0	3.73
Color		0.0	Calcium Carbonate	$CaCO_3$	176.0	10.50
Odor		0.0	Silica	SiO_2	16.0	0.93
Calcium	Ca	70.4				
Magnesium	Mg	45.0	Total		393.5	23.16
Ammonium	NH_4	trace				
Sodium	Na	2.3				
Sulfate	SO_4	103.0				
Nitrate	NO_3	2.8				
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		252.0				
Residue		405.0				
Total Hardness		392.0				

* Iron after treatment 0.0 p.p.m. (Lab. No. 82404).

NASHVILLE (2243). The raw water supply of the city of Nashville is obtained from an impounding reservoir on a tributary to Mill Creek. The reservoir and treatment plant were constructed in 1936.

NATIONAL CITY (267) (p. 709). National City is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

NAUVOO (966) (p. 709). The raw water supply of the city of Nauvoo is obtained from Mississippi River. The water is untreated and not used for domestic purposes.

NEOGA (995) (p. 462). The water supply of Neoga is obtained from the two wells described on page 462. Most of the supply is taken, however, from the northeast well, the original depth of which is shown on page 463 as 30 feet deep. The water from the northeast well had a total residue of 400, a total hardness of 240, and a content of iron of 1.7 parts per million, as shown by the partial analysis of sample number 83706, collected June 16, 1938.

The water from the east or older well, the original depth of which is shown on page 462 as 16 feet, had a total residue of 657, a total hardness of 396, and an iron content of 1.9 parts per million, as shown by analysis of sample number 83707, collected June 16, 1938.

Analysis of Sample Number 83707 from East Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		.05	Sodium Chloride	NaCl	64.3	3.75
(unfiltered)		1.92	Sodium Sulfate	Na_2SO_4	189.0	11.02
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	12.7	0.74
Silica	SiO_2	15.0	Magnesium Carbonate	$MgCO_3$	149.7	8.73
Turbidity		17.0	Calcium Carbonate	$CaCO_3$	218.5	12.74
Color		0.0	Iron Oxide	Fe_2O_3	0.1	0.01
Odor		0.0	Silica	SiO_2	15.0	0.87
Calcium	Ca	87.5				
Magnesium	Mg	43.2	Total		651.0	37.96
Ammonium	NH_4	trace				
Sodium	Na	92.5				
Sulfate	SO_4	128.0				
Nitrate	NO_3	1.3				
Chloride	Cl	39.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		408.0				
Residue		657.0				
Total Hardness		396.0				

NEW ATHENS (1269) (p. 709). The raw water supply of the village of New Athens is obtained from Kaskaskia River. The water is treated before entering the distribution system.

NEW BADEN (1243). New Baden is located in the southwestern part of Clinton County on the drainage area of Kaskaskia River, a tributary of Mississippi River. A public water supply was installed in 1909. Many private wells from 20 to 35 feet deep are in use.

Water for the public supply was first secured from a well 200 feet deep, belonging to the New Baden Milling Company.

In 1921 the village drilled a well near the southwestern limits of the village. It is 8 inches in diameter and 218 feet deep. It is cased to rock at a depth of about 60 feet. The water-bearing formation is a stratum of sandstone about 20 feet thick. The elevation of the ground surface at the site of the well is between 455 and 460 feet above sea level.

The well is equipped with a Myers single-acting deep-well pump which discharges about 7 gallons per minute.

The well at the mill, although of smaller diameter, is known to yield much more water than the village well.

Temperature of the water from the village well is 57° F. The water had a total residue of 1356, a total hardness of only 23, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 60793, collected December 9, 1927.

Analysis of Sample Number 60793 from Village Well 218 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Potassium Nitrate	KNO_3	2.0	.12
Manganese	Mn	0.0	Potassium Chloride	KCl	15.8	.92
Turbidity		0.0	Sodium Chloride	NaCl	646.5	37.80
Silica	SiO_2	19.8	Sodium Sulfate	Na_2SO_4	3.4	.20
Nonvolatile		2.0	Sodium Carbonate	Na_2CO_3	653.0	38.19
Alumina	Al_2O_3	0.3	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	.06
Calcium	Ca	4.0	Magnesium Carbonate	$MgCO_3$	10.6	.62
Magnesium	Mg	3.1	Calcium Carbonate	$CaCO_3$	10.0	.59
Ammonium	NH_4	0.4	Silica	SiO_2	19.8	1.15
Potassium	K	9.1	Iron Oxide	Fe_2O_3	0.1	.01
Sodium	Na	538.7	Alumina	Al_2O_3	0.3	.02
Sulfate	SO_4	2.3	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.2	Nonvolatile		2.0	.12
Chloride	Cl	400.0				
Alkalinity as $CaCO_3$			Total		1,364.5	79.80
Phenolphthalein		26.0				
Methyl Orange		640.0				
Residue		1,356.0				
Total Hardness		23.0				

During 1934 the village drilled a well about 50 feet west of the riser-pipe on the 40,000-gallon elevated tank located near the center of the village. This well is cased 12 inches in diameter to rock, which is encountered at a depth of about 36 feet, and drilled 10 inches in diameter to a total depth of 279 feet. The operator reported that sand rock was encountered at a depth of about 96 feet and was continuous from that depth to the bottom of the well.

Water is pumped from the well to the distribution system by a Deming deep-well cylinder pump which has a 2½-inch cylinder and a 14-inch stroke. The drop-pipe is 3 inches in diameter and the cylinder is placed within 20 feet of the bottom of the well. The pump is belt driven by a 10-horsepower General Electric motor, and delivers between 15 and 18 gallons per minute to the elevated tank.

There are about 175 service connections. The daily usage is between 9000 and 10,000 gallons. Eates are as follows:

75 cents per 1000 gallons for the first 2000 gallons.
50 cents per 1000 gallons for all over 2000 gallons.
The minimum rate is 75 cents per month.

Sample number 83711 was collected on June 13, 1938. An analysis of this sample indicated a total residue of 1160, a total hardness of 19, and an iron content of 0.06 parts per million.

Analysis of Sample Number 83711 from New Village Well 279 Feet Deep.

Determinations Made.	Pts. per million.
Iron.....Fe	
(filtered).....	0.0
(unfiltered).....	.06
Manganese..Mn	0.0
Silica.....SiO_2	14.5
Turbidity.....	5.0
Color.....	0.0
Odor.....	0.0
Calcium.....Ca	3.2
Magnesium..Mg	2.6
Ammonium..NH_4	0.3
Sodium.....Na	463.4
Sulfate.....SO_4	0.0
Nitrate.....NO_3	1.7
Chloride.....Cl	335.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	36.0
Methyl Orange...	554.0
Residue.....	1,160.0
Total Hardness....	19.0

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	2.6	0.15
Sodium Chloride.....	NaCl	551.0	32.12
Sodium Carbonate.....	Na_2CO_3	566.0	33.00
Ammonium Carbonate..	$(NH_4)_2CO_3$	1.0	0.06
Magnesium Carbonate..	$MgCO_3$	9.3	0.54
Calcium Carbonate.....	$CaCO_3$	8.0	0.47
Silica.....	SiO_2	14.5	0.85
Total.....		1,152.4	67.19

NEW HOLLAND (353) (p. 464). In 1931 Eufus Rush of Stanford drilled a new well for New Holland. This well is located about 6 feet north of the old well, is 74 feet deep, 6 inches in diameter, and equipped with 10 feet of screen. The lower 5 feet of screen is number 24-slot and the upper 5 feet is number 14-slot. Static water level is 34 feet below the ground surface. The well is equipped with a double-acting deep-well cylinder pump. The cylinder is 5 feet long and is installed at a depth of 54 feet with 14 feet of suction pipe attached **below.**

The south well was repaired at the same time and is now 72 feet deep.

The water had a total residue of 700, a total hardness of 583, and an iron content of 0.4 parts per million as shown by the analysis of sample number 82575, collected December 8, 1937.

Analysis of Sample Number 82575 from Distribution System.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	51.0	2.98
Manganese	Mn	0.0	Magnesium Nitrate	$Mg(NO_3)_2$	50.4	2.94
Silica	SiO_2	17.0	Magnesium Chloride	$MgCl_2$	49.5	2.89
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	157.5	9.20
Color		0	Magnesium Carbonate	$MgCO_3$	41.6	2.43
Odor		0	Calcium Carbonate	$CaCO_3$	316.5	18.50
Calcium	Ca	126.5	Iron Oxide	Fe_2O_3	0.6	0.04
Magnesium	Mg	64.9	Silica	SiO_2	17.0	0.99
Ammonium	NH_4	trace				
Sodium	Na	13.8	Total		684.1	39.97
Sulfate	SO_4	126.0				
Nitrate	NO_3	79.5				
Chloride	Cl	37.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		366.0				
Residue		700.0				
Total Hardness		583.0				

NEWMAN (1054). Newman is located in the eastern part of Douglas County on the drainage area of Brushy Fork, a tributary of Embarrass River. Numerous private wells are in use. Most of these are shallow dug wells, but some are deep flowing wells which yield highly mineralized water. A public water supply was installed in 1934.

A well, 122 feet deep, was drilled at the intersection of Broadway and Mather Streets by C. W. McAllister in 1932. Water-bearing gravel was encountered at this depth and drilling stopped without penetrating the formation. No screen was used but water rose in the 8-inch casing to within three feet of the ground surface. Pumping at a rate of 30 gallons per minute for one hour lowered the water level 23 feet and caused sand to rise 7 feet in the well. In 1934 the well was deepened to 127 feet and equipped with 9 feet of 8-inch, number 30-slot Cook screen. The water level then was at a depth of 21 feet and was lowered 75 feet by a pumping rate of 28 gallons per minute. Water level in another well, 190 feet distant, was lowered more than nine feet by pumping the village well.

Well number 2 was drilled in 1934 by Meister Bros. It is located in the western part of town about ⅓ mile west of well number 1. It is 141¼ feet deep and penetrates sand and gravel below 117. feet. It is equipped with 12 feet of 8-inch number 20-slot Cook screen. In 1935 the water level was at a depth of 6 inches below the ground surface. A production test indicated that the well was capable of producing about 75 gallons per minute, but a large amount of gas (methane) in the water made it impossible to conduct an accurate test with the turbine pump which was used.

The well is equipped with a 9-stage Fairbanks-Morse deep-well turbine pump having 120 feet of 5-inch column pipe. The pump is rated at 100 gallons per minute and is driven by a 7½-horsepower electric motor.

A water treatment plant was built in 1935. Treatment consists of aeration, lime softening, recarbonation, and filtration through a pressure sand filter.

Water is pumped from the treatment plant to the distribution system by either of two Fairbanks-Morse centrifugal pumps, a single-stage pump driven by a 7½-horsepower electric motor or a two-stage pump driven by a 4-cylinder gasoline engine. An elevated steel tank located beside the well and treatment plant is connected to the mains.

The plant is operated from 8 to 10 hours daily except at times when a local cannery is in operation. It has been operated as much as 22 hours daily during periods of peak demand.

Water from well number 1 was similar in chemical quality to that from well number 2 which had a total residue of 1106, a total hardness of 316.5, and a content of iron of 6.0 parts per million as shown by the analysis of sample number 75587, collected January 18, 1935.

Analysis of Sample Number 75587 from Well Number 2.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.2	Sodium Chloride	NaCl	596.3	34.78
(unfiltered)		6.0	Sodium Carbonate	Na_2CO_3	152.2	8.97
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	38.4	2.24
Silica	SiO_2	12.0	Magnesium Carbonate	$MgCO_3$	117.2	6.83
Turbidity		80.0	Calcium Carbonate	$CaCO_3$	177.6	10.36
Calcium	Ca	71.0	Iron Oxide	Fe_2O_3	0.3	0.02
Magnesium	Mg	33.9	Silica	SiO_2	12.0	0.70
Ammonium	NH_4	14.4				
Sodium	Na	301.1	Total		1,095.7	64.00
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.2				
Chloride	Cl	361.7				
Alkalinity as $CaCO_3$						
Phenolphthalein		10.0				
Methyl Orange		500.0				
Residue		1,106.0				
Total Hardness		316.5				

The raw water contains 11.5 cubic feet of gas per 1000 gallons of which methane constitutes 94 per cent as shown by the analysis of sample number 81966, collected September 23, 1937.

NEWTON (2076) (p. 709). The raw water supply of the city of Newton is obtained from Embarrass River. The water is treated before entering the distribution system.

NEW WINDSOR (444) (p. 691). The public water supply of New Windsor was described on page 692 under the name Windsor.

The water works was completed in 1927 when a distribution system of 8-inch, 6-inch, and 4-inch pipe was laid. The well was equipped with a 2-stroke Cook deep-well pump driven by a 15-horsepower electric motor. The pump cylinder was 80 inches in length and set at a depth of 267 feet. The length of stroke was 18 inches.

In 1930 there were complaints about the taste and odor of the water. The demand was light and the iron content was high with the result that conditions were quite favorable for the growth of crenothrix in the mains. The quality of the water was quite different from that reported on page 692. The water had a total residue of 458, a total hardness of 350, and a content of iron of 3.0 parts per million as shown by the analysis of sample number 66660, collected June 11, 1930.

Analysis of Sample Number 66660 from the Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	3.0	Sodium Nitrate.....$NaNO_3$	0.9	0.05
Manganese..Mn	0.1	Sodium Chloride.....NaCl	4.7	0.27
Turbidity.....	30.0	Sodium Sulfate.....Na_2SO_4	8.5	0.50
Silica.....SiO_2	18.0	Sodium Carbonate.....Na_2CO_3	93.9	5.47
Calcium.....Ca	90.0	Ammonium Carbonate..$(NH_4)_2CO_3$	3.4	0.20
Magnesium..Mg	30.4	Magnesium Carbonate..$MgCO_3$	105.7	6.16
Ammonium..NH_4	1.3	Calcium Carbonate.....$CaCO_3$	224.7	13.12
Sodium.....Na	45.6	Silica.....SiO_2	18.0	1.05
Sulfate.....SO_4	5.8	Iron Oxide.....Fe_2O_3	4.3	0.25
Nitrate.....NO_3	0.6	Manganese Oxide.....MnO	0.1	0.01
Chloride.....Cl	3.0			
Alkalinity as $CaCO_3$		Total.....	464.2	27.08
Phenolphthalein..	0.0			
Methyl Orange...	442.0			
Residue.....	458.0			
Total Hardness....	350.0			

NILES (2135) (p. 709). No reported change.

NILES CENTER (5007) (p. 465). No reported change.

NOKOMIS (2454) (p. 466). Water for the public supply is still obtained from the wells described on page 467. The triplex pump is still in use.

Since 1935 all water has been treated in a water softening plant built at the site of the wells.

The service pumps are two single-stage Fairbanks-Morse centrifugal pumps rated at 500 and 300 gallons per minute and driven by 30 and 20-horsepower electric motors, respectively.

The chemical quality of the water from the wells now differs from that reported on page 468. Analysis of sample number 82654, collected December 28, 1937, shows the water to have a total residue of 931, a total hardness of 535.5, and a content of iron of 3.2 parts per million.

Analysis of Sample Number 82654 from City Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.2	Sodium Chloride	NaCl	135.0	7.89
(unfiltered)		3.2	Sodium Sulfate	Na_2SO_4	114.5	6.69
Manganese	Mn	0.5	Ammonium Sulfate	$(NH_4)_2SO_4$	14.5	0.85
Silica	SiO_2	19.0	Magnesium Sulfate	$MgSO_4$	204.0	11.90
Turbidity		40.0	Calcium Sulfate	$CaSO_4$	53.8	3.14
Color		0	Calcium Carbonate	$CaCO_3$	326.0	19.00
Odor		0	Iron Oxide	Fe_2O_3	0.3	.02
Calcium	Ca	146.0	Manganese Oxide	MnO	0.6	.04
Magnesium	Mg	41.4	Silica	SiO_2	9.0	1.10
Ammonium	NH_4	4.0				
Sodium	Na	91.0	Total		869.4	50.73
Sulfate	SO_4	288.5				
Nitrate	NO_3	1.5				
Chloride	Cl	82.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		326.0				
Residue		931.0				
Total Hardness		535.5				

NORMAL (6768) (p. 46S). Water for the public supply is now obtained from three wells, two of which were described on page 469. The 12-inch well was abandoned in 1931. The diameter of the 16-inch well was erroneously given as 15 inches on page 469. This well is now known as number 1 and the 18-inch well is known as number 2.

Well number 3 was drilled in 1931 by the Layne North Central Company. It is a 209-foot gravel-packed well with 25 feet of 18-inch screen and an outer easing 30 inches in diameter. It is located 60 feet south of the 18-inch well. The water level was at a depth of 176 feet when not pumping and was lowered 6 feet by pumping at a rate of 690 gallons per minute for two hours.

This well is equipped with a Layne turbine pump. The pump is driven by a 50-horsepower electric motor and operates about 10 hours daily.

Well number 1 is equipped with a 10-stage, 8-inch Worthington turbine pump having 200 feet of 6-inch column pipe and no suction pipe. The pump is rated at 210 gallons per minute and is driven by a 20-horsepower electric motor. It is used as much as 12 hours on some days and not at all on other days.

Well number 2 is equipped with a Layne turbine pump. The pump is driven by a 30-horsepower electric motor and is used about 16 hours daily.

Storage facilities remain as described on page 468. All well pumps discharge into the reservoir. One of the American centrifugal pumps has been removed and the other is seldom used. Two single-stage Fairbanks-Morse centrifugal pumps have been installed. One is rated at 1500 gallons per minute, is driven by a 60-horsepower electric motor, and is used for fire protection only. The other is rated at 900 gallons per minute, is driven by a 40-horsepower electric motor, and is used every day.

In 1938 more than 1400 service connections were in use and the daily pumpage was approximately 1,000,000 gallons.

NORRIS CITY (1109). Norris City is located in the southwestern part of White County on the drainage area of North Fork of Saline River, a tributary of Ohio River. The village is underlain by the Pennsylvanian Coal Measures.

In 1936 an attempt was made to locate a satisfactory source of ground water for a public supply. Test drilling indicated that only a small quantity of water could be obtained from wells. Test well number 1 was 180 feet deep and penetrated shales and sandstones. It yielded less than 15 gallons per minute.

In 1937 an impounding reservoir was constructed on the west fork of Indian Creek about one-half mile east of the village. The water is treated before entering the distribution system.

Water from test well number 1 had a total residue of 784, a total hardness of 541.5, and a content of iron of 1.2 parts per million as shown by the analysis of sample number 77816, collected May 1, 1936.

Analysis of Sample Number 77816 from Test Well Number 1.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.0				
(unfiltered)		1.2	Sodium Nitrate	$NaNO_3$	1.7	0.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	18.1	1.05
Silica	SiO_2	16.0	Sodium Sulfate	Na_2SO_4	128.5	7.50
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.3	0.08
Calcium	Ca	129.0	Magnesium Sulfate	$MgSO_4$	182.4	10.64
Magnesium	Mg	53.3	Magnesium Carbonate	$MgCO_3$	56.9	3.32
Ammonium	NH_4	0.4	Calcium Carbonate	$CaCO_3$	322.5	18.80
Sodium	Na	49.2	Silica	SiO_2	16.0	0.93
Sulfate	SO_4	233.8				
Nitrate	NO_3	1.3	Total		727.4	42.42
Chloride	Cl	11.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		390.0				
Residue		784.0				
Total Hardness		541.5				

NORTH AURORA (682). North Aurora is located in the southeastern part of Kane County on the banks of Fox River. A public water supply was installed in 1929 and water was obtained from a well at the Exposition Grounds south of the village. In 1938 a new well was drilled for the village and all water for public use will be obtained from this well. Water will be pumped from the well to a 50,000-gallon. wooden elevated tank located near the well and connected to the distribution system.

The Exposition Grounds well was originally 821 feet deep but between 1927 and 1931 was deepened to 865 feet and shot with a high explosive, after which the static water level dropped from 48 feet to 90

feet below the ground surface. This well is equipped with a 15-stage American turbine pump having 250 feet of column pipe and driven by a 100-horsepower electric motor. When pumping at a rate of 400 gallons per minute the water level is reported to be at a depth of 240 feet.

Water from the Exposition Grounds well had a total residue of 346, a total hardness of 217.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 82311, collected November 9, 1937.

Analysis of Sample Number 82311 from Well 865 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	.10
(unfiltered).....	0.0	Sodium Chloride.....NaCl	13.5	.79
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	57.5	3.35
Silica.....SiO_2	8.0	Sodium Carbonate.....Na_2CO_3	69.4	4.05
Turbidity.....	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$	1.0	.06
Color.....	0.0	Magnesium Carbonate..$MgCO_3$	84.4	4.92
Odor.....	0.0	Calcium Carbonate.....$CaCO_3$	117.5	6.86
Calcium.....Ca	46.9	Silica.....SiO_2	8.0	.47
Magnesium..Mg	24.5			
Ammonium..NH_4	0.4	Total.....	353.0	20.60
Sodium.....Na	54.5			
Sulfate.....SO_4	39.0			
Nitrate.....NO_3	1.5			
Chloride.....Cl	8.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	284.0			
Residue.....	346.0			
Total Hardness....	217.5			

The village well was drilled by S. B. Geiger of Chicago and is located east of the river in the southeastern part of the village. It is 807 feet deep, 10 inches in diameter at the bottom, and cased to a depth of 300 feet with 10-inch pipe.

The water level was at a depth of 143 feet when not pumping and was lowered 83 feet by pumping at a rate of 121 gallons per minute.

The well is equipped with a 15-stage, 7-inch American turbine pump with 260 feet of 4½-inch column pipe, 8 feet 4 inches of bowl assembly, and 10 feet of 5-inch suction pipe. The pump is rated at 100 gallons per minute against a total head of 360 feet at 1760 revolutions per minute, and is driven by a 15-horsepower electric motor.

Water from the village well had a total residue of 387, a total hardness of 288.5, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 84226, collected September 7, 1938. The temperature of the water was 54° F. and the pH was 7.0.

Analysis of Sample Number 84226 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	5.1	0.30
(filtered)		0.16	Sodium Chloride	NaCl	16.4	0.96
(unfiltered)		0.6	Sodium Sulfate	Na_2SO_4	72.5	4.24
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	7.8	0.45
Silica	SiO_2	13.0	Magnesium Carbonate	$MgCO_3$	104.0	6.06
Turbidity		12	Calcium Carbonate	$CaCO_3$	158.4	9.23
Color		0	Iron Oxide	Fe_2O_3	0.2	.01
Odor		0	Silica	SiO_2	13.0	0.76
Calcium	Ca	63.5				
Magnesium	Mg	31.6	Total		377.4	22.01
Ammonium	NH_4	trace				
Sodium	Na	31.2				
Sulfate	SO_4	55.1				
Nitrate	NO_3	3.6				
Chloride	Cl	10.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		387.0				
Total Hardness		288.5				

NORTHBROOK (1193) (p. 476). Since 1928 the village of Northbrook has obtained filtered Lake Michigan water from the village of Glencoe.

NOETH CHICAGO (8466) (p. 470). In 1937 the city of North Chicago placed a new water works and filtration plant in operation to supply filtered Lake Michigan water to the city.

NOETH CHILLICOTHE (1004) (p. 473). North Chillicothe is supplied with water by the Public Service Company of Northern Illinois from Chillicothe.

NORTHFIELD (311). The village of Northfield obtains filtered Lake Michigan water from Winnetka.

NORTH RIVERSIDE (969). The village of North Riverside obtains Lake Michigan water from Chicago through Berwyn.

NOETH UTICA (1120) (p. 473). The water-works and pumping equipment at North Utica are as described on page 474. The static water level in July, 1938 was at the ground surface. Water is supplied to 240 customers at a flat rate of $10.00 per year.

OAKLAND (1036) (p. 478). The water supply of Oakland is obtained from a dug well 25 feet deep located in the western part of the city. The water is used for fire protection, flushing and some sprinkling. Household water supplies are obtained from private wells.

All attempts to develop a satisfactory water supply from wells have proved discouraging.

In 1937 a dam was constructed across the valley of Hog Branch just east of the highway at the north edge of the village in Section 18, T. 14 N., E. 11 E. It was reported that the lake was originally developed for recreational purposes but it likely will be used for water supply purposes soon.

OAK LAWN (2045). In 1931 S. B. Geiger completed the drilling of a well for the public water supply at a depth of 1952 feet.

The well was equipped with a Sterling 12-inch deep-well turbine pump, the assembly of which consisted of 340 feet of column pipe, 17 stages (14 feet) of pump, and 30 feet of suction pipe with strainer. The pump is driven by a 75-horsepower motor and is rated at 500 gallons per minute against a 340-foot head.

The water had a strong odor of hydrogen sulfide, a total residue of 1416, a total hardness of 225, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 69431, collected in June, 1931.

Analysis of Sample Number 69431 from the Village Well, 1952 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.6	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	937.1	54.70
Silica	SiO_2	8.0	Sodium Sulfate	Na_2SO_4	142.1	8.30
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	108.7	6.34
Calcium	Ca	64.9	Ammonium Carbonate	$(NH_4)_2CO_3$	1.9	.11
Magnesium	Mg	15.5	Magnesium Carbonate	$MgCO_3$	53.6	3.13
Ammonium	NH_4	0.8	Calcium Carbonate	$CaCO_3$	162.0	9.45
Sodium	Na	462.1	Iron Oxide	Fe_2O_3	0.9	.05
Sulfate	SO_4	96.4	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.4	Silica	SiO_2	8.0	.47
Chloride	Cl	568.6				
Alkalinity as $CaCO_3$			Total		1,415.2	82.60
Phenolphthalein		0.0				
Methyl Orange		330.0				
Residue		1,416.0				
Total Hardness		225.0				

The following is a log of the well as supplied by the State Geological Survey:

	Thickness in feet.	Depth in feet.
Black soil	5	5
Sand, yellow	5	10
Clay, yellow	20	30
Large boulders	20	50
Gravel, coarse	15	65
Lime rock	10	75
Lime, white	185	260
Lime, black	40	300
Lime, sandy	30	330
Lime streak, shale	10	340
Lime, shale	10	350
Shale, blue	140	490
Shale	10	500
Limestone	20	520
(Reduced hole to 12½" at 524' 4".)		
Lime, gray and white	300	820
St. Peter, sand, hard	110	930
Shale and lime	2	932
Lime, yellow and marl, white	183	1115
Lime	173	1288
Sand and shale	107	1395
Lime, brown	15	1410
Sand, 1st Pottsdam	142	1552
Sand, lime and shale	328	1880
Sand, 2nd Pottsdam	20	1900
Sand	46	1946

The following length of casing was installed:

70' of 16" drive pipe
507.5'—12" casing
64.5'—10" casing
680.2'— 8" casing
1—12" by 10" swedge nipple
1—10" by 8" swedge nipple

In 1932 a plant for the removal of the iron and hydrogen sulfide odor and taste was installed. The high salt content was a continued source of objection.

In 1937 the W. L. Thorne Company completed well number 2 to a depth of 1600 feet. This well is located about one-half mile west of well number 1.

The water had a total residue of 742, a total hardness of 445.0, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 81614, collected July 13, 1937.

Analysis of Sample Number 81614 from Well Number 2, 1600 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.5	0.15
(filtered).....	0.0	Sodium Chloride.....NaCl	55.6	3.24
(unfiltered).....	0.2	Sodium Sulfate.....Na_2SO_4	127.7	7.45
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	258.1	15.05
Silica.....SiO_2	10.0	Calcium Sulfate.....$CaSO_4$	17.0	0.99
Turbidity.....	0.0	Calcium Carbonate.....$CaCO_3$	218.1	12.71
Calcium.....Ca	92.2	Silica.....SiO_2	10.0	0.58
Magnesium..Mg	51.6			
Sodium.....Na	64.2	Total.....	689.0	40.17
Sulfate.....SO_4	304.8			
Nitrate.....NO_3	2.0			
Chloride.....Cl	34.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	218.0			
Residue.....	742.0			
Total Hardness....	445.0			

Well number 2 is equipped with a Cook 10-inch deep-well pump consisting of 400 feet of column pipe, 13 stages (9 feet 4 inches) of pump and 30 feet of suction pipe. The pump was designed for 500 gallons per minute against 400-foot head.

After completion of well number 2 and the placing of it in service the W. L. Thorne Company undertook the repair of well number 1. The well was plugged from the bottom up to a depth of approximately 1600 feet.

After plugging well number 1 the same number 82466 was collected but it is still high in mineral. It is likely that the minerals had not been washed out. This will take some time if the well is not used much.

OAK PAEK (63,982) (p. 477). No reported change.

OBLONG (1,427). Oblong is located in the western part of Crawford County on the drainage area of Big Creek, a tributary of Embarrass River. A public water supply was installed in 1926.

Two wells were drilled in the valley of North Pork of Embarass River about 2 miles west of town by Mr. F. Thorpe. They were about 250 feet apart and alike in construction. The first well was drilled in 1926. It was 25 feet deep and 16 inches in diameter and is reported to have yielded 90 gallons per minute.

In 1929 water was drawn from both wells by a centrifugal pump located in a pit about 15 feet deep. Difficulty was experienced due to the water in the wells being drawn down to the bottom of the suction pipe.

The water drawn from both wells had a total residue of 718 and a content of iron of 4.0 parts per million as shown by the analysis of sample number 64944, collected. September 11, 1929. The high iron content caused much trouble. Water drawn from faucets was highly colored and had a disagreeable odor and taste. Very little water was consumed.

Between 1931 and 1934 a pipe-line was constructed which enabled the village to secure water from the Central Illinois Public Service Company at Eobinsoh. Since that time all water for a public supply has been obtained from that source.

In June, 1938 there were 210 active services and the average daily demand was reported as 35,000 gallons.

The village of Oblong purchases water from the company at the regular industrial rates and redistributes it to its local subscribers at the following rates:

60 cents per 1000 gallons for the first 3,000 gallons per month.
55 cents per 1000 gallons for the next 2,000 gallons per month.
50 cents per 1000 gallons for the next 5,000 gallons per month.
45 cents per 1000 gallons for the next 5,000 gallons per month.
40 cents per 1000 gallons for the next 10,000 gallons per month.
35 cents per 1000 gallons for the next 10,000 gallons per month.
30 cents per 1000 gallons for the next 10,000 gallons per month.
25 cents per 1000 gallons for the next 10,000 gallons per month.
20 cents per 1000 gallons for the next 30,000 gallons per month.
15 cents per 1000 gallons for the next 85,000 gallons per month.
The minimum charge is $1.50 per month.

ODELL (908) (p. 480). The air lift mentioned on page 481 was not used after 1926. In 1930 it was learned that the entire amount of water used was obtained from the 1360-foot well. Water was pumped by an airlift to the reservoir.

In 1935 a new 18-stage, 8-inch Peerless deep-well turbine pump with 320 feet of 5-inch column pipe and 35 feet of suction pipe was installed in the well. This pump is rated at 125 gallons per minute and discharges into the reservoir. It is driven by a 20-horsepower vertical electric motor. The regular service pump is a Rumsey triplex pump with 8-inch cylinders and 12-inch stroke. The Goulds centrifugal pump is used as a standby unit.

In 1937 the static water level was 180 feet below the ground surface. Water from the 1360-foot well had a total residue of 1669, a total hardness of 91.5, and a content of iron of 2.0 parts per million as shown by the analysis of sample number 75668, collected in February, 1935.

Analysis of Sample Number 75668 from Village Well 1360 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.8	0.05
(filtered)		0.0	Sodium Chloride	NaCl	1,193.2	69.60
(unfiltered)		2.0	Sodium Sulfate	Na_2SO_4	76.3	4.45
Manganese	Mn	7.6	Sodium Carbonate	Na_2CO_3	296.9	17.30
Silica	SiO_2	6.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.4	0.14
Turbidity		10.0	Magnesium Carbonate	$MgCO_3$	26.6	1.55
Calcium	Ca	24.0	Calcium Carbonate	$CaCO_3$	60.1	3.50
Magnesium	Mg	7.6	Silica	SiO_2	6.0	0.35
Ammonium	NH_4	0.9				
Sodium	Na	622.8	Total		1,662.3	96.94
Sulfate	SO_4	51.3				
Nitrate	NO_3	0.6				
Chloride	Cl	723.4				
Alkalinity as $CaCO_3$						
Phenolphthalein		18.0				
Methyl Orange		374.0				
Residue		1,669.0				
Total Hardness		91.5				

O'FALLON (2373) (p. 482). Since 1930 all water for the public supply has been filtered river water purchased from the East St. Louis and Interurban Water Company.

OGLESBY (3910) (p. 483.) A well 1700 feet deep drilled in 1931 by Layne North Central Company, is located in the southern part of the city. It was cased with 20-inch pipe to a depth of 102 feet, with 16-inch pipe from 102 to 306 feet, with 13-inch pipe from 306 to 567 feet, with 10-inch pipe from 567 to 880 feet, and with 8-inch pipe from 975 to 1255 feet.

One report stated that the water level was at a depth of 120 feet when not pumping and was lowered 200 feet by pumping at a rate of 170 gallons per minute. Another report stated that the yield was not 170, but 110 gallons per minute.

In 1932-1933 the well was deepened by the Sewell Well Company of St. Louis. When the well was 2240 feet deep the water level was at a depth of 115 feet when not pumping and was lowered 175 feet by pumping at a rate of 350 gallons per minute. Drilling was continued to a final depth of 2784 feet. The water level was then at a depth of 103 feet when not pumping and was lowered 67 feet by pumping at a rate of 362 gallons per minute. During the process of deepening the well the 8-inch liner was removed and a continuous string of 8-inch pipe installed from the ground surface to a depth of 1715 feet. When drilling was completed not all of this pipe could be removed. At present the 8-inch liner extends from 906 to 1715 feet. Except for this change the casing record is the same as that given for the original well.

A detailed record of material penetrated is available. A condensed log of the well is as follows:

	Thickness in feet.	Depth in feet.
Drift	98	98
Coal measures, Pennsylvanian	670	768
Dolomite, Silurian	237	1005
Shale, Maquoketa	170	1175
Limestone, Galena-Platteville	370	1545
Sandstone, Glenwood	25	1570
Sandstone, St. Peter	130	1700
Dolomite, Shakopee	170	1870
Sandstone, New Richmond	130	2000
Dolomite, Oneota	175	2175
Sandstone, dolomite, Jordan	20	2195
Dolomite, Trempealeau, Franconia	385	2580
Sandstone, Dresbach	200	2780
Dolomite, Eau Claire	4	2784

The elevation of the ground surface at the well is between 625 and 630 feet above sea level.

The well is equipped with a 10-inch, 7-stage Layne turbine pump with 159 feet of column pipe and 21 feet of suction pipe. A small air-line terminates at a point 180½ feet below the pump base. Water is pumped over a coke-tray aerator into a collecting reservoir. The aerator has proved most effective in removing the small amount of hydrogen sulfide and more than 90 per cent of the free carbon dioxide in the raw water. Prom the reservoir the water is pumped by a centrifugal pump

to an elevated steel tank connected to the distribution system. The well and service pumps are driven by 50 and 20-horsepower electric motors, respectively.

The water from the finished well had a total residue of 814, a total hardness of 311, and a content of iron of 0.9 parts per million as shown by the analysis of sample number 73171, collected June 1, 1933.

Analysis of Sample Number 73171 from Well 2785 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.9	Sodium Nitrate	$NaNO_3$	.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	432.5	25.25
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	85.9	5.01
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	.7	.04
Calcium	Ca	83.0	Magnesium Chloride	$MgCl_2$	2.4	.14
Magnesium	Mg	25.2	Magnesium Carbonate	$MgCO_3$	85.7	5.00
Ammonium	NH_4	.09	Calcium Carbonate	$CaCO_3$	192.5	11.24
Sodium	Na	198.2	Calcium Silicate	$CaSiO_3$	17.4	1.02
Sulfate	SO_4	60.3	Iron Oxide	Fe_2O_3	1.3	.08
Nitrate	NO_3	.2				
Chloride	Cl	262.4	Total		819.3	47.83
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		294.0				
Residue		814.0				
Total Hardness		311.0				

OHIO (510) (p. 485). The east well (388 feet deep) described on page 485 has been abandoned and the west well, (385 feet deep), is now equipped with a Cook deep-well cylinder pump, belt driven from a Wagner electric motor. It is used only for emergency.

Water for the public supply is now obtained from a well 8 inches in diameter at the top and 404 feet deep. It was drilled in 1933 by Jonah Stultz at a point 14 feet north of the old west well. The well is cased with 390 feet of 8-inch casing to the bottom of which is attached a 14-foot length of a 7½-inch Johnson screen.

The well is equipped with a Pomona deep-well turbine pump, rated at 100 gallons per minute, direct-connected to a 15-horsepower Westinghouse electric motor. At the time of the pump installation static water level was 250 feet below ground surface.

The well pump discharges into a 76,000-gallon concrete surface reservoir built in 1933. From the reservoir the water is pumped to the distribution system and elevated tank by a centrifugal pump, rated at 150 gallons per minute, powered by a 10-horsepower General Electric motor. There are 165 service connections, 80 of which are metered.

The water has a total residue of 284, a total hardness of 111, and an iron content of 1.6 parts per million as shown by the analysis of sample number 83695, collected June 6, 1938.

Analysis of Sample Number 83695 from 404-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.6	0.15
(filtered)		0.3	Sodium Carbonate	Na_2CO_3	156.0	9.10
(unfiltered)		1.6	Ammonium Carbonate	$(NH_4)_2CO_3$	5.7	0.33
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	20.7	1.21
Silica	SiO_2	14.5	Calcium Carbonate	$CaCO_3$	86.6	5.05
Turbidity		12.0	Iron Oxide	Fe_2O_3	0.4	0.02
Color		40	Silica	SiO_2	14.5	0.85
Odor		0				
Calcium	Ca	34.5	Total		286.5	16.71
Magnesium	Mg	6.0				
Ammonium	NH_4	2.5				
Sodium	Na	68.4				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.9				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		264.0				
Residue		284.0				
Total Hardness		111.0				

OKAWVILLE (647). Okawville is located in the northwestern part of Washington County on the drainage area of Kaskaskia River, a tributary of Mississippi River. Private wells of two types have been in use. They are either shallow dug wells or drilled wells penetrating sandstone at depths of 175-200 feet. Water from the deeper wells is highly mineralized and hard.

Water for the public supply, installed by the village in 1936, is obtained from a well two miles north of the village in the valley of Kaskaskia River. The well was drilled in 1936 by the Layne-Western Company and is of the gravel-walled type. The bottom of the 25-foot length of 10-inch Layne screen is at a depth of 69 feet 9 inches.

The water level was at a depth of 10½ feet when not pumping and was lowered 4½ feet by pumping at a rate of 42 gallons per minute.

The well is equipped with a Layne turbine pump rated at 75 gallons per minute and driven by a 3-horsepower electric motor. Water is pumped to a lime-soda softening plant with a pressure filter, 84 inches in diameter. The service pump is a Fairbanks-Morse centrifugal pump rated at 50 gallons per minute and driven by a 5-horsepower electric motor.

Water from this well had a total residue of 605, a total hardness of 433, and a content of iron of 12.0 parts per million as shown by the analysis of sample number 77663, collected March 24, 1936.

Analysis of Sample Number 77663 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.0	Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		12.0	Sodium Chloride	NaCl	23.4	1.36
Manganese	Mn	1.0	Sodium Sulfate	Na_2SO_4	78.8	4.59
Silica	SiO_2	16.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Turbidity		50.0	Magnesium Sulfate	$MgSO_4$	151.6	8.84
Calcium	Ca	123.6	Calcium Sulfate	$CaSO_4$	4.1	0.24
Magnesium	Mg	30.1	Calcium Carbonate	$CaCO_3$	306.0	17.85
Ammonium	NH_4	0.2	Manganese Oxide	MnO	1.3	0.08
Sodium	Na	35.2	Silica	SiO_2	16.0	0.93
Sulfate	SO_4	175.5				
Nitrate	NO_3	1.1	Total		583.6	34.03
Chloride	Cl	14.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		306.0				
Residue		605.0				
Total Hardness		433.0				

OLNEY (6140) (p. 710). The raw water supply of the city of Olney is obtained from an impounding reservoir on Pox River. The water is treated before entering the distribution system.

OLYMPIA FIELDS (143). The village well was purchased from Brown and Hammer, realtors, who drilled it about 1924 to supply the homes in the subdivision development.

The well is 8 inches in diameter by 130 feet deep. Water overflows the well during the winter when the demand is light and when the wells at the country club are not being pumped.

The well is equipped with an American Well Works pump that delivers water to a steel pressure tank that supplies water under pressure to 16 metered customers.

The water had a total residue of 705, a total hardness of 523.0, and an iron content of 0.0 parts per million as shown by the analysis of sample number 82519, collected December 5, 1937.

Analysis of Sample Number 82519 from Village Well 130 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	3.4	0.20
Manganese	Mn	0.0	Sodium Chloride	NaCl	3.5	0.20
Silica	SiO_2	13.0	Sodium Sulfate	Na_2SO_4	82.2	4.79
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	236.5	13.80
Color		0	Magnesium Carbonate	$MgCO_3$	16.8	0.98
Odor		0	Calcium Carbonate	$CaCO_3$	306.0	17.80
Calcium	Ca	122.4	Silica	SiO_2	13.0	0.76
Magnesium	Mg	52.9				
Ammonium	NH_4	trace	Total		661.4	38.53
Sodium	Na	29.0				
Sulfate	SO_4	245.0				
Nitrate	NO_3	2.7				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		326.0				
Residue		705.0				
Total Hardness		523.0				

The Olympia Fields Country Club has two wells that are pumped by power pumps during the summer season. Well number 1 is 370 feet deep and well number 2 is 187 feet deep. They are about 500 feet apart. The operation of these wells affects the water level at the village well. In addition to the two power operated wells there are nine hand-pump wells scattered over the property.

ONARGA (1469) (p. 486). No reported change.

Sample number 67457 was collected September 22, 1930 from the north well. The water had a total residue of 920, a total hardness of 592, and a content of iron of 1.6 parts per million as shown by the analysis.

Analysis of Sample Number 67457 from North City Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.6	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	.1	Sodium Chloride	NaCl	16.4	.96
Silica	SiO_2	21.0	Sodium Sulfate	Na_2SO_4	186.9	10.90
Turbidity		10.0	Ammonium Sulfate	$(NH_4)_2SO_4$	7.3	.42
Calcium	Ca	141.2	Magnesium Sulfate	$MgSO_4$	288.3	16.82
Magnesium	Mg	58.3	Calcium Sulfate	$CaSO_4$	53.1	3.10
Ammonium	NH_4	2.1	Calcium Carbonate	$CaCO_3$	314.1	18.33
Sodium	Na	67.5	Iron Oxide	Fe_2O_3	2.2	.13
Sulfate	SO_4	399.7	Manganese Oxide	MnO	0.1	.01
Nitrate	NO_3	1.2	Silica	SiO_2	21.0	1.23
Chloride	Cl	10.0				
Alkalinity as $CaCO_3$			Total		891.1	52.00
Phenolphthalein		0.0				
Methyl Orange		314.0				
Residue		920.0				
Total Hardness		592.0				

OQUAWKA (777) (p. 487). The source of water for the public supply is reported on page 487. About twice as many well points are now in use, but the supply of water is still inadequate for the needs of the village.

