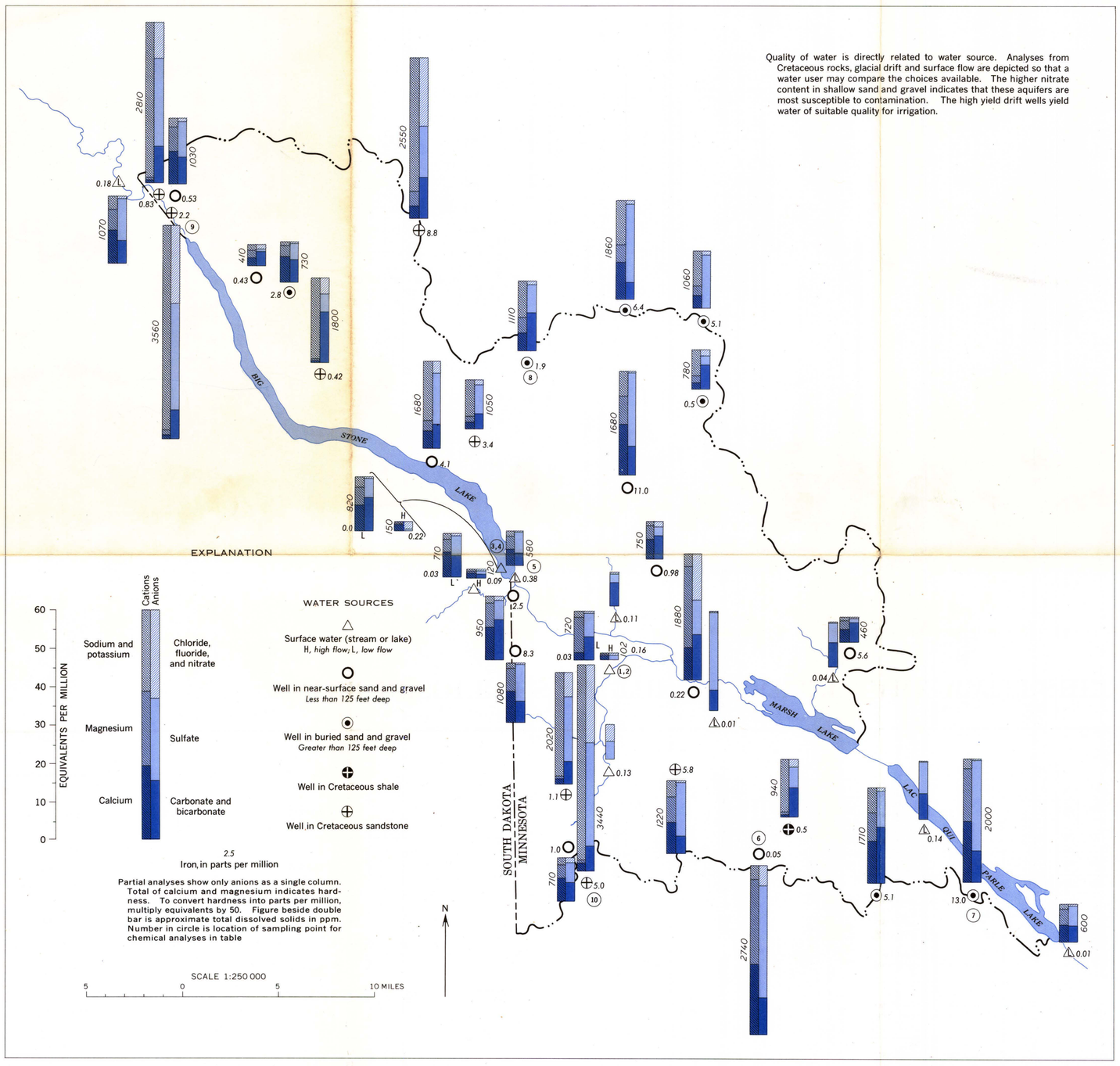
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF WATERS

HYDROLOGIC INVESTIGATIONS
ATLAS HA-213 (SHEET 3 OF 4)

