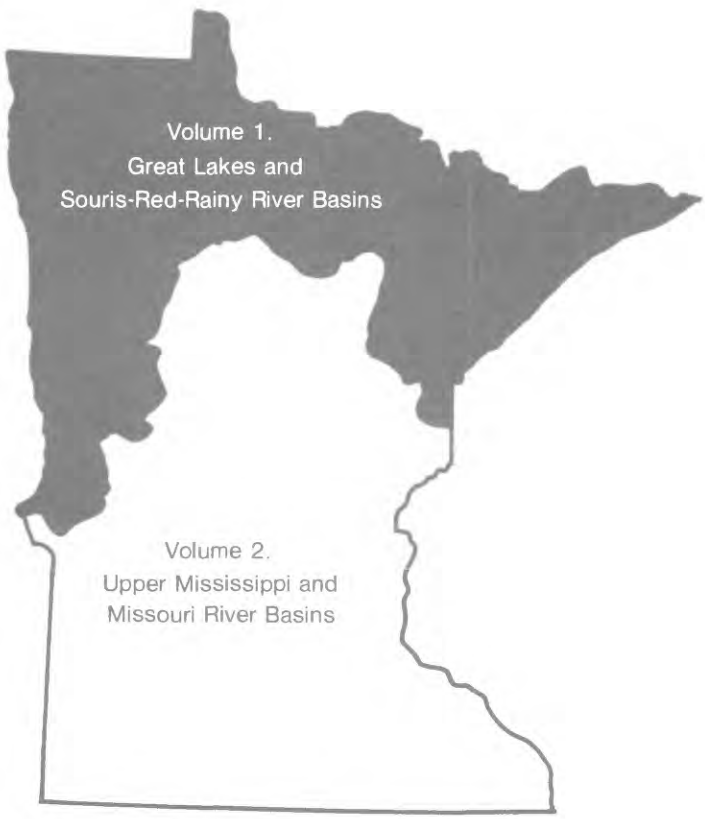
Water Resources Data Minnesota Water Year 1989

Volume 1. Great Lakes and Souris-Red-Rainy River Basins



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MN-89-1
Prepared in cooperation with the Minnesota Department of Natural Resources, Division of Waters; the Minnesota Department of Transportation; and with other State, municipal and Federal agencies

CALENDAR FOR WATER YEAR 1989

1988

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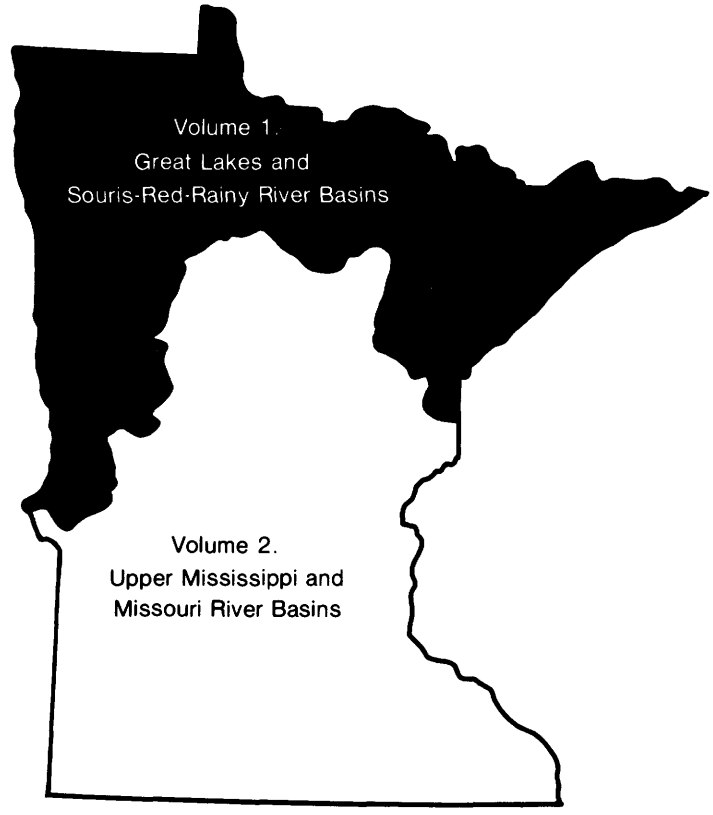
Water Resources Data Minnesota Water Year 1989

Volume 1. Great Lakes and Souris-Red-Rainy River Basins

by Kurt T. Gunard, Joseph H. Hess, James L. Zirbel, and Charles E. Cornelius



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MN-89-1
Prepared in cooperation with the Minnesota Department of Natural Resources, Division of Waters; the Minnesota Department of Transportation; and with other State, municipal, and Federal agencies

DEPARTMENT OF THE INTERIOR

MANUEL LUJAN, JR, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

District Chief, Water Resources Division
U.S. Geological Survey
702 Post Office Building
St. Paul, Minnesota 55101

1990

PREFACE

This volume of the annual hydrologic data report of Minnesota is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of streamflow, ground-water levels, and water quality provide the hydrologic information needed by State, local, and Federal agencies, and the private sector for developing and managing our Nation's land and water resources. Hydrologic data for Minnesota are contained in two volumes:

Volume 1. Great Lakes and Souris-Red-Rainy River Basins
Volume 2. Upper Mississippi and Missouri River Basins

This report is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. In addition to the authors, who had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to Geological Survey policy and established guidelines, the following individuals contributed significantly to the preparation of this report:

Lan H. Tornes, Water-Quality Specialist, Minnesota District
Alex Brietkrietz, Ground-Water Network Project Chief, Minnesota District

Most of the data were collected, processed, and tabulated by the following individuals:

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This report was prepared in cooperation with the State of Minnesota and with other agencies under the general supervision of William J. Herb, District Chief, Minnesota.

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15. Supplementary Notes

Prepared in cooperation with the State of Minnesota and with other agencies.

16. Abstract (Limit: 200 words)

Water-resources data for the 1989 water year for Minnesota consist of records of stage, discharge and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This volume contains discharge records for 43 gaging stations; stage-only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 13 stream stations; and water levels for 13 observation wells. Also included are 32 high-flow partial-record stations and 1 miscellaneous site. Additional water data were collected at various sites, not part of the systematic data collection program, and are published as miscellaneous measurements. These data together with the data in Volume 2, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota.

17. Document Analysis a. Descriptors

*Minnesota, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Sediments, Water temperatures, Sampling sites, Water levels, Water analyses, Data collection

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GAGING STATIONS, IN DOWNSTREAM ORDER, FOR WHICH RECORDS ARE PUBLISHED

Note.--Data for partial-record stations and miscellaneous sites for both surface-water quantity and quality are published in separate sections of the data report. See references at the end of this list for page numbers for these sections.

[Letters after station name designates type of data: (d) discharge; (e) gage height, elevation, or contents; (c) chemical, radio-chemical, or pesticides; (b) biological or mictro-biological; (p) physical (water temperature, sediment, or specific conductance)]

SURFACE-WATER STATIONS, IN DOWNSTREAM ORDER--Continued

GROUND-WATER WELLS, BY COUNTY, FOR WHICH RECORDS ARE PUBLISHED

GROUND-WATER LEVELS

COUNTIES WITH QUALITY OF GROUND WATER RECORDS

Poplar River at Lutsen, Minnesota. Ca. 1935.

WATER RESOURCES DATA FOR MINNESOTA, 1989

INTRODUCTION

The Water Resources Division of the U.S Geological Survey, in cooperation with State agencies, obtains a large amount of data pertaining to the water resources of Minnesota each water year. These data, accumulated during many years, constitute a valuable data base for developing an improved understanding of the water resources of the State. To make these data readily available to interested parties outside the Geological Survey, the data are published annually in this report series entitled "Water Resources Data - Minnesota."

Water resources data for the 1989 water year for Minnesota consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality of ground water. This volume contains discharge records for 43 gaging stations; stage only records for 1 gaging station; stage and contents for 5 lakes and reservoirs; water quality for 13 stream stations; and water levels for 13 observation wells. Also included are 32 high-flow partial-record stations and 1 miscellaneous site. Additional water data were collected at various sites, not involved in the systematic data collection program, and are published as miscellaneous measurements. These data, together with the data in Volume 2, represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Minnesota.

This series of annual reports for Minnesota began with the 1961 water year with a report that contained only data relating to the quantities of surface water. For the 1964 water year, a similar report was introduced that contained only data relating to water quality. Beginning with the 1975 water year, the report was changed to present, in one volume, data on quantities of surface water, quality of surface and ground water, and ground-water levels.

Prior to introduction of this series and for several water years concurrent with it, water-resources data for Minnesota were published in U.S. Geological Survey Water-Supply Papers. Data on stream discharge and stage and on lake or reservoir contents and stage, through September 1960, were published annually under the title "Surface-Water Supply of the United States, Parts 4, 5 and 6A." For the 1961 through 1970 water years, the data were published in two 5-year reports. Data on chemical quality, temperature, and suspended sediment for the 1941 through 1970 water years were published annually under the title "Quality of Surface Waters of the United States," and water levels for the 1935 through 1974 water years were published under the title "Ground-Water Levels in the United States." The above mentioned Water-Supply papers can be consulted in the libraries of the principal cities of the United States and may be purchased from Distribution Branch, Text Products Section, U.S. Geological Survey, 604 Pickett Street, Alexandria, VA 22304.

Publications similar to this report are published annually by the Geological Survey for all States. These official Survey reports have an identification number consisting of the two-letter State abbreviation, the last two digits of the water year, and volume number. For example, this volume is identified as the "U.S. Geological Survey Water-Data Report MN-89-1. For archiving and general distribution, the reports for 1971-1974 water years also are identified as water-data reports. These water-data reports are for sale in paper copy or in microfiche by the National Technical Information Service, U.S. Department of Commerce, Springfield, VA 22161.

Additional information, including current prices, for ordering specific reports may be obtained from the district chief at the address given on the back of the title page or by telephone (612) 229-2600.

COOPERATION

The U.S. Geological Survey and organizations of the State of Minnesota have had cooperative agreements for the systematic collection of streamflow records since 1909, for ground-water levels since 1948, and for water-quality records since 1952. Organizations that assisted in collecting data through cooperative agreement with the Survey are:

Minnesota Department of Natural Resources, Division of Waters, Ronald N. Nargang, director.

Minnesota Department of Transportation, Leonard W. Levine, commissioner.

Metropolitan Waste Control Commission of the Twin Cities Area, L. Baker-Kent, chairperson.

Beltrami Soil and Water Conservation District, John Cronemiller, chairperson

Elm Creek Conservation Commission, Fred G. Moore, chairperson.

Leech Lake Reservation Business Committee, Daniel Brown, chairperson.

Lower Red River Watershed Management Board, Donald Ogaard, Chairman.

Rochester Public Utilities, Robert Pawelski, General Manager.

Assistance in the form of funds or services was given by the U.S. Army Corps of Engineers, in collecting records for 46 gaging stations and 12 water-quality stations published in this report of 2 volumes. Thirteen gaging stations in the Hudson Bay and St. Lawrence River basins were maintained by funds appropriated to the United States Department of State. Eight of these, on water adjacent to the international boundary, are maintained by the United States (or Canada) under agreement with Canada (or the United States), and the records are obtained and compiled in a manner equally acceptable in both countries. These stations are designated herein as "International gaging stations."

SUMMARY OF HYDROLOGIC CONDITIONS

PRECIPITATION

Precipitation during the 1989 water year ranged from 8 in. (inches) below normal (based on record period 1951-80) in large areas of southern and central Minnesota to 8 in. above normal in parts of north-central and northeastern Minnesota (fig.1). Normal annual precipitation in Minnesota ranges from 19 in. in the northwest to 32 in. in the southeast. Precipitation during water year 1989 ranged from less than 16 in. in a small area in the northwest to greater than 32 in. in small areas in the northeast.

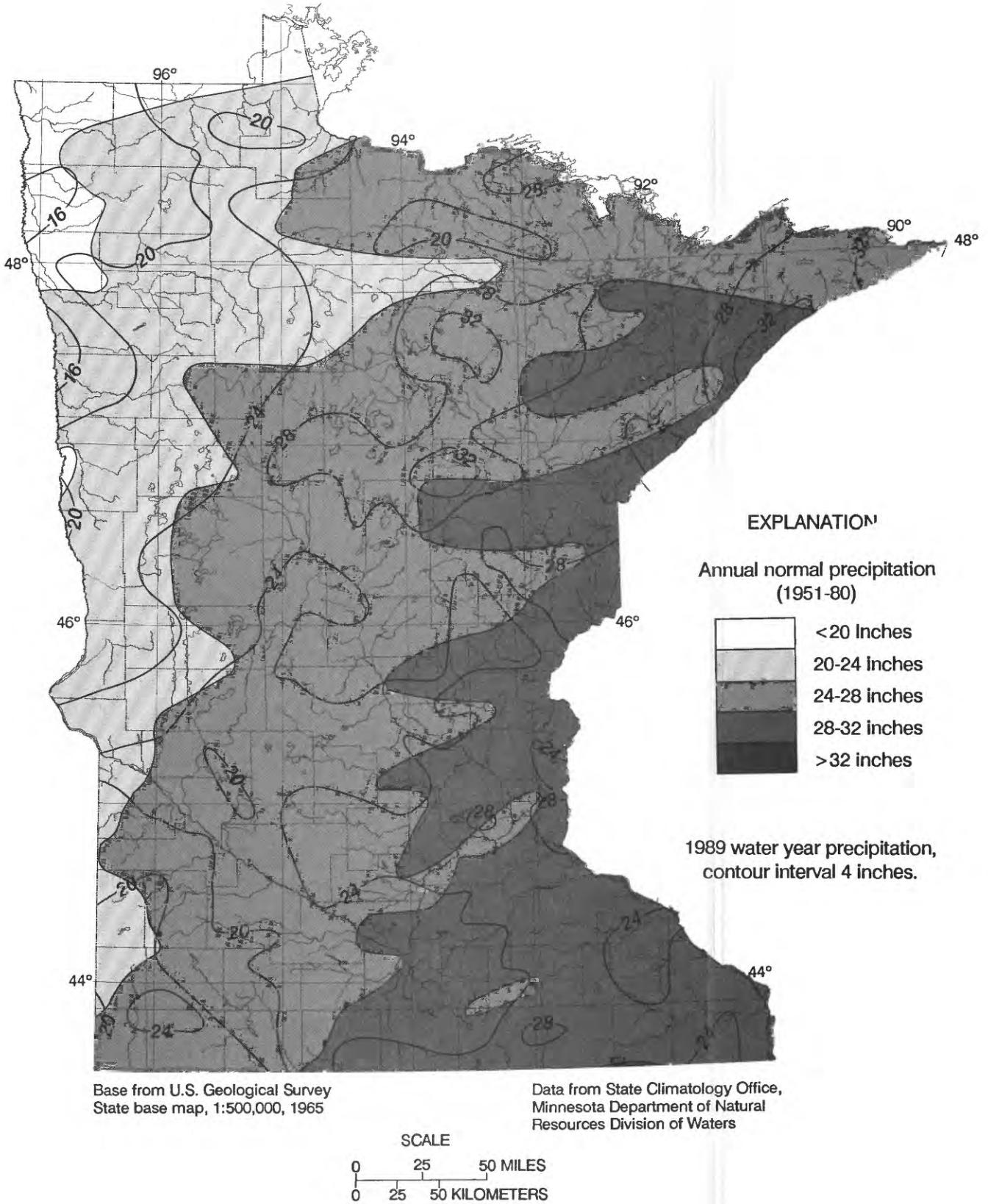


Figure 1.--Precipitation, in inches, during 1989 water year compared to normal annual precipitation in Minnesota.

The 1989 water year began with a 4- to 8-in. precipitation deficit throughout much of northwestern, central, and southern Minnesota. However, in much of north-central and northeastern Minnesota, precipitation had been normal or above in the previous year so that some areas had a 4-in. precipitation excess at the beginning of the 1989 water year. The following is a summary of the precipitation that occurred during water year 1989:

October--below normal Statewide.

November--above normal Statewide.

December--below normal Statewide.

January--above normal in northern half and below normal in southern half.

February--below normal Statewide.

March--below normal in north-central, northeastern, and central regions and above normal in remaining regions.

April--below normal except lower one-third, where it was above normal.

May--below normal Statewide.

June--below normal Statewide.

July--below normal except for southwest, where it was above normal.

August--below normal except for northwest and central regions, where it was above normal.

September--above normal in northern half and below normal in southern half.

At the close of the 1989 water year, much of southern Minnesota as well as small areas in northwestern Minnesota had a 4- to 8-in. annual precipitation deficit, while much of north-central and parts of northeastern Minnesota had a 4- to 8-in. precipitation excess. As a result of precipitation deficits in parts of Minnesota for the past 3 years (1987-89), some areas now have a cumulative deficit equal to 1 year of normal precipitation. Paradoxically, "in 1989 Minnesota farmers harvested their best soybean crop and fifth largest corn crop," according to the State Climatology Office (Gregory Spoden, Assistant State Climatologist, oral communication, 1990). The meager precipitation occurred at critical times during the growing season, and temperatures were moderate, which allowed for optimum utilization of available moisture.

STREAMFLOW

Average annual runoff in Minnesota ranges from 1 in. in the west to 14 in. in the northeast. Annual runoff in water year 1989 ranged from 0.4 in. in parts of north-central Minnesota to 19.1 in. in northeastern Minnesota (table 1). This translates to a low of 12 percent of average in a small part of north-central Minnesota to a high of 127 percent of average in northeastern Minnesota along the Canadian border. In contrast to the previous year when runoff at 60 percent of the streamflow stations was less than half the long-term average, runoff was less than half at only 10 percent of the stations during the 1989 water year.

In 1989, runoff was below average in parts of northwestern Minnesota to above-average in most of northeastern Minnesota. Runoff ranged from a low of 12 percent of average in the Red Lake River near Red Lake in northwestern Minnesota to a high of 127 percent in the Namakan River at the outlet of Lac la Croix in northeastern Minnesota along the Canadian border. In northwestern Minnesota, runoff in the Red Lake River at Crookston was 1.39 in.--48 percent of the station's 88-year average (1902-89) of 2.92 in. and was the 23rd lowest runoff of record. However, in the previous year, runoff was only 0.81 in. and the 11th lowest of record.

In north-central Minnesota, runoff in the Little Fork River at Littlefork was 10.13 in.--121 percent of the 66-year average (1912-16, 1929-89) of 8.34 in. Runoff in the previous year was considerably less at 6.53 in., and even less in 1987 when it was 5.89 in. In northeastern Minnesota, runoff in the Baptism River near Beaver Bay was 19.13 in.--117 percent of the 62-year average (1928-89) of 16.39 in. Runoff in the previous year was only 10.65 in.--44 percent less than in 1989. A comparison of annual and monthly mean discharges for these stations to median discharges for a 30-year base period is shown in figure 2.

No new record flows were established at any of the stations published in this volume. However, as a result of near-record snow pack and deep frost penetration in the Red River Valley in western and northwestern Minnesota, a combination of conditions that normally does not exist, severe flooding occurred along several tributaries as well as along the main stem of the Red River of the North. Most of the flooding resulted from ice jamming as snowmelt abruptly began after a colder-than-normal spring; this caused unusually high stages from relatively average spring flows. Even though no record flows occurred, the Red River of the North at Wahpeton, N.D., on the western border of Minnesota, had a record stage of 17.95 ft on April 5, 1987; the previous high was 17.0 ft in the spring of 1897.

WATER QUALITY

Evidence of the drought continued to be apparent in the water-quality data collected during the 1989 water year. The graphs in figure 3 compare the concentrations of dissolved solids in samples collected during the 1989 water year with historical monthly median concentrations collected during the previous years of sampling at four stations sampled for the U.S. Geological Survey's National Stream Accounting Network. Dissolved-solids concentrations during the 1989 water year at the Rainy and Baptism Rivers were nearly the same as the long-term averages. Below-average dissolved-solids concentrations in the St. Louis River indicate that above-average runoff was diluting the natural dissolved solids concentrations in the water. Data indicate that although much of Minnesota was experiencing a drought, the northeast part of the State was receiving normal or above-normal precipitation.

Higher-than-average dissolved solids concentrations in the Red Lake River indicate that little runoff occurred in northwestern Minnesota during the 1989 water year. The lack of runoff resulted in very little dilution of ground water inflow, which contains a much higher concentration of dissolved solids than does surface runoff.

The graphs in figure 4 compares nitrite plus nitrate nitrogen concentrations during the 1989 water year with previous median monthly concentrations for the same four stations discussed above. Concentrations generally followed normal seasonal patterns with some exceptions. Concentrations in the Red Lake and Rainy Rivers tend to be at or near the detection limit of 0.10 mg/L (milligrams per liter) most of the year, but tend to increase in the Red Lake River during winter and into spring. The source of the 0.97 mg/L nitrite plus nitrate nitrogen concentration in the Rainy River during March 1989 could not be determined; the concentration occurred before spring runoff and other available data suggest it did not result from agricultural sources or sewage effluent. Nitrite plus nitrate nitrogen concentrations generally were near average in the Baptism and St. Louis Rivers through the year, but they seem to have been slightly elevated during April runoff.

GROUND-WATER LEVELS

Water table wells in surficial aquifers are excellent indicators of excess or deficient precipitation in a given area (fig. 5). Of the seven water-table wells that appear in this volume, water levels in one well in northwestern and two wells in northeastern Minnesota were 0.5 ft to 3 ft higher throughout water year 1989 than levels in 1988, and water levels in one well in northwestern and one well in west-central Minnesota were 1 to 2 ft lower than levels in 1988. In northeastern Minnesota, along the Mesabi Iron Range, precipitation was very heavy from June through September (14.81 in.) and raised

Table 1.--Runoff at streamflow stations in 1989 compared with long-term average for river basins in Minnesota

[Average runoff for station is based on period of record. Maximum and minimum runoff and year of occurrence are shown. mi^2, square miles.]

Station no.	Station name	Drainage area (mi^2)	Runoff (inches)		Maximum runoff		Minimum runoff		Years of record
			1989 Water year	Average	Inches	Water year	Inches	Water year	
04010500	Pigeon River at Middle Falls near Grand Portage	600	14.35	11.45	19.01	1971	3.58	1958	66
04014500	Baptism River near Beaver Bay	140	19.13	16.39	32.50	1972	7.92	1963	62
04015330	Knife River near Two Harbors	85.6	11.71	14.55	23.32	1986	7.01	1977	15
04018750	St. Louis River at Forbes	713	10.55	10.65	14.99	1969	4.82	1977	25
04024000	St. Louis River at Scanlon	3,430	9.31	9.26	16.93	1972	3.74	1924	81
04024098	Deer Creek near Holyoke	7.77	9.53	13.04	33.70	1986	6.38	1980	13
05046000	Otter Tail River below Orwell Dam near Fergus Falls	1,830	2.01	2.38	6.25	1966	.15	1934	59
05050000	Bois de Sioux River near White Rock	1,160	1.06	.96	3.85	1986	.004	1977	48
05051500	Red River of the North at Wahpeton	4,010	1.84	1.86	5.00	1986	.18	1977	46
05061500	South Branch Buffalo River at Sabin	522	1.66	1.50	5.15	1962	.32	1977	39§
05062000	Buffalo River near Dilworth	1,040	1.97	1.75	5.76	1975	.33	1934	58
05064000	Wild Rice River at Hendrum	1,600	2.55	2.66	5.79	1975	.25	1977	44§
05069000	Sand Hill River at Climax	426	2.73	2.32	6.50	1950	.59	1977	42§
05074500	Red Lake River near Red Lake	1,950	.42	3.41	9.00	1951	.04	1936	56
05076000	Thief River near Thief River Falls	959	1.43	2.32	8.60	1966	.02	1939	71§
05078500	Clearwater River at Red Lake Falls	1,370	2.24	3.14	8.48	1950	.64	1939	62§
05079000	Red Lake River at Crookston	5,280	1.39	2.92	8.05	1950	.22	1934	88
05082500	Red River of the North at Grand Forks	30,100	1.18	1.17	3.42	1950	.11	1934	85

Table 1.--Runoff at streamflow stations in 1989 compared with long-term average for river basins in Minnesota--Continued

Station no.	Station name	Drainage area (mi^2)	Runoff (inches)		Maximum runoff		Minimum runoff		Years of record
			1989 Water year	Average	Inches	Water year	Inches	Water year	
05087500	Middle River at Argyle	265	1.23	2.05	5.74	1966	.08	1977	38§
05102500	Red River of the North at Emerson	40,200	1.00	1.14	4.09	1950	.11	1934	77
05104500	Roseau River below South Fork near Malung	573	1.27	3.29	8.18	1950	.29	1988	43
05107500	Roseau River at Ross	1,220	1.90	2.91	8.07	1950	.32	1934	61
05112000	Roseau River below State Ditch No. 51 near Caribou	1,570	1.65	2.45	5.91	1927	.31	1977	32§
05124480	Kawishiwi River near Ely	253	11.97	11.49	16.80	1971	5.07	1977	23
05127000	Kawishiwi River near Winton	1,229	12.92	11.46	21.73	1950	2.65	1924	61§
05127500	Basswood River near Winton	1,740	12.82	10.95	20.63	1950	4.35	1958	61§
05128000	Namakan River at Outlet of Lac la Croix	5,170	12.84	10.11	19.10	1950	2.53	1924	67
05130500	Sturgeon River near Chisholm	187	10.56	9.00	15.11	1950	4.58	1977	47
05131500	Little Fork River at Littlefork	1,730	10.13	8.34	15.01	1966	2.40	1931	66§
05132000	Big Fork River at Big Falls	1,460	8.30	6.82	12.67	1950	.86	1931	58§
05133500	Rainy River at Manitou Rapids	19,400	11.04	9.03	16.28	1950	4.10	1977	61

§ Noncontinuous period.

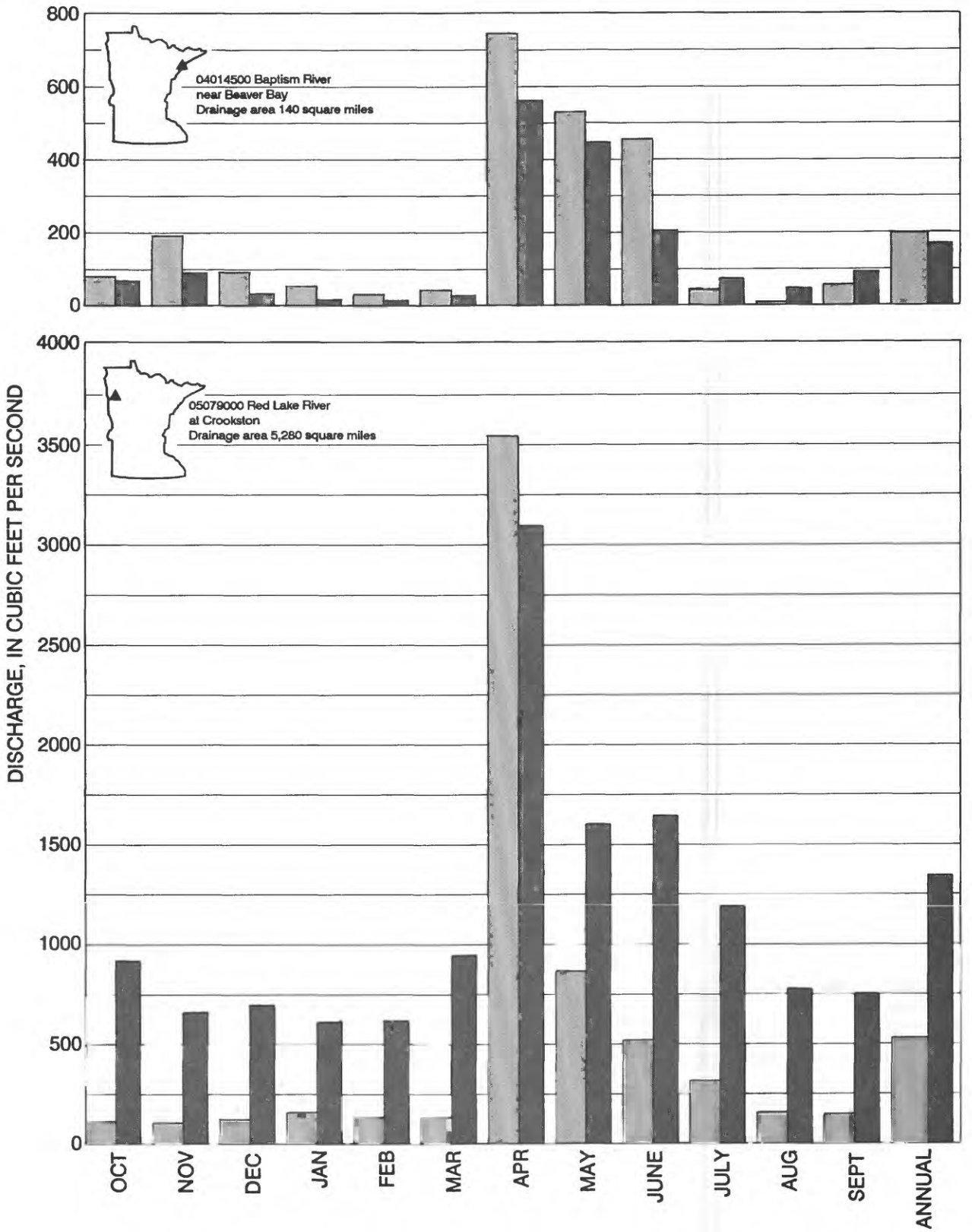
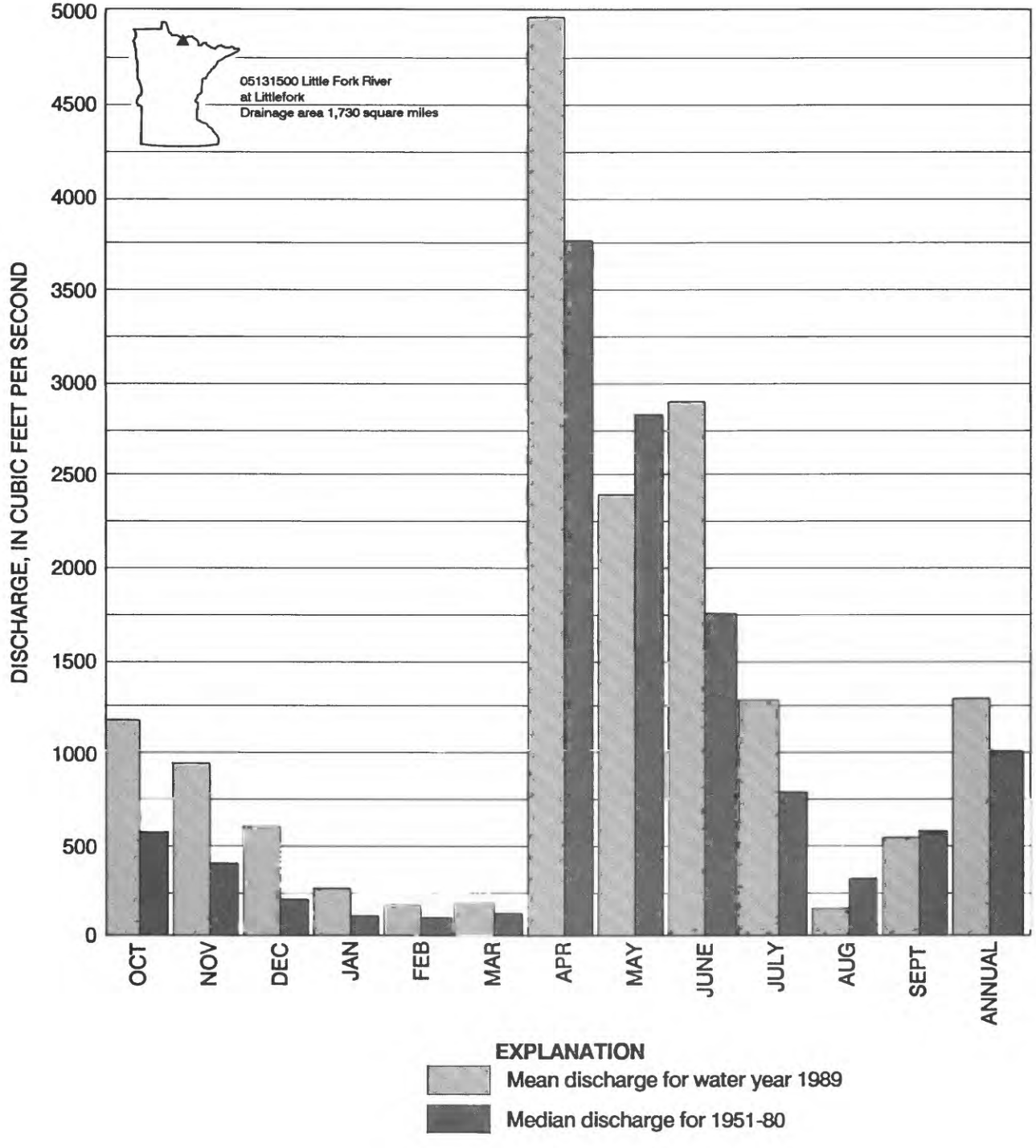


Figure 2.--Comparison of mean discharge for the 1989 water year with median



discharge for 1951-80 at three long-term representative gaging stations.

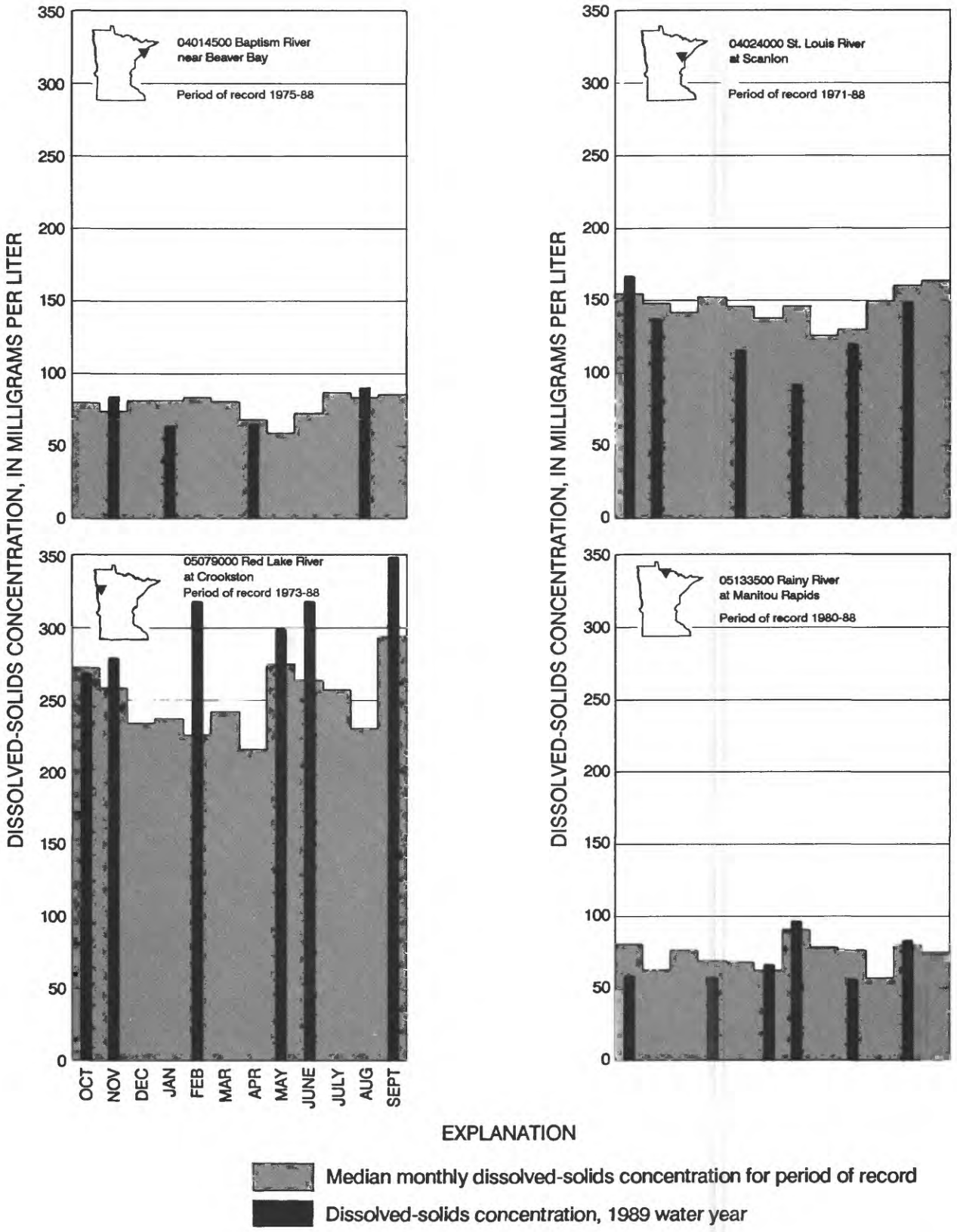


Figure 3.--Comparisons between dissoved-solids concentrations.

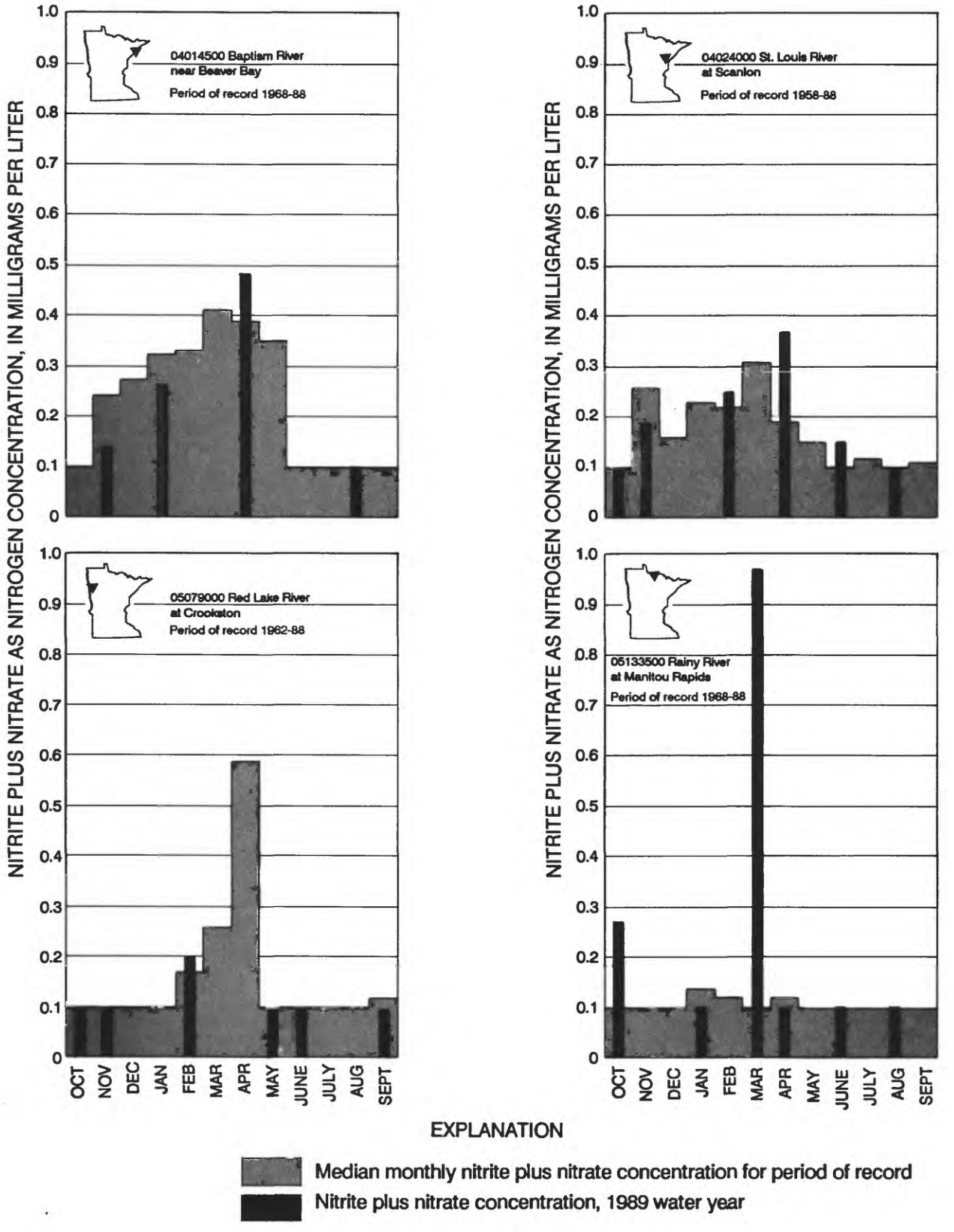


Figure 4.–Comparisons between nitrite plus nitrate concentrations.

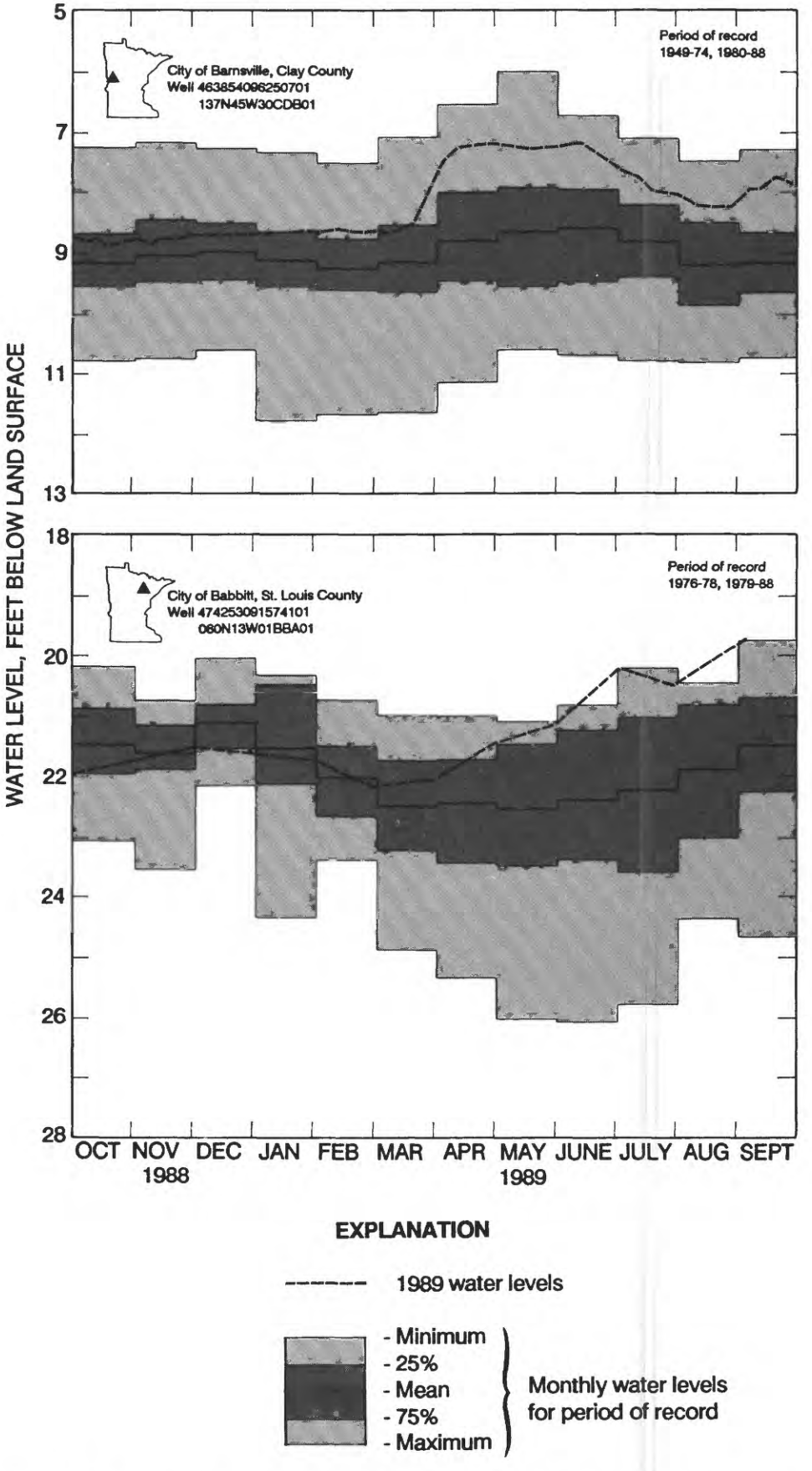


Figure 5.--Relation of water levels during 1989 to long-term levels in two representative water-table wells

water levels to record highs. However, in northwestern and west-central Minnesota, water levels were consistently lower than average throughout the water year because of deficient precipitation, which produced less-than-average recharge to the surficial aquifers. In one well in west-central and one in north-central Minnesota water-level declines were noticeable during the first half of the year. These declines were the result of the continuation of the drought of 1988; however, water levels rose the second half of the year in response to recharge by infiltration of excess precipitation.

Of five buried drift wells, water levels were noticeably higher for the year in four wells, while a record-low level occurred in one well in northwestern Minnesota during August. The record-low water level occurred in a well near Moorehead, where the amount of ground water pumped exceeds the amount of recharge from precipitation. Water levels were 1 to 3 feet higher for the year at three wells in northeastern Minnesota. Above normal rainfall from June-September helped contribute to these higher water levels as compared to the previous water year.

The water level in one bedrock well in northeastern Minnesota reached an all-time high in September for the 34-year period of record (1956-89). The rise in water level in this well has been steady and gradual since about 1982. The causes for this particular rise in water level are probably twofold: (1) Less pumping of ground water for iron mining, and (2) near-normal to somewhat above-normal precipitation over the last several years in this area.

SPECIAL NETWORKS AND PROGRAMS

Hydrologic Bench-Mark Network is a network of 57 sites in small drainage basins around the country whose purpose is to provide consistent data on the hydrology, including water quality, and related factors in representative undeveloped watersheds nationwide, and to provide analyses on a continuing basis to compare and contrast conditions observed in basins more obviously affected by the activities of man.

National Stream Quality Accounting Network (NASQAN) is a national data-collection network designed by the U.S. Geological Survey to meet many of the information needs of government agencies and other groups involved in natural or regional water-quality planning and management. The 500 or so sites in NASQAN are generally located at the downstream ends of the hydrologic accounting units designated by the U.S. Geological Survey Office of Water Data Coordination in consultation with the Water Resources Council. The objectives of NASQAN are (1) to obtain information on the quality and quantity of water moving within and from the United States through a systematic and uniform process of data collection, summarization, analysis, and reporting such that the data may be used for, (2) description of the areal variability of water quality in the Nation's rivers through analysis of data from this and other programs, (3) detection of changes or trends with time in the pattern of occurrence of water-quality characteristics, and (4) providing a nationally consistent data base useful for water quality assessment and hydrologic research.

The National Trends Network (NTN) is a 150-station network for sampling atmospheric deposition in the United States. The purpose of the network is to determine the variability, both in location and in time, of the composition of atmospheric deposition, which includes snow, rain, dust particles, and aerosols, and gases. The core from which the NTN was built was the already-existing deposition-monitoring network of the National Atmospheric Deposition Program (NADP).

Radiochemical program is a network of regularly sampled water-quality stations where samples are collected to be analyzed for radioisotopes. The streams that are sampled represent major drainage basins in the conterminous United States.

Tritium network is a network of stations which has been established to provide baseline information on the occurrence of tritium in the Nation's surface waters. In addition to the surface-water stations in the network, tritium data are also obtained at a number of precipitation stations. The purpose of the precipitation stations is to provide an estimate sufficient for hydrologic studies of the tritium input to the United States.

EXPLANATION OF THE RECORDS

The surface-water and ground-water records published in this report are for the 1989 water year that began October 1, 1988, and ended September 30, 1989. A calendar of the water year is provided on the inside of the front cover. The records contain streamflow data, stage and content data for lakes and reservoirs, water-quality data for the surface and ground water, and ground-water-level data. The locations of the stations and wells where the data were collected are shown in figures 7, 8, 9, and 10. The following sections of the introductory text are presented to provide users with a more detailed explanation of how the hydrologic data published in this report were collected, analyzed, computed, and arranged for presentation.

STATION IDENTIFICATION NUMBERS

Each data station, whether streamsite or well, in this report is assigned a unique identification number. This number is unique in that it applies specifically to a given station and to no other. The number usually is assigned when a station is first established and is retained for that station indefinitely. The system used by the U.S. Geological Survey to assign identification numbers for surface-water stations and for ground-water well sites differ, but both are based on geographic location. The "downstream order" system is used for regular surface-water stations and the "latitude-longitude" system is used for wells and, in Minnesota, for surface-water stations where only miscellaneous measurements are made.

Downstream Order System and Station Number

Since October 1, 1950, the order of listing hydrologic-station records in Survey reports is in a downstream direction along the main stream. All stations on a tributary entering upstream from a main-stream station are listed before that station. A station on a tributary that enters between two main-stream sections is listed between them. A similar order is followed by listing stations on first rank, second rank, and other ranks of tributaries. The rank of any tributary on which a station is situated with respect to the stream to which it is immediately tributary is indicated by an indentation in a list of stations in front of the report. Each indention represents one rank. This downstream order and system of indention show which stations are on tributaries between any two stations and the rank of the tributary on which each station is situated.

As an added means of identification, each hydrologic station and partial-record station has been assigned a station number. These are in the same downstream order in this report. In assigning station numbers, no distinction is made between partial-record stations and other stations; therefore, the station number for a partial-record station indicates downstream-order position in a list made up of both types of stations. Gaps are left in the series of numbers to allow for new stations that may be established; hence, the numbers are not consecutive. The complete 8-digit number for each station such as 05041000, which appears just to the left of the station name, includes the 2-digit part number "05" plus the 6-digit downstream order number "041000."

Latitude-Longitude System for Wells and Miscellaneous Sites

The 8-digit downstream order station numbers are not assigned to wells and miscellaneous sites where only random water-quality samples or discharge measurements are taken.

The well and miscellaneous site numbering system of the U.S. Geological Survey is based on the grid system of latitude and longitude. The system provides the geographic location of the well or miscellaneous site and a unique number for each site. The number consists of 15 digits. The first 6 digits denote the degrees, minutes, and seconds of latitude, the next 7 digits denote degrees, minutes, and seconds of longitude, and the last 2 digits (assigned sequentially) identify the wells or other sites within a 1-second grid.

See figure 6. Each well site is also identified by a local well number which consists of township, range, and section numbers, three letters designating 1/4, 1/4, 1/4 section location, and a two-digit sequential number.

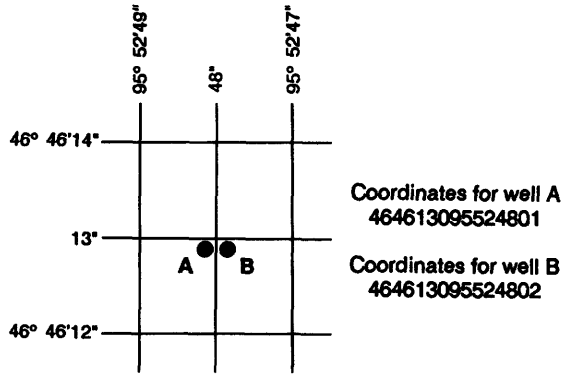


Figure 6.--Example of system for numbering wells and miscellaneous sites

RECORDS OF STAGE AND WATER DISCHARGE

Records of stage and water discharge may be complete or partial. Complete records of discharge are those obtained using a continuous stage-recording device through which either instantaneous or mean daily discharge may be computed for any time, or any period of time, during the period of record. Complete records of lake or reservoir content, similarly, are those for which stage or content may be computed or estimated with reasonable accuracy for any time, or period of time. They may be obtained using a continuous stage-recording device, but need not be. Because daily mean discharges and end-of-day contents commonly are published for such stations, they are referred to as "daily stations".

By contrast, partial records are obtained through discrete measurements without using a continuous stage-recording device and pertain only to a few flow characteristics, or perhaps only one. The nature of the partial record is indicated by table titles such as "High-flow partial records," or "Low-flow partial records." Records of miscellaneous discharge measurements or of measurements from special studies, such as low-flow seepage studies, may be considered as partial records, but they are presented separately in this report. Location of all complete-record and high-flow partial-record stations for which data are given in this report are shown in figures 7 and 9.

Data Collection and Computation

The data obtained at a complete-record gaging station on a stream or canal consist of a continuous record of stage, individual measurements of discharge throughout a range of stages, and notations regarding factors that may affect the relationships between stage and discharge. These data, together with supplemental information, such as weather records, are used to compute daily discharges. The data obtained at a complete-record gaging station on a lake or reservoir consist of a record of stage and of notations regarding factors that may affect the relationship between stage and lake content. These data are used with stage-area and stage-capacity curves or tables to compute water-surface areas and lake storage.

Continuous records of stage are obtained with analog recorders that trace continuous graphs of stage or with digital recorders that punch stage values on paper tapes at selected time intervals. Measurements of discharge are made with current meters using methods adapted by the Geological Survey as a result of experience accumulated since 1880. These methods are described in standard textbooks, in Water-Supply Paper 2175, and in U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A6.

In computing discharge records, results of individual measurements are plotted against the corresponding stages, and stage-discharge relation curves are then constructed. From these curves, rating tables indicating the approximate discharge for any stage within the range of the measurements are prepared. If it is necessary to define extremes of discharge outside the range of current-meter measurements, the curves are extended using: (1) logarithmic-plotting; (2) velocity-area studies; (3) results of indirect measurements of peak discharge, such as slope-area or contracted-opening measurements, and computations of flow-over-dams or weirs; or (4) step-backwater techniques.

Daily mean discharges are computed by applying the daily mean stages (gage heights) to the stage-discharge curves or tables. If the stage-discharge relation is subject to change because of frequent or continual change in the physical features that form the control, the daily mean discharge is determined by the shifting-control method, in which correction factors based on the individual discharge measurements and notes of the personnel making the measurements are applied to the gage heights before the discharges are determined from the curves or tables. This shifting-control method also is used if the stage-discharge relation is changed temporarily because of aquatic growth or debris on the control. For some stations, formation of ice in the winter may so obscure the stage-discharge relations that daily mean discharges must be estimated from other information such as temperature and precipitation records, notes of observations, and records for other stations in the same or nearby basins for comparable periods.

At some stream-gaging stations the stage-discharge relation is affected by the backwater from reservoirs, tributary streams, or other sources. This necessitates the use of the slope method in which the slope or fall in a reach of the stream is a factor in computing discharge. The slope or fall is obtained by means, of an auxiliary gage set at some distance from the base gage. At some stations the stage-discharge relation is affected by changing stage; at these stations the rate of change in stage is used as a factor in computing discharge.

In computing records of lake or reservoir contents, it is necessary to have available from surveys, curves, or tables defining the relationship of stage and content. The application of stage to the stage-content curves or tables gives the contents from which daily, monthly, or yearly changes then are determined. If the stage-content relationship changes because of deposition of sediment in a lake or reservoir, periodic resurveys may be necessary to redefine the relationship. Even when this is done, the contents computed may become increasingly in error as time since the last survey increases. Discharge over lake or reservoir spillways are computed from stage-discharge relationships much as other stream discharges are computed.

For some gaging stations there are periods when no gage-height record is obtained, or the recorded gage height is so faulty that it cannot be used to compute daily discharge or contents. This happens when the recorder stops or otherwise fails to operate properly, intakes are plugged, the float is frozen in the well, or for various other reasons. For such periods, the daily discharges are estimated from the recorded range in stage, previous or following record, discharge measurements, weather records, and comparison

with other station records from the same or nearby basins. Likewise, daily contents may be estimated from operator's logs, previous or following record, inflow-outflow studies, and other information. Information explaining how estimated daily-discharge values are identified in station records is included in the next two sections, "Data Presentation" (REMARKS paragraph) and "Identifying Estimated Daily Discharge."

Data Presentation

The records published for each gaging station consist of two parts, the manuscript or station description and the data table for the current water year. The manuscript provides, under various headings, descriptive information, such as station location; period of record; average discharge; historical extremes; record accuracy; and other remarks pertinent to station operation and regulation. The following information as appropriate is provided with each continuous record of discharge or lake content. Comments to follow clarify information presented under the various headings of the station description.

LOCATION.--Information on locations is obtained from the most accurate maps available. The location of the gage with respect to the cultural and physical features in the vicinity and with respect to the reference place mentioned in the station name is given. River mileages, given for only a few stations, were determined by methods given in "River Mileage Measurement," Bulletin 14, Revision of October 1968, prepared by the Water Resources Council or were provided by the U.S. Army Corps of Engineers.

DRAINAGE AREA.--Drainage areas are measured using the most accurate maps available. Because the type of maps available varies from one drainage basin to another, the accuracy of drainage areas likewise varies. Drainage areas are updated as better maps become available.

PERIOD OF RECORD.--This indicates the period for which there are published records for the station or for an equivalent station. An equivalent station is one that was in operation at a time when the present station was not, and whose location was such that records from it can reasonably be considered equivalent with records from the present station.

REVISED RECORDS.--Published records, because of new information, occasionally are found to be incorrect, and revisions are printed in later reports. Listed under this heading are all reports in which revisions have been published for the station and water years to which the revisions apply. If a revision did not include daily, monthly, or annual figures of discharge, that fact is noted after the year dates as follows: "(M)" means that only the instantaneous maximum discharge was revised; "(m)" that only the instantaneous minimum was revised; and "(P)" that only peak discharges were revised. If the drainage area has been revised, the report in which the most recently revised figure was first published is given.

GAGE.--The type of gage in current use, the datum of the current gage referred to National Geodetic Vertical Datum of 1929 (see glossary), and a condensed history of the types, locations, and datum of previous gages are given under this heading.

REMARKS.--All periods of estimated daily-discharge record will either be identified by date in this paragraph of the station description for water-discharge stations or flagged in the daily-discharge table. If a remarks statement is used to identify estimated record, the paragraph will begin with this information presented as the first entry. The paragraph is also used to present information relative to the accuracy of the records, to special methods of computation, to conditions that affect natural flow at the station and, possibly, to other pertinent items. For reservoir stations, information is given on the dam forming the reservoir, the capacity, outlet works and spillway, and purpose and use of the reservoir.

COOPERATION.--Records provided by a cooperating organization or obtained for the Geological Survey by a cooperating organization are identified here.

AVERAGE DISCHARGE.--The discharge value given is the arithmetic mean of the water-year mean discharges. It is computed only for stations having at least 5 water years of complete record, and only water years of complete record are included in the computation. It is not computed for stations where diversions, storage, or other water-use practices cause the value to be meaningless. If water developments significantly altering flow at a station are put into use after the station has been in operation for a period of years, a new average is computed as soon as 5 water years of record have accumulated following the development. The median of yearly mean discharges also is given under this heading for stations having 10 or more water years of record, if the median differs from the average given by more than 10 percent.

EXTREMES FOR PERIOD OF RECORD.--Extremes may include maximum and minimum stages and maximum and minimum discharges or content. Unless otherwise qualified, the maximum discharge or content is the instantaneous maximum corresponding to the highest stage that occurred. The highest stage may have been obtained from a graphic or digital recorder, a crest-stage gage, or by direct observation of a nonrecording gage. If the maximum stage did not occur on the same day as the maximum discharge or content, it is given separately. Similarly, the minimum is the instantaneous minimum discharge, unless otherwise qualified, and was determined and is reported in the manner as the maximum.

EXTREMES OUTSIDE PERIOD OF RECORD.--Included here is the information concerning major floods or unusually low flows that occurred outside the stated period of record. The information may or may not have been obtained by the U.S. Geological Survey.

EXTREMES FOR THE CURRENT YEAR.--Extremes given here are similar to those for the period of record, except the peak discharge listing which may include secondary peaks. For stations meeting certain criteria, all peak discharges and stages occurring during the water year and greater than a selected base discharge are presented under this heading. The peaks greater than the base discharge, excluding the highest one, are referred to as secondary peaks. Peak discharges are not published for canals, ditches, drains, or streams for which the peaks are subject to substantial control by man. The time of occurrence for peaks is expressed in 24-hour local standard time. For example, 12:30 a.m. is 0030, and 1:30 p.m. is 1330. The minimum for the current water year appears below the table of peak data.

REVISIONS.--If a critical error in published records is discovered, a revision is included in the first report published following discovery of the error.

Although rare, occasionally the records of a discontinued gaging station may need revision. Because, for these stations, there would be no current or, possibly, future station manuscript published to document the revision in a "Revised Records" entry, users of data for these stations who obtained the record from previously published data reports may wish to contact the district office to determine if the published records were ever revised after the station was discontinued. Of course, if the data were obtained by computer retrieval, the data would be current and there would be no need to check because any published revision of data is always accompanied by revision of the corresponding data in computer storage.

For most gaging stations on lakes and reservoirs the data presented comprise a description of the station and a monthly summary table of stage and contents. For some reservoirs a table showing daily contents or stage is given.

