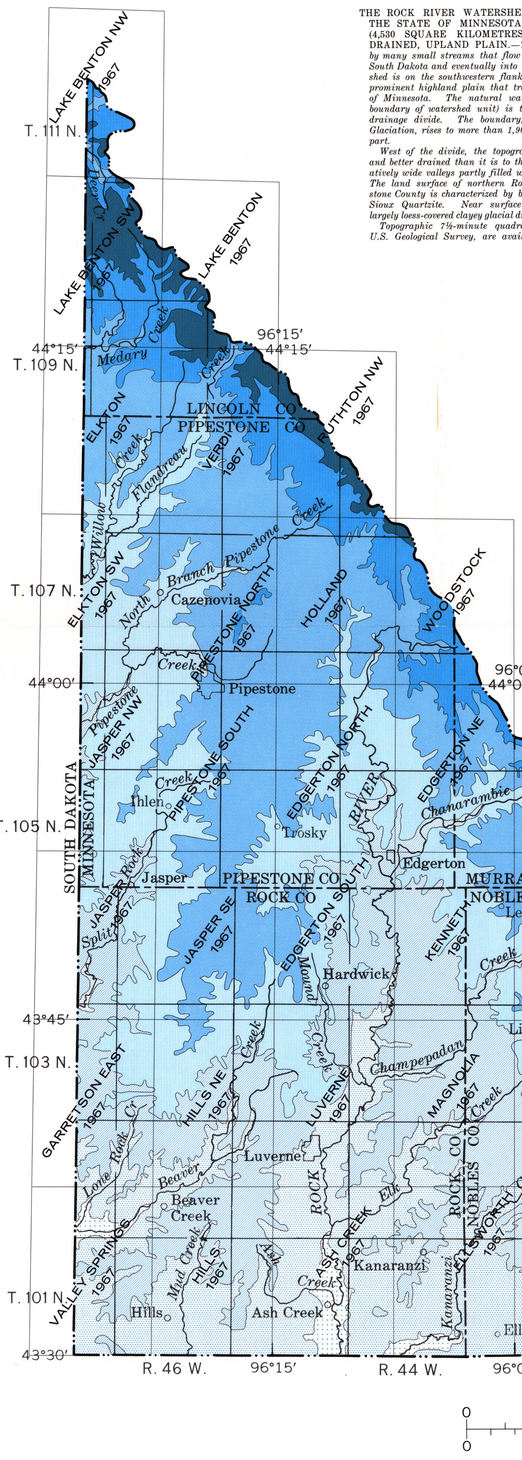
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
MINNESOTA DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATERS, SOILS, AND MINERALS

HYDROLOGIC INVESTIGATIONS
ATLAS HA-555 (SHEET 1 OF 3)

INTRODUCTION



THE ROCK RIVER WATERSHED UNIT (AS DEFINED BY THE STATE OF MINNESOTA) IS 1,750 SQUARE MILES (4,530 SQUARE KILOMETRES) OF DISSECTED, WELL-DRAINED, UPLAND PLAIN.—*The watershed unit is drained by many small streams that flow south and west into Iowa and South Dakota and eventually into the Missouri River. The watershed is on the southwestern flank of the Coteau des Prairies, a prominent highland plain that traverses the southwestern corner of Minnesota. The natural watershed boundary (northeastern boundary of watershed unit) is the Mississippi-Missouri Rivers drainage divide. The boundary, formed during a Wisconsin Glaciation, rises to more than 1,900 feet (580 m) in the northern part.*

West of the divide, the topography is generally more mature and better drained than it is to the east. Some streams have relatively wide valleys partly filled with water-laid sand and gravel. The land surface of northern Rock County and southern Pipestone County is characterized by bedrock outcrops of Precambrian Sioux Quartzite. Near surface unconsolidated materials are largely loess-covered clayey glacial drift.

Topographic 7½-minute quadrangle maps, published by the U.S. Geological Survey, are available for the entire watershed.