The water had a mineral content of 280, a total hardness of 226, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 60366, collected October 10, 1927.

Analysis of Sample Number 60366 from the Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Potassium Nitrate	KNO_3	3.7	.22
Manganese	Mn	0.0	Sodium Nitrate	$NaNO_3$	32.6	1.90
Silica	SiO_2	22.5	Magnesium Nitrate	$Mg(NO_3)_2$	12.8	.75
Nonvolatile		0.5	Magnesium Chloride	$MgCl_2$	13.9	.81
Alumina	Al_2O_3	0.9	Magnesium Sulfate	$MgSO_4$	51.2	3.00
Calcium	Ca	63.2	Calcium Sulfate	$CaSO_4$	0.9	.05
Magnesium	Mg	16.6	Calcium Carbonate	$CaCO_3$	151.5	8.86
Ammonium	NH_4	0.0	Silica	SiO_2	22.5	1.31
Potassium	K	1.5	Iron Oxide	Fe_2O_3	0.0	.00
Sodium	Na	9.1	Alumina	Al_2O_3	0.9	.05
Sulfate	SO_4	40.1	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	35.4	Nonvolatile		0.5	.03
Chloride	Cl	10.0				
Alkalinity as $CaCO_3$			Total		290.5	16.98
Phenolphthalein		0.0				
Methyl Orange		146.0				
Residue		280.0				

ORANGEVILLE (383). Orangeville is located in the north central part of Stephenson County on the east side of Eichland Creek, a tributary of Pecatonica River.

A public water supply was installed during 1896 and 1897. From the records it appears that Mr. E. Wareham of Freeport was awarded the contract to drill an 8-inch well which is thought to be about 200 feet deep. The well was equipped with a Fairbanks-Morse deep-well cylinder type of pump.

In 1904 a new 12-inch well was drilled by P. E. Millis to a reported depth of 250 to 300 feet. The well was originally equipped with a Goulds triplex pump set in a pit 21 feet deep surrounding the well. About 1932 the well casing was extended to the surface, the pit filled and the well equipped with a Fairbanks-Morse deep-well turbine pump direct connected to a 25-horsepower Fairbanks-Morse electric motor. The pump operates at 1800 revolutions per minute and is rated to deliver 275 gallons per minute.

An elevated wooden tank having a capacity of 47,000 gallons and supported on a brick masonry tower is connected to the distribution system. Pressures of from 50 to 60 pounds per square inch are maintained in the distribution system.

Water from the well drilled by Mr. Millis had a total residue of 308, a total hardness of 291, and a content of iron of 1.1 parts per million as shown by the analysis of sample number 82736, collected January 6, 1938.

Analysis of Sample Number 82736 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	15.3	0.89
(filtered)		.2	Magnesium Nitrate	$Mg(NO_3)_2$	2.2	0.13
(unfiltered)		1.1	Magnesium Chloride	$MgCl_2$	10.9	0.64
Manganese	Mn	.32	Magnesium Sulfate	$MgSO_4$	13.2	0.77
Silica	SiO_2	17.0	Magnesium Carbonate	$MgCO_3$	115.1	6.71
Turbidity		6.0	Calcium Carbonate	$CaCO_3$	130.0	7.58
Color		0.0	Iron Oxide	Fe_2O_3	0.3	0.02
Odor		C	Manganese Oxide	MnO	0.4	0.02
Calcium	Ca	52.0	Silica	SiO_2	17.0	0.99
Magnesium	Mg	39.3				
Ammonium	NH_4	trace	Total		304.4	17.75
Sodium	Na	4.1				
Sulfate	SO_4	10.5				
Nitrate	NO_3	13.3				
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		267.0				
Residue		308.0				
Total Hardness		291.0				

OREGON (2376) (p. 488). The well and pumps described on pages 488 and 489 are still in use but the old reservoirs have been abandoned. The top of the well casing has been sealed and no water is allowed to run to waste. The service pumps take suction directly from the well and discharge into the distribution system.

ORIENT CITY (1267). Orient City is located in the southern part of Franklin County on, the drainage area of Middle Fork of Big Muddy River, a tributary of Mississippi River. A public water supply was installed in 1913.

Water for the public supply is obtained from the water ring at a depth of 175 feet in the shaft of the Orient mine. This mine is owned by the Chicago, Wilmington and Franklin Coal Company. The water is pumped by the coal company and furnished without cost to the residents of the town.

The water had a total residue of 555, a total hardness of 367.5, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 72329, collected January 17, 1933.

Analysis of Sample Number 72329 from the Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.2	Sodium Nitrate	$NaNO_3$	13.6	.79
Manganese	Mn	0.0	Sodium Chloride	NaCl	70.7	4.13
Silica	SiO_2	18.0	Sodium Sulfate	Na_2SO_4	95.2	5.55
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	23.8	1.39
Calcium	Ca	85.6	Magnesium Carbonate	$MgCO_3$	129.4	7.56
Magnesium	Mg	37.4	Calcium Carbonate	$CaCO_3$	214.0	12.50
Ammonium	NH_4	.02	Iron Oxide	Fe_2O_3	.3	.02
Sodium	Na	72.7	Silica	SiO_2	18.0	1.05
Sulfate	SO_4	64.2				
Nitrate	NO_3	9.73	Total		565.0	32.99
Chloride	Cl	43.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		390.0				
Residue		555.0				
Total Hardness		367.5				

ORION (620). Orion is located in the western part of Henry County on the drainage area of Mosquito Creek, a tributary of Rock River. A public water supply was installed by the village in 1928.

Water for the public supply is secured from a well, 615 feet deep, drilled by R. J. Bauereisen in 1928. It is located on the south side of Jackson Street between Girard and Bank Streets. The elevation of the ground surface is about 770 feet above sea level. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	80	80
Clay	83	163
Sand and gravel	28	191
Red rock	11	202
Blue slate, soft	44	246
Blue lime, soft	10	256
Gray lime, hard	114	370
Shale	5	375
Sandstone	7	382
Gray lime, soft	233	615

The well is cased with 10-inch pipe from the ground surface to a depth of 250 feet and with 8-inch pipe from 222 to 405 feet. Below the casing the diameter is 8 inches.

The water level was at a depth of 205 feet when not pumping. When pumping at a rate of 115 gallons per minute the water level was lowered 37 feet.

The temperature of the water was 53° F. The water had a total residue of 545, a total hardness of 212, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 61281, collected March 9, 1928.

Analysis of Sample Number 61281 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	0.8	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	6.6	0.38
Silica	SiO_2	14.0	Sodium Sulfate	Na_2SO_4	38.9	2.27
Alumina	Al_2O_3		Sodium Carbonate	Na_2CO_3	200.8	11.71
(filtered)		1.4	Ammonium Carbonate	$(NH_4)_2CO_3$	8.2	0.48
(unfiltered)		22.4	Magnesium Carbonate	$MgCO_3$	86.3	5.03
Calcium	Ca	44.0	Calcium Carbonate	$CaCO_3$	109.8	6.40
Magnesium	Mg	24.9	Iron Oxide	Fe_2O_3	0.6	0.03
Ammonium	NH_4	3.1	Alumina*	Al_2O_3	1.4	0.08
Sulfate	SO_4	26.3	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.6	Silica	SiO_2	14.0	0.82
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$			Total		467.4	27.25
Phenolphthalein		0.0	* An additional 22.4 ppm. Al_2O_3 and 15.5 ppm. SiO_2 were in suspension.			
Methyl Orange		410.0				
Residue		545.0				

OELAND PAEK (571) (p. 490). The source of the public water supply is the same as described on page 490. In 1929 the old Goulds single-acting pump was replaced with a double-acting deep-well cylinder pump of the same size and make, the cylinder being placed at a depth of 180 feet. When operating at a speed of 28 strokes per minute a delivery of 56 gallons per minute was obtained.

Static water level was reported to be 40 feet below the pump base on April 26, 1932.

Sometime between 1932 and 1938 the deep-well cylinder pump was replaced by an American Well Works, 6-inch deep-well turbine pump, rated at 150 gallons per minute against a 170-foot head when operating at 2550 revolutions per minute. The pump assembly consists of 100 feet of 4-inch column pipe, 9 stages of bowls having an over-all length of 4 feet 4 inches, and 10 feet of 3½-inch suction pipe.

The pump is powered by a 15-horsepower U. S. electric motor operating at 850 revolutions per minute. The motor is connected to the pump by a right angle spiral gear arrangement which permits a speed ratio of 1:3.

When tested after installation, a production of 235 gallons per minute was obtained without breaking suction. The normal operating rate of discharge is 200 gallons per minute.

The Capitol Dairy has a private well that is 4 inches in diameter at the top by 110 feet deep. It is thought the well was somewhat deeper

when completed more than 40 years ago. The well is equipped with a steam-operated direct-action suction pump which operates about 8 hours per day at a rate of 20 gallons per minute.

OSWEGO (932) (p. 490). In 1932 B. L. Palmer and Sons of Aurora drilled a well 720 feet deep located in the southwest corner of the triangular block on the west side of the main road to the southeast of Oswego. The well was drilled 10½ inches in diameter to 192 feet and cased with 8-inch casing from the ground surface to a depth of 192 feet. The hole is 8 inches in diameter from 192 feet to 200 feet and 6 inches in diameter from 200 feet to 720 feet. The static water level was 90 feet and the water level was 175 feet below the ground surface when pumping at a rate of 100 gallons per minute.

A blue-print log of the well prepared by the State Geological Survey indicates that the following materials were penetrated:

	Thickness in feet.	Depth in feet.
Drift	24	24
Limestone, Alexandrian	21	45
Shale, Richmond	147	192
Limestone, Galena	243	435
Limestone, Platteville	105	540
Limestone, Glenwood	10	550
Sandstone, St. Peter	170	720

The St. Peter sandstone was very compact and hard and the yield was less than is obtained from other wells in this area.

Water is pumped from the well by a 10-stage, turbine pump rated at 120 gallons per minute. The drop pipe is 150 feet long and 10 feet of 4-inch suction pipe is attached to the bottom of the bowls. Power is furnished by a 15-horsepow.er U. S. electric motor. In August 1932 the static water level was 90 feet below the ground surface and the draw down was 120 to 125 feet. The old well located in the business district is available but seldom used.

An analysis of sample number 70544, collected March 14, 1932, shows a total residue of 461, a total hardness of 180, and an iron content of 0.0 parts per million.

Analysis of Sample Number 70544 from the Village Well 720 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.0	Sodium Nitrate.....$NaNO_3$	.9	.05
Manganese..Mn	0.0	Sodium Chloride.....NaCl	44.5	2.59
Silica.....SiO_2	13.0	Sodium Sulfate.....Na_2SO_4	155.5	9.05
Calcium.....Ca	32.3	Sodium Carbonate.....Na_2CO_3	90.1	5.25
Magnesium..Mg	24.1	Ammonium Carbonate..$(NH_4)_2CO_3$	2.9	.17
Ammonium..NH_4	1.1	Magnesium Carbonate..$MgCO_3$	83.5	4.85
Sodium.....Na	107.2	Calcium Carbonate.....$CaCO_3$	81.1	4.73
Sulfate.....SO_4	105.3	Silica.....SiO_2	13.0	.76
Nitrate.....NO_3	.4			
Chloride.....Cl	27.0	Total.....	471.5	27.45
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	268.0			
Residue.....	461.0			
Total Hardness....	180.0			

OTTAWA (15,094) (p. 492). On page 492 it is stated that four of the original wells were deepened in 1906. Evidently this work was done in 1896 as reference to the work is given in a report made in 1901. This report further stated that one of the wells was drilled to a depth of 1750 feet and the flow was great enough to throw an 8-inch stream 30 feet into the air.

In 1926 it was reported that the wells in use were 1120, and not 1200 feet deep. One of the wells was abandoned in 1926 and a new well was drilled by J. Otis Heflin of Joliet. It was 1120 feet deep and 10 inches in diameter at the bottom. It was cased with 10-inch pipe to a depth of 288 feet. It caused the water level in the other wells to rise about nine feet. The flow from the wells was very slight in 1927.

In 1931-1932 a well was drilled by the Layne North Central Company at State Street and Watson Avenue on the south side of Illinois River. Numerous difficulties were encountered in drilling and almost a year was required to reach the final depth of 1290 feet. The well yielded more than 900 gallons per minute but the mineral content of the water was so high as to render it unfit for use. The well was abandoned. A detailed record of material penetrated is available.

Another well located near the intersection of Joliet and Kendall Streets was drilled in 1932 by the Layne North Central Company. It is 1178 feet deep and 15 inches in diameter at the bottom. It is cased with 16-inch pipe to a depth of 272 feet. The elevation of the ground surface at the well site is about 488 feet above sea level. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Sandstone, St. Peter	165	165
Dolomite, Shakopee	130	295
Sandstone, New Richmond	110	405
Dolomite, Oneota	160	565
Sandstone, dolomite, Jordan	45	610
Dolomite, Trempealeau	245	855
Sandstone, dolomite, Franconia, Ironton	215	1070
Sandstone, Dresbach	108	1178

This well began flowing when drilling had reached a depth of 790 feet. The rate of free flow at the top of the finished well was between 10 and 20 gallons per minute. The water level was lowered to a depth of 123 feet by pumping at a rate of 1260 gallons per minute. Pumping 1100 gallons per minute from the well lowered the water level to a depth of 63 feet.

Samples of water for chemical analysis were collected at 100-foot intervals of drilling. These indicated that the most desirable water from the chemical standpoint was to be obtained at the 350-foot or the 900-foot levels. Water from the finished well had a total residue of 531, a total hardness of 282.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 82438, collected November 24, 1937.

Analysis of Sample Number 82438 from Joliet Street Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		5.1	0.30
(filtered).....	0.0	Sodium Chloride.....NaCl		208.0	12.10
(unfiltered).....	0.4	Sodium Sulfate.....Na_2SO_4		8.4	0.49
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3		20.7	1.21
Silica.....SiO_2	13.0	Magnesium Carbonate..$MgCO_3$		83.0	4.84
Turbidity.....	2.0	Calcium Carbonate.....$CaCO_3$		184.0	10.70
Color.....	0	Silica.....SiO_2		13.0	0.76
Odor.....	0				
Calcium.....Ca	73.6	Total.....		522.2	30.40
Magnesium..Mg	24.0				
Ammonium..NH_4	trace				
Sodium.....Na	95.0				
Sulfate.....SO_4	5.5				
Nitrate.....NO_3	3.6				
Chloride.....Cl	126.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	302.0				
Residue.....	531.0				
Total Hardness....	282.5				

PALATINE (2118) (p. 494). The 2-inch well called well number 1 has been abandoned but well number 2 (6 inch) and well number 3 (10 inch) still furnish water for the public supply.

Well number 2 is equipped with a 6-inch Layne deep-well turbine pump, consisting of column pipe, 15 stages of pump and 20 feet of suction pipe, which was an over-all length of 130 feet. The pump is direct connected to a 20-horsepower General Electric Company electric motor and delivers 175 gallons per minute when operating at a speed of 1755 revolutions per minute. This well furnishes most of the water and usually operates from seven to eight hours per day.

Well number 3 is equipped with a 6-inch Layne deep-well turbine pump, consisting of column pipe, a 15-stage bowl assembly, and 20 feet of suction pipe, which has an over-all length of 130 feet. The pump is direct connected to a 30-horsepower General Electric Company electric motor and delivers 250 gallons per minute when operating at a speed of 1755 revolutions per minute. This well is seldom used.

Both wells flow when the pumps are not operating, the water being wasted into the old ground reservoir which in turn is connected to the sewer. The centrifugal service pump, as well as the two steam service pumps as described on page 495, have all been abandoned.

In 1927 a new village hall and pumping station house was erected at the location of the old station and a new 100,000-gallon elevated storage was constructed at the side of the old stand-pipe.

PALESTINE (1670) (p. 497). Palestine is supplied with water by the Central Illinois Public Service Company from the same wells and water works pumping station that supply water to Eobinson and Oblong. The water works station is located on company property situated a short distance west of the west village limits. The distribu-

tion system is maintained under direct pressure. For description of plant see Eobinson.

Water is sold directly to the subscriber at the following rates:

27 cents per 100 cu. ft. for the first 2,600 cu. ft. per month.
18 cents per 100 cu. ft. for the next 6,700 cu. ft. per month.
11.7 cents per 100 cu. ft. for the next 6,700 cu. ft. per month.
7.2 cents per 100 cu. ft. for the next 16,000 cu. ft. per month.
5.4 cents per 100 cu. ft. for the next 40,000 cu. ft. per month.

The minimum charge is $1.00 per month for residential users and $25.00 per month for subscribers taking the lowest rate.

PANA (5835) (p. 497). Since 1925 the well supply has been abandoned and all water secured from an impounding reservoir known as Pana Eeservoir. The water is treated before entering the distribution system.

PARIS (8781) (p. 710). Raw water for the public supply is obtained from two reservoirs known as Twin Lakes. One reservoir is on Silver Creek and the other on Sugar Creek. The water is treated before entering the distribution system.

PARK RIDGE (10,417) (p. 499). The well water supply has been discontinued and water from Lake Michigan is now obtained from the city of Chicago. In 1933 the wells were still held in reserve for summer draft if needed.

PAWNEE (959). Pawnee purchases water from the city of Springfield. The distribution system was installed in 1935.

PAW PAW (559) (p. 501). No reported change in the source of the public water supply.

PAXTON (2,892) (p. 502). The city of Paxton obtains its water supply from three wells. Two of these wells are described on page 503 and the third was drilled by E. W. Johnson of Bloomington in 1930. All other wells formerly used by the city have been abandoned and plugged.

The 8-inch well, 148 feet deep, located at the city hall has been equipped with a 6-inch, 11-stage Fairbanks-Morse turbine pump. The column pipe is 120 feet long and 10 feet of suction pipe is attached to the bottom of the bowls. The pump is driven by a 5-horsepower Fairbanks-Morse electric motor. Water is pumped from the well to a collecting reservoir 38 feet in diameter.

The well drilled in 1921 by Otto Stiegman near State and Taft Streets has been equipped with an 8-inch, 9-stage Sterling pump rated at 150 gallons per minute against a total head of 250 feet. The pump bowls are attached to 130 feet of 4-inch drop pipe. Ten feet of suction pipe is attached below the bowls. The pump is driven by a 15-horsepower Westinghouse electric motor.

The well drilled in 1930 by E. W. Johnson is located approximately fifty feet east of Taft Street and ten feet south of the alley between State and Holmes Streets. It is 150 feet deep and 10 inches in diameter. A Johnson screen 10 inches in diameter and 21 feet long is installed in the well. Water is pumped by an 8-inch, 15-stage Sterling pump rated at 250 gallons per minute against a total head of 250 feet. The pump bowls are attached to 130 feet of 5-inch drop pipe. Seven feet of 5-inch suction pipe is attached to the bottom of the bowls.

In 1938 the water rates were revised to be:

60 cents per 1000 gallons for the first 3,000 gallons.
50 cents per 1000 gallons for the next 7,000 gallons.
45 cents per 1000 gallons for the next 10,000 gallons.
40 cents per 1000 gallons for the next 10,000 gallons.
20 cents per 1000 gallons for the next 70,000 gallons.
15 cents per 1000 gallons for all over 100,000 gallons.
The minimum charge is $1.50 per quarter.

PAYSON (414). Payson is located in the south part of Adams County on a ridge between the drainage basins of Pigeon Creek and Pall Creek, both tributaries of Mississippi River.

The public water supply is obtained from a rock well reported to be either 315 or 345 feet deep. The well is equipped with a deep-well cylinder pump, the cylinder being set at a depth of 180 feet. It is reported that the well will produce more than 60 gallons per minute. Water pressure is maintained by a 60,000-gallon elevated water tank. In addition to fire protection fourteen private subscribers use water from the public supply.

The water had a total residue of 286, a total hardness of 215 and a content of iron of 0.0 parts per million as shown by the analysis of sample number 81496 collected July 16, 1937.

Analysis of Sample Number 81496 from the Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	43.4	2.53
(unfiltered)		0.0	Sodium Chloride	NaCl	1.2	0.07
Manganese	Mn	0.0	Magnesium Chloride	$MgCl_2$	23.3	1.36
Silica	SiO_2	10.0	Magnesium Sulfate	$MgSO_4$	15.1	0.88
Turbidity		0.0	Magnesium Carbonate	$MgCO_3$	10.9	0.64
Calcium	Ca	66.0	Calcium Carbonate	$CaCO_3$	165.1	9.63
Magnesium	Mg	12.1	Silica	SiO_2	10.0	0.58
Sodium	Na	12.2				
Sulfate	SO_4	12.1	Total		269.0	15.69
Nitrate	NO_3	31.9				
Chloride	Cl	18.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		178.0				
Residue		286.0				
Total Hardness		215.0				

PEARL (492) (p. 504). No record of change.

PEARL CITY (406) (p. 505). The 8-inch well 322 feet deep reported on page 506 and from which the village obtained its water up until 1925 was deepened to 438 feet during that year by Gus Nelson of Hayfield, Minnesota. The top of the well is about 8 feet below the railroad track at the depot or 815 feet above sea level. The well is cased with 8-inch casing to rock (Galena-Platteville dolomite) at a depth of 40 feet. St. Peter sandstone was entered at a depth of 402 feet. When this well was originally drilled it was equipped with an A. Y. McDonald deep-well cylinder pump. The pump was of the double-stroke type and consisted of a 4¾-inch diameter cylinder by 24-inch stroke, attached to 200 feet of discharge pipe. The pump operated at 25 strokes per minute. The capacity of the pump was estimated at 5520 gallons per hour. The well would not maintain this rate, however, for after pumping for one hour air would be discharged with the Water. After the well was deepened to 428 feet the same pump was reinstalled but the cylinder was set 65 feet lower or to 265 feet. After resetting the pump was operated at only 16 revolutions per minute.

In July 1932 the cylinder pump was removed and a Pomona deep-well turbine pump installed. The installation consisted of 225 feet of column pipe, 14 feet of bowls and 13 feet of suction pipe. Power was supplied by a Westinghouse overhead electric motor rated at 20-horsepower and which operated at the full load speed of 1760 revolutions per minute.

The elevated storage tank is 22 feet in diameter and the pump will increase the storage at a rate of about 2 feet per hour while at the same -time it supplies the municipal demand.

Water from this well had a mineral content of 425, a total hardness of 408, and a content of iron of 1.4 parts per million as shown by the analysis of sample number 57795, collected January 1925.

Analysis of Sample Number 57795 from Village Well 428 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	1.4	Potassium Nitrate.....KNO_3	0.1	0.01
Manganese..Mn	0.0	Potassium Chloride.....KCl	4.8	0.28
Silica.....SiO_2	9.3	Sodium Chloride.....NaCl	40.7	2.38
Nonvolatile.....	0.8	Sodium Sulfate.....Na_2SO_4	9.9	0.58
Alumina.....Al_2O_3	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	1.5	0.09
Calcium.....Ca	83.1	Magnesium Sulfate.....$MgSO_4$	22.0	1.29
Magnesium..Mg	43.9	Magnesium Carbonate..$MgCO_3$	134.1	7.84
Ammonium..NH_4	0.4	Calcium Carbonate.....$CaCO_3$	203.7	11.91
Potassium...K	2.6	Silica.....SiO_2	9.3	0.54
Sodium.....Na	19.6	Iron Oxide.....Fe_2O_3	2.0	0.12
Sulfate.....SO_4	24.9	Alumina.....Al_2O_3	0.0	0.00
Nitrate.....NO_3	0.1	Manganese Oxide.....MnO	0.0	0.00
Chloride.....Cl	26.5	Nonvolatile.....	0.8	0.05
Alkalinity as $CaCO_3$				
Phenolphthalein..		Total.....	428.9	25.09
Methyl Orange...	356.0			
Residue.....	425.0			
Total Hardness....	408.0			

Until 1925 the Sullivan Milk Company obtained water from two wells 85 and 104 feet deep, both of which were reported as having pene-

trated into rock formations. Water was drawn from these wells by direct suction, the suction pipe extending into each well to a depth of 25 feet.

During the year 1925 a third well, located some 50 to 60 feet from the village's 428-foot well, was drilled 10 inches in diameter to a depth of 421 feet. This well was first equipped with a steam head direct acting deep-well cylinder pump with the cylinder set at 265 feet. It was reported that the well could be pumped at a rate of 125 gallons per minute.

During December 1925 the well was equipped with an air-lift pump. The 7-inch eductor pipe extended 200 feet into the well and to a height of 32 feet above the top of the well. The air pipe was installed inside the eductor pipe and consisted of 185 feet of 2½-inch pipe. A pressure of 50 pounds was carried. The discharge was at a rate of 55 gallons per minute.

Static water level on February 12, 1927 was given by the company as 32 feet. After 7 hours and 15 minutes of pumping during which time the village well was also in operation the pumping level receded to 86 feet, which represented a draw down of 54 feet. The operation of the village well has a marked influence on the milk company well.

The Dean Milk Company, successor to the Sullivan Milk Company, had a new well constructed in 1937 by P. E. Millis at a point about 200 feet east of the village well. This well, drilled to a depth of 1040 feet, is cased with 10-inch pipe from the surface to a depth of 115 feet. It is equipped with a Layne deep-well turbine pump, consisting of 200 feet of 7-inch column pipe, 5 stages (4'-8") of 9½-inch outside diameter bowls and 20 feet of 6-inch suction pipe. The pump is powered by a General Electric overhead electric motor, which operates at a full load speed of 1765 revolutions per minute.

Static water level was reported in December 1937 as 57 feet and that a draw down of 30 feet occurred when the pump was delivering 720 gallons per minute.

PECATONICA (1152) (p. 507). Water for the public supply is now obtained from a new well drilled in 1936 by P. E. Millis of Byron. The dug well described on page 507 is seldom used and the pipe line from the spring has been plugged. All of the old pumping equipment has been removed from the station.

The new well, located 30 feet north of the dug well in the southern part of the village, is 660 feet deep, 10 inches in diameter, and cased with 45 feet of 10-inch pipe.

The driller's log of the material penetrated shows St. Peter sandstone between depths of 115 and 350 feet and[1] Galesville sandstone between depths of 555 and 660 feet.

When tested on December 4, 1936 the static water level was reported to be at a depth of 15 feet and the draw down was 18 feet when pumping at the rate of 240 gallons per minute. In 1938 the static level was said to be at a depth of 8 feet.

The well is equipped with a 3-stage, 10-inch Worthington turbine pump driven by a 10-horsepower electric motor. It discharges to

the suction side of a single-stage Advance centrifugal pump, rated at 450 gallons per minute and driven by a 20-horsepower electric motor, which discharges to the distribution system. In case of emergency, water can be pumped from the dug well by a centrifugal pump belt-driven by a 30-horsepower gasoline engine.

In 1938 there were 306 service connections in use. None were metered and customers were charged a flat rate of $1.00 per month. The daily pumpage was not known.

Additional private supplies not described on page 507 are a well owned by the Chicago and Northwestern Railway and a well owned by the Dean Milk Company. The latter was drilled in 1919 by William Piper, a local driller, and is 302 feet deep and 8 inches in diameter. Mr. Piper stated that the 8-inch casing was set at a depth of about 20 feet. Static water level is about 12 feet below the surface. The well is equipped with a Layne turbine pump, rated at 600 gallons per minute, which operates about 20 hours daily.

The temperature of the water from the new village well is 55° F. The water had a total residue of 350, a total hardness of 313, and a content of iron of 0.5 parts per million as shown by the analysis of sample number 84146, collected August 17, 1938.

Analysis of Sample Number 84146 from Well 660 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	10.0	0.58
(filtered)		trace	Magnesium Nitrate	$Mg(NO_3)_2$	28.2	1.65
(unfiltered)		0.5	Magnesium Chloride	$MgCl_2$	5.2	0.30
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	39.1	2.28
Silica	SiO_2	13.5	Magnesium Carbonate	$MgCO_3$	75.1	4.38
Turbidity		5.0	Calcium Carbonate	$CaCO_3$	167.0	9.73
Color		0.0	Silica	SiO_2	13.5	0.79
Odor		0.0				
Calcium	Ca	66.8	Total		338.1	19.71
Magnesium	Mg	35.5				
Ammonium	NH_4	trace				
Sodium	Na	2.8				
Sulfate	SO_4	31.3				
Nitrate	NO_3	31.0				
Chloride	Cl	4.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		256.0				
Residue		350.0				
Total Hardness		313.0				

PEKIN (16,129) (p. 508). The wells and pumps described on page 508 are still available, but are seldom used. All water is usually obtained from three wells installed by the Kelly Well Company of Grand Island, Nebraska. The concrete casings and screens in these wells have an inside diameter of 25 inches and an outside diameter of 32 inches.

Well number 1 is located near the corner of Broadway and Capitol Streets, is 90 feet deep, and has a screen below a depth of 37 feet. It yielded 390 gallons per minute with a draw down of 11 inches from a static level 27 feet below the ground surface. This well furnishes most

of the water used and is pumped about 8 hours daily by either of the two Allis-Chalmers centrifugal pumps set in a pit 20 feet deep. Each pump is rated at 1320 gallons per minute against a total head of 185 feet and is driven by a 100-horsepower electric motor.

Well number 2 is located near the corner of Fayette and Mechanic Streets, is 92 feet deep, and has a screen below a depth of 45 feet. It was constructed in 1931 and yielded 2200 gallons per minute with a draw down of 6 feet 2 inches from a static level 34 feet below the ground surface. It is equipped with a 3-stage, 15-inch Aurora turbine pump rated at 1400 gallons per minute against a total head of 300 feet and driven by a 150-horsepower electric motor. The pump consists of 40 feet of 10-inch column pipe, the bowl assembly 4 feet 7 inches long, and 10 feet of 10-inch suction pipe, and when the stand-pipe is nearly full will deliver 2000 gallons per minute against a head of 163 feet.

Well number 3 is located about 150 feet east of number 1 and was constructed in 1937. It is 100 feet deep and has a screen below a depth of 45 feet. When tested at a rate of 2400 gallons per minute the water level was lowered 9 feet and the water level in well number 1 was lowered one foot. This well is equipped with a 7-stage, 18-inch Aurora turbine pump rated at 3600 gallons per minute against a total head of 200 feet and driven by a 250-horsepower electric motor. The pump consists of 45 feet of 12-inch column pipe, the bowl assembly 10 feet 7 inches long, and 10 feet of 12-inch suction pipe.

All of these wells penetrate sand and gravel below a depth of about 5 feet. Wells numbers 2 and 3 are pumped not more than one hour daily. In 1938 there were 4-800 metered service connections in use, which required a daily pumpage of about 1,000,000 gallons.

Water from well number 2 had a total residue of 500, a total hardness of 433 parts per million and a trace of iron as shown by the analysis of sample number 73997, collected December 20, 1933.

Analysis of Sample Number 73997 from Well Number 2.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	trace	Sodium Nitrate.....$NaNO_3$	39.1	2.28
Manganese..Mn	0.0	Sodium Chloride.....NaCl	11.1	.65
Silica.....SiO_2	7.0	Magnesium Chloride....$MgCl_2$	19.0	1.11
Turbidity.....	0	Magnesium Sulfate.....$MgSO_4$	144.0	8.40
Calcium.....Ca	107.1	Magnesium Carbonate..$MgCO_3$	22.0	1.28
Magnesium..Mg	40.3	Calcium Carbonate.....$CaCO_3$	256.0	14.93
Ammonium..NH_4	.02	Calcium Silicate.....$CaSiO_3$	13.4	.78
Sodium.....Na	15.0			
Sulfate.....SO_4	115.2	Total.....	504.6	29.43
Nitrate.....NO_3	28.4			
Chloride.....Cl	21.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	282.0			
Residue.....	500.0			
Total Hardness....	433.0			

PEOEIA (104,969) (p. 509). There has been no reported change in the source of supply or pumping equipment except that practically all the supply is obtained from the main well at the pumping station and

from wells numbers 7, 8, 9 and 10, collectively known as the Sankoty wells. All other wells previously described are held in reserve and are not generally used.

Well number 10 was constructed in 1935 by the Kelly Well Company of Grand Island, Nebraska, and is located 680 feet northeast of number 9. It is 93 feet deep and has 23 feet 10 inches of concrete screen with an inside diameter of 25 inches and a wall thickness of 3½ inches. The well penetrates coarse sand, gravel, and stones below a depth of 57 feet.

The water level was 19 feet 6 inches below the pump house floor when not pumping and was lowered 6 feet 2 inches by pumping at a rate of 1980 gallons per minute.

This well is now equipped with a 5-stage, 18-inch Peerless turbine pump consisting of 73 feet of 14-inch column pipe, the bowl assembly 8 feet 2 inches long, and 5 feet of 12-inch suction pipe. The pump is rated at 2100 gallons per minute against a head of 110 feet and is driven by a 75-horsepower electric motor.

Well number 2 is now equipped with a single-stage, 14-inch Sterling turbine pump having 40 feet of 10-inch column pipe and no suction pipe. The pump is rated at 1400 gallons per minute against a head of 38 feet and is driven by a 25-horsepower electric motor.

The other wells are equipped with pumps as described on previous pages. All of these pumps are now driven by electric motors. All of the well pumps discharge into the steel tank in the main well, from where the water is pumped to the distribution system by three 2-stage De Laval centrifugal pumps driven by electric moters. Eatings of the pumps vary from 3150 to 6250 gallons per minute against a head of 330 feet. The steam driven Allis-Chalmers pump described on page 510 is available but is seldom used.

In the latter part of August, 1938 the week-day demand was close to 12,000,000 gallons. The Sankoty wells supply about one-half of this amount. To a major degree the water required by the industries is obtained by private wells. There are more than 60 industrial concerns, hotels, stores, theatres, hospitals, and parks that have private well supplies, the daily production of which is estimated to be about 50,000,000 gallons or more.

Many of these private wells obtain water from a sand and gravel deposit lying at a depth of 50 to 125 feet, depending on the location. This water is cold and is used by a number of stores for air cooling.

A well, 1298 feet deep, located in Logan Field Park was repaired and deepened in 1930 by the Gray-Mileager Drilling Company of Milwaukee. It is near the intersection of Livingston and Humboldt Streets in the western part of the city. It is now 1499 feet deep. It is cased with 10-inch pipe to a depth of 213 feet, with 8-inch pipe from 410 to 788 feet, and with 6-inch pipe from 213 to 1299 feet. The lower 20 feet of 6-inch pipe is perforated.

In 1930 the natural flow from this well was 312 gallons per minute. The temperature of the water was 62° F.

The water had a total residue of 1557, a total hardness of 249.5, and a content of iron of 0.7 parts per million as shown by the analysis of sample number 80060, collected January 4, 1934.

Analysis of Sample Number 80060 from Well 1499 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.7	Sodium Nitrate	$NaNO_3$	.8	.05
Manganese	Mn	0.1	Sodium Chloride	NaCl	415.0	24.20
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	925.0	53.90
Turbidity		0	Ammonium Sulfate	$(NH_4)_2SO_4$	5.3	.31
Calcium	Ca	60.9	Magnesium Sulfate	$MgSO_4$	3.0	.17
Magnesium	Mg	23.6	Magnesium Carbonate	$MgCO_3$	79.8	4.65
Ammonium	NH_4	1.4	Calcium Carbonate	$CaCO_3$	137.5	8.02
Sodium	Na	463.5	Calcium Silicate	$CaSiO_3$	17.4	1.02
Sulfate	SO_4	633.5	Iron Oxide	Fe_2O_3	1.0	.06
Nitrate	NO_3	.8	Manganese Oxide	MnO	.1	.01
Chloride	Cl	252.0				
Alkalinity as $CaCO_3$			Total		1,584.9	92.39
Phenolphthalein		0.0				
Methyl Orange		232.0				
Residue		1,557.0				
Total Hardness		249.5				

PEORIA HEIGHTS (3279) (p. 512). In 1934 the village discontinued the purchase of water from the Peoria Water Works Company. Water for the public supply since that year has been secured from two wells, drilled by Mike Ebert in 1934, located about one-fourth mile west of Galena Road (Highway 29) and near the northern limit of the village.

Well number 1 is 102 feet deep and 16 inches in diameter. The 25-foot length of 15-inch Cook screen has slots; ranging from 0.020 to 0.120 inch wide with the largest slots at the bottom. This well yielded 550 gallons per minute with a draw down of 10 feet from a static level of 55 feet.

Well number 2 is 200 feet south and 50 feet west of well number 1. Due to a higher surface elevation it is 130 feet deep. The diameter of casing and the diameter and length of screen are the same as in well number 1. The screen has slots ranging from 0.060 to 0.187 inch wide with the largest slots at the bottom. This well yielded 510 gallons per minute with a draw down of 6 feet from a static level of 91 feet.

Each well is equipped with a 12-inch American turbine pump rated at 500 gallons per minute and driven by a 75-horsepower electric motor.

The water from well number 1 had a total residue of 497, a total hardness of 468.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 76278, collected June 26, 1935.

Water from well number 2 was of similar chemical quality.

Analysis of Sample Number 76278 from Village Well Number 1.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	6.0	0.35
Manganese	Mn	0.0	Magnesium Nitrate	$Mg(NO_3)_2$	0.7	0.04
Silica	SiO_2	10.0	Magnesium Chloride	$MgCl_2$	13.3	0.78
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	100.5	5.86
Calcium	Ca	108.3	Magnesium Carbonate	$MgCO_3$	84.3	4.92
Magnesium	Mg	47.7	Calcium Carbonate	$CaCO_3$	254.8	14.85
Ammonium	NH_4	0.0	Calcium Silicate	$CaSiO_3$	19.2	1.12
Sodium	Na	1.6				
Sulfate	SO_4	80.2	Total		478.8	27.92
Nitrate	NO_3	4.9				
Chloride	Cl	10.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		354.0				
Residue		497.0				
Total Hardness		468.5				

PEOTONE (1154) (p. 513). Water is secured from a well drilled in 1930 by J. 0. Heflin of Joliet. The well is located 20 feet northwest of the old well. It is 10 inches in diameter, 135 feet deep and cased to rock at a depth of 60 feet.

The well is equipped with a Pomona turbine pump rated at 300 gallons per minute. The bowls are set at a depth of 80 feet. The pump is driven by a 25-horsepower electric motor.

The old well is as described on page 513 except that the deep-well pump cylinder is set at a depth of 80 feet. This well is maintained for emergency use.

PEECY (907). Percy is located in the southeastern part of Randolph County on the drainage area of Mary's River, a tributary of Mississippi River.

Water for the public supply, installed by the village in 1935, is obtained from a well near the center of the village, drilled in 1934 by the Sewell Well Company of St. Louis. It is 423 feet deep and 8 inches in diameter at the bottom. It is cased with 8-inch pipe to a depth of 312 feet. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	20	20
Lime, shale, coal, McLeansboro	20	40
Shale, lime, coal, Carbondale	165	205
Lime, shale, sandstone, Pottsville	100	305
Sandstone, Pottsville	118	423

The water level was at a depth of 57½ feet when not pumping and was lowered 134 feet by a pumping rate of 108 gallons per minute. The temperature of the water was 61½° F.

The well is equipped with a 10-stage, 8-inch Cook turbine pump having 185 feet of column pipe and 10 feet of suction pipe. The pump is direct connected to a 15-horsepower electric motor.

The water had a total residue of 323, a total hardness of 185.5, and a content of iron of 2.0 parts per million as shown by the analysis of sample number 75577, collected January 17, 1935.

Analysis of Sample Number 75577 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		1.7	0.10
(filtered).....	0.0	Sodium Chloride.....NaCl		31.6	1.84
(unfiltered).....	2.0	Sodium Sulfate.....Na_2SO_4		22.1	1.29
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3		73.6	4.29
Silica.....SiO_2	10.0	Ammonium Carbonate..$(NH_4)_2CO_3$		1.0	0.06
Turbidity.....	75.0	Magnesium Carbonate..$MgCO_3$		56.9	3.39
Calcium.....Ca	47.2	Calcium Carbonate.....$CaCO_3$		118.2	6.82
Magnesium..Mg	16.4	Silica.....SiO_2		10.0	0.58
Ammonium..NH_4	0.4				
Sodium.....Na	52.0	Total.....		315.1	18.37
Sulfate.....SO_4	15.0				
Nitrate.....NO_3	1.1				
Chloride.....Cl	19.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	256.0				
Residue.....	323.0				
Total Hardness....	185.5				

PERU (9121) (p. 514). Well number 5 located at the intersection of Water and Peoria Streets was drilled in 1931 by the Sewell Well Company of St. Louis. It is 2601 feet deep and 12 inches in diameter at the bottom. It is cased with 26-inch pipe to a depth of 74 feet, with 20-inch pipe from the ground surface to a depth of 459 feet, with 15-inch pipe from the ground surface to a depth; of 1020 feet, and with 12-inch pipe from 1478 to 1616 feet. In order to shut off water from the 550-foot level which contained more than 4000 parts per million of sodium chloride the 15-inch easing was cemented in the well. Drilling was then continued until the well was 2601 feet deep. The elevation of the top of the casing was 464.7 feet above sea level. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Coal measures, Pennsylvanian	390	390
Dolomite, Devonian	205	595
Dolomite, Silurian	215	810
Sandstone, Silurian	10	820
Shale, Maquoketa	160	980
Dolomite, Galena-Platteville	385	1365
Sandstone, St. Peter	135	1500
Shale, St. Peter	10	1510
Dolomite, Shakopee	175	1685
Sandstone, New Richmond	130	1815
Dolomite, Oneota	160	1975
Shale, sandstone, Jordan	35	2010
Dolomite, Trempealeau, Franconia	365	2375
Sandstone, Ironton	126	2501
Sandstone, Dresbach	74	2575
Dolomite, shale, Eau Claire	26	2601

The well flowed after a depth of 550 feet had been reached. After the casing was cemented the well did not flow again until a depth of 1668 feet was reached. When the well was finished the flow was estimated to be about 700 gallons per minute. Pumping rates of 1000 and 1850 gallons per minute lowered the water 2 and 34 feet, respectively, below the top of the casing. A length of 5½ feet was then cut off the top of the easing and the well was capped. The static pressure was then reported to be 37 pounds per square inch.

The temperature of the water was 73½° F. The water had a total residue of 741, a total hardness of 262, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 70126, collected January 4, 1932.

A treatment plant for iron removal and softening was built in 1933. In 1937 all water for the public supply was obtained from well number 5 and treated in this plant.

Analysis of Sample Number 70126 from Well Number 5.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.2	Sodium Nitrate	$NaNO_3$	.8	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	399.0	23.25
Silica	SiO_2	16.0	Sodium Sulfate	Na_2SO_4	61.8	3.61
Turbidity		0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	3.3	.19
Calcium	Ca	60.8	Magnesium Sulfate	$MgSO_4$	14.4	.84
Magnesium	Mg	26.8	Magnesium Carbonate	$MgCO_3$	82.5	4.81
Ammonium	NH_4	.9	Calcium Carbonate	$CaCO_3$	152.0	8.86
Sodium	Na	177.3	Iron Oxide	Fe_2O_3	.3	.02
Sulfate	SO_4	55.6	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	.2	Silica	SiO_2	16.0	.93
Chloride	Cl	242.0				
Alkalinity as $CaCO_3$			Total		730.1	42.56
Phenolphthalein		0.0				
Methyl Orange		250.0				
Residue		741.0				
Total Hardness		262.0				

PETERSBURG (2319) (p. 518). No change has been made in the source of the municipal water supply.