The daily table for stream-gaging stations gives mean discharge for each day and is followed by monthly and yearly summaries. In the monthly summary below the daily table, the line headed "TOTAL" gives the sum of the daily figures. The line headed "MEAN" gives the average flow in cubic feet per second during the month. The lines headed "MAX" and "MIN" give the maximum and minimum daily discharges, respectively, for the month. Discharge for the month also is usually expressed in cubic feet per second per

square mile (line headed "CFSM"), or in inches (line headed "IN."), or in acre-feet (line headed "AC-FT"). Figures for cubic feet per second per square mile and runoff in inches are omitted if there is extensive regulation or diversion or if the drainage area includes large noncontributing areas. In the yearly summary below the monthly summary, the figures shown are the appropriate discharges for the calendar and water years. At some stations monthly and (or) yearly observed discharges are adjusted for reservoir storage or diversion, or diversions or reservoir contents are given. These figures are identified by a symbol and corresponding footnote.

Data collected at partial-record stations follow the information for continuous-record sites. Data for partial-record discharge stations are presented in two tables. The first is a table of discharge measurements at low-flow partial-record stations, and the second is a table of annual maximum stage and discharge at crest-stage stations. The tables of partial-record stations are followed by a listing of discharge measurements made at sites other than continuous-record or partial-record stations. These measurements are generally made in times of drought or flood to give better areal coverage to those events. Those measurements and others collected for some special reason are called measurements at miscellaneous sites.

Identifying Estimated Daily Discharge

Estimated daily-discharge values published in the water-discharge tables of annual State data reports are identified either by flagging individual daily values with the letter symbol "e" and printing a table footnote, "e Estimated", or by listing the dates of the estimated record in the REMARKS paragraph of the station description.

Accuracy of the Records

The accuracy of streamflow records depends primarily on: (1) The stability of the stage-discharge relation or, if the control is unstable, the frequency of discharge measurements; and (2) the accuracy of measurements of stage, measurements of discharge, and interpretation of records.

The accuracy attributed to the records is indicated under "REMARKS." "Excellent" means that about 95 percent of the daily discharges are within 5 percent of the true; "good," within 10 percent; and "fair," within 15 percent. Records that do not meet the criteria mentioned, are rated "poor." Different accuracies may be attributed to different parts of a given record.

Daily mean discharges in this report are given to the nearest hundredth of a cubic foot per second for values less than 1 ft^3/s; to the nearest tenth between 1.0 and 10 ft^3/s; to whole numbers between 10 and 1000 ft^3/s; and to 3 significant figures for more than 1000 ft^3/s. The number of significant figures used is based solely on the magnitude of the discharge value. The same rounding rules apply to discharges listed for partial-record stations and miscellaneous sites.

Discharge at many stations, as indicated by the monthly mean, may not reflect natural runoff due to the effects of diversion, consumption, regulation by storage, increase or decrease in evaporation due to artificial causes, or to other factors. For such stations, figures of cubic feet per second per square mile and of runoff, in inches, are not published unless satisfactory adjustments can be made for diversions, for changes in contents of reservoirs, or for other changes incident to use and control. Evaporation from a reservoir is not included in the adjustments for changes in reservoir contents, unless it is so stated. Even at those stations where adjustments are made, large errors in computed runoff may occur if adjustments or losses are large in comparison with the observed discharge.

Other Records Available

Information of a more detailed nature than that published for most of the gaging stations such as observations of water temperatures, discharge measurements, gage-height records, and rating tables is on file in the district office. Also most gaging-station records are available in computer-usable form and many statistical analyses have been made.

Information on the availability of unpublished data or statistical analyses may be obtained from the district office.

The National Water Data Exchange, Water Resources Division, U.S. Geological Survey, National Center, Reston, VA 22092, maintains an index of all discharge measurement sites in the State as well as an index of records of discharge collected by other agencies but not published by the Geological Survey. Information on records available at specific sites can be obtained upon request.

RECORDS OF SURFACE-WATER QUALITY

Records of surface water quality ordinarily are obtained at or near stream-gaging stations because interpretation of records of surface-water quality nearly always requires corresponding discharge data. Records of surface-water quality in this report may involve a variety of types of data and measurement frequencies.

Classification of Records

Water-quality data for surface-water sites are grouped into one of three classifications. A continuing-record station is a site where data are collected on a regularly scheduled basis. Frequency may be once or more times daily, weekly, monthly, or quarterly. A partial-record station is a site where limited water-quality data are collected systematically over a period of years. Frequency of sampling is usually less than quarterly. A miscellaneous sampling site is a location other than a continuing or partial-record station, where random samples are collected to give better areal coverage to define water-quality conditions in the river basin.

A careful distinction needs to be made between "continuing records" as used in this report and "continuous recordings," which refers to a continuous graph or a series of discrete values punched at short intervals on a paper tape. Some records of water quality, such as temperature and specific conductance, may be obtained through continuous recordings; however, because of costs, most data are obtained only monthly or less frequently. Locations of stations for which records on the quality of surface water appear in this report are shown in figure 8.

Arrangement of Records

Water-quality records collected at a surface-water daily record station are published immediately following that record, regardless of the frequency of sample collection. Station number and name are the same for both records. Where a surface-water daily record station is not available or where the water quality differs significantly from that at the nearby surface-water station, the continuing water-quality record is published with its own station number and name in the regular downstream-order sequence. Water-quality data for partial-record stations and for miscellaneous sampling sites appear in separate tables following the table of discharge measurements at miscellaneous sites.

Onsite Measurement and Collection

In obtaining water quality data, a major concern needs to be assuring that the data obtained represents the in situ quality of water. To assure this, certain measurements, such as water temperature, pH, and dissolved oxygen need to be made onsite when the samples are taken. To assure that measurements made in the laboratory also represent the in situ water, carefully prescribed procedures need to be followed in collecting the samples, in treating the samples to prevent changes in quality pending analysis, and in shipping the samples to the laboratory. Procedures for onsite measurements and for collecting, treating, and shipping samples are given in publications on "Techniques of Water-Resources Investigations," Book 1, Chap. D2; Book 3, Chap. C2; Book 5 Chap. A1, A3, and A4. All of these references are listed on p. 17 of this report. Also, detailed information on collecting, treating, and shipping samples may be obtained from the Geological Survey district office.

One sample can define adequately the water quality at a given time if the mixture of solutes throughout the stream cross section is homogeneous. However, the concentration of solutes at different locations in the cross section may vary widely with different rates of water discharge, depending on the source of material and the turbulence and mixing of the stream. Some streams must be sampled through several vertical sections to obtain a representative sample needed for an accurate mean concentration and for use in calculating load. All samples obtained for the National Stream Quality Accounting Network (see definitions) are obtained from at least several verticals. Whether samples are obtained from the centroid of flow or from several verticals, depends on flow conditions and other factors which must be evaluated by the collector.

Chemical-quality data published in this report are considered to be the most representative values available for the stations listed. The values reported represent water-quality conditions at the time of sampling as much as possible, consistent with available sampling techniques and methods of analysis. In the rare case where an apparent inconsistency exists between a reported pH value and the relative abundance of carbon dioxide species (carbonate and bicarbonate), the inconsistency is the result of a slight uptake of carbon dioxide from the air by the sample between measurement of pH in the field and determination of carbonate and bicarbonate in the laboratory.

For chemical-quality stations equipped with digital monitors, the records consist of daily maximum, minimum, and mean values for each constituent measured and are based upon hourly punches beginning at 0100 hours and ending at 2400 hours for the day of record. More detailed records (hourly values) may be obtained from the U.S.G.S. district office whose address is given on the back of the title page of this report.

Water Temperature

Water temperatures are measured at most of the water-quality stations. In addition, water temperatures are taken at time of discharge measurements for water-discharge stations. For stations where water temperatures are taken manually once or twice daily, the water temperatures are taken at about the same time each day. Large streams have a small diurnal temperature change; shallow streams may have a daily range of several degrees and may follow closely the changes in air temperature. Some streams may be affected by waste-heat discharges.

At stations where recording instruments are used, either mean temperatures or maximum and minimum temperatures for each day are published. Water temperatures measured at the time of water-discharge measurements are on file in the district office.

Sediment

Suspended-sediment concentrations are determined from samples collected by using depth-integrating samplers. Samples usually are obtained at several verticals in the cross section, or a single sample may be obtained at a fixed point and a coefficient applied to determine the mean concentration in the cross sections.

During periods of rapidly changing flow or rapidly changing concentration, samples may have been collected more frequently (twice daily or, in some instances, hourly). The published sediment discharges for days of rapidly changing flow or concentration were computed by the subdivided-day method (time-discharge weighted average). Therefore, for those days when the published sediment discharge value differs from the value computed as the product of discharge times mean concentration times 0.0027, the reader can assume that the sediment discharge for that day was computed by the subdivided-day method. For periods when no samples were collected, daily loads of suspended sediment were estimated on the basis of water discharge, sediment concentrations observed immediately before and after the periods, and suspended-sediment loads for other periods of similar discharge.

At other stations, suspended-sediment samples were collected periodically at many verticals in the stream cross section. Although data collected periodically may represent conditions only at the time of observations, such data are useful in establishing seasonal relations between quality and streamflow and in predicting long-term sediment-discharge characteristics of the stream.

In addition to the records of suspended sediment discharge, records of the periodic measurements of the particle-size distribution of the suspended sediment and bed material are included for some stations.

Laboratory Measurements

Samples for indicator bacteria and specific conductance are analyzed locally. All other samples are analyzed in the Geological Survey laboratories in Arvada, Colo., Doraville, Ga., or Iowa City, Ia. Methods used in analyzing sediment samples and computing sediment records are given in TWRI, Book 5, Chap. C1. Methods used by the Geological Survey laboratories are given in TWRI, Book 1, Chap. D2; Book 3, Chap. C2; Book 5, Chap. A1, A3, and A4.

Data Presentation

For continuing-record stations, information pertinent to the history of station operation is provided in descriptive headings preceding the tabular data. These descriptive headings give details regarding location, drainage area, period of record, type of data available, instrumentation, general remarks, cooperation, and extremes for parameters currently measured daily. Tables of chemical, physical, biological, radiochemical data, and so forth, obtained at a frequency less than daily are presented first. Tables of "daily values" of specific conductance, pH, water temperature, dissolved, and suspended sediment then follow in sequence.

In the descriptive headings, if the location is identical to that of the discharge gaging station, neither the LOCATION nor the DRAINAGE AREA statements are repeated. The following information, when appropriate, is provided with each continuous-record station. Comments that follow clarify information presented under the various headings of the station description.

LOCATION.--See Data Presentation under "Records of stage and Water Discharge"; same comments apply.

DRAINAGE AREA.--See Data Presentation under "Records of stage and Water Discharge"; same comments apply.

PERIOD OF RECORD.--This indicates the periods for which there are published water-quality records for the station. The periods are shown separately for records of parameters measured daily or continuously and those measured less than daily. For those measured daily or continuously, periods of record are given for the parameters individually.

INSTRUMENTATION.--Information on instrumentation is given only if a water-quality monitor, temperature recorder, sediment pumping sampler, or other sampling device is in operation at a station.

REMARKS.--Remarks provide added information pertinent to the collection, analysis, or computation of the records.

COOPERATION.--Records provided by a cooperating organization or obtained for the Geological Survey by a cooperating organization are identified here.

EXTREMES.--Maximums and minimums are given only for parameters measured daily or more frequently. None are given for parameters measured weekly or less frequently, because the true maximums or minimums may not have been sampled. Extremes, when given, are provided for both the period of record and for the current water year.

REVISIONS.--If errors in published water-quality records are discovered after publication, appropriate updates are made to the Water-Quality File in the U.S. Geological Survey's computerized data system, WATSTORE, and subsequently by monthly transfer of update transactions to the U.S. Environmental Protection Agency's STORET system. Because the usual volume of updates makes it impractical to document individual changes in the State data-report series or elsewhere, potential users of U.S. Geological Survey water-quality data are encouraged to obtain all required data from the appropriate computer file to insure the most recent updates.

The surface-water-quality records for partial-record stations and miscellaneous sampling sites are published in separate tables following the table of discharge measurements at miscellaneous sites. No descriptive statements are given for these records. Each station is published with its own station number and name in the regular downstream-order sequence.

Remark Codes

The following remark codes may appear with the water-quality data in this report:

PRINTED OUTPUT	REMARK
E	Estimated value
>	Actual value is known to be greater than the value shown
<	Actual value is known to be less than the value shown
K	Results based on colony count outside the acceptance range (non-ideal colony count)
L	Biological organisms count less than 0.5 percent (organisms may be observed rather than counted)
D	Biological organism count equal to or greater than 15 percent (dominant)
&	Biological organism estimated as dominant

RECORDS OF GROUND-WATER LEVELS

Only water-level data from a national network of observation wells are given in this report. These data are intended to provide a sampling and historical record of water-level changes in the Nation's most important aquifers. Locations of the observation wells in this network in Minnesota are shown in figure 10.

Although, in this report, records of water levels are presented for fewer than 200 wells, records are obtained through cooperative efforts of many Federal, State, and local agencies for several hundred observation wells throughout Minnesota and are placed in computer storage. Each spring, the Minnesota Department of Natural Resources, Division of Waters publishes a report for the previous water year entitled "Observation Well Data Summary, Water Year 19__." This report contains hydrographs of recorder wells, detailed maps showing the location of active observation wells, and other useful items. Information about the availability of the data in the water-level file may be obtained from the District Chief, Minnesota District. (See address on back of front page).

Data Collection and Computation

Measurements of water levels are made in many types of wells under varying conditions, but the methods of measurement are standardized to the extent possible. The equipment and measuring techniques used at each observation well assure that measurements at each well are of consistent accuracy and reliability.

Tables of water-level data are presented by counties arranged in alphabetical order. The prime identification number for a given well is the 15-digit number that appears in the upper left corner of the table. The secondary identification number is the local well number, an alphanumeric number, derived from the township-range location of the well.

Water-level records are obtained from direct measurements with a steel tape or from the graph or punched tape of a water-stage recorder. The water-level measurements in this report are given in feet with reference to land-surface datum (lsd). Land-surface datum is a datum plane that is approximately at land surface at each well. If known, the elevation of the land-surface datum is given in the well description. The height of the measuring point (MP) above or below land-surface datum is given in each well description. Water levels in wells equipped with recording gages are reported for every fifth day and the end of each month (eom).

All water-level measurements are reported to the nearest hundredth of a foot. The error of water-level measurements is normally only a hundredth or a few hundredth of a foot.

Hydrographs showing water-level fluctuations are included for 5 representative wells; 2 in surficial-sand aquifers, 2 in buried sand aquifers, and 1 in a bedrock aquifer.

Data Presentation

Each well consists of two parts, the station description and the data table of water levels observed during the water year. The description of the well is presented first through use of descriptive headings preceding the tabular data. The comments to follow clarify information presented under the various headings.

LOCATION.--This paragraph follows the well-identification number and reports the latitude and longitude (given in degrees, minutes and seconds); a landline location designation; the hydrologic-unit number; the distance and direction from a geographic point of reference; and the owner's name.

AQUIFER.-- This entry designates by name (if a name exists) and geologic age the aquifer(s) open to the well.

WELL CHARACTERISTICS.--This entry describes the well in terms of depth, diameter, casing depth and/or screened interval, method of construction, use, and includes additional information such as casing breaks, collapsed screen, and other changes since construction.

DATUM.--This entry describes both the measuring point and the land-surface elevation at the well. The measuring point is described physically (such as top of collar, notch in the top of casing, plug in pump base and so on), and in relation to land surface (such as 1.3 ft above land-surface datum). The elevation of the land-surface datum is described in feet above (or below) National Geodetic Vertical Datum of 1929 (NGVD of 1929); it is reported with a precision depending on the method of determination.

REMARKS.--This entry describes factors that may influence the water level in a well or the measurement of the water level. It should identify wells that are also water-quality observation wells, and may be used to acknowledge the assistance of local (non-Survey) observers.

PERIOD OF RECORD.--This entry indicates the period for which there are published records for the well. It reports the month and year of the start of the publication of water-level records by the U.S. Geological Survey and the words "to current year" if the records are to be continued into the following year. Periods for which water-level records are available, but are not published by the Geological Survey, may be noted.

EXTREMES FOR THE PERIOD OF RECORD.--This entry contains the highest and lowest water levels of the period of published record, with respect to land-surface datum, and the dates of their occurrence.

A table of water levels follows the station description for each well. Water levels are reported in feet below land-surface datum and all taped measurements of water level are listed. For wells equipped with recorders, abbreviated tables are published; generally, only water-level lows are listed for every fifth day and at the end of the month (eom). The highest and lowest water levels of the water year and their dates of occurrence are shown on a line below the abbreviated table. Because all values are not published for wells with recorders, the extremes may be values that are not listed in the table. Missing records are indicated by dashes in place of the water level.

RECORDS OF GROUND-WATER QUALITY

Records of ground-water quality in this report differ from other types of records in that for most sampling sites they consist of only one set of measurements for the water year. The quality of ground water ordinarily changes only slowly; therefore, for most general purposes one annual sampling, or only a few samples taken at infrequent intervals during the year, is sufficient. Frequent measurement of the same constituents is not necessary unless one is concerned with a particular problem, such as monitoring for trends in nitrate concentration. In the special cases where the quality of ground water may change more rapidly, more frequent measurements are made to identify the nature of the changes.

Data Collection and Computation

The records of ground-water quality in this report were obtained mostly as a part of special studies in specific areas. Consequently, a number of chemical analyses are presented for some counties but none are presented for others. As a result, the records for this year, by themselves, do not provide a balanced view of ground-water quality statewide. Such a view can be attained only by considering records for this year in context with similar records obtained for these and other counties in earlier years.

Most methods for collecting and analyzing water samples are described in the "U.S. Geological Survey Techniques of Water-Resources Investigation" manuals listed on a following page. The values reported in this report represent water-quality conditions at the time of sampling as much as possible, consistent with available sampling techniques and methods of analysis. All samples were obtained by trained personnel. The wells sampled were pumped long enough to assure that the water collected came directly from the aquifer and had not stood for a long time in the well casing where it would have been exposed to the atmosphere and to the material, possibly metal, comprising the casings.

Data Presentation

The records of ground-water quality are published in a section titled QUALITY OF GROUND WATER immediately following the ground-water-level records. Data for quality of ground water are listed alphabetically by County, and are identified by well number. The prime identification number for wells sampled is the 15-digit number derived from the latitude-longitude locations. No descriptive statements are given for ground-water-quality records; however, the well number, depth of well, date of sampling, and other pertinent data are given in the table containing the chemical analyses of the ground water. The REMARK codes listed for surface-water-quality records are also applicable to ground-water-quality records.

ACCESS TO WATSTORE DATA

The National WATer Data STOrage and REtrieval System (WATSTORE) was established for handling water data collected through the activities of the U.S. Geological Survey and to provide for more effective and efficient means of releasing the data to the public. The system is operated and maintained on the central computer facilities of the Survey at its National Center in Reston, Virginia.

WATSTORE can provide a variety of useful products ranging from simple data tables to complex statistical analyses. A minimal fee, plus the actual computer cost incurred in producing a desired product, is charged to the requester. Information about the availability of specific types of data, the acquisition of data or products, and user charges can be obtained locally from each of the Water Resources Division's district offices (see address given on back of the title page).

General inquiries about WATSTORE may be directed to:

Hydrologist
U.S. Geological Survey
437 National Center
Reston, Virginia 22092

DEFINITION OF TERMS

Terms related to streamflow, water-quality, and other hydrologic data, as used in this report, are defined below. See also table for converting inch-pound units to International System of units (SI) on the inside of back cover.

Acre-foot (AC-FT, acre-ft) is the quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or about 326,000 gallons or 1,233 cubic meters.

Adenosine triphosphate (ATP) is the primary energy donor in cellular life process. Its central role in living cells makes it an excellent indicator of the presence of living material in water. A measure of ATP, therefore, provides a sensitive and rapid estimate of biomass. ATP is reported in micrograms per liter of the original water sample.

Algae are mostly aquatic single-celled, colonial, or multi-celled plants, containing chlorophyll and lacking roots, stems, and leaves.

Algal growth potential (AGP) is the maximum algal dry weight biomass that can be produced in a natural water sample under standardized laboratory conditions. The growth potential is the algal biomass present at stationary phase and is expressed as milligrams dry weight of algae produced per liter of sample.

Aquifer is a geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield significant quantities of water to wells and springs.

Artesian means confined and is used to describe a well in which the water level stands above the top of the aquifer tapped by the well. A flowing artesian well is one in which the water level is above the land surface.

Bacteria are microscopic unicellular organisms, typically spherical, rodlike, or spiral and threadlike in shape, often clumped into colonies. Some bacteria cause disease, others perform an essential role in nature in the recycling of materials; for example, by decomposing organic matter into a form available for reuse by plants.

Total coliform bacteria are a particular group of bacteria that are used as indicators of possible sewage pollution. They are characterized as aerobic or facultative anaerobic, gram-negative, nonspore- forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C. In the laboratory these bacteria are defined as the organisms which produce colonies with a golden-green metallic sheet within 24 hours when incubated at 35°C ±1.0°C on M-Endo medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample.

Fecal coliform bacteria are bacteria that are present in the intestine or feces of warmblooded animals. They are often used as indicators of the sanitary quality of the water. In the laboratory they are defined as all organisms which produce blue colonies within 24 hours when incubated at 44.5°C ±0.2°C on M-FC medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample.

Fecal streptococcal bacteria are bacteria also found in the intestine of warmblooded animals. Their presence in water is considered to verify fecal pollution. They are characterized as gram-positive, cocci bacteria which are capable of growth in brain-heart infusion broth. In the laboratory they are defined as all the organisms which produce red or pink colonies within 48 hours at 35°C ±1.0°C on M-FC medium (nutrient medium for bacterial growth). Their concentrations are expressed as number of colonies per 100 mL of sample.

Bed material is the unconsolidated material of which a streambed, lake, pond, reservoir, or estuary bottom is composed.

Biochemical oxygen demand (BOD) is a measure of the quantity of dissolved oxygen, in milligrams per liter, necessary for the decomposition of organic matter by microorganisms, such as bacteria.

Biomass is the amount of living matter present at any given time, expressed as the mass per unit area or volume of habitat.

Ash mass is the mass or amount of residue present after the residue from the dry mass determination has been ashed in a muffle furnace at a temperature of 500°C for 1 hour. The ash mass values of zooplankton and phytoplankton are expressed in grams per cubic meter (g/m^3), and periphyton and benthic organisms in grams per square meter (g/m^2).

Dry mass refers to the weight of residue present after drying in an oven at 60°C for zooplankton and 105°C for periphyton, until the mass remains unchanged. This mass represents the total organic matter, ash and sediment, in the sample. Dry mass values are expressed in the same units as ash mass.

Organic mass or volatile mass of the living substance is the difference between the dry mass and the ash mass, and represents the actual mass of the living matter. The organic mass is expressed in the same units as for ash mass and dry mass.

Wet mass is the mass of living matter plus contained water.

Bottom material: See Bed Material.

Cells/volume refers to the number of cells or any organism which is counted by using a microscope and grid or counting cell. Many planktonic organisms are multicelled and are counted according to the number of contained cells per sample, usually milliliters (mL) or liters (L).

Cfs-day is the volume of water represented by a flow of 1 cubic foot per second for 24 hours. It is equivalent to 86,400 cubic feet, approximately 1.9835 acre-feet, or about 646,000 gallons or 2,447 cubic meters.

Chemical oxygen demand (COD) is a measure of the chemically oxidizable material in the water, and furnishes an approximation of the amount of organic and reducing material present. The determined value may correlate with natural water color or with carbonaceous organic pollution from sewage or industrial wastes.

Chlorophyll refers to the green pigments of plants. Chlorophyll a and b are the two most common pigments in plants.

Color unit is produced by one milligram per liter of platinum in the form of the chloroplatinate ion. Color is expressed in units of the platinum-cobalt scale.

Contents is the volume of water in a reservoir or lake. Unless otherwise indicated, volume is computed on the basis of a level pool and does not include bank storage.

Control designates a feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, an artificial structure, or a uniform cross section over a long reach of the channel.

Cubic feet per second per square mile (CFSM) is the average number of cubic feet of water flowing per second from each square mile of area drained, assuming that the runoff is distributed uniformly in time and area.

Cubic foot per second (FT^3/s, ft^3/s) is the rate of discharge representing a volume of 1 cubic foot passing a given point during 1 second and is equivalent to approximately 7.48 gallons per second or 448.8 gallons per minute or 0.02832 cubic meters per second.

Discharge is the volume of water (or more broadly, volume of fluid plus suspended sediment), that passes a given point within a given period of time.

Mean discharge (MEAN) is the arithmetic mean of individual daily mean discharges during a specific period.

Instantaneous discharge is the discharge at a particular instant of time.

Dissolved refers to the amount of substance present in true chemical solution. In practice, however, the term includes all forms of substance that will pass through a 0.45-micrometer membrane filter, and thus may include some very small (colloidal) suspended particles. Analyses are performed on filtered samples.

Dissolved-solids concentration of water is determined either analytically by the "residue-on-evaporation" method, or mathematically by totaling the concentrations of individual constituents reported in a comprehensive chemical analysis. During the analytical determination of dissolved solids, the bicarbonate (generally a major dissolved component of water) is converted to carbonate. Therefore, in the mathematical calculation of dissolved-solids concentration, the bicarbonate value, in milligrams per liter, is multiplied by 0.492 to reflect the change.

Diversity index is a numerical expression of evenness of distribution of aquatic organisms. The formula for diversity index is:

$$\bar{d} = -\sum_{i=1}^{s} \frac{n_i}{n} \log_2 \frac{n_i}{n}$$

Where 'n_i' is the number of individuals per taxon, 'n' is the total number of individuals, and 's' is the total number of taxa in the sample of the community. Diversity index values range from zero, when all the organisms in the sample are the same, to some positive number, when some or all of the organisms in the sample are different.

Drainage area of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

Drainage basin is a part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water.

Gage height (G.H.) is the water-surface elevation referred to some arbitrary gage datum. Gage height is often used interchangeably with the more general term "stage," although gage height is more appropriate when used with a reading on a gage.

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observations of hydrologic data are obtained.

Hardness of water is a physical-chemical characteristic that is commonly recognized by the increased quantity of soap required to produce lather. It is attributable to the presence of alkaline earths (principally calcium and magnesium) and is expressed as equivalent calcium carbonate ($CaCO_3$).

Hydrologic unit is a geographic area representing part or all of a surface drainage basin or distinct hydrologic feature as delineated by the Office of Water Data Coordination on the State Hydrologic Unit Maps; each hydrologic unit is identified by an 8-digit number.

Metamorphic stage refers to the stage of development that an organism exhibits during its transformation from an immature form to an adult form. This developmental process exists for most insects, and the degree of difference from the immature stage to the adult form varies from relatively slight to pronounced, with many intermediates. Examples of metamorphic stages of insects are egg-larva-adult or egg-nymph-adult.

Methylene blue active substance (MBAS) is a measure of apparent detergents. This determination depends on the formation of a blue color when methylene blue dye reacts with synthetic detergent compounds.

Micrograms per gram (UG/G, ug/g) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (gram) of sediment.

Micrograms per kilogram (MG/KG, mg/kg) is a unit expressing the concentration of a chemical element as the mass (micrograms) of the element sorbed per unit mass (kilogram) of sediment.

Micrograms per liter (UG/L, ug/L) is a unit expressing the concentration of chemical constituents in solution as mass (micrograms) of solute per unit volume (liter) of water. One thousand micrograms per liter is equivalent to one milligram per liter.

Milligrams per liter (MG/L, mg/L) is a unit for expressing the concentration of chemical constituents in solution. Milligrams per liter represent the mass of solute per unit volume (liter) of water. Concentration of suspended sediment also is expressed in mg/L, and is based on the mass of sediment per liter of water-sediment mixture.

National Geodetic Vertical Datum of 1929 (NGVD) is a geodetic datum derived from a general adjustment of the first order level nets of both the United States and Canada. It was formerly called "Sea Level Datum of 1929" or "mean sea level" in this series of reports. Although the datum was derived from the average sea level over a period of many years at 26 tide stations along the Atlantic, Gulf of Mexico, and Pacific Coasts, it does not necessarily represent local mean sea level at any particular place.

National Stream Quality Accounting Network (NASQAN) is a nationwide data-collection network designed by the U.S. Geological Survey to meet many of the information needs of government agencies and other groups involved in natural or regional water-quality planning and management. The 500 or so sites in NASQAN are generally located at the downstream ends of hydrologic accounting units designated by the U.S. Geological Survey Office of Water Data Coordination in consultation with the Water Resources Council. The objectives of NASQAN are (1) to obtain information on the quality and quantity of water moving within and from the United States through a systematic and uniform process of data collection, summarization, analysis, and reporting such that the data may be used for, (2) description of the areal variability of water quality in the Nation's rivers through analysis of data from this and other programs, (3) detection of changes or trends with time in the pattern of occurrence of water-quality characteristics, and (4) providing a nationally consistent data base useful for water-quality assessment and hydrologic research.

The National Trends Network (NTN) is a 150-station network for sampling atmospheric deposition in the United States. The purpose of the network is to determine the variability, both in location and in time, of the composition of atmospheric deposition, which includes snow, rain, dust particles, aerosols, and gases, The core from which the NTN was built was the already-existing deposition-monitoring network of the National Atmospheric Deposition Program (NADP).

Organism is any living entity, such as an insect, phytoplankter, or zooplankter.

Organism count/area refers to the number of organisms collected and enumerated in a sample and adjusted to the number per area habitat, usually square meters (m^2), acres, or hectares. Periphyton, benthic organisms, and macrophytes are expressed in these terms.

Organism count/volume refers to the number of organisms collected and enumerated in a sample and adjusted to the number per sample volume, usually milliliters (mL) or liters (L). Numbers of planktonic organisms can be expressed in these terms.

Total organism count is the total number of organisms collected and enumerated in any particular sample.

Parameter code numbers are unique five-digit code numbers assigned to each parameter placed into storage. These codes are assigned by the Environmental Protection Agency and are also used to identify data exchanged among agencies.

Partial-record station is a particular site where limited streamflow and (or) water-quality data are collected systematically over a period of years for use in hydrologic analyses.

Particle size is the diameter, in millimeters (mm), of suspended sediment or bed material determined by either sieve or sedimentation methods. Sedimentation methods (pipet, bottom-withdrawal tube, visual-accumulation tube) determine fall diameter of particles in distilled water (chemically dispersed).

Particle-size classification used in this report agrees with recommendations made by the American Geophysical Union Subcommittee on Sediment Terminology.

The classification is as follows:

Classification	Size (mm)	Method of analysis
Clay	0.00024 - 0.004	Sedimentation
Silt	.004 - .062	Sedimentation
Sand	.062 - 2.0	Sedimentation or sieve
Gravel	2.0 - 64.0	Sieve

The particle-size distributions given in this report are not necessarily representative of all particles in transport in the stream. Most of the organic material is removed and the sample is subjected to mechanical and chemical dispersion before analysis in distilled water.

Percent composition is a unit for expressing the ratio of a particular part of a sample or population to the total sample or population, in terms of types, numbers, mass or volume.

Periphyton is the assemblage of microorganisms attached to and growing upon solid surfaces. While primarily consisting of algae, they also include bacteria, fungi, protozoa, rotifers, and other small organisms. Periphyton is a useful indicator of water quality.

Pesticides are chemical compounds used to control undesirable plants and animals. Major categories of pesticides include insecticides, miticides, fungicides, herbicides, and rodenticides. Insecticides and herbicides, which control insects and plants respectively, are the two categories reported.

Picocurie (PC, pCi) is one trillionth (1×10^{-12}) of the amount of radioactivity represented by a curie (C1). A curie is the amount of radioactivity that yields 3.7×10^{10} radioactive disintegrations per second. A picocurie yields 2.22 dpm (disintegrations per minute).

Plankton is the community of suspended, floating, or weakly swimming organisms that live in the open water of lakes and rivers.

Phytoplankton is the plant part of the plankton. They are usually microscopic and their movement is subject to the water currents. Phytoplankton growth is dependent upon solar radiation and nutrient substances. Because they are able to incorporate as well as release materials to the surrounding water, the phytoplankton have a profound effect upon the quality of the water. They are the primary food producers in the aquatic environment, and are commonly known as algae.

Blue-green algae are a group of phytoplankton organisms having a blue pigment, in addition to the green pigment called chlorophyll. Blue-green algae often cause nuisance conditions in water.

Diatoms are the unicellular or colonial algae having a siliceous shell. Their concentrations are expressed as number of cells/mL of sample.

Green algae have chlorophyll pigments similar in color to those of higher green plants. Some forms produce algal mats or floating "moss" in lakes. Their concentrations are expressed as number of cells/mL of sample.

Zooplankton is the animal part of the plankton. Zooplankton are capable of extensive movements within the water column, and are often large enough to be seen with the unaided eye. Zooplankton are secondary consumers feeding upon bacteria, phytoplankton, and detritus. Because they are the grazers in the aquatic environment, the zooplankton are a vital part of the aquatic food web. The zooplankton community is dominated by small crustaceans and rotifers.

Polychlorinated biphenyls (PCBs) are industrial chemicals that are mixtures of chlorinated biphenyl compounds having various percentages of chlorine. They are similar in structure to organochlorine insecticides.

Primary productivity is a measure of the rate at which new organic matter is formed and accumulated through photosynthetic and chemosynthetic activity of producer organisms (chiefly green plants). The rate of primary production is estimated by measuring the amount of oxygen released (oxygen method) or the amount of carbon assimilated by the plants (carbon method).

Milligrams of carbon per area or volume per unit time [mg $C/(m^2 \cdot$ time) for periphyton and macrophytes and mg $C/(m^3 \cdot$ time) for phytoplankton] are units for expressing primary productivity. They define the amount of carbon dioxide consumed as measured by radioactive carbon (carbon 14). The carbon 14 method is of greater sensitivity than the oxygen light and dark bottle method, and is preferred for use in unenriched waters. Unit time may be either the hour or day, depending on the incubation period.

Milligrams of oxygen per area or volume per unit time [mg $O_2/(m^2 \cdot$ time) for periphyton and macrophytes and mg $O_2/(m^3 \cdot$ time) for phytoplankton] are the units for expressing primary productivity. They define production and respiration rates as estimated from changes in the measured dissolved oxygen concentration. The oxygen light and dark bottle method is preferred if the rate of primary production is sufficient for accurate measurements to be made within 24 hours. Unit time may be either the hour or day, depending on the incubation period.

Radiochemical program is a network of regularly sampled water-quality stations where samples are collected to be analyzed for radioisotypes. The streams that are sampled represent major drainage basins in the conterminous United States.

Recoverable from bottom material is the amount of a given constituent that is in solution after a representative sample of bottom material has been digested by a method (usually using an acid or mixture of acids) that results in dissolution of only readily soluble substances. Complete dissolution of all bottom material is not achieved by the digestion treatment and thus the determination represents less than the total amount (that is, less than 95 percent) of the constituent in the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

Return period is the average time interval between occurrences of a hydrological event of a given or greater magnitude, usually expressed in years. May also be called recurrence interval.

Runoff in inches (IN, in) shows the depth to which the drainage area would be covered if all the runoff for a given time period were uniformly distributed on it.

Sediment is solid material that originates mostly from disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics, and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree of slope, length of slope, soil characteristics, land usage, and precipitation.

Bed load is the sediment that is transported in a stream by rolling, sliding, or skipping along the bed and very close to it. In this report, bed load is considered to consistof particles in transit within 0.25 ft of the streambed.

Bed load discharge (tons per day) is the quantity of bed load measured by dry weight that moves past a section as bed load in a given time.

Suspended sediment is the sediment that at any given time is maintained in suspension by the upward components of turbulent currents or that exists in suspension as a colloid.

Suspended-sediment concentration is the velocity-weighted concentration of suspended sediment in the sampled zone (from the water surface to a point approximately 0.3 ft above the bed) expressed as milligrams of dry sediment per liter of water-sediment mixture (mg/L).

Mean concentration is the time-weighted concentration of suspended sediment passing a stream section during a 24-hour day.

Suspended-sediment discharge (tons/day) is the rate at which dry weight of sediment passes a section of a stream or is the quantity sediment, as measured by dry weight or volume, that passes a section in a given time. It is computed by multiplying discharge times mg/L times 0.0027.

Suspended-sediment load is quantity of suspended sediment passing a section in a specified period.

Total sediment discharge (tons/day) is the sum of the suspended-sediment discharge and the bed-load discharge. It is the total quantity of sediment, as measured by dry weight or volume, that passes a section during a given time.

Total-sediment load or total load is a term which refers to the total sediment (bed load plus suspended-sediment load) that is in transport. It is not synonymous with total-sediment discharge.

7-day 10 year low flow (7 Q_{10}) is the discharge at the 10-year recurrence interval taken from a frequency curve of annual values of the lowest mean discharge for 7 consecutive days (the 7-day low flow).

Sodium-adsorption-ratio (SAR) is the expression of relative activity of sodium ions in exchange reactions within soil and is an index of sodium or alkali hazard to the soil. Waters range in respect to sodium hazard from those which can be used for irrigation on almost all soils to those which are generally unsatisfactory for irrigation.

Solute is any substance derived from the atmosphere, vegetation, soil, or rocks that is dissolved in water.

Specific conductance is a measure of the ability of a water to conduct an electrical current. It is expressed in micromhos per centimeter at 25°C. Specific conductance is related to the type and concentration of ions in solution and can be used for approximating the dissolved-solids content of the water. Commonly, the concentration of dissolved solids (in milligrams per liter) is about 65 percent of the specific conductance (in micromhos). This relation is not constant from stream to stream, and it may vary in the same source with changes in the composition of the water.

Stage-discharge relation is the relation between gage height (stage) and volume of water per unit of time, flowing in a channel.

Streamflow is the discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the word "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as a streamflow may be applied to discharge whether or not it is affected by diversion of regulation.

Substrate is the physical surface upon which an organism lived.

Natural substrates refers to any naturally occurring emersed or submersed solid surface, such as a rock or tree, upon which an organism lived.

Artificial substrate is a device which is purposely placed in a stream or lake for colonization of organisms. The artificial substrate simplifies the community structure by standardizing the substrate from which each sample is taken. Examples of artificial substrates are basket samplers (made of wire cages filled with clean streamside rocks) and miltiplate samplers (made of hardboard) for benthic organism collection, and plexiglass strips for periphyton collection.

Surface area of a lake is that area outlined on the latest USGS topographic map as the boundary of the lake and measured by a planimeter in acres. In localities not covered by topographic maps, the areas are computed from the best maps available at the time planimetered. All areas shown are those for the stage when the planimetered map was made. All areas shown are those for the stage when the planimetered map was made.

Surficial bed material is that part (0.1 to 0.2 ft) of the bed material that is sampled using U.S. Series Bed-Material Samplers.

Suspended (as used in tables of chemical analyses) refers to the amount (concentration) of the total concentration in a water-sediment mixture. The water-sediment mixture is associated with (or sorbed on) that material retained on a 0.45 micrometer filter.

Suspended, recoverable is the amount of a given constituent that is in solution after the part of a representative water-suspended sediment sample that is retained on a 0.45 micrometer filter has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolution of all the particulate matter is not achieved by the digestion treatment and thus the determination represents something less than the "total" amount (that is, less than 95 percent) of the constituent present in the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

Determinations of "suspended, recoverable" constituents are made either by analyzing portions of the material collected on the filter or, more commonly, by difference, based on determinations of (1) dissolved and (2) total recoverable concentrations of the constituent.

Suspended, total is the total amount of a given constituent in the part of a representative water-suspended sediment sample that is retained on a 0.45 um membrane filter. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to determine when the results should be reported as "suspended, total."

Determinations of "suspended, total" constituents are made either by analyzing portions of the material collected on the filter or, more commonly, by difference, based on determinations of (1) dissolved and (2) total concentrations of the constituent.

Taxonomy is the division of biology concerned with the classification and naming of organisms. The classification of organisms is based upon a hierarchical scheme beginning with Kingdom and ending with Species at the base. The higher the classification level, the fewer features the organisms have in common. For example, the taxonomy of a particular mayfly, Hexagenia limbata is the following:

Kingdom.....Animal
Phylum.....Arthropoda
Class.....Insects
Order.....Ephemeroptera
Family.....Ephermeridae
Genus.....Hexageria
Species.....Hexagenia limbata

Thermograph is an instrument that continuously records variations of temperature on a chart. The more general term "temperature recorder" is used in the table headings and refers to any instrument that records temperature whether on a chart, a tape, or any other medium.

Time-weighted average is computed by multiplying the number of days in the sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the products by the total number of days. A time-weighted average represents the composition of water that would be contained in a vessel or reservoir that had received equal quantities of water from the stream each day for the year.

Tons per acre-foot indicates the dry mass of dissolved solids in 1 acre-foot of water. It is computed by multiplying the concentration in milligrams per liter by 0.00136.

Tons per day is the quantity of substance in solution or suspension that passes a stream section during a 24-hour day.

Total is the total amount of a given constituent in a representative water-suspended sediment sample, regardless of the constituent's physical or chemical form. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent present in both the dissolved and suspended phases of the sample. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total." (Note that the word "total" does double duty here, indicating both that the sample consists of a water-suspended sediment mixture and that the analytical method determines all of the constituent in the sample.)

Total in bottom material is the total amount of a given constituent in a representative sample of bottom material. This term is used only when the analytical procedure assures measurement of at least 95 percent of the constituent determined. A knowledge of the expected form of the constituent in the sample, as well as the analytical methodology used, is required to judge when the results should be reported as "total in bottom material."

Total load (tons) is the total quantity of any individual constituent, as measured by dry mass or volume, that is dissolved in a specific amount of water (discharge) during a given time. It is computed by multiplying the total discharge, times the mg/L of the constituent, times the factor 0.0027, times the number of days.

Total recoverable refers to the amount of a given constituent that is in solution after a representative water-suspended sediment sample has been digested by a method (usually using a dilute acid solution) that results in dissolution of only readily soluble substances. Complete dissolution of all particulate matter is not achieved by the digestion treatment, and thus the determination represents something less than the "total" amount (that is, less than 95 percent) of the constituent percent in the dissolved and suspended phases of the sample. To achieve comparability of analytical data, equivalent digestion procedures would be required of all laboratories performing such analyses because different digestion procedures are likely to produce different analytical results.

Tritium Network is a network of stations which has been established to provide baseline information on the occurrence of tritium in the Nation's surface waters. In addition to the surface-water stations in the network, tritium data are also obtained at a number of precipitation stations. The purpose of the precipitation stations is to provide an estimate sufficient for hydrologic studies of the tritium input to the United States.

Water year in Geological Survey reports dealing with surface-water supply is the 12-month period, October 1 through September 30. The water year is designated by the calendar year in which it ends and which includes 9 of the 12 months. Thus, the year ending September 30, 1980, is called the "1980 water year."

WDR is used as an abbreviation for "Water-Data Report" in reference to published reports beginning in 1975.

Weighted average is used in this report to indicate discharge-weighted average. It is computed by multiplying the discharge for a sampling period by the concentrations of individual constituents for the corresponding period and dividing the sum of the products by the sum of the discharges. A discharge- weighted average approximates the composition of water that would be found in a reservoir containing all the water passing a given location during the water year after thorough mixing in the reservoir.

WRD is used as an abbreviation for "Water-Resources Data" in the REVISED RECORDS paragraph to refer to State annual basic-data reports published before 1975.

WSP is used as an abbreviation for "Water-Supply Paper" in references to previously published reports.

PUBLICATIONS ON TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS

The U.S. Geological Survey publishes a series of manuals describing procedures for planning and conducting specialized work in water-resources investigations. The material is grouped under major subject headings called books and is further divided into sections and chapters. For example, Section A of Book 3 (Applications of Hydraulics) pertains to surface water. The chapter, the unit of publication, is limited to a narrow field of subject matter. This format permits flexibility in revision and publication as the need arises.

The reports listed below are for sale by the U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, Colorado 80225 (authorized agent of the Superintendent of Documents, Government Printing Office). Prepayment is required. Remittance should be sent by check or money order payable to the U.S. Geological Survey. Prices are not included because they are subject to change. Current prices can be obtained by writing to the above address. When ordering or inquiring about prices for any of these publications, please give the title, book number, chapter number, and "U.S. Geological Survey Techniques of Wster-Resources Investigations."

1-D1. *Water temperature--influential factors, field measurement, and data presentation*, by H. H. Stevens, Jr., J. F. Ficke, and G. F. Smoot: USGS--TWRI Book 1, Chapter D1. 1975. 65 pages.

1-D2. *Guidelines for collection and field analysis of ground-water samples for selected unstable constituents*, by W. W. Wood: USGS--TWRI Book 1, Chapter D2. 1976. 24 pages.

2-D1. *Application of surface geophysics to ground-water investigations*, by A. A. R. Zohdy, G. P. Eaton, and D. R. Mabey: USGS--TWRI Book 2, Chapter D1. 1974. 116 pages.

2-D2. *Application of seismic-refraction techniques to hydrologic studies*, by F. P. Haeni: USGS--TWRI Book 2, Chapter D2. 1988. 86 pages.

2-E1. *Application of borehole geophysics to water-resources investigations*, by W. S. Keys and L. M. MacCary: USGS--TWRI Book 2, Chapter E1. 1971. 126 pages.

2-F1. *Application of drilling, coring, and sampling techniques to test holes and wells*, by Eugene Shuter and Warren E. Teasdale: USGS--TWRI Book 2, Chapter F1. 1989. 97 pages.

3-A1. *General field and office procedures for indirect discharge measurements*, by M. A. Benson and Tate Dalrymple: USGS--TWRI Book 3, Chapter A1. 1967. 30 pages.

3-A2. *Measurement of peak discharge by the slope-area method*, by Tate Dalrymple and M. A. Benson: USGS--TWRI Book 3, Chapter A2. 1967. 12 pages.

3-A3. *Measurement of peak discharge at culverts by indirect methods*, by G. L. Bodhaine: USGS--TWRI Book 3, Chspter A3. 1968. 60 pages.

3-A4. *Measurement of peak discharge at width contractions by indirect methods*, by H. F. Matthai: USGS--TWRI Book 3, Chapter A4. 1967. 44 pages.

3-A5. *Measurement of peak discharge at dams by indirect methods*, by Harry Hulsing: USGS--TWRI Book 3, Chapter A5. 1967. 29 pages.

3-A6. *General procedure for gaging streams*, by R. W. Carter and Jacob Davidian: USGS--TWRI Book 3, Chapter A6. 1968. 13 pages.

3-A7. *Stage measurements at gaging stations*, by T. J. Buchanan and W. P. Somers: USGS--TWRI Book 3. Chapter A7. 1968. 28 pages.

3-A8. *Discharge measurements at gaging stations*, by T. J. Buchanan and W. P. Somers: USGS--TWRI Book 3, Chapter A8. 1969. 65 pages.

3-A9. *Measurement of time of travel in streams by dye tracing*, by F. A. Kilpatrick and J. F. Wilson, Jr.: USGS--TWRI Book 3, Chapter A9. 1989. 27 pages.

3-A10. *Discharge ratings at gaging stations*, by E. J. Kennedy: USGS--TWRI Book 3, Chapter A10. 1984. 59 pages.

3-A11. *Measurement of discharge by moving-boat method*, by G. F. Smoot and C. E. Novak: USGS--TWRI Book 3, Chapter A11. 1969. 22 pages.

3-A12. *Fluorometric procedures for dye tracing*, by J. F. Wilson, Jr., E. D. Cobb, and F. A. Kilpatrick: USGS--TWRI Book 3, Chapter A12. 1986. 41 pages.

3-A13. *Computation of continuous records of streamflow*, by E. J. Kennedy: USGS--TWRI Book 3, Chapter A13. 1983. 53 pages.

3-A14. *Use of flumes in measuring discharge*, by F. A. Kilpatrick and V. R. Schneider: USGS--TWRI Book 3, Chapter A14. 1983. 46 pages.

3-A15. *Computation of water-surface profiles in open channels*, by Jacob Davidian: USGS--TWRI Book 3, Chapter A15. 1984. 48 pages.

3-A16. *Measurement of discharge using tracers*, by F. A. Kilpatrick and E. D. Cobb: USGS--TWRI Book 3, Chapter A16. 1985. 52 pages.

3-A17. *Acoustic velocity meter systems*, by Antonius Laenen: USGS--TWRI Book 3, Chapter A17. 1985. 38 pages.

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PUBLICATIONS ON TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS--Continued

3-B1. *Aquifer-test design, observation, and data analysis*, by R. W. Stallman: USGS--TWRI Book 3, Chapter B1. 1971. 26 pages.

3-B2. *Introduction to ground-water hydraulics, a programmed text for self-instruction*, by G. D. Bennett: USGS--TWRI Book 3, Chapter B2. 1976. 172 pages.

3-B3. *Type curves for selected problems of flow to wells in confined aquifers*, by J. E. Reed: USGS--TWRI Book 3, Chapter B3. 1980. 106 pages.

3-B5. *Definition of boundary and initial conditions in the analysis of saturated ground-water flow systems--An introduction*, by O. L. Franke, T. E. Reilly, and G. D. Bennett: USGS--TWRI Book 3, Chapter B5. 1987. 15 pages.

3-B6. *The principle of superposition and its application in ground-water hydraulics*, by T. E. Reilly, O. L. Franke, and G. D. Bennett: USGS--TWRI Book 3, Chapter B6. 1987. 28 pages.

3-C1. *Fluvial sediment concepts*, by H. P. Guy: USGS--TWRI Book 3, Chapter C1. 1970. 55 pages.

3-C2. *Field methods for measurement of fluvial sediment*, by H. P. Guy and V. W. Norman: USGS--TWRI Book 3, Chapter C2. 1970. 59 pages.

3-C3. *Computation of fluvial-sediment discharge*, by George Porterfield: USGS--TWRI Book 3, Chapter C3. 1972. 66 pages.

4-A1. *Some statistical tools in hydrology*, by H. C. Riggs: USGS--TWRI Book 4, Chapter A1. 1968. 39 pages.

4-A2. *Frequency curves*, by H. C. Riggs: USGS--TWRI Book 4, Chapter A2. 1968. 15 pages.

4-B1. *Low-flow investigations*, by H. C. Riggs: USGS--TWRI Book 4, Chapter B1. 1972. 18 pages.

4-B2. *Storage analyses for water supply*, by H. C. Riggs and C. H. Hardison: USGS--TWRI Book 4, Chapter B2. 1973. 20 pages.

4-B3. *Regional analyses of streamflow characteristics*, by H. C. Riggs: USGS--TWRI Book 4, Chapter B3. 1973. 15 pages.

4-D1. *Computation of rate and volume of stream depletion by wells*, by C. T. Jenkins: USGS-TWRI Book 4, Chapter D1. 1970. 17 pages.

5-A1. *Methods for determination of inorganic substances in water and fluvial sediments*, by M. J. Fishman and L. C. Friedman: USGS--TWRI Book 5, Chapter A1. 1989. 545 pages.

5-A2. *Determination of minor elements in water by emission spectroscopy*, by P. R. Barnett and E. C. Mallory, Jr.: USGS--TWRI Book 5, Chapter A2. 1971. 31 pages.

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5-A4. *Methods for collection and analysis of aquatic biological and microbiological samples*, by L. J. Britton and P. E. Greeson, editors: USGS--TWRI Book 5, Chapter A4. 1989. 363 pages.

5-A5. *Methods for determination of radioactive substances in water and fluvial sediments*, by L. L. Thatcher, V. J. Janzer, and K. W. Edwards: USGS--TWRI Book 5, Chapter A5. 1977. 95 pages.

5-A6. *Quality assurance practices for the chemical and biological analyses of water and fluvial sediments*, by L. C. Friedman and D. E. Erdmann: USGS--TWRI Book 5, Chapter A6. 1982. 181 pages.

5-C1. *Laboratory theory and methods for sediment analysis*, by H. P. Guy: USGS--TWRI Book 5, Chapter C1. 1969. 58 pages.

6-A1. *A modular three-dimensional finite-difference ground-water flow model*, by M. G. McDonald and A. W. Harbaugh: USGS--TWRI Book 6, Chapter A1. 1988. 586 pages.

7-C1. *Finite difference model for aquifer simulation in two dimensions with results of numerical experiments*, by P. C. Trescott, G. F. Pinder, and S. P. Larson: USGS--TWRI Book 7, Chapter C1. 1976. 116 pages.

7-C2. *Computer model of two-dimensional solute transport and dispersion in ground water*, by L. F. Konikow and J. D. Bredehoeft: USGS--TWRI Book 7, Chapter C2. 1978. 90 pages.

7-C3. *A model for simulation of flow in singular and interconnected channels*, by R. W. Schaffrannek, R. A. Baltzer, and D. E. Goldberg: USGS--TWRI Book 7, Chapter C3. 1981. 110 pages.

8-A1. *Methods of measuring water levels in deep wells*, by M. S. Garber and F. C. Koopman: USGS--TWRI Book 8, Chapter A1. 1968. 23 pages.

8-A2. *Installation and service manual for U.S. Geological Survey manometers*, by J. D. Craig: USGS--TWRI Book 8, Chapter A2. 1983. 57 pages.

8-B2. *Calibration and maintenance of vertical-axis type current meters*, by G. F. Smoot and C. E. Novak: USGS--TWRI Book 8, Chapter B2. 1968. 15 pages.

DISCONTINUED GAGING STATIONS

The following continuous-record streamflow or stage stations in Minnesota have been discontinued or converted to partial-record stations. Daily streamflow or stage records were collected and published for the period of record shown for each station.

Station number	Station name	Drainage area (mi^2)	Period of record
	Streams tributary to Lake Superior		
04010000	Pigeon River above mouth of Arrow River, MN	256	1924-27
04011000	Brule River at mouth near Hoveland, MN	248	1911†
04011500	Devil Track River at mouth near Grand Marais, MN	a77	1911†
04012000	Cascade River at mouth near Grand Marais, MN	111	1911†
*04012500	Poplar River at Lutsen, MN	114	1911†, 1912-17, 1928-47, 1952-61
04013000	Cross River at Schroeder, MN	a91	1931-32
04015000	Beaver Creek (Beaver Bay Run) at Beaver Bay, MN	126	1911-14, 1928-31
04015455	South Branch Partridge River near Babbitt, MN	18.5	1977-80
04015475	Partridge River above Colby Lake, at Hoyt Lakes, MN	106	1979-88
04015500	Second Creek near Aurora, MN	29	1955-80
04016000	Partridge River near Aurora, MN	161	1942-82
04016500	St. Louis River near Aurora, MN	290	1942-87
04017000	Embarrass River at Embarrass, MN	93.8	1942-64
04018000	Embarrass River near McKinley, MN	171	1953-62
04018900	East Two Rivers near Iron Junction, MN	40.0	1966-79
04019000	West Two Rivers near Iron Junction, MN	65.3	1953-62, 1965-79
04019300	West Swan River near Silica, MN	16.3	1963-79
04019500	East Swan River near Toivola, MN	112	1953-62, 1964-71
04020000	Swan River near Toivola, MN	254	1952-61
04021000	Whiteface River below (at) Meadowlands, MN	453	1909-17
04021530	Stoney Brook at Brookston, MN	97.3	1983-84
04023000	Cloquet River at Independence, MN	a750	1909-17
04023150	Simian Creek near Brookston, MN	-	1983-84
04023500	St. Louis River near Cloquet, MN	a3,400	1903†
04023600	Squaw Creek near Cloquet, MN	-	1983-84
04024015	Otter Creek near Cloquet, MN	-	1983-84
04024090	Elim Creek near Holyoke, MN	1.06	1976-78
04024093	Skunk Creek below Elim Creek near Holyoke, MN	8.83	1976-78
	Red River of the North basin		
05030000	Otter Tail River near Detroit Lakes, MN	270	1937-71
05030500	Otter Tail River at German Church, near Fergus Falls, MN	a1,230	1904-17
05033900	Pelican River at Detroit Lakes, MN	-	1968-71, 1974-75
05034100	Pelican River at Detroit Lake outlet near Detroit Lakes, MN	-	1968-71, 1972-75

"See footnotes at end of table."

DISCONTINUED GAGING STATIONS

Station number	Station name	Drainage area (mi^2)	Period of record
	Red River of the North basin--Continued		
05035100	Long Lake outlet near Detroit Lakes, MN	-	1968-71
05035200	West Branch County Ditch No. 14 near Detroit Lakes, MN	-	1968-71
05035300	East Branch County Ditch No. 14 near Detroit Lakes, MN	-	1968-71
05035500	St. Clair Lake outlet near Detroit Lakes, MN	-	1968-75
05035600	Pelican River at Muskrat Lake outlet near Detroit Lakes, MN	-	1968-75
05037100	Pelican River at Sallie Lake outlet near Detroit Lakes, MN	-	1968-75
05039100	Pelican River at Lake Melissa outlet near Detroit Lakes, MN	-	1968-75
05040000	Pelican River near Detroit Lakes, MN	123	1942-53
05040500	Pelican River near Fergus Falls, MN	482	1909-12, 1942-80
05045500	Otter Tail River (Red River) near Fergus Falls, MN	a1,690	1909-10†
05046500	Otter Tail River near Breckenridge, MN	a2,040	1931-32, 1939-46†
05047000	Mustinka River (head of Bois de Sioux River) near Norcross, MN	-	1940-47
05047500	Mustinka ditch above West Branch Mustinka River (Twelve Mile Creek) near Charlesville, MN	-	1943-55
05048000	Mustinka ditch below West Branch Mustinka River (Twelve Mile Creek) near Charlesville, MN	-	1943-55
05048500	West Branch Mustinka River (Twelve Mile Creek) below Mustinka ditch near Charlesville, MN	-	1943-55
05049000	Mustinka River above (near) Wheaton, MN	834	1915-24, 1930-58
05050500	Bois de Sioux River below Fairmont, ND	a1,540	1919-44
05051000	Rabbit River at Cambell, MN	266	1942-52
05054020	Red River of the North below Fargo, ND	-	1969-78
*05061200	Whiskey Creek at Barnesville, MN	25.3	1964-66
05062500	Wild Rice River at Twin Valley, MN	888	1909-17 1930-83
05063000	Wild Rice River near Ada, MN	a1,100	1948-54
*05063500	South Branch Wild Rice River near Borup, MN	254	1944-49
05067000	Marsh River below Ada, MN	-	1948-52
05068000	Sand Hill River at Beltrami, MN	a324	1943-58
05068500	Sand Hill ditch at Beltrami, MN	-	1943-58
05075500	Thief River near Gatske, MN	-	1953-56
05076500	Red Lake River at Thief River Falls, MN	a3,450	1909-18, 1920-30
05077000	Clearwater River near Pinewood, MN	132	1940-45
05077500	Clearwater River near Leonard, MN	153	1934-47
*05077700	Ruffy Brook near Gonvick, MN	45.2	1960-78
05083500	Red River of the North at Oslo, MN	331,200	1936-37, 1941-43, 1945-60, 1973-78
05085500	Snake River at Warren, MN	a175	1945, 1953-56

"See footnotes at end of table."

DISCONTINUED GAGING STATIONS

Station number	Station name	Drainage area (mi^2)	Period of record
	Red River of the North basin--Continued		
05086000	Snake River at Alvarado, MN	309	1945, 1953-56
05086500	Snake River near Argyle, MN	481	1945
05087000	Middle River near Strandquist, MN	-	1953-56
05090500	Tamarac River near Strandquist, MN	-	1953-56
05091000	Tamarac River at Stephen, MN	-	1945
05091500	Tamarac River near Stephen, MN	a320	1945, 1953-55
05092500	Two Rivers (Middle Fork Two Rivers) near Hallock, MN	131	1931-38
05093000	South Branch (South Fork) Two Rivers near Pelan, MN	281	1928-38, 1953-56
05094500	South Branch Two Rivers (Two Rivers) at Hallock, MN	-	1940-47
05095000	Two Rivers (South Branch Two Rivers) at Hallock, MN		1911-14 1929-30 1938-39 1941-43
05095500	Two Rivers below Hallock, MN	644	1945-55
05096000	North Branch (North Fork) Two Rivers near Lancaster, MN	a32	1929-38, 1941-55
05096500	State Ditch 85 near Lancaster, MN	a95	1929-38, 1942-55
05097000	North Branch Two Rivers at Lancaster, MN	209	1941-42, 1953-56
05097500	North Branch Two Rivers near Northcote, MN	386	1941-42, 1945-51
05098000	Two Rivers below North Branch near Hallock, MN	a1,060	1941-43
05103000	Roseau River (at) near Malung, MN	252	1928-46
05104000	South Fork (West Branch) Roseau River near Malung, MN	312	1911-14, 1928-46
05105000	Roseau River at Roseau, MN	-	1940-47
05105500	Roseau River near Roseau, MN	-	1930-60
05106000	Sprague Creek near Sprague, Manitoba	176	1928-81
05107000	Pine Creek near Pine Creek, MN	74.6	1928-53
05108000	Roseau River near Badger, MN	-	1928-69
05108500	Roseau River near Duxby, MN	-	1929-51, 1952-56
05109000	Badger Creek near Badger, MN	a2.2	1929-30, 1931-38
05109500	Roseau River near Haug, MN	-	1932-66
05110000	Roseau River at outlet of State Ditch 69 near Oak Point, MN	-	1939-42
05110500	Roseau River at head of State Ditch 51 near Oak Point, MN	-	1933-42
05111000	Roseau River at Oak Point, MN	-	1933-39, 1941-60
05112500	Roseau River at International boundary, near Caribou, MN	a1,590	1933-69

*See footnotes at end of table."

