WATER RESOURCES INVESTIGATIONS
79-38

Low-Flow Characteristics of Streams in the Lake Superior Basin, Wisconsin

PREPARED BY
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
IN COOPERATION WITH
WISCONSIN DEPARTMENT OF NATURAL RESOURCES

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W. A. GEBERT

U. S. GEOLOGICAL SURVEY
Water Resources Investigations
Open-File Report 79-38

Prepared in cooperation with the Wisconsin Department of Natural Resources

April 1979

UNITED STATES DEPARTMENT OF THE INTERIOR

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Low-Flow Characteristics of Streams in the Lake Superior Basin, Wisconsin

W. A. GEBERT

ABSTRACT

The purpose of this report is to describe low-flow characteristics of streams in the Lake Superior basin where streamflow data have been collected and to present equations for estimating low-flow characteristics at ungaged sites. Included are estimates of low-flow frequency and flow duration at 9 gaging stations, and low-flow frequency characteristics at 16 low-flow partial-record stations and 119 miscellaneous sites.

Six equations are provided to estimate low-flow characteristics at ungaged sites and at sites where one base-flow discharge measurement is available. The relationships were determined from multiple-regression analyses that related the low-flow characteristics at gaging stations and low-flow partial-record stations to basin characteristics. Drainage area (A) and drift thickness (H) were the most significant characteristics in explaining the variations in low flow for ungaged sites. The equations and standard error of estimates (SE) for ungaged sites are:

$$Q_{7,2} = 4.6X10^{-5}A^{1.12}H^{1.55} \qquad SE_{7,2} = 99 \text{ percent}$$

$$Q_{7,10} = 6.1X10^{-7}A^{1.27}H^{2.21} \qquad SE_{7,10} = 131 \text{ percent}$$

For sites where one base-flow measurement has been made drainage area (A), basin storage (Bs), transmissivity (T), and base-flow index (Bf) were the most significant characteristics. The equations and standard error of estimate are:

$$Q_{7,2} = 0.295A^{0.924}T^{0.113}Bf^{0.929} \qquad SE_{7,2} = 39 \text{ percent}$$

$$Q_{7,10} = 0.489A^{1.25}Bs^{-0.435}Bf^{1.03} \qquad SE_{7,10} = 65 \text{ percent}$$

Low-flow characteristics estimated for the Lake Superior basin have a moderately high standard error of estimate when compared with other basins in Wisconsin. This reflects the large variability of low flow for streams in the Lake Superior basin which is due to the large variation in geologic or aquifer characteristics that provide ground-water inflow for the streams.

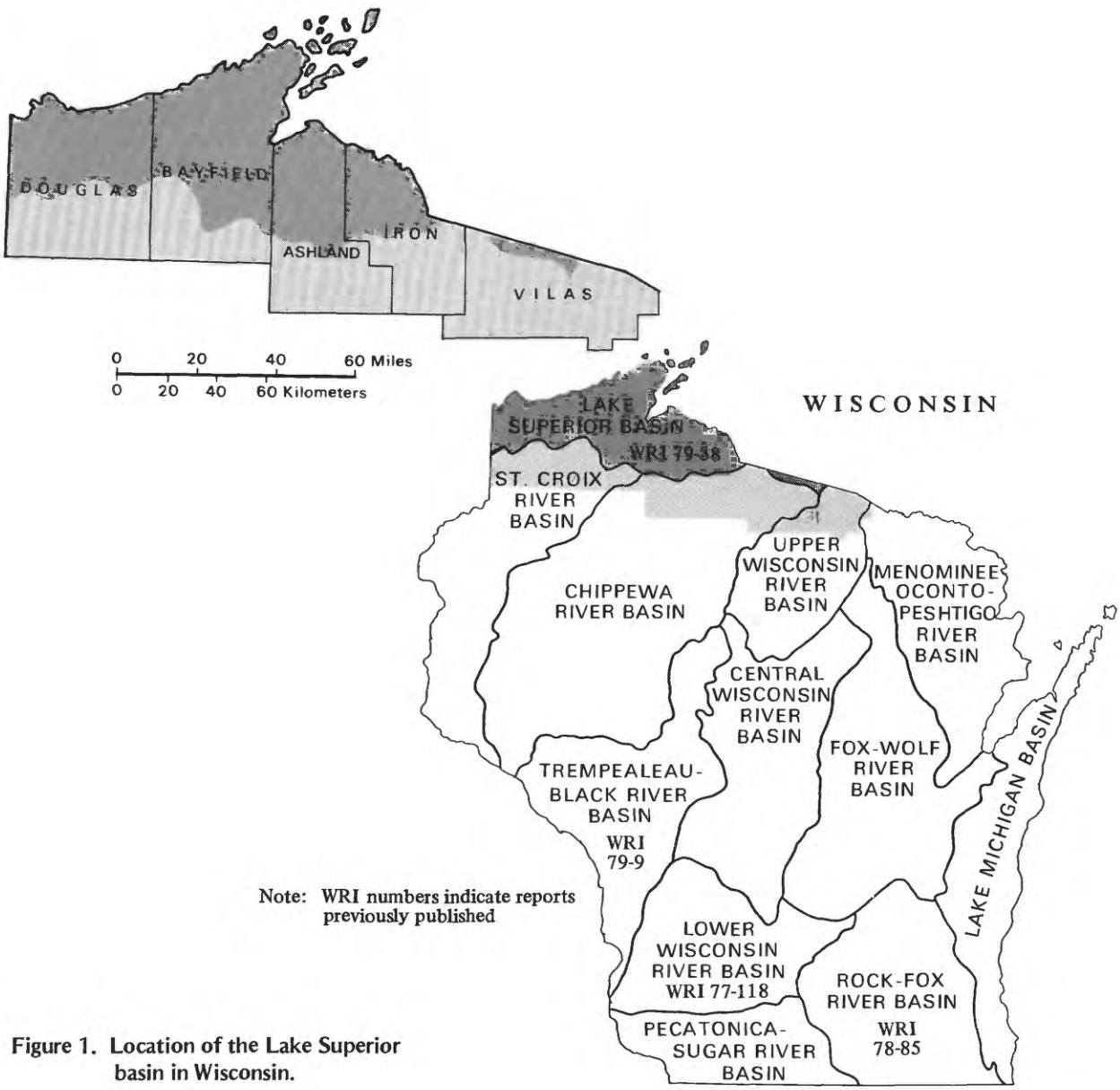

Figure 1. Location of the Lake Superior basin in Wisconsin.

INTRODUCTION

The purpose of this report is to describe low-flow characteristics of streams in the Lake Superior basin where streamflow data have been collected and to present equations for estimating low-flow characteristics at ungaged sites.

This study was done in cooperation with the Wisconsin Department of Natural Resources. This report is part of a series of 12 planned reports to describe low-flow characteristics of the major basins in Wisconsin (fig. 1).

The report includes: estimates of the magnitude and frequency of recurrence of low flow for various sites where systematic streamflow information has been collected, low-flow discharge measurements that have been obtained at numerous sites throughout the basin, and a method to estimate low-flow characteristics at ungaged sites.

In recent years, a great demand has been placed on water resources in Wisconsin by increased multiple uses such as: maintenance of fish and wildlife habitat, irrigation of crops, dilution and assimilation of wastes, production of hydropower, construction of impoundments for real-estate developments, and maintenance of adequate flow for canoeing. This increased demand requires an accurate determination of water resources during low-flow periods to ensure proper consideration of all users.

Low-flow frequency analyses and flow-duration analyses are presented for all current and discontinued gaging stations in the Lake Superior basin. These analyses have been completed for nine gaging stations through water year 1976. Low-flow frequency data are included in the report for 16 low-flow partial-record stations and for 119 miscellaneous sites.

Previous reports by Gebert and Holmstrom (1974) and Gebert (1971) contain preliminary information on low-flow characteristics of this basin.

For the convenience of readers who prefer metric units, the data may be converted by using the following factors:

Multiply	By	To obtain
mile (mi)	1.609	kilometer (km)
foot (ft)	0.3048	meter (m)
square mile (mi^2)	2.59	square kilometer (km^2)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
inch (in.)	2.54	centimeter (cm)
cubic foot per second per square mile {$(ft^3/s)/mi^2$}	0.01094	cubic meter per second per square kilometer {$(m^3/s)/km^2$}
gallon per day (gal/d)	0.003786	cubic meter per day (m^3/d)
gallon per day per square foot {$(gal/d)/ft^2$}	3.517×10^{-4}	cubic meter per day per square meter {$(cm^3/d)/m^2$}

BASIN DESCRIPTION

The Lake Superior basin is in northwestern Wisconsin and includes all the area in Wisconsin that drains into Lake Superior. The basin has a drainage area of 2,885 mi^2 or about 5.2 percent of the State.

The basin is mainly a rural area with a population of about 70,400 people in 1970. The largest cities are Superior, Ashland, and Hurley with populations of 32,237, 9,615, and 2,418, respectively. The economy is diversified with agriculture, forestry, shipping, and tourism being the major sources of employment. Hay and dairy farming are the principal agricultural activities and the pulp-logging industry is the major forest activity. Superior and Ashland are lake-shipping ports with Superior harbor ranking second among Great Lakes ports in annual tonnage shipped. Industrial development is generally light in the basin with the major industry being related to paper and wood products.

The mean annual precipitation for the basin is 31 in. (Wisconsin Statistical Reporting Service, 1931-60), ranging from less than 28 in. near Superior to more than 35 in. near Hurley. Snowfall is 20.4 percent of the mean annual precipitation and ranges from 50 in. near Superior to 120 in. at Hurley. The mean annual runoff from the basin is 12.8 in. and the mean annual evapotranspiration is 17.7 in. (Young and Skinner, 1974).

The Lake Superior basin has three distinct types of topography. A flat lake plain, formed on thick deposits of red clay, adjoins the Lake Superior shoreline except for the shoreline along the Bayfield Peninsula. Streams on the lake plain are short and youthful, having few tributaries and flow in narrow, straight valleys.

The topography of the Bayfield Peninsula is rugged knob-and-kettle type formed by thick end moraine deposits and pitted outwash. Similar topography exists along the southern boundary of the basin from the Bois Brule River to the headwaters of the White River. There areas lack surficial drainage and have numerous deep dry depressions and kettle lakes.

The topography in the remainder of the basin is largely controlled by bedrock. Bedrock ridges with little or no drift cover occur in the Gogebic Range. Streams in this area are developed in the least resistant layers of rocks or cut through the ridges of the resistant rock along transverse faults. Along the south edge of the lake plain between the Nemadji and Iron Rivers the escarpment is the result of resistant lava flows that were raised by faulting. This is an area of prominent water falls as is the central part of the basin where falls were formed at the edge of the resistant basalt. Types and location of glacial deposits and bedrock geology are described by Young and Skinner (1974).

LOW–FLOW CHARACTERISTICS

Low flow generally refers to the low range of stream discharge. A probability of occurrence and a time period can be specified for a more precise definition. Low flow is usually ground-water runoff or base flow, although a 30-, 60-, or 90-day low flow could contain some direct or storm runoff.

A typical low-flow period is illustrated by the discharge hydrograph for Bad River near Odanah gaging station (fig. 2). The annual 90-day low flow occurred from June 11 to September 9. Although this was the lowest flow for 90 consecutive days during the year, periods of substantial direct runoff occurred on many occasions during this period. Except for these rises in stream discharge, the remainder of streamflow for the period was predominantly base flow or ground-water runoff.

Base flow is very important for many low-flow studies because during this period stream discharge is the most stable. Thus, low-flow characteristics can be transferred from a stream where systematic streamflow records have been collected for a period of years to a nearby stream where only a minimum amount of base-flow discharge measurements are available.

Table 1 contains low-flow characteristics for 162 sites in the Lake Superior basin. Each site is identified by station number and station name. The site location, drainage area, type of site, and other pertinent data are included. Characteristics included for each site depend upon the type of site: gaging station, low-flow partial-record station, or miscellaneous sites. The location of the sites are shown on plate 1.

ANALYTICAL TECHNIQUES

Low-flow characteristics in table 1 were determined by three methods of analysis. These methods depended on the three basic types of data available: (1) continuous record of daily streamflows (continuous-record gaging stations); (2) 14 to 17 base-flow discharge measurements (low-flow partial-record stations); (3) 1 to 4 base-flow discharge measurements (miscellaneous sites).

GAGING STATIONS

Low-flow characteristics of a stream where systematic streamflow records have been collected can be determined by flow-duration analysis or frequency analysis. The two analyses serve different purposes. The flow-duration curve indicates the percentage of time that a daily mean flow exceeds a given discharge and the low-flow frequency curve indicates the probability that a 7-day, 14-day, 30-day, 60-day, and 90-day consecutive mean flow will be exceeded in any given year. The recommended and more generally used analysis for most low-flow applications is the low-flow frequency analysis. In the Lake Superior basin the annual minimum 7-day mean flow below which the flow will fall on the average of once in 2 years ($Q_{7,2}$) is approximately equal to 92 percent flow duration. The annual

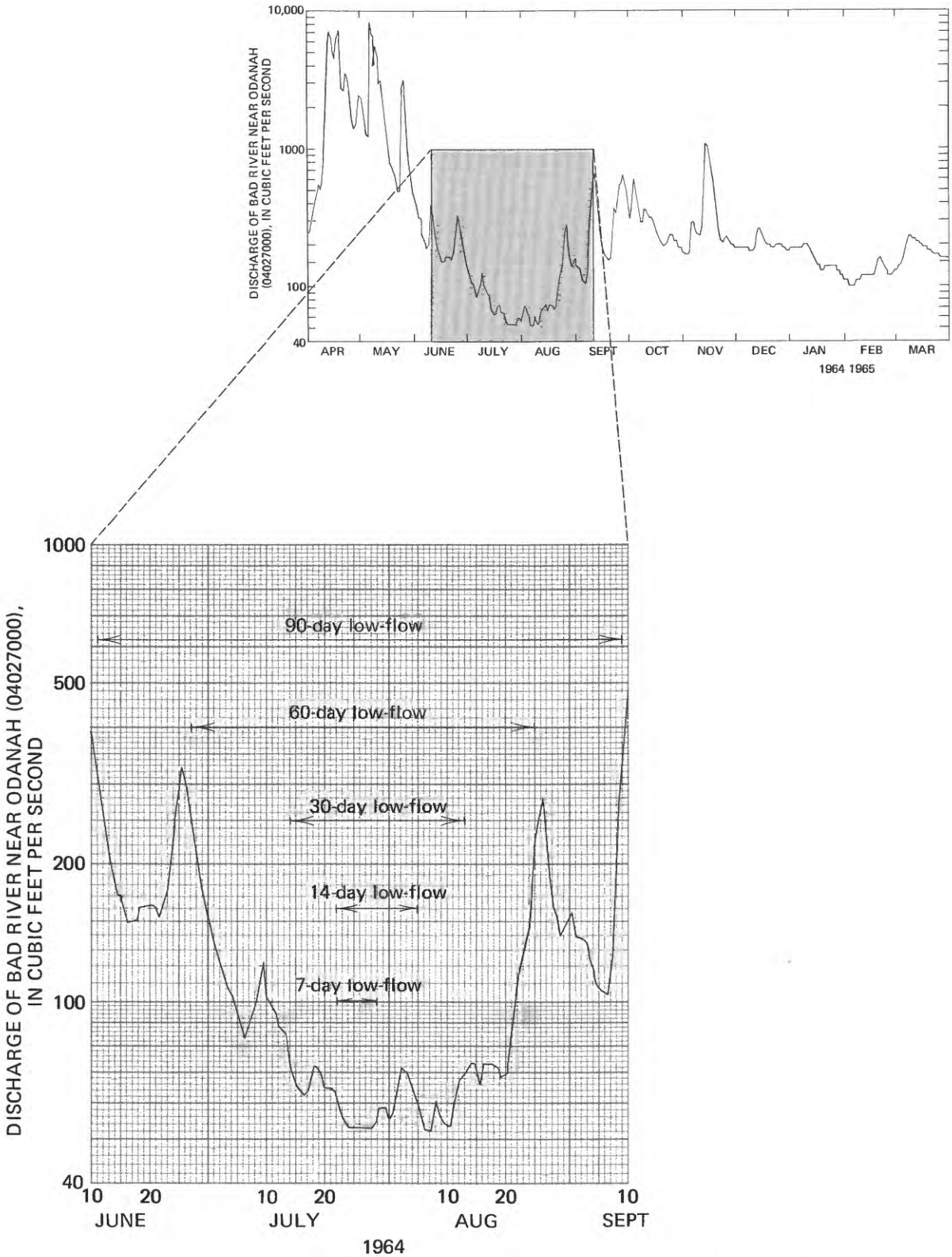

Figure 2. Daily discharge of Bad River near Odanah, for 1965 climatic year, showing annual low-flow periods for various numbers of days.

minimum 7-day mean flow below which the flow will fall on the average of once in 10 years ($Q_{7,10}$) is about equal to 99.6 percent flow duration.

Low-flow frequency and flow-duration analyses were completed for all continuous-record gaging stations that have sufficient data: 10 years of record for low-flow frequency analysis and flow-duration analysis. Low-flow frequency values are listed in table 1 showing the magnitude and frequency of annual low flows for 7, 14, 30, 60, and 90 consecutive days. Table 1 also lists flow-duration values showing the percentage of time that specified discharges were exceeded.

The low-flow frequency characteristics were determined from the daily discharge records using a log-Pearson Type III probability distribution. The results of these analyses were compared to graphs of the annual minimum flows for the various consecutive days (Riggs, 1972). If the two curves did not agree, a graphical interpretation was made to determine the various low-flow characteristics. Figure 3 is an example of a low-flow frequency curve for the Bad River near Odanah gaging station, and figure 4 is a flow-duration curve for the same site.

