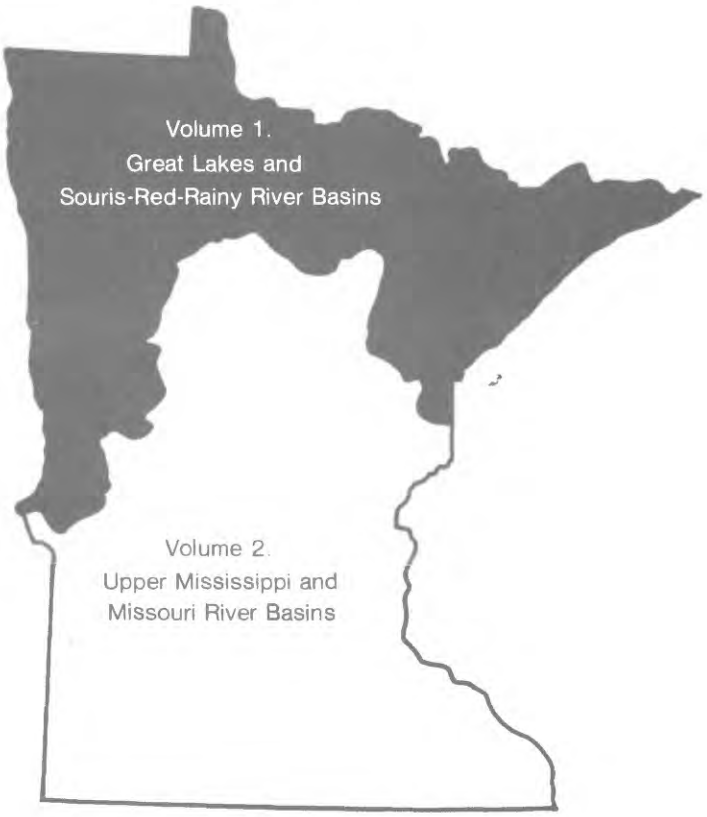
Water Resources Data Minnesota Water Year 1988

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



U.S. GEOLOGICAL SURVEY WATER-DATA REPORT MN-88-1
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 1988

1987

OCTOBER

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AUGUST

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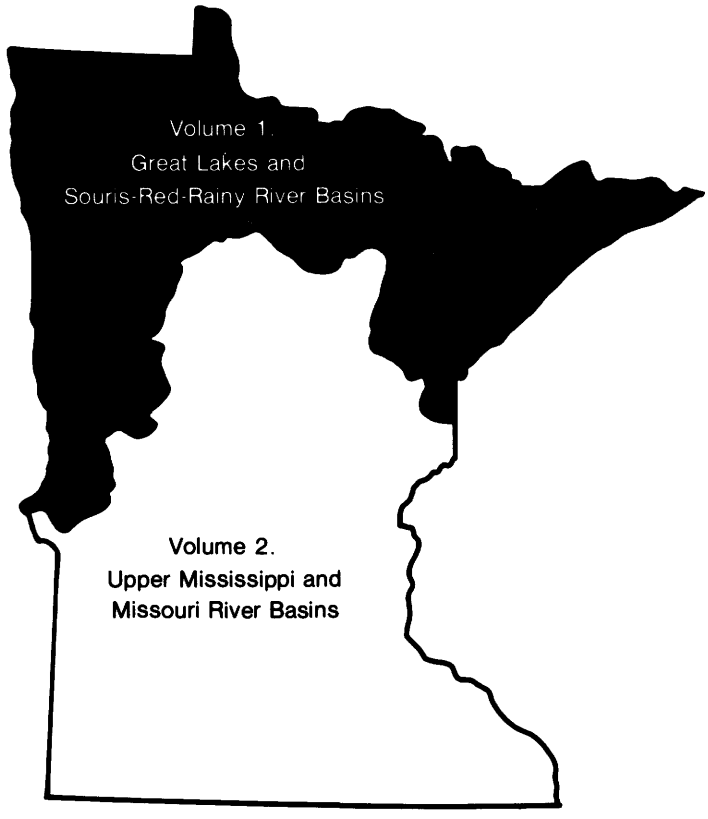
Water Resources Data Minnesota Water Year 1988

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-88-1
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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5. Report
February 1990

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

16. Abstract (Limit: 200 words)

Water-resources data for the 1988 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 44 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 14 observation wells. Also included are 31 high-flow partial-record stations and 42 low-flow partial-record stations. 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

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b. Identifiers/Open-Ended Terms

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

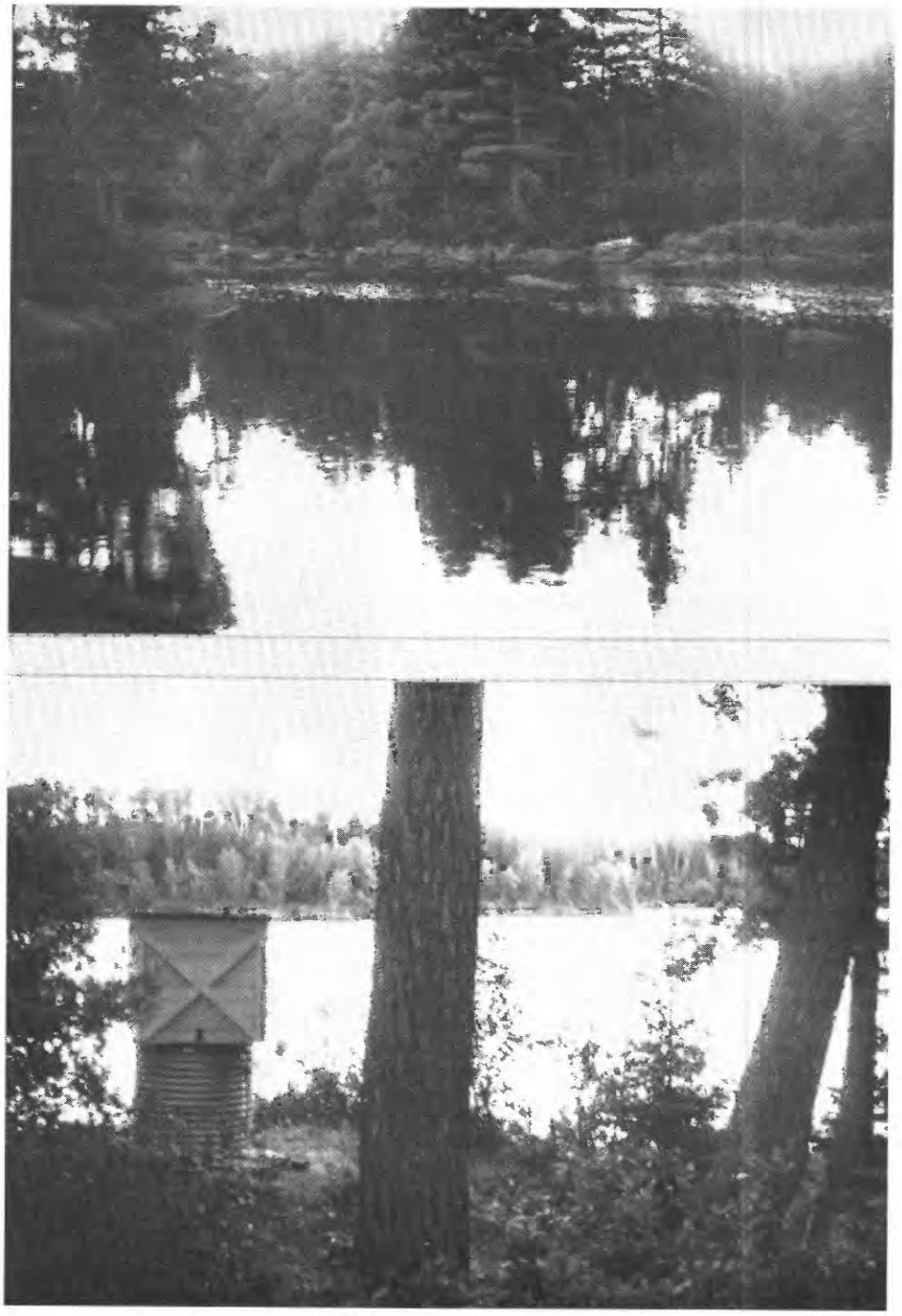
Note.--Data for partial-record stations and miscellaneous sites for both surface-water quantity and quality are published in separate sections of the data report. See references at the end of this list for page numbers for these sections.

[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



South Kawishiwi River near Ely
1953-61
1976-78

WATER RESOURCES DATA FOR MINNESOTA, 1988

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 1988 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 44 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 14 observation wells. Also included are 31 high-flow partial-record stations and 42 low-flow partial-record stations. 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-88-1. 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, President.

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 48 gaging stations and 12 water-quality stations published in this report. 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 1988 water year ranged from 12 in. (inches) below normal (1951-80 mean) in a small area in central Minnesota to 4 in. above normal in 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 1988 ranged from less than 12 in. in the northwest to greater than 32 in. in the northeast.

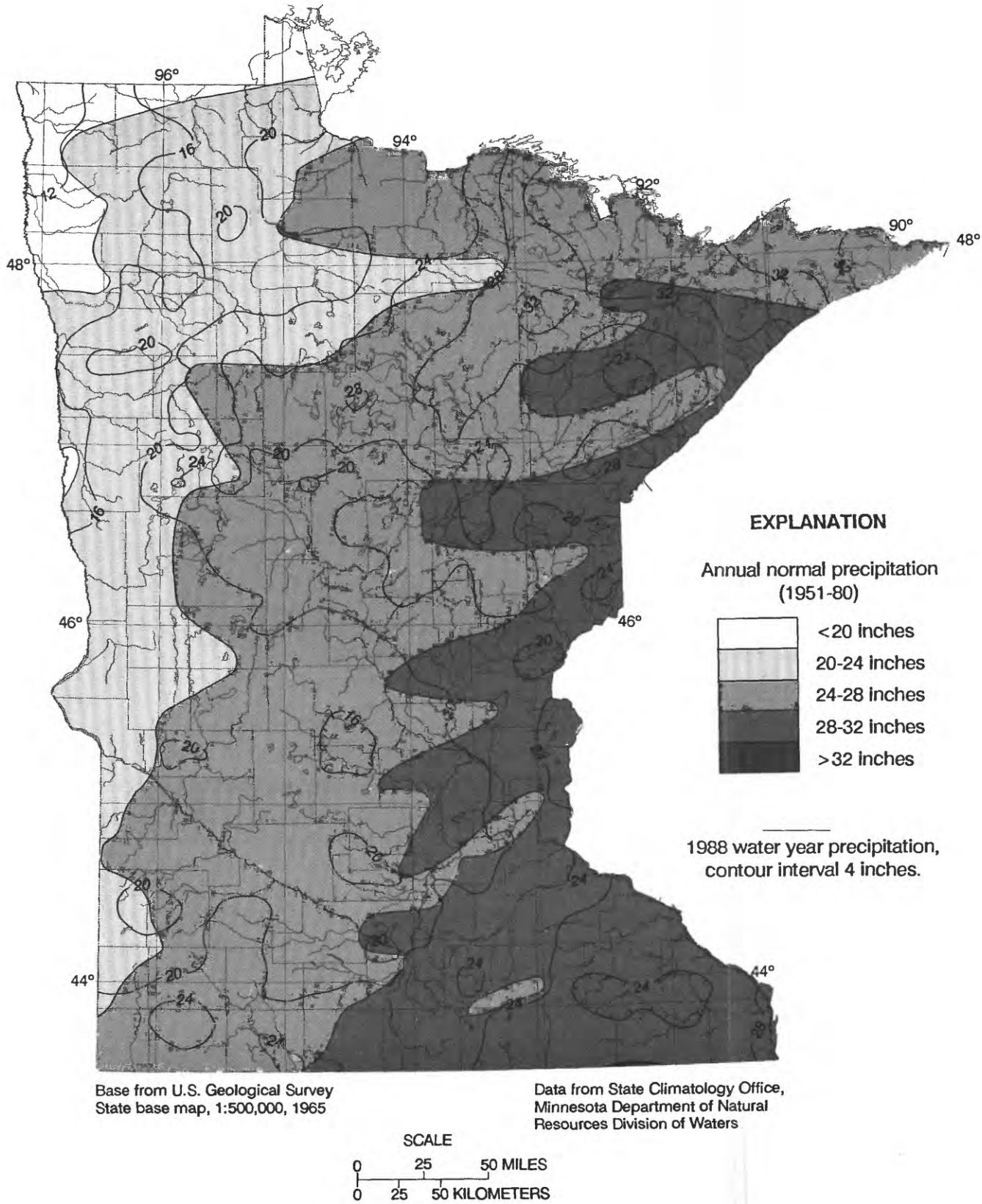


Figure 1.--Precipitation, in inches, during 1988 water year compared to normal annual precipitation in Minnesota

The 1988 water year began with a 4 to 8 in. precipitation deficit throughout most of Minnesota. Below-normal precipitation continued though the first quarter of the year in the north and west, but returned to above normal in the south and east during November and December. During the second quarter, below-normal precipitation prevailed in the north during January, but was above normal in the south. In February, precipitation was considerably below normal statewide. The precipitation pattern reversed in March with above-normal precipitation in the northern one-third of the State and below-normal precipitation in the southern two-thirds. During the first month of the third quarter (April), precipitation reverted back to the original pattern with below-normal amounts in the northern two-thirds of the State and slightly above-normal amounts in the southern one-third. For the remainder of the quarter (May and June), precipitation was below normal statewide. During June, a period when 4 in. of precipitation normally falls in the Twin City area, only 0.22 in. was measured at the Minneapolis-St. Paul Airport. "This is the lowest precipitation ever recorded since 1891 (when modern-day record keeping began)", according to the State Climatology Office (James Zandlo, State Climatologist, oral communication, 1988). In the final quarter of the water year, precipitation continued in the deficient range statewide through July. The "drought pattern" was finally broken in August and September when above-normal precipitation occurred statewide.

As a result of generally deficient precipitation in much of Minnesota throughout water year 1988, precipitation was only 50 to 75 percent of normal in most of the southern one-half of the State as well as in all the counties along the western border in the Red River Valley. Total annual precipitation in most of the State was 4 to 8 in. below the long-term (1951-80) annual normal for the second consecutive year.

STREAMFLOW

Average runoff in Minnesota ranges from 1 in. in the west to 14 in. in the northeast. Annual runoff in water year 1988 ranged from 0.1 in. in a small area along the western border to 12.1 in. in northeastern Minnesota (table 1). Runoff ranged from a low of 6 percent of average in part of the west to a high of only 103 percent of average in north-central Minnesota. Runoff at 60 percent of the streamflow stations in the gaging network was less than one-half the long-term average at each of the stations; runoff at one-third of these stations was only 25 percent, or less, of average.

In water year 1988, records for stations in northern Minnesota indicate less than average runoff, ranging from 28 percent to 79 percent of annual average long-term runoff. In northwestern Minnesota, runoff in the Red Lake River at Crookston was 0.81 in. -- only 28 percent of the 87-year average (1902-88) annual runoff of 2.94 in. and the 11th lowest runoff of record. In the previous water year, runoff was more than twice as large -- 2.26 in. In north-central Minnesota, runoff in the Little Fork River at Littlefork was 6.53 in. and 79 percent of the 65-year average (1912-16, 1929-88) annual runoff of 8.31 in. In the previous year runoff was actually somewhat less at 5.89 in. In northeastern Minnesota, runoff in the Baptism River near Beaver Bay was 10.65 in. and 65 percent of the 61-year average (1928-88) annual runoff of 16.39 in. Runoff in the previous year was 31 percent greater than that in 1988 at 13.95 in. 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 peaks of record were exceeded during the 1988 water year at any stations for which records are published in this volume. However, record-breaking monthly volumes of runoff occurred at several streamflow gaging stations during the last two months of the water year in north-central and northeastern Minnesota. As a result of intense, above-normal precipitation during August in these areas, monthly streamflow volumes increased dramatically from 1st to 5th lowest July flow of record to 1st to 5th highest August flow of record.

WATER QUALITY

Much of Minnesota was affected by drought during the 1988 water year. Reduced runoff during a drought generally results in increased concentrations of dissolved solids because flow in streams is dominated by discharge of ground water which generally has higher concentrations of dissolved solids than does surface runoff from precipitation. Figure 3 shows the concentrations of dissolved solids measured during the 1988 water year compared to the historical median monthly concentrations at four stations sampled for the U.S. Geological Survey's National Stream Quality Accounting Network.

The bar graphs in figure 3 show that no substantial deviation from normal occurred at three of the streams displayed for northern Minnesota, but the dissolved-solids concentrations measured at the Red Lake River at Crookston were much larger during the 1988 water year than were the median monthly values from previous years, probably because of reduced rainfall and minimal runoff during the drought. The graphs for the other three streams depicted in figure 3, however, show that their watersheds may not have been seriously affected by drought. Rainfall records show that, while most of Minnesota was experiencing a drought, the northeastern part of Minnesota was receiving normal or above-normal precipitation during the 1988 water year as reflected by dissolved-solids concentrations measured in the Rainy, St. Louis, and Baptism rivers that were either near normal or even slightly smaller than normal.

Nitrite plus nitrate-nitrogen concentrations -- an indicator of input from agricultural or human sources -- are shown in figure 4. Although consistent deviations from normal are not indicated at the stations shown, even at the Red Lake River at Crookston, where concentrations tend to be very high during spring runoff, some unusual concentrations were measured. Concentrations measured in the Rainy River in April (probably a sample from snowmelt runoff) and the Baptism River (probably sampled after spring runoff) were much larger than the median concentrations normally measured during those months. Although the source of the nitrite plus nitrate nitrogen measured in these samples is not known, the measured concentration in the Baptism River was more than two times the concentration most commonly encountered. Concentrations of nitrates (the primary component of nitrite plus nitrate nitrogen) for all samples collected from streams shown in figure 4 were well below the safe drinking-water regulation of 10 milligrams per liter established by the U. S. Environmental Protection Agency. Samples of ground water were not collected from the area covered by this report during the 1988 water year.

GROUND-WATER LEVELS

Fourteen wells were maintained in the USGS-DNR observation network during water year 1988. Of the 8 deep wells, 2 had record-low water levels and 1 had a record-high level (fig. 5). The two record-low levels occurred in the northwestern part of the State near the city of Moorhead in wells completed in the Buffalo River aquifer. Declining water levels there are undoubtedly related to increased withdrawals of ground water by the city of Moorhead as well as the severe drought conditions in this part of the State during 1987 and 1988. The one record-high level occurred in the northeastern part of the State. This high is probably associated with decreased pumping of ground water for iron mining activities. There has been a gradual rise in water level in this well since 1983, and this date coincides with a reduction in mining in the vicinity of this well.

Ground water levels in the 6 shallow water-table wells all declined during the water year (fig. 6). At the end of the water year these declines were 1 to 2 feet lower than those at the close of the previous water year. As previously mentioned, drought conditions in a large part of the State contributed to these water-level declines.

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.

Table 1.--Runoff at streamflow stations in 1988 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
			1988 Water year	Average	Inches	Water year	Inches	Water year	
04010500	Pigeon River at Middle Falls near Grand Portage	600	9.10	11.41	19.01	1971	3.58	1958	65
04014500	Baptism River near Beaver Bay	140	10.65	16.39	32.50	1972	7.92	1963	61
04015330	Knife River near Two Harbors	85.6	9.58	14.75	23.32	1986	7.01	1977	14
04015475	Partridge River above Colby Lake at Hoyt Lake	106	6.58	11.22	14.22	1983	6.14	1980	10
04018750	St. Louis River at Forbes	713	6.03	10.67	14.99	1969	4.82	1977	24
04024000	St. Louis River at Scanlon	3,430	5.71	9.26	16.93	1972	3.74	1924	80
04024098	Dear Creek near Holyoke	7.77	6.58	13.32	33.70	1986	6.38	1980	12
05046000	Otter Tail River below Orwell Dam near Fergus Falls	1,830	1.40	2.39	6.25	1966	.15	1934	58
05050000	Bois de Sioux River near White Rock	1,160	.09	.96	3.85	1986	.004	1977	47
05051500	Red River of the North at Wahpeton	4,010	.75	1.86	5.00	1986	.18	1977	45
05061500	South Branch Buffalo River at Sabin	522	.45	1.49	5.15	1962	.32	1977	38§
05062000	Buffalo River near Dilworth	1,040	.92	1.75	5.76	1975	.33	1934	57
05064000	Wild Rice River at Hendrum	1,600	1.38	2.25	5.79	1975	.25	1977	43§
05069000	Sand Hill River at Climax	426	1.49	2.31	6.50	1950	.59	1977	41
05074500	Red Lake River near Red Lake	1,950	.53	3.46	9.00	1951	.04	1936	55
05076000	Thief River near Thief River Falls	959	.38	2.34	8.60	1966	.02	1939	70§
05078500	Clearwater River at Red Lake Falls	1,370	1.62	3.15	8.48	1950	.64	1939	61§
05079000	Red Lake River at Crookston	5,280	.81	2.94	8.05	1950	.22	1934	87

Table 1.--Runoff at streamflow stations in 1988 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
			1988 Water year	Average	Inches	Water year	Inches	Water year	
05082500	Red River of the North at Grand Forks	30,100	0.48	1.18	3.42	1950	0.11	1934	106
05087500	Middle River at Argyle	265	.42	2.08	5.74	1966	.08	1977	37§
05102500	Red River of the North at Emerson	40,200	.44	1.15	4.09	1950	.11	1934	76
05104500	Roseau River below South Fork near Malung	573	.29	3.34	8.18	1950	.29	1988	42
05107500	Roseau River at Ross	1,220	.46	2.92	8.07	1950	.32	1934	60
05112000	Roseau River below State No. 51 near Caribou	1,570	.36	2.47	5.91	1927	.31	1977	31§
05124480	Kawishiwi River near Ely	253	12.08	11.49	16.80	1971	5.07	1977	22
05127000	Kawishiwi River near Winton	1,229	11.47	11.44	21.73	1950	2.65	1924	60§
05127500	Basswood River near Winton	1,740	10.28	10.92	20.63	1950	4.35	1958	60§
05128000	Namakan River at Outlet of Lac la Croix	5,170	9.77	10.07	19.10	1950	2.53	1924	66
05130500	Sturgeon River near Chisholm	187	6.04	9.00	15.11	1950	4.58	1977	46
05131500	Little Fork River at Littlefork	1,730	6.53	8.31	15.01	1966	2.40	1931	65§
05132000	Big Fork River at Big Falls	1,460	3.99	6.79	12.67	1950	.86	1931	57§
05133500	Rainy River at Manitou Rapids	19,400	6.40	9.00	16.28	1950	4.10	1977	60

§ Noncontinuous period.

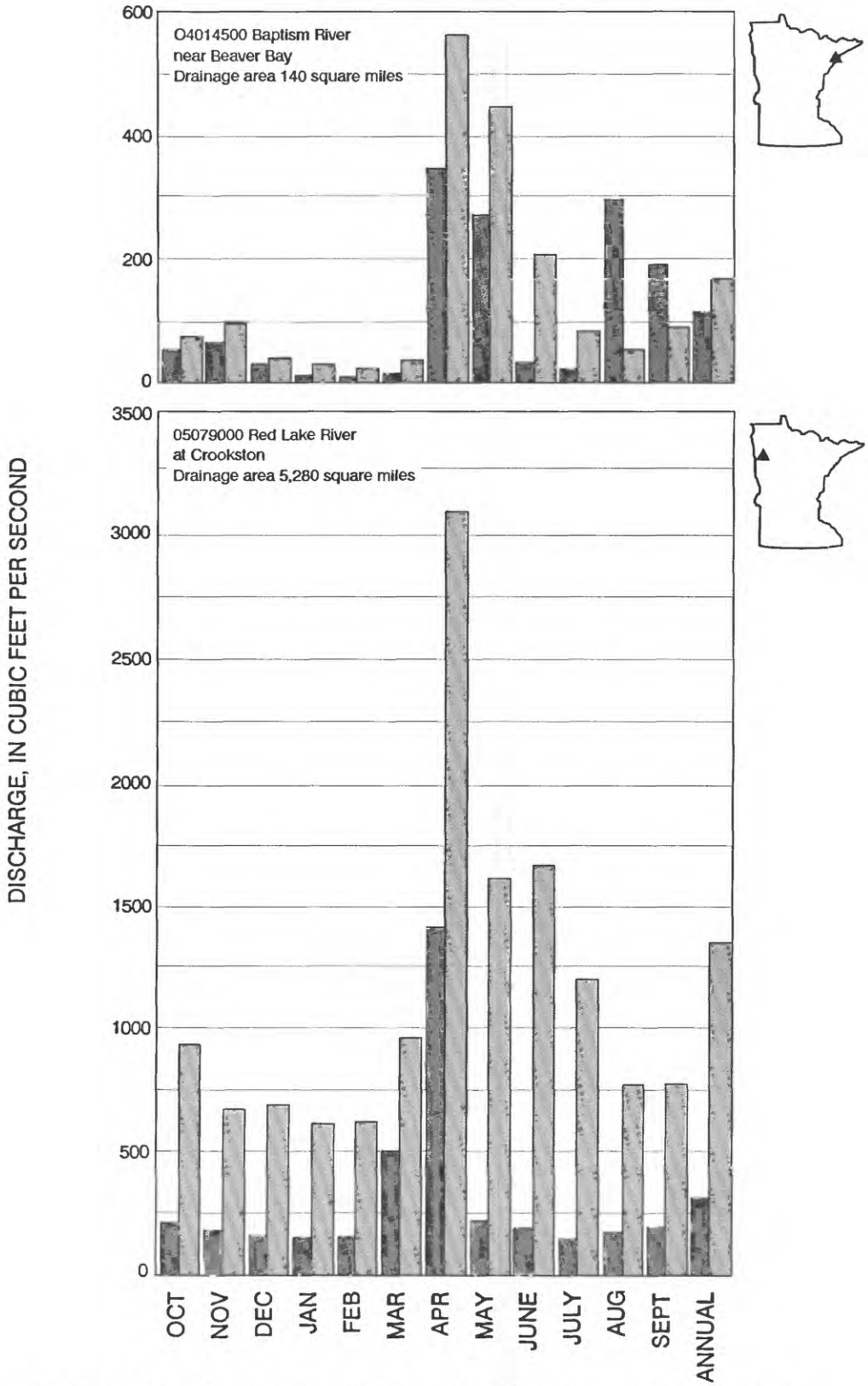
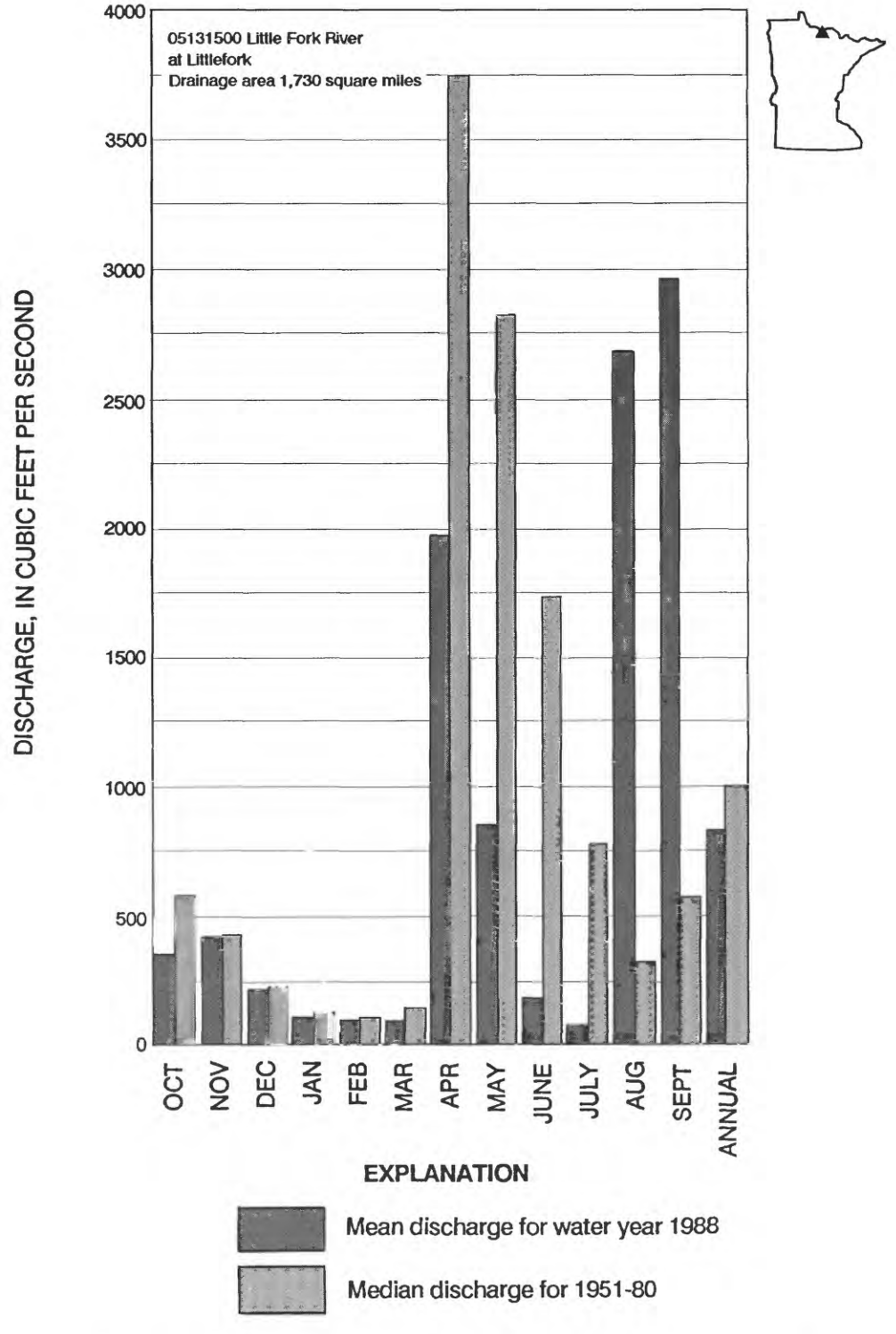


Figure 2.--Comparison of mean discharge for the 1988 water year with median



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

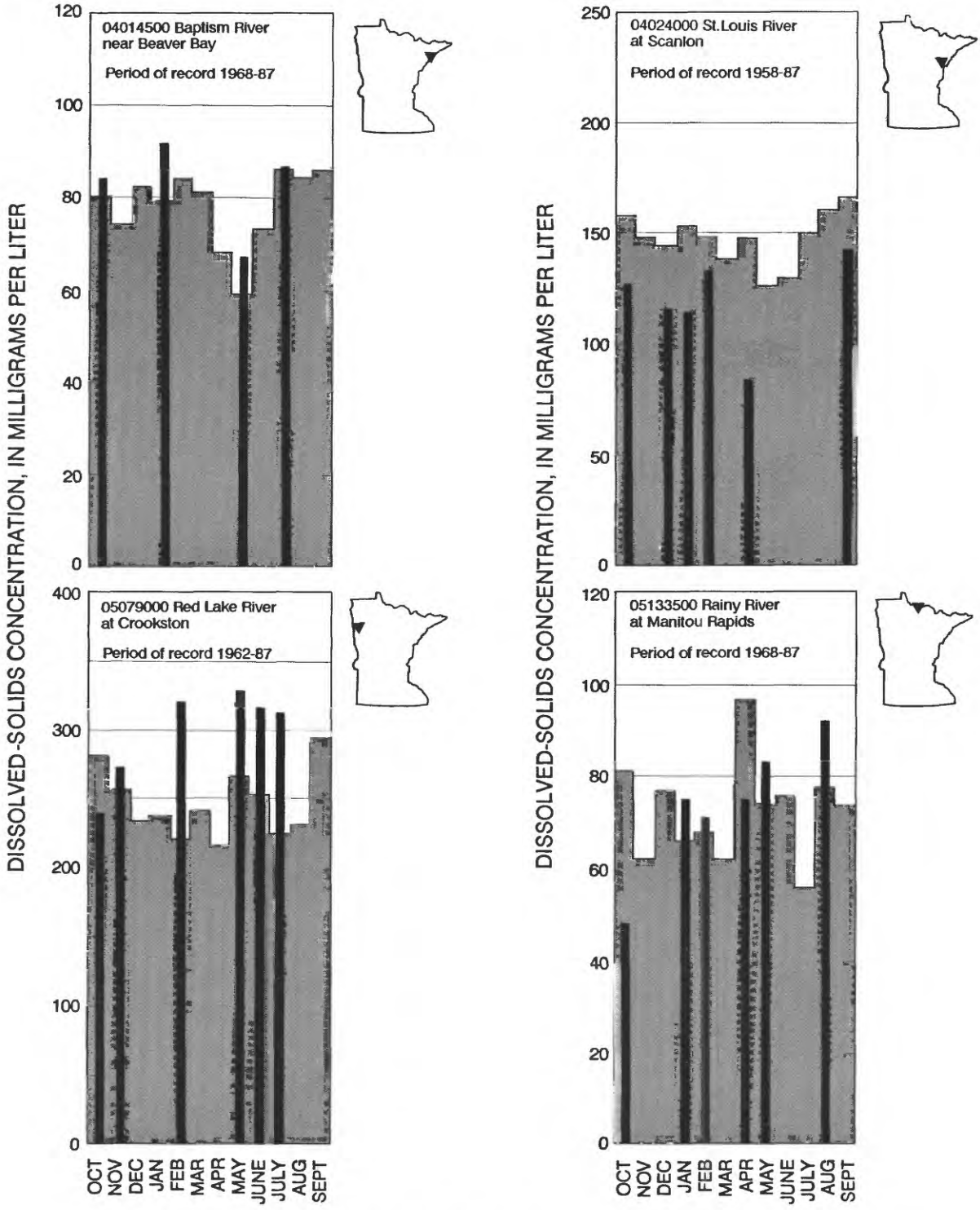


Figure 3.--Comparisons between dissolved-solids concentrations

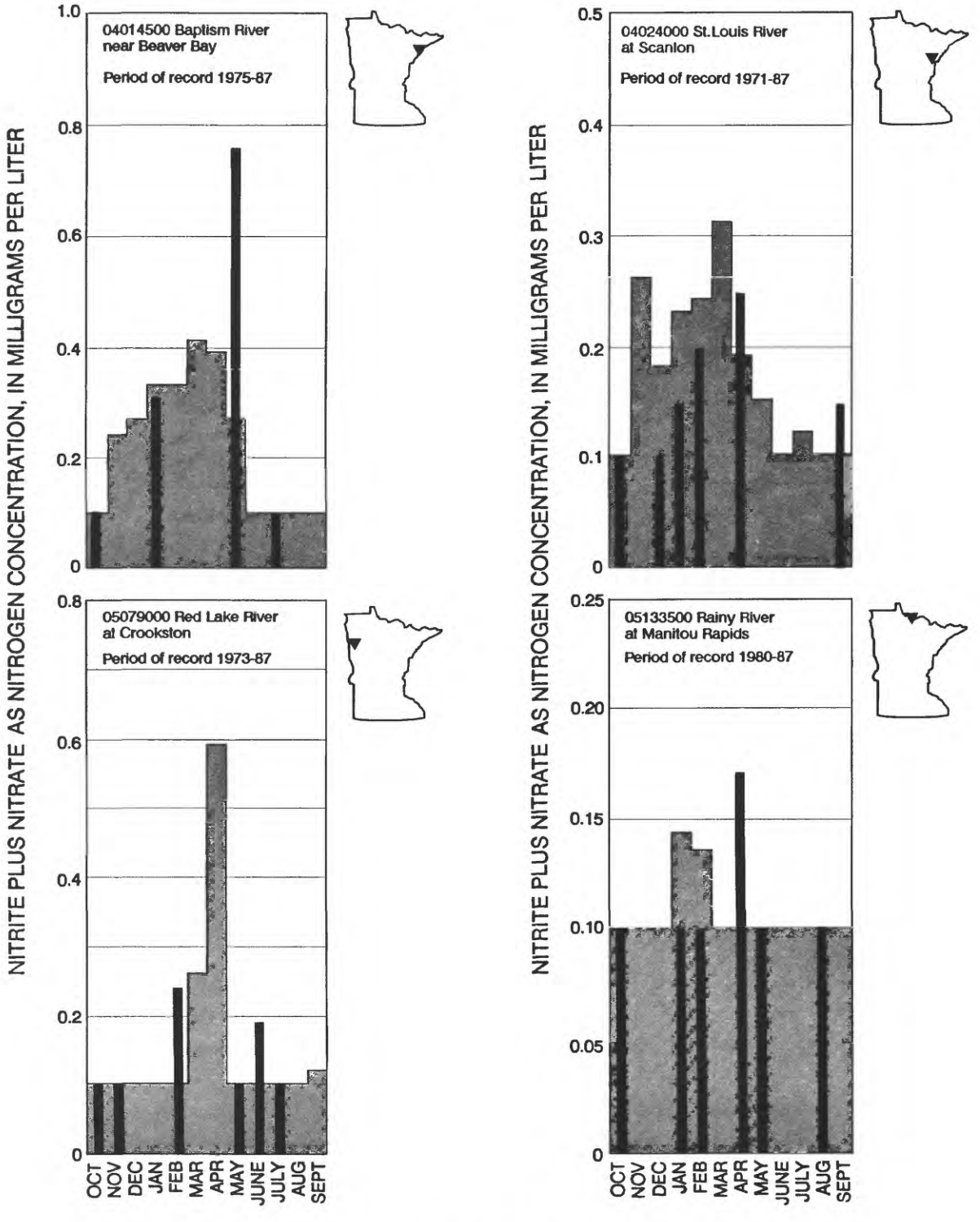


Figure 4.--Comparisons between nitrite plus nitrate concentrations.