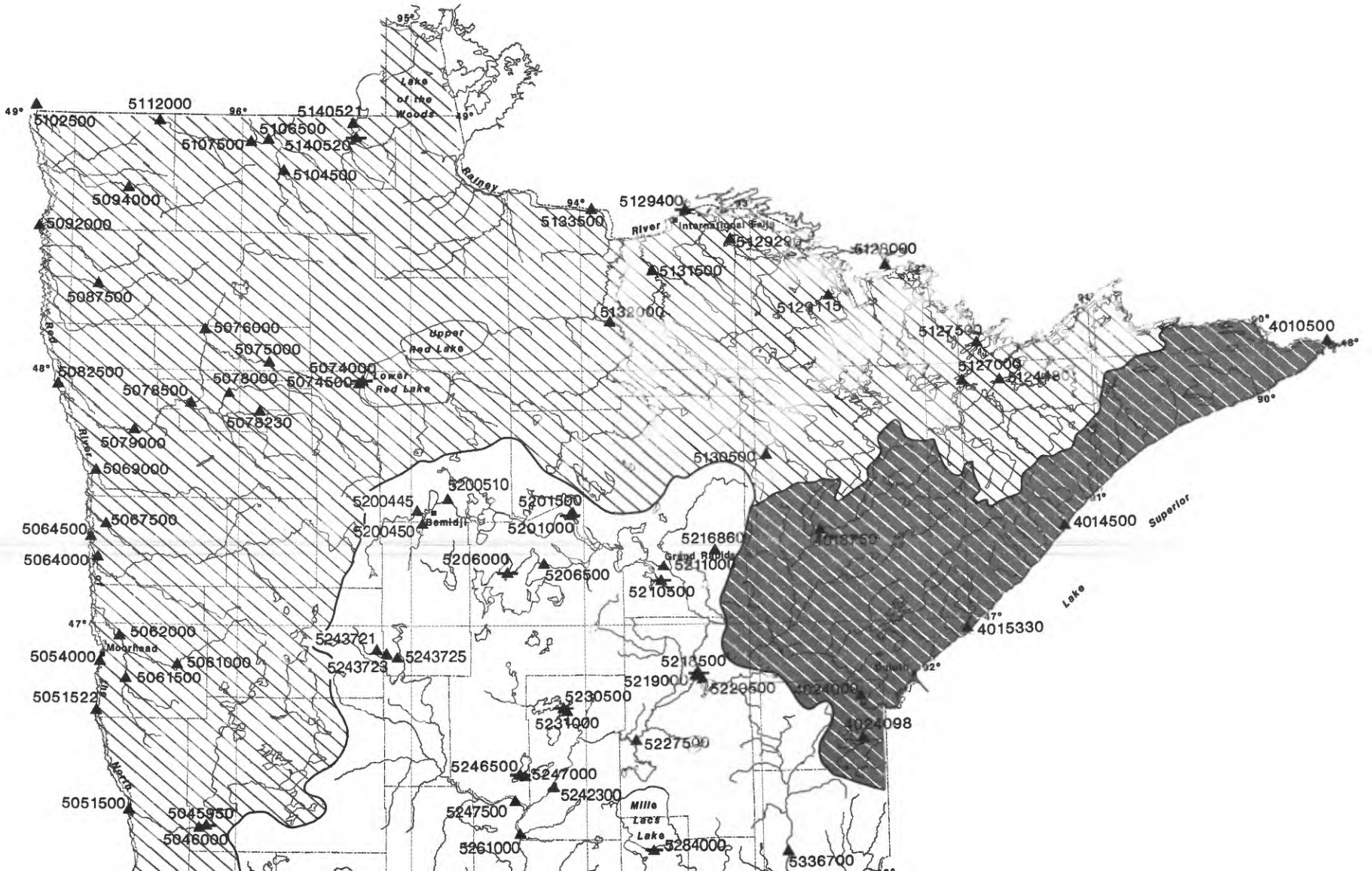
DISCONTINUED GAGING STATIONS

Station number	Station name	Drainage area (mi^2)	Period of record
	Lake of the Woods basin		
05124500	Isabella River near Isabella, MN	341	1953-61, 1976-77
05124990	Filson Creek near Ely, MN	9.66	1974-85
05125000	South Kawishiwi River near Ely, MN	-	1953-61, 1976-78
05125500	Stony River near Isabella, MN	180	1953-64
05125550	Stony River near Babbitt, MN	219	1975-80
05126000	Dunka River near Babbitt, MN	53.4	1951-62, 1975-80
05126210	South Kawishiwi River above White Iron Lake near Ely, MN		1975-78
05126500	Bear Island River near Ely, MN	68.5	1953-62, 1975-77
05127205	Burntside River near Ely, MN	-	1967-78
05127207	Bjorkman's Creek near Ely, MN	1.36	1972-78
05127210	Armstrong Creek near Ely, MN	5.29	1967-78
05127215	Longstorff Creek near Ely, MN	8.84	1967-78
05127219	Shagawa Lake tributary at Ely, MN	1.84	1971-78
05127220	Burgo Creek near Ely, MN	3.04	1967-78
05127230	Shagawa River near Ely, MN	99	1967-78
05128200	Vermilion Lake near Soudan, MN	-	1913-15†, 1941-42†, 1946-87†
05128340	Pike River near Biwabik, MN	-	1977-79
05128500	Pike River near Embarrass, MN	115	1953-64, 1976-79
05129000	Vermilion River below Vermilion Lake near Tower, MN	483	1911-17, 1928-81
05129500	Rainy River at International Falls, MN	14,900	1905-60
05130000	Sturgeon River (Lake) at Side Lake, MN	-	1938-47
05131000	Dark River near Chisholm, MN	50.6	1942-61, 1965-79
05131800	Deer Lake outlet (Deer Lake) near Effie, MN	-	1937-39, 1940-46
05132500	Big Fork River at Laurel, MN	-	1909
05133000	Black River near Loman, MN	-	1909
05134200	Rapid River near Baudette, MN	543	1956-85
05139500	Warroad River near Warroad, MN	162	1946-80
*05140000	Bulldog Run near Warroad, MN	14.2	1946-51, 1966-77
*05140500	East Branch Warroad River near Warroad, MN	102	1946-54, 1966-77

* Presently operated as high-flow partial-record station.
† Stage records only.
a Approximately.

Discharge measurement through the ice on the Mississippi River at Elk River, Minnesota. Ca. 1935.

Streamflow-gaging station on the Rum River near St. Francis, Minnesota. Ca. 1935.


Lake of the Woods
Rainy River
Upper Red Lake
Lower Red Lake
Red River
Lake Superior
Mille Lacs Lake
Moorhead
Grand Rapids
Bemidji
International Falls
Duluth
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5112000
5140521
5106500
5107500
5140526
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5094000
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5087500
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5284000
5336700

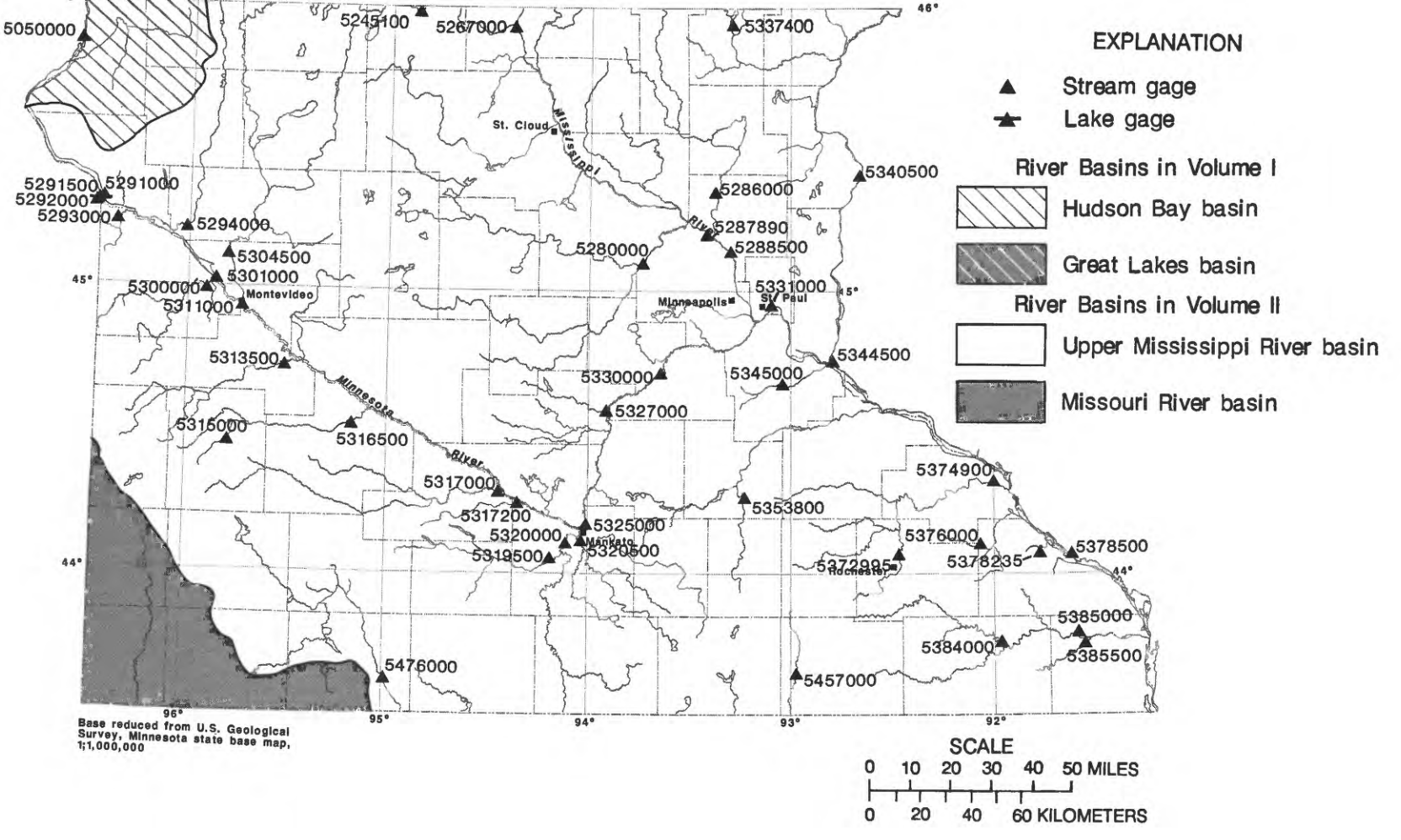


Figure 7.--Location of lake and stream-gaging stations


95°
Lake of the Woods
49°
96°
5102500
5112000
Rainy
94°
5133500
River
International Falls
93°
5092000
Red
48°
5082500
Upper Red Lake
Lower Red Lake
5124480
90°
5079000
River
5064500
Bemidji
Grand Rapids
91°
Superior
Lake
47°
465724094402601
Moorhead
5054000
Red
5051522
North
5051500
Duluth
92°
Mille Lacs Lake

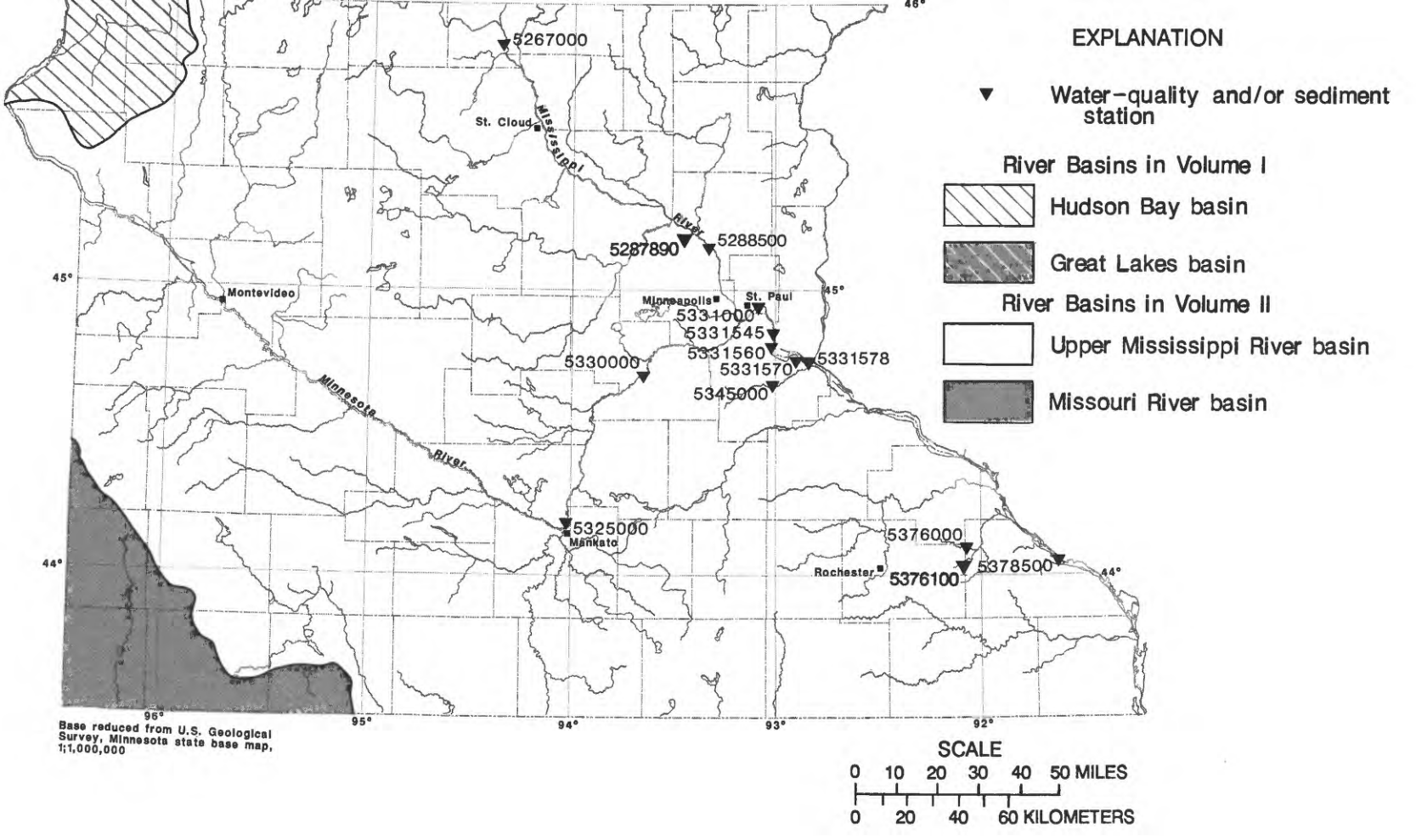


Figure 8.--Location of surface-water-quality stations

STREAMS TRIBUTARY TO LAKE SUPERIOR

04010500 PIGEON RIVER AT MIDDLE FALLS, NEAR GRAND PORTAGE, MN
(International gaging station)

LOCATION.--Lat 48°00'44", long 89°36'58", in SW¼NE¼ sec.24, T.64 N., R.6 E., Cook County, Hydrologic Unit 04010101, on the Grand Portage Indian Reservation, on right bank 400 ft upstream from Middle Falls, 2.5 mi upstream from Grand Portage Port of Entry, 3.5 mi upstream from mouth, and 4.7 mi northeast of city of Grand Portage.
DRAINAGE AREA.--600 mi^2.
PERIOD OF RECORD.--June to October 1921, April to November 1922, March 1923 to current year. Published as "at International Bridge" April 1924 to September 1940; as "below International Bridge" October 1940 to September 1965. Monthly discharge only for some periods, published in WSP 1307.
REVISED RECORDS.--WSP 744: 1927-28. WSP 804: 1934(M). WSP 974: Drainage area. WSP 1337: 1924(M), 1925, 1926-28(M), 1931(M), 1938(M), 1941(M), 1945-46(M), 1947, 1948(M), 1950(M).
GAGE.--Water-stage recorder. Datum of gage is 787.58 ft above National Geodetic Vertical Datum of 1929. Prior to Sept. 30, 1940, nonrecording gage at International Bridge, 5.8 mi upstream at datum 102.24 ft higher. Oct. 1, 1940, to Dec. 31, 1975, at present site at datum 2.00 ft higher.
REMARKS.--Records good except those for estimated daily discharges, which are fair. Satellite telemeter at station.
COOPERATION.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.
AVERAGE DISCHARGE.--66 years (water years 1924-89), 506 ft^3/s, 11.45 in/yr.
EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 11,000 ft^3/s, May 5, 1934, gage height, 7.6 ft, site and datum then in use, from rating curve extended above 7,000 ft^3/s; minimum daily, 1.0 ft^3/s, Jan. 15-21, 1977; minimum recorded gage height, 1.24 ft, Jan. 7, 8, 15, 1977, but may have been less during period of no gage-height record, Jan. 16 to Apr. 17, 1977.
EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 3,000 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 27	2200	3,240	8.35	June 16	0730	*3,680	*8.75
May 5	1700	3,190	8.31				

Minimum discharge, 116 ft^3/s, Sept. 30, gage height, 2.74 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	671	e320	e540	e390	e290	e200	e280	2520	1550	639	250	221
2	604	e300	e530	e390	e280	e200	e295	2360	1440	583	284	207
3	548	e290	e520	e390	e280	e190	e310	2360	1350	552	263	186
4	511	e290	e510	e390	e280	e190	e380	2500	1290	517	255	287
5	487	e290	e500	e390	e270	e190	e460	3040	1220	487	244	533
6	452	e300	e490	e390	e270	e190	e550	3050	1160	458	233	477
7	414	e350	e480	e380	e270	e190	e580	2720	1100	435	223	387
8	388	e360	e470	e380	e260	e180	e580	2520	1060	413	212	325
9	370	e370	e460	e380	e260	e180	e570	2340	1310	390	202	278
10	351	e390	e450	e370	e260	e180	e560	2190	1280	373	193	247
11	335	e410	e450	e370	e250	e180	e540	2060	1150	355	189	227
12	328	e420	e440	e370	e250	e180	e530	1950	1100	336	178	217
13	306	e450	e440	e360	e250	e180	e530	1860	3230	316	168	204
14	282	e480	e440	e360	e240	e180	e540	1790	2820	309	162	198
15	267	e520	e440	e360	e240	e180	e570	1730	2170	304	159	179
16	272	e2000	e430	e360	e240	e170	e600	1660	1760	335	156	163
17	290	e2000	e430	e350	e230	e170	e650	1570	1520	339	150	154
18	302	e1700	e430	e350	e230	e170	e780	1480	1340	324	143	146
19	297	e1400	e420	e350	e230	e170	e1000	1430	1230	309	141	143
20	280	e1200	e420	e340	e220	e170	e1200	1840	1130	297	156	150
21	279	e1000	e420	e340	e220	e170	e1350	2090	1030	283	166	159
22	272	e900	e420	e330	e220	e170	e1500	1830	951	269	188	172
23	307	e800	e420	e330	e210	e170	e1900	1660	956	258	203	177
24	429	e750	e410	e320	e210	e175	e2150	1560	1020	247	197	172
25	492	e700	e410	e320	e210	e180	2610	1920	990	236	181	163
26	466	e650	e410	e310	e200	e195	2860	1830	970	236	168	148
27	452	e600	e410	e310	e200	e220	3100	1680	958	256	163	135
28	e450	e580	e400	e310	e200	e240	3140	1690	904	276	160	131
29	e420	e560	e400	e300	---	e260	2970	1710	831	274	209	121
30	e390	e550	e400	e300	---	e270	2720	1760	763	260	222	117
31	e350	---	e390	e290	---	e275	---	1670	---	248	225	---
TOTAL	12062	20930	13780	10880	6770	5965	35805	62370	39583	10914	6043	6424
MEAN	389	698	445	351	242	192	1193	2012	1319	352	195	214
MAX	671	2000	540	390	290	275	3140	3050	3230	639	284	533
MIN	267	290	390	290	200	170	280	1430	763	236	141	117
AC-FT	23920	41510	27330	21580	13430	11830	71020	123700	78510	21650	11990	12740
CFSM	.65	1.16	.74	.58	.40	.32	1.99	3.35	2.20	.59	.32	.36
IN.	.75	1.30	.85	.67	.42	.37	2.22	3.87	2.45	.68	.37	.40

CAL YR 1988 TOTAL 164428 MEAN 449 MAX 3800 MIN 83 AC-FT 326100 CFSM .75 IN. 10.19
WTR YR 1989 TOTAL 231526 MEAN 634 MAX 3230 MIN 117 AC-FT 459200 CFSM 1.06 IN. 14.35

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN

LOCATION.--Lat 47°20'07", long 91°12'06", in SE¼NE¼ sec.15, T.56 N., R.7 W., Lake County, Hydrologic Unit 04010101, on right bank 400 ft upstream from bridge on U.S. Highway 61, 0.3 mi upstream from mouth, 4 mi northeast of Silver Bay, and 7 mi northeast of city of Beaver Bay.

DRAINAGE AREA.--140 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1927 to current year. Monthly discharge only for some periods, published in WSP 1307.

REVISED RECORDS.--WSP 894: 1939. WSP 1337: 1933-34(M), 1935.

GAGE.--Water-stage recorder. Datum of gage is 613.65 ft above National Geodetic Vertical Datum of 1929 (U.S. Army Corps of Engineers bench mark). Prior to Oct. 5, 1934, nonrecording gage, and Oct. 5, 1934 to Nov. 22, 1978, water-stage recorder at site 370 ft downstream and at datum 3.68 ft lower.

REMARKS.--Records fair except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--62 years, 169 ft^3/s, 16.39 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 10,000 ft^3/s, Sept. 24, 1977, gage height, 8.33 ft site and datum then in use, from highwater mark in well, from rating curve extended above 4,200 ft^3/s on basis of slope-area measurement of peak flow; maximum gage height, 11.06 ft, Apr. 12, 1965, site and datum then in use, from floodmark (backwater from ice); no flow Jan. 14 to Mar. 2, 1977.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 1,300 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 20	0015	1,970	9.92	June 13	2000	*2,750	*10.60
May 5	0915	1,320	9.20				

Minimum discharge, 5.2 ft^3/s, Aug. 12, 13, gage height, 5.42 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	127	80	e140	e75	e46	e30	e240	963	303	214	18	48
2	121	76	e135	e74	e45	e30	e230	881	248	174	16	43
3	120	74	e130	e73	e45	e30	e230	899	237	135	14	34
4	118	78	e125	e72	e44	e30	e238	931	191	104	13	107
5	114	86	e120	e71	e44	e30	e300	1260	164	85	12	209
6	98	93	e113	e70	e43	e29	e448	1010	151	76	9.7	148
7	87	106	e110	e68	e43	e29	409	745	136	65	8.7	105
8	81	107	e107	e67	e42	e29	360	615	184	56	7.5	78
9	73	102	e105	e66	e41	e29	302	533	424	49	7.0	56
10	68	127	e103	e65	e40	e29	288	475	284	44	6.6	42
11	67	125	e101	e64	e40	e29	252	424	196	39	6.3	36
12	83	121	e100	e63	e39	e29	225	377	564	34	5.4	37
13	68	132	e99	e62	e38	e29	213	334	2200	30	8.2	33
14	58	130	e98	e62	e38	e29	239	310	2110	26	12	30
15	53	149	e96	e61	e37	e28	332	288	1130	24	13	28
16	52	678	e95	e61	e37	e28	535	255	675	27	11	24
17	53	e600	e93	e60	e36	e28	728	220	446	40	9.4	20
18	55	514	e92	e59	e35	e28	720	205	318	36	8.7	18
19	55	398	e91	e58	e35	e28	822	266	242	32	9.0	17
20	55	310	e90	e58	e34	e28	967	518	185	26	15	26
21	68	e260	e88	e57	e33	e28	1060	399	151	23	14	72
22	69	235	e87	e56	e33	e28	1280	283	648	19	12	79
23	97	e220	e86	e55	e32	e28	1310	296	622	17	11	79
24	e110	e200	e85	e54	e32	e28	1470	394	440	15	10	66
25	e100	182	e84	e53	e31	e30	1920	874	327	14	9.1	55
26	99	e170	e82	e52	e31	e35	1790	662	311	14	9.3	49
27	85	e165	e81	e51	e31	e40	1610	467	261	14	14	43
28	89	e160	e80	e50	e30	e70	1430	342	198	14	12	38
29	83	e150	e78	e49	---	e150	1280	343	157	15	13	32
30	80	e145	e77	e48	---	e250	1080	467	176	21	15	28
31	79	---	e76	e47	---	e250	---	384	---	20	35	---
TOTAL	2565	5973	3047	1881	1055	1516	22308	16420	13679	1502	364.9	1680
MEAN	82.7	199	98.3	60.7	37.7	48.9	744	530	456	48.5	11.8	56.0
MAX	127	678	140	75	46	250	1920	1260	2200	214	35	209
MIN	52	74	76	47	30	28	213	205	136	14	5.4	17
AC-FT	5090	11850	6040	3730	2090	3010	44250	32570	27130	2980	724	3330
CFSM	.59	1.42	.70	.43	.27	.35	5.31	3.78	3.26	.35	.08	.40
IN.	.68	1.59	.81	.50	.28	.40	5.93	4.36	3.63	.40	.10	.45

CAL YR 1988 TOTAL 47531.5 MEAN 130 MAX 1160 MIN 5.0 AC-FT 94280 CFSM .93 IN. 12.63
WTR YR 1989 TOTAL 71990.9 MEAN 197 MAX 2200 MIN 5.4 AC-FT 142800 CFSM 1.41 IN. 19.13

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN--Continued

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1968 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, IN CUBIC FEET PER SECOND (00060)	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)
NOV												
01...	1230	--	79	69	75	7.1	8.0	0.5	1.6	779	--	K9
JAN												
18...	1530	58	--	80	84	7.6	7.6	0.0	1.5	764	14.2	K1
APR												
11...	1345	--	279	63	65	7.6	7.9	0.0	1.7	777	14.7	K2
AUG												
15...	1400	--	12	120	129	8.1	8.3	19.0	0.4	780	9.2	K9

DATE	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)
NOV												
01...	35	9.2	3.2	2.8	0.5	29	27	0	35	15	2.9	0.2
JAN												
18...	K17	9.5	3.1	2.8	1.7	32	32	0	39	16	2.3	0.2
APR												
11...	K4	7.3	2.6	2.8	0.5	17	18	0	21	4.0	3.5	0.2
AUG												
15...	260	15	4.8	4.2	1.0	53	54	0	65	3.0	4.5	0.2

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV												
01...	11	84	<0.01	0.14	0.01	0.01	0.5	0.01	0.01	<0.01	10	44
JAN												
18...	14	64	<.01	.26	.07	.07	.5	.02	.01	<.01	2	100
APR												
11...	12	65	<.01	.48	.03	.03	.5	.01	<.01	<.01	8	69
AUG												
15...	8.3	90	<.01	<.10	.01	.01	.3	.01	<.01	<.01	2	85

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
NOV											
01...	1230	80	<1	4	<0.5	1	<1	<3	1	290	<5
JAN											
18...	1530	70	1	10	<.5	<1	10	<3	3	330	<5
APR											
11...	1345	110	<1	9	<.5	<1	2	<3	2	250	<5
AUG											
15...	1400	20	<1	9	<.5	1	1	<3	1	87	<1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
NOV										
01...	<4	3	<0.1	<10	1	<1	1.0	26	<6	19
JAN										
18...	<4	3	<.1	<10	<1	<1	1.0	27	<6	6
APR										
11...	<4	8	<.1	<10	1	<1	1.0	20	<6	40
AUG										
15...	<4	3	<.1	<10	1	<1	<1.0	44	<6	4

STREAMS TRIBUTARY TO LAKE SUPERIOR

04015330 KNIFE RIVER NEAR TWO HARBORS, MN

LOCATION.--Lat 46°56'49", long 91°47'32", in SW¼NW¼ sec.31, T.52 N., R.11 W., Lake County, Hydrologic Unit 04010102, on right bank 600 ft downstream from bridge on U.S. Highway 61, 0.5 mi upstream from bridge on County Highway 102, in town of Knife River, 0.8 mi upstream from Lake Superior, and 7.8 mi southwest of Two Harbors.

DRAINAGE AREA.--85.6 mi^2.

PERIOD OF RECORD.--Occasional low-flow measurements, water years 1970-71, July 1974 to current year.

GAGE.--Water-stage recorder and crest-stage gage. Elevation of gage is 640 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--Records fair except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--15 years, 91.7 ft^3/s, 14.55 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 7,440 ft^3/s, May 10, 1979, gage height, 11.16 ft; minimum, no flow Dec. 2, 1976 to Mar. 4, 1977.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 800 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Nov. 16	Unknown	1,390	5.95	Apr. 16	2000	*1,430	6.03
Mar. 30	1300	Ice jam	*6.46	May 25	0030	1,090	5.66

Minimum discharge, 3.2 ft^3/s, Aug. 12, 13, 14, 19, gage height, 2.52 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e29	21	e37	e17	e10	e7.5	e110	303	36	96	8.8	40
2	e28	e21	e36	e16	e9.5	e7.5	e105	229	31	62	7.7	18
3	e28	e22	e35	e16	e9.5	e7.5	e110	180	27	41	6.7	12
4	e27	e23	e34	e16	e9.5	e7.5	e150	150	22	26	6.1	50
5	e27	e25	e33	e15	e9.5	e7.5	e250	244	19	19	5.6	95
6	e26	e27	e32	e15	e9.0	e7.5	e350	196	18	35	5.3	40
7	e26	e30	e31	e15	e9.0	e7.5	e450	155	17	56	4.5	24
8	e25	e35	e30	e14	e9.0	e7.5	e450	125	16	32	4.1	15
9	e25	e40	e30	e14	e9.0	e7.5	316	105	21	22	4.2	9.5
10	e24	e45	e29	e14	e9.0	e7.5	244	86	23	19	4.2	6.9
11	e24	e42	e28	e14	e9.0	e7.5	199	71	18	15	3.9	6.2
12	e23	e41	e27	e13	e8.5	e7.5	180	59	49	13	3.5	6.8
13	e23	e40	e27	e13	e8.5	e7.5	316	50	358	12	3.3	7.2
14	e22	e40	e26	e13	e8.5	e7.5	474	44	545	11	3.3	7.1
15	e22	57	e25	e13	e8.5	e7.5	762	43	247	9.7	3.9	5.8
16	e22	1100	e24	e13	e8.5	e7.5	1080	38	125	9.6	4.7	6.3
17	e21	e350	e23	e12	e8.5	e7.5	1060	33	72	10	4.2	7.5
18	e21	e200	e23	e12	e8.0	e7.5	807	30	47	9.8	3.6	6.7
19	e21	e130	e22	e12	e8.0	e7.5	788	60	34	9.4	3.9	6.6
20	e21	e100	e22	e12	e8.0	e7.5	820	103	25	8.5	6.0	11
21	e21	e80	e21	e12	e8.0	e7.5	703	83	20	7.6	8.4	185
22	e21	e65	e21	e12	e8.0	e7.5	736	53	23	7.0	6.1	102
23	e22	e55	e20	e11	e8.0	e7.5	625	39	30	7.1	5.2	52
24	e22	e50	e20	e11	e8.0	e7.5	480	170	27	6.8	4.7	34
25	e23	e47	e19	e11	e8.0	e7.5	510	641	22	6.8	4.3	25
26	e23	e44	e19	e11	e8.0	e10	492	205	31	6.4	4.5	19
27	e23	e42	e18	e11	e8.0	e50	367	110	32	6.4	7.3	16
28	e22	e40	e18	e11	e7.5	e130	266	69	24	5.9	8.8	13
29	e22	e39	e18	e10	---	e130	215	54	19	6.4	5.7	12
30	e21	e38	e17	e10	---	e120	270	51	63	9.0	4.7	10
31	e21	---	e17	e10	---	e115	---	44	---	10	23	---
TOTAL	726	2889	782	399	240.5	742.5	13685	3823	2041	595.4	180.2	849.6
MEAN	23.4	96.3	25.2	12.9	8.59	24.0	456	123	68.0	19.2	5.81	28.3
MAX	29	1100	37	17	10	130	1080	641	545	96	23	185
MIN	21	21	17	10	7.5	7.5	105	30	16	5.9	3.3	5.8
AC-FT	1440	5730	1550	791	477	1470	27140	7580	4050	1180	357	1690
CFSM	.27	1.12	.29	.15	.10	.28	5.33	1.44	.79	.22	.07	.33
IN.	.32	1.26	.34	.17	.10	.32	5.95	1.66	.89	.26	.08	.37

CAL YR 1988 TOTAL 25044.8 MEAN 68.4 MAX 1100 MIN 1.3 AC-FT 49680 CFSM .80 IN. 10.88
WTR YR 1989 TOTAL 26953.2 MEAN 73.8 MAX 1100 MIN 3.3 AC-FT 53460 CFSM .86 IN. 11.71

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04018750 ST. LOUIS RIVER AT FORBES, MN

LOCATION.--Lat 47°21'48", long 92°35'56", in NE¼SE¼ sec.3, T.56 N., R.18 W., St. Louis County, Hydrologic Unit 04010201, on right bank at downstream side of highway bridge, 1.8 mi downstream from Eveleth Taconite Company dam, 0.6 mi south of Forbes, 1.8 mi upstream from Elbow Creek.

DRAINAGE AREA.--713 mi^2.

PERIOD OF RECORD.--August 1964 to September 1989 (discontinued).

GAGE.--Water-stage recorder. Datum of gage is 1,293.11 ft above National Geodetic Vertical Datum of 1929. Prior to Oct. 28, 1964, nonrecording gage at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Natural flow of stream affected by continually changing iron-mining activities that include diversions for iron-ore processing, regulation of storage reservoirs and tailing ponds, and mine pit dewatering. There is some regulation at medium and low flows by Eveleth Taconite Company dam 1.8 mi upstream.

AVERAGE DISCHARGE.--25 years, 559 ft^3/s, 10.65 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 6,200 ft^3/s, Apr. 25, 1979, gage height, 17.71 ft; minimum daily, 6.1 ft^3/s, Oct. 27, 1987; minimum gage height 4.91 ft, Nov. 30, 1987.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,930 ft^3/s, Apr. 25, 26, gage height, 12.36 ft; maximum gage height, 13.93 ft, Apr. 16 (backwater from ice); mimimum daily discharge, 50 ft^3/s, Feb. 6; minimum gage height, 5.07 ft, Aug. 28.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	360	296	e340	e170	e150	e110	e500	2500	1140	1070	201	244
2	338	276	e330	e170	e140	e110	e600	2380	1090	1080	194	253
3	322	289	e310	e170	e150	e110	e700	2210	1050	1020	192	240
4	314	276	e250	e160	e150	e110	e800	2100	992	950	195	315
5	305	289	e330	e160	e150	e110	e900	2020	911	873	201	338
6	296	246	e300	e160	e50	e110	e1100	1920	844	1020	188	523
7	290	254	e290	e160	e160	e110	e1400	1830	771	978	176	524
8	283	266	e285	e160	e150	e110	e1700	1740	738	825	172	498
9	277	271	e280	e160	e140	e110	e1900	1640	728	725	167	486
10	268	280	e260	e160	e140	e110	e1900	1560	679	649	160	491
11	263	283	e240	e160	e140	e110	e1900	1440	610	579	155	479
12	251	286	e220	e160	e140	e110	e1800	1320	602	516	145	454
13	244	298	e150	e160	e130	e105	e1700	1200	760	462	137	415
14	241	297	e160	e160	e130	e105	e1600	1100	1030	414	135	364
15	241	297	e160	e160	e130	e105	e1800	1020	1180	373	137	322
16	240	355	e220	e160	e130	e100	e2000	949	1240	354	134	290
17	244	384	e170	e160	e130	e100	e2300	876	1260	344	133	272
18	246	452	e160	e160	e120	e100	2450	805	1230	337	123	253
19	244	445	e180	e160	e120	e100	2560	654	1160	349	122	81
20	249	459	e60	e160	e120	e100	2700	873	1070	361	127	221
21	258	e450	e160	e140	e120	e100	2780	697	975	338	134	396
22	267	e450	e220	e100	e120	e100	2810	655	1170	312	132	554
23	268	e450	e200	e140	e120	e100	2830	636	1440	293	130	550
24	273	e450	e180	e150	e120	e110	2840	413	1460	274	127	447
25	295	e440	e170	e160	e120	e110	2860	844	1410	254	83	507
26	299	e420	e170	e130	e120	e110	2870	993	1370	238	110	429
27	280	e400	e170	e110	e120	e110	2820	1030	1290	225	124	478
28	299	e390	e170	e110	e110	e150	2770	1090	1170	278	76	406
29	273	e380	e170	e150	---	e200	2680	1140	1050	221	216	417
30	281	e360	e170	e200	---	e300	2600	1200	1020	262	192	399
31	300	---	e170	e60	---	e400	---	1200	---	218	218	---
TOTAL	8609	10489	6645	4680	3620	3925	60170	40035	31440	16192	4736	11646
MEAN	278	350	214	151	129	127	2006	1291	1048	522	153	388
MAX	360	459	340	200	160	400	2870	2500	1460	1080	218	554
MIN	240	246	60	60	50	100	500	413	602	218	76	81
AC-FT	17080	20800	13180	9280	7180	7790	119300	79410	62360	32120	9390	23100
CFSM	.39	.49	.30	.21	.18	.18	2.81	1.81	1.47	.73	.21	.54
IN.	.45	.55	.35	.24	.19	.20	3.14	2.09	1.64	.84	.25	.61

CAL YR 1988 TOTAL 126617 MEAN 346 MAX 1750 MIN 20 AC-FT 251100 CFSM .49 IN. 6.61
WTR YR 1989 TOTAL 202187 MEAN 554 MAX 2870 MIN 50 AC-FT 401000 CFSM .78 IN. 10.55

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024000 ST. LOUIS RIVER AT SCANLON, MN

LOCATION.--Lat 46°42'12", long 92°25'07", in NW¼ sec.30, T.49 N., R.16 W., Carlton County, Hydrologic Unit 04010201, on right bank 25 ft downstream from lower bridge on U.S. Highway 61 at Scanlon, 0.6 mi downstream from Minnesota Power Co. powerplant, 3 mi upstream from Thomson Reservoir, and 3.2 mi upstream from Midway River.

DRAINAGE AREA.--3,430 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--January 1908 to current year. Monthly discharge only for some periods published in WSP 1307. Published as "near Thomson" 1908-50.

REVISED RECORDS.--WSP 1337: 1911-12.

GAGE.--Water-stage recorder. Datum of gage is 1,101.23 ft above National Geodetic Vertical Datum of 1929. Oct. 5, 1909, to Sept. 5, 1914, nonrecording gage 3 mi downstream and 50 ft below powerplant at datum about 420 ft lower. Sept. 6, 1914, to Aug. 4, 1953, powerplant record at Thomson hydroelectric plant.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Diurnal fluctuation caused by powerplant upstream. Flow regulated by Whiteface Reservoir and Boulder, Island, Rice and Fish Lakes, combined capacity, 332,160 acre-ft; the water-discharge table shows the monthly change in contents (†).

AVERAGE DISCHARGE (UNADJUSTED).--81 years, 2,339 ft^3/s, 9.26 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 37,900 ft^3/s, May 9, 1950; maximum gage height, 15.8 ft, May 9, 1950, from Minnesota Department of Transportation (discharge uncertain); minimum discharge, 54 ft^3/s, July 30, 1980; minimum daily, 88 ft^3/s, Aug. 24, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 19,300 ft^3/s, Apr. 17, gage height, 10.27 ft; minimum daily, 331 ft^3/s, Aug. 14; minimum gage height, 2.05 ft, Aug. 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1190	783	1850	e1300	e1350	e1100	2640	8370	3590	2710	567	890
2	1330	1040	1850	e1300	e1300	e1100	2690	7880	3250	2880	539	827
3	1230	1120	1970	e1300	e1200	e1100	2840	7190	3010	2790	592	892
4	1140	1370	1800	e1300	e1200	e1150	3420	6500	2830	2530	508	1030
5	1040	1090	1830	e1300	e1200	e1150	4760	6350	2620	2390	469	1090
6	967	1180	1900	e1350	e1300	e1100	6520	6360	2320	2140	483	1380
7	1020	1250	1890	e1400	e1300	e1100	8140	6060	2120	2130	452	1650
8	825	1180	1640	e1400	e1400	e1100	9160	5950	1900	2770	474	1600
9	915	1270	1400	e1300	e1100	e1150	9310	6420	1800	2560	471	1440
10	872	1250	1330	e1300	e1200	e1250	8590	6360	1790	2130	406	1260
11	764	1240	985	e1300	e1200	e1250	7870	6070	1810	1820	403	1170
12	763	1320	1300	e1300	e1200	e1200	7020	5560	1710	1580	353	1110
13	751	1300	1680	e1300	e1200	e1200	6550	5080	1940	1400	340	1030
14	666	1310	1670	e1300	e1200	e1200	7210	4470	2850	1160	331	972
15	668	1350	1590	e1400	e1200	e1200	9080	4100	3970	1110	337	908
16	673	1680	1210	e1400	e1150	e1100	12100	3790	4190	872	435	800
17	667	1590	1540	e1400	e1150	e1200	15800	3220	3660	866	546	784
18	611	1810	1600	e1400	e1150	e1200	15900	2900	3400	817	528	665
19	760	2080	1530	e1400	e1150	e1100	15000	2640	3110	773	376	725
20	757	2060	1530	e1400	e1150	e1100	14100	2790	2810	771	800	663
21	746	1930	1560	e1400	e1100	e1100	12900	2720	2690	776	870	1130
22	733	1820	1440	e1350	e1100	e1100	12000	2500	2830	788	690	1270
23	817	1900	1450	e1350	e1100	e1100	11300	2230	3630	699	1020	1750
24	897	2020	e1400	e1350	e1100	e1100	10500	2260	4110	675	1490	2150
25	799	2090	e1350	e1350	e1100	e1100	9690	3500	3730	649	1400	2040
26	807	2220	e1300	e1350	e1100	e1200	9910	4460	3520	592	1490	1640
27	887	2070	e1300	e1400	e1100	1430	9920	4450	3560	563	1510	1550
28	836	1890	e1400	e1400	e1100	1770	9340	4030	3210	453	1260	1370
29	813	1920	e1300	e1350	---	2130	8640	3780	2990	546	826	1250
30	744	2060	e1300	e1350	---	2820	8350	3740	2690	577	667	1130
31	744	---	e1300	e1350	---	2940	---	3710	---	653	979	---
TOTAL	26432	47193	47195	41850	33100	40840	271250	145440	87640	43170	21612	36166
MEAN	853	1573	1522	1350	1182	1317	9042	4692	2921	1393	697	1206
MAX	1330	2220	1970	1400	1400	2940	15900	8370	4190	2880	1510	2150
MIN	611	783	985	1300	1100	1100	2640	2230	1710	453	331	663
†	210	34	-555	-665	-633	-451	2302	691	77	-118	-451	104
MEAN‡	1,063	1,607	967	685	549	866	11,340	5,383	2,998	1,275	246	1,310
CFSM‡	.31	.47	.28	.20	.16	.25	3.31	1.57	.87	.37	.07	.38
IN.‡	.36	.52	.33	.23	.17	.29	3.69	1.81	.98	.43	.08	.43

CAL YR 1988 TOTAL 535737 MEAN 1464 MAX 8340 MIN 103 MEAN‡ 1,562 CFSM‡ .46 IN‡ 6.18
WTR YR 1989 TOTAL 841888 MEAN 2307 MAX 15900 MIN 331 MEAN‡ 2,351 CFSM‡ .69 IN‡ 9.31

† Change in contents, equivalent in cubic feet per second, in Whiteface Reservoir, and Boulder, Island, Rice and Fish Lakes; records furnished by Minnesota Power Co.
‡ Adjusted for change in reservoir contents.

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024000 ST. LOUIS RIVER AT SCANLON, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1958-66, 1968 to current year.

REMARKS.--Letter K indicates non-ideal colony count. Samples collected at cableway 0.75 mi downstream from gage.

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT												
31...	1245	741	230	220	7.6	8.2	2.0	3.5	757	--	21	K12
NOV												
30...	1400	2060	166	167	7.6	7.6	0.0	5.0	764	13.8	K17	80
FEB												
21...	1145	1080	160	169	7.1	7.7	0.0	3.2	759	13.2	K12	K2
APR												
10...	1200	8450	120	117	7.2	7.6	0.0	10	771	14.6	20	47
JUN												
26...	1330	3410	110	134	7.4	7.7	21.0	2.9	761	8.4	K16	400
AUG												
14...	1145	317	227	229	8.1	7.9	23.0	1.2	767	7.5	150	K1200

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
OCT												
31...	21	12	9.0	1.9	80	80	0	98	27	7.8	0.3	9.6
NOV												
30...	17	8.6	5.5	1.3	60	60	0	73	19	5.5	0.2	10
FEB												
21...	17	8.4	6.3	1.3	60	66	0	73	17	4.4	0.3	11
APR												
10...	11	5.0	4.9	1.8	34	35	0	41	8.0	8.1	0.1	8.1
JUN												
26...	14	6.8	4.6	1.1	45	48	0	55	12	5.0	0.2	6.6
AUG												
14...	20	11	9.1	1.5	79	83	0	96	18	8.9	0.2	6.4

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHOROUS TOTAL (MG/L AS P) (00665)	PHOS-PHOROUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHOROUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
31...	168	<0.01	<0.10	0.04	0.04	0.8	0.02	0.02	<0.01	7	96
NOV											
30...	138	.01	.19	<.03	.03	0.8	.04	.04	.02	5	93
FEB											
21...	115	<.01	.25	.04	.04	1.0	.02	.02	<.01	5	85
APR											
10...	92	<.01	.37	.10	.10	0.7	.07	.02	<.01	34	99
JUN											
26...	121	<.01	.15	.08	.07	0.9	.04	.02	.02	13	94
AUG											
14...	149	<.01	<.10	<.01	<.01	0.5	.03	.02	<.01	10	57

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024000 ST. LOUIS RIVER AT SCANLON, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
31...	1245	30	1	15	<0.5	<1	<1	<3	1	610	<5
NOV											
30...	1400	50	<1	17	<.5	<1	<1	<3	2	530	<5
FEB											
21...	1145	40	<1	15	<.5	<1	<1	<3	3	680	<5
APR											
10...	1200	110	<1	19	<.5	<1	2	<3	3	450	<5
JUN											
26...	1330	70	1	18	<.5	<1	<1	<3	7	630	2

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
31...	5	59	<0.1	<10	<1	<1	<1.0	65	<6	10
NOV										
30...	<4	61	<.1	<10	5	<1	<1.0	50	<6	5
FEB										
21...	<4	34	<.1	<10	<1	<1	<1.0	49	<6	6
APR										
10...	<4	100	<.1	<10	1	<1	<1.0	30	<6	10
JUN										
26...	<4	38	<.1	<10	2	<1	<1.0	45	<6	10

STREAMS TRIBUTARY TO LAKE SUPERIOR

04024098 DEER CREEK NEAR HOLYOKE, MN

LOCATION.--Lat 46°31'30", long 92°23'20", in NE¼SE¼ sec.29, T.47 N., R.16 W., Carlton County, Hydrologic Unit 04010301, on left bank 179 ft west of State Highway No. 23, 0.9 mi upstream from mouth and 4.0 mi north of Holyoke.

DRAINAGE AREA.--7.77 mi^2.

PERIOD OF RECORD.--October 1976 to current year.

GAGE.--Water-stage recorder and crest-stage gage. Datum of gage is 786.14 ft above National Geodetic Vertical Datum of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--13 years, 7.46 ft^3/s, 13.04 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,000 ft^3/s, Sept. 3, 1985, gage height, 32.76 ft, from floodmarks, from rating curve extended above 1,000 ft^3/s, on basis of flow through culvert computations; minimum discharge, 0.20 ft^3/s, Aug. 13, 16, 1982, July 12, 1989.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 109 ft^3/s, Apr. 5, gage height, 13.46 ft; minimum discharge, 0.20 ft^3/s, July 12, gage height, 11.13 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2.0	3.0	e2.4	e1.8	e2.0	e2.1	e7.3	32	4.8	1.3	1.7	4.4
2	2.3	2.1	e2.3	e1.8	e2.0	e2.2	15	18	3.5	1.4	1.9	3.4
3	2.1	2.0	e2.3	e1.8	e1.9	e2.2	38	12	2.9	1.4	1.9	2.6
4	2.0	2.1	e2.4	e1.8	e1.9	e2.2	51	9.9	2.4	.94	1.9	10
5	1.9	2.3	e2.4	e1.8	e1.9	e2.2	66	30	7.1	.97	1.4	6.8
6	1.8	2.2	e2.3	e1.8	e1.9	e2.2	e60	14	2.1	5.8	1.7	7.0
7	1.9	2.1	e2.2	e1.8	e1.9	e2.2	e49	9.0	1.7	1.4	1.6	2.6
8	1.9	2.0	e2.1	e1.8	e1.9	e2.2	e33	17	4.2	1.1	5.3	2.9
9	1.9	2.3	e2.0	e1.8	e1.9	e2.2	e16	18	2.4	.62	1.8	2.4
10	1.8	2.5	e1.9	e1.8	e2.0	e2.2	e12	9.8	2.2	.96	1.6	1.5
11	1.8	2.4	e1.9	e1.8	e2.0	e2.2	11	6.9	1.7	4.5	3.8	1.7
12	1.8	2.6	e1.8	e1.8	e2.0	e2.2	16	5.4	2.2	1.4	1.9	1.9
13	1.8	2.6	e1.8	e1.8	e2.1	e2.2	33	4.3	6.9	2.8	2.1	1.8
14	1.8	3.0	e1.8	e1.8	e2.1	e2.2	59	3.9	4.1	1.2	2.1	1.7
15	1.9	3.2	e1.8	e1.8	e2.1	e2.2	54	4.1	3.2	1.1	5.4	1.6
16	1.8	e23	e1.8	e1.8	e2.1	e2.2	56	3.2	2.6	1.1	2.3	1.4
17	2.3	e5.1	e1.8	e1.8	e2.1	e2.2	34	3.0	1.8	4.3	1.8	1.4
18	2.1	e3.9	e1.8	e1.9	e2.1	e2.2	19	3.9	1.9	1.4	4.2	1.1
19	2.2	e3.0	e1.8	e1.9	e2.1	e2.2	16	13	2.9	.91	2.2	1.4
20	2.1	e2.7	e1.8	e1.9	e2.1	e2.2	13	35	1.6	3.6	2.8	2.1
21	2.2	e2.4	e1.8	e1.9	e2.1	e2.2	11	14	1.3	1.5	2.1	3.7
22	2.2	e2.2	e1.8	e1.9	e2.1	e2.2	9.9	7.3	1.8	1.1	5.5	3.1
23	2.2	e2.3	e1.8	e2.0	e2.1	e2.3	7.9	5.4	4.4	1.2	2.6	2.2
24	2.2	e2.4	e1.8	e2.1	e2.1	e2.4	7.2	12	1.4	1.5	3.3	2.0
25	2.2	e2.8	e1.8	e2.2	e2.1	e2.7	6.7	37	1.8	5.1	2.6	1.9
26	2.0	e4.5	e1.8	e2.1	e2.1	e6.2	6.3	12	3.7	2.7	2.9	1.8
27	2.0	e7.1	e1.8	e2.0	e2.1	e27	6.2	6.7	1.9	1.4	3.2	1.8
28	2.0	e4.5	e1.8	e2.1	e2.1	e37	8.4	5.0	1.6	2.8	2.4	1.8
29	2.4	e2.9	e1.8	e2.1	---	e22	9.5	9.3	2.5	2.8	3.3	1.8
30	2.0	e2.6	e1.8	e2.2	---	e14	31	17	1.7	2.6	2.8	1.8
31	1.9	---	e1.8	e2.2	---	e6.5	---	7.6	---	1.9	18	---
TOTAL	62.5	107.8	60.2	59.1	56.9	168.4	762.4	385.7	84.3	62.80	98.1	81.6
MEAN	2.02	3.59	1.94	1.91	2.03	5.43	25.4	12.4	2.81	2.03	3.16	2.72
MAX	2.4	23	2.4	2.2	2.1	37	66	37	7.1	5.8	18	10
MIN	1.8	2.0	1.8	1.8	1.9	2.1	6.2	3.0	1.3	.62	1.4	1.1
AC-FT	124	214	119	117	113	334	1510	765	167	125	195	162
CFSM	.26	.46	.25	.25	.26	.70	3.27	1.60	.36	.26	.41	.35
IN.	.30	.52	.29	.28	.27	.81	3.65	1.85	.40	.30	.47	.39

CAL YR 1988 TOTAL 1417.6 MEAN 3.87 MAX 98 MIN 1.3 AC-FT 2810 CFSM .50 IN. 6.79
WTR YR 1989 TOTAL 1989.80 MEAN 5.45 MAX 66 MIN .62 AC-FT 3950 CFSM .70 IN. 9.53

e Estimated

RED RIVER OF THE NORTH BASIN

05045950 ORWELL LAKE NEAR FERGUS FALLS, MN

LOCATION.--Lat 46°12'55", long 96°10'40", in SW¼ sec.26, T.132 N., R.44 W., Otter Tail County, Hydrologic Unit 09020103, at dam on Otter Tail River at outlet of Orwell Lake, 7 mi southwest of Fergus Falls.

DRAINAGE AREA.--1,830 mi^2, approximately.

PERIOD OF RECORD.--March 1953 to current year. Prior to October 1971, published as Orwell Reservoir.

GAGE.--Water-stage recorder. Datum of gage is adjustment of 1912.

REMARKS.--Reservoir is formed by earth dam with concrete spillway with one taintor gate; storage began in March 1953. Capacity to elevation 1,070 ft (maximum operating stage) is 14,100 acre-ft of which 13,100 acre-ft is controlled storage above elevation 1,048 ft (minimum operating stage). Dead storage is 210 acre-ft. Figures given herein represent total contents. Reservoir is used for flood control and to increase low flow for water supply and pollution abatement.

COOPERATION.--Records were provided by U.S. Army Corps of Engineers.

EXTREMES FOR PERIOD OF RECORD.--Maximum contents, 16,920 acre-ft, June 17, 1962, May 23, 1966, elevation, 1,072.38 ft; minimum (after initial filling), 844 acre-ft, Aug. 26, 27, 1953, elevation, 1,046.96 ft.

EXTREMES FOR CURRENT YEAR.--Maximum contents, 14,290 acre-ft, Apr. 8, elevation, 1,070.23 ft; minimum, 4,240 acre-ft, Mar. 29, elevation, 1,057.78 ft.

MONTHEND ELEVATION AND CONTENTS, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

Date	Elevation (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	1,062.84	7,430	
Oct. 31	1,063.16	7,670	+240
Nov. 30	1,064.89	9,060	+1,390
Dec. 31	1,066.05	10,050	+990
CAL YR 1988			-2,560
Jan. 31	1,066.85	10,850	+800
Feb. 28	1,064.80	8,980	-1,870
Mar. 31	1,059.40	5,160	-3,820
Apr. 30	1,064.30	8,560	+3,400
May 31	1,066.27	10,270	+1,710
June 30	1,064.06	8,350	-1,920
July 31	1,064.06	8,350	0
Aug. 31	1,064.27	8,530	+180
Sept. 30	1,064.03	8,320	-210
WTR YR 1989			+890

RED RIVER OF THE NORTH BASIN

05046000 OTTER TAIL RIVER BELOW ORWELL DAM, NEAR FERGUS FALLS, MN

LOCATION.--Lat 46°12'35", long 96°11'05", in NE¼ sec.34, T.132 N., R.44 W., Otter Tail County, Hydrologic Unit 09020103, on left bank 0.7 mi downstream from Orwell Dam, 6.1 mi downstream from Dayton Hollow Dam, 8 mi southwest of Fergus Falls, and 11.1 mi downstream from Pelican River.

DRAINAGE AREA.--1,830 mi^2, approximately.

PERIOD OF RECORD.--October 1930 to current year. Prior to October 1952, published as Otter Tail River below Pelican River, near Fergus Falls. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 785: 1934(M). WSP 1208: 1947(M). WSP 1308: 1931(M).

GAGE.--Water-stage recorder. Datum of gage is 1,029.65 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Oct. 11, 1930, to Nov. 17, 1933, at same site at datum 2.00 ft higher; Nov. 18, 1933, to Mar. 21, 1953, at site 6.1 mi upstream at datum 40.30 ft higher.

REMARKS.--Records good. Flow regulated by Orwell Lake (station 05045950) beginning Mar. 21, 1953 and powerplants upstream.

AVERAGE DISCHARGE.--59 years, 321 ft^3/s, 232,600 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 1,710 ft^3/s, June 17, 1953, gage height, 5.60 ft, backwater from aquatic vegetation; minimum, 0.70 ft^3/s, Aug. 5, 1970, gage height, 1.28 ft, result of regulation.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,180 ft^3/s, Apr. 10, gage height, 4.17 ft, result of regulation; minimum, 5.8 ft^3/s, Aug. 25, gage height, 1.95 ft, result of regulation.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	66	65	53	e56	226	e190	128	560	873	466	207	181
2	64	65	53	e56	229	e190	135	560	900	460	207	217
3	64	65	53	e56	230	e192	123	542	884	366	207	215
4	65	65	53	e56	226	e192	202	530	875	301	182	207
5	65	65	54	e56	224	e192	394	530	711	373	171	207
6	65	65	55	e56	181	e192	398	530	603	432	169	167
7	65	63	55	e56	141	e192	634	530	617	391	107	141
8	80	63	55	e57	141	e192	779	530	624	362	58	156
9	90	63	55	e57	119	e210	779	530	622	363	54	171
10	80	63	55	e58	112	283	986	530	614	355	53	171
11	73	63	55	e58	123	329	1170	530	616	345	59	171
12	72	63	55	e60	123	333	1160	534	619	329	77	171
13	71	63	55	e65	133	334	1130	537	614	309	75	171
14	71	63	55	e80	141	334	1120	542	606	290	144	171
15	71	63	55	89	141	334	1100	551	599	278	225	159
16	71	63	e55	89	166	341	1080	576	593	277	241	150
17	71	e60	e55	89	188	403	937	607	590	271	240	145
18	71	54	e55	89	188	424	649	645	589	299	177	128
19	71	e51	e55	89	188	424	610	686	530	316	136	118
20	68	51	e55	92	188	423	606	686	493	288	136	110
21	63	51	e55	92	188	419	573	687	496	267	136	188
22	63	49	e55	92	e188	418	536	694	478	259	129	255
23	63	49	e55	92	e188	431	536	669	471	255	127	255
24	63	51	e55	92	e188	474	536	634	467	234	127	253
25	63	53	e55	107	188	489	536	640	467	226	62	157
26	63	53	e55	124	188	478	533	635	467	233	108	99
27	64	53	e56	138	188	507	546	633	467	241	141	99
28	64	53	e56	177	e188	532	559	637	443	227	131	99
29	63	53	e56	181	---	536	560	645	424	220	123	148
30	63	53	e56	199	---	407	560	683	446	217	127	171
31	63	---	e56	221	---	209	---	783	---	207	127	---
TOTAL	2109	1754	1701	2879	4912	10604	19595	18606	17798	9457	4263	5051
MEAN	68.0	58.5	54.9	92.9	175	342	653	600	593	305	138	168
MAX	90	65	56	221	230	536	1170	783	900	466	241	255
MIN	63	49	53	56	112	190	123	530	424	207	53	99
AC-FT	4180	3480	3370	5710	9740	21030	38870	36900	35300	18760	8460	10020
CFSM	.04	.03	.03	.05	.10	.19	.36	.33	.32	.17	.08	.09
IN.	.04	.04	.03	.06	.10	.22	.40	.38	.36	.19	.09	.10

CAL YR 1988 TOTAL 61962 MEAN 169 MAX 405 MIN 49 AC-FT 122900 CFSM .09 IN. 1.26
WTR YR 1989 TOTAL 98729 MEAN 270 MAX 1170 MIN 49 AC-FT 195800 CFSM .15 IN. 2.01

e Estimated

RED RIVER OF THE NORTH BASIN

05050000 BOIS DE SIOUX RIVER NEAR WHITE ROCK, SD

LOCATION.--Lat 45°51'45", long 96°34'25", in SW¼SW¼ sec.27, T.128 N., R.47 W., Roberts County, Hydrologic Unit 09020101, on Sisseton Indian Reservation, on left bank just downstream from Big Slough Outlet, 300 ft downstream from White Rock Dam, 4 mi south of White Rock, and 5 mi northwest of Wheaton, MN.

DRAINAGE AREA.--1,160 mi^2, approximately.

PERIOD OF RECORD.--October 1941 to current year.

GAGE.--Water-stage recorder. Datum of gage is 960.00 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Jan. 14, 1943, nonrecording gage at same site at datum 0.11 ft lower. Jan. 15, 1943, to Sept. 30, 1963, water-stage recorder at same site at datum 0.11 ft lower.

REMARKS.--Records fair. Flow regulated by Lake Traverse-Boise de Sioux Flood Control and Water Conservation project (available capacity for flood control, 137,000 acre-ft).

