GEOLOGICAL SURVEY CIRCULAR 206

THE INDUSTRIAL UTILITY OF PUBLIC WATER SUPPLIES IN THE WEST NORTH-CENTRAL STATES, 1952

By E. W. Lohr, P. C. Benedict, H. A. Swenson, and T. B. Dover

UNITED STATES DEPARTMENT OF THE INTERIOR
Oscar L. Chapman, Secretary

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W. E. Wrather, Director

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INTRODUCTION

The location of industrial plants is dependent on an ample water supply of suitable quality. Information relating to the chemical characteristics of the water supplies is not only essential to the location of many plants but also is an aid in the manufacture and distribution of many commodities.

Public water supplies are utilized extensively as a source of supply for many industrial plants, used either as delivered for domestic consumption or with further treatment if necessary to meet specific needs of the plant, such as water for processing, cooling, and steam generation. The industrial use of water in the United States in 1950 was estimated to be more than 75 billion gallons per day from private sources. In addition, about 6 billion gallons per day was estimated to be taken from public water supplies.

U. S. Geological Survey Water-Supply Paper 658, "The industrial utility of public water supplies in the United States, 1932" contains information pertaining to the public water supplies of 670 of the larger cities throughout the United States. This report, which is still in print and being distributed, has filled an important need in the field of water-supply engineering. The demand for more up-to-date information and more extended coverage has led to studies by the Geological Survey for revision of the information contained in the 1932 report. The revised report, which will include data pertaining to public water supplies of more than 1,200 cities in the United States, will eventually be published as a Geological Survey Water-Supply Paper. However, in order that the information might be available at the earliest possible time, nine preliminary reports are being issued which give data on the larger cities in each state. These nine reports are being released as Geological Survey Circulars, each covering a group of states as delineated by the Bureau of Census in taking the census of the population of the country. (See fig. 1). The reports give descriptive information and analytical data for approximately three-fourths of the cities that will be included in the final report for each of the states.

This circular is the third of the series and includes data for the States of Iowa, Kansas, Minnesota, Missouri, Nebraska, North Dakota, and South Dakota. (See fig. 1). The report gives the population (1950) of the city, population supplied, ownership, sources and treatment of supplies, capacity of treatment plants, storage facilities for both raw and finished waters, and chemical analyses of the water for a total of 112 cities in the 7 states. The data for each city are essentially the same as will appear in the complete report for the whole country.

Data for the supplies in all the states except for 13 cities in Kansas were compiled under the direction of H. A. Swenson, chemist, under the general supervision of P. C. Benedict, regional engineer, Lincoln, Nebr. Data for 13 of the 20 cities of Kansas included in the report were compiled by T. B. Dover, chemist, Stillwater, Okla. Review and final assembly of the data were made by E. W. Lohr in the Washington office, under the supervision of S. K. Love, Chief, Quality of Water Branch.

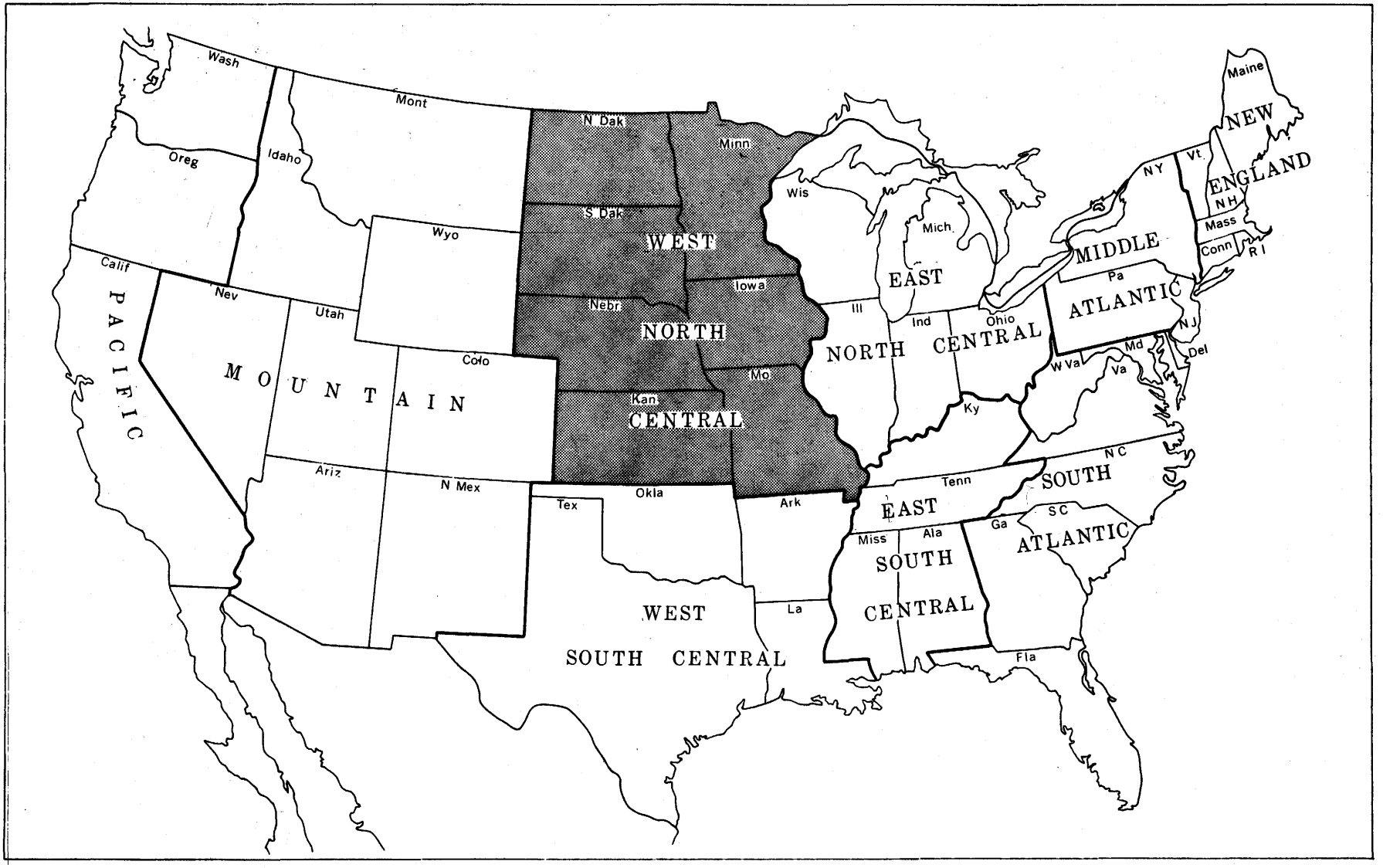

Figure 1. -Map of the United States showing sections covered by the nine circulars on the Industrial Utility of Public Water Supplies of the United States, 1952. The shaded portion represents the section of the country covered by this circular.

AMES
(Population, 22,898)

Ownership: Municipal.
Source: 4 wells (1, and 3 to 5), 109, 112, 120, and 127 ft deep. The yield of the wells is reported to be 500, 600, 1,000, and 1,600 gpm. Normally well 5 is used most of the time for the supply. The other wells are pumped as needed.
Treatment: Aeration, softening with lime and soda ash, sedimentation, recarbonation, chlorination, sodium hexametaphosphate, and rapid sand filtration.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,750,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 5 (raw water)	Well 5 (finished water)		Well 5 (raw water)	Well 5 (finished water)
Silica (SiO_2)	24	15	Hardness as $CaCO_3$:		
Iron (Fe)	6.3	.13	Total	363	73
Manganese (Mn)	.20	.03	Noncarbonate	60	44
Calcium (Ca)	98	23			
Magnesium (Mg)	29	3.8	Color	4	4
Sodium (Na)	13	27	pH	7.5	8.5
Potassium (K)	3.2	3.5	Specific conductance (micromhos at 25 C.)	716	284
Carbonate (CO_3)	0	--			
Bicarbonate (HCO_3)	369	1/36	Turbidity	2	0.2
Sulfate (SO_4)	87	85	Temperature (F.)	52	52
Chloride (Cl)	8.0	9.0	Date of collection	2/23/51	2/23/51
Fluoride (F)	.4	.3			
Nitrate (NO_3)	.3	1.3			
Dissolved solids	464	190			

Depth (feet)	127
Diameter (inches)	30
Date drilled	1947
Percent of supply	--

1/Includes the equivalent of less than 5 ppm of carbonate (CO_3).

BOONE
(Population, 12,164)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 12,400.
Source: 10 wells (11 to 20), 46, 67, 52, 54, 67, 51, 61, 55, 56, and 64 ft deep. The yield of the wells is reported to be (well 11 not reported) 900, 780, 600, 875, 900, 300, 300, 300, and 300 gpm, respectively.
Treatment: Chlorination.
Raw-water storage: 3,000,000 gal.
Finished-water storage: 1,100,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	18	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	418
Manganese (Mn)	.57	Noncarbonate	126
Calcium (Ca)	103		
Magnesium (Mg)	39	Color	5
Sodium (Na)	27	pH	7.7
Potassium (K)	3.7	Specific conductance (micromhos at 25 C.)	844
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	357	Turbidity	0.7
Sulfate (SO_4)	141	Temperature (F.)	54
Chloride (Cl)	31	Date of collection	2/23/51
Fluoride (F)	.2		
Nitrate (NO_3)	2.5		
Dissolved solids	564		

BURLINGTON
(Population, 30,613)

Ownership: Municipal; also supplies about 1,600 people outside the city limits. Total population supplied, about 32,200.
Source: Mississippi River.
Treatment: Prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 7,200,000 gpd.
Raw-water storage: None.
Finished-water storage: 3,500,000 gal.

The chemical composition of the raw water varies considerably throughout the year.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	8.8	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	154
Manganese (Mn)	.00	Noncarbonate	49
Calcium (Ca)	41		
Magnesium (Mg)	13	Color	12
Sodium (Na)	4.1	pH	7.8
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.)	324
Carbonate (CO_3)	0	Turbidity	16
Bicarbonate (HCO_3)	128	Temperature (F.)	47
Sulfate (SO_4)	47	Date of collection	4/11/51
Chloride (Cl)	8.0		
Fluoride (F)	.1		
Nitrate (NO_3)	3.6		
Dissolved solids	248		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	178	92	7.9	8.4	6.6	180	200	90	60	1100	40
Finished water	152	158	90	7.3	7.7	7.1	180	200	122	.37	5.5	0

CEDAR FALLS
(Population, 14,334)

Ownership: Municipal; also supplies 25 people outside the city limits. Total population supplied, 14,359.
Source: 7 wells (1 to 7) each 125 ft deep.
Treatment: None.
Storage: 750,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (composite) City tap		Wells (composite) City tap
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	244
Manganese (Mn)	.00	Noncarbonate	24
Calcium (Ca)	65		
Magnesium (Mg)	20	Color	2
Sodium (Na)	4.6	pH	7.6
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	475
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	268	Temperature (F.)	--
Sulfate (SO_4)	21	Date of collection	5/9/51
Chloride (Cl)	4.5		
Fluoride (F)	.2		
Nitrate (NO_3)	8.3		
Dissolved solids	278		

Depth (feet)	125
Diameter (inches)	8-16
Date drilled	1912-49
Percent of supply	100

CEDAR RAPIDS
(Population, 72,296)

Ownership: Municipal.
Source: Cedar River.
Treatment: Softening with lime and soda ash, coagulation with alum and ferric sulfate, activated carbon, recarbonation, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 24,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 8,200,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water	1/Raw water
Silica (SiO_2)	12	9.7	11
Iron (Fe)	.18	.11	.07
Manganese (Mn)	.00	.00	.00
Calcium (Ca)	64	30	58
Magnesium (Mg)	17	5.9	19
Sodium (Na)	6.9	12	11
Potassium (K)	1.8	1.9	2.4
Carbonate (CO_3)	0	--	0
Bicarbonate (HCO_3)	207	2/44	218
Sulfate (SO_4)	44	61	37
Chloride (Cl)	9.0	12	13
Fluoride (F)	.2	.3	.2
Nitrate (NO_3)	18	13	8.1
Dissolved solids	300	182	277
Hardness as $CaCO_3$:			
Total	228	99	224
Noncarbonate	58	63	--
Color	10	1	14
pH	7.7	9.0	7.7
Specific conductance (micromhos at 25 C.)	464	278	455
Turbidity	30	0.5	--
Temperature (F.)	--	--	54
Date of collection	5/12/51	5/12/51	1944-45

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	152	--	--	8.4	--	--	192	--	--	145	--	--
Finished water	43	--	--	9.5	--	--	88	--	--	0	--	--

1/Average of 36 analyses of 10-day composites of daily samples of Cedar River at Cedar Rapids, 1944-45 (Water Supply Paper 1030, p. 148, 1949). Extremes:- Dissolved solids, maximum 370 ppm; minimum 193 ppm. Total hardness, max- 300 ppm; minimum 151 ppm.

2/Includes the equivalent of less than 5 ppm of carbonate (CO_3).

CHARLES CITY
(Population, 10,309)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 10,500.

Source: 4 wells (1, and 3 to 5), 1,241, 1,260, 1,315, and 287 ft deep. The yield of the wells is reported to be 500, 580, 690, and 1,500 gpm. Well 5 is a flowing well, reported as yielding from Cedar Valley limestone.

Treatment: None.

Storage: 800,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 1, 3, and 4 (composite)		Wells 1, 3, and 4 (composite)
Silica (SiO_2)	8.5	Hardness as $CaCO_3$:	
Iron (Fe)	.17	Total	244
Manganese (Mn)	.00	Noncarbonate	13
Calcium (Ca)	61		
Magnesium (Mg)	22	Color	3
Sodium (Na)	13	pH	7.8
Potassium (K)	5.8	Specific conductance (micromhos at 25 C.)	515
Carbonate (CO_3)	0	Turbidity	0.4
Bicarbonate (HCO_3)	282	Temperature (F.)	--
Sulfate (SO_4)	39	Date of collection	5/9/51
Chloride (Cl)	2.5		
Fluoride (F)	.8		
Nitrate (NO_3)	1.7		
Dissolved solids	294		

CHEROKEE
(Population, 7,705)

Ownership: Municipal; also supplies Illinois Central Railroad Co. Total population supplied, 7,705.
Source: 3 wells (1 to 3), 209, 201, and 210 ft deep. The wells are located in the same area.
Treatment: Chlorination.
Raw-water storage: 500,000 gal.
Finished-water storage: 500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	28	Hardness as $CaCO_3$:	
Iron (Fe)	.45	Total	344
Manganese (Mn)	.03	Noncarbonate	50
Calcium (Ca)	94		
Magnesium (Mg)	27	Color	4
Sodium (Na)	26	pH	7.5
Potassium (K)	5.1	Specific conductance (micromhos at 25 C.)	704
Carbonate (CO_3)	0	Turbidity	3
Bicarbonate (HCO_3)	359	Temperature (F.)	53
Sulfate (SO_4)	106	Date of collection	2/21/51
Chloride (Cl)	1.5		
Fluoride (F)	.6		
Nitrate (NO_3)	1.9		
Dissolved solids	486		

Depth (feet)	201-210
Diameter (inches)	8-15
Date drilled	1912-47
Percent of supply	100

CLINTON
(Population, 30,379)

Ownership: Clinton Water Works Co.
Source: 5 artesian wells (3, and 5 to 8), 1,685, 1,800, 2,101, 2,101, and 2,106 ft deep. The yield of the wells is reported to be 1,000, 800, 1,250, 2,000, and 1,348 gpm. Well 8 furnishes about one-third of the supply.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 1,250,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Finished 1/ water	Well 8 (finished water)		Finished 1/ water	Well 8 (finished water)
Silica (SiO_2)	10	9.8	Hardness as $CaCO_3$:		
Iron (Fe)	.14	.33	Total	277	258
Manganese (Mn)	.00	.00	Noncarbonate	8	8
Calcium (Ca)	64	54			
Magnesium (Mg)	29	30	Color	1	2
Sodium (Na)	36	13	pH	8.2	7.9
Potassium (K)	8.0	7.0	Specific conductance (micromhos at 25 C.)	670	535
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	329	306			
Sulfate (SO_4)	47	23	Turbidity	0.6	1
Chloride (Cl)	29	11	Temperature (F.)	68	--
Fluoride (F)	.4	.3	Date of collection	5/11/51	5/11/51
Nitrate (NO_3)	.9	1.0			
Dissolved solids	388	300			

Depth (feet)	2,106
Diameter (inches)	16-12
Date drilled	1944
Percent of supply	33

1/Composite sample from well 3 (10 percent) and well 7 (90 percent).

COUNCIL BLUFFS
(Population, 45,429)

Ownership: Municipal.
Source: Missouri River.
Treatment: Prechlorination, coagulation with alum and lime, sedimentation, ammoniation and postchlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 13,000,000 gal.

There is considerable variation in the composition of the water throughout the year. The new treatment plant, now under construction, will have provisions for softening the supply.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	262
Manganese (Mn)	.03	Noncarbonate	88
Calcium (Ca)	69		
Magnesium (Mg)	22	Color	4
Sodium (Na)	54	pH	8.3
Potassium (K)	5.0	Specific conductance (micromhos at 25 C.)	720
Carbonate (CO_3)	0	Turbidity	4
Bicarbonate (HCO_3)	212	Temperature (F.)	34
Sulfate (SO_4)	180	Date of collection	2/27/51
Chloride (Cl)	16		
Fluoride (F)	.5		
Nitrate (NO_3)	2.0		
Dissolved solids	484		

CRESTON
(Population, 8,317)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 8,400.
Source: Artificial lake (impounded surface runoff).
Treatment: Coagulation with alum, lime, carbon, ammoniation (ammonium sulfate), sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: 461,900,000 gal in lake.
Finished-water storage: Elevated tank, 1,200,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	8.2	7.3	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.03	Total	96	112
Manganese (Mn)	.04	.02	Noncarbonate	13	24
Calcium (Ca)	26	32			
Magnesium (Mg)	7.6	7.8	Color	20	4
Sodium (Na)	6.0	5.3	pH	7.4	7.8
Potassium (K)	5.9	4.8	Specific conductance (micromhos at 25 C.)	225	256
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	101	108			
Sulfate (SO_4)	23	31	Turbidity	45	2
Chloride (Cl)	3.0	6.5	Temperature (F.)	42	44
Fluoride (F)	.4	.3	Date of collection	2/27/51	2/27/51
Nitrate (NO_3)	2.8	1.2			
Dissolved solids	160	172			

Regular determinations at treatment plant

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	92	60	--	8.0	7.2	--	103	86	--	--	--
Finished water	--	90	50	--	8.0	7.0	--	103	86	--	--	--

DAVENPORT
(Population, 74,549)

Ownership: Davenport Water Co.; also supplies about 500 people outside the city limits, and the city of Bettendorf. Total population supplied, about 80,200.
Source: Mississippi River.
Treatment: Coagulation with alum, sedimentation, carbon if necessary, lime for pH adjustment, rapid sand filtration, chlorination, and fluoridation (approved 1952).
Rated capacity of treatment plant: 14,000,000 gpd.
Raw-water storage: 5,000,000 gal.
Finished-water storage: 5,000,000 gal.