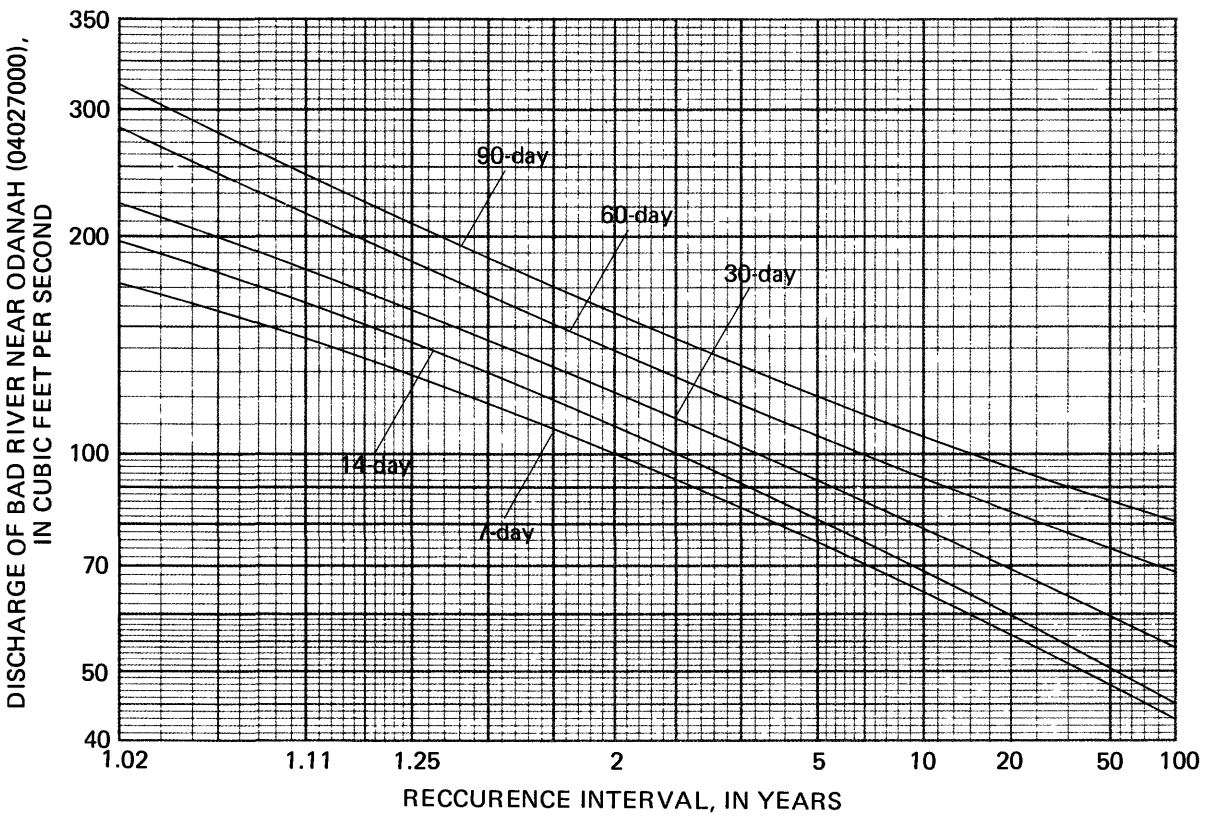

Figure 3. Low-flow frequency curves of the annual lowest mean discharge for the indicated number of consecutive days at Bad River near Odanah.

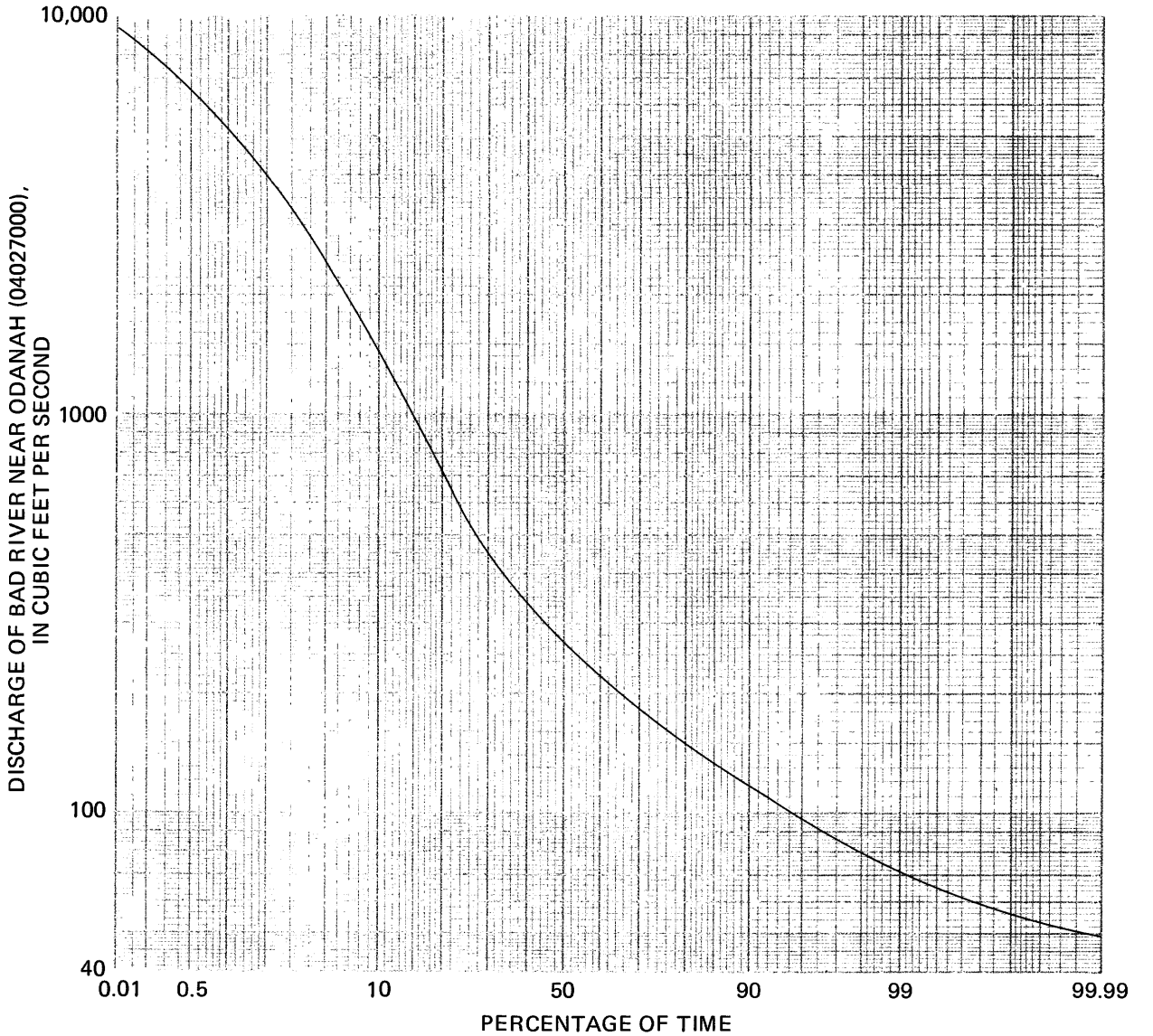

Figure 4. Flow-duration curve showing the percentage of time a given discharge was exceeded for Bad River near Odanah.

For gaging stations that have insufficient data for low-flow frequency analysis or flow duration, the low-flow characteristics were determined by a procedure similar to that outlined in the following section for low-flow partial-record stations.

LOW-FLOW PARTIAL-RECORD STATIONS

Low-flow characteristics determined for low-flow partial-record stations are $Q_{7,2}$ and $Q_{7,10}$. Estimates of $Q_{7,2}$ and $Q_{7,10}$ are presented in table 1 for 16 low-flow partial-record stations. Characteristics were determined from a relation line established by correlating 14 to 17 base-flow discharge measurements at low-flow partial-record stations with concurrent discharges at continuous-record gaging stations in the area (Gebert, 1971). The $Q_{7,2}$ and $Q_{7,10}$ at the continuous-record gaging station then were transferred through the relation line to estimate $Q_{7,2}$ and $Q_{7,10}$ for the partial-record station. Figure 5 is an example of this type of analysis for Marengo River at Marengo.

MISCELLANEOUS SITES

Base-flow measurements have been obtained at 137 miscellaneous sites in the Lake Superior basin as part of other water-resource investigations. Low-flow characteristics were estimated for most of these sites (table 1) by one of two methods.

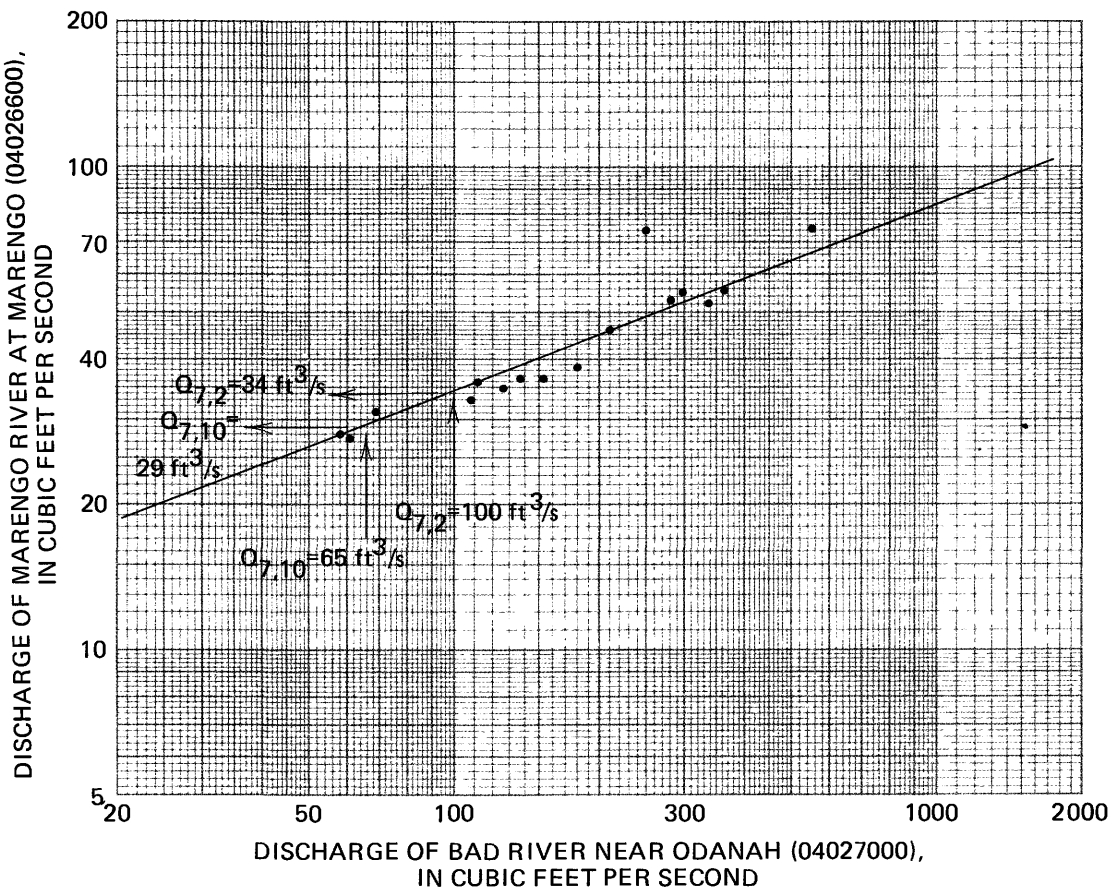

Figure 5. Method of estimating $Q_{7,2}$ and $Q_{7,10}$ at low-flow partial-record stations.

Estimates of $Q_{7,2}$ and $Q_{7,10}$ were made at 38 sites by the same type of analysis that was used for partial-record stations (Gebert and Holmstrom, 1974) for the following conditions: if at least three base-flow discharge measurements were available and a well-defined relationship existed between the measured discharge and the concurrent daily mean discharge at a nearby gaging station. Figure 6 illustrates this type of analysis for Alder Creek near Upson. The slope of the relation line for miscellaneous sites was compared to established relation lines of nearby low-flow partial-record stations and other miscellaneous sites for uniformity. Generally the relation line should have approximately the same slope if the factors that influence low flow are uniform for the area. If the relation line at the site being studied was defined by three discharge measurements that had significant scatter, the line was adjusted to agree more closely with the better established relation line at a low-flow partial-record station.

For 81 miscellaneous sites that have less than three discharge measurements, the low-flow characteristics were estimated by regression equations. The regression equations used and discussion of their development is presented later in the report (p. 13-19).

Low-flow characteristics were not estimated at 18 miscellaneous sites for the following reasons: discharge measurements were affected by upstream regulation or contained substantial effluent from industrial or sewage-treatment plant discharge, less than three discharge measurements were available but the site had a drainage area greater than 150 mi^2, or regression equations provided estimates that were obviously poor when compared to existing data at nearby sites.

ACCURACY

The low-flow characteristics in table 1 are estimates of flow expected in the future. Low-flow characteristics like other streamflow characteristics are only estimates, with their true value being difficult or impossible to determine. The estimates are based on data collected at each site and analyzed by several methods. Each estimate has an error associated with it, dependent on the amount and kind of data, and the analytical method. Two major sources of error are the time-sampling error in streamflow records and the error in the analytical method.

The expected degree of accuracy for the $Q_{7,2}$ and $Q_{7,10}$ estimates are presented in table 1 for each site. The accuracy is determined by the standard error of estimate for the 7-day, 2-year low flow ($SE_{7,2}$) and for the 7-day, 10-year low flow ($SE_{7,10}$). The standard error of estimate is a range such that the values estimated by the method are within this range at about 67 percent of the sites, and are within twice this range at about 95 percent of the sites.

The method used to obtain the standard errors are not precise, and the standard errors presented in the table should be used as a relative guide to indicate a general level of confidence. In addition, there may be greater error associated with accuracy estimates for low-flow estimates that approach 0 ft^3/s.

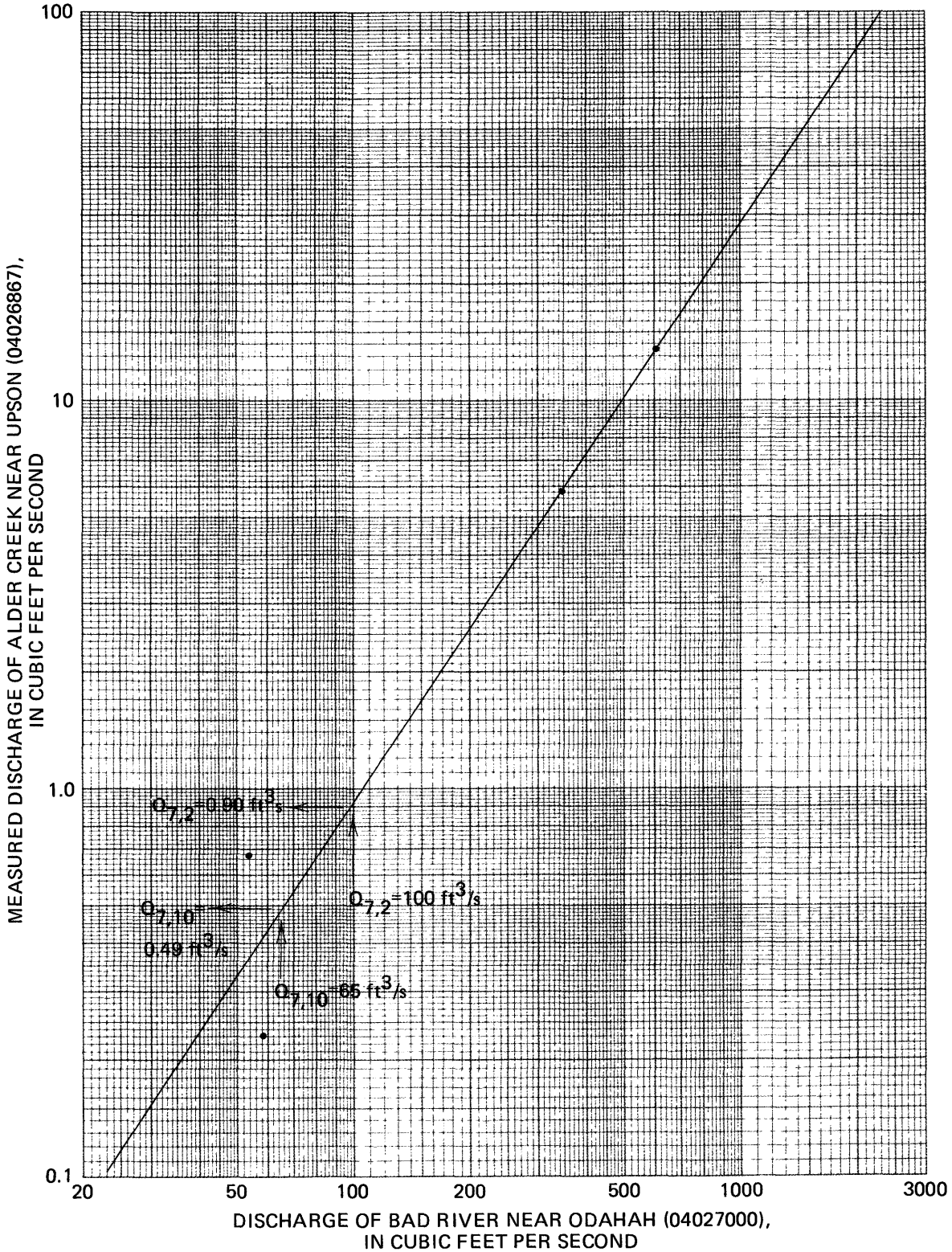

Figure 6. Method of estimating $Q_{7,2}$ and $Q_{7,10}$ at miscellaneous sites.

GAGING STATIONS

Accuracy of low-flow characteristics at gaging stations was determined according to Hardison and Moss (1969). An average $SE_{7,2}$ of 4 percent and $SE_{7,10}$ of 6 percent was determined for the two gaging stations in the Lake Superior basin that had greater than 10 years of unregulated-streamflow record.

A common length of record was used to compare the accuracy of low-flow characteristics determined from recorded discharge at gaging stations in the Lake Superior basin with that of gaging stations throughout the State. This analysis assumed that 10 years of record was available at each gaging station to determine the $Q_{7,10}$ discharge. An $SE_{7,10}$ of 10 percent was determined for the Lake Superior basin as compared to an $SE_{7,10}$ of 16 percent for gaging stations throughout the State. This significant difference does not adequately evaluate the overall accuracy that can be achieved at gaging stations because of the small number of stations available for analysis. This is especially true since one of the stations is the Bois Brule River at Brule which has a high and stable base-flow discharge, providing very accurate determination of low-flow characteristics. Both $SE_{7,2}$ and $SE_{7,10}$ are 2 percent for this station.

LOW-FLOW PARTIAL-RECORD STATIONS

The accuracy of low-flow characteristics at low-flow partial-record stations was determined by a method developed by Hardison and Moss (1972). Using this method, an average $SE_{7,10}$ of 22 percent was found for the 16 low-flow partial-record stations in the Lake Superior basin. This compares to an average $SE_{7,10}$ of 29 percent for 265 low-flow partial-record stations throughout the State.

MISCELLANEOUS SITES

The accuracy of low-flow characteristics that were determined by correlating discharge measurements at the 38 miscellaneous sites is an average value for the entire basin. It was determined by analyzing data collected at low-flow partial-record stations. Three random base-flow measurements were selected from the 14 to 17 measurements available at the 16 low-flow partial-record stations. Low-flow characteristics were determined from these three measurements using the same procedure used for miscellaneous sites. Then low-flow characteristics determined by this method were plotted against the low-flow characteristics based on 14 to 17 measurements. The SE between the two methods was determined from this plotted relationship. The overall SE includes the SE determined by the plotted relationship and the SE associated with the low-flow estimates based on 14 to 17 measurements. Assuming the two errors are independent, the overall SE can be approximated by taking the square root of the sum of the squares of the two different SE's. For the Lake Superior basin this resulted in an $SE_{7,10}$ of 50 percent which is listed in table 1 as the average basin accuracy.