AVERAGE DISCHARGE.--48 years, 81.9 ft^3/s, 59,340 acre-ft/yr; median of yearly mean discharges, 54 ft^3/s, 39,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,770 ft^3/s, occurred during period Apr. 19-21, 1969, gage height, 15.07 ft, from floodmark; no flow at times in most years.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 693 ft^3/s, Apr. 14, gage height, 10.72 ft, due to regulation (backwater from Rabbit River inflow downstream); no flow on many days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.12	.00	.00	.00	.00	e20	621	175	.91	52	.09
2	.00	.12	.00	.00	.00	.00	e25	614	106	.82	43	.05
3	.00	.13	.00	.00	.00	.00	e28	604	152	.63	30	.06
4	.00	.13	.00	.00	.00	.00	e35	602	151	.58	17	.13
5	.00	.13	.00	.00	.00	.00	e29	604	151	.79	9.5	.13
6	.00	.13	.00	.00	.00	.00	e26	590	150	.13	12	.10
7	.00	.13	.00	.00	.00	.00	e16	579	152	.03	20	.10
8	.00	.13	.00	.00	.00	e.01	e24	574	150	.81	2.4	.10
9	.00	.13	.00	.00	.00	e.02	e20	567	147	.58	1.9	.07
10	.00	.13	.00	.00	.00	e.03	e65	559	147	.61	1.7	.07
11	.00	.13	.00	.00	.00	e.10	e160	547	146	.56	1.4	.07
12	.00	.15	.00	.00	.00	e.24	e275	542	149	.61	1.3	.07
13	.00	.20	.00	.00	.00	e.67	e525	538	146	.43	1.1	70
14	.00	e.17	.00	.00	.00	e.88	689	532	111	.45	1.6	121
15	.00	e.16	.00	.00	.00	e.70	675	526	72	.46	1.9	122
16	.01	e.15	.00	.00	.00	e.60	672	520	71	.49	3.3	126
17	.10	e.15	.00	.00	.00	e.50	660	513	73	.90	2.4	122
18	.12	e.15	.00	.00	.00	e.40	662	504	75	1.5	1.5	106
19	.10	e.15	.00	.00	.00	e.35	674	489	74	4.6	.59	98
20	.10	e.15	.00	.00	.00	e.30	679	471	73	2.4	.56	94
21	.10	e.15	.00	.00	.00	e.28	679	459	79	1.4	.55	96
22	.10	e.12	.00	.00	.00	e.28	666	449	50	1.1	.52	109
23	.10	e.12	.00	.00	.00	e.35	657	435	16	.93	.43	99
24	.10	e.10	.00	.00	.00	e.45	652	421	10	1.0	.20	94
25	.10	e.08	.00	.00	.00	e.69	647	408	9.2	.91	.04	121
26	.11	e.06	.00	.00	.00	e1.3	638	377	9.9	.73	.10	174
27	.11	e.04	.00	.00	.00	e2.0	632	335	12	.38	.03	184
28	.12	e.02	.00	.00	.00	e3.4	628	326	13	.43	.06	181
29	.12	e.01	.00	.00	---	e6.0	635	319	14	17	.11	142
30	.12	.00	.00	.00	---	e10	630	307	8.1	61	.04	89
31	.12	---	.00	.00	---	e12	---	297	---	56	.02	---
TOTAL	1.63	3.54	0.00	0.00	0.00	41.55	12423	15229	2692.2	159.17	207.25	2149.04
MEAN	.053	.12	.00	.00	.00	1.34	414	491	89.7	5.13	6.69	71.6
MAX	.12	.20	.00	.00	.00	12	689	621	175	61	52	184
MIN	.00	.00	.00	.00	.00	.00	16	297	8.1	.03	.02	.05
AC-FT	3.2	7.0	.0	.0	.0	82	24640	30210	5340	316	411	4260
CFSM	.00	.00	.00	.00	.00	.00	.36	.42	.08	.00	.01	.06
IN.	.00	.00	.00	.00	.00	.00	.40	.49	.09	.01	.01	.07

CAL YR 1988 TOTAL 1729.61 MEAN 4.73 MAX 148 MIN .00 AC-FT 3430 CFSM .00 IN. .06
WTR YR 1989 TOTAL 32906.38 MEAN 90.2 MAX 689 MIN .00 AC-FT 65270 CFSM .08 IN. 1.06

e Estimated

RED RIVER OF THE NORTH BASIN

05051500 RED RIVER OF THE NORTH AT WAHPETON, ND

LOCATION.--Lat 46°15'55", long 96°35'40", in NE¼ sec.8, T.132 N., R.47 W., Richland County, Hydrologic Unit 09020104, on left bank in Wahpeton, 800 ft downstream from confluence of Bois de Sioux and Otter Tail Rivers, and at mile 548.6.

DRAINAGE AREA.--4,010 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1942 to October 1942, March 1943 to current year. Gage-height records collected in this vicinity since 1917 are contained in reports of the U.S. Weather Bureau.

GAGE.--Water-stage recorder and concrete and wooden dam. Datum of gage is 942.97 ft above National Geodetic Vertical Datum of 1929. Prior to Aug. 6, 1943, U.S. Weather Bureau nonrecording gage 800 ft upstream, converted to present datum. Aug. 6, 1943, to Oct. 27, 1950, nonrecording gage at present site and datum.

REMARKS.--Estimated daily discharges: Nov. 18 to Apr. 7 and May 26-29. Records good except those for period of estimated daily discharge, which are fair. Flow regulated by Orwell Reservoir, capacity, 14,100 acre-ft at elevation 1,070 ft above National Geodetic Vertical Datum of 1929, adjustment of 1912; Lake Traverse, capacity, 137,000 acre-ft, available for flood control; numerous other controlled lakes and ponds, and several powerplants.

AVERAGE DISCHARGE.--46 years (1944-89), 549 ft^3/s, 397,800 acre-ft/yr; median of yearly mean discharges, 497 ft3/s, 360,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,200 ft^3/s, Apr. 10, 1969, gage height, 16.34 ft; maximum gage height, 17.95 ft, Apr. 5, 1989; minimum daily, 1.7 ft^3/s, Aug. 28 to Sept. 5, 9, 10, 1976.

EXTREMES OUTSIDE PERIOD OF RECORD.--A stage of 17.0 ft, discharge, 10,500 ft^3/s, occurred in the spring of 1897 and has not been exceeded since.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 8,370 ft^3/s, Apr. 5, gage height, 17.95 ft, backwater from ice; minimum daily, 29 ft^3/s, Nov. 17.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	65	69	e52	e54	e163	e170	e3540	1220	1120	488	215	149
2	61	67	e57	e53	e153	e167	e4180	1220	1090	514	210	174
3	59	65	e58	e47	e207	e198	e5940	1200	1020	514	211	227
4	58	66	e57	e42	e215	e210	e7770	1190	1010	444	222	243
5	59	68	e56	e50	e220	e219	e8310	1150	1000	312	214	245
6	59	55	e56	e52	e215	e210	e7860	1130	930	317	192	239
7	58	74	e56	e54	e182	e204	e6830	1130	769	443	190	214
8	59	71	e52	e51	e165	e211	5490	1120	736	431	155	164
9	63	67	e45	e31	e140	e211	4310	1110	742	379	84	162
10	83	65	e46	e43	e140	e229	3420	1100	732	367	65	184
11	87	50	e40	e50	e110	e243	2840	1090	725	357	57	196
12	73	72	e50	e56	e110	e295	2440	1080	772	341	56	196
13	68	80	e52	e61	e100	e337	2130	1070	771	331	85	195
14	67	80	e50	e64	e102	e377	1980	1060	755	304	81	189
15	68	74	e48	e67	e114	e383	1950	1050	740	274	97	188
16	68	53	e41	e77	e117	e374	1940	1040	707	255	188	179
17	71	29	e55	e81	e116	e371	1880	1050	685	249	231	167
18	72	e45	e54	e82	e156	e402	1810	1080	676	269	239	162
19	71	e76	e56	e80	e186	e435	1570	1090	666	274	234	169
20	72	e71	e56	e85	e180	e476	1410	1120	629	297	154	222
21	72	e64	e53	e76	e179	e531	1360	1100	571	300	146	276
22	67	e63	e54	e79	e176	e569	1330	1090	572	271	146	273
23	65	e62	e56	e83	e161	e581	1260	1080	554	252	135	350
24	64	e63	e50	e82	e165	e592	1230	1080	589	246	130	357
25	65	e64	e45	e81	e176	e604	1220	1010	633	238	127	355
26	67	e63	e47	e81	e185	e649	1210	e980	594	214	150	292
27	91	e56	e50	e93	e152	e714	1200	e970	555	212	112	179
28	67	e36	e54	e106	e170	e870	1210	e1000	523	236	148	181
29	60	e40	e48	e121	---	e1590	1230	e1100	500	269	146	205
30	70	e46	e52	e128	---	e2420	1230	1430	483	237	138	246
31	83	---	e54	e117	---	e3080	---	1280	---	221	153	---
TOTAL	2112	1854	1600	2227	4455	17922	90080	34420	21849	9856	4711	6578
MEAN	68.1	61.8	51.6	71.8	159	578	3003	1110	728	318	152	219
MAX	91	80	58	128	220	3080	8310	1430	1120	514	239	357
MIN	58	29	40	31	100	167	1200	970	483	212	56	149
AC-FT	4190	3680	3170	4420	8840	35550	178700	68270	43340	19550	9340	13050

CAL YR 1988 TOTAL 72636 MEAN 198 MAX 855 MIN 29 AC-FT 144100
WTR YR 1989 TOTAL 197664 MEAN 542 MAX 8310 MIN 29 AC-FT 392100

e - Estimated

RED RIVER OF THE NORTH BASIN

05051500 RED RIVER OF THE NORTH AT WAHPETON, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
04...	1420	58	530	--	10.0	9.5	--	--	--	--	--	--
NOV												
17...	1150	24	565	--	-5.0	1.0	--	--	--	--	--	--
22...	1150	63	590	--	-3.0	0.5	--	--	--	--	--	--
JAN												
10...	1500	46	645	--	-28.5	0.0	--	--	--	--	--	--
MAR												
01...	1335	157	610	--	-15.0	0.0	--	--	--	--	--	--
APR												
04...	1105	6540	252	--	3.0	0.5	--	--	--	--	--	--
04...	1805	7990	252	--	3.0	0.5	--	--	--	--	--	--
05...	1340	8310	300	7.30	7.0	4.0	110	27	10	8.0	13	0.3
08...	1330	5740	--	--	-3.0	3.0	--	--	--	--	--	--
14...	1035	2020	425	--	7.0	4.5	--	--	--	--	--	--
MAY												
24...	1330	1130	575	--	18.5	19.0	--	--	--	--	--	--
JUL												
14...	0940	332	490	--	22.0	23.0	--	--	--	--	--	--
AUG												
31...	1100	157	420	8.50	19.5	20.0	210	36	28	11	10	0.3

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR												
05...	5.2	86	0	70	6.8	45	5.7	0.20	10	177	154	0.24
AUG												
31...	4.3	250	0	200	1.2	32	11	0.10	14	254	258	0.35

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
05...	3970	3	30	120	1	20	40	0.1	1	2	160
AUG											
31...	108	4	80	50	1	10	10	<0.1	2	<10	190

RED RIVER OF THE NORTH BASIN

05051522 RED RIVER OF THE NORTH AT HICKSON, ND

LOCATION.--Lat 46°39'35", long 96°47'44", in SW¼ sec.19, T.137 N., R.48 W., Clay County, MN, Hydrologic Unit 09020104, on right bank 60 ft downstream from bridge on township road, and 1 mi southeast of Hickson, ND.

DRAINAGE AREA.--4,300 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--October 1975 to current year.

GAGE.--Water-stage recorder and concrete control. Datum of gage is 877.06 ft above National Geodetic Vertical Datum of 1929.

REMARKS.--Estimated daily discharges: Feb. 6 to Apr. 19. Records good except those for period of estimated daily discharge, which are fair. Flow regulated by Orwell Reservoir, capacity, 14,100 acre-ft at elevation 1,070 ft above National Geodetic Vertical Datum of 1929, adjustment of 1912; Lake Traverse, capacity, 137,000 acre-ft, available for flood control, numerous other controlled lakes and ponds, and several powerplants.

AVERAGE DISCHARGE.--14 years, 616 ft^3/s, 446,300 acre-ft/yr; median of yearly mean discharges, 570 ft^3/s, 413,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 12,900 ft^3/s, Apr. 7, 1989, gage height, 35.81 ft; no flow Oct. 26, 1976 to Jan. 9, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 12,900 ft^3/s, Apr. 7, gage height, 35.81 ft; minimum daily, 36 ft^3/s, Dec. 2.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	66	72	43	53	123	e164	e2330	1250	1420	527	248	150
2	67	77	36	55	147	e160	e2840	1250	1260	508	230	151
3	63	77	49	58	156	e160	e3550	1250	1170	511	221	146
4	59	72	59	60	158	e160	e4290	1250	1110	524	216	170
5	59	68	61	61	169	e160	e5550	1230	1070	517	213	224
6	65	69	61	59	e180	e160	e8200	1200	1050	412	222	246
7	72	70	61	59	e192	e160	e12000	1180	1020	310	212	253
8	75	68	60	58	e208	e164	e11100	1180	910	354	200	253
9	74	64	56	58	e220	e168	e8990	1180	813	471	197	218
10	71	69	51	59	e202	e172	e7800	1180	791	454	161	175
11	67	70	44	61	e184	e176	e6780	1170	786	408	97	165
12	69	66	40	48	e161	e180	e5700	1160	781	397	70	182
13	79	66	39	40	e137	e202	e4620	1140	793	384	64	193
14	79	64	41	40	e107	e216	e3640	1130	816	374	56	192
15	74	66	45	40	e106	e251	e3080	1120	809	355	72	191
16	71	73	48	45	e110	e293	e2680	1110	799	317	80	188
17	70	49	52	51	e108	e337	e2390	1100	773	283	85	189
18	71	44	53	57	e124	e373	e2180	1100	743	277	165	180
19	72	55	49	66	e135	e395	e2030	1120	720	282	235	165
20	72	53	53	74	e138	e412	1840	1130	705	283	258	165
21	71	49	55	83	e150	e432	1580	1140	711	291	225	184
22	72	66	58	88	e160	e459	1460	1150	671	317	159	251
23	68	72	61	89	e164	e496	1410	1140	613	302	145	274
24	69	72	61	86	e178	e504	1360	1140	601	266	141	287
25	68	72	59	86	e176	e529	1310	1140	603	254	128	362
26	64	72	62	95	e174	e548	1280	1110	657	251	125	381
27	63	71	63	99	e170	e547	1250	1070	653	231	130	378
28	64	69	54	94	e168	e580	1240	1040	612	214	163	302
29	67	58	53	90	---	e731	1240	1010	580	228	138	200
30	72	53	53	99	---	e937	1240	1050	551	266	142	178
31	69	---	53	109	---	e1500	---	1330	---	278	157	---
TOTAL	2142	1966	1633	2120	4405	11726	114960	35750	24591	10846	4955	6593
MEAN	69.1	65.5	52.7	68.4	157	378	3832	1153	820	350	160	220
MAX	79	77	63	109	220	1500	12000	1330	1420	527	258	381
MIN	59	44	36	40	106	160	1240	1010	551	214	56	146
AC-FT	4250	3900	3240	4210	8740	23260	228000	70910	48780	21510	9830	13080

CAL YR 1988 TOTAL 74248 MEAN 203 MAX 818 MIN 36 AC-FT 147300
WTR YR 1989 TOTAL 221687 MEAN 607 MAX 12000 MIN 36 AC-FT 439700

e - Estimated

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1976 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
06...	1135	65	460	--	12.0	10.5	--	--	--	--	--	--
NOV												
15...	1530	67	585	--	0.0	2.0	--	--	--	--	--	--
MAR												
03...	1145	160	625	--	-12.5	0.0	--	--	--	--	--	--
APR												
07...	1405	14100	238	7.70	-1.0	1.0	92	21	9.5	7.5	14	0.4
09...	1555	8710	308	--	2.0	1.0	--	--	--	--	--	--
11...	1415	6770	332	--	3.5	3.0	--	--	--	--	--	--
14...	1535	3500	410	--	10.5	5.0	--	--	--	--	--	--
JUN												
01...	1615	1470	455	--	23.0	16.5	--	--	--	--	--	--
JUL												
19...	1450	286	550	--	30.0	26.5	--	--	--	--	--	--
SEP												
01...	1425	152	430	8.40	21.5	21.5	210	37	28	11	10	0.3

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR												
07...	5.2	85	0	70	2.7	45	3.6	0.10	12	168	146	0.23
SEP												
01...	4.3	240	0	200	1.5	37	10	0.10	14	257	262	0.35

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
07...	6400	3	60	60	<1	9	40	0.3	1	<10	110
SEP											
01...	105	4	60	60	2	10	<10	<0.1	2	<10	210

RED RIVER OF THE NORTH BASIN

05054000 RED RIVER OF THE NORTH AT FARGO, ND

LOCATION.--Lat 46°51'40", long 96°47'00", in NW¼NE¼ sec.18, T.139 N., R.48 W., Cass County, Hydrologic Unit 09020104, at waterplant on 4th St. S. in Fargo, 25 mi upstream from mouth of Sheyenne River, and at mi 453.

DRAINAGE AREA.--6,800 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--May 1901 to current year. Published as "at Moorhead, Minn." 1901. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 1308: 1902-4, 1906-7, 1910-14, 1916, 1918, 1924. WSP 1388: 1905-6, 1917-20(M), 1935(M), 1938-39(M), 1943.

GAGE.--Water-stage recorder and concrete control. Datum of gage is 861.8 ft above National Geodetic Vertical Datum of 1929. Oct. 1, 1960, to Sept. 30, 1962, water-stage recorder at present site at datum 5.6 ft higher. See WSP 1728 or 1913 for history of changes prior to Oct. 1, 1960.

REMARKS.--Estimated daily discharges: Feb. 1 to Apr. 21. Records good except those for period of estimated daily discharges, which are fair. Flow regulated by Orwell Reservoir, capacity, 14,100 acre-ft at elevation 1,070 ft above National Geodetic Vertical Datum of 1929, adjustment of 1912; Lake Traverse, capacity 137,000 acre-ft, available for flood control, other controlled lakes and ponds, and several powerplants. Some small diversions for municipal supply. Figures of daily discharge do not include diversions to cities of Fargo and Moorhead and from Sheyenne River.

AVERAGE DISCHARGE (UNADJUSTED).--88 years, 578 ft^3/s, 418,800 acre-ft/yr; median of yearly mean discharges, 470 ft^3/s, 340,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 25,300 ft^3/s, Apr. 15, 1969, gage height, 37.34 ft; no flow for many days in each year for period 1932-41, Sept. 30, Oct. 1-2, 1970, Oct. 10-19, 1976.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of Apr. 7, 1897, reached a stage of 39.1 ft present datum, discharge, 25,000 ft^3/s at site 1.5 mi downstream.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 18,900 ft^3/s, Apr. 9, gage height, 35.39 ft; minimum daily, 22 ft^3/s, Dec. 15 and Jan. 15.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	58	46	30	35	e82	e158	e1710	1320	1490	515	243	165
2	60	52	26	38	e90	e162	e2840	1300	1530	495	221	146
3	59	52	24	37	e102	e168	e4210	1280	1370	481	207	221
4	58	55	23	41	e128	e176	e5360	1250	1270	475	196	163
5	55	52	29	35	e145	e182	e6470	1240	1160	486	180	172
6	47	50	30	36	e158	e190	e9240	1240	1100	448	192	205
7	46	57	31	42	e176	e200	e13300	1200	1050	350	200	226
8	50	58	32	43	e192	e188	e17400	1180	985	307	188	236
9	55	53	31	44	e200	e180	e18600	1160	867	360	169	231
10	52	49	29	49	e184	e172	e17600	1150	783	404	150	209
11	50	51	27	43	e162	e168	e15400	1150	767	378	119	177
12	50	65	26	36	e146	e166	e12900	1140	769	356	185	163
13	53	60	39	29	e135	e164	e10900	1150	768	341	77	177
14	60	55	27	26	e118	e161	e9230	1140	805	322	50	187
15	60	55	22	22	e104	e178	e7940	1130	811	311	44	196
16	56	50	27	26	e100	e187	e6730	1110	827	299	48	195
17	61	39	29	27	e108	e198	e5550	1140	828	267	55	200
18	57	35	31	32	e112	e227	e4390	1110	791	289	77	198
19	59	40	31	33	e120	e251	e3230	1090	769	262	184	188
20	61	40	29	37	e126	e267	e2330	1090	762	258	211	190
21	70	39	28	48	e132	e274	e2050	1100	803	248	234	237
22	65	38	35	50	e142	e304	1850	1120	758	260	205	219
23	66	42	34	55	e148	e320	1720	1120	668	268	155	274
24	59	45	35	60	e156	e307	1630	1150	626	247	132	290
25	57	50	36	63	e158	e330	1540	1120	666	222	122	320
26	58	50	38	76	e158	e405	1460	1100	615	213	162	368
27	58	51	40	81	e158	e417	1400	1060	632	204	119	385
28	53	49	36	81	e158	e407	1370	972	608	194	147	370
29	52	44	37	78	---	e626	1340	1010	571	205	133	292
30	51	37	32	76	---	e813	1330	1010	535	213	132	217
31	50	---	33	76	---	e1090	---	1150	---	235	302	---
TOTAL	1746	1459	957	1455	3898	9036	191020	35482	25984	9913	4839	6817
MEAN	56.3	48.6	30.9	46.9	139	291	6367	1145	866	320	156	227
MAX	70	65	40	81	200	1090	18600	1320	1530	515	302	385
MIN	46	35	22	22	82	158	1330	972	535	194	44	146
AC-FT	3460	2890	1900	2890	7730	17920	378900	70380	51540	19660	9600	13520
(+)	1348	1206	1124	1115	1070	1157	1026	1362	1509	2102	1661	1215
MEAN*	78.2	68.8	49.2	65.0	158	310	6384	1167	891	354	183	247
AC-FT*	4810	4100	3020	4000	8800	19080	379930	71740	53050	21760	11260	14740

CAL YR 1988 TOTAL 74596 MEAN 204 MAX 924 MIN 15 AC-FT 148000 MEAN 229 AC-FT 165630
WTR YR 1989 TOTAL 292606 MEAN 802 MAX 18600 MIN 22 AC-FT 580400 MEAN 823 AC-FT 596260

\+ - Diversions in acre-feet to cities of Fargo and Moorhead. e - Estimated.
* - Adjusted for diversions to cities of Fargo and Moorhead.

RED RIVER OF THE NORTH BASIN

05054000 RED RIVER OF THE NORTH AT FARGO, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1956 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
06...	1435	44	528	--	17.0	12.0	--	--	--	--	--	--
NOV												
16...	0905	49	630	--	-3.5	1.5	--	--	--	--	--	--
JAN												
04...	1350	45	805	--	-12.0	0.0	--	--	--	--	--	--
MAR												
01...	1635	158	550	--	-11.5	0.0	--	--	--	--	--	--
14...	1420	161	--	--	-5.5	0.0	--	--	--	--	--	--
APR												
05...	1735	6650	--	--	--	0.0	--	--	--	--	--	--
06...	0945	8830	--	--	--	0.0	--	--	--	--	--	--
07...	1120	15800	180	--	3.0	1.5	--	--	--	--	--	--
08...	1225	17900	210	7.90	-6.0	0.5	85	21	8.0	6.5	13	0.3
09...	1155	18800	--	--	-11.0	--	--	--	--	--	--	--
14...	1845	8760	340	--	8.5	5.0	--	--	--	--	--	--
JUN												
01...	1110	1510	640	--	18.0	18.0	--	--	--	--	--	--
JUL												
12...	1430	351	500	--	33.5	28.0	--	--	--	--	--	--
AUG												
17...	1005	50	--	--	24.0	22.5	--	--	--	--	--	--
29...	0940	134	630	--	16.5	21.5	--	--	--	--	--	--
SEP												
01...	0920	155	390	8.30	17.5	20.5	180	34	24	14	14	0.5

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR												
08...	5.2	85	0	70	1.7	33	4.0	0.10	14	140	134	0.19
SEP												
01...	4.4	190	0	150	1.5	44	9.9	0.10	11	237	234	0.32

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
08...	6770	2	100	30	<1	8	60	0.3	1	<10	79
SEP											
01...	99.2	1	70	30	2	20	<10	<0.1	2	<10	180

RED RIVER OF THE NORTH BASIN

05061000 BUFFALO RIVER NEAR HAWLEY, MN

LOCATION.--Lat 46°51'00", long 96°19'45", in NW¼SE¼ sec.14, T.139 N., R.45 W., Clay County, Hydrologic Unit 09020106, near left downstream end of bridge on farm lane, 2 mi southwest of Hawley.

DRAINAGE AREA.--322 mi^2.

PERIOD OF RECORD.--March 1945 to current year, WY 1981 (annual maximum only), March 1982 to September 1985 (no winter records).

REVISED RECORDS.--WSP 1308: 1945-46(M), 1948(M).

GAGE.--Water-stage recorder. Datum of gage is 1,111.91 ft above National Geodetic Vertical Datum of 1929. Prior to Jan. 29, 1953, nonrecording gage at bridge 1,800 ft upstream at datum 3.17 ft lower.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--39 years (water years 1945-80, 1986-89), 72.7 ft^3/s, 52,670 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,050 ft^3/s, July 1, 1975, gage height, 9.76 ft; minimum, 2.8 ft^3/s, Aug. 26, 1977; minimum gage height, 2.55 ft, Sept. 5, 1961.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known, about 11.3 ft, present datum, spring of 1921, from information by local resident.

EXTREMES FOR CURRENT YEAR:--Maximum discharge, 1,510 ft^3/s, Apr. 5, gage height, 9.11 ft; minimum discharge, 7.4 ft^3/s, Aug. 11, 23, 25; minimum gage height, 2.99 ft, Aug. 11.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	16	17	e16	e18	e20	e19	e315	129	72	19	10	141
2	15	16	e17	e18	e20	e19	e440	123	66	17	9.3	120
3	14	16	e17	e18	e20	e18	710	114	60	16	10	131
4	14	18	e17	e18	e20	e18	1250	104	54	16	12	198
5	13	17	e18	e18	e20	e18	1410	99	49	15	11	180
6	13	17	e18	e18	e20	e18	1210	96	46	15	10	125
7	13	e17	e18	e18	e20	e18	1050	93	46	14	9.7	84
8	13	16	e18	e18	e20	e19	931	91	44	16	9.5	64
9	13	17	e18	e18	e20	e22	784	92	42	16	9.0	53
10	13	17	e18	e18	e20	e24	756	93	40	16	9.0	45
11	15	e17	e18	e18	e20	e26	736	89	38	16	8.5	40
12	14	e17	e18	e18	e20	e26	616	87	37	18	11	36
13	12	18	e18	e18	e20	e25	532	81	37	17	8.8	35
14	13	e18	e18	e18	e20	e22	468	75	38	15	9.4	31
15	13	e17	e18	e18	e20	e20	431	72	36	14	9.4	25
16	14	e16	e18	e18	e19	e20	391	69	35	12	9.7	22
17	15	e16	e18	e19	e19	e19	358	72	33	12	8.6	20
18	18	e15	e18	e19	e19	e19	330	78	30	12	8.1	16
19	16	e15	e18	e19	e19	e19	306	78	26	12	9.8	16
20	16	15	e18	e19	e19	e19	288	77	22	13	8.7	16
21	16	15	e18	e20	e19	e23	261	75	29	12	8.6	25
22	16	15	e18	e21	e19	e20	234	69	30	12	9.5	32
23	18	14	e18	e21	e19	e26	217	65	24	12	8.3	43
24	17	13	e18	e20	e19	e38	198	69	21	11	8.3	42
25	18	14	e18	e24	e20	e35	195	71	27	11	8.0	38
26	18	e16	e17	e21	e20	e48	181	71	23	11	14	37
27	e20	e17	e18	e22	e19	e120	169	65	24	9.7	9.8	31
28	e19	e17	e18	e22	e19	e90	157	60	23	9.8	23	38
29	e18	e16	e18	e21	---	e79	146	60	21	11	15	30
30	17	e16	e18	e22	---	e83	138	62	20	11	13	26
31	17	---	e18	e18	---	e205	---	66	---	10	77	---
TOTAL	477	485	552	596	549	1175	15208	2545	1093	421.5	386.0	1740
MEAN	15.4	16.2	17.8	19.2	19.6	37.9	507	82.1	36.4	13.6	12.5	58.0
MAX	20	18	18	24	20	205	1410	129	72	19	77	198
MIN	12	13	16	18	19	18	138	60	20	9.7	8.0	16
AC-FT	946	962	1090	1180	1090	2330	30170	5050	2170	836	766	3450
CFSM	.05	.05	.06	.06	.06	.12	1.57	.25	.11	.04	.04	.18
IN.	.06	.06	.06	.07	.06	.14	1.76	.29	.13	.05	.04	.20

CAL YR 1988 TOTAL 13777.4 MEAN 37.6 MAX 318 MIN 6.9 AC-FT 27330 CFSM .12 IN. 1.59
WTR YR 1989 TOTAL 25227.5 MEAN 69.1 MAX 1410 MIN 8.0 AC-FT 50040 CFSM .21 IN. 2.91

e Estimated

RED RIVER OF THE NORTH BASIN

05061500 SOUTH BRANCH BUFFALO RIVER AT SABIN, MN

LOCATION.--Lat 46°46'20", long 96°37'40", in SW¼SW¼ sec.9, T.138 N., R.47 W., Clay County, Hydrologic Unit 09020106, near center of span on downstream side of highway bridge, 0.3 mi downstream from Stony Creek and 1 mi east of Sabin.

DRAINAGE AREA.--522 mi^2.

PERIOD OF RECORD.--March 1945 to current year, WY 1981 (annual maximum only), March 1982 to September 1985 (no winter records).

REVISED RECORDS.--WSP 1308: 1949(M).

GAGE.--Nonrecording gage and crest-stage gage. Datum of gage is 902.39 ft above National Geodetic Vertical Datum of 1929 (levels by Soil Conservation Service). Prior to Aug. 17, 1948, nonrecording gage at site 1 mi downstream at different datum.

REMARKS.--Records fair.

AVERAGE DISCHARGE.--39 years (water years 1945-80, 1986-89), 57.5 ft^3/s, 41,660 acre-ft/yr; median of yearly mean discharges, 41 ft^3/s, 29,700 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 8,500 ft^3/s, July 2, 1975, gage height, 19.90 ft; no flow on many days in most years.

EXTREMES FOR CURRENT PERIOD.--Maximum discharge, 3,800 ft^3/s, Apr. 4, 5, gage height, 16.30 ft, confirmed by highwater mark; no flow on many days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e3.1	4.2	e6.6	e2.0	e2.4	e3.4	e212	50	21	e6.5	.00	.87
2	e3.0	4.7	e6.4	e2.0	e2.4	e3.4	e412	46	18	e5.5	.00	1.0
3	2.8	4.7	e6.2	e2.0	e2.4	e3.4	e1880	41	17	4.6	.00	e5.4
4	2.8	7.0	e6.1	e2.0	e2.4	e3.5	e3630	39	e15	5.5	.00	20
5	2.8	8.4	e6.0	e2.0	e2.4	e3.5	3740	34	13	5.7	.00	23
6	2.8	e7.4	e6.0	e2.0	e2.4	e3.5	3160	31	8.7	5.4	.00	24
7	2.8	6.9	e5.9	e2.0	e2.5	e3.5	2000	e29	7.5	2.8	.00	24
8	e2.8	6.2	e5.6	e2.0	e2.5	e3.5	1250	26	6.3	3.0	.00	25
9	e2.8	6.5	e5.0	e2.0	e2.6	e3.5	794	24	6.3	e2.8	.00	22
10	2.8	6.8	e4.3	e2.0	e2.6	e3.5	618	21	8.3	2.8	.00	e17
11	2.8	e7.2	e3.8	e2.0	e2.7	e3.5	483	20	e8.0	1.2	.00	e12
12	2.8	e8.0	e3.4	e2.0	e2.7	e3.5	334	18	12	.76	.00	7.9
13	2.8	e8.0	e3.3	e2.0	e2.8	e3.5	229	e17	10	.97	.00	7.9
14	2.8	e8.0	e3.2	e2.0	e2.8	e3.5	182	e16	8.9	1.0	.00	7.9
15	2.8	e8.0	e2.9	e2.1	e2.9	e3.5	177	15	7.5	1.1	.00	7.5
16	e2.8	e8.1	e2.8	e2.1	e3.0	e3.6	e168	15	7.2	e.82	.00	6.6
17	2.8	e8.1	e2.7	e2.2	e3.0	e3.6	161	15	e7.4	.32	.00	e6.4
18	3.0	e8.2	e2.6	e2.2	e3.1	e3.6	153	17	e7.6	.18	.00	e6.6
19	2.9	e8.4	e2.5	e2.3	e3.1	e3.6	e153	19	7.9	.00	.00	6.5
20	2.9	e8.4	e2.4	e2.3	e3.2	e3.6	153	21	8.8	.00	.00	4.8
21	2.9	e8.5	e2.4	e2.4	e3.2	e3.6	141	e22	7.4	.00	.00	10
22	2.9	e8.6	e2.4	e2.4	e3.3	e3.7	116	23	13	.00	.00	9.7
23	e3.0	e8.4	e2.4	e2.4	e3.3	e3.7	e112	24	13	.00	.00	18
24	3.0	e8.1	e2.4	e2.4	e3.4	e3.7	107	24	e11	.00	.00	19
25	3.0	e7.9	e2.4	e2.4	e3.4	e3.8	101	28	e10	.00	.00	20
26	3.0	e7.9	e2.3	e2.4	e3.4	e3.8	92	29	9.7	.00	.00	17
27	3.1	e7.8	e2.3	e2.4	e3.4	e3.8	89	e28	8.3	.00	.00	15
28	3.2	e7.5	e2.2	e2.4	e3.4	e9.0	75	e27	7.4	.00	.00	12
29	3.8	e7.3	e2.1	e2.4	---	e20	64	e26	7.9	.00	.00	10
30	e4.0	e6.9	e2.1	e2.4	---	e70	e57	25	7.4	.00	.00	e9.5
31	4.2	---	e2.0	e2.4	---	e144	---	22	---	.00	1.0	---
TOTAL	93.0	222.1	112.7	67.6	80.7	339.3	20843	792	299.5	50.75	1.00	376.57
MEAN	3.00	7.40	3.64	2.18	2.88	10.9	695	25.5	9.98	1.64	.032	12.6
MAX	4.2	8.6	6.6	2.4	3.4	144	3740	50	21	6.5	1.0	25
MIN	2.8	4.2	2.0	2.0	2.4	3.4	57	15	6.3	.00	.00	.87
AC-FT	184	441	224	134	160	673	41340	1570	594	101	2.0	747
CFSM	.01	.01	.01	.00	.01	.02	1.33	.05	.02	.00	.00	.02
IN.	.01	.02	.01	.00	.01	.02	1.49	.06	.02	.00	.00	.03

CAL YR 1988 TOTAL 5949.50 MEAN 16.3 MAX 158 MIN .00 AC-FT 11800 CFSM .03 IN. .42
WTR YR 1989 TOTAL 23278.22 MEAN 63.8 MAX 3740 MIN .00 AC-FT 46170 CFSM .12 IN. 1.66

e Estimated

RED RIVER OF THE NORTH BASIN

05062000 BUFFALO RIVER NEAR DILWORTH, MN

LOCATION.--Lat 46°57'40", long 96°39'40", in SW¼SE¼ sec.6, T.140 N., R.47 W., Clay County, Hydrologic Unit 09020106, on left bank 4.5 mi southeast of Kragnes, 6.5 mi northeast of Dilworth, and 9 mi downstream from South Branch.

DRAINAGE AREA.--1,040 mi^2, approximately.

PERIOD OF RECORD.--March 1931 to current year. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 1308: 1931(M).

GAGE.--Water-stage recorder. Datum of gage is 878.31 ft above National Geodetic Vertical Datum of 1929 (levels by U.S Army Corps of Engineers). Prior to Apr. 5, 1937, nonrecording gage at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--58 years, 134 ft^3/s, 97,080 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 13,600 ft^3/s, July 2, 1975, gage height, 27.10 ft; no flow at times in 1936.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,380 ft^3/s, Apr. 6, gage height, 22.80 ft; minimum discharge, 9.3 ft^3/s, Aug. 4, 5, gage height, 2.51 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	17	e24	e27	e21	e21	e19	e525	250	107	35	12	205
2	15	e23	e27	e21	e21	e19	e670	234	105	32	12	137
3	15	23	e24	e21	e21	e20	e923	219	104	29	11	154
4	16	23	e23	e21	e21	e20	e1600	201	96	25	9.9	187
5	16	23	e23	e21	e21	e20	e3650	182	86	23	9.4	216
6	16	23	e23	e21	e21	e20	5260	168	78	21	9.4	242
7	17	23	e23	e21	e20	e21	4890	159	70	20	11	229
8	17	24	e22	e21	e20	e21	3690	153	62	19	11	184
9	16	24	e22	e21	e20	e21	2780	147	57	18	12	139
10	15	25	e22	e21	e20	e22	2260	141	53	18	11	112
11	15	24	e22	e21	e20	e23	1870	136	48	19	9.9	97
12	15	24	e22	e21	e20	e23	1590	130	44	18	10	84
13	15	e25	e22	e21	e20	e22	1410	124	43	18	11	70
14	18	e25	e22	e21	e19	e21	1230	118	41	17	14	57
15	17	e24	e21	e21	e19	e21	1030	108	39	17	14	50
16	16	e24	e21	e21	e19	e22	872	98	41	16	12	42
17	17	23	e21	e21	e19	e22	765	94	40	15	11	36
18	17	24	e21	e21	e19	e23	690	96	38	14	11	32
19	17	e24	e21	e21	e19	e23	626	101	36	14	11	28
20	17	e24	e21	e21	e19	e23	567	102	34	14	11	25
21	20	e24	e21	e21	e19	e23	527	103	32	13	12	25
22	19	e24	e21	e21	e19	e24	498	104	34	13	13	28
23	18	23	e21	e21	e19	e24	455	105	49	13	13	35
24	18	e24	e21	e21	e19	e25	412	106	51	12	13	40
25	18	e24	e21	e21	e19	e26	382	107	49	12	12	52
26	18	e25	e21	e21	e19	e29	361	112	53	12	12	63
27	19	e25	e21	e21	e19	e40	342	115	57	12	14	65
28	20	e24	e21	e21	e19	e50	321	117	50	11	16	65
29	17	e23	e21	e21	---	e150	298	117	44	11	17	60
30	20	e24	e21	e21	---	e325	272	117	40	11	22	56
31	23	---	e21	e21	---	e405	---	112	---	12	177	---
TOTAL	534	716	681	651	551	1547	40766	4176	1681	534	544.6	2815
MEAN	17.2	23.9	22.0	21.0	19.7	49.9	1359	135	56.0	17.2	17.6	93.8
MAX	23	25	27	21	21	405	5260	250	107	35	177	242
MIN	15	23	21	21	19	19	272	94	32	11	9.4	25
AC-FT	1060	1420	1350	1290	1090	3070	80860	8280	3330	1060	1080	5580
CFSM	.02	.02	.02	.02	.02	.05	1.31	.13	.05	.02	.02	.09
IN.	.02	.03	.02	.02	.02	.06	1.46	.15	.06	.02	.02	.10

CAL YR 1988 TOTAL 24193.7 MEAN 66.1 MAX 635 MIN 5.3 AC-FT 47990 CFSM .06 IN. .87
WTR YR 1989 TOTAL 55196.6 MEAN 151 MAX 5260 MIN 9.4 AC-FT 109500 CFSM .15 IN. 1.97

e Estimated

RED RIVER OF THE NORTH BASIN

05064000 WILD RICE RIVER AT HENDRUM, MN

LOCATION.--Lat 47°16'05", long 96°47'50", in SE¼SE¼ sec.19, T.144 N., R.48 W., Norman County, Hydrologic Unit 09020108, on right bank 30 ft downstream from highway bridge, 0.5 mi east of Hendrum and 4 mi upstream from mouth.

DRAINAGE AREA.--1,600 mi^2, approximately.

PERIOD OF RECORD.--March 1944 to September 1984 and May 1985 to current year. Operated as a high-flow partial-record station October 1984 to April 1985.

REVISED RECORDS.--WSP 1728: 1958.

GAGE.--Water-stage recorder. Datum of gage is 836.75 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers). Prior to July 18, 1989, nonrecording gage at same site and datum.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Large part of high flow diverted into Marsh River basin at overflow section 3.5 mi east of Ada. Another diversion into the Marsh River basin formed in 1947, 1.5 mi southeast of Ada and diverted water at all stages 1947-51, after which it was closed except for a small regulated flow diverted for abatement of pollution from Ada sewage plant effluent. Amount of diversion not known.

AVERAGE DISCHARGE.--44 years, (Water Years 1945-84, 1986-89), 266 ft^3/s, 192,700 acre-ft/yr; median of yearly mean discharges, 240 ft^3/s, 174,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,350 ft^3/s, Apr. 10, 1978, gage height, 31.42 ft; maximum gage height, 32.30 ft, Apr. 21, 1979, backwater from Red River of the North; no flow some days in 1948-49.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,480 ft^3/s, Apr. 7, gage height, 29.60 ft (backwater from Red River at the North); minimum daily discharge, 8.1 ft^3/s, Aug. 19.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	44	57	e50	e50	e53	e55	e500	812	481	158	16	660
2	40	58	e50	e50	e53	e55	e1000	776	474	137	15	e475
3	34	48	e50	e50	e53	e55	e2000	745	452	121	14	275
4	30	45	e50	e50	e53	e55	e3000	715	414	111	15	376
5	27	48	e50	e50	e53	e55	e4350	678	390	95	14	e322
6	32	53	e50	e50	e53	e55	e5050	657	359	86	12	288
7	33	48	e50	e50	e54	e55	e5450	614	328	e80	10	182
8	31	45	e50	e50	e54	e55	e5300	597	309	79	10	108
9	29	61	e50	e50	e54	e55	e4900	e564	281	77	10	73
10	27	54	e50	e50	e54	e57	e4400	530	261	77	10	56
11	25	54	e50	e50	e54	e60	e3900	505	245	76	e10	47
12	28	52	e50	e50	e55	e60	e3500	488	226	76	e10	43
13	26	55	e50	e50	e55	e60	e3000	457	216	69	e10	41
14	24	57	e50	e50	e55	e60	e2600	435	200	66	9.4	36
15	24	58	e50	e50	e55	e60	e2300	402	186	e60	10	30
16	23	55	e50	e50	e55	e60	e2100	381	182	55	9.9	26
17	23	40	e50	e50	e55	e60	e1980	359	179	50	9.0	23
18	22	33	e50	e50	e55	e60	e1880	379	167	47	8.8	20
19	25	e50	e50	e50	e55	e60	e1750	361	161	43	8.1	17
20	29	e55	e50	e50	e55	e60	e1650	360	173	40	9.4	15
21	29	e55	e50	e50	e55	e60	e1600	370	163	37	9.7	15
22	35	e55	e50	e50	e55	e60	1380	385	158	34	9.2	15
23	35	e54	e50	e50	e55	e62	1180	371	221	32	13	18
24	38	e54	e50	e50	e55	e64	1100	380	266	31	16	15
25	41	e54	e50	e51	e55	e67	1060	388	237	29	18	17
26	41	e50	e50	e51	e55	e74	1020	437	247	26	15	20
27	40	e50	e50	e52	e55	e84	974	441	262	23	16	24
28	45	e50	e50	e52	e55	e100	936	437	e250	21	19	18
29	27	e50	e50	e52	---	e125	884	415	224	19	26	14
30	31	e50	e50	e52	---	e175	860	419	186	19	22	13
31	44	---	e50	e52	---	e210	---	459	---	18	33	---
TOTAL	982	1548	1550	1562	1523	2233	71604	15317	7898	1892	417.5	3282
MEAN	31.7	51.6	50.0	50.4	54.4	72.0	2387	494	263	61.0	13.5	109
MAX	45	61	50	52	55	210	5450	812	481	158	33	660
MIN	22	33	50	50	53	55	500	359	158	18	8.1	13
AC-FT	1950	3070	3070	3100	3020	4430	142000	30380	15670	3750	828	6510
CFSM	.02	.03	.03	.03	.03	.05	1.49	.31	.16	.04	.01	.07
IN.	.02	.04	.04	.04	.04	.05	1.66	.36	.18	.04	.01	.08

CAL YR 1988 TOTAL 54025.3 MEAN 148 MAX 1180 MIN 3.4 AC-FT 107200 CFSM .09 IN. 1.26
WTR YR 1989 TOTAL 109808.5 MEAN 301 MAX 5450 MIN 8.1 AC-FT 217800 CFSM .19 IN. 2.55

e Estimated

RED RIVER OF THE NORTH BASIN

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN
(National stream quality accounting network station and radiochemical program station)

LOCATION.--Lat 47°21'10", long 96°50'50", on line between secs.24 and 25, T.145 N., R.49 W., Traill County, Hydrologic Unit 09020107, on left bank on upstream side of highway bridge, 0.5 mi west of Halstad, 2.5 mi downstream from Wild Rice River, and at mile 375.2.

DRAINAGE AREA.--21,800 mi^2, approximately, including 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1936 to June 1937 (no winter records), April 1942 to September 1960 (spring and summer months only), May 1961 to current year.

REVISED RECORDS.--WSP 1388: 1936, 1950. WSP 1728: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 826.65 ft above National Geodetic Vertical Datum of 1929. Prior to July 17, 1961, nonrecording gage at same site and datum.

REMARKS.--Estimated daily discharges: Nov. 16 to Apr. 19. Records good except those for period of estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--28 years (1961-89), 1,798 ft^3/s, 1,303,000 acre-ft/yr; median of yearly mean discharges, 1,760 ft^3/s, 1,280,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 42,000 ft^3/s, Apr. 22, 1979, gage height, 39.00 ft; minimum observed, 5.4 ft^3/s, Oct. 8, 9, 12-14, 1936.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in 1897 reached a stage of about 38.5 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 26,000 ft^3/s, Apr. 9, gage height, 35.65 ft, backwater from ice; minimum daily, 131 ft^3/s, Oct. 15.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	200	208	e245	e145	e209	e309	e5000	3040	1960	1030	303	3030
2	197	200	e250	e145	e213	e313	e8000	2950	2170	938	295	3470
3	182	191	e235	e140	e213	e315	e10000	2860	2430	870	295	2560
4	170	184	e230	e140	e215	e319	e13000	2780	2450	819	286	2080
5	161	188	e225	e140	e217	e321	e19000	2700	2300	774	268	1870
6	156	206	e225	e140	e220	e320	e22000	2610	2150	759	254	1580
7	144	218	e225	e140	e228	e321	e24500	2520	2000	752	247	1240
8	140	204	e225	e140	e236	e323	e25100	2440	1870	709	243	1040
9	136	198	e220	e140	e243	e321	e25500	2360	1780	630	240	907
10	132	214	e220	e140	e252	e319	e25600	2290	1670	559	234	796
11	133	211	e220	e140	e270	e330	e25600	2230	1550	563	251	685
12	134	201	e215	e140	e285	e346	e25200	2190	1450	599	253	587
13	136	197	e215	e145	e300	e365	e24500	2140	1390	593	250	510
14	133	200	e215	e150	e290	e379	e23400	2080	1370	560	350	448
15	131	208	e215	e150	e278	e386	e22000	2030	1340	529	318	419
16	133	e205	e210	e155	e266	e393	e20500	1980	1340	503	240	399
17	135	e200	e210	e150	e258	e392	e18700	1960	1320	474	209	379
18	140	e190	e200	e143	e246	e392	e16700	1970	1280	447	192	350
19	146	e200	e190	e137	e238	e395	e14500	2050	1240	426	191	333
20	150	e220	e180	e133	e227	e406	12600	1990	1200	417	192	321
21	153	e230	e185	e133	e223	e424	9480	1960	1170	399	213	319
22	166	e250	e185	e136	e235	e445	6730	1980	1150	387	298	305
23	182	e260	e190	e139	e242	e467	5070	1990	1200	379	324	319
24	191	e255	e180	e144	e249	e490	4360	2050	1260	374	345	331
25	196	e250	e175	e150	e268	e530	4010	2300	1180	383	311	320
26	200	e245	e170	e157	e276	e650	3770	2380	1150	373	292	345
27	197	e240	e165	e169	e284	e800	3560	2240	1200	358	273	364
28	204	e240	e165	e181	e298	e1000	3400	2090	1190	343	309	402
29	200	e240	e160	e193	---	e1300	3260	2000	1170	326	323	435
30	202	e240	e155	e203	---	e1800	3150	1950	1110	312	319	430
31	195	---	e150	e205	---	e2500	---	1930	---	307	601	---
TOTAL	5075	6493	6250	4663	6979	17371	428190	70040	46040	16892	8719	26574
MEAN	164	216	202	150	249	560	14270	2259	1535	545	281	886
MAX	204	260	250	205	300	2500	25600	3040	2450	1030	601	3470
MIN	131	184	150	133	209	309	3150	1930	1110	307	191	305
AC-FT	10070	12880	12400	9250	13840	34460	849300	138900	91320	33510	17290	52710

CAL YR 1988 TOTAL 240210 MEAN 656 MAX 4940 MIN 64 AC-FT 476500
WTR YR 1989 TOTAL 643286 MEAN 1762 MAX 25600 MIN 131 AC-FT 1276000

e - Estimated

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN--CONTINUED
(National stream quality accounting network station and radiochemical program station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1961-67, 1972 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	OXYGEN, DIS-SOLVED (MG/L) (00300)	OXYGEN, DIS-SOLVED (PER-CENT SATUR-ATION) (00301)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT											
14...	1415	135	735	9.00	16.5	8.5	14	9.2	78	12	46
NOV											
14...	1225	202	N980	8.60	0.0	1.0	8.2	14.4	102	--	--
JAN											
18...	1600	143	750	--	-2.0	0.0	--	--	--	--	--
FEB											
24...	1300	253	--	8.60	-10.0	0.0	2.6	6.0	41	--	--
APR											
06...	1400	22100	255	--	4.0	0.5	--	--	--	--	--
07...	1325	24500	280	--	2.0	0.5	--	--	--	--	--
09...	1040	24800	260	--	-3.5	0.5	--	--	--	--	--
10...	1305	25600	272	--	2.5	1.0	--	--	--	--	--
13...	1130	24500	260	--	6.0	2.5	--	--	--	--	--
17...	1510	18500	390	--	2.0	5.5	--	--	--	--	--
27...	1230	3490	575	8.30	8.0	12.0	87	11.5	107	12	770
JUN											
07...	1350	1990	632	8.20	14.5	19.0	91	7.0	77	27	1400
AUG											
02...	1150	292	680	8.50	30.5	27.5	83	6.7	85	39	--
SEP											
08...	1500	1020	--	--	22.0	20.0	--	--	--	--	--

DATE	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT WH TOT IT FIELD MG/L AS CACO3 (00419)	BICAR-BONATE WATER WH IT FIELD MG/L AS HCO3 (00450)	CAR-BONATE WATER WH IT FIELD MG/L AS CO3 (00447)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)
OCT											
14...	310	62	37	46	24	1	7.6	248	255	23	120
NOV											
14...	350	71	43	77	31	2	8.5	286	334	7	170
FEB											
24...	360	76	41	41	19	1	9.3	308	353	11	97
APR											
27...	260	59	27	20	14	0.6	6.9	190	232	0	94
JUN											
07...	290	63	32	24	15	0.6	6.2	202	246	0	110
AUG											
02...	260	53	32	39	24	1	7.2	206	232	10	88

DATE	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)
OCT										
14...	24	0.30	7.6	460	450	0.63	168	--	<0.010	<0.100
NOV										
14...	36	0.30	10	595	587	0.81	325	--	--	--
FEB										
24...	23	0.20	22	525	499	0.71	359	0.750	0.010	0.760
APR										
27...	12	0.20	16	395	349	0.54	3720	0.220	0.020	0.240
JUN										
07...	12	0.20	12	403	383	0.55	2170	0.610	0.070	0.680
AUG										
02...	25	0.40	17	422	392	0.57	333	1.28	0.020	1.30

RED RIVER OF THE NORTH BASIN

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN--CONTINUED
(National stream quality accounting network station and radiochemical program station)

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	NITROGEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOSPHOROUS TOTAL (MG/L AS P) (00665)	PHOSPHOROUS DISSOLVED (MG/L AS P) (00666)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P) (00671)	PHOSPHOROUS ORGANIC TOTAL (MG/L AS P) (00670)	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)
OCT 14...	0.040	0.020	0.80	0.330	0.170	0.140	0.33	<10	4	61
FEB 24...	0.240	0.210	1.1	0.120	0.120	0.100	0.12	<10	2	86
APR 27...	0.240	0.260	0.90	0.190	0.160	0.130	0.19	20	4	59
JUN 07...	0.100	0.070	1.9	0.430	0.200	0.210	0.43	--	--	--
AUG 02...	0.040	<0.010	1.2	0.500	0.430	0.410	0.50	20	7	64

DATE	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)
OCT 14...	<0.5	<1	<1	<3	3	9	<5	44	<1	<0.1
FEB 24...	<0.5	<1	2	<3	3	19	<5	39	42	<0.1
APR 27...	<0.5	<1	<1	<3	<3	23	<1	27	1	<0.1
AUG 02...	<0.5	<1	<1	<3	8	12	1	35	3	<0.1

DATE	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT 14...	<10	2	<1	<1.0	260	<6	3	45	16	73
NOV 14...	--	--	--	--	--	--	--	21	11	91
FEB 24...	<10	6	<1	<1.0	290	<6	15	17	12	81
APR 27...	<10	3	<1	<1.0	200	<6	9	215	2030	100
AUG 02...	<10	14	1	<1.0	230	7	5	154	121	99

RED RIVER OF THE NORTH BASIN

05067500 MARSH RIVER NEAR SHELLY, MN

LOCATION.--Lat 47°24'45", long 96°45'50", in NE¼NW¼ sec.3, T.145 N., R.48 W., Norman County, Hydrologic Unit 09020107, near center of span on downstream truss of bridge, 3.8 mi southeast of Shelly and 10 mi upstream from mouth.

DRAINAGE AREA.--151 mi^2.

PERIOD OF RECORD.--March 1944 to September 1983 and April 1985 to current year. Monthly discharge only for March 1944, published in WSP 1308. Operated as a high-flow partial-record station October 1983 to March 1985.

GAGE.--Water-stage recorder. Datum of gage is 841.14 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct.1, 1965, nonrecording gage at datum 3.0 ft higher. Oct. 1, 1965, to May 17, 1989, nonrecording gage at present site and datum.

REMARKS.--Records fair. Large part of high flow of Wild Rice River diverted into Marsh River basin at overflow section 4.6 mi east of Ada. Another diversion from Wild Rice River basin formed in 1947, 1.5 mi southeast of Ada and diverted water at all stages 1947-51, after which it was closed except for a small regulated flow diverted for abatement of pollution from Ada sewage plant effluent.

AVERAGE DISCHARGE.--43 years (water years 1945-83, 1986-89), 63.3 ft^3/s, 45,860 acre-ft/yr; median of yearly mean discharges, 46 ft^3/s, 33,300 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,880 ft^3/s, Apr. 19, 1979, gage height, 23.36 ft, from floodmark; no flow for many days most years.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 3,490 ft^3/s, Apr. 7, gage height, 21.18 ft (backwater from Red River of the North); no flow for many days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e1.0	e.02	e.00	e.00	e.00	e.00	e100	19	19	.50	.00	.00
2	.72	.08	e.00	e.00	e.00	e.00	e250	e18	21	.35	.00	.00
3	.32	.26	e.00	e.00	e.00	e.00	e550	e18	19	.21	.00	.00
4	.17	.21	e.00	e.00	e.00	e.00	e1000	e17	16	.17	.00	.00
5	e.14	.12	e.00	e.00	e.00	e.00	e1600	e17	13	.12	.00	.00
6	e.11	.03	e.00	e.00	e.00	e.00	e2350	16	9.2	.10	.00	.00
7	e.08	e.10	e.00	e.00	e.00	e.00	e3250	13	6.2	.10	.00	.00
8	e.04	e.10	e.00	e.00	e.00	e.00	e2800	9.9	4.6	.08	.00	.00
9	.01	e.10	e.00	e.00	e.00	e.00	e1900	e9.0	3.4	.09	.00	.00
10	.00	e.10	e.00	e.00	e.00	e.00	e1200	8.0	2.6	.07	.00	.00
11	.00	.19	e.00	e.00	e.00	e.00	e700	5.3	2.1	.10	.00	.00
12	.00	.21	e.00	e.00	e.00	e.00	e440	e4.4	1.7	.11	.00	.00
13	.00	.17	e.00	e.00	e.00	e.00	e340	3.5	1.4	.09	.00	.00
14	.00	.15	e.00	e.00	e.00	e.00	e285	2.7	1.1	.06	.00	.00
15	.00	.12	e.00	e.00	e.00	e.00	e250	e2.4	1.1	.04	.00	.00
16	.00	e.08	e.00	e.00	e.00	e.00	e225	e2.0	.98	.04	.00	.00
17	.00	e.05	e.00	e.00	e.00	e.00	e200	2.4	.82	.04	.00	.00
18	e.00	e.04	e.00	e.00	e.00	e.00	e170	2.9	.64	.03	.00	.00
19	.01	e.03	e.00	e.00	e.00	e.00	124	7.7	.66	.02	.00	.00
20	.00	e.02	e.00	e.00	e.00	e.00	90	8.9	.47	.02	.00	.00
21	e.01	e.01	e.00	e.00	e.00	e.00	74	11	.45	.02	.00	.00
22	.02	e.00	e.00	e.00	e.00	e.00	e65	9.8	.51	.01	.00	.00
23	.12	e.00	e.00	e.00	e.00	e.00	57	7.6	.43	.00	.00	.00
24	.10	e.00	e.00	e.00	e.00	e.00	46	13	2.5	.00	.00	.00
25	.06	e.00	e.00	e.00	e.00	e.00	42	27	3.1	.00	.00	.00
26	.04	e.00	e.00	e.00	e.00	e.00	37	27	1.8	.00	.00	.00
27	e.02	e.00	e.00	e.00	e.00	e.00	33	23	1.1	.00	.00	.00
28	.02	e.00	e.00	e.00	e.00	e.00	30	24	1.1	.00	.00	.00
29	.02	e.00	e.00	e.00	---	e.00	26	21	1.2	.00	.00	.00
30	.02	e.00	e.00	e.00	---	e5.0	23	18	.76	.00	.00	.00
31	e.02	---	e.00	e.00	---	e10	---	19	---	.00	.00	---
TOTAL	3.05	2.19	0.00	0.00	0.00	15.00	18257	387.5	137.92	2.37	0.00	0.00
MEAN	.098	.073	.00	.00	.00	.48	609	12.5	4.60	.076	.00	.00
MAX	1.0	.26	.00	.00	.00	10	3250	27	21	.50	.00	.00
MIN	.00	.00	.00	.00	.00	.00	23	2.0	.43	.00	.00	.00
AC-FT	6.0	4.3	.0	.0	.0	30	36210	769	274	4.7	.0	.0
CFSM	.00	.00	.00	.00	.00	.00	4.03	.08	.03	.00	.00	.00
IN.	.00	.00	.00	.00	.00	.00	4.50	.10	.03	.00	.00	.00

CAL YR 1988 TOTAL 4360.01 MEAN 11.9 MAX 230 MIN .00 AC-FT 8650 CFSM .08 IN. 1.07
WTR YR 1989 TOTAL 18805.03 MEAN 51.5 MAX 3250 MIN .00 AC-FT 37300 CFSM .34 IN. 4.63

e Estimated

RED RIVER OF THE NORTH BASIN

05069000 SAND HILL RIVER AT CLIMAX, MN

LOCATION.--Lat 47°36'43", long 96°48'52", in NE¼NE¼ sec.30, T.148 N., R.48 W., Polk County, Hydrologic Unit 09020301, on left bank 25 ft upstream from bridge on U.S. Highway 75 in Climax and 3.7 mi upstream from mouth.

DRAINAGE AREA.--426 mi^2.

PERIOD OF RECORD.--March 1943 to September 1984, June 1985 to current year (winter records incomplete prior to 1947). Monthly discharge only for some periods, published in WSP 1308 and 1728. October 1984 to May 1985, operated as a high-flow partial-record station.

REVISED RECORDS.--WSP 1388: 1943(M), 1944, 1947(M). WSP 1728: 1951(M), 1960 (Average discharge).