The water from the river flows by gravity into a raw-water well from which it is pumped at the beginning of the treatment process.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	7.9	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	128
Manganese (Mn)	.00	Noncarbonate	61
Calcium (Ca)	36		
Magnesium (Mg)	9.3	Color	5
Sodium (Na)	3.4	pH	7.2
Potassium (K)	2.2	Specific conductance (micromhos at 25 C.)	291
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	82	Temperature (F.)	55
Sulfate (SO_4)	56	Date of collection	5/11/51
Chloride (Cl)	5.0		
Fluoride (F)	.1		
Nitrate (NO_3)	5.4		
Dissolved solids	196		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	125	139	108	7.6	8.1	7.2	140	162	112	130	570	35
Finished water	107	123	94	7.0	7.1	6.9	144	162	127	.20	.83	.11

DES MOINES
(Population, 177,965)

Ownership: Municipal; also supplies a population of about 17,600 in other communities outside the city limits. Total population supplied, about 195,000.
Source: Infiltration gallery along the Raccoon River, 50 to 75 percent of supply; Raccoon River impounded, 25 to 50 percent of the supply.
Treatment: Softening with lime and soda ash, coagulation with alum, recarbonation, rapid sand filtration and addition of polyphosphate for stabilization, and chlorination.
Rated capacity of treatment plant: 48,000,000 gpd.
Raw-water storage: Impounding reservoir, 1,570,000,000 gal.
Finished-water storage: Clear wells, 10,000,000 gal; tower, 2,000,000 gal.

The infiltration gallery is constructed of reinforced concrete rings 2 ft long and 4 and 5 ft inside diameter, placed in the sand and gravel 15 to 31 ft deep in one continuous line parallel with the river and from 150 to 300 ft back from the main channel. It is constructed to permit the entrance of water from the surrounding sand and gravel through openings between each ring, and serves the double purpose of collecting the water and carrying it by gravity to the pumping station. At the present time the gallery is approximately 3 miles long.
The impounding reservoir is located southwest of Commerce in the Raccoon River valley. Water from this source is used during drought periods or in emergencies.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished 1/water		1/Raw water	Finished 1/water
Silica (SiO_2)	16	11	Hardness as $CaCO_3$:		
Iron (Fe)	.10	.03	Total	342	78
Manganese (Mn)	.03	.02	Noncarbonate	71	31
Calcium (Ca)	88	12			
Magnesium (Mg)	30	12	Color	5	3
Sodium (Na)	16	38	pH	7.6	9.8
Potassium (K)	3.1	3.6	Specific conductance (micromhos at 25 C.)	677	341
Carbonate (CO_3)	0	26			
Bicarbonate (HCO_3)	330	4.0			
Sulfate (SO_4)	87	90	Turbidity	2	0.4
Chloride (Cl)	14	14	Temperature (F.)	48	52
Fluoride (F)	.3	.2	Date of collection	2/26/51	2/26/51
Nitrate (NO_3)	1.4	1.4			
Dissolved solids	432	212			

Regular determinations at treatment plant

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	229	275	206	7.5	7.8	7.4	290	365	202	21	1000	0.30
Finished water	39	49	29	10.1	10.3	9.8	83	114	44	.18	.61	0

1/Infiltration gallery.

DUBUQUE
(Population, 49,671)

Ownership: Municipal.
Source: 8 wells (1 to 8), 1,300, 1,300, 1,460, 1,460, 1,500, 1,504, 1,563, and 1,781 ft deep for regular supply; mine tunnel (known as the "Levels" Spring), auxiliary supply. The yield of the wells is reported to be 2,800 (wells 1 to 4, pumped as a unit), 900, 2,000, 2,400, and 2,430 gpm.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: 10,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs, elevated tanks, and standpipe 12,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (finished water)		Wells (finished water)
Silica (SiO_2)	12	Hardness as $CaCO_3$:	
Iron (Fe)	.24	Total	282
Manganese (Mn)	.00	Noncarbonate	18
Calcium (Ca)	57		
Magnesium (Mg)	34	Color	3
Sodium (Na)	3.4	pH	7.8
Potassium (K)	2.6	Specific conductance (micromhos at 25 C.)	525
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	322	Temperature (F.)	--
Sulfate (SO_4)	18	Date of collection	5/10/51
Chloride (Cl)	5.5		
Fluoride (F)	.2		
Nitrate (NO_3)	.4		
Dissolved solids	296		

Depth (feet)	1,300-1,781
Diameter (inches)	6-15
Date drilled	1899-1946
Percent of supply	100

FORT DODGE
(Population, 25,115)

Ownership: Municipal; also supplies about 3,500 people outside the city limits. Total population supplied, about 28,600.
Source: 5 artesian wells (8, 9, 12, 14, and 15), 1,040, 553, 507, 973, and 2,307 ft deep. The yield of the wells is reported to be 1,000, 1,500, 1,500, 2,800, and 2,800 gpm. The greater part of the supply is furnished by well 15.
Treatment: Aeration, chlorination, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 9,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 15 1/(raw water)	2/Wells 8, 9, 12, and 14		Well 15 1/raw water)	2/Wells 8, 9, 12, and 14
Silica (SiO_2)	29	14	Hardness as $CaCO_3$:		
Iron (Fe)	.4	.16	Total	432	466
Manganese (Mn)	--	.03	Noncarbonate	172	99
Calcium (Ca)	104	115			
Magnesium (Mg)	42	44	Color	--	4
Sodium (Na)	175	60	pH	7.1	7.6
Potassium (K)		6.6	Specific conductance (micromhos at 25 C.)	--	1,050
Carbonate (CO_3)	0	0	Turbidity	--	2
Bicarbonate (HCO_3)	318	448	Temperature (F.)	--	52
Sulfate (SO_4)	223	170	Date of collection	12/31/48	2/23/51
Chloride (Cl)	227	40			
Fluoride (F)	.2	.7			
Nitrate (NO_3)	--	3.1			
Dissolved solids	1,073	692			

Depth (feet)	2,307	
Diameter (inches)	12	
Date drilled	1948	
Percent of supply	--	

1/Analysis by Sanitary and Hydraulic Engineer, Ames, Iowa.
2/Finished water.

FORT MADISON
(Population, 14,954)

Ownership: Municipal.
Source: Mississippi River.
Treatment: Coagulation with alum and lime, activated carbon, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 650,000 gal.
Finished-water storage: 130,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	9.2	Hardness as $CaCO_3$:	
Iron (Fe)	.18	Total	135
Manganese (Mn)	.00	Noncarbonate	83
Calcium (Ca)	38		
Magnesium (Mg)	9.8	Color	4
Sodium (Na)	4.0	pH	7.0
Potassium (K)	3.0	Specific conductance (micromhos at 25 C.)	304
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	64	Temperature (F.)	49
Sulfate (SO_4)	68	Date of collection	4/11/51
Chloride (Cl)	13		
Fluoride (F)	.1		
Nitrate (NO_3)	7.9		
Dissolved solids	228		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	100	150	90	7.4	7.8	7.0	100	150	--	200	3000	--
Finished water	110	140	100	7.0	7.2	7.0	120	164	--	.5	.5	0.5

IOWA CITY
(Population, 27,212)

Ownership: Iowa Water Service Co.; also supplies University Heights and Coralville. Total population supplied, about 28,600.
Source: Iowa River.
Treatment: Aeration (spray), prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: 500,000 gal.
Finished-water storage: 1,700,000 gal.

The composition of the raw water varies considerably throughout the year. Extremes for the year (Oct. 1, 1944 to Sept. 30, 1945, 36 analyses of 10-day composites), dissolved solids, 400-203 ppm; total hardness, 345-156 ppm (Geological Survey W. S. P. 1030, page 142, 1949).

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	238
Manganese (Mn)	.00	Noncarbonate	114
Calcium (Ca)	68		
Magnesium (Mg)	17	Color	5
Sodium (Na)	4.6	pH	7.2
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	491
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	151	Temperature (F.)	--
Sulfate (SO_4)	90	Date of collection	5/12/51
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	17		
Dissolved solids	332		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	350	3200	3
Finished water	--	--	--	7.6	8.0	7.2	240	340	120	--	--	--

KEOKUK
(Population, 16,144)

Ownership: Municipal.
Source: Mississippi River.
Treatment: Prechlorination, coagulation with alum, softening with lime, sedimenation, activated carbon, ammoniation (ammonium sulfate), recarbonation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,000,000 gal.

The composition of the raw water varies considerably throughout the year.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	8.4	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	170
Manganese (Mn)	.00	Noncarbonate	77
Calcium (Ca)	55		
Magnesium (Mg)	7.9	Color	3
Sodium (Na)	3.6	pH	7.8
Potassium (K)	3.0	Specific conductance (micromhos at 25 C.)	362
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	114	Temperature (F.)	--
Sulfate (SO_4)	64	Date of collection	4/11/51
Chloride (Cl)	9.0		
Fluoride (F)	.0		
Nitrate (NO_3)	7.4		
Dissolved solids	246		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	160	198	40	7.7	8.6	6.8	198	230	62	80	1200	5
Finished water	72	122	32	8.8	9.3	8.0	100	170	68	0	2	0

MARSHALLTOWN
(Population, 19,821)

Ownership: Municipal; also supplies Soldiers Home and about 150 people outside the city limits. Total population supplied, about 20,500.
Source: 4 wells, 50, 100, 170, and 225 ft deep for regular supply. Iowa River, auxiliary supply. The yield of the wells is reported to be 350, 2,000, 700, and 700 gpm, respectively.
Treatment: Aeration, softening with lime, recarbonation, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Wells (raw water)	Wells (finished water)		Wells (raw water)	Wells (finished water)
Silica (SiO_2)	16	9.1	Hardness as $CaCO_3$:		
Iron (Fe)	2.7	.08	Total	308	112
Manganese (Mn)	.46	.02	Noncarbonate	70	72
Calcium (Ca)	81	23			
Magnesium (Mg)	26	13	Color	5	4
Sodium (Na)	21	21	pH	7.7	7.5
Potassium (K)	2.3	2.3	Specific conductance (micromhos at 25 C.)	643	337
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	291	49			
Sulfate (SO_4)	105	105	Turbidity	15	0.5
Chloride (Cl)	5.0	5.5	Temperature (F.)	46	47
Fluoride (F)	.4	.3	Date of collection	2/24/51	2/24/51
Nitrate (NO_3)	1.8	3.5			
Dissolved solids	416	220			

Depth (feet)	50-225
Diameter (inches)	6-12
Date drilled	--
Percent of supply	100

MASON CITY
(Population, 27,980)

Ownership: Municipal.
Source: 6 wells (7 to 12), 1,230, 1,219, 1,200, 1,243, 1,306, and 1,585 ft deep. The yield of wells 7, 8, 9, and 10 is reported to be 1,000 gpm, each, and of wells 11 and 12, 1,200 gpm, each.
Treatment: None.
Storage: 6,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (composite)		Wells (composite)
Silica (SiO_2)	8.3	Hardness as $CaCO_3$:	
Iron (Fe)	.19	Total	330
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	79		
Magnesium (Mg)	32	Color	1
Sodium (Na)	40	pH	7.5
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	760
Carbonate (CO_3)	0	Turbidity	0.8
Bicarbonate (HCO_3)	407	Temperature (F.)	50
Sulfate (SO_4)	66	Date of collection	5/9/51
Chloride (Cl)	7.5		
Fluoride (F)	.6		
Nitrate (NO_3)	2.2		
Dissolved solids	444		

MUSCATINE
(Population, 19,041)

Ownership: Municipal; also supplies about 600 people outside the city limits. Total population supplied, about 20,600.
Source: 12 wells, each 50 ft deep. Five 8-in. wells, and five 12-in. wells are pumped into a single suction line. The two 20-in. wells (1 and 2) are pumped separately. The yields are reported to be (not reported for the 8-in. wells) 900 gpm, each, for the 12-in. wells, and 1,100 gpm, each, for wells 1 and 2.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 3,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	16	Hardness as $CaCO_3$:	
Iron (Fe)	.14	Total	162
Manganese (Mn)	.00	Noncarbonate	31
Calcium (Ca)	42		
Magnesium (Mg)	14	Color	1
Sodium (Na)	4.4	pH	8.0
Potassium (K)	.6	Specific conductance (micromhos at 25 C.)	334
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	160	Temperature (F.)	--
Sulfate (SO_4)	20	Date of collection	5/11/51
Chloride (Cl)	7.0		
Fluoride (F)	.1		
Nitrate (NO_3)	11		
Dissolved solids	204		

NEWTON
(Population, 11,723)

Ownership: Municipal; also supplies about 1,500 people outside the city limits. Total population supplied, about 13,200.
Source: 11 wells 51 to 65 ft deep. The yield for most of the wells is reported to be 300 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: Reservoir, 3,200,000 gal; elevated tank, 600,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	22	Hardness as $CaCO_3$:	
Iron (Fe)	.68	Total	337
Manganese (Mn)	.31	Noncarbonate	96
Calcium (Ca)	86		
Magnesium (Mg)	30	Color	3
Sodium (Na)	7.7	pH	7.5
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	622
Carbonate (CO_3)	0	Turbidity	3
Bicarbonate (HCO_3)	294	Temperature (F.)	53
Sulfate (SO_4)	95	Date of collection	2/26/51
Chloride (Cl)	5.5		
Fluoride (F)	.1		
Nitrate (NO_3)	1.3		
Dissolved solids	414		

OELWEIN
(Population, 7,858)

Ownership: Municipal.
Source: 2 wells (35 and 42), 119 and 1,328 ft deep. A third well (31), 122 ft deep, is to be put into service soon (1951). The yield of the wells is reported to be 520 and 750 gpm.
Treatment: None.
Storage: 780,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 35 and 42		Wells 35 and 42
Silica (SiO_2)	8.0	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	234
Manganese (Mn)	.00	Noncarbonate	3
Calcium (Ca)	44		
Magnesium (Mg)	30	Color	1
Sodium (Na)	20	pH	7.7
Potassium (K)	7.8	Specific conductance (micromhos at 25 C.)	526
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	282	Temperature (F.)	--
Sulfate (SO_4)	45	Date of collection	5/10/51
Chloride (Cl)	2.5		
Fluoride (F)	.9		
Nitrate (NO_3)	2.9		
Dissolved solids	302		

OSKALOOSA
(Population, 11,124)

Ownership: Municipal; also supplies about 275 people outside the city limits. Total population supplied, about 11,400.
Source: Skunk River, 70 percent of supply; 4 wells (11 to 14), 52, 54, 44, and 44 ft deep, 30 percent of supply. The yield of the wells is reported to be 900, 975, 900, and 1,000 gpm.
Treatment: Softening with lime and soda ash, coagulation with alum, recarbonation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 7,000,000 gal.
Finished-water storage: 750,000 gal.

At the time of the collection of the sample for analysis in May 1951, the wells were furnishing the entire supply because of a special condition of the Skunk River which required a long detention period for clarification. There is a possibility that the river may be discontinued as a source of supply, although this was the principal source in 1950.

ANALYSES

(Analyses, in parts per million, by State Hygienic Laboratory, Iowa City)

	Well 11	Well 12	Well 14	1/Wells	2/Wells
Silica (SiO_2)	--	--	--	--	12
Iron (Fe)	0.4	7.5	5.0	0.1	.08
Manganese (Mn)	.6	3.2	2.2	.0	.00
Calcium (Ca)	68	82	92	24	25
Magnesium (Mg)	21	24	26	4.9	5.5
Sodium (Na)	12	14	13	22	17
Potassium (K)					1.3
Carbonate (CO_3)	0	--	0	5	0
Bicarbonate (HCO_3)	251	303	361	46	58
Sulfate (SO_4)	57	71	59	66	59
Chloride (Cl)	10	6	6.0	7	8.0
Fluoride (F)	.3	.1	.2	.1	.2
Nitrate (NO_3)	2.1	1.8	1.8	3.5	2.9
Dissolved solids	325	372	411	167	166
Hardness as $CaCO_3$:					
Total	258	326	349	80	85
Noncarbonate	50	54	44	34	37
Color	--	--	--	--	2
pH	7.4	7.2	7.2	8.6	8.3
Specific conductance (micromhos at 25 C.)	492	562	621	241	264
Turbidity	--	--	--	--	0.5
Temperature (F.)	58	52	--	--	--
Date of collection	12/5/50	12/5/50	12/16/50	12/5/50	5/14/51
Depth (feet)	52	54	44		
Diameter (inches)	26	26	26		
Date drilled	1945	1947	1949		
Percent of supply	--	--	--		

1/Finished water, composite.
2/Finished water, composite. Analyzed by Geological Survey.

OTTUMWA
(Population, 33,631)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 34,100.
Source: Des Moines River.
Treatment: Aeration, softening with lime and soda ash, coagulation with alum or iron sulfate, activated carbon, recarbonation, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 11,000,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	12	7.1	Hardness as $CaCO_3$:		
Iron (Fe)	.29	.12	Total	131	80
Manganese (Mn)	.13	.00	Noncarbonate	32	50
Calcium (Ca)	38	30			
Magnesium (Mg)	8.8	1.3	Color	40	2
Sodium (Na)	1.6	11	pH	7.4	7.8
Potassium (K)	3.3	3.2	Specific conductance (micromhos at 25 C.)	271	233
Carbonate (CO_3)	0	0	Turbidity	310	0.9
Bicarbonate (HCO_3)	119	36	Temperature (F.)	--	--
Sulfate (SO_4)	30	63	Date of collection	4/10/51	4/10/51
Chloride (Cl)	2.0	4.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	11	7.9			
Dissolved solids	186	162			

Regular determinations at treatment plant, 1949

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	161	270	85	7.8	8.5	7.0	224	338	156	416	8000	20
Finished water	36	80	16	8.0	9.2	7.2	86	122	70	.20	1.5	0

SIOUX CITY
(Population, 83,991)

Ownership: Municipal; also supplies Morningside, Leeds, and Riverside. Total population supplied, about 91,000.
Source: 12 wells (2 to 7, 11, 14, and 16 to 19), 288 to 377 ft deep. The yield of the wells is reported to range from 1,110 to 1,750 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 24,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished 1/water		Finished 1/water
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	.40	Total	472
Manganese (Mn)	.12	Noncarbonate	141
Calcium (Ca)	125		
Magnesium (Mg)	39	Color	2
Sodium (Na)	37	pH	7.5
Potassium (K)	8.4	Specific conductance (micromhos at 25 C.)	982
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	404	Temperature (F.)	54
Sulfate (SO_4)	183	Date of collection	6/15/51
Chloride (Cl)	26		
Fluoride (F)	.1		
Nitrate (NO_3)	1.2		
Dissolved solids	672		

Depth (feet)	323-374
Diameter (inches)	16-20
Date drilled	1940-48
Percent of supply	--

1/Composite sample, wells 14, 17, 18, and 19, Main Street pumping station.