EXPLANATION

Land-surface altitude, in feet (metres) above mean sea level

- 1300–1400 (396–427)
- 1400–1500 (427–457)
- 1500–1600 (457–488)
- 1600–1700 (488–518)
- 1700–1800 (518–549)
- 1800–1900 (549–579)
- >1900 (>579)

EDGERTON NORTH 1967

Published U.S. Geological Survey topographic map and date of survey

Watershed boundary

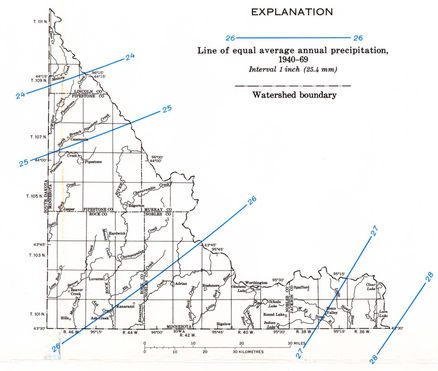
WATER BUDGET

25.8 inches (656 mm) PRECIPITATION (measured)	=	3.1 inches (79 mm) RUNOFF (measured)	+	22.7 inches (577 mm) EVAPOTRANSPIRATION (remainder)	±	0 UNDERFLOW (estimated)	±	0 CHANGE IN STORAGE (assumed)
Average annual, 1940-69		Average annual, from stream-gaging records water years 1940-69		Obtained by difference in water budget		The difference between ground-water flow into and out of the watershed is estimated to be less than 0.1 inch (2.5 mm)		Long-term gains in ground-water, surface-water, and soil-moisture storage are assumed to be balanced by long-term losses

EXPLANATION

26 — 26 Line of equal average annual precipitation, 1940-69
Interval 1 inch (25.4 mm)

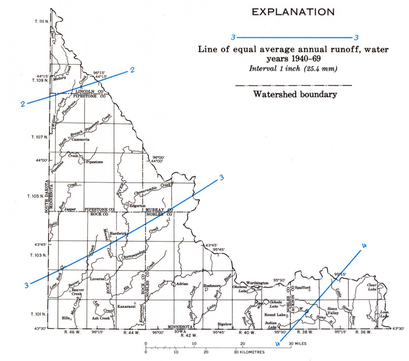
Watershed boundary



EXPLANATION

3 — 2 Line of equal average annual runoff, water years 1940-69
Interval 1 inch (25.4 mm)

Watershed boundary



THE AVERAGE ANNUAL WATER BUDGET FOR 1940-69 SHOWS THAT PRECIPITATION ON THE WATERSHED IS EQUAL TO SURFACE RUNOFF PLUS EVAPOTRANSPIRATION.—*The areal distribution of precipitation gradually increases from northwest to southeast, and a comparable increase occurs in average annual runoff. No areas of long-term ground-water-level decline are known except locally at Worthington. This indicates that storage is fairly constant and ground-water withdrawal generally does not exceed recharge, although ground water is difficult to obtain in many places because of limited aquifers.*

SUMMARY

EVALUATION OF WATER RESOURCES

Purpose	Considerations	Surface water: Rock River	Surface water: Lakes	Surface water: Tributaries and smaller streams	Ground water: Quaternary, Surficial sand and gravel	Ground water: Quaternary, Buried sand and gravel	Ground water: Cretaceous, Sandstone	Ground water: Precambrian, Sioux Quartzite
Muncipal and industrial supply	For a moderate supply, principal needs are: Quantity Minimum available surface-water supply of 1 ft³/s (0.03 m³/s) or wells yielding 250 gal/min (16 l/s). Quality Dissolved-solids concentration less than 500 mg/l. Hardness less than 180 mg/l.	Adequate supply in lower reaches with development of storage facilities. Bacterial disinfection mandatory for human consumption. Undesirable odors from algal growth.	Most would be inadequate.	Not adequate.	Adequate yields. Good recharge. Aquifer easily defined. Most are confined to stream valleys. Easily contaminated.	Adequate supply locally. Distribution irregular. Dissolved solids and iron concentrations high locally.	Available locally in southern part of watershed. Missing or deeply buried most areas. Dissolved solids, sulfate and iron concentrations high locally.	Adequate supply locally where fractured or weathered. Low yields common. Quality highly variable. Susceptible to contamination
Rural domestic and stock supply	For an adequate farm supply, needs are: Quantity Minimum of 5 gal/min (0.3 l/s). Quality Dissolved-solids concentration less than 1,000 mg/l.	Generally adequate supply. Available only to riparian lands. Bacterial disinfection mandatory for human consumption.	Adequate supply from some lakes for limited use. Available only to riparian lands. Undesirable odors from algal growth. Water-quality data inadequate.	Adequate for stock during spring and summer only. Available only to riparian lands. Most go dry in fall and winter.	Adequate yields. Restricted distribution. Easily contaminated.	Adequate supply locally. Distribution irregular. Dissolved solids and iron concentrations high locally.	Adequate supply locally in southern part of watershed. Missing or deeply buried most areas. Dissolved solids, sulfate and iron concentrations high locally.	Near surface in many areas. Water soft where drift cover thin. Deep drilling sometimes necessary. Quality highly variable. Susceptible to contamination.
Irrigation supply	For an average farm, needs are: Quantity Minimum available surface-water supply of 2 ft³/s (0.06 m³/s) during growing season or wells yielding 250 gal/min (16 l/s). Quality Dissolved-solids concentration less than 2,000 mg/l is desired. Suitability of water quality for irrigation as indicated by classification of U.S. Dept. of Agriculture (Wilcox 1955)	Adequate supply from May through July. Available only to riparian lands. May be inadequate in August and September.	Adequate supply from some lakes. Limited use from others. Available only to riparian lands.	Not adequate.	Adequate yields. Acceptable quality. Restricted distribution. Sodium concentrations high locally.	Adequate supply locally. Distribution irregular. Low yields common. Sodium concentrations high locally.	Adequate locally in southern part of watershed. Missing or deeply buried most areas. Quality highly variable. Sodium concentrations high locally.	Adequate supply where fractured or weathered. Low yields common. Sodium concentration high locally.
Fish and wildlife habitat	Adequate depth and quality of water for fish in lakes and streams. Adequate cover for wildlife habitat is provided by: Wetlands–lakes or potholes surrounded by marsh areas. Streams–marsh and woodland along banks.	Good fish habitat. Good wildlife habitat along banks. Occasional high water.	Excellent migratory water-fowl resting and feeding areas. Excellent wildlife habitats in marsh areas and along shores. Good fishing conditions at some, restricted at others. Some lakes are shallow overall. Siltation is a problem.	Good migratory waterfowl resting and feeding areas. Good habitat along shores and banks. No water at times. Fluctuating water stage.				
Recreation	Adequate access to lakes and streams. Availability of areas suitable for hunting, fishing, and other water sports. Available resorts, lake cottages, and campgrounds. Esthetic values and absence of pollution.	Hunting, fishing and canoeing. Occasional high water. Water-quality data inadequate.	Hunting, fishing, and water sports. Public access at most. Water-quality data inadequate.	Hunting and trapping near many. Most are shallow and may go dry.				