GAGE.--Water stage recorder. Datum of gage is 820.10 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct. 1, 1966, nonrecording gage at site 3.2 mi upstream at datum 12.78 ft higher. Oct. 1, 1966, to Sept 5, 1989, nonrecording gage at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--42 years (water years 1947-84, 1986-89), 72.7 ft^3/s, 52,670 acre-ft/yr; median of yearly mean discharges, 57 ft^3/s, 41,300 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,560 ft^3/s, Apr. 14, 1965, gage height, 17.81 ft, site and datum then in use; maximum gage height, 32.79 ft, Apr. 23, 1979, from floodmark (backwater from Red River of the North); minimum daily discharge, 1.0 ft^3/s, Jan. 17, 18, 1962.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,430 ft^3/s, Apr. 10, gage height, 25.00 ft (backwater from Red River of the North); minimum daily, 8.6 ft^3/s, Oct. 3.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e9.8	20	e15	e15	e12	e11	e100	116	81	62	13	16
2	9.8	19	e15	e15	e12	e11	e150	109	76	64	13	17
3	8.6	17	e15	e15	e12	e11	e300	104	69	e60	12	19
4	8.9	16	e15	e15	e12	e11	e600	e96	61	e56	12	18
5	14	16	e15	e15	e12	e11	e800	88	54	54	12	e17
6	11	14	e15	e15	e12	e11	e1150	e85	49	49	10	16
7	10	15	e15	e15	e11	e11	e1500	81	44	46	11	16
8	12	20	e15	e15	e11	e11	e1200	77	41	40	11	15
9	10	20	e15	e15	e11	e11	e1800	76	39	34	11	14
10	12	17	e15	e15	e11	e11	e2400	72	36	33	10	14
11	12	12	e15	e14	e11	e11	e2300	e66	33	e30	10	14
12	12	16	e15	e14	e11	e11	e1900	64	31	28	9.5	14
13	12	22	e15	e14	e11	e11	e1400	60	31	25	8.7	15
14	e13	27	e15	e14	e11	e11	e1100	58	35	24	10	14
15	14	19	e15	e14	e11	e11	e950	54	32	23	10	14
16	14	14	e15	e14	e11	e11	e850	50	31	21	e10	13
17	14	8.7	e15	e14	e11	e11	e820	48	29	19	e10	13
18	13	e18	e15	e14	e11	e11	e730	66	29	18	e10	13
19	13	e20	e15	e13	e11	e11	e590	81	28	19	10	11
20	14	e20	e15	e13	e11	e11	e420	e80	24	e18	9.8	11
21	15	e19	e15	e13	e11	e12	e360	78	24	17	10	11
22	17	e18	e15	e13	e11	e12	333	74	41	17	14	12
23	15	e17	e15	e13	e11	e13	285	70	40	16	19	15
24	15	e16	e15	e13	e11	e14	238	71	34	15	16	15
25	15	e16	e15	e13	e11	e15	209	e85	29	14	14	14
26	14	e15	e15	e13	e11	e16	200	100	34	14	14	14
27	15	e15	e15	e13	e11	e17	179	100	37	12	e15	14
28	14	e14	e15	e13	e11	e19	160	92	39	12	17	15
29	14	e14	e15	e12	---	e22	144	95	40	13	15	14
30	15	e14	e15	e12	---	e30	131	90	54	14	15	15
31	22	---	e15	e12	---	e50	---	85	---	13	16	---
TOTAL	408.1	508.7	465	428	314	440	23299	2471	1225	880	378.0	433
MEAN	13.2	17.0	15.0	13.8	11.2	14.2	777	79.7	40.8	28.4	12.2	14.4
MAX	22	27	15	15	12	50	2400	116	81	64	19	19
MIN	8.6	8.7	15	12	11	11	100	48	24	12	8.7	11
AC-FT	809	1010	922	849	623	873	46210	4900	2430	1750	750	859
CFSM	.03	.04	.04	.03	.03	.03	1.82	.19	.10	.07	.03	.03
IN.	.04	.04	.04	.04	.03	.04	2.03	.22	.11	.08	.03	.04

CAL YR 1988 TOTAL 16075.9 MEAN 43.9 MAX 600 MIN 5.8 AC-FT 31890 CFSM .10 IN. 1.40
WTR YR 1989 TOTAL 31249.8 MEAN 85.6 MAX 2400 MIN 8.6 AC-FT 61980 CFSM .20 IN. 2.73

e Estimated

RED RIVER OF THE NORTH BASIN

05074000 LOWER RED LAKE NEAR RED LAKE, MN

LOCATION.--Lat 47°57'27", long 95°16'34", in SW¼NW¼ sec.28, T.152 N., R.36 W., Clearwater County, Hydrologic Unit 09020302, on Red Lake Indian Reservation, on left bank just upstream from dam at outlet, 13 mi northwest of city of Red Lake.

DRAINAGE AREA.--1,950 mi^2, approximately.

PERIOD OF RECORD.--June 1930 to November 1932 and May 1933 to current year. Published as "Red Lake at Redby" prior to May 1933 and as "Red Lake near Red Lake" May 1933 to September 1940. Records on Upper Red Lake published as Red Lake at Waskish, April 1930 to September 1933, all in reports of Geological Survey. October 1921 to September 1929 gage heights at Redby and on Upper Red Lake at Waskish in files of Minnesota Department of Natural Resources (fragmentary).

GAGE.--Water-stage recorder. Datum of gage is 1,100.00 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers); gage readings have been reduced to elevations based on adjustment of 1912. May 1933 to Sept. 6, 1934, nonrecording gage and Sept. 7, 1934 to Sept. 30, 1986, recording gage at same site at datum 69.00 ft higher. Nonrecording gages at Waskish and Redby.

REMARKS.--Water level subject to fluctuation caused by change in direction and velocity of wind and by seiches.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 1,178.53 ft, June 25, 1950; minimum recorded, 1,169.80 ft, Nov. 20, 1936.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 1,174.62 ft, May 24; maximum daily, 1,174.10 ft, July 11; minimum, 1,171.76 ft, Nov. 16; minimum daily, 1,172.02 ft, Nov. 16.

MONTHEND ELEVATION, IN FEET, OCTOBER 1988 TO SEPTEMBER 1989

Oct. 31 ..... 1,172.27	Feb. 28 ..... 1,172.65	June 30 ..... 1,173.83
Nov. 30 ..... 1,172.41	Mar. 31 ..... 1,172.74	July 31 ..... 1,173.72
Dec. 31 ..... 1,172.49	Apr. 30 ..... 1,173.08	Aug. 31 ..... 1,173.77
Jan. 31 ..... 1,172.64	May 31 ..... 1,173.41	Sept. 30 ..... 1,173.33

NOTE.--Mean daily gage heights are available.

RED RIVER OF THE NORTH BASIN

05074500 RED LAKE RIVER NEAR RED LAKE, MN

LOCATION.--Lat 47°57'27", long 95°16'35", in SW¼NW¼ sec.28, T.152 N., R.36 W., Clearwater County, Hydrologic Unit 09020302, on Red Lake Indian Reservation, on left bank 50 ft downstream from dam at outlet of Lower Red Lake and 13 mi northwest of village of Red Lake.

DRAINAGE AREA.--1,950 mi^2, approximately.

PERIOD OF RECORD.--May 1933 to current year. Monthly discharge only for May 1933, published in WSP 1308.

GAGE.--Water-stage recorder. Datum of gage is 1,100.00 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Sept. 7, 1934, nonrecording gage at site 50 ft upstream at datum 69.00 ft higher. Sept. 7, 1934, to Nov. 26, 1951, water-stage recorder at present site at datum 69.00 ft higher. Nov. 27, 1951 to Sept. 30, 1986, water-stage recorder at present site at datum 67.00 ft higher.

REMARKS.--Records poor. Flow completely regulated by outlet dam on Lower Red Lake.

AVERAGE DISCHARGE.--56 years, 489 ft^3/s, 354,300 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,600 ft^3/s, June 25, 1950, gage height, 78.19 ft, affected by seiches and backwater from aquatic vegetation, present datum, from rating curve extended above 1,400 ft^3/s; no flow at times.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 72 ft^3/s, July 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 20; maximum gage height, 70.44 ft, July 20; minimum daily discharge, 54 ft^3/s, Oct. 26, Oct. 31 to Nov. 25.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	57	54	e55	e56	e56	e56	e57	60	63	70	70	68
2	56	54	e55	e56	e56	e56	e57	60	64	70	70	68
3	56	54	e55	e56	e56	e56	e58	61	65	70	70	67
4	56	54	e55	e56	e56	e56	e58	61	64	70	70	67
5	56	54	e55	e56	e56	e56	e58	63	64	70	70	66
6	56	54	e55	e56	e56	e56	e58	59	65	70	70	66
7	56	54	e55	e56	e56	e56	e58	58	65	70	69	66
8	56	54	e55	e56	e56	e56	e58	60	66	70	69	66
9	56	54	e55	e56	e56	e56	e58	60	66	71	69	66
10	56	54	e55	e56	e56	e56	e58	60	66	71	69	66
11	56	54	e55	e56	e56	e56	e58	60	67	70	68	66
12	56	54	e55	e56	e56	e56	e58	60	68	70	68	66
13	56	54	e55	e56	e56	e56	e58	60	68	71	68	65
14	56	54	e55	e56	e56	e56	e58	60	68	70	68	64
15	56	54	e55	e56	e56	e56	e58	60	68	70	68	62
16	56	e54	e55	e56	e56	e56	e58	60	68	70	68	62
17	56	e54	e55	e56	e56	e56	e58	60	68	70	68	62
18	56	e54	e55	e56	e56	e56	e58	60	68	70	68	62
19	56	e54	e55	e56	e56	e56	60	61	68	70	68	65
20	55	e54	e55	e56	e56	e56	58	63	68	70	68	62
21	56	e54	e55	e56	e56	e56	58	62	69	70	68	63
22	55	e54	e55	e56	e56	e56	57	62	70	70	68	63
23	56	e54	e55	e56	e56	e56	58	62	70	70	68	62
24	56	e54	e55	e56	e56	e56	58	61	70	70	68	61
25	55	e54	e55	e56	e56	e56	59	63	70	70	68	62
26	54	e55	e56	e56	e56	e56	60	64	70	70	68	60
27	55	e55	e56	e56	e56	e56	59	62	70	70	68	60
28	56	e55	e56	e56	e56	e56	58	62	70	70	68	60
29	56	e55	e56	e56	---	e57	59	62	70	70	68	59
30	55	e55	e56	e56	---	e57	60	62	70	70	68	58
31	54	---	e56	e56	---	e57	---	62	---	70	68	---
TOTAL	1728	1625	1711	1736	1568	1739	1746	1890	2026	2173	2124	1910
MEAN	55.7	54.2	55.2	56.0	56.0	56.1	58.2	61.0	67.5	70.1	68.5	63.7
MAX	57	55	56	56	56	57	60	64	70	71	70	68
MIN	54	54	55	56	56	56	57	58	63	70	68	58
AC-FT	3430	3220	3390	3440	3110	3450	3460	3750	4020	4310	4210	3790
CFSM	.03	.03	.03	.03	.03	.03	.03	.03	.03	.04	.04	.03
IN.	.03	.03	.03	.03	.03	.03	.03	.04	.04	.04	.04	.04

CAL YR 1988 TOTAL 25306 MEAN 69.1 MAX 98 MIN 45 AC-FT 50190 CFSM .04 IN. .48
WTR YR 1989 TOTAL 21976 MEAN 60.2 MAX 71 MIN 54 AC-FT 43590 CFSM .03 IN. .42

e Estimated

RED RIVER OF THE NORTH BASIN

05075000 RED LAKE RIVER AT HIGH LANDING, NEAR GOODRIDGE, MN

LOCATION.--Lat 48°02'34", long 95°48'28", in NW¼NW¼ sec.28, T.153 N., R.40 W., Pennington County, Hydrologic Unit 09020303, on left bank 50 ft upstream from highway bridge at High Landing, 7 mi south of Goodridge and 33 mi upstream from Thief River.

DRAINAGE AREA.--2,300 mi^2, approximately.

PERIOD OF RECORD.--September 1929 to current year. Prior to October 1930, published as "at Kratka".

GAGE.--Water-stage recorder. Datum of gage is 1,141.57 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). See WSP 1308 or 1738 for history of changes prior to Oct. 1, 1949.

REMARKS.--Records fair. Flow regulated by outlet dam on Lower Red Lake.

AVERAGE DISCHARGE.--60 years, 551 ft^3/s, 399,200 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,060 ft^3/s, July 7, 1975, gage height, 13.39 ft; maximum gage height, 13.44 ft, July 3, 1975; no flow during infrequent periods in 1931-34, 1936-37.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 600 ft^3/s, Apr. 14, gage height, 7.55 ft (backwater from ice); maximum gage height, 8.61 ft, Apr. 6 (backwater from ice); minimum discharge, 42 ft^3/s, Nov. 15, gage height, 0.92 ft, result of freeze up.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	68	82	e75	e76	e73	e72	e86	90	95	89	76	100
2	67	78	e75	e76	e73	e72	e88	87	90	90	77	90
3	69	69	e75	e76	e73	e72	e100	85	89	89	83	79
4	68	65	e75	e76	e73	e72	e150	82	86	89	88	84
5	70	65	e75	e76	e73	e72	e300	81	86	92	89	83
6	70	60	e75	e76	e73	e72	e400	91	86	95	91	77
7	68	75	e75	e76	e73	e72	e450	90	85	94	93	80
8	67	77	e73	e76	e73	e72	e400	92	88	92	91	78
9	69	67	e70	e76	e73	e72	e350	102	93	88	88	75
10	67	63	e61	e76	e73	e72	e300	95	91	88	88	74
11	68	64	e60	e76	e73	e72	e280	93	87	87	91	77
12	70	76	e60	e76	e73	e72	e280	86	90	87	93	78
13	71	88	e70	e76	e73	e72	e350	81	91	87	95	77
14	69	62	e80	e76	e73	e72	e500	77	102	87	96	74
15	68	52	e80	e76	e73	e72	e500	76	104	89	94	73
16	67	57	e76	e74	e73	e72	e400	74	97	88	92	71
17	68	59	e76	e74	e73	e72	e350	77	94	89	89	68
18	70	e80	e76	e74	e73	e72	e300	86	91	89	89	67
19	69	e90	e76	e74	e73	e72	274	90	92	90	88	63
20	71	e84	e76	e74	e73	e72	277	89	92	86	88	66
21	71	e80	e76	e74	e73	e72	214	83	91	85	92	77
22	69	e77	e76	e74	e73	e72	195	85	92	90	106	79
23	71	e75	e76	e74	e73	e72	179	82	90	98	106	72
24	67	e75	e76	e74	e73	e72	151	89	88	103	97	68
25	67	e75	e76	e74	e73	e72	131	106	90	100	90	66
26	71	e75	e76	e74	e73	e75	122	105	108	96	89	64
27	80	e75	e76	e74	e73	e77	112	107	121	87	85	65
28	51	e75	e76	e74	e73	e79	106	101	117	86	89	62
29	63	e75	e76	e74	---	e81	98	96	108	91	103	60
30	85	e75	e76	e74	---	e82	93	100	90	86	96	62
31	86	---	e76	e74	---	e84	---	98	---	79	94	---
TOTAL	2155	2170	2295	2324	2044	2278	7536	2776	2824	2786	2826	2209
MEAN	69.5	72.3	74.0	75.0	73.0	73.5	251	89.5	94.1	89.9	91.2	73.6
MAX	86	90	80	76	73	84	500	107	121	103	106	100
MIN	51	52	60	74	73	72	86	74	85	79	76	60
AC-FT	4270	4300	4550	4610	4050	4520	14950	5510	5600	5530	5610	4380
CFSM	.03	.03	.03	.03	.03	.03	.11	.04	.04	.04	.04	.03
IN.	.03	.04	.04	.04	.03	.04	.12	.04	.05	.05	.05	.04

CAL YR 1988 TOTAL 33835 MEAN 92.4 MAX 550 MIN 51 AC-FT 67110 CFSM .04 IN. .55
WTR YR 1989 TOTAL 34223 MEAN 93.8 MAX 500 MIN 51 AC-FT 67880 CFSM .04 IN. .55

e Estimated

RED RIVER OF THE NORTH BASIN

05076000 THIEF RIVER NEAR THIEF RIVER FALLS, MN

LOCATION.--Lat 48°11'08", long 96°10'11", in NW¼SW¼ sec.3, T.154 N., R.43 W., Marshall County, Hydrologic Unit 09020304, on right bank, 0.2 mi upstream from highway bridge, 5 mi north of city of Thief River Falls, 7 mi upstream from mouth, and 9 mi downstream from Mud Lake National Wildlife Refuge.

DRAINAGE AREA.--959 mi^2.

PERIOD OF RECORD.--July 1909 to September 1917, April 1920 to September 1921, October 1922 to September 1924, October 1928 to September 1981, March 1982 to current year. Monthly discharge only for some periods, annual maximums for water years 1919, 1922, 1925, 1926, published in WSP 1308. October 1981 to February 1982, operated as a high-flow partial-record station.

REVISED RECORDS.--WSP 925: Drainage area. WSP 1308: 1917(M), 1924(M), 1929(M), 1931-33(M), 1935(M), 1937(M).

GAGE.--Water-stage recorder and control of grouted boulders. Datum of gage is 1,112.33 ft above National Geodetic Vertical Datum of 1929 (levels by Minnesota Department of Transportation). Prior to May 4, 1939, nonrecording gages at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Some regulation by Thief and Mud Lakes.

AVERAGE DISCHARGE.--71 years (water years 1910-17, 1921, 1923-24, 1929-81, 1983-89), 164 ft^3/s, 118,800 acre-ft/yr; median of yearly mean discharges, 110 ft^3/s, 79,700 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,610 ft^3/s, May 13, 1950, gage height, 17.38 ft; no flow at times in some years.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,300 ft^3/s, Apr. 16, gage height, 14.31 ft (backwater from ice); no flow Dec. 11, 12 and Sept. 17-30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.2	1.1	e.65	e.20	e.18	e.28	e15	727	173	155	17	.56
2	3.2	1.2	e.60	e.20	e.18	e.30	e20	136	164	151	16	.43
3	2.8	1.3	e.50	e.20	e.18	e.30	e25	79	152	148	16	.41
4	1.9	5.7	e.45	e.20	e.18	e.30	e30	72	143	144	16	.47
5	1.4	4.8	e.40	e.20	e.18	e.30	e50	66	131	138	15	.36
6	1.5	4.5	e.35	e.20	e.18	e.30	e160	68	81	137	15	.25
7	1.5	3.8	e.30	e.20	e.18	e.30	e180	70	82	131	13	.19
8	1.3	3.1	e.25	e.20	e.18	e.30	e200	77	79	126	12	.15
9	1.1	2.6	e.23	e.20	e.18	e.35	e220	170	75	125	17	.11
10	.73	2.2	e.20	e.20	e.18	e.45	e250	200	73	119	21	.09
11	.44	1.9	e.00	e.20	e.18	e.50	e270	259	74	117	19	.13
12	.40	1.9	e.00	e.20	e.18	e.49	e300	311	74	116	18	.16
13	.34	1.9	e.10	e.20	e.18	e.48	e400	300	76	115	20	.14
14	.29	1.8	e.15	e.20	e.18	e.46	e800	289	202	109	18	.11
15	.23	e1.7	e.20	e.20	e.18	e.44	e1300	282	254	106	18	.08
16	.18	e1.7	e.20	e.20	e.17	e.42	e2150	278	122	105	18	.03
17	.21	e1.6	e.20	e.20	e.16	e.40	e1900	279	90	103	13	.0
18	.27	e1.5	e.20	e.20	e.15	e.38	e1800	304	87	71	9.4	.00
19	.31	e1.4	e.20	e.20	e.15	e.37	e1700	406	83	55	7.8	.00
20	.36	e1.3	e.20	e.20	e.15	e.36	e1500	398	81	53	6.0	.00
21	.37	e1.2	e.20	e.20	e.15	e.35	1070	219	119	52	4.6	.00
22	.35	e1.2	e.20	e.20	e.15	e.34	921	184	447	40	4.0	.00
23	.42	e1.1	e.20	e.20	e.15	e.33	785	170	448	29	2.5	.00
24	.40	e1.1	e.20	e.20	e.15	e.32	702	164	295	27	1.7	.00
25	5.4	e1.0	e.20	e.20	e.17	e.31	717	182	259	27	1.2	.00
26	3.1	e.95	e.20	e.18	e.20	e.70	761	262	246	26	1.1	.00
27	1.9	e.90	e.20	e.18	e.23	e1.5	809	281	232	26	.86	.00
28	1.3	e.80	e.20	e.18	e.26	e3.0	893	247	171	26	.83	.00
29	1.1	e.75	e.20	e.18	---	e5.0	948	203	161	23	.74	.00
30	1.1	e.70	e.20	e.18	---	e7.0	930	198	157	19	.56	.00
31	.99	---	e.20	e.18	---	e10	---	183	---	17	.62	---
TOTAL	39.09	56.70	7.58	6.08	4.94	36.33	21806	7064	4831	2636	323.91	3.67
MEAN	1.26	1.89	.24	.20	.18	1.17	727	228	161	85.0	10.4	.12
MAX	5.4	5.7	.65	.20	.26	10	2150	727	448	155	21	.56
MIN	.18	.70	.00	.18	.15	.28	15	66	73	17	.56	.00
AC-FT	78	112	15	12	9.8	72	43250	14010	9580	5230	642	7.3
CFSM	.00	.00	.00	.00	.00	.00	.76	.24	.17	.09	.01	.00
IN.	.00	.00	.00	.00	.00	.00	.85	.27	.19	.10	.01	.00

CAL YR 1988 TOTAL 9705.81 MEAN 26.5 MAX 1150 MIN .00 AC-FT 19250 CFSM .03 IN. .38
WTR YR 1989 TOTAL 36815.30 MEAN 101 MAX 2150 MIN .00 AC-FT 73020 CFSM .11 IN. 1.43

e Estimated

RED RIVER OF THE NORTH BASIN

05078000 CLEARWATER RIVER AT PLUMMER, MN

LOCATION.--Lat 47°55'24", long 96°02'46", in SE¼SW¼ sec. 4, T.151 N., R.42 W., Red Lake County, Hydrologic Unit 09020305, on right bank 200 ft downstream from Soo Line Railroad bridge, 300 ft downstream from bridge on U.S. Highway 59, 0.9 mi northwest of railroad depot in Plummer, and 8 mi upstream from Hill River.

DRAINAGE AREA.--512 mi^2.

PERIOD OF RECORD.--April 1939 to September 1979, March 1982 to current year. Annual maximums only, October 1979 to February 1982.

GAGE.--Water-stage recorder. Datum of gage is 1,099.12 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Nov. 10, 1939, nonrecording gage at site 100 ft upstream at same datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Since 1968, undetermined amounts of water diverted for the flooding of wild rice paddies upstream.

AVERAGE DISCHARGE.--47 years (water years 1940-79, 1983-89), 175 ft^3/s, 126,800 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,940 ft^3/s, Apr. 25, 1979, gage height, 12.31 ft; maximum gage height, 12.37 ft, Apr. 18, 1979 (backwater from ice); minimum discharge, 2.5 ft^3/s, May 16, 17, 1977, gage height, 1.71 ft.

EXTREMES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 500 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Apr. 9	Unknown	1,000	*a9.36	Apr. 15	--	*1,200	a9.34

Minimum daily, 15 ft^3/s, Nov. 28; minimum gage height, 2.18 ft, Nov. 17.

(a) Backwater from ice.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	93	67	e27	e80	e55	e47	e20	230	227	110	97	97
2	85	35	e29	e80	e54	e47	e20	204	212	94	136	114
3	72	29	e30	e79	e54	e47	e60	137	200	88	130	98
4	61	32	e31	e79	e53	e47	e80	135	174	85	112	90
5	57	51	e31	e78	e52	e49	e200	147	156	82	117	91
6	52	47	e32	e78	e51	e50	e400	141	143	122	125	83
7	46	40	e31	e78	e50	e50	e700	133	133	151	121	76
8	41	42	e30	e77	e50	e50	e950	146	123	152	100	69
9	38	53	e21	e76	e49	e51	e950	161	115	145	90	65
10	38	48	e22	e75	e49	e51	e880	157	117	129	75	61
11	34	37	e24	e74	e48	e51	e720	122	112	113	53	61
12	35	37	e25	e73	e48	e51	e650	128	108	112	45	59
13	32	58	e26	e72	e48	e52	e650	126	100	108	39	63
14	31	45	e29	e70	e47	e52	e700	109	104	102	34	59
15	23	26	e33	e69	e47	e54	e1100	99	117	102	33	52
16	31	21	e38	e67	e47	e54	e1000	86	96	96	28	47
17	42	e30	e41	e66	e47	e45	e930	68	66	81	26	44
18	45	e50	e44	e65	e47	e35	e600	76	75	84	26	40
19	43	e60	e47	e65	e47	e45	554	74	79	92	24	38
20	35	e52	e50	e64	e47	e45	522	119	73	87	20	40
21	31	e36	e53	e64	e47	e46	448	136	73	93	21	43
22	39	e35	e56	e63	e47	e46	471	121	92	84	24	49
23	48	e35	e60	e63	e47	e46	492	95	133	83	32	70
24	55	e35	e63	e62	e47	e46	471	98	184	90	66	77
25	58	e30	e66	e61	e47	e46	374	141	144	78	56	67
26	45	e25	e69	e60	e47	e48	349	228	170	78	51	61
27	68	e20	e72	e60	e47	e51	328	252	201	86	39	55
28	47	e15	e76	e59	e47	e54	275	236	170	80	42	48
29	51	e20	e78	e58	---	e56	257	217	138	80	46	42
30	64	e25	e79	e57	---	e57	257	223	119	97	65	35
31	63	---	e79	e56	---	e35	---	237	---	94	74	---
TOTAL	1503	1136	1392	2128	1366	1504	15408	4582	3954	3078	1947	1894
MEAN	48.5	37.9	44.9	68.6	48.8	48.5	514	148	132	99.3	62.8	63.1
MAX	93	67	79	80	55	57	1100	252	227	152	136	114
MIN	23	15	21	56	47	35	20	68	66	78	20	35
AC-FT	2980	2250	2760	4220	2710	2980	30560	9090	7840	6110	3860	3760
CFSM	.09	.07	.09	.13	.10	.09	1.00	.29	.26	.19	.12	.12
IN.	.11	.08	.10	.15	.10	.11	1.12	.33	.29	.22	.14	.14

CAL YR 1988 TOTAL 28280 MEAN 77.3 MAX 880 MIN 15 AC-FT 56090 CFSM .15 IN. 2.05
WTR YR 1989 TOTAL 39892 MEAN 109 MAX 1100 MIN 15 AC-FT 79130 CFSM .21 IN. 2.90

e Estimated

RED RIVER OF THE NORTH BASIN

05078230 LOST RIVER AT OKLEE, MN

LOCATION.--Lat 47°50'35", long 95°51'30", in SE¼NE¼ sec.2, T.150 N., R.41 W., Red Lake County, Hydrologic Unit 09020305, on downstream side of bridge on State Highway 222 at northwest edge of Oklee, 12 mi upstream from mouth.

DRAINAGE AREA.--266 mi^2.

PERIOD OF RECORD.--April 1960 to September 1981, February 1982 to current year. Monthly and daily figures for April 1960, to June 1960, published in WSP 2113.

GAGE.--Water-stage recorder. Datum of gage is 1,126.94 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Sept. 9, 1960, reference points at same site at datum 8.00 ft higher. Sept. 9, 1960, to Sept. 30, 1964, nonrecording gage at same site at datum 8.00 ft higher. Oct. 1, 1964, to Sept. 30, 1981, and Feb. 24, 1982, to Sept. 6, 1989, nonrecording gage at same site and datum.

REMARKS.--Records poor.

AVERAGE DISCHARGE.--28 years, 72.7 ft^3/s, 52,670 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,210 ft^3/s, Apr. 11, 1969, gage height, 14.91 ft, from floodmark; maximum gage height, 16.72 ft, present datum, May 24, 1962; no flow Feb. 16 to Mar. 21, 1963, Feb. 15 to Mar. 2, 1964, Jan. 6 to Mar. 11, 1977.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known since at least 1897, 18.39 ft, present datum, Apr. 21, 1950, from floodmarks, discharge, 2,790 ft^3/s.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 940 ft^3/s, Apr. 6, gage height, 13.57 ft (backwater from ice); minimum daily, 0.85 ft^3/s, Aug. 15-18.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.5	6.6	e7.4	e9.5	e8.0	e8.0	e150	121	84	69	6.8	6.8
2	3.9	6.8	e7.5	e9.5	e8.0	e8.0	e200	111	72	46	4.7	9.2
3	4.3	7.2	e7.5	e9.5	e8.0	e8.0	e250	103	63	30	4.2	9.0
4	3.5	7.4	e7.5	e9.5	e8.0	e8.0	e350	93	54	30	3.0	8.5
5	2.8	7.8	e7.6	e9.5	e8.0	e8.0	e700	94	38	23	2.2	7.2
6	1.9	6.0	e7.8	e9.5	e8.0	e8.0	e900	86	27	139	1.9	5.8
7	2.0	7.2	e7.9	e9.5	e8.0	e8.0	e825	87	22	106	1.6	5.4
8	2.6	9.5	e8.0	e9.5	e8.0	e8.0	e750	87	21	91	1.3	6.0
9	3.7	9.0	e8.1	e9.0	e8.0	e8.0	e650	88	21	67	1.0	4.2
10	3.0	8.7	e8.3	e9.0	e8.0	e8.0	e550	78	20	46	1.2	3.0
11	2.4	8.5	e8.4	e9.0	e8.0	e8.0	e500	70	18	35	1.2	3.0
12	2.0	8.5	e8.5	e9.0	e8.0	e8.0	e450	58	17	30	1.2	3.2
13	1.9	9.2	e8.6	e9.0	e8.0	e8.0	e370	35	16	26	1.1	3.3
14	2.4	12	e8.8	e9.0	e8.0	e8.0	e370	27	15	23	.95	3.2
15	2.1	12	e8.9	e9.0	e8.0	e8.0	e380	19	15	22	.85	3.3
16	2.2	11	e9.0	e8.5	e8.0	e8.0	e400	16	14	29	.85	3.0
17	2.1	9.5	e9.0	e8.5	e8.0	e8.0	e380	18	12	19	.85	3.3
18	4.5	9.5	e9.2	e8.5	e8.0	e8.0	e350	19	11	24	.85	4.5
19	4.5	9.5	e9.2	e8.5	e8.0	e8.0	326	22	13	24	.95	8.7
20	4.0	e9.0	e9.3	e8.5	e8.0	e8.0	308	24	14	23	1.1	9.2
21	4.0	e8.8	e9.4	e8.0	e8.0	e8.2	282	22	22	23	1.0	8.5
22	5.1	e8.6	e9.4	e8.0	e8.0	e8.5	250	19	117	19	1.2	9.0
23	5.2	e8.3	e9.5	e8.0	e8.0	e9.0	231	17	130	18	1.4	8.0
24	5.2	e8.0	e9.5	e8.0	e8.0	e9.5	210	40	108	13	1.6	7.6
25	6.0	e7.8	e9.5	e8.0	e8.0	e10	190	93	96	9.5	1.6	10
26	5.8	e7.6	e9.5	e8.0	e8.0	e12	172	117	240	10	3.2	15
27	5.6	e7.4	e9.5	e8.0	e8.0	e13	159	118	188	11	3.7	11
28	5.1	e7.4	e9.5	e8.0	e8.0	e15	149	104	133	11	4.0	8.2
29	5.6	e7.3	e9.5	e8.0	---	e25	140	99	109	9.5	3.0	7.0
30	6.2	e7.4	e9.5	e8.0	---	e63	129	99	89	8.7	2.9	5.4
31	6.6	---	e9.5	e8.0	---	e90	---	89	---	9.5	4.3	---
TOTAL	119.7	253.5	270.8	269.5	224.0	423.2	11071	2073	1799	1044.2	65.70	199.5
MEAN	3.86	8.45	8.74	8.69	8.00	13.7	369	66.9	60.0	33.7	2.12	6.65
MAX	6.6	12	9.5	9.5	8.0	90	900	121	240	139	6.8	15
MIN	1.9	6.0	7.4	8.0	8.0	8.0	129	16	11	8.7	.85	3.0
AC-FT	237	503	537	535	444	839	21960	4110	3570	2070	130	396
CFSM	.01	.03	.03	.03	.03	.05	1.39	.25	.23	.13	.01	.02
IN.	.02	.04	.04	.04	.03	.06	1.55	.29	.25	.15	.01	.03

CAL YR 1988 TOTAL 10754.68 MEAN 29.4 MAX 600 MIN .20 AC-FT 21330 CFSM .11 IN. 1.50
WTR YR 1989 TOTAL 17813.10 MEAN 48.8 MAX 900 MIN .85 AC-FT 35330 CFSM .18 IN. 2.49

e Estimated

RED RIVER OF THE NORTH BASIN

05078500 CLEARWATER RIVER AT RED LAKE FALLS, MN

LOCATION.--Lat 47°53'15", long 96°16'25", in NW¼NE¼ sec.22, T.151 N., R.44 W., Red Lake County, Hydrologic Unit 09020305, on left bank 40 ft downstream from Great Northern Railroad bridge in Red Lake Falls, 1.4 mi upstream from mouth, and 3 mi downstream from Badger Creek.

DRAINAGE AREA.--1,370 mi^2, approximately.

PERIOD OF RECORD.--June 1909 to September 1917, October 1934 to September 1981, March 1982 to current year. Monthly discharge only for October, November, 1934, published in WSP 1308. October 1981 to February 1982, operated as a high-flow partial-record station.

REVISED RECORDS.--WSP 355: 1911-12. WSP 1438: 1910-11, 1917(M). WDR MN-84-1:1983.

GAGE.--Water-stage recorder. Datum of gage is 949.49 ft, adjustment of 1912 (levels by U.S. Army Corps of Engineers). Prior to Sept. 12, 1911, nonrecording gage at site 0.5 mi upstream, and Sept. 12, 1911, to Sept. 30, 1917, nonrecording gage at site 40 ft upstream at different datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--62 years (1910-17, 1935-81, 1983-89), 317 ft^3/s, 229,700 acre-ft/yr; median of yearly mean discharges, 280 ft^3/s, 203,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 10,300 ft^3/s, Apr. 25, 1979, gage height, 12.38 ft; maximum gage height, 15.85 ft, Mar. 6, 1983, from high-water mark (backwater from ice); no flow Sept. 15, 1936, Sept. 14, 1939, Aug. 19-22, 1940.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,550 ft^3/s, Apr. 7, gage height, 7.62 ft (backwater from ice); maximum gage height, 9.38 ft, Apr. 5 (backwater from ice); minimum discharge, 22 ft^3/s, Nov. 17, gage height, 1.64 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	104	82	e45	e100	e80	e75	e200	547	467	265	115	94
2	109	94	e50	e100	e80	e75	e300	505	430	240	116	115
3	100	69	e55	e100	e80	e75	e500	445	393	211	155	136
4	88	54	e60	e100	e75	e75	e1000	371	359	187	143	118
5	77	54	e60	e100	e75	e75	e1500	375	319	174	125	108
6	71	59	e60	e95	e75	e75	e2300	361	290	288	129	107
7	69	81	e60	e95	e75	e75	e2400	344	265	329	136	98
8	66	60	e60	e95	e75	e75	e2200	338	242	287	131	88
9	58	67	e60	e95	e75	e75	e2000	351	224	265	112	81
10	51	74	e45	e90	e75	e75	e1900	357	207	228	100	77
11	49	69	e40	e90	e75	e76	e1700	322	206	201	91	77
12	46	72	e50	e90	e75	e76	e1600	280	194	181	79	76
13	46	54	e55	e90	e75	e76	e1550	280	188	175	76	72
14	45	63	e60	e90	e73	e76	e1700	260	186	166	60	73
15	44	66	e65	e90	e73	e76	e1800	225	194	157	47	71
16	38	44	e70	e85	e73	e76	e2200	205	204	154	43	65
17	33	32	e70	e85	e73	e76	e2000	190	170	147	40	61
18	43	e40	e75	e85	e73	e76	e1800	221	144	132	33	56
19	55	e45	e75	e85	e73	e76	1450	215	149	134	33	48
20	57	e55	e80	e85	e73	e76	1370	224	144	139	31	45
21	53	e60	e80	e85	e73	e76	1250	267	197	134	31	48
22	41	e60	e85	e85	e73	e77	1170	256	201	137	36	52
23	57	e60	e90	e80	e73	e78	1150	232	183	125	33	55
24	65	e65	e90	e80	e73	e79	1060	227	282	119	30	70
25	71	e65	e95	e80	e73	e80	929	318	306	123	59	79
26	76	e65	e95	e80	e73	e83	811	437	280	107	74	73
27	68	e60	e100	e80	e73	e86	753	552	434	102	66	69
28	65	e50	e100	e80	e73	e90	679	532	429	109	64	71
29	53	e40	e100	e80	---	e95	601	487	349	108	53	66
30	63	e35	e100	e80	---	e120	592	460	292	104	57	61
31	86	---	e100	e80	---	e150	---	470	---	118	82	---
TOTAL	1947	1794	2230	2735	2085	2524	40465	10654	7928	5346	2380	2310
MEAN	62.8	59.8	71.9	88.2	74.5	81.4	1349	344	264	172	76.8	77.0
MAX	109	94	100	100	80	150	2400	552	467	329	155	136
MIN	33	32	40	80	73	75	200	190	144	102	30	45
AC-FT	3860	3560	4420	5420	4140	5010	80260	21130	15730	10600	4720	4580
CFSM	.05	.04	.05	.06	.05	.06	.98	.25	.19	.13	.06	.06
IN.	.05	.05	.06	.07	.06	.07	1.10	.29	.22	.15	.06	.06

CAL YR 1988 TOTAL 57721 MEAN 158 MAX 1920 MIN 23 AC-FT 114500 CFSM .12 IN. 1.57
WTR YR 1989 TOTAL 82398 MEAN 226 MAX 2400 MIN 30 AC-FT 163400 CFSM .16 IN. 2.24

e Estimated

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN

LOCATION.--Lat 47°46'32", long 96°36'33", in SW¼SW¼ sec.30, T.150 N., R.46 W., Polk County, Hydrologic Unit 09020303, on right bank 100 ft upstream from Sargent Street bridge in Crookston, 0.3 mi downstream from Interstate Power Co.'s dam, 0.6 mi downstream from bridge on U.S. Highway 75, and 53 mi upstream from mouth.

DRAINAGE AREA.--5,280 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--May 1901 to current year. Monthly discharge only for some periods, published in WSP 1308. Figures of daily discharge for Apr. 3-30, 1904, published in WSP 130, have been found unreliable and should not be used.

REVISED RECORDS.--WSP 1115: 1906, 1915-16, 1919-20, 1922, 1925, 1927, 1929. WSP 1308: 1916(M), 1919(M), 1928(M), 1930(M). See also PERIOD OF RECORD.

GAGE.--Water-stage recorder. Datum of gage is 832.72 ft above National Geodetic Vertical Datum of 1929. May 18, 1901, to June 30, 1909, nonrecording gage at bridge 300 ft upstream at same datum. July 1, 1909, to Sept. 25, 1911, nonrecording gage, Sept. 26, 1911, to Sept. 30, 1919, water-stage recorder, Oct. 1, 1919, to Sept. 30, 1930, nonrecording gage, at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Diurnal fluctuation prior to 1975 caused by powerplant 1,000 ft upstream. Runoff from 1,950 mi^2 in the headwaters of Red Lake River is completely controlled by dam at outlet of Lower Red Lake. Flow partially affected by occasional regulation at Thief and Mud Lakes in Thief River basin (see station 05076000).

AVERAGE DISCHARGE.--88 years, 1,135 ft^3/s, 822,300 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 28,400 ft^3/s, Apr. 12, 1969, gage height, 27.33 ft; no flow for part of July 13, 1960 (caused by regulation of powerplant upstream).

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 8,800 ft^3/s, Apr. 17, gage height, 16.11 ft (backwater from ice); maximum gage height, 18.10 ft, Apr. 7, from highwater mark (backwater from ice); minimum discharge, 54 ft^3/s, Nov. 17, gage height, 2.46 ft, result of freeze up.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	169	142	e80	e195	e160	e145	e230	1680	865	555	199	211
2	158	142	e85	e195	e160	e145	e270	1650	821	519	194	189
3	161	185	e90	e195	e160	e145	e300	1340	734	470	189	223
4	152	157	e95	e195	e160	e145	e600	839	677	433	210	259
5	139	153	e100	e195	e160	e145	e1000	634	599	402	193	232
6	154	142	e110	e195	e155	e145	e3000	600	565	394	192	208
7	147	139	e120	e190	e155	e145	e5000	600	515	531	218	192
8	144	152	e120	e190	e155	e145	e6000	600	451	537	217	161
9	141	125	e120	e190	e155	e145	e5500	603	410	481	218	164
10	137	151	e120	e190	e155	e145	e5000	621	381	471	190	170
11	127	123	e120	e190	e155	e145	e4700	683	347	419	172	147
12	132	172	e100	e190	e150	e145	e4400	736	342	387	162	147
13	104	149	e105	e185	e150	e145	e4100	700	346	350	156	151
14	122	125	e120	e185	e150	e145	e4000	787	348	347	172	145
15	117	139	e125	e185	e150	e145	e6000	679	348	340	159	146
16	121	97	e130	e185	e150	e145	e8000	671	417	333	141	159
17	132	72	e135	e180	e150	e145	e8650	635	497	312	130	130
18	134	120	e140	e180	e150	e145	e6000	762	391	298	99	120
19	120	122	e145	e180	e150	e145	5280	1100	277	280	136	119
20	142	120	e155	e180	e150	e145	4350	1160	272	276	105	116
21	139	109	e160	e175	e150	e150	3870	1120	287	259	146	120
22	148	123	e165	e175	e150	e150	3150	993	421	239	159	118
23	151	e130	e170	e175	e150	e155	2770	737	582	230	116	123
24	141	e130	e175	e170	e150	e155	2570	648	815	214	114	120
25	160	e130	e180	e170	e150	e155	2250	659	856	202	126	123
26	157	e125	e185	e170	e145	e160	2030	867	706	203	106	156
27	152	e115	e190	e165	e145	e160	1920	1000	674	188	168	163
28	121	e100	e195	e165	e145	e170	1840	1180	796	187	204	130
29	102	e80	e195	e165	---	e180	1820	1070	751	198	220	120
30	103	e80	e195	e160	---	e190	1790	943	633	203	181	120
31	147	---	e195	e160	---	e210	---	884	---	199	187	---
TOTAL	4274	3849	4320	5620	4265	4735	106390	27181	16124	10458	5179	4682
MEAN	138	128	139	181	152	153	3546	877	537	337	167	156
MAX	169	185	195	195	160	210	8650	1680	865	555	220	259
MIN	102	72	80	160	145	145	230	600	272	187	99	116
AC-FT	8480	7630	8570	11150	8460	9390	211000	53910	31980	20740	10270	9290
CFSM	.03	.02	.03	.03	.03	.03	.67	.17	.10	.06	.03	.03
IN.	.03	.03	.03	.04	.03	.03	.75	.19	.11	.07	.04	.03

CAL YR 1988 TOTAL 108747 MEAN 297 MAX 4780 MIN 72 AC-FT 215700 CFSM .06 IN. .77
WTR YR 1989 TOTAL 197077 MEAN 540 MAX 8650 MIN 72 AC-FT 390900 CFSM .10 IN. 1.39

e Estimated

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1962, 1974-76, 1979 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT												
17...	1545	127	460	441	8.3	8.2	11.5	6.5	780	13.0	53	75
NOV												
29...	1420	80	445	482	8.0	8.3	0.5	3.1	768	13.2	K3	43
FEB												
14...	1530	163	640	506	7.6	7.7	0.0	3.9	777	9.4	K8	26
MAY												
09...	1500	601	478	487	8.4	8.4	14.5	5.0	778	10.0	K7	K19
JUN												
20...	1330	229	460	479	8.4	8.3	24.0	9.4	764	8.4	140	200
SEP												
12...	0930	149	450	528	8.6	8.4	13.0	4.6	770	9.4	100	230

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
OCT												
17...	53	24	10	3.7	177	198	0	216	35	8.1	0.1	5.6
NOV												
29...	57	25	8.6	3.4	220	231	0	270	28	5.0	0.1	12
FEB												
14...	64	26	9.0	3.6	240	249	0	293	23	5.6	0.2	22
MAY												
09...	61	25	7.2	4.3	173	203	5	201	59	5.3	0.2	5.3
JUN												
20...	57	23	7.7	3.1	188	194	6	217	55	6.7	0.1	6.4
SEP												
12...	64	28	8.9	4.4	192	203	10	215	78	6.8	0.2	4.9

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
17...	269	<0.01	<0.10	0.04	0.02	0.6	0.03	0.03	0.01	24	97
NOV											
29...	280	<.01	<.10	.02	.02	0.7	.02	.01	<.01	32	92
FEB											
14...	319	<.01	.20	.26	.24	1.1	.05	.03	.02	57	91
MAY											
09...	300	<.01	<.10	.04	.04	1.7	.03	.02	<.01	17	88
JUN											
20...	319	<.01	<.10	.04	.02	0.8	.04	.03	.02	23	95
SEP											
12...	349	.01	<.10	.03	.03	1.0	.05	.03	.02	11	97

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
17...	1545	<10	2	51	<0.5	<1	<1	<3	3	19	<5
FEB											
14...	1530	<10	1	75	<.5	<1	<1	<3	3	14	<5
MAY											
09...	1500	<10	2	58	<.5	2	<1	<3	3	21	1
SEP											
12...	0930	10	4	62	<.5	<1	10	<3	3	8	<1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
17...	14	7	<0.1	<10	3	<1	<1.0	130	<6	16
FEB										
14...	21	35	<.1	<10	3	<1	<1.0	150	<6	14
MAY										
09...	15	13	<.1	<10	2	1	<1.0	150	<6	18
SEP										
12...	16	13	<.1	<10	2	<1	<1.0	180	<6	7

RED RIVER OF THE NORTH BASIN

05082500 RED RIVER OF THE NORTH AT GRAND FORKS, ND

LOCATION.--Lat 47°55'38", long 97°01'34", in sec.2, T.151 N., R.50 W., Grand Forks County, Hydrologic Unit 09020301, on the right bank, 200 ft upstream from the DeMers Avenue bridge, .4 mi downstream from Red Lake River, and at mile 293.8.

DRAINAGE AREA.--30,100 mi^2, approximately, including 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1882 to current year. Prior to January 1904 monthly discharge only, published in WSP 1308.

REVISED RECORDS.--WSP 855: 1936(M). WSP 1115: 1942. WSP 1175: 1897(M). WSP 1388: 1904, 1914-15, 1917-19, 1921-22, 1927, 1950. WSP 1728: Drainage area. WRD-ND-81-1: 1882, 1897 (M).

GAGE.--Water-stage recorder. Datum of gage is 779.00 ft above National Geodetic Vertical Datum of 1929. Oct. 1, 1983, to Sept. 30, 1986, datum of gage was 780.00 ft at same site. Apr. 14, 1965, to Sept. 30, 1983, water-stage recorder 1.9 mi downstream at a datum of 778.35 ft. Nov. 3, 1933, to Apr. 13, 1965, water-stage recorder 0.3 mi upstream at 778.35 ft datum. See WSP 1728 or 1913 for history of changes prior to Nov. 3, 1933.

REMARKS.--Estimated daily discharges: Nov. 20 to Mar. 22 and Apr. 3-30. Records good except those for periods of estimated daily discharge, which are fair.

AVERAGE DISCHARGE.--85 years (water year 1905-89), 2,601 ft^3/s, 1,884,000 acre-ft/yr; median of yearly mean discharge, 2,320 ft^3/s, 1,683,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, about 85,000 ft^3/s, Apr. 10, 1897, gage height, 50.2 ft, site and datum then in use, from rating curve extended above 54,000 ft^3/s; minimum, 1.8 ft^3/s, Sept. 2, 1977, caused by unusual regulation during repair of dam at Grand Forks.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 39,600 ft^3/s, Apr. 13, gage height, 43.21 ft, occurred on the recession following the peak gage height of 44.37 ft on Apr. 12; minimum daily, 208 ft^3/s, Dec. 14-15.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	431	366	e316	e278	e332	e360	2450	5310	2890	1750	488	614
2	409	381	e308	e281	e341	e335	3650	5100	2840	1570	484	2020
3	359	367	e299	e282	e350	e344	e5600	4880	2930	1440	457	3080
4	355	373	e300	e281	e355	e352	e9900	4360	3090	1310	453	2630
5	340	374	e299	e280	e360	e361	e16000	3850	3100	1170	435	2160
6	332	389	e290	e276	e360	e370	e22000	3640	2940	1070	445	1900
7	313	390	e294	e271	e352	e379	e26600	3470	2720	1040	434	1640
8	313	396	e293	e266	e356	e388	e30100	3320	2530	1050	429	1310
9	300	391	e277	e262	e360	e397	e33000	3220	2350	1120	442	1050
10	279	386	e258	e262	e364	e406	e35100	3130	2190	1040	447	922
11	285	375	e242	e262	e368	e396	e37000	3060	2060	948	440	844
12	274	375	e225	e260	e372	e406	e37900	3000	1890	876	423	761
13	263	379	e212	e260	e376	e416	e39500	2990	1740	870	392	680
14	256	387	e208	e259	e381	e427	e39300	2950	1670	843	390	619
15	251	377	e208	e262	e376	e435	e37700	2920	1630	825	405	575
16	252	314	e216	e265	e370	e442	e37000	2820	1580	783	482	520
17	261	237	e225	e271	e372	e450	e36100	2710	1570	748	471	527
18	260	221	e228	e275	e374	e458	e34800	2710	1670	705	384	521
19	275	255	e234	e270	e376	e466	e32200	2780	1650	686	372	492
20	281	e268	e235	e281	e378	e474	e28400	3030	1460	664	331	462
21	282	e281	e235	e278	e380	e483	e23500	3160	1420	624	329	443
22	313	e294	e242	e279	e370	e491	e18700	3090	1360	610	347	417
23	301	e304	e253	e269	e362	499	e14600	2990	1410	590	437	453
24	330	e321	e252	e267	e360	507	e11900	2860	1560	580	517	441
25	340	e334	e264	e284	e225	507	e9900	2780	1870	568	494	462
26	356	e347	e269	e291	e360	544	e8200	2970	1970	540	507	493
27	344	e360	e270	e298	e340	592	e7000	3230	1820	545	450	496
28	368	e345	e270	e303	e350	678	e6250	3300	1790	556	460	544
29	322	e333	e272	e312	---	846	e5800	3320	1850	551	473	623
30	310	e322	e274	e319	---	1050	e5400	3200	1860	527	531	637
31	331	---	e276	e323	---	1470	---	3030	---	524	601	---
TOTAL	9686	10242	8044	8627	10020	15729	655550	103180	61410	26723	13750	28336
MEAN	312	341	259	278	358	507	21850	3328	2047	862	444	945
MAX	431	396	316	323	381	1470	39500	5310	3100	1750	601	3080
MIN	251	221	208	259	225	335	2450	2710	1360	524	329	417
AC-FT	19210	20320	15960	17110	19870	31200	1300000	204700	121800	53010	27270	56200

CAL YR 1988 TOTAL 361115 MEAN 987 MAX 8400 MIN 168 AC-FT 716300
WTR YR 1989 TOTAL 951297 MEAN 2606 MAX 39500 MIN 208 AC-FT 1887000

e - Estimated

RED RIVER OF THE NORTH BASIN

05082500 RED RIVER OF THE NORTH AT GRAND FORKS, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1949, 1956 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
20...	1140	278	665	--	6.0	9.5	--	--	--	--	--	--
DEC												
28...	1315	270	900	--	-15.0	0.0	--	--	--	--	--	--
JAN												
26...	1400	298	760	--	-7.0	0.0	--	--	--	--	--	--
FEB												
23...	1455	364	765	--	-14.0	0.0	--	--	--	--	--	--
MAR												
27...	1455	618	910	--	0.0	0.0	--	--	--	--	--	--
APR												
14...	1235	39300	298	7.20	4.0	3.0	120	30	11	11	16	0.5
16...	1720	36900	--	--	-3.5	2.0	--	--	--	--	--	--
24...	1525	11700	--	--	14.0	11.5	--	--	--	--	--	--
27...	1900	6780	505	--	10.0	8.0	--	--	--	--	--	--
MAY												
03...	1240	4870	535	--	18.0	13.0	--	--	--	--	--	--
08...	1225	3280	545	--	15.0	12.0	--	--	--	--	--	--
16...	1345	2800	610	--	25.0	18.0	--	--	--	--	--	--
26...	1305	2970	600	--	15.0	17.0	--	--	--	--	--	--
JUN												
26...	1250	2030	600	--	23.0	23.0	--	--	--	--	--	--
JUL												
28...	1545	558	600	--	24.0	26.0	--	--	--	--	--	--
AUG												
28...	1650	499	620	--	22.5	23.0	--	--	--	--	--	--
SEP												
28...	1145	508	670	--	18.0	15.5	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR												
14...	6.6	120	0	95	12	33	5.3	0.10	11	158	165	0.21

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
14...	16800	2	30	220	2	20	50	0.1	1	1	140

RED RIVER OF THE NORTH BASIN

05087500 MIDDLE RIVER AT ARGYLE, MN

LOCATION.--Lat 48°20'25", long 96°48'58", in NE¼NW¼ sec.15, T.156 N., R.48 W., Marshall County, Hydrologic Unit 09020309, on left bank 30 ft upstream of bridge on County Highway 4 in Argyle and 14 mi upstream from mouth.

DRAINAGE AREA.--265 mi^2.

PERIOD OF RECORD.--March to September 1945, October 1950 to September 1981, February 1982 to current year. Monthly discharge only for some periods, published in WSP 1728. October 1981 to January 1982, operated as a high-flow partial-record station.

GAGE.--Water-stage recorder. Datum of gage is 828.53 ft above National Geodetic Vertical Datum of 1929. Prior to Nov. 8, 1951, nonrecording gage and Nov. 8, 1951, to Sept. 18, 1952, water-stage recorder at site 800 ft downstream at datum 1.0 ft higher. Sept. 19, 1952, to June 28, 1982, recording gage at site 800 feet downstream at present datum. June 29, 1982, to Sept. 20, 1983, nonrecording gage at present site and datum.

REMARKS.--Records fair except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--38 years (water years 1951-81, 1983-89), 40.1 ft^3/s, 29,050 acre-ft/yr; median of yearly mean discharges, 31 ft^3/s, 22,500 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,260 ft^3/s, July 3, 1975, gage height, 16.59 ft present datum, site then in use; no flow at times in most years.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of April 1950 reached a stage of 15.25 ft present datum, site then in use, from floodmarks, discharge, 2,790 ft^3/s.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,550 ft^3/s, April 18, gage height, 15.25 ft^3/s, from highwater mark (backwater from ice); no flow Oct. 1 to Dec. 6, Aug. 27, 30 and Sept 1, 2, 6-30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.00	e.00	e.02	e.01	e.02	e.05	66	32	16	.21	.00
2	.00	.00	e.00	e.01	e.01	e.02	e.06	55	26	12	.21	.00
3	.00	.00	e.00	e.01	e.01	e.02	e.07	51	22	9.3	.23	.02
4	.00	.00	e.00	e.01	e.01	e.02	e.10	46	19	7.2	.21	.03
5	.00	.00	e.00	e.01	e.01	e.02	e.20	33	16	6.0	.19	.01
6	.00	.00	e.00	e.01	e.01	e.02	e.30	29	13	5.1	.18	.00
7	.00	.00	e.02	e.01	e.01	e.02	e.50	27	12	4.1	.16	.00
8	.00	.00	e.02	e.01	e.01	e.02	e1.0	23	10	3.6	.14	.00
9	.00	.00	e.02	e.01	e.01	e.02	e3.0	23	10	3.2	.11	.00
10	.00	.00	e.02	e.01	e.01	e.02	e5.0	20	7.1	2.6	.08	.00
11	.00	.00	.02	e.01	e.01	e.02	e15	17	6.0	e2.4	.07	.00
12	.00	.00	.03	e.01	e.01	e.02	e30	19	6.0	e2.2	.07	.00
13	.00	.00	.04	e.01	e.01	e.02	e80	21	5.5	e2.1	.08	.00
14	.00	.00	e.03	e.01	e.01	e.02	e150	20	5.0	e1.9	.07	.00
15	.00	.00	e.03	e.01	e.01	e.02	e300	19	5.1	e1.8	.05	.00
16	.00	.00	e.03	e.01	e.01	e.02	e500	17	4.6	e1.6	.03	.00
17	.00	.00	e.03	e.01	e.02	e.02	e900	16	4.1	e1.5	.01	.00
18	.00	.00	e.03	e.01	e.02	e.02	e1400	17	3.8	e1.4	.01	.00
19	.00	.00	e.03	e.01	e.02	e.02	847	17	3.4	1.3	.15	.00
20	.00	.00	e.03	e.01	e.02	e.02	516	17	3.0	1.2	.10	.00
21	.00	e.00	e.02	e.01	e.02	e.02	419	14	3.4	1.0	.08	.00
22	.00	e.00	e.02	e.01	e.02	e.02	380	13	3.6	.90	.08	.00
23	.00	e.00	e.02	e.01	e.02	e.02	e300	18	6.6	.69	.05	.00
24	.00	e.00	e.02	e.01	e.02	e.02	257	26	130	.60	.03	.00
25	.00	e.00	e.02	e.01	e.02	e.02	215	28	167	.45	.01	.00
26	.00	e.00	e.02	e.01	e.02	e.02	175	27	139	.32	.01	.00
27	.00	e.00	e.02	e.01	e.02	e.02	147	30	89	.25	.00	.00
28	.00	e.00	e.02	e.01	e.02	e.03	118	44	44	.22	.02	.00
29	.00	e.00	e.02	e.01	---	e.03	95	46	27	.21	.01	.00
30	.00	e.00	e.02	e.01	---	e.03	78	44	21	.20	.00	.00
31	.00	---	e.02	e.01	---	e.04	---	38	---	.21	.01	---
TOTAL	0.00	0.00	0.60	0.32	0.40	0.67	6932.28	881	844.2	91.55	2.66	0.06
MEAN	.00	.00	.019	.010	.014	.022	231	28.4	28.1	2.95	.086	.002
MAX	.00	.00	.04	.02	.02	.04	1400	66	167	16	.23	.03
MIN	.00	.00	.00	.01	.01	.02	.05	13	3.0	.20	.00	.00
AC-FT	.0	.0	1.2	.6	.8	1.3	13750	1750	1670	182	5.3	.1
CFSM	.00	.00	.00	.00	.00	.00	.87	.11	.11	.01	.00	.00
IN.	.00	.00	.00	.00	.00	.00	.97	.12	.12	.01	.00	.00

CAL YR 1988 TOTAL 2940.38 MEAN 8.03 MAX 308 MIN .00 AC-FT 5830 CFSM .03 IN. .41
WTR YR 1989 TOTAL 8753.74 MEAN 24.0 MAX 1400 MIN .00 AC-FT 17360 CFSM .09 IN. 1.23

e Estimated

RED RIVER OF THE NORTH BASIN

05092000 RED RIVER OF THE NORTH AT DRAYTON, ND

LOCATION.--Lat 48°34'20", long 97°08'50", in SE¼SE¼SE¼ sec.24, T.159 N., R.51 W., Pembina County, Hydrologic Unit 09020311, on downstream end of east pier of interstate highway bridge, 1.5 mi northeast of Drayton, and at mile 206.7.

DRAINAGE AREA.--34,800 mi^2, approximately, includes 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April 1936 to June 1937, April 1941 to current year (fragmentary prior to April 1949).

REVISED RECORDS.--WSP 1388: 1949-50. WSP 1728: Drainage area.

GAGE.--Water-stage recorder and concrete control. Datum of gage is 755.00 ft above National Geodetic Vertical Datum of 1929 (Minnesota highway benchmark). Prior to Nov. 30, 1954, nonrecording gage at site 1.5 mi upstream at datum 1.59 ft higher.

REMARKS.--Estimated daily discharges: Nov. 18 to Dec. 12, 15-17, 27 to June 8, and Aug. 18 to Sept. 2. Records good. Some regulation by reservoirs on tributaries.