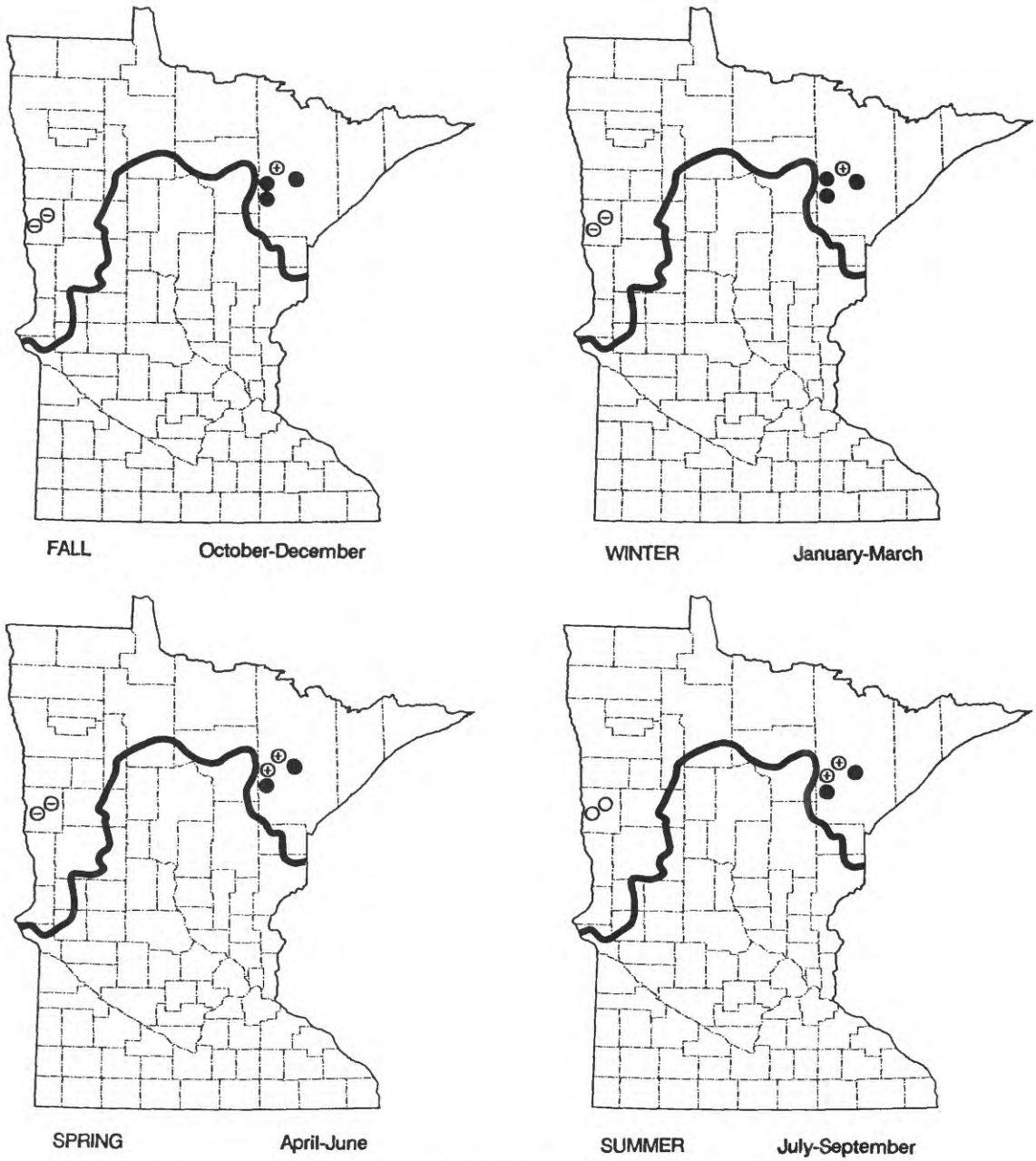


Figure 5.--Relation of seasonal water levels in confined aquifers to long-term normal levels

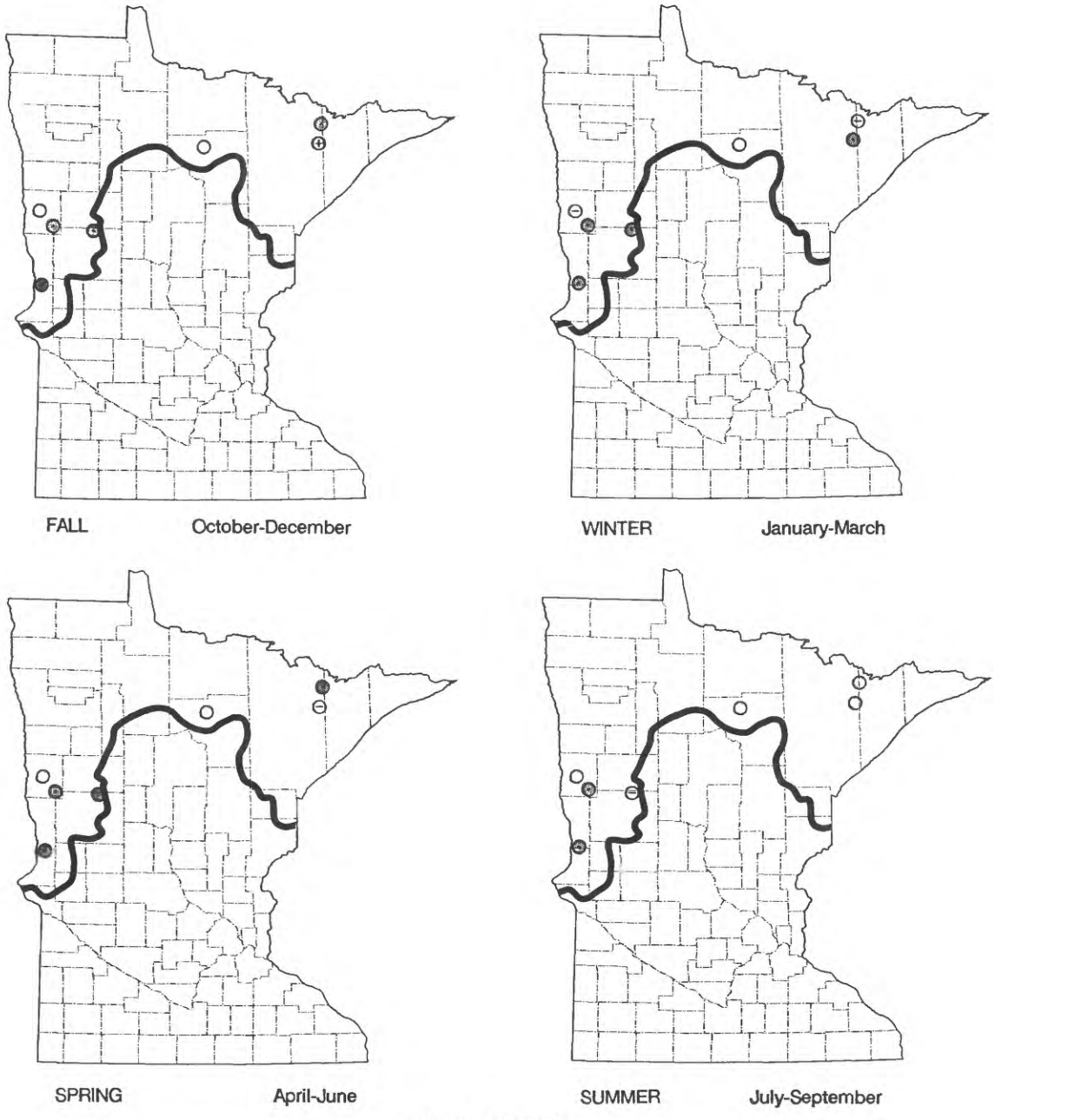


Figure 6.--Relation of seasonal water-table levels to long-term normal levels

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 1988 water year that began October 1, 1987, and ended September 30, 1988. 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 8, 9, 10, and 11. 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 7. 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.

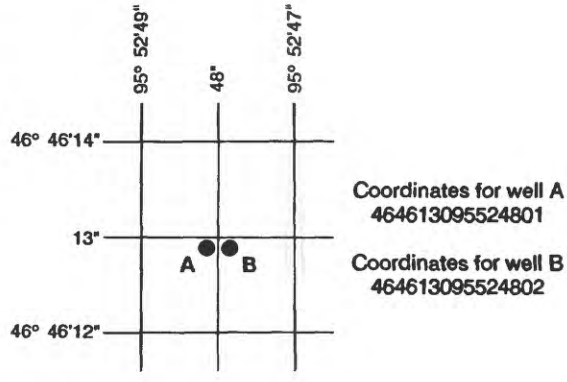


Figure 7.--Example of system for numbering wells and miscellaneous sites

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 8 and 10.

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 10.

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 11.

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 2 representative wells; both are in surficial-sand aquifers.

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 milliters (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 organo-chlorine 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 Water-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-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.

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, Chapter A3. 1968. 60 pages.

3-A4. Measurement of peak discharge at width contractions by indirect methods, by H. J. 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 and dispersion in streams by dye tracing, by E. F. Hubbard, F. A. Kilpatrick, L. A. Martens, and J. F. Wilson, Jr.: USGS--TWRI Book 3, Chapter A9. 1982. 44 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.

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

PUBLICATIONS ON TECHNIQUES OF WATER-RESOURCES INVESTIGATIONS--Continued

3-B2. Introduction to ground-water hydraulics, a programed test 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.

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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. W. Skougstad and others, editors: USGS--TWRI Book 5, Chapter A1. 1979. 626 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.

5-A3. Methods for analysis of organic substances in water, by D. F. Goerlitz and Eugene Brown: USGS--TWRI Book 5, Chapter A3. 1972. 40 pages.

5-A4. Methods for collection and analysis of aquatic biological and microbiological samples, edited by P. E. Greeson, T. A. Ehlke, G. A. Irwin, B. W. Lium, and K. V. Slack: USGS--TWRI Book 5, Chapter A4. 1977. 332 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
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

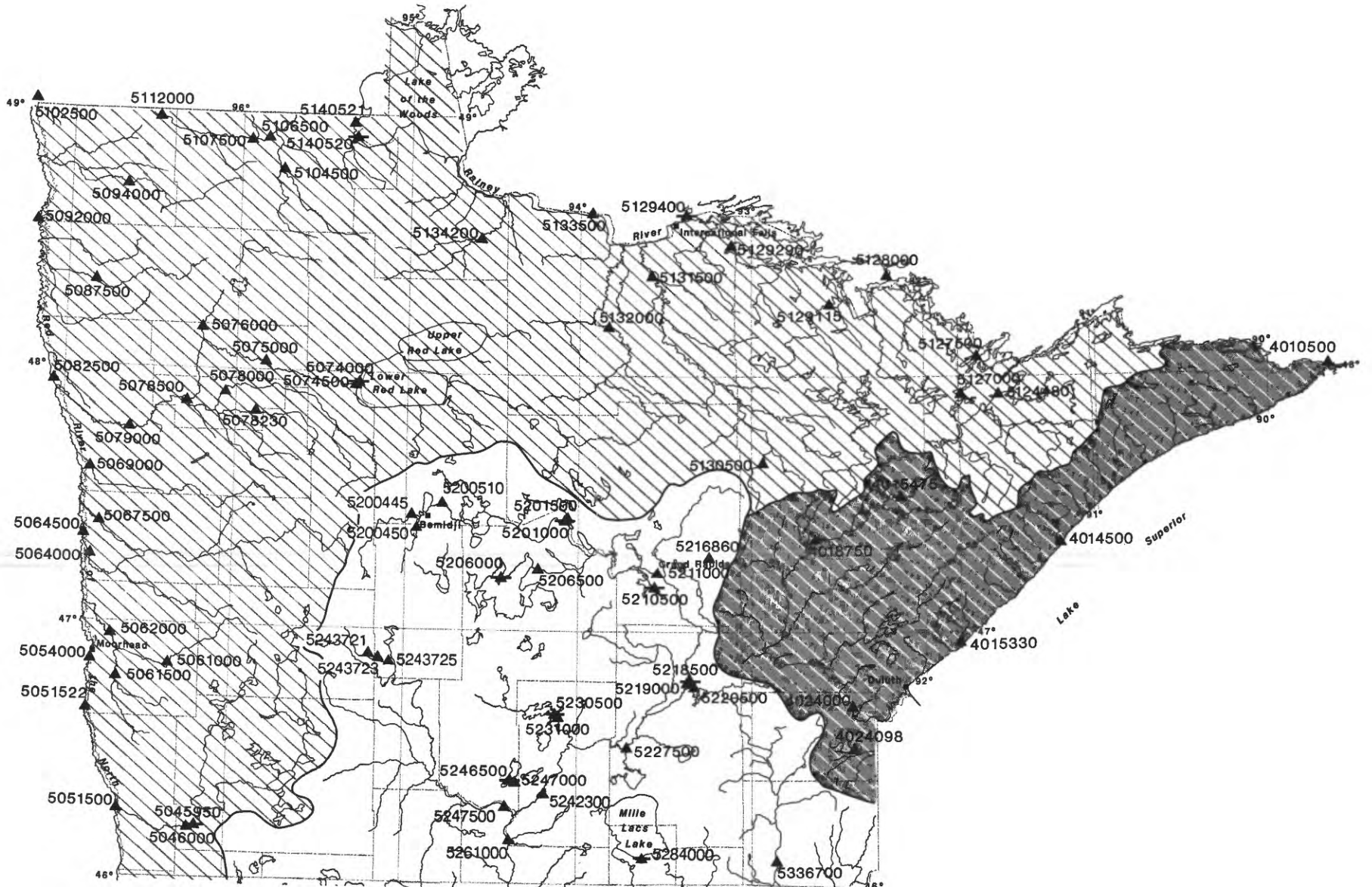
Station number	Station name	Drainage area (mi^2)	Period of record
	Red River of the North basin--Continued		
05086000	Snake River at Alvarado, MN	309	1945, 1953-56
05086500	Snake River near Argyle, MN	481	1945
05087000	Middle River near Strandquist, MN	-	1953-56
05090500	Tamarac River near Strandquist, 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.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Lake of the Woods
Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Bemidji
Grand Rapids
Superior
Lake
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Moorhead
Mille Lacs Lake
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91°
90°

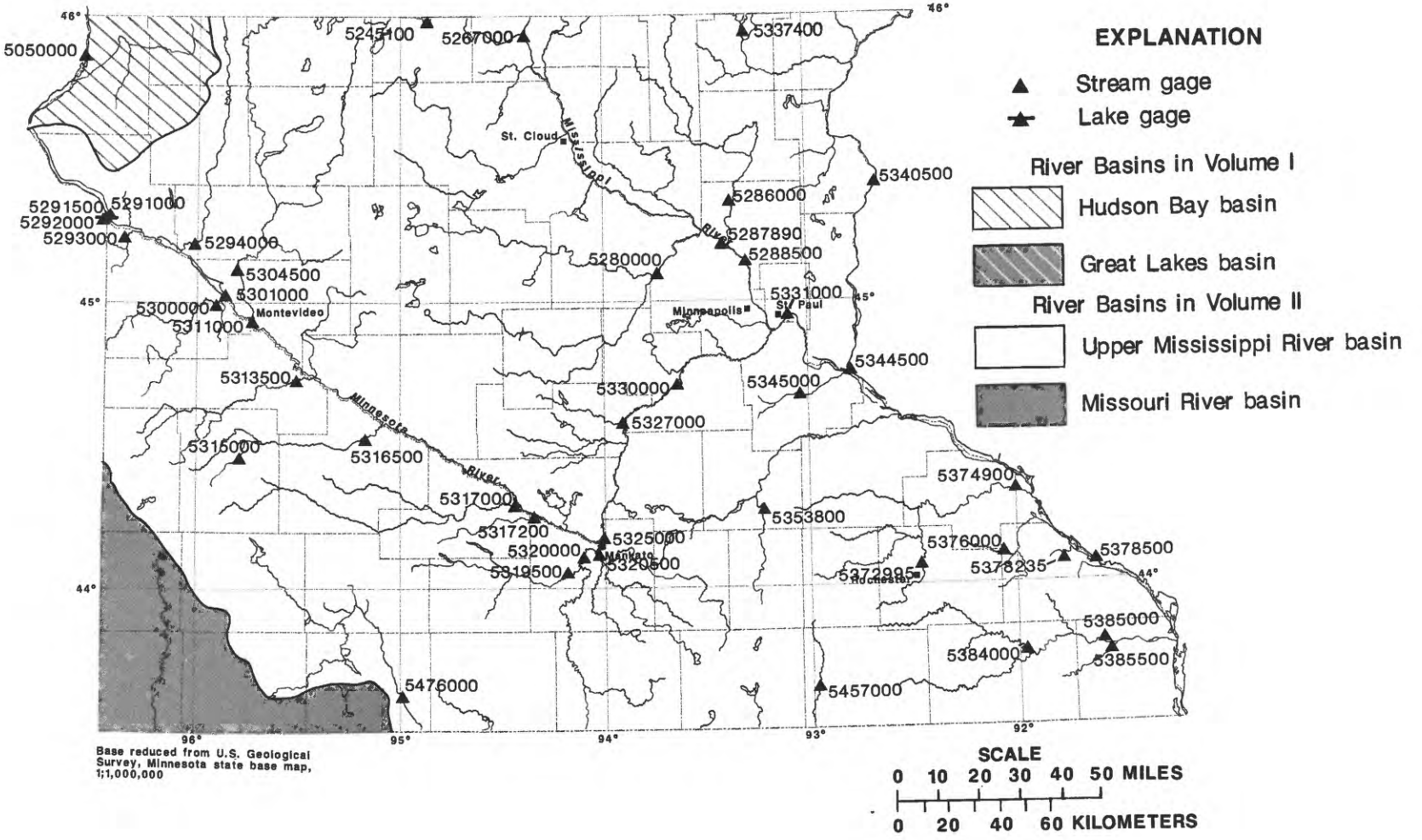
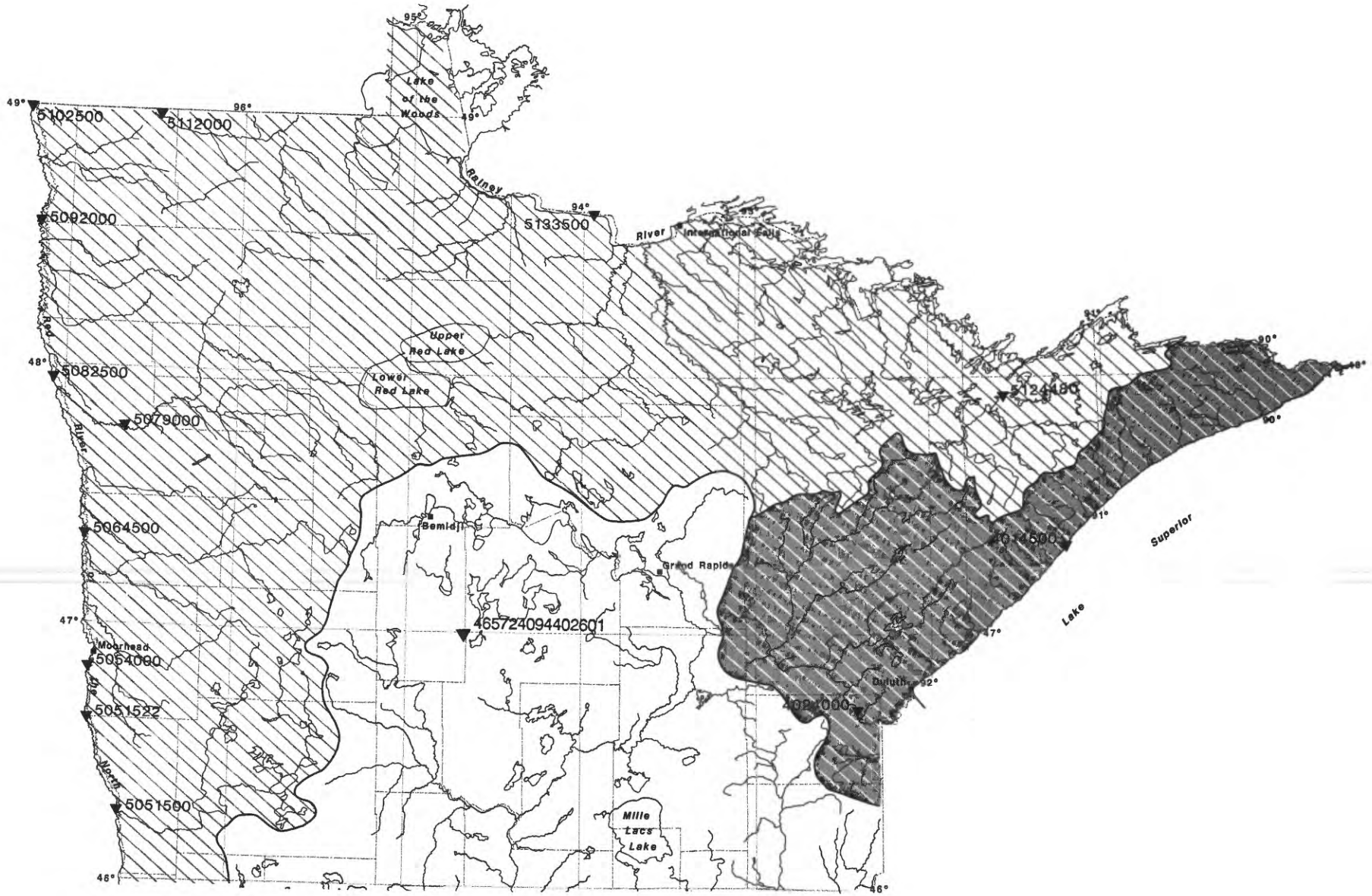


Figure 8.--Location of lake and stream-gaging stations


Lake of the Woods
Rainy River
International Falls
Upper Red Lake
Lower Red Lake
Red River
Bemidji
Grand Rapids
Moorhead
Duluth
Superior
Lake
Mille Lacs Lake
5102500
5112000
5092000
5133500
5082500
5079000
5064500
5124480
5054000
5051522
5051500
465724094402601
49°
96°
95°
94°
48°
47°
46°
92°
91°
90°

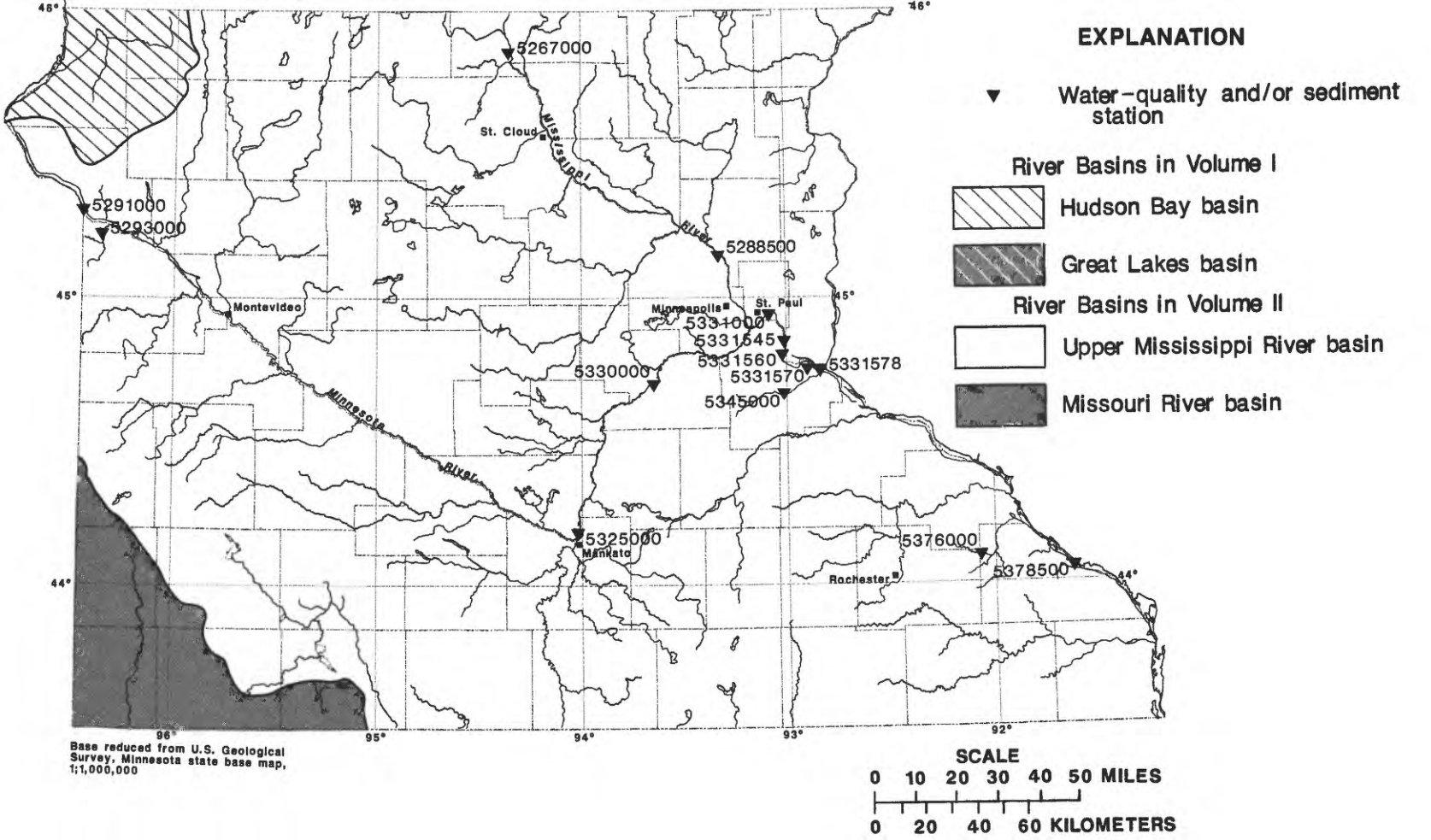


Figure 9.--Location of surface-water-quality stations

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.--65 years (water years 1924-88), 504 ft^3/s, 11.41 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)
Sept. 20	Unknown	*4,160	*9.15	No other peak greater than base discharge.			

Minimum discharge, 79 ft^3/s, July 28, 29, gage height, 2.56 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	501	435	e240	e155	e135	e110	e190	e510	624	e300	99	526
2	487	415	e235	e155	e135	e110	e190	e510	580	e270	111	719
3	473	404	e230	e155	e135	e110	e195	e500	534	e250	110	709
4	441	398	e225	e155	e130	e105	e200	e500	503	e230	121	705
5	408	387	e220	e150	e130	e105	e220	e500	466	e210	146	590
6	392	381	e215	e150	e130	e105	e250	e500	434	e190	170	509
7	386	367	e210	e150	e130	e101	e400	e500	404	e170	200	457
8	375	348	e205	e150	e130	e105	e600	e600	392	e160	236	416
9	369	342	e200	e150	e130	e105	e900	815	e370	e150	252	376
10	367	305	e200	e150	e130	e105	e1000	1240	e350	e140	234	347
11	368	324	e195	e147	e130	e105	e1200	1690	e330	e130	204	329
12	356	331	e195	e147	e130	e105	e1400	1520	e310	e125	182	299
13	340	297	e190	e145	e130	e105	e1600	1610	e300	e120	182	269
14	327	314	e190	e145	e125	e105	1820	1710	e290	e150	288	256
15	312	294	e185	e145	e125	e110	1500	1490	e280	e180	325	243
16	343	303	e185	e140	e125	e110	1250	1340	e270	e180	335	238
17	425	454	e180	e140	e125	e115	1190	1230	e287	e150	753	252
18	433	e500	e180	e140	e125	e115	1110	1120	e300	e130	782	256
19	404	e450	e180	e140	e120	e120	1000	1000	e330	112	592	2430
20	381	e400	e175	e140	e120	e120	905	913	e330	121	474	e3800
21	358	e360	e175	e140	e120	e120	821	850	e320	114	404	2550
22	345	e330	e175	e140	e120	e125	755	815	e290	118	373	1760
23	346	e310	e170	e140	e120	e125	709	806	e270	116	1300	1370
24	367	e291	e170	e140	e115	e130	e650	789	e300	112	1310	1110
25	379	e280	e170	e140	e115	e180	e600	755	e280	109	998	935
26	494	e270	e165	e140	e115	e200	e550	722	e250	99	788	814
27	665	e260	e165	e140	e115	e210	e540	714	e230	92	677	753
28	625	e255	e165	e135	e115	e210	e530	743	e300	83	611	680
29	550	e250	e160	e135	e110	e200	e520	764	e320	84	569	654
30	495	e245	e160	e135	---	e195	e520	739	e320	86	526	704
31	463	---	e160	e135	---	e190	---	682	---	90	481	---
TOTAL	12975	10300	5870	4469	3615	4056	23315	28177	10564	4571	13833	25056
MEAN	419	343	189	144	125	131	777	909	352	147	446	835
MAX	665	500	240	155	135	210	1820	1710	624	300	1310	3800
MIN	312	245	160	135	110	101	190	500	230	83	99	238
AC-FT	25740	20430	11640	8860	7170	8050	46250	55890	20950	9070	27440	49700
CFSM	.70	.57	.32	.24	.21	.22	1.30	1.51	.59	.25	.74	1.39
IN.	.80	.64	.36	.28	.22	.25	1.45	1.75	.65	.28	.86	1.55

CAL YR 1987 TOTAL 124873 MEAN 342 MAX 1960 MIN 71 AC-FT 247700 CFSM .57 IN. 7.74
WTR YR 1988 TOTAL 146801 MEAN 401 MAX 3800 MIN 83 AC-FT 291200 CFSM .67 IN. 9.10

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.--61 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. 7	1500	Ice jam	*9.50	No peak greater than base discharge.			
Aug. 23	0730	*1,230	9.03				

Minimum daily discharge, 5.0 ft^3/s, Feb. 10-17; minimum gage height, 5.48 ft, July 28, 29.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	38	58	e41	e16	e7.0	e5.5	e27	144	75	33	14	108
2	41	56	e39	e15	e7.0	e5.5	e27	143	62	25	19	117
3	40	84	e37	e15	e7.0	e5.5	e50	142	54	20	24	106
4	40	82	e36	e14	e6.5	e5.5	e200	140	46	16	28	95
5	40	57	e34	e12	e6.5	e5.5	e300	137	40	14	100	90
6	39	58	e33	e10	e6.0	e5.5	e400	136	34	12	206	74
7	41	53	e32	e9.0	e6.0	e5.5	e450	131	30	10	193	65
8	43	46	e30	e8.0	e5.5	e5.5	e500	174	31	10	252	57
9	43	49	e30	e7.5	e5.5	e5.5	e500	738	35	21	210	47
10	42	63	e29	e7.0	e5.0	e6.0	e550	978	30	24	146	40
11	39	60	e28	e7.0	e5.0	e6.0	e600	739	26	18	103	36
12	38	49	e27	e7.5	e5.0	e6.0	798	560	23	15	65	32
13	38	40	e26	e8.0	e5.0	e6.0	964	561	19	18	122	31
14	36	41	e25	e8.5	e5.0	e6.0	813	472	17	18	477	28
15	36	39	e24	e9.0	e5.0	e6.0	587	376	18	59	374	28
16	53	55	e24	e9.5	e5.0	e6.0	501	314	20	76	252	49
17	58	104	e23	e10	e5.0	e6.0	491	262	22	50	514	107
18	56	e95	e23	e10	e5.5	e6.0	400	212	22	32	e550	95
19	51	90	e22	e10	e5.5	e6.0	323	187	33	23	e350	682
20	49	78	e21	e10	e5.5	e6.0	261	164	33	18	261	1050
21	46	58	e21	e10	e5.5	e6.0	210	155	27	15	271	e750
22	46	54	e20	e9.5	e5.5	e6.0	180	196	24	14	434	e500
23	55	60	e20	e9.5	e5.5	e7.0	163	224	18	12	1160	356
24	68	61	e19	e9.0	e5.5	e8.0	150	190	18	11	884	241
25	66	e56	e19	e9.0	e5.5	e25	146	160	22	12	649	e177
26	64	e54	e18	e8.5	e5.5	e35	141	140	18	16	467	167
27	71	e51	e18	e8.5	e5.5	e35	139	139	17	22	329	159
28	75	e48	e17	e8.0	e5.5	e32	138	139	31	13	236	e154
29	74	e45	e17	e8.0	e5.5	e30	138	124	45	25	166	e148
30	74	e43	e16	e7.5	---	e27	144	108	41	21	138	142
31	71	---	e16	e7.5	---	e27	---	93	---	15	119	---
TOTAL	1571	1787	785	298.0	163.0	353.5	10291	8378	931	688	9113	5731
MEAN	50.7	59.6	25.3	9.61	5.62	11.4	343	270	31.0	22.2	294	191
MAX	75	104	41	16	7.0	35	964	978	75	76	1160	1050
MIN	36	39	16	7.0	5.0	5.5	27	93	17	10	14	28
AC-FT	3120	3540	1560	591	323	701	20410	16620	1850	1360	18080	11370
CFSM	.36	.43	.18	.07	.04	.08	2.45	1.93	.22	.16	2.10	1.36
IN.	.42	.47	.21	.08	.04	.09	2.73	2.23	.25	.18	2.42	1.52

CAL YR 1987 TOTAL 41980 MEAN 115 MAX 1920 MIN 14 AC-FT 83270 CFSM .82 IN. 11.15
WTR YR 1988 TOTAL 40089.5 MEAN 110 MAX 1160 MIN 5.0 AC-FT 79520 CFSM .78 IN. 10.65

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 1987 TO SEPTEMBER 1988

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 AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)
OCT										
13...	1415	38	88	97	7.35	7.4	13.0	5.5	0.30	742
JAN										
21...	1415	10	116	128	7.6	8.0	-5.0	0.0	1.8	781
MAY										
09...	1800	1050	57	68	7.3	7.3	12.0	8.5	5.6	763
JUL										
12...	1030	15	100	103	7.9	7.8	18.0	19.0	0.30	785

DATE	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)	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)
OCT									
13...	11.5	K9	K10	12	3.9	3.2	0.40	38	39
JAN									
21...	--	K8	89	14	4.8	4.5	0.40	47	48
MAY									
09...	11.2	89	K540	7.2	2.3	2.8	0.60	15	17
JUL									
12...	9.2	K5	79	13	4.2	4.1	0.60	41	45

DATE	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)	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)
OCT									
13...	0	45	15	2.9	0.3	10	84	<0.01	<0.10
JAN									
21...	0	57	17	3.7	0.3	15	92	<0.01	0.31
MAY									
09...	0	18	19	3.5	0.3	8.0	67	<0.01	0.76
JUL									
12...	0	50	11	3.0	0.2	1.9	87	<0.01	<0.10

STREAMS TRIBUTARY TO LAKE SUPERIOR

04014500 BAPTISM RIVER NEAR BEAVER BAY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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)	PHOSPHORUS TOTAL (MG/L AS P) (00665)	PHOSPHORUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT									
13...	0.05	0.05	0.50	0.01	0.01	--	2	0.21	100
JAN									
21...	0.04	0.04	0.40	0.01	<0.01	<0.01	2	0.05	100
MAY									
09...	0.10	0.05	1.2	0.03	0.01	<0.01	50	142	91
JUL									
12...	0.13	0.06	0.90	<0.01	<0.01	<0.01	6	0.24	70

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...	1415	50	<1	10	<0.5	<1	<1	<3	2	300	<5
JAN											
21...	1415	40	<1	13	<0.5	1	<1	<3	2	250	<5
MAY											
09...	1800	140	1	12	<0.5	<1	<1	<3	2	200	<5
JUL											
12...	1030	30	<1	38	<0.5	<1	<1	<3	1	<3	<5

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	5	<0.1	<10	<1	<1	<1.0	33	<6	31
JAN										
21...	<4	5	<0.1	<10	<1	<1	<1.0	40	<6	7
MAY										
09...	<4	11	<0.1	<10	3	<1	<1.0	21	<6	6
JUL										
12...	27	<1	<0.1	<10	1	<1	<1.0	460	<6	<3

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.--14 years, 93.0 ft^3/s, 14.75 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)
Apr. 8	2400	877	5.17	Aug. 13	2045	*2,510	*7.21
May 9	1415	890	5.24	Aug. 22	2345	1,720	6.34
				Sept. 20	Unknown	1,510	6.07

Minimum discharge, 1.3 ft^3/s, Jan. 11; minimum gage height, 2.37 ft, July 29.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	16	13	e12	e4.5	e3.5	e3.0	e70	32	24	11	3.5	26
2	16	13	e12	e4.0	e3.5	e3.0	e100	30	21	8.5	5.1	80
3	14	13	e11	e4.0	e3.5	e3.0	e200	29	19	6.8	7.8	171
4	12	14	e11	e3.5	e3.5	e3.0	e300	25	17	5.9	13	71
5	12	15	e10	e3.0	e3.5	e3.0	e450	23	16	4.7	51	38
6	12	14	e9.5	e2.5	e3.5	e3.0	e550	21	14	4.5	44	25
7	13	14	e9.0	e2.0	e3.5	e3.0	e750	19	11	6.9	26	19
8	12	13	e9.0	e1.7	e3.5	e4.0	e800	34	11	15	73	15
9	11	11	e8.5	e1.5	e3.5	e5.0	746	564	14	7.9	38	13
10	10	16	e8.5	e1.4	e3.5	e7.0	510	535	12	5.3	20	11
11	10	18	e8.0	e1.3	e3.0	e10	492	260	10	3.9	12	9.5
12	9.8	14	e8.0	e1.5	e3.0	e9.0	488	183	8.6	3.7	8.9	8.7
13	10	12	e7.5	e2.0	e3.0	e8.0	498	376	7.4	5.2	1100	8.8
14	10	11	e7.5	e2.5	e3.0	e8.0	359	218	8.8	8.4	971	8.7
15	10	13	e7.5	e3.0	e3.0	e8.0	228	160	9.0	6.5	276	8.1
16	12	16	e7.0	e3.5	e3.0	e8.0	180	125	19	4.7	117	12
17	15	92	e7.0	e4.0	e3.0	e8.0	188	95	17	3.8	73	85
18	14	139	e7.0	e4.0	e3.0	e8.0	166	74	11	4.1	57	69
19	13	79	e7.0	e4.0	e3.0	e8.0	120	60	52	4.2	35	95
20	14	45	e6.5	e4.0	e3.0	e8.0	93	52	33	3.5	25	1050
21	13	e40	e6.5	e4.0	e3.0	e8.0	75	49	17	3.0	43	e500
22	13	e40	e6.5	e4.0	e3.0	e8.0	64	42	13	2.7	334	e200
23	15	e29	e6.0	e4.0	e3.0	e10	57	35	9.9	2.6	993	e100
24	19	e23	e6.0	e4.0	e3.0	e30	53	32	8.1	2.5	322	e70
25	19	e18	e6.0	e4.0	e3.0	e100	49	24	7.5	2.2	145	e60
26	18	e15	e5.5	e4.0	e3.0	e85	49	21	6.7	2.3	85	e50
27	17	e14	e5.5	e4.0	e3.0	e70	45	69	5.7	2.4	57	e45
28	15	e14	e5.5	e3.5	e3.0	e65	40	79	11	2.2	39	e40
29	15	e13	e5.0	e3.5	e3.0	e60	37	48	33	1.9	29	e35
30	14	e13	e5.0	e3.5	---	e58	35	34	19	1.9	24	e30
31	14	---	e5.0	e3.5	---	e55	---	28	---	2.9	21	---
TOTAL	417.8	794	236.0	99.9	92.0	669.0	7792	3376	465.7	151.1	5048.3	2953.8
MEAN	13.5	26.5	7.61	3.22	3.17	21.6	260	109	15.5	4.87	163	98.5
MAX	19	139	12	4.5	3.5	100	800	564	52	15	1100	1050
MIN	9.8	11	5.0	1.3	3.0	3.0	35	19	5.7	1.9	3.5	8.1
AC-FT	829	1570	468	198	182	1330	15460	6700	924	300	10010	5860
CFSM	.16	.31	.09	.04	.04	.25	3.03	1.27	.18	.06	1.90	1.15
IN.	.18	.35	.10	.04	.04	.29	3.39	1.47	.20	.07	2.19	1.28

CAL YR 1987 TOTAL 20395.3 MEAN 55.9 MAX 1890 MIN 3.7 AC-FT 40450 CFSM .65 IN. 8.86
WTR YR 1988 TOTAL 22095.6 MEAN 60.4 MAX 1100 MIN 1.3 AC-FT 43830 CFSM .71 IN. 9.60

e Estimated

STREAMS TRIBUTARY TO LAKE SUPERIOR

04015475 PARTRIDGE RIVER ABOVE COLBY LAKE, AT HOYT LAKES, MN

LOCATION.--Lat 47°31'38", long 92°7'21", in SW¼NE¼ sec.9, T.58 N., R.14 W., St. Louis County, Hydrologic Unit 04010201, in Superior National Forest, 10 ft upstream from bridge on County Highway 110, 1 mi east of Hoyt Lakes.

DRAINAGE AREA.--106 mi^2 of which 6.0 mi^2 is noncontributing.

PERIOD OF RECORD.--October 1978 to September 1988 (discontinued).

GAGE.--Water-stage recorder. Elevation of gage is 1,455 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.--10 years, 87.6 ft^3/s, 11.22 in/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 2,020 ft^3/s, Apr. 22, 1979, gage height, 10.89 ft; minimum, 0.33 ft^3/s, July 30, 31, 1988, gage height, 4.77 ft.

EXTREMES OUTSIDE PERIOD OF RECORD.--A discharge of 0.50 ft^3/s was measured Aug. 23, 1976.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 490 ft^3/s, Aug. 25, 26, gage height, 8.00 ft; minimum, 0.33 ft^3/s, July 30, 31, gage height, 4.77 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	33	19	13	5.4	e2.0	1.0	4.0	48	44	10	.68	134
2	33	18	13	6.0	e2.0	.93	6.3	50	38	9.9	1.4	155
3	32	18	12	5.7	e2.0	1.2	14	53	32	8.9	1.5	178
4	31	18	12	5.4	e2.0	1.1	19	56	29	7.6	2.4	176
5	30	18	11	e5.1	e2.0	.90	26	59	26	7.3	5.3	154
6	29	18	10	e4.8	e1.9	.65	39	57	22	7.1	8.2	131
7	29	18	9.0	e4.5	e1.9	.61	74	57	19	6.4	19	111
8	28	17	8.4	e4.2	e1.9	.81	168	63	18	6.9	57	94
9	26	16	8.4	e4.0	e1.8	1.3	260	120	17	7.0	132	79
10	24	15	8.1	e3.8	e1.8	1.3	309	298	15	6.6	147	68
11	22	14	7.8	e3.5	e1.7	1.4	339	413	13	5.6	122	58
12	21	14	7.8	e3.3	e1.7	1.9	336	454	11	4.7	89	49
13	21	14	7.5	e3.1	e1.6	1.9	319	436	10	4.5	73	45
14	20	13	7.9	2.9	e1.6	2.0	309	388	9.7	3.9	127	39
15	19	13	7.6	2.6	e1.5	2.1	286	329	9.1	4.1	198	34
16	19	14	7.5	2.3	e1.5	2.0	243	273	9.1	3.9	217	32
17	19	18	8.2	2.1	1.5	1.9	210	223	9.1	3.6	212	31
18	18	22	8.4	1.9	1.4	1.7	183	180	8.5	3.2	217	32
19	18	25	8.4	1.7	1.3	1.6	150	149	9.8	2.9	207	48
20	18	25	8.0	1.9	1.3	1.9	126	127	10	3.0	181	76
21	17	23	7.5	1.9	1.3	2.0	107	111	10	3.8	217	82
22	17	21	7.3	e2.0	1.1	2.2	92	101	10	3.4	273	76
23	17	19	7.0	e2.0	1.2	2.0	79	95	9.4	3.0	357	69
24	17	17	6.7	e2.0	1.1	2.3	69	87	8.5	2.6	432	63
25	17	16	6.4	e2.0	1.1	3.9	63	73	7.3	1.8	480	56
26	17	15	6.6	e2.0	1.1	4.5	58	63	6.6	1.4	475	49
27	17	14	7.2	e2.0	1.2	4.9	54	57	6.0	.86	406	45
28	18	14	6.2	e2.0	1.0	5.0	53	54	7.2	.54	309	42
29	18	14	5.6	e2.0	1.0	4.6	51	49	8.7	.80	230	41
30	18	13	5.4	e2.0	---	4.0	49	47	10	.72	176	41
31	18	---	5.3	e2.0	---	3.8	---	47	---	.56	142	---
TOTAL	681	513	255.2	96.1	44.5	67.40	4095.3	4617	443.0	136.58	5514.48	2288
MEAN	22.0	17.1	8.23	3.10	1.53	2.17	137	149	14.8	4.41	178	76.3
MAX	33	25	13	6.0	2.0	5.0	339	454	44	10	480	178
MIN	17	13	5.3	1.7	1.0	.61	4.0	47	6.0	.54	.68	31
AC-FT	1350	1020	506	191	88	134	8120	9160	879	271	10940	4540
CFSM	.21	.16	.08	.03	.01	.02	1.29	1.41	.14	.04	1.68	.72
IN.	.24	.18	.09	.03	.02	.02	1.44	1.62	.16	.05	1.94	.80

CAL YR 1987 TOTAL 26870.2 MEAN 73.6 MAX 874 MIN 5.3 AC-FT 53300 CFSM .69 IN. 9.43
WTR YR 1988 TOTAL 18751.56 MEAN 51.2 MAX 480 MIN .54 AC-FT 37190 CFSM .48 IN. 6.58

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 current year.