WATERLOO
(Population, 65,198)

Ownership: Municipal.
Source: 7 wells (7 to 13), 84, 82, 87, 81, 82, 87, and 81 ft deep. The yield of each well is reported to be 2,000 gpm.
Treatment: Chlorination and ammoniation.
Raw-water storage: None.
Finished-water storage: 9,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	16	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	241
Manganese (Mn)	.00	Noncarbonate	48
Calcium (Ca)	67		
Magnesium (Mg)	18	Color	2
Sodium (Na)	6.6	pH	7.9
Potassium (K)	.8	Specific conductance (micromhos at 25 C.)	477
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	236	Temperature (F.)	--
Sulfate (SO_4)	35	Date of collection	5/9/51
Chloride (Cl)	10		
Fluoride (F)	.2		
Nitrate (NO_3)	13		
Dissolved solids	294		

Depth (feet)	81-87
Diameter (inches)	16-24
Date drilled	1931-48
Percent of supply	100

ARKANSAS CITY
(Population, 12,903)

Ownership: Municipal.
Source: 8 wells.
Treatment: Chlorination.
Rated capacity of treatment plant: 8,000,000 gpd.
Raw-water storage: --
Finished-water storage: 2,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.0	Total	342
Manganese (Mn)	--	Noncarbonate	130
Calcium (Ca)	106		
Magnesium (Mg)	19	Color	5
Sodium (Na)	107	pH	7.5
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	1,110
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	260	Temperature (F.)	--
Sulfate (SO_4)	119	Date of collection	5/25/51
Chloride (Cl)	162		
Fluoride (F)	.3		
Nitrate (NO_3)	5.0		
Dissolved solids	706		

ATCHISON
(Population, 12,792)

Ownership: Atchison City Water Works, Inc. (nonprofit company); also supplies about 1,500 people outside the city limits. Total population supplied, about 14,300.
Source: Missouri River.
Treatment: Plain sedimentation in two basins of 2,000,000 gal capacity, each, coagulation with lime and alum, sedimentation, break point chlorination, and rapid sand filtration.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 7,500,000 gal.
Finished-water storage: 1,500,000 gal.

The composition of the raw water varies throughout the year.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	286
Manganese (Mn)	.00	Noncarbonate	94
Calcium (Ca)	82		
Magnesium (Mg)	20	Color	2
Sodium (Na)	59	pH	8.0
Potassium (K)	5.6	Specific conductance (micromhos at 25 C.)	779
Carbonate (CO_3)	0	Turbidity	0.3
Bicarbonate (HCO_3)	234	Temperature (F.)	35
Sulfate (SO_4)	181	Date of collection	3/23/51
Chloride (Cl)	27		
Fluoride (F)	.4		
Nitrate (NO_3)	2.7		
Dissolved solids	538		

Regular determinations at treatment plant

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	160	280	88	7.9	8.4	7.1	210	360	120	1500	2000	10
Finished water	150	240	80	7.9	8.6	7.2	220	380	120	.1	.2	.05

COFFEYVILLE
(Population, 17,113)

Ownership: Municipal.
Source: Verdigris River.
Treatment: Coagulation with alum, softening with lime and soda ash, activated carbon at times, sedimentation, recarbonation, coagulation with alum, secondary sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: --
Finished-water storage: 6,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.0	7.9	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.00	Total	176	82
Manganese (Mn)	--	--	Noncarbonate	32	58
Calcium (Ca)	54	30			
Magnesium (Mg)	10	1.7	Color	50	5
Sodium (Na)	28	28	pH	7.9	9.4
Potassium (K)	2.2	2.1	Specific conductance (micromhos at 25 C.)	480	327
Carbonate (CO_3)	0	8	Turbidity	--	--
Bicarbonate (HCO_3)	176	13	Temperature (F.)	74	57
Sulfate (SO_4)	26	39	Date of collection	5/31/51	5/31/51
Chloride (Cl)	51	57			
Fluoride (F)	--	.1			
Nitrate (NO_3)	2.2	1.4			
Dissolved solids	297	215			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	58	--	--	9.0	--	--	114	--	--	1	--	--

DODGE CITY
(Population, 11,262)

Ownership: Municipal.
Source: 6 wells. The yield of the wells is reported to range from 500 to 1,200 gpm. The water is pumped from the wells directly into the distribution system.
Treatment: None.
Storage: 1,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (city tap)		Wells (city tap)
Silica (SiO_2)	29	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	248
Manganese (Mn)	--	Noncarbonate	56
Calcium (Ca)	63		
Magnesium (Mg)	22	Color	5
Sodium (Na)	17	pH	7.6
Potassium (K)	3.6	Specific conductance (micromhos at 25 C.)	528
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	234	Turbidity	--
Sulfate (SO_4)	54	Temperature (F.)	--
Chloride (Cl)	15	Date of collection	5/23/51
Fluoride (F)	1.6		
Nitrate (NO_3)	13		
Dissolved solids	368		

EL DORADO
(Population, 11,037)

Ownership: Municipal.
Source: Satchel Creek impounded in Lake El Dorado, 4.7 miles from the Courthouse in the city. Walnut River, emergency supply.
Treatment: Coagulation with alum and lime, sedimentation, activated carbon at times, rapid sand filtration, and chlorination. Copper sulfate is used for control of algae, when necessary.
Rated capacity of treatment plant: 2,500,000 gpd.
Raw-water storage: 1,000,000,000 gal.
Finished-water storage: 1,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	9.2	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	121
Manganese (Mn)	--	Noncarbonate	52
Calcium (Ca)	43		
Magnesium (Mg)	3.4	Color	10
Sodium (Na)	5.0	pH	7.8
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	268
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	85	Temperature (F.)	--
Sulfate (SO_4)	50	Date of collection	5/24/51
Chloride (Cl)	7.8		
Fluoride (F)	.0		
Nitrate (NO_3)	1.4		
Dissolved solids	179		

EMPORIA
(Population, 15,669)

Ownership: Municipal.
Source: Neosho River (impounded). Emergency supply, Kaholo Lake.
Treatment: Coagulation with alum and lime, carbon at times, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: (Not reported.)
Finished-water storage: 3,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	10	Hardness as $CaCO_3$:		
Iron (Fe)	1.8	.01	Total	115	107
Manganese (Mn)	--	--	Noncarbonate	6	39
Calcium (Ca)	36	41			
Magnesium (Mg)	6.2	1.1	Color	100	5
Sodium (Na)	7.3	6.5	pH	7.5	10.5
Potassium (K)	2.9	2.6	Specific conductance (micromhos at 25 C.)	244	269
Carbonate (CO_3)	0	1/41	Turbidity	--	--
Bicarbonate (HCO_3)	133	0	Temperature (F.)	--	--
Sulfate (SO_4)	13	45	Date of collection	5/24/51	5/24/51
Chloride (Cl)	2.8	8.0			
Fluoride (F)	--	.1			
Nitrate (NO_3)	3.9	1.7			
Dissolved solids	192	168			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	68	--	--	9.0	--	--	102	--	--	1	--	--

1/Includes the equivalent of 1.0 ppm of hydroxide (OH).

GREAT BEND
(Population, 12,665)

Ownership: Western Light and Telephone Co., Inc.
Source: 4 wells (1 to 4), 75, 117, 68, and 99 ft deep.
Treatment: Chlorination.
Finished-water storage: None.

Water from the wells is pumped directly into the distribution system.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Finished water (composite)	Well 2	Well 3	Well 4
Silica (SiO_2)	18	--	--	--
Iron (Fe)	.0	--	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	92	--	--	--
Magnesium (Mg)	18	--	--	--
Sodium (Na)	107	--	--	--
Potassium (K)	3.6	--	--	--
Carbonate (CO_3)	0	--	--	--
Bicarbonate (HCO_3)	202	212	204	204
Sulfate (SO_4)	156	--	--	--
Chloride (Cl)	135	170	145	140
Fluoride (F)	.6	--	--	--
Nitrate (NO_3)	3.0	--	--	--
Dissolved solids	678	688	660	713
Hardness as $CaCO_3$:				
Total	304	292	306	296
Noncarbonate	138	118	139	129
Color	0	--	--	--
pH	7.6	--	--	--
Specific conductance (micromhos at 25 C.)	1,040	1,080	1,030	1,030
Turbidity	--	--	--	--
Temperature (F.)	--	--	--	--
Date of collection	5/23/51	5/23/51	5/23/51	5/23/51
Depth (feet)		117	68	99
Diameter (inches)		18	18	19
Date drilled		1937	1937	1946
Percent of supply		--	--	--

HUTCHINSON
(Population, 33,575)

Ownership: Glenn Dunn Co., Wichita, Kans.
Source: 8 wells (Adams Street, Main Street, Northwest, Northeast, Cleveland, Lorraine, North, and East), 65, 75, 60, 58, 80, 50, 65, and 59 ft deep, respectively; each 24 in. in diameter.
Treatment: Chlorination.
Finished-water storage: None.

Water from the wells is pumped directly into the distribution system. Partial analysis of a sample from each well indicates a range in dissolved solids from 479 to 1,070 ppm and hardness from 232 to 366 ppm.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Finished water (composite)	Northeast well	Adams Street well
Silica (SiO_2)	16	--	--
Iron (Fe)	.0	--	--
Manganese (Mn)	--	--	--
Calcium (Ca)	110	--	--
Magnesium (Mg)	19	--	--
Sodium (Na)	144	--	--
Potassium (K)	3.4	--	--
Carbonate (CO_3)	0	--	--
Bicarbonate (HCO_3)	255	230	270
Sulfate (SO_4)	125	--	--
Chloride (Cl)	230	125	385
Fluoride (F)	.5	--	--
Nitrate (NO_3)	11	--	--
Dissolved solids	853	479	1,070
Hardness as $CaCO_3$:			
Total	352	232	364
Noncarbonate	144	44	143
Color	0	--	--
pH	7.3	--	--
Specific conductance (micromhos at 25 C.)	1,340	854	1,810
Turbidity	--	--	--
Temperature (F.)	--	--	--
Date of collection	5/23/51	5/23/51	5/23/51

INDEPENDENCE
(Population, 11,335)

Ownership: Municipal.
Source: Verdigris River (impounded).
Treatment: Softening with excess lime, coagulation with alum, activated carbon at times, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: (Not reported.)
Finished-water storage: 2,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.4	7.0	Hardness as $CaCO_3$:		
Iron (Fe)	.12	.00	Total	186	143
Manganese (Mn)	--	--	Noncarbonate	29	82
Calcium (Ca)	58	42			
Magnesium (Mg)	10	9.2	Color	100	0
Sodium (Na)	29	29	pH	7.9	7.5
Potassium (K)	2.5	2.6	Specific conductance (micromhos at 25 C.)	501	432
Carbonate (CO_3)	0	0	Turbidity	--	--
Bicarbonate (HCO_3)	191	74	Temperature (F.)	--	80
Sulfate (SO_4)	27	69	Date of collection	5/31/51	5/31/51
Chloride (Cl)	52	49			
Fluoride (F)	.2	.1			
Nitrate (NO_3)	1.8	1.4			
Dissolved solids	322	281			

JUNCTION CITY
(Population, 13,462)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 14,000.
Source: 6 wells (2 to 7), 66, 59, 73, 67, 71, and 70 ft deep. The yield of well 2 is reported to be 950 gpm, and of remaining wells, each 1,000 gpm.
Treatment: Aeration, softening with lime and soda ash, coagulation with alum, sedimentation, rapid sand filtration, recarbonation, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,200,000 gal.

Water from several wells is mixed before entering treatment plant.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished 2/water		1/Raw water	Finished 2/water
Silica (SiO_2)	23	20	Hardness as $CaCO_3$:		
Iron (Fe)	.01	.01	Total	284	122
Manganese (Mn)	.00	.00	Noncarbonate	42	57
Calcium (Ca)	88	27			
Magnesium (Mg)	16	13	Color	3	2
Sodium (Na)	28	26	pH	7.5	8.1
Potassium (K)	7.3	7.4	Specific conductance (micromhos at 25 C.)	658	392
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	295	79	Turbidity	1.0	0
Sulfate (SO_4)	55	50	Temperature (F.)	58	59
Chloride (Cl)	32	33	Date of collection	3/20/51	3/20/51
Fluoride (F)	.4	.3			
Nitrate (NO_3)	15	26			
Dissolved solids	424	254			

1/Composite of all wells.
2/Three wells.

KANSAS CITY
(Population, 129,553)

Ownership: Municipal; also supplies about 35,000 people outside the city limits. Total population supplied, about 164,600.

Source: Missouri River. The raw water is obtained by means of either or both of two intake structures and equipment. It is first pumped to the electric power station where it is used for condensing purposes. When it leaves the condenser a sufficient amount is pumped to the settling basins at the water plant for the city supply. The remainder is wasted back into the river.

Treatment: Coagulation with alum, lime, silica, activated carbon, sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 31,750,000 gpd.

Raw-water storage: None.

Finished-water storage: Reservoirs, 17,000,000 gal; elevated storage, 1,800,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	276
Manganese (Mn)	.00	Noncarbonate	82
Calcium (Ca)	75		
Magnesium (Mg)	22	Color	3
Sodium (Na)	59	pH	7.9
Potassium (K)	5.6	Specific conductance (micromhos at 25 C.)	770
Carbonate (CO_3)	0	Turbidity	0.3
Bicarbonate (HCO_3)	237	Temperature (F.)	46
Sulfate (SO_4)	172	Date of collection	3/23/51
Chloride (Cl)	29		
Fluoride (F)	.4		
Nitrate (NO_3)	2.8		
Dissolved solids	520		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	153	253	102	8.2	8.6	7.9	220	368	136	1870	9830	26
Finished water	152	252	99	7.9	8.4	7.4	235	360	158	<1	<1	<1

LAWRENCE
(Population, 23,351)

Ownership: Municipal; supplies also the University of Kansas and about 3,000 people outside the city limits. Total population supplied, about 31,300.
Source: Kansas River (60-75 percent of supply); 3 wells (1 to 3), 50, 50, and 51 ft deep (25-40 percent of supply). The yield of the wells is reported to be 450, 450, and 400 gpm.
Treatment: Prechlorination, softening with lime and soda ash, coagulation with alum, copperas (part time only), chlorine dioxide when needed, carbon, recarbonation, addition of calgon, sedimentation, rapid sand filtration, and ammoniation.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 1,900,000 gal.
Finished-water storage: 1,373,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished water		1/Raw water	Finished water
Silica (SiO_2)	24	18	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.01	Total	368	109
Manganese (Mn)	.00	.00	Noncarbonate	54	52.
Calcium (Ca)	118	32			
Magnesium (Mg)	18	7.1	Color	5	2
Sodium (Na)	53	55	pH	7.5	9.0
Potassium (K)	6.8	6.5	Specific conductance (micromhos at 25 C.)	890	506
Carbonate (CO_3)	0	17			
Bicarbonate (HCO_3)	384	34			
Sulfate (SO_4)	82	80	Turbidity	95	0.3
Chloride (Cl)	64	70	Temperature (F.)	46	47
Fluoride (F)	.2	.2	Date of collection	3/21/51	3/21/51
Nitrate (NO_3)	4.4	2.0			
Dissolved solids	568	324			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	220	350	100	7.9	8.3	7.2	275	450	120	1800	15000	20
Finished water	50	80	36	9.1	9.6	8.7	112	152	84	<1	<1	<1

1/Kansas River 75 percent, wells 25 percent.

LEAVENWORTH
(Population, 20,579)

Ownership: Municipal; also supplies about 600 people outside the city limits. Total population supplied, about 21,200.
Source: Missouri River.
Treatment: Plain sedimentation, softening with lime and soda ash, sedimentation, rapid sand filtration, recarbonation, and chlorination.
Rated capacity of treatment plant: 5,000,000 gpd.
Raw-water storage: 15,000,000 gal.
Finished-water storage: 5,000,000 gal.

The composition of the raw water varies throughout the year.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	13	Hardness as $CaCO_3$:	
Iron (Fe)	.05	Total	130
Manganese (Mn)	.00	Noncarbonate	56
Calcium (Ca)	27		
Magnesium (Mg)	15	Color	2
Sodium (Na)	55	pH	8.9
Potassium (K)	5.3	Specific conductance (micromhos at 25 C.)	523
Carbonate (CO_3)	14	Turbidity	0.5
Bicarbonate (HCO_3)	62	Temperature (F.)	74
Sulfate (SO_4)	140	Date of collection	3/23/51
Chloride (Cl)	24		
Fluoride (F)	.4		
Nitrate (NO_3)	2.9		
Dissolved solids	346		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	60	112	42	8.2	9.6	7.2	110	118	100	<1	<1	<1

MANHATTAN
(Population, 19,056)

Ownership: Municipal; also supplies about 2,000 people outside the city limits. Total population supplied, about 21,100.
Source: 5 wells (5 to 9), 68, 68, 63, 64, and 68 ft deep. The yield of the wells is reported to be 1,600, 1,200, 1,500, 800, and 1,700 gpm.
Treatment: Softening with lime and soda ash, and rapid sand filtration.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,600,000 gal in reservoir and elevated tank.

A different well is pumped every half hour. Determinations made at the treatment plant show little or no difference in the chemical composition of water from each of the wells.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished 1/water		1/Raw water	Finished 1/water
Silica (SiO_2)	31	17	Hardness as $CaCO_3$:		
Iron (Fe)	6.9	.01	Total	370	54
Manganese (Mn)	1.4	.00	Noncarbonate	20	12
Calcium (Ca)	113	14			
Magnesium (Mg)	21	4.6	Color	2	2
Sodium (Na)	22	33	pH	7.3	8.3
Potassium (K)	5.1	5.5	Specific conductance (micromhos at 25 C.)	755	296
Carbonate (CO_3)	0	0	Turbidity	0.9	0.2
Bicarbonate (HCO_3)	428	51	Temperature (F.)	56	56
Sulfate (SO_4)	52	55	Date of collection	3/20/51	3/20/51
Chloride (Cl)	18	25			
Fluoride (F)	.4	.1			
Nitrate (NO_3)	.9	1.4			
Dissolved solids	488	196			

Depth (feet)	63-68
Diameter (inches)	18-26
Date drilled	1929-45
Percent of supply	100

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	424	430	400	6.9	7.5	5.3	450	463	425	100	120	90
Finished water	45	48	38	9.5	10.6	8.6	75	85	65	<1	<1	<1

1/Composite.