The average $SE_{7,10}$ value should be used cautiously for any particular site since the actual value for a subbasin could be significantly different from the mean for the basin. If the low-flow characteristics are based on more than three discharge measurements, the accuracy probably will be improved and should approach the accuracy at low-flow partial-record stations as additional measurements are obtained.

The accuracy of the low-flow characteristics that were determined by regression equations at the other 81 miscellaneous sites is also an average value for the basin. It was determined as part of the regression analysis and is discussed later in the report (p. 17-19).

ESTIMATING LOW-FLOW CHARACTERISTICS AT UNGAGED SITES

A method is required to transfer low-flow characteristics from gaged sites to ungaged sites because it is impossible to obtain actual streamflow data for all sites where the information is needed. The most practical transfer method relates low-flow characteristics to topographic, geologic, and climatic characteristics of the drainage basin by multiple-regression analysis. Characteristics used in the multiple-regression analysis and the equations determined are discussed in the following paragraphs. The method is outlined in detail by Thomas and Benson (1970).

STREAMFLOW CHARACTERISTICS

Streamflow characteristics that were studied are the $Q_{7,2}$ and $Q_{7,10}$ which are widely used to describe low flow. The multiple-regression analysis included low-flow characteristics for 5 gaging stations and 16 low-flow partial-record stations in the Lake Superior basin. The streamflow characteristics are the dependent variable in the multiple-regression analysis.

BASIN CHARACTERISTICS

Differences in streamflow for various locations and times are caused by the differences in precipitation patterns and the differences in runoff characteristics. Climatic, topographic, and aquifer characteristics are quantified to explain the variation in low flow. These indices are the independent variables in the multiple-regression analysis.

Basin characteristics were selected for the analyses because of their known influence on the rainfall-runoff process. The following list of the drainage-basin characteristics contains a brief discussion of their effect on low flow and how the indices were determined.

Values for these basin characteristics for low-flow partial-record stations and selected gaging stations (drainage areas less than 150 mi^2) in the Lake Superior basin are listed in table 2.

Drainage area (A).--Size of the drainage area is the most significant characteristic in explaining differing streamflow between sites. Because low flow is ground-water runoff, the contributing area is defined by the ground-water divide of a basin which can be determined from potentiometric maps. Because detailed potentiometric maps are not available for most areas in the Lake Superior basin, the surface-water divide was used to define the contributing drainage area. Due to the relatively steep relief, the difference between the area of ground-water drainage and surface-water drainage is probably slight.

Drainage areas, in square miles, were computed from U.S. Geological Survey topographic maps. Most drainage-area data for this study were obtained from Holmstrom (1972).

Main-channel slope (S).--Main-channel slope (Benson, 1962 and 1964) is a characteristic that relates to the change in streamflow for different basins. The index of slope used in this analysis is the average slope in feet per mile between points 10 percent and 85 percent of the distance upstream from the gaged site to the drainage-basin divide.

Main-channel length (L).--Main-channel length is another landform characteristic that indicates basin shape in conjunction with drainage area of the basin. In estimating ground-water runoff to the stream, L can be viewed as describing the length of the vertical cross-sectional area of the porous aquifer material through which the flow occurs. Channel length was obtained from the U.S. Geological Survey topographic maps by measuring the total indicated blue-line length by a digitizer, divider, or other means.

Basin storage (Bs).--Basin storage is that part of total drainage area occupied by lakes and marshes. Variations in streamflow can be caused by retention and release of water from basin storage. For some streams, runoff is delayed by storage, but total runoff may not be reduced; whereas on other streams prolonged retention allows increased evapotranspiration that results in decreased runoff. Essentially, the basin storage index is used in the analysis to reflect the effect of evapotranspiration on low flow.

The basin storage area was obtained from U.S. Geological Survey topographic maps. A value of 1.00 percent was added to all values of basin storage to avoid problems of using zero in the regression analysis.

Forest cover (F).--Forests affect streamflow in several ways. Their major influences on low flow are intercepting precipitation before it reaches the ground and transpiration. In the "sand plain" area of Wisconsin, Weeks and Stangland (1971) found that converting 10 percent of the headwater drainage area from grassland to forest would reduce the late summer streamflow by about 5 percent.

The forest cover index used in this analysis is the percentage of drainage area covered by forests as shown on U.S. Geological Survey topographic maps. A value of 1.00 percent was added to all values of forest cover to avoid problems of using zero in the regression analysis.

Mean annual precipitation (P).--Mean annual precipitation of a basin expresses the amount of water available for potential runoff. The precipitation that infiltrates the soil and passes through the unsaturated zone to the ground-water supply is the source of base flow for a stream. The mean annual precipitation, in inches, for each basin was computed from an isohyetal map determined from precipitation recorded at U.S. Weather Bureau stations (Wisconsin Statistical Reporting Service, 1967, p. 18).

A constant of 20 in. was subtracted from each value for use in the regression analysis. This reduction provides constants and exponents in the regression equation that are more manageable.

Soil-infiltration rate (I).--Soil permeability influences the amount of direct runoff from a storm and the amount of water that infiltrates the soil. The permeability used is an average rate for the basin under average soil and moisture conditions.

Soil types and average permeability, in inches per hour, for each basin were determined from maps by Young and Skinner (1974).

Mean annual snowfall (Sn).--Mean annual snowfall, like mean annual precipitation, is an indicator of water available for runoff. For each basin an average mean annual snowfall, in inches, was determined from an isohyetal map determined from snowfall recorded in the period 1930-59 (Wisconsin Statistical Reporting Service, 1970) and average snowfall values from National Weather Service weather stations in the basin (Wisconsin Crop Reporting Service, 1961). A constant of 20 in. was subtracted from each value to provide more manageable constants and exponents in the equations.

Base-flow index (Bf).--A good indicator of a stream's low-flow potential is a discharge measurement made during base-flow conditions. Base-flow measurements provide considerable information about the characteristics of the aquifers supplying outflow to the stream. To use base-flow measurements, it is necessary to convert them to a uniform basis because measurements generally are obtained at various points on the base-flow recession curves. Discharge at the 90 percent flow duration was selected to represent the base-flow index value. To evaluate the technique and develop the necessary relationships for this study, sites were selected that had discharge measurements obtained for a low-flow investigation during the period August 25-27, 1970.

Measured discharges (Q_m) at low-flow partial-record stations and miscellaneous sites were converted to a unit discharge by dividing the values by their respective drainage areas (A). These values then were adjusted by a basin ratio to determine the base-flow index for each site. Basin ratios were determined for gaging stations on unregulated streams within the Lake Superior basin by dividing the discharge at 90 percent flow duration (Q_{90}) by the observed average daily discharge during August 25-27, 1970 (Q_r). Thus, base-flow index values were determined by the equation:

$$Bf = \frac{Q_m \, Q_{90}}{A \, Q_r}$$

Plate 2 shows the locations of 108 sites with base-flow index values, their respective drainage-area outlines, and their computed base-flow index values.

Hydraulic conductivity (K).--Hydraulic conductivity of an aquifer is the volume of water at the existing kinematic viscosity that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. Average values of hydraulic conductivity were given to the glacial drift in the Lake Superior basin and are:

	Hydraulic conductivity {(gal/d)/ft^2}
Lake clay	1
Ground moraine (till; consists of clay, silt, sand, gravel, and boulders)	10
End moraine (till; sand and gravel)	100
Lake sand	1,000
Outwash (sand and gravel)	2,500

Average values of hydraulic conductivity were obtained for each of the subbasins by the following procedures: (1) outline subbasin divide on glacial geology map (Young and Skinner, 1974, sheet 1) (pl. 3), (2) determine the subbasin for each of the glacial drift types, (3) multiply these subareas by the hydraulic conductivity values assigned to the glacial drift, and (4) divide the sum of these products by the sum of the subareas.

Drift thickness (H).--Glacial drift serves as an aquifer that stores water for release to streams in the basin. The thickness of glacial drift ranges from less than 50 ft in the western part of the basin to nearly 500 ft in the southeastern part of the basin. An average drift thickness for each subbasin was determined from the glacial geology and drift thickness map by Young and Skinner (1974, sheet 1) (pl. 3).

Transmissivity (T).--The water-transmitting capability of an aquifer is expressed in terms of transmissivity. Values of transmissivity were obtained by the product of hydraulic conductivity and drift thickness.

REGRESSION ANALYSIS

Multiple-regression analysis was used to determine the relationship between the low-flow characteristics (dependent variables) and the basin characteristics (independent variables). The analysis provides an equation, or series of equations, relating the dependent to the independent variables. This analysis defined mathematical equations of the form:

$$Q_T = a\, A^{b_1} B^{b_2} C^{b_3} \ldots\ldots\ldots\ldots\ldots\ldots N^{b_n},$$

where:

Q_T is a 7-day low-flow characteristic having a T-year recurrence interval, in cubic feet per second;

a is a regression constant defined by the regression analysis;

ABC.....N are drainage-basin characteristics; and

$b_1 b_2 b_3 \ldots\ldots b_n$ are regression coefficients defined by regression analysis.

The analysis also defined the standard error of estimate (SE) of the analytical method and the statistical significance of each variable in the equation.

The standard error of estimate is a measure of the accuracy of the regression relationships. It describes a range in error between the defined relationship and the data included in the analysis. Values estimated by the regression equations are within the range of one standard error of estimate at about 67 percent of the sites and within twice this range for 95 percent of the sites.

Step-backward regression analyses were performed by digital computer using procedures outlined by Thomas and Benson (1970). The equations with the lowest standard error of estimate with all variables significant at the 99 percent or the 95 percent confidence level were selected as the best equations for prediction.

Two separate sets of analyses were performed to develop equations for sites without streamflow data available and for sites with minimum streamflow data available. One analysis included all the drainage-basin characteristics except for base-flow index, and the other analysis contained all the drainage-basin characteristics including the base-flow index.

Drainage area, basin storage, drift thickness, transmissivity, and base-flow index were found the most significant characteristics in explaining the differences in low flow. Although other characteristics may logically explain or quantify the precipitation-runoff process, they do not differ across the area studied and therefore cannot explain the differences in low flow. Mean annual precipitation is an example of this type of characteristic that does not differ enough across the basin.

SITES WITHOUT STREAMFLOW DATA

Two equations were selected from the analyses for sites without streamflow data available. The equations and their respective standard error of estimates are:

Equation	Standard error	
$Q_{7,2} = 4.6X10^{-5}A^{1.12}H^{1.55}$	$SE_{7,2}$ = 99 percent	(1)
$Q_{7,10} = 6.10X10^{-7}A^{1.27}H^{2.21}$	$SE_{7,10}$ = 131 percent	(2)

$Q_{7,2}$ is the 7-day, 2-year low flow, in cubic feet per second;

$Q_{7,10}$ is the 7-day, 10-year low flow, in cubic feet per second;

A is drainage area, in square miles; and

H is the average thickness of glacial drift within a basin, in feet.

Equations 1 and 2 apply to sites without streamflow data and for drainage areas less than 150 mi^2.

SITES WITH MINIMUM STREAMFLOW DATA

Two sets of equations were selected from the analyses for sites with minimum streamflow data available. The equations and their respective standard errors of estimate are:

Equation	Standard error	
$Q_{7,2} = 0.295A^{0.924}T^{0.113}Bf^{0.929}$	$SE_{7,2}$ = 39 percent	(3)
$Q_{7,2} = 0.664A^{1.02}Bf^{0.985}$	$SE_{7,2}$ = 45 percent	(4)
$Q_{7,10} = 0.489A^{1.25}Bs^{-0.435}Bf^{1.03}$	$SE_{7,10}$ = 65 percent	(5)
$Q_{7,10} = 0.321A^{1.19}Bf^{1.28}$	$SE_{7,10}$ = 84 percent	(6)

$Q_{7,2}$, $Q_{7,10}$, and A are as defined for equations 1 and 2;

T is the transmissivity, in gallons per day per foot;

Bs is the basin storage, expressed as percentage of the total drainage area plus 1.00 percent; and

Bf is the base-flow index, in cubic feet per second per square mile.

Equations 3 and 5 are the better equations because they have lower standard error of estimates. Equations 4 and 6 are provided, even though they have a higher standard error, because they are easier to apply and might be used for some purposes.

Equations 3, 4, 5, and 6 should provide estimates of $Q_{7,2}$ and $Q_{7,10}$ at approximately the SE indicated for sites where base-flow discharge measurements have been made. In addition, for sites without streamflow data and not on small tributaries, equations 3, 4, 5, and 6 should provide more reliable estimates than equations 1 and 2 for the following conditions:

1. For ungaged sites that are located in an area where the degree of uniformity among Bf values is high, as shown on plate 2.

2. For ungaged sites that are located within the indicated subbasins on plate 2.

Equations 3 through 6 are applicable for use at sites with drainage areas less than 150 mi^2.

VERIFICATION OF REGRESSION EQUATIONS THAT USE BASE-FLOW INDEX

To test the validity of equations 3 and 5 for other flow conditions and time periods, the following comparison was performed using streamflow data collected at low-flow partial-record stations. Periods selected for analyses were: a high base-flow period, June 16-17, 1971; a medium base-flow period, September 18-19, 1973; and during a low base-flow period, August 3-4, 1976. Values of Bf were obtained as outlined previously. Substituting these new values of Bf into equations 3 and 5, estimates of $Q_{7,2}$ and $Q_{7,10}$ were determined for low-flow partial-record stations. When compared to the $Q_{7,2}$ and $Q_{7,10}$ values listed in table 1 the following SE's were determined for the estimated low-flow characteristics.

Regression analysis equations	SE from regression analysis	SE using various flow conditions to determine Bf			Average SE for three flow conditions
		Low base flow	Medium base flow	High base flow	
Equation 3	39 percent	27 percent	48 percent	67 percent	47 percent
Equation 5	65 percent	46 percent	59 percent	72 percent	59 percent

As illustrated, equations 3 and 5 provide satisfactory results for low and medium base-flow conditions. For high base-flow conditions equation 5 also provides results reasonably similar to the SE expected from the regression analysis but equation 3 provided estimates with a significantly higher SE than indicated from the regression analysis.

APPLICATION OF ESTIMATING PROCEDURES

SITES WITHOUT STREAMFLOW DATA

Computation of low-flow characteristics at an ungaged site may be made as follows:

1. If the conditions listed on page 19 are met, use equations 3 and 5 (page 18) to determine the low-flow characteristics at ungaged sites.

2. Determine base-flow index from plate 2.

3. Compute drainage area and basin storage as indicated on page 14 and transmissivity as indicated on page 16.

4. Substitute these values into equations 3 and 5 and solve for the low-flow characteristics.

5. Use equations 1 and 2 (page 18) to determine low-flow characteristics for sites where the conditions outlined on page 19 cannot be met.

6. Compute the drainage area as indicated on page 14.

7. Determine drift thickness as indicated on page 16.

8. Substitute drainage-area and drift thickness values into equations 1 and 2 and solve for the low-flow characteristics.

For ungaged sites where the degree of uniformity of base-flow index values is high, Bf can be determined from plate 2 and equations 3 and 5 can be used to determine the low-flow characteristics. For example, to determine the low-flow characteristics for Iron River at a country road crossing about 1 mi upstream from the confluence with Muskeg Creek the applicable equations are:

$$Q_{7,2} = 0.295A^{0.924}T^{0.113}Bf^{0.929} \qquad (3)$$

$$Q_{7,10} = 0.489A^{1.25}Bs^{-0.435}Bf^{1.03} \qquad (5)$$

Drainage area was determined as outlined on page 14 and is 31.1 mi^2.

The base-flow index is determined from plate 2 and is a weighted average based on drainage area:

$$Bf = \frac{A_1Bf_1 + A_2Bf_2}{A_1 + A_2}$$

where: A_1 = drainage area at station 04026045 = 26.4 mi^2,

Bf_1 = base-flow index at station 04026045 = 0.42,

A_2 = intervening drainage area between site of interest and station 04026045 = 4.7 mi^2,

Bf_2 = base-flow index for intervening area between site of interest and station 04026045 = 0.21.

$$Bf = \frac{A_1Bf_1 + A_2Bf_2}{A_1 + A_2}$$

$$Bf = \frac{26.4(0.42) + 4.7(0.21)}{26.4 + 4.7}$$

$$Bf = \frac{11.1 + 1.0}{31.1} = \frac{12.1}{31.1}$$

$$Bf = 0.39$$

The following calculations were made to determine transmissivity with values of hydraulic conductivity and drift thickness being determined from plate 3.

(1) Glacial deposits	(2) Hydraulic conductivity {(gal/d)/ft^2}	(3) Surface area of glacial deposit (mi^2)	(4) Average drift thickness (ft)	Columns (2)X(3)X(4)
Lake clay	1	24.6	250	6,150
End moraine	100	1.9	300	57,000
		3.9	425	166,000
Outwash	2,500	.7	450	788,000
		31.1		1,017,150

Transmissivity (T) = $\frac{1,017,150}{31.1}$ = 32,700 (gal/d)/ft

The area of lakes and swamps in the drainage basin was determined to be 4.00 mi^2 from the Iron Lake, Drummond, Ellison Lake, and Brule quadrangle maps. Therefore, Bs = $(\frac{4.00}{31.1})100 + 1.0$ = 13.9 percent.

Substituting these values into their respective equations:

$$Q_{7,2} = 0.295A^{0.924}T^{0.113}Bf^{0.929}$$
$$= 0.295(31.1)^{0.924}(32,700)^{0.113}(0.39)^{0.929}$$
$$= 0.295(24.0)(3.24)(0.42)$$
$$= 9.6 \text{ ft}^3/\text{s}$$

$$Q_{7,10} = 0.489A^{1.25}Bs^{-0.435}Bf^{1.03}$$
$$= 0.489(31.1)^{1.25}(13.9)^{-0.435}(0.39)^{1.03}$$
$$= 0.489(73.4)(0.318)(0.38)$$
$$= 4.3 \text{ ft}^3/\text{s}$$

Low-flow characteristics for ungaged sites in which conditions on page 19 are not met can be determined by regression equations 1 and 2. The low-flow characteristics of Apple Creek near Upson are determined to illustrate the application of equations 1 and 2.