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.--24 years, 560 ft^3/s, 10.67 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, 1,950 ft^3/s, Apr. 12, gage height, 12.32 ft (backwater from ice); mimimum daily, 6.1 ft^3/s, Oct. 27; minimum gage height, 4.91 ft, Nov. 30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	292	146	e100	e170	e60	e60	e55	387	314	104	88	1220
2	279	192	e50	e40	e30	e60	e120	371	296	96	85	1210
3	263	202	e180	e110	e55	e60	e250	369	276	89	99	1140
4	254	282	e200	e190	e60	e45	e450	355	260	89	158	1070
5	252	24	e60	e20	e40	e60	e700	341	246	92	224	994
6	253	162	e180	e100	e100	e40	e900	332	229	102	256	929
7	254	313	e160	e150	e55	e35	e1400	327	215	100	237	866
8	246	86	e60	e30	e30	e80	e1300	343	200	108	312	778
9	243	173	e90	e100	e35	e30	e1600	508	189	112	332	682
10	238	206	e140	e80	e60	e80	e1700	826	176	99	282	600
11	232	146	e120	e40	e55	e20	e1750	977	189	89	259	545
12	226	162	e60	e130	e80	e100	e1750	1100	183	83	284	489
13	218	178	e50	e25	e50	e30	e1600	1180	172	84	401	439
14	214	37	e90	e80	e40	e80	e1250	1220	160	87	811	397
15	211	172	e110	e45	e80	e60	1020	1290	161	80	910	360
16	212	206	e100	e60	e55	e45	925	1320	164	74	857	344
17	213	243	e15	e50	e40	e70	926	1270	155	68	807	354
18	215	232	e120	e50	e80	e45	859	1190	147	63	745	343
19	213	199	e120	e60	e55	e90	787	1090	152	59	660	366
20	211	112	e110	e60	e35	e25	724	989	151	74	593	407
21	210	222	e90	e50	e80	e70	675	899	138	74	674	404
22	210	166	e40	e55	e80	e80	613	818	127	70	811	408
23	209	140	e130	e50	e35	e30	579	740	122	68	1220	407
24	207	e210	e90	e60	e60	e80	536	657	115	69	1460	396
25	207	e200	e60	e50	e60	e60	501	588	202	67	1470	397
26	92	e180	e100	e60	e60	e70	473	527	58	57	1560	396
27	6.1	e70	e70	e55	e60	e60	453	475	42	53	1640	384
28	271	e110	e50	e55	e90	e90	421	428	98	52	1640	366
29	9.4	e180	e60	e55	e25	e60	398	387	108	62	1560	237
30	182	e180	e90	e50	---	e60	396	354	111	58	1430	394
31	315	---	e40	e50	---	e70	---	330	---	80	1300	---
TOTAL	6657.5	5131	2935	2180	1645	1845	25111	21988	5156	2462	23165	17322
MEAN	215	171	94.7	70.3	56.7	59.5	837	709	172	79.4	747	577
MAX	315	313	200	190	100	100	1750	1320	314	112	1640	1220
MIN	6.1	24	15	20	25	20	55	327	42	52	85	237
AC-FT	13210	10180	5820	4320	3260	3660	49810	43610	10230	4880	45950	34360
CFSM	.30	.24	.13	.10	.08	.08	1.17	.99	.24	.11	1.05	.81
IN.	.35	.27	.15	.11	.09	.10	1.31	1.15	.27	.13	1.21	.90

CAL YR 1987 TOTAL 178247.5 MEAN 488 MAX 4000 MIN 6.1 AC-FT 353600 CFSM .68 IN. 9.30
WTR YR 1988 TOTAL 115597.5 MEAN 316 MAX 1750 MIN 6.1 AC-FT 229300 CFSM .44 IN. 6.03

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).--80 years, 2,340 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, 8,780 ft^3/s, Aug. 16, gage height, 7.11 ft; minimum daily, 103 ft^3/s, Aug. 1; minimum gage height, 1.79 ft, July 31, Aug. 1, 2.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1190	1030	1340	e700	e1100	1090	1100	1180	852	204	103	2710
2	1150	1260	1190	e900	e1050	1050	1040	1120	691	363	192	2830
3	1150	1380	1280	e650	e1000	1100	1340	1130	737	355	185	2950
4	1170	1280	1260	e1200	e1050	1000	1930	1090	692	237	182	2640
5	1110	1400	1190	e1000	e1000	1040	3630	1090	625	237	277	2350
6	1170	1450	1300	e700	e1000	930	4400	943	535	130	318	2140
7	1060	1410	1400	e900	e1000	1000	5410	961	541	214	425	1870
8	1110	1330	1450	e1000	e1000	1080	6460	1020	392	272	676	1780
9	1080	1640	1410	e1200	e900	1090	7090	1760	461	248	639	1530
10	1090	1450	1420	e1000	e1000	1060	6810	3560	382	218	572	1410
11	1100	1290	1440	e1000	e950	1150	6360	4790	337	207	771	1200
12	948	1290	1380	e1000	e950	1100	5980	4500	340	234	777	1210
13	1140	1540	1330	e1000	e950	1000	5440	4310	356	221	891	1090
14	940	1380	1320	e1000	e950	1060	4750	4330	361	222	4690	910
15	984	1330	1260	e1050	e950	1060	4090	4060	340	212	7850	822
16	1060	1430	1240	e1100	e1050	1030	3620	3700	310	216	8340	1010
17	926	1520	1160	e1100	e950	1030	3330	3500	283	221	7490	914
18	1060	1550	1050	e1100	e950	1040	3020	3190	313	208	6300	905
19	944	1600	891	e1100	e950	1020	2720	2870	573	159	4810	1070
20	962	1360	1210	e1100	e950	982	2470	2640	543	158	3640	2100
21	990	1390	1200	e1100	e900	957	2210	2340	657	105	2880	2310
22	975	1410	1210	e1100	e1000	977	2020	2110	562	143	2610	2370
23	1010	1420	1300	e1100	e1000	934	1840	1950	398	303	2680	2150
24	1050	1420	1270	e1100	e900	1040	1720	1730	397	120	3950	1990
25	986	1450	1180	e1050	e950	1230	1620	1560	409	119	3980	1680
26	1080	1470	1120	e1000	e950	1470	1520	1390	269	114	3570	1450
27	937	1370	795	e1050	e950	1670	1440	1470	255	146	3420	1470
28	1070	1440	1450	e1050	e950	1700	1350	1190	536	126	3190	1270
29	848	1510	1400	e1100	e950	1480	1280	1170	218	151	3130	1220
30	911	1480	1260	e1100	---	1250	1210	968	382	176	2750	1300
31	954	---	e1100	e1100	---	1140	---	980	---	120	2610	---
TOTAL	32155	42280	38806	31650	28250	34760	97200	68602	13747	6159	83898	50651
MEAN	1037	1409	1252	1021	974	1121	3240	2213	458	199	2706	1688
MAX	1190	1640	1450	1200	1100	1700	7090	4790	852	363	8340	2950
MIN	848	1030	795	650	900	930	1040	943	218	105	103	822
†	-374	-668	-688	-632	-652	-539	1224	701	68	-33	873	429
MEAN‡	663	741	564	389	322	582	4464	2914	526	166	3579	2117
CFSM‡	.19	.22	.16	.11	.09	.17	1.30	.85	.15	.05	1.04	.62
IN‡	.22	.24	.19	.13	.10	.20	1.45	.98	.17	.06	1.20	.69

CAL YR 1987 TOTAL 777723 MEAN 2131 MAX 17100 MIN 553 MEAN‡ 2029 CFSM‡ 0.59 IN‡ 8.03
WTR YR 1988 TOTAL 528158 MEAN 1443 MAX 8340 MIN 103 MEAN‡ 1419 CFSM‡ 0.41 IN‡ 5.63

† 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 1987 TO SEPTEMBER 1988

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 AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)
OCT										
28...	1315	1010	180	192	8.0	8.1	6.0	5.0	2.8	732
DEC										
08...	1400	1600	153	168	7.9	8.0	2.0	0.0	2.1	725
JAN										
19...	1330	1160	134	166	7.4	7.8	-1.0	0.0	1.9	764
FEB										
23...	1330	1040	175	187	7.4	7.7	-15.0	0.0	2.5	760
APR										
12...	1045	5720	104	107	7.4	7.7	13.0	1.0	10	768
SEP										
07...	1215	1680	120	146	7.15	7.9	16.0	17.5	3.0	766

DATE	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)	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)
OCT									
28...	12.2	K12	360	17	9.6	6.8	1.4	68	70
DEC									
08...	13.5	K10	22	15	7.7	5.3	1.4	62	62
JAN									
19...	12.3	K19	51	16	8.0	5.1	1.0	61	64
FEB									
23...	10.6	20	26	19	9.2	6.5	8.5	69	72
APR									
12...	14.5	K3	33	9.2	4.7	3.0	2.8	33	34
SEP									
07...	8.3	K14	81	15	8.0	5.3	1.5	55	52

DATE	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)	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)
OCT									
28...	0	84	19	1.3	0.9	7.7	127	<0.01	<0.10
DEC									
08...	0	76	17	4.8	0.3	7.8	116	<0.01	<0.10
JAN									
19...	0	74	15	3.6	0.2	9.2	114	<0.01	0.15
FEB									
23...	0	84	16	5.1	0.2	11	133	<0.01	0.20
APR									
12...	0	40	20	5.0	0.1	5.5	84	0.01	0.25
SEP									
07...	0	67	18	6.1	0.2	9.6	142	<0.01	0.15

WATER QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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)	PHOSPHORUS TOTAL (MG/L AS P) (00665)	PHOSPHORUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT									
28...	0.04	0.02	0.40	0.04	0.02	<0.01	4	11	92
DEC									
08...	0.05	0.04	2.5	0.02	0.02	<0.01	4	17	87
JAN									
19...	0.07	0.07	0.90	0.02	0.02	<0.01	2	6.3	100
FEB									
23...	0.09	0.07	0.50	0.03	0.02	<0.01	2	5.6	100
APR									
12...	0.14	0.14	1.0	0.10	0.03	<0.01	24	371	100
SEP									
07...	0.05	0.05	1.2	0.04	0.03	0.02	9	41	99

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											
28...	1315	30	<1	18	<0.5	<1	<1	<3	1	440	<5
FEB											
23...	1330	40	<1	19	<0.5	<1	<1	<3	1	500	<5
APR											
12...	1045	50	3	19	<0.5	<1	<1	<3	2	390	<5
SEP											
07...	1215	80	2	21	<0.5	<1	<1	<3	2	920	<5

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										
28...	5	35	<0.1	<10	<1	<1	1.0	51	<6	9
FEB										
23...	<4	27	<0.1	<10	<1	<1	<1.0	53	<6	11
APR										
12...	<4	88	<0.1	<10	<1	<1	<1.0	28	<6	6
SEP										
07...	<4	90	<0.1	<10	<1	<1	<1.0	51	<6	16

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 Nov. 29 to Apr. 2, which are fair and those for Apr. 3-27, which are poor.

AVERAGE DISCHARGE.--12 years, 7.62 ft^3/s, 13.32 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.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 166 ft^3/s, May 9, gage height, 14.25 ft; minimum discharge, 0.95 ft^3/s, July 9, 15, 24, Aug. 24; minimum gage height, 11.22 ft, July 9, 15, 24.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.5	2.0	e2.8	e1.5	e1.5	e2.9	e6.0	2.6	1.6	1.4	1.9	2.0
2	1.5	2.0	e2.4	e1.5	e1.5	e2.6	e7.0	3.1	1.9	1.4	1.8	1.7
3	1.5	2.0	e2.4	e1.5	e1.5	e2.1	e8.5	2.5	2.3	1.4	1.8	1.6
4	1.4	2.3	e2.4	e1.5	e1.5	e2.1	e11	2.3	2.0	1.4	2.2	1.8
5	1.8	2.2	e2.3	e1.5	e1.5	e2.0	e14	2.3	2.1	1.3	2.2	1.5
6	2.1	2.0	e2.3	e1.5	e1.5	e2.2	e47	2.2	2.1	1.5	1.8	1.5
7	1.6	2.1	e2.4	e1.5	e1.5	e2.4	e85	2.2	2.0	1.5	1.9	1.6
8	1.4	2.1	e2.5	e1.5	e1.5	e5.4	e58	4.4	2.1	1.6	2.7	1.5
9	1.4	1.8	e2.6	e1.5	e1.5	e9.9	e40	98	2.2	1.4	1.5	1.5
10	1.5	1.9	e2.7	e1.5	e1.5	e7.8	e34	33	2.0	1.6	1.5	1.6
11	1.5	2.1	e2.6	e1.5	e1.5	e4.4	e26	13	2.0	1.4	1.5	1.7
12	1.5	2.1	e2.5	e1.5	e1.5	e3.2	e21	8.9	2.0	1.5	2.5	1.6
13	1.5	2.2	e2.4	e1.5	e1.5	e2.6	e15	8.3	2.0	2.1	13	1.6
14	1.5	2.2	e2.3	e1.5	e1.5	e2.4	e11	6.3	2.1	1.6	8.3	1.6
15	1.6	2.2	e2.3	e1.5	e1.5	e2.5	e8.8	4.8	1.8	1.5	2.4	1.7
16	1.7	2.4	e2.2	e1.5	e1.5	e2.5	e7.0	4.3	1.6	1.5	1.9	2.5
17	1.7	3.2	e2.2	e1.5	e1.6	e2.5	e6.0	3.3	1.7	1.3	1.8	2.2
18	1.6	3.3	e2.2	e1.5	e1.6	e2.5	e5.6	2.7	1.6	1.5	1.7	1.7
19	1.6	2.8	e2.2	e1.5	e1.7	e2.5	e5.2	2.4	2.4	1.5	1.6	8.7
20	1.6	2.1	e2.2	e1.5	e1.6	e2.6	e4.9	2.3	1.7	1.7	1.6	55
21	1.8	2.1	e2.2	e1.5	e1.6	e2.7	e4.5	2.1	1.5	1.5	1.6	8.3
22	1.8	2.1	e2.1	e1.5	e1.6	e2.9	e4.0	2.0	1.6	1.5	1.9	4.7
23	1.8	2.2	e2.1	e1.5	e1.7	e3.1	e3.5	2.0	1.3	1.5	4.0	3.4
24	1.8	2.0	e2.0	e1.5	e1.8	e3.2	e3.1	1.7	1.4	1.4	1.7	2.6
25	2.0	2.0	e1.9	e1.5	e1.9	e3.3	e2.8	1.7	1.4	1.3	1.4	2.2
26	2.1	2.0	e1.8	e1.5	e2.0	e3.5	e2.6	1.8	1.3	1.4	1.5	2.0
27	2.0	2.0	e1.8	e1.5	e2.3	e3.7	e2.5	2.1	1.3	1.4	1.5	1.9
28	1.9	2.0	e1.7	e1.5	e2.6	e4.0	3.2	2.0	1.9	1.4	1.6	1.9
29	1.9	e2.5	e1.6	e1.5	e3.0	e4.3	2.4	1.8	1.9	1.5	1.8	2.1
30	1.9	e3.5	e1.5	e1.5	---	e4.7	2.3	1.8	1.5	1.6	1.7	2.1
31	2.0	---	e1.5	e1.5	---	e5.0	---	1.6	---	2.0	1.7	---
TOTAL	52.5	67.4	68.1	46.5	49.0	107.5	451.9	229.5	54.3	46.6	76.0	125.8
MEAN	1.69	2.25	2.20	1.50	1.69	3.47	15.1	7.40	1.81	1.50	2.45	4.19
MAX	2.1	3.5	2.8	1.5	3.0	9.9	85	98	2.4	2.1	13	55
MIN	1.4	1.8	1.5	1.5	1.5	2.0	2.3	1.6	1.3	1.3	1.4	1.5
AC-FT	104	134	135	92	97	213	896	455	108	92	151	250
CFSM	.22	.29	.28	.19	.22	.45	1.94	.95	.23	.19	.32	.54
IN.	.25	.32	.33	.22	.23	.51	2.16	1.10	.26	.22	.36	.60

CAL YR 1987 TOTAL 1209.4 MEAN 3.31 MAX 39 MIN 1.4 AC-FT 2400 CFSM .43 IN. 5.79
WTR YR 1988 TOTAL 1375.1 MEAN 3.76 MAX 98 MIN 1.3 AC-FT 2730 CFSM .48 IN. 6.58

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, 12,680 acre-ft, Dec. 28, elevation, 1,268.68 ft; minimum, 6,650 acre-ft, Sept. 17, elevation, 1,261.77 ft.

MONTHEND ELEVATION AND CONTENTS, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

Date	Elevation (feet)	Contents (acre-feet)	Change in contents (acre-feet)
Sept. 30	1,267.96	11,960	
Oct. 31	1,268.42	12,420	+460
Nov. 30	1,268.13	12,130	-290
Dec. 31	1,268.61	12,610	+480
CAL YR 1987			+990
Jan. 31	1,268.18	12,180	-430
Feb. 29	1,265.55	9,620	-2,560
Mar. 31	1,264.00	8,300	-1,320
Apr. 30	1,263.99	8,290	-10
May 31	1,263.70	8,080	-210
June 30	1,264.00	8,300	+220
July 31	1,264.90	9,060	+760
Aug. 31	1,263.44	7,880	-1,180
Sept. 30	1,262.84	7,430	-450
WTR YR 1988			-4,530

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.--58 years, 322 ft^3/s, 233,300 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, 408 ft^3/s, Mar. 25, gage height, 3.05 ft, result of regulation; maximum gage height, 3.06 ft, May 23, 24, 25, result of regulation; minimum, 16 ft^3/s, Aug. 2, gage height, 2.16 ft, result of regulation.

DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	173	155	123	182	247	234	350	361	286	103	80	81
2	174	155	122	180	243	233	350	361	286	80	76	82
3	171	155	118	182	200	233	350	361	285	80	79	82
4	171	155	117	188	177	286	379	365	278	80	79	82
5	171	155	114	188	205	361	401	366	275	79	79	82
6	171	155	114	188	241	361	398	366	271	80	78	82
7	171	155	114	188	240	361	362	367	270	81	79	82
8	166	155	114	188	240	361	345	371	270	81	79	82
9	154	155	110	188	240	360	345	357	271	81	78	82
10	141	129	111	188	240	355	345	349	213	81	79	82
11	141	113	146	147	240	328	345	350	182	80	78	82
12	142	114	181	121	235	314	345	300	182	79	78	82
13	138	114	178	119	233	314	345	289	183	70	79	82
14	127	113	177	118	233	314	345	299	185	61	78	82
15	127	114	178	116	233	314	350	303	185	61	76	82
16	124	114	182	110	233	275	350	332	187	61	77	73
17	123	121	178	114	233	227	350	353	188	61	77	63
18	125	127	177	114	228	268	350	355	180	61	77	63
19	126	127	177	136	227	288	281	358	180	63	77	65
20	107	127	177	182	233	288	240	361	180	64	76	85
21	94	125	177	178	233	287	274	357	181	62	79	65
22	92	125	177	181	233	286	334	360	180	67	79	65
23	93	124	158	178	233	317	361	385	162	79	79	65
24	93	123	118	181	233	347	361	400	146	79	79	65
25	92	123	118	177	233	385	361	398	142	79	79	65
26	104	123	118	177	233	405	361	396	143	79	79	67
27	114	119	118	177	233	400	361	390	143	79	79	68
28	122	118	154	177	233	368	361	381	144	79	79	68
29	127	118	178	215	233	350	361	375	145	79	79	68
30	143	122	180	240	---	350	361	372	133	79	79	66
31	155	---	182	246	---	350	---	325	---	79	79	---
TOTAL	4172	3928	4586	5264	6698	9920	10422	11063	6056	2327	2428	2220
MEAN	135	131	148	170	231	320	347	357	202	75.1	78.3	74.0
MAX	174	155	182	246	247	405	401	400	286	103	80	82
MIN	92	113	110	110	177	227	240	289	133	61	76	63
AC-FT	8280	7790	9100	10440	13290	19680	20670	21940	12010	4620	4820	4400
CFSM	.07	.07	.08	.09	.13	.17	.19	.20	.11	.04	.04	.04
IN.	.08	.08	.09	.11	.14	.20	.21	.22	.12	.05	.05	.05

CAL YR 1987 TOTAL 136485 MEAN 374 MAX 1000 MIN 60 AC-FT 270700 CFSM .20 IN. 2.77
WTR YR 1988 TOTAL 69084 MEAN 189 MAX 405 MIN 61 AC-FT 137000 CFSM .10 IN. 1.40

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.--47 years, 81.8 ft^3/s, 59,260 acre-ft/yr; median of yearly mean discharges, 53 ft^3/s, 38,400 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, 180 ft^3/s, Apr. 12, gage height, 5.84 ft, due to regulation; no flow on many days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	18	e6.1	e1.6	e.00	e.24	15	59	2.7	.00	.00	.00
2	.00	17	e6.3	e1.5	e.00	e.70	14	8.5	2.3	.00	.00	.00
3	.00	17	e6.0	e1.3	e.00	e2.5	13	3.6	1.8	.00	.00	.00
4	.00	9.4	e5.0	e1.2	e.00	e5.4	11	2.9	1.5	.00	.00	.00
5	.00	16	e4.4	e1.1	e.00	e9.8	9.6	2.2	1.2	.00	.00	.00
6	.00	15	e4.7	e.90	e.00	e8.1	19	2.0	.88	.00	.00	.00
7	.00	15	e5.0	e.78	e.00	e7.5	15	1.6	.75	.00	.00	.00
8	.00	4.7	e5.2	e.60	e.00	e7.5	22	1.1	.60	.00	.00	.00
9	.00	6.4	e5.2	e.35	e.00	e11	29	1.6	.48	.00	.00	.00
10	.00	8.8	e5.4	e.15	e.00	e25	24	1.5	.38	.00	.00	.00
11	.00	8.8	e5.4	e.07	e.00	e17	24	1.0	.23	.00	.00	.00
12	.00	8.8	e5.6	e.04	e.00	e13	119	.79	.06	.00	.00	.00
13	23	7.2	e5.5	e.01	e.00	e21	148	.43	.01	.00	.00	.00
14	23	e7.8	e5.4	e.00	e.00	e7.5	113	.45	.24	.00	.00	.00
15	.02	e6.7	e5.2	e.00	e.00	e6.1	103	.31	.21	.00	.02	.00
16	31	e3.0	e5.1	e.00	e.00	6.9	111	.19	.15	.00	.00	.00
17	84	e2.5	e5.0	e.00	e.00	5.2	53	.17	.07	.00	.00	.00
18	77	e2.9	e4.9	e.00	e.00	5.4	71	.17	.00	.00	.02	.00
19	78	e3.7	e4.8	e.00	e.00	5.2	76	.55	.00	.00	.10	.00
20	73	e3.9	e4.8	e.00	e.00	4.9	28	.74	.00	.00	.03	.00
21	63	e6.7	e4.7	e.00	e.00	4.9	50	1.2	.00	.00	.00	.00
22	39	e8.1	e4.6	e.00	e.00	4.1	15	3.0	.00	.00	.00	.00
23	30	e8.4	e4.5	e.00	e.00	4.5	15	5.7	.00	.00	.00	.00
24	24	e9.4	e4.5	e.00	e.00	5.6	41	5.1	.00	.00	.00	.00
25	37	e8.9	e4.3	e.00	e.00	6.0	19	7.2	.00	.00	.00	.00
26	19	e8.0	e3.7	e.00	e.01	9.0	15	8.8	.00	.00	.00	.00
27	9.4	e7.1	e2.7	e.00	e.04	4.8	13	10	.00	.00	.00	.00
28	22	e6.4	e2.0	e.00	e.08	19	11	7.3	.00	.00	.00	.00
29	25	e5.6	e1.9	e.00	e.14	29	17	5.2	.00	.00	.00	.00
30	19	e5.9	e1.9	e.00	---	24	37	3.8	.00	.00	.00	.00
31	19	---	e1.8	e.00	---	20	---	3.3	---	.00	.00	---
TOTAL	695.42	257.1	141.6	9.60	0.27	300.84	1250.6	149.40	13.56	0.00	0.17	0.00
MEAN	22.4	8.57	4.57	.31	.009	9.70	41.7	4.82	.45	.00	.005	.00
MAX	84	18	6.3	1.6	.14	29	148	59	2.7	.00	.10	.00
MIN	.00	2.5	1.8	.00	.00	.24	9.6	.17	.00	.00	.00	.00
AC-FT	1380	510	281	19	.5	597	2480	296	27	.0	.3	.0
CFSM	.02	.01	.00	.00	.00	.01	.04	.00	.00	.00	.00	.00
IN.	.02	.01	.00	.00	.00	.01	.04	.00	.00	.00	.00	.00

CAL YR 1987 TOTAL 6822.85 MEAN 18.7 MAX 177 MIN .00 AC-FT 13530 CFSM .02 IN. .22
WTR YR 1988 TOTAL 2818.56 MEAN 7.70 MAX 148 MIN .00 AC-FT 5590 CFSM .01 IN. .09

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. 22 to Mar 28. 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; numerous other controlled lakes and ponds, and several powerplants.

AVERAGE DISCHARGE.--45 years (1944-88), 549 ft^3/s, 397,800 acre-ft/yr; median of yearly mean discharges, 480 ft^3/s, 348,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,200 ft^3/s, Apr. 10, 1969, gage height, 16.34 ft; 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, 911 ft^3/s, Mar. 27, gage height, 5.58 ft (backwater from ice); minimum daily, 57 ft^3/s, Sept. 23-27.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	167	186	111	161	220	366	461	432	368	143	93	83
2	164	187	114	190	247	357	462	401	301	125	148	74
3	172	187	113	190	282	341	471	416	291	92	141	71
4	169	183	114	190	233	338	461	414	288	82	123	73
5	167	183	102	180	139	372	478	407	284	80	101	73
6	173	183	116	190	143	443	500	401	280	75	96	72
7	174	179	114	190	200	538	504	390	279	76	90	72
8	170	175	114	190	260	627	471	393	281	79	89	70
9	165	173	113	190	250	650	410	410	276	83	88	69
10	161	179	113	190	245	701	410	411	277	86	81	71
11	143	157	113	180	240	758	409	403	247	81	79	72
12	141	133	115	132	240	657	406	377	195	89	83	70
13	141	128	134	100	244	483	406	330	201	185	88	72
14	137	124	163	105	248	425	429	266	219	142	92	73
15	129	123	200	110	252	465	464	265	207	91	86	74
16	129	131	168	115	256	508	458	276	199	70	81	88
17	129	132	170	110	260	527	443	298	196	63	77	84
18	124	122	185	110	259	464	449	327	193	60	78	64
19	123	133	190	110	257	427	435	336	190	58	78	96
20	123	104	190	120	254	447	367	344	190	58	78	79
21	126	119	190	143	223	448	304	358	191	59	78	65
22	130	131	190	161	270	480	313	385	191	61	79	59
23	144	130	188	146	280	518	369	368	202	59	78	57
24	131	128	160	132	290	633	411	374	188	78	76	57
25	128	124	120	123	300	753	400	405	160	85	76	57
26	119	128	105	108	323	662	390	406	155	82	75	57
27	122	127	119	138	345	855	412	421	151	81	77	57
28	138	126	123	157	358	693	410	421	147	79	77	64
29	147	122	130	162	360	517	392	412	147	83	78	72
30	152	120	160	182	---	474	408	407	147	83	79	69
31	166	---	180	200	---	467	---	406	---	86	78	---
TOTAL	4504	4357	4417	4705	7478	16394	12703	11660	6641	2654	2721	2114
MEAN	145	145	142	152	258	529	423	376	221	85.6	87.8	70.5
MAX	174	187	200	200	360	855	504	432	368	185	148	96
MIN	119	104	102	100	139	338	304	265	147	58	75	57
AC-FT	8930	8640	8760	9330	14830	32520	25200	23130	13170	5260	5400	4190

CAL YR 1987 TOTAL 158667 MEAN 435 MAX 1700 MIN 54 AC-FT 314700
WTR YR 1988 TOTAL 80348 MEAN 220 MAX 855 MIN 57 AC-FT 159400

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 1987 TO SEPTEMBER 1988

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)
OCT											
27...	1010	120	--	--	2.5	4.0	--	--	--	--	--
DEC											
16...	1430	169	555	--	-7.0	0.0	--	--	--	--	--
FEB											
04...	1125	242	562	--	-21.0	0.0	--	--	--	--	--
APR											
06...	1045	510	522	8.10	14.0	5.5	250	47	32	13	10
MAY											
11...	1105	407	690	--	21.5	17.0	--	--	--	--	--
JUN											
15...	1300	212	460	--	21.5	22.5	--	--	--	--	--
JUL											
07...	1305	84	495	--	22.5	27.5	--	--	--	--	--
27...	1020	79	460	8.60	28.0	27.0	220	35	32	12	10
AUG											
30...	1140	79	472	--	22.0	18.0	--	--	--	--	--

DATE	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	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 DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
06...	0.4	5.4	240	51	13	0.10	12	324	315	446	0.44
JUL											
27...	0.4	5.8	220	32	14	0.20	3.9	248	277	53.2	0.34

DATE	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										
06...	3	160	10	<1	18	<10	<0.1	1	1	200
JUL										
27...	4	90	10	<1	20	<10	0.1	1	<1	270

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: Nov. 18 to Mar. 1. 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, numerous other controlled lakes and ponds, and several powerplants.

AVERAGE DISCHARGE.--13 years, 616 ft^3/s, 446,300 acre-ft/yr; median of yearly mean discharges, 530 ft^3/s, 384,000 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 9,600 ft^3/s, Apr. 18, 1979, gage height, 33.03 ft; no flow Oct. 26, 1976, to Jan. 9, 1977.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 826 ft^3/s, Mar. 30, gage height, 10.97 ft; minimum daily, 53 ft^3/s, July 20, 21, 22 and Sept. 28.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	148	149	127	168	125	356	684	405	419	126	75	78
2	157	162	114	183	178	370	689	430	420	128	96	85
3	164	184	96	158	205	368	699	425	377	129	101	87
4	167	190	89	159	229	362	671	394	328	114	137	79
5	175	195	89	197	262	356	587	401	311	93	141	75
6	176	194	102	203	230	368	517	399	305	76	118	74
7	173	186	108	165	192	397	527	394	300	72	104	74
8	178	179	118	176	165	438	543	408	292	75	94	70
9	175	179	130	190	175	524	535	398	283	76	89	71
10	173	171	124	179	204	613	480	401	290	74	83	68
11	163	175	122	190	235	673	442	412	291	78	79	68
12	157	183	120	190	258	685	444	411	285	80	93	66
13	144	171	113	179	248	688	421	395	261	89	82	70
14	138	141	115	166	245	621	416	369	225	141	88	71
15	137	131	134	117	224	500	411	315	215	187	89	70
16	136	136	163	102	229	425	441	265	213	139	92	75
17	131	141	173	98	248	419	459	259	205	90	86	81
18	125	144	176	95	258	452	459	271	207	67	81	86
19	126	144	167	100	264	476	449	305	203	57	77	93
20	123	102	184	103	258	458	453	341	205	53	77	90
21	121	82	200	110	245	428	435	362	212	53	76	88
22	126	101	206	118	274	430	362	388	197	53	75	85
23	132	132	210	142	240	434	308	401	201	55	75	74
24	156	135	210	162	257	459	310	422	204	56	76	63
25	183	135	200	148	263	509	370	404	183	57	75	57
26	159	148	192	135	270	597	399	404	171	63	75	56
27	128	131	145	144	276	672	382	431	148	72	69	54
28	117	139	115	112	296	680	400	436	139	73	71	53
29	113	148	120	130	321	773	412	441	130	73	74	56
30	126	142	125	144	---	818	409	436	127	75	77	60
31	142	---	139	140	---	752	---	423	---	72	77	---
TOTAL	4569	4550	4426	4600	6874	16101	14114	11946	7347	2646	2702	2177
MEAN	147	152	143	148	237	519	470	385	245	85.4	87.2	72.6
MAX	183	195	210	203	321	818	699	441	420	187	141	93
MIN	113	82	89	95	125	356	308	259	127	53	69	53
AC-FT	9060	9020	8780	9120	13630	31940	28000	23690	14570	5250	5360	4320

CAL YR 1987 TOTAL 178772 MEAN 490 MAX 2430 MIN 61 AC-FT 354600
WTR YR 1988 TOTAL 82052 MEAN 224 MAX 818 MIN 53 AC-FT 162800

RED RIVER OF THE NORTH BASIN

05051522 RED RIVER OF THE NORTH AT HICKSON, ND--CONTINUED

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)
OCT											
27...	1445	133	550	--	5.0	4.5	--	--	--	--	--
FEB											
04...	1535	242	570	--	-20.0	0.0	--	--	--	--	--
APR											
06...	1535	505	555	8.20	22.0	4.0	260	50	33	14	10
MAY											
11...	1725	422	675	--	23.0	16.5	--	--	--	--	--
JUN											
16...	1600	218	520	--	30.0	23.0	--	--	--	--	--
JUL											
13...	1335	89	480	--	26.0	24.0	--	--	--	--	--
26...	1530	65	480	8.60	34.0	28.0	210	39	28	15	13
SEP											
01...	1110	77	--	--	23.0	19.5	--	--	--	--	--

DATE	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	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 DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
06...	0.4	5.6	230	76	13	0.20	12	349	339	476	0.47
JUL											
26...	0.5	6.1	170	82	12	0.20	9.1	286	296	50.2	0.39

DATE	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										
06...	2	160	20	<1	21	<10	0.2	2	1	210
JUL										
26...	3	130	10	<1	20	<10	0.5	2	<1	280

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 city waterplant on 4th St. S. in Fargo, 25 mi upstream from mouth of Sheyenne River, and at mile 453.0.

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: Nov. 13 to Mar. 3. 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).--87 years, 576 ft^3/s, 417,300 acre-ft/yr; median of yearly mean discharges, 450 ft^3/s, 326,000 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, 981 ft^3/s, Mar. 11, gage height, 15.10 ft; minimum daily, 15 ft^3/s, July 22, 25, and 26.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	142	135	125	121	125	317	832	412	395	105	45	45
2	146	140	113	154	142	339	768	415	387	112	87	39
3	154	155	101	161	182	364	799	421	369	121	86	52
4	153	174	85	151	219	367	802	405	319	116	106	57
5	162	183	78	166	256	386	804	412	278	101	145	51
6	161	182	84	182	276	380	696	414	258	73	152	41
7	157	179	96	203	280	396	605	441	249	66	136	43
8	164	175	104	182	239	451	601	426	240	51	112	39
9	166	177	115	181	211	495	595	410	238	55	93	33
10	161	170	132	202	235	662	564	413	234	56	88	34
11	163	165	136	194	245	924	491	412	233	49	67	41
12	158	174	131	202	259	909	455	440	235	49	55	38
13	151	174	118	195	275	831	434	431	259	66	92	42
14	136	149	107	204	278	828	428	392	272	58	78	41
15	137	132	105	177	271	739	426	352	206	123	67	63
16	139	129	121	135	249	603	428	304	199	166	65	100
17	141	127	157	93	251	519	454	267	191	130	61	85
18	136	128	173	92	240	497	472	263	181	76	59	145
19	138	130	161	83	235	514	463	273	175	46	48	191
20	135	115	160	78	230	517	455	328	157	28	51	99
21	134	90	166	82	233	488	448	379	164	21	53	98
22	128	76	180	79	244	469	405	386	156	15	48	93
23	129	94	194	99	234	499	339	394	172	16	41	86
24	136	108	203	137	225	575	307	409	166	20	39	78
25	161	126	211	161	244	684	324	415	161	15	38	65
26	162	125	207	120	296	721	382	397	164	15	35	53
27	130	136	175	131	311	792	399	429	142	21	39	45
28	121	124	133	128	314	867	383	427	120	40	40	57
29	110	133	98	107	284	833	391	440	112	46	39	59
30	108	139	97	113	---	901	414	441	110	45	37	52
31	123	---	107	141	---	900	---	417	---	51	40	---
TOTAL	4442	4244	4173	4454	7083	18767	15364	12165	6542	1952	2142	1965
MEAN	143	141	135	144	244	605	512	392	218	63.0	69.1	65.5
MAX	166	183	211	204	314	924	832	441	395	166	152	191
MIN	108	M76	78	78	125	317	307	263	110	15	35	33
AC-FT	8810	8420	8280	8830	14050	37220	30470	24130	12980	3870	4250	3900
†	1302	1167	1181	1249	1107	1233	1323	1675	2064	2073	1689	1596
MEAN‡	164	161	154	164	263	625	534	419	253	96.7	96.6	92.3
AC-FT‡	10110	9590	9460	10080	15160	38450	31790	25800	15040	5940	5940	5500

CAL YR 1987 TOTAL 184803 MEAN 506 MAX 2980 MIN 40 AC-FT 366600 | MEAN‡ 530 AC-FT‡ 383090
WTR YR 1988 TOTAL 83293 MEAN 228 MAX 924 MIN 15 AC-FT 165200 | MEAN‡ 252 AC-FT‡ 182870

† - Diversions in acre-feet to cities of Fargo and Moorhead.
‡ - 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 1987 TO SEPTEMBER 1988

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)
OCT											
27...	1715	125	535	--	6.0	5.0	--	--	--	--	--
DEC											
21...	1605	166	600	--	-2.0	0.0	--	--	--	--	--
FEB											
18...	1130	238	730	--	0.0	0.0	--	--	--	--	--
APR											
07...	1640	592	570	8.20	26.0	3.5	230	46	28	15	12
MAY											
13...	1055	428	530	--	11.0	17.5	--	--	--	--	--
JUN											
17...	0955	195	510	--	20.0	23.0	--	--	--	--	--
JUL											
12...	1230	48	490	--	28.0	24.0	--	--	--	--	--
26...	1305	15	455	8.80	24.0	26.5	210	26	36	14	12
28...	0810	34	480	--	24.0	26.0	--	--	--	--	--
AUG											
30...	1610	37	510	--	26.0	22.0	--	--	--	--	--

DATE	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	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 DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
07...	0.4	5.3	210	74	11	0.10	10	325	314	519	0.44
JUL											
26...	0.4	5.8	210	44	14	0.30	9.0	264	274	10.9	0.36

DATE	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...	4	170	10	<1	20	<10	0.3	1	1	210
JUL										
26...	4	130	10	<1	20	<10	0.1	2	<1	220

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.--38 years (water years 1945-80, 1986-88), 72.8 ft^3/s, 52,740 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, 350 ft^3/s, Apr 2, gage height, 6.12 ft; maximum gage height, 7.25 ft, Mar. 12 (backwater from ice); minimum discharge 5.7 ft^3/s, July 27, gage height, 2.90 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	17	19	23	e20	e18	e65	290	36	26	10	8.8	9.6
2	15	18	e22	e20	e18	e70	318	36	25	10	14	9.4
3	16	18	e23	e20	e18	e85	318	33	22	9.4	13	8.3
4	16	18	e23	e20	e18	e75	283	32	20	8.7	18	8.5
5	19	17	e23	e20	e18	e70	262	31	24	8.5	21	9.4
6	18	18	e23	e20	e18	e90	226	30	18	10	16	10
7	18	18	22	e20	e18	e125	201	31	18	17	18	8.3
8	18	18	22	e20	e18	e150	170	37	16	13	15	8.1
9	16	17	e23	e20	e18	e155	151	55	15	14	13	7.4
10	16	17	e23	e20	e18	e95	133	53	14	12	11	8.4
11	16	17	e22	e20	e18	e80	120	46	19	11	12	8.3
12	17	17	e22	e20	e18	e290	106	45	18	10	18	8.4
13	18	18	e22	e20	e18	e215	96	44	21	19	27	9.1
14	18	17	e21	e20	e18	e160	89	45	23	13	24	8.9
15	18	17	e20	e20	e18	e130	81	42	20	11	35	9.3
16	18	20	e20	e20	e19	e110	77	42	20	11	29	13
17	19	23	e21	e20	e19	e106	70	40	18	9.9	23	12
18	18	25	e21	e20	e20	e104	64	38	16	8.9	17	17
19	19	23	e21	e20	e21	e104	58	40	15	8.4	13	28
20	27	e23	e21	e19	e21	e102	53	43	15	8.7	12	43
21	23	26	e21	e19	e23	e102	52	42	15	9.0	13	41
22	35	23	e21	e19	e24	100	52	43	13	8.4	15	37
23	21	22	e21	e18	e24	112	50	50	16	9.6	12	32
24	25	e23	e21	e18	e25	145	48	51	16	12	15	28
25	26	21	e21	e18	e26	184	44	48	14	10	16	23
26	25	20	e21	e18	e27	181	42	43	13	8.5	14	20
27	24	21	e21	e18	e27	188	40	40	12	6.9	13	18
28	23	21	e21	e18	e44	204	39	37	12	8.3	12	14
29	20	21	e21	e18	e65	226	37	34	11	9.0	11	14
30	20	21	e21	e18	---	245	36	30	10	8.6	9.4	14
31	19	---	e20	e18	---	272	---	27	---	8.0	9.0	---
TOTAL	618	597	668	599	655	4340	3606	1244	515	321.8	497.2	485.4
MEAN	19.9	19.9	21.5	19.3	22.6	140	120	40.1	17.2	10.4	16.0	16.2
MAX	35	26	23	20	65	290	318	55	26	19	35	43
MIN	15	17	20	18	18	65	36	27	10	6.9	8.8	7.4
AC-FT	1230	1180	1320	1190	1300	8610	7150	2470	1020	638	986	963
CFSM	.06	.06	.07	.06	.07	.43	.37	.12	.05	.03	.05	.05
IN.	.07	.07	.08	.07	.08	.50	.42	.14	.06	.04	.06	.06