QUALITY OF WATER

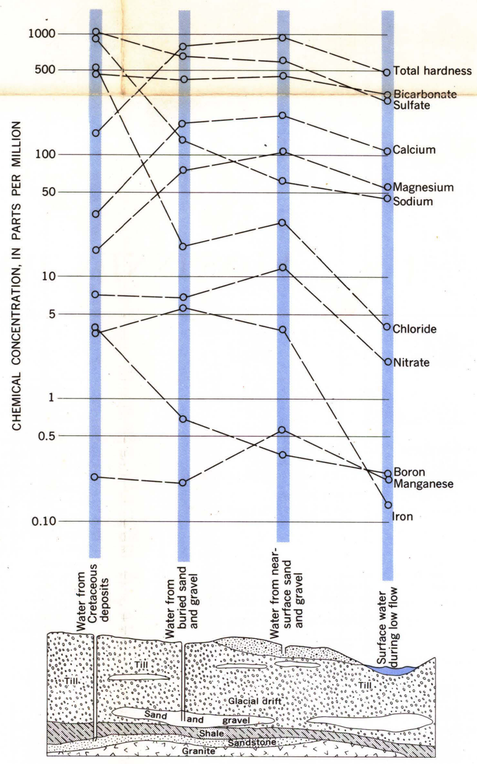
Quality of water is directly related to water source. Analyses from Cretaceous rocks, glacial drift and surface flow are depicted so that a water user may compare the choices available. The higher nitrate content in shallow sand and gravel indicates that these aquifers are most susceptible to contamination. The high yield drift wells yield water of suitable quality for irrigation.



SURFACE WATER AND WATER FROM WELLS IN THE GLACIAL DRIFT, ALTHOUGH HARD, IS GENERALLY SUITABLE FOR MOST PURPOSES.—*Water from Cretaceous rocks has less hardness than water from other sources, but has more total dissolved solids. Yields from wells in Cretaceous rocks are low, and dissolved solids, percent sodium, and boron content of the water indicates that this water is unsuitable for irrigation*

SELECTED CHEMICAL ANALYSES OF GROUND WATER AND SURFACE WATER.—*Changes in the quality of water from the same stream reflect the dilution effect of rapid overland runoff during periods of high flow. Surface water is probably the best source for most industrial use. Results are expressed in parts per million, except as indicated*

	Location	Date of collection	Depth of well (feet)	Temperature (°F)	Silica (SiO_2)	Iron (Fe)	Manganese (Mn)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue on evaporation at 180° C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Non-carbonate	Specific conductance (micromhos per cm at 25° C)	pH	Color	Percent sodium	Sodium adsorption ratio
	Surface water																									
1	Yellow Bank River near Odessa, Minn. Low flow (1.0 cfs)	2 Oct 60	----	----	21	----	----	39	116	28	6.7	370	0	311	11	0.2	0.8	0.24	789	574	271	1,080	7.9	4	9	0.5
2	Yellow Bank River near Odessa, Minn. High flow (1,620.0 cfs)	29 Mar 62	----	----	5.1	0.16	0.00	22	4.6	2.5	7.0	76	0	20	2.0	.2	1.4	.03	120	74	12	180	6.6	45	6	.1
3	Big Stone Lake at Ortonville, Minn. Pool elevation 965.20 ft.	15 May 61	----	----	5.5	.00	.35	132	56	56	9.0	296	0	397	19	.3	1.0	.21	886	561	318	1,170	7.6	15	18	1.0
4	Big Stone Lake at Ortonville, Minn. Pool elevation 965.79 ft.	29 Mar 62	----	----	5.5	.22	.00	31	7.9	3.8	7.4	104	0	32	.2	.1	9.2	.03	169	110	25	256	6.7	37	7	.2
	Pleistocene near-surface sand and gravel																									
5	NW¼NW¼SW¼, sec. 16, T. 121 N., R. 46 W.	27 Sept 63	71	51	31	2.5	0.24	171	76	47	11	638	0	244	32	0.2	20	0.26	973	741	218	1,430	7.9	----	12	0.7
6	NE¼NW¼NE¼, sec. 29, T. 119 N., R. 44 W.	17 Oct 63	16	48	28	.05	.68	369	272	83	11	584	0	1,400	86	.3	205	.21	2,930	2,040	1,560	3,170	7.8	----	8	.8
	Pleistocene buried sand and gravel																									
7	SW¼NE¼NE¼, sec. 6, T. 118 N., R. 42 W.	16 Oct 63	140	----	23	13	0.16	322	167	58	10	494	0	1,160	1.0	0.4	0.3	0.53	2,140	1,490	1,080	2,400	7.7	----	8	0.7
8	SE¼NW¼SE¼, sec. 16, T. 123 N., R. 46 W.	3 Oct 63	335	49	29	1.9	.09	92	50	206	5.5	438	0	482	26	.6	5.4	.86	1,150	434	75	1,620	7.8	----	50	4.3
	Cretaceous sandstone																									
9	SW¼SE¼SW¼, sec. 4, T. 124 N., R. 49 W.	2 Oct 63	400	----	8.8	2.2	0.00	21	15	1,230	8.2	453	0	1,330	704	5.2	12	4.0	3,630	113	0	5,360	8.0	----	96	50
10	NE¼NE¼SE¼, sec. 35, T. 119 N., R. 46 W.	17 Oct 63	293	----	6.3	5.0	.06	37	11	1,170	11	381	0	1,300	705	2.9	0.3	4.3	3,470	139	0	5,240	8.1	----	94	43