NEWTON
(Population, 11,590)

Ownership: Municipal.
Source: 7 wells in use; four additional wells drilled but not in use at this time. The wells are located 7 to 10 miles from the city.
Treatment: Chlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: --
Finished-water storage: 4,200,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	26	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	167
Manganese (Mn)	--	Noncarbonate	0
Calcium (Ca)	53		
Magnesium (Mg)	8.4	Color	0
Sodium (Na)	27	pH	7.0
Potassium (K)	1.4	Specific conductance (micromhos at 25 C.)	416
Carbonate (CO_3)	0	Turbidity	--
Bicarbonate (HCO_3)	211	Temperature (F.)	--
Sulfate (SO_4)	28	Date of collection	5/24/51
Chloride (Cl)	8.8		
Fluoride (F)	.0		
Nitrate (NO_3)	7.7		
Dissolved solids	264		

PARSONS
(Population, 14,750)

Ownership: Municipal.
Source: La Bette Creek. Auxiliary supply, Neosho River.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination. Copper sulfate is used for the control of algae when necessary.
Rated capacity of treatment plant: 5,180,000 gpd.
Raw-water storage: 10,000,000 gal.
Finished-water storage: 510,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	La Bette Cr. (finished water)		La Bette Cr. (finished water)
Silica (SiO_2)	4.9	Hardness as $CaCO_3$:	
Iron (Fe)	.00	Total	131
Manganese (Mn)	--	Noncarbonate	66
Calcium (Ca)	43		
Magnesium (Mg)	5.8	Color	25
Sodium (Na)	10	pH	7.2
Potassium (K)	2.4	Specific conductance (micromhos at 25 C.)	329
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	79	Turbidity	--
Sulfate (SO_4)	82	Temperature (F.)	79
Chloride (Cl)	7.2	Date of collection	5/31/51
Fluoride (F)	.0		
Nitrate (NO_3)	1.1		
Dissolved solids	224		

16098

PITTSBURG
(Population, 19,341)

Ownership: Municipal.
Source: 3 wells (1 to 3), about 1,400 ft deep.
Treatment: Softening with excess lime, coagulation with alum, sedimentation, recarbonation, and rapid sand filtration.
Rated capacity of treatment plant: 3,630,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,700,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 1 (raw water)	Well 2 (raw water)	Well 3 (raw water)	Finished water (composite)
Silica (SiO_2)	10	9.7	8.9	4.7
Iron (Fe)	.02	.12	.25	.02
Manganese (Mn)	--	--	--	--
Calcium (Ca)	66	68	67	11
Magnesium (Mg)	31	33	34	14
Sodium (Na)	86	82	91	87
Potassium (K)	5.4	5.1	6.2	5.4
Carbonate (CO_3)	0	0	0	--
Bicarbonate (HCO_3)	333	334	355	1/68
Sulfate (SO_4)	72	82	90	87
Chloride (Cl)	100	86	82	98
Fluoride (F)	.5	.5	.7	.3
Nitrate (NO_3)	.1	.9	.8	.7
Dissolved solids	535	531	556	342
Hardness as $CaCO_3$:				
Total	292	305	307	85
Noncarbonate	19	32	16	30
Color	5	5	10	5
pH	7.5	7.4	7.3	8.6
Specific conductance (micromhos at 25 C.)	929	929	933	615
Turbidity	--	--	--	--
Temperature (F.)	70	--	68	85
Date of collection	11/29/51	11/29/51	11/29/51	11/29/51

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	272	--	--	--	--	--	297	--	--	--	--	--
Finished water	60	--	--	--	--	--	85	--	--	--	--	--

1/Includes the equivalent of less than 5 ppm of carbonate (CO_3).

SALINA
(Population, 26,176)

Ownership: Municipal.
Source: 10 wells (N-1, N-2, N-3, and 4 to 10), 62, 69, 86, 77, 62, 78, 70, 71, 64, and 75 ft deep. The yield of the wells is reported to be 1,040, 900, 800, 1,090, 1,040, 1,120, 1,090, 1,020, 900, and 1,200 gpm.
Treatment: Chlorination.
Rated capacity of treatment plant: 11,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,671,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	24	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	552
Manganese (Mn)	.44	Noncarbonate	184
Calcium (Ca)	176		
Magnesium (Mg)	27	Color	3
Sodium (Na)	47	pH	7.3
Potassium (K)	8.5	Specific conductance (micromhos at 25 C.)	1,150
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	450	Temperature (F.)	58
Sulfate (SO_4)	188	Date of collection	3/20/51
Chloride (Cl)	68		
Fluoride (F)	.2		
Nitrate (NO_3)	1.8		
Dissolved solids	800		

Depth (feet)	62-86
Diameter (inches)	24
Date drilled	1924-49
Percent of supply	100

TOPEKA
(Population, 78,791)

Ownership: Municipal; also supplies about 14,200 people outside the city limits and 1,000 at Forbes Air Base. Total population supplied, about 94,000.

Source: Kansas River, 90 percent of supply; 3 wells, 37, 50, and 50 ft deep, 10 percent of supply. Water from the river and wells is mixed before entering the sedimentation basin.

Treatment: Plain sedimentation, softening with excess lime and soda ash, coagulation with alum, sedimentation, recarbonation, chlorination, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 12,000,000 gpd (to be increased to 16,000,000 gpd).

Raw-water storage: None.

Finished-water storage: Reservoirs and elevated storage, 13,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	20	14	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.01	Total	317	100
Manganese (Mn)	.00	.00	Noncarbonate	78	56
Calcium (Ca)	95	29			
Magnesium (Mg)	19	6.7	Color	7	3
Sodium (Na)	71	83	pH	7.9	8.3
Potassium (K)	7.9	7.6	Specific conductance (micromhos at 25 C.)	906	638
Carbonate (CO_3)	0	5	Turbidity	230	0.8
Bicarbonate (HCO_3)	292	43	Temperature (F.)	37	41
Sulfate (SO_4)	113	112	Date of collection	3/21/51	3/21/51
Chloride (Cl)	88	93			
Fluoride (F)	.3	.2			
Nitrate (NO_3)	4.9	3.6			
Dissolved solids	572	390			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	204	327	77	8.3	8.7	8.0	253	418	90	1754	9040	100
Finished water	50	95	32	9.4	10.1	8.9	98	143	68	0	0	0

WICHITA
(Population, 168,279)

Ownership: The city owns the production facilities; The Wichita Water Co. (a subsidiary of the American Water Works Co., Inc.) owns the pumping station and water-distribution system.

Source: 35 wells (1 to 35) ranging in depth from 90 to 265 ft, with average of about 200 ft, located in the Equus Beds west and south of the city of Halstead 30 to 35 miles from Wichita, for regular supply. Seven local wells (1 to 7) near the treatment plant are used in case of an emergency. Two wells (16 and 17) belonging to the Wichita Water Co. are so connected to the system that the water from them can be treated at the treatment plant. Shallow wells of the Wichita Water Co. located in the vicinity of the treatment plant and which have a total capacity of 20,000,000 gpd are available but are never used except in case of emergency.

Treatment: Aeration, softening with lime, chlorination, ammoniation, sedimentation, rapid sand filtration, postchlorination, and polyphosphate (Calgon) for stabilization.

Rated capacity of treatment plant: 48,000,000 gpd.

Raw-water storage: None.

Finished-water storage: Clear wells, 1,000,000 gal; 2 reservoirs, 3,000,000 gal each. Wichita Water Co., 1 reservoir, 3,800,000 gal; 2 elevated tanks, 1,000,000 and 300,000 gal.

The regular supply wells are spaced at least half a mile apart in the well field and have an average yield of about 1,000 gpm. The wells, equipped with turbine pumps, pump into spur lines connected to the 48-in. supply line which conveys the water to the treatment plant located in the city. The control, the operation of which is manual, of the wells is centered at the treatment plant, so that individual wells may be cut in or out of the pumpage as desired. There is considerable variation in the chemical composition of the water from the individual wells. The hardness ranges from about 115 to 250 ppm.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished 1/water		1/Raw water	Finished 1/water
Silica (SiO_2)	21	20	Hardness as $CaCO_3$:		
Iron (Fe)	1.6	.00	Total	200	86
Manganese (Mn)	--	--	Noncarbonate	0	0
Calcium (Ca)	62	19			
Magnesium (Mg)	11	9.4	Color	0	5
Sodium (Na)	56	56	pH	7.3	9.1
Potassium (K)	2.1	1.9	Specific conductance (micromhos at 25 C.)	595	418
Carbonate (CO_3)	0	13			
Bicarbonate (HCO_3)	255	84			
Sulfate (SO_4)	54	54	Turbidity	--	--
Chloride (Cl)	36	43	Temperature (F.)	--	--
Fluoride (F)	.3	.5	Date of collection	5/24/51	5/24/51
Nitrate (NO_3)	1.8	1.9			
Dissolved solids	370	260			

1/Composite.

MINNESOTA

ALBERT LEA
(Population, 13,545)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 14,000.
Source: 2 wells, 400 and 600 ft deep; tie-in with Wilson Co. for auxiliary supply. The yield of the wells is reported to be 1,750 and 1,250 gpm.
Treatment: Chlorination, addition of sodium metaphosphate (Nalco-18) for water stabilization after the water leaves the storage reservoirs.
Raw-water storage: None.
Finished-water storage: Reservoirs, 2,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	1.0	Total	350
Manganese (Mn)	.01	Noncarbonate	5
Calcium (Ca)	92		
Magnesium (Mg)	29	Color	3
Sodium (Na)	12	pH	7.6
Potassium (K)	1.8	Specific conductance (micromhos at 25 C.)	645
Carbonate (CO_3)	0	Turbidity	2
Bicarbonate (HCO_3)	421	Temperature (F.)	48
Sulfate (SO_4)	20	Date of collection	5/8/51
Chloride (Cl)	5.5		
Fluoride (F)	.1		
Nitrate (NO_3)	2.1		
Dissolved solids	404		

Depth (feet)	400, 600
Diameter (inches)	12
Date drilled	--
Percent of supply	100

AUSTIN
(Population, 23,100)

Ownership: Municipal.
Source: Sargeant Springs, 50 percent of supply; 1 well, 112 ft deep, 50 percent of supply. The yield for Sargeant Springs is reported to be 2,200 gpm, and for the well, 1,940 gpm.
Treatment: Chlorination. Fluoridation of the supply has been proposed.
Raw-water storage: None.
Finished-water storage: Reservoir, 2,186,000 gal; elevated storage, 750,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	236
Manganese (Mn)	.00	Noncarbonate	12
Calcium (Ca)	59		
Magnesium (Mg)	22	Color	1
Sodium (Na)	4.2	pH	7.8
Potassium (K)	1.0	Specific conductance (micromhos at 25 C.)	446
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	274	Temperature (F.)	--
Sulfate (SO_4)	13	Date of collection	5/8/51
Chloride (Cl)	3.0		
Fluoride (F)	.2		
Nitrate (NO_3)	3.5		
Dissolved solids	256		

BRAINERD
(Population, 12,637)

Ownership: Municipal.
Source: 4 wells (3 to 6), 120, 120, 145, and 150 ft deep. The yield of the wells is reported to be 1,200, 1,200, 2,400, and 2,500 gpm. Two wells are pumped at one time into reservoir and tower storage and then into the mains.
Treatment: Iron and manganese removal by upward flow of water through beds of manganese ore, aeration and percolation through beds of coke, and rapid sand filtration.
Rated capacity of treatment plant: 3,300,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoir, 800,000 gal; tower, 300,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 3 and 6 (finished water)		Wells 3 and 6. (finished water)
Silica (SiO_2)	20	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	229
Manganese (Mn)	.00	Noncarbonate	21
Calcium (Ca)	66		
Magnesium (Mg)	16	Color	3
Sodium (Na)	9.5	pH	7.6
Potassium (K)	.5	Specific conductance (micromhos at 25 C.)	439
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	254	Turbidity	0.2
Sulfate (SO_4)	29	Temperature (F.)	47
Chloride (Cl)	5.5	Date of collection	5/2/51
Fluoride (F)	.0		
Nitrate (NO_3)	4.4		
Dissolved solids	288		

Depth (feet)	120, 150
Diameter (inches)	16, 16
Date drilled	1939, 1947
Percent of supply	--

DULUTH
(Population, 104,511)

Ownership: Municipal; also supplies about 2,700 people in Proctor. Total population supplied, about 107,200.
Source: Lake Superior for regular supply; Fond du Lac wells for auxiliary supply.
Treatment: Prechlorination, detention 4 hours, postchlorination, and ammoniation.
Rated capacity of treatment plant: 30,000,000 gpd.
Raw-water storage: None.
Finished-water storage: Reservoirs, tanks, and standpipes, 55,380,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Lake Superior (finished water)		Lake Superior (finished water)
Silica (SiO_2)	3.3	Hardness as $CaCO_3$:	
Iron (Fe)	.15	Total	44
Manganese (Mn)	.00	Noncarbonate	3
Calcium (Ca)	14		
Magnesium (Mg)	2.2	Color	1
Sodium (Na)	1.1	pH	7.4
Potassium (K)	.4	Specific conductance (micromhos at 25 C.)	102
Carbonate (CO_3)	0	Turbidity	0.9
Bicarbonate (HCO_3)	50	Temperature (F.)	35
Sulfate (SO_4)	1.0	Date of collection	5/3/51
Chloride (Cl)	3.5		
Fluoride (F)	.1		
Nitrate (NO_3)	1.6		
Dissolved solids	54		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	43	44	42	7.6	--	--	46	47	45	0.35	13	0

FARIBAULT
(Population, 16,028)

Ownership: Municipal.
Source: 3 wells (1 to 3), 750, 450, and 1,385 ft deep. The yield of the wells is reported to be 2,400, 2,400, and 1,360 gpm.
Treatment: Chlorination and aeration.
Raw-water storage: None.
Finished-water storage: 4,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.70	Total	348
Manganese (Mn)	.02	Noncarbonate	18
Calcium (Ca)	88		
Magnesium (Mg)	31	Color	2
Sodium (Na)	9.0	pH	7.7
Potassium (K)	2.0	Specific conductance (micromhos at 25 C.)	642
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	403	Temperature (F.)	48
Sulfate (SO_4)	33	Date of collection	5/7/51
Chloride (Cl)	4.0		
Fluoride (F)	.1		
Nitrate (NO_3)	4.4		
Dissolved solids	376		

FERGUS FALLS
(Population, 12,917)

Ownership: Municipal; also supplies 2,000 people outside the city limits. Total population supplied, about 14,900.
Source: Otter Tail River.
Treatment: Softening with lime, coagulation with ferric sulfate and sodium aluminate, slow mechanical mixing and sludge blanket clarification, recarbonation, carbon when needed, fluoridation with sodium silicofluoride, rapid sand filtration, ammoniation, chlorination, and stabilization with polyphosphate.
Rated capacity of treatment plant: 3,500,000 gpd.
Raw-water storage: Lake.
Finished-water storage: 700,000 gal.(additional storage of 1,500,000 gal is planned for in 1951).

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	9.8	7.1	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	176	75
Manganese (Mn)	.00	.00	Noncarbonate	1	0
Calcium (Ca)	31	9.0			
Magnesium (Mg)	24	13	Color	4	2
Sodium (Na)	5.2	6.5	pH	7.9	9.2
Potassium (K)	3.1	2.9	Specific conductance (micromhos at 25 C.)	345	179
Carbonate (CO_3)	0	13	Turbidity	2	2
Bicarbonate (HCO_3)	214	65	Temperature (F.)	68	68
Sulfate (SO_4)	11	10	Date of collection	5/25/51	5/25/51
Chloride (Cl)	1.5	3.5			
Fluoride (F)	.1	1.2			
Nitrate (NO_3)	1.0	.4			
Dissolved solids	212	118			

Regular determinations at treatment plant, 1951 1/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	205	220	170	8.0	8.1	7.9	213	220	180	2	5	0
Finished water	68	70	65	9.2	9.2	9.2	63	66	61	0	0	0

1/Fiscal year (Apr. 1, 1950 to Mar. 31, 1951).

HIBBING
(Population, 16,276)

Ownership: Municipal; also supplies about 3,000 people outside the city limits. Total population supplied, about 19,300.

Source: Mine shaft, 50 percent of supply; 7 wells (1-A, 2-A, 3-A, 4, 8-A, 9, and 12), 112, 118, 148, 88, 135, 182, and 138 ft deep, 50 percent of supply. The yield of the wells is reported to be 700, 500, 700, 300, 700, 450, and 450 gpm. All the wells are connected to a 1,000,000 gal reservoir at the main pumping station.

Treatment: Chlorination of water from mine shaft.

Raw-water storage: None.

Finished-water storage: Underground storage, 4,000,000 gal; elevated tank, 650,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	15	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	132
Manganese (Mn)	.01	Noncarbonate	17
Calcium (Ca)	28		
Magnesium (Mg)	15	Color	2
Sodium (Na)	5.6	pH	7.0
Potassium (K)	.6	Specific conductance (micromhos at 25 C.)	274
Carbonate (CO_3)	0	Turbidity	0.8
Bicarbonate (HCO_3)	140	Temperature (F.)	45
Sulfate (SO_4)	19	Date of collection	5/3/51
Chloride (Cl)	8.0		
Fluoride (F)	.1		
Nitrate (NO_3)	.7		
Dissolved solids	168		

MANKATO
(Population, 18,809)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 19,000.

Source: 6 wells (5 to 10), 68, 325, 65, 68, and 67 ft deep (depth not reported for well 10). The yield of the wells is reported to be 600, 500 (flow), 700, 600, 1,500, and 1,700 gpm.

Treatment: Prechlorination, iron removal by aeration and contact beds of manganese ore and coke, and rapid sand filtration.

Rated capacity of treatment plant: 4,500,000 gpd.

Raw-water storage: None.

Finished-water storage: High tower, 250,000 gal; concrete reservoir, 3,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite) 1/ 2/		Finished water (composite) 1/ 2/
Silica (SiO_2)	20	Hardness as $CaCO_3$:	
Iron (Fe)	2.2	Total	324
Manganese (Mn)	.00	Noncarbonate	83
Calcium (Ca)	77		
Magnesium (Mg)	32	Color	5
Sodium (Na)	22	pH	8.0
Potassium (K)	4.7	Specific conductance (micromhos at 25 C.)	714
Carbonate (CO_3)	0	Turbidity	9
Bicarbonate (HCO_3)	294	Temperature (F.)	50
Sulfate (SO_4)	107	Date of collection	5/31/51
Chloride (Cl)	11		
Fluoride (F)	.1		
Nitrate (NO_3)	4.4		
Dissolved solids	462		

1/Chlorination only. Treatment plant out of service for repairs at time of collection of sample.

2/Wells 5, 8, and 9.

MINNEAPOLIS
(Population, 521,718)

Ownership: Municipal; also supplies about 11,000 people outside the city limits and about 3,700 at other places. Total population supplied, about 536,400.
Source: Mississippi River.
Treatment: Prechlorination, softening with lime and soda ash, coagulation with ferrous sulfate, and Ferrifloc as required, clarification stablization with alum, carbon dioxide or Ferrifloc or a combination of these as required, rapid sand filtration, postchlorination, and ammoniation.
Rated capacity of treatment plants: Fridley softening plant, 100,000,000 gpd; Columbia Heights Filtration Plant, 78,000,000 gpd; Fridley Filtration Plant, 80,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 61,000,000 gal.