CAL YR 1987 TOTAL 18595 MEAN 50.9 MAX 328 MIN 14 AC-FT 36880 CFSM .16 IN. 2.15
WTR YR 1988 TOTAL 14146.4 MEAN 38.7 MAX 318 MIN 6.9 AC-FT 28060 CFSM .12 IN. 1.63

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.--38 years (water years 1945-80, 1986-88), 57.4 ft^3/s, 41,590 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, 175 ft^3/s, Mar. 9, gage height, 10.64 ft (backwater from ice), from highwater mark; no flow on many days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	10	e9.7	e13	e.00	e.00	e18	e76	e21	30	.00	.00	.00
2	8.8	10	e13	e.00	e.00	e19	e75	19	25	e.00	.00	.00
3	8.8	11	e13	e.00	e.00	e22	e75	17	17	e.00	.00	e.00
4	e8.8	12	e13	e.00	e.00	e28	e75	18	14	e.00	.00	e.00
5	8.8	9.6	e13	e.00	e.00	e54	74	30	e16	.00	e.00	.00
6	7.3	9.7	e13	e.00	e.00	e62	73	26	18	.00	.00	.00
7	e6.0	12	e13	e.00	e.00	e71	74	e26	7.3	.00	e.00	.00
8	5.5	e12	e13	e.00	e.00	e101	68	e27	4.9	.00	.00	.00
9	4.3	12	e13	e.00	e.00	e158	64	27	3.8	.00	.00	.00
10	4.2	12	e13	e.00	e.00	e158	e67	27	4.4	e.00	.00	.00
11	e4.2	12	e12	e.00	e.00	e147	70	46	2.7	.00	.00	e.00
12	4.2	12	e12	e.00	e.00	e140	84	36	e2.5	.00	.00	.00
13	4.2	13	e12	e.00	e.00	e129	78	28	2.4	.00	.00	.00
14	4.2	13	e11	e.00	e.02	e107	78	25	1.4	.00	e.35	.00
15	4.1	e13	e11	e.00	e.08	e90	78	e24	1.4	.00	1.3	.00
16	4.2	e14	e11	e.00	e.55	e82	76	22	1.4	e.00	1.0	.00
17	5.8	e15	e11	e.00	e.80	e80	e72	22	1.0	e.00	e.70	.00
18	e6.3	e16	e11	e.00	e1.0	e80	68	22	1.3	.00	.00	e.00
19	6.6	e17	e10	e.00	e1.2	e80	64	22	3.4	.00	.00	.00
20	7.0	e16	e8.0	e.00	e1.5	e77	64	24	3.4	.00	.00	.00
21	7.0	e16	e5.7	e.00	e2.0	e78	47	24	3.1	.00	.00	e.00
22	7.9	e16	e4.2	e.00	e2.0	e78	26	e35	3.4	.00	.00	.00
23	7.9	e15	e3.5	e.00	e1.9	e74	27	42	2.5	.00	.00	.00
24	7.9	e14	e2.7	e.00	e1.9	e97	e27	41	2.4	e.00	.00	1.8
25	e7.9	e14	e2.1	e.00	e2.1	e105	27	41	e2.3	.00	.00	e2.0
26	7.8	e13	e1.5	e.00	e2.3	e101	27	36	e2.1	.00	.00	2.3
27	7.8	e13	e1.0	e.00	e2.7	e91	27	34	2.0	.00	e.00	2.5
28	7.8	e13	e.70	e.00	e4.5	e86	22	e34	1.6	.00	e.00	3.6
29	7.8	e13	e.45	e.00	e6.6	e83	24	e35	.00	.00	.00	4.1
30	8.4	e13	e.20	e.00	---	e82	24	36	.00	.00	.00	3.2
31	8.9	---	e.02	e.00	---	e78	---	33	---	e.00	.00	---
TOTAL	210.4	391.0	261.07	0.00	31.15	2656	1731	900	180.70	0.00	3.35	19.50
MEAN	6.79	13.0	8.42	.00	1.07	85.7	57.7	29.0	6.02	.00	.11	.65
MAX	10	17	13	.00	6.6	158	84	46	30	.00	1.3	4.1
MIN	4.1	9.6	.02	.00	.00	18	22	17	.00	.00	.00	.00
AC-FT	417	776	518	.0	62	5270	3430	1790	358	.0	6.6	39
CFSM	.01	.02	.02	.00	.00	.16	.11	.06	.01	.00	.00	.00
IN.	.01	.03	.02	.00	.00	.19	.12	.06	.01	.00	.00	.00

CAL YR 1987 TOTAL 12960.74 MEAN 35.5 MAX 664 MIN .02 AC-FT 25710 CFSM .07 IN. .92
WTR YR 1988 TOTAL 6384.17 MEAN 17.4 MAX 158 MIN .00 AC-FT 12660 CFSM .03 IN. .45

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.--57 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, 648 ft^3/s, Apr. 4, gage height, 10.55 ft (backwater from ice); maximum gage height, 11.09 ft, Mar. 11 (backwater from ice); minimum discharge, 5.0 ft^3/s, July 30; minimum gage height, 2.34 ft, Sept. 12.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25	37	e52	e28	e20	e38	e470	59	98	9.9	6.3	9.7
2	25	37	e51	e27	e20	e50	e515	60	84	9.4	6.9	8.4
3	25	38	e49	e27	e20	e64	e580	66	69	9.0	8.2	8.1
4	27	39	e48	e26	e20	e61	e635	68	58	9.1	11	7.2
5	28	40	e47	e26	e20	e58	e620	67	49	8.5	10	7.7
6	29	43	e46	e25	e20	e74	e570	67	40	7.4	12	7.6
7	31	41	e46	e25	e20	e102	e515	65	36	7.4	14	7.1
8	31	39	e44	e24	e20	e131	442	66	30	7.8	14	7.2
9	28	e36	e43	e24	e20	e202	381	67	27	11	13	7.4
10	27	e32	e42	e24	e20	e340	325	70	26	11	13	6.5
11	25	e36	e41	e24	e20	e480	287	87	23	11	12	6.2
12	23	48	e40	e24	e20	e480	264	116	21	12	12	6.0
13	22	45	e39	e24	e20	e418	258	119	21	9.4	14	6.4
14	23	41	e37	e24	e21	e348	245	103	26	9.1	16	7.5
15	23	41	e37	e24	e22	e300	225	91	28	13	22	7.9
16	24	43	e37	e24	e22	e263	211	83	26	9.7	20	9.8
17	25	e43	e37	e24	e23	e246	201	78	23	8.4	23	11
18	25	e42	e37	e24	e23	e242	192	74	21	7.9	23	14
19	26	e51	e36	e24	e23	e242	178	72	20	7.1	20	16
20	27	e55	e36	e24	e24	e236	166	70	18	6.2	17	17
21	28	e55	e35	e23	e24	e236	153	74	17	6.0	13	24
22	34	e56	e35	e23	e24	e233	141	79	16	5.6	11	30
23	38	e56	e33	e22	e24	e230	116	83	16	5.7	11	32
24	44	e55	e31	e21	e25	e257	98	87	15	5.5	12	29
25	40	e54	e30	e20	e26	e336	90	98	14	6.3	12	26
26	42	e56	e29	e20	e27	e360	85	104	14	8.0	11	24
27	45	e55	e29	e19	e27	e390	81	101	13	7.7	11	22
28	43	e54	e29	e19	e28	e435	74	91	12	7.1	12	20
29	42	e53	e29	e19	e30	e440	68	79	11	6.2	12	18
30	41	e52	e29	e19	---	e435	61	74	10	5.3	11	18
31	39	---	e28	e20	---	e435	---	91	---	5.9	10	---
TOTAL	955	1373	1182	721	653	8162	8247	2509	882	253.6	413.4	421.7
MEAN	30.8	45.8	38.1	23.3	22.5	263	275	80.9	29.4	8.18	13.3	14.1
MAX	45	56	52	28	30	480	635	119	98	13	23	32
MIN	22	32	28	19	20	38	61	59	10	5.3	6.3	6.0
AC-FT	1890	2720	2340	1430	1300	16190	16360	4980	1750	503	820	836
CFSM	.03	.04	.04	.02	.02	.25	.26	.08	.03	.01	.01	.01
IN.	.03	.05	.04	.03	.02	.29	.29	.09	.03	.01	.01	.02

CAL YR 1987 TOTAL 40529 MEAN 111 MAX 950 MIN 21 AC-FT 80390 CFSM .11 IN. 1.45
WTR YR 1988 TOTAL 25772.7 MEAN 70.4 MAX 635 MIN 5.3 AC-FT 51120 CFSM .07 IN. .92

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, near center of span on downstream side of 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.--Nonrecording gage and crest-stage gage. Datum of gage is 836.75 ft above National Geodetic Vertical Datum of 1929 (levels by U.S. Army Corps of Engineers).

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.--43 years, (Water Years 1945-84, 1986-88), 265 ft^3/s, 192,000 acre-ft/yr; median of yearly mean discharges, 225 ft^3/s, 163,000 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, 1,190 ft^3/s, Apr. 8, gage height, 11.30 ft; maximum gage height, 12.59 ft, Mar. 13 (backwater from ice); minimum daily discharge, 3.4 ft^3/s, July 29.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	94	129	e100	e75	e60	e70	e900	305	94	28	3.7	12
2	89	124	e100	e75	e60	e75	e900	302	86	e26	e6.0	11
3	94	130	e100	e75	e60	e80	e950	279	86	e23	10	10
4	88	124	e95	e70	e60	e90	e1000	281	84	e22	6.7	8.8
5	84	120	e90	e70	e60	e110	e1050	282	79	e21	7.9	7.5
6	84	128	e80	e70	e58	e150	e1100	271	68	e20	9.4	e9.0
7	86	111	e90	e70	e58	e200	1160	238	66	e20	e8.8	9.9
8	91	118	e100	e70	e58	e250	1180	224	e60	e20	8.6	9.9
9	93	100	e100	e70	e57	e300	1100	219	e55	e20	9.2	9.9
10	94	e80	e100	e70	e56	e400	924	224	e50	e20	8.6	9.0
11	87	e65	e100	e70	e56	e500	860	254	e45	e21	12	10
12	83	e80	e100	e70	e56	e600	831	231	e40	e22	38	12
13	82	e90	e100	e65	e58	e600	796	206	e43	e23	58	9.4
14	84	e100	e100	e65	e58	e500	762	216	e46	e24	49	9.4
15	107	e100	e100	e65	e58	e450	e730	209	49	e25	45	9.7
16	121	e100	e100	e65	e60	e450	692	207	50	e18	68	12
17	134	e65	e100	e65	e60	e450	660	192	60	e16	63	15
18	142	e70	e95	e65	e60	e450	628	199	52	e15	49	18
19	150	e100	e95	e65	e60	e450	597	185	47	e15	37	52
20	154	e100	e95	e65	e60	e450	561	175	46	e15	e30	47
21	159	e90	e90	e65	e60	e460	531	186	41	e15	23	44
22	159	e70	e90	e65	e60	e480	494	219	46	e13	20	68
23	157	e100	e90	e60	e60	e520	456	211	53	e12	18	103
24	152	e105	e85	e60	e60	e600	426	180	53	e10	16	81
25	149	e110	e85	e60	e60	e700	415	171	46	e8.0	14	65
26	146	e110	e85	e60	e60	e800	393	165	45	e7.0	12	e60
27	139	e110	e80	e60	e62	e900	385	146	49	e6.0	13	55
28	140	e105	e80	e60	e65	e850	370	125	41	4.8	14	53
29	141	e105	e80	e60	e65	e850	344	106	32	3.4	12	55
30	139	e105	e80	e60	---	e850	323	105	31	4.0	12	50
31	134	---	e75	e60	---	e850	---	96	---	3.7	12	---
TOTAL	3656	3044	2860	2045	1725	14485	21518	6409	1643	500.9	693.9	925.5
MEAN	118	101	92.3	66.0	59.5	467	717	207	54.8	16.2	22.4	30.8
MAX	159	130	100	75	65	900	1180	305	94	28	68	103
MIN	82	65	75	60	56	70	323	96	31	3.4	3.7	7.5
AC-FT	7250	6040	5670	4060	3420	28730	42680	12710	3260	994	1380	1840
CFSM	.07	.06	.06	.04	.04	.29	.45	.13	.03	.01	.01	.02
IN.	.09	.07	.07	.05	.04	.34	.50	.15	.04	.01	.02	.02

CAL YR 1987 TOTAL 98854 MEAN 271 MAX 1470 MIN 65 AC-FT 196100 CFSM .17 IN. 2.30
WTR YR 1988 TOTAL 59505.3 MEAN 163 MAX 1180 MIN 3.4 AC-FT 118000 CFSM .10 IN. 1.38

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., Trail 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. 21 to Apr. 2. Records good except those for period of estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--27 years (1961-88), 1,799 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, 5,010 ft^3/s, Mar. 28, gage height, 12.42 ft; maximum gage height, 12.57 ft, Mar. 12 (backwater from ice); minimum daily, 64 ft^3/s, July 30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	414	452	532	355	362	613	4500	925	747	233	81	103
2	400	441	524	340	374	670	4220	910	729	220	94	102
3	389	449	500	345	390	700	3810	898	715	206	102	101
4	379	450	468	352	399	705	3640	874	706	195	106	101
5	379	450	456	363	413	715	3730	872	673	194	125	98
6	386	464	451	357	428	800	3660	876	611	193	129	96
7	384	483	449	337	449	955	3410	853	544	187	145	100
8	379	487	462	329	472	1150	3180	832	497	176	174	103
9	384	484	448	331	485	1430	2900	849	458	161	173	103
10	405	448	447	331	485	2120	2580	851	430	157	158	98
11	413	443	456	324	472	3200	2300	841	412	147	150	92
12	404	466	464	323	463	3620	2100	847	411	145	186	86
13	391	470	474	323	476	3500	1940	823	415	160	222	85
14	381	456	452	330	486	3170	1810	840	422	143	200	90
15	380	474	443	334	494	2680	1720	864	454	147	219	94
16	387	488	456	334	500	2380	1650	845	510	161	264	106
17	392	472	445	328	507	2290	1580	824	475	154	257	115
18	395	452	439	312	509	2250	1520	748	434	181	234	128
19	411	419	454	289	506	2240	1480	683	396	210	211	213
20	428	443	476	276	510	2250	1450	641	341	209	187	303
21	440	493	481	272	519	2350	1400	644	321	202	171	409
22	446	436	470	268	532	2480	1330	694	297	167	153	397
23	446	484	464	268	540	2710	1280	778	311	135	141	333
24	441	523	465	274	540	3200	1190	787	329	119	129	289
25	438	486	467	279	541	4010	1090	759	335	103	116	260
26	437	495	465	288	541	4640	1010	754	338	86	110	250
27	446	548	468	309	539	4890	969	761	320	85	106	236
28	461	558	467	326	548	4940	985	747	302	79	112	228
29	475	559	456	329	573	4940	987	735	283	68	114	220
30	477	543	422	339	---	4800	954	742	255	64	107	209
31	472	---	388	353	---	4660	---	741	---	65	103	---
TOTAL	12860	14316	14309	9918	14053	81058	64375	24838	13471	4752	4779	5148
MEAN	415	477	462	320	485	2615	2146	801	449	153	154	172
MAX	477	559	532	363	573	4940	4500	925	747	233	264	409
MIN	379	419	388	268	362	613	954	641	255	64	81	85
AC-FT	25510	28400	28380	19670	27870	160800	127700	49270	26720	9430	9480	10210

CAL YR 1987 TOTAL 579423 MEAN 1587 MAX 9740 MIN 378 AC-FT 1149000
WTR YR 1988 TOTAL 263877 MEAN 721 MAX 4940 MIN 64 AC-FT 523400

RED RIVER OF THE NORTH BASIN

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN--CONTINUED

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 (FTU) (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)	HARD-NESS TOTAL (MG/L AS CACO3) (00900)
NOV												
04...	1430	449	710	8.50	9.0	8.0	9.2	11.5	98	25	47	310
JAN												
26...	1435	292	830	8.00	-3.0	0.0	2.6	12.1	--	30	30	360
MAR												
02...	1330	667	775	7.90	-3.0	0.0	7.6	11.5	79	--	--	310
APR												
11...	1715	580	580	--	21.0	4.5	--	--	--	--	--	--
28...	1205	954	658	8.60	17.5	10.5	24	13.0	117	0	20	300
JUN												
21...	1250	319	765	8.30	27.0	26.5	64	6.5	81	--	--	290
JUL												
13...	1725	161	685	--	26.5	27.5	--	--	--	--	--	--
21...	1200	204	670	8.90	27.0	24.0	82	6.1	73	140	39	270
SEP												
02...	1430	102	--	--	23.0	19.0	--	--	--	--	--	--

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)	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)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)
NOV												
04...	66	34	38	21	1	6.8	270	316	7	100	19	0.30
JAN												
26...	77	40	47	22	1	9.0	310	378	0	120	18	0.30
MAR												
02...	63	37	44	23	1	8.5	282	344	0	89	31	0.30
APR												
28...	65	34	24	14	0.6	6.0	227	270	4	110	13	0.20
JUN												
21...	58	35	54	28	1	8.3	242	290	2	110	36	0.50
JUL												
21...	50	35	44	25	1	8.8	224	235	19	96	27	0.30

DATE	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, 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 DIS-SOLVED (MG/L AS NH4) (71846)	NITRO-GEN, AM-MONIA + ORGANIC TOTAL (MG/L AS N) (00625)	PHOS-PHOROUS TOTAL (MG/L AS P) (00665)
NOV												
04...	7.3	453	435	0.62	549	0.01	0.21	0.17	0.24	0.31	1.3	0.23
JAN												
26...	16	503	517	0.68	397	0.01	0.58	0.41	0.42	0.54	1.4	0.16
MAR												
02...	16	465	462	0.63	837	0.02	0.94	0.33	0.30	0.39	1.4	0.17
APR												
28...	8.0	407	398	0.55	1050	0.02	0.16	0.03	0.04	0.05	0.8	0.12
JUN												
21...	12	467	463	0.64	402	0.02	0.93	0.05	0.08	0.10	0.70	0.49
JUL												
21...	5.0	439	403	0.60	242	0.01	0.30	0.04	0.03	0.04	1.3	0.93

05064500 RED RIVER OF THE NORTH AT HALSTAD, MN--CONTINUED

WATER-QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DATE	PHOS-PHOROUS DIS-SOLVED (MG/L AS P) (00666)	PHOS-PHOROUS ORTHO, DIS-SOLVED (MG/L AS P) (00671)	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)
NOV											
04...	0.18	0.13	<10	3	140	<0.5	<1	<1	<3	4	9
JAN											
26...	0.14	0.11	--	--	--	--	--	--	--	--	--
MAR											
02...	0.14	0.09	<10	3	78	<0.5	<1	<1	<3	3	11
APR											
28...	0.08	0.04	<10	3	93	<0.5	<1	<1	<3	2	11
JUN											
21...	0.34	0.26	--	--	--	--	--	--	--	--	--
JUL											
21...	0.60	0.55	<10	11	61	1	45	<1	<3	5	7

DATE	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)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)
NOV											
04...	<5	35	5	<0.1	<10	5	<1	1.0	250	<6	8
MAR											
02...	<5	37	45	<0.1	<10	3	<1	<1.0	230	<6	8
APR											
28...	<5	26	3	<0.1	<10	5	<1	1.0	230	<6	7
JUL											
21...	<5	14	2	<0.1	<10	5	1	<1.0	230	10	<3

DATE	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT) (80040)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137) (03516)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90) (80050)	GROSS BETA, SUSP. TOTAL (PCI/L AS SR/YT-90) (80060)	RADIUM 226, DIS-SOLVED, RADON METHOD (PCI/L) (09511)	URANIUM NATURAL DIS-SOLVED (UG/L AS U) (22703)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
NOV											
04...	2.8	<0.4	8.3	<0.4	6.1	<0.4	0.08	1.5	68	82	97
JAN											
26...	--	--	--	--	--	--	--	--	47	37	56
MAR											
02...	--	--	--	--	--	--	--	--	23	41	100
APR											
28...	1.5	<0.4	12	<0.4	8.5	<0.4	0.08	2.2	117	301	99
JUN											
21...	--	--	--	--	--	--	--	--	130	112	99
JUL											
21...	--	--	--	--	--	--	--	--	145	80	100

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.--Nonrecording gage and crest-stage gage. 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.

REMARKS.--Records poor. 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.--42 years (water years 1945-83, 1986-88), 63.6 ft^3/s, 46,080 acre-ft/yr; median of yearly mean discharges, 42 ft^3/s, 30,400 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, 250 ft^3/s, Mar. 26, gage height, 7.86 ft, from highwater mark (backwater from ice); maximum gage height, 8.49 ft, Mar. 12, from highwater mark (backwater from ice); no flow for many days.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	e3.0	.50	e.55	e.30	e.14	e.60	e120	9.1	.01	.00	.00	.00
2	1.5	.55	e.55	e.25	e.14	e.80	e130	7.3	.00	.00	.00	.00
3	.85	.60	e.55	e.25	e.13	e1.0	e150	3.7	.01	.00	.00	.00
4	.41	.66	e.55	e.25	e.13	e1.5	e140	4.1	.01	.00	.00	.00
5	.72	.66	e.55	e.25	e.12	e2.0	e120	3.3	e.01	.00	.00	.00
6	.50	.66	e.50	e.25	e.12	e2.5	e110	2.9	e.01	.00	.00	.00
7	.41	.72	e.50	e.25	e.12	e3.5	e100	2.6	e.01	.00	.00	.00
8	.66	e.80	e.50	e.25	e.12	e5.0	e85	2.0	.00	.00	.00	.00
9	.35	e.86	e.50	e.25	e.11	e8.0	e75	1.8	.00	.00	.00	.00
10	e.40	e.93	e.50	e.25	e.11	e15	e60	1.5	.01	.00	.00	.00
11	e.45	1.0	e.45	e.20	e.11	e50	e50	e1.2	.00	.00	.00	.00
12	e.50	e.84	e.45	e.20	e.11	e200	e45	e1.0	.00	.00	.00	.00
13	e.50	.72	e.45	e.20	e.11	e170	e40	.92	.01	.00	5.3	.00
14	.50	.78	e.45	e.20	e.11	e140	34	.78	.00	.00	32	.00
15	.38	e.80	e2.0	e.20	e.11	e120	26	.85	.01	.00	23	.00
16	.60	e.80	e4.0	e.20	e.11	e100	24	.72	.00	.00	e15	.15
17	e.80	e.75	e1.0	e.20	e.11	e90	22	.35	.00	.00	e6.0	.01
18	1.0	e.75	e.70	e.20	e.11	e85	20	.45	.00	.00	4.3	.00
19	.85	e.75	e.50	e.15	e.11	e80	18	.45	.00	.00	1.6	.00
20	.72	e.70	e.45	e.15	e.12	e75	e17	.41	.00	.00	.55	e60
21	e.74	e.70	e.40	e.15	e.13	e75	e16	.50	.55	.00	.45	e35
22	e.76	e.70	e.40	e.15	e.14	e70	15	.60	.78	.00	.01	21
23	.78	e.65	e.35	e.15	e.15	e75	11	.41	e.64	.00	.05	16
24	.72	e.65	e.35	e.15	e.20	e100	9.1	e.35	.55	.00	.66	12
25	.92	e.65	e.35	e.15	e.25	e150	8.0	.29	.21	.00	.60	8.4
26	.92	e.60	e.35	e.15	e.30	e230	7.3	.24	.06	.00	.55	6.4
27	.78	e.60	e.30	e.15	e.35	e200	7.3	.19	e.05	.00	.29	4.8
28	.66	e.60	e.30	e.15	e.40	e150	11	.15	.04	.00	.10	3.1
29	.60	e.60	e.30	e.15	e.50	e130	11	.08	.02	.00	.04	2.1
30	.55	e.60	e.30	e.15	---	e110	10	.05	e.01	.00	e.02	1.5
31	.55	---	e.30	e.15	---	e100	---	.02	---	.00	e.01	---
TOTAL	23.08	21.18	19.40	6.10	4.77	2539.90	1491.7	48.31	3.00	0.00	90.53	170.46
MEAN	.74	.71	.63	.20	.16	81.9	49.7	1.56	.10	.00	2.92	5.68
MAX	3.0	1.0	4.0	.30	.50	230	150	9.1	.78	.00	32	60
MIN	.35	.50	.30	.15	.11	.60	7.3	.02	.00	.00	.00	.00
AC-FT	46	42	38	12	9.5	5040	2960	96	6.0	.0	180	338
CFSM	.00	.00	.00	.00	.00	.54	.33	.01	.00	.00	.02	.04
IN.	.01	.01	.00	.00	.00	.63	.37	.01	.00	.00	.02	.04

CAL YR 1987 TOTAL 16792.01 MEAN 46.0 MAX 1660 MIN .01 AC-FT 33310 CFSM .30 IN. 4.14
WTR YR 1988 TOTAL 4418.43 MEAN 12.1 MAX 230 MIN .00 AC-FT 8760 CFSM .08 IN. 1.09

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, near center of span on downstream side of 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.--Nonrecording gage and crest-stage gage. 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.

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

AVERAGE DISCHARGE.--41 years (water years 1947-84, 1986-88), 72.4 ft^3/s, 52,450 acre-ft/yr; median of yearly mean discharges, 53 ft^3/s, 38,400 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, 610 ft^3/s, Apr. 5, gage height, 8.94 ft (backwater from ice); maximum gage height, 10.43 ft, Apr. 2, from highwater mark (backwater from ice); minimum daily discharge, 5.8 ft^3/s, Aug. 22.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	23	28	e25	e23	e18	e18	e400	55	27	26	9.1	8.9
2	22	28	e25	e23	e17	e19	e450	55	27	23	12	9.1
3	21	28	e25	e23	e17	e20	e550	52	25	19	16	e8.2
4	21	28	e24	e23	e17	e22	e600	50	23	17	14	e7.6
5	20	29	e24	e22	e17	e24	e600	45	23	16	14	7.3
6	24	28	e24	e22	e17	e26	e520	44	21	16	15	7.5
7	26	25	e25	e22	e17	e30	e450	42	17	15	14	7.7
8	35	29	e25	e22	e17	e40	e370	42	17	17	14	7.3
9	25	33	e25	e22	e16	e50	e300	36	16	16	12	7.5
10	26	36	e25	e21	e16	e60	212	34	16	16	10	8.6
11	26	29	e25	e21	e16	e70	196	32	14	15	10	8.9
12	26	26	e25	e21	e16	e70	171	32	15	14	8.9	8.9
13	25	29	e25	e21	e16	e65	151	34	16	16	12	10
14	25	28	e25	e21	e16	e60	130	35	18	19	14	10
15	28	26	e25	e20	e16	e60	115	31	e21	14	16	10
16	28	24	e26	e20	e16	e60	105	33	23	14	14	15
17	29	21	e26	e20	e16	e60	96	34	18	13	7.8	14
18	27	e25	e25	e20	e16	e60	91	32	16	13	6.7	16
19	28	e31	e25	e20	e16	e60	82	31	23	11	6.7	45
20	27	e29	e25	e19	e16	e60	e77	33	27	13	6.4	72
21	28	e28	e25	e19	e16	e75	e74	35	144	12	6.2	28
22	28	e27	e24	e19	e16	e100	71	36	121	12	5.8	17
23	28	e26	e24	e19	e16	e150	65	35	97	11	7.2	14
24	28	e25	e24	e19	e16	e250	63	36	e80	10	7.2	12
25	29	e25	e24	e19	e16	e330	60	36	e65	9.8	6.6	10
26	28	e25	e24	e18	e16	e340	59	37	e50	7.8	6.8	9.8
27	29	e25	e24	e18	e17	e340	57	36	e40	7.8	6.6	10
28	28	e25	e24	e18	e17	e340	55	34	e35	7.3	6.7	9.5
29	28	e25	e23	e18	e17	e340	52	29	e30	8.9	6.7	9.8
30	29	e25	e23	e18	---	e350	52	28	27	e9.0	6.2	9.5
31	28	---	e23	e18	---	e370	---	27	---	e9.0	7.8	---
TOTAL	823	816	761	629	476	3919	6274	1151	1092	427.6	306.4	419.1
MEAN	26.5	27.2	24.5	20.3	16.4	126	209	37.1	36.4	13.8	9.88	14.0
MAX	35	36	26	23	18	370	600	55	144	26	16	72
MIN	20	21	23	18	16	18	52	27	14	7.3	5.8	7.3
AC-FT	1630	1620	1510	1250	944	7770	12440	2280	2170	848	608	831
CFSM	.06	.06	.06	.05	.04	.30	.49	.09	.09	.03	.02	.03
IN.	.07	.07	.07	.05	.04	.34	.55	.10	.10	.04	.03	.04

CAL YR 1987 TOTAL 25091 MEAN 68.7 MAX 481 MIN 15 AC-FT 49770 CFSM .16 IN. 2.19
WTR YR 1988 TOTAL 17094.1 MEAN 46.7 MAX 600 MIN 5.8 AC-FT 33910 CFSM .11 IN. 1.49

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, 1,174.20 ft, May 7; maximum daily, 1,173.72 ft, June 8; minimum, 1,171.89 ft, Sept. 9; minimum daily, 1,172.22 ft, Sept. 9.

MONTHEND ELEVATION, IN FEET, OCTOBER 1987 TO SEPTEMBER 1988

Oct. 31	1,173.22	Feb. 29	1,173.27	June 30	1,173.25
Nov. 30	1,173.18	Mar. 31	1,173.44	July 31	1,172.95
Dec. 31	1,173.18	Apr. 30	1,173.61	Aug. 31	1,172.76
Jan. 31	1,173.25	May 31	1,173.57	Sept. 30	1,172.46

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.--55 years, 497 ft^3/s, 360,100 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, 235 ft^3/s, Oct. 1, gage height, 70.07 ft, stage falling, peak occurred in previous water year; maximum independent peak discharge, 108 ft^3/s, Aug. 23, gage height, 69.54 ft; maximum gage height, 70.20 ft, Mar. 13, 14 (backwater from ice); minimum daily discharge, 45 ft^3/s, May 2.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	203	84	e65	e65	e65	e65	e65	47	74	93	91	87
2	110	86	e65	e65	e65	e65	e65	45	76	89	91	88
3	99	e90	e65	e65	e65	e65	e65	48	78	89	91	88
4	e100	e90	e65	e65	e65	e65	e65	60	80	89	91	87
5	e100	e90	e65	e65	e65	e65	e65	56	82	89	91	82
6	e95	89	e65	e65	e65	e65	e70	48	82	89	91	79
7	91	89	e65	e65	e65	e65	e70	48	82	e85	91	74
8	e90	95	e65	e65	e65	e65	e70	58	82	91	91	e70
9	e90	91	e65	e65	e65	e65	e70	76	82	89	91	e70
10	e90	89	e65	e65	e65	e65	e70	68	84	91	91	66
11	91	93	e65	e65	e65	e65	e70	72	86	91	90	59
12	86	93	e65	e65	e65	e65	e70	e70	86	91	90	68
13	89	93	e65	e65	e65	e65	e70	65	86	e85	95	e70
14	89	86	e65	e65	e65	e65	e70	61	89	91	95	e70
15	80	86	e65	e65	e65	e65	68	e60	89	91	91	e70
16	82	e84	e65	e65	e65	e65	72	59	89	91	94	e70
17	86	e82	e65	e65	e65	e65	82	58	89	91	93	e70
18	e85	e80	e65	e65	e65	e65	68	56	89	91	92	e70
19	e85	e78	e65	e65	e65	e65	72	68	91	91	93	e70
20	87	e77	e65	e65	e65	e65	64	68	91	91	92	e70
21	95	e75	e65	e65	e65	e65	60	68	93	91	90	e70
22	92	e73	e65	e65	e65	e65	54	68	93	91	93	69
23	93	e72	e65	e65	e65	e65	56	70	93	91	97	69
24	95	e70	e65	e65	e65	e65	60	67	e90	91	98	68
25	89	e69	e65	e65	e65	e65	78	70	e90	91	97	67
26	e90	e68	e65	e65	e65	e65	60	70	e90	91	91	66
27	e90	e67	e65	e65	e65	e65	60	72	e90	91	95	68
28	91	e66	e65	e65	e65	e65	58	72	e90	91	92	58
29	91	e66	e65	e65	e65	e65	56	72	89	91	88	67
30	89	e65	e65	e65	---	e65	54	72	91	91	83	69
31	86	---	e65	e65	---	e65	---	72	---	91	83	---
TOTAL	2929	2436	2015	2015	1885	2015	1977	1964	2596	2799	2842	2149
MEAN	94.5	81.2	65.0	65.0	65.0	65.0	65.9	63.4	86.5	90.3	91.7	71.6
MAX	203	95	65	65	65	65	82	76	93	93	98	88
MIN	80	65	65	65	65	65	54	45	74	85	83	58
AC-FT	5810	4830	4000	4000	3740	4000	3920	3900	5150	5550	5640	4260
CFSM	.05	.04	.03	.03	.03	.03	.03	.03	.04	.05	.05	.04
IN.	.06	.05	.04	.04	.04	.04	.04	.04	.05	.05	.05	.04

CAL YR 1987 TOTAL 101282 MEAN 277 MAX 700 MIN 56 AC-FT 200900 CFSM .14 IN. 1.93
WTR YR 1988 TOTAL 27622 MEAN 75.5 MAX 203 MIN 45 AC-FT 54790 CFSM .04 IN. .53

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 good except those for estimated daily discharges, which are fair. Flow regulated by outlet dam on Lower Red Lake.

AVERAGE DISCHARGE.--59 years, 559 ft^3/s, 405,000 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. 4, gage height, 7.75 ft (backwater from ice); minimum, 61 ft^3/s, Sept. 10, gage height, 1.48 ft; minimum gage height, 1.17 ft, Nov. 20.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	257	90	e90	e85	e84	e95	e250	86	81	79	85	78
2	228	89	e90	e85	e84	e94	e300	83	78	79	97	75
3	154	87	e90	e85	e84	e92	e400	80	80	78	104	76
4	108	87	e90	e85	e84	e90	e550	78	88	77	90	78
5	95	84	e90	e85	e84	e90	e550	79	90	83	85	75
6	97	90	e90	e85	e84	e95	e450	82	89	85	85	72
7	100	89	e90	e85	e84	e100	e350	82	86	90	81	72
8	98	87	e90	e85	e84	e100	e300	84	87	93	81	70
9	92	88	e90	e85	e84	e105	e250	84	94	85	83	66
10	93	100	e88	e85	e84	e105	e200	80	89	76	79	62
11	94	106	e87	e85	e84	e110	168	82	88	77	74	69
12	91	100	e86	e84	e84	e105	147	80	89	78	77	73
13	93	87	e86	e84	e84	e100	133	80	94	80	82	68
14	89	88	e86	e84	e84	e100	117	86	102	75	93	66
15	91	89	e85	e84	e84	e100	109	79	96	79	96	65
16	96	89	e85	e84	e84	e100	104	82	93	77	88	74
17	95	e90	e85	e84	e84	e100	93	86	94	75	89	82
18	91	e90	e85	e84	e84	e100	94	83	91	75	95	79
19	88	91	e85	e84	e84	e100	92	81	94	77	93	118
20	90	77	e85	e84	e84	e100	88	82	93	79	86	114
21	88	e100	e85	e84	e84	e100	87	84	96	77	88	92
22	89	e100	e85	e84	e84	e100	86	85	93	75	106	81
23	95	e100	e85	e84	e84	e110	85	84	91	74	108	72
24	95	e95	e85	e84	e84	e150	81	79	96	77	93	70
25	95	e95	e85	e84	e84	e250	87	85	93	80	85	68
26	93	e95	e85	e84	e84	e220	86	80	89	79	83	71
27	86	e95	e85	e84	e85	e200	84	84	99	75	83	69
28	91	e90	e85	e84	e90	e180	84	84	97	73	80	69
29	92	e90	e85	e84	e95	e170	83	89	101	74	80	75
30	87	e90	e85	e84	---	e170	84	86	93	76	81	72
31	89	---	e85	e84	---	e200	---	84	---	79	79	---
TOTAL	3240	2748	2688	2615	2454	3831	5592	2563	2744	2436	2709	2271
MEAN	105	91.6	86.7	84.4	84.6	124	186	82.7	91.5	78.6	87.4	75.7
MAX	257	106	90	85	95	250	550	89	102	93	108	118
MIN	86	77	85	84	84	90	81	78	78	73	74	62
AC-FT	6430	5450	5330	5190	4870	7600	11090	5080	5440	4830	5370	4500
CFSM	.05	.04	.04	.04	.04	.05	.08	.04	.04	.03	.04	.03
IN.	.05	.04	.04	.04	.04	.06	.09	.04	.04	.04	.04	.04

CAL YR 1987 TOTAL 117249 MEAN 321 MAX 910 MIN 77 AC-FT 232600 CFSM .14 IN. 1.90
WTR YR 1988 TOTAL 35891 MEAN 98.1 MAX 550 MIN 62 AC-FT 71190 CFSM .04 IN. .58

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 fair except those for estimated daily discharges, which are poor. Some regulation by Thief and Mud Lakes.

AVERAGE DISCHARGE.--70 years (water years 1910-17, 1921, 1923-24, 1929-81, 1983-88), 165 ft^3/s, 119,500 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, 1,170 ft^3/s, Apr. 4, gage height, 10.37 ft (backwater from ice); no flow July 1-8, Aug. 4-26 and Sept. 7-17.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.8	4.0	.96	.42	.04	.04	e60	11	97	.00	.06	.46
2	3.5	2.7	.96	.39	.04	.04	e100	9.1	23	.00	.03	.44
3	3.5	2.3	.96	.38	.04	.05	e500	9.4	29	.00	.02	.25
4	2.9	2.6	.96	.37	.03	.06	e1150	8.3	251	.00	.0	.14
5	2.8	1.8	.96	.34	.03	.07	e1100	7.6	263	.00	.00	.07
6	2.8	1.6	.95	.32	.03	.07	e1050	7.5	239	.00	.00	.03
7	2.7	1.6	.96	.29	.03	.09	e980	7.0	36	.00	.0	.00
8	2.8	1.3	.96	.25	.03	.10	e700	7.1	4.7	.00	.00	.00
9	2.7	1.2	.96	.21	.02	.11	494	6.2	1.7	.24	.00	.00
10	2.7	1.1	.96	.18	.02	.11	288	7.4	.64	.49	.00	.00
11	2.4	1.3	.92	.16	.02	.12	193	8.8	.35	.43	.00	.00
12	2.4	1.3	.89	.14	.02	e.15	141	10	.21	.32	.00	.00
13	2.3	1.3	.85	.13	.02	e.20	108	8.8	.22	.48	.00	.00
14	2.1	1.3	.81	.12	.02	e.50	89	7.3	.23	.57	.00	.00
15	2.4	1.4	.78	.11	.02	e.70	64	7.4	.32	.55	.00	.00
16	2.6	1.7	.75	.11	.02	e.70	50	7.1	.42	.44	.00	.00
17	2.5	1.4	.71	.11	.02	e.65	43	6.2	.32	.25	.00	.00
18	2.6	1.5	.69	.10	.02	e.65	38	5.7	.26	.69	.00	.02
19	2.3	1.7	.66	.10	.02	e.60	31	5.4	.21	1.7	.00	12
20	2.3	1.6	.62	.09	.03	e.60	23	5.0	.17	1.5	.00	87
21	2.0	1.6	.60	.09	.03	e.55	20	5.8	.17	1.2	.00	97
22	2.2	1.5	.58	.08	.03	e.55	18	6.4	.14	.93	.00	68
23	2.4	1.4	.56	.07	.03	e.50	16	5.3	.17	.64	.00	42
24	2.6	1.2	.55	.07	.03	e1.0	15	4.6	.28	.53	.00	26
25	2.6	1.1	.53	.07	.03	e10	14	4.8	.27	.44	.00	18
26	2.7	1.1	.51	.06	.03	e40	14	5.2	.23	.67	.00	12
27	2.5	1.0	.50	.06	.03	e50	13	5.0	.17	.73	.08	8.8
28	2.2	.96	.49	.06	.03	e50	13	4.1	.13	.46	1.3	6.8
29	2.1	.94	.46	.05	.03	e50	12	111	.08	.25	.94	5.7
30	2.0	.96	.44	.05	---	e50	11	162	.02	.14	.62	4.5
31	7.9	---	.43	.04	---	e50	---	118	---	.10	.50	---
TOTAL	86.3	46.46	22.92	5.02	0.79	308.21	7348	584.5	949.41	13.75	3.55	389.21
MEAN	2.78	1.55	.74	.16	.027	9.94	245	18.9	31.6	.44	.11	13.0
MAX	7.9	4.0	.96	.42	.04	50	1150	162	263	1.7	1.3	97
MIN	2.0	.94	.43	.04	.02	.04	11	4.1	.02	.00	.00	.00
AC-FT	171	92	45	10	1.6	611	14570	1160	1880	27	7.0	772
CFSM	.00	.00	.00	.00	.00	.01	.26	.02	.03	.00	.00	.01
IN.	.00	.00	.00	.00	.00	.01	.29	.02	.04	.00	.00	.02

CAL YR 1987 TOTAL 30723.41 MEAN 84.2 MAX 1540 MIN .00 AC-FT 60940 CFSM .09 IN. 1.19
WTR YR 1988 TOTAL 9758.12 MEAN 26.7 MAX 1150 MIN .00 AC-FT 19360 CFSM .03 IN. .38

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.--46 years (water years 1940-79, 1983-88), 177 ft^3/s, 128,200 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. 7	--	*900	*a8.22	No other peak greater than base discharge.			