COMPARISON OF REPRESENTATIVE CONCENTRATIONS OF DISSOLVED CONSTITUENTS IN WATER FROM 4 SOURCES.—*Based on water analyses from 5 wells in each ground-water source and from 6 streams. Concentrations representing low flow are shown for surface water because concentrations of most constituents are highest during low-flow periods*

WATER USE AND MUNICIPAL SUPPLY POTENTIAL

TOTAL WATER USE.—*Present surface-water use is for industrial cooling, irrigation, and livestock watering. All other use is from ground water*

Source of appropriation	Domestic	Industrial, commercial, and institutional	Agricultural	Total use (gpd)
	Average use in gallons per day			
Community wells	320,000	130,000	0	450,000
Private wells	380,000	420,000	100,000	900,000
Surface water	0	*11,020,000	480,000	11,500,000
Total	700,000	11,570,000	580,000	12,850,000

*Cooling water from Big Stone Lake Reservoir used in power plant at Ortonville

MUNICIPAL WATER SUPPLIES.— *All of the municipalities have more water available than they are now using*

Municipality	Wells: In use (1963)	Wells: Standby (1963)	Wells: Abandoned (partial list)	Depth (feet)	Diameter (inches)	Date drilled	Aquifer	Water quality considerations which may limit its usefulness (parts per million)	Average pumpage: Gallons per minute (1963)	Average pumpage: Gallons per day (1962)	Test pumping to determine well characteristics: Date of test	Pumping rate (gpm)	Duration of test (hours)	Drawdown (feet)	Available drawdown (feet) from static water level to top of screen	Specific capacity (to nearest whole number)	Remarks
Beardsley	1			78	8	1958	Near-surface sand and gravel	Very hard (510 ppm); high in iron and manganese	210	40,000	1958	300	5	6	25	50	29 foot screen
		1		52	10?	------	Near-surface sand and gravel	Very hard (480 ppm)	55	-----	----	----	----	----	----	----	Acidized in 1961
			1	81	10	1951	Near-surface sand and gravel	----------	----	-----	1951	80	------	37	82	2	Originally 120 feet deep. Abandoned because of pumping sand.
Bellingham	1			152	10	1960	Cretaceous sandstone	Very hard; high in iron	150	20,000	1960	150	10	20	116	7	Gravel packed. 16 foot screen
			1	154	10	1938	Cretaceous sandstone	Very hard (290 ppm); high in iron	----	-----	----	----	----	----	----	----	
Browns Valley	1			46	12	1958	Near-surface sand and gravel	Very hard (900 ppm); high in manganese	65	62,000	1958	300	9	3	20	100	Coefficient of transmissibility = 4,000 gpd per foot. Coefficient of permeability = 110 gpd per square foot.
											1963	65	1	4	20	16	
			3	27	16	1948	Near-surface sand and gravel	----------	----	-----	1948	180	------	2.3	8	73	In 1956, yield was less than 50 gpm
				35	12	1955	Near-surface sand and gravel	Very hard (880 ppm)	----	-----	1955	50	------	5	17	10	6 foot screen
				465	2	1884	Cretaceous sandstone	High in chlorides and sulfates	5	-----	----	----	------	----	------	------	Flows; water has laxative effect
Clinton	1			333	8	1927	Buried sand and gravel	Very hard (450 ppm); high in iron	120	43,000	----	------	------	-----	------	------	30 foot screen
		1		338	8	1946	Buried sand and gravel	Very hard (460 ppm); high in iron	120	-----	1952	260	------	20	214	13	20 foot screen
Correll	1			158	10	1947	Buried sand and gravel	Very hard (600 ppm); high in iron	----	12,000	1947	250	8	12	110	21	20 foot screen
Odessa	1			120	8	1949	Buried sand and gravel	Very hard (490 ppm)	15	33,000	1963	15	1	-----	39	------	Well pumps air at higher pumping rates. Coefficient of permeability = 17,000 gpd per foot. Coefficient of permeability = 1,700 gpd per square foot. Coefficient of storage = .00005.
		1		50	12	1960	Buried sand and gravel	Very hard (470 ppm); high in iron	60		----	----	----	-----	27	------	10 foot screen; water level "draws down rapidly" when pumped
Ortonville	2			52	20	1940	Near-surface sand and gravel	Very hard (730 ppm); high in iron	595	235,000	1940	300	1	4	7	75	27 foot screen; gravel packed. Coefficient of storage = .005. Coefficient of transmissibility = 200,000 gpd per foot. Coefficient of permeability = 7,700 gpd per square foot.
											1963	595	1	-----	7	------	
				55	18	1936	Near-surface sand and gravel	----------	102		1936	400	------	28	18	14	15 foot screen
		1		79	16	1962	Near-surface sand and gravel	Very hard (1,100 ppm); high in iron	----	-----	1962	450	71	-----	45	------	20 foot screen. Coefficient of storage = .002. Coefficient of transmissibility = 90,000 gpd per foot. Coefficient of permeability = 1,400 gpd per square foot.
			2	83	20	1956	Near-surface sand and gravel	----------	----	-----	1956	340	10	20	41	17	21 foot screen
				49	20	------	Near-surface sand and gravel	----------	----	-----	----	275	------	19	------	14	Pumps air now