PHOENIX (3033). The village of Phoenix obtains Lake Michigan water from the city of Chicago through the city of Harvey. The water distribution system was installed in 1926.

PINCKNEYVILLE (3046) (p. 710). The raw water supply of the city of Pinckneyville is obtained from Beaucoup Creek. The water is treated before entering the distribution system.

PIPER CITY (650) (p. 520). No reported change.

PITTSFIELD (2356) (p. 710). The raw water supply of the city of Pittsfield is obtained from an impounding reservoir on a branch of Panther Creek. The water is treated before entering the distribution system.

PLAINFIELD (1428) (p. 524). The two wells reported on page 524 have been abandoned and since 1929 all water for the public supply has been obtained from two wells, located about one-half mile north of the village, drilled by the Layne and Bowler Company. These wells are 400 feet apart, 200 feet deep and 15 inches in diameter. It is reported that each well was cased to rock with 25-inch pipe and each yielded 200 gallons per minute.

The wells are equipped with identical Layne turbine pumps driven by 10-horsepower electric motors. Each pump consists of 119 feet of 6-inch column pipe, a 3-stage 10-inch bowl assembly, 2 feet 9 inches in length, and 20 feet of 6-inch suction pipe. Each pump is rated at 140 gallons per minute against a total head of 125 feet, and is operated 3 or 4 hours daily. The pumps discharge into a 42,000-gallon concrete reservoir. Water is pumped from the reservoir to the distribution system and a 60,000-gallon elevated steel tank by two Fairbanks-Morse centrifugal pumps driven by 15-horsepower electric motors.

Water from the wells had a total residue of 460, a total hardness of 243, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 65584, collected December 12, 1929.

Analysis of Sample Number 65584 from Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.3	Sodium Nitrate	$NaNO_3$	0.8	.04
Manganese	Mn	0.0	Sodium Chloride	NaCl	13.2	.77
Turbidity		5	Sodium Sulfate	Na_2SO_4	80.7	4.70
Silica	SiO_2	10.0	Sodium Carbonate	Na_2CO_3	142.3	8.32
Calcium	Ca	51.5	Ammonium Carbonate	$(NH_4)_2CO_3$	1.2	.07
Magnesium	Mg	27.7	Magnesium Carbonate	$MgCO_3$	96.2	5.62
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	128.5	7.52
Sodium	Na	93.4	Silica	SiO_2	10.0	.58
Sulfate	SO_4	54.7	Iron Oxide	Fe_2O_3	0.4	.02
Nitrate	NO_3	0.5	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$			Total		473.3	27.64
Phenolphthalein		0.0				
Methyl Orange		378.0				
Residue		460.0				
Total Hardness		243.0				

PLANO (1785) (p. 527). No record of change.

PLEASANT HILL (700). Pleasant Hill is located in the southwestern part of Pike County on the flood plain of the Mississippi River.

Water for the public supply, installed by the village in 1936, is obtained from a well located about one-fourth mile south of the Chicago and Alton Railroad station. The well is 57 feet deep and 8 inches in diameter. It is cased with 8-inch pipe to a depth of 47 feet below which is a 10-foot length of number 20-slot Cook screen. The material penetrated was sand, varying from fine to coarse from the surface to the bottom of the well.

The water level was at a depth of 13 feet when not pumping and was lowered 5.4 feet by a pumping rate of 178 gallons per minute.

The well is equipped with an 8-inch American turbine pump rated at 100 gallons per minute against 60-foot head made up of 40 feet of column pipe, 3 stages of pump and 10 feet of suction pipe. The pump is direct-connected to a 3-horsepower electric motor operating at a speed of 1750 revolutions per minute.

A treatment plant is located at the well site. Water from the well is pumped over a coke-tray aerator to a collecting basin, thence through pressure filters to the distribution system. Two filters, each about 6 feet high and 5 feet in diameter, are located in the building which houses all of the physical equipment. Two small alum pots are available, but no chemicals are added to the water at present. The service pump is a 2-stage American centrifugal pump driven by a 10-horsepower electric motor.

The temperature of the raw water was 57° F. The raw water had a total residue of 272, a total hardness of 216, and a content of iron of 1.5 parts per million as shown by the analysis of sample number 78243, collected June 22, 1936.

Analysis of Sample Number 78243 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0				
(unfiltered).....	1.5	Sodium Nitrate.....$NaNO_3$		7.7	0.45
Manganese..Mn	1.8	Sodium Chloride.....NaCl		16.4	0.96
Silica.....SiO_2	15.0	Sodium Sulfate.....Na_2SO_4		10.7	0.63
Turbidity.....	20.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		0.7	0.04
Odor.....	M1	Magnesium Sulfate.....$MgSO_4$		12.0	0.70
Calcium.....Ca	65.5	Magnesium Carbonate..$MgCO_3$		35.9	2.09
Magnesium..Mg	12.8	Calcium Carbonate.....$CaCO_3$		163.5	9.54
Ammonium..NH_4	0.3	Manganese Oxide.....MnO		2.3	0.13
Sodium.....Na	12.0	Silica.....SiO_2		15.0	0.87
Sulfate.....SO_4	17.0				
Nitrate.....NO_3	5.3	Total.....		264.2	15.41
Chloride.....Cl	10.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	206.0				
Residue.....	272.0				
Total Hardness....	216.0				

POLO (1871) (p. 528). A record of material penetrated by the old 2098-foot well drilled in 1891 is as follows:

	Thickness in feet.	Depth in feet.
Drift	37	37
Dolomite, Galena-Platteville	348	385
Shale, dolomite, Glenwood	15	400
Sandstone, St. Peter	65	465
Dolomite, Shakopee	105	570
Sandstone, dolomite, New Richmond	30	600
Dolomite, Oneota	140	740
Jordan Formation	35	775
Dolomite, Trempealeau	175	950
Shale, sandstone, Mazomanie	125	1075
Sandstone, Dresbach	85	1160
Dolomite, shale, sandstone, Eau Claire	205	1365
Sandstone, Mt. Simon	733	2098

The two city wells were repaired in 1931 by P. E. Millis and Company. The east well described on page 529 was shot with dynamite as follows: 50 pounds at 1030 feet, 20 pounds at 930 feet, 30 pounds at 780 feet, 20 pounds at 550 feet, and 20 pounds at 440 feet. After being cleaned out to the present depth of 1165 feet this well produced 260 gallons per minute. Some work was done on the 2098-foot well but the exact nature of this work is not known. This well is now reported to be cased to a depth of 43 feet with 10-inch pipe and to contain a liner at an unknown depth. After the repair work was completed the combined yield of the two wells was about 410 gallons per minute with the 2098-foot well furnishing about 150 gallons per minute with a draw down of 165 feet from a static level of 126 feet.

PONTIAC (8272). The raw water supply of the city of Pontiac is obtained from Vermilion River. The water is treated before entering the distribution system.

POPLAR GROVE (349) (p. 530). The public water supply is as reported on page 530.

The water had a total residue of 376, a total hardness of 293, and a content of iron of 0.6 parts per million as shown by the partial analysis of sample number 83761, collected from a tap in the pumping station June 22, 1938.

POSEN (1329). The village of Posen obtains Lake Michigan water from the city of Chicago through the city of Harvey.

PRINCETON (4762) (p. 531). Water for the public supply is still obtained from wells 3 and 4. In 1931 a great deal of fine sand was pumped from number 4 and it was necessary to recase the well. A string of 12-inch wrought iron casing, extending from the surface to the top of the screen, was placed inside the concrete casing. Then the space between the metal and concrete casings was filled with cement grout. After the repairs had been completed, the well was pumped at a rate of 770 gallons per minute.

Well number 3 is equipped with the same pump described on page 533. Well number 4 is equipped with a 13-stage, 12-inch Cook turbine pump having 168 feet of column pipe and 20 feet of suction pipe.

Water is pumped from the wells to an iron removal and lime-softening plant built about 1930. Three service pumps are available. A Worthington centrifugal pump rated at 520 gallons per minute and driven by a 30-horsepower electric motor is used most of the time. A 4-inch American centrifugal pump driven by a 28-horsepower steam turbine serves as a stand-by unit. A 6-inch American centrifugal pump driven by a 110-horsepower steam turbine is used in case of fire.

Storage facilities are provided by two underground reservoirs with a total capacity of 190,000 gallons and a 150,000-gallon elevated steel tank.

The quality of water from well number 4 is similar to that shown on page 534. Water from well number 3 had a total residue of 202,

a total hardness of 117, and a content of iron of 1.1 parts per million as shown bv the analysis of sample number 82692, collected January 3, 1938.

Analysis of Sample Number 82692 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	5.9	.34
(filtered)		.06	Sodium Chloride	NaCl	3.9	.23
(unfiltered)		1.1	Sodium Sulfate	Na_2SO_4	2.3	.13
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	66.7	3.89
Silica	SiO_2	16.0	Magnesium Carbonate	$MgCO_3$	50.0	2.92
Turbidity		5.0	Calcium Carbonate	$CaCO_3$	57.5	3.35
Color		0.0	Iron Oxide	Fe_2O_3	.1	.01
Odor		M_2	Silica	SiO_2	16.0	
Calcium	Ca	23.0				
Magnesium	Mg	14.5	Total		201.4	11.75
Ammonium	NH_4	trace				
Sodium	Na	33.1				
Sulfate	SO_4	16.5				
Nitrate	NO_3	4.4				
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		180.0				
Residue		202.0				
Total Hardness		117.0				

Water from well number 3 has a gas content of 3.2 cubic feet per thousand gallons, of which 31 per cent is methane. Water from well number 4 has a gas content of 5.9 cubic feet per thousand gallons, of which 57 per cent is methane.

PRINCEVILLE (994) (p. 534). Water for the public supply is still obtained from the well previously described. In 1930 new pumping equipment was installed and a 100,000-gallon ground storage reservoir was constructed.

The well is now equipped with an 8-stage, 8-inch Fairbanks-Morse deep-well turbine pump rated at 300 gallons per minute having 240 feet of 6-inch column pipe, and driven by a 25-horsepower electric motor. The water is pumped to the reservoir, and then to the distribution system by a 4-inch Fairbanks-Morse centrifugal pump rated at 350 gallons per minute and driven by a 20-horsepower electric motor.

The well is reported to be cased with 10-inch pipe to a depth of 370 feet, 6-inch pipe from 370 to 841 feet, 5⅜-inch pipe from 841 to 1380 feet, and 5-inch pipe from 1380 to 1450 feet.

A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	40	40
Pennsylvanian	330	370
Osage and St. Louis	140	510
Kinderhook	155	665
Upper Devonian	60	725
Hamilton	135	860
Niagaran	120	980
Maquoketa	100	1080
Galena-Trenton	420	1500
St. Peter	100	1600

In 1926 the static water level was at a depth of 156 feet and was reported to be receding at the rate of about 2 feet per year. The temperature of the water at that time was 71° F.

In 1938 a new well was drilled by Thorpe Well Company of Des Moines, Iowa, at a point about 40 feet from the old well.

PROPHETSTOWN (1353) (p. 535). The wells at Prophetstown described on page 535 have been deepened. The 16-foot diameter well has beeen deepened 3 feet and is now 27 feet deep measured from the well curb. At the last visit on July 10, 1933 the 8-foot well was being deepened. The quality of sample number 73228 collected on July 10, .1933 was similar to that of sample number 36193 given on page 536.

QUINCY (39,241) (p. 710). The raw water supply for the city of Quincy is obtained from Mississippi River. The water is softened before entering the distribution system.

RAMSEY (807). Ramsey is located in the northern part of Fayette County on the drainage area of Kaskaskia River. A public water supply was installed by the village in 1934-'35. Water was secured from a 10-inch well 135 feet deep drilled in October, 1934 by E. C. Baker of Sigel. According to a log of the materials penetrated the water is obtained from eleven feet of sand and gravel between depths of 123 and 134 feet. The lower five feet of the formation is screened with a 10-inch, number 10-slot screen and the upper six feet of the formation is screened with a 10-inch, number 20-slot screen. A production test made on February 22, 1935 indicated a yield of 25 gallons per minute and a specific capacity of 0.26 gallons per minute per foot of draw down. The static water level was 26 feet below the ground surface at the time of the test. The well is located in the northeast part of the village. A 6-inch 18-stage Cook vertical deep-well turbine pump rated at 25 gallons per minute against a 260-foot head was installed in the well. The top of the bowls was set 110 feet below the pump base. The over-all length of the bowl assembly is 7 feet 6⅞ inches. Twenty feet of suction pipe was added below the bowls. The pump is driven by a 5-horsepower, 1800 revolutions per minute, U. S. electric motor.

An increase in power consumption prompted an investigation in August, 1936. A production test was made on the well on October 6, 1936. At that time all of the water was withdrawn from the well and the pump broke suction after pumping at an average rate of 5.7 gallons per minute for 1 hour and 35 minutes. On October 21, 1937 static water level was reported to be 94 feet below the pump base, and the pump broke suction after running for four minutes.

In 1937 E. C. Baker of Sigel drilled a well known as test well number 3. This well is located in the southwest part of town about 30 feet south of Sixth Street and 700 feet west of the Illinois Central tracks. The well is 163 feet deep. Water-bearing sand and gravel was encountered between depths of 149 and 152 feet and also between depths of 159 and 162 feet. The screen consisted of 45 feet of 5-inch pipe with

slots cut by a hack-saw. The static water level was 70 feet below the ground surface. The draw down was 48 feet when pumping at a rate of 7 gallons per minute. The municipality plans to use this well as the source of supply until a new well can be constructed. Water is pumped from the well by a small Goulds plunger pump driven by a gasoline engine.

Test well number 4 is located west of town in the valley of Eamsey Creek. This well was 37 feet 3 inches deep and 8 inches in diameter. Sand and gravel was entered at one foot, and lack of casing prevented the penetration of the total thickness of the gravel. The aquifer became progressively coarser as the depth increased. The static water level was 3.2 feet below the top of the casing. The draw down was 10.6 feet when pumping at a rate of 75 gallons per minute. All of the water entered the well through the bottom of the casing since no screen was installed.

A 50,000-gallon elevated tank is connected to the system. The average daily usage is estimated at 4200 gallons.

An analysis of sample number 75712, collected from the 135-foot village well on February 22, 1935 shows the water to have a total residue of 640, a total hardness of 97.5, and an iron content of 0.9 parts per million. A partial mineral analysis of sample number 78809, collected from the same well on October 23, 1936, shows the quality of the water to be very similar to that of sample number 75712.

An analysis of sample number 82220, collected from test hole number 3 on October 23, 1937, shows the water to have a total residue of 660, a total hardness of 144, and an iron content of 2.7 parts per million. The water also contains 2.2 cubic feet of methane per 1000 gallons as shown by gas analysis number 82185.

An analysis of sample number 82286, collected from test hole number 4 on November 1, 1937, shows a total residue of 820, a total hardness of 584, and an iron content of 2.7 parts per million.

Analysis of Sample Number 82220 from Test Hole Number 3.

Determinations Made.	Pts. per million.
Iron.....Fe	
(filtered).....	1.3
(unfiltered).....	2.7
Manganese..Mn	0.0
Silica.....SiO_2	10.0
Turbidity.....	18
Color.....	0
Odor.....	Acl
Calcium.....Ca	35.9
Magnesium..Mg	13.1
Ammonium..NH_4	0.9
Sodium.....Na	212.8
Sulfate.....SO_4	2.5
Nitrate.....NO_3	1.5
Chloride.....Cl	113.0
Alkalinity as $CaCO_3$	
Phenolphthalein..	8.0
Methyl Orange...	446.0
Residue.....	660
Total Hardness....	144.0

Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Sodium Nitrate.....	$NaNO_3$	1.7	.10
Sodium Chloride.....	NaCl	186.5	10.87
Sodium Sulfate.....	Na_2SO_4	3.5	.20
Sodium Carbonate.....	Na_2CO_3	317.5	18.50
Ammonium Carbonate..	$(NH_4)_2CO_3$	2.4	.14
Magnesium Carbonate..	$MgCO_3$	45.5	2.65
Calcium Carbonate.....	$CaCO_3$	90.0	5.23
Silica.....	SiO_2	10.0	.58
Total.....		657.10	38.27

Analysis of Sample Number 82286 from Test Hole Number 4.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	.10
(filtered)		0.4	Sodium Chloride	NaCl	42.1	2.45
(unfiltered)		2.7	Sodium Sulfate	Na_2SO_4	105.1	6.12
Manganese	Mn	0.	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Silica	SiO_2	10.	Magnesium Sulfate	$MgSO_4$	273.8	15.95
Turbidity		15.	Magnesium Carbonate	$MgCO_3$	3.0	.17
Color		0	Calcium Carbonate	$CaCO_3$	352.5	20.55
Odor		0	Silica	SiO_2	10.0	.58
Calcium	Ca	140.9				
Magnesium	Mg	56.1	Total		790.2	46.04
Ammonium	NH_4	0.5				
Sodium	Na	51.0				
Sulfate	SO_4	291.2				
Nitrate	NO_3	1.2				
Chloride	Cl	25.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0				
Methyl Orange		356.				
Residue		820.0				
Total Hardness		583.5				

RANKIN (840) (p. 536). Rankin obtains water from the well described on page 537 and a well drilled by Charles Krauss and Sons of Indianapolis, Indiana in 1926. A report made in 1926 indicates that the well described on page 537 is 10 inches in diameter instead of 8 inches as reported.

The well drilled in 1926 is located 18 feet east of the original well. It is 10 inches in diameter and 282 feet deep. Water is obtained from gravel between depths of 262 feet and 282 feet. A 17-foot length of number 5½ Krauss brass screen is installed in the well. The well is equipped with a double-acting deep-well pump which delivers about 128 gallons per minute. The pump is driven by a 7½-horsepower electric motor.

In 1926 the old well was reported to be equipped with an Erb cylinder attached to 88 feet of drop pipe. The water level was reported to be at a depth of 43 feet 7 inches after long continued pumping at a rate of 74 gallons per minute. The water level in the old well was lowered to a depth of 45 feet 3 inches below the top of the casing with both pumps operating.

There are about 210 customers. It is necessary to pump the old well about 3½ hours per day and the new well about 3 hours per day. The pumps are seldom operated together.

RANSOM (456) (p. 539). Well number 2 was drilled in 1932 by the Layne North Central Company. It is located on Thomas Street about 25 feet south of well number 1. It is 831 feet deep and 10 inches in diameter at the bottom. It is cased with 10-inch pipe to a depth of 364 feet. A gas vein at a depth of about 302 feet is thus cased off. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows :

	Thickness in feet.	Depth in feet.
Drift	150	150
Coal measures	202	352
Limestone, Galena-Platteville	322	674
Sandstone, St. Peter	157	831

The water level was at a depth of 185 feet when not pumping and was lowered 25 feet by bailing at the rate of 20 gallons per minute.

The water had a total residue of 846, a total hardness of 255, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 71161, collected June 20, 1932.

Analysis of Sample Number 71161 from Well Number 2.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	463.6	27.05
Silica	SiO_2	11.0	Sodium Sulfate	Na_2SO_4	57.5	3.36
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	67.9	3.96
Magnesium	Mg	29.5	Magnesium Carbonate	$MgCO_3$	102.0	5.95
Calcium	Ca	53.9	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	.03
Ammonium	NH_4	0.2	Calcium Carbonate	$CaCO_3$	134.5	7.85
Sodium	Na	230.8	Iron Oxide	Fe_2O_3	0.0	.00
Sulfate	SO_4	38.9	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.4	Silica	SiO_2	11.0	.64
Chloride	Cl	281.1				
Alkalinity as $CaCO_3$			Total		837.9	48.89
Phenolphthalein		0.0				
Methyl Orange		320.0				
Residue		846.0				
Total Hardness		255.0				

The well was equipped with a Goulds deep-well cylinder pump that formerly had been in well number 1 but the water was so corrosive that the metal of the pump and pump rods were rapidly destroyed. Not only did the water affect the pump and fittings, but it was reported that the water also had an effect on the water mains and service pipes and as a result the pumping equipment was removed and the use of the well discontinued.

Shortly after well number 2 was completed the Goulds deep-well cylinder pump in well number 1 was removed and replaced by a 6-inch Pomona deep-well turbine pump, the original assembly of which consisted of 230 feet of 4-inch column, 25 bowls having an over-all length of about 12 feet and 20 feet of 3-inch suction pipe. The pump was rated at 60 gallons per minute.

Well number 1 was unable to furnish all the village demands and in January, 1938 it was deepened to 325 feet.

It was reported that water veins were encountered at about 160-200 feet during the original construction and at 305 feet when deepened. Gas in small amounts had been noticed ever since this well was first finished but not in sufficient amounts to cause difficulty. However, when the well was deepened a rather strong vein of gas was encountered at a depth of about 302 feet. This gas has since given considerable trouble by reducing the delivery of the pump.

When the pump was reinstalled in the well after deepening four bowls were removed, thus making the present over-all length of the assembly about 260 feet. The pump is direct connected to a Westinghouse electric motor of 7½-horsepower operating at 1750 revolutions per minute. A small air pipe line for determining water levels has been installed with its lower end at a depth of 260 feet below the pump base.

When not pumping the water level stands about 75 feet below the pump base.

On account of the trouble with gas locking, the pump operates for about only 15 to 20 minutes at 10 to 15-minute intervals.

RANTOUL (1555) (p. 540). The source of the public water supply is still from wells penetrating water-bearing beds of sand and gravel. Of the four wells in use and described on page 541 only three were in service in February, 1925. Well number 1, one of the two first wells (south well), had been abandoned and a new well (number 5) constructed in March, 1925 had taken its place.

The new well was 138 feet deep and was cased with 10-inch casing to a depth of 110 feet. The 10-inch by 14-foot screen installed had been removed, along with the casing, from well number 1 and was recut from a number 6 slot to a number 8 slot. The well was equipped with a motor driven two-stroke, 18 revolutions per minute, deep-well pump removed from well number 3 as described on page 541. Unfortunately this well was crooked and gave much trouble on account of excessive pump repair and was finally abandoned in 1933.

It was reported that many years ago a well was drilled in the south part of Eantoul to a depth of 250 feet from which a soft water had been obtained. The village being desirous of obtaining a softer water as well as one with less iron, decided to explore the possibilities of a better supply by drilling to a depth of 300 feet if necessary.

Well number 6 is located on the water-works station lot about 15 feet north of well number 4. It was drilled by Mr. E. W. Johnson of Bloomington to a total depth of 293 feet and penetrating 2 feet into a hard tough clay at the base of the sand and gravel bed. The material penetrated as classified in a log prepared by the State Geological Survey is as follows:

	Thickness in feet.	Depth in feet.
Wisconsin drift	83	83
Sangamon sands and gravel water-bearing, static level 85 feet	59¾	142¾
Illinoisan, non-water-bearing	99¼	242
Yarmouth, non-water-bearing	15	257
Kansan sand and gravel water-bearing, static water level 65 feet	36	293

The well was cased with 269½ feet of 8-inch casing below which there was exposed to the sand and gravel 15 feet of 7½-inch outside diameter, number 40-slot Cook screen resting on a 2-foot thick layer of coarse gravel artificially admitted and thoroughly consolidated in the well. The finished well is thus 284.5 feet deep.

At the time of the test of the well static water level was 65 feet below ground surface. The test indicated a specific capacity for the well of slightly more than 5 gallons per minute per foot of draw down between delivery rates of 190 gallons per minute and 400 gallons per minute.

The rumor that a deeper well than those previously drilled would yield a softer water was not borne out by the analysis of sample number 74611 collected at the completion of the test period. It shows a total residue of 415, a total hardness of 337.5, and an iron content of 1.0 parts per million.

Analysis of Sample Number 74611 from Well Number 6, 284.5 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Sodium Nitrate	$NaNO_3$	3.4	0.20
Manganese	Mn	0.0	Sodium Chloride	NaCl	1.8	0.11
Silica	SiO_2	15.0	Sodium Carbonate	Na_2CO_3	92.8	5.42
Turbidity		0.0	Magnesium Carbonate	$MgCO_3$	111.8	6.52
Calcium	Ca	82.0	Calcium Carbonate	$CaCO_3$	180.0	10.50
Magnesium	Mg	32.2	Calcium Silicate	$CaSiO_3$	29.0	1.69
Ammonium	NH_4	0.02	Iron Oxide	Fe_2O_3	1.4	0.08
Sodium	Na	41.8				
Sulfate	SO_4		Total		420.2	24.52
Nitrate	NO_3	2.7				
Chloride	Cl	1.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		400.0				
Residue		415.0				
Total Hardness		337.5				

BAYMOND (726). Raymond is located in the northwestern part of Montgomery County on the drainage area of Shoal Creek, a tributary of Kaskaskia Elver. A public water supply was installed by the village in 1936. A few test wells were drilled in the valley of West Fork of Shoal Creek southwest of the village, but they revealed no extensive water-bearing formation.

Water for the public supply is obtained from a well drilled by L. B. Burt of Elwin about one mile southeast of the business district. The well is located in the valley of a small unnamed tributary of West Pork of Shoal Creek and penetrates sand and gravel between depths of 12 and 30 feet. It is a gravel-packed well having a number 100-slot Johnson screen 10 feet 7 inches long. The 12-inch inner casing terminates 17 feet 7 inches below the surface and the 26-inch outer casing terminates 19 feet below the surface.

The water level was at a depth of 13.3 feet when not pumping and was lowered 4.8 feet by pumping at a rate of 79 gallons per minute. The temperature of the water was 54° F.

The well is equipped with a 13-stage Fairbanks-Morse turbine pump having 22 feet of 4-inch column pipe and driven by a 7½-horsepower electric motor. The pump is rated at 75 gallons per minute and delivers water into a pressure main leading to the village. An elevated steel tank located near the business district is connected to the distribution system.

The water had a total residue of 377, a total hardness of 287.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 78240, collected June 16, 1936.

Analysis of Sample Number 78240 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	3.4	0.20
(unfiltered).....	0.0	Sodium Chloride.....NaCl	13.5	0.79
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	68.9	4.01
Silica.....SiO_2	11.0	Sodium Carbonate.....Na_2CO_3	6.9	0.40
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	81.8	4.77
Odor.....	M2	Calcium Carbonate.....$CaCO_3$	190.6	11.11
Calcium.....Ca	76.1	Silica.....SiO_2	11.0	0.64
Magnesium..Mg	23.6			
Sodium.....Na	31.5	Total.....	376.1	21.92
Sulfate.....SO_4	46.6			
Nitrate.....NO_3	2.2			
Chloride.....Cl	8.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	294.0			
Residue.....	377.0			
Total Hardness....	287.5			

RED BUD (1208) (p. 542). The 294-foot well, which is described on page 542, was abandoned about 1920.

In 1919 Metzler and Hartmen of Bed Bud drilled a new municipal well in the northwest part of the city to a depth of 278 feet. It is eased with 8-inch pipe to rock at a depth of 260 feet. When the well was completed the water stood at a depth of 15 feet below the ground surface. It was pumped by the driller at a rate of 60 or 70 gallons per minute for ten hours.

The well is equipped with an air lift. A 3-inch eductor pipe extends to a depth of 260 feet and a 1-inch air pipe extends to a depth of 230 feet. On August 1-2, 1934 a production test was made on this well. The water level was reported to be 38 feet below the well curb when not pumping. The water level was lowered to a depth of 93.5 feet at the end of one hour and the rate of discharge was 29 gallons per minute.

Air is supplied by a 9-inch by 9-inch compressor driven by a 20-horsepower electric motor and the water is discharged into a ground storage reservoir with a capacity of 100,000 gallons.

A Beeves and Skinner Machine Company duplex steam pump was used to pump from the ground reservoir to the distribution system until July 1924 when it was replaced by a Fairbanks-Morse centrifugal pump driven by a 25-horsepower electric motor. A 75,000-gallon elevated tank is connected to the distribution system.

The water had a total residue of 288, a total hardness of 250 and an iron content of 0.3 parts per million as shown by the analysis of sample number 74833, collected July 12, 1934. The temperature of the water was 59° F.

Analysis of Sample Number 74833 from 278-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.3	Sodium Nitrate	$NaNO_3$	1.7	0.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	9.9	0.58
Silica	SiO_2	7.0	Sodium Sulfate	Na_2SO_4	15.6	0.91
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	28.6	1.67
Calcium	Ca	58.0	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	0.03
Magnesium	Mg	25.6	Magnesium Carbonate	$MgCO_3$	88.6	5.17
Ammonium	NH_4	0.3	Calcium Carbonate	$CaCO_3$	133.5	7.78
Sodium	Na	21.9	Calcium Silicate	$CaSiO_3$	13.4	0.78
Sulfate	SO_4	10.5	Iron Oxide	Fe_2O_3	0.4	0.02
Nitrate	NO_3	1.2				
Chloride	Cl	6.0	Total		292.2	17.04
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		266.0				
Residue		288.0				
Total Hardness		250.0				

In 1934 Charles Wiese of St. Louis, Missouri drilled a well for the city. It is located 250 feet east and 30 feet south of the 278-foot well. The well is 10 inches in diameter and 292 feet deep. The static water level was 52 feet below the ground surface when the well was completed. The pumping level as determined by a test made September 1, 1934 was 188.6 feet below the ground surface when pumping at a rate of 48 gallons per minute.

A 7-inch, 15-stage Fairbanks-Morse turbine was installed in the well with the bottom of the 10-foot length of suction, pipe at a depth of 196 feet.

The water had a total residue of 341, a total hardness of 165 and an iron content of 1.0 parts per million as shown by the analysis of sample number 74998, collected September 1, 1934.

Analysis of Sample Number 74998 from 292-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.0	Sodium Nitrate	$NaNO_3$	0.8	0.05
Manganese	Mn	trace	Sodium Chloride	NaCl	8.2	0.48
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	25.6	1.49
Turbidity		20.0	Sodium Carbonate	Na_2CO_3	17.5	1.02
Calcium	Ca	71.6	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	0.03
Magnesium	Mg	20.9	Magnesium Carbonate	$MgCO_3$	72.5	4.22
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	179.4	10.45
Sodium	Na	19.3	Iron Oxide	Fe_2O_3	1.4	0.08
Sulfate	SO_4	17.3	Silica	SiO_2	10.0	0.58
Nitrate	NO_3	0.62				
Chloride	Cl	5.0	Total		315.9	18.46
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		341.0				
Total Hardness		165.0				

RICHMOND (514). Eichmond is located in the northeast part of McHenry County on the drainage area of North Branch of Nippersink Creek.

A public water supply was installed by the village in 1927. Water is pumped from a well directly into the distribution system, to which an elevated tank is connected, by a deep-well cylinder pump driven by an electric motor. The tank is of 50,000 gallons capacity and is located on a high knoll in the north part of the village some 2000 feet from the well and pumping station. It has a total height of 125 feet and a height of 91.5 feet from the ground to the bottom of the tank.

Water is secured from a well about 168 feet deep drilled by the W. L. Thorne Company of Des Plaines in 1927. It is located in the eastern part of the village on the village hall lot, north of George Street and east of Broadway. The elevation of the top of the well is 818.5 feet above sea level. A record of material penetrated, prepared by the supervising engineer, is as follows:

	Thickness in feet.	Depth in feet.
Clay and gravel	10	10
Black clay and gravel, struck water at 30 feet	30	40
Black gravel	10	50
Brown shale, marl, 4 to 5 feet	5	55
Stiff clay	5	60
Pink clay	10	70
Black clay	5	75
Clay and gravel	5	80
Fine and coarse sand	5	85
Fine gray sand	10	95
Medium sand and gravel	5	100
Fine to coarse sand and gravel	5	105
Fine to medium sand and gravel	5	110
Fine to coarse sand and gravel	5	115
Fine sand and gravel	5	120
Medium sand and gravel	5	125
Clay	5	130
No sample received	15	145
Fine sand and gravel (dirty)	5	150
Sand and gravel with clay	5	155
Fine to coarse sand and gravel	5	160
Limestone	5	165
Sand and clay	5	170

Stopped casing at 162 or 163 feet (1 foot in rock). Drilled through about 7 feet of limestone and 6 feet in shale or blue clay. Then backfilled with about 6 or 7 feet of coarse gravel hens egg size.

The well is cased with 10-inch casing. After the well was completed and the coarse gravel placed, the casing which had been seated in the limestone at 162 feet was cut at a depth of 120 feet and the top portion pulled back sufficiently to expose a 15-foot length of 10-inch Cook well strainer having a width of slot opening of 0.016 inches.

The acceptance test for production gave a specific capacity of 7.5 gallons per minute per foot of draw down from a static water level of 9.4 feet below well top.

The well is equipped with an electric motor driven American Well Works single-stroke deep-well cylinder pump. The cylinder has an inside diameter of 7¼ inches. The pump stroke is 24 inches long. At a speed of 23 to 24 strokes per minute the displacement is approximately 100 gallons per minute.

The water has a total residue of 326, a total hardness of 282, and an iron content of 2.6 parts per million as shown by the analysis of sample number 83552, collected at the well May 20, 1938.

Analysis of Sample Number 83552 from the Village Supply.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	2.6	0.15
(filtered).....	0.06	Sodium Chloride.....NaCl	3.5	0.20
(unfiltered).....	2.6	Sodium Sulfate.....Na_2SO_4	14.9	0.87
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	27.0	1.57
Silica.....SiO_2	17.0	Ammonium Carbonate..$(NH_4)_2CO_3$	0.5	0.03
Turbidity.....	15.0	Magnesium Carbonate..$MgCO_3$	108.2	6.32
Color.....	0	Calcium Carbonate.....$CaCO_3$	153.8	8.97
Odor.....	Csl	Iron Oxide.....Fe_2O_3	0.1	0.01
Calcium.....Ca	61.5	Silica.....SiO_2	17.0	0.99
Magnesium..Mg	31.2			
Ammonium..NH_4	0.1	Total.....	327.6	19.11
Sodium.....Na	18.6			
Sulfate.....SO_4	10.3			
Nitrate.....NO_3	1.9			
Chloride.....Cl	2.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	308.0			
Residue.....	326.0			
Total Hardness....	282.0			

The Wagner Dairy Products Company had a well drilled in 1936 by F. M. Gray, Jr. to a depth of 350 feet. It is cased with 8-inch pipe to rock at 150 feet, and with 6-inch pipe from above the bottom of the 8-inch to a depth of 225 feet. The bore was finished as a 6-inch hole. The 8-inch casing was perforated with one hundred holes between depths of 96 and 102 feet to permit the entrance of water from a gravel zone. Static water level was 11 feet below ground surface when the well was completed.

The well is equipped with a 7-stage, 8-inch Peerless deep-well turbine pump consisting of 100 feet of 4-inch column, 4 feet of pump bowls, and 20 feet of 4-inch suction pipe, and rated at 100 gallons per minute against a head of 200 feet. It is driven by a 10-horsepower electric motor. It operates about 4 hours per day.

The water had a total residue of 306, a total hardness of 270.5, and a content of iron of 3.4 parts per million as shown by the analysis of sample number 83758, collected June 21, 1938.

RIDGE FARM (888). Ridge Farm is located in the southeastern part of Vermilion County on the drainage area of North Fork of Bruillets Creek, a tributary of Wabash River. A number of shallow private wells have been in use in the past.

The water for the public supply, installed by the village in 1935, is obtained from a well in the southeastern part of the village, which was drilled in 1935 by the W. L. Thorne Company of Des Plaines. The well is 87 feet deep and of the gravel-walled type. It is equipped with a 20-foot length of 12-inch screen having 3/16-inch slots.

The water level was at a depth of 26½ feet when not pumping and was lowered about 51 feet by pumping at a rate of 200 gallons per minute.

The well is equipped with a 12-stage Fairbanks-Morse turbine pump having 75 feet of 6-inch column pipe and rated at 200 gallons per minute. The pump is direct-connected to a 20-horsepower electric motor.

Water is pumped from the well directly into the distribution system, to which is connected an elevated steel tank. The total pumpage for the month of December, 1937 was approximately 210,000 gallons. At that time there were 85 service connections, but no large consumers.

The water had a total residue of 345, a total hardness of 303, and a content of iron of 0.8 parts per million as shown by the analysis of sample number 75951, collected April 15, 1935.

Analysis of Sample Number 75951 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	3.4	0.20
(unfiltered)		0.8	Sodium Chloride	NaCl	29.8	1.74
Manganese	Mn	0.0	Magnesium Chloride	$MgCl_2$	5.2	0.30
Silica	SiO_2	10.0	Magnesium Sulfate	$MgSO_4$	88.5	5.16
Turbidity		10.0	Magnesium Carbonate	$MgCO_3$	39.2	2.28
Calcium	Ca	71.0	Calcium Carbonate	$CaCO_3$	177.6	10.36
Magnesium	Mg	30.5	Iron Oxide	Fe_2O_3	1.1	0.00
Ammonium	NH_4	0.08	Silica	SiO_2	10.0	0.58
Sodium	Na	12.6				
Sulfate	SO_4	70.7	Total		354.8	20.62
Nitrate	NO_3	2.4				
Chloride	Cl	22.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		224.0				
Residue		345.0				
Total Hardness		303.0				

RIVER FOREST (8829) (p. 544). River Forest now obtains Lake Michigan water from Chicago. Up until the early part of 1925 practically all the water for River Forest was obtained from two wells located at the water works pumping station. One of the wells was 1000 feet deep and the other (well number 3) had been deepened from an original depth of 1980 feet to 2150 feet. At times of shortage Lake Michigan water was purchased from Oak Park. However, well number 3 furnished the major portion of the supply.

In 1925 there was finished and placed in service a new deep well (well number 4). The new storage reservoir had been completed sometime previous. These improvements were located in the northern part of the village at Jackson Avenue and Berkshire Street about 1¼ miles distant from the original pumping station.

The well was completed to a depth of 2102 feet. An 81-foot 7-inch length of 20-inch outside diameter drive casing was set from the surface to a seat in the limestone. The well was then continued as a 19⅛-inch bore to 468 feet, a 15-inch bore to 553 feet, a 12-inch bore

to 1312½ feet, and a 10-inch bore for the balance of the distance or to 2102 feet. In addition to the 20-inch outside diameter casing set at the top there was installed 109.5 feet of 16-inch outside diameter liner seated at 553 feet and 166.5 feet of 10-inch inside diameter liner seated at 1312½ feet. Static water level was 68 feet below well top.

The well was equipped with an American Well Works deep-well turbine pump, the bottom of the bowls being set at a depth of 354 feet. A 35-foot length of suction pipe was attached to the bottom of the bowl assembly. The temperature of the water was 61.7°F.

The water had a total residue of 659, a total hardness of 245.8, and a content of iron of 0.2 parts per million as shown by analysis of sample number 58437, collected February 22, 1927.

Analysis of Sample Number 58437 from Village Well, 2102 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Potassium Nitrate	KNO_3	1.0	.06
Manganese	Mn	0.0	Potassium Chloride	KCl	29.0	1.70
Silica	SiO_2	11.6	Sodium Chloride	NaCl	187.7	10.97
Nonvolatile		0.6	Sodium Sulfate	Na_2SO_4	176.4	10.31
Alumina	Al_2O_3	0.3	Sodium Carbonate	Na_2CO_3	18.5	1.08
Calcium	Ca	61.3	Ammonium Carbonate	$(NH_4)_2CO_3$	1.2	.07
Magnesium	Mg	22.6	Magnesium Carbonate	$MgCO_3$	79.7	4.66
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	155.9	9.12
Potassium	K	15.3	Silica	SiO_2	11.6	.68
Sodium	Na	136.6	Iron Oxide	Fe_2O_3	0.3	.02
Sulfate	SO_4	121.4	Alumina	Al_2O_3	0.3	.02
Nitrate	NO_3	0.6	Manganese Oxide	MnO	0.0	.00
Chloride	Cl	130.0	Nonvolatile		0.6	.03
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		662.2	38.72
Methyl Orange		274.0				
Residue		659.0				
Total Hardness		245.8				

The reservoir on the same property as well number 4 is 66 feet by 100 feet in plan and 13 feet deep. Water from well number 4 was discharged into it for repumping to distribution system. Facilities were also provided whereby Lake Michigan water could be received when desired.

By June, 1926 well number 4 was furnishing all the well water supply required by the village, the average rate of pumpage being 850 gallons per minute.

RIVER GROVE (2741). A public water supply distribution system was installed in 1924. Water is obtained from Lake Michigan through Chicago.

RIVERDALE (2504) (p. 574 and 710). No record of change.

RIVERSIDE (6770) (p. 548). The well drilled in 1924 by the J. P. Miller Artesian Well Company is known as well number 3. This well is 20 inches in diameter for the first 800 feet and 10 inches in diameter to the bottom at 2047 feet. It was equipped with a Layne

deep-well turbine pump, the bottom of the suction being originally set at a depth of 360 feet. Static water level was reported as 260 feet below ground surface and the pump was rated at 1000 gallons per minute when water level under the influence of pumping was at a depth of 300 feet. The temperature of the water was 61° F.

Water from this well had a total residue of 852, a total hardness of 296, and a content of iron of 0.1 Darts per million in February, 1926. In July, 1931 water from this well had a total residue of 817, a total hardness of 566, and a content of iron of 0.4 parts per million. The well was repaired in 1932 and on September 13, 1935 the water had a total residue of 777, a total hardness of 324.0 parts per million, and a trace of iron as shown by the analysis of sample number 76613.

Analysis of Sample Number 76613 from Well Number 3, 2047 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	trace	Sodium Nitrate.....$NaNO_3$	1.8	0.10
Manganese..Mn	0.0	Sodium Chloride.....NaCl	263.3	15.35
Silica.....SiO_2	10.0	Sodium Sulfate.....Na_2SO_4	179.1	10.45
Turbidity.....	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	0.7	0.04
Calcium.....Ca	79.0	Magnesium Sulfate.....$MgSO_4$	21.7	1.27
Magnesium..Mg	30.8	Magnesium Carbonate..$MgCO_3$	91.4	5.33
Ammonium..NH_4	0.1	Calcium Carbonate.....$CaCO_3$	197.6	11.53
Sodium.....Na	162.1	Silica.....SiO_2	10.0	0.58
Sulfate.....SO_4	138.8			
Nitrate.....NO_3	1.2	Total.....	765.6	44.65
Chloride.....Cl	160.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	306.0			
Residue.....	777.0			
Total Hardness....	324.0			

Well number 3 was put in service immediately upon its completion and by July, 1925 it was supplying practically all the water required by the village, the production being at a rate of about 1000 gallons per minute. A small amount of water was obtained from the east well of the two original wells. The west well had been taken out of service.

In 1927 the average daily demand of the village was estimated as 575,000 gallons. Meter readings indicated that well number 3 was supplying on the average of 523,000 gallons per day. The well was being pumped from 10 to 12 hours per day and producing at a rate of 800 gallons per minute.

