Statistical Summaries of Streamflow in Montana and Adjacent Areas, Water Years 1900 through 2002

By Peter M. McCarthy

Abstract

In response to the need to have more current information about streamflow characteristics in Montana, the U.S. Geological Survey, in cooperation with the Montana Department of Environmental Quality, Confederated Salish and Kootenai Tribes, and Bureau of Land Management, conducted a study to analyze streamflow data. Updated statistical summaries of streamflow characteristics are presented for 286 streamflow-gaging sites in Montana and adjacent areas having 10 or more years of record for water years 1900 through 2002. Data include the magnitude and probability of annual low and high flow, the magnitude and probability of low flow for three seasons (March-June, July-October, and November-February), flow duration of the daily mean discharge, and the monthly and annual mean discharges. For streamflow-gaging stations where 20 percent or more of the contributing drainage basin is affected by dams or other large-scale human modification, streamflow is considered regulated. Separate streamflow characteristics are presented for the unregulated and regulated periods of record for sites with sufficient data.

Introduction

Information about streamflow characteristics is essential for development and management of surface-water resources. Water and land-use managers, planners, administrators, builders, engineers, recreationists, and the general public use information on all aspects of streamflow to evaluate various water conditions and land-use alternatives.

Annual low-flow and seasonal streamflow characteristics and annual high-flow streamflow characteristics are particularly important for characterizing streamflow variability. Low-flow frequency data for annual and seasonal periods indicate how frequently small values of discharge might occur and are used for assessing the capability of streams to receive and assimilate treated wastewater, developing wastewater permits, determining total maximum daily loads of streams, and assessing aquatic habitat. Annual high-flow frequency data, in conjunction with flood-frequency data (Parrett and Johnson, 2004), indicate how frequently large values of discharge might occur and are useful for effective flood planning and for safe and economical design of highway bridges, culverts, dams, levees, and other structures on or near streams.

The U.S. Geological Survey (USGS) has previously published reports that describe and document streamflow characteristics at streamflow-gaging stations in Montana (Shields and White, 1981; Waltemeyer and Shields, 1982; and Omang, 1984). Two of these reports were based on data through 1979, and one used data through 1982. Since the completion of these reports, nearly 20 years of additional data have become available, and many new gages have been installed which now have 10 or more years of streamflow records. In response to the need to have more current information about streamflow characteristics in Montana, the USGS, in cooperation with the Montana Department of Environmental Quality, Confederated Salish and Kootenai Tribes, and Bureau of Land Management, conducted a study to analyze streamflow data from 286 sites having at least 10 years of streamflow record.

Purpose and Scope

The purpose of this report is to provide statistical summaries of streamflow characteristics at selected sites in Montana and adjacent areas for water years 1900 through 2002. Data include the magnitude and probability of annual low and high flow, the magnitude and probability of low flow for three seasons (March-June, July-October, and November-February), flow duration of the daily mean discharge, and the monthly and annual mean discharges. For streamflow-gaging stations where 20 percent or more of the contributing drainage basin is affected by dams or other large-scale human modification, streamflow is considered regulated. Separate streamflow-characteristics data are presented for the unregulated and regulated periods of record for sites with sufficient data.

Site Selection

The sites selected for analysis are shown in figure 1 and described in table 1. A total of 286 streamflow-gaging stations were selected—269 of these stations are in Montana, 3 are at or near the international boundary between the United States and Canada, 2 are in Alberta, 2 are in British Columbia, 1 is in Idaho, and 9 are in Yellowstone National Park, Wyoming. Of the 286 sites, data for 224 stations were analyzed for periods of

unregulated flow only, data for 47 stations were analyzed for periods of regulated flow only, and data for 15 stations were analyzed for separate periods of unregulated and regulated flow (fig. 1). For clarity in table 1 and figure 1, stations were assigned site numbers 1 through 286. The period of record by type of streamflow condition is listed in table 1. Of the 224 sites where data were analyzed for periods of unregulated flow only, 8 stations were analyzed for periods before regulation only, and the remaining 216 stations were analyzed for the entire period of record for unregulated flows.

The statistical summaries provided for periods of unregulated flow might differ from summaries provided for periods of regulated flow. Typically these differences are the result of changes in regulation. However, differences in statistical summaries also might be the result of different climatic conditions rather than difference in regulation.