AVERAGE DISCHARGE.--40 years (water years 1950-89), 3,817 ft^3/s, 2,765,000 acre-ft/yr; median of yearly mean discharges, 3,360 ft^3/s, 2,430,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 92,900 ft^3/s, Apr. 28, 1979, gage height, 43.66 ft; minimum observed, 7.7 ft^3/s, Oct. 16, 1936, gage height, 1.75 ft, former site and datum.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of April 1897 reached a stage of about 41 ft, at site and datum in use prior to Nov. 30, 1954.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 41,800 ft^3/s, Apr. 19, gage height, 39.35 ft; maximum gage height, 39.70 ft, Apr. 21; minimum daily discharge, 225 ft^3/s, Dec. 16 and 17.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	676	368	e325	e270	e320	e315	e715	e13800	e3280	2030	615	e500
2	613	352	e322	e269	e315	e315	e920	e11800	e3150	2010	605	e550
3	578	318	e320	e267	e310	e315	e1670	e10300	e2980	1930	596	763
4	553	355	e315	e265	e320	e315	e3530	e9100	e2830	1790	587	2080
5	524	359	e310	e262	e330	e320	e6730	e8000	e2780	1650	564	2910
6	481	369	e305	e258	e345	e330	e10300	e6800	e2860	1540	533	2840
7	445	376	e300	e258	e353	e340	e13300	e5300	e3010	1450	514	2580
8	413	376	e295	e244	e350	e360	e15800	e4400	e3000	1370	499	2270
9	376	379	e290	e244	e350	e370	e17800	e4300	2780	1340	492	2000
10	325	389	e280	e240	e350	e380	e19800	e3680	2620	1320	487	1730
11	308	414	e270	e240	e360	e390	e22900	e3490	2480	1340	479	1490
12	303	418	e260	e240	e360	e370	e26200	e3380	2370	1320	475	1320
13	289	406	266	e250	e360	e375	e27200	e3280	2270	1270	470	1180
14	269	393	259	e260	e360	e380	e29600	e3190	2160	1090	455	1040
15	257	361	e230	e255	e360	e380	e33400	e3120	2030	1040	442	845
16	245	316	e225	e255	e365	e385	e38400	e3070	1940	994	431	704
17	239	265	e225	e260	e380	e400	e40300	e3060	1880	972	420	646
18	244	e260	252	e260	e380	e400	e41400	e3010	1850	951	e410	618
19	251	e260	229	e260	e380	e425	e41800	e2900	1840	918	e400	609
20	256	e260	227	e260	e380	e450	e41700	e2780	1860	908	e390	572
21	258	e260	230	e279	e380	e460	e40000	e2770	1820	897	e380	510
22	258	e265	234	e293	e380	e475	e39900	e2830	1740	876	e370	425
23	258	e280	249	e290	e385	e520	e34600	e3080	1680	845	e360	467
24	258	e300	252	e288	e390	e525	e32000	e3200	1660	814	e357	409
25	258	e320	276	e286	e385	e530	e28700	e3120	1680	773	e340	376
26	258	e315	270	e283	e370	e535	e26400	e3010	1870	763	e350	408
27	258	e312	e285	e280	e340	e540	e24100	e2870	2070	704	e400	384
28	321	e310	e280	e286	e320	e540	e21800	e2780	2140	685	e400	376
29	350	e310	e280	e293	---	e540	e19400	e2960	2090	665	e375	416
30	356	e300	e270	e315	---	e570	e16700	e3210	2030	628	e350	433
31	371	---	e270	e345	---	e620	---	e3270	---	623	e450	---
TOTAL	10849	9966	8401	8355	9978	13170	717065	141860	68750	35506	13996	31451
MEAN	350	332	271	270	356	425	23900	4576	2292	1145	451	1048
MAX	676	418	325	345	390	620	41800	13800	3280	2030	615	2910
MIN	239	260	225	240	310	315	715	2770	1660	623	340	376
AC-FT	21520	19770	16660	16570	19790	26120	1422000	281400	136400	70430	27760	62380

CAL YR 1988 TOTAL 422676 MEAN 1155 MAX 13800 MIN 144 AC-FT 838400
WTR YR 1989 TOTAL 1069347 MEAN 2930 MAX 41800 MIN 225 AC-FT 2121000

e - Estimated

RED RIVER OF THE NORTH BASIN

05092000 RED RIVER OF THE NORTH AT DRAYTON, ND--CONTINUED

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972 to current year.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	PH (STAND-ARD UNITS) (00400)	TEMPER-ATURE AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM AD-SORP-TION RATIO (00931)
OCT												
24...	1545	260	1000	--	0.0	5.5	--	--	--	--	--	--
DEC												
30...	1210	270	670	--	-11.0	0.0	--	--	--	--	--	--
JAN												
06...	1400	261	1410	--	-6.0	0.0	--	--	--	--	--	--
20...	1410	257	1000	--	-10.5	0.0	--	--	--	--	--	--
27...	1400	280	860	--	-3.0	0.0	--	--	--	--	--	--
FEB												
06...	1420	349	785	--	-12.5	0.0	--	--	--	--	--	--
24...	1435	389	--	--	2.5	0.0	--	--	--	--	--	--
MAR												
03...	1440	317	--	--	--	0.0	--	--	--	--	--	--
10...	1345	379	--	--	2.5	0.0	--	--	--	--	--	--
20...	1540	450	--	--	-7.0	0.0	--	--	--	--	--	--
28...	1540	540	--	--	2.0	0.0	--	--	--	--	--	--
APR												
16...	1230	38500	275	--	11.5	1.5	--	--	--	--	--	--
18...	1225	41300	300	7.70	4.0	4.0	120	30	12	9.0	13	0.4
20...	1315	41400	540	--	12.0	5.0	--	--	--	--	--	--
25...	1325	28700	610	--	9.0	9.5	--	--	--	--	--	--
MAY												
01...	1140	13900	870	--	10.0	10.0	--	--	--	--	--	--
05...	1215	8050	900	--	4.0	11.5	--	--	--	--	--	--
16...	1305	3070	782	--	31.0	21.0	--	--	--	--	--	--
JUN												
09...	1200	2780	735	--	21.5	19.0	--	--	--	--	--	--
JUL												
07...	1345	1430	760	8.70	25.0	26.5	290	65	32	40	22	1
AUG												
24...	1320	351	650	--	28.5	26.0	--	--	--	--	--	--

DATE	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE, FET-LAB (MG/L AS HCO3) (95440)	CAR-BONATE, FET-LAB (MG/L AS CO3) (95445)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CARBON DIOXIDE DIS-SOLVED (MG/L AS CO2) (00405)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR												
18...	5.8	120	0	95	3.7	40	5.8	0.20	11	179	171	0.24
JUL												
07...	10	290	0	240	0.9	91	50	0.20	14	449	448	0.61

DATE	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BORON, DIS-SOLVED (UG/L AS B) (01020)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
APR											
18...	20000	3	40	90	1	10	30	<0.1	1	1	150
JUL											
07...	1730	5	100	30	1	40	10	0.2	4	<10	330

RED RIVER OF THE NORTH BASIN

05094000 SOUTH BRANCH TWO RIVERS AT LAKE BRONSON, MN

LOCATION.--Lat 48°43'50", long 96°39'50", in SW¼SW¼ sec.30, T.161 N., R.46 W., Kittson County, Hydrologic Unit 09020312, on left bank 70 ft upstream from culvert on U.S. Highway 59 at city of Lake Bronson and 3.4 mi downstream from dam at outlet of Bronson Lake.

DRAINAGE AREA.--444 mi^2.

PERIOD OF RECORD.--September 1928 to November 1936, April to September 1937, April 1941 to October 1943, April to December 1944, April 1945 to September 1947, October 1953 to September 1981, April 1985 to current year. Monthly discharge only for some periods, published in WSP 1308. October 1981 to March 1985, annual maximums only. Published as South Fork Two Rivers at Bronson prior to 1941.

REVISED RECORDS.--WSP 1308: 1929(M), 1931(M), 1936(M), 1944(M), 1947(M).

GAGE.--Water-stage recorder. Datum of gage is 928.53 ft above National Geodetic Vertical Datum of 1929 (Minnesota Department of Transportation bench mark). Prior to Nov. 23, 1953, nonrecording gage at bridge 100 ft downstream at datum 2.00 ft higher. Nov 23, 1953, to Oct. 5, 1963, water-stage recorder at same site at datum 2.00 ft higher.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Flow partly regulated since 1937 by Bronson Lake, usable capacity, 3,700 acre-ft.

AVERAGE DISCHARGE.--44 years (water years 1929-36, 1942, 1943, 1946, 1947, 1954-81, 1986-89), 86.1 ft^3/s, 62,380 acre-ft/yr; median of yearly mean discharges, 53 ft^3/s, 38,400 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,410 ft^3/s, Apr. 5, 1966, gage height, 18.23 ft; no flow at times in 1937, 1941, 1960, 1973.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,100 ft^3/s, Apr. 19, gage height, 10.78 ft; minimum daily, 0.10 ft^3/s, Mar. 12-14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.2	.48	.52	e.47	e.23	e.13	e5.0	124	21	93	1.7	1.4
2	.94	.45	.52	e.46	e.23	e.12	e4.0	128	19	25	1.6	1.6
3	1.0	.45	.59	e.45	e.22	e.12	e3.3	44	17	78	2.7	2.3
4	1.2	.44	.59	e.44	e.22	e.12	e3.0	76	15	81	2.1	2.0
5	1.5	.42	.66	e.43	e.21	e.12	e5.0	77	14	16	1.8	1.7
6	1.5	.39	.66	e.42	e.21	e.11	e4.0	55	13	23	2.0	1.6
7	1.5	.44	.59	e.41	e.20	e.11	e3.2	41	17	24	2.1	1.5
8	1.4	.45	.59	e.40	e.20	e.11	e3.0	43	13	22	2.0	1.6
9	1.6	.45	e.58	e.39	e.20	e.11	e3.0	42	11	21	2.0	1.5
10	1.5	.41	e.58	e.38	e.20	e.11	e3.0	42	9.9	17	1.7	1.6
11	1.5	.39	e.58	e.37	e.19	e.11	e3.0	40	9.1	15	5.8	2.1
12	24	.45	e.57	e.36	e.19	e.10	e3.0	25	11	14	2.6	1.8
13	3.0	.47	e.57	e.35	e.19	e.10	e3.0	10	13	12	1.7	1.5
14	.47	.49	e.57	e.35	e.18	e.10	e3.0	13	14	11	1.4	1.6
15	.23	.62	e.56	e.34	e.18	e.11	e3.0	14	16	9.7	1.5	1.4
16	.18	.68	e.56	e.33	e.17	e1.1	e50	15	18	9.4	1.5	1.2
17	.16	.59	e.55	e.32	e.17	e3.0	e400	16	18	8.7	1.4	1.3
18	.16	.52	e.55	e.31	e.16	e5.0	1040	18	18	8.4	4.6	1.1
19	.19	.52	e.54	e.30	e.16	e4.4	1860	19	15	8.6	4.6	.89
20	.29	.52	e.54	e.30	e.15	e3.8	1800	21	14	8.6	1.8	.68
21	.30	.52	e.53	e.29	e.15	e3.3	1390	18	14	7.7	1.7	.50
22	.35	.52	e.53	e.28	e.15	e2.8	1270	18	32	2.7	27	.17
23	.45	.52	e.52	e.28	e.14	e2.5	1160	18	396	2.4	6.3	.17
24	.46	.52	e.52	e.27	e.14	e2.2	1030	22	219	2.2	1.4	.21
25	.39	.53	e.51	e.27	e.14	e2.0	739	27	237	2.2	1.2	.16
26	.51	.58	e.50	e.26	e.13	e1.8	411	24	180	2.1	1.5	.20
27	.61	.59	e.50	e.26	e.13	e1.6	264	23	215	2.0	1.3	.25
28	.53	.59	e.49	e.25	e.13	e1.5	282	25	182	2.1	1.3	.30
29	.48	.58	e.49	e.25	---	e5.0	267	26	139	2.3	1.4	.37
30	.45	.52	e.49	e.24	---	e2.5	202	25	131	2.1	1.6	.38
31	.50	---	e.48	e.24	---	e2.0	---	23	---	2.2	1.5	---
TOTAL	48.55	15.10	17.03	10.47	4.97	46.18	12216.5	1112	2041.0	535.4	92.8	33.08
MEAN	1.57	.50	.55	.34	.18	1.49	407	35.9	68.0	17.3	2.99	1.10
MAX	24	.68	.66	.47	.23	5.0	1860	128	396	93	27	2.3
MIN	.16	.39	.48	.24	.13	.10	3.0	10	9.1	2.0	1.2	.16
AC-FT	96	30	34	21	9.9	92	24230	2210	4050	1060	184	66
CFSM	.00	.00	.00	.00	.00	.00	.92	.08	.15	.04	.01	.00
IN.	.00	.00	.00	.00	.00	.00	1.02	.09	.17	.04	.01	.00

CAL YR 1988 TOTAL 13194.57 MEAN 36.1 MAX 1130 MIN .02 AC-FT 26170 CFSM .08 IN. 1.11
WTR YR 1989 TOTAL 16173.08 MEAN 44.3 MAX 1860 MIN .10 AC-FT 32080 CFSM .10 IN. 1.36

e Estimated

RED RIVER OF THE NORTH BASIN

05102500 RED RIVER OF THE NORTH AT EMERSON, MAN
(National stream-quality accounting network station)
(International gaging station)

LOCATION.--Lat 49°00'30", long 97°12'40", in sec.2, T.1, R.2 E., on right bank 1,500 ft downstream from Canadian National Railway bridge in Emerson, 0.8 mi downstream from international boundary, 3.6 mi downstream from Pembina River, and at mile 154.3.

DRAINAGE AREA.--40,200 mi^2, approximately, includes 3,800 mi^2 in closed basins.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--March to November 1902 (gage heights only), May 1912 to September 1929 (monthly discharge only, published in WSP 1308), October 1929 to current year.

GAGE.--Water-stage recorder. Datum of gage is 700.00 ft above National Geodetic Vertical Datum of 1929, by Survey of Canada. See WSP 1728 or 1913 for history of changes prior to Apr. 10, 1953.

REMARKS.--Estimated daily discharges: Oct. 27 to Nov. 2 and Nov. 14 to Apr. 20. Discharge partially regulated by reservoirs on tributaries.

COOPERATION.--This station is one of the international gaging stations maintained by Canada under agreement with the United States. Records provided by Water Survey of Canada.

AVERAGE DISCHARGE.--77 years (water years 1913-89), 3,380 ft^3/s, 2,445,000 acre-ft/yr; median of yearly mean discharges, 2,890 ft^3/s, 2,090,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 95,500 ft^3/s, May 13, 1950, gage height, 90.89 ft; maximum gage height, 91.19 ft, May 1, 1979; minimum observed discharge, 0.9 ft^3/s, Feb. 6-8, 1937.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 42,700 ft^3/s, Apr. 23, gage height, 72.86 ft; minimum daily, 177 ft^3/s, Nov. 16.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	706	e348	e313	e242	e284	e349	e576	26600	3850	2300	498	445
2	632	e349	e315	e244	e287	e330	e607	23700	3780	2240	498	459
3	597	318	e327	e247	e290	e313	e674	20800	3640	2180	519	508
4	572	288	e328	e249	e297	e309	e893	17100	3520	2060	498	639
5	547	286	e323	e252	e304	e304	e1780	13500	3430	1910	470	1660
6	523	299	e317	e252	e311	e304	e3500	10300	3430	1780	445	2680
7	477	307	e313	e255	e321	e303	e5330	7910	3500	1650	431	2650
8	431	319	e303	e257	e335	e307	e6810	6250	3470	1510	434	2470
9	381	323	e295	e261	e351	e311	e8440	5260	3360	1390	434	2260
10	339	323	e286	e256	e360	e325	e9890	4770	3180	1300	434	2030
11	289	313	e271	e253	e371	e334	e11200	4340	2980	1250	427	1810
12	265	339	e263	e255	e378	e339	e12600	4170	2880	1230	427	1580
13	257	352	e262	e260	e388	e346	e13900	4100	2780	1200	424	1370
14	251	e318	e262	e269	e392	e357	e15400	3950	2670	1130	413	1200
15	244	e239	e256	e269	e395	e367	e18000	3850	2500	1050	399	1070
16	237	e177	e245	e266	e406	e378	e21200	3780	2360	1000	399	964
17	228	e212	e227	e264	e410	e385	e24900	3670	2250	957	392	862
18	224	e247	e212	e263	e417	e392	e29500	3600	2160	897	395	798
19	231	e302	e212	e263	e431	e403	e34600	3510	2100	851	470	724
20	237	e331	e212	e263	e445	e413	e37800	3430	2070	816	512	650
21	245	e357	e210	e263	e463	e434	40600	3350	2050	777	537	600
22	237	e364	e209	e262	e470	e448	41700	3360	2020	734	498	547
23	242	e350	e213	e263	e463	e459	42400	3450	1970	689	424	487
24	240	e325	e216	e267	e456	e466	42400	3530	1900	643	371	456
25	241	e316	e219	e273	e431	e480	41300	3530	1890	604	328	445
26	244	e313	e215	e276	e413	e494	39900	3520	1970	576	306	406
27	e250	e322	e211	e279	e395	e505	38500	3510	2080	544	306	392
28	e240	e321	e215	e281	e371	e516	36400	3510	2240	519	353	399
29	e250	e321	e228	e281	---	e526	33500	3600	2360	508	417	388
30	e275	e319	e234	e282	---	e544	30000	3710	2360	498	448	392
31	e323	---	e242	e282	---	e561	---	3810	---	494	452	---
TOTAL	10455	9298	7954	8149	10635	12302	644300	213470	80750	35287	13359	31341
MEAN	337	310	257	263	380	397	21480	6886	2692	1138	431	1045
MAX	706	364	328	282	470	561	42400	26600	3850	2300	537	2680
MIN	224	177	209	242	284	303	576	3350	1890	494	306	388
AC-FT	20740	18440	15780	16160	21090	24400	1278000	423400	160200	69990	26500	62160

CAL YR 1988 TOTAL 436278 MEAN 1192 MAX 15700 MIN 177 AC-FT 865400
WTR YR 1989 TOTAL 1077300 MEAN 2952 MAX 42400 MIN 177 AC-FT 2137000

e - Estimated

RED RIVER OF THE NORTH BASIN

05102500 RED RIVER AT EMERSON, MANITOBA--CONTINUED
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1978 to current year.

PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: October 1977 to current year.
WATER TEMPERATURE: October 1977 to current year.

REMARKS.--Records of daily mean values of water temperature and specific conductance are furnished by Water Survey of Canada.

EXTREMES FOR PERIOD OF DAILY RECORD.--
SPECIFIC CONDUCTANCE: Maximum daily mean, 1,480 microsiemens, Nov. 12, 1987; minimum daily mean, 330 microsiemens, Apr. 10, 16 and 17, 1978.

WATER TEMPERATURES: Maximum daily mean, 26.7°C, Aug. 16, 1988; minimum daily mean, 0.0°C, on many days during winter months.

EXTREMES FOR CURRENT YEAR.--
SPECIFIC CONDUCTANCE: Maximum daily mean, 2,180 microsiemens, Dec. 8; minimum daily mean, 259 microsiemens, Apr. 14.

WATER TEMPERATURES: Maximum daily mean, 26.4°C, July 22; minimum daily mean, 0.0°C, Mar. 17 and 19.

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DISCHARGE, INST. CUBIC FEET PER SECOND (00061)	SPECIFIC CONDUCTANCE (US/CM) (00095)	PH (STANDARD UNITS) (00400)	TEMPERATURE AIR (DEG C) (00020)	TEMPERATURE WATER (DEG C) (00010)	TURBIDITY (NTU) (00076)	OXYGEN, DISSOLVED (MG/L) (00300)	OXYGEN, DISSOLVED (PERCENT SATURATION) (00301)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML) (31625)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT											
04...	1115	--	690	8.70	4.5	9.0	80	9.3	80	7	110
NOV											
08...	1050	--	1260	8.90	1.5	3.5	12	12.2	92	0	60
MAR											
09...	1130	315	815	8.10	6.0	0.0	3.7	9.8	67	960	64
MAY											
17...	1040	3000	780	8.50	20.0	19.5	5.3	8.3	89	10	80
JUL											
06...	1300	--	710	8.50	24.0	27.0	120	5.4	68	16	8
SEP											
01...	1115	454	965	8.50	20.5	19.5	58	9.0	101	35	15

DATE	HARDNESS TOTAL (MG/L AS CACO3) (00900)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	SODIUM PERCENT (00932)	SODIUM ADSORPTION RATIO (00931)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY WAT WH TOT IT FIELD MG/L AS CACO3 (00419)	BICARBONATE WATER WH IT FIELD MG/L AS HCO3 (00450)	CARBONATE WATER WH IT FIELD MG/L AS CO3 (00447)	SULFATE DISSOLVED (MG/L AS SO4) (00945)
OCT											
04...	270	54	33	38	23	1	7.0	264	308	7	88
NOV											
08...	350	69	43	120	42	3	12	229	240	19	140
MAR											
09...	350	76	38	36	18	0.9	7.2	--	381	0	83
MAY											
17...	300	70	31	37	21	1	4.5	206	232	10	120
JUL											
06...	280	61	30	33	20	0.9	7.2	226	242	17	100
SEP											
01...	290	63	32	81	37	2	7.2	196	210	14	110

RED RIVER OF THE NORTH BASIN

05102500 RED RIVER AT EMERSON, MANITOBA--CONTINUED
(National stream-quality accounting network station)

WATER-QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L) (70301)	SOLIDS, DISSOLVED (TONS PER AC-FT) (70303)	SOLIDS, DISSOLVED (TONS PER DAY) (70302)	NITROGEN, NITRATE DISSOLVED (MG/L AS N) (00618)	NITROGEN, NITRITE DISSOLVED (MG/L AS N) (00613)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)
OCT 04...	33	0.30	9.3	396	421	0.54	0.0	--	<0.010	<0.100
NOV 08...	170	0.40	6.2	733	699	1.0	0.0	--	<0.010	<0.100
MAR 09...	22	0.30	21	485	475	0.66	412	0.900	0.010	0.910
MAY 17...	35	0.20	7.2	437	429	0.59	3540	--	<0.010	<0.100
JUL 06...	34	0.20	9.6	379	413	0.52	0.0	0.380	0.020	0.400
SEP 01...	110	0.30	14	558	535	0.76	684	--	<0.010	0.120

DATE	NITROGEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOSPHOROUS TOTAL (MG/L AS P) (00665)	PHOSPHOROUS DISSOLVED (MG/L AS P) (00666)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P) (00671)	PHOSPHOROUS ORGANIC TOTAL (MG/L AS P) (00670)	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)
OCT 04...	0.030	0.010	0.90	0.160	0.090	0.040	0.16	20	5	53
NOV 08...	0.040	0.040	1.3	0.400	0.310	0.240	0.40	--	--	--
MAR 09...	0.170	0.160	1.2	0.140	0.140	0.150	0.14	<10	2	71
MAY 17...	0.050	0.050	1.6	0.110	0.080	0.040	0.11	40	3	61
JUL 06...	0.060	0.110	0.80	0.090	0.090	0.100	0.09	--	--	--
SEP 01...	0.070	0.080	1.1	0.150	0.080	0.070	0.15	60	5	62

DATE	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)
OCT 04...	<0.5	<1	2	<3	4	21	<5	35	7	0.1
MAR 09...	<0.5	<1	2	<3	5	18	<5	34	31	0.2
MAY 17...	<0.5	<1	1	<3	7	50	1	32	8	<0.1
SEP 01...	<0.5	<1	1	<3	5	79	<1	46	11	<0.1

DATE	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT 04...	<10	<1	<1	<1.0	230	<6	7	148	229	98
NOV 08...	--	--	--	--	--	--	--	22	19	99
MAR 09...	<10	8	<1	<1.0	270	<6	24	25	22	83
MAY 17...	<10	5	<1	<1.0	270	<6	10	150	1220	100
JUL 06...	--	--	--	--	--	--	--	276	735	99
SEP 01...	10	3	<1	<1.0	310	<6	23	153	188	98

RED RIVER OF THE NORTH BASIN

05102500 RED RIVER AT EMERSON, MANITOBA--CONTINUED
(National stream-quality accounting network station)

SPECIFIC CONDUCTANCE, US/CM @ 25 DEGREES CENTIGRADE, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	714	891	934	1650	727	693	851	480	735	743	748	965
2	732	942	1060	1670	723	697	960	504	738	720	752	1060
3	735	912	1350	1700	718	702	1050	546	747	703	748	1200
4	707	893	1570	1770	708	706	932	600	775	685	756	1180
5	681	1100	1850	1800	702	704	830	635	771	703	768	961
6	631	1160	2030	1760	697	703	745	671	769	707	775	882
7	643	1190	2160	1770	694	700	597	689	756	705	777	616
8	627	1060	2180	1760	694	697	417	733	758	722	785	616
9	641	1020	2120	1710	691	696	334	749	754	736	798	639
10	648	1040	2050	1660	692	694	307	730	768	735	801	392
11	656	989	1970	1580	692	680	297	725	774	729	800	381
12	618	1020	1880	1490	695	680	266	705	765	721	810	366
13	573	1030	1770	1360	695	678	262	682	768	741	817	381
14	638	1200	1750	1300	695	669	259	680	764	756	835	399
15	699	1200	1750	1300	697	691	280	673	774	766	865	413
16	702	1110	1710	1300	692	722	263	654	767	776	941	435
17	708	957	1670	1310	696	726	265	669	784	778	966	455
18	742	916	1660	1320	691	729	271	709	824	747	959	461
19	767	922	1690	1290	685	734	288	718	829	734	884	464
20	768	980	1740	1240	653	750	298	722	836	739	839	483
21	779	1170	1770	1200	647	753	306	775	837	747	832	492
22	813	1170	1760	1140	662	755	315	745	847	757	815	513
23	809	954	1720	1080	699	758	328	769	843	764	851	545
24	822	972	1660	1020	702	762	336	754	857	763	849	553
25	899	943	1620	984	700	759	350	729	871	753	854	574
26	964	942	1600	950	698	750	372	705	808	740	845	594
27	990	901	1580	905	692	747	397	703	800	733	842	629
28	989	896	1570	869	707	758	427	733	813	737	851	703
29	938	933	1590	844	---	782	445	789	814	744	893	755
30	952	926	1620	812	---	809	464	781	768	740	943	786
31	922	---	1650	792	---	806	---	748	---	741	947	---
MEAN	758	1010	1710	1330	694	725	450	694	790	738	837	630

WATER TEMPERATURE, DEGREES CELSIUS, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	14.9	4.2	1.6	.4	.4	.1	.1	7.5	15.1	20.2	24.6	20.6
2	14.4	3.9	1.7	.4	.4	.2	.1	7.9	15.3	20.7	25.8	21.1
3	13.7	4.1	1.6	.5	.3	.3	.1	8.4	15.3	20.6	26.7	21.4
4	12.2	4.9	1.6	.5	.3	.3	.1	8.8	15.1	21.1	26.3	21.3
5	9.4	5.4	1.5	.4	.3	.3	.1	8.6	15.4	21.8	24.6	21.4
6	9.7	5.5	1.7	.4	.3	.2	.1	8.2	15.6	22.5	22.4	20.4
7	10.8	4.5	1.5	.4	.3	.1	.3	8.4	14.9	23.2	22.4	19.8
8	10.9	3.4	1.5	.4	.3	.1	.3	8.9	15.0	23.0	23.0	19.5
9	11.0	3.6	1.5	.4	.3	.2	.4	9.5	15.6	23.0	23.8	18.7
10	10.9	3.5	1.4	.3	.2	.2	1.1	10.5	16.1	23.0	24.4	17.8
11	10.3	2.5	1.4	.3	.3	.2	1.4	11.3	16.2	22.7	25.1	17.1
12	10.0	2.4	1.4	.3	.3	.3	.6	12.7	15.8	22.8	25.6	16.5
13	9.6	2.4	1.4	.3	.2	.3	.9	13.8	15.0	23.1	25.3	16.2
14	10.0	3.6	1.5	.3	.2	.2	.9	14.5	14.9	23.2	23.7	16.4
15	11.1	3.3	1.0	.3	.2	.1	.7	15.5	15.8	23.2	23.2	16.9
16	11.1	3.1	.6	.3	.1	.1	1.0	16.1	16.6	23.4	24.2	17.4
17	10.7	3.0	.7	.3	.1	.0	1.2	16.1	16.7	23.5	23.8	17.9
18	10.2	3.0	.5	.2	.2	.1	2.8	16.2	16.9	24.1	23.5	18.9
19	9.0	2.9	.6	.2	.2	.0	8.2	16.0	17.8	24.7	23.2	18.8
20	9.0	2.7	.5	.1	.2	.1	4.1	15.3	18.5	25.0	22.2	18.3
21	8.5	2.8	2.3	.2	.2	.1	4.6	15.1	18.1	25.9	21.4	17.5
22	7.5	2.9	.7	.1	.2	.1	6.3	15.3	17.8	26.4	21.9	16.1
23	7.5	2.8	.6	.1	.2	.1	7.0	15.6	18.6	25.9	22.9	14.4
24	6.6	2.9	.6	.2	.3	.1	7.1	15.8	18.6	25.6	23.7	13.9
25	5.4	1.6	.6	.2	.2	.2	7.0	15.2	18.8	25.7	23.6	14.2
26	4.5	1.7	.7	.2	.2	.2	7.2	14.2	18.8	25.9	23.3	13.9
27	4.5	1.7	.5	.1	.1	.2	7.1	14.1	18.2	25.0	23.0	14.3
28	5.0	1.7	.4	.2	.1	.2	7.0	14.4	18.4	24.0	22.5	15.2
29	5.1	1.8	.3	.1	---	.2	7.3	14.0	18.7	23.3	21.3	15.4
30	5.0	1.5	.3	.1	---	.3	7.3	14.2	19.1	23.5	20.3	15.9
31	4.6	---	.3	.1	---	.3	---	14.7	---	23.9	20.1	---
MEAN	9.1	3.1	1.0	.3	.2	.2	3.1	12.8	16.8	23.5	23.5	17.6

RED RIVER OF THE NORTH BASIN

05104500 ROSEAU RIVER BELOW SOUTH FORK NEAR MALUNG, MN

LOCATION.--Lat 48°47'30", long 95°44'40", in NW¼SW¼ sec.6, T.161 N., R.39 W., Roseau County, Hydrologic Unit 09020314, on left bank 0.3 mi downstream from South Fork and 1.5 mi northwest of Malung.

DRAINAGE AREA.--573 mi^2.

PERIOD OF RECORD.--October 1946 to current year.

REVISED RECORDS.--WSP 2113: 1948, 1950, 1951, 1956(M), 1957(M), 1962(M).

GAGE.--Water-stage recorder and concrete control. Datum of gage is 1,029.67 ft, adjustment of 1912.

REMARKS.--Records poor. Some flow bypasses the gaging station through a natural overflow channel 0.8 mi upstream and returns to river 0.5 mi downstream. Overflow begins at stage of about 13.0 ft, discharge, 1,800 ft^3/s. These records include any flow in the overflow channel.

AVERAGE DISCHARGE.--43 years, 139 ft^3/s, 100,700 acre-ft/yr; median of yearly mean discharges, 114 ft^3/s, 82,600 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,750 ft^3/s, July 18, 1968, gage height, 22.32 ft; maximum gage height, 23.37 ft, Apr. 3, 1966 (backwater from ice); no flow for part of Jan. 15, 1952 (caused by construction of concrete control), July 23 to Sept. 8, 1961, Dec. 22 to Mar. 10, 1977, Sept. 9-11, 1980, and Aug. 10 to Sept. 18, 1988.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,700 ft^3/s, Apr. 17, gage height, 17.63 ft, from highwater mark (backwater from ice); minimum, 0.05 ft^3/s, all or part of Sept. 29, 30; minimum gage height, 3.65 ft, Oct. 1.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.08	.27	e.38	.41	.72	.99	6.0	199	130	119	1.2	.32
2	.08	.27	e.38	.43	.66	.99	5.2	179	110	101	.94	.34
3	.09	.27	e.37	.43	.66	.99	14	159	94	90	1.2	.33
4	.09	.28	e.37	.43	.66	.99	45	145	81	84	1.3	.39
5	.10	.30	e.36	.44	.66	1.1	53	137	68	82	.83	.37
6	.11	.31	e.35	.46	.65	1.1	e100	122	58	77	1.0	.37
7	.12	.34	e.34	.48	.66	.99	e110	115	54	77	1.6	.55
8	.13	.36	e.33	.48	.70	1.1	e125	106	48	76	1.2	.52
9	.14	.38	e.32	.50	.71	1.1	e140	98	46	73	.78	.48
10	.16	.39	e.31	.49	.70	1.1	e155	90	43	66	.55	.34
11	.16	.38	.30	.51	.70	1.1	e185	85	39	61	.40	.32
12	.18	.39	.29	.51	.75	1.1	e215	78	39	57	.36	.39
13	.19	.42	.30	.51	.81	1.1	e245	69	42	53	.33	.45
14	.20	.40	.29	.52	.81	1.1	e300	62	56	48	.30	.73
15	.21	e.41	.28	.56	.87	1.3	e400	55	84	44	.29	.88
16	.22	e.42	.24	.58	.87	1.1	e900	51	117	38	.31	.92
17	.24	e.42	.25	.59	.87	.99	e1540	50	133	33	.27	.90
18	.24	e.42	.27	.60	.87	1.2	e1150	48	126	30	.22	.40
19	.25	e.42	.29	.63	.87	1.3	e750	61	107	26	.23	.34
20	.26	e.42	.30	.67	.81	.99	e600	79	91	23	.23	.32
21	.28	e.41	.31	.67	.81	.87	e520	87	102	18	.24	.30
22	.29	e.41	.33	.66	.87	.87	e480	97	199	16	.25	.26
23	.36	e.41	.34	.66	.87	.87	e450	97	307	13	.24	.20
24	.38	e.41	.36	.68	.81	.93	e420	90	312	12	.20	.18
25	.38	e.41	.37	.74	.87	.93	e400	109	267	7.8	.19	.17
26	.37	e.40	.39	.75	.87	1.1	e370	146	254	5.3	.28	.15
27	.38	e.40	.39	.75	.99	1.3	e330	190	235	3.6	.32	.14
28	.38	e.40	.40	.75	.99	1.4	e300	204	210	3.6	.34	.14
29	.35	e.39	.40	.75	---	3.6	263	193	176	2.3	.31	.07
30	.31	e.39	.39	.80	---	3.2	221	170	145	1.5	.28	.05
31	.29	---	.40	.81	---	4.8	---	149	---	1.2	.26	---
TOTAL	7.02	11.30	10.40	18.25	22.09	41.60	10792.2	3520	3773	1342.3	16.45	11.32
MEAN	.23	.38	.34	.59	.79	1.34	360	114	126	43.3	.53	.38
MAX	.38	.42	.40	.81	.99	4.8	1540	204	312	119	1.6	.92
MIN	.08	.27	.24	.41	.65	.87	5.2	48	39	1.2	.19	.05
AC-FT	14	22	21	36	44	83	21410	6980	7480	2660	33	22
CFSM	.00	.00	.00	.00	.00	.00	.63	.20	.22	.08	.00	.00
IN.	.00	.00	.00	.00	.00	.00	.70	.23	.24	.09	.00	.00

CAL YR 1988 TOTAL 4198.17 MEAN 11.5 MAX 600 MIN .00 AC-FT 8330 CFSM .02 IN. .27
WTR YR 1989 TOTAL 19565.93 MEAN 53.6 MAX 1540 MIN .05 AC-FT 38810 CFSM .09 IN. 1.27

e Estimated

RED RIVER OF THE NORTH BASIN

05106500 ROSEAU RIVER AT ROSEAU LAKE, MN

LOCATION.--Lat 48°54'22", long 95°49'55", in SW¼SW¼ sec.28, T.163 N., R.40 W., Roseau County, Hydrologic Unit 09020314, at downstream side of bridge on County Road 123 at Roseau Lake, 3.5 mi upstream from Pine Creek, 3.8 mi downstream from Sprague Creek, and 7 mi northwest of Roseau.

PERIOD OF RECORD.--November 1939 to current year (incomplete).

GAGE.--Water-stage recorder. Datum of gage is 1,018.59 ft, adjustment of 1928 (levels by Geodetic Survey of Canada); gage readings have been reduced to elevations, adjustment of 1928. Prior to Aug. 26, 1970, and Oct. 18, 1979 to Sept. 30, 1980, nonrecording gage at same site and datum.

EXTREMES FOR PERIOD OF RECORD.--Maximum elevation observed, 1,036.86 ft, May 13, 1950; minimum observed, 1,019.75 ft, Aug. 16, 1941.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in July 1919 reached an elevation of about 1,034 ft.

EXTREMES FOR CURRENT YEAR.--Maximum elevation recorded, 1,033.27 ft, Apr. 20; minimum observed, 1,021.25 ft, Oct. 31, but may have been lower during period of no gage-height record.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	23.34	29.79	24.93	27.54	---	---
2	---	---	---	---	---	---	23.41	29.53	24.48	27.39	---	---
3	---	---	---	---	---	---	23.48	29.26	24.06	27.55	---	---
4	---	---	---	---	---	---	23.49	28.99	23.69	27.60	---	---
5	---	---	---	---	---	---	23.71	28.71	23.36	27.58	---	---
6	---	---	---	---	---	---	24.48	28.38	23.15	27.56	---	---
7	---	---	---	---	---	---	25.61	28.07	23.20	27.43	---	---
8	---	---	---	---	---	---	25.99	27.75	23.54	27.17	---	---
9	---	---	---	---	---	---	25.99	27.41	23.62	26.87	---	---
10	---	---	---	---	---	---	26.00	27.06	23.44	26.54	---	---
11	---	---	---	---	---	---	26.00	26.66	23.15	26.18	---	---
12	---	---	---	---	---	---	25.94	26.22	23.09	25.82	---	---
13	---	---	---	---	---	---	25.81	25.81	23.77	25.54	---	---
14	---	---	---	---	---	21.94	26.14	25.37	---	25.17	---	---
15	---	---	---	---	---	---	---	24.88	---	24.59	---	---
16	---	---	---	---	---	---	---	24.26	25.54	24.06	---	---
17	---	---	---	---	---	---	---	23.76	25.30	23.62	---	---
18	---	---	---	---	---	---	32.37	23.66	24.95	23.17	---	---
19	---	---	---	---	---	---	32.89	23.76	24.54	22.81	---	---
20	---	---	---	---	---	---	---	23.96	24.13	22.58	---	---
21	---	---	---	---	---	---	31.66	24.01	25.92	22.42	---	---
22	---	---	---	---	---	---	31.47	23.91	27.76	---	---	---
23	---	---	---	---	---	---	31.38	23.81	28.22	---	---	---
24	---	---	---	---	---	---	31.26	23.74	28.29	---	---	---
25	---	---	---	---	---	---	31.13	24.64	28.18	---	---	---
26	---	---	---	---	---	22.97	30.94	25.84	28.02	---	---	---
27	---	---	---	---	---	22.99	30.74	26.12	27.92	---	---	---
28	---	---	---	---	---	23.02	30.52	26.11	27.73	---	---	---
29	---	---	---	---	---	23.04	30.28	25.97	27.45	---	21.55	---
30	---	---	---	---	---	23.10	30.04	25.72	27.49	---	---	---
31	21.25	---	---	---	---	23.20	---	25.36	---	---	---	---
MEAN	---	---	---	---	---	---	---	26.08	---	---	---	---
MAX	---	---	---	---	---	---	---	29.79	---	---	---	---
MIN	---	---	---	---	---	---	---	23.66	---	---	---	---

NOTE; Add 1,000 ft to obtain elevations in adjustment of 1928. Gage height below intake elevation of 1,022.23 ft (gage height, 22.23 ft) Oct. 1-31, July 22 to Sept. 30. No winter record.

RED RIVER OF THE NORTH BASIN

05107500 ROSEAU RIVER AT ROSS, MN

LOCATION.--Lat 48°54'37", long 95°55'18", in NE¼SE¼ sec.27, T.163 N., R.41 W., Roseau County, Hydrologic Unit 09020314, on left bank 300 ft downstream from highway bridge, 0.2 mi north of Ross, and 2.3 mi downstream from Pine Creek.

DRAINAGE AREA.--1,220 mi^2, approximately.

PERIOD OF RECORD.--July 1928 to current year.

REVISED RECORDS.--WSP 1055: 1945. WSP 1175: Drainage area. WSP 1308: 1936(M). WSP 1508: 1948-49(P).

GAGE.--Water-stage recorder. Datum of gage is 1,018.44 ft, adjustment of 1928 (levels by Geodetic Survey of Canada). Prior to Mar. 13, 1929, nonrecording gage at same site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are fair. High flow affected by natural storage in Roseau Lake.

AVERAGE DISCHARGE.--61 years, 261 ft^3/s, 189,100 acre-ft/yr; median of yearly mean discharges, 230 ft^3/s, 167,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 6,560 ft^3/s, May 12, 1950, gage height, 18.25 ft; no flow Aug. 29, 30, 1961, Jan. 3 to Mar. 3, 1977, Aug. 23-25, 1977 and Aug. 3, 1980.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known, about 19 ft in 1896. Other outstanding floods reached the following stages, from information by local residents: flood of July 1919, 17.5 ft; flood of 1927, about 16 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,560 ft^3/s, Apr. 27, gage height, 11.54 ft; maximum gage height, 12.36 ft, Apr. 21 (backwater from ice); minimum discharge, 1.0 ft^3/s, part or all of each day Dec. 20-24, Dec 26 to Jan 2, Jan 4-6.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.9	4.7	3.4	1.0	e1.8	e1.2	e17	1270	367	719	12	21
2	1.8	4.4	3.3	1.1	e1.8	e1.2	e23	1200	323	696	8.6	19
3	1.9	4.3	3.3	1.1	e1.8	e1.2	e30	1130	282	723	9.2	15
4	2.0	4.3	3.1	1.0	e1.8	e1.2	e40	1070	246	725	12	8.7
5	2.2	4.3	3.1	1.0	e1.8	e1.2	e50	994	215	717	29	9.5
6	2.2	4.1	3.1	1.1	e1.7	e1.2	e70	940	193	709	42	14
7	2.2	4.1	3.1	1.2	e1.7	e1.1	e85	877	194	685	40	19
8	2.3	3.9	3.0	1.4	e1.7	e1.1	e100	812	e190	644	32	12
9	2.5	3.7	2.9	1.4	e1.7	e1.1	e120	749	e190	592	25	7.2
10	2.7	3.5	2.7	1.5	e1.6	1.1	e150	687	e190	540	20	5.8
11	3.0	3.3	2.6	1.6	e1.6	1.1	e200	616	e195	491	18	5.4
12	3.3	3.4	2.4	1.4	e1.6	1.1	e250	546	e215	446	13	5.8
13	3.7	3.5	2.1	1.4	e1.6	1.1	e300	484	259	410	9.7	6.8
14	3.8	3.5	2.0	1.3	e1.6	1.3	e350	426	363	368	6.6	7.5
15	4.0	3.8	1.8	1.3	e1.5	e1.4	e450	369	424	313	5.4	8.8
16	3.8	3.9	1.8	1.4	e1.5	e1.5	e550	308	424	261	4.7	6.8
17	3.7	3.7	1.6	1.5	1.5	e1.6	e650	255	397	216	4.2	4.3
18	3.5	3.7	1.4	1.4	1.5	e1.7	e750	241	362	177	4.2	4.2
19	3.4	3.6	1.2	1.4	1.5	e1.8	e850	247	321	142	5.4	4.5
20	3.4	3.6	1.1	1.4	1.4	e1.9	e1000	267	282	118	20	5.3
21	3.4	e3.6	1.0	1.5	1.3	e2.1	e1100	272	499	100	64	4.9
22	3.6	e3.6	1.0	1.5	1.3	e2.3	e1200	264	769	76	71	4.1
23	3.5	e3.6	1.0	1.5	1.4	e2.6	e1300	254	851	60	65	4.0
24	3.5	e3.7	1.0	1.7	1.4	e2.9	e1400	246	862	49	58	4.4
25	3.5	e3.7	1.1	2.0	1.2	e3.3	e1470	326	844	41	50	4.2
26	4.2	e3.7	1.0	1.9	1.2	e3.8	e1550	458	818	35	41	4.9
27	4.4	e3.6	1.0	2.0	1.3	e4.8	1540	501	796	28	36	5.3
28	4.1	e3.6	1.0	1.9	1.2	e6.6	1470	502	762	23	34	5.1
29	4.2	e3.5	1.0	1.9	---	e8.2	1410	487	715	19	31	4.6
30	4.7	e3.5	1.0	1.9	---	e10	1330	455	716	16	28	4.1
31	5.5	---	1.0	1.9	---	e13	---	413	---	13	25	---
TOTAL	101.9	113.4	60.1	45.6	43.0	85.7	19805	17666	13264	10152	824.0	236.2
MEAN	3.29	3.78	1.94	1.47	1.54	2.76	660	570	442	327	26.6	7.87
MAX	5.5	4.7	3.4	2.0	1.8	13	1550	1270	862	725	71	21
MIN	1.8	3.3	1.0	1.0	1.2	1.1	17	241	190	13	4.2	4.0
AC-FT	202	225	119	90	85	170	39280	35040	26310	20140	1630	469
CFSM	.00	.00	.00	.00	.00	.00	.54	.47	.36	.27	.02	.01
IN.	.00	.00	.00	.00	.00	.00	.60	.54	.40	.31	.03	.01

CAL YR 1988 TOTAL 14691.89 MEAN 40.1 MAX 868 MIN .45 AC-FT 29140 CFSM .03 IN. .45
WTR YR 1989 TOTAL 62396.9 MEAN 171 MAX 1550 MIN 1.0 AC-FT 123800 CFSM .14 IN. 1.90

e Estimated

RED RIVER OF THE NORTH BASIN

05112000 ROSEAU RIVER BELOW STATE DITCH 51, NEAR CARIBOU, MN
(International gaging station)

LOCATION.--Lat 48°58'54", long 96°27'46", in SE¼SW¼ sec.34, T.164 N., R.45 W., Kittson County, Hydrologic Unit 09020314, on left bank 400 ft downstream from State ditch 51 (known locally as Caribou cutoff ditch) and 0.6 mi west of Caribou.

DRAINAGE AREA.--1,570 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--April to October 1917, April 1920 to current year (no winter records in water years 1931, 1932, 1934-36, 1938-40, 1944-72). Published as "at Caribou," prior to April 1929; as "below Cutoff ditch, near Caribou" April 1929 to September 1936. Records published for both sites April 1929 to September 1930. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 1308: 1938(M). WSP 1508: 1917(M), 1920, 1932(M), 1934-35(M). WSP 1913: 1954(M).

GAGE.--Water-stage recorder. Datum of gage is 1,002.14 ft, 1928 datum, (levels by Geodetic Survey of Canada). Prior to Apr. 1, 1929, nonrecording gage at site at Caribou 0.6 mi upstream at datum 0.95 ft lower.

REMARKS.--Records fair except those for estimated daily discharges, which are poor. Satellite telemeter at station. Occasionally, at high stages, there is some natural diversion of flow above station to headwaters of Two Rivers.

COOPERATION.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.

AVERAGE DISCHARGE.--32 years (water years 1921-30, 1933, 1937, 1941-43, 1973-89), 283 ft^3/s, 205,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,080 ft^3/s, May 19, 1950, gage height, 11.81 ft; no flow Aug. 13, 1936.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of 1916 is reported to have reached a stage of about 15.5 ft at former site.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,340 ft^3/s, part or all of each day May 2-4; maximum gage height, 8.51 ft, Apr. 20 (backwater from ice); minimum daily discharge, 0.92 ft^3/s, Mar. 13, 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	3.1	5.3	124	1.9	e1.6	e1.1	e7.0	1320	509	767	25	31
2	2.8	5.7	148	1.9	e1.6	e1.1	e9.0	1340	455	770	23	27
3	3.4	6.2	144	1.9	e1.6	e1.1	e11	1340	397	782	27	23
4	2.7	6.3	126	1.8	e1.6	e1.1	e14	1340	338	775	24	24
5	2.0	6.3	95	1.8	e1.5	e1.0	e17	1310	288	774	20	19
6	2.0	5.9	46	1.8	e1.5	e1.0	e21	1290	240	777	20	16
7	2.6	5.3	15	1.9	e1.5	e1.0	e30	1280	214	774	28	16
8	2.8	5.9	7.5	1.9	e1.5	e1.0	e40	1260	200	771	39	16
9	2.8	5.7	5.9	1.9	e1.5	e1.0	e50	1230	207	766	42	17
10	2.8	5.4	5.1	1.9	e1.4	e.95	e60	1180	219	751	38	16
11	2.7	5.3	4.4	1.9	e1.4	e.95	e75	1130	216	723	34	16
12	2.5	4.9	4.1	1.9	e1.4	e.95	e100	1060	218	685	31	17
13	2.4	5.1	4.1	1.9	e1.4	e.92	e150	987	249	631	e28	13
14	2.7	4.8	4.1	1.9	e1.4	e.92	e200	896	323	571	e23	9.5
15	3.3	4.6	3.7	1.9	e1.3	e.95	250	790	388	504	e21	8.1
16	4.0	4.9	3.2	1.9	e1.3	e1.0	e350	658	436	429	20	7.2
17	4.8	4.6	2.7	1.9	e1.3	e1.0	e450	526	452	352	19	6.2
18	4.6	4.4	2.4	1.9	e1.3	e1.1	e600	426	443	285	23	6.0
19	5.0	4.5	2.4	1.9	e1.3	e1.1	e850	357	408	231	33	5.1
20	5.1	e4.4	2.4	e1.9	e1.2	e1.2	e1000	339	362	181	24	4.7
21	5.1	e4.4	2.4	e1.9	e1.2	e1.3	e1070	331	364	141	19	6.2
22	4.6	e4.3	2.4	e1.8	e1.2	e1.4	1110	325	459	116	25	6.5
23	4.9	e4.2	2.4	e1.8	e1.2	e1.5	1130	310	603	92	55	5.9
24	5.1	e4.1	2.4	e1.8	e1.2	e1.6	1140	294	691	75	66	6.4
25	4.9	e4.1	2.4	e1.8	e1.2	e1.7	1170	318	732	62	62	6.3
26	4.6	e4.0	2.4	e1.7	e1.2	e1.8	1200	389	751	53	57	5.3
27	4.5	e4.0	2.4	e1.7	e1.1	e2.5	1220	484	760	45	51	6.0
28	5.1	e4.0	2.3	e1.7	e1.1	e3.0	1240	564	764	40	43	6.6
29	4.7	e4.0	2.2	e1.7	---	e3.5	1270	579	773	36	40	5.4
30	4.4	46	2.0	e1.7	---	e4.5	1300	568	777	32	35	5.1
31	4.7	---	1.9	e1.7	---	e5.5	---	542	---	28	34	---
TOTAL	116.7	188.6	775.2	57.0	38.0	48.74	16134.0	24763	13236	13019	1029	357.5
MEAN	3.76	6.29	25.0	1.84	1.36	1.57	538	799	441	420	33.2	11.9
MAX	5.1	46	148	1.9	1.6	5.5	1300	1340	777	782	66	31
MIN	2.0	4.0	1.9	1.7	1.1	.92	7.0	294	200	28	19	4.7
AC-FT	231	374	1540	113	75	97	32000	49120	26250	25820	2040	709
CFSM	.00	.00	.02	.00	.00	.00	.34	.51	.28	.27	.02	.01
IN.	.00	.00	.02	.00	.00	.00	.38	.59	.31	.31	.02	.01

CAL YR 1988 TOTAL 15877.27 MEAN 43.4 MAX 980 MIN .38 AC-FT 31490 CFSM .03 IN. .38
WTR YR 1989 TOTAL 69762.74 MEAN 191 MAX 1340 MIN .92 AC-FT 138400 CFSM .12 IN. 1.65

e Estimated

RED RIVER OF THE NORTH BASIN

05112000 ROSEAU RIVER BELOW STATE DITCH 51 NR CARIBOU, MN--Continued
(National stream-quality accounting network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1972 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT												
31...	1515	4.8	430	462	8.6	8.4	1.0	7.3	765	15.0	--	51
JAN												
31...	1045	1.7	--	874	7.9	7.4	0.5	15	758	1.0	K2	K4
APR												
25...	1230	1170	208	209	7.7	7.7	10.0	8.0	770	8.2	K6	32
AUG												
29...	1000	41	330	347	8.2	8.2	18.0	4.6	764	8.7	100	170

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
OCT												
31...	56	29	9.4	3.1	239	242	14	262	24	3.4	0.1	0.82
JAN												
31...	90	47	40	4.3	380	410	0	464	37	31	.2	16
APR												
25...	26	8.7	3.3	3.8	83	87	0	101	17	2.3	.1	8.7
AUG												
29...	45	19	6.6	1.9	177	178	0	216	<1.0	4.2	.1	17

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN,AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHOROUS TOTAL (MG/L AS P) (00665)	PHOS-PHOROUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHOROUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
31...	300	<0.01	<0.10	0.03	0.01	1.1	0.04	0.04	<0.01	13	94
JAN											
31...	508	<.01	<.10	1.30	1.30	2.1	.54	.02	.01	--	--
APR											
25...	145	.04	.62	.10	.09	0.8	.13	.11	.10	21	93
AUG											
29...	228	<.01	<.10	.04	.04	1.2	.06	.04	.04	16	77

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
31...	1515	20	2	41	<0.5	2	10	<3	3	38	<5
JAN											
31...	1045	<10	6	63	<.5	1	<1	<3	1	720	<5
APR											
25...	1230	20	1	30	<.5	<1	1	<3	3	71	<5
AUG											
29...	1000	20	2	34	<.5	<1	<1	<3	2	47	<1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
31...	13	9	<.1	<10	3	<1	1.0	130	<6	7
JAN										
31...	24	2400	<.1	<10	2	<1	<1.0	240	<6	9
APR										
25...	4	7	<.1	<10	2	<1	<1.0	51	<6	4
AUG										
29...	10	19	.1	<10	1	<1	<1.0	99	<6	8

LAKE OF THE WOODS BASIN

05124480 KAWISHIWI RIVER NEAR ELY, MN

(Hydrologic bench-mark station)

LOCATION.--Lat 47°55'22", long 91°32'06", in SE¼SE¼ sec.24, T.63 N., R.10 W., Lake County, Hydrologic Unit 09030001, in Superior National Forest, on left bank upstream from rapids, 2 mi upstream from South Kawishiwi River, 2.2 mi southwest of Fernberg Lookout Tower and 14 mi east of Ely.

DRAINAGE AREA.--253 mi^2.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--June 1966 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,450 ft above National Geodetic Vertical Datum of 1929, from topographic map.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--23 years, 214 ft^3/s, 11.49 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 1,720 ft^3/s, Apr. 24, 1976, gage height, 5.92 ft; minimum, 4.5 ft^3/s, Jan. 30 to Feb. 2, 1977, gage height, 2.14 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 1,080 ft^3/s, all or part of May 7-9, gage height, 5.35 ft; minimum, 45 ft^3/s, Sept. 30, gage height, 2.90 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	276	134	247	185	121	85	74	875	464	352	e115	63
2	262	131	250	184	119	83	73	926	449	348	e112	60
3	256	129	258	183	117	82	74	966	432	339	e109	58
4	248	129	260	182	114	80	77	1000	415	329	e106	74
5	236	129	260	179	112	80	80	1050	399	319	e103	83
6	227	130	260	174	111	79	82	1070	387	313	e100	80
7	220	129	260	173	110	77	84	1080	377	299	e98	78
8	212	129	260	173	110	77	90	1080	365	286	e96	75
9	207	129	260	169	108	77	94	1070	353	278	e94	72
10	199	133	259	165	106	76	94	1050	340	268	e92	68
11	189	134	254	161	105	75	94	1010	330	256	e90	67
12	180	134	254	164	105	75	94	968	335	243	e88	69
13	174	134	256	160	103	75	94	924	371	233	e86	66
14	170	134	256	157	103	74	96	878	391	e215	e83	64
15	166	134	251	154	101	72	100	836	405	e200	e80	62
16	163	156	247	149	98	71	109	796	418	e190	e77	60
17	160	170	243	149	96	69	126	753	424	e183	76	58
18	154	172	240	149	94	68	133	715	427	e177	72	57
19	148	178	237	149	93	68	144	683	423	e170	71	58
20	144	184	233	148	92	67	161	653	411	e163	73	59
21	142	189	229	146	91	66	183	618	396	e157	71	61
22	137	192	225	143	89	65	222	586	399	e150	69	64
23	140	196	221	140	87	65	263	559	393	e144	66	60
24	144	201	215	137	86	64	319	546	381	e138	63	57
25	144	204	210	136	86	64	404	556	374	e134	61	54
26	139	209	206	135	86	63	501	542	371	e130	59	53
27	138	234	206	132	86	63	603	523	366	e128	57	51
28	140	237	203	130	86	70	688	505	354	e124	59	49
29	137	241	197	128	---	72	759	498	342	e122	67	48
30	135	245	195	125	---	74	821	492	351	e120	65	46
31	134	---	189	124	---	75	---	481	---	e118	64	---
TOTAL	5521	4980	7341	4783	2815	2251	6736	24289	11643	6626	2522	1874
MEAN	178	166	237	154	101	72.6	225	784	388	214	81.4	62.5
MAX	276	245	260	185	121	85	821	1080	464	352	115	83
MIN	134	129	189	124	86	63	73	481	330	118	57	46
AC-FT	10950	9880	14560	9490	5580	4460	13360	48180	23090	13140	5000	3720
CFSM	.70	.66	.94	.61	.40	.29	.89	3.10	1.53	.84	.32	.25
IN.	.81	.73	1.08	.70	.41	.33	.99	3.57	1.71	.97	.37	.28

CAL YR 1988 TOTAL 90594 MEAN 248 MAX 1530 MIN 46 AC-FT 179700 CFSM .98 IN. 13.32
WTR YR 1989 TOTAL 81381 MEAN 223 MAX 1080 MIN 46 AC-FT 161400 CFSM .88 IN. 11.97

e Estimated

LAKE OF THE WOODS BASIN

05124480 KAWISHIWI RIVER NEAR ELY, MN--Continued
(Hydrologic bench-mark station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1966 to current year.

REMARKS.--Letter K indicates non-ideal colony count. Because of low concentrations and laboratory methods, some of the sulfate values may have a positive bias.

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)
OCT												
13...	1115	171	37	33	7.0	7.6	8.0	2.0	757	9.2	K2	K8
FEB												
27...	1300	81	27	33	6.7	7.6	0.5	1.5	--	--	<1	K1
MAY												
23...	1330	547	36	29	6.6	7.8	15.0	0.6	710	9.2	K2	K5
AUG												
16...	1030	79	27	31	8.1	7.8	21.0	0.7	760	8.0	K4	K570

DATE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)
OCT												
13...	3.3	1.6	1.0	0.5	10	10	0	13	10	0.8	0.1	4.9
FEB												
27...	3.7	1.7	1.4	.4	12	11	0	14	11	.7	.1	5.8
MAY												
23...	2.9	1.4	1.2	.4	9	9.0	0	12	3.0	.5	.1	6.1
AUG												
16...	3.1	1.3	1.0	.3	10	10	0	12	2.0	.5	<.1	4.1

DATE	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHOROUS TOTAL (MG/L AS P) (00665)	PHOS-PHOROUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHOROUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT											
13...	42	<0.01	<0.10	0.09	0.03	0.9	0.04	0.02	<0.01	1	100
FEB											
27...	40	<.01	.15	<.01	<.01	.5	.01	<.01	<.01	2	93
MAY											
23...	36	<.01	.18	.02	.02	.4	.01	.01	<.01	9	74
AUG											
16...	31	<.01	<.10	.01	.01	.4	.02	.01	.01	1	83

LAKE OF THE WOODS BASIN

05124480 KAWISHIWI RIVER NEAR ELY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
13...	1115	50	<1	4	<0.5	<1	<1	<3	3	290	<5
FEB											
27...	1300	70	<1	10	<.5	<1	1	<3	1	330	<5
MAY											
23...	1330	70	1	9	<.5	<1	8	<3	5	260	1
AUG											
16...	1030	30	<1	8	<.5	<1	1	<3	4	200	<1

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
13...	<4	7	<0.1	<10	1	<1	<1.0	12	<6	14
FEB										
27...	<4	12	<.1	<10	1	<1	<1.0	16	<6	43
MAY										
23...	<4	2	<.1	<10	1	<1	<1.0	12	<6	18
AUG										
16...	<4	4	<.1	<10	1	<1	<1.0	12	<6	10

RADIOCHEMICAL ANALYSES

DATE	TIME	GROSS ALPHA, DISSOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DISSOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DISSOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)	RADIUM 226, DISSOLVED, RADON METHOD (PCI/L) (09511)	URANIUM NATURAL DISSOLVED (UG/L AS U) (22703)
OCT									
13...	1115	<0.4	<0.4	1.7	0.5	1.6	0.5	0.03	<0.01
AUG									
16...	1030	.5	<.4	1.9	<.4	1.6	<.4	.04	1.2

LAKE OF THE WOODS BASIN

05127000 KAWISHIWI RIVER NEAR WINTON, MN

LOCATION.--Lat 47°56'05", long 91°45'50", in NE¼NW¼ sec.20, T.63 N., R.11 W., Lake County, Hydrologic Unit 09030001, Superior National Forest, at powerplant of Minnesota Power Co., just upstream from Fall Lake, and 1.8 mi east of Winton.

DRAINAGE AREA.--1,229 mi^2.

PERIOD OF RECORD.--June 1905 to June 1907, October 1912 to September 1919 (fragmentary), September 1923 to current year. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WDR MN-77-1: Drainage area.

REMARKS.--No estimated daily discharges. Records fair. Daily discharge computed from powerplant records. Flow regulated by powerplant and by Camp Six, Bald Eagle, Gabbro, Little Gabbro, Birch, White Iron, South Farm, and Garden Lakes.

COOPERATION.--Records collected by Minnesota Power Co., under general supervision of Geological Survey, in connection with a Federal Power Commission project.

AVERAGE DISCHARGE (unadjusted).--70 years (water years 1906, 1916-17, 1919, 1924-89), 1,037 ft^3/s, 11.46 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum daily discharge, 16,000 ft^3/s, May 18, 1950; no flow at times.