Minimum daily, 18 ft^3/s, Mar. 23.

(a) Backwater from ice.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	79	45	e57	e51	e50	e50	e300	82	59	40	67	32
2	72	45	e56	e47	e50	e51	e360	82	47	32	73	30
3	71	52	e48	e50	e50	e50	e390	57	34	38	174	30
4	64	47	e43	e52	e50	e47	e440	58	31	40	156	30
5	61	37	e40	e49	e50	e45	e560	65	52	36	139	37
6	60	39	e38	e47	e47	e49	e750	71	42	35	122	38
7	62	38	e47	e50	e46	e48	e880	62	42	38	103	36
8	64	44	e50	e48	e47	e52	e780	75	36	45	84	30
9	61	42	e50	e47	e47	e50	e600	80	32	72	80	29
10	61	e20	e53	e45	e47	e50	517	69	31	62	76	30
11	53	60	e53	e46	e46	e59	433	68	33	59	72	30
12	52	65	e60	e46	e46	e56	366	69	41	62	68	28
13	53	51	e50	e44	e45	e49	319	62	44	65	62	28
14	52	38	e39	e45	e42	e48	280	68	51	69	60	29
15	50	53	e48	e46	e44	e58	228	65	49	126	84	25
16	50	57	e50	e45	e44	e46	206	69	41	123	79	28
17	52	60	e55	e47	e44	e23	177	65	38	123	72	38
18	53	e55	e56	e47	e46	e40	168	46	44	109	67	47
19	52	e50	e57	e48	e48	e41	165	50	37	98	59	71
20	49	e50	e62	e48	e49	e49	104	58	58	105	49	87
21	42	e51	e58	e48	e49	e40	85	69	57	102	51	99
22	48	e54	e57	e48	e47	e22	70	72	54	97	53	81
23	55	e62	e56	e46	e48	e18	68	80	42	94	85	73
24	57	e64	e55	e48	e50	e100	84	67	40	97	70	77
25	57	e64	e56	e47	e49	e300	81	41	41	91	57	94
26	66	e62	e54	e50	e48	e300	76	36	33	75	47	83
27	77	e61	e50	e52	e48	e285	73	69	32	82	45	71
28	75	e60	e53	e52	e50	e275	70	71	35	86	38	67
29	72	e59	e52	e53	e50	e260	75	72	38	87	43	82
30	66	e58	e51	e50	---	e250	81	85	45	80	38	94
31	59	---	e52	e50	---	e250	---	78	---	85	33	---
TOTAL	1845	1543	1606	1492	1377	3061	8786	2061	1259	2353	2306	1554
MEAN	59.5	51.4	51.8	48.1	47.5	98.7	293	66.5	42.0	75.9	74.4	51.8
MAX	79	65	62	53	50	300	880	85	59	126	174	99
MIN	42	20	38	44	42	18	68	36	31	32	33	25
AC-FT	3660	3060	3190	2960	2730	6070	17430	4090	2500	4670	4570	3080
CFSM	.12	.10	.10	.09	.09	.19	.57	.13	.08	.15	.15	.10
IN.	.13	.11	.12	.11	.10	.22	.64	.15	.09	.17	.17	.11

CAL YR 1987 TOTAL 44486 MEAN 122 MAX 1280 MIN 20 AC-FT 88240 CFSM .24 IN. 3.23
WTR YR 1988 TOTAL 29243 MEAN 79.9 MAX 880 MIN 18 AC-FT 58000 CFSM .16 IN. 2.12

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.--Nonrecording gage and crest-stage gage. 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 6.00 ft higher.

REMARKS.--Records poor.

AVERAGE DISCHARGE.--27 years, 73.6 ft^3/s, 53,320 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, 620 ft^3/s, April 4, gage height, 9.68 ft (backwater from ice); minimum daily, 0.20 ft^3/s, Aug. 15.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	16	47	26	e19	e11	e7.5	e230	31	18	4.5	3.7	1.1
2	14	48	22	e19	e10	e8.0	e300	31	15	4.1	7.1	1.4
3	13	50	20	18	e10	e9.0	e400	29	11	4.7	4.9	1.6
4	12	45	16	18	e10	e10	e600	26	10	3.9	9.1	1.4
5	12	e43	16	18	e10	e12	e600	24	10	3.5	7.5	1.9
6	11	40	16	e18	e9.5	e14	e470	22	7.5	4.1	5.3	2.1
7	4.9	38	17	17	e9.5	e16	e400	20	7.1	5.5	6.8	1.8
8	2.7	34	18	17	8.3	e20	e350	24	7.5	4.9	3.7	.72
9	1.3	29	19	16	2.6	e25	289	26	7.5	4.9	3.1	.24
10	2.7	30	16	15	6.8	e28	249	21	7.3	5.1	2.1	.24
11	2.9	36	16	14	e6.5	e31	223	19	6.6	14	1.6	.22
12	2.7	36	15	14	6.2	e35	208	21	5.1	11	1.1	.22
13	4.9	32	14	12	6.2	e40	158	23	7.3	7.8	.65	.22
14	8.6	32	14	11	5.7	e45	141	24	14	7.8	.30	.22
15	11	32	22	13	e5.5	e45	126	25	13	7.5	.20	.24
16	11	e32	22	e15	e5.5	e45	114	26	12	6.2	.26	.86
17	15	e32	20	e15	e5.5	e44	110	25	9.7	4.3	1.6	1.9
18	17	e32	20	e15	e5.5	e44	103	23	7.8	3.9	3.2	1.6
19	15	e32	20	e15	e5.5	e44	89	26	8.6	3.4	2.6	4.9
20	14	32	20	e14	e5.5	e44	79	29	13	2.1	2.4	5.3
21	16	34	21	e14	e5.5	e44	69	34	26	3.2	1.9	3.5
22	20	36	21	e14	e5.5	e44	62	30	40	3.4	.65	2.9
23	21	36	22	e13	e5.5	e44	53	34	30	3.4	1.3	3.1
24	21	36	22	e13	e6.0	e100	48	26	21	5.1	1.1	3.1
25	26	36	22	e13	e6.0	e200	40	23	16	4.3	.86	3.7
26	31	37	22	e12	e6.5	e250	36	19	13	.65	.86	3.7
27	34	31	20	e12	e7.0	e240	35	17	7.3	.79	.65	3.7
28	40	29	20	e12	e7.0	e230	33	16	6.4	1.6	2.4	4.3
29	44	27	e20	e11	e7.0	e225	33	15	5.3	.86	1.7	5.1
30	44	28	e20	e11	---	e220	32	18	5.3	.65	1.1	6.4
31	46	---	e20	e11	---	e220	---	16	---	.51	.51	---
TOTAL	534.7	1062	599	449	201.3	2383.5	5680	743	368.3	137.66	80.24	67.68
MEAN	17.2	35.4	19.3	14.5	6.94	76.9	189	24.0	12.3	4.44	2.59	2.26
MAX	46	50	26	19	11	250	600	34	40	14	9.1	6.4
MIN	1.3	27	14	11	2.6	7.5	32	15	5.1	.51	.20	.22
AC-FT	1060	2110	1190	891	399	4730	11270	1470	731	273	159	134
CFSM	.06	.13	.07	.05	.03	.29	.71	.09	.05	.02	.01	.01
IN.	.07	.15	.08	.06	.03	.33	.79	.10	.05	.02	.01	.01

CAL YR 1987 TOTAL 19365.3 MEAN 53.1 MAX 586 MIN 1.3 AC-FT 38410 CFSM .20 IN. 2.71
WTR YR 1988 TOTAL 12306.38 MEAN 33.6 MAX 600 MIN .20 AC-FT 24410 CFSM .13 IN. 1.72

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.--61 years (1910-17, 1935-81, 1983-88), 318 ft^3/s, 230,400 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, 2,270 ft^3/s, Apr. 7, gage height, 6.05 ft; maximum gage height, 7.91 ft, Mar. 27, from highwater mark (backwater from ice); minimum discharge, 22 ft^3/s, Sept. 14, 15, gage height, 1.67 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	114	105	e90	e90	e94	e94	e1050	184	102	69	105	49
2	111	93	e90	e90	e94	e94	e1100	182	83	63	102	44
3	101	95	e85	e90	e94	e94	e1200	176	70	51	94	42
4	96	99	e75	e90	e94	e94	e1250	152	64	42	203	38
5	92	96	e65	e90	e94	e94	e1300	151	59	51	187	38
6	93	89	e70	e88	e94	e100	e1400	154	67	48	162	41
7	92	94	e70	e88	e94	e105	e1700	156	61	49	141	44
8	96	86	e70	e88	e94	e110	1920	147	54	52	124	41
9	95	70	e70	e88	e94	e120	1520	151	47	52	106	34
10	92	63	e70	e88	e94	e130	1190	153	39	77	100	28
11	89	83	e65	e88	e94	e150	1030	141	37	75	93	27
12	82	94	e65	e88	e94	e170	892	144	33	72	87	28
13	80	98	e65	e88	e94	e200	779	148	42	80	86	27
14	80	93	e60	e90	e94	e200	663	135	60	82	82	23
15	79	80	e55	e90	e94	e200	577	144	68	84	76	24
16	79	89	e67	e90	e94	e200	503	137	64	139	104	33
17	78	95	e70	e90	e94	e200	458	139	62	138	97	32
18	79	e85	e75	e90	e94	e190	406	130	57	135	88	38
19	80	e80	e75	e90	e94	e190	397	115	55	123	83	165
20	79	e70	e80	e90	e94	e190	349	116	49	117	75	138
21	78	e80	e80	e90	e94	e190	275	130	73	121	68	108
22	76	e90	e85	e90	e94	e190	249	142	107	115	69	116
23	80	e100	e90	e90	e94	e190	223	141	136	113	69	98
24	83	e100	e90	e90	e94	e250	216	143	147	129	100	86
25	87	e100	e92	e90	e94	e350	221	130	148	116	87	88
26	85	e95	e92	e92	e94	e600	213	102	139	110	74	108
27	93	e95	e92	e92	e94	e1200	201	88	112	92	68	96
28	103	e95	e92	e92	e94	e1150	190	109	86	95	65	85
29	103	e90	e90	e92	e94	e1100	181	108	74	98	56	80
30	101	e90	e90	e92	---	e1050	182	104	70	98	58	93
31	107	---	e90	e92	---	e1050	---	111	---	88	55	---
TOTAL	2783	2692	2415	2786	2726	10245	21835	4263	2265	2774	2964	1892
MEAN	89.8	89.7	77.9	89.9	94.0	330	728	138	75.5	89.5	95.6	63.1
MAX	114	105	92	92	94	1200	1920	184	148	139	203	165
MIN	76	63	55	88	94	94	181	88	33	42	55	23
AC-FT	5520	5340	4790	5530	5410	20320	43310	8460	4490	5500	5880	3750
CFSM	.07	.07	.06	.07	.07	.24	.53	.10	.06	.07	.07	.05
IN.	.08	.07	.07	.08	.07	.28	.59	.12	.06	.08	.08	.05

CAL YR 1987 TOTAL 84585 MEAN 232 MAX 2120 MIN 44 AC-FT 167800 CFSM .17 IN. 2.30
WTR YR 1988 TOTAL 59640 MEAN 163 MAX 1920 MIN 23 AC-FT 118300 CFSM .12 IN. 1.62

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.--87 years, 1,142 ft^3/s, 827,400 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, 5,090 ft^3/s, Apr. 8, gage height, 10.90 ft, from graph based on gage readings; maximum gage height, 16.03 ft, Apr. 7 (backwater from ice); minimum discharge, 78 ft^3/s, Sept. 11, 12, 15, gage height, 2.59 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	417	208	203	e160	e160	e160	e1700	289	335	118	179	134
2	409	217	201	e160	e160	e160	e1750	282	273	118	200	106
3	369	220	200	e160	e160	e160	e1900	281	282	125	181	127
4	369	209	236	e160	e160	e160	e2100	278	179	129	153	99
5	341	209	196	e160	e160	e160	e2350	258	131	107	253	113
6	283	212	164	e160	e160	e165	e2900	238	249	105	254	121
7	247	179	169	e160	e160	e175	e4000	243	352	107	231	122
8	210	213	175	e160	e160	e185	4780	257	339	129	224	205
9	173	168	173	e160	e160	e200	4100	248	218	139	214	131
10	198	146	193	e160	e160	e225	2610	255	140	123	179	92
11	212	155	193	e160	e160	e260	1960	237	119	132	150	81
12	170	194	171	e160	e160	e300	1580	257	118	139	145	81
13	203	192	184	e160	e160	e350	1340	253	122	130	153	81
14	161	206	146	e160	e160	e360	1160	240	138	130	166	82
15	221	229	e155	e160	e160	e350	1010	240	141	143	192	79
16	176	203	e155	e160	e160	e340	851	233	167	167	176	137
17	153	246	e155	e160	e160	e330	761	227	154	220	181	129
18	208	198	e155	e160	e160	e320	678	231	149	218	169	178
19	190	161	e155	e160	e160	e310	603	218	146	206	139	220
20	155	126	e155	e160	e160	e305	589	203	135	209	134	405
21	194	172	e160	e160	e160	e300	521	220	139	188	125	404
22	185	192	e160	e160	e160	e293	452	239	132	177	140	449
23	183	257	e160	e160	e160	e290	410	239	183	163	138	432
24	182	178	e160	e160	e160	e300	367	247	198	151	121	329
25	172	228	e160	e160	e160	e400	368	221	217	168	147	266
26	215	225	e160	e160	e160	e800	348	229	221	156	170	247
27	190	216	e160	e160	e160	e1300	344	205	209	151	160	257
28	206	208	e160	e160	e160	e1700	329	157	180	135	154	250
29	202	213	e160	e160	e160	e1850	298	171	141	127	141	242
30	212	207	e160	e160	---	e1800	316	179	123	132	132	197
31	220	---	e160	e160	---	e1700	---	223	---	144	110	---
TOTAL	7026	5987	5294	4960	4640	15708	42475	7298	5630	4586	5211	5796
MEAN	227	200	171	160	160	507	1416	235	188	148	168	193
MAX	417	257	236	160	160	1850	4780	289	352	220	254	449
MIN	153	126	146	160	160	160	298	157	118	105	110	79
AC-FT	13940	11880	10500	9840	9200	31160	84250	14480	11170	9100	10340	11500
CFSM	.04	.04	.03	.03	.03	.10	.27	.04	.04	.03	.03	.04
IN.	.05	.04	.04	.03	.03	.11	.30	.05	.04	.03	.04	.04

CAL YR 1987 TOTAL 268365 MEAN 735 MAX 5150 MIN 126 AC-FT 532300 CFSM .14 IN. 1.89
WTR YR 1988 TOTAL 114611 MEAN 313 MAX 4780 MIN 79 AC-FT 227300 CFSM .06 IN. .81

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 1987 TO SEPTEMBER 1988

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 AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)
OCT										
06...	1415	324	360	398	8.3	8.2	1.0	10.0	0.80	739
NOV										
10...	1400	138	370	457	8.3	8.5	8.0	2.0	1.3	746
FEB										
09...	1530	161	450	522	7.5	7.7	-10.0	0.5	2.8	786
MAY										
03...	1445	308	500	490	8.3	8.4	23.0	16.0	5.1	773
JUN										
14...	1445	162	486	485	8.1	8.1	16.0	22.0	6.2	770
JUL										
27...	1115	158	410	465	8.6	8.2	24.0	25.0	4.7	772

DATE	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)	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)
OCT									
06...	9.2	34	K160	52	20	6.9	3.3	190	187
NOV									
10...	11.6	49	K18	57	23	7.5	3.2	200	215
FEB									
09...	9.5	K16	K7	68	26	7.7	4.0	200	262
MAY									
03...	9.5	K21	K12	64	27	8.6	4.0	206	213
JUN									
14...	7.7	K150	K430	56	25	5.9	3.9	150	174
JUL									
27...	7.8	K200	K230	52	27	9.1	4.3	189	190

DATE	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)	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)
OCT									
06...	0	226	23	4.4	0.2	6.7	239	<0.01	<0.10
NOV									
10...	0	244	31	4.3	0.1	5.0	272	<0.01	<0.10
FEB									
09...	0	244	23	4.0	0.2	18	320	0.01	0.24
MAY									
03...	0	251	64	6.9	0.2	2.5	328	<0.01	<0.10
JUN									
14...	0	183	89	4.7	0.3	14	316	<0.01	0.19
JUL									
27...	11	209	52	7.6	0.2	5.4	312	<0.01	<0.10

RED RIVER OF THE NORTH BASIN

05079000 RED LAKE RIVER AT CROOKSTON, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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)	PHOSPHORUS TOTAL (MG/L AS P) (00665)	PHOSPHORUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT									
06...	0.02	0.02	1.2	0.06	0.04	<0.01	17	15	92
NOV									
10...	0.03	0.03	0.90	0.01	<0.01	<0.01	30	11	98
FEB									
09...	0.22	0.22	1.0	0.04	0.03	0.01	12	5.2	96
MAY									
03...	0.02	0.02	0.80	0.03	0.02	<0.01	48	40	82
JUN									
14...	0.11	0.11	0.80	0.04	0.04	0.02	23	10	91
JUL									
27...	0.04	0.02	1.1	0.05	0.03	0.01	17	7.3	100

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											
06...	1415	<10	2	49	<0.5	<1	<1	<3	<1	45	<5
FEB											
09...	1530	<10	1	78	<0.5	<1	<1	<3	<1	23	<5
MAY											
03...	1445	20	2	65	<0.5	<1	<1	<3	3	26	<5
JUL											
27...	1115	<10	4	66	<0.5	<1	<1	<3	2	12	<5

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										
06...	15	20	--	<10	<1	<1	<1.0	110	<6	22
FEB										
09...	18	42	<0.1	<10	1	<1	<1.0	150	<6	18
MAY										
03...	18	38	<0.1	<10	<1	1	<1.0	150	<6	14
JUL										
27...	14	6	<0.1	<10	2	<1	1.0	160	<6	5

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 May 1901 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: Dec. 30 to Apr. 4. Records good except those for period of estimated daily discharges, which are fair.

AVERAGE DISCHARGE.--106 years, 2,614 ft^3/s, 1,894,000 acre-ft/yr; median of yearly mean discharge, 2,370 ft^3/s, 1,720,000 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, 8,500 ft^3/s, Apr. 5, gage height, 21.16 ft; minimum daily, 168 ft^3/s, July 31.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	859	656	738	576	448	634	6100	1420	919	417	197	239
2	884	653	711	547	450	644	6140	1350	1030	372	226	221
3	855	636	687	520	455	676	6740	1280	1080	346	247	226
4	788	633	628	514	455	728	7670	1250	1020	324	261	220
5	753	654	565	510	465	778	8200	1230	944	321	261	225
6	759	651	574	510	470	822	8400	1220	799	331	253	218
7	729	659	620	502	475	915	8370	1180	709	295	292	208
8	659	668	638	487	480	1110	8130	1120	742	301	323	193
9	601	679	641	462	480	1310	7700	1130	765	284	335	206
10	578	687	636	444	480	1650	7060	1120	665	285	356	239
11	548	658	619	437	490	2410	6000	1130	561	286	340	224
12	596	629	627	442	500	3500	5100	1120	483	281	320	210
13	601	652	609	437	505	4160	4560	1110	480	289	306	192
14	584	690	597	421	509	4230	3990	1110	501	295	342	183
15	582	689	594	416	523	3980	3580	1100	501	270	378	176
16	566	704	565	431	532	3570	3250	1140	510	264	387	206
17	595	756	551	442	536	3180	2930	1140	538	252	433	225
18	564	732	573	445	532	2930	2750	1100	576	292	458	240
19	551	714	576	448	532	2820	2570	1030	551	330	451	319
20	581	540	584	438	532	2720	2410	976	533	357	422	417
21	601	404	612	423	538	2630	2330	885	516	381	381	564
22	581	492	641	407	546	2620	2210	870	554	382	326	856
23	620	645	652	412	548	2700	2070	907	540	351	302	932
24	615	608	645	417	565	3140	1940	1020	516	319	289	891
25	616	666	635	409	582	4150	1780	1080	525	297	274	755
26	584	705	623	413	594	4580	1660	1050	568	253	266	616
27	603	694	614	422	602	5050	1570	1030	585	236	247	537
28	624	724	614	409	629	5450	1490	1050	558	215	259	494
29	624	735	614	420	628	5830	1460	999	520	186	255	486
30	634	744	614	432	---	6060	1450	926	466	188	259	475
31	653	---	611	441	---	6140	---	917	---	168	249	---
TOTAL	19988	19757	19208	14034	15081	91117	129610	33990	19255	9168	9695	11193
MEAN	645	659	620	453	520	2939	4320	1096	642	296	313	373
MAX	884	756	738	576	629	6140	8400	1420	1080	417	458	932
MIN	548	404	551	407	448	634	1450	870	466	168	197	176
AC-FT	39650	39190	38100	27840	29910	180700	257100	67420	38190	18180	19230	22200

CAL YR 1987 TOTAL 1012949 MEAN 2775 MAX 17200 MIN 404 AC-FT 2009000
WTR YR 1988 TOTAL 392096 MEAN 1071 MAX 8400 MIN 168 AC-FT 777700

WATER-QUALITY RECORDS

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)
OCT											
26...	1510	571	700	--	6.0	5.5	--	--	--	--	--
NOV											
23...	1600	656	790	--	-3.0	1.0	--	--	--	--	--
JAN											
20...	1600	436	810	--	-10.0	0.5	--	--	--	--	--
FEB											
29...	1600	621	770	--	0.0	0.5	--	--	--	--	--
APR											
05...	1305	8360	475	7.60	5.0	5.0	220	51	22	14	12
11...	1335	5990	--	--	20.0	--	--	--	--	--	--
25...	1530	1730	590	--	6.0	8.0	--	--	--	--	--
MAY											
25...	1310	1100	665	--	27.0	18.0	--	--	--	--	--
JUN											
24...	0935	500	--	--	25.0	26.0	--	--	--	--	--
JUL											
11...	1100	288	640	--	20.0	25.0	--	--	--	--	--
25...	1000	296	580	7.50	21.0	24.0	240	49	29	35	23
AUG											
01...	0900	217	550	--	18.0	23.0	--	--	--	--	--
26...	1030	262	625	--	18.0	22.0	--	--	--	--	--
SEP											
26...	1200	627	--	--	10.0	12.0	--	--	--	--	--

DATE	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	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 DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
05...	0.4	6.7	170	75	13	0.10	16	283	299	6390	0.38
JUL											
25...	1	5.8	230	77	30	0.30	11	372	375	297	0.51

DATE	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...	3	140	110	1	18	20	0.5	2	3	190
JUL										
25...	8	110	10	<1	30	10	0.2	3	<1	290

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.--37 years (water years 1951-81, 1983-88), 40.5 ft^3/s, 29,340 acre-ft/yr; median of yearly mean discharges, 37 ft^3/s, 26,800 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, 357 ft^3/s, June 1, gage height, 7.21 ft; no flow Oct. 1-18, Aug. 6 to Sept. 17, and Sept. 25-30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.00	.32	.34	.21	e.06	e.06	e10	3.2	308	e.08	.06	.00
2	.00	.32	.34	.20	e.06	e.06	e30	2.8	245	e.07	.07	.00
3	.00	.34	.34	.20	e.06	.06	59	3.2	e130	e.06	.06	.00
4	.00	.45	.32	e.18	e.06	.12	133	3.2	e60	e.05	.04	.00
5	.00	.45	.32	e.15	e.06	.21	234	3.4	e30	.04	.02	.00
6	.00	.60	.32	.13	e.06	.26	227	3.4	e15	5.6	.0	.00
7	.00	.60	.34	.10	e.06	.23	261	3.2	e7.0	6.0	.00	.00
8	.00	.60	.34	.10	e.06	.26	182	3.4	e4.0	6.1	.00	.00
9	.00	.45	.34	.08	e.06	.26	125	3.4	e2.0	3.8	.00	.00
10	.00	.45	.45	.08	e.06	.27	106	3.0	e1.0	.87	.00	.00
11	.00	.34	.34	.08	e.06	.23	87	3.0	e.50	.55	.00	.00
12	.00	.34	.34	.08	e.06	.18	59	3.0	e.25	.30	.00	.00
13	.00	.34	.34	.07	e.06	.17	38	2.6	e.30	.24	.00	.00
14	.00	.60	.34	.06	e.06	.15	29	2.8	e.35	.19	.00	.00
15	.00	.90	.33	.06	e.06	.14	23	2.0	e.40	.17	.00	.00
16	.00	1.0	.32	e.06	e.06	.16	19	2.0	e.50	.20	.0	.00
17	.00	1.0	.32	e.06	e.06	.33	14	1.6	e.40	.21	.00	.00
18	.00	1.0	.32	e.06	e.06	.60	13	.80	e.30	.21	.00	.01
19	.02	.69	.32	e.06	e.06	.29	11	1.8	e.25	.20	.00	.12
20	.01	.45	.31	e.06	e.06	.26	9.1	1.6	e.20	.22	.00	.06
21	.02	.45	.31	e.06	e.06	.23	7.6	1.4	e.17	.18	.00	.06
22	.05	.34	.30	e.06	e.06	.25	6.6	1.5	e.15	.15	.00	.04
23	.12	.34	.29	e.06	e.06	.30	6.3	1.4	e.20	.15	.00	.02
24	.16	.34	.26	e.06	e.06	.33	5.7	1.1	e.30	.14	.00	.01
25	.20	.33	.26	e.06	e.06	.32	4.6	.96	e.27	.11	.00	.0
26	.17	.33	.25	e.06	e.06	.29	4.1	1.3	e.22	.12	.00	.0
27	.18	.33	.22	e.06	e.06	.26	4.1	1.4	e.18	.11	.00	.00
28	.22	.33	.21	e.06	e.06	.27	3.6	1.8	e.14	.11	.00	.0
29	.26	.34	.23	e.06	e.06	.33	3.4	8.7	e.11	.11	.00	.0
30	.29	.34	.24	e.06	---	e1.0	3.0	31	.10	.09	.00	.0
31	.30	---	.23	e.06	---	e3.0	---	268	---	.07	.00	---
TOTAL	2.00	14.71	9.53	2.74	1.74	10.88	1718.1	371.96	807.29	26.50	0.25	0.32
MEAN	.065	.49	.31	.088	.060	.35	57.3	12.0	26.9	.85	.008	.011
MAX	.30	1.0	.45	.21	.06	3.0	261	268	308	6.1	.07	.12
MIN	.00	.32	.21	.06	.06	.06	3.0	.80	.10	.04	.00	.00
AC-FT	4.0	29	19	5.4	3.5	22	3410	738	1600	53	.5	.6
CFSM	.00	.00	.00	.00	.00	.00	.22	.05	.10	.00	.00	.00
IN.	.00	.00	.00	.00	.00	.00	.24	.05	.11	.00	.00	.00

CAL YR 1987 TOTAL 8180.80 MEAN 22.4 MAX 540 MIN .00 AC-FT 16230 CFSM .08 IN. 1.15
WTR YR 1988 TOTAL 2966.02 MEAN 8.10 MAX 308 MIN .00 AC-FT 5880 CFSM .03 IN. .42

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: Dec. 21 to Apr. 22. Records good except those for period of estimated daily discharges, which are fair. Some regulation by reservoirs on tributaries.

AVERAGE DISCHARGE.--39 years (water years 1950-88), 3,840 ft^3/s, 2,782,000 acre-ft/yr; median of yearly mean discharges, 3,800 ft^3/s, 2,750,000 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, 13,900 ft^3/s, Apr. 7, gage height, 22.12 ft; minimum daily, 144 ft^3/s, Sept. 11.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	983	818	827	608	455	620	8120	1670	2520	532	195	210
2	1040	823	823	602	455	630	8620	1630	2320	492	183	204
3	982	833	815	600	455	640	9130	1570	1990	432	175	199
4	897	803	777	575	455	660	9830	1530	1740	383	169	192
5	880	814	746	537	455	670	10800	1510	1550	362	187	183
6	873	805	739	530	462	690	12400	1470	1380	383	227	179
7	842	787	739	510	468	720	13800	1450	1220	401	220	177
8	813	799	739	490	475	750	13300	1370	1070	437	234	166
9	790	815	747	460	482	800	12600	1280	983	411	247	154
10	787	821	751	440	489	880	11600	1270	940	389	266	148
11	736	809	747	440	489	1030	10300	1270	915	374	278	144
12	704	804	724	420	489	1190	8620	1270	821	360	314	145
13	661	788	687	413	500	1520	6920	1250	740	333	324	174
14	665	767	672	399	510	2250	5660	1250	641	321	319	184
15	676	756	672	416	515	3100	4800	1240	642	314	316	186
16	686	767	672	434	520	3720	4230	1220	639	317	298	186
17	711	785	672	421	525	3710	3840	1220	618	324	306	184
18	700	798	667	415	530	3580	3590	1220	594	321	323	184
19	714	808	663	415	530	3240	3300	1220	600	309	340	186
20	692	699	663	415	530	2860	3130	1200	623	300	361	199
21	680	684	660	420	530	2620	2900	1170	625	295	393	228
22	666	720	660	420	530	2450	2790	1130	608	295	366	252
23	679	676	650	420	540	2340	2660	1060	599	302	339	370
24	685	595	650	430	550	2300	2500	1000	586	311	324	586
25	705	597	640	425	556	2330	2310	999	570	335	317	786
26	694	669	630	420	582	2580	2180	999	587	336	298	855
27	723	736	630	440	584	3280	2030	1040	571	335	272	855
28	721	795	630	445	600	4310	1980	1210	548	318	245	841
29	723	823	630	450	620	5490	1840	2270	582	280	231	792
30	763	827	630	448	---	6580	1730	3260	571	250	224	713
31	801	---	620	448	---	7450	---	2980	---	227	220	---
TOTAL	23672	23021	21572	14306	14881	74990	187510	44228	28393	10779	8511	9862
MEAN	764	767	696	461	513	2419	6250	1427	946	348	275	329
MAX	1040	833	827	608	620	7450	13800	3260	2520	532	393	855
MIN	661	595	620	399	455	620	1730	999	548	227	169	144
AC-FT	46950	45660	42790	28380	29520	148700	371900	87730	56320	21380	16880	19560

CAL YR 1987 TOTAL 1263541 MEAN 3462 MAX 27500 MIN 595 AC-FT 2506000
WTR YR 1988 TOTAL 461725 MEAN 1262 MAX 13800 MIN 144 AC-FT 915800

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 1987 TO SEPTEMBER 1988

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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)
OCT											
06...	1730	849	875	--	9.0	11.0	--	--	--	--	--
NOV											
09...	1545	805	1200	--	2.0	3.0	--	--	--	--	--
JAN											
15...	1300	420	1090	--	-11.0	0.5	--	--	--	--	--
FEB											
26...	1410	587	870	--	3.0	0.5	--	--	--	--	--
APR											
08...	1630	13100	505	7.40	15.0	5.5	220	50	22	24	19
MAY											
09...	1510	1240	790	--	17.0	17.0	--	--	--	--	--
JUN											
20...	1515	800	780	--	28.0	24.0	--	--	--	--	--
JUL											
12...	1140	360	870	--	26.0	26.0	--	--	--	--	--
AUG											
04...	1020	170	1020	8.00	22.0	24.0	320	67	37	99	39
SEP											
08...	1635	156	910	--	18.0	18.0	--	--	--	--	--

DATE	SODIUM AD-SORP-TION RATIO (00931)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	ALKA-LINITY LAB (MG/L AS CACO3) (90410)	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 DAY) (70302)	SOLIDS, DIS-SOLVED (TONS PER AC-FT) (70303)
APR											
08...	0.7	6.8	170	87	27	0.20	12	351	330	12400	0.48
AUG											
04...	2	8.9	250	130	130	0.30	13	627	641	288	0.85

DATE	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...	3	190	110	1	22	20	0.6	2	3	230
AUG										
04...	6	200	10	<1	50	<10	0.3	4	<1	490

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.--43 years (water years 1929-36, 1942, 1943, 1946, 1947, 1954-81, 1986-88), 87.0 ft^3/s, 63,030 acre-ft/yr; median of yearly mean discharges, 56 ft^3/s, 40,600 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, 1,170 ft^3/s, Mar. 24, gage height, 8.46 ft; minimum, 0.02 ft^3/s, Aug. 11-14; minimum gage height, 3.08 ft, Aug. 13, 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.70	.56	1.6	e.80	e.60	e.60	e600	4.5	9.3	.52	.08	.14
2	.68	.71	1.8	e.80	e.60	e.65	610	4.1	11	.51	.11	.14
3	.73	.84	1.8	e.80	e.60	e.67	695	2.8	13	.36	.12	.14
4	.79	1.1	1.6	e.75	e.60	e1.0	518	2.8	12	.24	.11	.13
5	.90	1.0	1.6	e.75	e.60	e20	577	2.7	10	.16	.12	.13
6	.76	1.2	1.6	e.75	e.60	e100	504	3.0	8.8	.77	.09	.14
7	.70	1.5	1.8	e.70	e.60	e90	380	3.6	8.4	1.5	.08	.14
8	.67	1.5	1.9	e.70	e.60	e80	283	3.6	8.9	.87	.06	.12
9	.50	1.5	1.9	e.70	e.60	e70	199	3.2	8.8	.52	.06	.12
10	.42	1.6	e1.8	e.70	e.60	e65	137	2.8	2.8	.39	.06	.15
11	.41	1.6	e1.7	e.70	e.60	e60	116	2.5	.75	.33	.02	.33
12	.36	1.8	e1.7	e.65	e.60	e58	65	3.3	.27	.33	.02	.45
13	.29	2.0	e1.6	e.65	e.60	e56	63	4.6	.18	.68	.02	.52
14	.28	2.2	e1.5	e.65	e.60	e54	46	4.7	.43	.60	.02	.45
15	.32	2.5	e1.5	e.65	e.60	e52	25	4.2	.88	1.2	.03	.45
16	.29	2.2	e1.4	e.65	e.60	e50	20	3.9	.62	.98	.07	.60
17	.27	2.1	e1.4	e.65	e.60	e50	29	3.5	.39	.60	.12	.90
18	.24	2.0	e1.3	e.65	e.60	e50	21	3.7	.20	.39	.10	.80
19	.21	1.8	e1.3	e.60	e.60	e50	7.9	6.3	.20	.60	.10	.92
20	.18	1.5	e1.2	e.60	e.60	e50	7.5	6.3	.31	.45	.10	.75
21	.18	1.5	e1.2	e.60	e.60	e50	7.1	5.3	.33	.28	.11	.78
22	.21	1.6	e1.1	e.60	e.60	e200	6.3	4.5	.26	.22	.13	.86
23	.23	1.6	e1.1	e.60	e.60	1130	5.2	3.6	.28	.20	.12	.85
24	.28	1.4	e1.0	e.60	e.60	1060	8.0	3.1	.42	.15	.10	.66
25	.30	1.4	e1.0	e.60	e.60	790	7.0	1.9	.46	.13	.10	.61
26	.34	1.5	e1.0	e.60	e.60	e700	6.4	1.8	.48	.12	.11	.75
27	.33	1.5	e.95	e.60	e.60	e600	3.6	1.6	.41	.10	.11	.81
28	.37	1.6	e.90	e.60	e.60	547	2.1	5.2	.31	.09	.10	.84
29	.45	1.6	e.90	e.60	e.60	618	3.0	13	.34	.09	.12	.90
30	.45	1.6	e.85	e.60	---	e600	3.4	9.3	.46	.08	.13	1.1
31	.50	---	e.85	e.60	---	e600	---	9.2	---	.09	.14	---
TOTAL	13.34	46.51	42.85	20.50	17.40	7852.92	4955.5	134.6	100.98	13.55	2.76	15.68
MEAN	.43	1.55	1.38	.66	.60	253	165	4.34	3.37	.44	.089	.52
MAX	.90	2.5	1.9	.80	.60	1130	695	13	13	1.5	.14	1.1
MIN	.18	.56	.85	.60	.60	.60	2.1	1.6	.18	.08	.02	.12
AC-FT	26	92	85	41	35	15580	9830	267	200	27	5.5	31
CFSM	.00	.00	.00	.00	.00	.57	.37	.01	.01	.00	.00	.00
IN.	.00	.00	.00	.00	.00	.66	.42	.01	.01	.00	.00	.00

CAL YR 1987 TOTAL 16645.26 MEAN 45.6 MAX 917 MIN .11 AC-FT 33020 CFSM .10 IN. 1.39
WTR YR 1988 TOTAL 13216.59 MEAN 36.1 MAX 1130 MIN .02 AC-FT 26220 CFSM .08 IN. 1.11

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: Nov. 26 to Apr. 3. Records good. 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.--76 years (water years 1913-88), 3,390 ft^3/s, 2,456,000 acre-ft/yr; median of yearly mean discharges, 2,870 ft^3/s, 2,080,000 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 daily discharge, 15,700 ft^3/s, Apr. 8; minimum daily, 195 ft^3/s, Sept. 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1080	840	809	600	463	576	6110	1770	2630	742	273	248
2	1070	862	809	590	463	590	6600	1700	2350	735	253	241
3	1100	872	810	572	456	600	7060	1620	2180	696	239	235
4	1080	883	806	569	463	611	7770	1560	1960	639	229	231
5	1010	872	794	569	470	622	8900	1530	1730	593	220	225
6	982	869	788	551	477	639	11600	1510	1550	600	215	220
7	964	862	790	519	480	660	15000	1490	1410	625	218	214
8	929	844	788	487	484	699	15700	1480	1340	643	219	213
9	872	819	786	466	494	706	14500	1440	1190	646	222	208
10	855	844	771	448	501	717	13300	1420	1090	604	228	197
11	844	848	763	441	509	756	12100	1420	1020	551	238	198
12	809	855	755	438	512	837	10800	1410	985	509	246	199
13	777	858	737	438	516	1000	9320	1390	936	477	259	196
14	742	848	725	431	516	1380	7770	1390	862	427	278	195
15	720	833	702	420	523	2180	6430	1370	798	396	286	201
16	724	816	683	417	530	3100	5470	1350	745	371	294	208
17	735	809	682	420	533	3640	4770	1350	720	351	302	214
18	742	805	676	424	530	3740	4240	1340	713	344	315	221
19	749	833	669	431	530	3710	3780	1360	685	328	326	227
20	752	968	658	431	526	3500	3410	1340	660	320	337	223
21	745	883	650	431	526	3260	3120	1320	664	313	350	220
22	727	819	637	438	526	3060	2880	1290	678	309	360	228
23	713	883	626	445	523	2920	2690	1250	682	317	371	257
24	717	837	619	456	519	2850	2550	1190	692	331	378	321
25	720	784	617	456	530	2850	2410	1140	703	346	367	498
26	735	762	618	456	537	2850	2310	1110	710	364	334	717
27	749	750	615	456	544	3100	2200	1110	731	406	310	858
28	770	774	607	452	554	3670	2080	1150	745	413	285	897
29	777	800	596	448	562	4380	1970	1260	742	364	268	869
30	773	815	600	452	---	5090	1860	1930	738	320	259	791
31	802	---	603	459	---	5690	---	2780	---	289	253	---
TOTAL	25764	25147	21789	14611	14797	69983	198700	44770	32639	14369	8732	9970
MEAN	831	838	703	471	510	2258	6623	1444	1088	464	282	332
MAX	1100	968	810	600	562	5690	15700	2780	2630	742	378	897
MIN	713	750	596	417	456	576	1860	1110	660	289	215	195
AC-FT	51100	49880	43220	28980	29350	138800	394100	88800	64740	28500	17320	19780

CAL YR 1987 TOTAL 1515099 MEAN 4151 MAX 37400 MIN 596 AC-FT 3005000
WTR YR 1988 TOTAL 481271 MEAN 1315 MAX 15700 MIN 195 AC-FT 954600

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, 1,480 microsiemens, Nov. 12; minimum daily mean, 532 microsiemens, Apr. 9 and 10.