Well number 4 was drilled in 1931. It was drilled to a depth of 900 feet by W. L. Thorne Company and from 900 to 1980 feet by R. D. Anderson. It is located near the intersection of Northgate and Selborne Eoads. It is cased from the surface (elevation about 619) to a depth of 129 feet with 18-inch pipe. An 18-inch liner is set between depths of 337 and 519 feet. Below this the diameter is 15 inches to 1304 feet, 12 inches to 1375 feet, and 10 inches to the bottom of the well. A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	53	53
Dolomite, Niagaran	277	330
Shale and dolomite, Maquoketa	181	511
Dolomite, Galena-Platteville	319	830
Dolomite, sandy, Glenwood	17	847
Sandstone, St. Peter	135	982
Dolomite, Oneota, Jordan, Trempealeau	323	1305
Sandstone, shale, Mazomanie	67	1372
Sandstone, Dresbach	168	1540
Siltstone, shale, dolomite, Eau Claire	270	1810
Sandstone, Mt. Simon	170	1980

The well was equipped with a 14-inch Peerless deep-well turbine pump driven by a 200-horsepower electric motor. The pump assembly consisted of 400 feet of column pipe, 16 bowls of pump with suction pipe making an over-all length below the pump base of 445 feet 4 inches. A small air-line for determining water levels extended to a depth of 434 feet below the pump base.

Water level in the well was at a depth of 270 feet when not pumping and was lowered 15¼ feet by pumping at a rate of 1277 gallons per minute.

The water had a total residue of 737, a total hardness of 249, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 76614, collected September 12, 1935.

Analysis of Sample Number 76614 from Well Number 4.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.3	Sodium Nitrate	$NaNO_3$	0.9	0.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	217.4	12.67
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	206.8	12.05
Turbidity		0.0	Sodium Carbonate	Na_2CO_3	59.4	3.46
Calcium	Ca	58.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	0.06
Magnesium	Mg	25.3	Magnesium Carbonate	$MgCO_3$	87.6	5.11
Ammonium	NH_4	0.3	Calcium Carbonate	$CaCO_3$	145.0	8.46
Sodium	Na	178.5	Iron Oxide	Fe_2O_3	0.4	0.02
Sulfate	SO_4	139.6	Silica	SiO_2	10.0	0.58
Nitrate	NO_3	0.6				
Chloride	Cl	132.0	Total		728.5	42.46
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		306.0				
Residue		737.0				
Total Hardness		249.0				

All water for the public water supply is now obtained from wells numbers 3 and 4.

RIVERTON (1582). Riverton purchases water from the city of Springfield. The distribution system was installed in 1936.

ROANOKE (1088) (p. 552). No reported change.

ROBBINS (753). A public water supply distribution system was installed in 1931. Lake Michigan water is obtained from Chicago.

ROBERTS (410) (p. 555). No reported change.

A new sample, number 75975, collected on April 21, 1935 indicated a total residue of 672, a total hardness of 450, and an iron content of 1.4 parts per million.

ROBINSON (3668) (p. 556). The water works system supplying water to Eobinson, Palestine and Oblong is owned and operated by the Central Illinois Public Service Company. The wells and pumping station are located on company-owned property located a short distance west of the west limits of Palestine.

The dug well 24 feet in diameter and 28 feet deep reported on page 557 has been abandoned and filled up. The two 10-inch wells also described on page 557 are available but not used.

The water supply for Robinson and the other two municipalities is obtained from a porous concrete well having an inside diameter of 26 inches and a depth of 60 feet, constructed in 1926 by Mr. Thorpe of Alton, Illinois.

When not pumping, the water level is 21 feet 3 inches below the top of the well curb. Pumping at a rate of 400 gallons per minute creates a draw down of 6 feet 8 inches.

The average daily total production is about 365,000 gallons. This is divided among the three communities as follows: Robinson, 285,000; Palestine, 45,000 gallons and Oblong, 35,000 gallons.

The pumping equipment consists of two Manistee Iron Works centrifugal pumps rated at 400 gallons per minute at 1750 revolutions per minute against a head of 520 feet, and one Dayton-Dowd two-stage centrifugal pump rated at 300 gallons per minute. The latter is used at times of off-peak load. All pumps are powered by electric motors. An elevated water tank is connected to the system. Water is sold directly to the subscriber at the following rates:

27 cents per 100 cu. ft. for the first 2,600 cu. ft. per month.
18 cents per 100 cu. ft. for the next 6,700 cu. ft. per month.
11.7 cents per 100 cu. ft. for the next 6,700 cu. ft. per month.
7.2 cents per 100 cu. ft. for the next 16,000 cu. ft. per month.
5.4 cents per 100 cu. ft. for the next 40,000 cu. ft. per month.

The minimum charge is $1.00 per month for residential users and $25.00 per month for subscribers taking the lowest rate.

The water has a total residue of 362, a total hardness of 285, and a content of iron of .26 parts per million as shown by the analysis of sample number 83708 collected June 14, 1938.

Analysis of Sample Number 83708 from City Supply.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	31.4	1.83
(filtered).....	0.0	Sodium Chloride.....NaCl	12.3	.72
(unfiltered).....	.26	Magnesium Chloride....$MgCl_2$	14.3	0.83
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	81.8	4.77
Silica.....SiO_2	18.0	Magnesium Carbonate..$MgCO_3$	3.8	0.22
Turbidity.....	61.0	Calcium Carbonate.....$CaCO_3$	197.7	11.53
Color.....	0.0	Silica.....SiO_2	18.0	1.05
Odor.....	0.0			
Calcium.....Ca	79.1	Total.....	359.3	20.95
Magnesium..Mg	21.3			
Ammonium..NH_4	trace			
Sodium.....Na	13.1			
Sulfate.....SO_4	65.4			
Nitrate.....NO_3	23.0			
Chloride.....Cl	18.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	202.0			
Residue.....	362.0			
Total Hardness....	285.0			

The Lincoln Oil Refining Company has its own water supply system. Water is obtained from two wells about 65 feet deep, located within 500 feet of the water plant of the Central Illinois Public Service Company. These wells are pumped continuously 24 hours per day at a rate of 1000 gallons per minute.

ROCHELLE (3785) (p. 558). Well number 1 has not been used for several years except at times of peak demand. Well number 3 was drilled in 1923 by P. E. Millis and Company of Byron. It is located 150 feet east of well number 2 and is 1484 feet deep. It is cased with 16-inch pipe to a depth of 131 feet, is 15 inches in diameter from 131 to 301 feet and 12½ inches in diameter from 301 feet to the bottom of the well.

A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Soil	10	10
Dolomite, Platteville	75	85
Sandstone, St. Peter	400	485
Chert, dolomite, Prairie du Chien	105	590
Dolomite, sandstone, Franconia	115	705
Sandstone, Dresbach	140	845
Shale, sandstone, Eau Claire	275	1120
Sandstone, Mt. Simon	364	1484

In 1930 the water level was at a depth of 35 feet when not pumping and was lowered 77 feet by pumping at a rate of 680 gallons per minute.

The well is equipped with a 6-stage, 12-inch American turbine pump driven by a 40-horsepower electric motor. The bottom of the pump bowls is at a depth of 149 feet.

Well number 4 is located 150 feet east of well number 3. It was drilled in 1928-1929 by P. E. Millis and Company. It is 1450 feet deep and is cased with 16-inch pipe to a depth of 131 feet.

In 1930 the water level was at a depth of 35 feet when not pumping and was lowered 77 feet by pumping at a rate of 680 gallons per minute. The other wells were not being pumped when this test was made.

The well is equipped with an 8-stage, 12-inch American turbine pump driven by a 30-horsepower electric motor. The bottom of the pump is at a depth of 148 feet.

In 1935 the static water level in these wells was reported to be several feet lower than in 1930. Although the yield of the wells had not decreased much, the demand had increased a great deal due to the needs of several large consumers, notably a pea and corn cannery, and in 1937 the yield of the wells was barely sufficient to meet the demand. A total of 45 million gallons was pumped during one month of that year.

Water from the wells is pumped to a concrete reservoir and then, by means of centrifugal pumps, is pumped to the distribution system.

The California Packing Corporation has a well 404 feet deep located in the western part of the city. This well is reported to yield 431 gallons per minute with a draw down of only 16 feet.

The water from well number 3 had a total residue of 328, a total hardness of 281, and a content of iron of 0.07 parts per million as shown by the analysis of sample number 82732, collected January 6, 1938. The water from well number 4 was of similar chemical quality.

Analysis of Sample Number 82732 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		.02	Sodium Nitrate	$NaNO_3$	2.6	.15
(unfiltered)		.07	Sodium Sulfate	Na_2SO_4	14.2	.83
Manganese	Mn	0.00	Sodium Carbonate	Na_2CO_3	7.4	.43
Silica	SiO_2	17.5	Magnesium Carbonate	$MgCO_3$	123.0	7.18
Turbidity		8	Calcium Carbonate	$CaCO_3$	135.2	7.90
Color		0	Silica	SiO_2	17.5	1.02
Odor		M				
Calcium	Ca	54.0	Total		299.9	17.51
Magnesium	Mg	35.5				
Ammonium	NH_4	trace				
Sodium	Na	8.5				
Sulfate	SO_4	9.7				
Nitrate	NO_3	2.1				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		288.0				
Residue		328.0				
Total Hardness		281.0				

A new well, known as number 5, was drilled in 1938 by the W. L. Thorne Company. It is located on Sixth Avenue about ½ block east of 14th Street, and is 10 inches in diameter and 502 feet deep. It is cased from the surface to 42 feet with 15-inch pipe and from the surface

to 100 feet with 10-inch pipe. The 10-inch casing is grouted over its entire length.

The water level was 36 feet below the surface when not pumping and was lowered 47 feet by pumping at a rate of 700 gallons per minute. This well will be equipped with a deep-well turbine pump which will discharge directly into the distribution system.

The temperature of the water from well number 5 was 52° F. The water had a total residue of 278, a total hardness of 280, and a content of iron of 1.28 parts per million as shown by the analysis of sample number 83417, collected April 28, 1938.

Analysis of Sample Number 83417 from Well Number 5.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.3	.25
(filtered)		.06	Magnesium Nitrate	$Mg(NO_3)_2$	0.7	.04
(unfiltered)		1.28	Magnesium Chloride	$MgCl_2$	2.4	.14
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	3.6	.21
Silica	SiO_2	14.0	Magnesium Carbonate	$MgCO_3$	104.0	6.08
Turbidity		12.0	Calcium Carbonate	$CaCO_3$	151.5	8.83
Color		0.0	Manganese Oxide	MnO	.1	.01
Odor		0.0	Silica	SiO_2	14.0	.82
Calcium	Ca	61.0				
Magnesium	Mg	31.2	Total		280.6	16.38
Ammonium	NH_4	trace				
Sodium	Na	1.3				
Sulfate	SO_4	3.3				
Nitrate	NO_3	3.5				
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		274.0				
Residue		278.0				
Total Hardness		280.0				

ROCHESTEE (427). Eochester purchases water from the city of Springfield. The distribution system was installed in 1936.

ROCKDALE (1701) (p. 561). There has been no change in the source of supply. The well is now equipped with a 4-stage, 8-inch Peerless turbine pump having 190 feet of 5-inch column pipe and 35 feet of 5-inch suction pipe. The pump is rated at 150 gallons per minute against a 233-foot head and is driven by a 20-horsepower electric motor.

The chemical quality of the water is very similar to that reported on page 562.

ROCK PALLS (3893) (p. 560). No reported change.

ROCKFOED (85,864) (p. 563). All the old wells in the vicinity of the Old Park Avenue pumping station have been abandoned with the exception of well number 1.

Water for the city supply is obtained from six wells at the Pay Street pumping station, which are numbered from 1 to 6, from well

number 7 at Eleventh Street and Eighteenth Avenue, from well number 8 at Auburn Avenue and Camp Avenue, from well number 9 at James and Crosby Streets and from Potsdam well number 1 at Park Avenue and the River.

Wells numbered 1, *2, 3,* and 4 at Fay Street station have been previously described.

Well number 5 at Fay Street station was constructed in 1926 at a location in the parkway at the southwest corner of the intersection of Fay and Preston Streets. Ground surface is at an elevation of 725.9 feet above mean sea level and the well, constructed similarly to the first four in this area, is 1605 feet. It is pumped with air supplied by the compressers at the Fay Street station. The water is discharged into the concrete reservoir nearby.

Well number 6 at the Fay Street station was constructed in 1927 at a location in the parkway at the southwest corner of Fay and Chestnut Streets. Ground surface is at an elevation of 728.5 feet above mean sea level and the well, constructed similarly to the first four in this area, is 1608 feet deep. It is pumped with air supplied from the Fay Street station. The water is discharged into the concrete reservoir nearby.

Well number 9 was constructed in 1928 by F. M. Gray, Jr., on city property at the northeast corner of Crosby and James Streets in the northeasterly part of the city. Ground surface is at an elevation of 807.9 feet above mean sea level and the well is 1600 feet deep.

The materials penetrated in the construction of well number 9 with classifications by the State Geological Survey are as follows:

	Thickness in feet.	Depth in feet.
Pleistocene		
Drift	240	240
Ordovician		
Platteville dolomite	30	270
St. Peter sandstone	250	520
Cambrian		
Trempealeau dolomite	90	610
Franconia, shale and sandstone	140	750
Dresbach		
Galesville sandstone	80	830
Eau Claire sandstone	390	1220
Mt. Simon sandstone	380	1600

The well is cased with 18-inch outside diameter pipe from the surface to a depth of 240 feet 10 inches and with 12-inch inside diameter pipe between depths of 224 and 347 feet 3 inches. It was finished as a 12½-inch hole.

When this well was first completed a production of 2.2 million gallons per day was obtained but by September, 1936 the rate had fallen to 1.78 million gallons per day.

The water had a total residue of 351, a total hardness of 341.5 and an iron content of 1.0 parts per million as shown by the analysis of sample number 78639, collected September 8, 1936.

Analysis of Sample Number 78639 from Well Number 9.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe (unfiltered).....	1.0	Magnesium Nitrate.....$Mg(NO_3)_2$	3.1	0.18
Manganese..Mn	0.0	Magnesium Chloride....$MgCl_2$	5.2	0.30
Silica.....SiO_2	12.0	Magnesium Sulfate.....$MgSO_4$	16.9	0.99
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	113.0	6.59
Calcium.....Ca	74.4	Calcium Carbonate.....$CaCO_3$	186.0	10.84
Magnesium..Mg	37.8	Ferric Oxide.....Fe_2O_3	1.4	0.08
Sulfate.....SO_4	13.6	Silica.....SiO_2	12.0	0.70
Nitrate.....NO_3	2.0			
Chloride.....Cl	4.0	Total.....	337.6	19.68
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	320.0			
Residue.....	351.0			
Total Hardness....	341.5			

Well number 9 was reconditioned in 1936 and 1937 by the W. L. Thorne Company. The well was shot at five points between depths of 680 and 1370 feet with 100-pound charges of explosive. After all repairs had been completed, a production of 1300 gallons per minute was obtained with a draw down of 37½ feet from a static water level of 104 feet below top of well.

The original Layne-Bowler 12-inch deep-well turbine pump was reinstalled with 179 feet of column pipe, 6 stages of bowls having an over-all length of about 6 feet, and 30 feet of suction pipe.

A well identified as Potsdam well number 1 at the Park Avenue station, which was reported to have had an original depth of 1530 feet, was reconditioned during 1937 and 1938 by the W. L. Thorne Company. The old 10-inch casing was removed and the well reamed for the full depth of 1530 feet. The well was recased with 18-inch outside diameter pipe from the pump room floor into rock at a depth of 129½ feet. The hole is 18 inches in diameter below the casing to a depth of 200 feet below which it is 15 inches to the bottom.

After repairs were completed, static water level was 18 feet below the pump room floor and production rates of 680, 910, 1200, and 2100 gallons per minute were obtained with draw downs of 36, 47, 56½, and 92 feet respectively.

The well is equipped with an American Well Works, size 16 LC deep-well turbine pump rated at 2100 gallons per minute against a 140-foot head. The pump assembly consists of 130 feet of column pipe below the motor frame base and 3 stages of bowls. There is no suction pipe below the bowls. An air line for measuring water levels terminates at the top of the bowls. The pump is driven by a General Electric 100-horsepower electric motor operating at a full load speed of 1175 revolutions per minute.

This unit operates for eight to nine hours daily and discharges into a large ground storage reservoir nearby.

There are more than 75 private and industrial wells within the city. Old Potsdam well number 3, located in the parkway on the north side of Jefferson Street and about 135 feet west of the west line of north

Main Street has been equipped by the city with a small turbine pump to furnish water for air cooling for a nearby theater.

ROCK ISLAND (37,953) (p. 710). The raw water supply of the city of Rock Island is obtained from Mississippi River. The water is treated before entering the distribution system.

ROCKTON (1077) (p. 567). In 1938 all water for the public supply was obtained from the 8-inch well described on page 568 and a new well drilled in 1930 by P. E. Millis of Byron. The 6-inch wells have been abandoned.

The new well is 12 feet south of the 8-inch well, and is 395 feet deep and 12 inches in diameter with casing extending to rock. Static water level is reported to be at a depth of 19 feet.

The well is equipped with a 4-stage, 12-inch Layne turbine pump rated at 300 gallons per minute against a total head of 210 feet and driven by a 30-horsepower electric motor. The pump consists of 66½ feet of 7-inch column pipe, a bowl assembly 3 feet 7 inches long, and 20 feet of 6-inch suction pipe.

Because of a decrease in production the 8-inch well described on page 568 was surged and developed in 1938 by C. D. Acly of Walworth, Wisconsin. The well then produced 300 gallons per minute with a draw down of 52 feet from a static water level 18 feet below the surface. After the repair work was completed the well was equipped with a Layne turbine pump. The pump is driven by a 15-horsepower electric motor.

The 6-inch rock well was reported to be 160 feet deep in 1938 and produced 80 gallons per minute with a draw down of 41 feet from a static water level 21½ feet below the surface. This well is not equipped with a pump.

ROODHOTJSE (2621) (p. 569). Eoodhouse formerly obtained water for the public supply from springs. In 1927-'28 two wells were drilled into the rock from which the springs flowed. They are 20 inches in diameter and 150 feet deep, and are cased to a depth of 16 feet. They were drilled by the Layne North Central Company.

One well is equipped with a 17-stage, 15-inch Layne turbine pump driven by a 120-horsepower vertical Diesel engine. The other well is equipped with a 12-stage, 15-inch Layne turbine pump driven by a 75-horsepower vertical Diesel engine. The discharge rate of these pumps is 500 and 400 gallons per minute, respectively.

All water for the public supply is now obtained from these wells. The quality of the water is essentially the same as that shown by the analysis of sample number 46508 on page 569.

ROSELLE (807). Eoselle is located in the northern part of Du-Page County on the drainage area of Salt Creek, a tributary of Des Plaines River. Water for the public supply, installed in 1925, is obtained from a well, 182 feet deep, drilled by W. L. Thorne Company in 1924. The well is cased to a depth of 139 feet with 10-inch pipe. Below

this depth it is 10 inches in diameter to the top of the shale at a depth of 182 feet. It is reported to have been tested at a pumping rate of 100 gallons per minute.

The pump is a Keystone double-stroke pump having a 5¾-inch cylinder and 18-inch stroke.

The water had a mineral content of 467, a total hardness of 323, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 56030, collected January 30, 1926.

Analysis of Sample Number 56030 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Potassium Chloride	KCl	4.3	.25
Manganese	Mn	0.0	Potassium Sulfate	K_2SO_4	1.5	.09
Silica	SiO_2	22.2	Sodium Sulfate	Na_2SO_4	103.1	6.03
Nonvolatile		0.6	Ammonium Sulfate	$(NH_4)_2SO_4$	1.8	0.11
Alumina	Al_2O_3	0.3	Magnesium Sulfate	$MgSO_4$	99.9	5.84
Calcium	Ca	66.6	Magnesium Carbonate	$MgCO_3$	59.2	3.46
Magnesium	Mg	38.1	Calcium Carbonate	$CaCO_3$	162.8	9.52
Ammonium	NH_4	0.5	Silica	SiO_2	22.2	1.29
Potassium	K	3.0	Iron Oxide	Fe_2O_3	0.6	.03
Sodium	Na	34.1	Alumina	Al_2O_3	0.3	.02
Sulfate	SO_4	148.6	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.0	Nonvolatile		0.6	0.03
Chloride	Cl	2.0				
Alkalinity as $CaCO_3$			Total		456.3	26.67
Phenolphthalein		0.0				
Methyl Orange		228.0				
Residue		467.0				
Total Hardness		323.0				

EOSEVILLE (975) (p. 5??). The mine shaft and deep well described on page 570 have been abandoned. In 1925 two wells were drilled about one-half mile west of the village by Layne-Bowler Company. They were 38 and 40 feet deep, respectively, and 10 inches in diameter. They were abandoned in 1931 when the combined yield was only 50 gallons per minute. During the next three years water was obtained from a dug well 15 feet deep and 4 feet in diameter. This well yielded about 35 gallons per minute.

1n 1934 a new well was drilled about one-half mile west of the village by the W. L. Thorne Company of Des Plaines. It is now known as well number 1 and is 23 feet deep. It yields about 35 gallons per minute and is equipped with a centrifugal pump.

Well number 2, located about 75 feet northwest of well number 1, was drilled in 1936 by the W. L. Thorne Company. It is 19 feet deep, of the gravel-walled type, and the 16-inch inner casing, which extends from 2 feet above to 7 feet below the ground surface, has on its lower end a 12-foot length of screen with quarter-inch slots. It is equipped with a centrifugal pump which takes direct suction from the well.

The water level was 3.7 feet below the top of the inner casing when not pumping and was lowered 12.8 feet by pumping at a rate of 40 gallons per minute.

The water from well number 2 had a total residue of 250, a total hardness of 191, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 78460, collected July 24, 1936.

Analysis of Sample Number 78460 from Well Number 2.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	24.7	1.44
(unfiltered).....	0.0	Magnesium Nitrate.....$Mg(NO_3)_2$	39.3	2.29
Manganese..Mn	0.0	Magnesium Chloride....$MgCl_2$	21.4	1.24
Silica.....SiO_2	14.0	Magnesium Sulfate.....$MgSO_4$	41.0	2.39
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	3.8	0.22
Calcium.....Ca	41.5	Calcium Carbonate.....$CaCO_3$	103.5	6.03
Magnesium..Mg	21.3	Silica.....SiO_2	14.0	0.82
Sodium.....Na	6.4			
Sulfate.....SO_4	32.9	Total.....	247.7	14.43
Nitrate.....NO_3	50.9			
Chloride.....Cl	16.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	108.0			
Residue.....	250.0			
Total Hardness....	191.0			

ROSICLARE (1794). The raw water supply of the village of Eosiclare is obtained from Ohio River. The water is treated before entering the distribution system.

ROSSVILLE (1453) (p. 572). Rossville obtains water from three wells each 8 inches in diameter and about 133 feet deep. Two of the wells are described on page 573. The third well was drilled in 1928. It is located about 4 feet south of the 8-inch well. 126 feet deep which was drilled in 1910. The older well has been abandoned and filled.

A 20-foot length of number 30-slot A. D. Cook screen is installed in the well drilled in 1928. Water is pumped from the well by a 5½-inch Pomona turbine pump rated at 150 gallons per minute against a head of 160 feet. The pump assembly consists of 70 feet of column pipe, six bowls, and 10 feet of suction pipe. The pump is driven by a 15-horsepower Westinghouse electric motor.

The pump cylinder in the well drilled in 1918 is now set at a depth of 100 feet and the discharge is about 100 gallons pen minute. The pump cylinder in the south well is now set at a depth of 65 feet. Water is pumped from the well at a rate of 100 gallons per minute. The pump heads, cylinders and motors at these two older wells are as described on page 573.

The static water level in the newer well is 53 feet below the ground surface and the water level is 71 feet below the ground surface when water is being withdrawn from all three wells.

Water is pumped directly from the wells to the distribution system and 50,000-gallon elevated tank. There are 500 services. The average daily domestic usage is about 30,000 gallons. During the canning season a canning factory uses from 150,000 to 175,000 gallons per day.

Water is sold at a rate of 50 cents per 1000 gallons. The minimum charge is 75 cents per month.

The water had a total residue of 393, a total hardness of 334.6, and an iron content of 2.2 parts per million, as shown by the partial mineral analysis of sample number 84063, collected August 12, 1938.

ROUND LAKE (338) (p. 574). The water supply at Eound Lake is obtained from the well described on page 574. In 1928 an elevated tank with a capacity of 50,000 gallons was installed. The pressure tank is still in use.

In 1935 a 16-stage, 6-inch Cook turbine pump was installed in the well. The top of the bowls is at a depth of 120 feet below the ground surface. The over-all length of the bowl assembly is 75 inches, and 10 feet of suction pipe is attached below; the bowls. The pump is driven by a 10-horsepower General Electric motor. According to a meter at the plant the pump was delivering 110 gallons per minute against a discharge head of 114 feet. The average use is about 28,500 gallons per day.

ROXANA (1139). Roxana is located in the western part of Madison County near the east bank of Mississippi River. A public water supply was installed by the village in 1923. The village owned the distribution system and purchased water from the local refinery of the Shell Petroleum Corporation. Water was obtained from wells in sand and gravel. In 1936 the water was purchased from the city of Wood River.

In 1937 two wells were constructed for the village by the Thorpe Concrete Well Company. They are located in the eastern part of the village and are 150 feet apart. Each is 126 feet deep and has a porous concrete screen 72 feet long, 30 inches inside diameter, and 5 inches thick.

The yield characteristics of the two wells are similar. The north well, number 2, yielded 515 gallons per minute with a draw down of 5½ feet from a static level of 50 feet. The effect of the test of well number 2 on the water level in well number 1 was negligible.

Each well is equipped with a 3-stage Johnston turbine pump having 70 feet of column pipe and 2 feet of suction pipe. Each pump discharges 465 gallons per minute and is driven by a 15-horsepower electric motor.

Water is pumped from the wells to a coke-tray aerator. Then it is pumped through pressure filters to a 220,000-gallon steel ground storage tank near the filter plant building. No elevated tank is used.

Pour Dayton-Dowd centrifugal pumps are located in the filter plant building. Two are used to pump from the collecting basin, under the aerator, through the pressure filters, to the storage tank. Each of these is rated at 400 gallons per minute against a 35-foot head and is driven by a 7½-horsepower electric motor. The others are used to pump from the storage tank to the distribution system. One is rated at 400 gallons per minute against a 127-foot head and is driven by a 20-horsepower electric motor. This pump operates constantly. The other is rated at

800 gallons per minute at 127-foot head and is driven by a 6-cylinder gasoline engine. This pump is used only in case of emergency.

Water sample number 79855 was collected from well number 2 on April 8, 1937 after 24 hours continuous pumping at a rate in excess of 500 gallons per minute. The water had a total residue of 352, a total hardness of 264.5, and a content of iron of 2.8 parts per million as shown by the analysis.

Analysis of Sample Number 79855 from Well Number 2.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	2.0	Sodium Nitrate.....$NaNO_3$	1.7	0.10
(unfiltered).....	2.8	Sodium Chloride.....NaCl	8.2	0.48
Manganese..Mn	0.2	Sodium Sulfate.....Na_2SO_4	9.2	0.54
Silica.....SiO_2	18.0	Magnesium Sulfate.....$MgSO_4$	70.4	4.10
Turbidity.....	40.0	Magnesium Carbonate..$MgCO_3$	21.1	1.23
Odor.....	E1	Calcium Carbonate.....$CaCO_3$	181.0	10.55
Calcium.....Ca	72.3	Manganese Oxide.....MnO	0.3	0.02
Magnesium..Mg	20.3	Silica.....SiO_2	18.0	1.05
Sodium.....Na	6.7			
Sulfate.....SO_4	62.5	Total.....	309.9	18.07
Nitrate.....NO_3	1.3			
Chloride.....Cl	5.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	206.0			
Residue.....	352.0			
Total Hardness....	264.5			

ROYALTON (2108). The raw water supply of the village of Royalton is obtained from Big Muddy River. The water is treated before entering the distribution system.

ETJSHVILLE (2388) (p. 575). No reported change in either source of supply or pumping equipment.

The three infiltration wells described on page 577 do not furnish sufficient water and for several years the difference has been obtained by taking water from McElho Branch itself. The water is not filtered, but chlorine is added at the city pumping station.

Studies have been made from time to time looking toward an improved supply, particularly an improved surface supply with treatment.

In 1938 a careful investigation of the McElho Valley was made regarding its ability to furnish sufficient water for the city. Test borings indicated that the alluvial gravels in the lower valley of the Branch were not of sufficient extent to provide adequate subsurface storage to carry over during times of drought as the flow of the Branch has been as low as 35 gallons per minute during periods of low rainfall.

Test wells have recently been constructed out on Illinois River flood plain near the center of section 33 T. 1N., E. 1W of the 4th P. M., in the expectation that a satisfactory supply may be developed therefrom.

ST. ANNE (1078) (p. 578). A new well was drilled in 1929 by the W. L. Thorne Company of Des Plaines. It is located about 150 feet

west of the old well, is 265 feet deep and 10 inches in diameter, and is eased to rock with 94 feet of 10-inch pipe.

Static water level is reported to be 47 feet below the surface and the draw down is 16 feet when pumping at a rate of 300 gallons per minute.

The well is equipped with a 9-stage Pomona turbine pump rated at 300 gallons per minute and having 110 feet of column pipe and 40 feet of suction pipe. The pump is direct-connected to a 20-horsepower electric motor.

Identical pumping equipment has been installed in the old well reported as 257 feet deep. The old reservoir is no longer used. Water is pumped from the wells directly to the distribution system and elevated steel tank.

The quality of the water from the new well is similar to that of the water from the old well as reported on page 579.

ST. CHARLES (5377) (p. 580). The water supply of St. Charles is obtained from three wells. These are wells numbers 2 and 3 described on page 581 and well number 4 completed in 1936. Well number 1 has been abandoned for a number of years.

In 1931 well number 2 was repaired and reequipped with a Pomona deep-well turbine pump. The pump assembly consists of 250 feet of column pipe, 16 feet of bowls and 30 feet of suction pipe. When the new pump was installed, static water level was reported as 55 feet below ground surface. This well unit is held in reserve.

Well number 3 is now equipped with a Cook 12-inch deep-well turbine pump, the assembly of which consists of 200 feet of 8-inch column, 14 stages of bowls having an over-all length of 11 feet 2 inches and 28 feet of 8-inch suction pipe. The pump is direct connected to the General Electric Company 75-horsepower electric motor operating at a full load speed of 1160 revolutions per minute.

The pump discharges directly into the distribution system and alternates most of the time with the pump in well number 4. It was reported that in 1919, after an idleness of 48 hours, static water level was 14 feet below the ground surface and that a draw down of something over 90 feet took place when pumping at a rate of 555 gallons per minute. In 1924 it was reported that static water level was at 20 feet and in 1927 at 30 feet.

Well number 4 was completed in 1936 at a site on the east bank of Fox River about a half block north of State Street, by C. W. Varner of Dubuque, Iowa. The well is 2200 feet deep. It is cased with 15½-inch pipe from the surface to a depth of 400 feet, below this depth the hole is 15 inches in diameter to a depth of 1046 feet, at which point 128½ feet of 12-inch pipe was seated. Below the depth of 1046 feet the hole is 12 inches in diameter to the bottom of the well.

The driller's log of the well follows:

	Thickness in feet.	Depth in feet.
Fill, cinders, sand and gravel	8	8
Yellowish brown lime—bad crevice at 17 feet	14	22
Lime, gray	45	67
Shale, red and blue	8	75
Lime, gray, soft	36	111
Lime and shale	47	158
Shale, brown	37	195
Rock, hard	7	202
Shale, brown	17	219
Lime, gray	157	376
Lime, brownish-gray	54	430
Lime, brown	30	460
Limestone, blue	10	470
Limestone, brown	80	550
Limestone, gray	22	572
Sandstone	53	625
Limestone and shale	5	630
Sandstone	123	753
Sandstone, lime spots	18	771
Sandstone	137	908
Sandstone, yellow	24	932
Sandstone, turned red	7	939
Struck oil at 935 feet		
Red rock, soft, showing oil	6	945
Red rock and shale	5	950
Lime, brownish-gray, red shale	78	1028
Limestone, brown	12	1040
Sandstone	116	1256
Sandstone, shale showing	17	1273
Blue shale	152	1425
Sandstone	30	1455
Limestone, gray	146	1601
Limestone, gray, shale	23	1624
Limestone, gray	21	1645
Sandstone, brown	145	1790
Sandstone	610	2200

The formations were shot at depths 1980, 2100, 2160.

The well is equipped with a Deming 12-inch deep-well turbine pump, the assembly of which consists of 240 feet of 10-inch column pipe, 7 stages of bowls having an over-all length of 6 feet 10 inches and 30 feet of 8-inch suction pipe.

The pump is direct connected to a U. S. 100-horsepower electric motor which operates at a full load speed of 1750 revolutions per minute. The pump is rated at 1000 gallons per minute against a 250-foot head. The acceptance test gave a production of 1000 gallons per minute with a draw down of 145 feet below a static water level of 90 feet.

In addition to the municipal wells there are ten to twelve private wells that may be classed as industrial. These wells vary in depth from 100 feet to about 900 feet.

ST. ELMO (1329). The raw water supply for the city of St. Elmo is obtained from an impounding reservoir on Sugar Creek. The water is treated before entering the distribution system.

ST. FRANCISVILLE (1202). St. Francisville is located in the southeastern part of Lawrence County on the west bank of Wabash River.

Water for the public supply, installed by the city in 1928, is obtained from two wells located near the intersection of Fairview Eoad and 13th Street, drilled in 1928 by Enoch Potts, a local driller. They are of similar construction, being 134 feet deep, 8 inches in diameter, and cased to a depth of 60 feet with 8-inch pipe. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Top soil	10	10
Mud and quicksand	23	33
Brown sandstone	27	60
White sandstone	74	134

The wells are about 125 feet apart. The north well has always yielded some sand with the water. It is used only as a standby unit. The south well furnishes the entire supply during periods of normal demand. The water level was at a depth of 18 feet when not pumping and the well yielded 125 gallons per minute when new. A rate of 200 gallons per minute lowered the water level below the suction pipe or almost to the bottom of the well.

The south well is equipped with a Cook double-acting pump having a 5¾-inch diameter cylinder and 14-inch stroke and driven by a 7½-horsepower electric motor. The north well is equipped with a Cook single-stroke pump having a 5¾-inch diameter cylinder and 12-inch stroke and driven by a 10-horsepower electric motor.

The water from the south well had a total residue of 284, a total hardness of 256.5, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 72324, collected January 16, 1933.

Analysis of Sample Number 72324 from South Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.2	Sodium Nitrate	$NaNO_3$	1.7	.10
Manganese	Mn	trace	Sodium Chloride	NaCl	5.3	.31
Silica	SiO_2	18.	Magnesium Chloride	$MgCl_2$	2.4	.14
Turbidity		0.	Magnesium Sulfate	$MgSO_4$	14.5	.85
Calcium	Ca	68.5	Magnesium Carbonate	$MgCO_3$	59.8	3.49
Magnesium	Mg	20.8	Calcium Carbonate	$CaCO_3$	171.0	9.98
Ammonium	NH_4	.03	Iron Oxide	Fe_2O_3	.3	.02
Sodium	Na	2.5	Silica	SiO_2	18.0	1.05
Sulfate	SO_4	11.3				
Nitrate	NO_3	1.24	Total		273.0	15.94
Chloride	Cl	5.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.				
Methyl Orange		242.				
Residue		284.0				
Total Hardness		256.5				

SALEM (4420) (p. 710). The raw water supply of the city of Salem is obtained from an impounding reservoir on a branch of Crooked Creek. The water is treated before entering the distribution system.

SANDOVAL (1264). Sandoval installed a distribution system in 1936. Water is purchased from the city of Centralia.

SANDWICH (2611) (p. 585). The public water supply for the city of Sandwich is obtained exclusively from the 600-foot well described on pages 585 and 586.

Prior to 1925 this well was pumped by direct suction but during that year the well was equipped with an American Well Works deep-well turbine to discharge directly into the distribution system and the standpipe. Automatic control maintains a full standpipe. Static water level is still sufficiently high to permit an extraction of 75 gallons per minute by direct suction. The well and service pumps are in connected pits about 8 feet deep.

SAN JOSE (486) (p. 583). San Jose obtains water from two wells, one drilled in 1917 and described on page 584 and one drilled in 1921 by H. B. Smith. The well which was drilled in 1885 and deepened in 1911 was abandoned and filled about 1921.

The well drilled in 1917 was recased about 1934. At that time a 6-foot length of 6-inch, number 10-slot Cook screen was set with the bottom of the screen at a depth of 103 feet.

The north well, which was drilled in 1921, is equipped with a 10-foot length of number 10-slot Cook screen. The well is located about 11 feet northeast of the older well and is 101 feet deep. Mr. Smith reported that the well penetrated loam and clay to a depth of 30 or 35 feet, dry red sand and gravel to a depth of 70 or 75 feet and water-bearing red sand to the bottom of the well. The static water level was reported to be at a depth of about 70 feet in both wells.

The older well is equipped with a 6-inch single-acting Cook deep-well cylinder pump with a 24-inch stroke. The cylinder is wedged in the casing just above the screen. The pump is driven by a 10-horsepower Fairbanks-Morse gasoline engine.

The north well is equipped with a similar pump operating with an 18-inch stroke. The pump is driven by a 10-horsepower electric motor.

The pump driven by the electric motor is automatic and no estimate of the daily consumption could be made. There are 130 service connections.

The water had a total residue of 494, a total hardness of 409.5 and an iron content of 0.34 parts per million as shown by the analysis of sample number 83955. collected on July 28, 1938.

Analysis of Sample Number 83955 from Village Supply.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	29.8	1.74
(filtered).....	0.06	Magnesium Nitrate.....$Mg(NO_3)_2$	14.1	0.82
(unfiltered).....	0.34	Magnesium Chloride....$MgCl_2$	31.0	1.81
Manganese..Mn	0.0	Magnesium Sulfate.....$MgSO_4$	103.0	6.00
Silica.....SiO_2	14.5	Magnesium Carbonate..$MgCO_3$	35.4	2.06
Turbidity.....	10.0	Calcium Carbonate.....$CaCO_3$	240.0	13.99
Color.....	0.0	Iron Oxide.....Fe_2O_3	0.1	0.01
Odor.....	0.0	Silica.....SiO_2	14.5	0.85
Calcium.....Ca	96.1			
Magnesium..Mg	41.4	Total.....	467.9	27.28
Ammonium..NH_4	0.0			
Sodium.....Na	8.1			
Sulfate.....SO_4	82.1			
Nitrate.....NO_3	33.2			
Chloride.....Cl	23.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	282.0			
Residue.....	494.0			
Total Hardness....	409.5			

SAUNEMIN (376). Saunemin is located in the eastern part of Livingston County on the drainage area of North Fork of Vermilion River, a tributary of Illinois River. A public water supply was installed by the village in 1927.

Water for the public supply is obtained from a well located in the public park in the northern part of the village. The well was drilled in 1926 by a Mr. Baker. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Surface material	205	205
Shale	108	313
Sandstone	7	320
Shale	5	325
Coal, slate, sand	20	345
Shale	40	385
Limestone	170	555
Shale	5	560

It has been reported that the well was finished at a depth of 584 feet.

It is cased with 10-inch pipe to a depth of 253 feet and with 8-inch pipe to a depth of 400 feet.

The water level was at a depth of 118 feet when not pumping and was lowered 167 feet by a pumping rate of 20 gallons per minute.

The well is equipped with an American deep-well plunger pump driven by an electric motor. Water is pumped from the well to an elevated steel tank near the well.

The water had a total residue of 2599, a total hardness of 106, and a content of iron of 1.8 as shown by the analysis of sample number 56994, collected July 26, 1926.

Analysis of Sample Number 56994 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	1.8	Potassium Nitrate	KNO_3	2.0	.12
Manganese	Mn	0.0	Potassium Chloride	KCl	80.1	4.69
Silica	SiO_2	21.0	Sodium Chloride	NaCl	1,843.0	107.70
Nonvolatile		7.0	Sodium Sulphate	Na_2SO_4	146.7	8.57
Alumina	Al_2O_3	4.9	Sodium Carbonate	Na_2CO_3	558.8	32.68
Calcium	Ca	31.5	Ammonium Carbonate	$(NH_4)_2CO_3$	4.1	.24
Magnesium	Mg	6.3	Magnesium Carbonate	$MgCO_3$	21.8	1.28
Ammonium	NH_4	1.5	Calcium Carbonate	$CaCO_3$	78.2	4.57
Potassium	K	43.0	Silica	SiO_2	21.0	1.22
Sodium	Na	1,020.0	Iron Oxide	Fe_2O_3	2.6	.15
Sulfate	SO_4	98.8	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	1.2	Alumina	Al_2O_3	4.9	.29
Chloride	Cl	1,150.0	Nonvolatile		7.0	.41
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		2,770.2	161.92
Methyl Orange		632.0				
Residue		2,599.0				
Total Hardness		106.0				

SAVANNA (5086) (p. 586). By 1926 the free flow of the three wells described on page 587 had fallen below the consumption demand and plans were made to increase the supply and also furnish better pressure to the bluff area of the city.

A booster station to provide better pressure for residents on the bluff was constructed on North Fourth Street. This station, completed in January, 1927, consisted of a Worthington centrifugal pump driven by a 20-horsepower electric motor with automatic control. The pump took suction from the city main and discharged into a cylindrical pressure tank, 5 feet in diameter by 20 feet long. The automatic control maintained pressure between 87 and 105 pounds. This provided a pressure of 46 pounds at the last hydrant on the line. A total of 35 customers were served by this improvement.

A Worthington Axiflo deep-well turbine pump driven by a 30-horsepower electric motor was installed in well number 3 with the bottom of the pump at a reported depth of 100 feet. This unit was placed in service in January, 1927.

In September, 1927 a production test of the wells and pump was made. At that time the maximum free-flow from the three wells was found to be but 407 gallons per minute. When this rate was obtained the pump in well number 3 had been idle for 90 minutes and the reservoir had but 2½ to 4 feet of water in the bottom. During the same test a minimum free-flow rate of 351 gallons per minute was obtained when the pump in well number 3 had been idle for 80 minutes and the depth of water in the reservoir was between 6 to 8 feet. It was reported that the free-flow from well number 3 was increased by a low reservoir stage and decreased by a high reservoir stage.

When the pump in well number 3 was operated an average production rate from the three wells of about 800 gallons per minute was obtained. The production from well number 3 alone when pumping was about 645 gallons per minute.

A well 1308½ feet deep was drilled in 1935 by C. W. Varner of Dubuque, Iowa. It is located near the corner of Pike and Bowen Streets. It is cased to a depth of 318 feet with 16-inch wrought iron pipe and a 12-inch wrought iron liner is placed between 893 and 975 feet. The open hole is 15 inches in diameter between depths of 318 and 530 feet, and 12 inches in diameter to the bottom of the well. Static pressure was sufficient to raise the water to a point 13 feet 2 inches above the top of the casing. The well flowed 353 gallons per minute when the center line of the discharge pipe was 20 inches above the pump house floor and 405 gallons per minute when the center line of the discharge pipe was 6 inches above the pump house floor. Pumping rates of 500 and 650 gallons per minute lowered the water level 2 feet 5 inches and 6 feet, respectively, below the top of the casing which was about floor level.