The applicable equations for an ungaged area are:

$$Q_{7,2} = 4.6X10^{-5}A^{1.12}H^{1.5} \quad (1)$$
$$Q_{7,10} = 6.10X10^{-7}A^{1.27}H^{2.21} \quad (2)$$

The drainage area for this site as outlined on page 14 is 5.39 mi^2. The average drift thickness for the Apple Creek drainage area from plate 3 is 100 ft. Substituting these values into the respective equation:

$$Q_{7,2} = 4.6X10^{-5}A^{1.12}H^{1.55}$$
$$= (4.6X10^{-5})(5.39)^{1.12}(100)^{1.55}$$
$$= (4.6X10^{-5})(6.60)(1,260)$$
$$= 0.38 \text{ ft}^3/\text{s}$$

$$Q_{7,10} = 6.10X10^{-7}A^{1.27}H^{2.21}$$
$$= (6.1X10^{-7})(5.39)^{1.27}(100)^{2.21}$$
$$= (6.1X10^{-7})(8.49)(26,300)$$
$$= 0.14 \text{ ft}^3/\text{s}$$

SITES WITH MINIMUM STREAMFLOW DATA

Computation of the low-flow characteristics at sites with minimum streamflow data available is made as follows:

1. Use equations 3 and 5 listed on page 18 to determine the low-flow characteristics.

2. Determine from plate 1 and table 1 the type of streamflow data that are available.

3. If the streamflow measurements are made during base-flow conditions, the Bf should be determined as outlined on pages 15 and 16.

4. Compute the other basin characteristics, drainage area, transmissivity, and basin storage, used in the equation as outlined on pages 14 and 16.

5. Substitute values determined in steps 3 and 4 into equations 3 and 5.

To determine low-flow characteristics at sites using streamflow measurements, the following procedure at the site, Montreal River tributary near Hurley (station number 04027845), is used as an example.

The applicable equations are:

$$Q_{7,2} = 0.295A^{0.924}{}_T{}^{0.113}{}_{Bf}{}^{0.929}$$

$$Q_{7,10} = 0.489A^{1.25}{}_{Bs}{}^{-0.435}{}_{Bf}{}^{1.03}$$

Drainage area (A) obtained from table 1, page 60, is 2.92 mi^2.

The hydraulic conductivity and drift thickness are determined from the glacial geology and drift thickness map (pl. 3). The Montreal River tributary drainage basin is entirely end moraine with a K = 100 $(gal/d)/ft^2$. The average value of H for the drainage basin was estimated to be 100 ft. Hence transmissivity T = (K)(H) = 100X100 = 10,000 (gal/d)/ft.

The area of lakes and swamps in the drainage basin was determined to be 2.53 mi^2 from the Ironwood and Mercer quadrangle maps. Therefore, $Bs = (\frac{2.53}{2.92})100 + 1.0 = 87.6$ percent.

A Bf value was determined from the lowest of two base-flow measurements that are available at this site (table 1). The lowest base-flow measurement was used since it has been shown that low measurements produce better results (p. 19). Following the same general procedure indicated on pages 15 and 16, a Bf value was determined by the equation:

$$Bf = \frac{Q_m \, Q_{90}}{A \, Q_r}$$

where: Q_m is the measured discharge, 0.48 ft^3/s, of Montreal River tributary near Hurley on October 5, 1975;

A is the drainage area, 2.92 mi^2, of Montreal River tributary near Hurley;

Q_r is the recorded discharge at a nearby continuous-record gaging station. Referring to plate 1, station 04027000, Bad River near Odanah is the closest gaging station. From "Water Resources Data for Wisconsin" (1976) the average daily discharge for October 5, 1975, was 100 ft^3/s; and the

Q_{90} for Bad River near Odanah is 117 ft^3/s, obtained from table 1.

Substituting these values in the equation:

$$Bf = \frac{Q_m \, Q_{90}}{A \, Q_r}$$

$$= \frac{(0.48)(117)}{(2.92)\ 100}$$

$$= 0.192$$

The low-flow characteristics then can be determined by substituting these values in their respective equations:

$$Q_{7,2} = 0.295A^{0.924}T^{0.113}Bf^{0.929}$$

$$= (0.295)(2.92)^{0.924}(10,000)^{0.113}(0.192)^{0.929}$$

$$= (0.295)(2.69)(2.83)(0.216)$$

$$= 0.49 \ ft^3/s$$

$$Q_{7,10} = 0.489A^{1.25}Bs^{-0.435}Bf^{1.03}$$

$$= (0.489)(2.92)^{1.25}(87.6)^{-0.435}(0.192)^{1.03}$$

$$= (0.489)(3.82)(0.143)(0.183)$$

$$= 0.05 \ ft^3/s$$

COMPARISON OF METHODS

If estimates of low-flow characteristics are required at sites other than those presented in this report, the user interested in the data should evaluate the need for the low-flow information and then select a method based on following criteria. Generally the most important criteria in choosing a method are: accuracy requirements of the low-flow characteristics; time available to collect and analyze data; and cost of data collection and analyses.

Table 3 compares the methods available and provides: type of data required; number of sites where required data are available; time required to collect data; analytical method used to determine the low-flow characteristics; and standard error of estimate associated with the method. If a high degree of reliability is required of low-flow characteristics and sufficient time is available for data collection, a gaging station or low-flow partial-record station can be operated. If a lesser degree of reliability is acceptable at a site or time and money are limited, three base-flow discharge measurements can be obtained or one of the regression equations may be sufficient.

The moderately high SE's associated for all the methods, except for gaging stations and low-flow partial-record stations, reflects the large differences in low flow for streams in the Lake Superior basin. This is due to the large differences within the basin of the geologic or aquifer characteristics that provide the ground-water runoff to sustain low flow in streams. This is illustrated by the difference in transmissivity and corresponding low flow for North Fork Fish Creek near Ashland and Alder Creek near Upson. North Fork Fish Creek has a transmissivity of 435,000 (gal/d)/ft with a $Q_{7,10}$ of 0.82 $(ft^3/s)/mi^2$ whereas Alder Creek has a transmissivity of 520 (gal/d)/ft and a $Q_{7,10}$ of 0.007 $(ft^3/s)/mi^2$.

SUMMARY

Low-flow characteristics were determined for 9 gaging stations, 16 low-flow partial-record stations, and 119 miscellaneous sites in the Lake Superior basin.

The method used in estimating the low-flow characteristics was dependent on the amount of discharge data available at the site. The low-flow characteristics at a gaging station with 10 or more years of record was determined by a log-Pearson Type III frequency analysis or plotting-position analysis. At a low-flow partial-record station (seven or more discharge measurements) or miscellaneous site (three or more discharge measurements) a graphical correlation was used to determine the $Q_{7,2}$ and $Q_{7,10}$. At miscellaneous sites (one or two discharge measurements) and ungaged sites (no discharge measurements) multiple-regression equations were developed to determine the low-flow characteristics. The standard error of estimate of the 7-day, 10-year low flow ($SE_{7,10}$) ranged from 6 to 131 percent, depending on the type of data

available. The methods used to determine the standard errors are not precise and should be used as a relative guide to indicate a general level of confidence.

The multiple-regression equations developed made it possible to determine the low-flow characteristics at ungaged sites with an acceptable degree of accuracy for some purposes. Two sets of equations were determined, one for use at sites without any additional streamflow data and the other for sites with base-flow measurements. The latter equations had an $SE_{7,10}$ of 69 percent compared to 131 percent for the former. The most significant characteristics in explaining the variation in low flow were drainage area, basin storage, drift thickness, transmissivity, and base-flow index.

The moderately high SE's associated for all the methods, except for gaging stations and low-flow partial-record stations, reflects the large differences in low flow for streams in the Lake Superior basin. This is due to the large difference within the basin of the geologic or aquifer characteristics that provide the ground-water runoff to sustain low flow in streams.

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Table 1.--Low-flow characteristics for sites in the Lake Superior basin

04024041 Little Pokegama River near South Superior, Wis.

Location.--SW¼NE¼ sec. 7, T. 48 N., R. 14 W., Douglas County, at bridge on State Highway 105, 3.1 mi west of South Superior.

Drainage area.--6.13 mi^2. Tributary to.--St. Louis River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.02 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.01 ft^3/s, $Q_{7,10}$ = <0.01 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024051 Pokegama River near South Superior, Wis.

Location.--SE¼SW¼ sec. 25, T. 48 N., R. 15 W., Douglas County, at bridge on country road; 5.8 mi southwest of South Superior.

Drainage area.--11.7 mi^2. Tributary to.--St. Louis River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024067 Pokegama River near South Superior, Wis.

Location.--NW¼NW¼ sec. 10, T. 48 N., R. 14 W., Douglas County, at bridge on town road, 0.2 mi south of State Highway 105 and 0.8 mi west of State Highway 35, in South Superior.

Drainage area.--26.3 mi^2. Tributary to.--St. Louis River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 17, 1972, 0.96 ft^3/s; May 23, 1973, 13.8 ft^3/s; Sept. 18, 1973, 3.40 ft^3/s; Aug. 1, 1974, 0.33 ft^3/s; Aug. 3, 1976, <0.01 ft^3/s (est.).

Low-flow frequency.--$Q_{7,2}$ = 0.02 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 5 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04024300 Nemadji River at Borea, Wis.

Location.--SE¼SE¼ sec. 1, T. 47 N., R. 14 W., Douglas County, at bridge on town road, 0.5 mi south of Borea.

Drainage area.--Not available. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--July 2, 1973, 64.0 ft^3/s; Sept. 13, 1973, 71.8 ft^3/s.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04024310 Balsam Creek near Patzau, Wis.

Location.--SW¼SW¼ sec. 34, T. 47 N., R. 15 W., Douglas County, at bridge on County Trunk B, 1.5 mi northwest of Patzau.

Drainage area.--12.0 mi^2. Tributary to.--Nemadji River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 1.04 ft^3/s.

Remarks.--Additional discharge measurements required to estimate low-flow characteristics.

04024314 Little Balsam Creek at Patzau, Wis.

Location.--NE¼SW¼ sec. 3, T. 46 N., R. 15 W., Douglas County, at bridge on private road, 0.5 mi northwest of Patzau.

Drainage area.--5.00 mi^2. Tributary to.--Balsam Creek.

Type of site.--Gaging station.

Period of record.--January to September 1976.

Minimum discharge measured.--0.75 ft^3/s, Sept. 17-30, 1976.

Low-flow frequency.--$Q_{7,2}$ = 1.0 ft^3/s, $Q_{7,10}$ = 0.64 ft^3/s.

Basis of estimate.--Correlated with St. Croix River near Danbury using 6 mean daily discharge values recorded during 1976.

Accuracy.--$SE_{7,2}$ = 18 percent, $SE_{7,10}$ = 18 percent.

04024315 Little Balsam Creek near Patzau, Wis.

Location.--SE¼SW¼ sec. 34, T. 47 N., R. 15 W., Douglas County, at bridge on County Trunk B, 1.2 mi northwest of Patzau.

Drainage area.--5.18 mi^2. Tributary to.--Balsam Creek.

Type of site.--Gaging station.

Period of record.--November 1975 to September 1976.

Minimum discharge measured.--0.82 ft^3/s, Aug. 25, 1970.

Low-flow frequency.--$Q_{7,2}$ = 1.1 ft^3/s, $Q_{7,10}$ = 0.78 ft^3/s.

Basis of estimate.--Correlated with St. Croix River near Danbury using 8 mean daily discharge values and 1 discharge measurement obtained during the period 1970-76.

Accuracy.--$SE_{7,2}$ = 18 percent, $SE_{7,10}$ = 18 percent.

04024318 Little Balsam Creek tributary near Patzau, Wis.

Location.--NE¼NE¼ sec. 4, T. 46 N., R. 15 W., Douglas County, at bridge on County Trunk B, 1.3 mi northwest of Patzau.

Drainage area.--0.54 mi^2. Tributary to.--Little Balsam Creek.

Type of site.--Gaging station.

Period of record.--January to September 1976.

Minimum discharge measured.--No flow recorded on numerous occasions.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Numerous measurements of zero flow.

Accuracy.--Not applicable.

04024325 Balsam Creek near Patzau, Wis.

Location.--SE¼NE¼ sec. 13, T. 47 N., R. 15 W., Douglas County, at bridge on country road, 4.9 mi north of Patzau

Drainage area.--29.6 mi^2. Tributary to.--Nemadji River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 25, 1970, 2.18 ft^3/s; July 2, 1973, 7.48 ft^3/s; Sept. 13, 1973, 4.45 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 2.4 ft^3/s, $Q_{7,10}$ = 1.4 ft^3/s.

Basis of estimate.--Correlated with St. Croix River near Danbury using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04024350 Black River near Chaffey, Wis.

Location.--SE¼SW¼ sec. 19, T. 46 N., R. 14 W., Douglas County, at bridge on State Highway 35, 3.5 mi north of Chaffey and 4.0 mi southeast of Patzau.

Drainage area.--53.6 mi^2. Tributary to.--Nemadji River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--0.51 ft^3/s, Aug. 3, 1976.

Low-flow frequency.--$Q_{7,2}$ = 1.3 ft^3/s, $Q_{7,10}$ = 0.27 ft^3/s.

Basis of estimate.--Correlated with St. Croix River near Danbury using 15 discharge measurements made during the period 1964-76.

Accuracy.--$SE_{7,2}$ = 28 percent, $SE_{7,10}$ = 45 percent.

04024370 Black River near Patzau, Wis.

Location.--SE¼SE¼ sec. 21, T. 47 N., R. 14 W., Douglas County, at bridge on State Highway 35, 5.5 mi northeast of Patzau.

Drainage area.--75.6 mi^2. Tributary to.--Nemadji River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 2.97 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 2.2 ft^3/s, $Q_{7,10}$ = 0.79 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024380 Miller Creek tributary near Patzau, Wis.

Location.--SW¼NW¼ sec. 24, T. 47 N., R. 15 W., Douglas County, at bridge on country road, 3.6 mi north of Patzau.

Drainage area.--3.92 mi^2. Tributary to.--Miller Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.02 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.01 ft^3/s, $Q_{7,10}$ = <0.01 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024387 Black River near South Superior, Wis.

Location.--SE¼SE¼ sec. 5, T. 47 N., R. 14 W., Douglas County, at bridge and country road, 4.9 mi south of South Superior.

Drainage area.--Not available. Tributary to.--Nemadji River.

Type of site.--Miscellaneous site.

Discharge measurements.--July 2, 1973, 18.8 ft^3/s; Sept. 13, 1973, 12.5 ft^3/s.

04024390 Nemadji River near Superior, Wis.

Location.--NW¼SW¼ sec. 34, T. 48 N., R. 14 W., Douglas County, at bridge on State Highway 35, 8.0 mi south of Superior.

Drainage area.--385 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 25, 1970, 48.1 ft^3/s; Jan. 4, 1971, 90.2 ft^3/s.

04024430 Nemadji River near South Superior, Wis.

Location.--SW¼SW¼ sec. 14, T. 48 N., R. 14 W., Douglas County, at bridge on County Trunk C, 2.0 mi south of South Superior.

Drainage area.--422 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--December 1973 to September 1976.

Minimum discharge measured.--30 ft^3/s, Aug. 29, Sept. 5, 6, 8-10, 1976.

Low-flow frequency.--$Q_{7,2}$ = 52 ft^3/s, $Q_{7,10}$ = 32 ft^3/s.

Basis of estimate.--Correlated with St. Croix River near Danbury using 9 mean daily discharge values recorded during the period 1973-76.

Accuracy.--$SE_{7,2}$ = 21 percent, $SE_{7,10}$ = 21 percent.

04024450 Crawford Creek near South Superior, Wis.

Location.--SE¼SE¼ sec. 11, T. 48 N., R. 14 W., Douglas County, at bridge on County Trunk Z, 1.8 mi southeast of South Superior.

Drainage area.--7.97 mi^2. Tributary to.--Nemadji River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 26, 1970, 0 ft^3/s; July 25, 1975, 0.005 ft^3/s; Aug. 21, 1975, 0.041 ft^3/s; Aug. 3, 1976, 0 ft^3/s; Aug. 24, 1977, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--No flow was observed at site on three occasions.

Accuracy.--Not applicable.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04024456 Lake Superior tributary at Superior, Wis.

Location.--SW¼SE¼ sec. 25, T. 49 N., R. 14 W., Douglas County, at culvert on Stinson Avenue, 2.5 mi southeast of post office in Superior.

Drainage area.--0.50 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--July 25, 1975, 0.875 ft^3/s; June 20, 1975, 0.736 ft^3/s; Aug. 3, 1976, 0.376 ft^3/s; Aug. 24, 1977, 0 ft3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--No natural flow was observed.

Accuracy.--Not applicable.

Remarks.--Discharge measured was effluent from industrial plant.

04024460 Bluff Creek near South Superior, Wis.

Location.--SE¼SW¼ sec. 7, T. 48 N., R. 13 W., Douglas County, at bridge on County Trunk Z, 3.0 mi southeast of South Superior.

Drainage area.--16.7 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04024467 Bear Creek near South Superior, Wis.

Location.--SW¼SW¼ sec. 9, T. 48 N., R. 13 W., Douglas County, at bridge on County Trunk Z, 300 ft upstream from Douglas County Hospital and Sanatorium sewage-treatment plant, 4.3 mi southeast of South Superior.

Drainage area.--3.56 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Minimum discharge measured.--0 ft^3/s, Aug. 1, 1974, July 24 and Aug. 21, 1975.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--No flow was observed on three occasions.

Accuracy.--Not applicable.

04024510 Amnicon River near Patzau, Wis.

Location.--NE¼SE¼ sec. 14, T. 46 N., R. 14 W., Douglas County, at bridge on country road, 7.2 mi east of Patzau.

Drainage area.--5.09 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04024550 Bear Creek near Patzau, Wis.

Location.--SW¼SE¼ sec. 35, T. 46 N., R. 14 W., Douglas County, at bridge on country road, 8.4 mi southeast of Patzau.

Drainage area.--9.79 mi^2. Tributary to.--Amnicon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.32 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.25 ft^3/s, $Q_{7,10}$ = 0.07 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024660 Amnicon River near Solon Springs, Wis.

Location.--NW¼NW¼ sec. 23, T. 46 N., R. 13 W., Douglas County, at bridge on County Trunk L, 10.2 mi northwest of Solon Springs.

Drainage area.--50.2 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.98 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.80 ft^3/s, $Q_{7,10}$ = 0.26 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024710 Cranberry Creek near Solon Springs, Wis.

Location.--NW¼SE¼ sec. 23, T. 46 N., R. 13 W., Douglas County, at bridge on County Trunk L, 9.3 mi northwest of Solon Springs.

Drainage area.--8.70 mi^2. Tributary to.--Amnicon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.38 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.30 ft^3/s, $Q_{7,10}$ = 0.07 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024790 Amnicon River near Hines, Wis.

Location.--NE¼NW¼ sec. 2, T. 46 N., R. 13 W., Douglas County, at bridge on County Trunk B, 3.7 mi southwest of Hines.

Drainage area.--64.9 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 4.11 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.32 ft^3/s, $Q_{7,10}$ = 1.3 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04024810 Little Amnicon River near South Range, Wis.

Location.--SW¼NE¼ sec. 15, T. 47 N., R. 13 W., Douglas County, at bridge on County Trunk K, 3.5 mi south of South Range.