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

WATER-QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DATE	TIME	DIS-CHARGE, IN CUBIC FEET PER SECOND (00060)	STREAM-FLOW, INSTAN-TANEOUS (CFS) (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 (FTU) (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)
OCT											
21...	1200	745	--	832	8.10	-1.5	4.5	19	12.8	99	8
NOV											
24...	1030	837	--	1080	8.40	-4.5	0.0	8.2	15.6	107	6
FEB											
24...	1310	--	532	870	7.80	-4.0	0.0	3.5	9.2	62	4
APR											
19...	1050a	--	3600	688	8.40	7.0	7.5	88	11.7	98	4
JUN											
07...	1215	1410	--	912	8.40	34.0	29.0	120	5.4	71	70
AUG											
09...	1115	--	230	1190	8.70	25.0	23.5	62	8.0	95	36

DATE	STREP-TOCOCCI FECAL, KF AGAR (COLS. PER 100 ML) (31673)	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)
OCT											
21...	2100	310	69	33	53	27	1	7.6	254	310	0
NOV											
24...	10	360	78	39	83	33	2	7.9	370	416	17
FEB											
24...	420	370	83	40	50	22	1	8.0	176	215	0
APR											
19...	40	290	67	29	33	20	0.9	5.9	208	220	17
JUN											
07...	70	280	60	31	72	35	2	9.6	237	269	10
AUG											
09...	22	340	71	39	110	41	3	9.0	246	298	2

a - Joint sample collected with Environment Canada at 0955 hours to compare sampling methods. Analysis is available from ND District computer files.

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 1987 TO SEPTEMBER 1988

DATE	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)	SOLIDS, DIS-SOLVED (TONS PER DAY) (70302)	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)
OCT										
21...	110	61	0.30	10	491	502	0.67	988	<0.01	<0.10
NOV										
24...	130	100	0.30	2.6	630	662	0.86	1420	<0.01	<0.10
FEB										
24...	100	41	0.30	18	541	450	0.74	777	0.01	0.73
APR										
19...	110	36	0.20	17	509	431	0.69	4950	0.04	0.69
JUN										
07...	110	92	0.20	10	517	529	0.70	1970	0.06	0.42
AUG										
09...	140	150	0.20	16	697	685	0.95	433	<0.01	<0.10

DATE	NITRO-GEN, AMMONIA TOTAL (MG/L AS N) (00610)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS NH4) (71846)	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)	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)
OCT										
21...	0.02	0.03	0.04	0.8	0.10	<0.01	0.07	<10	3	56
NOV										
24...	0.01	0.02	0.03	1.1	0.12	0.06	0.04	--	--	--
FEB										
24...	0.23	0.34	0.44	1.1	0.14	0.12	0.12	<10	2	77
APR										
19...	0.06	0.10	0.13	0.7	0.11	0.09	0.09	740	3	60
JUN										
07...	0.11	0.20	0.26	1.0	0.13	0.09	0.05	--	--	--
AUG										
09...	0.05	0.02	0.03	1.4	0.17	0.05	0.03	40	5	85

DATE	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	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)
OCT										
21...	<0.5	<1	2	<3	1	11	7	40	6	0.3
FEB										
24...	<0.5	3	1	<3	3	13	<5	47	40	0.5
APR										
19...	<0.5	<1	1	<3	13	--	<5	26	--	--
AUG										
09...	<0.5	<1	<1	<3	7	44	<5	57	9	<0.1

DATE	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)	VANA-DIUM, DIS-SOLVED (UG/L AS V) (01085)	ZINC, DIS-SOLVED (UG/L AS ZN) (01090)	SEDI-MENT, SUS-PENDED (MG/L) (80154)	SEDI-MENT, DIS-CHARGE, SUS-PENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT										
21...	<10	2	<1	<1.0	290	<6	3	--	--	--
NOV										
24...	--	--	--	--	--	--	--	40	90	86
FEB										
24...	<10	6	<1	<1.0	310	<6	20	25	36	93
APR										
19...	<10	10	<1	<1.0	240	<6	12	270	2620	99
JUN										
07...	--	--	--	--	--	--	--	245	932	100
AUG										
09...	<10	5	1	<1.0	380	8	<3	101	63	95

RED RIVER OF THE NORTH BASIN

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

TEMPERATURE, WATER (DEG. C), WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	11.6	4.6	.4	.2	.1	.3	.7	10.1	24.3	21.8	23.8	21.0
2	11.0	5.8	.4	.2	.1	.3	.6	10.6	25.8	21.8	22.8	21.3
3	10.4	5.9	.4	.2	.0	.2	.7	11.0	25.7	22.3	22.8	20.9
4	10.0	5.5	.4	.2	.1	.2	.6	11.0	25.4	23.0	23.5	20.9
5	9.5	4.3	.4	.2	.0	.2	1.3	10.8	24.7	24.5	23.5	20.9
6	8.4	3.1	.4	.2	.1	.3	2.1	11.9	23.8	24.5	24.0	20.0
7	7.7	2.4	.4	.2	.0	.3	2.5	13.5	25.3	24.6	24.5	19.6
8	7.2	1.9	.4	.2	.0	.3	3.3	13.7	25.7	25.5	24.9	19.0
9	7.4	1.9	.4	.2	.1	.3	4.4	15.0	25.5	25.1	25.1	18.6
10	6.0	2.5	.4	.2	.0	.3	4.6	16.2	25.0	23.5	25.1	18.0
11	5.6	2.6	.4	.1	.0	.3	5.0	16.6	24.6	22.3	25.1	17.0
12	6.0	2.9	.4	.1	.0	.2	5.7	15.1	24.0	22.6	26.0	16.5
13	6.9	2.8	.4	.1	.1	.2	6.3	13.7	22.2	22.3	25.7	16.8
14	7.0	3.1	.4	.1	.1	.3	6.4	12.8	19.7	22.4	25.7	17.4
15	7.2	3.4	.4	.1	.1	.2	6.5	13.1	18.8	22.2	26.4	18.0
16	6.6	3.0	.4	.1	.1	.2	7.0	11.6	18.6	22.3	26.7	18.3
17	6.2	2.5	.4	.1	.1	.2	7.2	14.3	20.8	22.7	26.2	18.4
18	5.8	2.4	.4	.1	.1	.2	7.1	16.9	22.7	22.7	25.9	18.0
19	5.4	2.0	.4	.1	.1	.2	7.2	17.0	22.3	23.3	25.5	16.4
20	5.1	1.6	.4	.1	.1	.2	7.2	18.4	22.4	22.3	25.2	13.8
21	4.0	1.3	.4	.0	.1	.2	7.2	18.1	24.0	23.5	25.0	12.7
22	3.3	1.0	.2	.0	.3	.2	7.2	17.9	24.4	24.0	24.4	13.4
23	2.7	1.0	.2	.1	.3	.2	7.4	19.3	23.0	24.0	23.4	13.7
24	2.4	1.0	.2	.1	.3	.3	7.8	20.0	22.5	25.4	22.3	14.3
25	2.4	.9	.2	.1	.3	.3	7.8	19.8	22.1	24.9	21.0	14.3
26	2.6	1.0	.2	.1	.3	.3	7.5	20.5	21.1	25.3	21.0	14.6
27	3.1	1.1	.2	.1	.3	.3	7.6	20.9	22.6	25.0	20.0	14.5
28	3.0	1.0	.2	.1	.3	.3	8.2	22.5	23.0	25.3	21.9	13.9
29	3.2	.9	.2	.0	.3	.3	8.9	22.8	23.0	25.1	21.7	13.5
30	3.2	1.0	.2	.1	---	.3	9.7	23.9	22.5	24.6	20.3	14.0
31	3.2	---	.2	.1	---	.3	---	24.2	---	24.5	20.5	---
MEAN	5.9	2.5	.3	.1	.1	.3	5.5	16.2	23.2	23.7	23.9	17.0

SPECIFIC CONDUCTANCE MICROSIEMENS/CM AT 25 DEG C, WATER YEAR OCTOBER 1986 TO SEPTEMBER 1987
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	749	781	1250	1200	1100	818	715	762	690	879	1200	613
2	755	790	1190	1200	1090	813	675	763	782	866	1200	617
3	755	827	1200	1200	1090	809	598	765	1140	842	1200	618
4	757	894	1200	1200	1080	801	584	771	1010	840	1200	618
5	763	935	1190	1200	1070	812	578	762	943	848	1200	618
6	770	911	1190	1260	1110	810	611	757	866	745	1200	610
7	774	900	1200	1200	1060	805	604	699	873	612	1200	612
8	794	953	1200	1100	1060	790	570	818	879	758	1200	731
9	790	1080	1200	1200	1060	785	532	823	881	810	1170	738
10	840	1370	1200	1200	1070	786	532	830	906	829	1050	758
11	853	1200	1200	1070	1060	857	545	820	924	834	886	767
12	854	1480	1200	1090	1060	997	548	831	924	841	885	772
13	803	1200	1200	1100	1040	1030	567	829	931	853	906	782
14	802	1200	1200	1090	1010	990	588	887	896	867	886	801
15	817	1200	1200	1070	996	995	616	879	875	889	875	831
16	810	1170	1200	1200	1000	856	637	871	873	937	871	867
17	780	1180	1200	1200	1010	806	654	863	872	1020	862	874
18	773	1200	1200	1200	1010	683	668	883	898	1010	856	873
19	778	1170	1200	1200	1020	619	670	853	961	1080	848	854
20	773	1150	1200	1040	1020	614	688	830	960	1050	833	819
21	774	1140	1200	1050	960	630	693	845	902	1080	811	776
22	767	1150	1440	1090	890	632	700	834	914	1080	751	728
23	760	1140	1200	1200	895	623	713	789	903	1080	708	714
24	763	1120	1200	1200	890	628	717	782	895	1090	686	703
25	760	1120	1200	1150	853	634	717	831	884	1090	720	685
26	758	1160	1200	1170	837	645	714	856	895	1090	725	671
27	761	1160	1200	1150	847	654	710	877	912	1030	730	694
28	780	1130	1200	1070	852	680	721	915	915	1020	718	785
29	791	1110	1200	1200	833	704	737	909	931	1070	638	822
30	782	1110	1200	1200	---	736	757	879	911	1170	621	932
31	775	---	1200	1200	---	721	---	830	---	1200	623	---
MEAN	783	1100	1210	1160	996	767	645	827	905	949	912	743

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.--42 years, 141 ft^3/s, 102,200 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, 700 ft^3/s, Apr. 4, gage height, 11.00 ft, from graph based on gage readings,(backwater from ice); no flow Aug. 10 to Sept. 18; minimum gage height 2.91 ft, Sept 9, 10.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.55	2.3	e3.1	e4.1	e1.2	e2.6	e12	7.8	12	.23	.20	.00
2	.60	2.1	e3.2	e3.9	e1.2	e2.7	e20	7.8	20	.21	.19	.00
3	.63	4.1	e3.3	e3.7	e1.1	e2.8	e100	8.0	21	.18	.15	.00
4	.59	6.7	e3.4	e3.5	e1.1	e2.9	e600	8.0	18	.14	.10	.00
5	.68	3.6	3.5	e3.3	e1.1	e3.0	e500	8.0	16	.11	.08	.00
6	.70	2.3	3.6	e3.1	e1.0	e3.2	e400	7.8	12	.48	.07	.00
7	.76	1.7	4.1	e2.9	e1.0	e3.3	e320	7.5	8.7	4.3	.06	.00
8	.91	1.4	4.5	e2.8	e1.0	e3.4	e275	8.0	7.2	13	.04	.00
9	.93	1.1	5.0	e2.7	e.95	e3.5	250	13	8.8	15	.02	.00
10	.93	1.1	5.4	e2.6	e.95	e3.6	171	12	7.1	7.8	.00	.00
11	.93	1.3	5.9	e2.4	e.90	e3.8	135	12	6.1	6.7	.00	.00
12	1.0	1.4	6.0	e2.3	e.90	e3.9	101	12	5.4	4.6	.00	.00
13	1.3	1.5	e6.0	e2.2	e.90	e4.0	80	12	3.3	3.6	.00	.00
14	1.4	1.7	e6.1	e2.1	e.90	e4.1	63	12	2.2	2.8	.00	.00
15	1.5	e1.7	e6.2	e2.0	e.90	e4.2	52	12	2.6	2.8	.00	.00
16	2.0	e1.8	e6.2	e2.0	e.90	e4.3	44	10	2.7	2.9	.00	.00
17	3.1	e1.9	e6.2	e2.0	e.90	e4.4	37	9.4	2.1	2.9	.00	.00
18	2.4	e2.0	e6.3	e1.9	e.90	e4.5	31	9.2	2.0	2.6	.00	.00
19	1.7	e2.0	e6.4	e1.9	e.90	e4.6	27	8.6	1.9	2.6	.00	.03
20	1.3	e2.1	e6.5	e1.8	e.95	e4.7	22	7.6	1.6	2.4	.00	.04
21	1.1	e2.1	e6.6	e1.8	e.95	e4.9	19	7.5	1.3	2.6	.00	.05
22	.99	e2.2	e6.6	e1.7	e1.0	e5.1	17	7.9	.97	2.0	.00	.06
23	1.1	e2.3	e6.5	e1.7	e1.1	e5.4	17	8.3	.86	1.5	.00	.06
24	1.4	e2.4	e6.4	e1.6	e1.2	e5.6	16	9.0	1.3	1.3	.00	.07
25	1.7	e2.5	e6.2	e1.6	e1.3	e5.8	13	7.4	1.0	.93	.00	.07
26	1.6	e2.6	e5.9	e1.5	e1.5	e6.1	12	7.3	.52	.66	.00	.07
27	1.7	e2.7	e5.7	e1.5	e1.8	e6.8	12	8.8	.41	.48	.00	.07
28	1.8	e2.8	e5.4	e1.4	e2.1	e7.4	10	8.6	.56	.35	.00	.07
29	1.9	e2.9	e5.1	e1.4	e2.3	e8.0	9.2	12	.35	.30	.00	.08
30	2.1	e3.0	e4.7	e1.3	---	e9.0	8.0	9.4	.28	.25	.00	.08
31	2.2	---	e4.4	e1.3	---	e10	---	11	---	.22	.00	---
TOTAL	41.50	69.3	164.4	70.0	32.90	147.6	3373.2	289.9	168.25	85.94	0.91	0.75
MEAN	1.34	2.31	5.30	2.26	1.13	4.76	112	9.35	5.61	2.77	.029	.025
MAX	3.1	6.7	6.6	4.1	2.3	10	600	13	21	15	.20	.08
MIN	.55	1.1	3.1	1.3	.90	2.6	8.0	7.3	.28	.11	.00	.00
AC-FT	82	137	326	139	65	293	6690	575	334	170	1.8	1.5
CFSM	.00	.00	.01	.00	.00	.01	.20	.02	.01	.00	.00	.00
IN.	.00	.00	.01	.00	.00	.01	.22	.02	.01	.01	.00	.00

CAL YR 1987 TOTAL 13118.59 MEAN 35.9 MAX 1050 MIN .02 AC-FT 26020 CFSM .06 IN. .85
WTR YR 1988 TOTAL 4444.65 MEAN 12.1 MAX 600 MIN .00 AC-FT 8820 CFSM .02 IN. .29

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, 1,029.36 ft, Apr. 5; minimum observed, 1,020.50 ft, Aug. 9, but may have been lower during period of no gage-height record Aug. 10 to Sept. 18.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	---	---	---	---	---	---	---	---	---	---	---	---
2	---	---	---	---	---	---	---	---	---	---	---	---
3	---	---	---	---	---	---	---	---	---	---	---	---
4	---	---	---	---	---	---	---	---	---	---	---	---
5	---	---	---	---	---	---	29.31	---	---	---	---	---
6	---	---	---	---	---	---	29.17	---	---	---	---	---
7	---	---	---	---	---	---	28.73	---	---	22.34	---	---
8	---	---	---	---	---	---	28.33	---	---	23.62	---	---
9	---	---	---	---	---	---	28.03	---	---	23.67	20.50	---
10	---	---	---	---	---	---	27.74	---	---	23.41	---	---
11	---	---	---	---	---	---	27.35	---	---	23.06	---	---
12	---	---	---	---	---	---	26.91	---	---	22.73	---	---
13	---	---	---	---	---	---	26.33	---	---	22.54	---	---
14	---	---	---	---	---	---	25.73	---	---	22.49	---	---
15	---	---	---	---	---	---	25.22	---	---	22.42	---	---
16	---	---	---	---	---	---	24.66	---	---	22.41	---	---
17	---	---	---	---	---	---	23.85	21.40	---	22.28	---	---
18	---	---	---	---	---	---	23.03	---	---	---	---	---
19	---	---	---	---	---	---	22.50	---	---	---	---	21.02
20	21.37	---	---	---	---	---	22.23	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---	---	---
22	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	20.79	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---
30	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---
MAX	---	---	---	---	---	---	---	---	---	---	---	---
MIN	---	---	---	---	---	---	---	---	---	---	---	---

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. 1-20, Apr. 21 to July 6, July 18 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 poor. High flow affected by natural storage in Roseau Lake.

AVERAGE DISCHARGE.--60 years, 262 ft^3/s, 189,800 acre-ft/yr; median of yearly mean discharges, 235 ft^3/s, 170,000 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, 882 ft^3/s, Apr. 9, gage height, 8.69 ft; maximum gage height, 9.46 ft, Apr. 5 (backwater from ice); minimum discharge, 0.29 ft^3/s, Sept. 10, 11, gage height, 0.86 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.5	e6.5	e7.0	e3.8	e1.4	e3.3	e90	32	44	2.8	13	1.2
2	4.4	e6.0	e7.0	e3.6	e1.3	e3.5	e130	31	41	2.6	12	1.2
3	4.5	e6.0	e7.0	e3.4	e1.3	e3.8	e200	29	38	2.9	9.6	.97
4	4.8	e6.0	e7.0	e3.2	e1.2	e4.0	e400	29	38	3.1	7.7	.86
5	6.3	e6.0	e7.0	e3.0	e1.2	e4.5	e565	28	37	3.4	5.8	.80
6	6.2	e6.0	6.7	e2.9	e1.2	e4.5	e700	28	32	7.5	4.7	.73
7	6.7	e6.0	6.7	e2.8	e1.2	e4.8	e800	28	26	113	4.2	.55
8	5.7	e6.0	e8.0	e2.7	e1.1	e4.8	e850	29	19	247	3.7	.53
9	5.3	e6.0	e8.5	e2.6	e1.1	e5.0	868	31	14	258	3.5	.57
10	5.4	e6.0	e9.0	e2.5	e1.1	e5.0	813	32	9.7	234	3.2	.45
11	5.5	6.1	e9.0	e2.4	e1.1	e5.5	741	38	6.8	200	3.0	.61
12	4.6	5.9	e9.0	e2.4	e1.0	e5.5	659	36	5.6	168	2.8	1.5
13	4.6	6.0	e9.0	e2.3	e1.0	e6.0	560	34	5.0	145	2.6	1.6
14	4.4	6.3	e9.0	e2.2	e1.0	e6.0	474	32	4.2	137	2.7	1.3
15	4.2	7.7	e9.0	e2.2	e1.0	e6.5	411	31	5.4	131	2.5	1.0
16	4.7	e7.0	e9.0	e2.1	e1.0	e6.5	352	29	10	129	2.7	1.2
17	5.4	e7.0	e8.5	e2.1	e1.0	e7.0	274	28	14	114	2.6	1.2
18	5.7	e7.0	e8.0	e2.0	e1.0	e7.5	196	27	15	98	3.1	.92
19	7.5	e7.0	e7.5	e2.0	e1.0	e8.0	142	27	17	82	3.4	1.3
20	7.0	e7.0	e7.0	e2.0	e1.1	e8.5	110	27	15	67	3.3	1.0
21	e7.0	e7.0	e7.0	e1.9	e1.1	e9.0	89	27	11	55	3.0	1.8
22	e7.5	e7.0	e6.5	e1.9	e1.2	e10	76	26	9.9	46	2.8	1.9
23	e7.5	e7.0	e6.5	e1.8	e1.2	e11	67	27	8.0	38	2.6	2.0
24	e8.0	e7.0	e6.0	e1.8	e1.3	e13	60	26	6.0	34	2.7	2.6
25	e8.0	7.0	e6.0	e1.7	e1.4	e15	57	27	5.0	33	2.6	1.9
26	e8.0	7.1	e5.5	e1.7	e1.5	e20	51	25	4.4	28	2.4	2.1
27	e8.0	6.9	e5.5	e1.6	e1.6	e25	49	21	3.8	24	2.0	1.8
28	e8.0	7.1	e5.0	e1.6	e2.0	e30	47	19	3.4	20	1.9	1.7
29	e7.5	e7.0	e4.5	e1.5	e2.5	e45	40	27	3.0	16	2.0	1.8
30	e7.0	e7.0	e4.2	e1.5	---	e55	34	39	3.0	12	1.7	1.8
31	e7.0	---	e4.0	e1.4	---	e70	---	45	---	11	1.4	---
TOTAL	190.9	197.6	219.6	70.6	36.1	413.2	9905	915	454.2	2462.3	121.2	38.89
MEAN	6.16	6.59	7.08	2.28	1.24	13.3	330	29.5	15.1	79.4	3.91	1.30
MAX	8.0	7.7	9.0	3.8	2.5	70	868	45	44	258	13	2.6
MIN	4.2	5.9	4.0	1.4	1.0	3.3	34	19	3.0	2.6	1.4	.45
AC-FT	379	392	436	140	72	820	19650	1810	901	4880	240	77
CFSM	.01	.01	.01	.00	.00	.01	.27	.02	.01	.07	.00	.00
IN.	.01	.01	.01	.00	.00	.01	.30	.03	.01	.08	.00	.00

CAL YR 1987 TOTAL 51584.3 MEAN 141 MAX 1280 MIN 3.2 AC-FT 102300 CFSM .12 IN. 1.57
WTR YR 1988 TOTAL 15024.59 MEAN 41.1 MAX 868 MIN .45 AC-FT 29800 CFSM .03 IN. .46

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.--31 years (water years 1921-30, 1933, 1937, 1941-43, 1973-88), 286 ft^3/s, 207,200 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, 1,000 ft^3/s, Apr. 8, gage height, 6.78 ft (backwater from ice); minimum, 0.34 ft^3/s, Sept. 20; minimum gage height, 1.10 ft, Sept. 15, 16.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	2.6	8.2	7.5	e5.0	e1.2	e1.2	e50	31	28	3.6	18	1.5
2	2.6	7.9	7.5	e4.5	e1.1	e1.7	e65	29	31	3.4	16	1.6
3	2.6	7.5	7.1	e4.0	e1.1	e2.4	e90	29	31	2.8	15	1.6
4	2.4	7.2	6.7	e3.5	e1.1	e2.7	e150	28	28	2.6	14	1.5
5	3.0	6.5	6.7	e3.0	e1.0	e3.0	e250	27	26	2.6	13	1.2
6	3.7	6.0	6.6	e2.8	e1.0	e3.2	e600	27	25	4.4	11	1.0
7	4.1	6.0	7.0	e2.7	e.95	e3.3	e850	27	24	9.3	9.9	.90
8	4.4	6.0	8.0	e2.6	e.95	e3.4	e980	27	23	26	8.6	.85
9	4.6	6.0	8.4	e2.5	e.90	e3.5	965	29	22	142	7.6	.75
10	4.5	6.0	8.6	e2.4	e.90	e3.6	935	27	17	198	6.5	.65
11	4.1	6.0	8.6	e2.2	e.85	e3.8	908	28	14	198	6.6	.70
12	4.1	6.3	8.5	e2.1	e.85	e4.0	878	30	13	174	5.7	.80
13	4.1	6.3	7.9	e2.0	e.85	e4.1	830	32	11	148	5.1	.70
14	4.1	6.6	7.7	e2.0	e.80	e4.2	742	31	10	122	5.7	.65
15	4.0	6.4	8.9	e1.9	e.80	e4.3	628	29	10	110	5.1	.60
16	3.9	6.6	e8.7	e1.9	e.80	e4.5	e500	29	9.5	101	4.4	.55
17	3.9	6.6	e8.5	e1.8	e.80	e4.7	e400	28	8.7	97	4.1	.50
18	4.0	6.4	e8.2	e1.8	e.80	e5.0	e300	26	8.5	90	3.4	.45
19	4.0	6.4	e8.0	e1.7	e.80	e5.3	e200	27	9.7	78	3.6	.45
20	3.7	6.7	e7.8	e1.7	e.80	e5.6	134	27	11	72	3.9	.38
21	3.7	6.6	e7.7	e1.7	e.80	e6.0	97	26	11	62	3.2	.43
22	4.3	6.9	e7.5	e1.6	e.80	e6.5	76	25	11	52	3.0	.54
23	5.1	7.5	e7.4	e1.6	e.80	e7.0	64	24	9.8	45	3.2	.68
24	6.0	7.4	e7.3	e1.6	e.85	e8.0	56	23	8.7	40	3.2	.81
25	6.6	7.0	e7.2	e1.5	e.90	e9.0	49	23	8.5	35	2.8	.93
26	7.4	6.9	e7.1	e1.4	e.95	e10	48	22	6.7	31	2.4	1.0
27	8.0	6.9	e7.0	e1.4	e1.0	e12	44	23	5.7	28	2.3	1.3
28	8.3	7.2	6.9	e1.3	e1.1	e15	39	22	4.9	25	2.1	2.9
29	8.6	7.5	6.9	e1.3	e1.0	e20	38	28	4.4	24	1.8	3.6
30	8.6	7.5	6.6	e1.2	---	e30	35	26	4.1	21	1.6	3.6
31	8.6	---	6.6	e1.2	---	e40	---	24	---	20	1.5	---
TOTAL	149.6	203.0	235.1	67.9	26.55	237.0	11001	834	435.2	1967.7	194.3	33.12
MEAN	4.83	6.77	7.58	2.19	.92	7.65	367	26.9	14.5	63.5	6.27	1.10
MAX	8.6	8.2	8.9	5.0	1.2	40	980	32	31	198	18	3.6
MIN	2.4	6.0	6.6	1.2	.80	1.2	35	22	4.1	2.6	1.5	.38
AC-FT	297	403	466	135	53	470	21820	1650	863	3900	385	66
CFSM	.00	.00	.00	.00	.00	.00	.23	.02	.01	.04	.00	.00
IN.	.00	.00	.01	.00	.00	.01	.26	.02	.01	.05	.00	.00

CAL YR 1987 TOTAL 65411.2 MEAN 179 MAX 1630 MIN 1.2 AC-FT 129700 CFSM .11 IN. 1.55
WTR YR 1988 TOTAL 15384.47 MEAN 42.0 MAX 980 MIN .38 AC-FT 30520 CFSM .03 IN. .36

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 1987 TO SEPTEMBER 1988

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 AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)
OCT										
20...	1030	3.7	475	503	8.4	8.4	2.0	3.5	4.6	738
JAN										
12...	0930	2.1	820	1040	7.6	7.6	-20.0	0.5	5.1	771
MAY										
17...	0930	28	480	518	8.4	8.4	13.0	12.0	2.0	769
AUG										
09...	1030	7.9	369	371	8.4	8.3	25.0	21.5	7.2	772

DATE	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)	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)
OCT									
20...	11.0	53	180	61	29	11	3.1	248	254
JAN									
12...	--	K2	28	130	62	31	6.4	550	564
MAY									
17...	8.3	43	81	64	28	10	2.8	251	251
AUG									
09...	8.3	59	84	45	22	6.9	2.1	175	188

DATE	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)	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)
OCT									
20...	8	285	23	3.8	0.2	1.2	310	<0.01	<0.10
JAN									
12...	0	671	45	13	0.4	22	675	0.02	<0.10
MAY									
17...	8	288	34	5.2	0.3	0.93	321	<0.01	<0.10
AUG									
09...	2	209	20	2.9	0.2	9.1	254	<0.01	<0.10

05112000 ROSEAU RIVER BELOW STATE DITCH 51 NR CARIBOU, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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)	PHOSPHORUS TOTAL (MG/L AS P) (00665)	PHOSPHORUS DISSOLVED (MG/L AS P) (00666)	PHOSPHOROUS ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT									
20...	0.02	0.02	0.50	0.03	0.02	<0.01	8	0.08	100
JAN									
12...	0.08	0.08	1.2	0.06	0.03	0.02	--	--	--
MAY									
17...	0.02	0.02	0.90	0.03	0.02	<0.01	16	1.2	83
AUG									
09...	0.05	0.05	0.30	0.05	0.05	0.03	10	0.21	98

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											
20...	1030	<10	1	56	<0.5	<1	<1	<3	2	28	<5
JAN											
12...	0930	<10	3	110	<0.5	<1	<1	<3	77	51	<5
MAY											
17...	0930	<10	2	50	<0.5	<1	<1	<3	5	46	<5
AUG											
09...	1030	20	4	46	<0.5	1	<1	<3	1	31	<5

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										
20...	12	9	<0.1	<10	<1	10	<1.0	150	<6	17
JAN										
12...	27	85	<0.1	<10	2	<1	<1.0	340	<6	9
MAY										
17...	16	11	0.1	<10	<1	<1	<1.0	140	<6	85
AUG										
09...	14	33	0.2	<10	<1	<1	<1.0	100	<6	15

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 fair.

AVERAGE DISCHARGE.--22 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, 1,540 ft^3/s, Aug. 27, gage height, 5.81 ft; minimum, 45 ft^3/s, Mar. 7, 8, gage height, 2.92 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	184	101	83	77	62	48	52	263	299	131	97	1380
2	180	101	83	77	62	48	52	265	286	125	98	1360
3	171	99	83	e76	60	48	53	270	273	119	98	1320
4	167	96	82	e75	59	47	55	270	263	114	100	1260
5	165	94	82	e74	59	46	57	270	253	114	129	1190
6	165	93	82	e74	59	46	60	270	244	114	157	1120
7	161	91	82	e73	60	46	64	270	235	108	183	1050
8	156	90	82	e72	59	46	73	270	230	103	238	984
9	153	88	82	e72	58	48	83	300	220	99	272	909
10	147	86	82	e71	57	48	85	336	210	95	303	843
11	142	85	80	e71	57	50	89	350	200	89	316	787
12	140	83	80	e70	56	53	97	370	192	85	321	734
13	140	83	80	e70	56	54	104	389	188	83	331	683
14	140	82	80	70	54	54	109	402	186	81	398	635
15	138	82	80	69	54	53	114	412	178	99	404	589
16	138	82	80	68	54	52	122	418	177	102	451	559
17	136	90	80	68	54	52	130	414	168	95	824	529
18	134	93	80	66	51	50	134	406	162	90	1020	500
19	129	91	80	66	51	50	141	401	167	85	1150	481
20	127	90	80	65	51	49	149	392	162	82	1180	461
21	123	86	80	64	51	49	157	386	156	79	1160	441
22	121	85	80	63	51	48	166	381	165	77	1170	422
23	119	85	80	63	52	48	178	370	158	74	1330	399
24	119	85	80	63	51	48	190	360	152	73	1410	379
25	118	83	80	63	51	53	202	350	151	71	1490	360
26	114	83	80	62	50	53	215	340	146	68	1520	344
27	110	83	79	62	49	53	225	333	141	66	1530	327
28	110	83	79	60	48	53	235	326	144	66	1520	309
29	106	83	77	60	48	52	244	319	143	89	1480	299
30	105	83	77	60	---	52	256	316	136	103	1430	287
31	103	---	77	62	---	52	---	308	---	100	1380	---
TOTAL	4261	2639	2492	2106	1584	1549	3891	10527	5785	2879	23490	20941
MEAN	137	88.0	80.4	67.9	54.6	50.0	130	340	193	92.9	758	698
MAX	184	101	83	77	62	54	256	418	299	131	1530	1380
MIN	103	82	77	60	48	46	52	263	136	66	97	287
AC-FT	8450	5230	4940	4180	3140	3070	7720	20880	11470	5710	46590	41540
CFSM	.54	.35	.32	.27	.22	.20	.51	1.34	.76	.37	3.00	2.76
IN.	.63	.39	.37	.31	.23	.23	.57	1.55	.85	.42	3.45	3.08

CAL YR 1987 TOTAL 56945 MEAN 156 MAX 572 MIN 47 AC-FT 113000 CFSM .62 IN. 8.37
WTR YR 1988 TOTAL 82144 MEAN 224 MAX 1530 MIN 46 AC-FT 162900 CFSM .89 IN. 12.08

e Estimated

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 1987 TO SEPTEMBER 1988

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 AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)	BARO-METRIC PRES-SURE (MM OF HG) (00025)
OCT										
14...	1015	148	28	36	6.8	6.1	7.0	8.5	1.6	724
JAN										
14...	1200	69	23	38	7.1	7.7	-20.0	0.0	0.60	757
MAY										
11...	1100	372	29	32	7.2	7.5	15.0	13.0	0.80	755
JUL										
13...	1215	92	26	33	7.0	7.3	20.0	23.0	0.80	750

DATE	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)	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)
OCT									
14...	12.4	K5	78	3.2	1.6	1.0	0.4	11	11
JAN									
14...	13.0	K1	28	3.4	1.7	1.1	0.2	12	12
MAY									
11...	10.4	K13	K18	3.2	1.5	1.0	0.4	9	11
JUL									
13...	7.7	K2	220	2.8	1.6	1.6	0.3	10	12

DATE	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)	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)
OCT									
14...	0	13	18	0.70	0.20	3.8	24	<0.01	<0.10
JAN									
14...	0	15	15	0.50	0.10	3.7	40	<0.01	<0.10
MAY									
11...	0	11	8.4	0.60	0.20	3.5	38	<0.01	<0.10
JUL									
13...	0	13	8.7	0.60	<0.10	2.9	33	<0.01	<0.10

LAKE OF THE WOODS BASIN

05124480 KAWISHIWI RIVER NEAR ELY, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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)	PHOSPHORUS TOTAL (MG/L AS P) (00665)	PHOSPHORUS DISSOLVED (MG/L AS P) (00666)	PHOSPHORUS ORTHO, DISSOLVED (MG/L AS P) (00671)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT									
14...	0.02	0.02	0.80	0.01	0.01	<0.01	2	0.80	100
JAN									
14...	0.04	0.04	0.70	0.01	0.01	<0.01	1	0.19	73
MAY									
11...	0.03	0.03	0.70	0.01	0.01	<0.01	3	3.0	69
JUL									
13...	0.13	0.08	0.80	0.03	<0.01	<0.01	4	0.99	74

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											
14...	1015	30	<1	8	<0.5	<1	<1	<3	3	250	<5
JAN											
14...	1200	40	<1	11	<0.5	<1	<1	<3	3	240	<5
MAY											
11...	1100	40	1	12	<0.5	<1	<1	<3	2	170	<5
JUL											
13...	1215	20	<1	8	<0.5	3	<1	<3	5	170	<5

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										
14...	<4	4	<0.1	<10	1	<1	<1.0	13	<6	15
JAN										
14...	<4	6	<0.1	<10	3	<1	<1.0	12	<6	<3
MAY										
11...	<4	4	<0.1	<10	3	<1	<1.0	12	<6	<3
JUL										
13...	76	4	<0.1	<10	<1	<1	<1.0	11	9	53

RADIOCHEMICAL ANALYSES, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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									
14...	1015	<0.4	<0.4	1.2	<0.4	1.2	<0.4	0.14	<0.01
JUL									
13...	1215	<0.4	<0.4	1.6	0.4	1.5	0.4	0.03	0.01

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).--69 years (water years 1906, 1916-17, 1919, 1924-88), 1,035 ft^3/s, 11.44 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, 7,640 ft^3/s, Aug. 25; no flow July 23, 24.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	716	411	399	399	399	319	389	727	1460	399	249	5870
2	587	378	367	399	399	286	396	727	1230	302	331	6280
3	845	396	399	399	399	286	443	695	1150	399	334	5910
4	748	390	431	399	334	286	452	727	1050	367	367	5200
5	748	357	431	367	399	286	479	520	1060	399	736	5040
6	748	380	399	367	367	351	479	622	962	399	733	5290
7	748	399	399	399	367	318	595	462	1090	302	871	4350
8	748	367	399	399	399	318	642	559	865	399	1090	4140
9	630	399	431	367	367	385	712	964	897	399	1130	3930
10	668	399	399	399	302	318	793	937	818	302	1480	3900
11	603	302	399	367	399	350	805	1160	721	303	1570	3240
12	668	399	431	431	334	350	868	1630	817	321	1620	3900
13	481	399	399	399	366	350	918	2090	853	224	2060	2600
14	448	399	399	399	366	350	1020	2130	762	285	2500	2230
15	417	367	399	399	366	350	1080	2400	665	226	2910	1840
16	481	431	399	399	367	318	1080	2450	891	97	3020	1660
17	481	399	431	334	366	318	1180	2810	484	97	3720	1700
18	417	431	431	367	269	350	1210	3190	526	281	4970	1630
19	448	399	399	399	383	350	1250	2900	430	249	5070	1700
20	495	399	399	399	310	318	1050	2360	592	152	6040	1860
21	473	399	399	334	310	221	1120	2110	493	249	6310	1820
22	385	367	367	367	363	285	1020	2040	475	217	6810	1850
23	353	399	399	399	255	318	956	1950	411	.00	7270	1670
24	514	367	399	399	256	350	956	1760	475	.00	7450	1500
25	353	367	399	431	320	350	801	1390	382	249	7640	1340
26	447	399	399	399	320	350	944	1280	367	184	7380	1370
27	464	399	399	399	320	350	912	1350	359	246	7130	140
28	363	399	399	399	287	350	876	1420	506	178	6990	1310
29	443	399	399	399	286	479	861	1570	367	472	6750	1410
30	443	367	399	399	---	334	792	1530	367	32	6650	1350
31	443	---	399	399	---	342	---	1500	---	129	5850	---
TOTAL	16806	11663	12497	12111	9975	10286	25079	47960	21525	7858.00	117031	87290
MEAN	542	389	403	391	344	332	836	1547	717	253	3775	2910
MAX	845	431	431	431	399	479	1250	3190	1460	472	7640	6280
MIN	353	302	367	334	255	221	389	462	359	.00	249	1310
†	-31	+15	-56	-136	-169	-110	+316	+232	+87	-35	+199	-74
MEAN‡	511	404	347	255	175	222	1152	1779	804	218	3974	2836
CFSM‡	.42	.33	.28	.21	.14	.18	.94	1.45	.65	.18	3.23	2.31
IN‡	.48	.37	.33	.24	.15	.21	1.05	1.67	.73	.20	3.73	2.57

CAL YR 1987 TOTAL 280183 MEAN 768 MAX 4820 MIN 97 MEAN‡ 772 CFSM‡ .63 IN‡ 8.53
WTR YR 1988 TOTAL 380081 MEAN 1038 MAX 7640 MIN .00 MEAN‡ 1059 CFSM‡ .86 IN‡ 11.72

† 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.--60 years (water years 1926, 1927, 1931-88), 1,399 ft^3/s, 10.92 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, 8,020 ft^3/s, Sept. 2, gage height, 7.30 ft; minimum, 390 ft^3/s, July 28, gage height, 2.68 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1150	603	490	484	520	478	530	1130	1890	900	407	7880
2	1130	598	489	487	520	472	527	1120	1910	866	447	7970
3	1110	594	484	486	520	470	537	1110	1860	840	445	7950
4	1080	579	482	481	520	466	544	1110	1800	811	448	7880
5	1070	574	482	482	513	464	548	1100	1750	796	499	7750
6	1070	568	482	482	513	461	555	1100	1690	771	541	7560
7	1050	562	485	483	511	461	569	1070	1630	744	587	7300
8	1040	549	482	482	508	476	594	1050	1610	723	660	6970
9	1010	540	482	482	505	490	622	1110	1530	701	698	6630
10	988	536	482	482	505	489	658	1170	1470	669	741	6370
11	968	527	482	482	502	503	694	1180	1420	643	790	6110
12	958	523	479	482	500	518	730	1210	1370	627	849	5760
13	948	515	482	494	498	526	768	1280	1360	608	931	5430
14	918	519	482	505	497	523	810	1360	1350	595	1170	5120
15	906	515	482	505	500	521	850	1430	1310	676	1360	4810
16	885	526	483	505	499	519	892	1520	1350	674	1600	4520
17	858	543	485	505	497	516	920	1630	1300	645	2200	4250
18	824	546	484	505	497	509	948	1780	1260	616	2590	4020
19	797	530	483	505	497	504	974	1940	1230	586	2990	3840
20	771	526	484	505	497	501	997	2070	1180	560	3460	3630
21	748	531	485	505	497	498	1020	2170	1140	537	3950	3470
22	731	521	486	507	497	495	1040	2220	1190	519	4460	3330
23	714	514	483	505	497	490	1060	2220	1140	498	5110	3190
24	704	515	484	505	497	492	1080	2210	1120	483	5570	3090
25	687	510	487	512	493	523	1090	2170	1060	467	6030	2950
26	662	505	485	513	484	522	1110	2110	1040	446	6450	2850
27	651	505	482	513	482	523	1110	2050	1010	434	6820	2740
28	643	504	482	513	477	526	1120	2000	1010	414	7150	2650
29	629	497	484	513	483	542	1120	1950	977	419	7400	2550
30	615	493	482	510	---	537	1130	1930	937	411	7560	2460
31	609	---	483	520	---	534	---	1900	---	410	7650	---
TOTAL	26924	16068	14989	15440	14526	15549	25147	49400	40894	19089	91563	151030
MEAN	869	536	484	498	501	502	838	1594	1363	616	2954	5034
MAX	1150	603	490	520	520	542	1130	2220	1910	900	7650	7970
MIN	609	493	479	481	477	461	527	1050	937	410	407	2460
AC-FT	53400	31870	29730	30630	28810	30840	49880	97980	81110	37860	181600	299600
CFSM	.50	.31	.28	.29	.29	.29	.48	.92	.78	.35	1.70	2.89
IN.	.58	.34	.32	.33	.31	.33	.54	1.06	.87	.41	1.96	3.23

CAL YR 1987 TOTAL 403645 MEAN 1106 MAX 3390 MIN 449 AC-FT 800600 CFSM .64 IN. 8.63
WTR YR 1988 TOTAL 480619 MEAN 1313 MAX 7970 MIN 407 AC-FT 953300 CFSM .75 IN. 10.28

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.--66 years (water years 1923-88), 3,832 ft^3/s, 10.07 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, 15,600 ft^3/s, Sept. 7, elevation, 1,189.34 ft; minimum, 1,420 ft^3/s, Mar. 6, elevation, 1,182.63 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	5140	2910	2030	1670	1550	1460	1580	2970	4600	3640	2280	13800
2	5030	2870	2010	1670	1550	1450	1590	3000	4650	3570	2430	14300
3	4940	2820	2010	1670	1550	1450	1590	3030	4560	3540	2410	14700
4	4810	2720	2010	e1660	1540	1450	1610	3050	4530	3490	2370	15000
5	4660	2680	1980	e1660	1530	1450	1620	3070	4500	3500	2440	15200
6	4580	2670	1960	e1650	1530	1430	1630	3130	4430	3460	2500	15400
7	4510	2650	1950	e1650	1530	1440	1650	3150	4400	3390	2560	15500
8	4440	2590	1940	e1640	1520	1460	1680	3170	4430	3330	2620	15400
9	4280	2550	1920	e1640	1520	1500	1700	3230	4270	3270	2670	15300
10	4190	2530	1900	e1630	1510	1510	1730	3370	4200	3170	2720	15200
11	4110	2490	1900	e1630	1510	1530	1780	3450	4160	3120	2760	15100
12	4050	2460	1880	e1620	1500	1550	1840	3490	4080	3080	2810	14800
13	3970	2420	1870	e1620	1500	1560	1900	3610	4090	3000	2900	14500
14	3870	2420	1860	e1610	1500	1560	1960	3720	4070	2960	3300	14300
15	3840	2390	1850	e1610	1500	1560	2040	3770	4030	3230	3540	14000
16	3740	2370	1830	e1610	1500	1560	2120	3850	4090	3210	3830	13700
17	3670	2350	1830	e1600	1490	1550	2170	3930	4010	3150	4590	13400
18	3560	2320	1810	1590	1490	1540	2230	3990	3960	3070	5100	13100
19	3510	2250	1810	1590	1490	1530	2300	4040	3910	3000	5570	12900
20	3470	2250	1790	1580	1480	1530	2360	4070	3870	2930	6140	12600
21	3410	2260	1790	1580	1480	1520	2410	4140	3850	2920	6690	12300
22	3360	2230	1770	1580	1480	1520	2470	4200	3890	2860	7310	11900
23	3310	2190	1760	1570	1470	1520	2530	4250	3880	2800	8100	11500
24	3270	2180	1760	1560	1470	1520	2590	4310	3860	2720	8790	11100
25	3210	2160	1740	1570	1470	1560	2640	4350	3780	2670	9470	10700
26	3130	2130	1740	1560	1470	1560	2700	4390	3790	2610	10200	10400
27	3090	2120	1720	1560	1470	1560	2760	4460	3780	2570	10900	10000
28	3070	2100	1710	1550	1460	1570	2810	4510	3810	2480	11600	9710
29	3030	2080	1700	1550	1460	1580	2860	4530	3750	2410	12200	9390
30	2970	2050	1690	1540	---	1580	2920	4580	3690	2350	12800	9070
31	2940	---	1680	1560	---	1580	---	4590	---	2310	13200	---
TOTAL	119160	72210	57200	49780	43520	47140	63770	117400	122920	93810	176800	394270
MEAN	3844	2407	1845	1606	1501	1521	2126	3787	4097	3026	5703	13140
MAX	5140	2910	2030	1670	1550	1580	2920	4590	4650	3640	13200	15500
MIN	2940	2050	1680	1540	1460	1430	1580	2970	3690	2310	2280	9070
AC-FT	236400	143200	113500	98740	86320	93500	126500	232900	243800	186100	350700	782000
CFSM	.74	.47	.36	.31	.29	.29	.41	.73	.79	.59	1.10	2.54
IN.	.86	.52	.41	.36	.31	.34	.46	.84	.88	.67	1.27	2.84

CAL YR 1987 TOTAL 1137530 MEAN 3117 MAX 10000 MIN 1440 AC-FT 2256000 CFSM .60 IN. 8.18
WTR YR 1988 TOTAL 1357980 MEAN 3710 MAX 15500 MIN 1430 AC-FT 2694000 CFSM .72 IN. 9.77

e Estimated

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 except those for estimated daily discharges, which are poor.