EXTREMES FOR CURRENT YEAR.--Maximum daily discharge, 4,760 ft^3/s, May 8; no flow Aug. 6, 9, 12, 13, 20, 26, 27, and Sept. 3..

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1330	824	1380	857	727	394	592	4400	2530	1970	387	376
2	1110	824	1350	792	694	395	721	4490	2520	1920	374	375
3	1360	792	1380	792	724	363	594	4540	2520	1910	375	.00
4	1200	792	1380	792	723	395	551	4630	2500	1770	375	396
5	1200	760	1350	760	659	394	597	4630	2350	1590	375	747
6	1250	857	1320	792	643	362	598	4640	2240	1470	.00	833
7	1250	792	1400	792	542	241	640	4710	2210	1440	95	795
8	1220	824	1170	792	594	383	694	4760	2140	1390	141	795
9	1250	824	1230	760	659	297	775	4720	1810	1200	.00	794
10	1010	792	1190	794	627	361	779	4730	1680	1020	148	794
11	1020	792	1180	794	690	362	744	4510	1680	959	142	793
12	960	792	1190	762	592	395	901	4360	1680	959	.00	794
13	928	824	1120	665	564	363	980	4120	1880	959	.00	794
14	891	792	960	794	502	363	948	3410	2180	851	178	763
15	848	824	960	794	438	427	1080	3450	2260	795	252	745
16	880	958	960	729	503	424	1080	3400	2480	795	252	479
17	880	961	960	762	438	439	1210	3030	2600	795	263	480
18	912	964	960	792	471	440	1300	2680	2600	796	251	669
19	815	964	960	792	439	472	1430	2440	2750	572	251	545
20	783	964	928	792	409	466	1470	2300	2840	444	.00	398
21	880	1030	908	792	442	447	1750	2310	2740	681	251	398
22	880	977	817	792	395	479	2220	2300	3120	796	258	444
23	880	1250	882	760	395	551	2540	2290	3300	796	352	480
24	880	1470	882	760	427	467	2770	2080	3020	795	352	480
25	880	1430	882	760	426	595	2960	2060	2660	795	352	480
26	880	1580	817	760	394	594	3340	2260	2320	795	.00	426
27	880	1820	947	760	394	528	3380	2270	2060	795	.00	398
28	848	1870	817	727	394	542	3790	2270	1870	794	278	398
29	880	1900	833	727	---	445	4250	2270	1620	794	380	382
30	880	1600	792	727	---	615	4370	2270	1870	793	384	374
31	769	---	792	663	---	538	---	2410	---	595	376	---
TOTAL	30634	31843	32697	23827	14905	13537	49054	104740	70030	32034	6842.00	16625.00
MEAN	988	1061	1055	769	532	437	1635	3379	2334	1033	221	554
MAX	1360	1900	1400	857	727	615	4370	4760	3300	1970	387	833
MIN	769	760	792	663	394	241	551	2060	1620	444	.00	.00
†	-86	+51	-82	-224	-177	-131	+546	+129	-25	-119	+30	-25
MEAN‡	902	1112	973	545	355	306	2181	3508	2309	914	251	529
CFSM‡	.73	.90	.79	.44	.29	.25	1.77	2.85	1.88	.74	.20	.43
IN.‡	.85	1.01	.91	.51	.30	.29	1.98	3.29	2.10	.86	.24	.48

CAL YR 1988 TOTAL 434289.00 MEAN 1187 MAX 7640 MIN .0 MEAN‡ 1203 CFSM‡ .98 IN‡ 13.32
WTR YR 1989 TOTAL 426768.00 MEAN 1169 MAX 4760 MIN .0 MEAN‡ 1160 CFSM‡ .94 IN‡ 12.81

† Change in contents, equivalent in cubic feet per second, in Camp Six, Bald Eagle, Gabbro, Little Gabbro, Birch, White Iron, Farm, South Farm and Garden Lakes.

‡ Adjusted for change in reservoir content.

LAKE OF THE WOODS BASIN

05127500 BASSWOOD RIVER NEAR WINTON, MN

(International gaging station)

LOCATION.--Lat 48°04'57", long 91°39'09", in SE¼SE¼ sec.30, T.65 N., R.10 W., Lake County, Hydrologic Unit 09030001, in Superior National Forest, on island in Jackfish Bay of Basswood Lake, used to determine discharge at outlet [lat 48°06'21", long 91°38'51", in sec.19, T.65 N., R.10 W., on international boundary 14 mi northeast of Winton].

DRAINAGE AREA.--1,740 mi^2, approximately (above outlet of Basswood Lake).

PERIOD OF RECORD.--March to June 1924, September 1925 to March 1928, January 1930 to current year. Monthly discharge only for some periods, published in WSP 1308.

REVISED RECORDS.--WSP 955: Drainage area. WSP 1145: 1935, 1937.

GAGE.--Water-stage recorder. Datum of gage is 1,296.80 ft, 1928 datum, (levels by Geodetic Survey of Canada). Prior to Oct. 27, 1938, nonrecording gages at several sites in vicinity of gage, at datum 3.0 ft higher. Oct. 28, 1938, to Sept. 30, 1966, water-stage recorder at datum 3.0 ft higher.

REMARKS.--No estimated daily discharges. Records good. Satellite telemeter at station. Some regulation by powerplant on Kawishiwi River at Winton, and by many lakes located upstream from station.

COOPERATION.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.

AVERAGE DISCHARGE.--61 years (water years 1926, 1927, 1931-89), 1,403 ft^3/s, 10.95 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 15,600 ft^3/s, May 24, 1950, gage height 9.94 ft, present datum; minimum, 55 ft^3/s, Nov. 18, 1976, gage height, 1.67 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,250 ft^3/s, part or all of May 11-13, gage height, 6.10 ft; minimum, 429 ft^3/s, Aug. 28, gage height, 2.75 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2370	1260	1690	1360	1130	802	797	3550	3380	3150	1060	460
2	2290	1240	1700	1350	1110	798	825	3810	3360	3090	1030	459
3	2220	1220	1690	1350	1090	775	844	4040	3350	3010	1040	462
4	2170	1210	1690	1340	1080	747	864	4270	3310	2940	1030	542
5	2110	1190	1690	1320	1070	721	889	4510	3300	2870	979	563
6	2050	1190	1680	1310	1060	699	901	4730	3260	2800	932	572
7	1990	1190	1670	1310	1060	683	912	4880	3270	2690	878	581
8	1950	1180	1670	1310	1050	668	932	5000	3190	2590	835	590
9	1910	1180	1660	1310	1050	665	955	5090	3110	2490	801	606
10	1850	1180	1650	1290	1040	650	971	5170	3020	2380	763	614
11	1800	1170	1640	1290	1040	660	989	5230	2930	2280	728	644
12	1750	1170	1640	1290	1040	693	1010	5250	2930	2160	694	676
13	1700	1170	1640	1280	1030	705	1030	5240	3060	2070	689	685
14	1640	1150	1630	1270	1020	709	1050	5200	3000	1980	656	692
15	1600	1160	1610	1250	1020	703	1080	5120	2980	1880	622	702
16	1560	1210	1590	1250	1020	697	1110	5010	2970	1800	592	703
17	1530	1260	1560	1240	1020	691	1170	4900	2970	1740	569	707
18	1490	1290	1540	1240	1010	685	1220	4770	3000	1680	545	709
19	1450	1300	1520	1250	968	682	1260	4630	3030	1600	530	708
20	1420	1300	1500	1250	918	671	1310	4450	3060	1520	512	724
21	1390	1310	1480	1240	888	668	1370	4270	3070	1450	504	740
22	1370	1310	1460	1230	859	664	1460	4110	3170	1380	507	733
23	1370	1310	1440	1210	840	662	1600	3980	3230	1330	498	710
24	1360	1320	1430	1200	831	659	1750	3890	3290	1290	486	697
25	1340	1340	1400	1200	827	668	1950	3810	3370	1250	467	667
26	1320	1380	1390	1200	821	683	2190	3670	3430	1210	455	660
27	1310	1480	1400	1190	821	707	2450	3590	3400	1190	442	650
28	1290	1540	1390	1170	808	746	2710	3520	3330	1150	449	621
29	1280	1620	1380	1170	---	759	2990	3510	3230	1130	463	610
30	1280	1660	1370	1160	---	775	3270	3470	3220	1100	456	605
31	1260	---	1360	1150	---	784	---	3420	---	1080	469	---
TOTAL	51420	38490	48160	38980	27521	21879	41859	136090	95220	60280	20681	19092
MEAN	1659	1283	1554	1257	983	706	1395	4390	3174	1945	667	636
MAX	2370	1660	1700	1360	1130	802	3270	5250	3430	3150	1060	740
MIN	1260	1150	1360	1150	808	650	797	3420	2930	1080	442	459
AC-FT	102000	76340	95530	77320	54590	43400	83030	269900	188900	119600	41020	37870
CFSM	.95	.74	.89	.72	.56	.41	.80	2.52	1.82	1.12	.38	.37
IN.	1.10	.82	1.03	.83	.59	.47	.89	2.91	2.04	1.29	.44	.41

CAL YR 1988 TOTAL 560708 MEAN 1532 MAX 7970 MIN 407 AC-FT 1112000 CFSM .88 IN. 11.99
WTR YR 1989 TOTAL 599672 MEAN 1643 MAX 5250 MIN 442 AC-FT 1189000 CFSM .94 IN. 12.82

LAKE OF THE WOODS BASIN

05128000 NAMAKAN RIVER AT OUTLET OF LAC LA CROIX, ONTARIO

(International gaging station)

LOCATION.--Lat 48°21'14", long 92°13'01", at Campbell's Camp, on Lac La Croix Lake, used to determine discharge at outlet [Lat 48°23'00", long 92°10'40", 2.5 mi east of Campbell's Camp].

DRAINAGE AREA.--5,170 mi^2.

PERIOD OF RECORD.--September 1921 to January 1922, April 1922 to current year, in reports of Geological Survey. Monthly discharge only for some periods, published in WSP 1308. August 1921 to current year, in reports of Water Survey of Canada.

GAGE.--Water-stage recorder. Gage readings have been reduced to elevations, United States and Canada Boundary Survey datum. Prior to October 1933, nonrecording gages at various sites on Lac la Croix. October 1933 to Mar. 13, 1963, nonrecording gage at present site and datum.

REMARKS.--Records good. Satellite telemeter at station.

COOPERATION.--This station is one of the international stations maintained by Canada under agreement with the United States.

AVERAGE DISCHARGE.--67 years (water years 1923-89), 3,848 ft^3/s, 10.11 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 28,200 ft^3/s, May 31 to June 2, 1950, elevation, 1,193.30 ft; minimum, 535 ft^3/s at times in February, March and April 1924, elevation, 1,181.50 ft.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 10,900 ft^3/s, May 24, elevation, 1,187.63 ft; minimum, 1,990 ft^3/s, Sept. 28, elevation, 1,183.16 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	8750	4260	4330	4240	3600	2830	2230	5830	9640	8830	4660	2620
2	8510	4210	4380	4240	3570	2800	2240	6140	9500	8860	4560	2570
3	8220	4160	4430	4240	3530	2770	2240	6500	9320	8830	4590	2540
4	8040	4090	4450	4200	3510	2750	2240	6850	9150	8830	4630	2580
5	7800	4010	4480	4200	3480	2720	2250	7170	9080	8790	4480	2580
6	7550	3980	4510	4170	3450	2690	2260	7630	8930	8830	4340	2560
7	7320	3980	4520	4130	3420	2670	2280	8090	8900	8760	4240	2500
8	7130	3940	4560	4130	3390	2650	2310	8440	8760	8650	4100	2440
9	6900	3910	4520	4060	3380	2630	2340	8790	8720	8550	4030	2400
10	6650	3890	4530	4030	3350	2600	2360	9150	8620	8440	3920	2370
11	6460	3850	4530	4030	3310	2580	2380	9460	8550	8330	3810	2350
12	6300	3840	4530	4030	3280	2560	2400	9710	8550	8160	3710	2350
13	6120	3840	4540	4030	3250	2530	2430	9960	8790	7980	3740	2340
14	5970	3780	4560	4030	3220	2510	2450	10100	8900	7840	3710	2310
15	5810	3830	4570	3960	3220	2480	2490	10300	8970	7630	3600	2290
16	5640	3820	4560	3920	3180	2450	2540	10500	8970	7490	3530	2260
17	5560	3890	4530	3920	3140	2430	2610	10600	8930	7310	3480	2250
18	5400	3960	4520	3920	3110	2400	2680	10600	8860	7170	3390	2220
19	5270	4010	4530	3920	3080	2370	2770	10700	8830	7030	3300	2180
20	5150	4030	4490	3920	3020	2350	2890	10600	8790	6820	3200	2170
21	4990	4040	4480	3880	3020	2320	3030	10600	8720	6670	3150	2210
22	4930	4070	4450	3850	2990	2300	3210	10600	8790	6460	3150	2190
23	4830	4080	4450	3810	2950	2280	3420	10600	8720	6290	3100	2190
24	4730	4110	4430	3810	2940	2260	3670	10600	8650	6070	3030	2180
25	4640	4120	4380	3780	2950	2240	3960	10400	8650	5860	2930	2120
26	4580	4130	4340	3780	2920	2220	4240	10200	8650	5650	2860	2130
27	4510	4220	4340	3740	2870	2210	4560	10200	8550	5470	2770	2120
28	4370	4280	4340	3710	2860	2220	4840	10100	8580	5300	2760	2060
29	4390	4310	4250	3670	---	2220	5160	10000	8620	5120	2730	2060
30	4370	4310	4230	3640	---	2240	5510	9920	8760	4940	2700	2060
31	4310	---	4240	3600	---	2240	---	9780	---	4800	2680	---
TOTAL	185200	120950	138000	122590	89990	76520	89990	290120	265450	225760	110880	69200
MEAN	5974	4032	4452	3955	3214	2468	3000	9359	8848	7283	3577	2307
MAX	8750	4310	4570	4240	3600	2830	5510	10700	9640	8860	4660	2620
MIN	4310	3780	4230	3600	2860	2210	2230	5830	8550	4800	2680	2060
AC-FT	367300	239900	273700	243200	178500	151800	178500	575500	526500	447800	219900	137300
CFSM	1.16	.78	.86	.76	.62	.48	.58	1.81	1.71	1.41	.69	.45
IN.	1.33	.87	.99	.88	.65	.55	.65	2.09	1.91	1.62	.80	.50

CAL YR 1988 TOTAL 1553560 MEAN 4245 MAX 15500 MIN 1430 AC-FT 3081000 CFSM .82 IN. 11.18
WTR YR 1989 TOTAL 1784650 MEAN 4889 MAX 10700 MIN 2060 AC-FT 3540000 CFSM .95 IN. 12.84

LAKE OF THE WOODS BASIN

05129115 VERMILION RIVER NEAR CRANE LAKE, MN

LOCATION.--Lat 48°15'53", long 92°33'57", in NE¼NE¼ sec. 30, T.67 N., R.17 W., St. Louis County, Hydrologic Unit 09030002, in Superior National Forest, on left bank 350 ft downstream from bridge on Forest Route 491, 3.5 mi upstream from mouth, and 3.5 mi west of village of Crane Lake.

PERIOD OF RECORD.--August 1979 to current year.

GAGE.--Water-stage recorder. Elevation of gage is 1,180 ft above National Geodectic Vertical Datum of 1929, from topographic map.

REMARKS.--Records fair.

AVERAGE DISCHARGE.--10 years, 642 ft^3/s, 465,100 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 4,360 ft^3/s, Apr. 25, 1985, gage height, 15.20 ft; minimum, 38 ft^3/s, Aug. 13, 14, 1980, gage height, 3.68 ft.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood of April 1979 reached a stage of 15.15 ft, from high-water mark, discharge, about 4,600 ft^3/s.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 2,780 ft^3/s, Apr. 25, gage height, 12.76 ft; minimum, 196 ft^3/s, Aug. 28, gage height, 5.25 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1610	712	792	e490	e390	e305	e390	2270	1370	1860	456	229
2	1550	710	782	e490	e380	e300	e410	2190	1330	1870	433	230
3	1500	709	778	e490	e370	e300	e430	2120	1290	1830	487	230
4	1450	708	758	e480	e360	e300	e450	2050	1220	1750	498	291
5	1410	693	748	e480	e360	e295	e490	1960	1170	1660	482	351
6	1370	650	736	e480	e350	e295	e560	1940	1130	1610	465	383
7	1330	660	721	e480	e350	e290	e660	1910	1090	1530	444	403
8	1280	677	700	e470	e350	e290	e740	1890	1070	1450	432	403
9	1230	666	673	e470	e350	e285	e790	1850	1060	1380	414	387
10	1180	662	645	e470	e350	e280	e800	1810	1030	1300	396	369
11	1120	656	615	e460	e345	e280	e800	1750	1010	1220	378	353
12	1070	653	603	e460	e340	e280	e800	1690	1010	1160	364	362
13	1040	659	e580	e460	e340	e275	e800	1640	1240	1100	352	349
14	1010	653	e570	e450	e335	e275	e800	1590	1580	1040	333	339
15	978	643	e560	e450	e335	e270	897	1540	1680	977	318	329
16	953	684	e550	e450	e330	e265	1110	1490	1670	931	302	319
17	929	654	e540	e450	e330	e260	1440	1430	1610	882	289	309
18	905	716	e540	e440	e325	e255	1680	1370	1540	837	280	305
19	881	760	e540	e440	e325	e250	1850	1330	1450	810	272	298
20	855	773	e540	e440	e320	e245	2010	1310	1370	779	265	290
21	844	774	e530	e430	e320	e240	2220	1260	1330	743	252	303
22	813	767	e530	e430	e315	e235	2500	1200	1450	706	246	336
23	809	762	e530	e430	e315	e235	2660	1180	1590	675	235	323
24	814	758	e520	e430	e310	e240	2730	1160	1630	646	226	328
25	802	758	e520	e425	e310	e250	2760	1200	1630	619	218	326
26	773	766	e510	e420	e310	e265	2750	1190	1680	592	209	310
27	774	784	e510	e420	e305	e285	2670	1180	1740	559	203	302
28	776	785	e500	e415	e305	e305	2570	1170	1750	527	204	294
29	738	801	e500	e410	---	e335	2450	1230	1730	508	227	277
30	706	809	e500	e405	---	e355	2360	1310	1800	495	215	270
31	708	---	e490	e400	---	e370	---	1370	---	477	217	---
TOTAL	32208	21462	18611	13915	9425	8710	43577	48580	42250	32523	10112	9598
MEAN	1039	715	600	449	337	281	1453	1567	1408	1049	326	320
MAX	1610	809	792	490	390	370	2760	2270	1800	1870	498	403
MIN	706	643	490	400	305	235	390	1160	1010	477	203	229
AC-FT	63880	42570	36910	27600	18690	17280	86430	96360	83800	64510	20060	19040

CAL YR 1988 TOTAL 244048 MEAN 667 MAX 3030 MIN 52 AC-FT 484100
WTR YR 1989 TOTAL 290971 MEAN 797 MAX 2760 MIN 203 AC-FT 577100

e Estimated

LAKE OF THE WOODS BASIN

05129290 GOLD PORTAGE OUTLET FROM KABETOGAMA LAKE NEAR RAY, MN

LOCATION.--Lat 48°31'28", long 93°04'29", in SW¼NE¼ sec.30, T.70 N., R.21 W., St. Louis County, Hydrologic Unit 09030003, on right bank in bay at head of Gold Portage Outlet from Kabetogama Lake, 9.8 mi northeast of Ray.

PERIOD OF RECORD.--October 1982 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,100 ft, adjustment of 1912 (U.S. Army Corps of Engineers bench mark), water surface transfer.

REMARKS.--No estimated daily discharges. Records good. Flow completely regulated by outlet dam on Namakan Lake.

AVERAGE DISCHARGE.--7 years, 238 ft^3/s, 172,400 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 897 ft^3/s, Sept. 21, 1988, gage height, 19.23 ft; no flow from approximately the middle of January to the first of May each year; minimum gage height, 10.27 ft, Apr. 3, 5, 1989.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 772 ft^3/s, July 5, gage height, 18.67 ft; no flow Jan. 22 to Apr. 26; minimum gage height, 10.27 ft, Apr. 3, 5.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	632	217	111	12	.00	.00	.00	25	300	672	511	549
2	610	231	108	10	.00	.00	.00	35	290	674	509	550
3	561	228	97	9.9	.00	.00	.00	46	285	665	535	563
4	553	225	94	8.8	.00	.00	.00	57	278	679	567	573
5	540	211	91	7.6	.00	.00	.00	56	280	695	571	578
6	522	216	83	6.9	.00	.00	.00	78	282	681	563	592
7	504	233	76	6.8	.00	.00	.00	97	318	686	566	580
8	492	242	71	4.9	.00	.00	.00	113	338	685	566	567
9	475	260	68	4.6	.00	.00	.00	128	363	673	564	557
10	432	254	64	3.8	.00	.00	.00	145	393	657	563	548
11	423	265	61	3.7	.00	.00	.00	165	428	660	559	543
12	412	277	61	2.5	.00	.00	.00	184	477	641	564	537
13	403	268	58	2.5	.00	.00	.00	198	518	614	571	542
14	381	257	50	2.1	.00	.00	.00	212	521	598	581	533
15	362	276	46	1.1	.00	.00	.00	226	531	588	579	533
16	331	247	47	1.1	.00	.00	.00	238	536	580	576	521
17	315	240	42	.76	.00	.00	.00	247	539	569	583	521
18	305	244	41	.63	.00	.00	.00	249	532	561	590	524
19	287	232	39	.43	.00	.00	.00	253	538	559	589	493
20	277	210	34	.18	.00	.00	.00	256	556	545	564	492
21	256	203	34	.19	.00	.00	.00	257	562	539	566	490
22	261	193	33	.0	.00	.00	.00	268	574	533	578	458
23	243	181	29	.00	.00	.00	.00	270	587	524	579	468
24	228	171	26	.00	.00	.00	.00	276	597	512	580	476
25	218	153	22	.00	.00	.00	.00	285	613	506	568	437
26	216	143	21	.00	.00	.00	.00	273	623	500	559	449
27	217	135	20	.00	.00	.00	.37	276	616	477	537	452
28	193	129	17	.00	.00	.00	2.8	290	644	488	548	425
29	206	125	16	.00	---	.00	7.3	294	652	501	534	426
30	220	116	14	.00	---	.00	15	298	658	508	544	438
31	219	---	13	.00	---	.00	---	300	---	504	561	---
TOTAL	11294	6382	1587	90.49	0.00	0.00	25.47	6095	14429	18274	17425	15415
MEAN	364	213	51.2	2.92	.00	.00	.85	197	481	589	562	514
MAX	632	277	111	12	.00	.00	15	300	658	695	590	592
MIN	193	116	13	.00	.00	.00	.00	25	278	477	509	425
AC-FT	22400	12660	3150	179	.0	.0	51	12090	28620	36250	34560	30580

CAL YR 1988 TOTAL 85701.23 MEAN 234 MAX 876 MIN .00 AC-FT 170000
WTR YR 1989 TOTAL 91016.96 MEAN 249 MAX 695 MIN .00 AC-FT 180500

LAKE OF THE WOODS BASIN

05129400 RAINY LAKE NEAR FORT FRANCES, ONTARIO
(International gaging station)

LOCATION.--Lat 48°38'30", long 93°20'00", at Five Mile dock, approximately 5 mi northeast of city of Fort Frances.

PERIOD OF RECORD.--January 1910 to September 1917 and October 1934 to current year, in reports of Geological Survey. August 1911 to current year, in reports of Water Survey of Canada. Prior to October 1949, published as "at Ranier, Minn.", and as "at Fort Frances, Ontario" October 1949 to September 1964.

GAGE.--Water-stage recorder. Datum of gage is National Geodetic Vertical Datum of 1929 (United States and Canadian Boundary Survey). January 1910 to December 1949, nonrecording gage 3 mi northeast at Ranier, Minn., at same datum. January 1950 to October 1964, water-stage recorder on Government dock at Pither's Point at Fort Frances, and supplementary gage in town pumping station, 0.5 mi south, used during winter months, at same datum.

COOPERATION.--This station is one of the international gaging stations maintained by Canada under agreement with the United States.

EXTREMES FOR PERIOD OF RECORD.--Maximum elevation observed, 1,112.97 ft, July 5, 1950; minimum observed, 1,101.26 ft, Apr. 17, 1923, Apr. 2, 1930.

EXTREMES FOR CURRENT YEAR.--Maximum elevation, 1,108.44 ft, July 5; maximum daily elevation, 1,108.26 ft, July 6; minimum, 1,105.03 ft, Apr. 11; minimum daily, 1,105.04 ft, Apr. 9-11.

MONTHEND ELEVATION, IN FEET NGVD, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

Oct. 31	1,107.70	Feb. 28	1,105.52	June 30	1,108.23
Nov. 30	1,107.70	Mar. 31	1,105.09	July 31	1,107.71
Dec. 31	1,107.09	Apr. 30	1,106.43	Aug. 31	1,108.11
Jan. 31	1,106.25	May 31	1,107.52	Sept. 30	1,107.94

NOTE.--Elevations other than those shown are available.

LAKE OF THE WOODS BASIN

05130500 STURGEON RIVER NEAR CHISHOLM, MN

LOCATION.--Lat 47°40'25", long 92°54'00", in NE¼NW¼ sec.20, T.60 N., R.20 W., St. Louis County, Hydrologic Unit 09030005, on left bank 1,000 ft upstream from highway bridge, 0.6 mi downstream from East Branch Sturgeon River, and 11.5 mi north of Chisholm.

DRAINAGE AREA.--187 mi^2.

PERIOD OF RECORD.--August 1942 to current year.

REVISED RECORDS.--WSP 1438: 1946.

GAGE.--Water-stage recorder. Datum of gage is 1,305.7 ft above National Geodetic Vertical Datum of 1929. Prior to Aug. 24, 1944, nonrecording gage at site 1,000 ft downstream at different datum. Aug. 25, 1944, to Sept. 30, 1975, at present site at datum 1.00 ft higher.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--47 years, 124 ft^3/s, 9.00 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 3,630 ft^3/s, May 7, 1950, gage height, 7.41 ft, present datum, from rating curve extended above 1,600 ft^3/s, on basis of slope-area measurement of peak flow; minimum daily, 2.5 ft^3/s, July 30, 1988.

EXTREMES FOR CURRENT YEAR.--Peak discharge greater than base of 500 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage Height (ft)
Apr. 18	2200	*1,110	*5.04	No other peak greater than base discharge.			

Minimum, 17 ft^3/s, Aug. 19, gage height, 140 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	311	148	e133	e54	e38	e30	e95	427	266	179	40	151
2	296	148	e130	e54	e38	e30	e105	405	226	169	39	145
3	285	142	e126	e52	e38	e30	e115	374	196	160	39	134
4	268	137	e121	e52	e38	e30	e130	347	168	140	38	221
5	253	133	e117	e50	e38	e30	e160	338	147	124	36	283
6	239	130	e113	e50	e36	e30	e220	326	135	150	36	285
7	228	127	e110	e48	e36	e30	e270	312	121	156	35	263
8	218	126	e108	e48	e36	e30	e330	294	128	181	32	223
9	210	121	e100	e48	e36	e30	e380	278	143	198	31	182
10	199	121	e95	e46	e36	e30	e370	259	130	184	29	150
11	191	115	e92	e46	e36	e29	e357	242	115	158	26	128
12	184	112	e88	e46	e36	e29	e330	228	129	134	24	117
13	177	112	e85	e48	e34	e29	e325	213	229	116	23	104
14	171	115	e82	e46	e34	e29	e340	198	419	100	22	93
15	166	117	e79	e44	e34	e29	e380	188	469	87	21	85
16	165	124	e78	e44	e34	e29	612	177	450	80	20	80
17	162	112	e77	e44	e34	e29	893	166	364	74	19	74
18	163	136	e75	e44	e34	e29	1050	162	278	71	18	73
19	168	146	e73	e44	e34	e29	1060	162	217	70	18	72
20	165	150	e71	e42	e32	e29	950	167	175	65	20	70
21	167	148	e68	e42	e32	e29	856	161	153	61	20	83
22	164	140	e66	e42	e32	e29	809	151	181	58	22	105
23	164	136	e64	e42	e32	e29	771	149	175	54	25	116
24	163	132	e62	e40	e32	e29	727	154	163	51	28	122
25	160	138	e60	e40	e32	e29	683	222	167	53	28	112
26	155	144	e60	e40	e32	e30	628	246	192	49	31	120
27	152	144	e58	e40	e30	e33	577	253	197	46	33	107
28	152	e143	e58	e40	e30	e39	520	235	174	42	67	95
29	151	e140	e56	e40	---	e52	476	251	152	41	132	81
30	157	e137	e56	e40	---	e65	449	285	182	41	108	75
31	145	---	e56	e40	---	e80	---	290	---	40	134	---
TOTAL	5949	3974	2617	1394	964	1034	14968	7660	6239	3132	1194	3949
MEAN	192	132	84.4	45.0	34.4	33.4	499	247	208	101	38.5	132
MAX	311	150	133	54	38	80	1060	427	469	198	134	285
MIN	145	112	56	40	30	29	95	149	115	40	18	70
AC-FT	11800	7880	5190	2760	1910	2050	29690	15190	12380	6210	2370	7830
CFSM	1.03	.71	.45	.24	.18	.18	2.67	1.32	1.11	.54	.21	.70
IN.	1.18	.79	.52	.28	.19	.21	2.98	1.52	1.24	.62	.24	.79

CAL YR 1988 TOTAL 38964.1 MEAN 106 MAX 824 MIN 2.5 AC-FT 77290 CFSM .57 IN. 7.75
WTR YR 1989 TOTAL 53074 MEAN 145 MAX 1060 MIN 18 AC-FT 105300 CFSM .78 IN. 10.56

e Estimated

LAKE OF THE WOODS BASIN

05131500 LITTLE FORK RIVER AT LITTLEFORK, MN

LOCATION.--Lat 48°23'45", long 93°32'57", in NE¼SE¼ sec.9, T.68 N., R.25 W., Koochiching County, Hydrologic Unit 09030005, on right bank at town of Littlefork, 0.9 mi upstream from bridge on State Highway 217, 2.8 mi upstream from Beaver Creek, and 19 mi upstream from mouth.

DRAINAGE AREA.--1,730 mi^2, approximately.

PERIOD OF RECORD.--June to November 1909, April to November 1910, April 1911 to June 1917, September 1917, October 1917 to March 1919 (gage heights only), June 1928 to current year.

REVISED RECORDS.--WSP 955: Drainage area. WSP 1508: 1913, 1916, 1928-32, 1934. WRD MN-74: 1963.

GAGE.--Water-stage recorder. Datum of gage is 1,083.59 ft above National Geodetic Vertical Datum of 1929. June 23, 1909, to Mar. 4, 1917, nonrecording gage and July 21, 1937, to Oct. 23, 1979, water-stage recorder at site 1.2 mi downstream at datum 10.53 ft lower; Mar. 5 to Sept. 30, 1917, and June 22, 1928, to July 20, 1937, nonrecording gage at site 1.18 mi downstream at datum 10.53 ft lower.

REMARKS.--Records good except those for estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--66 years (water years 1912-16, 1929-89), 1,063 ft^3/s, 8.34 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 25,000 ft^3/s, Apr. 18, 1916, May 11, 1950, gage height, 37.00 ft, site and datum then in use; minimum observed, 21 ft^3/s, Aug. 26, 27, 1936.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 13,700 ft^3/s, Apr. 21, gage height, 17.04 ft; maximum gage height, 17.69 ft, Apr. 20 (backwater from ice); minimum discharge, 92 ft^3/s, Aug. 28, gage height, 1.94 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2340	953	e930	e360	e200	e165	e600	4510	3340	4400	212	283
2	2170	919	e900	e350	e200	e165	e800	e4100	2960	4380	208	381
3	1970	863	e860	e340	e195	e165	e1000	e3800	2500	3790	226	486
4	1820	839	e850	e330	e195	e165	e1300	e3550	2140	3060	225	576
5	1690	831	e800	e320	e190	e165	e1500	3320	1840	2350	228	575
6	1590	849	e780	e310	e190	e165	e1800	3420	1560	2080	236	786
7	1480	861	e770	e310	e190	e165	e2200	3240	1370	2010	216	1160
8	1370	934	e700	e300	e185	e165	e2700	3090	1270	1860	201	1200
9	1290	882	e600	e300	e185	e165	e3000	2910	1300	1710	187	1100
10	1210	792	e580	e290	e185	e165	e3000	2720	1320	1540	174	963
11	1110	835	e700	e290	e180	e165	e2950	2490	1430	1360	165	823
12	1030	778	e800	e280	e180	e165	e2850	2280	1350	1210	156	695
13	971	754	e700	e280	e180	e165	e2700	2060	1350	1100	148	586
14	940	742	e650	e270	e180	e165	e2700	1900	3600	970	139	508
15	905	740	e600	e265	e175	e165	e2900	1730	5250	854	136	463
16	867	722	e580	e260	e175	e165	e3500	1590	5330	764	126	426
17	841	992	e560	e255	e175	e165	e4400	1470	4610	718	119	395
18	820	887	e540	e250	e175	e165	e7400	1360	3800	672	111	368
19	828	e980	e520	e245	e170	e165	e10000	1280	2980	571	106	348
20	846	e1050	e500	e240	e170	e165	e12000	1280	2320	464	101	324
21	876	e1100	e480	e235	e170	e165	e12000	1350	1900	439	97	309
22	891	e1100	e470	e230	e170	e165	10200	1260	2770	438	100	300
23	899	e1100	e460	e225	e170	e165	8790	1200	4590	414	103	307
24	945	e1100	e450	e225	e170	e165	8720	1220	4490	376	104	354
25	989	e1080	e440	e220	e170	e165	8260	1470	3900	338	102	401
26	1000	e1050	e420	e215	e165	e170	7850	1990	3600	309	100	429
27	989	e1000	e410	e215	e165	e180	e7000	2250	3810	280	96	436
28	969	e970	e400	e210	e165	e200	e6200	2280	3650	255	106	421
29	881	e950	e390	e210	---	e250	e5600	2380	3190	241	126	390
30	707	e940	e380	e205	---	e390	e5000	3050	3240	228	117	377
31	867	---	e370	e205	---	e520	---	3510	---	216	127	---
TOTAL	36101	27593	18590	8240	5020	5835	148920	74060	86760	39397	4598	16170
MEAN	1165	920	600	266	179	188	4964	2389	2892	1271	148	539
MAX	2340	1100	930	360	200	520	12000	4510	5330	4400	236	1200
MIN	707	722	370	205	165	165	600	1200	1270	216	96	283
AC-FT	71610	54730	36870	16340	9960	11570	295400	146900	172100	78140	9120	32070
CFSM	.67	.53	.35	.15	.10	.11	2.87	1.38	1.67	.73	.09	.31
IN.	.78	.59	.40	.18	.11	.13	3.20	1.59	1.87	.85	.10	.35

CAL YR 1988 TOTAL 355959 MEAN 973 MAX 11600 MIN 43 AC-FT 706000 CFSM .56 IN. 7.65
WTR YR 1989 TOTAL 471284 MEAN 1291 MAX 12000 MIN 96 AC-FT 934800 CFSM .75 IN. 10.13

e Estimated

LAKE OF THE WOODS BASIN

05132000 BIG FORK RIVER AT BIG FALLS, MN

LOCATION.--Lat 48°11'45", long 93°48'25", in SW¼SE¼ sec.35, T.155 N., R.25 W., Koochiching County, Hydrologic Unit 09030006, on left bank at village of Big Falls, 700 ft downstream from falls, 0.3 mi downstream from bridge on U.S. Highway 71, and 4.8 mi upstream from Sturgeon River.

DRAINAGE AREA.--1,460 mi^2, approximately.

PERIOD OF RECORD.--August to November 1909, April to November 1910. April 1911 to September 1912 (gage heights and discharge measurements only). June 1928 to September 1979. October 1979 to September 1982, annual maximums only. October 1982 to current year.

REVISED RECORDS.--WSP 1308: 1935(M).

GAGE.--Water-stage recorder. Datum of gage is 1,144.71 ft above National Geodetic Vertical Datum of 1929. Prior to June 10, 1911, nonrecording gage at railroad bridge about 0.4 mi upstream at different datum. June 10, 1911, to Sept. 30, 1912, and June 22, 1928, to Dec. 17, 1937, nonrecording gage at site 200 ft upstream at same datum.

REMARKS.--Records good except for those for estimated daily discharges, which are fair. Prior to 1971, a powerplant, located 0.3 mi upstream, caused some diurnal fluctuation at low flows.

AVERAGE DISCHARGE.--58 years (water years 1929-79, 1983-89), 733 ft^3/s, 6.82 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 14,800 ft^3/s, May 8, 9, 1950; maximum gage height, 17.08 ft, May 8, 1950; minimum discharge recorded, 7 ft^3/s, Aug. 7, 1939.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 5,800 ft^3/s, Apr. 20, gage height, 10.08 ft (backwater from ice); maximum gage height, 11.67 ft, Apr. 19 (backwater from ice); minimum daily discharge, 137 ft^3/s, Mar. 4-23; minimum gage height, 3.28 ft, Oct. 30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	871	519	e460	e200	e170	e140	e800	2880	2250	2600	361	446
2	822	513	e440	e200	e170	e140	e850	2700	2030	2280	370	461
3	782	495	e420	e200	e170	e140	e900	2530	1790	2020	378	477
4	745	478	e400	e200	e165	e137	e950	2380	1570	1750	400	487
5	701	442	e380	e195	e165	e137	e1000	2300	1370	1500	411	520
6	664	408	e360	e195	e165	e137	e1400	2240	1200	1470	402	648
7	623	376	e340	e195	e165	e137	e2000	2150	1070	1470	396	664
8	583	427	e320	e195	e160	e137	e2500	2070	1100	1480	391	648
9	555	430	e300	e195	e160	e137	e2500	2000	1340	1360	381	632
10	524	427	e290	e190	e160	e137	e2500	1930	1520	1220	375	617
11	499	417	e280	e190	e160	e137	e2400	1850	1610	1100	366	596
12	475	409	e270	e190	e155	e137	e2200	1770	1470	1010	352	576
13	456	408	e260	e190	e155	e137	e2000	1670	1880	985	341	565
14	439	408	e245	e190	e155	e137	e2000	1580	3080	919	331	555
15	427	408	e233	e190	e155	e137	e2000	1500	3550	841	323	551
16	418	321	e230	e190	e150	e137	e2500	1460	3380	783	322	531
17	415	341	e225	e185	e150	e137	e3150	1410	2940	757	319	522
18	415	375	e225	e185	e150	e137	e4200	1340	2420	735	315	511
19	421	444	e220	e185	e150	e137	e5000	1290	1940	675	317	500
20	428	e480	e220	e185	e150	e137	e5500	1360	1570	631	321	498
21	433	e510	e215	e180	e145	e137	e5400	1430	1380	582	321	517
22	434	e520	e215	e180	e145	e137	e4500	1360	2530	537	327	532
23	440	e530	e210	e180	e145	e137	e4400	1300	4420	496	336	582
24	475	e530	e210	e180	e145	e145	e4300	1290	4530	466	344	626
25	493	e530	e210	e175	e145	e155	e4200	1600	3950	443	343	622
26	491	e520	e205	e175	e145	e175	e4000	1900	3460	414	344	599
27	483	e520	e205	e175	e140	e190	e3800	2000	2950	387	342	570
28	479	e510	e205	e175	e140	e230	3730	1940	2460	367	355	546
29	400	e490	e200	e175	---	e300	3380	1970	2090	353	364	537
30	339	e480	e200	e170	---	e400	3100	2180	2350	349	389	534
31	370	---	e200	e170	---	e600	---	2320	---	352	425	---
TOTAL	16100	13666	8393	5780	4330	5355	87160	57700	69200	30332	11062	16670
MEAN	519	456	271	186	155	173	2905	1861	2307	978	357	556
MAX	871	530	460	200	170	600	5500	2880	4530	2600	425	664
MIN	339	321	200	170	140	137	800	1290	1070	349	315	446
AC-FT	31930	27110	16650	11460	8590	10620	172900	114400	137300	60160	21940	33060
CFSM	.36	.31	.19	.13	.11	.12	1.99	1.27	1.58	.67	.24	.38
IN.	.41	.35	.21	.15	.11	.14	2.22	1.47	1.76	.77	.28	.42

CAL YR 1988 TOTAL 157312 MEAN 430 MAX 3800 MIN 35 AC-FT 312000 CFSM .29 IN. 4.01
WTR YR 1989 TOTAL 325748 MEAN 892 MAX 5500 MIN 137 AC-FT 646100 CFSM .61 IN. 8.30

e Estimated

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN

(International gaging station)

LOCATION.--Lat 48°38'04", long 93°54'47", in NW¼SE¼ sec.36, T.160 N., R.26 W., Koochiching County, Hydrologic Unit 09030004, on left bank at Manitou Rapids, 4 mi west of Indus.

DRAINAGE AREA.--19,400 mi^2, approximately.

WATER-DISCHARGE RECORDS

PERIOD OF RECORD.--July 1928 to current year. Monthly discharge only for some periods, published in WSP 1308. October 1911 to October 1924 (gage heights only) at site near Birchdale in files of U.S. Army Corps of Engineers Published as "near Birchdale" 1932-34.

GAGE.--Water-stage recorder. Datum of gage is 1,062.48 ft above National Geodetic Vertical Datum of 1929. Prior to Nov. 10, 1934, nonrecording gage at site near Birchdale, 7 mi. downstream at different datum.

REMARKS.--Records good. Satellite telemeter at station. Diurnal fluctuation caused by powerplant at International Falls. Some regulation at low and medium flows by Rainy and Namakan Lakes.

COOPERATION.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.

AVERAGE DISCHARGE.--61 years, 12,900 ft^3/s, 9.03 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 71,600 ft^3/s, May 12, 1950, gage height, 21.04 ft; minimum daily, 928 ft^3/s, Dec. 26, 1929.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 38,500 ft^3/s, June 27, gage height, 14.04 ft; minimum, 3,960 ft^3/s, Aug. 25, 26, gage height, 1.85 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	32900	11100	e18000	e12000	e13500	e9000	e9500	20500	30700	37400	7510	5520
2	32600	11100	e18000	e10500	e13000	e9000	e10000	19600	30300	37900	7490	7220
3	32000	10800	e17500	e10500	e13000	e9000	10200	18800	29800	37500	7630	8640
4	31700	10300	e17500	e12000	e13000	e9000	10900	18100	29100	36300	7800	8540
5	31200	10100	e17300	e12000	e13000	e9000	11600	17600	28100	35000	9830	6250
6	29700	9980	e17200	e12000	e13000	e9000	12200	17600	25800	35900	11300	7750
7	28300	9920	e17000	e12000	e13000	e9000	12900	17500	22200	35500	11600	9120
8	24100	10400	e17000	e12000	e13000	e9000	13600	17100	20600	34400	11600	9740
9	22400	10700	e16900	e12000	e13000	e9000	14400	16300	20200	33400	11500	9870
10	21800	10800	e16500	e12000	e13000	e9000	14600	16100	20500	32400	11400	9790
11	19700	10600	e15500	e12000	e12500	e9000	14400	15900	20800	31500	11300	9630
12	18400	10200	e15000	e13000	e11500	e9000	13300	16000	20900	30800	9310	8490
13	18000	10000	e15000	e14000	e11500	e9000	12600	19400	21000	30200	7800	7550
14	17800	9960	e15000	e15000	e11500	e9000	12400	20300	20300	29800	7400	7190
15	17700	9710	e15000	e15500	e11500	e9000	12400	20100	22300	29300	7280	7150
16	17600	8290	e15000	e15500	e11500	e9000	13700	20100	23600	28800	7200	7270
17	17600	10100	e14800	e15500	e11500	e9000	15600	22900	23200	28300	7040	6990
18	17600	11300	e14800	e15500	e11500	e9000	17900	23900	21800	27600	6530	6850
19	17500	11500	e14800	e15500	e11500	e9000	20800	24200	20000	24700	6340	6710
20	17500	11800	e14000	e15500	e11500	e9000	23800	25900	18500	23300	6350	6710
21	17300	12100	e13000	e15500	e10500	e9000	26800	26800	19700	22400	6380	6690
22	15300	12200	e13000	e15500	e9000	e8000	31800	26900	23300	19200	6360	6650
23	14200	12200	e13000	e15500	e9000	e8000	28700	26700	31800	17800	6240	6800
24	14000	12400	e12800	e15500	e9000	e9000	26800	26600	36800	17400	5110	6710
25	13000	16000	e12500	e14500	e9000	e9000	26200	26900	37900	17200	4190	6740
26	12500	17600	e10000	e13500	e9000	e9000	26600	27900	37800	16900	4440	6920
27	11800	17800	e11000	e13500	e9000	e6000	26000	29500	38400	14000	5000	6900
28	11600	18500	e11800	e13500	e9000	e7000	24700	30000	38200	12000	5250	6830
29	11400	18500	e11800	e13500	---	e9000	23200	29900	37000	9610	5360	6870
30	11200	e18300	e12000	e13500	---	e9000	21700	30200	36900	7990	5440	6790
31	10900	---	e12200	e13500	---	e9000	---	30700	---	7600	5510	---
TOTAL	609300	364260	454900	421500	320000	272000	539300	700000	807500	802100	233490	224880
MEAN	19650	12140	14670	13600	11430	8774	17980	22580	26920	25870	7532	7496
MAX	32900	18500	18000	15500	13500	9000	31800	30700	38400	37900	11600	9870
MIN	10900	8290	10000	10500	9000	6000	9500	15900	18500	7600	4190	5520
AC-FT	1209000	722500	902300	836000	634700	539500	1070000	1388000	1602000	1591000	463100	446000
CFSM	1.01	.63	.76	.70	.59	.45	.93	1.16	1.39	1.33	.39	.39
IN.	1.17	.70	.87	.81	.61	.52	1.03	1.34	1.55	1.54	.45	.43

CAL YR 1988 TOTAL 4000490 MEAN 10930 MAX 43700 MIN 3320 AC-FT 7935000 CFSM .56 IN. 7.67
WTR YR 1989 TOTAL 5749230 MEAN 15750 MAX 38400 MIN 4190 AC-FT 11400000 CFSM .81 IN. 11.02

e Estimated

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN--Continued
(National stream-quality network station)

WATER-QUALITY RECORDS

PERIOD OF RECORD.--Water years 1968-70, 1978 to current year.

REMARKS.--Letter K indicates non-ideal colony count.

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	DIS-CHARGE, IN CUBIC FEET PER SECOND (00060)	DIS-CHARGE, INST. CUBIC FEET PER SECOND (00061)	SPE-CIFIC CON-DUCT-ANCE (US/CM) (00095)	SPE-CIFIC CON-DUCT-ANCE LAB (US/CM) (90095)	PH (STAND-ARD UNITS) (00400)	PH LAB (STAND-ARD UNITS) (00403)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)	OXYGEN, DIS-SOLVED (MG/L) (00300)	COLI-FORM, FECAL, 0.7 UM-MF (COLS./ 100 ML) (31625)
OCT												
25...	1400	--	12800	71	77	7.7	7.9	4.5	4.1	763	11.6	K2200
JAN												
30...	1130	13500	--	45	83	6.7	7.6	0.0	1.5	755	15.1	41
MAR												
07...	1600	9000	--	74	83	7.3	7.5	0.0	1.6	767	13.1	K460
APR												
24...	1430	--	26300	112	99	7.6	7.7	1.5	37	762	13.2	390
JUN												
05...	1130	--	28400	65	69	7.2	7.2	12.5	1.5	760	10.9	76
AUG												
28...	1300	--	5340	100	89	7.3	7.6	20.0	1.2	766	6.9	K34

DATE	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY WAT DIS TOT IT FIELD MG/L AS CACO3 (39086)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	CAR-BONATE WATER DIS IT FIELD MG/L AS CO3 (00452)	BICAR-BONATE WATER DIS IT FIELD MG/L AS HCO3 (00453)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)
OCT												
25...	88	9.1	2.8	2.8	0.8	27	28	0	32	10	3.1	0.1
JAN												
30...	K17	9.5	2.9	3.0	1.2	34	30	0	41	11	2.7	0.2
MAR												
07...	180	9.7	2.8	3.8	0.9	29	30	0	35	12	4.2	0.1
APR												
24...	250	12	3.8	2.3	1.3	36	41	0	44	13	3.1	0.1
JUN												
05...	K17	8.5	2.6	2.3	0.7	25	27	0	31	5.0	2.7	0.1
AUG												
28...	64	9.0	2.6	5.2	0.8	29	27	0	35	5.0	5.5	0.1

DATE	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHORUS TOTAL (MG/L AS P) (00665)	PHOS-PHORUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHORUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT												
25...	2.7	59	<0.01	0.27	<0.01	<0.01	0.6	0.02	0.02	<0.01	12	51
JAN												
30...	3.9	57	<.01	<.10	.05	.05	.6	.02	.02	.02	5	75
MAR												
07...	4.4	66	<.01	.97	<.01	<.01	1.0	.03	.02	<.01	4	70
APR												
24...	6.4	96	<.01	<.10	.07	.06	.9	.12	.08	.02	121	98
JUN												
05...	3.4	56	<.01	<.10	.05	.02	<.6	.02	.01	.01	--	--
AUG												
28...	2.8	83	<.01	<.10	.06	.06	.5	.04	.02	.02	8	79

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	TIME	ALUMINUM, DISSOLVED (UG/L AS AL) (01106)	ARSENIC DISSOLVED (UG/L AS AS) (01000)	BARIUM, DISSOLVED (UG/L AS BA) (01005)	BERYLLIUM, DISSOLVED (UG/L AS BE) (01010)	CADMIUM DISSOLVED (UG/L AS CD) (01025)	CHROMIUM, DISSOLVED (UG/L AS CR) (01030)	COBALT, DISSOLVED (UG/L AS CO) (01035)	COPPER, DISSOLVED (UG/L AS CU) (01040)	IRON, DISSOLVED (UG/L AS FE) (01046)	LEAD, DISSOLVED (UG/L AS PB) (01049)
OCT											
25...	1400	30	<1	15	<0.5	<1	<1	<3	2	120	<5
MAR											
07...	1600	40	<1	15	<.5	<1	<1	<3	2	130	<5
APR											
24...	1430	80	<1	18	<.5	<1	2	<3	4	200	<5
AUG											
28...	1300	40	<1	14	<.5	<1	<1	<3	7	74	2

DATE	LITHIUM DISSOLVED (UG/L AS LI) (01130)	MANGANESE, DISSOLVED (UG/L AS MN) (01056)	MERCURY DISSOLVED (UG/L AS HG) (71890)	MOLYBDENUM, DISSOLVED (UG/L AS MO) (01060)	NICKEL, DISSOLVED (UG/L AS NI) (01065)	SELENIUM, DISSOLVED (UG/L AS SE) (01145)	SILVER, DISSOLVED (UG/L AS AG) (01075)	STRONTIUM, DISSOLVED (UG/L AS SR) (01080)	VANADIUM, DISSOLVED (UG/L AS V) (01085)	ZINC, DISSOLVED (UG/L AS ZN) (01090)
OCT										
25...	<4	10	--	<10	3	<1	<1.	27	<6	14
MAR										
07...	<4	9	<.1	<10	1	<1	1.	26	<6	14
APR										
24...	<4	22	<.1	<10	3	<1	<1.	25	<6	5
AUG										
28...	<4	6	<.1	<10	<1	<1	<1.	26	<6	14

LAKE OF THE WOODS BASIN

05140520 LAKE OF THE WOODS AT WARROAD, MN

(International gaging station)

LOCATION.--Lat 48°54'15", long 95°18'57", in SW¼SE¼ sec.29, T.163 N., R.36 W., Roseau County, Hydrologic Unit 09030009, on left bank of Warroad River in Warroad, 300 ft downstream from Canadian National railroad bridge, 1,000 ft downstream from bridge on State Highway 11, and 4,000 ft upstream from mouth of Warroad River.

DRAINAGE AREA.--27,200 mi^2.

PERIOD OF RECORD.--April to September 1978 (monthend elevations only), October 1978 to current year. Records collected prior to April 1978 are in reports of the Water Survey of Canada.

GAGE.--Water-stage recorder. Datum of gage is 1,000.00 ft, Lake of the Woods datum.

REMARKS.--Runoff conditions of the Warroad River can affect water levels obtained at this station. Water level subject to fluctuation caused by change in direction and velocity of wind and seiches.

COOPERATION.--This station is one of the international gaging stations maintained by the United States under agreement with Canada.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 62.38 ft, July 15, 1989; maximum daily, 61.84 ft, Sept. 12, 1978; minimum gage height recorded, 55.94 ft, Sept. 4, 1980; minimum daily recorded, 56.52 ft, Apr. 15, 1981.

EXTREMES FOR CURRENT YEAR.--Maximum gage height, 62.38 ft, July 5; maximum daily, 62.72 ft, June 13; minimum, 58.87 ft, Sept. 24; minimum daily, 59.09 ft, Apr. 14.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59.71	59.94	59.81	59.90	59.98	59.62	59.17	59.66	60.46	61.42	60.53	60.08
2	59.74	59.83	59.80	59.91	59.99	59.61	59.14	59.70	60.62	61.36	60.54	60.03
3	59.88	59.94	59.80	59.89	59.97	59.61	59.17	59.71	60.62	61.35	60.71	60.00
4	59.91	60.21	59.83	59.92	59.98	59.58	59.15	59.72	60.71	61.42	60.55	59.78
5	59.79	60.20	59.83	59.89	59.97	59.55	59.13	60.06	60.66	61.56	60.68	59.91
6	59.74	59.95	59.82	59.90	59.96	59.56	59.12	59.90	60.82	61.63	60.64	59.89
7	59.79	59.85	59.83	59.93	59.95	59.54	59.13	59.82	61.42	61.58	60.55	59.71
8	59.94	59.68	59.84	59.90	59.94	59.52	59.11	59.83	60.99	61.53	60.49	59.68
9	59.86	59.80	59.85	59.92	59.94	59.52	59.10	59.85	60.79	61.56	60.51	59.72
10	60.04	59.81	59.84	59.91	59.92	59.49	59.11	59.89	60.82	61.58	60.50	59.82
11	60.03	59.69	59.87	59.93	59.90	59.46	59.11	59.84	60.83	61.67	60.48	59.87
12	59.95	59.74	59.85	59.90	59.91	59.44	59.11	59.91	61.03	61.58	60.43	59.79
13	59.84	59.70	59.86	59.92	59.89	59.40	59.11	59.92	61.72	61.55	60.63	59.45
14	59.95	59.77	59.86	59.91	59.88	59.39	59.09	59.92	61.02	61.50	60.53	59.64
15	59.92	60.01	59.85	59.92	59.88	59.38	59.14	59.93	61.00	61.45	60.39	59.60
16	59.91	59.91	59.86	59.94	59.86	59.34	59.15	59.94	61.03	61.44	60.37	59.76
17	60.01	59.77	59.87	59.97	59.84	59.33	59.14	59.92	61.00	61.40	60.31	59.69
18	59.93	59.83	59.87	59.95	59.82	59.31	59.13	60.02	60.99	61.45	60.29	59.48
19	59.95	59.81	59.91	59.97	59.80	59.30	59.18	60.05	61.05	61.35	60.29	59.67
20	59.77	59.79	59.88	59.99	59.80	59.26	59.23	60.00	61.00	61.29	60.29	59.68
21	59.97	59.82	59.91	59.99	59.77	59.25	59.27	60.14	61.14	61.27	60.33	59.74
22	59.87	59.81	59.92	59.99	59.76	59.26	59.35	60.19	61.15	61.20	60.33	59.71
23	59.87	59.83	59.86	59.98	59.77	59.24	59.38	60.22	61.18	61.11	60.29	59.57
24	59.90	59.81	59.87	60.00	59.74	59.20	59.41	60.38	61.20	61.04	60.19	59.14
25	59.83	59.75	59.87	60.01	59.69	59.20	59.44	59.93	61.32	60.92	60.13	59.46
26	59.87	59.83	59.92	59.99	59.68	59.18	59.49	60.42	61.14	60.93	60.12	59.48
27	60.07	59.78	59.89	60.00	59.69	59.15	59.56	60.37	61.24	61.03	60.11	59.28
28	59.81	59.81	59.88	59.97	59.64	59.20	59.58	60.57	61.49	60.89	60.14	59.39
29	59.87	59.79	59.92	60.00	---	59.21	59.64	60.71	61.46	60.84	59.73	59.45
30	59.83	59.79	59.90	60.00	---	59.18	59.63	60.54	61.43	60.74	60.11	59.37
31	59.97	---	59.92	60.01	---	59.17	---	60.54	---	60.67	60.25	---
MEAN	59.89	59.84	59.86	59.95	59.85	59.37	59.25	60.05	61.04	61.30	60.37	59.66
MAX	60.07	60.21	59.92	60.01	59.99	59.62	59.64	60.71	61.72	61.67	60.71	60.08
MIN	59.71	59.68	59.80	59.89	59.64	59.15	59.09	59.66	60.46	60.67	59.73	59.14

WTR YR 1989 MEAN 60.04 MAX 61.72 MIN 59.09

LAKE OF THE WOODS BASIN

05140521 LAKE OF THE WOODS AT SPRINGSTEEL ISLAND NEAR WARROAD, MN

LOCATION.--Lat 48°56'45", long 95°18'24", in SW¼SW¼ sec.9, T.163 N., R.36 W., Roseau County, Hydrologic Unit 09030009, at Springsteel Resort on Springsteel Island, 2.8 mi north of Warroad.

DRAINAGE AREA.--27,200 mi^2.

PERIOD OF RECORD.--June 1985 to current year.

GAGE.--Water-stage recorder. Datum at gage is 1,000.00 ft, Lake of the Woods datum.

REMARKS.--Satellite telemeter at station. Water level subject to fluctuation caused by changes in direction and velocity of wind and seiches.

EXTREMES FOR PERIOD OF RECORD.--Maximum gage height, 62.24 ft, July 5, 1989; maximum daily, 61.81 ft, July 6, 7, 1985; minimum, 57.42 ft, Mar. 17, 18, 19, 20, 22, 25, 1988; minimum daily, 57.43 ft, Mar. 18, 19, 20, 1988.