A record of material penetrated, with part of the classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	5	5
Limestone, Galena-Platteville	325	330
Shale, sandstone, Glenwood	40	370
Sandstone, St. Peter	50	420
Sandstone, shale, Shakopee	50	470
Limestone, Shakopee	60	530
Limestone, cherty, Oneota and Jordan	230	760
Limestone, Trempealeau	160	920
Shale, caving, Franconia	50	970
Sandstone, Franconia and Dresbach	130	1100
Sandstone, some shale and dolomite, Eau Claire	208½	1308½

Water is pumped by direct suction by a De Laval centrifugal pump rated at 500 gallons per minute against a head of 220 feet.

The water had a mineral content of 285, total hardness of 280 parts per million, and a trace of iron as shown by the analysis of sample number 75822, collected March 20, 1937.

Analysis of Sample Number 75822 from City Well 1308½ Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	trace	Sodium Nitrate	$NaNO_3$	1.7	0.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	6.4	0.37
Silica	SiO_2	9.0	Magnesium Chloride	$MgCl_2$	2.8	1.6
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	15.6	0.91
Calcium	Ca	52.4	Magnesium Carbonate	$MgCO_3$	112.1	6.54
Magnesium	Mg	36.2	Calcium Carbonate	$CaCO_3$	113.1	6.59
Sodium	Na	3.0	Iron Oxide	Fe_2O_3	0.0	0.00
Sulfate	SO_4	12.1	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	1.1	Silica	SiO_2	9.0	0.52
Chloride	Cl	6.0				
Alkalinity as $CaCO_3$			Total		260.7	15.19
Phenolphthalein		0.0				
Methyl Orange		264.0				
Residue		285.0				
Total Hardness		280.0				

SAYBROOK (746). Saybrook is located in the southeastern part of McLean County on the drainage area of Sangamon River, a tributary

of Illinois River. Many private wells obtain water from deposits of sand and gravel in the glacial drift which is over 200 feet in thickness.

Water for the public supply, installed by the village in 1935, is obtained from a well in the public park, drilled in 1935 by E. H. Johnson and J. E. Hinkle of Bloomington. It is 59 feet deep, 10 inches in diameter, and is equipped with a 20-foot length of number 20-slot Cook screen.

The permanent well was located a few feet from a test well which penetrated the following material:

	Thickness in feet.	Depth in feet.
Till	25	25
Dirty gravel	10	35
Gravel	24	59
Till	21	80
Sand	10	90
Till	20	110
Sand	5	115
Till	40	155

The water level was at depth of 23 feet when not pumping and was lowered 6 feet by a pumping rate of 325 gallons per minute.

The well is equipped with an 11-stage Fairbanks-Morse deep-well turbine pump with the top of the bowls at a depth of 40 feet. The pump is direct-connected to a 7½-horsepower electric motor. Water is pumped to an elevated steel tank connected to the mains and located beside the pump-house.

About 45 service connections were in use in June of 1936. The pump was operated twice weekly for periods of 5 or 6 hours. The minimum pumping rate, occurring when the elevated tank was almost full, was about 106 gallons per minute.

The water had a total residue of 436, a total hardness of 377, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 78193, collected June 11, 1936.

Analysis of Sample Number 78193 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0			
(unfiltered).....	0.0	Sodium Nitrate.....$NaNO_3$	6.8	0.40
Manganese..Mn	0.0	Sodium Chloride.....NaCl	11.1	0.65
Silica.....SiO_2	8.0	Magnesium Chloride....$MgCl_2$	11.0	0.64
Turbidity.....	0.0	Magnesium Sulfate.....$MgSO_4$	120.0	6.98
Calcium.....Ca	92.9	Magnesium Carbonate..$MgCO_3$	28.7	1.67
Magnesium..Mg	35.3	Calcium Carbonate.....$CaCO_3$	232.0	13.52
Sodium.....Na	6.2	Manganese Oxide.....MnO	0.2	0.01
Sulfate.....SO_4	95.6	Silica.....	8.0	0.47
Nitrate.....NO_3	4.9			
Chloride.....Cl	15.0	Total.....	417.8	24.34
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	266.0			
Residue.....	436.0			
Total Hardness....	377.0			

SCHILLEE PARK (709) (p. 590). In 1933 the public water supply was as described on page 590.

Water from the 252-foot well had a total residue of 800, a total hardness of 397, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 73100, collected June 15, 1933.

Analysis of Sample Number 73100 from the Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Sodium Nitrate	$NaNO_3$	3.4	.20
Manganese	Mn	0.0	Sodium Chloride	NaCl	19.9	1.16
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	280.8	16.38
Turbidity		0.0	Magnesium Sulfate	$MgSO_4$	225.0	13.13
Calcium	Ca	84.0	Calcium Sulfate	$CaSO_4$	121.8	7.11
Magnesium	Mg	45.4	Calcium Carbonate	$CaCO_3$	104.0	6.07
Ammonium	NH_4	.005	Calcium Silicate	$CaSiO_3$	19.2	1.12
Sodium	Na	99.7	Iron Oxide	Fe_2O_3	.3	.02
Sulfate	SO_4	455.0				
Nitrate	NO_3	2.2	Total		774.4	45.19
Chloride	Cl	12.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		104.0				
Residue		800.0				
Total Hardness		397.0				

SEATON (310) (p. 590). No change has been made in the source of the municipal water.

In 1936 a buried concrete reservoir with a capacity of 10,000 gallons was reconditioned. It is located at the southwest corner of the public square. The deep-well pump discharges into this reservoir. Water is pumped to the distribution system by an American Well Works centrifugal pump rated at 90 gallons per minute against a head of 120 feet. A 5-horsepower motor drives the pump.

There are 85 service connections. The average use is about 10,000 gallons per day.

SECOE (280) (p. 591). No record of change.

On July 22, 1938 a sample of water was collected from the pressure tank at Secor. The mixture of water from the two wells had a total residue of 517, a total hardness of 432, and an iron content of 4.2 parts per million as shown by the analysis of sample number 83925.

Analysis of Sample Number 83925 from Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.06	Sodium Carbonate	Na_2CO_3	66.3	3.86
(unfiltered)		4.2	Ammonium Carbonate	$(NH_4)_2CO_3$	9.1	0.53
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	156.0	9.10
Silica	SiO_2	13.0	Calcium Carbonate	$CaCO_3$	247.4	14.42
Color		0.0	Iron Oxide	Fe_2O_3	0.1	0.01
Turbidity		18.0	Silica	SiO_2	13.0	0.76
Odor		Chl				
Calcium	Ca	98.7	Total		493.6	28.78
Magnesium	Mg	45.0				
Ammonium	NH_4	3.5				
Sodium	Na	29.2				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.0				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		504.0				
Residue		517.0				
Total Hardness		432.0				

SESSEE (2315). The raw water supply of the city of Sesser is obtained from an impounding reservoir on Sandusky. Creek. The water is treated before entering the distribution system.

SHABBONA (546) (p. 593). The water for the public supply is still obtained from wells entering sand and gravel deposits at about 150 feet deep.

The old east well formerly called well number 1 has been abandoned and a new well drilled by P. E. Millis in 1931 has taken its place. The new well is located about 6 feet north of the abandoned well and is now called well number 1. It is reported to be 10 inches in diameter at the top and 150 feet deep.

The new well is equipped with the deep-well cylinder pump formerly in the older well and is the one used most of the time.

There are 180 services all of which are metered. The pump operates from 6 to 7 hours daily at a rate of 100 gallons per minute.

A quarterly charge for water is as follows:

50 cents per 1000 gallons for first 10,000 gallons
25 cents per 1000 gallons for next 40,000 gallons
15 cents per 1000 gallons for all over 50,000 gallons
An additional service charge of 50 cents is made.

The water has a total residue of 364, a total hardness of 289 and an iron content of 2.02 parts per million as shown by the partial analysis of sample number 83759, collected June 22, 1938.

SHANNON (575) (p. 594). The source of the public water supply and pumping equipment are as reported on page 595.

There are 108 services and the pump is operated about 8 hours per day.

The water has a total residue of 471, a total hardness of 319.5, and a content of iron of 0.1 parts per million as shown by the partial analysis of sample number 83700, collected at the pump June 8, 1938.

SHAWNEETOWN (1440). Shawneetown is located in the southeastern part of Gallatin County on the west bank of Ohio River. The city installed a public water supply during 1936. The plant as well as the city was flooded in February, 1937, and the city is being moved to higher ground about three miles west of the original site. An attempt will be made to develop a water supply in the valley southwest of the new site.

Water for the public supply, installed in 1936, is obtained from a well in the southwestern part of the city. It was drilled by John Bolliger and Sons of Fairbury, Illinois. It is 61 feet deep and 10 inches in diameter. At the bottom of the well is a 20-foot length of number 20-slot Johnson brass screen. The material penetrated between depths of 12 and 61 feet is medium to coarse sand and gravel. The static water level varies with the height of water in the river. On July 7, 1936 the water level in the well was at a depth of 15.3 feet when not pumping and was lowered 6.7 feet when pumping at a rate of 304 gallons per minute.

A Fairbanks-Morse turbine pump rated at 175 gallons per minute is set at a depth of 57 feet. The pump is driven by a 15-horsepower Fairbanks-Morse electric motor.

The water is aerated by compressed air, a coagulant added under pressure, and filtered through two pressure filters.

The temperature of the water was 59° F. The water had a total residue of 338, a total hardness of 278, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 78367, collected July 8, 1936 at the end of a 24-hour production test.

Analysis of Sample Number 78367 from City Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.6	Sodium Nitrate	$NaNO_3$	2.5	0.15
(unfiltered)		1.0	Sodium Chloride	NaCl	16.4	0.96
Manganese	Mn	0.4	Sodium Sulfate	Na_2SO_4	35.5	2.07
Silica	SiO_2	11.0	Magnesium Sulfate	$MgSO_4$	9.6	0.56
Turbidity		5.0	Magnesium Carbonate	$MgCO_3$	69.2	4.03
Calcium	Ca	76.1	Calcium Carbonate	$CaCO_3$	188.0	10.95
Magnesium	Mg	21.9	Ferric Oxide	Fe_2O_3	0.9	0.05
Sodium	Na	18.6	Manganese Oxide	MnO	0.5	0.03
Sulfate	SO_4	31.9	Silica	SiO_2	11.0	0.64
Nitrate	NO_3	1.8				
Chloride	Cl	10.0	Total		333.6	19.44
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		270.0				
Residue		338.0				
Total Hardness		278.0				

SHEFFIELD (941) (p. 595). The well described on page 596 has been abandoned and a new well constructed at a point about 200 feet farther south. Three test wells were drilled and the permanent well was drilled at the site of the third test well.

A log of material penetrated by the well is as follows:

	Thickness in feet.	Depth in feet.
Clay	41	41
Sand	7	48
Clay	3	51
Sand	16½	41½

The well was constructed in a pit 34 feet deep and had a 9⅝-inch copper-wrapped screen 25 feet long with the bottom at a depth of 67 feet. The screen, attached to a 10-inch casing, was placed inside a 16-inch pipe. Pea-sized gravel was poured outside the screen and 10-inch pipe, and the 16-inch pipe then withdrawn.

The well was originally pumped by a centrifugal pump set at the bottom of the pit. Later the casing was extended to the surface and an 8-stage, 8-inch Pomona turbine pump driven by a 15-horsepower electric motor was installed. This pump, consisting of 60 feet of column pipe and a bowl assembly 5 feet long, is rated at 200 gallons per minute against a total head of 180 feet.

Water from the 67-foot well had a total residue of 460, a total hardness of 401.5, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 54104, collected June 9, 1925.

Analysis of Sample Number 54104 from Well 67 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.0	Potassium Nitrate	KNO_3	2.0	.12
Manganese	Mn	0.0	Potassium Chloride	KCl	6.1	.36
Silica	SiO_2	14.0	Sodium Chloride	NaCl	8.4	.49
Nonvolatile		.3	Sodium Sulfate	Na_2SO_4	26.0	1.52
Alumina	Al_2O_3	2.8	Sodium Carbonate	Na_2CO_3	32.5	1.90
Calcium	Ca	85.8	Ammonium Carbonate	$(NH_4)_2CO_3$	3.0	.18
Magnesium	Mg	45.6	Magnesium Carbonate	$MgCO_3$	158.2	9.24
Ammonium	NH_4	1.1	Calcium Carbonate	$CaCO_3$	214.1	12.50
Potassium	K	4.0	Iron Oxide	Fe_2O_3	0.0	0.00
Sodium	Na	26.0	Alumina	Al_2O_3	2.8	.16
Sulfate	SO_4	17.6	Silica	SiO_2	14.0	.82
Nitrate	NO_3	1.2	Nonvolatile		.3	.02
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$			Total		467.4	27.31
Phenolphthalein		0.0				
Methyl Orange		420.0				
Residue		460.0				
Total Hardness		401.5				

SHELBYVILLE (3491) (p. 597). No reported change.

SHELDON (1121) (p. 599). The 1770-foot well was abandoned in 1926. The well formerly reported to be 130 feet deep is now said to be 112 feet deep. It is equipped with a plunger pump with 4¼-inch diameter cylinder and 18-inch stroke. The cylinder is set at a depth

of 60 feet and below it is a 20-foot length of suction pipe. The pump is driven by a 7½-horsepower electric motor..

A new well was drilled in 1928 by Guy Marvin and Tom Mills of Sheldon. It is located 20 feet west of the 112-foot well and is 116 feet deep. It is 10 inches in diameter and is equipped with a home-made screen of perforated pipe. The gravel at the bottom of the well is reported to be quite coarse.

The water level in this well is at a depth of 35 feet when not pumping and is lowered 10 feet by a pumping rate of 100 gallons per minute.

The well is equipped with an air lift. Air is furnished by a Pennsylvania compressor driven by a 10-horsepower electric motor.

Water is pumped from these two wells to a concrete reservoir near the old elevated tank, and thence to the distribution system and elevated tank by means of centrifugal pumps.

A recent analysis of water from the 112-foot well shows it to be very similar to that reported on page 600.

SIBLEY (394) (p. 601). No reported change.

SIDELL (655). Sidell is located in the southwestern part of Vermilion County on the drainage area of Little Vermilion River, a tributary of Wabash River. A public water supply was installed by the village in 1928.

Water for the public supply is obtained from one or both of two wells about 100 feet apart, which are located near the business district. One well is 108 feet deep and 4 inches in diameter. It is used only when the other well will not supply enough water to meet the demand.

Water is usually obtained from a dug well 29 feet deep and 5 feet in diameter. This well was dug before 1910, and for many years furnished water for a blacksmith shop. The water level is about 12 feet below the ground surface when not pumping.

This well is equipped with a Westco centrifugal pump rated at 35 gallons per minute against a head of 120 pounds per square inch and driven by a 5-horsepower electric motor. The pump is set in a pit about 6 feet deep adjacent to the wall of the well.

The 108-foot well is equipped with an ordinary hand pump which can be power-driven in case of emergency. The water level is near the ground surface when not pumping. This well is used only during prolonged periods of dry weather when the shallow well does not supply sufficient water.

The amount of water which can be pumped from the shallow well is limited. The pump is usually operated three times daily for a period of thirty minutes. A rest period of a few hours follows each pumping period.

An elevated steel tank, located near the wells, is connected to the distribution system. Water is pumped from the wells directly to the system.

Water from the 108-foot well is said to cause corrosion of meters. It had a total residue of 1832, a total hardness of 197, and a content of iron of 1.3 parts per million as shown by the analysis of sample number

82810, collected January 20, 1938. Water from the 29-foot dug well had a total residue of 866, a total hardness of 565, and a content of iron of 0.08 parts per million as shown by the analysis of sample number 82811, collected January 20, 1938.

Analysis of Sample Number 82810 from Well 108 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.6	0.15
(filtered)		0.0	Sodium Chloride	NaCl	1,585.0	92.50
(unfiltered)		1.3	Magnesium Chloride	$MgCl_2$	41.1	2.40
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	9.0	0.53
Silica	SiO_2	10.5	Magnesium Carbonate	$MgCO_3$	66.1	3.86
Turbidity		8.0	Calcium Carbonate	$CaCO_3$	67.5	3.94
Color		0.0	Iron Oxide	Fe_2O_3	1.9	0.11
Odor		0.0	Silica	SiO_2	10.5	0.06
Calcium	Ca	26.9				
Magnesium	Mg	31.4	Total		1,783.7	103.55
Ammonium	NH_4	trace				
Sodium	Na	62.5				
Sulfate	SO_4	7.4				
Nitrate	NO_3	1.9				
Chloride	Cl	993.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		4.6				
Methyl Orange		146.0				
Residue		1,832.0				
Total Hardness		197.0				

Analysis of Sample Number 82811 from Well 29 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	19.6	1.14
(filtered)		0.0	Sodium Chloride	NaCl	178.5	10.13
(unfiltered)		0.08	Magnesium Chloride	$MgCl_2$	43.3	2.52
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	229.0	13.1
Silica		15.0	Calcium Sulfate	$CaSO_4$	72.8	4.2
Turbidity		5.0	Calcium Carbonate	$CaCO_3$	276.3	15.8
Color		0.0	Silica	SiO_2	15.0	0.87
Odor		0.0				
Calcium	Ca	131.8	Total		834.5	47.76
Magnesium	Mg	57.4				
Ammonium	NH_4	trace				
Sodium	Na	75.5				
Sulfate	SO_4	234.0				
Nitrate	NO_3	14.2				
Chloride	Cl	140.5				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		276.0				
Residue		866.0				
Total Hardness		565.0				

SILVIS (2650) (p. 602). Water for the public supply is still obtained from the two wells described on page 603, and located at the northeast corner of First Avenue and Twelfth Street. The 1985-foot well no longer flows, but is equipped with a 5-stage, 8-inch Peerless turbine pump having 80 feet of 6-inch column pipe and 10 feet of 6-inch

suction pipe. The pump is rated at 500 gallons per minute against a 76-foot head and is driven by a 15-horsepower electric motor. This pump discharges to the reservoir described on page 603 and is operated about 3½ hours daily.

Water is now pumped from the 28-foot well to the reservoir by a single-stage Goulds centrifugal pump driven by a 2-horsepower electric motor. The pumping rate is estimated to be more than 150 gallons per minute and the pump is operated 18 hours daily.

Water is pumped from the reservoir to the distribution system by either of the two centrifugal pumps. One is a 2-stage Worthington pump rated at 450 gallons per minute and driven by a 50-horsepower electric motor. The other is a single-stage Goulds pump rated at 350 gallons per minute and driven by a 30-horsepower electric motor. A 350,000-gallon stand-pipe, located on a hill south of the pumping station, is connected to the distribution system.

In 1938, there were 650 service connections in use and the daily pumpage was about 180,000 gallons.

Water from the 28-foot well is now much more highly mineralized than as reported on page 603. The analysis of sample number 83966, collected July 28, 1938, shows the water to have a total residue of 1125, a total hardness of 438.5, and a content of iron of .04 parts per million.

Analysis of Sample Number 83966 from Well 28 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	8.5	0.49
(filtered)		0.0	Sodium Chloride	NaCl	566.5	33.03
(unfiltered)		.04	Magnesium Chloride	$MgCl_2$	27.2	1.59
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	157.8	9.20
Silica	SiO_2	16.5	Calcium Sulfate	$CaSO_4$	148.4	8.65
Turbidity		3	Calcium Carbonate	$CaCO_3$	170.0	9.91
Color		0	Silica	SiO_2	16.5	.96
Odor		0				
Calcium	Ca	111.6	Total		1,094.9	63.83
Magnesium	Mg	38.8				
Ammonium	NH_4	trace				
Sodium	Na	225.2				
Sulfate	SO_4	231.0				
Nitrate	NO_3	5.9				
Chloride	Cl	363.8				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		170.0				
Residue		1,125.0				
Total Hardness		438.5				

SOMONAUK (578) (p. 605). No record of change.

SORENTO (831). Sorento is located in the northwestern part of Bond County on the drainage area of Shoal Creek, a tributary of Kaskaskia River. The glacial drift in this vicinity is thin, consisting primarily of dense clay with a few scattered lenses of sand and gravel. Private wells obtain some water from these sand and gravel deposits.

An attempt was made by the village in 1936 to develop a public water supply from a shallow well. An electrical earth resistivity survey was conducted and 12 test wells were drilled at various locations in and near the village. Only one of these, number 9, encountered a water-bearing formation. It was 31 feet deep and revealed a deposit of medium to coarse angular sand between depths of 21 and 22½ feet. It yielded only 12½ gallons per minute and did not warrant the construction of a permanent well.

At present the village has no public water system.

The water from test well number 9 had a mineral content of 387, a-total hardness of 268, and a content of iron of 1.6 parts per million as indicated by the analysis of sample number 78111, collected May 26, 1936.

Analysis of Sample Number 78111 from Test Well Number 9.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.0	Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		1.6	Sodium Chloride	NaCl	21.6	1.26
Manganese	Mn	0.7	Sodium Sulfate	Na_2SO_4	93.9	5.48
Silica	SiO_2	12.0	Magnesium Sulfate	$MgSO_4$	40.9	2.38
Turbidity		30.0	Magnesium Carbonate	$MgCO_3$	69.1	4.03
Calcium	Ca	60.9	Calcium Carbonate	$CaCO_3$	152.0	8.86
Magnesium	Mg	28.2	Manganese Oxide	MnO	0.9	0.05
Sodium	Na	39.8	Silica	SiO_2	12.0	0.70
Sulfate	SO_4	97.2				
Nitrate	NO_3	1.5	Total		392.1	22.86
Chloride	Cl	13.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		234.0				
Residue		387.0				
Total Hardness		268.0				

SOUTH BELOIT (2361) (p. 607). The distribution system of South Beloit is connected to that of Beloit, Wisconsin and both are owned by the AVisconsin Power and Light Company with headquarters in Beloit.

Water is obtained from a 969-foot well, a 1225-foot well, and 14 shallow gravel wells ranging in depth from 140 to 160 feet, all located in Beloit, and a well in South Beloit which was drilled in 1937 by C. W. Varner of Dubuque, Iowa, and is known as number 3.

The latter well is 1185 feet deep, is cased to a depth of 230 feet 5 inches with 18-inch pipe, and is 17 inches in diameter to 352 feet and 12¾ inches in diameter from 352 to 1185 feet.

A record of material penetrated, with classification by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Glacial drift, mostly gravel	225	225
Sandstone, St. Peter	10	235
Dolomite, Trempealeau	45	280
Sandstone, shale, Franconia	85	365
Sandstone, Galesville	105	470
Sandstone, dolomite, shale, Eau Claire	415	885
Sandstone, Mt. Simon	305	1190

The elevation of the ground surface at the well is about 735 feet above sea level.

A good flow of water was reported at a depth of 550 feet. At 555 feet the static level was 3 feet below the surface, at 630 feet the well began to flow, and when drilling was completed the free flow was 30 gallons per minute. The well was "shot" and cleaned out, after which the flow increased to 35 gallons per minute. When tested in November of 1937 the water level was at depths of 57½, 96, and 101 feet when pumping at rates of 1000, 1500, and 1675 gallons per minute, respectively.

The well is equipped with a Fairbanks-Morse turbine pump driven by a 75-horsepower electric motor. The pump discharges to a concrete reservoir having a capacity of 53,000 gallons. Water is pumped from the reservoir to the distribution system by a 6-inch Fairbanks-Morse centrifugal pump driven by a 100-horsepower electric motor.

An elevated steel tank, having a capacity of 210,000 gallons and located in Beloit, is connected to the mains. In South Beloit there are 332 service connections in use and the average daily consumption during July, 1938 was about 50,000 gallons.

The temperature of the water from well number 3 is reported to be 53° F. The water had a total residue of 321, a total hardness of 337, and a content of iron of 0.7 parts per million as shown by the analysis of sample number 84145, collected August 17, 1938.

Analysis of Sample Number 84145 from Well Number 3.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.9	.05
(filtered)		trace	Magnesium Nitrate	$Mg(NO_3)_2$	0.7	.04
(unfiltered)		0.7	Magnesium Sulfate	$MgSO_4$	3.0	.17
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	144.2	8.41
Silica	SiO_2	12.0	Calcium Carbonate	$CaCO_3$	163.1	9.51
Turbidity		6.0	Silica	SiO_2	12.0	0.70
Color		0.0				
Odor		Cn-1	Total		323.9	18.88
Calcium	Ca	65.3				
Magnesium	Mg	42.3				
Ammonium	NH_4	trace				
Sodium	Na	0.2				
Sulfate	SO_4	2.3				
Nitrate	NO_3	1.4				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		324.0				
Residue		321.0				
Total Hardness		337.0				

SOUTH CHICAGO HEIGHTS (1691) (p. 607). No reported change.

SOUTH HOLLAND (1873). A public water supply distribution system was installed in 1929. Lake Michigan water is obtained from the city of Chicago.

SOUTH JACKSONVILLE (562). Water for the public supply is purchased from the city of Jacksonville.

SOUTH PEKIN (1222). South Pekin is located in the western part of Tazewell County on the drainage area of Lost Creek, a tributary of Illinois River. A public water supply was installed by the village in 1926. The Chicago and Northwestern Eailroad has four wells ranging in depth from 72 to 81 feet.

Water for the public supply is obtained from two wells, located in the southwestern part of town, drilled in 1925 and 1926. The well drilled in 1925 is 12 inches in diameter by 90 feet deep and has a Layne screen of perforated pipe wrapped with gauze. A pit 13 feet in diameter and 39½ feet deep was constructed around the top of the casing, which was then cut off 12 inches above the floor of the pit.

The water level was 3 feet 8 inches below the top of the casing and was lowered 13½ feet by a pumping rate of 350 gallons per minute.

The well is equipped with a centrifugal pump, taking direct suction from the well and having a capacity of 350 gallons per minute. It is installed on the bottom of the pit and is driven by a 30-horsepower electric motor.

The well constructed in 1926 is 12 inches in diameter by 75 feet deep and was drilled through the bottom of the pump pit about 5 feet distant from the first well. The casing extends to about 20 feet above the pit floor. The well is equipped with a Cook deep-well cylinder pump belt connected to a Stover 18-horsepower kerosene engine. Both pump and engine are installed at pump house floor level at the top of the pit. The Cook pump discharge pipe is connected into the discharge pipe from the centrifugal pump and thus the pump discharges directly into the distribution system to which is connected a 60,000-gallon elevated steel tank.

The water had a total residue of 440, a total hardness of 393, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 56789, collected June 17, 1926.

Analysis of Sample Number 56789 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Potassium Nitrate	KNO_3	0.6	0.03
Manganese	Mn	0.2	Potassium Chloride	KCl	3.9	0.23
Silica	SiO_2	14.8	Sodium Chloride	NaCl	43.6	2.55
Nonvolatile		0.6	Ammonium Chloride	NH_4Cl	0.1	0.01
Alumina	Al_2O_3	1.0	Magnesium Chloride	$MgCl_2$	1.0	0.06
Calcium	Ca	90.8	Magnesium Sulfate	$MgSO_4$	81.2	4.75
Magnesium	Mg	40.6	Magnesium Carbonate	$MgCO_3$	80.5	4.71
Ammonium	NH_4	0.04	Calcium Carbonate	$CaCO_3$	222.0	12.98
Potassium	K	2.3	Silica	SiO_2	14.8	0.86
Sodium	Na	17.5	Iron Oxide	Fe_2O_3	0.6	0.03
Sulfate	SO_4	63.5	Alumina	Al_2O_3	1.0	0.06
Nitrate	NO_3	0.4	Manganese Oxide	MnO	0.3	0.02
Chloride	Cl	28.5	Nonvolatile		0.6	0.03
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		450.2	26.32
Methyl Orange		310.0				
Residue		440.0				
Total Hardness		393.0				

SOUTH WILMINGTON (822) (p. 608). No reported change.

SPAELAND (463). Sparland is located in the western part of Marshall County near the west bank of Illinois River.

Water for the public supply, installed by the village in 1937, is obtained from a well, located about one-half block southwest of the railroad station, drilled in 1936 by Mike Ebert of Washington, Illinois. It is 26 feet deep and 10 inches in diameter and has an 11-foot section of number 40-slot Cook screen. Water is obtained from a deposit of coarse sand below a depth of 15 feet. The temperature of the water was 54° F. on October 9, 1936. There is a seasonal variation in water temperature.

The water level was at a depth of 7.3 feet when not pumping and was lowered 7 feet by a pumping rate of 168 gallons per minute.

The well is equipped with an 11-stage, 4-inch Cook turbine pump having 20 feet of 3-inch column pipe and 10 feet of suction pipe. The pump is rated at 50 gallons per minute against a head of 220 feet, and is direct-connected to a 5-horsepower electric motor.

The water had a total residue of 954, a total hardness of 709, and a content of iron of 0.02 parts per million as shown by the analysis of sample number 82549, collected December 6, 1937.

Water is pumped through a pressure type zeolite softener into the distribution system to which is connected an elevated steel tank. About 90 per cent of the water is softened and 10 per cent is by-passed.

Analysis of Sample Number 82549 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	30.6	1.78
(filtered)		0.0	Sodium Chloride	NaCl	18.1	1.06
(unfiltered)		0.02	Sodium Sulfate	Na_2SO_4	27.3	1.59
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	372.5	21.70
Silica	SiO_2	17.0	Calcium Sulfate	$CaSO_4$	159.5	9.30
Turbidity		3.0	Calcium Carbonate	$CaCO_3$	282.0	16.40
Color		5.0	Silica	SiO_2	17.0	0.99
Odor		El				
Calcium	Ca	159.8	Total		907.0	52.82
Magnesium	Mg	75.5				
Ammonium	NH_4	trace				
Sodium	Na	24.4				
Sulfate	SO_4	428.0				
Nitrate	NO_3	22.0				
Chloride	Cl	11.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		954.0				
Total Hardness		709.0				

SPARTA (3385) (p. 710). The raw water supply of the city of Sparta is obtained from an impounding reservoir on branch of Mary's River. The water is treated before entering the distribution system.

SPRINGFIELD (71,864) (p. 610). Since 1935 all water for the public supply has been obtained from an impounding reservoir on Sugar Creek southeast of the city. The water is treated before entering the distribution system.

SPRING VALLEY (5270) (p. 609). No reported change.

The south well was shot in 1936 by Mr. J. 0. Heflin and the yield was increased by 50 gallons per minute, but in May, 1938 it was reported that the flow had decreased to what it was before shooting. The combined flow from the two wells is now about 188 gallons per minute.

STANDARD (352) (p. 614). The source of water for the public supply has not been changed, but the deep-well pump was replaced by an air lift sometime before 1927. Air is supplied by a 6-inch Sullivan compressor driven by a 10-horsepower electric motor. The air lift consists of 348 feet of 2½-inch pipe and the same length of 1-inch air pipe. Water is pumped from the well to the wood-stave tank, and flows directly to the distribution system. The elevated steel tank is no longer used.

There were about 60 service connections in 1938. The average daily pumpage was about 18,000 gallons. Water is sold at a flat rate per month of $1.00 for residences and $2.00 for business houses.

The quality of the water is similar to that previously reported.

STANFORD (443) (p. 616). No reported change.

STAUNTON (4618) (p. 710). The raw water supply of the city of Staunton is obtained from an impounding reservoir on East Fork, a tributary of Cahokia Creek. The water is treated before entering the distribution system.

STEELEVILLE (909). Steeleville is located in the southeastern part of Randolph County on the drainage area of Mary's River, a tributary of Mississippi River. A public water supply was installed in 1928.

Water was first secured from a well owned by the Gilster Milling Company and drilled by Charles Baue of Steeleville. This well was 265 feet deep and obtained water from sandstones of the Pennsylvanian system. The water level was at a depth of 8 feet when not pumping and was lowered more than 50 feet by a pumping rate of 60 gallons per minute. The well was equipped with a Chippewa double-acting deep-well pump driven by a 7½-horsepower electric motor.

In 1935 the purchase of water from the Gilster Milling Company was discontinued and a well was drilled for the village by Fred M. Luth of St. Louis. It is 285 feet deep and 8 inches in diameter. It is cased with 8-inch pipe to a depth of 190 feet. The bottom 10 feet of the casing is perforated. An anchor packer is in place at 158 feet to prevent admission of surface water.

A record of material penetrated, with classification by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	69	69
Shale, limestone, coal, sandstone, Carbondale	11	80
Sandstone, Pottsville	60	140
Shale, coal, Pottsville	5	145
Sandstone, Pottsville	100	245
Shale, Pottsville	5	250
Sandstone, Pottsville	25	275
Shale, Pottsville	10	285

The water level was at a depth of 29 feet when not pumping and was lowered 96 feet by a pumping rate of 95 gallons per minute.

The well is equipped with a deep-well turbine pump driven by an electric motor.

The water had a total residue of 364, a total hardness of 150, and a content of iron of 0.1 parts per million as shown by the analysis of sample number 75998, collected April 23, 1935. The temperature of the water was 56° F.

Analysis of Sample Number 75998 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.1	Sodium Nitrate	$NaNO_3$	1.7	0.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	49.7	2.90
Silica	SiO_2	10.0	Sodium Sulfate	Na_2SO_4	24.2	1.41
Turbidity		10.0	Sodium Carbonate	Na_2CO_3	134.2	7.82
Calcium	Ca	36.4	Ammonium Carbonate	$(NH_4)_2CO_3$	1.4	0.08
Magnesium	Mg	14.3	Magnesium Carbonate	$MgCO_3$	49.7	2.90
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	91.1	5.31
Sodium	Na	86.0	Iron Oxide	Fe_2O_3	0.1	0.01
Sulfate	SO_4	16.4	Silica	SiO_2	10.0	0.58
Nitrate	NO_3	1.1				
Chloride	Cl	30.0	Total		362.1	21.11
Alkalinity as $CaCO_3$						
Phenolphthalein		10.0				
Methyl Orange		278.0				
Residue		364.0				
Total Hardness		150.0				

STEGER (2985) (p. 617). A new well is reported to have been constructed since 1928.

STEELING (10,012) (p. 618). The public water supply is now owned by the Illinois Water Service Company. Water is also supplied to the city of Rock Falls. There has been no change in the source of supply, but pumping equipment has been changed. A new 1,000,000-gallon concrete reservoir was constructed in 1934 just east of the old reservoirs. Since that time the old reservoirs have not been used.

In 1921 the flow from the four wells was estimated to be 1,500,000 gallons daily. In 1938 the static water level in all wells was about 20 feet below the ground surface.

Well number 3 is now equipped with a 4-stage, 8-inch Peerless turbine pump having 60 feet of 6-inch column pipe and 10 feet of 5-inch suction pipe. The pump, driven by an electric motor, is rated at 500 gallons per minute against a 67-foot head, and is operated about 18 hours daily. Well number 4 is equipped with a Peerless turbine pump exactly like the one in well number 3. It operates about 22 hours daily. Wells 1 and 2 are equipped with air lifts and are used only at times of peak demand.

Water is pumped from the wells to the reservoir. Prom the reservoir it is pumped to the distribution system by any of four service pumps. The Prescott pump described on page 618 and a steam-driven Laidlaw-Dunn-Gordon pump rated at 2,000,000 gallons per day are maintained as stand-by units. An Allis-Chalmers centrifugal pump rated at 750 gallons per minute against a 170-foot head and driven by a 50-horsepower electric motor is used about 22 hours daily. An Allis-Chalmers centrifugal pump rated at 1250 gallons per minute against a 170-foot head and driven by a 75-horsepower electric motor is used only for fire protection.

In 1938 there were 3400 service connections in use in Sterling and 600 in Eock Falls. At that time the average daily pumpage was about 850,000 gallons.

STEWARD (230) (p. 620). No reported change in the source of the public water supply.

STICKNEY (2005). . A public water supply distribution system was installed in 1926. Lake Michigan water is obtained from the city of Chicago.

STOCKTON (1505) (p. 621). The 1440-foot well and the 1528-foot railroad well described on page 622, and the concrete reservoir near the 1440-foot well have not been used since 1925. These wells are not equipped with pumps.

From 1925 to 1938 water was obtained from two wells located 35 feet apart on a hillside in the northwestern part of town. One of these wells was described on page 623 and is cased to a depth of 130 feet with 12-inch pipe. The other well was drilled in 1925 and is of similar construction. Both wells were drilled by Gust Nelson of Hayfield, Minnesota, and both were equipped with deep-well cylinder pumps.

In 1937 the south well, drilled in 1925, was equipped with a 17-stage, 8-inch Fairbanks-Morse turbine pump having 420 feet of 6-incb column pipe. The pump was fitted with a right-angle drive head and was driven by a 60-horsepower, 6-cylinder Diesel engine. The following year the north well was cleaned, the turbine pump was moved to this well, and the south well was abandoned. The north well is pumped at infrequent intervals.

In 1938 nearly all water was obtained from a well drilled that year by C. W. Varner of Dubuque, Iowa. This well is located in the business

district on the north side of Queen Street east of Main Street. It is 1277 feet deep and 12 inches in diameter at the bottom. It is cased to a depth of 77 feet with 12½-inch pipe.

The water level was at a depth of 143 feet when not pumping and was lowered 138½ feet by pumping at a rate of 394 gallons per minute. The temperature of the water was 53° F.

The St. Peter sandstone was found between depths of 397 and 513 feet and was said to be rather tight and silty. When the well was 528 feet deep the water level was 119 feet below the top of the casing when not pumping and was lowered 154 feet by pumping at a rate of 196 gallons per minute. The temperature of the water was then 52° F., and the water had a total residue of 381, a total hardness of 303, and a content of iron of 2.6 parts per million as shown by the analysis of sample number 82869, collected February 1, 1938.

The 1277-foot well is equipped with a 12-stage, 10-inch Sterling turbine pump having 380 feet of 6-inch column pipe and 20 feet of 6-inch suction pipe. The pump is rated at 300 gallons per minute against a 480-foot head and is driven by a 60-horsepower electric motor.

The water from the finished well had a total residue of 384, a total hardness of 368.5, and a content of iron of 0.5 parts per million as shown by the analysis of sample number 83705, collected June 8, 1938.

Analysis of Sample Number 82869 from Well 528 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	5.1	0.30
(filtered)		0.1	Sodium Chloride	NaCl	5.8	0.40
(unfiltered)		2.6	Sodium Sulfate	Na_2SO_4	23.4	1.36
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	45.6	2.65
Silica	SiO_2	16.9	Magnesium Carbonate	$MgCO_3$	136.0	7.93
Turbidity		215.0	Calcium Carbonate	$CaCO_3$	141.5	8.25
Color		0.0	Iron Oxide	Fe_2O_3	0.3	0.02
Odor		E3	Silica	SiO_2	16.9	0.99
Calcium	Ca	56.6				
Magnesium	Mg	39.2	Total		374.4	21.90
Ammonium	NH_4	trace				
Sodium	Na	31.1				
Sulfate	SO_4	15.6				
Nitrate	NO_3	3.6				
Chloride	Cl	3.5				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		346.0				
Residue		381.0				
Total Hardness		303.0				

Analysis of Sample Number 83705 from Well 1277 Feet Deep

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		1.7	0.10
(filtered).....	0.0	Sodium Chloride.....NaCl		1.8	0.10
(unfiltered).....	0.5	Sodium Sulfate.....Na_2SO_4		17.1	1.00
Manganese..Mn	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		1.3	0.08
Silica.....SiO_2	15.0	Magnesium Sulfate.....$MgSO_4$		0.6	0.03
Turbidity.....	4.0	Magnesium Carbonate..$MgCO_3$		133.0	7.75
Color.....	0.0	Calcium Carbonate.....$CaCO_3$		210.0	12.24
Odor.....	0.0	Silica.....SiO_2		15.0	0.87
Calcium.....Ca	84.0				
Magnesium..Mg	38.6	Total.....		380.5	22.17
Ammonium..NH_4	0.4				
Sodium.....Na	6.7				
Sulfate.....SO_4	13.0				
Nitrate.....NO_3	1.3				
Chloride.....Cl	1.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	368.0				
Residue.....	384.0				
Total Hardness....	368.5				

STONINGTON (1057) (p. 624). The public water supply is still obtained from a dug well described on page 624.

Prior to 1930 the Dean steam pump was discontinued but not removed and an American Well Works 3-stage deep-well turbine pump installed. This pump rated at 200 gallons per minute was powered by a 15-horsepower electric motor.

In 1930 the pump operated on an average of 80 hours per month. It was reported that when the pump was started the water level was lowered about six feet but remained at that level for the remainder of the pumping period.

In 1934 rather extensive alterations were made at the water works plant. A second well pump was installed, a new 60,000-gallon elevated tank erected and iron removal and water softening equipment installed.

The new well pump was a Fairbanks-Morse deep-well turbine rated at 80 gallons per minute against 140-foot head. It was powered by a 7.5-horsepower electric motor. When pumping at a rate of 81 gallons per minute the well draw down was 4.2 feet from a non-pumping level of 18.9 feet below the pump-house floor. The filters in connection with the softening and iron removal equipment are of the pressure type.

In 1938 it was reported that the average winter demand was 40,000 gallons per day while in the summer it was 80,000 gallons per day.

The raw water had a total residue of 424, a total hardness of 304.5 and an iron content of 2.6 parts per million as. shown by the analysis of sample number 66545, collected May 23, 1930.

Analysis of Sample Number 66545 from Village Supply.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	2.6	Sodium Nitrate	$NaNO_3$	.9	.05
Manganese	Mn	0.3	Sodium Chloride	NaCl	52.6	3.03
Turbidity		20.0	Sodium Sulfate	Na_2SO_4	52.5	3.03
Silica	SiO_2	14.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Calcium	Ca	74.5	Magnesium Sulfate	$MgSO_4$	0.6	.04
Magnesium	Mg	28.8	Magnesium Carbonate	$MgCO_3$	99.3	5.79
Ammonium	NH_4	.6	Calcium Carbonate	$CaCO_3$	186.1	10.86
Sodium	Na	37.9	Silica	SiO_2	14.0	.82
Sulfate	SO_4	37.6	Iron Oxide	Fe_2O_3	3.7	.22
Nitrate	NO_3	.35	Manganese Oxide	MnO	0.4	.02
Chloride	Cl	32.0				
Alkalinity as $CaCO_3$			Total		412.1	23.98
Phenolphthalein		0.0				
Methyl Orange		304.0				
Residue		424.0				
Total Hardness		304.5				

STRAWN (221) (p. 625). The well described on page 625 has been abandoned as a source of supply for Strawn. About 1933 John Bolliger and Sons of Fairbury drilled a new well for the village. It is 6 inches in diameter and 60 feet deep, and is located about 15 feet west of the pumping station.

Water is pumped from the well to the distribution system by the Goulds triplex pump described on page 625. Power is now furnished by a 10-horsepower General Electric Company electric motor.

The water is sold at a flat rate of $7.00 per year for residences and $15.00 per year for garages. The services are not metered and no record is kept of the quantity of water pumped.

The water had a total residue of 442, a total hardness of 390 and an iron content of 1.4 parts per million as shown by the analysis of sample number 84156, collected on August 25, 1938.