AVERAGE DISCHARGE.--9 years, 625 ft^3/s, 452,800 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, 3,040 ft^3/s, Aug. 24, 25, gage height, 13.23 ft; minimum, 50 ft^3/s, Aug. 1, gage height, 3.90 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	302	168	140	102	110	e82	e100	591	458	221	52	2190
2	278	168	136	100	108	e82	e108	586	430	206	108	2150
3	272	168	131	98	e104	e82	e117	560	413	189	196	2140
4	274	166	127	96	e102	e82	e128	538	395	176	196	2090
5	269	155	123	94	e100	e84	e140	519	374	175	242	2020
6	262	150	118	92	e100	e86	e150	501	356	175	378	1950
7	254	149	118	91	e98	e88	178	504	333	164	425	1880
8	251	145	118	86	e98	e90	751	517	314	150	547	1800
9	248	141	118	86	e98	e90	e1000	555	312	139	629	1730
10	241	138	117	86	e98	e90	1360	777	294	129	655	1630
11	230	138	118	86	e96	e90	1380	899	277	118	643	1550
12	222	136	118	94	e96	e90	1390	946	260	108	572	1500
13	219	135	118	96	e96	e90	1430	993	260	113	510	1430
14	212	134	118	94	e94	e90	1480	1010	272	108	994	1360
15	200	133	118	97	e94	e90	1400	990	273	107	1380	1290
16	196	147	117	101	e94	e90	1300	931	311	105	1440	1250
17	192	159	122	100	e92	e90	1200	887	315	97	2200	1240
18	187	170	115	96	e92	e90	1080	845	298	91	2850	1210
19	180	176	114	94	e92	e90	959	802	293	88	2990	1540
20	178	165	114	94	e90	e90	885	758	267	85	2910	2550
21	174	163	113	94	e90	e90	823	717	250	84	2810	2850
22	170	163	112	105	e90	e90	775	685	259	79	2700	2770
23	168	161	106	105	e88	e90	734	658	239	77	2860	2590
24	168	156	105	105	e88	e90	696	623	262	79	3010	2400
25	174	153	105	104	e86	e90	672	600	262	75	3030	2210
26	180	150	105	104	e86	e92	644	573	232	70	2960	2040
27	180	148	105	e101	e84	e94	625	545	218	66	2830	1890
28	178	146	104	e106	e84	e94	610	520	229	62	2670	1770
29	176	145	103	107	e82	e96	598	508	240	58	2530	1710
30	172	142	103	107	---	e96	593	496	233	55	2390	1670
31	170	---	103	112	---	e98	---	480	---	53	2270	---
TOTAL	6577	4568	3582	3033	2730	2776	23306	21114	8929	3502	49977	56400
MEAN	212	152	116	97.8	94.1	89.5	777	681	298	113	1612	1880
MAX	302	176	140	112	110	98	1480	1010	458	221	3030	2850
MIN	168	133	103	86	82	82	100	480	218	53	52	1210
AC-FT	13050	9060	7100	6020	5410	5510	46230	41880	17710	6950	99130	111900

CAL YR 1987 TOTAL 146701 MEAN 402 MAX 1580 MIN 103 AC-FT 291000
WTR YR 1988 TOTAL 186494 MEAN 510 MAX 3030 MIN 52 AC-FT 369900

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.--Records good. Flow completely regulated by outlet dam on Namakan Lake.

AVERAGE DISCHARGE.--6 years, 237 ft^3/s, 171,700 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, 10.30 ft, Mar. 23, 1987.

EXTREMES FOR CURRENT YEAR.--Maximum discharge, 897 ft^3/s, Sept. 21, gage height, 19.23 ft; no flow Jan. 23 to May 6; minimum gage height, 11.29 ft, Apr. 5, 6.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	438	227	39	4.1	.00	.00	.00	.00	94	379	489	814
2	428	220	37	4.5	.00	.00	.00	.00	102	385	502	804
3	436	208	35	3.7	.00	.00	.00	.00	102	394	504	801
4	422	179	32	2.6	.00	.00	.00	.00	107	403	509	801
5	396	169	31	2.4	.00	.00	.00	.00	115	423	517	801
6	396	171	30	2.3	.00	.00	.00	.00	121	430	542	807
7	400	166	28	2.5	.00	.00	.00	.03	132	425	558	823
8	411	147	26	1.5	.00	.00	.00	.03	150	430	564	801
9	369	139	23	1.6	.00	.00	.00	.05	144	432	574	772
10	365	140	22	1.8	.00	.00	.00	.37	149	423	588	788
11	371	134	20	1.2	.00	.00	.00	.91	161	430	593	810
12	373	126	16	.98	.00	.00	.00	1.7	165	444	601	769
13	375	116	15	.79	.00	.00	.00	1.6	178	446	604	763
14	357	119	14	.97	.00	.00	.00	e3.4	191	448	629	754
15	368	118	13	.87	.00	.00	.00	e5.6	193	477	669	754
16	361	109	11	.75	.00	.00	.00	8.4	223	475	708	754
17	360	95	12	.41	.00	.00	.00	15	235	479	791	738
18	339	95	12	.44	.00	.00	.00	20	243	482	791	720
19	339	76	11	.42	.00	.00	.00	26	242	487	763	763
20	334	78	10	.13	.00	.00	.00	28	250	490	782	807
21	327	87	9.3	.13	.00	.00	.00	e34	263	495	804	856
22	324	79	8.8	.05	.00	.00	.00	e40	277	499	828	876
23	307	69	8.7	.0	.00	.00	.00	46	298	502	856	853
24	294	69	7.8	.0	.00	.00	.00	50	313	492	833	856
25	292	66	7.0	.00	.00	.00	.00	62	302	494	813	823
26	272	60	7.0	.00	.00	.00	.00	e66	325	499	817	807
27	255	57	6.3	.00	.00	.00	.00	70	339	499	788	760
28	258	53	5.6	.00	.00	.00	.00	77	364	494	791	744
29	253	47	5.7	.00	.00	.00	.00	81	370	487	807	702
30	233	44	5.8	.00	---	.00	.00	87	374	479	814	678
31	234	---	4.0	.00	---	.00	---	91	---	494	823	---
TOTAL	10687	3463	513.0	34.14	0.00	0.00	0.00	815.09	6522	14216	21252	23599
MEAN	345	115	16.5	1.10	.00	.00	.00	26.3	217	459	686	787
MAX	438	227	39	4.5	.00	.00	.00	91	374	502	856	876
MIN	233	44	4.0	.00	.00	.00	.00	.00	94	379	489	678
AC-FT	21200	6870	1020	68	.0	.0	.0	1620	12940	28200	42150	46810

CAL YR 1987 TOTAL 66961.37 MEAN 183 MAX 748 MIN .00 AC-FT 132800
WTR YR 1988 TOTAL 81101.23 MEAN 222 MAX 876 MIN .00 AC-FT 160900

e Estimated

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, Sept. 28; maximum daily elevation, 1,108.41 ft, Sept. 26; minimum, 1,105.24 ft, Mar. 23; minimum daily, 1,105.25 ft, Mar. 18.

MONTHEND ELEVATION, IN FEET NGVD, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

Oct. 31 ..... 1,107.22	Feb. 29 ..... 1,105.47	June 30 ..... 1,106.34
Nov. 30 ..... 1,107.02	Mar. 31 ..... 1,105.28	July 31 ..... 1,106.49
Dec. 31 ..... 1,106.61	Apr. 30 ..... 1,105.74	Aug. 31 ..... 1,108.01
Jan. 31 ..... 1,105.91	May 31 ..... 1,106.12	Sept.30 ..... 1,108.27

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.--46 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. 9	1400	598	4.07	Sept. 22	1500	630	4.10
Aug. 16	1000	*841	*4.50				

Minimum daily discharge, 2.5 ft^3/s, July 30.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	53	48	38	25	e18	e16	e21	64	28	11	12	185
2	49	49	35	25	e18	e16	e23	66	21	9.6	31	194
3	49	50	34	24	e18	e16	e27	65	20	8.6	38	179
4	48	51	33	23	e18	e16	e35	65	18	7.5	31	166
5	49	50	32	20	e18	e16	e60	62	17	7.5	44	153
6	48	53	31	16	e17	e16	e150	59	15	7.8	50	141
7	48	53	32	14	e17	e16	352	57	14	7.2	120	127
8	55	51	33	13	e17	e16	510	59	13	e6.5	235	116
9	50	49	34	13	e17	e16	594	85	13	e6.5	237	104
10	48	45	34	12	e17	e16	547	140	11	e6.5	228	95
11	47	47	33	13	e17	e16	502	152	10	e7.0	195	90
12	46	47	34	e13	e17	e16	436	146	9.2	e7.0	180	88
13	48	46	32	e14	e17	e16	365	145	9.1	7.8	200	83
14	51	48	31	e14	e17	e16	310	135	11	7.2	469	80
15	53	47	30	e15	e17	e16	263	126	12	7.2	690	78
16	48	53	30	e15	e17	e16	230	111	14	7.2	824	79
17	47	58	29	e16	e17	e16	205	97	18	7.2	689	83
18	47	58	29	e16	e17	e16	183	84	16	e7.0	487	86
19	48	56	28	e17	e17	e16	165	76	20	e5.0	342	294
20	49	48	28	e17	e17	e16	150	84	19	e6.0	260	555
21	51	46	28	e17	e16	e16	132	77	18	e5.0	220	603
22	52	46	27	e18	e16	e16	111	66	16	e4.5	263	624
23	52	46	27	e18	e16	e16	100	59	14	e4.0	365	592
24	52	43	27	e18	e16	e17	96	52	13	e3.7	368	526
25	52	43	27	e18	e16	e17	91	47	13	e3.4	360	461
26	53	42	26	e18	e16	e17	84	42	10	e3.1	317	411
27	52	42	25	e18	e16	e17	76	40	10	e2.9	269	368
28	52	42	25	e18	e16	e18	77	36	12	2.8	231	335
29	52	41	25	e18	e16	e18	71	32	14	e2.6	201	333
30	51	40	25	e18	---	e18	65	30	12	e2.5	180	324
31	50	---	25	e18	---	e19	---	27	---	e4.0	162	---
TOTAL	1550	1438	927	532	489	509	6031	2386	440.3	185.8	8298	7553
MEAN	50.0	47.9	29.9	17.2	16.9	16.4	201	77.0	14.7	5.99	268	252
MAX	55	58	38	25	18	19	594	152	28	11	824	624
MIN	46	40	25	12	16	16	21	27	9.1	2.5	12	78
AC-FT	3070	2850	1840	1060	970	1010	11960	4730	873	369	16460	14980
CFSM	.27	.26	.16	.09	.09	.09	1.08	.41	.08	.03	1.43	1.35
IN.	.31	.29	.18	.11	.10	.10	1.20	.47	.09	.04	1.65	1.50

CAL YR 1987 TOTAL 30779 MEAN 84.3 MAX 820 MIN 21 AC-FT 61050 CFSM .45 IN. 6.12
WTR YR 1988 TOTAL 30339.1 MEAN 82.9 MAX 824 MIN 2.5 AC-FT 60180 CFSM .44 IN. 6.04

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.--65 years (water years 1912-16, 1929-88), 1,059 ft^3/s, 8.31 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, 11,800 ft^3/s, Sept. 22, gage height, 15.11 ft; minimum, 42 ft^3/s, July 30, 31, Aug. 1, gage height, 1.57 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	355	514	e300	e140	e95	e85	e150	689	357	151	43	2070
2	335	506	e280	e135	e95	e85	e160	686	335	151	53	1890
3	349	503	e270	e130	e90	e85	e200	697	305	143	58	2230
4	327	486	e260	e125	e90	e85	e300	695	284	136	100	2450
5	320	467	e260	e120	e90	e85	e500	683	266	123	246	2260
6	324	436	e260	e120	e90	e85	e900	664	246	111	315	1950
7	338	425	e260	e115	e90	e85	e1500	638	217	105	342	1660
8	340	425	e250	e115	e90	e85	e2500	653	198	95	366	1420
9	336	421	e250	e115	e90	e85	e4000	768	178	86	642	1240
10	341	352	e250	e110	e90	e85	e6700	952	168	77	1540	1090
11	329	367	e240	e110	e90	e85	e7300	1120	163	67	1720	1010
12	324	438	e240	e110	e90	e85	5330	1300	138	61	1590	906
13	321	442	e230	e105	e90	e85	4190	1470	133	71	1320	834
14	315	381	e220	e105	e90	e85	3380	1510	145	75	1090	766
15	308	437	e215	e105	e90	e85	2810	1460	158	72	2160	709
16	297	417	e210	e100	e90	e85	2530	1350	175	66	3940	685
17	292	431	e205	e100	e90	e85	2190	1240	174	60	4230	673
18	296	459	e200	e100	e90	e85	1910	1140	159	56	4690	676
19	293	450	e195	e100	e90	e85	1670	1020	160	56	4660	1000
20	293	416	e190	e100	e90	e90	1480	932	148	54	4290	5140
21	290	329	e185	e100	e85	e90	1340	846	139	54	3760	10300
22	292	e400	e180	e95	e85	e90	1210	785	148	52	3460	11600
23	296	e450	e175	e95	e85	e90	1090	751	140	50	5350	9280
24	330	e420	e170	e95	e85	e90	995	699	148	50	7170	6410
25	419	e400	e165	e95	e85	e90	919	638	139	46	6860	4970
26	432	e390	e160	e95	e85	e95	853	579	130	45	5910	4110
27	429	e370	e155	e95	e85	e100	791	517	119	46	4870	3470
28	422	e350	e150	e95	e85	e110	759	472	125	46	3950	2950
29	423	e340	e150	e95	e85	e120	726	451	128	45	3230	2610
30	468	e320	e145	e95	---	e130	700	412	143	43	2730	2440
31	519	---	e140	e95	---	e140	---	384	---	43	2370	---
TOTAL	10753	12542	6560	3310	2575	2850	59083	26201	5466	2336	83055	88799
MEAN	347	418	212	107	88.8	91.9	1969	845	182	75.4	2679	2960
MAX	519	514	300	140	95	140	7300	1510	357	151	7170	11600
MIN	290	320	140	95	85	85	150	384	119	43	43	673
AC-FT	21330	24880	13010	6570	5110	5650	117200	51970	10840	4630	164700	176100
CFSM	.20	.24	.12	.06	.05	.05	1.14	.49	.11	.04	1.55	1.71
IN.	.23	.27	.14	.07	.06	.06	1.27	.56	.12	.05	1.79	1.91

CAL YR 1987 TOTAL 251983 MEAN 690 MAX 6390 MIN 119 AC-FT 499800 CFSM .40 IN. 5.42
WTR YR 1988 TOTAL 303530 MEAN 829 MAX 11600 MIN 43 AC-FT 602100 CFSM .48 IN. 6.53

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.--57 years (water years 1929-79, 1983-88), 730 ft^3/s, 6.79 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, 4,200 ft^3/s, Apr. 12, gage height, 11.30 ft (backwater from ice), from highwater mark; minimum, 35 ft^3/s, July 29, 30, 31, gage height, 2.59 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	450	467	410	e220	e140	e115	e190	827	347	131	52	401
2	452	463	e400	e210	e140	e115	e200	816	339	115	78	381
3	447	462	e400	e210	e140	e115	e220	804	312	101	129	373
4	445	462	e380	e200	e140	e115	e250	796	301	90	170	355
5	448	464	e350	e200	e140	e115	e300	788	284	83	188	331
6	453	457	e340	e195	e140	e115	e500	771	268	76	201	311
7	463	452	e340	e195	e135	e115	e1000	740	247	71	203	293
8	474	439	e340	e190	e135	e115	e1500	718	225	68	303	271
9	468	434	e340	e190	e135	e115	e2000	756	209	65	456	251
10	460	399	e340	e185	e135	e115	e2500	822	190	65	560	236
11	454	404	e340	e180	e135	e115	e3100	865	176	58	496	221
12	458	466	e340	e180	e130	e115	e3800	848	165	56	407	214
13	451	498	e340	e175	e130	e115	3010	818	177	70	337	208
14	443	448	e340	e175	e130	e115	2410	786	185	68	349	201
15	438	436	e340	e170	e130	e115	2080	765	184	65	393	195
16	442	448	e330	e170	e130	e115	1850	737	184	62	449	198
17	445	456	e320	e165	e125	e115	1660	711	182	57	556	201
18	443	480	e310	e165	e125	e115	1540	693	169	56	575	213
19	443	484	e300	e160	e125	e120	1420	650	158	57	517	576
20	450	454	e300	e160	e125	e120	1300	629	150	53	447	2010
21	466	319	e290	e160	e125	e120	1210	603	147	49	406	2710
22	466	268	e280	e155	e120	e120	1130	600	146	51	368	2210
23	469	453	e270	e155	e120	e125	1070	585	150	51	472	2040
24	469	592	e260	e155	e120	e130	1020	547	146	49	1060	1790
25	473	444	e250	e150	e120	e135	991	509	131	48	929	1520
26	483	437	e250	e150	e120	e140	963	474	121	44	839	1300
27	490	439	e240	e150	e115	e150	937	453	111	44	767	1140
28	515	445	e240	e145	e115	e160	900	433	137	40	654	1030
29	503	431	e230	e145	e115	e170	863	423	143	36	546	959
30	488	418	e230	e145	---	e180	841	393	143	35	479	913
31	475	---	e220	e145	---	e190	---	369	---	40	435	---
TOTAL	14324	13319	9660	5350	3735	3930	40755	20729	5827	1954	13821	23052
MEAN	462	444	312	173	129	127	1358	669	194	63.0	446	768
MAX	515	592	410	220	140	190	3800	865	347	131	1060	2710
MIN	438	268	220	145	115	115	190	369	111	35	52	195
AC-FT	28410	26420	19160	10610	7410	7800	80840	41120	11560	3880	27410	45720
CFSM	.32	.30	.21	.12	.09	.09	.93	.46	.13	.04	.31	.53
IN.	.36	.34	.25	.14	.10	.10	1.04	.53	.15	.05	.35	.59

CAL YR 1987 TOTAL 228945 MEAN 627 MAX 5590 MIN 189 AC-FT 454100 CFSM .43 IN. 5.83
WTR YR 1988 TOTAL 156456 MEAN 427 MAX 3800 MIN 35 AC-FT 310300 CFSM .29 IN. 3.99

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.--60 years, 12,850 ft^3/s, 9.00 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, 44,000 ft^3/s, Sept. 23, gage height, 15.31 ft; minimum, 3,310 ft^3/s, July 22, 23, gage height, 1.37 ft.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	11700	7780	8380	e6500	e7000	e5500	4450	5780	5200	4230	3420	30400
2	12400	7700	8180	e4000	e7000	e5200	4400	5790	5120	4160	3480	30100
3	11800	7680	7400	e5500	e7000	e5000	4950	5820	5030	4100	3460	30000
4	11300	7640	e7500	e7500	e6500	e5900	5460	5890	4980	4020	3460	30100
5	11300	8050	e7500	e7500	e6000	e5700	6710	6110	4970	3990	3520	30100
6	10900	8300	e7500	e7500	e6000	e5500	8270	6010	4960	3780	3720	29500
7	9230	8280	e7500	e7500	e6000	e5500	9670	5830	4900	3590	3880	27600
8	8840	8280	e7500	e7500	e6000	e5500	11300	5780	4820	3540	3970	25900
9	9290	8260	e7500	e7500	e6000	e5500	12500	5800	4690	3500	4000	25300
10	9790	8040	e7500	e7500	e6000	e5500	13600	6090	4650	3460	4270	25100
11	9580	7650	e7500	e7500	e6000	e5500	14500	6390	4640	3460	5160	25000
12	9400	7780	7520	e7500	e5000	e5500	16500	6680	4610	3430	6190	24900
13	9330	8080	7520	e7500	e5300	e5500	16800	7010	4760	3440	5900	24800
14	9160	8370	7510	e7500	e5500	e5500	14600	7120	4740	3440	5480	24600
15	8870	8400	7440	e7500	e5500	e5500	12100	7090	4800	3460	5110	24600
16	9020	8410	e7500	e7500	e5500	e5500	11100	7060	4930	3480	5690	24600
17	9060	8380	e7500	e7500	e5500	e5500	10400	6970	5030	3480	7230	24600
18	9020	8470	e7500	e7500	e5500	e5500	10100	6710	5100	3450	8640	24600
19	9090	8390	e7500	e7500	e5500	e5500	9580	6530	5020	3410	9570	26200
20	9050	8350	e7500	e7500	e5500	e5500	9060	6380	4980	3380	9790	30700
21	8730	8310	e7500	e7300	e5500	e5500	8280	6280	4860	3380	11600	37700
22	8440	8230	e7500	e7000	e5500	e5500	7840	6180	4810	3320	13100	42700
23	8090	8380	e7700	e7000	e5500	e5100	7540	6020	4770	3400	13600	43700
24	8090	8480	e8000	e7000	e5500	e5200	7310	5940	4690	3510	19500	41600
25	8200	8500	e7000	e7000	e5500	e5500	7040	5830	4690	3560	24800	39000
26	8250	8530	e5500	e7000	e5500	e5500	6890	5670	4740	3540	30800	37200
27	8350	8530	e6500	e7000	e5500	e5500	6420	5540	4630	3530	32200	35800
28	8390	8510	e7500	e7000	e5500	e5500	6090	5440	4590	3500	31600	34800
29	8350	8430	e7500	e7000	e5500	e5500	5970	5380	4470	3420	30800	34100
30	8320	8410	e7500	e7000	---	e5500	5880	5320	4310	3400	30900	33400
31	7990	---	e7500	e7000	---	5010	---	5260	---	3420	30500	---
TOTAL	289330	246600	231150	220800	167800	169110	275310	189700	144490	110780	375340	918700
MEAN	9333	8220	7456	7123	5786	5455	9177	6119	4816	3574	12110	30620
MAX	12400	8530	8380	7500	7000	5900	16800	7120	5200	4230	32200	43700
MIN	7990	7640	5500	4000	5000	5000	4400	5260	4310	3320	3420	24600
AC-FT	573900	489100	458500	438000	332800	335400	546100	376300	286600	219700	744500	1822000
CFSM	.48	.42	.38	.37	.30	.28	.47	.32	.25	.18	.62	1.58
IN.	.55	.47	.44	.42	.32	.32	.53	.36	.28	.21	.72	1.76

CAL YR 1987 TOTAL 2820670 MEAN 7728 MAX 17200 MIN 2850 AC-FT 5595000 CFSM .40 IN. 5.41
WTR YR 1988 TOTAL 3339110 MEAN 9123 MAX 43700 MIN 3320 AC-FT 6623000 CFSM .47 IN. 6.40

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 1987 TO SEPTEMBER 1988

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 AIR (DEG C) (00020)	TEMPER-ATURE WATER (DEG C) (00010)	TUR-BID-ITY (NTU) (00076)
OCT										
19...	1400	--	9180	79	84	7.5	7.8	5.0	6.0	19
JAN										
11...	1115	7500	--	--	102	7.3	7.7	-15.0	0.5	1.6
FEB										
29...	1100	5500	--	95	112	7.3	7.4	-8.0	1.0	0.60
APR										
04...	1115	--	5350	110	114	6.9	8.0	3.5	2.0	1.9
MAY										
16...	1245	--	7230	130	117	7.5	7.7	11.0	12.5	1.2
AUG										
08...	1330	--	3980	121	120	7.1	7.4	25.0	23.0	1.9

DATE	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)	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)
OCT										
19...	731	10.9	410	K5	8.6	2.5	3.7	0.80	26	28
JAN										
11...	765	14.2	K4	K14	11	3.3	4.3	1.0	40	36
FEB										
29...	774	11.2	40	K18	12	3.5	4.9	1.0	35	39
APR										
04...	757	11.0	K540	>400	9.2	2.9	4.8	1.9	34	37
MAY										
16...	770	9.6	K14	K6	13	4.1	4.5	0.90	43	41
AUG										
08...	774	6.9	26	60	12	3.8	7.1	0.90	36	38

DATE	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)	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)
OCT									
19...	0	32	4.8	2.9	0.1	1.4	48	<0.01	<0.10
JAN									
11...	0	49	15	4.7	0.1	2.9	75	0.02	<0.10
FEB									
29...	0	43	12	5.8	0.1	3.7	71	<0.01	0.10
APR									
04...	0	41	16	7.3	0.1	3.1	75	0.01	0.17
MAY									
16...	0	52	17	5.8	0.2	2.2	83	<0.01	<0.10
AUG									
08...	0	43	11	8.7	0.1	2.1	92	<0.01	<0.10

LAKE OF THE WOODS BASIN

05133500 RAINY RIVER AT MANITOU RAPIDS, MN--Continued

WATER QUALITY DATA, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

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)	SEDIMENT, SUSPENDED (MG/L) (80154)	SEDIMENT, DISCHARGE, SUSPENDED (T/DAY) (80155)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM (70331)
OCT 19...	0.01	<0.01	0.70	0.02	0.01	<0.01	10	248	86
JAN 11...	0.02	0.02	0.50	0.02	0.01	<0.01	5	101	85
FEB 29...	0.05	0.05	0.70	0.02	0.02	0.02	2	30	60
APR 04...	0.05	0.05	0.60	0.05	0.05	0.04	13	188	96
MAY 16...	0.08	0.05	0.90	0.03	0.02	<0.01	14	273	90
AUG 08...	0.09	0.06	0.60	0.04	0.04	0.02	--	--	--

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 19...	1400	40	<1	18	<0.5	<1	<1	<3	2	70	<5
FEB 29...	1100	80	<1	19	<0.5	<1	<1	<3	2	68	<5
APR 04...	1115	30	<1	16	<0.5	<1	<1	<3	2	91	<5
AUG 08...	1330	40	<1	18	<0.5	<1	<1	<3	4	59	<5

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 19...	<4	6	<0.1	<10	3	2	1.0	24	<6	5
FEB 29...	<4	10	3.9	<10	5	<1	<1.0	31	<6	16
APR 04...	<4	22	0.2	<10	1	<1	1.0	27	<6	6
AUG 08...	<4	20	<0.1	<10	2	<1	<1.0	35	<6	21

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, 62.36 ft, Sept. 12, 1978; 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, 60.13 ft, Sept. 11; maximum daily, 59.76 ft, Sept. 28; minimum, 57.10 ft, May 7; minimum daily, 57.41 ft, Mar. 18.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	58.61	58.64	58.44	58.14	57.85	57.48	57.47	57.82	58.04	57.95	58.20	58.36
2	58.83	58.59	58.44	---	57.87	57.46	57.46	57.81	58.11	57.89	58.14	58.46
3	58.33	58.55	58.41	---	57.83	57.45	57.48	57.87	58.10	57.86	57.98	58.62
4	58.27	58.44	58.41	---	57.82	57.43	57.57	57.88	58.09	57.95	58.06	58.77
5	58.54	58.45	58.42	---	57.78	57.43	57.52	57.93	58.06	58.10	57.99	58.64
6	58.81	58.56	58.39	---	57.81	57.42	57.52	57.99	58.02	58.17	57.95	58.56
7	58.70	58.56	58.39	---	57.78	57.48	57.56	57.83	58.05	58.18	57.86	58.46
8	58.69	58.63	58.36	---	57.79	57.47	57.61	58.01	58.37	58.18	58.02	58.42
9	58.77	58.54	58.33	---	57.76	57.45	57.55	58.10	58.05	58.16	57.85	58.34
10	58.40	58.41	58.35	---	57.75	57.47	57.59	57.97	57.90	58.25	57.75	58.86
11	58.41	58.40	58.30	58.05	57.76	57.48	57.62	58.00	57.89	58.26	57.98	59.26
12	58.62	58.49	58.32	58.03	57.75	57.46	57.64	57.90	57.96	58.21	57.98	58.85
13	58.45	58.52	58.33	58.02	57.75	57.44	57.66	57.95	58.03	58.05	58.01	58.69
14	58.52	58.58	58.33	58.03	57.71	57.43	57.69	57.82	58.06	58.25	57.97	58.88
15	58.74	58.52	58.33	58.03	57.72	57.43	57.72	57.92	58.08	58.27	57.93	58.94
16	58.79	58.67	58.32	57.99	57.70	57.43	57.74	57.95	58.13	58.17	58.19	59.02
17	58.55	58.74	58.34	58.00	57.71	57.42	57.74	57.89	57.92	58.20	58.30	59.04
18	58.36	58.11	58.30	58.02	57.70	57.41	57.75	57.86	57.94	58.15	58.11	59.27
19	58.52	58.38	58.30	57.98	57.63	57.42	57.76	57.92	58.00	58.17	57.98	59.39
20	58.65	58.46	58.27	57.97	57.62	57.42	57.77	57.98	58.06	58.22	58.16	59.35
21	58.63	58.47	58.27	57.98	57.63	57.43	57.78	58.09	57.99	58.18	58.10	59.24
22	58.70	58.53	58.26	57.94	57.57	57.43	57.80	57.99	58.12	58.14	57.89	59.14
23	58.63	58.57	58.25	57.97	57.56	57.43	57.81	58.01	58.14	58.05	57.71	59.20
24	58.65	58.54	58.25	57.94	57.56	57.48	57.82	58.12	57.92	58.16	57.95	59.39
25	58.41	58.52	58.23	57.92	57.57	57.44	57.79	57.78	58.01	58.11	58.02	59.50
26	58.46	58.46	58.21	57.92	57.53	57.46	57.83	57.99	58.06	58.05	58.02	59.67
27	58.58	58.47	58.21	57.91	57.55	57.52	57.84	57.99	58.05	58.17	58.00	59.68
28	58.60	58.47	58.19	57.93	57.49	57.51	57.84	58.02	58.52	58.09	58.12	59.76
29	58.50	58.48	58.21	57.90	57.52	57.47	57.86	58.01	58.22	58.15	58.23	59.62
30	58.66	58.48	58.18	57.89	---	57.46	57.86	58.05	58.07	58.12	58.29	59.45
31	58.59	---	58.14	57.85	---	57.46	---	58.02	---	58.08	58.34	---
MEAN	58.58	58.51	58.31	---	57.69	57.45	57.69	57.95	58.07	58.13	58.03	59.03
MAX	58.83	58.74	58.44	---	57.87	57.52	57.86	58.12	58.52	58.27	58.34	59.76
MIN	58.27	58.11	58.14	---	57.49	57.41	57.46	57.78	57.89	57.86	57.71	58.34

CAL YR 1987 MEAN 58.42 MAX 59.11 MIN 57.75
WTR YR 1988 MAX 59.76 MIN 57.41

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, 62.12 ft, July 3, 1985; 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, 59.98 ft, Sept. 11; maximum daily, 59.77 ft, Sept. 28; minimum, 57.42 ft, Mar. 17, 18, 19, 20, 22, 25; minimum daily, 57.43 ft, Mar. 18, 19, 20.

GAGE HEIGHT, FEET, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	58.55	58.66	58.46	58.17	57.87	57.52	57.49	57.96	58.11	57.97	58.25	58.37
2	58.78	58.62	58.45	58.18	57.89	57.50	57.52	57.94	58.17	57.92	58.19	58.45
3	58.36	58.59	58.44	58.12	57.85	57.50	57.49	57.95	58.16	57.93	58.05	58.60
4	58.33	58.45	58.43	58.10	57.84	57.49	57.51	57.93	58.14	57.97	58.13	58.72
5	58.54	58.50	58.44	58.09	57.81	57.47	57.50	57.95	58.13	58.13	58.05	58.63
6	58.78	58.57	58.41	58.10	57.83	57.47	57.50	58.04	58.10	58.16	58.02	58.58
7	58.69	58.56	58.41	58.09	57.81	57.51	57.55	58.04	58.12	58.18	57.94	58.52
8	58.73	58.60	58.41	58.07	57.81	57.53	57.60	58.04	58.41	58.21	58.03	58.43
9	58.72	58.54	58.38	58.08	57.78	57.50	57.54	58.07	58.09	58.20	57.89	58.35
10	58.42	58.45	58.39	58.07	57.76	57.51	57.58	57.98	57.95	58.26	57.82	58.81
11	58.40	58.43	58.31	58.06	57.77	57.55	57.61	58.03	57.97	58.29	57.98	59.20
12	58.60	58.50	58.32	58.04	57.77	57.51	57.66	57.91	58.00	58.27	57.99	58.82
13	58.52	58.53	58.34	58.04	57.77	57.48	57.66	58.03	58.04	58.10	58.01	58.70
14	58.52	58.61	58.35	58.06	57.75	57.45	57.68	57.94	58.06	58.30	57.97	58.88
15	58.72	58.56	58.36	58.05	57.74	57.45	57.72	57.96	58.08	58.32	57.95	58.95
16	58.77	58.64	58.35	58.03	57.73	57.44	57.76	57.95	58.12	58.23	58.15	59.02
17	58.58	58.70	58.37	58.05	57.71	57.44	57.74	---	57.96	58.24	58.24	59.04
18	58.36	58.22	58.36	58.06	57.70	57.43	57.75	57.94	57.98	58.20	58.09	59.22
19	58.51	58.41	58.35	58.03	57.70	57.43	57.76	57.96	58.01	58.25	57.99	59.31
20	58.63	58.49	58.31	58.02	57.65	57.43	57.77	57.99	58.07	58.23	58.16	59.33
21	58.66	58.51	58.31	58.03	57.68	57.45	57.77	58.07	58.02	58.22	58.15	59.26
22	58.75	58.55	58.31	57.98	57.64	57.46	57.80	57.99	58.10	58.24	57.91	59.16
23	58.66	58.58	58.30	58.00	57.58	57.44	57.81	58.00	58.15	58.17	57.73	59.22
24	58.65	58.56	58.28	57.99	57.57	57.48	57.84	58.12	57.99	58.24	57.95	59.41
25	58.46	58.54	58.27	57.97	57.59	57.46	57.81	57.94	58.01	58.20	58.00	59.51
26	58.49	58.48	58.25	57.95	57.57	57.48	57.83	58.05	58.05	58.13	58.03	59.68
27	58.57	58.48	58.24	57.94	57.57	57.53	57.85	58.06	58.10	58.24	58.00	59.67
28	58.61	58.48	58.24	57.96	57.55	57.54	57.87	58.10	58.51	58.16	58.11	59.77
29	58.53	58.50	58.24	57.96	57.55	57.48	57.89	58.11	58.24	58.20	58.23	59.64
30	58.66	58.49	58.21	57.94	---	57.47	57.91	58.15	58.08	58.20	58.30	59.50
31	58.62	---	58.19	57.88	---	57.48	---	58.13	---	58.14	58.36	---
MEAN	58.59	58.53	58.34	58.04	57.72	57.48	57.69	---	58.10	58.18	58.05	59.02
MAX	58.78	58.70	58.46	58.18	57.89	57.55	57.91	---	58.51	58.32	58.36	59.77
MIN	58.33	58.22	58.19	57.88	57.55	57.43	57.49	---	57.95	57.92	57.73	58.35

CAL YR 1987 MEAN 58.39 MAX 58.91 MIN 57.87
WTR YR 1988 MAX 59.97 MIN 57.43

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 discharge at low-flow partial-record stations and the second 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 third table.

Low-flow partial-record stations

Measurements of streamflow in the area covered by this report made at low-flow partial-record stations are given in the following table. These measurements were made during periods of base flow when streamflow is primarily from ground-water storage. These measurements, when correlated with the simultaneous discharge of a nearby stream when continuous records are available, will give a picture of the low-flow potentiality of a stream. The column headed "Period of record" shows the water years in which measurements were made at the same, or practically the same site.