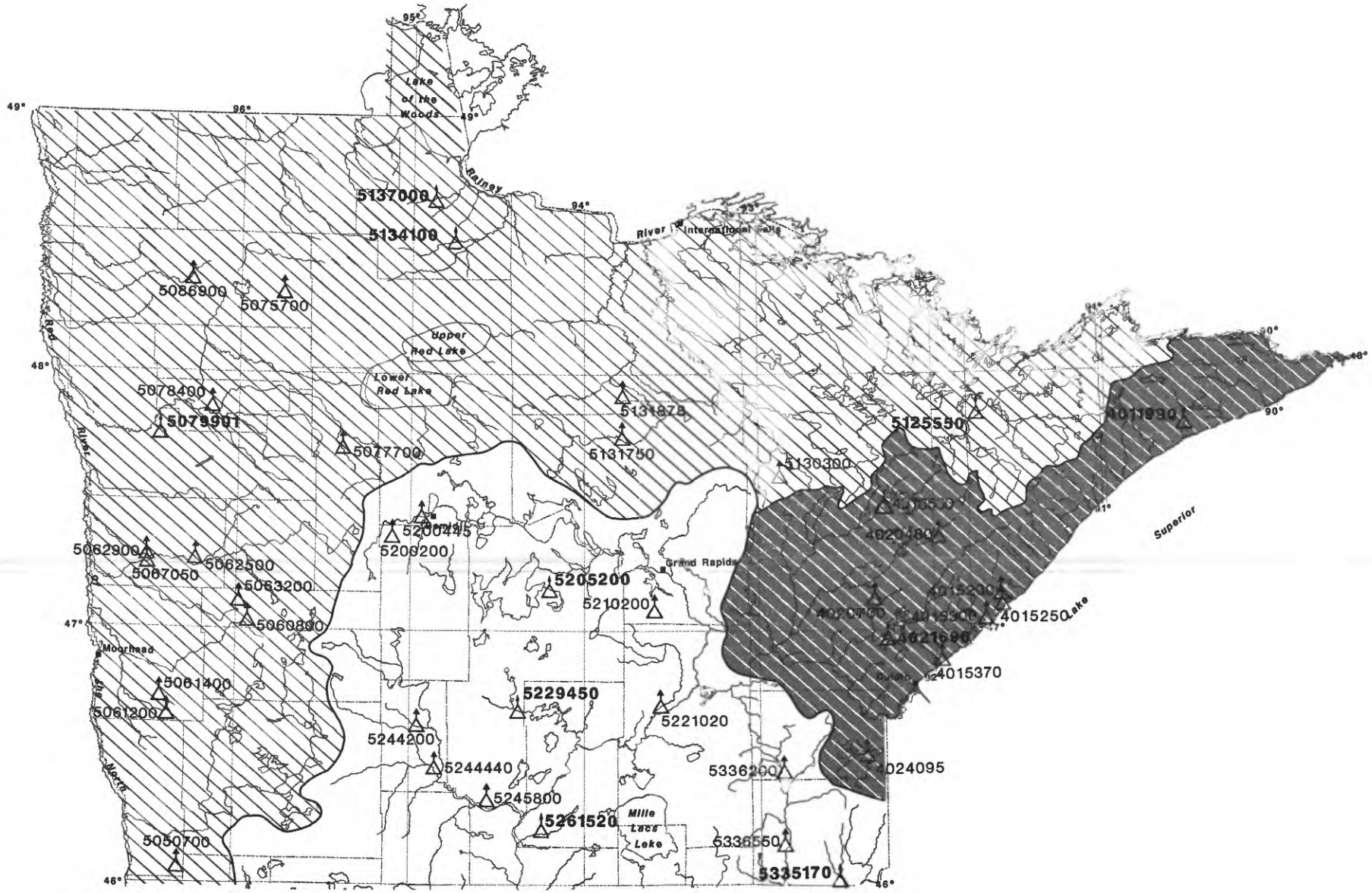
EXTREMES FOR CURRENT YEAR.--Maximum gage height, 62.24 ft, July 5; maximum daily, 61.65 ft, July 11; minimum, 59.04 ft, Sept. 24; minimum daily, 59.07 ft, Apr. 14.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	59.71	59.91	59.80	59.87	59.95	59.59	59.16	59.66	---	61.42	60.59	60.03
2	59.75	59.83	59.79	59.87	59.95	59.58	59.14	59.69	---	61.37	60.58	59.99
3	59.83	59.91	59.79	59.86	59.93	59.58	59.15	59.71	---	61.35	60.70	60.00
4	59.89	60.13	59.81	59.88	59.94	59.55	59.13	59.70	---	61.43	60.57	59.79
5	59.81	60.10	59.83	59.86	59.94	59.52	59.12	59.92	---	61.55	60.62	59.91
6	59.77	59.91	59.82	59.88	59.94	59.54	59.11	59.87	---	61.61	60.60	59.90
7	59.81	59.83	59.82	59.91	59.93	59.52	59.11	59.81	---	61.57	60.52	59.73
8	59.94	59.67	59.82	59.87	59.91	59.51	59.09	59.83	---	61.52	60.46	59.69
9	59.88	59.78	59.82	59.87	59.92	59.51	59.09	59.84	60.80	61.53	60.49	59.72
10	59.99	59.78	59.81	59.86	59.91	59.48	59.09	59.89	60.84	61.55	60.49	59.79
11	60.02	59.69	59.84	59.90	59.89	59.45	59.09	59.88	60.85	61.65	60.47	59.85
12	59.97	59.73	59.83	59.87	59.91	59.44	59.09	59.92	61.03	61.57	60.43	59.76
13	59.88	59.68	59.84	59.90	59.88	59.39	59.10	59.92	61.61	61.54	60.58	59.48
14	59.97	59.75	59.83	59.90	59.86	59.37	59.07	---	61.01	61.48	60.49	59.63
15	59.94	59.97	59.81	59.89	59.85	59.35	59.10	---	60.99	61.42	60.37	59.64
16	59.92	59.79	59.83	59.92	59.83	59.31	59.09	---	61.02	61.42	60.35	59.74
17	59.98	59.74	59.84	59.94	59.81	59.31	59.10	---	60.99	61.38	60.33	59.73
18	59.93	59.81	59.85	59.94	59.79	59.29	59.11	---	60.98	61.43	60.33	59.59
19	59.94	59.79	59.88	59.96	59.79	59.29	59.15	---	61.04	61.36	60.27	59.67
20	59.81	59.77	59.86	59.95	59.78	59.24	59.20	---	61.02	61.30	60.19	59.68
21	59.94	59.80	59.88	59.97	59.75	59.24	59.24	---	61.11	61.28	60.26	59.73
22	59.92	59.80	59.90	59.97	59.73	59.25	59.32	---	61.13	61.21	60.29	59.65
23	59.85	59.81	59.85	59.96	59.75	59.24	59.36	---	61.16	61.13	60.27	59.58
24	59.88	59.80	59.84	59.97	59.74	59.19	59.40	---	61.18	61.06	60.19	59.24
25	59.79	59.74	59.84	59.99	59.68	59.19	59.44	---	61.30	60.95	60.14	59.44
26	59.84	59.81	59.88	59.97	59.66	59.17	59.49	---	61.14	60.94	60.12	59.49
27	59.99	59.77	59.87	59.99	59.67	59.14	59.54	---	61.22	61.01	60.11	59.36
28	59.77	59.78	59.85	59.96	59.62	59.19	59.57	---	61.46	60.90	60.15	59.41
29	59.84	59.77	59.88	59.98	---	59.19	59.63	---	61.44	60.86	59.69	59.46
30	59.82	59.77	59.87	59.99	---	59.16	59.63	---	61.42	60.74	60.05	59.43
31	59.93	---	59.88	59.99	---	59.15	---	---	---	60.69	60.18	---
MEAN	59.88	59.81	59.84	59.92	59.83	59.35	59.23	---	---	61.30	60.35	59.67
MAX	60.02	60.13	59.90	59.99	59.95	59.59	59.63	---	---	61.65	60.70	60.03
MIN	59.71	59.67	59.79	59.86	59.62	59.14	59.07	---	---	60.69	59.69	59.24

PARTIAL-RECORD STATIONS

Discharge measurements of the Embarrass River at Embarrass, Minnesota. Ca. 1935.


Lake of the Woods
Rainy River
International Falls
Red River
Upper Red Lake
Lower Red Lake
Grand Rapids
Moorhead
Superior Lake
Mille Lacs Lake
5137000
5134100
5086900
5075790
5078400
5079901
5077700
5131878
5131750
5125550
5130390
4011990
4020480
4015250
4021690
4015370
5200445
5200200
5205200
5210200
5062900
5067050
5062500
5063200
5060800
5061400
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5244440
5245800
5261520
5336200
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5050700

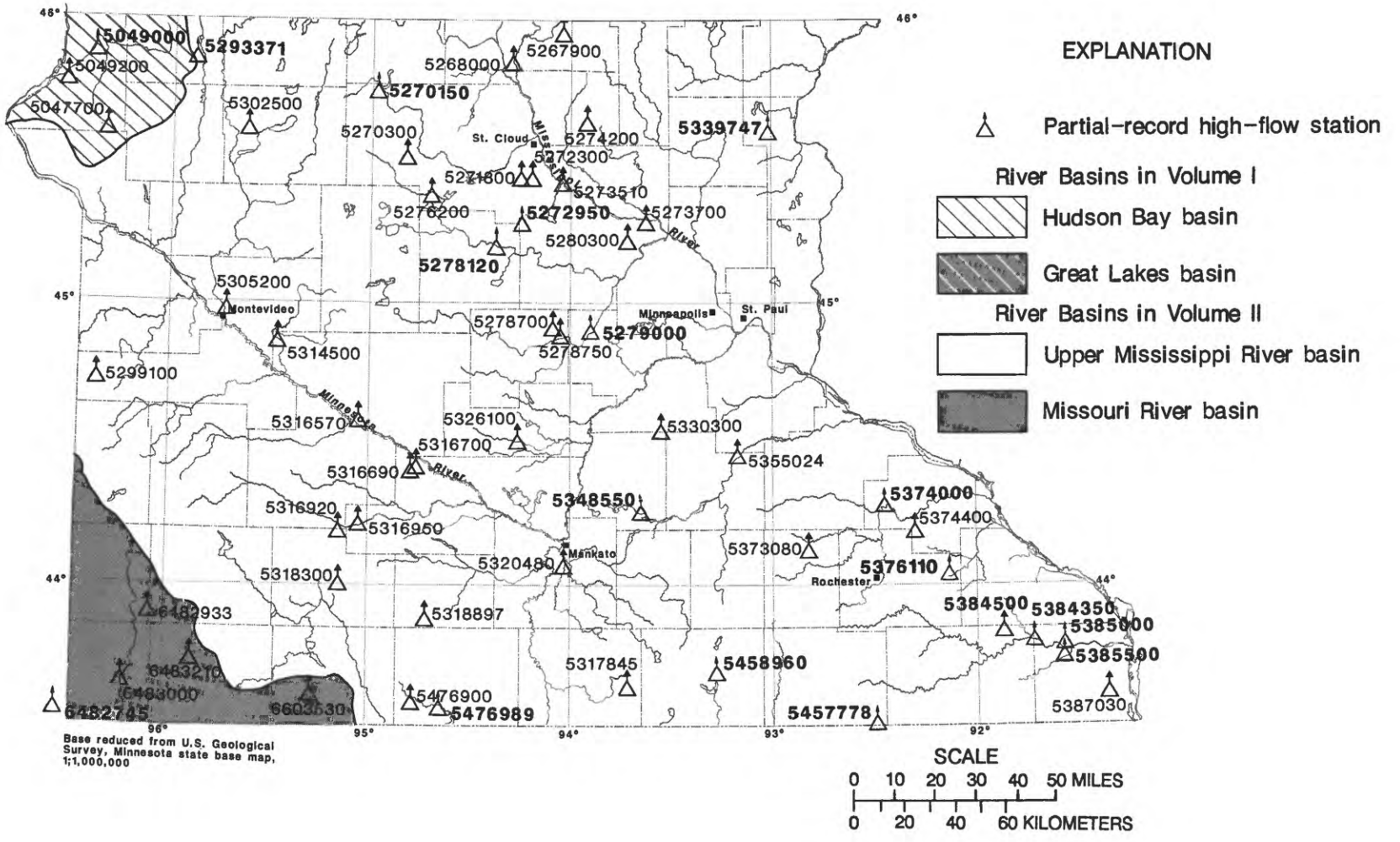


Figure 9.--Location of high-flow partial-record stations

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

As the number of streams on which streamflow information is likely to be desired far exceeds the number of stream-gaging stations feasible to operate at one time, the Geological Survey collects limited streamflow data at sites other than stream-gaging stations. When limited streamflow data are collected on a systematic basis over a period of years for use in hydrologic analyses, the site at which the data are collected is called a partial-record station. Data collected at these partial-record stations are usable in low-flow or flood-flow analyses, depending on the type of data collected. In addition, discharge measurements are made at other sites not included in the partial-record program. These measurements are generally made in times of drought or flood to give better areal coverage to those events. Those measurements and others collected for some special reason are called measurements at miscellaneous sites.

Records collected at partial-record stations are presented in two tables. The first is a table of annual maximum stage and discharge at crest-stage stations. Discharge measurements made at miscellaneous sites for both low flow and high flow are given in a second table.

High-flow partial-record stations

The following table contains annual maximum discharge for high-flow stations. A high-flow partial-record station is equipped with a crest-stage gage, a device which will register the peak stage occurring between inspections of the gage. A stage-discharge relation for each gage is developed from discharge measurements made by indirect measurements of peak flow or by current meter. The date of the maximum discharge is not always certain but is usually determined by comparison with nearby continuous-record stations, weather records, or local inquiry. Only the maximum discharge for each water year is given. Information on some lower floods may have been obtained, and discharge measurements may have been made for purposes of establishing the stage-discharge relation, but these are not published herein. The years given in the period of record represent water years for which the annual maximum has been determined.

Annual maximum discharge at high-flow partial-record stations during water year 1989

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Annual maximum Date	Gage height (feet)	Discharge (ft^3/s)
		Streams tributary to Lake Superior					
04011990	Cascade River near Grand Marais, MN	Lat 47°47'24", long 90°31'35", in SE¼ sec.1, T.61 N., R.2 W., Cook County, Hydrologic Unit 04010101, at bridge on Forest Road 45, 6.6 miles upstream from mouth, 9.5 miles west of Grand Marais.	-	1985-89	4-27-89	a11.45	660
04015200	Encampment River tributary at Silver Creek, MN	Lat 47°07'01", long 91°36'04", in NE¼SE¼ sec.33, T.54 N., R.10 W., Lake County, Hydrologic Unit 04010102, at culvert on County Highway 3, 0.3 mile north of Silver Creek, 1.4 miles upstream from mouth, 7.2 miles northeast of Two Harbors.	.96	1960-89	4-16-89	ab9.19	48
04015250	Silver Creek tributary near Two Harbors, MN	Lat 47°04'40", long 91°36'49", in SW¼NE¼ sec.16, T.53 N., R.10 W., Lake County, Hydrologic Unit 04010102, at culvert on County Highway 3, 1.0 mile upstream from mouth, 4.5 miles northeast of Two Harbors.	3.72	1965-89	4-23-89	ab4.37	135
04015300	Little Stewart River near Two Harbors, MN	Lat 47°03'52", long 91°40'03", in SE¼NE¼ sec.24, T.53 N., R.11 W., Lake County, Hydrologic Unit 04010102, at culvert on County Highway 2, 2.0 miles upstream from mouth, 2.7 miles north of Two Harbors.	5.54	1960-89	4-16-89	a11.25	144
04015370	Talmadge River at Duluth, MN	Lat 46°53'20", long 91°55'21", in SE¼NE¼ sec.24, T.51 N., R.13 W., St. Louis County, Hydrologic Unit 04010102, at culvert on U.S. Highway 61, 0.6 mile upstream from mouth, 0.5 mile northeast of Duluth city limits.	5.79	1964-89	4-16-89	a14.58	187
04016500	St. Louis near Aurora, MN	Lat 47°29'30", long 92°14'20", in NW¼SW¼ sec.22, T.58 N., R.15 W., St. Louis County, Hydrologic Unit 04010201, on left bank at upstream side of County Highway 100 bridge, 0.8 mile downstream from Partridge River and 1.5 mile south of Aurora.	290	1942-87 1988-89	8-27-88 4-27-89	bc3.39 4.12	904 1,370

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1989--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Annual maximum Gage height Date	Gage height (feet)	Discharge (ft^3/s)
		Streams tributary to Lake Superior--Continued					
04020480	North Branch Whiteface River near Fairbanks, MN	Lat 47°22'20", long 91°56'28", in NW¼NW¼ sec.1, T.56 N., R.13 W., , St. Louis County, Hydrologic Unit 04010201, on right downstream wing wall of double box culvert on County Highway 16, 2 miles upstream from the mouth of Jenkins Creek, 0.7 mile west of Fairbanks.	17.1	1979-89	4-19-89	a12.58	215
04020700	Bug Creek at Shaw, MN	Lat 47°06'40", long 92°21'03", in SW¼SE¼ sec.34, T.54 N., R.16 W., St. Louis County, Hydrologic Unit 04010201, at left bank on downstream side of culverts on County Road 15 at Shaw, 7.5 miles upstream from mouth.	24.0	1979-89	4-18-89	a13.68	245
04021690	Cloquet River near Toimi, MN	Lat 47°21'00", long 91°39'30", in NE¼SW¼ sec.7, T.56 N., R.10 W., Lake County, Hydrologic Unit 04010202, at bridge on County Highway 2, 5.8 miles southeast of Toimi, 23 miles north of Two Harbors.	-	1986-89	4-5-89	7.08	505
04024095	Nemadji River near Holyoke, MN	Lat 46°31'04", long 92°23'22", in NE¼NE¼ sec.32, T.47 N., R.16 W., Carlton County, Hydrologic Unit 04010301, at bridge on State Highway 23, 3.5 miles north of Holyoke, 7 miles south of Wrenshall.	118	1972-89	4-5-89	a13.61	1,600
		Red River of the North basin					
05047700	West Branch Mustinka River tributary near Graceville, MN	Lat 45°36'53", long 96°19'47", in NE¼NW¼ sec.28, T.125 N., R.45 W., Traverse County, Hydrologic Unit 09020102, at culvert on township road, 6.0 miles northeast of Graceville.	3.37	1964-89	3-26-89	a10.12	232
05049000	Mustinka River above Wheaton, MN	Lat 45°49'15", long 96°29'25", in SW¼ sec.8, T.127 N., R.46 W., Traverse County, Hydrologic Unit 09020102, at bridge on U.S. Highway 75, one mile upstream from Chicago, Milwaukee and St. Paul railroad bridge, 0.5 mile north of Wheaton, about 8 miles above Lake Traverse.	834	1915-24#, 1930-58#, 1985-89	3-29-89	20.01	5,400
05049200	Eighteenmile Creek near Wheaton, MN	Lat 45°47'18", long 96°31'52", in NW¼NW¼ sec.25, T.127 N., R.47 W., Traverse County, Hydrologic Unit 09020102, at culvert on County Highway 7, 1.4 miles upstream from mouth, 2.0 miles southwest of Wheaton.	68.5	1965-68, 1970-89	3-26-89	13.24	740
05050700	Rabbit River near Nashua, MN	Lat 46°04'30", long 96°18'24", in SE¼NE¼ sec.15, T.130 N., R.45 W., Wilkin County, Hydrologic Unit 09020101, at right downstream piling of bridge on County Road 19, 2.6 miles north of Nashua, 4.8 miles upstream from mouth of South Fork Rabbit River.	56.1	1979-89	3-27-89	a15.08	760
05060800	Buffalo River near Callaway, MN	Lat 47°01'17", long 95°54'43", in SW¼SW¼ sec.17, T.141 N., R.41 W., Becker County, Hydrologic Unit 09020106, at culvert on U.S. Highway 59, 2.7 miles north of Callaway.	94.5	1960-89	4-3-89	a14.99	290

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1989--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Date	Annual maximum Gage height (feet)	Annual maximum Discharge (ft^3/s)
		Red River of the North basin--Continued					
05061200	Whiskey Creek at Barnesville, MN	Lat 46°39'35", long 96°23'54", in SE¼SW¼ sec.20, T.137 N., R.45 W., Clay County, Hydrologic Unit 09020106, at culvert on State Highway 34, 0.7 mile upstream from Blue Eagle Lake, 1.0 mile northeast of Barnesville.	25.3	1961-64, 1965-66#, 1967-89	4-3-89	6.44	142
05061400	Spring Creek above Downer, MN	Lat 46°44'37", long 96°25'12", in NW¼NW¼ sec.30, T.138 N., R.45 W., Clay County, Hydrologic Unit 09020106, at culvert on county road, 3.1 miles east of Downer.	5.81	1961-89	3-27-89	a8.33	51
05062500	Wild Rice River at Twin Valley, MN	Lat 47°16'00", long 96°14'40", in NW¼NE¼ sec.27, T.144 N., R.44 W., Norman County, Hydrologic Unit 09020108, on left bank, 100 ft upstream from highway bridge on County Highway 29, 0.8 mile northeast of village of Twin Valley.	888	1909-17#, 1930-83#, 1985-89	4-5-89	a13.65	5,260
05062900	Wild Rice River above Ada, MN	Lat 47°17'29", long 96°26'09", in SE¼NE¼ sec.13, T.144 N., R.46 W., Norman County, Hydrologic Unit 09020108, at bridge on County Highway 24, 3.2 miles southeast of Ada.	-	1965-89	4-6-89	ab25.63	4,500
05063200	Spring Creek tributary near Ogema, MN	Lat 47°07'22", long 95°57'35", in SE¼SE¼ sec.11, T.142 N., R.42 W., Becker County, Hydrologic Unit 09020108, at culvert on township road, 2.0 miles northwest of Ogema.	4.99	1963-89	4-3-89	ab8.57	80
05067050	Marsh River Ditch near Ada, MN	Lat 47°17'46", long 96°26'09", in NE¼NE¼ sec.13, T.144 N., R.46 W., Norman County, Hydrologic Unit 09020108, at bridge on County Highway 24, 3.5 miles southeast of Ada.	-	1985-89	4-6-89	b16.74	1,070
05075700	Mud River near Grygla, MN	Lat 48°19'31", long 95°44'35", in NE¼NE¼ sec.23, T.156 N., R.40 W., Hydrologic Unit 09020304, Marshall County, at bridge on State Highway 89, 6 miles west of Grygla.	170	1979-89	4-16-89	a16.93	1,000
05077700	Ruffy Brook near Gonvick, MN	Lat 47°44'50", long 95°24'45", in SE¼SE¼ sec.5, T.149 N., R.37 W., Clearwater County, Hydrologic Unit 09020305, on downstream side of double culverts on County Highway 17, 4.0 miles upstream from mouth, 4.8 miles east of Gonvick.	45.2	1960-78#, 1979-85, 1986,# 1987-89	4-5-89	a4.44	178
05078400	Clearwater River tributary near Plummer, MN	Lat 47°52'34", long 96°08'35", in SE¼SE¼ sec.22, T.151 N., R.43 W., Red Lake County, Hydrologic Unit 09020305, at culvert on County Highway 1, 1.2 miles upstream from mouth, 5.3 miles southwest of Plummer.	6.51	1961-89	4-9-89	a14.56	70

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1989--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Date	Annual maximum Gage height (feet)	Annual maximum Discharge (ft^3/s)
		Red River of the North basin--Continued					
05079901	Burnham Creek near Crookston, MN	Lat 47°43'59", long 96°39'52", in SE¼SW¼ sec.10, T.149 N., R.47 W., Polk County, Hydrologic Unit 09020303, at triple box culvert on U.S. Highway 75, 0.75 mile northeast of Girard, 3 miles southwest of Crookston, 7 miles above mouth.	d111	1986-89	3-29-86 3-22-87 4-4-88 4-4-89	a17.04 a15.77 a15.22 20.44	c450 c310 c190 1,900
05086900	Middle River near Newfolden, MN	Lat 48°22'04", long 96°16'47", in NE¼NE¼ sec.3, T.156 N., R.44 W., Marshall County, Hydrologic Unit 09020309, at bridge on township road, 2.0 miles northeast of Newfolden.	91.1	1979-89	4-17-89	15.93	600
		Lake of the Woods basin					
05125550	Stony River near Babbitt, MN	Lat 47°41'36", long 91°45'38", in SW¼SW¼ sec.8, T.60 N., R.11 W., Lake County, Hydrologic Unit 09030001, in Superior National Forest, at bridge on Forest Road 424, 4.7 miles upstream from mouth, 8.5 miles southeast of Babbitt.	219	1975-80#, 1986-89	4-28-89	7.38	1,450
05130300	Boriin Creek near Chisholm, MN	Lat 47°36'14", long 92°51'58", in SE¼SE¼ sec.9, T.59 N., R.20 W., St. Louis County, Hydrologic Unit 09030005, at culvert on State Highway 73, 1.3 miles upstream from mouth, 7.8 miles north of Chisholm.	13.7	1959-89	4-17-89	a12.39	140
05131750	Big Fork River near Bigfork, MN	Lat 47°44'56", long 93°46'31", in SW¼NE¼ sec.27, T.61 N., R.27 W., Itasca County, Hydrologic Unit 09030006, at bridge on State Highway 6, 5.5 miles west of Bigfork.	602	1973-89	6-22-89	b12.39	1,430
05131878	Bowerman Brook near Craigville, MN	Lat 47°55'29", long 93°45'34", in NE¼NW¼ sec.26, T.63 N., R.27 W., Koochiching County, Hydrologic Unit 09030006, at culvert on State Highway 6, 2.4 miles upstream from mouth, 7.0 miles west of Craigville.	25.0	1979-89	6-22-89	14.62	620
05134100	North Branch Rapid River near Baudette, MN	Lat 48°31'56", long 94°38'50", in NW¼SW¼ sec.4, T.158 N., R.31 W., Lake of the Woods County, Hydrologic Unit 09030007, at bridge on County Highway 1, 12.7 miles southwest of Baudette.	d18.0	1986-89	4-22-89	e<10.0	f600
05137000	Winter Road River near Baudette, MN	Lat 48°42'39", long 94°41'52", in NW¼NE¼ sec.1, T.160 N., R.32 W., Lake of the Woods County, Hydrologic Unit 0903008, at bridge on State Highway 11, 4.5 miles west of Baudette, 1.8 miles east of Pitt, 5 miles upstream of mouth.	d14.5	1986-89	4-18-89	9.62	370

< Less than, peak stage unknown, discharge estimated.
Operated as a continuous-record gaging station.
a Backwater from ice, discharge estimated.
b Not annual maximum gage height.
c Not published previously.
d Approximate.
e Peak stage did not reach bottom of pipe.
f Discharge estimated.

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measurements at miscellaneous sites

Measurements of streamflow at points other than gaging stations are given in the following table. The measurements of base flow are designated by an asterisk (*); measurements of peak flow by a dagger (†).

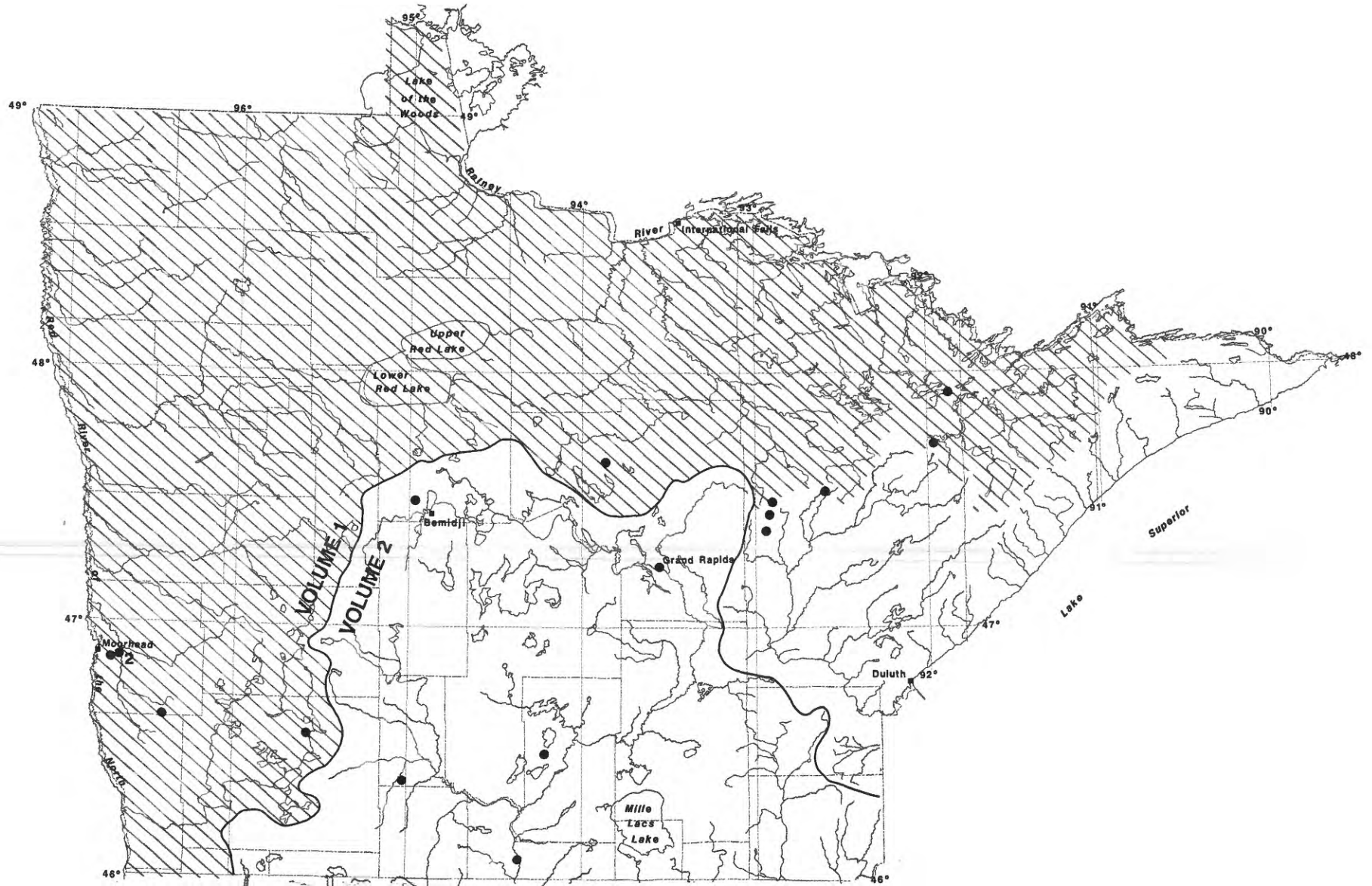
Discharge measurements made at miscellaneous sites during water year 1988

Stream	Tributary	Location	Drainage area (mi2)	Period of record	Date	Discharge (ft^3/s)
		Lake Superior basin				
Cloquet River	St. Louis River	Lat 46°57'29", long 92°27'34", in NW¼SE¼ sec.26, T.52 N., R.17 W., St. Louis County, Hydrologic Unit 04010202, at bridge #3232, on U.S. Highway 53, 0.1 mile southeast of Independence, 12 miles north of Cloquet, 1.7 miles northeast of Brookston (04023000).	a750	1909-17#, 1965, 1989	3-21-89	742

Operated as continuous-record gaging station.
a Approximately.

GROUND-WATER LEVELS

Installing a well at Leech Lake Indian Reservation, 1988.


95°
Lake
of the
Woods
49°
96°
Rainy
River
94°
93°
International Falls
92°
91°
90°
48°
Red
Upper
Red Lake
Lower
Red Lake
River
VOLUME 1
VOLUME 2
Bemidji
Grand Rapids
Superior
Lake
47°
Moorhead
Fargo
Red
River
of the
North
Duluth
Mille
Lacs
Lake
46°

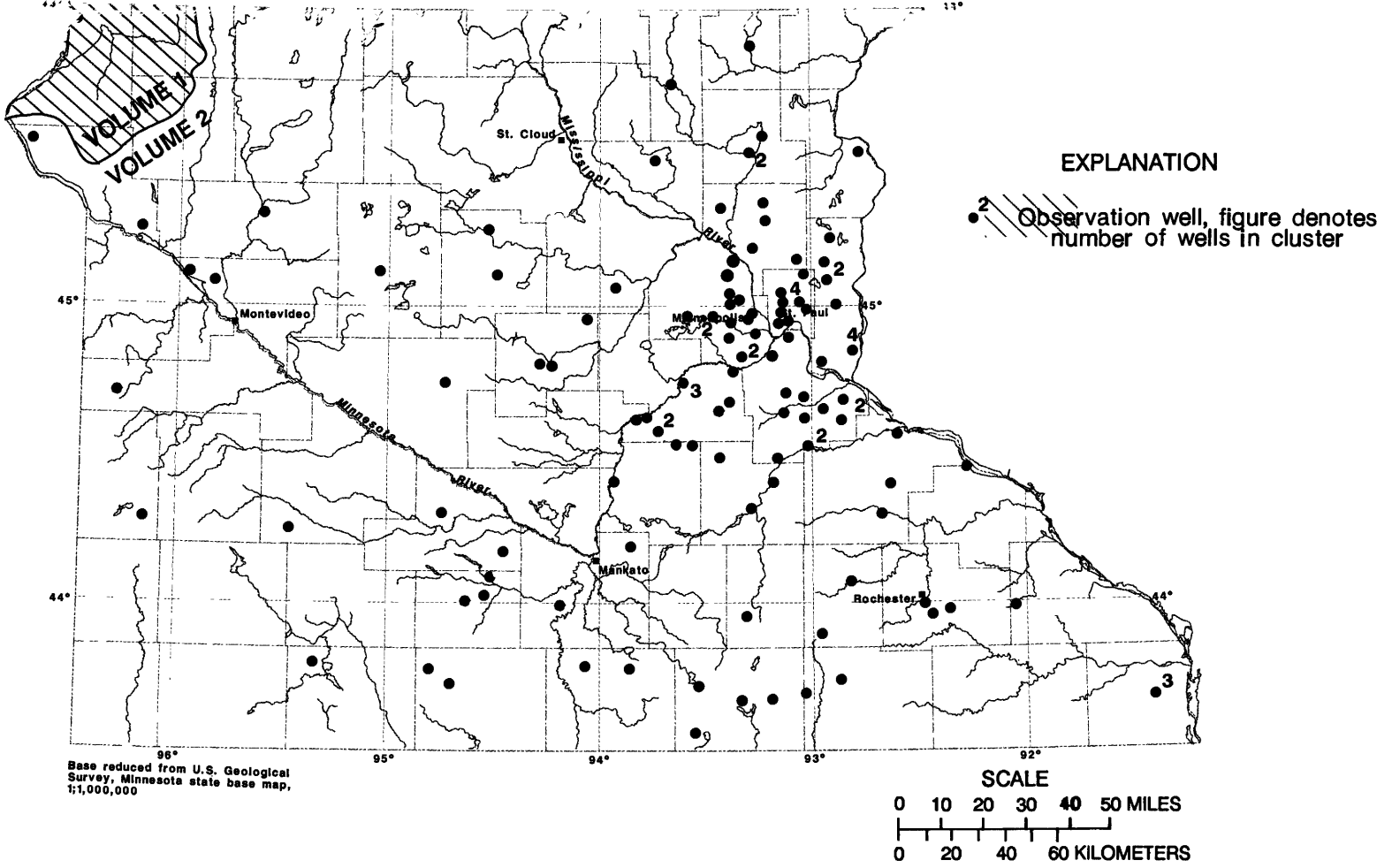


Figure 10.--Location of ground-water wells

CLAY COUNTY

463854096250701. Local number, 137N45W30CDB01.
LOCATION.--Lat 46°38'54", long 96°25'07", in NW¼SE¼SW¼ sec.30, T.137 N., R.45 W., Hydrologic Unit 09020106, in Barnesville.
Owner: City of Barnesville, well 3.
AQUIFER.--Surficial sand of Pleistocene Age.
ELL CHARACTERISTICS.--Drilled unused water-table well, diameter 10 in. (0.25 m), depth 73 ft (22.2 m).
DATUM.--Altitude of land-surface datum is 1,022 ft (312 m). Measuring point: Top of casing, 1.50 ft (0.46 m) above land-surface datum.
PERIOD OF RECORD.--January 1949 to January 1975, May 1980 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.86 ft (0.57 m) below land-surface datum, June 9, 1962; lowest, 11.86 ft (3.61 m) below land-surface datum, June 3, 1970.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 07	8.83	Dec. 02	8.75	Feb. 10	8.64	Apr. 07	7.50	Jun. 02	7.30	Aug. 04	8.12
14	8.80	16	8.72	24	8.67	14	7.33	09	7.26	11	8.24
21	8.90	Jan. 06	8.68	Mar. 03	8.65	21	7.28	16	7.23	25	8.30
Nov. 04	8.83	13	8.70	10	8.70	28	7.23	30	7.53	Sep. 01	8.25
11	8.88	20	8.70	17	8.60	May 05	7.23	Jul. 07	7.70	08	7.97
14	8.82	28	8.66	24	8.55	12	7.26	14	7.78	15	7.97
25	8.80					19	7.30	21	8.00	22	7.97
										29	7.88

465237096383901. Local number, 139N47W05CDC01.
LOCATION.--Lat 46°52'37", long 96°38'39", in SW¼SE¼SW¼ sec.5, T.139 N., R.47 W., Hydrologic Unit 09020104, 2.4 mi (3.9 km) east of Dilworth.
Owner: City of Moorhead, MS-1.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled observation water-table well, diameter 8 in. (0.20 m), depth 131 ft (39.9 m), slotted 91 to 107 ft (27.7 to 32.6 m).
DATUM.--Land-surface datum is 916.7 ft (279.4 m) National Geodetic Vertical Datum of 1929. Measuring point: Top of recorder floor, 3.60 ft (1.10 m) above land-surface datum.
REMARKS.--Water level affected by pumping from nearby wells.
PERIOD OF RECORD.--January 1947 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 12.19 ft (3.72 m) below land-surface datum, July 15, 1947; lowest, 32.94 ft (10.04 m) below land-surface datum, Aug. 24, 1988.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 22	31.76	Jan. 25	31.73	Mar. 27	30.38	May 23	30.55	Aug. 28	32.58

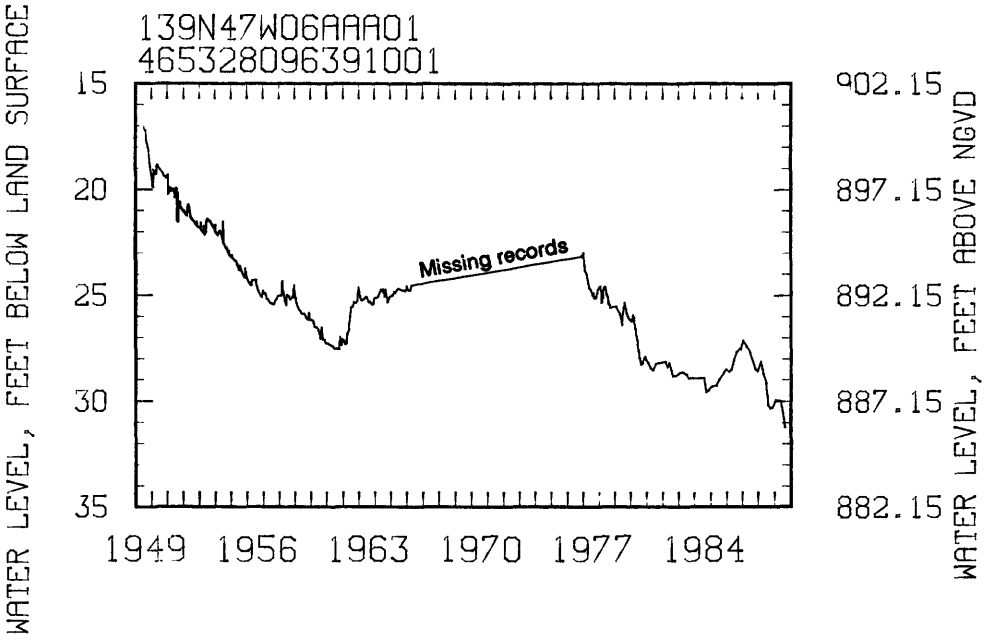
465328096391001. Local number, 139N47W06AAA01.
LOCATION.--Lat 46°53'27", long 96°39'08", in NE¼NE¼NE¼ sec.6, T.139 N., R.47 W., Hydrologic Unit 09020104, 2.7 mi (4.3 km) northeast of Dilworth.
Owner: U.S. Geological Survey, M-80.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled observation artesian well, diameter 3 in. (0.08 m), depth 103 ft (31.4 m), casing slotted near bottom.
DATUM.--Altitude of land-surface datum is 915 ft (279 m). Measuring point: Top of casing, 2.50 ft (0.76 m) above land-surface datum.
REMARKS.--Water level affected by pumping.
PERIOD OF RECORD.--July 1949 to April 1966, November 1976 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 16.94 ft (5.16 m) below land-surface datum, July 16, 1949; lowest, 31.27 ft (9.53 m) below land-surface datum, Aug. 28, 1989.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 22	30.30	Jan. 25	29.97	Mar. 27	30.00	May 23	30.05	Aug. 28	31.27

GROUND-WATER LEVELS

CLAY COUNTY--Continued



465231096415801. Local number, 139N48W11ABA01.
LOCATION.--Lat 46°52'31", long 96°41'58", in NE¼NW¼NE¼ sec.11, T.139 N., R.48 W., Hydrologic Unit 09020104, at Dilworth.
Owner: City of Dilworth.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 8 in. (0.20 m), depth 152 ft (46.3 m).
DATUM.--Altitude of land-surface datum is 908 ft (277 m). Measuring point: Top of recorder platform, 2.40 ft (0.73 m) above land-surface datum.
REMARKS.--Water level affected by pumping.
PERIOD OF RECORD.--May 1965 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 101.33 ft (30.88 m) below land-surface datum, Dec. 29, 1965; lowest, 131.24 ft (40.00 m) below land-surface datum, July 18, 1985.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 22	125.88	Jan. 25	124.09	Mar. 27	118.26	May 23	123.09	Aug. 28	123.25

ITASCA COUNTY

473840093515101. Local number, 148N25W08DDD01.
LOCATION.--Lat 47°38'40", long 93°51'51", in SE¼SE¼SE¼ sec.8, T.148 N., R.25 W., Hydrologic Unit 09030006, at Spring Lake.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in. (0.03 m), depth 10 ft (3.0 m), screened 8 to 10 ft (2.4 to 3.0 m).
DATUM.--Altitude of land-surface datum is 1,350 ft (411 m). Measuring point: Top of casing, 3.40 ft (1.04 m) above land-surface datum.
PERIOD OF RECORD.--September 1970 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 4.40 ft (1.34 m) below land-surface datum, July 13, 1979; lowest, 7.57 ft (2.30 m) below land-surface datum, Jan. 22, 1985.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 24	7.20	Jan. 22	7.31	Apr. 24	6.04	Jul. 11	6.04
Dec. 06	7.20	Mar. 06	7.45	May 30	6.10	Aug. 23	6.87

GROUND-WATER LEVELS

OTTER TAIL COUNTY

463956095352601. Local number, 137N39W22ACD01.
LOCATION.--Lat 46°39'56", long 95°35'26", in SE¼SW¼NE¼ sec.22, T.137 N., R.39 W., Hydrologic Unit 09020103, 4.5 mi (7.2 km) north of Perham.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 2 in. (0.10 m), depth 24 ft (7.3 m), screened 21 to 24 ft (6.4 to 7.3 m).
DATUM.--Altitude of land-surface datum is 1,370 ft (418 m). Measuring point: Top of casing, 0.50 ft (0.15 m) above land-surface datum.
PERIOD OF RECORD.--December 1967 to current year.
EXTREMES FOR PERIOD OF RECORD.--Higheest water level, 6.84 ft (2.08 m) below land-surface datum, Aug. 12, 1985; lowest, 11.41 ft (3.48 m) below land-surface datum, Mar. 10, 15, 1977.

WATER LEVEL, IN FEET ABOVE LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

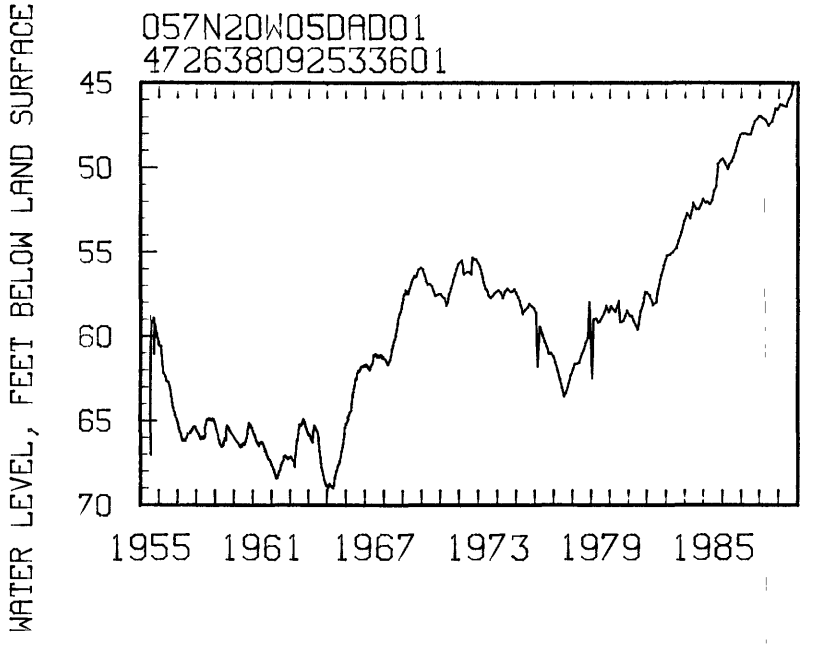
DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 19	10.62	Jan. 14	11.01	Mar. 24	10.47	May 20	9.52	Jul. 17	10.07	Sep. 20	9.50
Nov. 30	10.79	Feb. 15	11.14	Apr. 17	9.95	Jun. 16	9.52	Aug. 18	10.05		

ST. LOUIS COUNTY

472638092533601. Local number, 057N20W05DAD01.
LOCATION.--Lat 47°26'38", long 92°53'36", in SE¼NE¼SE¼ sec.5, T.57 N., R.20 W., Hydrologic Unit 04010201, 2.5 mi (4.0 km) east of Hibbing.
Owner: Burlington Northern, Inc.
AQUIFER.--Biwabik Iron Formation of Middle Precambrian Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 12 in. (0.30 m), depth 430 ft (131 m), cased to 315 ft (96.0 m).
DATUM.--Altitude of land-surface datum is 1,470 ft (448 m). Measuring point: Top of platform, 1.20 ft (0.37 m) above land-surface datum.
PERIOD OF RECORD.--August 1955 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 45.14 ft (13.76 m) below land-surface datum, Sept. 28, 1989; lowest, 69.07 ft (21.05 m) below land-surface datum, Jan. 15, 1965.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	46.47	Jan. 26	46.23	May 22	46.40	Aug. 21	45.72
Dec. 08	46.59	Mar. 10	46.31	Jul. 13	45.92	Sep. 28	45.14



ST. LOUIS COUNTY--Continued

472230092561001. Local number, 057N20W31DBC01.
LOCATION.--Lat 47°22'30", long 92°56'10", in SW¼NW¼SE¼ sec.31, T.57 N., R.20 W., Hydrologic Unit 04010201, 1.4 mi (2.25 km) south of Hibbing.
Owner: Mesaba County Club.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused artesian and water-table well, diameter 18 in. (0.46 m), depth 92 ft (28.0 m), screened 82 to 92 ft (25.0 to 28.0 m).
DATUM.--Altitude of land-surface datum is 1,391 ft (424 m). Measuring point: Hole east side of pump base, 3.00 ft (0.91 m) above land-surface datum.
REMARKS.--Water level affected by pumping.
PERIOD OF RECORD.--February 1958 to March 1965, July 1979 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.85 ft (0.55 m) below land-surface datum, July 26, 1985; lowest, 15.05 ft (3.56 m) below land-surface datum, June 30, 1980.

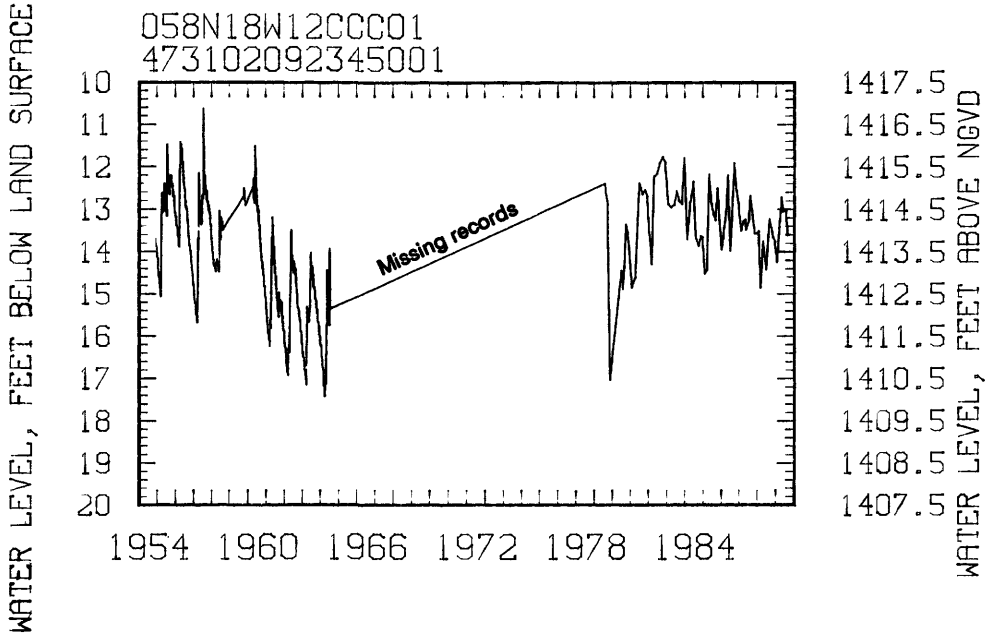
WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 29	2.80	Dec. 08	2.60	Jan. 27	2.44	Aug. 21	2.02

473102092345001. Local number, 058N18W12CCC01.
LOCATION.--Lat 47°31'02", long 92°34'50, in SW¼SW¼SW¼ sec.12, T.58 N., R.18 W., Hydrologic Unit 04010201, 1 mi (1.6 km) west of Virginia.
Owner: U.S. Steel Corp.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled observation artesian well, diameter 6 in. (0.15 m), depth 97 ft (29.6 m), slotted casing between 67 to 97 ft (20.4 to 29.6 m).
DATUM.--Land-surface datum is 1,427.5 ft (435.1 m) National Geodetic Vertical Datum of 1929. Measuring point: Edge of vent pipe, 1.90 ft (0.58 m) above land-surface datum.
PERIOD OF RECORD.--December 1954 to July 1964 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 10.64 ft (3.24 m) below land-surface datum, July 20, 1957; lowest, 17.47 ft (5.32 m) below land-surface datum, Apr. 2, 1964.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	13.67	Jan. 26	14.26	Apr. 25	12.72	Jul. 13	13.02
Dec. 07	13.77	Mar. 10	13.44	May 22	13.07	Aug. 21	13.62



473011092524301. Local number, 058N20W16DBC01.
LOCATION.--Lat 47°30'11", long 92°52'43", in SW¼NW¼SE¼ sec.16, T.58 N., R.20 W., Hydrologic Unit 04010201, in Chisholm.
Owner: City of Chisholm.
AQUIFER.--Buried sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 12 in. (0.30 m), depth 40 ft (12.2 m), screened 30 to 40 ft (9.1 to 12.2 m).
DATUM.--Altitude of land-surface datum is 1,500 ft (457 m). Measuring point: Top of wood platform, 1.70 ft (0.52 m) above land-surface datum.
REMARKS.--Water level affected by pumping. Water-level subject to freezing during winter months.
PERIOD OF RECORD.--August 1953 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 0.23 ft (0.07 m) below land-surface datum, May 10, 1954; lowest, 15.60 ft (4.75 m) below land-surface datum, Mar. 23-24, 1957.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 27	2.75	Dec. 08	2.78	May 22	1.87	Jul. 13	1.57	Aug. 21	3.43	Sep. 28	2.45

474253091574101. Local number, 060N13W01BBA01.
LOCATION.--Lat 47°42'53", long 91°57'41", in NE¼NW¼NW¼ sec.1, T.60 N., R.13 W., Hydrologic Unit 09030001, at Babbitt water tower.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 2 in. (0.05 m), depth 30 ft (9.1 m), screened 27 to 30 ft (8.2 to 9.1 m).
DATUM.--Altitude of land-surface datum is 1,485 ft (453 m). Measuring point: Top of 3 in (0.08 m) pipe, 4.00 ft (1.22 m) above land-surface datum.
PERIOD OF RECORD.--October 1975 to June 1978, July 1979 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 19.79 ft (6.03 m) below land-surface datum, Sept. 6, 1989; lowest, 26.03 ft (7.93 m) below land-surface datum, June 14, 1977.

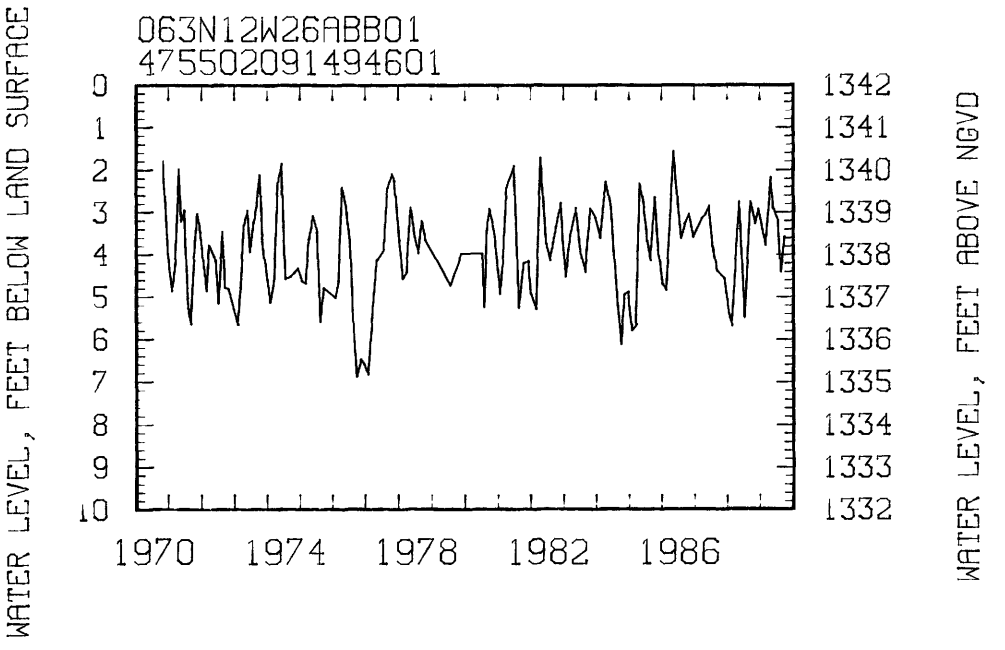
WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 03	22.00	Dec. 01	21.54	Feb. 01	21.83	Apr. 03	22.08	Jun. 01	21.17	Aug. 01	20.50
Nov. 03	21.71	Jan. 04	21.67	Mar. 03	22.17	May 01	21.50	Jul. 05	20.25	Sep. 06	19.79

475502091494601. Local number, 063N12W26ABB01.
LOCATION.--Lat 47°55'02", long 91°49'46", NW¼NW¼NE¼ sec.26, T.63 N., R.12 W., Hydrologic Unit 09030001, at Ely.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand and gravel of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in. (0.03 m), depth 9 ft (2.7 m), screened 7 to 9 ft (2.1 to 2.7 m).
DATUM.--Altitude of land-surface datum is 1,342 ft (409 m). Measuring point: Top of casing, 4.00 ft (1.22 m) above land-surface datum.
PERIOD OF RECORD.--October 1970 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 1.53 ft (0.46 m) below land-surface datum, May 14, 1986; lowest, 6.87 ft (2.09 m) below land-surface datum, Sept. 27, 1976.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 02	3.26	Jan. 19	3.37	Apr. 26	2.15	Jul. 14	3.20	Sep. 27	3.57
Dec. 06	2.91	Feb. 27	3.77	May 23	2.90	Aug. 16	4.42		

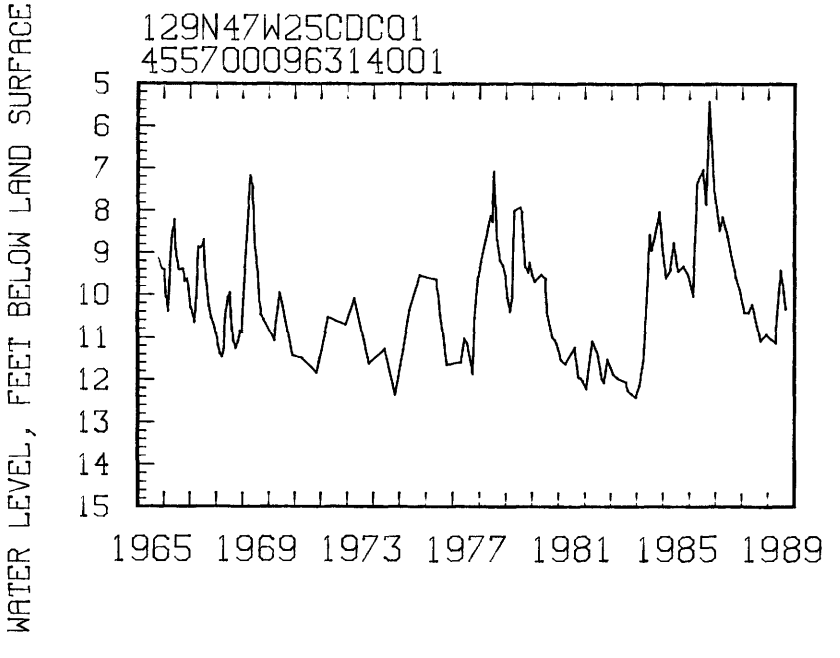


TRAVERSE COUNTY

455700096314001. Local number, 129N47W25CDC01.
LOCATION.--Lat 45°57'00", long 93°31'40", in SW¼SE¼SW¼ sec.25, T.129 N., R.47 W., Hydrologic Unit 09020101, 9 mi (14.5 km) north of Wheaton.
Owner: U.S. Geological Survey.
AQUIFER.--Surficial sand of Pleistocene Age.
WELL CHARACTERISTICS.--Bored observation water-table well, diameter 1¼ in. (0.03 m), depth 39 ft (11.9 m), open end.
DATUM.--Altitude of land-surface datum is 1,010 ft (308 m). Measuring point: Top of casing, 2.00 ft (0.61 m) above land-surface datum.
PERIOD OF RECORD.--October 1965 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 5.39 ft (1.64 m) below land-surface datum, Sept. 23, 1986; lowest, 12.42 ft (3.79 m) below land-surface datum, Dec. 2, 1983.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1988 TO SEPTEMBER 1989

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 18	10.90	Mar. 24	11.13	Jun. 07	9.40	Aug. 15	10.32



CLEARWATER COUNTY

STATION NUMBER	LOCAL IDENTIFIER	GEOLOGIC UNIT	DATE	TIME	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET) (72019)	DEPTH OF WELL, TOTAL (FEET) (72008)	ELEV. OF LAND SURFACE DATUM (FT. ABOVE NGVD) (72000)	SPECIFIC CONDUCTANCE (US/CM) (00095)	SPECIFIC CONDUCTANCE LAB (US/CM) (90095)
473150095210500	147.37.22CDD BAGLEY OLD HW	112DMDF	08-03-89	1530	1.32	29.00	1470	810	808
473832095253300	148N37W18 BBC NORDLUND	112DMDF	08-16-89	1600	--	155.00	1460	890	887

STATION NUMBER	PH (STANDARD UNITS) (00400)	PH LAB (STANDARD UNITS) (00403)	TEMPERATURE WATER (DEG C) (00010)	CALCIUM DISSOLVED (MG/L AS CA) (00915)	MAGNESIUM, DISSOLVED (MG/L AS MG) (00925)	SODIUM, DISSOLVED (MG/L AS NA) (00930)	POTASSIUM, DISSOLVED (MG/L AS K) (00935)	ALKALINITY WAT WH TOT FET FIELD MG/L AS CACO3 (00410)	ALKALINITY WAT WH TOT IT FIELD MG/L AS CACO3 (00419)	ALKALINITY LAB (MG/L AS CACO3) (90410)	SULFATE DISSOLVED (MG/L AS SO4) (00945)
473150095210500	7.4	7.4	10.5	99	33	15	3.0	--	336	343	5.0
473832095253300	7.4	7.5	9.5	97	46	30	5.0	457	--	456	57

STATION NUMBER	CHLORIDE, DISSOLVED (MG/L AS CL) (00940)	FLUORIDE, DISSOLVED (MG/L AS F) (00950)	SILICA, DISSOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L) (70300)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N) (00631)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N) (00608)	NITROGEN,AMMONIA + ORGANIC DIS. (MG/L AS N) (00623)	PHOS+PHOROUS DIS+SOLVED (MG/L AS P) (00666)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P) (00671)	CARBON, ORGANIC DISSOLVED (MG/L AS C) (00681)	PHENOLS TOTAL (UG/L) (32730)
473150095210500	63	0.1	23	404	<0.10	0.15	<0.2	0.035	0.023	1.5	9
473832095253300	1.1	.2	21	521	<.10	.58	.8	.004	<.001	2.8	5

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October 1, 1978

FACTORS FOR CONVERTING INCH-POUND UNITS TO INTERNATIONAL SYSTEM UNITS (SI)

The following factors may be used to convert the inch-pound units published herein to the International System of Units (SI).

Multiply inch-pound units	By	To obtain SI units
	Length	
inches (in)	2.54×10^{1}	millimeters (mm)
	2.54×10^{-2}	meters (m)
feet (ft)	3.048×10^{-1}	meters (m)
miles (mi)	1.609×10^{0}	kilometers (km)
	Area	
acres	4.047×10^{3}	square meters (m^2)
	4.047×10^{-1}	square hectometers (hm^2)
	4.047×10^{-3}	square kilometers (km^2)
square miles (mi^2)	2.590×10^{0}	square kilometers (km^2)
	Volume	
gallons (gal)	3.785×10^{0}	liters (L)
	3.785×10^{0}	cubic decimeters (dm^3)
	3.785×10^{-3}	cubic meters (m^3)
million gallons	3.785×10^{3}	cubic meters (m^3)
	3.785×10^{-3}	cubic hectometers (hm^3)
cubic feet (ft^3)	2.832×10^{1}	cubic decimeters (dm^3)
	2.832×10^{-2}	cubic meters (m^3)
cfs-days	2.447×10^{3}	cubic meters (m^3)
	2.447×10^{-3}	cubic hectometers (hm^3)
acre-feet (acre-ft)	1.233×10^{3}	cubic meters (m^3)
	1.233×10^{-3}	cubic hectometers (hm^3)
	1.233×10^{-6}	cubic kilometers (km^3)
	Flow	
cubic feet per second (ft^3/s)	2.832×10^{1}	liters per second (L/s)
	2.832×10^{1}	cubic decimeters per second (dm^3/s)
	2.832×10^{-2}	cubic meters per second (m^3/s)
gallons per minute (gal/min)	6.309×10^{-2}	liters per second (L/s)
	6.309×10^{-2}	cubic decimeters per second (dm^3/s)
	6.309×10^{-5}	cubic meters per second (m^3/s)
million gallons per day	4.381×10^{1}	cubic decimeters per second (dm^3/s)
	4.381×10^{-2}	cubic meters per second (m^3/s)
	Mass	
tons (short)	9.072×10^{-1}	megagrams (Mg) or metric tons

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