Analysis of Sample Number 84156 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.9	0.05
(filtered)		trace	Sodium Chloride	NaCl	29.8	1.74
(unfiltered)		1.4	Sodium Sulfate	Na_2SO_4	2.1	0.12
Manganese	Mn	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Silica	SiO_2	13.5	Magnesium Sulfate	$MgSO_4$	129.8	7.57
Turbidity		12.0	Magnesium Carbonate	$MgCO_3$	56.4	3.29
Color		0.0	Calcium Carbonate	$CaCO_3$	215.5	12.56
Odor		0.0	Silica	SiO_2	13.5	0.79
Calcium	Ca	86.0				
Magnesium	Mg	42.5	Total		448.7	26.16
Ammonium	NH_4	0.2				
Sodium	Na	12.7				
Sulfate	SO_4	105.5				
Nitrate	NO_3	0.7				
Chloride	Cl	18.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		282.0				
Residue		442.0				
Total Hardness		390.0				

STEEATOE (14,728) (p. 710). The raw water supply of the city of Streator is obtained from Vermilion River. The water is treated before entering the distribution system.

STRONGHURST (734) (p. 626). In 1934 consideration was given to a change in the source of the public supply and an inspection of two springs was made. It was recommended that test wells be drilled in the "Dixon Spring" area at the south edge of town.

Two test wells and a permanent well were constructed in 1938. The log of the permanent well is as follows:

	Thickness in feet.	Depth in feet.
Drift, clay	37	37
Yellow limestone	9	46
Chert, lime and mud	23½	69½

When completed the well had a production, at the end of a 21-hour test period, of 61 gallons per minute with a draw down of 6.8 feet from a non-pumping level at the start of 26 feet.

The water had a total residue of 375, a total hardness of 283.5, and a content of iron of 7.6 parts per million as shown by the analysis of sample number 83714, collected June 17, 1938.

As soon as the equipment can be installed in the well and a water softening and iron removal plant erected, the deep-well supply will be discontinued.

SUBLETTE (261) (p. 628). No reported change in the source of the public water supply.

SUGAR GEOVE (unincorporated). Sugar Grove is a small community located in the southern part of Kane County on the drainage area of Blackberry Creek, a tributary of Fox River. About 1890 a well was drilled to supply a hotel owned by William West, and pipe was laid to two or three nearby residences. Later more service connections were made, and a 3-inch well 90 feet deep was drilled. In 1905 a well 230 feet deep was drilled by B. L. Palmer and Sons of Aurora. Tt is 4 inches in diameter and is located on the hotel property. The upper 185 feet is in the drift and below that depth the well is in shale. Drilling was stopped at the top of the Galena limestone.

The well is equipped with a deep-well pump. For about seven months of the year when the demand is least the pump is driven by a windmill. During the remainder of the year it is driven by a gasoline engine. The pump cylinder is set at a depth of about 60 feet. Water stands at a depth of about 40 feet.

Water is pumped from the 230-foot well into the distribution system to which a 10,000-gallon elevated wooden tank is connected. The distribution system is made up of galvanized pipes, the largest of these being three inches in diameter. No fire hydrants are available. The well and pump are owned by Edward West.

Water from the well had a total residue of 350, a total hardness of 138, and a content of iron of 0.0 parts per million as shown by the analysis of sample number 82312, collected November 10, 1937.

Analysis of Sample Number 82312 from Well 230 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.9	.05
(unfiltered)		0.0	Sodium Chloride	NaCl	4.7	.27
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	212.0	12.36
Silica	SiO_2	8.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.9	.17
Turbidity		0	Magnesium Carbonate	$MgCO_3$	35.8	2.09
Color		0	Calcium Carbonate	$CaCO_3$	95.5	5.56
Odor		0	Silica	SiO_2	8.0	.47
Calcium	Ca	38.2				
Magnesium	Mg	10.5	Total		359.8	20.97
Ammonium	NH_4	0.7				
Sodium	Na	94.0				
Sulfate	SO_4	none				
Nitrate	NO_3	0.7				
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		340.0				
Residue		350.0				
Total Hardness		138.0				

SULLIVAN (2339) (p. 629). A number of test borings made in 1925 indicated the presence of a pre-glacial channel of the Kaskaskia River about two miles south of the city. Two wells were drilled at this location by Layne-Bowler Company in 1926. They are about 350 feet apart. Each has a 45-foot length of 18-inch screen and each is of the gravel-walled type with 24-inch outer casing. The southwest well is 115 feet deep and the northeast well is 120 feet deep.

The water level in the northeast well was at a depth of 54½ feet when not pumping and was lowered 50½ feet by a pumping rate of 636 gallons per minute. At the same time the water level in the other well was lowered one foot.

Each well is equipped with a 5-stage Fairbanks-Morse turbine pump having 90 feet of 5-inch column pipe and driven by a 10-horsepower electric motor.

These two wells now furnish the entire supply for the city.

Water from the northeast well had a total residue of 381, a total hardness of 320, and a content of iron of 3.0 parts per million as shown by the analysis of sample number 63279, collected December 26, 1928. Water from the other well was of similar quality.

In 1936 a water treatment plant was built. A small compressor mixes air with the water as it comes from the wells. The water then flows over a coke-tray aerator, is treated with lime and alum, and is filtered through rapid sand filters.

The daily consumption of water has increased about one-third since the treatment plant was put in service. The treated[1] water is pumped by means of centrifugal pumps to the city distribution system to which an elevated steel tank is connected.

Analysis of Sample Number 63279 from Well 120 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	3.0	Potassium Chloride	KCl	3.6	0.21
Manganese	Mn	0.0	Sodium Chloride	NaCl	5.7	0.34
Turbidity		5.0	Sodium Sulfate	Na_2SO_4	12.1	0.71
Silica	SiO_2	17.5	Sodium Carbonate	Na_2CO_3	35.4	2.07
Nonvolatile		2.1	Ammonium Carbonate	$(NH_4)_2CO_3$	9.2	0.54
Aluminum	Al_2O_3	0.1	Magnesium Carbonate	$MgCO_3$	110.6	6.47
Calcium	Ca	73.7	Calcium Carbonate	$CaCO_3$	177.1	10.35
Magnesium	Mg	33.2	Silica	SiO_2	17.5	1.02
Ammonium	NH_4	3.6	Iron Oxide	Fe_2O_3	4.3	0.25
Potassium	K	1.9	Alumina	Al_2O_3	0.1	0.01
Sodium	Na	18.7	Manganese Oxide	MnO	0.0	0.00
Sulfate	SO_4	0.8	Nonvolatile		2.1	0.12
Nitrate	NO_3	0.0				
Chloride	Cl	5.0	Total		377.7	22.09
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		338.0				
Residue		381.0				
Total Hardness		320.4				

SUMMIT (6548) (p. 631). The village of Summit now obtains Lake Michigan water from the city of Chicago.

SWANSEA (1201). Swansea is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

SYCAMORE (4021) (p. 633). The city of Sycamore obtains water for its public supply from three wells all as described on page 634.

The double acting steam head pump formerly installed in well number 2 (the south well at station) was replaced sometime prior to 1930 with a Worthington Coniflow deep-well turbine. This pump assembly consists of 12 stages of 8-inch pump installed with the bottom of the bowls at 130 feet, while near the top is a 2-stage 12-inch booster unit. The bottom of a suction pipe below the lower bowls is 146 feet below the base of the pump.

On October 8, 1929 static water level was reported as 44 feet and with a production of 600 gallons per minute a draw down of 16.2 feet resulted.

Well number 4 was drilled by the J. P. Miller Artesian Well Company in 1924 at a site between Harvester Street and the Chicago Great Western Railroad, a short distance north of cottage row.

This well was finished at 1290 feet. It was cased with 16-inch outside diameter casing from the surface to a seat in the limestone at 213 feet. From 213 feet to 550 feet the hole is 15 inches in diameter, between 550 feet and 877 feet the hole is 12 inches in diameter, and below 877 feet the hole is 10 inches in diameter. When the well was completed a test was made and a production of 300 gallons per minute was reported. Static water level was 136 feet.

The well was equipped with a 12-inch Worthington Coniflow 12-stage deep-well pump with a setting of 186 feet from ground surface to

bottom of pump or 180 feet from bottom of pump pit. This well was never used much and some years later it was discontinued and pump removed.

At the present time well number 1 is used at night, the discharge being at a rate of 165 gallons per minute. Well number 2 is pumped at a rate of 650 gallons per minute and well number 3 at a Tate of 275 gallons per minute.

SYMERTON (77). Reported to have a drift well to supply water for fire protection only.

TAMPICO (693) (p. 636). No reported change.

TAYLORVILLE (7316) (p. 637). Taylorville secures water from four wells 100 to 119 feet deep. The wells are all located on the lot with the pumping station at the corner of Cherokee and Vine streets.

Except for lowering the top of the pump bowls to 62 feet, well number 1 remains as described on page 638. Well number 2 which was located 105 feet south of well number 1 has been abandoned and filled.

Well number 3, drilled by A. D. Cook in 1929, is located south of the pump-house. It is 18 inches in diameter and 100 feet deep. The screen is made up of 14 feet of number 125-slot Cook screen and 6 feet of number 60-slot Johnson screen. The draw down was reported to have been 35 feet when pumping at a rate of 800 gallons per minute. Water is pumped from the well by a 5-stage Pomona deep-well turbine set with the top of the bowls 72 feet below the ground level. A 20-foot length of suction pipe is attached to the bottom of the bowls. The pump delivers about 500 gallons per minute to the surface storage reservoirs. A 15-horsepower Westinghouse motor operates the pump.

Well number 4 was drilled by L. R. Burt in 1936. It is 115 feet deep, 18 inches in diameter and located northwest of the pumping station. The well is equipped with 15 feet of number 125-slot and 10.5 feet of number 60-slot Johnson screen. Water is pumped from the well by a 15-inch, 11-stage Layne-Bowler pump which delivers about 670 gallons per minute directly to the distribution system. The top of the bowls are set 74 feet 7 inches below the pump base with 32 feet of suction pipe attached below the bowl assembly. Power is furnished by a 75-horsepower Fairbanks-Morse electric motor. Static water level was reported to be 34 feet below the pump base.

Well number 5 was drilled by L. R. Burt in 1937 at a site 60 feet west of well number 4. It is 119 feet deep by 18 inches in diameter. The screen consists of 15 feet of number 127-slot Cook screen and 4 feet of number 60-slot Johnson screen. The pumping equipment is identical with that installed in well number 4. The draw down was reported to be 39 feet when pumping at a rate of 870 gallons per minute.

There are about 2300 service connections. The daily usage is about 100,000 gallons. The rates are as follows:

40 cents per 100 cu. ft. for the first 1,000 cu. ft.
30 cents per 100 cu. ft. for the next 1,000 cu. ft.
20 cents per 100 cu. ft. for the next 1,000 cu. ft.
14 cents per 100 cu. ft. for the next 20,000 cu. ft.
12 cents per 100 cu. ft. for the next 50,000 cu. ft.
10 cents per 100 cu. ft. for all over 73,000 cu. ft.
The minimum charge is $2.50 per quarter.

Analysis of sample number 65424 collected from well number 3 on November 17, 1929 showed a total residue of 999, a total hardness of 722, and an iron content of 2.0 parts per million.

Analysis of sample number 62919 collected from well number 2 on October 26, 1928 showed a total residue of 1030, a total hardness of 707, and an iron content of 2.0 parts per million.

Analysis of sample number 62918 collected from well number 1 on October 26, 1928 showed a total residue of 970, a total hardness of 659, and an iron content of 1.2 parts per million.

These analyses indicate an increase in mineral content and total hardness since sample number 53562 was collected April 7, 1925 (page 639).

Wells numbers 1 and 3 discharge into the ground storage reservoir and the water is repumped to the distribution system. Wells numbers 4 and 5 discharge directly into the distribution system.

In 1929 a study was undertaken in an effort to locate a ground water supply of 10,000,000 gallons per day for an industry and an additional supply for the city of 200,000 gallons per day. The results of this study indicated that a supply of 10,000,000 gallons per day was not available.

THEBES (751). The raw water supply for the village of Thebes is obtained from Mississippi River. The water is treated before entering the distribution system.

THOMPSON (508) (p. 639). The source of the public water supply and the pumping station equipment is as described on page 639. There are ai present 80 service connections.

THORNTON (1012). Thornton is located in the southeastern part of Cook County. The population increased from 767 in 1920 to 1012 in 1930. A well to furnish water for the public supply was drilled in 1923 by the W. L. Thorne Company and the distribution system was installed in 1924.

The well is located in the southwest corner of Swalb and Francis Streets adjacent to the land of the Cook County Forest Preserve. It was cased with 12-inch pipe from the surface to rock at a depth of 42.5 feet. Below this the bore was 12 inches in diameter to a depth of 477 feet where shale was found.

When first constructed the well was equipped with a Worthington two-stroke deep-well cylinder pump The cylinder was 5¾ inches in diameter and was attached to a line of 6-inch drop pipe so that the

bottom of the cylinder was 303 feet below the surface. A 20-foot length of 6-inch suction pipe was attached to the bottom of the cylinder. Static water level was 30 feet and water lowered to a depth of 255 feet when pumping at a rate of 75 gallons per minute. Water was pumped directly into the distribution mains and into the 60,000-gallon elevated tank which was connected to the system.

Changes in the operation and setting of the pump were made during the latter part of 1925. These changes involved lowering the pump 45 feet and changing the operation from a two-stroke to a single-acting cylinder with a 24-inch stroke. The pump operated at a rate of 17 strokes per minute. After pumping at this rate for 45 to 50 minutes the water level was drawn down to the bottom of the suction pipe at 368 feet. The well would refill in a like interval of time and pumping could then be resumed.

The water had a total residue of 542, a total hardness of 359.0, and an iron content of 0.2 parts per million as shown by the analysis of sample number 57161, collected August 26, 1926.

Analysis of Sample Number 57161 from Village Well Number 1, 477 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Potassium Nitrate	KNO_3	0.3	.02
Manganese	Mn	0.0	Potassium Chloride	KCl	12.2	.71
Silica	SiO_2	13.5	Sodium Chloride	NaCl	17.2	1.01
Nonvolatile		0.3	Sodium Sulfate	Na_2SO_4	138.6	8.10
Alumina	Al_2O_3	0.7	Sodium Carbonate	Na_2CO_3	13.1	.77
Calcium	Ca	66.4	Ammonium Carbonate	$(NH_4)_2CO_3$	1.2	.07
Magnesium	Mg	47.0	Magnesium Carbonate	$MgCO_3$	160.5	9.39
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	163.4	9.56
Potassium	K	6.6	Silica	SiO_2	13.5	.79
Sodium	Na	58.1	Iron Oxide	Fe_2O_3	0.3	.02
Sulfate	SO_4	92.5	Alumina	Al_2O_3	0.7	.04
Nitrate	NO_3	0.2	Manganese Oxide	MnO	0.0	0.00
Chloride	Cl	16.0	Nonvolatile		0.3	.02
Alkalinity as $CaCO_3$						
Phenolphthalein			Total		521.3	30.50
Methyl Orange		362.0				
Residue		542.0				
Total Hardness		359.0				

In 1927 the Worthington pump was replaced by an Erb double-acting deep-well cylinder pump placed at a depth of 337 feet and operating at 12½ revolutions per minute. The cylinder had an inside diameter of 5¾ inches. Static water level was reported on October 24, 1927 at 31 feet.

More recently the Erb pump was replaced by a Pomona deep-well turbine with a 300-foot setting and a 10-foot length of suction pipe in the bottom of the bowls. When the pump is first started the discharge is at a rate of 140 gallons per minute but the capacity of the well falls off to about 50 gallons per minute in a short while.

On December 3, 1937 the water had a total residue of 704, a total hardness of 474.0, and an iron content of 1.6 parts per million as shown by the analysis of sample number 82516.

Analysis of Sample Number 82516 from Well Number 1, 477 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	5.1	0.30
(filtered)		0.2	Sodium Chloride	NaCl	35.6	2.08
(unfiltered)		1.6	Sodium Sulfate	Na_2SO_4	151.3	8.80
Manganese	Mn	0.0	Magnesium Sulfate	$MgSO_4$	103.2	6.00
Silica	SiO_2	17.0	Magnesium Carbonate	$MgCO_3$	110.8	6.45
Turbidity		5.	Calcium Carbonate	$CaCO_3$	256.5	14.95
Color		0.	Silica	SiO_2	17.0	0.99
Odor		0.				
Calcium	Ca	102.5	Total		679.5	39.57
Magnesium	Mg	53.0				
Ammonium	NH_4	trace				
Sodium	Na	65.1				
Sulfate	SO_4	186.6				
Nitrate	NO_3	3.9				
Chloride	Cl	22.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		388.0				
Residue		704.0				
Total Hardness		474.0				

In the early part of 1928, W. H. Cater completed a new well to a depth of 408 feet at Water and Eleanor Streets. It was 12 inches in diameter for the entire distance. The upper 18 feet of the well was in drift and the balance in rock. Water was first found at a depth of 102 feet.

The well was equipped with a Byron-Jackson deep-well turbine pump driven by a 30-horsepower electric motor. The pump was rated at 400 gallons per minute and when operated with valve on the discharge line wide open it quickly drew the water down to the bottom of the suction. With the discharge valve partly closed a discharge of 160 gallons per minute could be measured. The water was discharged directly into the distribution system. Changes in the bowl assembly of the pump were made later and in December, 1937 the pump was operated about four hours per day at a delivery rate of about 100 gallons per minute.

The water had a total residue of 756, a total hardness of 580.0, and an iron content of 0.2 parts per million as shown by the analysis of sample number 82517, collected December 3, 1937.

Analysis of Sample Number 82517 from Well Number 2, 408 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	4.3	0.25
(unfiltered)		0.2	Sodium Chloride	NaCl	28.0	1.63
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	25.6	1.49
Silica	SiO_2	13.0	Magnesium Sulfate	$MgSO_4$	322.2	18.80
Turbidity		0.	Calcium Sulfate	$CaSO_4$	10.9	0.64
Color		10.	Calcium Carbonate	$CaCO_3$	304.0	17.70
Odor		0.	Iron Oxide	Fe_2O_3	0.3	.02
Calcium	Ca	124.8	Silica	SiO_2	13.0	0.76
Magnesium	Mg	65.2				
Ammonium	NH_4	trace	Total		708.3	41.29
Sodium	Na	20.5				
Sulfate	SO_4	282.0				
Nitrate	NO_3	2.8				
Chloride	Cl	17.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		304.0				
Residue		756.0				
Total Hardness		580.0				

TILTON (1394). Tilton is located in the central part of Vermilion County on the drainage area of Vermilion River, a tributary of Wabash River. A public water supply system was installed in 1907. It is owned by the Interstate Water Company of Danville, Illinois.

All water for the public supply is filtered lake water pumped from the company's plant at Danville.

TINLEY PARK (823) (p. 640). No reported change.

TISKILWA (893) (p. 641). No reported change.

TOLEDO (733). Toledo is located in the central part of Cumberland County on the drainage area of Cottonwood Creek, a tributary of Embarrass River. In 1899 a public water supply project was started. Upon completion of an impounding reservoir the project was abandoned due to financial difficulties on the part of the contractor. A public water supply was finally installed in 1926.

A well, 20 feet deep, was constructed by F. Thorpe in 1925. It is located near the west bank of Cottonwood Creek and about three-quarters of a mile east of the public square. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Soil and clay	10	10
Coarse gravel	2	12
Very coarse gravel	2	14
Coarse gravel	3	17
Fine gravel	2	19
Fine sand	1	20

The water-bearing formation is screened with 12 feet of porous concrete screen which is 3 inches thick. Inside diameter is 16 inches. The

water level was at a depth of 4.5 feet when not pumping and was lowered to within 7 or 8 inches of the bottom of the well by a pumping rate of 75 gallons per minute maintained for 3 hours.

Water was pumped to the elevated tank and distribution system by a two-stroke Chippewa deep-well pump with a 4¾-inch diameter cylinder and 20-inch stroke.

This well and pump have been out of service since the completion of the new well.

The water had a total residue of 376, a total hardness of 278.5 and a content of iron of 3.2 parts per million as shown by the analysis of sample number 62583 collected September 20, 1928.

Analysis of Sample Number 62583 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	3.2	Potassium Nitrate	KNO_3	1.3	0.08
Manganese	Mn	0.0	Potassium Chloride	KCl	2.4	0.14
Turbidity		30.0	Sodium Chloride	NaCl	26.6	1.56
Silica	SiO_2	19.4	Sodium Sulfate	Na_2SO_4	58.6	3.42
Nonvolatile		0.7	Sodium Carbonate	Na_2CO_3	24.2	1.41
Alumina	Al_2O_3	0.6	Ammonium Carbonate	$(NH_4)_2CO_3$	1.6	0.10
Calcium	Ca	64.7	Magnesium Carbonate	$MgCO_3$	97.3	5.69
Magnesium	Mg	28.5	Calcium Carbonate	$CaCO_3$	159.0	9.29
Ammonium	NH_4	0.6	Silica	SiO_2	19.4	1.13
Sodium	Na	40.6	Iron Oxide	Fe_2O_3	4.6	0.27
Potassium	K	1.8	Alumina	Al_2O_3	0.6	0.03
Sulfate	SO_4	39.0	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	0.8	Nonvolatile		0.7	0.04
Chloride	Cl	17.0				
Alkalinity as $CaCO_3$ Phenolphthalein			Total		396.3	23.16
Methyl Orange		294.0				
Residue		376.0				
Total Hardness		278.5				

The porous concrete screen in this old well became clogged and in 1934 the village constructed a new well about 50 feet west of it.

The new well is 12 feet in diameter and 28 feet deep below the top of the well curb. The lower 16 feet is walled with brick placed without mortar, while the upper 12! feet is walled with brick placed in mortar and waterproofed with three coats of asphalt. The ground has been built up 4 or 5 feet above the normal level and the top of the well curb is about 1 foot above the earth fill.

A 6-inch by 6-inch Meyer's Self-Oiling Bulldozer pump taking water by direct suction from the well is installed in a vault adjacent to the well. The pump is rated at 35 gallons per minute and is driven by a 5-horsepower Century motor.

There are about 80 service connections. The daily use, estimated from the number of hours of pumping, is about 20,000 gallons per day. The minimum rate is $1.50 per quarter which permits the use of 4500 gallons of water.

A sample of water collected August 24, 1935 had a total residue of 498.0, a total hardness of 355.5 and an iron content of 0.0 parts per million as shown by the analysis of sample number 76531.

Analysis of Sample Number 76531 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.0	Sodium Nitrate.....$NaNO_3$	4.3	0.25
Manganese..Mn	0.0	Sodium Chloride.....NaCl	28.1	1.64
Silica.....SiO_2	10.0	Sodium Sulfate.....Na_2SO_4	113.0	6.59
Turbidity.....	0.0	Magnesium Sulfate.....$MgSO_4$	40.3	2.35
Color.....	0.5	Magnesium Carbonate..$MgCO_3$	88.9	5.18
Odor.....	0	Calcium Carbonate.....$CaCO_3$	216.6	12.64
Calcium.....Ca	86.5	Silica.....SiO_2	10.0	0.58
Magnesium..Mg	33.8			
Sodium.....Na	48.8	Total.....	501.2	29.23
Sulfate.....SO_4	108.8			
Nitrate.....NO_3	3.1			
Chloride.....Cl	17.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	322.0			
Residue.....	498.0			
Total Hardness....	355.5			

TOLONO (790) (p. 642). Until 1934 the village of Tolono obtained its water supply largely from well number 3 described on page 643.

In 1934 a new 10-inch well (well number 4) was drilled at a point about 15 feet southeast of well number 3. The 10-inch casing extended to a depth of 168 feet at which point the well was reduced to 8 inches and finished in a 2-foot layer of sand and gravel. The number 40-slot Cook screen which was 8 inches in diameter by 7 feet 10 inches long was set with its bottom at a depth of 186¼ feet. On test the water level drew down from a static level of 71 feet 10 inches to within 1 foot 1 inch of the bottom when producing more than 70 gallons per minute.

The well was equipped with a 14-stage, 7-inch Sterling deep-well turbine pump. The bottom of the suction pipe was set at a depth of 185 feet 2 inches.

The water had a total residue of 466, a total hardness of 235 and an iron content of 1.00 parts per million as shown by the analysis of sample number 74759, collected July *2*, 1934.

Analysis of Sample Number 74759 from Well Number 4, 186 Feet 3 Inches Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	1.0	Sodium Nitrate.....$NaNO_3$	1.7	0.10
Manganese..Mn	0.0	Sodium Chloride.....NaCl	32.7	1.91
Silica.....SiO_2	12.0	Sodium Sulfate.....Na_2SO_4	2.8	0.16
Turbidity.....	5.0	Sodium Carbonate.....Na_2CO_3	212.0	12.36
Calcium.....Ca	58.0	Ammonium Carbonate..$(NH_4)_2CO_3$	1.0	0.06
Magnesium..Mg	21.8	Magnesium Carbonate..$MgCO_3$	75.8	4.42
Ammonium..NH_4	0.3	Calcium Carbonate.....$CaCO_3$	125.0	7.29
Sodium.....Na	106.3	Calcium Silicate.....$CaSiO_3$	23.2	1.35
Sulfate.....SO_4	1.8	Iron Oxide.....Fe_2O_3	1.4	0.08
Nitrate.....NO_3	1.5			
Chloride.....Cl	20.0	Total.....	475.6	27.73
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	416.0			
Residue.....	466.0			
Total Hardness....	235.0			

In 1936 a test well was drilled in the northeast part of the village by E. W. Johnson. This test well was located at a site recommended by the State Geological Survey on the basis of an electrical earth resistivity survey. The following is a log of the drilling as prepared from cuttings by the State Geological Survey:

	Thickness in feet.	Depth in feet.
Pleistocene system		
Wisconsin glacial drift, soil black	5	5
Till (clay), brownish gray	95	100
Illinoian glacial drift		
Soil, dark brown	5	105
Sand, dirty dark brown	5	110
Till, clay, calcareous brownish gray	5	125
Gravel, fine sandy, clean	5	120
Till, clay calcareous brownish gray	5	125
Sand, fine, clean	15	140
Gravel, sandy, clean	15	155
Till, calcareous, red, brown and gray	15	170
Sand, medium to coarse, clean	10	180
Sand and gravel, clean	5	185

On the basis of this test well a permanent well (known as well number 5) was constructed but on test a production of but 25 gallons per minute was obtained and the well was not equipped.

In 1938 well number 3 had been abandoned and the entire supply was secured from well number 4.

In 1938 well number 5 was repaired by substituting a 15-foot length of slotted pipe between depths of 170 and 185 feet for the original screen. The slots are about ⅛ of an inch wide and 18 inches long. The original screen was made up with slot sizes varying from number 10 to number 60. The static water level was 76 feet below the ground level. The water level was lowered 62 feet when pumping at a rate of 98 gallons per minute. A large amount of fine sand was pumped from this well during the test on July 25, 1938. The temperature of the water was 56° F.

The water had a total residue of 457, a total hardness of 216, and an iron content of 3.6 parts per million as shown by the analysis of sample number 83941, collected July 25, 1938.

Analysis of Sample Number 83941 from Well Number 5, 185 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.6	0.15
(filtered)		.08	Sodium Chloride	NaCl	38.0	2.22
(unfiltered)		3.6	Sodium Carbonate	Na_2CO_3	170.6	9.95
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	0.06
Silica	SiO_2	18.0	Magnesium Carbonate	$MgCO_3$	72.5	4.23
Turbidity		120.0	Calcium Carbonate	$CaCO_3$	130.0	7.58
Color		0.0	Iron Oxide	Fe_2O_3	0.1	.01
Odor		0.0	Silica	SiO_2	18.0	1.05
Calcium	Ca	52.0				
Magnesium	Mg	20.9	Total		432.8	25.25
Ammonium	NH_4	0.3				
Sodium	Na	89.7				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.7				
Chloride	Cl	23.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		378.0				
Residue		457.0				
Total Hardness		216.0				

TOLUCA (1413) (p. 644). The air-lift was removed from the well at Toluca some time prior to 1927. Water is now pumped by a 2-stroke Keystone deep-well pump with an 18-inch stroke. The pump is driven at 32 strokes per minute by a 20-horsepower Western Electric motor.

There are about 300 service connections. The following flat rates are charged per quarter:

House	$2.00
House with toilet	2.50
House with toilet and bath	2.75
Public garage	5.00

The water had a total residue of 2480, a total hardness 214.5, and a content of iron of 0.4 parts per million as shown by the analysis of sample number 83964, collected July 27, 1938.

Analysis of Sample Number 83964 from Village Well at Toluca.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	17.9	1.04
(filtered)		trace	Sodium Chloride	NaCl	1,914.6	111.62
(unfiltered)		0.4	Sodium Sulfate	Na_2SO_4	250.0	14.58
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	64.6	3.76
Silica	SiO_2	19.75	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	0.03
Turbidity		5	Magnesium Carbonate	$MgCO_3$	80.2	4.67
Color		0	Calcium Carbonate	$CaCO_3$	119.5	6.97
Odor		Cm-1	Silica	SiO_2	19.5	1.14
Calcium	Ca	47.8				
Magnesium	Mg	23.1	Total		2,466.8	143.81
Ammonium	NH_4	0.1				
Sodium	Na	867.1				
Sulfate	SO_4	169.0				
Nitrate	NO_3	13.3				
Chloride	Cl	1,161.4				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		276.0				
Residue		2,480.0				
Total Hardness		214.5				

TONICA (500). Tonica is located in the southwestern part of LaSalle County on the drainage area of Bailey Creek, a tributary of Vermilion River. A public water supply was installed in 1934-1935. Previous to that time there were a number of interconnected cisterns located at various points in the village which supplied water for fire protection.

Water for the public supply is obtained from a well located near the center of the village on the east side of the Illinois Central tracks. It was drilled in 1934 by Guy Kinsey of Wenona. The depth of the well is reported to be 250 feet. It is cased with 6-inch pipe to a depth of 167 feet and with 4¼-inch perforated pipe from 167 to 220 feet. Below a depth of 140 feet the material penetrated is reported to be sand rock.

The driller reported that the water level was at a depth of 145 feet when not pumping and was lowered 35 feet by a pumping rate of 6 gallons per minute. It is thought that these figures were obtained when the well was only 202 feet deep. In January of 1937 the water level was at a depth of 132 feet when not pumping.

The well is equipped with a Cook deep-well pump with a 3¼-inch diameter cylinder and 9-inch stroke. The cylinder is set at a depth of 204 feet. Water is pumped from the well to an elevated steel tank connected to the distribution system.

The water had a total residue of 463, a total hardness of 52, and a content of iron of 0.6 parts per million as shown by the analysis of sample number 79648, collected March 9, 1937.

Analysis of Sample Number 79648 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	0.10
(filtered).....	0.0	Sodium Chloride.....NaCl	32.7	1.91
(unfiltered).....	0.6	Sodium Sulfate.....Na_2SO_4	7.1	0.41
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	359.1	20.95
Silica.....SiO_2	10.0	Ammonium Carbonate..$(NH_4)_2CO_3$	1.0	0.06
Turbidity.....	5.0	Magnesium Carbonate..$MgCO_3$	17.3	1.01
Odor.....	E1	Calcium Carbonate.....$CaCO_3$	31.5	1.84
Calcium.....Ca	12.6	Silica.....SiO_2	10.0	0.58
Magnesium..Mg	5.0			
Ammonium..NH_4	0.3	Total.....	460.4	26.86
Sodium.....Na	171.5			
Sulfate.....SO_4	5.0			
Nitrate.....NO_3	1.1			
Chloride.....Cl	20.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	14.0			
Methyl Orange...	392.0			
Residue.....	463.0			
Total Hardness....	52.0			

TOULON (1203) (p. 645). There has been no change in the source of water for the public supply. The well is now pumped by air-lift. The cylinder of the old deep-well pump is wedged in the casing and a foot piece for the air-lift could not be installed when the change of pumping equipment was made in 1923. Air is admitted to the well through a 2-inch well point, 5 feet long, attached to 450 feet of 2-inch pipe. The starting pressure is about 150 pounds per square inch and the operating pressure is about 125 pounds per square inch. The pumping rate is approximately 200 gallons per minute. Air is supplied by an Ingersoll-Eand air compressor driven by a 50-horsepower electric motor. There has been no change in the service pump.

The quality of the water is similar to that reported on page 646.

TREMONT (798) (p. 647). The wells previously described are still in use, although the east well, 135 feet deep, is pumped only once a week.

The west well is equipped with a 24-stage, 6-inch Pomona turbine pump having 120 feet of column pipe and no suction pipe, rated at 70 gallons per minute at 240-foot head, and driven by a 7½-horsepower electric motor. The over-all length of the bowl assembly is 10 feet.

The water from the west well had a total residue of 602.0, a total hardness of 521.5, and an iron content of 7.4 parts per million as shown by the analysis of sample number 84053, collected August 6, 1938.

Analysis of Sample Number 84053 from West Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	16.2	0.95
(filtered)		0.6	Sodium Chloride	NaCl	9.9	0.58
(unfiltered)		7.4	Sodium Carbonate	Na_2CO_3	85.4	5.00
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	248.0	14.46
Silica	SiO_2	21.0	Calcium Carbonate	$CaCO_3$	228.0	13.29
Turbidity		50	Iron Oxide	Fe_2O_3	0.9	.05
Color		15	Silica	SiO_2	21.0	1.22
Odor		Dm-2				
Calcium	Ca	91.0	Total		610.3	35.55
Magnesium	Mg	71.6				
Ammonium	NH_4	trace				
Sodium	Na	45.3				
Sulfate	SO_4	0.0				
Nitrate	NO_3	11.5				
Chloride	Cl	6.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		602.0				
Residue		602.0				
Total Hardness		521.5				

TRENTON (1271) (p. 648). No reported change.

TEOY (1122). Troy is located in the southern part of Madison County on the drainage area of Silver Creek, a tributary of Kaskaskia River. An attempt to develop a supply of water from wells was made in 1926 but was not successful. A distribution system was installed by the city in 1936 and water for the public supply is now purchased from the city of Collinsville.

TUSCOLA (2569) (p. 650). Tuscola maintains the two wells described on page 652 as stand-by units. The Luitwieler pump in well number 2 has been replaced by a Cook differential plunger pump with a 24-inch stroke. The pump is driven at a rate of 28 strokes per minute by a 15-horsepower General Electric motor. It has not been necessary to use these wells since 1931.

Well number 3 furnishes all of the water now used by the city. It is 10 inches in diameter and 523 feet deep. It was drilled by George Meister of Tuscola in 1931. The well is located near the center of the lot at the northeast corner of Heim and Daggy Streets about 225 feet west of the old wells. A blue-print log of the well, prepared by the State Geological Survey, indicates that the well penetrated the following materials:

	Thickness in feet.	Depth in feet.
Glacial drift (no samples)	119	119
Limestone	9	128
Dolomite	30	158
Limestone	87	245
Dolomite	14	259
Sandstone	5	264
Limestone	8	272
Sandstone	16	288
Dolomite, Niagaran (?)	235	523

The well is cased to a depth of 119 feet and 6 inches.

Water is pumped from this well to a 23,000-gallon receiving reservoir located about 75 feet north of the well by means of an air-lift. The air-lift consists of 377 feet of 4-inch eductor pipe and a 1-inch air-line also 377 feet long. Air is furnished by an 8 by 8-inch Gardner-Denver compressor rated at 125 pounds per square inch when operating at 300 revolutions per minute. The compressor is driven by 25-horsepower General Electric Motor. The air-lift starting pressure is 110 pounds per square inch and the operating pressure is about 98 pounds per square inch. The air-line was lengthened 30 feet in 1937. No production test has been made since the air-line was extended. Prior to that time the well was reported to yield 100 gallons per minute.

Water is pumped from the receiving reservoir to the distribution system and 75,000-gallon elevated tank by either of two identical single-stage Worthington centrifugal pumps. These pumps are each rated at 175 gallons per minute against a head of 117 feet. Each pump is driven by a 10-horsepower General Electric motor. The service pumps and air compressor are housed in a building constructed above the receiving reservoir.

The larger of the two reservoirs at the plant in the business district (see page 650) is maintained full to furnish additional water in case of a prolonged fire. A Manistee Iron Works centrifugal pump rated at 750 gallons per minute against a head of 231 feet is available to pump water from this reservoir to the distribution system. This pump may be driven by either a 25-horsepower electric motor or a gasoline engine.

There are about 500 service connections and the average daily usage is about 100,000 gallons. The air-lift is operated about 14½ hours per day. Water is sold at the following rates:

45 cents per 100 cubic feet for the first 300 cubic feet
25 cents per 100 cubic feet for the next 14,700 cubic feet
15 cents per 100 cubic feet for all over 15,000 cubic feet

Minimum bill is $1.00 per month.

The water had a total residue of 420, a total hardness of 226 parts per million and no iron as shown by the analysis of sample number 79647, collected on March 9, 1937.

Analysis of Sample Number 79647 from 523-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron (unfiltered)	Fe	0.0	Sodium Chloride	NaCl	64.4	3.75
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	10.7	0.63
Silica	SiO_2	12.0	Sodium Carbonate	Na_2CO_3	122.5	7.14
Turbidity		0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	2.4	0.14
Odor		Ch	Magnesium Carbonate	$MgCO_3$	78.0	4.55
Calcium	Ca	53.3	Calcium Carbonate	$CaCO_3$	133.5	7.78
Magnesium	Mg	22.5	Silica	SiO_2	12.0	0.70
Ammonium	NH_4	0.8				
Sodium	Na	81.8	Total		423.5	24.69
Sulfate	SO_4	7.0				
Chloride	Cl	39.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		14.0				
Methyl Orange		344.0				
Residue		420.0				
Total Hardness		226.0				

UNION (367) (p. 653). The source of water supply and pumping equipment remained the same as previously described until about 1928 when a Fairbanks-Morse single-stage centrifugal pump powered by a 20 horsepower electric motor, all automatically controlled, replaced the older equipment.

In 1935 the well described on page 654 was abandoned and the water supply for the village obtained from a well 12 inches in diameter at the top by 192 feet deep drilled by P. E. Millis.

The well is equipped with a Pomona deep-well turbine pump direct connected to a Westinghouse 5-horsepower electric motor operating at a full load speed of 1740 revolutions per minute. This pump discharges into a concrete surface reservoir of about 8000-gallon storage capacity.

Water is drawn from the storage reservoir and discharged into a 10,000-gallon pressure tank and the distribution system by a Worthington single-stage centrifugal pump rated at 200 gallons per minute. The maximum tank pressure is 65 pounds. In May, 1938 there were 64 services.

The water has a total residue of 302, a total hardness of 220.5, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 83843, collected July 12, 1938.

Analysis of Sample Number 83843 from Village Well 192 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	.10
(filtered).....	0.0	Sodium Carbonate.....Na_2CO_3	72.5	4.22
(unfiltered).....	0.3	Ammonium Carbonate..$(NH_4)_2CO_3$	2.9	.17
Manganese..Mn	0.0	Magnesium Carbonate..$MgCO_3$	84.3	4.92
Silica.....SiO_2	12.0	Calcium Carbonate.....$CaCO_3$	121.0	7.05
Turbidity.....	8.0	Silica.....SiO_2	12.0	.70
Color.....	0.0			
Odor.....	0.0	Total.....	294.4	17.16
Calcium.....Ca	48.2			
Magnesium..Mg	24.3			
Ammonium..NH_4	1.1			
Sodium.....Na	32.0			
Sulfate.....SO_4	0.0			
Nitrate.....NO_3	1.3			
Chloride.....Cl	0.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	292.0			
Residue.....	302.0			
Total Hardness....	220.5			

The Union Milk Company plant located at the east edge of the village obtains water from a well reported to be 1365 feet deep and formerly owned by Libby, McNeil and Libby Company.

The well is equipped with an electric motor driven American Well Works deep-well turbine pump rated at 250 gallons per minute against a 300-foot head at a speed of 1750 revolutions per minute.

The water had a total residue of 309, a total hardness of 287, and a content of iron of 0.32 parts per million as shown by analysis of sample number 83547, collected May 19, 1938.

Analysis of Sample Number 83547 from Well 1365 Feet Deep at the Union Milk Company.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.9	0.05
(filtered)		0.02	Sodium Sulfate	Na_2SO_4	3.6	0.21
(unfiltered)		0.32	Sodium Carbonate	Na_2CO_3	17.0	0.99
Manganese	Mn	0.00	Ammonium Carbonate	$(NH_4)_2CO_3$	1.0	0.06
Silica	SiO_2	13.00	Magnesium Carbonate	$MgCO_3$	115.4	6.73
Turbidity		4	Calcium Carbonate	$CaCO_3$	150.1	8.75
Color		0	Silica	SiO_2	13.0	0.76
Odor		M-1				
Calcium	Ca	60.00	Total		301.0	17.55
Magnesium	Mg	33.3				
Ammonium	NH_4	0.3				
Sodium	Na	8.5				
Sulfate	SO_4	2.5				
Nitrate	NO_3	0.6				
Chloride	Cl	0.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		2.0				
Methyl Orange		304.0				
Residue		309.0				
Total Hardness		287.0				

URBANA (p. 655). See Champaign-Urbana.

VANDALIA (4342). The raw water supply for the city of Vandalia is obtained from Kaskaskia River. The water is treated before entering the distribution system.

VENICE (5362) (p. 710). Venice is supplied with water by the East St. Louis and Interurban Water Company of East St. Louis.

VERMONT (948). Vermont is located in the southwestern part of Fulton County on the drainage areas of Sugar and Otter Creeks, tributaries of Illinois River.

Many years ago a well was drilled in the public square by Job Marshall. It is reported that at a depth of 1000 feet there was an ample supply of water of good quality, but that Marshall continued drilling, hoping to obtain a flowing well, and finally encountered highly mineralized and very unsatisfactory water. Another report states that the well is 2600 feet deep. Unfortunately, no accurate records were kept and there is no way to prove the truth of these reports.

In 1936 an attempt was made to develop a supply of ground water. An electrical earth resistivity survey was conducted and several test wells were drilled in the vicinity of the village. No extensive deposit of sand and gravel was found which would be capable of furnishing enough water for a public supply.

Deep rock wells in this territory are known to yield very unsatisfactory water so the test wells were limited in depth.

At present the village has no public water supply.

VIENNA (874). A public water supply system was installed in 1937. The raw water supply is obtained from an impounding reservoir on McCorkle Creek. The water is treated before entering the distribution system.

VILLA GROVE (2001) (p. 655). Villa Grove obtains water from the two wells reported on page 655. Equipment in well number 1 is as reported on page 656. The equipment in well number 2 is now a Keystone Driller pump, the cylinder of which is 7¾ inches in diameter by 7 feet 9 inches long. It is the two-stroke type with 18-inch stroke and rated at 270 gallons per minute at 40 strokes per minute.

A water treatment plant was constructed in 1936. Treatment consists of aeration, softening with lime and filtration through rapid sand filters, and chlorination. Due to the high concentration of hydrogen sulfide in the water some difficulty is experienced in maintaining a residual of chlorine.

Two Fairbanks-Morse centrifugal pumps rated at 300 gallons per minute are used to pump the treated water to the distribution system. One pump is driven by a 20-horsepower electric motor, the other is driven by a 4-cylinder gasoline engine.