Drainage area.--20.5 mi^2. Tributary to.--Amnicon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.36 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.26 ft^3/s, $Q_{7,10}$ = 0.13 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025000 Amnicon River near Poplar, Wis.

Location.--NE¼NE¼ sec. 32, T. 48 N., R. 12 W., Douglas County, at bridge on U.S. Highway 2, 4.5 mi northwest of Poplar.

Drainage area.--113 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Minimum discharge measured.--2.60 ft^3/s, Aug. 3, 1976.

Low-flow frequency.--$Q_{7,2}$ = 4.7 ft^3/s, $Q_{7,10}$ = 2.2 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River near Brule using 15 discharge measurements made during the period 1964-76.

Accuracy.--$SE_{7,2}$ = 20 percent, $SE_{7,10}$ = 21 percent.

Remarks.--A continuous-record gaging station was operated at this site during the period 1914-16 (published as "near Amnicon Falls"). Minimum discharge during that period was about 1 ft^3/s on Sept. 7, 1915.

04025010 Amnicon River near South Range, Wis.

Location.--SW¼SE¼ sec. 8, T. 48 N., R. 12 W., Douglas County, at bridge on State Highway 13, 5.0 mi northeast of South Range.

Drainage area.--118 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 5.98 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 4.50 ft^3/s, $Q_{7,10}$ = 2.0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025050 Middle River near Hawthorne, Wis.

Location.--SW¼SE¼ sec. 34, T. 47 N., R. 12 W., Douglas County, at bridge on County Trunk B, 0.2 mi east of Hawthorne.

Drainage area.--26.9 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 1.17 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.84 ft^3/s, $Q_{7,10}$ = 0.27 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025057 Middle River near Hines, Wis.

Location.--SE¼NW¼ sec. 21, T. 47 N., R. 12 W., Douglas County, at Middle River Sanitarium sewage-treatment plant, 1.4 mi east of Hines.

Drainage area.--31.6 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Minimum discharge measured.--1.07 ft^3/s, Aug. 21, 1975.

Low-flow frequency.--$Q_{7,2}$ = 0.88 ft^3/s, $Q_{7,10}$ = 0.43 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River near Brule using 6 discharge measurements made during the period 1972-75.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04025070 Middle River near Poplar, Wis.

Location.--NW¼SW¼ sec. 36, T. 48 N., R. 12 W., Douglas County, at bridge on U.S. Highway 2, 1.4 mi northwest of Poplar.

Drainage area.--44.8 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 1.67 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 1.2 ft^3/s, $Q_{7,10}$ = 0.49 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025100 Middle River near Poplar, Wis.

Location.--SE¼SE¼ sec. 12, T. 48 N., R. 12 W., Douglas County, at bridge on State Highway 13, 4.6 mi north of Poplar.

Drainage area.--51.6 mi^2. Tributary to.--Lake Superior.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--0.36 ft^3/s, Aug. 3, 1976.

Low-flow frequency.--$Q_{7,2}$ = 1.2 ft^3/s, $Q_{7,10}$ = 0.58 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 14 discharge measurements made during the period 1964-76.

Accuracy.--$SE_{7,2}$ = 25 percent, $SE_{7,10}$ = 29 percent.

04025110 Poplar River near Hawthorne, Wis.

Location.--SW¼NE¼ sec. 30, T. 47 N., R. 11 W., Douglas County, at bridge on town road, 3.5 mi northeast of Hawthorne.

Drainage area.--9.71 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.19 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.14 ft^3/s, $Q_{7,10}$ = 0.04 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04025120 Poplar River near Poplar, Wis.

Location.--SE¼NW¼ sec. 6, T. 47 N., R. 11 W., Douglas County, at bridge on U.S. Highway 2, 0.2 mi east of Poplar.

Drainage area.--22.5 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.72 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.52 ft^3/s, $Q_{7,10}$ = 0.18 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025140 Poplar River near Poplar, Wis.

Location.--SE¼SE¼ sec. 7, T. 48 N., R. 11 W., Douglas County, at bridge on State Highway 13, 4.6 mi north of Poplar.

Drainage area.--27.2 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.57 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.41 ft^3/s, $Q_{7,10}$ = 0.16 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025250 Pearson Creek near Maple, Wis.

Location.--SE¼SE¼ sec. 34, T. 49 N., R. 11 W., Douglas County, at bridge on country road, 6.1 mi north of Maple.

Drainage area.--8.85 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04025300 Bois Brule River near Solon Springs, Wis.

Location.--SE¼SE¼ sec. 25, T. 46 N., R. 11 W., Douglas County, at bridge on County Trunk S, at Stone Bridge Campground, 8.5 mi northeast of Solon Springs.

Drainage area.--27.6 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 25, 1970, 26.0 ft^3/s; July 21, 1971, 24.8 ft^3/s; Aug. 17, 1971, 29.6 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 18 ft^3/s, $Q_{7,10}$ = 11 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025370 Bois Brule River near Brule, Wis.

Location.--NW¼NE¼ sec. 34, T. 47 N., R. 10 W., Douglas County, at bridge on County Trunk B, 2.6 mi southwest of Brule.

Drainage area.-- Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--May 12, 1960, 116 ft^3/s; July 14, 1960, 95.0 ft^3/s.

04025450 Nebagamon Creek near Brule, Wis.

Location.--SW¼NW¼ sec. 27, T. 47 N., R. 10 W., Douglas County, at bridge on town road, 2.6 mi southwest of Brule.

Drainage area.--59.3 mi^2. Tributary to.--Bois Brule River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 13.2 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 9.4 ft^3/s, $Q_{7,10}$ = 4.5 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04025500 Bois Brule River at Brule, Wis.

Location.--NW¼SW¼ sec. 23, T. 47 N., R. 10 W., Douglas County, at ranger station 1.4 mi southwest of Brule.

Drainage area.--120 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Average discharge.--33 years, 171 ft^3/s.

Extremes.--Maximum discharge, 1,520 ft^3/s June 5, 1944; minimum discharge, 67 ft^3/s Mar. 13, 1943.

Period of consecutive days	Magnitude and frequency of annual low flow. Discharge, in cubic feet per second, for indicated recurrence interval, in years					
	2	5	10	20	50	100
7	115	107	103	99	95	93
14	117	108	104	100	96	94
30	121	111	106	102	98	95
60	125	115	110	106	102	99
90	128	118	113	106	105	102

Duration table of daily flow. Discharge, in cubic feet per second, which was exceeded for indicated percent of time							
Percent	2	5	10	20	30	40	50
ft^3/s	430	331	258	197	170	156	146
Percent	60	70	80	90	95	99	99.9
ft^3/s	139	132	126	118	113	105	95

Accuracy.--$SE_{7,2}$ = 2 percent, $SE_{7,10}$ = 2 percent.

04025502 Little Bois Brule River near Brule, Wis.

Location.--NW¼NW¼ sec. 35, T. 47 N., R. 10 W., Douglas County, at bridge on State Highway 27, 2.5 mi southwest of Brule.

Drainage area.-- Tributary to.--Bois Brule River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 3, 1976, 4.32 ft^3/s; Aug. 24, 1977, 2.27 ft^3/s.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04025518 Sandy Run at Brule, Wis.

Location.--SW¼NE¼ sec. 13, T. 47 N., R. 10 W., Douglas County, at culvert on U.S. Highway 2, 0.8 mi east of Brule.

Drainage area.--3.04 mi^2. Tributary to.--Bois Brule River.

Type of site.--Miscellaneous site.

Discharge measurements.--July 23, 1975, 4.08 ft^3/s; Aug. 20, 1975, 4.28 ft^3/s; Aug. 3, 1976, 3.66 ft^3/s; Aug. 24, 1977, 3.52 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.4 ft^3/s, $Q_{7,10}$ = 3.2 ft^3/s.

Basis of estimate.--Correlated with Brule River at Brule using 4 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04026000 Bois Brule River near Brule, Wis.

Location.--NE¼ sec. 26, T. 48 N., R. 10 W., Douglas County, at former site of Brule Outing Club, 4.4 mi north of Brule.

Drainage area.--153 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--1914-17.

Extremes.--Maximum discharge, 1,490 ft^3/s Apr. 21, 1916; minimum discharge, 115 ft^3/s Mar. 20, 1914.

Low-flow frequency.--$Q_{7,2}$ = 122 ft^3/s, $Q_{7,10}$ = 110 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 12 daily discharge values during the period 1914-17.

Accuracy.--$SE_{7,2}$ = 11 percent, $SE_{7,10}$ = 11 percent.

04026001 Bois Brule River near Brule, Wis.

Location.--NE¼NE¼ sec. 22, T. 48 N., R. 10 W., Douglas County, at bridge on County Trunk FF, 5.8 mi north of Brule.

Drainage area.--175 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 140 ft^3/s.

04026005 Bois Brule River near Lake Superior, Wis.

Location.--SW¼SE¼ sec. 22, T. 49 N., R. 10 W., Douglas County, at bridge on country road, 2.9 mi upstream from mouth, 10.5 mi north of Brule.

Drainage area.--181 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Minimum discharge measured.--150 ft^3/s, July 21, 1971.

Low-flow frequency.--$Q_{7,2}$ = 140 ft^3/s, $Q_{7,10}$ = 123 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 7 discharge measurements made during the period 1970-71.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04026007 Bois Brule River near Brule, Wis.

Location.--NE¼SW¼ sec. 10, T. 49 N., R. 10 W., Douglas County, approximately 0.6 mi upstream from mouth, 13.2 mi north of Brule.

Drainage area.--Not available. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 20, 1912, 32.5 ft^3/s.

04026030 Reefer Creek near Port Wing, Wis.

Location.--SW¼SW¼ sec. 4, T. 49 N., R. 9 W., Bayfield County, at town road, 6.2 mi southwest of Port Wing.

Drainage area.--10.9 mi^2. Tributary to.--Lake Superior.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--2.00 ft^3/s, Aug. 20, 1969.

Low-flow frequency.--$Q_{7,2}$ = 2.7 ft^3/s, $Q_{7,10}$ = 2.4 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River near Brule using 15 discharge measurements made during the period 1964-76.

Accuracy.--$SE_{7,2}$ = 21 percent, $SE_{7,10}$ = 21 percent.

04026032 Reefer Creek near Port Wing, Wis.

Location.--SW¼NW¼ sec. 4, T. 49 N., R. 9 W., Bayfield County, at bridge on State Highway 13, 6.0 mi west of Port Wing.

Drainage area.--11.4 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 3.04 ft^3/s.

04026040 Iron River at Iron River, Wis.

Location.--NW¼NE¼ sec. 7, T. 47 N., R. 8 W., Bayfield County, at country bridge and sewage-treatment plant, at Iron River.

Drainage area.--19.1 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Minimum discharge measured.--10.8 ft^3/s, Sept. 18, 1973.

Low-flow frequency.--$Q_{7,2}$ = 7.4 ft^3/s, $Q_{7,10}$ = 5.7 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River near Brule using 6 discharge measurements made during the period 1972-75.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04026045 Iron River near Iron River, Wis.

Location.--SW¼SW¼ sec. 19, T. 48 N., R. 8 W., Bayfield County, at culvert on County Trunk B, 3.8 mi north of Iron River.

Drainage area.--26.4 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 11.2 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 7.9 ft^3/s, $Q_{7,10}$ = 4.4 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026060 Muskeg Creek near Iron River, Wis.

Location.--SW¼NW¼ sec. 26, T. 48 N., R. 9 W., Bayfield County, at bridge on country road, 4.4 mi northwest of Iron River.

Drainage area.--17.0 mi^2. Tributary to.--Iron River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 5.21 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.7 ft^3/s, $Q_{7,10}$ = 1.8 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026070 Iron River near Iron River, Wis.

Location.--SW¼SW¼ sec. 26, T. 49 N., R. 9 W., Bayfield County, at bridge on country road, 9.3 mi north of Iron River.

Drainage area.--59.7 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 19.8 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 14 ft^3/s, $Q_{7,10}$ = 11 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026110 East Fork near Iron River, Wis.

Location.--SE¼SE¼ sec. 25, T. 49 N., R. 9 W., Bayfield County, at bridge on town road, 8.7 mi north of Iron River.

Drainage area.--63.2 mi^2. Tributary to.--Iron River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 27.4 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 20 ft^3/s, $Q_{7,10}$ = 20 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026115 Jardine Creek near Port Wing, Wis.

Location.--SW¼NE¼ sec. 35, T. 50 N., R. 9 W., Bayfield County, at bridge on State Highway 13, 3.4 mi west of Port Wing.

Drainage area.--4.58 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026120 Flag River at Port Wing, Wis.

Location.--SE¼NW¼ sec. 28, T. 50 N., R. 8 W., Bayfield County, at State Highway 13, 0.7 mi northeast of Port Wing.

Drainage area.--34.0 mi^2. Tributary to.--Lake Superior.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--27.2 ft^3/s, June 17, 1971.

Low-flow frequency.--$Q_{7,2}$ = 29 ft^3/s, $Q_{7,10}$ = 27 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River near Brule using 15 discharge measurements made during the period 1964-76.

Accuracy.--$SE_{7,2}$ = 8 percent, $SE_{7,10}$ = 8 percent.

04026130 East Fork Cranberry River near Port Wing, Wis.

Location.--NE¼NW¼ sec. 29, T. 50 N., R. 7 W., Bayfield County, at bridge on town road, 5.4 mi east of Port Wing.

Drainage area.--48.2 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 24.0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 17 ft^3/s, $Q_{7,10}$ = 13 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026150 Lost Creek No. 2 near Cornucupia, Wis.

Location.--SE¼NE¼ sec. 5, T. 50 N., R. 6 W., Bayfield County, at bridge on country road, 1.7 mi southwest of Cornucopia.

Drainage area.--1.99 mi^2. Tributary to.--Lost Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.80 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.52 ft^3/s, $Q_{7,10}$ = 0.43 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026160 Siskiwit River at Cornucopia, Wis.

Location.--SW¼NW¼ sec. 35, T. 51 N., R. 6 W., Bayfield County, at bridge on country road, 0.5 mi east of Cornucopia.

Drainage area.--28.8 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 6.59 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 4.6 ft^3/s, $Q_{7,10}$ = 3.1 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026190 Sand River near Red Cliff, Wis.

Location.--SW¼NE¼ sec. 14, T. 51 N., R. 5 W., Bayfield County, at bridge on State Highway 13, 8.5 mi northwest of Red Cliff.

Drainage area.--28.2 mi^2. Tributary to.--Lake Superior.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--3.99 ft^3/s, Aug. 3, 1976.

Low-flow frequency.--$Q_{7,2}$ = 4.2 ft^3/s, $Q_{7,10}$ = 3.8 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 15 discharge measurements made during the period 1964-76.

Accuracy.--$SE_{7,2}$ = 12 percent, $SE_{7,10}$ = 12 percent.

04026215 Raspberry River near Sand Bay, Wis.

Location.--NW¼SE¼ sec. 2, T. 51 N., R. 4 W., Bayfield County, at bridge on road, on Red Cliff Indian Reservation, 3.2 mi southeast of Sand Bay.

Drainage area.--13.9 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.64 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.50 ft^3/s, $Q_{7,10}$ = 0.40 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026230 North Pikes Creek near Bayfield, Wis.

Location.--SW¼SW¼ sec. 16, T. 50 N., R. 4 W., Bayfield County, at bridge on town road, 3.0 mi west of Bayfield.

Drainage area.--15.5 mi^2. Tributary to.--Pikes Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.75 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 1.1 ft^3/s, $Q_{7,10}$ = 0.61 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

040262301 Pikes Creek near Bayfield, Wis.

Location.--NW¼NE¼ sec. 28, T. 50 N., R. 4 W., Bayfield County, at Department of Natural Resources fish hatchery, 3.0 mi southwest of Bayfield.

Drainage area.--30.4 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--July 23, 1975, 8.05 ft^3/s; Aug. 3, 1976, 7.75 ft^3/s; Aug. 25, 1977, 6.81 ft^3/s; Nov. 15, 1978, 13.1 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 8.0 ft^3/s, $Q_{7,10}$ = 6.2 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 4 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04026300 Sioux River near Washburn, Wis.

Location.--NE¼NE¼ sec. 35, T. 49 N., R. 5 W., Bayfield County, at County Trunk C, 2.5 mi northwest of Washburn.

Drainage area.--35.2 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Minimum discharge measured.--6.0 ft^3/s, July 23 and 24, 1966.

Low-flow frequency.--$Q_{7,2}$ = 7.0 ft^3/s, $Q_{7,10}$ = 6.0 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 20 discharge measurements made during the period 1962-71.

Accuracy.--$SE_{7,2}$ = 10 percent, $SE_{7,10}$ = 13 percent.

Remarks.--Station was operated as continuous-record gaging station during open-water season from September 1958 to April 1970. Since April 1970 daily discharge records are available only for flood peaks. Daily precipitation also has been observed at the site.

04026309 Sioux River near Washburn, Wis.

Location.--SE¼NE¼ sec. 18, T. 49 N., R. 4 W., Bayfield County, upstream from Little Sioux River, 3.9 mi north of Washburn.

Drainage area.--52.3 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 23.0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 16 ft^3/s, $Q_{7,10}$ = 12 ft^3/s.

Basis of estimate.--Used regression equations 4 and 6.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 84 percent.

04026315 Little Sioux River near Washburn, Wis.

Location.--SE¼NE¼ sec. 18, T. 49 N., R. 4 W., Bayfield County, at bridge on country road, 3.9 mi north of Washburn.

Drainage area.--24.1 mi^2. Tributary to.--Sioux River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 11.8 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 8.5 ft^3/s, $Q_{7,10}$ = 5.7 ft^3/s.

Basis of estimate.--Used regression equations 4 and 6.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 84 percent.

04026318 Boyd Creek near Ashland, Wis.

Location.--NE¼SE¼ sec. 22, T. 48 N., R. 5 W., Bayfield County, at bridge on country road, 4.5 mi northwest of courthouse at Ashland.

Drainage area.--3.11 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--July 22, 1975, <0.1 ft^3/s; Aug. 4, 1976, 0 ft^3/s; Aug. 25, 1977, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Observed stream dry on two occasions.

Accuracy.--Not applicable.

04026320 Whittlesey Creek near Ashland, Wis.

Location.--NW¼SW¼ sec. 35, T. 48 N., R. 5 W., Bayfield County, at country road bridge, 3.8 mi east of Ashland.

Drainage area.--Not available. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 18, 1972, 18.1 ft^3/s.

04026323 Whittlesey Creek tributary near Ashland, Wis.

Location.--SW¼NW¼ sec. 35, T. 48 N., R. 5 W., Bayfield County, just below confluence of two tributaries, at country road 0.3 mi south of Ondassagon School, 4.0 mi east of Ashland.

Drainage area.--0.94 mi^2. Tributary to.--Whittlesey Creek.

Type of site.--Miscellaneous site.

Minimum discharge measured.--0.51 ft^3/s, Oct. 18, 1972.