Discharge measurements made at low-flow partial-record stations during water year 1988

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Red River of the North				
05030300	Otter Tail River near Richville, Minn.	Lat 46°30'48", long 95°31'04", in SW¼SE¼ sec.7, T.135 N., R.38 W., Otter Tail County, Hydrologic Unit 09020103, at bridge on County Highway 14, 5 miles east of Richville.	765	1963, 1970-74, 1976-77, 1988	7-7-88	37.2
05030401	Otter Tail River at Otter Tail Lake outlet near Amor, Minn.	Lat 46°21'34", long 95°44'00", in NE¼SW¼ sec.4, T.133 N., R.40 W., Otter Tail County, Hydrologic Unit 09020103, at bridge on County Highway 72, 4 miles south of Amor.	1,160	1933, 1935-36, 1968, 1970-74, 1976-77, 1988	7-7-88	91.9
05040500	Pelican River near Fergus Falls, Minn.	Lat 46°20'10", long 96°07'10", in NE¼ sec.17, T.133 N., R.43 W., Otter Tail County, Hydrologic Unit 09020103, on left bank 990 feet downstream from bridge on U.S. Highway 52, 3 miles northwest of Fergus Falls, and 7.5 miles upstream from mouth.	482	1909-12, 1942-80#, 1988	7-20-88	9.67
05046000	Otter Tail River below Orwell Dam, near Fergus Falls, Minn.	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 mile downstream from Orwell Dam, 6.1 miles downstream from Dayton Hallow Dam, 8 miles southwest of Fergus Falls, and 11.1 miles downstream from Pelican River.	1,830	1930-88#	7-7-88	83.4
05046900	Mustinka River near Elbow Lake, Minn.	Lat 45°54'19", long 96°02'23", on line between secs.11 and 14, T.128 N., R.43 W., Grant County, Hydrologic Unit 09020102, at bridge on County Highway 8, 6.7 miles southwest of Elbow Lake.	a120	1964-66, 1970, 1973-74, 1988	7-21-88	.03
05049000	Mustinka River above Wheaton, Minn.	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, 1 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#, 1985-88+	7-21-88	0

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measurements made at low-flow partial-record stations during water year 1988--Continued

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Red River of the North--Continued				
05051500	Red River of the North at Wahpeton, N. Dak.	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 feet downstream from confluence of Bois de Sioux and Otter Tail Rivers and at mile 548.6.	4,010	1942-88#	7-7-88	84.3
05051520	Whiskey Creek near Kent, Minn.	Lat 46°24'41", long 96°39'32", in SE¼SE¼ sec.13, T.134 N., R.48 W., Wilkin County, Hydrologic Unit 09020104, at double pipe-arch culvert on County Highway 20, 1.7 miles southeast of Kent.	80	1964-66, 1970-74, 1976, 1988	7-21-88	0
05051525	Wolverton Creek at Comstock, Minn.	Lat 46°39'59", long 96°44'13", in NE¼NE¼ sec.21, T.137 N., R.48 W., Clay County, Hydrologic Unit 09020104, at bridge on county road, 1 mile northeast of Comstock.	70	1964-66, 1970-73, 1976, 1988	7-21-88	0
05061000	Buffalo River near Hawley, Minn.	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 land, 2 miles southwest of Hawley.	322	1945-88#	7-20-88	9.25
05061020	Buffalo River near Glyndon, Minn.	Lat 46°53'59", long 96°36'34", in SW¼NW¼ sec.34, T.140 N., R.47 W., Clay County, Hydrologic Unit 09020106, at bridge on County Highway 68, 1.6 miles north of State Highway 10, 2.1 miles northwest of Glyndon.	-	1948, 1977-78, 1980, 1988	7-20-88	9.56
05061040	South Branch Buffalo River near Lawndale, Minn.	Lat 46°43'31", long 96°30'59", in SW¼SE¼ sec.30, T.136 N., R.46 W., Wilkin County, Hydrologic Unit 09020106, at bridge on County Highway 30, 7.2 miles directly west of Lawndale.	-	1978, 1980, 1988	7-21-88	0
05061080	Deerhorn Creek near Lawndale, Minn.	Lat 46°34'45", long 96°29'17", in NE¼SE¼ sec.20, T.136 N., R.46 W., Wilkin County, Hydrologic Unit 09020106, at bridge on county road, 1.2 miles west of State Highway 9, about 6 miles southwest of Barnesville, 6.4 miles northwest of Lawndale.	48.4	1970-73, 1976-78, 1988	7-21-88	3.91
05061100	South Branch Buffalo River near Barnesville, Minn.	Lat 46°39'35", long 96°34'57", in SW¼SW¼ sec.23, T.137 N., R.47 W., Clay County, Hydrologic Unit 09020106, at bridge on County Highway 2, 4 miles south of Baker, 7.4 miles west of Barnesville.	185	1964-66, 1970-73, 1976-77, 1988	7-20-88	0
05061200	Whiskey Creek at Barnesville, Minn.	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#, 1967-88+	7-20-88	0
05061400	Spring Creek above Downer, Minn.	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	1961-88+	7-20-88	<.01

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measurements made at low-flow partial-record stations during water year 1988--Continued

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Red River of the North--Continued				
05061490	Stony Creek near Sabin, Minn.	Lat 46°44'48", long 96°36'26", in SW¼SW¼ sec.22, T.138 N., R.47 W., Clay County, Hydrologic Unit 09020106, at bridge on County Road 65, 3 miles southeast of Sabin.	145	1964-66, 1970-73, 1976-78, 1988	7-20-88	0
05061500	South Branch Buffalo River at Sabin, Minn.	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 mile downstream from Stony Creek, 1 mile east of Sabin.	522	1945-88#	7-20-88	0
05062000	Buffalo River near Dilworth, Minn.	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 miles southeast of Kragnes, 6.5 miles northeast of Dilworth, and 9 miles downstream of South Branch.	1,020	1931-88#	7-20-88	6.15
05062900	Wild Rice River above Ada, Minn.	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.	1,050	1945-51, 1965-72, 1975-76, 1978-70, 1988	7-28-88	5.92
05073560	Shotley Brook near Shotley, Minn.	Lat 48°04'38", long 94°35'05", in NW¼NE¼ sec.14, T.153 N., R.31 W., Beltrami County, Hydrologic Unit 09020302, at bridge on County Highway 23, 2 miles upstream from mouth, 3.2 miles northeast of Shotley.	a75	1964-67, 1970-73, 1976, 1980, 1988	7-27-88	.12
05086000	Snake River at Alvarado, Minn.	Lat 48°11'50", long 97°00'20", in NE¼NE¼ sec.6, T.154 N., R.49 W., Marshall County, Hydrologic Unit 09020309, at bridge on State Highway 1, at west edge of Alvarado.	a309	1945-46, 1948-51, 1978-80, 1983, 1986, 1988	8-11-88	0
05090500	Tamarac River near Strandquist, Minn.	Lat 48°25'30", long 96°37'40", in NE¼NE¼ sec.18, T.157 N., R.46 W., Marshall County, Hydrologic Unit 09020311, at County Highway 1, 1.2 miles south of Florian, 9 miles southwest of Strandquist.	-	1953-56#, 1963, 1983, 1987-88	8-11-88	0
05095000	Two Rivers at Hallock, Minn.	Lat 48°46'30", long 96°55'52", in SE¼SE¼ sec.12, T.161 N., R.49 W., Kittson County, Hydrologic Unit 09020312, at bridge on State Highway 175 at east edge of Hallock 0.2 mile downstream from South Branch Two Rivers.	625	1911-14#, 1929-30#, 1941-43#, 1967-70, 1976, 1978-80, 1987-88	10-21-87 8-11-88	.05 .13
05096500	State Ditch 85 near Lancaster, Minn.	Lat 48°52'02", long 96°40'01", in SW¼SW¼ sec.6, T.162 N., R.46 W., Kittson County, Hydrologic Unit 09020312, at bridge on County Highway 4, 1.3 miles upstream from mouth, 6.5 miles northeast of Lancaster.	-	1928, 1929-38#, 1942-55#, 1987-88	10-21-87 8-11-88	0 0
05102600	Joe River near Noyes, Minn.	Lat 48°59'30", long 97°07'43", in NW¼NW¼ sec.34, T.164 N., R.50 W., Kittson County, Hydrologic Unit 09020311, 1.1 miles upstream of Minnesota-Canadian border, 3.5 miles east of Junction of U.S. Highway 75 and County Road 16, on township road.	-	1984, 1987-88	10-21-87 8-11-88	0 0

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measurements made at low-flow partial-record stations during water year 1988--Continued

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Red River of the North--Continued				
05105000	Roseau River at Roseau, Minn.	Lat 48°51'53", long 95°45'38", in SE¼SW¼ sec.13, T.162 N., R.40 W., Roseau County, Hydrologic Unit 09020314, at dam 0.2 mile downstream from State Highway 11.	-	1911-14, 1943, 1967-70, 1978-79, 1987-88	8-9-88	.34
05106000	Sprague Creek near Sprague, Manitoba	Lat 48°59'33", long 95°39'43", in NE¼ sec.34, T.164 N., R.39 W., Roseau County, Hydrologic Unit 09020314, on left bank 0.5 mile, south of international boundary, 3.5 miles south of Sprague, Manitoba, 8 miles upstream from mouth, 10.5 miles northeast Roseau.	176	1928-81#, 1988	8-9-88	.78
05107500	Roseau River at Ross, Minn.	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 feet downstream from highway bridge, 0.2 mile north of Ross, and 2.3 miles downstream from Pine Creek.	1,220	1928-88#	8-11-88	3.0*
05110500	Roseau River at head of state ditch 51, near Oak Point, Minn.	Lat 48°56'53", long 96°22'56", in NE¼NE¼ sec.18, T.163 N., R.44 W., Roseau County, Hydrologic Unit 09020314, at head of state ditch 51 (known locally as Caribou cut-off ditch), 2 miles southeast of Oak Point.	-	1933, 1941, 1986-88	8-9-88	7.39
		Lake of the Woods basin				
05131500	Little Fork River at Littlefork, Minn.	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 mile upstream from bridge on State Highway 217, 2.8 miles upstream from Beaver Creek, and 19 miles upstream from mouth.	1,730	1909-19, 1928-88#	7-26-88	45*
05131600	Bowstring River near Talmoon, Minn.	Lat 47°32'12", long 93°47'45", in SE¼NE¼ sec.23, T.147 N., R.25 W., Itasca County, Hydrologic Unit 09030006, at bridge on State Highway 6, 0.4 mile south of Bowstring, 4.5 miles south of Talmoon.	90.2	1969-72, 1975-76, 1980, 1988	7-19-88	.34
05131770	Gale Brook near Big Fork, Minn.	Lat 47°43'22", long 93°39'26", in NE¼NW¼ sec.4, T.60 N., R.26 W., Itasca County, Hydrologic Unit 09030006, at culvert on County Highway 7, 1.5 miles south of Bigfork.	27.8	1969-72, 1975-76, 1980, 1988	7-19-88	.01
05131900	Caldwell Brook at Caldwell Road near Effie, Minn.	Lat 47°57'15", long 93°52'54", in NW¼SW¼ sec.29, T.152 N., R.25 W., Koochiching County, Hydrologic Unit 09030006, at bridge on Caldwell Road, 12 miles northwest of Effie.	122	1969-72, 1975-76, 1980, 1988	7-19-88	0.12
05132000	Big Fork River at Big Falls, Minn.	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 town of Big Falls, 700 feet downstream from falls, 0.3 mile downstream from bridge on U.S. Highway 71, and 4.8 miles upstream from Sturgeon River.	1,460	1909-12, 1928-79#, 1979-82+, 1982-88#	7-19-88	57*

"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Discharge measurements made at low-flow partial-record stations during water year 1988--Continued

Station no.	Station name	Location	Drainage area (mi^2)	Period of record	Measurements Date	Measurements Discharge (ft^3/s)
		Lake of the Woods basin--Continued				
05132200	Sturgeon River near Big Falls, Minn.	Lat 48°12'57", long 93°55'54", in NE¼SE¼ sec.26, T.155 N., R.26 W., Koochiching County, Hydrologic Unit 09030006, at bridge on County Highway 30, 6.2 miles northwest of Big Falls.	a280	1969-72, 1975-76, 1980, 1988	7-19-88	4.31
05132400	Bear River near Littlefork, Minn.	Lat 48°24'13", long 93°41'21", in SE¼SW¼ sec.4, T.68 N., R.26 W., Koochiching County, Hydrologic Unit 09030006, at bridge on County Highway 1, 5.5 miles west of Littlefork.	105	1969-72, 1975-76, 1980, 1988	7-26-88	0.34
05132900	Black River near Loman, Minn.	Lat 48°27'19", long 93°49'38", in SW¼SE¼ sec.34, T.158 N., R.25 W., Koochiching County, Hydrologic Unit 09030004, at end of county road near farm house, 4 miles southwest of Loman.	a280	1970-72, 1975-76, 1980, 1988	7-26-88	6.16
05133200	West Fork Black River near Loman, Minn.	Lat 48°31'37", long 93°49'54", in SE¼SW¼ sec.3, T.158 N., R.25 W., Koochiching County, Hydrologic Unit 09030004, at bridge on County Highway 82, 1.6 miles northwest of Loman.	a288	1969-72, 1975-76, 1980, 1988	7-26-88	3.37
05134200	Rapid River near Baudette, Minn.	Lat 48°32'10", long 94°33'45", in SE¼NE¼ sec.1, T.158 N., R.31 W., Lake of the Woods County, Hydrologic Unit 09030007, on left bank 20 feet upstream from bridge on State Highway 72, 1.2 miles downstream from North Branch Rapid River, 12 miles south of Baudette.	543	1956-85# 1988	7-27-88	9.90
05136000	Baudette River near Baudette, Minn.	Lat 48°39'25", long 94°37'23", in SW¼SW¼ sec.22, T.160 N., R.31 W., Lake of the Woods County, Hydrologic Unit 09030008, at bridge on county road, 4 miles southwest of Baudette.	45.6	1969-72, 1975-76, 1980, 1988	7-26-88	0.04
05137000	Winter Road River near Baudette, Minn.	Lat 48°42'51", long 94°41'50", in SE¼SE¼ sec.36, T.161 N., R.32 W., Lake of the Woods County, Hydrologic Unit 09030008, at bridge on old State Highway 11, 4.5 miles west of Baudette.	145	1969-72, 1975-76, 1980, 1988	7-26-88	1.96

Operated as a continuous record site.
+ Operated as a high-flow partial record site.
* Discharge from stage/discharge rating for station.
a Approximately.
< Less than.

HIGH-FLOW PARTIAL-RECORD STATIONS

Baptism River near Beaver Bay


Lake of the Woods
Rainy River
International Falls
Red River
Upper Red Lake
Lower Red Lake
Grand Rapids
Superior
Lake
Duluth
Moorhead
Mille Lacs Lake
5137000
5134100
5086900
5075700
5078400
5079901
5077700
5131878
5131750
5125550
5130300
5200445
5209200
5205200
5210200
5062900
5062500
5067050
5063200
5060800
4020480
4015200
4020700
4015300
4015250
4021690
4015370
5061400
5061200
5229450
5221020
5244200
5244440
5245800
5261520
5336200
4024095
5050700
5336550
5335170

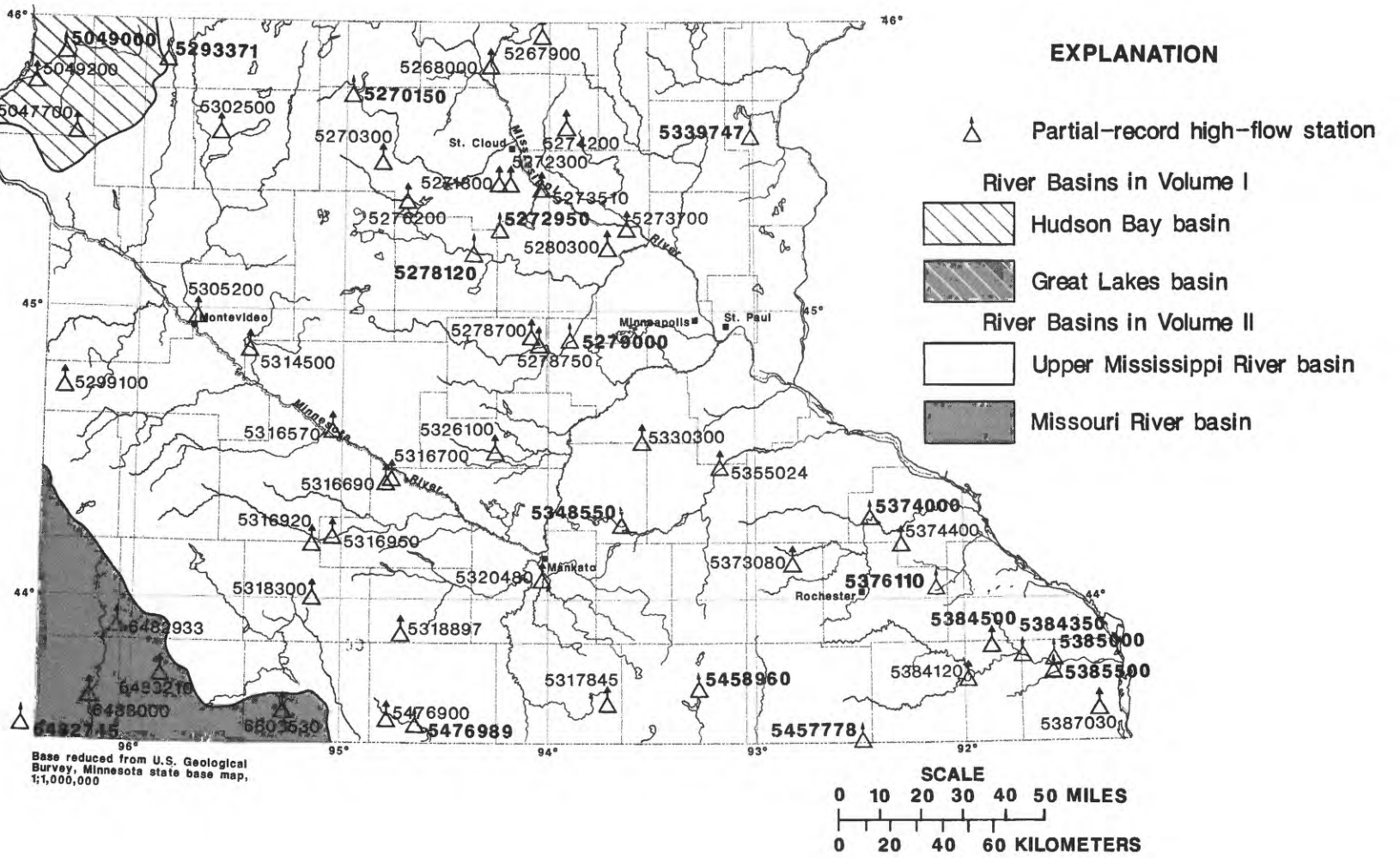


Figure 10.--Location of high-flow partial-record stations

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

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 1988

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.	-	1985-88	8-17-88	11.25	760
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.	.96	1960-88	7-3-83	7.22	b36
					6-10-84	a7.12	b35
					6-25-85	8.65	b74
					9-25-86	8.93	b81
					7-18-87	7.59	b45
					8-13-88	a8.26	b63
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	1965-88	8-13-88	6.31	380
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, 2.0 miles upstream from mouth, 2.7 miles north of Two Harbors.	5.54	1960-88	9-4-80	a10.10	b148
					6-3-81	a10.71	b200
					5-5-82	a9.94	b135
					10-6-82	a9.54	b100
					6-10-84	a9.64	b109
					6-25-85	a9.65	b110
					9-25-86	a9.68	b113
					5-18-87	a10.23	b160
					8-13-88	a10.30	165
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	1964-88	9-19-88	ac13.48	70
04020480	North Branch Whiteface River near Fairbanks, MN	Lat 47°22'20", long 91°56'28", at common corner of secs.35, 36, 1, and 2, along line between T.57 N., and 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	1979-88	5-9-88	ac11.85	100
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	1979-88	8-13-88	c13.80	250

"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 1988--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Date	Annual maximum Gage height (feet)	Discharge (ft^3/s)
		Streams tributary to Lake Superior--Continued					
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 04010201, at bridge on County Highway 2, 5.8 miles southeast of Toimi, 23 miles north of Two Harbors.	-	1986-88	8-14-88	7.00	500
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.	118	1972-88	5-9-88	10.23	1,150
		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 county highway, 6.0 miles northeast of Graceville.	3.37	1964-88	5-25-88	d6.94	9
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#, 1985-88	5- -88	e	<250
05049200	Eighteenmile Creek near Wheaton, MN	Lat 45°47'18", long 96°31'52", on west quarter of line between secs.24 and 25, T.127 N., R.47 W., Traverse County, Hydologic Unit 09020102, at culvert on County Highway 67, 1.4 miles upstream from mouth, 2.0 miles southwest of Wheaton.	68.5	1965-68, 1970-88	3- -88	e	<15
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	1979-88	3- -88	d11.23	<120
05060800	Buffalo River near Callaway, MN	Lat 47°01'17", long 95°54'43", in SW¼SE¼, 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	1960-88	4-3-80 3-30-81 7-10-82 7-4-83 6-8-84 5-12-85 4-14-86 3-8-87 4-2-88	d14.23 d13.18 13.05 16.85 12.70 17.13 13.21 d13.03 d14.01	b305 b38 b204 b600 b176 b635 f220 71 124
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#, 1967-88	5-7-88	a3.81	74

"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 1988--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					
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	1961-88	7-13-88	a6.15	15
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 0.8 mile northeast of village of Twin Valley.	888	1909-17#, 1930-83#, 1985-88	4-5-88	6.28	711
05062900	Wild Rice River near 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.	-	1985-88	4-5-88	d19.66	900
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 county highway, 2.0 miles northwest of Ogema.	4.99	1963-88	4-5-88	d7.47	37
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.	-	1985-88	3-26-88	11.92	43
05075700	Mud River near Grygla, MN	Lat 48°19'31", long 95°44'35", at common corner of secs.13, 14, 23, and 24, T.156 N., R.40 W., Hydrologic Unit 09020304, Marshall County, at bridge on State Highway 89, 6 miles west of Grygla.	170	1979-88	4-4-88	d14.62	450
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 bridge on County Highway 17, 4.0 miles upstream from mouth, 4.8 miles east of Gonvick.	45.2	1960-78#, 1979-85, 1986,# 1988	4-4-88	d5.20	165
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, 1.2 miles upstream from mouth, 5.3 miles southwest of Plummer.	6.51	1961-88	3-14-73	10.92	b27
					4-12-74	d13.24	b60
					4-28-75	a11.54	b37
					3-30-76	a11.42	b13
					9-27-77	e	b<17
					4-8-78	a11.96	b49
					4-24-79	a13.01	b94
					4-2-80	12.56	b71
					6-28-81	16.92	b420
					7-16-82	a11.80	b44
					5-13-83	a11.56	b37
					6-8-84	a12.02	b52
					5-12-85	a11.84	b45
					5-1-86	g15.73	b60
					5-27-87	a11.48	b35
					4-5-88	cg12.34	32
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 culvert on U.S. Highway 75, 0.75 mile northeast of Girard, 3 miles southwest of Crookston, 7 miles above mouth.	h111	1986-88	4-4-88	15.77	†

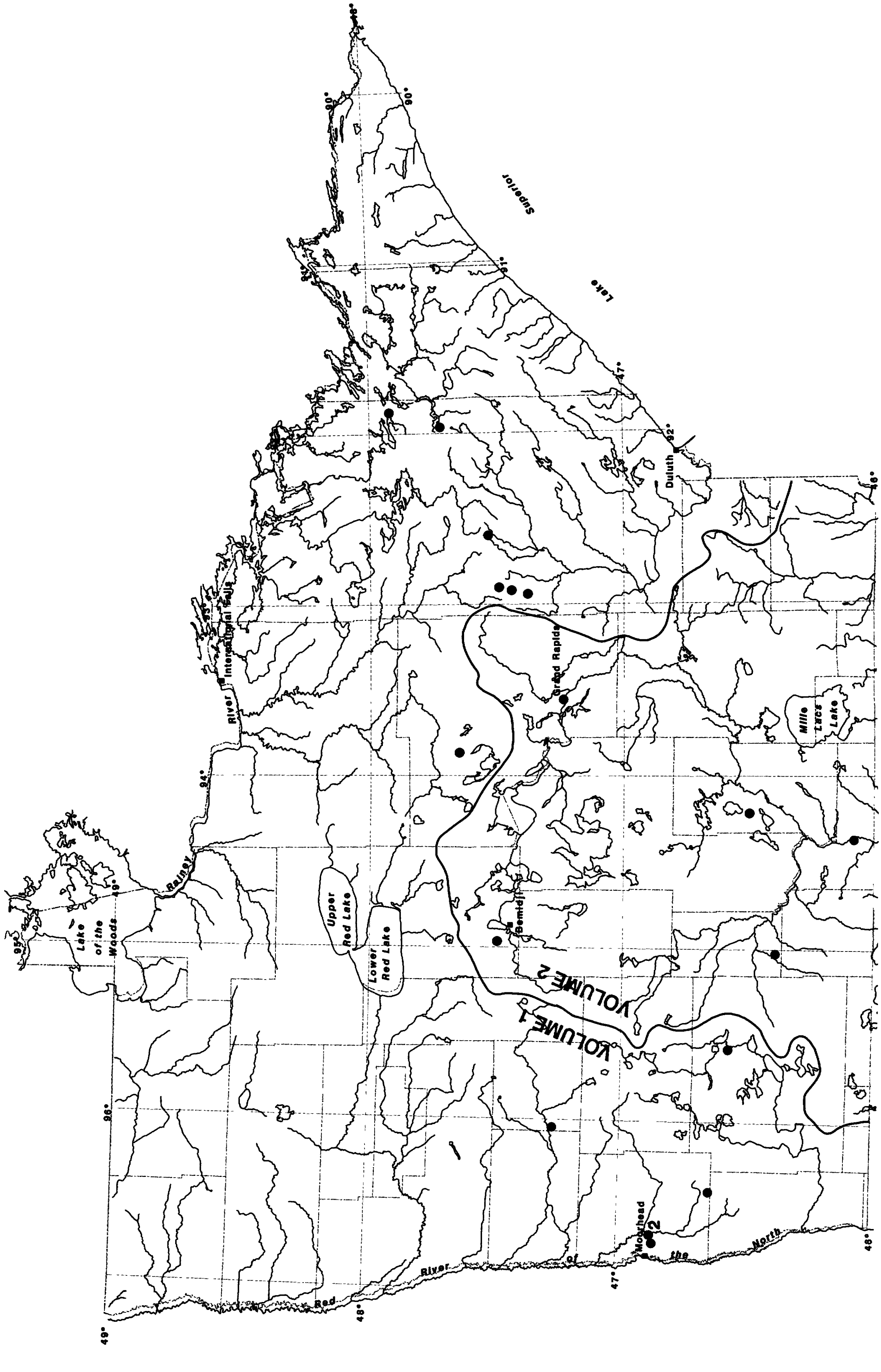
"See footnotes at end of the table."

DISCHARGE AT PARTIAL-RECORD STATIONS AND MISCELLANEOUS SITES

Annual maximum discharge at high-flow partial-record stations during water year 1988--Continued

Station No.	Station name	Location	Drainage area (mi^2)	Period of Record	Annual maximum Date	Gage height (feet)	Discharge (ft^3/s)
		Red River of the North basin--Continued					
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	1979-88	4-4-88	ad13.64	100
		Lake of the Woods basin					
05125550	Stony River near Babbitt, MN	Lat 47°41'39", long 91°45'38", in SW¼SW¼ sec.8, T.60 N., R.11 W., Lake County, Hydrologist Unit 09030001, in Superior National Forest, at bridge on Forest Route 424, 4.7 miles upstream from mouth, 8.5 miles southeast of Babbitt.	219	1975-80#, 1986-88	8-17-88	6.63	1,090
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	1959-88	8-13-88	c12.66	110
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	1973-88	4-10-88	d12.60	1,000
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, on left downstream wing wsll of bridge on State Highway 6, 2.4 miles upstream from mouth, 7.0 miles west of Craigville.	25.0	1979-88	4-8-88	d12.76	110
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.	-	1986-88	4-8-88	d7.00	150
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 No. 11, 4.5 miles west of Baudette, 1.8 miles east of Pitt, 5 miles upstream of mouth.	-	1986-88	3-31-86 3-25-87 4-8-88	14.3 9.41 dh8.2	b1,400 b336 100

< Less than, peak stage unknown, discharge estimated.
Operated as a continuous-record gaging station.
† Discharge not determined.
a Not annual maximum gage height.
b Not published previously.
c Affected by shifting control.
d Backwater from ice, discharge estimated.
e Peak stage did not reach bottom of pipe.
f Revised
g Affected by Beaver Dam.
h Approximate.


Lake Superior
Duluth
International Falls
Rainy River
Lake of the Woods
Upper Red Lake
Lower Red Lake
Grand Rapids
Mille Lacs Lake
Bemidji
VOLUME 2
VOLUME 1
Moorhead
2
Red River of the North
90°
91°
92°
93°
94°
95°
96°
46°
47°
48°
49°

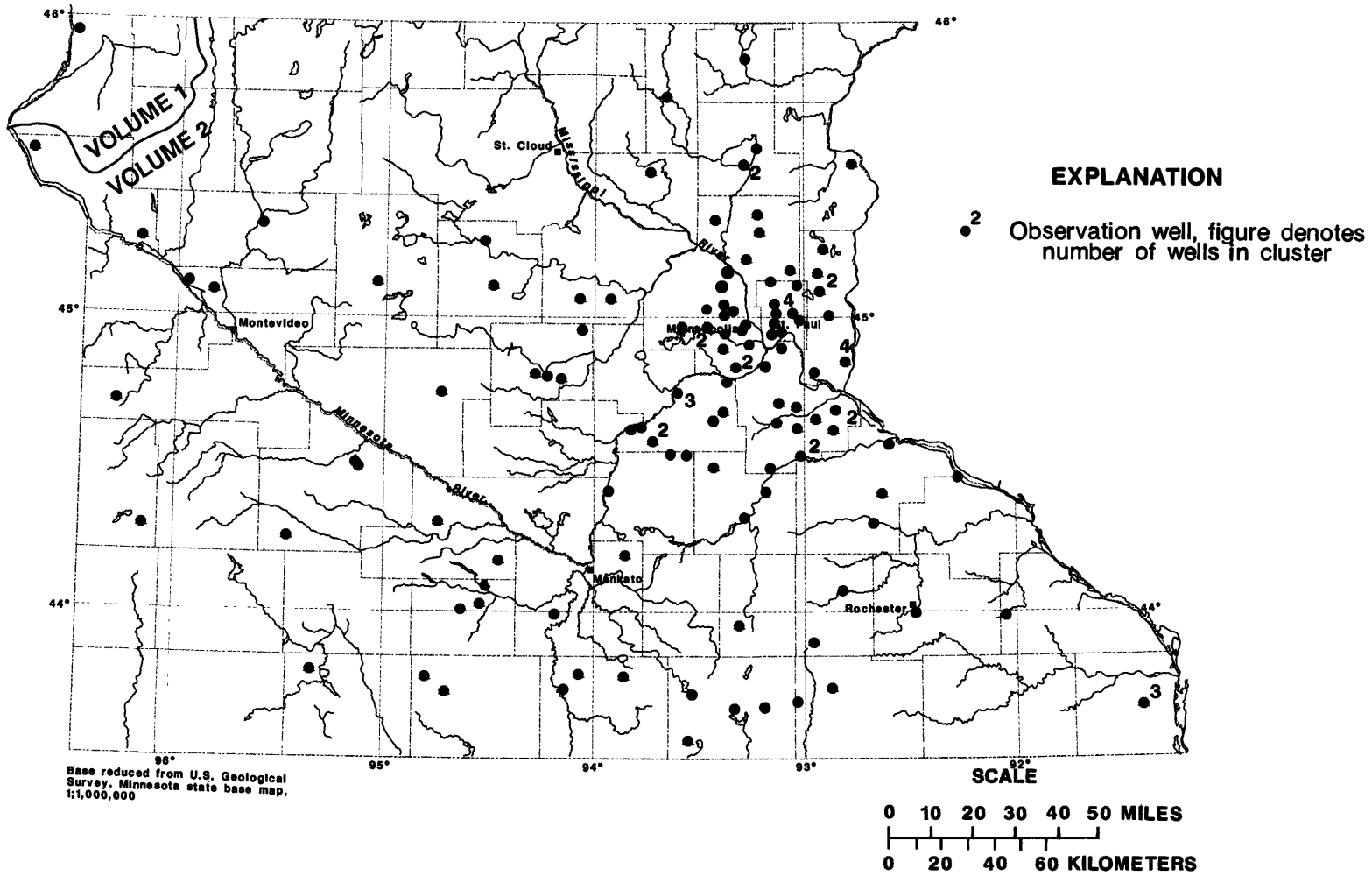


Figure 11.--Location of ground-water wells

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.
WELL 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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 02	8.00	Nov. 27	8.03	Jan. 29	8.10	Apr. 08	7.94	Jun. 10	7.87	Aug. 26	8.65
09	8.00	Dec. 04	8.04	Feb. 12	8.17	15	7.95	17	7.85	Sep. 02	8.70
16	7.93	11	8.00	19	8.10	22	7.90	24	8.00	09	8.75
23	7.94	18	8.00	26	8.20	29	7.87	Jul. 01	8.18	16	8.79
31	7.97	24	8.02	Mar. 05	8.10	May 06	7.83	15	8.35	23	8.80
Nov. 06	7.96	Jan. 08	8.10	11	8.00	13	7.80	29	8.54	30	8.79
13	7.97	15	8.00	18	8.00	20	7.75	Aug. 05	8.60		
20	8.02	22	8.10	25	7.91	27	7.65	19	8.60		

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 15	29.99	Feb. 24	29.94	Jun. 27	31.70	Sep. 26	32.50
Dec. 10	30.61	Apr. 20	30.42	Aug. 24	32.94		

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, 30.39 ft (9.26 m) below land-surface datum, Sept. 26, 1988.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 15	28.50	Feb. 24	28.15	Jun. 27	29.18	Sep. 26	30.39
Dec. 10	28.62	Apr. 20	28.75	Aug. 24	30.26		

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 15	126.49	Feb. 24	125.10	Jun. 27	128.56	Jul. 20	125.80	Aug. 24	125.79	Sep. 26	127.09
Dec. 10	124.38	Apr. 20	124.90								

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 03	6.64	Dec. 15	6.86	Mar. 01	7.04	Apr. 18	6.00	Jun. 20	7.03	Aug. 22	7.33

MAHNOMEN COUNTY

471653096020301. Local number, 144N42W20BBA01.
LOCATION.--Lat 47°16'53", long 96°02'03", in NE¼NW¼NW¼ sec.20, T.144 N., R.42 W., Hydrologic Unit 09020108, about 3 mi (4.8 km) southwest of Mahnomen.
Owner: Tom Wendt.
AQUIFER.--Buried sand of Pleistocene.
WELL CHARACTERISTICS.--Drilled unused artesian well, diameter 4 in. (0.10 m), depth 130 ft (39.6 m).
DATUM.--Altitude of land-surface datum is 1,197 ft (365 m). Measuring point: Top of casing, 1.60 ft (0.49 m) above land-surface datum.
PERIOD OF RECORD.--August 1964 to September 1969, August 1979 to current year.
EXTREMES FOR PERIOD OF RECORD.--Highest water level, 44.33 ft (13.28 m) below land-surface datum, May 22, 1986; lowest, 47.81 ft (14.57 m) below land-surface datum, Sept. 16, 1981.

WATER LEVEL, IN FEET BELOW LAND-SURFACE DATUM, WATER YEAR OCTOBER 1987 TO SEPTEMBER 1988

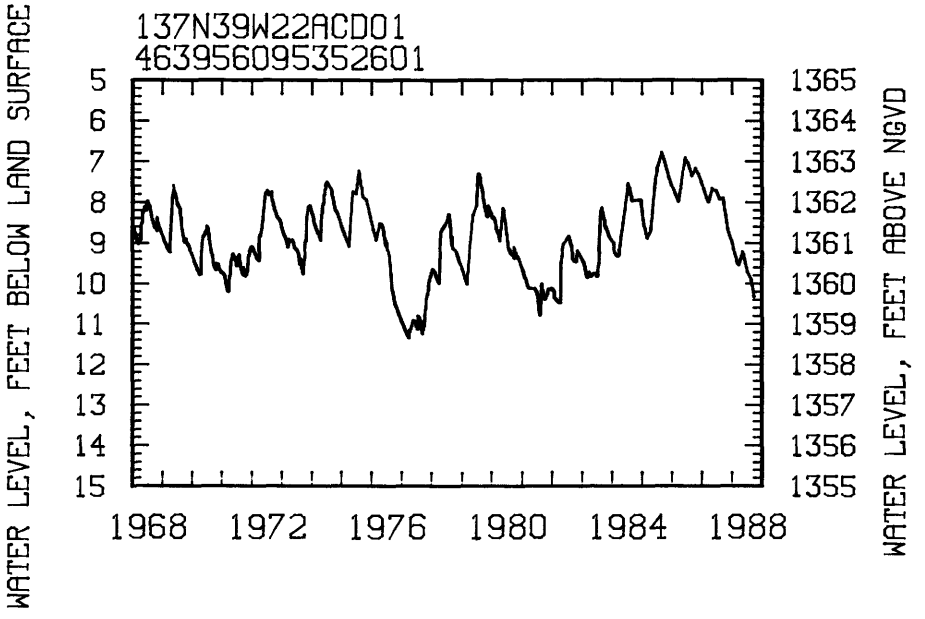
DATE	WATER LEVEL
Oct. 07	45.50

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 21	8.72	Dec. 15	9.04	Feb. 10	9.55	Mar. 23	9.47	Jun. 16	9.79	Sep. 07	10.40
Nov. 11	8.87	Jan. 12	9.32	Mar. 04	9.62	Apr. 22	9.28	Aug. 03	9.97		



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, 46.91 ft (14.30 m) below land-surface datum, Dec. 17, 1987; 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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 06	47.10	Jan. 28	46.93	Apr. 21	47.18	Aug. 26	47.25
Dec. 17	46.91	Mar. 03	47.08	Jun. 22	47.53		

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 06	4.65	Jan. 22	3.85	Apr. 20	3.14	Aug. 26	5.12
Dec. 17	4.07	Mar. 03	4.21				

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 05	13.59	Jan. 22	13.52	Apr. 20	13.75	Aug. 25	13.22
Dec. 16	13.58	Mar. 03	14.88	Jun. 22	14.43		

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 1987 TO SEPTEMBER 1988

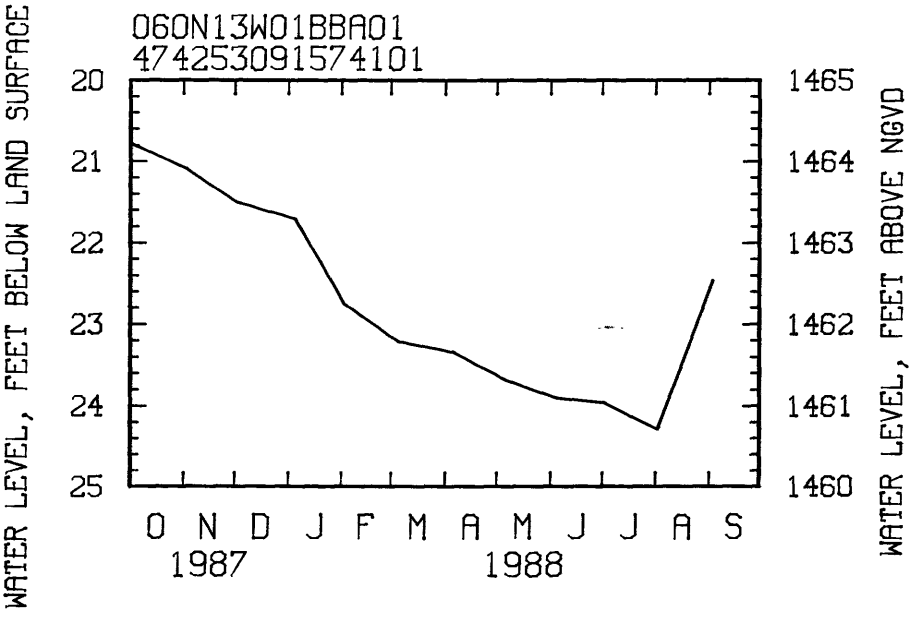
DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 05	3.73	Dec. 16	4.27	Apr. 21	2.80	Jun. 22	3.79	Aug. 26	2.04

ST. LOUIS COUNTY--Continued

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, 20.06 ft (6.11 m) below land-surface datum, Dec. 2, 1986; 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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Oct. 02	20.83	Dec. 01	21.54	Feb. 02	22.79	Apr. 05	23.38	Jun. 03	23.94	Aug. 01	24.33
Nov. 02	21.13	Jan. 04	21.75	Mar. 04	23.25	May 04	23.71	Jul. 01	24.00	Sep. 02	22.50



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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 24	4.56	Jan. 13	5.35	Feb. 17	5.68	May 10	2.72	Jul. 12	5.50	Sep. 12	2.72

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 1987 TO SEPTEMBER 1988

DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL	DATE	WATER LEVEL
Nov. 24	9.95	Jan. 21	10.41	Mar. 22	10.41	May 10	10.21	Aug. 30	11.08

Water-lilies
Red Lake

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*U.S. GOVERNMENT PRINTING OFFICE: 1990--756-141

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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