The public supply of Minneapolis is obtained from the Mississippi River at the Fridley pumping station No. 5 located north of the city proper. After the water is softened at the Fridley water-softening plant it is divided for filtration. Centrifugal pumps deliver part of the water to the Columbia Heights Filtration Plant from which after filtration and sterilization finished water is supplied to the city by gravity from the covered finished-water reservoir. The other portion is pumped by low service pumps to the Fridley Filtration Plant from which the finished water is pumped directly into the mains from the covered reservoir. The western half of the city is supplied by direct pumping into the mains and the balance is served by gravity. The Columbia Heights Plant generally serves the entire city from midnight to 5 o'clock in the morning.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	4.4	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.17	Total	148	68
Manganese (Mn)	.00	.00	Noncarbonate	13	43
Calcium (Ca)	40	20			
Magnesium (Mg)	12	4.4	Color	47	7
Sodium (Na)	3.6	4.2	pH	7.9	7.6
Potassium (K)	2.0	2.3	Specific conductance (micromhos at 25 C.)	296	182
Carbonate (CO_3)	0	0	Turbidity	5	0.9
Bicarbonate (HCO_3)	165	30	Temperature (F.)	69	66
Sulfate (SO_4)	18	44	Date of collection	5/29/51	5/29/51
Chloride (Cl)	1.0	8.0			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	2.0	.9			
Dissolved solids	198	126			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	151	196	95	8.1	8.7	7.5	163	194	142	9.6	90	2
Finished water	42	58	18	8.0	8.6	7.4	77	83	74	.3	2.2	0

MOORHEAD
(Population, 14,870)

Ownership: Municipal.
Source: 5 wells (5 to 9), 265, 265, 116, 116, and 116 ft deep. The yield of the wells is reported to be 500, 500, 200, 1,400, and 1,400 gpm.
Treatment: Softening with lime, coagulation with ferric sulphate, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,800,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 5 (raw water)	Well 9 (raw water)	Wells 5 & 9 (finished water)
Silica (SiO_2)	28	27	20
Iron (Fe)	.63	.26	.14
Manganese (Mn)	.00	.04	.00
Calcium (Ca)	55	70	22
Magnesium (Mg)	13	26	8.3
Sodium (Na)	155	74	100
Potassium (K)	5.0	5.5	4.9
Carbonate (CO_3)	0	0	10
Bicarbonate (HCO_3)	329	380	142
Sulfate (SO_4)	144	104	121
Chloride (Cl)	74	14	32
Fluoride (F)	.2	.2	.2
Nitrate (NO_3)	3.8	3.3	3.4
Dissolved solids	644	518	396
Hardness as $CaCO_3$:			
Total	189	280	89
Noncarbonate	0	0	0
Color	4	3	2
pH	7.7	7.6	8.7
Specific conductance (micromhos at 25 C.)	1,010	801	616
Turbidity	2	1	1
Temperature (F.)	48	45	49
Date of collection	5/25/51	5/25/51	5/25/51
Depth (feet)	265	116	
Diameter (inches)	16	12	
Date drilled	1930	1947	
Percent of supply	--	--	

ROCHESTER
(Population, 29,885)

Ownership: Municipal.
Source: 11 wells (2 to 11), 430 to 510 ft deep. The yield of the wells is reported to range from 190 to 1,100 gpm.
Treatment: None (chlorination planned to be started in June 1951).
Storage: 2,400,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (composite)		Wells (composite)
Silica (SiO_2)	11	Hardness as $CaCO_3$:	
Iron (Fe)	.15	Total	260
Manganese (Mn)	.00	Noncarbonate	20
Calcium (Ca)	70		
Magnesium (Mg)	21	Color	1
Sodium (Na)	3.7	pH	7.7
Potassium (K)	1.6	Specific conductance (micromhos at 25 C.)	477
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	292	Temperature (F.)	52
Sulfate (SO_4)	23	Date of collection	5/7/51
Chloride (Cl)	5.0		
Fluoride (F)	.1		
Nitrate (NO_3)	4.1		
Dissolved solids	288		

ST. CLOUD
(Population, 28,410)

Ownership: Municipal.
Source: Mississippi River.
Treatment: Prechlorination, ammoniation, coagulation with alum, activated carbon, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 3,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	6.0	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	134
Manganese (Mn)	.00	Noncarbonate	51
Calcium (Ca)	35		
Magnesium (Mg)	11	Color	4
Sodium (Na)	3.6	pH	7.0
Potassium (K)	2.1	Specific conductance (micromhos at 25 C.)	287
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	101	Temperature (F.)	55
Sulfate (SO_4)	53	Date of collection	5/1/51
Chloride (Cl)	4.5		
Fluoride (F)	.0		
Nitrate (NO_3)	.8		
Dissolved solids	190		

ST. LOUIS PARK
(Population, 22,644)

Ownership: Municipal.
Source: 6 wells (1 to 6). Wells 1, 2, and 3 are 290 ft deep; wells 4, 5, and 6 are 500 ft deep. The yield of the wells is reported to be as follows: Wells 1 and 2, 930 gpm, each; wells 3, 4, 5, and 6, 1,200 gpm, each.
Treatment: Chlorination, polyphosphate for stabilization, and aeration in surface storage tank.
Raw-water storage: None.
Finished-water storage: Elevated tank, 1,600,000 gal; steel surface tank, 1,500,000 gal.

Continuous problem with Crenothrix. Water is pumped directly into mains. The iron content is reported to vary from 0.8 to 3.4 ppm.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 3 (finished water)	Well 4 (finished water)		Well 3 (finished water)	Well 4 (finished water)
Silica (SiO_2)	20	17	Hardness as $CaCO_3$:		
Iron (Fe)	.18	.65	Total	334	290
Manganese (Mn)	.00	.02	Noncarbonate	72	13
Calcium (Ca)	81	73			
Magnesium (Mg)	32	26	Color	5	4
Sodium (Na)	3.6	4.0	pH	8.0	8.1
Potassium (K)	1.7	1.7	Specific conductance (micromhos at 25 C.)	620	537
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	320	338	Turbidity	2	10
Sulfate (SO_4)	52	13	Temperature (F.)	49	49
Chloride (Cl)	16	6.5	Date of collection	5/30/51	5/30/51
Fluoride (F)	.1	.1			
Nitrate (NO_3)	7.3	1.4			
Dissolved solids	432	308			

Depth (feet)	290	500
Diameter (inches)	24	18
Date drilled	1939	1946
Percent of supply	--	--

ST. PAUL
(Population, 311,349)

Ownership: Municipal; also supplies 10,000 people outside the city limits. Total population supplied, about 325,000.

Source: Mississippi River and watershed of impounding lakes for regular supply; Centerville Lakes System for auxiliary supply. The principal impounding reservoirs of the present water-supply system are lakes Vadnais, Pleasant, Otter, Charles, and Sucker. Water storage in the Vadnais impounding system may be augmented from two principal sources: water pumped from the Centerville Lake system, which consists of four principal lakes and lies 18 to 20 miles north of the city; water pumped from the Mississippi River to the Vadnais storage reservoir through Charles and Pleasant Lakes.

Treatment: Aeration, coagulation with alum, softening with lime, recarbonation, sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 70,000,000 gpd.

Raw-water storage: 6,750,000,000 gal.

Finished-water storage: 70,000,000 gal.

Water from Otter Lake and the overflow from Bald Eagle Lake may be taken by gravity into the Vadnais system as a reserve source of supply. During low water stages, however, the water in Otter Lake is highly colored and is seldom used. Two artesian well fields are held in reserve. One field which has 28 wells with an average depth of 400 ft, is located along the shores of Centerville Lake. The other field which has 6 wells ranging in depth from 700 to 1,000 ft is located at McCarron Station.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	5.1	5.1	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.13	Total	149	58
Manganese (Mn)	.00	.00	Noncarbonate	6	10
Calcium (Ca)	39	21			
Magnesium (Mg)	13	1.4	Color	15	5
Sodium (Na)	4.2	4.4	pH	8.1	7.9
Potassium (K)	2.0	2.1	Specific conductance (micromhos at 25 C.)	301	148
Carbonate (CO_3)	0	0	Turbidity	3	1
Bicarbonate (HCO_3)	174	59	Temperature (F.)	64	67
Sulfate (SO_4)	12	15	Date of collection	5/29/51	5/30/51
Chloride (Cl)	1.0	4.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.3	.8			
Dissolved solids	180	92			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	148	168	132	8.3	8.6	8.1	159	179	144	3	6	1
Finished water	57	70	42	8.6	8.8	8.5	72	86	56	Tr	Tr	Tr

SOUTH ST. PAUL
(Population, 15,909)

Ownership: Municipal.
Source: 3 wells (2 to 4), 982, 340, and 960 ft deep. The yield of the wells is reported to be 1,200, 1,900, and 2,000 gpm. The water is pumped directly to the mains and to storage.
Treatment: None.
Storage: 2,400,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 2	Well 3		Well 2	Well 3
Silica (SiO_2)	18	19	Hardness as $CaCO_3$:		
Iron (Fe)	.25	.10	Total	306	337
Manganese (Mn)	.00	.00	Noncarbonate	48	77
Calcium (Ca)	76	84			
Magnesium (Mg)	28	31	Color	2	2
Sodium (Na)	6.8	25	pH	8.0	7.7
Potassium (K)	2.3	2.3	Specific conductance (micromhos at 25 C.)	578	735
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	315	317			
Sulfate (SO_4)	42	53	Turbidity	2	0.8
Chloride (Cl)	7.5	39	Temperature (F.)	52	51
Fluoride (F)	.1	.1	Date of collection	5/29/51	5/29/51
Nitrate (NO_3)	13	23			
Dissolved solids	380	476			

Depth (feet)	982	340
Diameter (inches)	10	24
Date drilled	1923	1937
Percent of supply	--	--

VIRGINIA
(Population, 12,486)

Ownership: Municipal; also supplies about 800 people outside the city limits. Total population supplied, about 13,300.
Source: Mesabi pit shaft for regular supply; 1 well, 400 ft deep, for auxiliary supply.
Treatment: Softening with lime, coagulation with sodium aluminate, sedimentation, recarbonation, rapid sand (pressure) filtration, stabilization with polyphosphate, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 500,000 gal.
Finished-water storage: 1,200,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	14	14	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.04	Total	197	75
Manganese (Mn)	.00	.00	Noncarbonate	31	42
Calcium (Ca)	47	30			
Magnesium (Mg)	19	.1	Color	2	1
Sodium (Na)	7.9	20	pH	7.6	10.6
Potassium (K)	1.4	1.3	Specific conductance (micromhos at 25 C.)	400	272
Carbonate (CO_3)	0	1/20	Turbidity	5	5
Bicarbonate (HCO_3)	203	0	Temperature (F.)	--	43
Sulfate (SO_4)	35	35	Date of collection	5/3/51	5/3/51
Chloride (Cl)	10	12			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.4	2.2			
Dissolved solids	248	148			

1/Hydroxide (OH) 10 ppm.

WINONA
(Population, 25,031)

Ownership: Board of municipal water works.
Source: 6 wells (5 to 10), 500, 486, 452, 150, 149, and 150 ft deep. The yield of the wells is reported to be 1,002, 1,110, 840, 900, 1,136, and 1,100 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: Underground reservoir, 2,000,000 gal; elevated tank, 500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.59	Total	241
Manganese (Mn)	.05	Noncarbonate	0
Calcium (Ca)	58		
Magnesium (Mg)	23	Color	4
Sodium (Na)	57	pH	7.7
Potassium (K)	4.8	Specific conductance (micromhos at 25 C.)	696
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	306	Turbidity	1
Sulfate (SO_4)	52	Temperature (F.)	50
Chloride (Cl)	44	Date of collection	5/8/51
Fluoride (F)	.4		
Nitrate (NO_3)	.8		
Dissolved solids	412		

CAPE GIRARDEAU
(Population, 21,578)

Ownership: Missouri Utilities Co.
Source: Mississippi River.
Treatment: Coagulation with lime and ferrous sulfate, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,200,000 gpd.
Raw-water storage: 1,000,000 gal.
Finished-water storage: 3,000,000 gal.

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water		Finished water
Silica (SiO_2)	8.0	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	240
Manganese (Mn)	--	Noncarbonate	98
Calcium (Ca)	63		
Magnesium (Mg)	20	Color	--
Sodium (Na)	17	pH	6.9
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	1.4
Bicarbonate (HCO_3)	173	Temperature (F.)	--
Sulfate (SO_4)	100	Date of collection	2/4/52
Chloride (Cl)	20		
Fluoride (F)	--		
Nitrate (NO_3)	3.8		
Dissolved solids	364		

Regular determinations at treatment plant, 1951

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	--	--	--
Finished water	120	142	110	7.3	8.4	7.0	213	241	196	0.2	1.4	0.1

CLAYTON
(Population, 16,035)

Ownership: Supplied by the St. Louis County Water Co. (See University City)

COLUMBIA
(Population, 31,974)

Ownership: Municipal; also supplies approximately 150 people outside the city limits. Total population supplied, about 32,124.
Source: 4 wells, 1,100 to 1,500 ft deep for regular supply; connection with a limited number of wells at the University of Missouri for auxiliary or emergency supply.
Treatment: Chlorination.
Raw-water storage: 5,000,000 gal.
Finished-water storage: 1,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 1 & 5 (city tap)		Wells 1 & 5 (city tap)
Silica (SiO_2)	9.0	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	270
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	58		
Magnesium (Mg)	31	Color	3
Sodium (Na)	44	pH	8.2
Potassium (K)	6.4	Specific conductance (micromhos at 25 C.)	668
Carbonate (CO_3)	0	Turbidity	0.7
Bicarbonate (HCO_3)	368	Temperature (F.)	56
Sulfate (SO_4)	35	Date of collection	4/16/51
Chloride (Cl)	26		
Fluoride (F)	1.4		
Nitrate (NO_3)	1.0		
Dissolved solids	406		

HANNIBAL
(Population, 20,444)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 21,400.
Source: Mississippi River.
Treatment: Plain sedimentation, coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 7,500,000 gal.
Finished-water storage: 7,500,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	6.3	Hardness as $CaCO_3$:	
Iron (Fe)	.07	Total	157
Manganese (Mn)	.00	Noncarbonate	77
Calcium (Ca)	47		
Magnesium (Mg)	9.7	Color	8
Sodium (Na)	3.2	pH	7.5
Potassium (K)	2.7	Specific conductance (micromhos at 25 C.)	340
Carbonate (CO_3)	0	Turbidity	0.9
Bicarbonate (HCO_3)	98	Temperature (F.)	49
Sulfate (SO_4)	71	Date of collection	4/12/51
Chloride (Cl)	6.5		
Fluoride (F)	.0		
Nitrate (NO_3)	7.9		
Dissolved solids	246		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	120	164	76	7.8	8.2	7.2	161	198	122	315	2000	25
Finished water	119	150	72	7.4	7.9	6.9	176	204	142	.1	.3	0

INDEPENDENCE
(Population, 36,963)

Ownership: Missouri Water Co.--Independence Division; also supplies about 24,000 people outside the city limits. Total population supplied, about 61,000.
Source: Missouri River. (See Kansas City.)
Finished-water storage: Closed surface reservoir, 2,000,000 gal; elevated tank, 600,000 gal; and stand pipe, 25,000 gal.

JEFFERSON CITY
(Population, 25,099)

Ownership: Capital City Water Co.
Source: Missouri River.
Treatment: Lime, iron compound, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 2,000,000 gal.
Finished-water storage: 1,250,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	8.4	Hardness as $CaCO_3$:	
Iron (Fe)	.12	Total	109
Manganese (Mn)	.00	Noncarbonate	62
Calcium (Ca)	41		
Magnesium (Mg)	1.6	Color	4
Sodium (Na)	27	pH	7.8
Potassium (K)	3.5	Specific conductance (micromhos at 25 C.)	366
Carbonate (CO_3)	0	Turbidity	0.6
Bicarbonate (HCO_3)	57	Temperature (F.)	46
Sulfate (SO_4)	99	Date of collection	4/17/51
Chloride (Cl)	15		
Fluoride (F)	.2		
Nitrate (NO_3)	2.8		
Dissolved solids	248		

JENNINGS
(Population, 15,282)

Ownership: Supplied by the St. Louis County Water Co. (See University City.)

JOPLIN
(Population, 38,711)

Ownership: Joplin Water Works Co. (private). Total population supplied, about 40,000.
Source: Shoal Creek.
Treatment: Coagulation with alum and lime, carbon when required, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 2,100,000 gal.
Finished-water storage: 1,360,000 gal.

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water		Finished water
Silica (SiO_2)	6.0	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	131
Manganese (Mn)	--	Noncarbonate	11
Calcium (Ca)	48		
Magnesium (Mg)	2.7	Color	--
Sodium (Na)	6.4	pH	7.4
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.1
Bicarbonate (HCO_3)	146	Temperature (F.)	--
Sulfate (SO_4)	9.9	Date of collection	6/18/51
Chloride (Cl)	7.6		
Fluoride (F)	--		
Nitrate (NO_3)	5.3		
Dissolved solids	167		

Regular determinations at treatment plant, 1951

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	114	120	108	7.5	7.6	7.2	--	--	--	30	3000	20
Finished water	112	115	106	7.5	7.5	7.2	112	130	100	0	0	0

KANSAS CITY
(Population, 456,622)

Ownership: Municipal; also supplies Avondale, Grandview, Independence, Lees Summit, Sugar Creek, a number of water districts in Clay and Jackson Counties, and private water companies. Total population supplied, about 689,000.

Source: Missouri River. The intake is located about 4 miles upstream from the city.

Treatment: Plain sedimentation (clarifier-equipped basins), softening with lime and soda ash, clarification and coagulation with ferric sulphate and alum, recarbonation, ammoniation (ammonium sulfate), activated carbon (aqua Nuchar), sedimentation, rapid sand filtration, and chlorination.

Rated capacity of treatment plant: 150,000,000 gpd.

Raw-water storage: None.

Finished-water storage: 52,000,000 gal.

The raw water is pumped from the river to the purification works by the Low Lift Pumping Station. From the finished-water reservoirs at the purification site the water is pumped by the Secondary Pumping Station through a tunnel under the Missouri River to reservoirs at the sites of two pumping stations in the city, Turkey Creek and East Bottoms Pumping Stations. The water is delivered from these reservoirs by these two to pumping station into the city's main distribution system. Turkey Creek Pumping Station is steam operated and handles about two-thirds of the total demand on the distribution system. All others are electrically operated. Repumping is required, during hours of maximum demand in the summer months, in an area in the south and southwest part of the city and in an area to the south of the city limits.

(Analyses, in parts per million, by U. S. Geological Survey)

	Finished water	Finished water 1/average	Raw water 1/average
Silica (SiO_2)	11	9.4	12
Iron (Fe)	.04	--	--
Manganese (Mn)	.00	--	--
Calcium (Ca)	21	23	61
Magnesium (Mg)	8.2	6.3	17
Sodium (Na)	66	51	41
Potassium (K)	5.2		
Carbonate (CO_3)	9	--	--
Bicarbonate (HCO_3)	24	2/49	2/192
Sulfate (SO_4)	159	126	120
Chloride (Cl)	27	19	19
Fluoride (F)	.3	--	--
Nitrate (NO_3)	2.6	--	--
Dissolved solids	346	297	3/365
Hardness as $CaCO_3$:			
Total	86	84	221
Noncarbonate	51	43	64
Color	3	--	--
pH	8.7	9.4	8.3
Specific conductance (micromhos at 25 C.)	520	--	--
Turbidity	.3	.26	2,170
Temperature (F.)	45	54	54
Date of collection	3/23/51	--	--

Regular determinations at treatment plant, 1951 4/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	157	238	113	8.3	8.4	8.2	221	305	145	2170	5800	200
Finished water	40	47	37	9.4	9.5	9.3	84	91	66	.26	.6	.1

1/Analyzed by Purification Division, Kansas City Water Dept. Composite analyses, May 1950 to Feb. 1951, inclusive.