EXPLANATION

Good / Fair / Poor

Adequate supply, generally acceptable quality. — Advantages

Very hard water, iron high. — Disadvantages

Overall evaluation for purpose and considerations indicated.

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ACKNOWLEDGMENTS

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MUNICIPAL SUPPLIES

Municipality	Estimated population served (1970)	Water use: Annual industrial use (million gallons)	Water use: Annual domestic use (million gallons)	Water use: Total annual pumpage (million gallons)	Water use: Average daily pumpage (thousand gallons)	Water use: Per capita domestic use (gal/day)	Water source: Aquifer	Water source: Thickness of aquifers open to well (ft)	Water system: Number of wells	Water system: Approximate well depth (ft)	Water system: Normal pumping rate (gal/min)	Water system: Specific capacity [(gal/min)/ft]	Water system: Daily plant capacity (thousand gallons)	Representative water quality (mg/l): Year sampled	Iron (Fe)	Manganese (Mn)	Sulfate (SO_4)	Chloride (Cl)	Dissolved solids, calculated	Hardness as $CaCO_3$
Adrian	1,350	7.0	32	39	107	65	Surficial sand and gravel	5	4	40	115	20	742	1968	0.03	--	230	71	--	500
Beaver Creek	235	--	4.4	4.4	12	51	Sioux Quartzite	22	1	505	11	.09	39	1968	2.7	0.18	100	1.9	--	360
							Buried fine sand	30	1	137	16	--		1968	.5	.29	47	<1	--	280
Bigelow	262	--	4.0	4.0	11	42	Surficial sand and gravel	12	2	89	50	--	144	1969	5.1	.41	770	5.2	2,000	1,300
Chandler	319	--	11	11	30	94	Surficial sand and gravel	25	1	30	100	100	144	1969	.58	<.02	220	41	830	630
Edgerton	1,119	--	23	23	63	56	Surficial sand and gravel	10	7	28	30	10	576	1968	.08	<.02	46	15	--	400
							Sioux Quartzite	413	1	596	100	--		--	--	--	--	--	--	--
Ellsworth	588	--	9.2	9.2	25	43	Buried sand and gravel	2	2	19	50	17	158	1968	.13	.02	69	1.8	--	320
Hardwick	274	5.0	5.0	10	28	51	Sioux Quartzite	340	1	440	50	--	72	1968	.05	.02	28	8.5	--	210
Hills	571	--	15	15	41	72	Buried sand	10	1	250	110	5.0	158	1960	1.8	.44	830	--	--	1,200
Ihlen	132	--	2.3	2.3	6.3	48	Sioux Quartzite	400	1	406	75	--	108	1962	.5	<.02	74	5.6	--	470
Jasper	754	--	25	25	68	90	Sioux Quartzite	--	3	Springs	30	--	--	1968	.1	<.02	17	6.6	--	220
Leota	216	--	4.0	4.0	11	51	Buried gravel	11	1	21	30	30	43	--	--	--	--	--	--	--
Lismore	323	--	5.1	5.1	14	43	Surficial gravel	10	2	26	50	12	144	1969	1.1	.22	300	<1	1,600	630
Luverne	4,703	292	158	450	1,230	92	Surficial sand and gravel	12	13	40	200	7.0	3,377	1970	1.5	.37	67	35	--	360
Pipestone	5,328	57	114	171	468	59	Sioux Quartzite	400	4	500	450	1.5	2,143	1969	.02	.02	180	58	700	490
Round Lake	506	--	18	18	49	97	Buried sand and gravel	14	2	149	180	2.5	540	1964	4.8	.79	1,800	.6	--	1,800
Rushmore	394	--	10	10	27	69	Buried sand	15	1	375	100	18	144	1968	7.2	.31	1,200	3.0	--	1,300
Trosky	109	--	1.2	1.2	3.3	30	Sioux Quartzite	133	1	241	15	0.5	22	1968	.05	<.02	87	4.0	--	370
Worthington	9,916	518	318	836	2,290	88	Surficial sand and gravel	10	10	60	350	--	3,000	1970	2.8	.33	390	16	1,000	560
							Buried sand and gravel	10	8	80	200	--		1958	4.5	1.2	812	15	1,480	1,040
Total	27,099	879.0	759.2	1,638.2	4,483.6	77														