Low-flow frequency.--$Q_{7,2}$ = 0.58 ft^3/s, $Q_{7,10}$ = 0.54 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 8 discharge measurements made during the the period 1972-77.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04026325 Whittlesey Creek near Ashland, Wis.

Location.--SE¼NE¼ sec. 35, T. 48 N., R. 5 W., Bayfield County, at bridge on State Highway 13, 3.6 mi west of Ashland.

Drainage area.--25.3 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 17.2 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 12 ft^3/s, $Q_{7,10}$ = 9 percent.

Basis of estimate.--Used regression equations 4 and 6.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 84 percent.

04026331 South Fish Creek at Benoit, Wis.

Location.--NE¼SE¼ sec. 35, T. 47 N., R. 6 W., Bayfield County, at bridge on County Trunk F, 0.4 mi north of Benoit.

Drainage area.--12.2 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026335 South Fish Creek near Benoit, Wis.

Location.--NE¼SE¼ sec. 24, T. 47 N., R. 6 W., Bayfield County, at bridge on U.S. Highway 63, 2.7 mi northeast of Benoit.

Drainage area.--17.3 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.13 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.09 ft^3/s, $Q_{7,10}$ = 0.07 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026337 South Fish Creek near Moquah, Wis.

Location.--SE¼NE¼ sec. 20, T. 47 N., R. 5 W., Bayfield County, at bridge on town road, 4.0 mi southeast of Moquah.

Drainage area.--Not available. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 19, 1964, 0.05 ft^3/s.

04026341 South Fish Creek near Ashland, Wis.

Location.--NE¼NE¼ sec. 15, T. 47 N., R. 5 W., Bayfield County, 1.8 mi upstream from State Highway 112, 4.7 mi southwest of Ashland.

Drainage area.--38.7 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.42 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.13 ft^3/s, $Q_{7,10}$ = 0.08 ft^3/s.

Basis of estimate.--Used regression equations 4 and 6.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 84 percent.

04026346 North Fish Creek near Benoit, Wis.

Location.--NE¼NW¼ sec. 29, T. 47 N., R. 6 W., Bayfield County, at bridge on U.S. Highway 2, 3.8 mi northwest of Benoit.

Drainage area.--38.3 mi^2. Tributary to.--Fish Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 1.37 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 1.0 ft^3/s, $Q_{7,10}$ = 0.34 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 84 percent.

04026347 Pine Creek at Moquah, Wis.

Location.--NW¼NE¼ sec. 15, T. 47 N., R. 6 W., Bayfield County, at bridge on town road, 1.4 mi southwest of Moquah.

Drainage area.--5.90 mi^2. Tributary to.--North Fish Creek.

Type of site.--Gaging station.

Period of record.--October 1975 to September 1977.

Minimum discharge measured.--3.4 ft^3/s, May 26-29, 1976.

Low-flow frequency.--$Q_{7,2}$ = 3.4 ft^3/s, $Q_{7,10}$ = 2.9 ft^3/s.

Basis of estimate.--Correlated with Bois Brule at Brule using 12 daily discharge values recorded during the period 1976-77.

Accuracy.--$SE_{7,2}$ = 14 percent, $SE_{7,10}$ = 14 percent.

04026348 Pine Creek tributary at Moquah, Wis.

Location.--SW¼SE¼ sec. 1, T. 47 N., R. 6 W., Bayfield County, at bridge on County Trunk G, 1.1 mi east of Moquah.

Drainage area.--0.57 mi^2. Tributary to.--Pine Creek.

Type of site.--Miscellaneous site.

Period of record.--November 1975 to September 1976.

Minimum discharge observed.--No flow on many days.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Observation of no flow on many days.

Accuracy.--Not applicable.

04026349 Pine Creek near Moquah, Wis.

Location.--SW¼SE¼ sec. 13, T. 47 N., R. 6 W., Bayfield County, at bridge on town road, 1.8 mi southeast of Moquah.

Drainage area.--21.5 mi^2. Tributary to.--North Fish Creek.

Type of site.--Gaging station.

Period of record.--November 1975 to September 1977.

Minimum discharge measured.--18 ft^3/s, Mar. 17, 1976.

Low-flow frequency.--$Q_{7,2}$ = 20 ft^3/s, $Q_{7,10}$ = 20 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 13 daily discharge values recorded during the period 1976-77.

Accuracy.--$SE_{7,2}$ = 4 percent, $SE_{7,10}$ = 4 percent.

04026350 North Fish Creek near Ashland, Wis.

Location.--NW¼SW¼ sec. 2, T. 27 N., R. 5 W., Bayfield County, at bridge on U.S. Highway 2, 3.9 mi west of Ashland.

Drainage area.--88.1 mi^2. Tributary to.--Fish Creek.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--70.0 ft^3/s, June 17, 1971.

Low-flow frequency.--$Q_{7,2}$ = 74 ft^3/s, $Q_{7,10}$ = 72 ft^3/s.

Basis of estimate.--Correlated with Bois Brule River at Brule using 16 discharge measurements made during the period 1967-76.

Accuracy.--$SE_{7,2}$ = 12 percent, $SE_{7,10}$ = 12 percent.

04026360 Bay City Creek near Ashland, Wis.

Location.--NE¼NE¼ sec. 17, T. 47 N., R. 4 W., Ashland County, at bridge on country road, 2.1 mi south of Ashland.

Drainage area.--2.61 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026365 Bay City Creek near Ashland, Wis.

Location.--SW¼NE¼ sec. 4, T. 47 N., R. 4 W., Ashland County, at bridge on State Highway 13, near Northland College, in Ashland.

Drainage area.--4.78 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026368 Bay City Creek at Ashland, Wis.

Location.--SW¼NE¼ sec. 33, T. 48 N., R. 4 W., Ashland County, at bridge on U.S. Highway 2, near mouth, in Ashland.

Drainage area.--6.01 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026378 Beartrap Creek near Ashland, Wis.

Location.--NE¼NW¼ sec. 27, T. 27 N., R. 4 W., Ashland County, at bridge on State Highway 13, 4.3 mi south of Ashland.

Drainage area.--3.75 mi^2. Tributary to.--Kakagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026380 Beartrap Creek near Ashland, Wis.

Location.--SW¼SW¼ sec. 13, T. 47 N., R. 4 W., Ashland County, at bridge on town road, 4.2 mi southeast of Ashland.

Drainage area.--9.33 mi^2. Tributary to.--Kakagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026385 Beartrap Creek near Ashland, Wis.

Location.--SW¼NW¼ sec. 6, T. 47 N., R. 3 W., Ashland County, at bridge on County Trunk A, 4.0 mi east of Ashland.

Drainage area.--18.6 mi^2. Tributary to.--Kakagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026390 Beartrap Creek near Ashland, Wis.

Location.--SE¼NE¼ sec. 29, T. 48 N., R. 3 W., Ashland County, at bridge on U.S. Highway 2, 5.9 mi east of Ashland.

Drainage area.--22.9 mi^2. Tributary to.--Kakagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04026400 Spillerberg Creek near Cayuga, Wis.

Location.--NE¼NW¼ sec. 21, T. 43 N., R. 2 W., Ashland County, at bridge on State Highway 13, 4.3 mi southeast of Cayuga.

Drainage area.--6.16 mi^2. Tributary to.--Bad River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--No flow was observed on July 27, 1964.

Low-flow frequency.--$Q_{7,2}$ = 0.52 ft^3/s, $Q_{7,10}$ = 0.05 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 15 discharge measurements made during the period 1961-76.

Accuracy.--$SE_{7,2}$ = 75 percent, $SE_{7,10}$ = 75 percent.

04026410 Bad River at Morse, Wis.

Location.--SW¼NE¼ sec. 9, T. 43 N., R. 2 W., Ashland County, at bridge on country road, 0.3 mi north of Morse.

Drainage area.--32.6 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 1.64 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 2.5 ft^3/s, $Q_{7,10}$ = 1.1 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026449 Iron River near Mellen, Wis.

Location.--NE¼NW¼ sec. 26, T. 44 N., R. 3 W., Ashland County, at bridge on country road, at mouth, 4.4 mi southwest of Mellen.

Drainage area.--27.9 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 2.24 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.4 ft^3/s, $Q_{7,10}$ = 1.3 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026450 Bad River near Mellen, Wis.

Location.--NE¼NW¼ sec. 26, T. 44 N., R. 3 W., Ashland County, on left bank 150 ft downstream from bridge on country road, 250 ft downstream from Iron River, 4.4 mi southwest of Mellen.

Drainage area.--83.4 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Average discharge.--5 years, 103 ft^3/s.

Extremes.--Maximum discharge, 2,130 ft^3/s July 23, 1972; minimum discharge, 4.9 ft^3/s Aug. 19, 1975.

Low-flow frequency.--$Q_{7,2}$ = 8.6 ft^3/s, $Q_{7,10}$ = 4.7 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 4 annual 7-day low-flow values and 12 daily discharge values during the period 1972-75.

Duration table of daily flow

Discharge, in cubic feet per second, which was exceeded for indicated percent of time

Percent	2	5	10	20	30	40	50
ft^3/s	655	400	242	128	71	59	44
Percent	60	70	80	90	95	99	99.9
ft^3/s	36	31	27	20	15	7.4	5.1

Accuracy.--$SE_{7,2}$ = 24 percent, $SE_{7,10}$ = 25 percent.

04026500 Bad River at Mellen, Wis.

Location.--NW¼NE¼ sec. 6, T. 44 N., R. 2 W., Ashland County, at bridge on State Highway 13, at Mellen.

Drainage area.--105 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--May 1948 to September 1955.

Average discharge.--7 years, 131 ft^3/s.

Extremes.--Maximum discharge, 4,340 ft^3/s July 4, 1949; minimum discharge, 3.8 ft^3/s Aug. 25-27, 1948.

Period of consecutive days	Magnitude and frequency of annual low flow. Discharge, in cubic feet per second, for indicated recurrence interval, in years				
	2	5	10	20	50
7	12	7.2	5.4	4.2	3.0
14	13	8.2	6.2	4.9	3.8
30	16	10	8.1	6.5	5.1
60	21	14	11	9	6.8
90	26	17	13	11	8.8

Duration table of daily flow

Discharge, in cubic feet per second, which was exceeded for indicated percent of time

Percent	2	5	10	20	30	40	50
ft^3/s	930	525	300	150	88	60	43
Percent	60	70	80	90	95	98	99.9
ft^3/s	32	26	21	16	13	9.3	6.8

Accuracy.--$SE_{7,2}$ = 9 percent, $SE_{7,10}$ = 15 percent.

Remarks.--Period of record used for low-flow frequency analyses was extended to 35 years (1916-22, 1949-76) by regression relationship with streamflow record at Bad River near Odanah.

04026510 Montreal Creek at Mellen, Wis.

Location.--NE¼NE¼ sec. 6, T. 44 N., R. 2 W., Ashland County, at bridge on country road, at mouth, 0.4 mi northeast of Mellen.

Drainage area.--26.2 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 3.16 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 4.8 ft^3/s, $Q_{7,10}$ = 4.1 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026530 Tyler Forks River near Mellen, Wis.

Location.--SW¼NW¼ sec. 21, T. 44 N., R. 1 E., Iron County, at bridge on country road, 8.2 mi southeast of Mellen.

Drainage area.--25.0 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 1.35 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 2.0 ft^3/s, $Q_{7,10}$ = 0.72 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026550 Tyler Forks River near Upson, Wis.

Location.--NW¼SE¼ sec. 28, T. 45 N., R. 1 W., Iron County, at State Highway 77, 4.3 mi southwest of Upson.

Drainage area.--41.3 mi^2. Tributary to.--Bad River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--1.68 ft^3/s, Aug. 4, 1976.

Low-flow frequency.--$Q_{7,2}$ = 4.3 ft^3/s, $Q_{7,10}$ = 2.4 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 15 discharge measurements made during the period 1967-76.

Accuracy.--$SE_{7,2}$ = 14 percent, $SE_{7,10}$ = 20 percent.

04026560 Tyler Forks River near Mellen, Wis.

Location.--NE¼SE¼ sec. 2, T. 45 N., R. 2 W., Ashland County, at bridge on State Highway 169, 7.2 mi northeast of Mellen.

Drainage area.--69.4 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 4.39 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 6.6 ft^3/s, $Q_{7,10}$ = 3.1 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026580 Marengo River near Grandview, Wis.

Location.--NE¼SE¼ sec. 16, T. 44 N., R. 5 W., Bayfield County, at bridge on U.S. Forest Service Road 198, 7.8 mi southeast of Grandview.

Drainage area.--24.7 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 4.53 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 6.6 ft^3/s, $Q_{7,10}$ = 3.0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026590 Marengo River near Grandview, Wis.

Location.--SE¼SW¼ sec. 22, T. 45 N., R. 5 W., Bayfield County, at bridge on country road, 6.0 mi east of Grandview.

Drainage area.--49.8 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 8.88 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 13 ft^3/s, $Q_{7,10}$ = 8.5 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026600 Marengo River near Marengo, Wis.

Location.--NW¼NW¼ sec. 36, T. 46 N., R. 4 W., Ashland County, at State Highway 13, 0.2 mi north of Marengo.

Drainage area.--101 mi^2. Tributary to.--Bad River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--28.0 ft^3/s, Aug. 26, 1970.

Low-flow frequency.--$Q_{7,2}$ = 34 ft^3/s, $Q_{7,10}$ = 29 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 17 discharge measurements made during the period 1967-76.

Accuracy.--$SE_{7,2}$ = 4 percent, $SE_{7,10}$ = 6 percent.

04026620 Brunsweiler River at Marengo, Wis.

Location.--NW¼NE¼ sec. 1, T. 45 N., R. 4 W., Ashland County, at bridge on State Highway 13, 0.8 mi southeast of Marengo.

Drainage area.--62.9 mi^2. Tributary to.--Marengo River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 26, 1970, 6.09 ft^3/s; Aug. 19, 1975, 6.48 ft^3/s; Aug. 4, 1976, 6.70 ft^3/s; Aug. 24, 1977, 11.4 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 10 ft^3/s, $Q_{7,10}$ = 6.4 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 4 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04026650 Trout Brook near High Bridge, Wis.

Location.--NW¼SW¼ sec. 8, T. 45 N., R. 3 W., Ashland County, at State Highway 13, 1.9 mi west of High Bridge.

Drainage area.--8.60 mi^2. Tributary to.--Brunsweiler River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--0.38 ft^3/s, Aug. 4, 1976.

Low-flow frequency.--$Q_{7,2}$ = 1.1 ft^3/s, $Q_{7,10}$ = 0.60 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 15 discharge measurements made during the period 1967-76.

Accuracy.--$SE_{7,2}$ = 14 percent, $SE_{7,10}$ = 21 percent.

04026740 Marengo River near Mellen, Wis.

Location.--SE¼SE¼ sec. 33, T. 46 N., R. 3 W., Ashland County, at bridge on country road, 2.4 mi northwest of Mellen.

Drainage area.--189 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 35.8 ft^3/s.

04026760 Silver Creek near Mellen, Wis.

Location.--SE¼SW¼ sec. 10, T. 45 N., R. 3 W., Ashland County, at bridge on State Highway 13, 5.3 mi northwest of Mellen.

Drainage area.--8.00 mi^2. Tributary to.--Marengo River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 1.19 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 1.7 ft^3/s, $Q_{7,10}$ = 1.1 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026859 Potato River at Upson, Wis.

Location.--SW¼NE¼ sec. 19, T. 45 N., R. 1 E., Iron County, at bridge on State Highway 77, at Upson.

Drainage area.--31.1 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 2.25 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.3 ft^3/s, $Q_{7,10}$ = 1.7 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026861 Alder Creek at Pence, Wis.

Location.--NE¼SE¼ sec. 31, T. 46 N., R. 2 E., Iron County, at culvert on Minneapolis, St. Paul, and Sault Ste. Marie Railroad, 0.4 mi northwest of Pence.

Drainage area.--Not available. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 18, 1972, 0.16 ft^3/s.

04026862 Alder Creek near Pence, Wis.

Location.--SW¼NW¼ sec. 30, T. 46 N., R. 2 E., Iron County, at culvert on country road, 2.0 mi northwest of Pence.

Drainage area.--Not available. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurements.--July 27, 1974, 0.08 ft^3/s; Oct. 18, 1972, 1.46 ft^3/s.

04026863 Alder Creek near Iron Belt, Wis.

Location.--SE¼NW¼ sec. 36, T. 46 N., R. 1 E., Iron County, 10 ft upstream from unnamed tributary, 1.7 mi north of Iron Belt.

Drainage area.--Not available. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurement.--June 4, 1964, 2.35 ft^3/s.

040268639 Alder Creek tributary at Iron Belt, Wis.

Location.--NW¼NW¼ sec. 2, T. 45 N., R. 1 E., Iron County, on road past sewage lagoon, 1.0 mi northwest of Iron Belt.

Drainage area.--1.24 mi^2. Tributary to.--Alder Creek.

Type of site.--Miscellaneous site.

Minimum discharge measured.--[1]0.36 ft^3/s, Aug. 19, 1975.

Low-flow frequency.--$^1Q_{7,2}$ = 0.40 ft^3/s, $^1Q_{7,10}$ = 0.36 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 6 discharge measurements made during the period 1972-75.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

Remarks.--[1]Discharge measured and low-flow frequency estimates include about 0.30 ft^3/s seepage from sewage lagoon.

04026864 Alder Creek tributary near Iron Belt, Wis.

Location.--SW¼SW¼ sec. 35, T. 46 N., R. 1 E., Iron County, at mouth, 1.3 mi northwest of Iron Belt.

Drainage area.--1.30 mi^2. Tributary to.--Alder Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--[1]Oct. 18, 1972, 0.79 ft^3/s.

Remarks.--[1]Discharge measured includes about 0.30 ft^3/s seepage from sewage lagoon.

04026865 Alder Creek near Iron Belt, Wis.

Location.--SW¼SW¼ sec. 35, T. 46 N., R. 1 E., Iron County, 300 ft downstream from Alder Creek tributary, 1.3 mi northwest of Iron Belt.

Drainage area.--11.6 mi^2. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 18, 1972, 4.62 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.49 ft^3/s, $Q_{7,10}$ = 0.12 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026867 Alder Creek near Upson, Wis.

Location.--SW¼SW¼ sec. 4, T. 45 N., R. 1 E., Iron County, at culvert on County Trunk E, 2.6 mi northeast of Upson.

Drainage area.--17.22 mi^2. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurements.--July 27, 1964, 0.68 ft^3/s; Aug. 26, 1970, 0.23 ft^3/s; Oct. 18, 1972, 5.91 ft^3/s; May 23, 1973, 13.7 ft^3/s.

Remarks.--Additional discharge measurements required to estimate low-flow characteristics.

040268675 Alder Creek tributary near Upson, Wis.

Location.--SW¼NE¼ sec. 5, T. 45 N., R. 1 E., Iron County, at culvert on County Trunk E, 3.0 mi northeast of Upson.