2/Includes the equivalent of any carbonate (CO_3).

3/Sum of determined constituents.

4/May 1950 to February 1951.

KIRKWOOD
(Population, 18,640)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 19,100.
Source: Ranney collecter, 53 ft deep and 13 ft in diameter, with valve controlled lateral perforated infiltration pipes along Meramec River.
Treatment: Aeration, softening with quick lime, prechlorination, mechanical flocculation, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,500,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	9.2	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.02	Total	267	128
Manganese (Mn)	.00	.00	Noncarbonate	71	68
Calcium (Ca)	65	21			
Magnesium (Mg)	26	18	Color	2	2
Sodium (Na)	21	20	pH	7.2	9.5
Potassium (K)	1.8	1.0	Specific conductance (micromhos at 25 C.)	585	373
Carbonate (CO_3)	0	18			
Bicarbonate (HCO_3)	239	36	Turbidity	3	0.2
Sulfate (SO_4)	61	65	Temperature (F.)	55	56
Chloride (Cl)	41	31	Date of collection	4/14/51	4/14/51
Fluoride (F)	.0	.1			
Nitrate (NO_3)	1.3	1.0			
Dissolved solids	420	244			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	213	217	197	6.6	6.6	6.5	279	328	256	1.9	8	0.9
Finished water	56	61	50	9.4	9.5	9.3	120	127	110	.1	.1	.1

MAPLEWOOD
(Population, 13,416)

Ownership: Supplied by the St. Louis County Water Co. (See University City)

MOBERLY
(Population, 13,115)

Ownership: Municipal; also supplies Huntsville and about 300 consumers outside the city limits. Total population supplied, about 14,900.
Source: Sugar Creek (impounded) for regular supply; Old Water Works Lake for auxiliary or emergency supply.
Treatment: Coagulation with alum and lime, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 2,304,000 gpd.
Raw-water storage: Reservoir, 1,145,000,000 gal.
Finished-water storage: 817,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished 1/water		Finished 1/water
Silica (SiO_2)	2.7	Hardness as $CaCO_3$:	
Iron (Fe)	.14	Total	137
Manganese (Mn)	.00	Noncarbonate	55
Calcium (Ca)	43		
Magnesium (Mg)	7.2	Color	9
Sodium (Na)	5.2	pH	7.9
Potassium (K)	2.8	Specific conductance (micromhos at 25 C.)	295
Carbonate (CO_3)	0	Turbidity	6
Bicarbonate (HCO_3)	100	Temperature (F.)	--
Sulfate (SO_4)	60	Date of collection	4/16/51
Chloride (Cl)	5.0		
Fluoride (F)	.1		
Nitrate (NO_3)	2.1		
Dissolved solids	210		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	98	65	--	--	--	--	151	111	20	80	6
Finished water	82	100	70	8.0	8.4	7.8	120	151	111	5	5	5

1/Sugar Creek Reservoir.

POPLAR BLUFF
(Population, 15,064)

Ownership: Municipal; also supplies 75 people outside the city limits. Total population supplied, 15,139.
Source: Black River.
Treatment: Coagulation with lime and alum, sedimentation, rapid sand filtration, and chlorination.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: 336,000 gal.
Finished-water storage: 1,200,000 gal.

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water		Finished water
Silica (SiO_2)	5.0	Hardness as $CaCO_3$:	
Iron (Fe)	.10	Total	129
Manganese (Mn)	--	Noncarbonate	7
Calcium (Ca)	27		
Magnesium (Mg)	15	Color	--
Sodium (Na)	8.2	pH	7.8
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.4
Bicarbonate (HCO_3)	149	Temperature (F.)	--
Sulfate (SO_4)	15	Date of collection	9/11/51
Chloride (Cl)	6.3		
Fluoride (F)	--		
Nitrate (NO_3)	.4		
Dissolved solids	150		

Regular determinations at treatment plant, 1951

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	25	170	20
Finished water	122	129	122	8.1	8.3	8.0	130	134	128	.1	.1	.1

RICHMOND HEIGHTS
(Population, 15,045)

Ownership: Supplied by the St. Louis County Water Co. (See University City)

ST. CHARLES
(Population, 14,314)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 14,500.
Source: Missouri River.
Treatment: Plain sedimentation, prechlorination, softening with lime, coagulation and clarification with alum, stabilization with calgon, chloramine, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: 1,000,000 gal (fill and draw system).
Finished-water storage: Steel standpipe, 1,000,000 gal; concrete and steel standpipe, 250,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	7.8	Hardness as $CaCO_3$:		
Iron (Fe)	.08	.08	Total	166	116
Manganese (Mn)	0	0	Noncarbonate	45	60
Calcium (Ca)	48	32			
Magnesium (Mg)	11	8.8	Color	15	12
Sodium (Na)	24	23	pH	7.8	9.2
Potassium (K)	4.3	3.6	Specific conductance (micromhos at 25 C.)	437	359
Carbonate (CO_3)	0	10			
Bicarbonate (HCO_3)	148	48			
Sulfate (SO_4)	85	90	Turbidity	2,000	0.6
Chloride (Cl)	9.0	12	Temperature (F.)	46	46
Fluoride (F)	.1	.3	Date of collection	4/13/51	4/13/51
Nitrate (NO_3)	5.4	4.6			
Dissolved solids	318	232			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	120	250	75	7.9	8.2	7.8	200	350	80	2000	18000	50
Finished water	50	100	40	9.1	9.5	8.8	100	175	50	.1	1.0	.05

ST. JOSEPH
(Population, 78,588)

Ownership: St. Joseph Water Co.; also supplies 3,708 people outside the city limits. Total population supplied, about 82,300.
Source: Missouri River.
Treatment: Plain sedimentation, prechlorination, coagulation with alum and lime, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 14,800,000 gpd.
Raw-water storage: None.
Finished-water storage: 16,680,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	14	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	250
Manganese (Mn)	.00	Noncarbonate	73
Calcium (Ca)	71		
Magnesium (Mg)	18	Color	6
Sodium (Na)	49	pH	8.0
Potassium (K)	5.2	Specific conductance (micromhos at 25 C.)	678
Carbonate (CO_3)	0	Turbidity	0.9
Bicarbonate (HCO_3)	216	Temperature (F.)	42
Sulfate (SO_4)	153	Date of collection	3/26/51
Chloride (Cl)	20		
Fluoride (F)	.3		
Nitrate (NO_3)	.2.8		
Dissolved solids	462		

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	2570	19830	25
Finished water	160	272	99	7.8	8.4	7.2	232	372	136	--	--	--

ST. LOUIS
(Population, 856,796)

Ownership: Municipal; also supplies about 2,000 people outside the city limits. Total population supplied, about 858,800.

Source: Mississippi River at the Chain of Rocks Plant, 5 miles below the confluence with the Missouri River, 67 percent of supply; Missouri River at the Howard Bend Plant, 37 miles above its confluence with the Mississippi River, 33 percent of supply.

Treatment (both plants): Plain sedimentation, softening with lime, coagulation with ferrous sulfate, sedimentation, secondary coagulation and sedimentation with alum, ammoniation (ammonium hydroxide), chlorination, rapid sand filtration, and postchlorination.

Rated capacity of treatment plants: Chain of Rocks Plant, 160,000,000 gpd; Howard Bend Plant, 80,000,000 gpd.

Raw-water storage: Plain sedimentation basin at Chain of Rocks Plant, 24,000,000 gal; plain sedimentation basin at Howard Bend Plant, 11,000,000 gal.

Finished-water storage: Mississippi River water--Baden basins, 20,000,000 gal; Bissell's Point basins, 54,000,000 gal; and Compton Hill Reservoir, 85,000,000 gal. Missouri River water--Howard Bend basin, 5,000,000 gal, and Stacy Park reservoir, 100,000,000 gal. Total, 264,000,000 gal.

The raw water from both sources of supply is pumped into the plain sedimentation basins at the respective treatment plants from which it flows by gravity through the treatment plants. The finished water from the Chain of Rocks Plant flows by gravity to storage basins at Baden, $3\frac{1}{2}$ miles south, and Bissell's Point basins, 7 miles south of Chain of Rocks. From these basins three-fourths of the output of the plant is pumped into the city mains connected with the Compton Hill Reservoir, which floats on the system, and supplies the lower part of the city. The remainder of the output is pumped from the Baden basins directly into the mains at a higher pressure and serves the higher sections of the city.

The finished water from the Howard Bend Plant is pumped into Stacy Park Reservoir, about 9 miles distant, at an elevation high enough to supply by gravity flow the highest sections of the city.

ANALYSES

(Analyses, in parts per million, by the St. Louis Water Department)

	Mississippi River		Missouri River	
	Raw water 1/average	Fin. water 1/average	Raw water 1/average	Fin. water 1/average
Silica (SiO_2)	13	9.0	12	9.3
Iron (Fe)	--	.01	--	--
Manganese (Mn)	--	--	--	--
Calcium (Ca)	50	23	50	23
Magnesium (Mg)	14	9.7	13	9.4
Sodium (Na) / Potassium (K)	35	33	34	33
Carbonate (CO_3)	1.2	13	0	12
Bicarbonate (HCO_3)	156	20	163	22
Sulfate (SO_4)	97	109	96	108
Chloride (Cl)	16	17	16	17
Fluoride (F)	--	--	--	--
Nitrate (NO_3)	4.6	5.4	4.9	5.4
Dissolved solids	326	236	326	241
Hardness as $CaCO_3$:				
Total	183	97	181	96
Noncarbonate	53	60	48	58
Color	19	7	21	8
pH	7.9	9.2	8.0	9.2
Specific conductance (micromhos at 25 C.)	--	--	--	--
Turbidity	1,100	.07	1,300	0.07
Temperature (F.)	58	--	57	62
Date of collection	--	--	--	--

Regular determinations at treatment plant, 1950 2/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	130	226	77	7.9	8.1	7.6	183	289	107	1100	6400	80
Finished water	37	86	20	9.2	9.6	8.5	97	156	70	.07	.60	.02

Regular determinations at treatment plant, 1950 3/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	133	232	77	8.0	8.3	7.6	181	296	102	1300	6600	105
Finished water	38	85	23	9.2	9.9	7.9	96	150	66	.07	.30	.03

1/Monthly composite analyses.
2/Chain of Rocks (fiscal year ending April 1950).
3/Howard Bend (fiscal year ending April 1950).

SEDALIA
(Population, 20,354)

Ownership: Sedalia Water Co.; also supplies about 400 people outside the city limits. Total population supplied, about 20,750.
Source: Spring Fork Lake and Lake Tebo. The two lakes are interconnected, and water from both is mixed before going into the mains.
Treatment: Prechlorination, coagulation with alum, lime for pH control, activated carbon as needed, and rapid sand filtration. Copper sulfate is used for algae control.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: Spring Fork Lake, 560,000,000 gal; Lake Tebo, 175,000,000 gal; Reservoir (settling basin), 50,000,000 gal. Total, 785,000,000 gal.
Finished-water storage: 600,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water		Finished water
Silica (SiO_2)	4.3	Hardness as $CaCO_3$:	
Iron (Fe)	.10	Total	55
Manganese (Mn)	.00	Noncarbonate	37
Calcium (Ca)	13		
Magnesium (Mg)	5.5	Color	3
Sodium (Na)	2.7	pH	7.8
Potassium (K)	1.4	Specific conductance (micromhos at 25 C.)	140
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	22	Turbidity	0.6
Sulfate (SO_4)	35	Temperature (F.)	--
Chloride (Cl)	4.0	Date of collection	4/17/51
Fluoride (F)	.0		
Nitrate (NO_3)	2.8		
Dissolved solids	106		

SPRINGFIELD
(Population, 66,731)

Ownership: Springfield City Water Co. (private); also supplies about 10,000 people outside the city limits. Total population supplied, about 76,700.
Source: Springs, 70 percent of supply; lake, 20 percent of supply; 1 well, 1,404 ft deep, 10 percent of supply.
Treatment: Prechlorination, coagulation with alum, carbon, sedimentation, rapid sand filtration, postchlorination, and ammoniation.
Rated capacity of treatment plant: 12,000,000 gpd.
Raw-water storage: 1,300,000,000 gal.
Finished-water storage: 5,000,000 gal.

ANALYSIS

Analysis, in parts per million, by Div. of Health of Missouri, Jefferson City, Mo.

	Finished water (city tap)		Finished water (city tap)
Silica (SiO_2)	4.0	Hardness as $CaCO_3$:	
Iron (Fe)	.17	Total	178
Manganese (Mn)	--	Noncarbonate	18
Calcium (Ca)	62		
Magnesium (Mg)	5.7	Color	--
Sodium (Na)	6.4	pH	7.1
Potassium (K)		Specific conductance (micromhos at 25 C.)	--
Carbonate (CO_3)	0	Turbidity	0.1
Bicarbonate (HCO_3)	196	Temperature (F.)	--
Sulfate (SO_4)	13	Date of collection	10/2/51
Chloride (Cl)	9.7		
Fluoride (F)	--		
Nitrate (NO_3)	5.3		
Dissolved solids	247		

Regular determinations at treatment plant, 1951

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	157	178	130	7.5	8.7	7.1	--	--	--	6	25	1
Finished water	157	184	130	7.4	7.8	7.2	--	--	--	0	0	0

UNIVERSITY CITY
(Population, 39,892)

Ownership: St. Louis County Water Co.; also supplies Berkeley, Brentwood, Clayton, Ferguson, Jennings, Kinlock, Ladue, Maplewood, Overland, Pine Lawn, Richmond Heights, Webster Groves, Wellston, and a large number of incorporated and unincorporated places in St. Louis County. Total population supplied about 268,000.

Source: Missouri River for regular supply; connection to the supply of St. Louis for auxiliary or emergency use.

Treatment: Prechlorination, softening with lime, coagulation with ferric sulfate, sedimentation, rapid sand filtration, and postchlorination.

Rated capacity of treatment plant: 45,000,000 gpd.

Raw-water storage: 50,000,000 gal.

Finished-water storage: 12,000,000 gal.

The treatment plant is located on the Missouri River near St. Louis' Howard Bend Plant.

ANALYSES

(Analyses, in parts per million, by the St. Louis County Water Company)

	1/Raw water average	Finished water average		1/Raw water average	Finished water average
Silica (SiO_2)	13	12	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.0	Total	2/174	2/91
Manganese (Mn)	--	--	Noncarbonate	2/40	2/50
Calcium (Ca)	2/48	2/22			
Magnesium (Mg)	2/16	2/8.6	Color	2/17	2/9
Sodium (Na)	33	34	pH	2/7.9	2/9.7
Potassium (K)			Specific conductance (micromhos at 25 C.)	--	--
Carbonate (CO_3)	2/1	2/8	Turbidity	2/1,700	2/0.1
Bicarbonate (HCO_3)	2/162	2/28	Temperature (F.)	--	56
Sulfate (SO_4)	91	98	Date of collection	--	--
Chloride (Cl)	17	19			
Fluoride (F)	.4	.4			
Nitrate (NO_3)	2	2			
Dissolved solids	2/314	2/224			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	135	267	99	7.9	8.3	7.2	174	321	81	1700	10000	60
Finished water	40	74	25	9.7	10.2	8.6	91	134	51	.1	2	.1

1/Monthly composite analyses of daily samples, except as indicated.
2/Daily determinations.

WEBSTER GROVES
(Population, 23,390)

Ownership: Supplied by the St. Louis County Water Co. (See University City)

NEBRASKA

BEATRICE
(Population, 11,813)

Ownership: Municipal.
Source: 4 wells (1 to 4), 94, 95, 93, and 96 ft deep. The yield of the wells is reported to be 1,250, 820, 800, and 800 gpm.
Treatment: None.
Storage: 3,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 1, 2, and 3 (composite)		Wells 1, 2, and 3 (composite)
Silica (SiO_2)	30	Hardness as $CaCO_3$:	
Iron (Fe)	.01	Total	168
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	53		
Magnesium (Mg)	8.7	Color	2
Sodium (Na)	20	pH	7.4
Potassium (K)	3.5	Specific conductance (micromhos at 25 C.)	398
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	216	Turbidity	0.4
Sulfate (SO_4)	25	Temperature (F.)	63
Chloride (Cl)	10	Date of collection	3/19/51
Fluoride (F)	.1		
Nitrate (NO_3)	2.9		
Dissolved solids	276		

FREMONT
(Population, 14,762)

Ownership: Municipal; also supplies about 200 people outside the city limits. Total population supplied, about 15,000.
Source: 3 wells (Northwest, Northeast, and Southeast), 100, 102, and 105 ft deep; 4 condenser by-pass wells for use in emergency. The yield of the wells is reported to be 1,900 gpm, each. The water is pumped directly into the mains.
Treatment: None.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells (tap sample)		Wells (tap sample)
Silica (SiO_2)	29	Hardness as $CaCO_3$:	
Iron (Fe)	.14	Total	313
Manganese (Mn)	.03	Noncarbonate	106
Calcium (Ca)	78		
Magnesium (Mg)	29	Color	4
Sodium (Na)	31	pH	7.4
Potassium (K)	10	Specific conductance (micromhos at 25 C.)	723
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	253	Turbidity	0.6
Sulfate (SO_4)	146	Temperature (F.)	54
Chloride (Cl)	18	Date of collection	2/27/51
Fluoride (F)	.3		
Nitrate (NO_3)	8.3		
Dissolved solids	490		

GRAND ISLAND
(Population, 22,682)

Ownership: Municipal.
Source: 12 wells, seven of which are standby for summer use. Five of the wells (Harrison St., Locust St., Park View 1 and 2, and Dodge Acres) are 84, 113, 81, 78, and 101 ft deep, respectively. The yield of these wells is reported to be 820, 1,300, 1,000, 890, and 910 gpm.
Treatment: None.
Storage: Reservoir, 4,000,000 gal.

The analysis given represents reasonably well the composition of the water served to theconsumers.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 1/(composite)		Wells 1/(composite)
Silica (SiO_2)	27	Hardness as $CaCO_3$:	
Iron (Fe)	.06	Total	189
Manganese (Mn)	.00	Noncarbonate	53
Calcium (Ca)	62		
Magnesium (Mg)	8.3	Color	2
Sodium (Na)	19	pH	7.2
Potassium (K)	7.6	Specific conductance (micromhos at 25 C.)	465
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	166	Turbidity	0.6
Sulfate (SO_4)	64	Temperature (F.)	60
Chloride (Cl)	13	Date of collection	4/27/51
Fluoride (F)	.2		
Nitrate (NO_3)	20		
Dissolved solids	324		

1/Clebum, Hart, Parkview 1 and 2, and Harrison St. wells.