ESTIMATED WATER USE 1970

(million gallons)

	Ground water	Surface water	Total
Public supply			
Domestic (population 27,099)	759	0	759
Industrial	879	0	879
Rural supply			
Domestic (population 20,426)	559	0	559
Livestock	1,130	199	1,329
Irrigation	4	35	39
Self supplied			
Industrial	2	40	42
Watershed total (population 47,525)	3,333	274	3,607

GLACIAL DRIFT AND SIOUX QUARTZITE AQUIFERS PROVIDE ABOUT 90 PERCENT OF THE WATER USED IN THE WATERSHED.—*Availability of water varies from place to place. In the west-central part of the watershed on a bedrock high, Sioux Quartzite is the only aquifer. Yields from wells in quartzite range from less than 1gal/min (0.06 l/s) to as much as 450gal/min (28 l/s). Locally some dry holes have been drilled. Buried and surficial outwash sand and gravel provide most of the water used in the watershed. Cretaceous sandstone provides only small supplies and less than 8 percent of the water used is surface water.*

Although total annual water use is only 0.4 percent of inflow (average annual precipitation), difficulty in obtaining water of good quality and in sufficient quantity is a problem in places.

METRIC CONVERSION TABLE

in (inches)	×	25.4 = mm (millimetres)
ft (feet)	×	.3048 = m (metres)
mi (miles)	×	1.609 = km (kilometres)
ft/mi (feet per mile)	×	.1894 = m/km (metres per kilometre)
mi^2 (square miles)	×	2.590 = km^2 (square kilometres)
acres	×	.4047 = hm^2 (square hectometre)
acre-ft (acre-feet)	×	.1233 = m^3 (cubic metres)
gal (gallons)	×	3.785 = l (litres)
million gallons	×	3.785 × 10^{-3} = hm^3 (cubic hectometres)
gal/min (gallons per minute)	×	.06309 = l/s (litres per second)
(gal/min)/ft (gallons per minute per foot)	×	.2067 = (l/s)/m (litres per second per metre)
ft^3/s (cubic feet per second)	×	.02832 = m^3/s (cubic metres per second)
$(ft^3/s)/mi$ (cubic feet per second per mile)	×	.01758 = $(m^3/s)/km$ (cubic metres per second per kilometre)
$(ft^3/s)/mi^2$ (cubic feet per second per square mile)	×	.01093 = $(m^3/s)/km^2$ (cubic metres per second per square kilometre)
tons (short)	×	0.9072 = t (tonnes)

Base from U.S. Geological Survey
1:250,000 series: Fairmont, Minn., 1954; Sioux Falls, 1955, and Watertown, 1953, S. Dak.

Interior–Geological Survey, Reston, Va.–1976

WATER RESOURCES OF THE ROCK RIVER WATERSHED, SOUTHWESTERN MINNESOTA

By

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1976

For sale by U.S. Geological Survey
Denver, Colo. 80225 and Reston, Va. 22092, price $1.75 per set.