Drainage area.--Not available. Tributary to.--Alder Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--May 23, 1973, 1.50 ft^3/s.

04026868 Alder Creek near Upson, Wis.

Location.--SE¼SE¼ sec. 7, T. 45 N., R. 1 E., Iron County, 0.25 mi upstream from bridge on State Highway 122, 1.4 mi north of Upson.

Drainage area.--21.4 mi^2. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurement.--May 23, 1973, 17.8 ft^3/s.

04026869 Alder Creek tributary near Upson, Wis.

Location.--NE¼NE¼ sec. 18, T. 45 N., R. 1 E., Iron County, at private road culvert 500 ft upstream from mouth, 1.2 mi north of Upson.

Drainage area.--Not available. Tributary to.--Alder Creek.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 18, 1972, 0.37 ft^3/s; May 23, 1973, 0.82 ft^3/s.

04026870 Alder Creek near Upson, Wis.

Location.--SE¼SE¼ sec. 7, T. 45 N., R. 1 E., Iron County, on right bank 10 ft upstream from bridge on State Highway 122, 1.0 mi north of Upson.

Drainage area.--22.3 mi^2. Tributary to.--Potato River.

Type of site.--Gaging station.

Period of record.--1973-76.

Average discharge.--4 years, 26 ft^3/s.

Extremes.--Maximum discharge, 702 ft^3/s Aug. 17, 1972; minimum, 0.10 ft^3/s Aug. 12, 1975.

Low-flow frequency.--$Q_{7,2}$ = 0.50 ft^3/s, $Q_{7,10}$ = 0.16 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 31 daily discharge values recorded during the period 1972-76.

Duration table of daily flow

Discharge, in cubic feet per second, which was exceeded for indicated percent of time

Percent	2	5	10	20	30	40	50
ft^3/s	200	120	59	27	16	12	9.2
Percent	60	70	80	90	95	98	99.9
ft^3/s	7.5	6.0	4.2	1.9	0.06	0.02	0.01

Accuracy.--$SE_{7,2}$ = 58 percent, $SE_{7,10}$ = 59 percent.

Remarks.--Station discontinued in September 1977.

04026894 Lawrence Creek near Saxon, Wis.

Location.--NE¼NE¼ sec. 14, T. 46 N., R. 1 W., Iron County, at bridge on country road, 2.2 mi southwest of Saxon.

Drainage area.--10.4 mi^2. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.24 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.36 ft^3/s, $Q_{7,10}$ = 0.14 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04026900 Potato River near Gurney, Wis.

Location.--NW¼SW¼ sec. 16, T. 46 N., R. 1 W., Iron County, at bridge on State Highway 169, 0.7 mi south of Gurney.

Drainage area.--92.7 mi^2. Tributary to.--Bad River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--6.22 ft^3/s, Aug. 19, 1975.

Low-flow frequency.--$Q_{7,2}$ = 12 ft^3/s, $Q_{7,10}$ = 7.4 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 14 discharge measurements made during the period 1967-75.

Accuracy.--$SE_{7,2}$ = 9 percent, $SE_{7,10}$ = 14 percent.

04026945 Vaughn Creek at Saxon, Wis.

Location.--SE¼NW¼ sec. 6, T. 46 N., R. 1 E., Iron County, at bridge on State Highway 122, at Saxon.

Drainage area.--1.11 mi^2. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 19, 1972, 0 ft^3/s; Aug. 15, 1972, 0 ft^3/s; May 22, 1973, 0.155 ft^3/s; Sept. 19, 1973, 0 ft^3/s; July 30, 1974, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--No flow was observed on four occasions.

Accuracy.--Not applicable.

04026950 Vaughn Creek near Gurney, Wis.

Location.--NW¼SE¼ sec. 10, T. 46 N., R. 2 W., Ashland County, at bridge on country road, 4.4 mi west of Gurney.

Drainage area.--16.9 mi^2. Tributary to.--Potato River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 2.12 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.1 ft^3/s, $Q_{7,10}$ = 2.0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027000 Bad River near Odanah, Wis.

Location.--SE¼SE¼ sec. 2, T. 46 N., R. 3 W., Ashland County, at bridge on Elm Hoist Trail, 8.5 mi south of Odanah.

Drainage area.--611 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--1915-22, 1949-76.

Average discharge.--36 years, 614 ft^3/s.

Extremes.--Maximum discharge, 27,700 ft^3/s Apr. 24, 1960; minimum discharge, 49 ft^3/s Aug. 8, 1964.

Period of consecutive days	Magnitude and frequency of annual low flow. Discharge, in cubic feet per second, for indicated recurrence interval, in years					
	2	5	10	20	50	100
7	100	76	65	57	48	43
14	107	81	69	60	51	45
30	120	91	79	69	60	55
60	142	108	94	84	74	68
90	159	123				

Duration table of daily flow. Discharge, in cubic feet per second, which was exceeded for indicated percent of time							
Percent	2	5	10	20	30	40	50
ft^3/s	3,950	2,400	1,440	730	455	347	279
Percent	60	70	80	90	95	98	99.9
ft^3/s	228	187	152	117	95	69	54

Accuracy.--$SE_{7,2}$ = 5 percent, $SE_{7,10}$ = 9 percent.

04027045 White River near Delta, Wis.

Location.--NE¼NE¼ sec. 21, T. 46 N., R. 7 W., Bayfield County, at bridge on country road, 1.8 mi southeast of Delta.

Drainage area.--72.8 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 57.8 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 46 ft^3/s, $Q_{7,10}$ = 32 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027095 White River near Mason, Wis.

Location.--NE¼SE¼ sec. 25, T. 46 N., R. 7 W., Bayfield County, at bridge on country road, 5.5 mi west of Mason.

Drainage area.--95.7 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 83.4 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 67 ft^3/s, $Q_{7,10}$ = 50 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027110 Long Lake Branch at Drummond, Wis.

Location.--SE¼SE¼ sec. 32, T. 45 N., R. 7 W., Bayfield County, at bridge on U.S. Highway 63, 0.5 mi south of Drummond.

Drainage area.--22.5 mi^2. Tributary to.--White River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 1.24 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 1.0 ft^3/s, $Q_{7,10}$ = 0.41 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027113 Long Lake Branch at Drummond, Wis.

Location.--NE¼SE¼ sec. 29, T. 45 N., R. 7 W., Bayfield County, at trail crossing just downstream from Drummond Lake, 0.8 mi north of Drummond.

Drainage area.--24.5 mi^2. Tributary to.--White River.

Type of site.--Miscellaneous site.

Minimum discharge measured.--No flow on June 10, 1977 and Aug. 25, 1977. (Caused by regulation of lake outlet just upstream.)

Low-flow frequency.--$Q_{7,2}$ = 1.5 ft^3/s, $Q_{7,10}$ = 0.70 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 6 discharge measurements made during the period 1975-77.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04027140 Long Lake Branch near Grandview, Wis.

Location.--SW¼SE¼ sec. 9, T. 45 N., R. 6 W., Bayfield County, at bridge on country road, 1.5 mi north of Grandview.

Drainage area.--61.7 mi^2. Tributary to.--White River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 28.1 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 24 ft^3/s, $Q_{7,10}$ = 13 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027160 Eighteen Mile Creek at Grandview, Wis.

Location.--SW¼NE¼ sec. 21, T. 45 N., R. 6 W., Bayfield County, at culvert on U.S. Highway 63, 0.5 mi west of Grandview.

Drainage area.--27.2 mi^2. Tributary to.--Long Lake Branch.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 16.8 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 13 ft^3/s, $Q_{7,10}$ = 6.8 ft^3/s.

Basis of estimate.--Regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027200 Pearl Creek at Grandview, Wis.

Location.--SE¼NE¼ sec. 22, T. 45 N., R. 6 W., Bayfield County, at bridge on U.S. Highway 63, 0.8 mi east of Grandview.

Drainage area.--16.9 mi^2. Tributary to.--Long Lake Branch.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--4.78 ft^3/s, July 25, 1964.

Low-flow frequency.--$Q_{7,2}$ = 6.8 ft^3/s, $Q_{7,10}$ = 5.4 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 19 discharge measurements made during the period 1961-76.

Accuracy.--$SE_{7,2}$ = 5 percent, $SE_{7,10}$ = 7 percent.

04027250 White River near Mason, Wis.

Location.--SE¼SE¼ sec. 25, T. 46 N., R. 6 W., Bayfield County, at bridge on U.S. Highway 63, 0.6 mi southeast of Mason.

Drainage area.--243 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurements.--Feb. 24, 1914, 145 ft^3/s; Aug. 27, 1970, 138 ft^3/s.

04027260 Schramm Creek near Mason, Wis.

Location.--NE¼SE¼ sec. 12, T. 46 N., R. 6 W., Bayfield County, at bridge on U.S. Highway 63, 2.9 mi north of Mason.

Drainage area.--8.33 mi^2. Tributary to.--White River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 0 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--Not applicable.

04027265 Spring Creek near Mason, Wis.

Location.--NE¼NE¼ sec. 13, T. 46 N., R. 6 W., Bayfield County, at bridge on U.S. Highway 63, 2.5 mi north of Mason.

Drainage area.--3.23 mi^2. Tributary to.--Schramm Creek.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 0.55 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.42 ft^3/s, $Q_{7,10}$ = 0.35 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027500 White River near Ashland, Wis.

Location.--NE¼NE¼ sec. 6, T. 46 N., R. 4 W., Ashland County, at powerplant 6.4 mi south of downtown Ashland.

Drainage area.--279 mi^2. Tributary to.--Bad River.

Type of site.--Gaging station.

Period of record.--1949-76.

Average discharge.--28 years, 286 ft^3/s.

Extremes.--Maximum discharge, 6,270 ft^3/s July 1, 1953; minimum discharge, 3.1 ft^3/s Apr. 28-30, 1949.

Period of consecutive days	Magnitude and frequency of annual low flow. Discharge, in cubic feet per second, for indicated recurrence interval, in years					
	2	5	10	20	50	100
7	149	135	128	122	116	113
14	159	143	136	130	124	121
30	168	150	142	136	130	126
60	177	159	151	145	138	134
90	184	165	156	149	142	137

Duration table of daily flow. Discharge, in cubic feet per second, which was exceeded for indicated percent of time							
Percent	2	5	10	20	30	40	50
ft^3/s	1,080	710	475	315	255	225	205
Percent	60	70	80	90	95	98	99.9
ft^3/s	195	186	178	165	150	125	92

Accuracy.--$SE_{7,2}$ = 2 percent, $SE_{7,10}$ = 3 percent.

Remarks.--Flow occasionally regulated by dam located 0.6 mi upstream. Minimum flow of 3.1 ft^3/s was caused by regulation.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04027525 White River near Ashland, Wis.

Location.--SW¼SW¼ sec. 26, T. 47 N., R. 4 W., Ashland County, at bridge on Soo Line Railroad, 5.5 mi southeast of the courthouse in Ashland.

Drainage area.--Not available. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Feb. 23, 1914, 130 ft^3/s.

04027650 Denomie Creek near Odanah, Wis.

Location.--SE¼NE¼ sec. 31, T. 48 N., R. 2 W., Ashland County, at bridge on U.S. Highway 2, 2.0 mi southeast of Odanah.

Drainage area.--13.8 mi^2. Tributary to.--Bad River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.018 ft^3/s.

Low-flow frequency--$Q_{7,2}$ = 0.02 ft^3/s, $Q_{7,10}$ = 0.01 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$Q_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027845 Montreal River tributary near Hurley, Wis.

Location.--SE¼NW¼ sec. 33, T. 44 N., R. 3 E., Iron County, at bridge on country road, 14.2 mi south of Hurley.

Drainage area.--2.92 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--June 14, 1973, 1.27 ft^3/s; Oct. 5, 1975, 0.48 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.39 ft^3/s, $Q_{7,10}$ = 0.08 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027850 Montreal River near Hurley, Wis.

Location.--NE¼NW¼ sec. 29, T. 44 N., R. 3 E., Iron County, at culvert at outlet of Pine Lake.

Drainage area.--7.74 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--June 14, 1973, 16.9 ft^3/s; Oct. 5, 1975, 4.58 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 3.7 ft^3/s, $Q_{7,10}$ = 1.0 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027852 Montreal River tributary near Hurley, Wis.

Location.--SW¼SW¼ sec. 20, T. 44 N., R. 3 E., Iron County, at culvert on U.S. Highway 51, 12.6 mi south of Hurley.

Drainage area.--0.59 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 14, 1971, 0.217 ft^3/s; June 14, 1975, 0.16 ft^3/s; Oct. 5, 1975, 0.052 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.01 ft^3/s, $Q_{7,10}$ = <0.01 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027860 Montreal River tributary near Hurley, Wis.

Location.--NW¼SW¼ sec. 8, T. 44 N., R. 3 E., Iron County, at culvert on U.S. Highway 51, 10.2 mi south of Hurley.

Drainage area.--0.25 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 14, 1971, 0.279 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.08 ft^3/s, $Q_{7,10}$ = 0.01 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04027876 Laymans Creek near Hurley, Wis.

Location.--SE¼SW¼ sec. 1, T. 44 N., R. 2 E., Iron County, at culvert on town road, 9.3 mi south of Hurley.

Drainage area.--0.40 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 13, 1971, 2.30 ft^3/s; June 14, 1973, 3.48 ft^3/s; Oct. 5, 1975, 0.300 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.11 ft^3/s, $Q_{7,10}$ = 0.04 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Iron wood using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027880 Laymans Creek near Hurley, Wis.

Location.--SW¼NW¼ sec. 6, T. 44 N., R. 3 E., Iron County, above confluence with tributary, 9.0 mi south of Hurley.

Drainage area.--5.02 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 13, 1971, 4.65 ft^3/s; June 14, 1973, 6.68 ft^3/s; Oct. 5, 1975, 0.67 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.22 ft^3/s, $Q_{7,10}$ = 0.08 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04027890 Laymans Creek tributary near Hurley, Wis.

Location.--NW¼SW¼ sec. 6, T. 44 N., R. 3 E., Iron County, at culverts on town road, 9.1 mi south of Hurley.

Drainage area.--9.00 mi^2. Tributary to.--Laymans Creek.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 13, 1971, 5.52 ft^3/s; June 14, 1973, 9.62 ft^3/s; Oct. 5, 1975, 1.56 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.36 ft^3/s, $Q_{7,10}$ = 0.13 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027891 Laymans Creek near Hurley, Wis.

Location.--SW¼NW¼ sec. 6, T. 44 N., R. 3 E., Iron County, 10 ft below confluence of unnamed tributary, 8.0 mi south of Hurley.

Drainage area.--14.0 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 6, 1975, 1.40 ft^3/s.

Remarks.--Additional discharge measurements required to estimate low-flow characteristics.

04027895 Laymans Creek tributary near Hurley, Wis.

Location.--NE¼NE¼ sec. 6, T. 44 N., R. 3 E., Iron County, at Schomberg Park, 8.6 mi south of Hurley.

Drainage area.--2.17 mi^2. Tributary to.--Laymans Creek.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 12, 1971, 1.45 ft^3/s; June 14, 1973, 1.65 ft^3/s; Oct. 5, 1975, 0.62 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.09 ft^3/s, $Q_{7,10}$ = 0.03 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027900 Laymans Creek near Hurley, Wis.

Location.--NE¼NE¼ sec. 6, T. 44 N., R. 3 E., Iron County, at bridge on U.S. Highway 51, 8.8 mi south of Hurley.

Drainage area.--17.5 mi^2. Tributary to.--Montreal River.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--0.135 ft^3/s, Aug. 18, 1975.

Low-flow frequency.--$Q_{7,2}$ = 0.50 ft^3/s, $Q_{7,10}$ = 0.18 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 18 discharge measurements made during the period 1967-76.

Accuracy.--$SE_{7,2}$ = 23 percent, $SE_{7,10}$ = 34 percent.

04027905 Laymans Creek near Hurley, Wis.

Location.--NW¼NE¼ sec. 32, T. 45 N., R. 3 E., Iron County, at bridge on town road, 8.0 mi south of Hurley.
Drainage area.--18.4 mi^2. Tributary to.--Montreal River.
Type of site.--Miscellaneous site.
Discharge measurements.--Oct. 13, 1971, 14.1 ft^3/s; June 14, 1973, 15.3 ft^3/s; Oct. 5, 1975, 3.16 ft^3/s.
Low-flow frequency.--$Q_{7,2}$ = 0.66 ft^3/s, $Q_{7,10}$ = 0.24 ft^3/s.
Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.
Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027920 Montreal River near Hurley, Wis.

Location.--SE¼NE¼ sec. 28, T. 45 N., R. 3 E., Iron County, at end of town road, 7.5 mi south of Hurley.
Drainage area.--39.1 mi^2. Tributary to.--Lake Superior.
Type of site.--Miscellaneous site.
Discharge measurements.--Oct. 12, 1971, 28.0 ft^3/s; June 14, 1973, 37.6 ft^3/s; Oct. 4, 1975, 14.0 ft^3/s.
Low-flow frequency.--$Q_{7,2}$ = 4.5 ft^3/s, $Q_{7,10}$ = 2.3 ft^3/s.
Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.
Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027932 Montreal River tributary near Hurley, Wis.

Location.--NW¼NW¼ sec. 29, T. 45 N., R. 3 E., Iron County, at culvert on town road, 6.8 mi south of Hurley.
Drainage area.--0.68 mi^2. Tributary to.--Montreal River.
Type of site.--Miscellaneous site.
Discharge measurements.--Oct. 13, 1971, 0.317 ft^3/s; June 14, 1973, 0.232 ft^3/s; Oct. 6, 1975, 0.049 ft^3/s.
Low-flow frequency.--$Q_{7,2}$ = 0.01 ft^3/s, $Q_{7,10}$ = <0.01 ft^3/s.
Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.
Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027935 Montreal River tributary near Hurley, Wis.

Location.--NW¼SW¼ sec. 20, T. 45 N., R. 3 E., Iron County, at culverts on town road, 6.2 mi south of Hurley.
Drainage area.--1.84 mi^2. Tributary to.--Montreal River.
Type of site.--Miscellaneous site.
Discharge measurements.--Oct. 12, 1971, 0.60 ft^3/s; June 14, 1973, 0.53 ft^3/s; Oct. 6, 1975, 0.072 ft^3/s.
Low-flow frequency.--$Q_{7,2}$ = 0.03 ft^3/s, $Q_{7,10}$ = 0.01 ft^3/s.
Basis of estimate.--Correlated with Montreal RIver at Ironwood using 3 discharge measurements.
Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04027940 Montreal River tributary near Hurley, Wis.

Location.--NE¼NE¼ sec. 20, T. 45 N., R. 3 E., Iron County, at culvert on town road, 5.8 mi south of Hurley.