HASTINGS
(Population, 20,211)

Ownership: Municipal; also supplies 54 people outside the city limits. Total population supplied, 20,265.
Source: 9 wells (1 to 9), 180, 215, 156, 180, 182, (not reported), 195, 195, and 190 ft deep. The yield of wells is reported to be 980, 2,254, 1,012, (not reported, not reported), 1,025, 1,000, 2,040, and 1,000 gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 1,550,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 1, 2, and 5 (tap sample)		Wells 1, 2, and 5 (tap sample)
Silica (SiO_2)	25	Hardness as $CaCO_3$:	
Iron (Fe)	.08	Total	155
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	51		
Magnesium (Mg)	6.7	Color	1
Sodium (Na)	26	pH	7.5
Potassium (K)	5.7	Specific conductance (micromhos at 25 C.)	410
Carbonate (CO_3)	0	Turbidity	0.3
Bicarbonate (HCO_3)	208	Temperature (F.)	55
Sulfate (SO_4)	34	Date of collection	5/1/51
Chloride (Cl)	8.0		
Fluoride (F)	.3		
Nitrate (NO_3)	3.8		
Dissolved solids	266		

KEARNEY
(Population, 12,115)

Ownership: Municipal.
Source: 9 wells (2 to 10), 41, 42, 39, 50, 54, 50, 47, 50, and 44 ft deep. The yield of the wells is reported to be 500, 600, 500, 600, 900, 600, 600, 875, and 500 gpm.
Treatment: None.
Storage: 1,000,000 gal.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Wells 2, 6, and 9 (tap sample)		Wells 2, 6, and 9 (tap sample)
Silica (SiO_2)	36	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	395
Manganese (Mn)	.00	Noncarbonate	122
Calcium (Ca)	116		
Magnesium (Mg)	26	Color	2
Sodium (Na)	98	pH	7.5
Potassium (K)	10	Specific conductance (micromhos at 25 C.)	1,110
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	333	Turbidity	1
Sulfate (SO_4)	272	Temperature (F.)	55
Chloride (Cl)	28	Date of collection	5/1/51
Fluoride (F)	.4		
Nitrate (NO_3)	21		
Dissolved solids	808		

LINCOLN
(Population, 98,884)

Ownership: Municipal; also supplies about 1,850 people outside the city limits and other places. Total population supplied, about 100,700.

Source: 13 wells (1, 1A, 2-2, 2A, 3, 3A-2, 4, 4A, 5, 6, 7, 8, and 9), 50, 92, 88, 85, 65, 49, 54, 53, 67, 85, 84, 83, and 87 ft deep, located 3 miles northeast of Ashland, Nebr. for regular supply; 18 wells, located within Lincoln city limits, 130 to 188 ft deep, for auxiliary supply. The yield of the wells of the regular supply is reported to range from 1,170 gpm (well 4) to 2,090 gpm (well 9).

Treatment: Prechlorination, aeration, postchlorination, ammoniation, sedimentation, and rapid sand filtration, for regular supply. Chlorination only for auxiliary supply.

Rated capacity of treatment plant: 27,000,000 gpd.

Raw-water storage: None.

Finished-water storage: Underground reservoirs, 30,100,000 gal; elevated storage, 385,000 gal; concrete tanks, 2,000,000 gal. Total, 32,485,000 gal.

A collecting pipeline carries the water from the wells to the treatment plant just east of Ashland. After treatment the water is pumped into a concrete reservoir and then into a 36 in. cast-iron pipeline to Lincoln, a distance of 25 miles.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Regular Supply		Auxiliary Supply	
	Ashland well 2-2	Ashland wells 1/(fin. water)	Lincoln well 16	Lincoln wells 1/(fin. water)
Silica (SiO_2)	24	34	25	39
Iron (Fe)	.09	.1	.07	.2
Manganese (Mn)	.32	.02	.00	.0
Calcium (Ca)	55	59	56	69
Magnesium (Mg)	10	15	14	18
Sodium (Na)	32	31	30	40
Potassium (K)	8.0		4.0	
Carbonate (CO_3)	--	--	--	--
Bicarbonate (HCO_3)	202	212	239	239
Sulfate (SO_4)	83	76	42	55
Chloride (Cl)	8.0	16	14	55
Fluoride (F)	.4	.3	.1	.3
Nitrate (NO_3)	.5	.1	9.6	2.0
Dissolved solids	336	310	336	396
Hardness as $CaCO_3$:				
Total	180	206	196	247
Noncarbonate	14	32	0	51
Color	--	--	--	--
pH	7.5	7.8	7.0	7.3
Specific conductance (micromhos at 25 C.)	492	--	500	--
Turbidity	--	--	--	--
Temperature (F.)	--	--	55	--
Date of collection	5/29/51	9/51	7/17/51	9/51
Depth (feet)	88		142	
Diameter (inches)	24		12	
Date drilled	1,950		--	
Percent of supply	--		--	

1/Analyzed by Lincoln Water Dept.

NORFOLK
(Population, 11,335)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 11,400.
Source: 4 wells (1 to 4), each 110 ft deep. The yield of the wells is reported to be 900, 800, 500, and 700 gpm. One or two of the four wells are held in reserve.
Treatment: Aeration, sedimentation, and rapid sand filtration.
Rated capacity of treatment plant: 3,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,500,000 gal in clear wells and under pressure.

The water from the different wells is mixed before it reaches the treatment plant. The analyses given of the raw and finished water do not represent water from the same 3 wells. The composition of the finished water varies to some extent depending on what wells are being pumped for the supply.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	3 Wells 1/(raw water)	Finished 1/water		3 Wells 1/(raw water)	Finished 1/water
Silica (SiO_2)	31	32	Hardness as $CaCO_3$:		
Iron (Fe)	1.4	.04	Total	284	310
Manganese (Mn)	.29	.03	Noncarbonate	34	55
Calcium (Ca)	85	94			
Magnesium (Mg)	18	18	Color	5	4
Sodium (Na)	15	16	pH	7.4	7.8
Potassium (K)	6.8	7.8	Specific conductance (micromhos at 25 C.)	585	633
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	306	311			
Sulfate (SO_4)	61	83	Turbidity	10	0.5
Chloride (Cl)	10	13	Temperature (F.)	55	55
Fluoride (F)	.3	.3	Date of collection	2/20/51	2/20/51
Nitrate (NO_3)	0	.5			
Dissolved solids	398	442			

1/Composite.

NORTH PLATTE
(Population, 15,433)

Ownership: Municipal.
Source: 45 wells. Forty-one wells in one well field (field No. 1) with an average depth of 100 ft; in another well field 4 wells (2, 3, 4, and 5 or Dunlap well) 97, 92, 135, and 256 ft deep. The yield of the four wells is reported to be 1,750, 1,800, 500, and 800 gpm, respectively, and the combined yield of the 41 wells is 3,400 gpm.
Storage: None.

The wells in field No. 1 are operated as a unit, whereas the other four wells are pumped separately.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	1/Wells (tap sample)		1/Wells (tap sample)
Silica (SiO_2)	41	Hardness as $CaCO_3$:	
Iron (Fe)	.03	Total	326
Manganese (Mn)	.00	Noncarbonate	120
Calcium (Ca)	99		
Magnesium (Mg)	19	Color	2
Sodium (Na)	112	pH	7.8
Potassium (K)	12	Specific conductance (micromhos at 25 C.)	1,100
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	252	Turbidity	0.6
Sulfate (SO_4)	268	Temperature (F.)	60
Chloride (Cl)	64	Date of collection	5/1/51
Fluoride (F)	.8		
Nitrate (NO_3)	11		
Dissolved solids	798		

1/Well Field 1 and well 5 (Dunlap well).

OMAHA
(Population, 251,117)

Ownership: Metropolitan Utilities District; also supplies about 13,000 people outside the city limits. Total population supplied, about 264,100.
Source: Missouri River. The intake and treatment plant are located on the Missouri River at Florence.
Treatment: Plain sedimentation, prechlorination, coagulation with alum, sedimentation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 90,000,000 gpd.
Raw-water storage: 86,000,000 gal.
Finished-water storage: 44,000,000 gal.

There is considerable variation in the chemical quality of the water throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water	Finished water
Silica (SiO_2)	13	8.5	--
Iron (Fe)	.04	.02	0.11
Manganese (Mn)	.01	.00	.03
Calcium (Ca)	72	64	--
Magnesium (Mg)	6.4	20	--
Sodium (Na)	41	62	--
Potassium (K)	4.7	2.8	--
Carbonate (CO_3)	0	0	--
Bicarbonate (HCO_3)	174	170	175
Sulfate (SO_4)	138	221	158
Chloride (Cl)	9.5	14	--
Fluoride (F)	.4	.6	--
Nitrate (NO_3)	4.0	1.4	--
Dissolved solids	386	492	418
Hardness as $CaCO_3$:			
Total	206	242	230
Noncarbonate	64	102	86
Color	5	--	4
pH	7.7	8.0	7.8
Specific conductance (micromhos at 25 C.)	575	756	629
Turbidity	500	--	1
Temperature (F.)	34	--	34
Date of collection	2/27/51	10/12/47	2/27/51

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	--	--	--	200	15000	25
Finished water	146	232	91	7.8	8.2	7.3	261	380	175	.2	6.0	0

SCOTTSBLUFF
(Population, 12,858)

Ownership: Municipal; also supplies about 100 people outside the city limits. Total population supplied, about 12,950.
Source: 4 wells (2 to 5), 105, 105, 100, and 100 ft deep, for regular supply; 3 standby wells for emergency use. Two additional wells 102 ft deep are under construction. The yield of wells 4 and 5 is reported as 1,361 and 1,380 gpm.
Treatment: None.
Storage: 2 elevated tanks, 300,000 and 100,000 gal.

Three of the wells used for the regular supply are located in the south part of the city and the other in the north part. The water from the wells is pumped directly into the mains, which are interconnected in the midcity area, and consumers in the area receive mixed water from the four wells, whereas in the other sections they receive water from three wells and one. The analysis given is of a sample collected in the midcity area.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	4 Wells (composite)		4 Wells (composite)
Silica (SiO_2)	48	Hardness as $CaCO_3$:	
Iron (Fe)	.04	Total	290
Manganese (Mn)	.00	Noncarbonate	0
Calcium (Ca)	76		
Magnesium (Mg)	24	Color	2
Sodium (Na)	104	pH	7.7
Potassium (K)	9.9	Specific conductance (micromhos at 25 C.)	952
Carbonate (CO_3)	0	Turbidity	1
Bicarbonate (HCO_3)	364	Temperature (F.)	55
Sulfate (SO_4)	178	Date of collection	4/30/51
Chloride (Cl)	22		
Fluoride (F)	.3		
Nitrate (NO_3)	14		
Dissolved solids	670		

Depth (feet)	100-105
Diameter (inches)	16-36
Date drilled	1935-48
Percent of supply	100

BISMARK
(Population, 18,640)

Ownership: Municipal; also supplies 800 people outside the city limits. Total population supplied, 19,440.
Source: Missouri River.
Treatment: Plain sedimentation, softening with lime and soda ash, coagulation with alum, activated carbon, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: 1,500,000 gal.
Finished-water storage: 4,100,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	6.6	3.4	Hardness as $CaCO_3$:		
Iron (Fe)	.04	.05	Total	130	84
Manganese (Mn)	.00	.00	Noncarbonate	23	55
Calcium (Ca)	35	28			
Magnesium (Mg)	10	3.4	Color	33	5
Sodium (Na)	31	31	pH	7.9	8.3
Potassium (K)	3.4	3.5	Specific conductance (micromhos at 25 C.)	393	338
Carbonate (CO_3)	0	0	Turbidity	330	2
Bicarbonate (HCO_3)	131	35	Temperature (F.)	32	32
Sulfate (SO_4)	85	114	Date of collection	4/6/51	4/6/51
Chloride (Cl)	2.5	7.0			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	2.7	.5			
Dissolved solids	250	244			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	151	232	74	8.0	8.5	7.1	208	338	104	1295	4600	25
Finished water	72	148	18	8.8	10.2	7.7	90	200	44	0	0	0

DICKINSON
(Population, 7,469)

Ownership: Municipal.
Source: 6 wells, 199, 214, 173, 175, 140, and 129 ft deep, about 59 percent of the supply; Heart River, about 41 percent of supply. During the 1950 calendar year the supply consisted of a mixture of river water and well water from May through September, and well water, exclusively, the remainder of the year. The use of well water will be discontinued as soon as the new treatment plant is ready for operation. The completion date for the plant is set for Mar. 1, 1952.
Treatment: Coagulation with alum and lime, activated carbon, sedimentation, filtration, chlorination, and ammoniation for river water. Addition of polyphosphate (Nalco) to both well water and river water for stabilization and corrosion control.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,400,000 gal.

There is tremendous variation in the composition of the river water throughout the year. The analyses show approximately the range in composition of the raw river water.
The wells furnish water of similar composition. The analysis given represents water of the maximum concentration of dissolved solids.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well (raw water)	Heart River		Finished 1/ water
		Raw water	Raw water	
Silica (SiO_2)	12	4.2	6.0	10
Iron (Fe)	.05	.70	.25	.03
Manganese (Mn)	--	--	--	--
Calcium (Ca)	9.0	9.4	60	53
Magnesium (Mg)	7.0	3.6	19	21
Sodium (Na)	574	10	290	199
Potassium (K)	6.4	6.6		3.6
Carbonate (CO_3)	--	0	31	--
Bicarbonate (HCO_3)	2/911	68	500	388
Sulfate (SO_4)	528	9.0	376	316
Chloride (Cl)	7.0	2.5	2.0	10
Fluoride (F)	.2	.0	.5	.2
Nitrate (NO_3)	.5	.2	.5	.5
Dissolved solids	1,600	87	1,070	814
Hardness as $CaCO_3$:				
Total	51	38	228	219
Noncarbonate	0	0	0	0
Color	--	--	--	--
pH	8.4	7.5	8.2	8.5
Specific conductance (micromhos at 25 C.)	2,260	136	1,430	1,260
Turbidity	--	--	--	--
Temperature (F.)	--	--	52	--
Date of collection	7/18/47	3/23/47	5/26/47	8/3/47

1/ Composite of well and river water.
2/ Alkalinity as bicarbonate (HCO_3).

FARGO
(Population, 38,256)

Ownership: Municipal; also supplies about 600 people outside the city limits. Total population supplied, about 38,900.
Source: Red River of the North for regular supply; 1 well, 195 ft deep, for auxiliary supply. The auxiliary supply is used only during extremely dry periods. During 1950 a total of 6,100,000 gal of well water was used.
Treatment: Softening with lime and soda ash, sedimentation, recarbonation, chlorination, ammoniation, and rapid sand filtration.
Rated capacity of treatment plant: 10,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,600,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	13	9.4	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	314	155
Manganese (Mn)	.00	.00	Noncarbonate	129	74
Calcium (Ca)	66	30			
Magnesium (Mg)	36	19	Color	9	3
Sodium (Na)	23	49	pH	7.8	9.1
Potassium (K)	7.5	7.5	Specific conductance (micromhos at 25 C.)	669	536
Carbonate (CO_3)	0	15	Turbidity	40	1
Bicarbonate (HCO_3)	226	69	Temperature (F.)	67	68
Sulfate (SO_4)	167	165	Date of collection	5/25/51	5/25/51
Chloride (Cl)	5.5	8.5			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	1.8	.4			
Dissolved solids	464	360			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH 1/			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	250	350	70	8.0	8.4	7.6	273	431	155	50	1500	0
Finished water	85	178	60	9.0	9.8	8.8	129	226	89	0	0	0

1/1949.

GRAND FORKS
(Population, 26,836)

Ownership: Municipal; also supplies 300 people outside the city limits. Total population supplied, 27,136.
Source: Red Lake River, 60 percent of supply; Red River of the North, 40 percent of supply. Water from both rivers is mixed before entering the treatment plant.
Treatment: Prechlorination, softening with lime and soda ash, coagulation with alum, occasionally sodium aluminate, sedimentation, recarbonation, ammoniation, rapid sand filtration, and postchlorination.
Rated capacity of treatment plant: 4,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,500,000 gal.

There is considerable variation in the composition of the river water throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Red Lake 1/River (raw water)	Red River of 1/the North (raw water)	Raw water	Finished water
Silica (SiO_2)	10	2.0	9.8	3.8
Iron (Fe)	--	--	.03	.03
Manganese (Mn)	--	--	.00	.00
Calcium (Ca)	46	74	61	36
Magnesium (Mg)	20	40	23	1.5
Sodium (Na)	19	38	10	33
Potassium (K)			4.5	4.3
Carbonate (CO_3)	--	--	0	--
Bicarbonate (HCO_3)	244	348	216	2/50
Sulfate (SO_4)	31	111	88	114
Chloride (Cl)	2.0	20	4.0	9.0
Fluoride (F)	.0	.0	.1	.1
Nitrate (NO_3)	5.3	4.4	1.6	.8
Dissolved solids	245	464	338	248
Hardness as $CaCO_3$:				
Total	197	349	246	96
Noncarbonate	0	64	69	55
Color	--	--	23	3
pH	--	--	7.6	8.4
Specific conductance (micromhos at 25 C.)	--	--	508	363
Turbidity	--	--	55	3
Temperature (F.)	--	--	66	66
Date of collection	11/6/50	11/6/50	5/24/51	5/24/51

1/Analyzed by University of North Dakota.
2/Includes the equivalent of less than 5 ppm of carbonate (CO_3).

Regular determinations at treatment plant, 1950 3/

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water.....	203	330	75	7.4	8.2	7.2	271	425	85	10	120	5
Finished water...	67	120	30	9.4	9.8	8.8	81	170	44	1	5	0

3/ Fiscal year.

JAMESTOWN
(Population, 10,697)

Ownership: Municipal.
Source: 6 drilled wells (1 to 6) 80 to 87 ft deep; 1 dug well, 36 ft deep and 25 ft in diameter. The yield of the wells is reported to be 300, 300, 300, 300, 500, over 500, and 1,300 gpm.
Treatment: Aeration, softening with lime, coagulation with sodium aluminate, sedimentation, recarbonation, rapid sand filtration, chlorination, and addition of polyphosphate.
Rated capacity of treatment plant: 2,250,000 gpd.
Raw-water storage: None.
Finished-water storage: 2,610,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/ Raw water	Finished 1/ water		1/ Raw water	Finished 1/ water
Silica (SiO_2)	26	14	Hardness as $CaCO_3$:		
Iron (Fe)	2.8	.07	Total	432	116
Manganese (Mn).....	1.0	.00	Noncarbonate.....	55	40
Calcium (Ca).....	107	35			
Magnesium (Mg).....	40	6.9	Color	2	1
Sodium (Na)	113	110	pH	7.8	9.5
Potassium (K)	6.7	6.7	Specific conductance (micromhos at 25 C.).....	1,180	746
Carbonate (CO_3).....	0	25			
Bicarbonate (HCO_3)	460	42			
Sulfate (SO_4)	233	222	Turbidity	35	0.2
Chloride (Cl).....	38	38	Temperature (F.)...	43	47
Fluoride (F).....	.1	.1	Date of collection...	4/11/51	4/11/51
Nitrate (NO_3)	3.8	2.5			
Dissolved solids.....	810	510			

1/ Composite.