The raw water from well number 1 contains 6.6 cubic feet of gas per 1000 gallons (exclusive of hydrogen sulfide) of which methane constitutes 76 per cent.

VILLA PARK (6220) (p. 657). The two wells drilled in 1924 by the J. P. Miller Artesian Well Company, and described on page 659, were equipped with pumps in 1926.

The southwest well was equipped with a Cook double-stroke deep-well cylinder pump, having a cylinder 8 inches in diameter by 18-inch stroke and operating at 20 revolutions per minute. It was driven by a 25-horsepower electric motor, but a Worthington 15-horsepower gas engine with belt connection was available as a stand-by unit. It was estimated that this unit produced at a rate of about 200 gallons per minute.

The northeast well was equipped with a Cook double-stroke deep-well cylinder pump having a cylinder 5¾ inches in diameter by 18-inch stroke and operating at 16 revolutions per minute. It was driven by a 25-horsepower electric motor but was arranged for a belt connection to a tractor engine in case of need. It was estimated this unit produced at a rate of about 70 gallons per minute.

Both pumps were automatically controlled when operating by electric motors. They operated about 17 hours per day.

In December, 1926 the extension of the distribution system had been sufficiently extensive to permit the serving of 500 customers. The rate for water was 25 cents per 1000 gallons with a minimum charge of $2.50 per quarter.

Some of the residents, at this time, were still being supplied with water by the privately owned installations.

In 1928 arrangements were made to purchase water from the wells that Mr. S. B. Geiger was to drill at his own expense.

The first well was completed in 1928 to a depth of 1912 feet at a site on the north side of Home Avenue about 400 feet west of south Ardmore Avenue.

During the drilling the water stood in the hole within 60 to 65 feet of the ground surface until a depth of 550 feet was reached when it raised to within 40 feet.

The formations penetrated are given in the following log prepared by the State Geological Survey:

	Thickness in feet.	Depth in feet.
Pleistocene system		
Glacial drift	71	71
Silurian system		
"Niagaran" limestone, water	139	210
Ordovician system		
Maquoketa shale & limestone	210	420
Galena-Platteville limestone	330	750
St. Peter formation		
sandstone, water	305	1055
Shale	15	1070
Cambrian system		
Trempealeau limestone	25	1095
Franconia red shale	160	1255
Dresbach formation		
Galesville sandstone, water	170	1425
Eau Claire member		
Limestone	15	1440
Shale	170	1610
Limestone	70	1680
Shale	10	1690
Limestone	25	1715
Shale	20	1735
Sandstone (probably tight)	80	1815
Mt. Simon		
Sandstone, water	85	1900
Sandstone, red, water	12	1912

The size of the drilled hole was:

22 inches in diameter from 0 feet to 76 feet
20 inches in diameter from 76 feet to 445 feet
15 inches in diameter from 445 feet to 1095 feet
12 inches in diameter from 1095 feet to 1165 feet
10 inches in diameter from 1165 feet to 1912 feet

A .20-inch casing was installed from the surface to a depth of 445 feet below which was an open hole.

When the well had reached a depth of 1912 feet, the village made arrangements to obtain water from it as the other wells were not able to supply the growing demand. The well was then equipped with a deep-well turbine pump set with the bottom of the suction pipe, which was 38 feet long, at a depth of 478 feet.

The second deep well drilled by Mr. Greiger was completed in 1931 to a final depth of 2125 feet at a site 50 feet east of Yale Avenue and 100 feet south of St. Charles Eoad or some 250 feet west of the 1912-foot well.

When a depth of 1980 feet was reached water stood in the well at a depth of 64 feet below the surface of the ground.

The formations penetrated are indicated in the following driller's log:

	Thickness in feet.	Depth in feet.
Shale	71	71
Lime	349	420
Lime	330	750
Sand, St. Peters	305	1055
Shale	15	1070
Lime	25	1095
Shale, red	160	1255
Sand	170	1425
Lime	15	1440
Shale	170	1610
Lime	70	1680
Shale	10	1690
Lime	25	1715
Shale	20	1735
Sand	165	1900
Sand, red	12	1912
Total depth		1225

In 1936 the 1912-foot well, otherwise known as number 1, was reported to be equipped with a Sterling deep-well turbine pump set at 420 feet and rated at 800 gallons per minute at 1200 revolutions per minute. It was direct connected to a 150-horsepower Ideal Electric Company electric motor and discharged into a surface storage reservoir. From the reservoir water is pumped into the distribution system by a Dayton-Dowd centrifugal pump rated at 1000 gallons per minute at 1750 revolutions per minute against a head of 160 feet.

The 2125-foot well, known as number 2, was equipped with a 3-stage Sterling deep-well turbine pump set at 420 feet and rated at 800 gallons per minute at 1200 revolutions per minute. It was direct connected to a 150-horsepower Electric Machine Manufacturing Company electric motor. The Sterling deep-well turbine pump discharges into the suction side of a Morris Machine Works centrifugal service pump which in turn discharges into the distribution system.

A sharp decrease in production occurred during the early months of 1936, the water lines having lowered some 20 feet during the six months preceding April 1, 1936.

A corresponding recession in water levels at the Wander Company plant had also been observed.

The water from the 2125-foot well had a total residue of 467.0, a total hardness of 293.5 and a content of iron of 5.6 parts per million as shown by the analysis of sample number 77752, collected April 17, 1936.

Analysis of Sample Number 77752 from Well 2125 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe				
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$	1.7	0.09
(unfiltered).....	5.6	Sodium Chloride.....NaCl	34.5	2.01
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	101.0	5.88
Silica.....SiO_2	8.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	1.3	0.07
Turbidity.....	5.0	Magnesium Sulfate.....$MgSO_4$	30.7	1.79
Calcium.....Ca	74.0	Magnesium Carbonate..$MgCO_3$	69.9	4.08
Magnesium..Mg	26.4	Calcium Carbonate.....$CaCO_3$	185.0	10.80
Ammonium..NH_4	0.4	Silica.....SiO_2	8.0	0.46
Sodium.....Na	47.1			
Sulfate.....SO_4	94.7	Total.....	432.1	25.18
Nitrate.....NO_3	1.5			
Chloride.....Cl	21.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	268.0			
Residue.....	467.0			
Total Hardness....	293.5			

The Wander Company, a large industrial plant within the village, is located in a triangular plot of ground between the Chicago Great Western Eailroad and the Aurora, Elgin and Chicago Eailroad, and east of Villa Park Avenue. It has its own well water supply which consists of nine wells.

Well number 1 was drilled in 1917 to a depth of 120 feet. It had a free flow until 1921 and by June, 1926 static level had receded to 28 feet below the surface and production was but 100 gallons per minute. By February, 1929 production had dropped to 80 gallons per minute. The well was originally equipped with a cylinder pump which had a 64-foot setting.

Well number 2 was drilled in 1918 to a depth of 180 feet. The well flowed when first drilled. It was equipped originally with a direct suction centrifugal pump. In 1921 an air-lift was installed. Static water level was 30 feet below surface in June, 1926 and production was but 40 gallons per minute.

Well number 3 was drilled in 1921-1922 to a depth of 220 feet. Static water level was 19 feet below surface. It was originally equipped with an American Well Works deep-well turbine pump. When pumping at 350 gallons per minute a draw down of 40 feet occurred when the well was new. A Layne-Bowler deep-well turbine pump as installed in 1925. At this time a production of 200 gallons per minute created a draw down of 120 feet. By 1925 static water level had receded to 31 feet below the surface.

Well number 4 was drilled in 1924 to a depth of 187 feet. The static water level was 26 feet below surface. The well was originally equipped with a Worthington Axiflo deep-well turbine pump. When new the well produced 500 gallons per minute with a 55-foot draw down. The pump was lowered 33 feet in 1925 at which time a production of 300 gallons per minute created a draw down of 80 feet. Static water level in 1925 was 33 feet.

Well number 5 was drilled in 1926 to a depth of 197 feet. Static water level was 30 feet below the surface. The well was originally equipped with a Luitwieler deep-well cylinder pump which delivered 200 gallons per minute with a draw down of 60 feet.

Well number 6 was drilled in 1926 to a depth of 190 feet. Static water level was 30 feet below the surface. The well was originally equipped with a Luitwieler deep-well cylinder pump. The yield was 80 gallons per minute in 1929;

Well number 7 was drilled in 1926 to a depth of 1900 feet. Static water level was 100 feet below the surface. The well was originally equipped with a 12-stage, 13-inch Layne deep-well turbine pump with 500 feet of column and 31 feet of suction pipe below the bowls. During a test made in February, 1929 a yield of 1275 gallons per minute was obtained.

Well number 8 was drilled in 1926 to a depth of 190 feet. Static water level was 34 feet below the surface. It was equipped with a 6-stage, 12-inch Layne deep-well turbine pump with 120 feet of column and 18 feet of suction pipe below the bowls. This well has produced consistently at a rate of 300 gallons per minute to 350 gallons per minute.

Wells numbers 1 to 8 inclusive are located on the site of the company building, but well number 9 is located northeast across the right-of-way of the Chicago Great Western Eailroad.

Well number 9 was completed in 1933 to a depth of 2000 feet. It was cased with 26-inch outside diameter casing from the surface to the top of the limestone at 38 feet, and with 20-inch outside diameter casing from the surface to a depth of 376 feet. A 13-inch outside diameter liner was placed between depths of 852 feet and 1085 feet. The well was finished with a 12-inch bottom. When completed, static water level was at a depth of 227 feet. The well was permanently equipped with a 13-stage, 15-inch Layne deep-well turbine pump with 550 feet of column and 30 feet of suction pipe below the bowls. The test pump consisted of 12 stages of 17-inch bowls set with the bottom of the bowls at 513 feet, and 30-foot section of suction pipe below the bowls. At the end of 24 hours the production was 1100 gallons per minute. The well was later shot with eleven charges of explosive. Upon a second test of 24 hours a production of 2190 gallons per minute was obtained with a draw down of 220 feet from a static level of 228 feet. This well was affected by pumping the other wells at the plant, particularly well number 7 which was 800 feet distant and was operated at 1160 gallons per minute during the time of the test on well number 9.

The water from well number 9 had a total residue of 780, a total hardness of 546.5 and a content of iron of 15 parts per million, as shown by the analysis of sample number 76639, collected September 19, 1935.

Analysis of Sample Number 76639 from Wander Company Well Number 9.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	0.10
(filtered).....	0.2	Sodium Chloride.....NaCl	77.8	4.54
(settled 1 hr.)....	0.7	Sodium Sulfate.....Na_2SO_4	63.2	3.68
(unsettled).....	15.0	Magnesium Sulfate.....$MgSO_4$	243.6	14.20
Manganese..Mn	0.0	Magnesium Carbonate..$MgCO_3$	14.8	0.86
Silica.....SiO_2	11.0	Calcium Carbonate.....$CaCO_3$	326.5	19.05
Turbidity.....	0.0	Iron Oxide.....Fe_2O_3	0.3	0.02
Calcium.....Ca	130.5	Silica.....SiO_2	11.0	0.64
Magnesium..Mg	53.5			
Sodium.....Na	51.5	Total.....	738.9	43.09
Sulfate.....SO_4	237.2			
Nitrate.....NO_3	1.5			
Chloride.....Cl	47.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	344.0			
Residue.....	780.0			
Total Hardness....	546.5			

VIOLA (566) (p. 659). No change has been made in the source of the municipal water supply.

VIRDEN (3011). The city of Virden installed a distribution system in 1935. Water is purchased from the city of Springfield.

VIRGINIA (1494). Several attempts to obtain a satisfactory water supply from wells have been made in times past but all proved valueless.

In 1933 a public water supply system was installed. The raw water supply is obtained from an artificial reservoir of 60,000,000 gallons capacity located in the west branch of Jobs Creek. The water is treated before entering the distribution system.

WALNUT (833) (p. 661). The first well constructed in 1896 is now equipped with a Deming deep-well cylinder pump, belt-connected to a Westinghouse electric motor. The well constructed in 1918 is now equipped with an American Well Works single-acting deep-well cylinder pump, belt-connected to a Westinghouse electric motor. They are arranged to discharge into the old pressure tank which serves as a reservoir. The single-stage centrifugal service pump takes suction from the old pressure tank and discharges the water into the distribution system. It is direct-connected to a 25-horsepower Westinghouse electric motor.

These wells and their auxilliary service pump equipment are seldom used. All of the other older wells have been abandoned.

The public water supply is now obtained from a well 8 inches in diameter at the top and 271 feet deep, drilled in 1936 by Henry Albrecht at a point about 15 feet south of the well drilled in 1918. The well is cased with 8-inch casing to a depth of 245 feet below which is 26 feet of Johnson screen 7½ inches outside diameter with number 10 slots.

The material penetrated as reported by Mr. Albrecht was:

	Thickness in feet.	Depth in feet.
Yellow clay	40	40
Blue clay	140	180
Blue clay and sand	10	190
Sand fine at top, coarse at bottom	83	273

The well is equipped with a 10-stage, 8-inch Aurora Pump Company turbine pump having 160 feet of 6-inch column pipe and 10 feet of 6-inch suction pipe. The pump is rated at 340 gallons per minute against a 215-foot head and is driven by a 30-horsepower electric motor.

At the time of the pump installation static water level was reported at 100 feet and a production of 300 gallons per minute was obtained. The pump operates about three hours daily and discharges into the elevated tank. This well furnishes all the water required except in cases of emergency.

There are 275 service connections all but 15 of which are metered.

The water had a total residue of 336, a total hardness of 300, and a content of iron of 4.6 parts per million as shown by the analysis of sample number 83697, collected June 7, 1938.

Analysis of Sample Number 83697 of Village Well 271 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.5	0.15
(filtered)		.04	Sodium Chloride	NaCl	1.8	0.10
(unfiltered)		4.6	Sodium Carbonate	Na_2CO_3	6.4	0.37
Manganese	Mn	0.0	Ammonium Carbonate	$(NH_4)_2CO_3$	1.9	0.11
Silica	SiO_2	19.5	Magnesium Carbonate	$MgCO_3$	98.0	5.72
Turbidity		18.0	Calcium Carbonate	$CaCO_3$	184.0	10.72
Color		0.0	Iron Oxide	Fe_2O_3	0.1	0.01
Odor		0.0	Silica	SiO_2	19.5	1.14
Calcium	Ca	73.6				
Magnesium	Mg	28.2	Total		314.2	18.32
Ammonium	NH_4	0.7				
Sodium	Na	4.1				
Sulfate	SO_4	0.0				
Nitrate	NO_3	1.7				
Chloride	Cl	1.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		308.0				
Residue		336.0				
Total Hardness		300.0				

WARREN (1179) (p. 662). No reported change.

WARRENSBURG (517). Warrensburg is located in the northwestern part of Macon County on the drainage area of Sangamon River, a tributary of Illinois River.

Water for the public supply, installed by the village in 1935, is obtained from a well located at the northwestern corner of the village limits, drilled by Johnson and Hinkle of Bloomington in 1935. It is 118 feet deep and 12 inches in diameter. The water-bearing sand and

gravel formation is screened with a 7-foot length of number 50-slot Cook screen.

The water level in the well was 63½ feet below the top of the casing when not pumping and was lowered 18½ feet by a pumping rate of 158 gallons per minute.

The well is equipped with a 10-stage, 8-inch Pomona turbine pump having 100 feet of 6-inch column pipe and driven by a 15-horsepower electric motor. The pump delivers about 120 gallons per minute to the distribution system to which is connected a 40,000-gallon elevated steel tank.

The water had a total residue of 437, a total hardness of 359.5, and a content of iron of 4.7 parts per million as shown by the analysis of sample number 76875, collected October 21, 1935.

Analysis of Sample Number 76875 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	1.7	0.10
(filtered)		0.0	Sodium Chloride	NaCl	13.5	0.79
(settled 1 hr.)		1.8	Sodium Sulfate	Na_2SO_4	9.9	0.58
(unsettled)		4.7	Sodium Carbonate	Na_2CO_3	42.4	2.47
Manganese	Mn	0.0	Magnesium Carbonate	$MgCO_3$	134.5	7.84
Silica	SiO_2	10.0	Calcium Carbonate	$CaCO_3$	200.2	11.67
Turbidity		50.0	Silica	SiO_2	10.0	0.58
Calcium	Ca	80.3				
Magnesium	Mg	38.7	Total		412.2	24.03
Ammonium	NH_4	2.8				
Sodium	Na	27.5				
Sulfate	SO_4	6.6				
Nitrate	NO_3	1.1				
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		408.0				
Residue		437.0				
Total Hardness		359.5				

WARSAW (1866) (p. 710). The raw water supply of the city of Warsaw is obtained from Mississippi River. The water is treated before entering the distribution system.

WASHBURN (854). Washburn is located in Woodford and Marshall Counties on the drainage area of Snag Creek, a tributary of Illinois River. Many private dug wells range in depth from 30 to 40 feet and secure water from sand. Another stratum of sand is found at depths above 150 feet.

Water for the public supply, installed by the village in 1927, is obtained from a well drilled in 1927 by H. W. Packard of Washburn. The well is 137 feet deep and 12 inches in diameter. It is cased with 12-inch casing to a depth of 129 feet, below which is a 10-foot length of Cook screen with the following slot sizes: upper 3 feet is number 20 slot, next 3 feet is number 25 slot, and lower 4 feet is number 30 slot.

The water level was at a depth of 15 feet when not pumping. The yield of the well was reported to be 200 gallons per minute.

The well is equipped with a Keystone Driller Company 2-stroke deep-well pump belt-connected to a General Electric 20-horsepower electric motor. The pump has an 18-inch stroke and is rated at 225 gallons per minute.

The water had a total residue of 429, a total hardness of 306, and a content of iron of 0.12 parts per million as shown by the analysis of sample number 83492, collected May 12, 1938.

Analysis of Sample Number 83492 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	0.9	0.05
(filtered)		0.10	Sodium Chloride	NaCl	28.0	1.63
(unfiltered)		0.12	Sodium Carbonate	Na_2CO_3	69.0	4.02
Manganese	Mn	0.00	Ammonium Carbonate	$(NH_4)_2CO_3$	5.3	0.31
Silica	SiO_2	23.00	Magnesium Carbonate	$MgCO_3$	117.0	6.70
Turbidity		13	Calcium Carbonate	$CaCO_3$	167.0	9.73
Color		0	Iron Oxide	Fe_2O_3	0.1	0.01
Odor		Csl	Manganese Oxide	MnO	23.0	1.34
Calcium	Ca	66.8				
Magnesium	Mg	33.7	Total		410.3	23.79
Ammonium	NH_4	2.0				
Sodium	Na	41.2				
Sulfate	SO_4	0.0				
Nitrate	NO_3	0.6				
Chloride	Cl	17.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		376.0				
Residue		429.0				
Total Hardness		306.0				

WASHINGTON (1741) (p. 663). There has been no change in the source of the public water supply.

WASHINGTON PAEK (3837). Washington Park is supplied with water by the Bast St. Louis and Interurban Water Company.

WATEELOO (2239) (p. 710). The raw water supply of the city of Waterloo is obtained from an impounding reservoir on Fountain Creek. The water is treated before entering the distribution system.

WATERMAN (520) (p. 665). The public water supply of the village of Waterman is obtained from the same well as described on page 665. About 1930-1931 the casing and screen were renewed and in 1937 a 14-stage, 6-inch Cook deep-well turbine pump was installed. This pump consists of 50 feet of 4-inch column pipe, the bowl assembly 5½ feet long, and no suction pipe. It is powered by a 7½-horsepower electric motor and has a capacity of 100 gallons per minute.

Static water level is at 22 feet and when the pump is operating water is drawn down to a depth of 37 feet. A small air-line 52 feet long for measuring water level was installed with the pump.

WATSEKA (3144) (p. 666). In 1937 John Bolliger drilled a well 10 inches in diameter and 168 feet deep for Watseka. This well is located about 60 feet south of the two 150-foot wells drilled by the city

in 1892. The location of these two wells was erroneously given as "on the east side of Second Street between Walnut and Cherry Streets". They are actually located north of Cherry Street about midway between Third and Fourth Streets. The old wells are used only in case of an emergency.

The 168-foot well is equipped with a 27-foot length of 10-inch screen. Static water level was 16 feet and the water level, when pumping at a rate of 350 gallons per minute, 44 feet below the pump base. An 8-inch, 9-stage Pomona turbine pump driven by a 30-horsepower General Electric motor pumps water from the well. The pump bowls are attached to 120 feet of 6-inch column pipe and 10 feet of 6-inch suction pipe is attached below the bowls.

The pump is operated about 16 hours peri day to supply water to approximately 1000 customers.

The water has a total residue of 360, a total hardness of 146, and a content of iron of 0.7 parts per million as shown by the partial analysis of sample number 84064, collected August 12, 1938.

WAUCONDA (554) (p. 667). The water supply of Wauconda is as described on page 667. During 1937 the village attempted to increase the quantity of water available by constructing an additional well. On March 10, 1937 a production test was made on a test well located east of Maple Avenue midway between Bangs and Mill Streets. The well was 187 feet deep and was equipped with a 5-foot length of 4-inch well point covered with number 60 gauze. Static water level was reported to be at a depth of 30 feet below the ground surface. When pumping at a rate of 30 gallons per minute the water level was lowered 123 feet. The yield of the test well was so low that the project was abandoned.

The water had a total residue of 382, a total hardness of 370, and an iron content of 1.6 parts per million as shown by the analysis of sample number 79696, collected on March 16, 1937.

Analysis of Sample Number 79696 Collected from the 187-Foot Test Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe					
(filtered)		0.6	Sodium Nitrate	$NaNO_3$	1.7	0.10
(unfiltered)		1.6	Sodium Chloride	NaCl	4.7	0.27
Manganese	Mn	0.0	Sodium Sulfate	Na_2SO_4	2.8	0.16
Silica	SiO_2	14.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Turbidity		20.0	Magnesium Sulfate	$MgSO_4$	12.0	0.70
Calcium	Ca	74.2	Magnesium Carbonate	$MgCO_3$	147.1	8.58
Magnesium	Mg	45.2	Calcium Carbonate	$CaCO_3$	185.5	10.82
Ammonium	NH_4	0.2	Silica	SiO_2	14.0	0.82
Sodium	Na	3.2				
Sulfate	SO_4	12.1	Total		368.5	21.49
Nitrate	NO_3	1.0				
Chloride	Cl	3.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		18.0				
Methyl Orange		360.0				
Residue		382.0				
Total Hardness		370.0				

WAUKEGAN (33,499). Waukegan uses Lake Michigan water. It has a filtration plant of 10,000,000-gallon capacity.

WAYNESVILLE (511) (p. 668). The wells described on page 668 have all been abandoned and filled. Water is now obtained from two wells, one of which was drilled in 1925 and the other in 1934.

The well, constructed in 1925, is located in the business district north of Second Street and between Malthy and Isham Streets. It is 8 inches in diameter by 165 feet deep and is eased with 8-inch casing. The well terminates in water-bearing sand.

When first completed the well was equipped with a deep-well cylinder pump.

The well is now equipped with an American Well Works 6-inch deep-well turbine pump consisting of 140 feet of 4-inch column pipe, 15 stages of bowls having an over-all length of 6 feet 7¾ inches, and 10 feet of 3½-inch suction pipe. It is direct connected to a U. S. 7½-horsepower electric motor operating at 1800 revolutions per minute.

The pump is rated at 60 gallons per minute against a head of 222 feet. Static water level is reported to be 95 feet below the pump base. The well furnishes all the demand except in case of an emergency.

The pump delivers directly into the distribution system and elevated tank.

The well, constructed in 1934, is located at the old pumping station in the southeast corner of the intersection of Fourth and Main Streets. It was drilled by Ira DeMerit of Hallsville and is 6 inches in diameter by 125 feet deep. A 12-foot length of 6-inch well screen is set on the bottom of the well above which is 6-inch casing.

The well is equipped with a steam-head single-acting Cook deep-well cylinder pump. The cylinder is wedged in the casing at 110 feet and the pump operates with a 36-inch stroke. This unit is used only in case of an emergency.

There are 116 service connections and the daily demand is between 12,000 and 15,000 gallons.

The rates for water are:

Minimum per month $1.25 which permits the use of 125 cubic feet.
Next additional 200 cubic feet $1.00 per 100 cubic feet.
Next additional 300 cubic feet $0.75 per 100 cubic feet.
All additional $0.50 per 100 cubic feet.

The water from the well in the business district had a total residue of 620, a total hardness of 488.5 and a content of iron of 2.4 parts per million as shown by the analysis of sample number 83937, collected June 22, 1938.

Analysis of Sample Number 83937 from Village Well 165 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		3.4	0.20
(filtered).....	0.0	Sodium Chloride.....NaCl		4.7	0.27
(unfiltered).....	2.4	Sodium Carbonate.....Na_2CO_3		86.4	5.04
Manganese..Mn	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$		17.3	1.01
Silica.....SiO_2	18.0	Magnesium Carbonate..$MgCO_3$		198.6	11.58
Turbidity.....	15.0	Calcium Carbonate.....$CaCO_3$		253.7	14.79
Color.....	0.0	Silica.....SiO_2		18.0	1.05
Odor.....	0.0				
Calcium.....Ca	101.2	Total.....		582.1	33.94
Magnesium..Mg	57.5				
Ammonium..NH_4	6.4				
Sodium.....Na	40.2				
Sulfate.....SO_4	0.0				
Nitrate.....NO_3	2.4				
Chloride.....Cl	3.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	588.0				
Residue.....	620.0				
Total Hardness....	488.5				

WELDON (499) (p. 670). No record of change.

WENONA (1005) (p. 672). Since 1930 a great deal of trouble has been experienced with the deep-well pump in the 1857-foot well. Lack of sufficient water has caused the pump to pound severely and pump rods have been broken frequently. Lowering the pump gave only temporary relief. Several minor cave-ins have caused murky water to be pumped.

In 1930 a well was drilled near the intersection of Third and Spruce Streets by Mike Ebert of Washington. It is cased with 6-inch pipe which is perforated between depths of 47 and 52 feet. Water is obtained from a layer of sand. A 4-inch Pomona turbine pump rated at 50 gallons per minute was installed in the well. For several years this well supplied most of the water used by the city.

In 1937 a new well was drilled for the city by Joseph Egerer of Milwaukee, Wisconsin. It is 1865 feet deep and is located about 50 feet north of the old deep well. It is cased with 12-inch pipe to a depth of 354 feet 8 inches and with 8-inch pipe from the surface to a depth of 1350 feet. The diameter at the bottom of the well is 8 inches.

In May, 1937 the water level was at a depth of 191 feet when not pumping and was lowered 107 feet by a pumping rate of 25 gallons per minute. After the well had been in service for a few weeks the yield began to increase. In August of the same year the yield was reported to be about 50 gallons per minute with the water level lowered to a depth of 330 feet. All the water for the public supply was then obtained from this well, with the shallow well serving as a stand-by unit.

The well is equipped with an 18-stage Pomona deep-well turbine pump having 370 feet of column pipe and 20 feet of suction pipe and driven by a 7½-horsepower electric motor.

The water had a mineral content of 1298, a total hardness of 272.5, and a content of iron of 4.0 parts per million as shown by the analysis of sample number 81265, collected May 12, 1937.

Water from the shallow well had a mineral content of 725, a total hardness of 438, and a content of iron of 1.0 parts per million as shown by the analysis of sample number 75817, collected March 21, 1935.

Analysis of Sample Number 81265 from Well 1865 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	1.7	Sodium Nitrate.....$NaNO_3$		1.7	0.10
(unfiltered).....	4.0	Sodium Chloride.....NaCl		758.1	44.40
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4		245.8	14.32
Silica.....SiO_2	8.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		5.3	0.31
Turbidity.....	32.0	Magnesium Sulfate.....$MgSO_4$		24.7	1.44
Calcium.....Ca	62.8	Magnesium Carbonate..$MgCO_3$		80.1	4.67
Magnesium..Mg	28.0	Calcium Carbonate.....$CaCO_3$		157.1	9.16
Ammonium..NH_4	1.4	Silica.....SiO_2		8.0	0.47
Sodium.....Na	378.2				
Sulfate.....SO_4	189.6	Total.....		1,280.8	74.87
Nitrate.....NO_3	1.3				
Chloride.....Cl	460.3				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	252.0				
Residue.....	1,298.0				
Total Hardness....	272.5				

Analysis of Sample Number 75817 from Well 52 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.0	Sodium Nitrate.....$NaNO_3$		1.7	0.10
(unfiltered).....	1.0	Sodium Chloride.....NaCl		49.7	2.90
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4		147.1	8.57
Silica.....SiO_2	9.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		1.3	0.08
Turbidity.....	10.0	Magnesium Sulfate.....$MgSO_4$		211.9	12.39
Calcium.....Ca	100.6	Magnesium Carbonate..$MgCO_3$		8.8	0.51
Magnesium..Mg	45.4	Calcium Carbonate.....$CaCO_3$		251.7	14.67
Ammonium..NH_4	0.3	Silica.....SiO_2		9.0	0.52
Sodium.....Na	67.6				
Sulfate.....SO_4	269.5	Total.....		681.2	39.74
Nitrate.....NO_3	1.5				
Chloride.....Cl	30.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	262.0				
Residue.....	725.0				
Total Hardness....	438.0				

WEST BROOKLYN (201) (p. 674). No change has been made in either the source of the public water supply or the pumping equipment.

WESTCHESTER (358). A public water supply distribution system was installed in 1927. Lake Michigan water is obtained from the city of Chicago.

WEST CHICAGO (3477) (p. 676). Well number 1, previously reported to be 775 feet deep, was measured in January, 1930 and found to be 885 feet deep.

Analysis of a sample of water from this well, collected November 22, 1930, showed the chemical quality to be similar to that reported on page 678.

Analysis of a sample of water, collected on the same date, from the well 322; feet deep showed the chemical quality of this water to have changed considerably. This analysis showed the water to have a total residue of 695, a total hardness of 542, and a content of iron of 3.2 parts per million.

Analysis of Sample Number 68025 from Well 322 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	3.2	Sodium Nitrate	$NaNO_3$	2.6	.15
Manganese	Mn	0.0	Sodium Chloride	NaCl	41.5	2.42
Silica	SiO_2	12.0	Ammonium Chloride	NH_4Cl	0.5	.03
Turbidity		40.0	Magnesium Chloride	$MgCl_2$	8.6	.50
Calcium	Ca	114.0	Magnesium Sulfate	$MgSO_4$	258.4	15.08
Magnesium	Mg	62.4	Magnesium Carbonate	$MgCO_3$	27.8	1.62
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	285.0	16.62
Sodium	Na	17.0	Iron Oxide	Fe_2O_3	4.6	.27
Sulfate	SO_4	206.3	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	1.8	Silica	SiO_2	12.0	.70
Chloride	Cl	32.0				
Alkalinity as $CaCO_3$			Total		641.0	37.39
Phenolphthalein		0.0				
Methyl Orange		318.0				
Residue		695.0				
Total Hardness		542.0				

In Woodland and East Woodland subdivisions, southeast of the city, is a distribution system installed by a real estate company. Water is obtained from a well, 6 inches in diameter and 137 feet deep, drilled in 1912 by John Diebold. In 1930 this well was reported to flow when the pump was not in operation. It was equipped with a centrifugal pump having a capacity of 125 gallons per minute.

Water from the well was similar in chemical quality to water from the 885-foot well of the city. Analysis of sample number 68013, collected from the 137-foot well on November 22, 1930 showed the water to have a total residue of 402, a total hardness of 372, and a content of iron of 8.0 parts per million.

The Chicago and Northwestern Eailroad has two wells. One of these was reported in 1919 as having an original depth of 2081 feet but that it was an old well. In 1930 this well was still in service and at that time the water had a total residue of 419, a total hardness of 380 and an iron content of 0.2 parts per million as shown by analysis of sample number 68015, collected November 22, 1930.

Analysis of Sample Number 68015 from Chicago and Northwestern Railroad Well 2081 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	.2	Sodium Nitrate.....$NaNO_3$	1.7	.10
Manganese..Mn	0.0	Sodium Chloride.....NaCl	6.4	.37
Silica.....SiO_2	14.0	Sodium Sulfate.....Na_2SO_4	4.3	.25
Turbidity.....	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$	1.3	.08
Calcium.....Ca	79.8	Magnesium Sulfate.....$MgSO_4$	93.9	5.48
Magnesium..Mg	44.0	Magnesium Carbonate..$MgCO_3$	86.5	5.05
Ammonium..NH_4	0.4	Calcium Carbonate.....$CaCO_3$	199.5	11.62
Sodium.....Na	4.4	Iron Oxide.....Fe_2O_3	0.3	.02
Sulfate.....SO_4	79.0	Manganese Oxide.....MnO	0.0	.00
Nitrate.....NO_3	1.2	Silica.....SiO_2	14.0	.82
Chloride.....Cl	4.0			
Alkalinity as $CaCO_3$		Total.....	407.9	23.79
Phenolphthalein..	0.0			
Methyl Orange...	302.0			
Residue.....	419.0			
Total Hardness....	380.0			

During 1932-1933 the railroad constructed a second well to a depth of 2282 feet terminating in the Mt. Simon sandstone.

WEST CITY (1091). West City purchases water from the city of Benton.

WEST DUNDEE (1697) (p. 678). No reported changes.

Analysis of sample number 76311, collected July 16, 1935, shows a total residue of 364, a total hardness of 330 parts per million and a trace of iron.

Analysis of Sample Number 76311 from Spring Owned by West Dundee.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.0	Sodium Nitrate.....$NaNO_3$	2.6	0.15
Manganese..Mn	0.0	Magnesium Nitrate.....$Mg(NO_3)_2$	14.8	0.86
Silica.....SiO_2	10.0	Magnesium Chloride....$MgCl_2$	3.8	0.22
Turbidity.....	0.0	Magnesium Sulfate.....$MgSO_4$	77.0	4.49
Color.....	0	Magnesium Carbonate..$MgCO_3$	62.0	3.63
Odor.....	0	Calcium Carbonate.....$CaCO_3$	178.6	10.42
Calcium.....Ca	71.4	Silica.....SiO_2	10.0	0.58
Magnesium..Mg	36.8			
Ammonium..NH_4		Total.....	348.8	20.35
Sodium.....Na	0.7			
Sulfate.....SO_4	61.7			
Nitrate.....NO_3	14.2			
Chloride.....Cl	3.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	252.0			
Residue.....	364.0			
Total Hardness....	330.0			

WESTERN SPRINGS (3894) (p. 681). Following the completion and placing in service of the 385-foot well at Wolf Eoad and the Chicago, Burlington and Quincy Eailroad tracks the use of the 2040-foot well in the southwest part of the village was discontinued.

In 1928 attempts were made to locate a site for a sand and gravel well capable of yielding 600 gallons per minute and having a water less highly mineralized than the water from the Wolf Eoad well.

These efforts were unsuccessful and in the latter part of 1930 Mr. Showalter of Wheaton completed a well to a depth of 312 feet at a site located at the northeast corner of Johnson Avenue and Hillgrove Avenue. The ground surface is at elevation 98 feet village datum.

The log taken from the driller's record is as follows:

	Thickness in feet.	Depth in feet.
Glacial drift	16	16
Shale, brown	2	18
Clay, yellow, some gravel	17	35
Limestone, soft	65	100
Blue clay	2	102
Limestone, soft	43	145
Limestone, harder, water dirty	10	155
Limestone	50	205
Limestone, water very milky	5	210
Limestone	38	248
Limestone, green	2	250
Limestone, brown	8	258
Limestone, white	9	267
Limestone, green	3	270
Limestone, white	15	285
Limestone, light brown	28	313

The well is cased with 15-inch pipe to top of limestone.

When both the Johnson Avenue and Wolf Eoad wells were not operating the water level in the Johnson Avenue well was 61.5 feet below the surface. On test a production of 500 gallons per minute with a draw down of 22.5 feet was obtained. The specific capacity of the well remained at 22 gallons per minute per foot of draw down for all rates of discharge between 200 gallons per minute and 500 gallons per minute.

When the Johnson Avenue well was not operating and the Wolf Eoad well was operating at a rate of 450 gallons per minute it was observed that the water level was lowered 5 feet in the Johnson Avenue well.

In September, 1927 when the Wolf Eoad well was not operating, water stood within 49 feet of the top and on January, 1931 water stood 58.5 feet from the top. The elevation of the ground surface or top of the well was 93.6 feet, village datum.

The water from the new Johnson Avenue well had a total residue of 1134, a total hardness of 907, and a content of iron of 5.0 parts per million as shown bv analvsis of sample number 70883, collected May 7, 1932.

Analysis of Sample Number 70883 from Johnson Avenue Well 312 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	5.0	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	19.9	1.16
Silica	SiO_2	9.0	Sodium Sulfate	Na_2SO_4	21.3	1.24
Turbidity		30.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	.04
Calcium	Ca	216.4	Magnesium Sulfate	$MgSO_4$	440.0	25.67
Magnesium	Mg	88.8	Calcium Sulfate	$CaSO_4$	193.2	11.28
Ammonium	NH_4	0.2	Calcium Carbonate	$CaCO_3$	400.3	23.34
Sodium	Na	14.9	Iron Oxide	Fe_2O_3	7.1	.41
Sulfate	SO_4	501.9	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.1	Silica	SiO_2	9.0	.52
Chloride	Cl	12.0				
Alkalinity as $CaCO_3$			Total		1,092.4	63.71
Phenolphthalein		0.0				
Methyl Orange		400.0				
Residue		1,134.0				
Total Hardness		907.0				

A water softening and iron removal plant was completed and placed in operation during the early part of 1932.

WESTPIELD (646) (p. 685). The well 158 feet deep in rock described on page 685 is not used now and water is obtained from the dug well at the north edge of the village in the valley of Mill Creek.

A slight reduction in the quantity of water takes place yearly. The water contains objectionable amounts of iron and consequently drinking water is obtained from private wells.

WEST FRANKFORT (14,683) (p. 680 and 710). The raw water supply of the city of West Prankfort is obtained from an impounding reservoir on Tilley Creek. The water is treated before entering the distribution system.

WESTMONT (2733). Westmont is located in the southeastern part of DuPage County on the drainage area of East Pork of DuPage River, a tributary of Des Plaines River. A public water supply was installed in 1921 by the A. T. Mcintosh Company.

Water was obtained from a well 890 feet deep, drilled in 1921. The well was eased with 8-inch steel pipe to rock at a depth of 152 feet, and with 6-inch steel pipe from 152 to 512 feet. The water level was at a depth of 140 feet when not pumping and the rate of pumping was about 60 gallons per minute. The well was equipped with an air-lift.

The temperature of the water was 51° F. The water had a total residue of 627, a total hardness of 454, and a content of iron of 1.6 parts per million as shown by the analysis of sample number 53074, collected January 13, 1925.

In 1926 a new well was drilled on Cass Avenue about one-quarter of a mile north of the Chicago, Burlington and Quincy Railroad. The well was drilled by Layne and Bowler to a depth of 316 feet. It was cased with 14-inch pipe to an unrecorded depth. It was equipped with a Layne deep-well turbine pump. The rate of pumping was slightly

more than 600 gallons per minute. Layne and Bowler owned the well and water was purchased by the village.

The temperature of the water was 52° F. The water had a total residue of 639, a total hardness of 494, and a content of iron of 2.8 parts per million as shown by the analysis of sample number 58489, collected March 1, 1927.

In 1935 a new well was drilled for the village by Smyth and Weinstein of Chicago. It is located at the northwest corner of the intersection of Wilmette and 55th Streets and is 302 feet deep. It was originally cased with 17-inch pipe to a depth of 162½ feet, but yielded only 35 gallons per minute. The yield was greatly increased by slotting the casing between depths of 145 and 160 feet. Below the casing the diameter of the well is 16 inches. The water level was at a depth of 121½ feet when not pumping and was lowered 28 feet by a pumping rate of 320 gallons per minute.

The well is equipped with a 9-stage American deep-well turbine pump rated at 250 gallons per minute and driven by a 25-horsepower electric motor. The top of the bowls is placed at a depth of 160 feet, and the bottom of the 30-foot suction pipe is at a depth of 190½ feet.

The temperature of the water was 52° F. The water had a total residue of 640, a total hardness of 503.5, and a content of iron of 0.8 parts per million as shown by the analysis of sample number 78401, collected July 15, 1936.

Analysis of Sample Number 78401 from Well 302 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe					
(filtered).....	0.5	Sodium Nitrate.....	$NaNO_3$	3.4	0.20
(unfiltered).....	0.8	Sodium Chloride.....	NaCl	9.9	0.58
Manganese..Mn	0.0	Sodium Sulfate.....	Na_2SO_4	77.4	4.52
Silica.....SiO_2	13.0	Ammonium Sulfate.....	$(NH_4)_2SO_4$	2.0	0.12
Turbidity.....	10.0	Magnesium Sulfate.....	$MgSO_4$	158.3	9.23
Calcium.....Ca	141.7	Magnesium Carbonate..	$MgCO_3$	14.8	0.86
Magnesium..Mg	36.2	Calcium Carbonate.....	$CaCO_3$	354.5	20.68
Ammonium..NH_4	0.6	Ferric Oxide.....	Fe_2O_3	0.7	0.04
Sodium.....Na	29.9	Silica.....	SiO_2	13.0	0.76
Sulfate.....SO_4	180.4				
Nitrate.....NO_3	2.2	Total.....		634.0	36.99
Chloride.....Cl	6.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	372.0				
Residue.....	640.0				
Total Hardness....	503.5				

WESTVILLE (3901). Westville is located in the south central part of Vermilion County on the drainage area of Vermilion Biver, a tributary of Wabash Biver. A public water supply system was installed by the village in 1932.

All water for the public supply is filtered lake water purchased from the Interstate Water Company at Danville.

WHEATON (7258) (p. 686). The water works plant remained as previously described until 1927 when a new surface storage reservoir of 250,000-gallon capacity was constructed.

During the winter of 1929-1930 a new well was drilled by Thorpe Brothers Well Company on a site south of the Chicago, Burlington and Quincy Eailroad and not far from the county courthouse. A 38-inch steel casing extends from 3 feet below the ground surface to a depth of about 55 feet. The top of this easing is embedded in the concrete pump foundation while the bottom overlaps a 24-inch casing that is part of a screen assembly. A 24-inch casing extends between depths of 47 feet and 57 feet, a 24-inch metal screen (gravel packed) between 57 feet and 81 feet, and 24-inch blank pipe between 81 feet and 89 feet. A 20-inch casing extends between a depth of 84 feet and 113.5 feet, the lower end being seated in the top of the limestone. The annular space between the 20-inch and 24-inch pipes between depths of 84 feet and 89 feet was sealed with concrete. Below the bottom of the 20-inch casing the hole was 16 inches in diameter to a depth of 167 feet and 12 inches in diameter from this depth to the bottom at 184 feet. The screen was placed in a zone of water-bearing sand, gravel, and boulders. Limestone was found at a depth of 113 feet and shale at the depth of 180 feet.

The well was equipped with a Peerless deep-well turbine pump consisting of 113 feet of column, 6 feet of bowls and 10 feet of suction pipe.

On test the well gave a maximum production of 1040 gallons per minute with a draw down of about 82.5 feet from a static water level of about 32 feet.