Drainage area.--3.03 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 12, 1971, 0.926 ft^3/s; June 14, 1973, 0.487 ft^3/s; Oct. 4, 1975, 0.052 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.02 ft^3/s, $Q_{7,10}$ = 0.01 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Ironwood using 3 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027948 Whitney Creek near Ironwood, Mich.

Location.--SE¼NW¼ sec. 13, T. 46 N., R. 46 W., Gogebic County, at bridge on town road, 5.4 mi south of Ironwood.

Drainage area.--4.18 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Oct. 14, 1973, 2.38 ft^3/s; June 14, 1973, 1.23 ft^3/s.

Remarks.--Additional discharge measurements required to estimate low-flow characteristics.

04027950 Montreal River near Hurley, Wis.

Location.--SW¼SE¼ sec. 8, T. 45 N., R. 3 E., Iron County, at bridge on County Trunk C, 4.7 mi south of Hurley.

Drainage area.--52.1 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 27, 1970, 2.36 ft^3/s; Jan. 5, 1971, 21.0 ft^3/s; Oct. 12, 1971, 30.4 ft^3/s; June 14, 1973, 43.3 ft^3/s; Oct. 4, 1975, 14.7 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 5.4 ft^3/s, $Q_{7,10}$ = 2.8 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 5 discharge measurements.

Accuracy.--$SE_{7,10}$ = 50 percent (basin average).

04027970 Montreal River near Hurley, Wis.

Location.--NE¼NE¼ sec. 6, T. 45 N., R. 3 E., Iron County, beyond end of town road, 2.8 mi south of Hurley.

Drainage area.--54.7 mi^2. Tributary to.--Lake Superior.

Type of site.--Miscellaneous site.

Discharge measurements.--June 14, 1973, 52.0 ft^3/s; Oct. 4, 1975, 15.1 ft^3/s.

Remarks.--Additional discharge measurements required to estimate low-flow characteristics.

04027973 Whiskers Creek near Ironwood, Mich.

Location.--NW¼SE¼ sec. 34, T. 47 N., R. 3 E., Gogebic County, at country road bridge, 0.3 mi above mouth, 2.0 mi southeast of Ironwood.

Drainage area.--3.79 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 6, 1975, 0.24 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.20 ft^3/s, $Q_{7,10}$ = 0.07 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04028000 Montreal River at Ironwood, Mich.

Location.--NW¼SE¼ sec. 24, T. 46 N., R. 2 E., Iron County, at Aurora Street bridge between Hurley, Wis., and Ironwood, Mich.

Drainage area.--63.8 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--1918-22, 1924-25, 1949-54.

Average discharge.--9 years, 75.3 ft^3/s.

Extremes.--Maximum discharge, 1,810 ft^3/s Apr. 19, 1952; minimum discharge, 0.1 ft^3/s Sept. 26, 1925.

Low-flow frequency.--$Q_{7,2}$ = 4.7 ft^3/s, $Q_{7,10}$ = 2.4 ft^3/s.

Basis of estimate.--Low-flow frequency analysis using 10 years of record.

Duration table of daily flow

Discharge, in cubic feet per second, which was exceeded for indicated percent of time

Percent	2	5	10	20	30	40	50
ft^3/s	650	355	192	83	46	30	21
Percent	60	70	80	90	95	98	99.9
ft^3/s	16	12	10	7.8	5.6	2.8	0.8

Accuracy.--$SE_{7,2}$ = 14 percent, $SE_{7,10}$ = 22 percent.

Remarks.--Occasional diurnal fluctuation caused by dam upstream.

04028500 Montreal River near Kimball, Wis.

Location.--NE¼SW¼ sec. 32, T. 47 N., R. 2 E., Iron County, 300 ft upstream from West Branch Montreal River, 2.5 mi northeast of Kimball.

Drainage area.--98.6 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--June 1924 to December 1925.

Minimum discharge measured.--2.0 ft^3/s, Aug. 8-19, 1925.

Low-flow frequency.--$Q_{7,2}$ = 5.2 ft^3/s, $Q_{7,10}$ = 2.3 ft^3/s.

Basis of estimate.--Correlated with Montreal River at Ironwood using 10 daily discharge values.

Accuracy.--$SE_{7,2}$ = 42 percent, $SE_{7,10}$ = 46 percent.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04028650 West Fork Montreal River near Upson, Wis.

Location.--NW¼SW¼ sec. 17, T. 44 N., R. 2 E., Iron County, at bridge on country road, 8.2 mi southeast of Upson.

Drainage area.--10.6 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.13 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.20 ft^3/s, $Q_{7,10}$ = 0.04 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04028710 West Fork Montreal River tributary near Montreal, Wis.

Location.--SW¼NW¼ sec. 32, T. 45 N., R. 2 E., Iron County, at bridge on town road, 6.3 mi south of Montreal.

Drainage area.--Not available. Tributary to.--West Fork Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.2 ft^3/s.

04028980 West Fork Montreal River near Montreal, Wis.

Location.--NW¼SE¼ sec. 21, T. 45 N., R. 2 E., Iron County, at bridge on country road, just upstream from Gile Flowage, 4.8 mi south of Montreal.

Drainage area.--38.6 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 27, 1970, 1.00 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 1.5 ft^3/s, $Q_{7,10}$ = 0.51 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04028985 East River near Montreal, Wis.

Location.--SE¼SE¼ sec. 8, T. 45 N., R. 2 E., Iron County, at culvert on country road, 2.5 mi south of Montreal.

Drainage area.--4.19 mi^2. Tributary to.--West Fork Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 27, 1970, 0.02 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.03 ft^3/s, $Q_{7,10}$ = 0.01 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04028992 West Fork Montreal River near Pence, Wis.

Location.--SE¼NE¼ sec. 5, T. 45 N., R. 2 E., Iron County, at country road, 0.75 mi southeast of Pence.

Drainage area.--0.53 mi^2. Tributary to.--West Fork Montreal River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 14, 1972, 0 ft^3/s; Oct. 19, 1972, 0 ft^3/s; May 21, 1973, 2.32 ft^3/s; Sept. 19, 1973, 0 ft^3/s; July 30, 1974, 0.33 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0 ft^3/s, $Q_{7,10}$ = 0 ft^3/s.

Basis of estimate.--No flow observed on three occasions.

Accuracy.--Not applicable.

04029000 West Fork Montreal River at Gile, Wis.

Location.--NW¼NE¼ sec. 34, T. 46 N., R. 2 E., Iron County, at outlet structure of Gile Reservoir, 0.2 mi southwest of Gile.

Drainage area.--72.7 mi^2. Tributary to.--Montreal River.

Type of site.--Gaging station.

Period of record.--1918-25, 1942-47.

Average discharge.--12 years, 79.5 ft^3/s.

Extremes.--Maximum discharge, 1,550 ft^3/s Apr. 21, 1923; minimum discharge, [1]1.2 ft^3/s Mar. 31, 1945.

Low-flow frequency.--$Q_{7,2}$ = 4.8 ft^3/s, $Q_{7,10}$ = 2.8 ft^3/s.

Basis of estimate.--Frequency analysis using 6 years of unregulated streamflow record (1918-25).

Accuracy.--$SE_{7,2}$ = 12 percent, $SE_{7,10}$ = 16 percent.

Unregulated record (1918-25)

Duration table of daily flow Discharge, in cubic feet per second, which was exceeded for indicated percent of time							
Percent	2	5	10	20	30	40	50
ft^3/s	426	270	170	89	48	32	24
Percent	60	70	80	90	95	98	99.9
ft^3/s	18	14	9.6	13	10	2.1	1.6

Regulated record (1942-47)

Duration table of daily flow Discharge, in cubic feet per second, which was exceeded for indicated percent of time							
Percent	2	5	10	20	30	40	50
ft^3/s	326	208	170	146	125	110	93
Percent	60	70	80	90	95	98	99.9
ft^3/s	74	51	28	13	10	3.5	1.8

Remarks.--Flow completely regulated by Gile Flowage since 1941. [1]Reservoir gates were closed.

04029500 West Fork Montreal River near Kimball, Wis.

Location.--SW¼SW¼ sec. 32, T. 47 N., R. 2 E., Iron County, 1,000 ft upstream from mouth, 2.3 mi northeast of Kimball.

Drainage area.--84.1 mi^2. Tributary to.--Montreal River.

Type of site.--Gaging station.

Period of record.--1924-25.

Minimum discharge observed.--1.6 ft^3/s, Aug. 17-20, 1925.

Low-flow frequency.--$Q_{7,2}$ = 5.1 ft^3/s, $Q_{7,10}$ = 3.0 ft^3/s.

Basis of estimate.--Correlated with West Fork Montreal River using 10 mean daily discharge values.

Accuracy.--$SE_{7,2}$ = 24 percent, $SE_{7,10}$ = 26 percent.

04029530 Flood Creek near Montreal, Wis.

Location.--NW¼SW¼ sec. 32, T. 47 N., R. 2 E., Iron County, at mouth, 5.5 mi north of Montreal.

Drainage area.--Not available. Tributary to.--West Fork Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Oct. 30, 1924, 0.55 ft^3/s.

04029700 Boomer Creek near Saxon, Wis.

Location.--SW¼NE¼ sec. 3, T. 46 N., R. 1 E., Iron County, at bridge on U.S. Highway 2, 3.0 mi east of Saxon.

Drainage area.--7.15 mi^2. Tributary to.--Fourche Creek.

Type of site.--Low-flow partial-record station.

Minimum discharge measured.--0.025 ft^3/s, July 26, 1964.

Low-flow frequency.--$Q_{7,2}$ = 0.13 ft^3/s, $Q_{7,10}$ = 0.04 ft^3/s.

Basis of estimate.--Correlated with Bad River near Odanah using 9 discharge measurements.

Accuracy.--$SE_{7,2}$ = 26 percent, $SE_{7,10}$ = 42 percent.

04029780 Fourche Creek near Saxon, Wis.

Location.--SE¼NW¼ sec. 26, T. 47 N., R. 1 E., Iron County, at bridge on Wall Street Road, 4.5 mi northeast of Saxon.

Drainage area.--15.6 mi^2. Tributary to.--Montreal River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 26, 1970, 0.54 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.80 ft^3/s, $Q_{7,10}$ = 0.43 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04030000 Montreal River near Saxon, Wis.

Location.--SW¼NW¼ sec. 23, T. 48 N., R. 49 W., Iron County, 1.8 mi upstream from mouth, 3.6 mi north of Saxon.

Drainage area.--262 mi^2. Tributary to.--Lake Superior.

Type of site.--Gaging station.

Period of record.--1939-70.

Average discharge.--32 years, 325 ft^3/s.

Extremes.--Maximum discharge, 6,600 ft^3/s Apr. 24, 1960; minimum discharge, 2 ft^3/s Sept. 21, Oct. 8, 1939, and Sept. 9, 1965.

Period of consecutive days	Magnitude and frequency of annual low flow. Discharge, in cubic feet per second, for indicated recurrence interval, in years					
	2	5	10	20	50	100
7	86	45	29	19	12	7.9
14	94	50	34	23	14	10
30	104	60	43	31	21	16
60	126	76	54	39	27	20
90	148	92	66	47	31	22

Duration table of daily flow. Discharge, in cubic feet per second, which was exceeded for indicated percent of time							
Percent	2	5	10	20	30	40	50
ft^3/s	1,850	1,120	620	328	247	210	192
Percent	60	70	80	90	95	98	99.9
ft^3/s	185	170	141	92	56	24	11

Accuracy.--$SE_{7,2}$ = 11 percent, $SE_{7,10}$ = 28 percent.

Remarks.--Diurnal fluctuation caused by Saxon Falls powerplant 1.5 mi upstream. Flow regulated by Gile Flowage on West Branch Montreal River since April 1941.

04031200 South Branch Presque Isle River near Presque Isle, Wis.

Location.--SE¼SE¼ sec. 33, T. 44 N., R. 6 E., Vilas County, at bridge on country road, 0.8 mi west of Presque Isle.

Drainage area.--15.8 mi^2. Tributary to.--West Branch Presque Isle River.

Type of site.--Miscellaneous site.

Discharge measurements.--Aug. 25, 1970, 4.14 ft^3/s; Jan. 28, 1971, 13.8 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 5.9 ft^3/s, $Q_{7,10}$ = 1.8 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04031215 Oxbow Lake outlet near Boulder Junction, Wis.

Location.--SE¼NW¼ sec. 12, T. 43 N., R. 6 E., Vilas County, at culvert on country road, 7.8 mi north of Boulder Junction.

Drainage area.--15.1 mi^2. Tributary to.--South Branch Presque Isle River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 0.05 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 0.08 ft^3/s, $Q_{7,10}$ = 0.02 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04036490 Spring Creek near Land O'Lakes, Wis.

Location.--NE¼SW¼ sec. 21, T. 43 N., R. 9 E., Vilas County, at bridge on County Trunk Z, 8.0 mi west of Land O'Lakes.

Drainage area.--14.4 mi^2. Tributary to.--South Branch Ontonagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 10.1 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 15 ft^3/s, $Q_{7,10}$ = 5.2 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

04036510 Helen Creek near Land O'Lakes, Wis.

Location.--SE¼SE¼ sec. 19, T. 43 N., R. 9 E., Vilas County, at bridge on County Trunk B, 9.6 mi west of Land O'Lakes.

Drainage area.--6.57 mi^3. Tributary to.--Cisco Branch Ontonagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 3.86 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 5.6 ft^3/s, $Q_{7,10}$ = 1.5 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

Table 1.--Low-flow characteristics for sites in the Lake Superior basin--Continued

04038400 Ontonagon River near Boulder Junction, Wis.

Location.--SW¼SW¼ sec. 28, T. 43 N., R. 8 E., Vilas County, at culvert on County Trunk B, 7.7 mi northeast of Boulder Junction.

Drainage area.--6.41 mi^2. Tributary to.--Cisco Branch Ontonagon River.

Type of site.--Miscellaneous site.

Discharge measurement.--Aug. 25, 1970, 3.24 ft^3/s.

Low-flow frequency.--$Q_{7,2}$ = 4.7 ft^3/s, $Q_{7,10}$ = 1.5 ft^3/s.

Basis of estimate.--Used regression equations 4 and 5.

Accuracy.--$SE_{7,2}$ = 45 percent, $SE_{7,10}$ = 65 percent.

Table 2.--Basin characteristics for low-flow partial-record and selected gaging stations in the Lake Superior basin

Station number	Station name	Drainage area (mi^2) A	Main-channel slope (ft/mi) S	Main-channel length (mi) L	Basin storage (percent) Bs	Forest cover (percent) F
04024350	Black River near Chaffey	53.6	4.74	17.0	49.4	47.1
04025000	Amnicon River near Poplar	112	8.11	38.2	30.5	61.0
04025100	Middle River near Poplar	51.6	19.6	26.5	31.4	47.5
04025500	Bois Brule River at Brule	120	3.60	18.6	15.4	85.0
04026030	Reefer Creek near Port Wing	10.9	21.3	13.5	1.0	64.5
04026120	Flag River at Port Wing	33.9	32.3	12.5	3.0	89.5
04026190	Sand River near Red Cliff	28.2	27.1	12.4	3.8	97.2
04026300	Sioux River near Washburn	35.2	48.6	9.6	1.21	82.6
04026350	North Fork Fish Creek near Ashland	88.1	21.8	22.1	2.5	76.5
04026400	Spillerberg Creek near Cayuga	6.21	11.5	4.45	39.4	81.4
04026500	Bad River at Mellen	101	16.2	22.7	17.9	79.3
04026550	Tyler Forks River near Upson	41.3	10.1	18.5	30.0	71
04026600	Marengo River near Marengo	101	24.0	32.9	7.6	79
04026650	Trout Brook near High Bridge	8.60	70.5	8.68	30.3	44
04026870	Alder Creek near Upson	22.3	10.7	13.3	12.4	80
04026900	Potato River near Gurney	92.7	24.8	22.7	17.0	76.8
04027200	Pearl Creek at Grandview	16.9	34.4	7.6	10.8	84.3
04027900	Layman Creek near Hurley	17.8	12.0	8.2	46.2	54.8
04028000	Montreal River at Ironwood	63.0	8.62	19.2	15.7	81.1
04029000	West Branch Montrèal River at Gile	72.7	17.1	19.4	20.8	89.8
04029700	Boomer Creek near Saxon	5.94	84.6	5.85	13.1	84.1

Table 2.--Basin characteristics for low-flow partial-record and selected gaging stations in the Lake Superior basin

Mean annual precipitation (in.) P	Soil infiltration rate (in/hr) I	Mean annual snowfall (in.) Sn	Base-flow index {$(ft^3/s)/mi^2$} Bf	Hydraulic conductivity {$(gal/d)/ft^2$} K	Drift thickness (ft) H	Transmissivity {(gal/d)/ft} T
30.0	1.65	51	0.016	958	76	72,800
30.2	1.25	52	.074	96	82	7,800
30.4	1.24	53	.082	62	71	4,400
30.5	2.79	55	1.02	985	205	202,000
29.5	2.10	56	.279	2	107	210
29.5	5.65	57	.891	418	247	103,000
29.5	1.88	60	.149	123	263	32,300
29.0	5.25	69	.220	1,160	363	421,000
30.0	4.28	67	.894	1,280	340	435,000
33.4	2.05	59	.208	20	70	1,400
33.0	1.74	65	.100	92	71	6,500
33.7	1.65	59	.128	95	122	11,600
32.0	1.35	65	.554	61	201	12,300
32.3	2.85	67	.181	82	126	10,300
33.4	2.83	95	.029	10	52	520
33.5	2.62	85	.387	23	75	1,700
32.0	1.65	55	.452	100	103	10,300
35.0	1.84	85	.029	87	101	8,800
35.0	2.06	100	-----	77	91	7,000
34.5	2.83	85	-----	51	103	5,200
32.5	2.90	100	0	16	75	1,200

Table 3.--Comparison of methods available to estimate low-flow characteristics in the Lake Superior basin

Type of site	Type of data	Number of sites with data	Time required to collect data	Analytical method to determine $Q_{7,10}$	Standard error of 10-year low flow ($SE_{7,10}$)
Gaging station	10 years or more recorded streamflow	2	33-34 years	Frequency analysis	6 percent
Gaging station	10 years recorded streamflow	None[1]	10 years	Frequency analysis	10 percent
Low-flow partial-record stations	14-17 base-flow discharge measurements	16	3-10 years	Correlation analysis	22 percent
Miscellaneous measurement sites	3 base-flow discharge measurements	--	1- 2 years	Correlation analysis	50 percent
Miscellaneous measurement sites	1 base-flow discharge measurement and drainage-basin characteristics	106	1 day	Regression analysis	65 percent
Ungaged sites with drainage areas less than 150 mi^2	Drainage-basin characteristics	Unlimited	1 hour	Regression analysis	131 percent

[1]Example was presented to illustrate the accuracy that could be obtained from 10 years of recorded streamflow in the basin. Data from existing gaging stations were adjusted to represent 10 years of recorded streamflow for the analysis.

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