MANDAN
(Population, 7,298)

Ownership: Municipal; also supplies about 500 people outside the city limits. Total population supplied, about 7,800.
Source: Missouri River. The intake is about 5 miles north of Mandan.
Treatment: Plain sedimentation, aeration, softening with lime and soda ash, coagulation with alum and sodium aluminate, ammoniation, chlorination, sedimentation, recarbonation, polyphosphates (918-Y balls), and rapid sand filtration.
Rated capacity of treatment plant: 2,000,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,500,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	11	9.4	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.03	Total	192	114
Manganese (Mn)	.00	.00	Noncarbonate	50	56
Calcium (Ca)	49	32			
Magnesium (Mg)	17	8.3	Color	7	2
Sodium (Na)	57	63	pH	7.7	9.1
Potassium (K)	4.6	4.7	Specific conductance (micromhos at 25 C.)	636	533
Carbonate (CO_3)	0	10	Turbidity	500	1
Bicarbonate (HCO_3)	173	50	Temperature (F.)	63	62
Sulfate (SO_4)	155	178	Date of collection	5/17/51	5/21/51
Chloride (Cl)	7.5	12			
Fluoride (F)	.4	.4			
Nitrate (NO_3)	1.7	.9			
Dissolved solids	408	348			

Regular determinations at treatment plant

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	160	222	120	8.1	8.3	8.0	229	316	142	--	--	--
Finished water	87	125	64	9.1	9.2	8.9	112	133	89	--	--	--

MINOT
(Population, 22,032)

Ownership: Municipal.
Source: 7 wells (1, and 3 to 8) 131, 158, 158, 147, 139, 125, and 132 ft deep. The yield of the wells is reported to be 533, 350, 450, 800, 800, 860, and 860 gpm. In 1950 well 7 furnished 75 percent of the supply, and wells 3, 4, and 5, the remainder.
Treatment: Chlorination.
Raw-water storage: 4,100,000 gal.
Finished-water storage: 4,100,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 3 (finished water)	Well 5 (finished water)	Well 7 (finished water)
Silica (SiO_2)	26	26	23
Iron (Fe)	2.6	2.7	2.5
Manganese (Mn)	.04	.22	.02
Calcium (Ca)	86	112	84
Magnesium (Mg)	29	42	33
Sodium (Na)	359	180	233
Potassium (K)	5.8	6.7	4.9
Carbonate (CO_3)	0	0	0
Bicarbonate (HCO_3)	789	558	748
Sulfate (SO_4)	120	153	70
Chloride (Cl)	240	156	128
Fluoride (F)	.2	.1	.2
Nitrate (NO_3)	3.0	2.2	.8
Dissolved solids	1,280	980	972
Hardness as $CaCO_3$:			
Total	334	454	347
Noncarbonate	0	0	0
Color	18	7	13
pH	7.6	7.5	7.7
Specific conductance (micromhos at 25 C.)	2,070	1,550	1,560
Turbidity	25	35	5
Temperature (F.)	51	49	48
Date of collection	5/17/51	5/17/51	5/17/51
Depth (feet)	158	158	125
Diameter (inches)	12	16	16
Date drilled	1931	1939	1948
Percent of supply	--	--	--

WILLISTON
(Population, 7,378)

Ownership: Municipal; also supplies about 650 people outside the city limits. Total population supplied, about 8,050.
Source: Missouri River for regular supply; 2 wells each 220 ft deep for auxiliary supply. The yield of the wells is reported to be 550 and 600 gpm.
Treatment: Plain sedimentation, softening with lime (soda ash in winter), coagulation with alum and sodium aluminate, sedimentation, rapid sand filtration, ammoniation, and chlorination.
Rated capacity of treatment plant: 1,200,000 gpd.
Raw-water storage: 1,000,000 gal.
Finished-water storage: 630,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	10	9.8	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.11	Total	191	151
Manganese (Mn)	.01	.00	Noncarbonate	56	52
Calcium (Ca)	50	41			
Magnesium (Mg)	16	12	Color	9	4
Sodium (Na)	55	57	pH	7.9	8.9
Potassium (K)	4.9	4.2	Specific conductance (micromhos at 25 C.)	599	553
Carbonate (CO_3)	0	16	Turbidity	95	20
Bicarbonate (HCO_3)	165	89	Temperature (F.)	60	64
Sulfate (SO_4)	161	158	Date of collection	5/17/51	5/17/51
Chloride (Cl)	8.5	9.5			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	1.5	.8			
Dissolved solids	394	374			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	145	170	120	--	--	--	257	340	205	40	54	32
Finished water	55	68	53	--	--	--	137	214	68	40	54	32

SOUTH DAKOTA

ABERDEEN
(Population, 21,051)

Ownership: Municipal; also supplies 175 people outside the city limits. Total population supplied, 21,226.

Source: Elm River (impounded) supplemented by Maple and Willow Creeks (impounded) for main supply; 2 gravel pits, located northeast of treatment plant, for auxiliary supply.

Treatment: Softening with lime and soda ash, sedimentation, activated carbon, recarbonation, addition of polyphosphates (918-Y balls), coagulation with alum and sodium aluminate, secondary sedimentation, rapid sand filtration, ammoniation, and chlorination.

Rated capacity of treatment plant: 4,000,000 gpd.

Raw-water storage: No. 1 dam, 60,000,000 gal; No. 2 dam, 170,000,000 gal; No. 4 dam, 76,000,000 gal; Elm Lake, 5,000,000 gal.

Finished-water storage: 3,700,000 gal.

The treatment plant is located 8 miles northeast of Aberdeen. River was at high stage when samples were collected. Fluoridation of public supply will be started soon.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Elm River	2/Elm River		1/Elm River	2/Elm River
Silica (SiO_2)	9.8	6.0	Hardness as $CaCO_3$:		
Iron (Fe)	.03	.06	Total	97	75
Manganese (Mn)	.00	.00	Noncarbonate	17	41
Calcium (Ca)	25	28			
Magnesium (Mg)	8.4	1.3	Color	33	5
Sodium (Na)	26	25	pH	7.1	8.8
Potassium (K)	7.0	6.8	Specific conductance (micromhos at 25 C.)	326	313
Carbonate (CO_3)	0	3	Turbidity	10	0.4
Bicarbonate (HCO_3)	98	35	Temperature (F.)	39	39
Sulfate (SO_4)	56	80	Date of collection	4/11/51	4/11/51
Chloride (Cl)	14	16			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	3.6	.5			
Dissolved solids	204	188			

Regular determinations at treatment plant, 1950

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Turbidity		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	400	40	--	8.6	7.2	--	500	40	--	400	20
Finished water	--	75	20	9.5	10	9	70	110	30	--	--	--

1/Raw water.
2/Finished water.

BROOKINGS
(Population, 7,764)

Ownership: Municipal; also supplies a few people outside the city limits. Total population supplied, about 7,800.
Source: 3 wells (1, 2, and 3), each 60 ft deep, and each reported to yield 1,000 gpm.
Treatment: Aeration (for iron removal), sedimentation, and chlorination.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 4,000,000 gal.

The treatment plant is 2 miles north of Brookings.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Well 1 (raw water)	Finished water		Well 1 (raw water)	Finished water
Silica (SiO_2)	24	25	Hardness as $CaCO_3$:		
Iron (Fe)	4.5	.19	Total	656	672
Manganese (Mn)	.75	.93	Noncarbonate	370	383
Calcium (Ca)	171	173			
Magnesium (Mg)	56	58	Color	2	3
Sodium (Na)	17	18	pH	8.0	8.3
Potassium (K)	2.5	2.4	Specific conductance (micromhos at 25 C.)	1,160	1,160
Carbonate (CO_3)	0	10			
Bicarbonate (HCO_3)	349	333			
Sulfate (SO_4)	383	388	Turbidity	70	1
Chloride (Cl)	5.0	9.5	Temperature (F.)	48	48
Fluoride (F)	.3	.3	Date of collection	4/3/51	4/3/51
Nitrate (NO_3)	1.6	1.4			
Dissolved solids	874	890			

Depth (feet)	60	
Diameter (inches)	18	
Date drilled	1930	
Percent of supply	--	

HURON
(Population, 12,788)

Ownership: Municipal.
Source: James River for regular supply; 3 wells for auxiliary supply.
Treatment: Prechlorination, activated carbon, softening with lime and soda ash, coagulation and clarification with sodium aluminate, recarbonation, sedimentation, charcoal, and rapid sand filtration.
Rated capacity of treatment plant: 4,500,000 gpd.
Raw-water storage: None.
Finished-water storage: 1,600,000 gal.

There is considerable variation in the composition of the water throughout the year. The treatment varies throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	James 1/River	James 2/River		James 1/River	James 2/River
Silica (SiO_2)	9.0	8.2	Hardness as $CaCO_3$:		
Iron (Fe)	.02	.05	Total	152	158
Manganese (Mn)	.00	.69	Noncarbonate	39	88
Calcium (Ca)	37	38			
Magnesium (Mg)	15	15	Color	45	7
Sodium (Na)	39	46	pH	7.5	7.3
Potassium (K)	11	11	Specific conductance (micromhos at 25 C.)	497	559
Carbonate (CO_3)	0	0	Turbidity	15	0.3
Bicarbonate (HCO_3)	138	85	Temperature (F.)	37	38
Sulfate (SO_4)	97	149	Date of collection	4/10/51	4/10/51
Chloride (Cl)	21	30			
Fluoride (F)	.1	.1			
Nitrate (NO_3)	5.6	1.4			
Dissolved solids	340	384			

1/Raw water.
2/Finished water.

LEAD
(Population, 6,422)

Ownership: Homestake Mining Co.; also supplies about 1,000 people in Deadwood and 500 in Central City and Terraville, and Pluma. Total population supplied, about 7,900.
Source: Springs in upper Spearfish Creek basin.
Treatment: Chlorination and ammoniation.
Rated capacity of treatment plant: Unknown.
Raw-water storage: None.
Finished-water storage: Reservoirs, 2,165,000 gal.

The water is pumped from the springs as needed to keep the reservoirs full.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	12	11	Hardness as $CaCO_3$:		
Iron (Fe)	.07	.08	Total	250	255
Manganese (Mn)	.00	.00	Noncarbonate	1	2
Calcium (Ca)	62	60			
Magnesium (Mg)	23	26	Color	1	1
Sodium (Na)	.6	.6	pH	8.0	8.2
Potassium (K)	.3	.4	Specific conductance (micromhos at 25 C.)	444	446
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	304	308			
Sulfate (SO_4)	1.0	1.0	Turbidity	0.4	0.9
Chloride (Cl)	1.0	1.3	Temperature (F.)	--	--
Fluoride (F)	.1	.1	Date of collection	5/15/51	5/15/51
Nitrate (NO_3)	1.3	1.8			
Dissolved solids	251	255			

MITCHELL
(Population, 12,123)

Ownership: Municipal; also supplies about 125 people outside the city limits, and air base, and Hormel Packing Co. Total population supplied, about 12,250.
Source: Firesteel Creek impounded in Lake Mitchell.
Treatment: Softening with lime-soda ash, coagulation with sodium aluminate, carbon, sedimentation, rapid sand filtration, recarbonation, and chlorination.
Rated capacity of treatment plant: 6,000,000 gpd.
Raw-water storage: 3,565,000,000 gal.
Finished-water storage: 1,550,000 gal.

There is considerable variation in the composition of the raw water throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	5.4	5.1	Hardness as $CaCO_3$:		
Iron (Fe)	.14	.14	Total	392	126
Manganese (Mn)	.20	.03	Noncarbonate	214	20
Calcium (Ca)	82	31			
Magnesium (Mg)	46	12	Color	9	4
Sodium (Na)	66	144	pH	7.6	9.7
Potassium (K)	14	14	Specific conductance (micromhos at 25 C.)	1,010	960
Carbonate (CO_3)	0	37	Turbidity	--	--
Bicarbonate (HCO_3)	217	54	Temperature (F.)	36	36
Sulfate (SO_4)	323	311	Date of collection	2/18/52	2/18/52
Chloride (Cl)	24	24			
Fluoride (F)	.3	.3			
Nitrate (NO_3)	2.3	2.0			
Dissolved solids	724	631			

Regular determinations at treatment plant

	Alkalinity as $CaCO_3$ (ppm)			pH			Hardness as $CaCO_3$ (ppm)			Temperature		
	Av	Max	Min	Av	Max	Min	Av	Max	Min	Av	Max	Min
Raw water	--	--	--	--	--	--	240	300	190	--	65	33
Finished water	--	--	--	9.5	--	--	85	--	--	--	65	33

RAPID CITY
(Population, 25,310)

Ownership: Municipal.
Source: Jackson Springs (82 percent of supply, 1950); 4 wells (1 to 4) 1,460, 902, 957, and 1,075 ft deep (18 percent of supply, 1950). The yield of the wells is reported to be 380 (flowing), 240 (flowing), 669, and 690 (flowing) gpm.
Treatment: Chlorination.
Raw-water storage: None.
Finished-water storage: 3,000,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Jackson 1/Springs	Finished 2/water		Jackson 1/Springs	Finished 2/water
Silica (SiO_2)	13	11	Hardness as $CaCO_3$:		
Iron (Fe)	.05	.06	Total	185	193
Manganese (Mn)	.03	.00	Noncarbonate	21	20
Calcium (Ca)	41	43			
Magnesium (Mg)	20	21	Color	--	0
Sodium (Na)	1.8	5.2	pH	7.9	7.8
Potassium (K)		2.1	Specific conductance (micromhos at 25 C.)	369	376
Carbonate (CO_3)	0	0	Turbidity	--	0.7
Bicarbonate (HCO_3)	200	211	Temperature (F.)	--	--
Sulfate (SO_4)	20	28	Date of collection	7/27/49	5/23/51
Chloride (Cl)	1.6	3.5			
Fluoride (F)	.2	.1			
Nitrate (NO_3)	1.1	1.4			
Dissolved solids	210	219			

1/Raw water.
2/Composite.

SIOUX FALLS
(Population, 52,696)

Ownership: Municipal; also supplies about 1,000 people outside the city limits. Total population supplied, about 53,700.

Source: 17 shallow wells 36 to 45 ft deep in the Big Sioux River bottoms. The yield of the wells ranges from 300 gpm (well 10) to 1,025 gpm (well 14), and averages 779 gal.

Treatment: Aeration, chlorination, sedimentation, rapid sand filtration, and stabilization with polyphosphate (Nalco).

Rated capacity of treatment plant: 8,000,000 gpd.

Raw-water storage: None.

Finished-water storage: Elevated tanks, 1,905,000 gal; storage reservoirs, 5,200,000 gal. Total, 7,105,000 gal.

The quality of the water from the wells is affected by change in the stage of the Big Sioux River. There is considerable variation in the composition of the water throughout the year.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	1/Raw water	Finished 2/water		1/Raw water	Finished 2/water
Silica (SiO_2)	18	20	Hardness as $CaCO_3$:		
Iron (Fe)	6.3	.42	Total	320	484
Manganese (Mn)	.71	1.6	Noncarbonate	129	227
Calcium (Ca)	85	122			
Magnesium (Mg)	26	44	Color	5	4
Sodium (Na)	7.6	17	pH	7.9	7.6
Potassium (K)	2.6	3.4	Specific conductance (micromhos at 25 C.)	624	921
Carbonate (CO_3)	0	0			
Bicarbonate (HCO_3)	233	314			
Sulfate (SO_4)	131	237	Turbidity	1	2
Chloride (Cl)	5.5	14	Temperature (F.)	45	50
Fluoride (F)	.3	.4	Date of collection	4/3/51	4/3/51
Nitrate (NO_3)	1.8	.6			
Dissolved solids	430	646			

1/Composite, all wells except well 24.
2/Composite, all wells.

WATERTOWN
(Population, 12,699)

Ownership: Municipal.
Source: Lake Kampeska, 75 percent of supply; 3 wells (2 to 4), each 28 ft deep, 25 percent of supply. The yield of the wells is reported to be 104, 104, and 139 gpm.
Treatment: Lake water: coagulation with alum, sedimentation, rapid sand filtration, ammoniation, and chlorination.
Rated capacity of treatment plant: 1,000,000 gpd.
Raw-water storage: Lake Kampeska.
Finished-water storage: 2,400,000 gal.

The treatment plant is located near the lake. The finished lake water is mixed with the raw well water and the mixed water is delivered to the distribution system.

ANALYSIS

(Analysis, in parts per million, by U. S. Geological Survey)

	Finished water (composite)		Finished water (composite)
Silica (SiO_2)	19	Hardness as $CaCO_3$:	
Iron (Fe)	.02	Total	342
Manganese (Mn)	.00	Noncarbonate	124
Calcium (Ca)	81		
Magnesium (Mg)	34	Color	3
Sodium (Na)	53	pH	7.8
Potassium (K)	6.8	Specific conductance (micromhos at 25 C.)	901
Carbonate (CO_3)	0		
Bicarbonate (HCO_3)	266	Turbidity	0.8
Sulfate (SO_4)	115	Temperature (F.)	43
Chloride (Cl)	88	Date of collection	4/12/51
Fluoride (F)	.1		
Nitrate (NO_3)	5.7		
Dissolved solids	586		

YANKTON
(Population, 7,709)

Ownership: Municipal; also supplies about 3,000 people outside the city limits. Total population supplied, about 10,700.
Source: Missouri River.
Treatment: Coagulation with alum and sodium aluminate, softening with lime, sedimentation, rapid sand filtration, chlorination, and ammoniation.
Rated capacity of treatment plant: 1,500,000 gpd.
Raw-water storage: None.
Finished-water storage: Clear well and tank, 1,250,000 gal.

ANALYSES

(Analyses, in parts per million, by U. S. Geological Survey)

	Raw water	Finished water		Raw water	Finished water
Silica (SiO_2)	15	12	Hardness as $CaCO_3$:		
Iron (Fe)	.10	.05	Total	245	113
Manganese (Mn)	.03	.01	Noncarbonate	78	80
Calcium (Ca)	65	26			
Magnesium (Mg)	20	12	Color	5	4
Sodium (Na)	57	61	pH	8.0	9.8
Potassium (K)	5.1	4.0	Specific conductance (micromhos at 25 C.)	693	531
Carbonate (CO_3)	0	17			
Bicarbonate (HCO_3)	203	5.0	Turbidity	45	1
Sulfate (SO_4)	187	194	Temperature (F.)	35	37
Chloride (Cl)	11	12	Date of collection	2/20/51	2/20/51
Fluoride (F)	.5	.6			
Nitrate (NO_3)	1.6	1.6			
Dissolved solids	494	368			

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