The water is discharged directly into the distribution system. The water had a total residue of 358, a total hardness of 302, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 68158, collected December 8, 1930.

Analysis of Sample Number 68158 from 184-Foot Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	.2	Sodium Nitrate	$NaNO_3$	0.9	.05
Manganese	Mn	0.0	Sodium Chloride	NaCl	1.8	.10
Silica	SiO_2	16.0	Sodium Sulfate	Na_2SO_4	40.5	2.36
Turbidity		5.0	Ammonium Sulfate	$(NH_4)_2SO_4$	2.0	.12
Calcium	Ca	63.1	Magnesium Sulfate	$MgSO_4$	31.3	1.83
Magnesium	Mg	35.2	Magnesium Carbonate	$MgCO_3$	100.0	5.83
Ammonium	NH_4	0.5	Calcium Carbonate	$CaCO_3$	157.5	9.18
Sodium	Na	14.0	Iron Oxide	Fe_2O_3	0.3	.02
Sulfate	SO_4	53.7	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.9	Silica	SiO_2	16.0	.93
Chloride	Cl	1.0				
Alkalinity as $CaCO_3$			Total		350.3	20.42
Phenolphthalein		0.0				
Methyl Orange		276.0				
Residue		358.0				
Total Hardness		302.0				

WHEELING (467). Wheeling is located in the northern part of Cook County on the west bank of Des Plaines River. A public water supply was installed in 1926.

Water is secured from a well, 200 feet deep, located near the intersection of Milwaukee and Center Avenues. It was drilled by E. M. Gray, Jr. in 1926. It is cased to a depth of 108 feet with 12-inch wrought iron pipe. Below the casing the diameter is 10 inches. A record of material penetrated is as follows:

	Thickness in feet.	Depth in feet.
Drift	60	60
Dolomite	140	200

Elevation of the ground surface is about 647 feet above sea level.

The water level was at a depth of 15 feet when not pumping and was lowered 20 feet by a pumping rate of 150 gallons per minute.

The well is equipped with a two-stroke deep-well pump with a 6¾-inch cylinder and 15-inch stroke. An elevated steel tank located on the same lot as the pumping station is connected to the mains.

Water from this well had a total residue of 350, a total hardness of 157, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 62541, collected September 10, 1928.

Analysis of Sample Number 62541 from Village Well, 200 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.2	Potassium Nitrate	KNO_3	0.9	.05
Manganese	Mn	0.0	Potassium Chloride	KCl	7.2	.42
Turbidity		0.0	Sodium Chloride	NaCl	8.1	.47
Silica	SiO_2	17.4	Sodium Sulfate	Na_2SO_4	164.4	9.61
Nonvolatile		0.6	Sodium Carbonate	Na_2CO_3	33.8	1.98
Alumina	Al_2O_3	0.6	Ammonium Carbonate	$(NH_4)_2CO_3$	0.7	.04
Calcium	Ca	25.1	Magnesium Carbonate	$MgCO_3$	76.4	4.47
Magnesium	Mg	23.0	Calcium Carbonate	$CaCO_3$	60.0	3.51
Ammonium	NH_4	0.3	Silica	SiO_2	17.4	1.01
Potassium	K	4.3	Iron Oxide	Fe_2O_3	0.3	.02
Sodium	Na	74.1	Alumina	Al_2O_3	0.6	.03
Sulfate	SO_4	106.8	Manganese Oxide	MnO	0.0	.00
Nitrate	NO_3	0.5	Nonvolatile		0.6	.03
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$			Total		370.4	21.64
Phenolphthalein						
Methyl Orange		176.0				
Residue		350.0				
Total Hardness		157.0				

WHITE HALL (2928) (p. 710). The raw water supply of the city of White Hall is obtained from an impounding reservoir on Wolf Run Creek. The water is treated before entering the distribution system.

WILLIAMSVILLE (661). Williamsville is located in the northern part of Sangamon County on the drainage area of Sangamon River, a tributary of Illinois River. Many shallow private wells have been used in the past. A public water supply was installed by the village in 1936.

In the process of locating a suitable site for a finished well, more than a score of test wells were drilled in 1933 and 1935. The permanent

well was finally drilled near the site of test well number 13. It is 30 feet deep, of the gravel-walled type, and has an 8-foot length of 12-inch, number 187-slot, Cook wire-wound screen. The diameter of inner and outer casings are 12 and 26 inches, respectively. The well was drilled in 1935 by L. E. Burt of Elwin, and is located about ¾ mile east of the village.

The water level was at a depth of 12½ feet when not pumping and was lowered 9 feet by a pumping rate of 52 gallons per minute.

The well is equipped with a 10-stage Fairbanks-Morse turbine pump having 24 feet of 4-inch column pipe and driven by a 7½-horsepower electric motor. The pump discharges approximately 40 gallons per minute against a pressure of 60 pounds.

Water is pumped from the well to the distribution system in the village. An elevated steel tank, located in the business district, is connected to the mains. There are between 70 and 80 service connections. The average daily pumpage is about 7500 gallons.

The water had a total residue of 432, a total hardness of 228, and a content of iron of 0.64 parts per million as shown by the analysis of sample number 82870, collected February 2, 1938.

Analysis of Sample Number 82870 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		1.7	0.10
(filtered).....	0.04	Sodium Chloride.....NaCl		6.4	0.37
(unfiltered).....	0.64	Sodium Sulfate.....Na_2SO_4		56.8	3.31
Manganese..Mn	0.00	Magnesium Sulfate.....$MgSO_4$		48.2	2.81
Silica.....SiO_2	16.9	Magnesium Carbonate..$MgCO_3$		78.5	4.58
Turbidity.....	4.0	Calcium Carbonate.....$CaCO_3$		205.0	11.95
Color.....	0.0	Iron Oxide.....Fe_2O_3		0.1	0.01
Odor.....	M1				
Calcium.....Ca	82.0	Total.....		413.6	24.12
Magnesium..Mg	32.4				
Ammonium..NH_4	trace				
Sodium.....Na	21.4				
Sulfate.....SO_4	77.0				
Nitrate.....NO_3	1.1				
Chloride.....Cl	4.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	297.8				
Residue.....	432.0				
Total Hardness....	228.0				

WILMETTE (15,233). Wilmette obtains its water supply from Lake Michigan. The water is filtered.

WILMINGTON (1741) (p. 688). A new well, number 2, was drilled in 1936 by C. W. Varner of Dubuque, Iowa at a site about 75 feet north of the old well. It is 1566 feet deep and 10 inches in diameter at the bottom. It is cased with 12½-inch pipe to a depth of 23 feet, and with 10-inch pipe from the surface to a depth of 218 feet.

A record of material penetrated, with classifications by the State Geological Survey Division, is as follows:

	Thickness in feet.	Depth in feet.
Drift	20	20
Limestone shale, Maquoketa	127	147
Limestone, Galena	183	330
Dolomite, Decorah, Platteville	175	505
Sandstone, Glenwood	20	525
Sandstone, St. Peter	155	680
Dolomite, Ordovician	280	960
Dolomite, Cambrian	304	1264
Sandstone, dolomite, Franconia	136	1400
Sandstone, Galesville	166	1566

The water level was at a depth of 59 feet when not pumping and was lowered 6½ feet by a pumping rate of 485 gallons per minute.

The well is equipped with a 7-stage, 10-inch Peerless turbine pump having 100 feet of 7-inch column pipe and 35 feet of suction pipe. The pump is driven by a 40-horsepower electric motor and discharges directly to the distribution system. The pumping rate indicated by the flow meter is 560 gallons per minute.

The use of well number 1 and the old concrete reservoir has been discontinued. Pumping costs are now only one-third of the former costs. There are 417 service connections and the average daily pumpage is about 85,000 gallons.

Water from well number 2 had a total residue of 1161, a total hardness of 428, and a content of iron of 1.06 parts per million, as shown by the analysis of sample number 83455, collected May 3, 1938.

Analysis of Sample Number 83455 from Well Number 2.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron....Fe		Sodium Nitrate	$NaNO_3$	0.7	0.04
(filtered)	0.12	Sodium Chloride	NaCl	460.0	26.82
(unfiltered)	1.06	Sodium Sulfate	Na_2SO_4	201.0	11.72
Manganese..Mn	0.0	Magnesium Sulfate	$MgSO_4$	196.5	11.46
Silica....SiO_2	10.0	Calcium Sulfate	$CaSO_4$	28.6	1.67
Turbidity	8.0	Calcium Carbonate	$CaCO_3$	245.0	14.28
Color	0.0	Iron Oxide	Fe_2O_3	0.2	0.01
Odor	0.0	Silica	SiO_2	10.0	0.58
Calcium....Ca	106.0				
Magnesium..Mg	39.6	Total		1,142.0	66.58
Ammonium..NH_4	trace				
Sodium....Na	247.5				
Sulfate....SO_4	312.0				
Nitrate....NO_3	5.1				
Chloride....Cl	279.0				
Alkalinity as $CaCO_3$					
Phenolphthalein	0.0				
Methyl Orange	244.0				
Residue	1,161.0				
Total Hardness	428.0				

WINCHESTER (1532) (p. 689). A third well was drilled in 1923 by C. P. Hudson of Jacksonville. It is 60 feet deep and 8 inches in diameter and is equipped with 24 feet of screen. The three wells are located in a line about 100 feet apart and east of Big Sandy Creek.

The well drilled in 1923 is nearest the creek and is equipped with a 4-stage, 8-inch American deep-well turbine pump having 20 feet of 5-inch column pipe and no suction pipe. The pump is direct-connected to a 5-horsepower electric motor.

Each of the other wells is equipped with a 4-stage, 8-inch American deep-well turbine pump having 40 feet of 5-inch column pipe and 10 feet of 5-inch suction pipe. Bach pump is direct-connected to a 5-horsepower electric motor.

Water is pumped from the wells to a treatment plant in the southern part of the city. Here the water is softened with lime and alum, recarbonated, and filtered through rapid-sand filters before being pumped to the distribution system. An elevated steel tank, located near the treatment plant, is connected to the mains. Either of two service pumps can be used. Each is an American centrifugal pump rated at 150 gallons per minute against a head of 125 feet, and is driven by a 10-horsepower electric motor.

Water from the well drilled in 1923 had a total residue of 455, a total hardness of 363.5, and a content of iron of 10 parts per million as shown by the partial analysis of sample number 82359, collected November 13, 1937.

WINDSOR (927). Windsor is located in the northeastern part of Shelby County on the drainage area of Kaskaskia River, a tributary of Illinois River. A public water supply was installed by the city in 1935.

An extensive search for an adequate supply of ground water was made. It included collecting logs of existing wells, making an electrical earth resistivity survey, and drilling a number of test wells in and near the city. The data acquired by this search indicated the existence of a northeast-southeast buried pre-glacial valley south of the city. The finished well was drilled at the site of test well number 6 about one mile south of the city limits. It was drilled in 1935 by W. L. Thorne Company of Des Plaines. It is 101 feet deep, of the gravel-walled type, and has a 12-foot length of 12-inch screen with 3/16-inch slots. The diameters of the inner and outer casings are 12 and 26 inches, respectively.

The water level was at a depth of 63½ feet when not pumping and was lowered to a point between depths of 92½ and 99 feet by a pumping rate of 100 gallons per minute.

The well is equipped with a 10-stage, 7-inch, Fairbanks-Morse turbine pump driven by an electric motor. The top of the bowls is at a depth of 89½ feet and the bottom of the 3½ foot suction pipe is at a depth of 99 feet.

The water contains a large amount of inflammable gas, probably methane. The well casing is vented and the amount of gas which enters the pump suction pipe is not enough to cause any noticeable interference with the operation of the pump.

The water from the 110-foot well at the high school has been shown to have 11.0 cubic feet of gas per 1000 gallons. Methane constituted 91 percent of this gas.

Samples of water from test well number 6 and the permanent well were of similar quality. The water from test well number 6 had a total

residue of 569, a total hardness of 306, and a content of iron of 4.0 parts per million as shown by the analysis of sample number 75696, collected February 20, 1935.

Analysis of Sample Number 75696 from Test Well Number 6.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		0.8	0.05
(filtered).....	0.6	Sodium Chloride.....NaCl		6.4	0.37
(unfiltered).....	4.0	Sodium Carbonate.....Na_2CO_3		245.0	14.28
Manganese..Mn	0.0	Ammonium Carbonate..$(NH_4)_2CO_3$		22.1	1.29
Silica.....SiO_2	10.0	Magnesium Carbonate..$MgCO_3$		118.5	6.91
Turbidity.....	30.0	Calcium Carbonate.....$CaCO_3$		165.7	9.66
Calcium.....Ca	66.2	Iron Oxide.....Fe_2O_3		0.9	0.05
Magnesium..Mg	34.2	Silica.....SiO_2		10.0	0.58
Ammonium..NH_4	8.2				
Sodium.....Na	109.0	Total.....		569.4	33.19
Sulfate.....SO_4	0.0				
Nitrate.....NO_3	0.9				
Chloride.....Cl	4.0	Color 6.0			
Alkalinity as $CaCO_3$		Odor 2 H_2S			
Phenolphthalein..	0.0				
Methyl Orange...	560.0				
Residue.....	569.0				
Total Hardness....	306.0				

WINFIELD (445). A public water supply system was installed in 1927 when an 8-inch well 200 feet deep was drilled. The well is equipped with a direct suction pump which discharges into a 9-foot by 40-foot cylindrical pressure tank. There are 70 customers.

The water had a total residue of 669, a total hardness of 569, and a content of iron of 0.8 parts per million as shown by the analysis of sample number 80229, collected January 25, 1934.

Analysis of Sample Number 80229 from Village Well.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$		1.7	.10
(filtered).....	0.0	Sodium Chloride.....NaCl		8.2	.48
(unfiltered).....	0.8	Sodium Sulfate.....Na_2SO_4		4.3	.25
Manganese..Mn	0.0	Ammonium Sulfate.....$(NH_4)_2SO_4$		.7	.04
Silica.....SiO_2	10.0	Magnesium Sulfate.....$MgSO_4$		322.0	18.78
Turbidity.....	5.0	Calcium Sulfate.....$CaSO_4$		13.6	.79
Calcium.....Ca	120.7	Calcium Carbonate.....$CaCO_3$		292.2	17.07
Magnesium..Mg	65.0	Silica.....SiO_2		10.0	.58
Ammonium..NH_4	.2				
Sodium.....Na	5.3	Total.....		652.7	38.09
Sulfate.....SO_4	269.1				
Nitrate.....NO_3	1.3				
Chloride.....Cl	5.0				
Alkalinity as $CaCO_3$					
Phenolphthalein..	0.0				
Methyl Orange...	292.0				
Residue.....	669.0				
Total Hardness....	569.0				

WINNETKA (12,166). Winnetka obtains its water supply from Lake Michigan. The water is filtered.

WINSLOW (359) (p.. 693). The well described on page 693 continued to supply water to the village of Winslow until the end of 1927 when a new well, completed in November of that year by P. B. Millis was put into operation. This well, 355 feet deep, is located outside of the pumping station. It is 16 inches in diameter to a depth of 100 feet, 12 inches between 100 feet and 288 feet, and 10 inches to the bottom. A record of material penetrated, with classifications by the State Geological Survey, is as follows:

	Thickness in feet.	Depth in feet.
Galena-Platteville	95	95
St. Peter	148	243
Prairie du Chien	112	355

The driller reported four crevices at the bottom of the well. These were from 1 to 2½ feet deep and were separated by ledges one foot thick. When these crevices were struck the water flowed over the top of the casing. The rate of flow was estimated to be more than 1000 gallons per minute. It was measured in 1935 and found to be 420 gallons per minute. Static level was then approximately nine feet above the ground surface.

The old well has been capped and abandoned and the old triplex pump is connected to the new well. It pumps at a rate of 200 gallons per minute about two hours daily.

The temperature of the water was 51½° F. The water had a total residue of 312, a total hardness of 296.5, and a content of iron of 0.2 parts per million as shown by the analysis of sample number 80200, collected January 17, 1934.

Analysis of Sample Number 80200 from Village Well 355 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.2	Sodium Chloride.....NaCl	1.8	0.10
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	16.3	0.95
Silica.....SiO_2	12.0	Sodium Carbonate.....Na_2CO_3	3.7	0.22
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	125.3	7.31
Calcium.....Ca	59.3	Calcium Carbonate.....$CaCO_3$	148.0	8.62
Magnesium..Mg	36.1	Iron Oxide.....Fe_2O_4	0.3	0.02
Ammonium..NH_4	0.0	Silica.....SiO_2	12.0	0.70
Sodium.....Na	7.6			
Sulfate.....SO_4	10.9	Total.....	307.4	17.92
Nitrate.....NO_3	trace			
Chloride.....Cl	1.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	300.0			
Residue.....	312.0			
Total Hardness....	296.5			

WINTHROP HARBOR (661) (p. 694). The 159-foot well in use in 1922 is now used only during the summer months. In 1926 a well 957 feet deep was drilled by W. L. Thorne Company of Des Plaines. It is located at the highest point in the village about 50 feet south of the old well. The elevation of the ground surface is about 650 feet above sea level. The well is cased with 12-inch pipe to a depth of 153 feet

and with 10-inch pipe from 278 to 632 feet. Below 632 feet **the** diameter is 10 inches. The St. Peter Sandstone was reported to be only 15 or 20 feet thick and to be so tight and hard as to contain little water. The static water level was reported to have dropped from 33 to 40 feet when drilling in the St. Peter. A report by the driller states that the water level was lowered from 39 to 225 feet by a pumping rate of 75 gallons per minute.

The well is equipped with a Keystone two-stroke deep-well pump with a 7¾-inch diameter cylinder and, 18-inch stroke. The cylinder is set a depth of 250 feet. In 1927 the well was pumped at a rate of 110 gallons per minute.

The water had a total residue of 264, a total hardness of 113, and a content of iron of 0.06 parts per million as shown by the analysis of sample number 83845, collected July 15, 1938.

Analysis of Sample Number 83845 from City Well 957 Feet Deep.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	2.6	0.15
(filtered)		0.00	Sodium Chloride	NaCl	9.3	0.54
(unfiltered)		0.06	Sodium Sulfate	Na_2SO_4	88.1	5.14
Manganese	Mn	0.00	Sodium Carbonate	Na_2CO_3	45.0	2.62
Silica	SiO_2	15.0	Ammonium Carbonate	$(NH_4)_2CO_3$	0.5	0.03
Turbidity		4	Magnesium Carbonate	$MgCO_3$	44.7	2.61
Color		0	Calcium Carbonate	$CaCO_3$	60.0	3.50
Odor		0	Silica	SiO_2	15.0	0.87
Calcium	Ca	23.9				
Ammonium	NH_4	0.1	Total		265.2	15.46
Sodium	Na	52.5				
Magnesium	Mg	12.9				
Sulfate	SO_4	60.2				
Nitrate	NO_3	1.6				
Chloride	Cl	6.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		156.0				
Residue		264.0				
Total Hardness		113.0				

WITT (1561) (p. 695). No reported change.

Analysis of sample number 82501, collected from the distribution system December 3, 1937 showed little change in the quality of water.

Analysis of Sample Number 82501 from Distribution System.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe		Sodium Nitrate.....$NaNO_3$	1.7	0.10
(filtered).....	0.0	Sodium Chloride.....NaCl	38.0	2.22
(unfiltered).....	0.4	Sodium Sulfate.....Na_2SO_4	97.8	5.70
Manganese..Mn	0.0	Sodium Carbonate.....Na_2CO_3	13.2	0.77
Silica.....SiO_2	17.0	Magnesium Carbonate..$MgCO_3$	90.0	5.25
Turbidity.....	15.0	Calcium Carbonate.....$CaCO_3$	186.5	10.90
Color.....	10	Silica.....SiO_2	17.0	0.99
Odor.....	E1			
Calcium.....Ca	74.6	Total.....	444.2	25.93
Magnesium..Mg	26.0			
Ammonium..NH_4	0.1			
Sodium.....Na	53.0			
Sulfate.....SO_4	66.5			
Nitrate.....NO_3	1.6			
Chloride.....Cl	23.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	306.0			
Residue.....	455.0			
Total Hardness....	293.5			

WOODHULL (567) (p. 698). In 1938 water for the public supply was obtained from two wells. The well, reservoir, and pumping equipment described on page 698 were still in use. The second well was drilled in 1925 by the J. P. Miller Artesian Well Company of Chicago. It is located 33 feet north of the old well and is 1369 feet deep. It is cased with 10-inch pipe to a depth of 159½ feet and with 8-inch pipe from 156½ to 609 feet. Below the 8-inch casing the open hole is 8 inches in diameter to the bottom of the well. In 1926 the water level was reported to be at a depth of 248 feet when the pump was not in operation.

A record of material penetrated is similar to that given on page 698. A layer of coal was reported between depths of 260 and 263 feet.

The 1369-foot well is equipped with an American two-stroke pump with a 5¾-inch diameter[1] cylinder attached to 307 feet of 6-inch drop pipe. There is no suction pipe below the cylinder. The pump operates with a 24-inch stroke at the rate of 22 strokes per minute and is belt-driven by an electric motor. This pump discharges to the reservoir.

The temperature of the water from the 1369-foot well was 62° F. in 1926. The chemical quality of the water was similar to that of water from the 1394-foot well as shown on page 699.

WOODLAND (304). Woodland is located in the central part of Iroquois County on the drainage area of Iroquois River, a tributary of Kankakee River.

Water for the public supply, installed by the village about the year 1904, is obtained from a well near the center of the village. The exact depth of the well is not known but is thought to be 130 feet. The diameter is 6 inches. Water is obtained from a deposit of sand in the glacial drift.

The well is equipped with a triplex pump, belt-driven by a 10-horsepower electric motor, which draws water by direct suction from the well and discharges it into a steel pressure tank 36 feet long and 8 feet in diameter, located in the same building with the well and pump.

Water from the well had a total residue of 490, a total hardness of 372, and a content of iron of 0.3 parts per million as shown by the analysis of sample number 82393, collected November 17, 1937.

Analysis of Sample Number 82393 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	30.6	1.78
(filtered)		trace	Sodium Chloride	NaCl	14.7	.86
(unfiltered)		0.3	Sodium Sulfate	Na_2SO_4	22.0	1.28
Manganese	Mn	0.0	Sodium Carbonate	Na_2CO_3	50.9	2.97
Silica	SiO_2	12.0	Magnesium Carbonate	$MgCO_3$	129.0	7.52
Turbidity		2.0	Calcium Carbonate	$CaCO_3$	219.5	12.80
Color		0.0	Silica	SiO_2	12.0	.70
Odor		0.0				
Calcium	Ca	87.6	Total		478.7	27.91
Magnesium	Mg	37.2				
Ammonium	NH_4	trace				
Sodium	Na	43.2				
Sulfate	SO_4	14.8				
Nitrate	NO_3	22.1				
Chloride	Cl	9.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		420.0				
Residue		490.0				
Total Hardness		372.0				

WOOD RIVER (8136) (p. 696). In 1930 the city discontinued the practice of buying water from the Standard Oil Company. Two wells were constructed in that year near the intersection of 14th Street and Madison Avenue in the extreme eastern part of the city. They were constructed by the Thorpe Concrete Well Company and are equipped with porous concrete screens 26 inches inside diameter. Well number 1 is 106½ feet deep. Well number 2 is 105 feet deep, but was abandoned in 1937 when two new wells were put into service.

Wells numbers 3 and 4, constructed by the Thorpe Company, are located a short distance southeast of the old wells and are 150 feet apart. They are alike in construction, each being 113½ feet deep and having 73½ feet of porous concrete screen. Inside diameter of the screens is 26 inches and outside diameter is 36 inches. Each well is equipped with a 6-stage Pomona turbine pump rated at 500 gallons per minute driven by a 40-horsepower electric motor. The water level was at a depth of 40 feet when not pumping.

Water from well number 3 had a. total residue of 327, a total hardness of 285, and a content of iron of 0.3 parts per million as shown by the analysis of sample number .81507, collected June 23, 1937. Water from the other wells was of similar quality.

Analysis of Sample Number 81507 from City Well Number 3.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe (filtered).....	0.2	Sodium Nitrate.....$NaNO_3$	2.5	0.15
(unfiltered).....	0.3	Sodium Chloride.....NaCl	3.5	0.20
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	1.4	0.08
Silica.....SiO_2	16.0	Magnesium Sulfate.....$MgSO_4$	75.8	4.42
Turbidity.....	0.0	Magnesium Carbonate..$MgCO_3$	32.9	1.92
Calcium.....Ca	73.2	Calcium Carbonate.....$CaCO_3$	183.0	10.67
Magnesium..Mg	24.8	Silica.....SiO_2	16.0	0.93
Sodium.....Na	2.5			
Sulfate.....SO_4	61.2	Total.....	315.1	18.37
Nitrate.....NO_3	1.6			
Chloride.....Cl	2.0			
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0			
Methyl Orange...	222.0			
Residue.....	327.0			
Total Hardness....	285.0			

WOODSTOCK (5471) (p. 699). The source of the public water supply is the same as previously described. The pumping equipment both on the wells and for domestic pressure remains the same, except during the latter part of 1927 a new Allis-Chalmers centrifugal pump powered by a 100-horsepower electric motor was installed to help carry the domestic consumption load. This pump had a rating of 750 gallons per minute against 100 pounds pressure.

In 1934 an iron removal and water softening plant was constructed.

The Oakside Dairy located in the east part of the city has a 5-inch well 80 feet deep from which water is pumped at a rate of 22 gallons per minute from a static water level of 30 feet by a Pomona 4-inch deep-well turbine pump. This pump is powered by a 5-horsepower motor operating at a speed of 36 revolutions per minute. At this rate of production of 22 gallons per minute the draw down is 45 feet. The water is hard and high in iron.

The Alemite Die Casting Company occupying the plant of the Oliver Typewriter Company has a well from which water is obtained for practically all purposes, but principally for boiler and air cooling purposes. The well is equipped with a Cook double-acting deep-well cylinder pump having a cylinder 9 inches in diameter by an 18-inch stroke. The cylinder is set at 165 feet and the pump operates at 24 strokes per minute.

The R. O. Andrews Ice and Seed Company has a 12-inch well 227 feet deep equipped with a 3-stage, 10-inch Layne deep-well turbine pump set at 90 feet below pump-room floor. The pump is rated at 334 gallons per minute when operating at a speed of 1760 revolutions per minute.

The Borden-Wieland Milk Company has abandoned its wells and takes water from the city as also does the Woodstock Typewriter Company.

WYANET (859) (p. 702). No reported change.

The pump operates about 5 hours per day and it is reported that it produces at a rate of about 130 gallons per minute. There are now 130 service connections.

The water has a total residue of 392, a total hardness of 358, and a content of iron of 0.08 parts per million as shown by the partial analysis of sample number 83694, collected June 6, 1938.

WYOMING (1408) (p. 704). There has been no change in the source of water for the public supply, or in the chemical quality of the water, but new pumping equipment has been installed.

In 1930 the deep-well pump was replaced by an 8-stage, 6-inch Pomona turbine pump having 160 feet of 6-inch column pipe. This pump is operated about 8 hours daily. In 1922 a 4-inch Fairbanks-Morse centrifugal pump rated at 500 gallons per minute replaced the old triplex service pump. Both of the new pumps are belt-driven by a 50-horsepower Diesel engine installed in 1922.

In 1938 the static water level was about 130 feet below the surface. There were 350 service connections and the average daily pumpage was 60,000 gallons.

YOEKVILLE (492) (p. 705). All water for the public supply is now obtained from the well described on page 706. The well no longer flows and the springs are not used.

The well is equipped with a 13-stage, 6-inch Fairbanks-Morse turbine pump having 130 feet of 4-inch column pipe and no suction pipe. The pump discharges about 160 gallons per minute to the reservoir described on page 705 and is driven by a 7½-horsepower electric motor.

Water is pumped from the reservoir to the distribution system by either of two American 2-stage centrifugal pumps. One pump is driven by a 10-horsepower electric motor and is used most. The other pump is driven by a gasoline engine and is used only in case of emergency. Either pump will deliver about 250 gallons per minute.

Water from the well had a total residue of 355.0, a total hardness of 335.5 parts per million and a trace of iron as shown by the analysis of sample number 84144, collected August 18, 1938.

Analysis of Sample Number 84144 from Village Well.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe		Sodium Nitrate	$NaNO_3$	3.4	0.20
(filtered)		trace	Sodium Chloride	NaCl	2.9	0.17
(unfiltered)		trace	Ammonium Nitrate	NH_4NO_3	0.5	0.03
Manganese	Mn	0.0	Magnesium Chloride	$MgCl_2$	8.1	0.47
Silica	SiO_2	15.0	Magnesium Sulfate	$MgSO_4$	44.5	2.59
Turbidity		3	Magnesium Carbonate	$MgCO_3$	108.8	6.34
Color		0	Calcium Carbonate	$CaCO_3$	161.0	9.39
Odor		0	Silica	SiO_2	15.0	0.87
Calcium	Ca	64.5				
Magnesium	Mg	42.4	Total		344.2	20.06
Ammonium	NH_4	0.1				
Sodium	Na	2.1				
Sulfate	SO_4	35.4				
Nitrate	NO_3	2.6				
Chloride	Cl	8.0				
Alkalinity as $CaCO_3$						
Phenolphthalein		0.0				
Methyl Orange		290.0				
Residue		355.0				
Total Hardness		335.5				

ZEIGLER (3816) (p. 710). The raw water supply of the city of Zeigler is obtained from Big Muddy River. The water is treated before entering the distribution system.

ZION (5991). Zion is located in the northeastern part of Lake County about one mile west of Lake Michigan. For many years private wells supplied all the water for the residents of the city. These wells varied from wells terminating in sand and gravel beds in the drift to wells terminating in limestone at depths of 200 feet or more. Many private wells are still in regular service. In some instances several homes are served by a private water system supplied by one well.

In 1901 and 1902 P. M. Gray of Milwaukee drilled three deep wells. One of these is about 500 feet south of the center of Shiloh Boulevard in the southeast part of Shiloh Park. The ground elevation at the well is about 648 feet above sea level. The well is reported to be 1568 feet deep and eased with 6-inch casing to rock at a depth of 113 feet. St. Peter sandstone was reported between 850 feet and 1040 feet and Dresbach sandstone between 1160 feet and 1285 feet. Mt. Simon sandstone was entered at 1,535 feet according to a log of the well. Water overflowed the well top when the St. Peter sandstone was pierced. An overflow continued for a number of years but by 1922 it had ceased to flow at the surface.

The water from the well had a total residue of 680, a total hardness of 420, and an iron content of 0.4 parts per million as shown by an analysis of sample number 64617 collected July 31, 1929.

The water from this well was not used as the public supply.

Analysis of Sample Number 64617 from Shiloh Park Well 1568 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.	Pts. per million.	Grs. per gallon.
Iron.....Fe	0.4	Sodium Chloride.....NaCl	21.4	1.25
Manganese..Mn	0.0	Sodium Sulfate.....Na_2SO_4	110.6	6.45
Silica.....SiO_2	12.0	Magnesium Sulfate.....$MgSO_4$	101.5	5.92
Calcium.....Ca	134.4	Calcium Sulfate.....$CaSO_4$	115.9	6.74
Magnesium..Mg	20.5	Calcium Carbonate.....$CaCO_3$	250.1	14.59
Sodium.....Na	44.7	Silica.....SiO_2	12.0	0.70
Sulfate.....SO_4	239.1	Iron Oxide.....Fe_2O_3	0.6	0.03
Chloride.....Cl	13.0	Manganese Oxide.....MnO	0.0	0.00
Alkalinity as $CaCO_3$				
Phenolphthalein..	0.0	Total.....	612.1	35.68
Methyl Orange...	250.0			
Residue.....	680.0			
Total Hardness....	420.0			

Another well was constructed in the northeast part of Edina Park, west of the Chicago and Northwestern Eailroad depot. The ground surface is at elevation 595 feet above mean sea level and the, well was drilled to a reported depth of 1500 feet and cased with 6-inch casing to rock.

This well flowed with a strong pressure but was allowed to flow to waste into the park pond except for a small amount piped over to the railroad depot.

Water from this well had a total residue of 591, a hardness of 422, and an iron content of 2.6 parts per million as shown by the analysis of sample number 48664 collected November 16, 1922.

The third deep well drilled by Mr. Gray is located on the south side of 28th Street and a few hundred feet east of the Chicago and Forthwestern Eailroad. The ground surface is about elevation 590 feet above mean sea level. The well has been reported to have a depth of from 1100 feet to 1500 feet but a depth of 1440 feet seems the most authentic. It is cased to rock with 5-inch casing and the hydraulic pressure is sufficient to give a good free flow in the bakery building across the street to the north.

The water from this well has a total residue of 594, a total hardness of 408, and an iron content of 0.4 parts per million as is shown by analysis of sample number 68232 collected December 17, 1930.

Analysis of Sample Number 68232 from a 1440-Foot Well near the Bakery Building.

Determinations Made.		Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron	Fe	0.4	Sodium Nitrate	$NaNO_3$	1.7	0.10
Manganese	Mn	0.0	Sodium Chloride	NaCl	14.6	0.85
Silica	SiO_2	15.0	Sodium Sulfate	Na_2SO_4	57.5	3.36
Turbidity		10.0	Ammonium Sulfate	$(NH_4)_2SO_4$	0.7	0.04
Calcium	Ca	127.0	Magnesium Sulfate	$MgSO_4$	109.5	6.38
Magnesium	Mg	22.2	Calcium Sulfate	$CaSO_4$	89.2	5.20
Ammonium	NH_4	0.1	Calcium Carbonate	$CaCO_3$	252.0	14.70
Sodium	Na	24.8	Iron Oxide	Fe_2O_3	0.6	0.04
Sulfate	SO_4	190.0	Manganese Oxide	MnO	0.0	0.00
Nitrate	NO_3	1.1	Silica	SiO_2	15.0	0.88
Chloride	Cl	9.0				
Alkalinity as $CaCO_3$			Total		540.8	31.55
Phenolphthalein		0.0				
Methyl Orange		252.0				
Residue		594.0				
Total Hardness		408.0				

Another well generally known as the creamery well is reported to be 969 feet deep. The water from this well has a total residue of 593, a hardness of 352, and an iron content of 0.2 parts per million as shown by analysis of sample number 48665 collected December 16, 1922.

In 1926 the city constructed a well to a depth of 1025 feet as a water supply well for the municipality. The well is located near the corner of 27th Street and Elesha Avenue on ground having an elevation of about 635 feet above mean sea level.

The formations penetrated as reported by the driller were as follows:

	Thickness in feet.	Depth in feet.
Drift	163	163
Lime, streak of shale	209	372
Shale	48	420
Lime	54	474
Shale	73	547
Lime	293	840
Sandstone, Glenwood	24	864
Lime	32	896
Sandstone, St. Peter	127	1023
Marl	2	1025

The well was cased as follows:

16-inch outside diameter casing	0	to 163	feet.
15-inch hole uncased	163	to 313	feet.
12-inch casing	313	to 575.5	feet.
12-inch hole uncased	575.5	to 1025.5	feet.

When the well reached a depth of 221 feet a production of 25 gallons per minute was obtained when pumping with the bailer. Static water level was 90 feet below the surface until the well reached a depth of 900 feet, then it rose to 30 feet. At a depth of 960 feet it rose to 25 feet; at 970 feet it rose to 22 feet; at 985 feet it rose to 16 feet and at 1020 feet static water level was reported as 12 feet below the surface. The 16-inch casing was slotted at the gravel section or between 105 and 130 feet. It was also reported that the well was shot in the St. Peter sandstone.

The well was equipped with a deep-well turbine pump with an original setting of 250 feet of column pipe. When the elevated tank was filled for the first time the well produced at the average rate of 414 gallons per minute for a period of 4 hours and 22 minutes.

During a 48-hour test period the pump drew air when pumping at a rate of 250 gallons per minute. The bowls were then lowered to a 300-foot setting and in April, 1927 a production of 402 gallons per minute was obtained. Static water level was found to be 34 feet below the level of the station floor. The temperature of the water was reported as 54° F.

Water from the well had a total residue of 587, a total hardness of 336, and an iron content of 0.3 parts per million as shown by analysis number 56083 of a sample collected February 8, 1926.

Analysis of Sample Number 56083 from City Well 1025.5 Feet Deep.

Determinations Made.	Pts. per million.	Hypothetical Combinations.		Pts. per million.	Grs. per gallon.
Iron....Fe	0.3	Potassium Nitrate	KNO_3	1.5	0.09
Manganese..Mn	0.0	Potassium Chloride	KCl	22.8	1.34
Silica....SiO_2	19.7	Sodium Chloride	NaCl	30.0	1.75
Nonvolatile	6.4	Sodium Sulfate	Na_2SO_4	130.2	7.62
Alumina....Al_2O_3	0.0	Ammonium Sulfate	$(NH_4)_2SO_4$	1.1	0.07
Calcium....Ca	90.1	Magnesium Sulfate	$MgSO_4$	75.2	4.40
Magnesium..Mg	26.7	Magnesium Carbonate	$MgCO_3$	36.4	2.12
Ammonium..NH_4	0.3	Calcium Carbonate	$CaCO_3$	216.6	12.67
Potassium...K	13.0	Silica	SiO_2	19.7	1.15
Sodium....Na	56.0	Iron Oxide	Fe_2O_3	0.4	0.02
Sulfate....SO_4	143.7	Alumina	Al_2O_3	0.0	0.00
Nitrate....NO_3	0.9	Manganese Oxide	MnO	0.0	0.00
Chloride....Cl	28.0	Nonvolatile		6.4	0.37
Alkalinity as $CaCO_3$					
Phenolphthalein..		Total		540.3	31.60
Methyl Orange...	250.0				
Residue	587.0				
Total Hardness....	335.7				

In 1930 the city installed a zeolite water softener not only to improve the water but also to reduce corrosion if possible.

In January, 1931 it was observed that the water temperature had raised to 59° F.

In the early part of 1935 J. P. Miller Artesian Well Company constructed a second city well to a final depth of 995 feet. The well is

located on a lot owned by the city at the northwest corner of Sheridan Road and 29th Street. The ground surface elevation is about 625 feet above sea level. The formations penetrated are shown in the following log from the files of the State Geological Survey:

	Thickness in feet.	Depth in feet.
Drift	125	125
Sand and gravel, very little water	5	130
Drift	16	146
Sand, sample of water to Water Survey	1	147
Lime rock, gray	183	330
Marl, red	20	350
Lime, gray	20	370
Shale, blue	190	560
Lime, gray, hard	303	863
Sand, gray	11	874
Lime, dark	26	900
Sand, gray	93	993
Marl, red	2	995

The well is cased with 12½-inch inside diameter casing from the surface to 147 feet, a seat for the bottom of the casing being made in the limestone. Below 147 feet the well is continued as a 12-inch hole to a depth of 564 feet. Between depths of 310 and 564 feet a 10-inch liner was installed. An open hole 10 inches in diameter extends below the 564-foot depth to the bottom at 995 feet.

The St. Peter sandstone was shot at three positions, i. e., at the bottom, at a depth of 960 feet, and at a depth of 925 feet. Each charge consisted of 50 pounds of 60 per cent straight dynamite.

On the date of the production test (May 15-16, 1935) static water level was found to be 33 feet below the surface. The production tests indicated a yield of:

125 gallons per minute with a draw down of 182 feet.
150 gallons per minute with a draw down of 217 feet.
175 gallons per minute with a draw down of 252 feet.
200 gallons per minute with a draw down of 302 feet.

The actual rate of production did not quite reach 200 gallons per minute.

Water from this well had a total residue of 561, a total hardness of 287.5, and an iron content of 0.3 parts per million as shown by the analysis of sample number 76098, collected May 16, 1935 at the end of the 24-hour test period.

Analysis of Sample Number 76098 for City Well Number 2, 995 Feet Deep.

Determinations Made.

		Pts. per million.
Iron	Fe	
(unfiltered)		0.3
Manganese	Mn	0.0
Silica	SiO_2	11.0
Turbidity		2.0
Color		1.0
Odor		0.0
Calcium	Ca	78.7
Magnesium	Mg	22.0
Ammonium	NH_4	
Sodium	Na	90.6
Sulfate	SO_4	152.2
Nitrate	NO_3	2.0
Chloride	Cl	40.0
Alkalinity as $CaCO_3$		
Phenolphthalein		0.0
Methyl Orange		268.0
Residue		561.0
Total Hardness		287.5

Hypothetical Combinations.

		Pts. per million.	Grs. per gallon.
Sodium Nitrate	$NaNO_3$	2.5	0.15
Sodium Chloride	NaCl	66.1	3.85
Sodium Sulfate	Na_2SO_4	197.5	11.51
Magnesium Sulfate	$MgSO_4$	23.5	1.37
Magnesium Carbonate	$MgCO_3$	60.3	3.51
Calcium Carbonate	$CaCO_3$	196.6	11.46
Iron Oxide	Fe_2O_3	0.4	0.02
Silica	SiO_2	11.0	0.64
Total		557.9	32.51

CIRCULARS OF THE STATE WATER SURVEY

No. **1.** Well Water Recessions in Illinois by G. C. Habermeyer (1928).
No. 2. The Effect of Certain Illinois Waters on Lead by O. W. Rees and A. L. Elder (1928).
No. 3. Removal of Colloids from Sewage by A. M. Buswell, R. A. Shive, and S. L. Neave (1928).
No. 4. Control of Scum in Sewage Tanks by A. M. Buswell (1929).
No. 5. The Biology of a Sewage Treatment Plant. A Preliminary Survey, Decatur, Illinois, by H. P. K. Agersborg and W. D. Hatfield (1929).
No. 6. Some Idiosyncrasies of Grand Waters by W. D. Gerber (1930).
No. 7. Fermentation Products of Cellulose by C. S. Boruff and A. M. Buswell (1929).
No. 8. Chemical Studies on Sludge Digestion by S. L. Neave with A. M. Buswell (1930).
No. 9. Illinois River Studies, 1929-30 by C. S. Boruff. (1930).
No. 10. Production of Fuel Gas by Anaerobic Fermentations by A. M. Buswell (1930).
No. 11. The Hydrology of Industrial and Municipal Water Supplies in Illinois by Winfred D. Gerber (1931).
No. 12. Some Economic Problems of the Illinois River Valley. Papers presented before the Economics Section of the Illinois State Academy of Science, Peoria, Illinois, May 8, 1931.
No. 13. Soap Usage and Water Hardness by Hersel Wendell Hudson (1934).
No. 14. A Carbon Study of Sludge Digestion by T. E. Larson, C. S. Boruff, and A. M. Buswell (1934).
No. 15. The Determination of Free Chlorine by D. Tarvin, H. R. Todd, and A. M. Buswell (1935).
No. 16. The Treatment of "Beer Slop" and Similar Wastes by A. M. Buswell (1935).
No. 17. Data on the Ground Waters of Lake County, Illinois by W. D. Gerber, S. M. McClure, D. Tarvin, and A. M. Buswell (1935).
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No. 19. Water Quality for Fire Fighting. The Relation of Water Resistivity to Safe Distance from Nozzle to Electric Lines by A. M. Buswell (1937).
No. 20. Model Study of Spillway Characteristics West Frankfort by J. J. Doland, T. E. Larson, and C. O. Reinhardt (1935-37).