Potential for additional water supplies for municipality

SURFACE WATER: Poor—no source within 2 miles; Good—source within 1 mile; Very good—good source at the municipality

GROUND WATER: Unknown; Missing in this area; Poor—source probably will not support present municipal needs; Fair—source may be capable of supporting present municipal needs; Good—source now being used and will probably yield more than at present; Very good—source will yield much more than present municipal use

Municipality	Potential for additional water supplies for municipality
Beardsley	SURFACE WATER: Poor: Nearest source is Big Stone Lake, over 3 miles GROUND WATER: Near-surface sand and gravel: Very good, will yield many times the present pumpage. Recharge from precipitation is rapid through sandy soil. Sewage pollution is a problem. Buried sand and gravel: Unknown. About 200 feet of glacial drift underlies the near-surface sand and gravel. Cretaceous sandstone: Unknown. No data in immediate area. Believed to be more than 200 feet of Cretaceous sediments here.
Bellingham	SURFACE WATER: Poor: Nearest source is South Fork of Yellow Bank River, over 3 miles GROUND WATER: Near-surface sand and gravel: Missing in this area. Buried sand and gravel: Fair. Water of good quality reportedly is present in the 75 feet of glacial drift which overlies the Cretaceous sediments. However, the quantity is small. Cretaceous sandstone: Good. Additional water can be obtained from this unit.
Browns Valley	SURFACE WATER: Very good: Village is on the Little Minnesota River; Lake Traverse is less than 2 miles; Big Stone Lake is about 3 miles GROUND WATER: Near-surface sand and gravel: Good. Small deposit of moderately permeable sand and gravel; limited area; limited recharge. Buried sand and gravel: Poor. No significant aquifers discovered during extensive drilling by the village. Cretaceous sandstone: Poor. This aquifer yields little water and the water is of poor quality.
Clinton	SURFACE WATER: Poor: No large surface-water bodies nearby. Eli Lake is not a water-table lake and will not support continued withdrawals. GROUND WATER: Near-surface sand and gravel: Missing in this area. Buried sand and gravel: Good. About 30 feet of sand and gravel at about 300 feet. This bed is fairly extensive areally. Four smaller sand and gravel lenses are present above this level at the present well site. Cretaceous sandstone: Unknown, but probably poor. Cretaceous sediments are believed to be about 80 feet thick here and no aquifers are known.
Correll	SURFACE WATER: Good: About 1 mile from Marsh Lake. GROUND WATER: Near-surface sand and gravel: Missing, but about 25 feet of surficial sand is present ½ mile north of the village. Buried sand and gravel: Good. Withdrawals from the aquifer can be increased. Cretaceous sandstone: Missing.
Odessa	SURFACE WATER: Good: ½ mile from the Minnesota River GROUND WATER: Near-surface sand and gravel: Fair: Total drift thickness averages less than 75 feet, and Buried sand and gravel: contains thin beds of water-bearing sand and gravel. Cretaceous sandstone: Missing in this area.
Ortonville	SURFACE WATER: Very good. City is on Big Stone Lake, at the mouth of the Whetstone River, and the point where Minnesota River leaves the lake. GROUND WATER: Near-surface sand and gravel: Very good. Areas adjacent to Big Stone Lake receive recharge from the lake. Buried sand and gravel: Poor. Most of the aquifer within the 70 to 180 feet of glacial drift is near-surface type. Cretaceous sandstone: Poor. Absent or very thin here.

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WATER RESOURCES OF THE BIG STONE LAKE WATERSHED, WEST-CENTRAL MINNESOTA

By

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