Methods of Creating the Statistical Summaries

The tables of statistical summaries of streamflow are preceded by a station description which typically includes station location, drainage area, period of record (by water years or by month and year), revised records, gage information, and remarks. The period of record included in the station descriptions might not include all years in which data were recorded at the station, and thus, might not coincide with the period of record used for analysis (table 1). Information about the number of years, seasons, or months used for analysis are included in the table headings. Remarks include information on the history of regulating structures, if any, and comments on the other factors that may affect flow. Remarks are based on information available at the time the stations were in operation, and thus, might not represent streamflow conditions in 2002. However, the latitude and longitude for stations that were discontinued before about 1960 have been updated (2004).

Daily mean streamflow values for each station were retrieved using the computer program Automated Data Processing System (ADAPS) (U. S. Geological Survey, 2003) and processed using the computer program Input and Output for Watershed Data Management (IOWDM) (U.S. Geological Survey, 2002a). High- and low-flow frequency data, monthly and annual-flow characteristics, and flow-duration data were then computed using the computer program Surface-Water Statistics (SWSTAT) (U.S. Geological Survey, 2000b).

Annual and Seasonal Low-Flow Frequencies

Annual low-flow frequency data are developed from annual series of the lowest mean discharges for specified consecutive *n*-day periods within a climatic year. For example, an annual series of 7-day low flows consists of the lowest mean discharge that occurred over any 7-day consecutive period during each year of record. Seasonal low-flow frequency data are developed from annual series of the lowest mean discharges for each of the spring (March through June), summer (July through September), and winter (October through February) seasons for specified consecutive *n*-day periods within a climatic year. The periods selected for spring, summer, and winter were based on consultations with the Montana Department of Environmental Quality (Tom Reid, Montana Department of Environmental Quality, oral commun., 2002) and reflect typical runoff and irrigation patterns in Montana.

The Pearson Type III probability distribution was used to estimate annual and seasonal low-flow frequency data (U.S. Geological Survey, 2002b). The Pearson Type III distribution is a three-parameter distribution, commonly applied to the base 10 logarithms of streamflow data, that requires estimates of the logarithms of the population mean, the standard deviation, and the skew coefficient to determine streamflow magnitude for various non-exceedance or exceedance probabilities. For low-flow frequency, the population values are assumed to be equal to the values computed from the station record, and streamflow magnitudes are determined for non-exceedance probabilities.

The annual low-flow frequency data indicate the lowest mean discharges for consecutive periods of 1, 3, 7, 14, 30, 60, 90, 120, and 183 days and for non-exceedance probabilities of 50, 20, 10, 5, 2, and 1 percent. The non-exceedance probability (in decimal form before conversion to percent) associated with a low flow is the reciprocal of the recurrence interval, in years. The seasonal low-flow frequency data indicate lowest mean discharges for consecutive periods of 1, 3, 7, 14, and 30 days for non-exceedance probabilities of 50, 20, 10, 5, 2, and 1 percent.

Each value of discharge in the annual and seasonal low-flow tables is a mean low flow within the year or season for a consecutive *n*-day period that can be expected to be lower, on average, once in any specified recurrence interval (every *y* years). Similarly, each value of discharge in the low-flow tables has a specified (*x*-percent) non-exceedance probability that, in any given year, a smaller value *n*-day mean low-flow value will occur. For example, the low-flow value for a consecutive 7-day period and the 2-year recurrence interval can be expected to be lower, on average, once every 2 years. Similarly, a low flow for a consecutive 7-day period and 50-percent non-exceedance probability has a 50-percent chance of being lower in any given year.

For any *n*-day period, discharges decrease with increasing recurrence interval and decreasing non-exceedance probability. Conversely, for any given recurrence interval or non-exceedance probability, discharge increases with increasing *n*-day periods. Seasonal and annual low-flow frequency data are only reported in the tables for recurrence intervals of twice the period of record or less (Parrett, 1997). For example, if the period of record is 10 years, only low-flow data for recurrence intervals of 20 years or less were presented. The symbol "--" is shown in the tables for recurrence intervals more than twice the period of record. Seasonal low-flow data commonly include more years of record than the annual low-flow data; thus, because of partial-record years the seasonal low-flow frequency data might be shown for longer recurrence intervals than the annual low-flow frequency data.

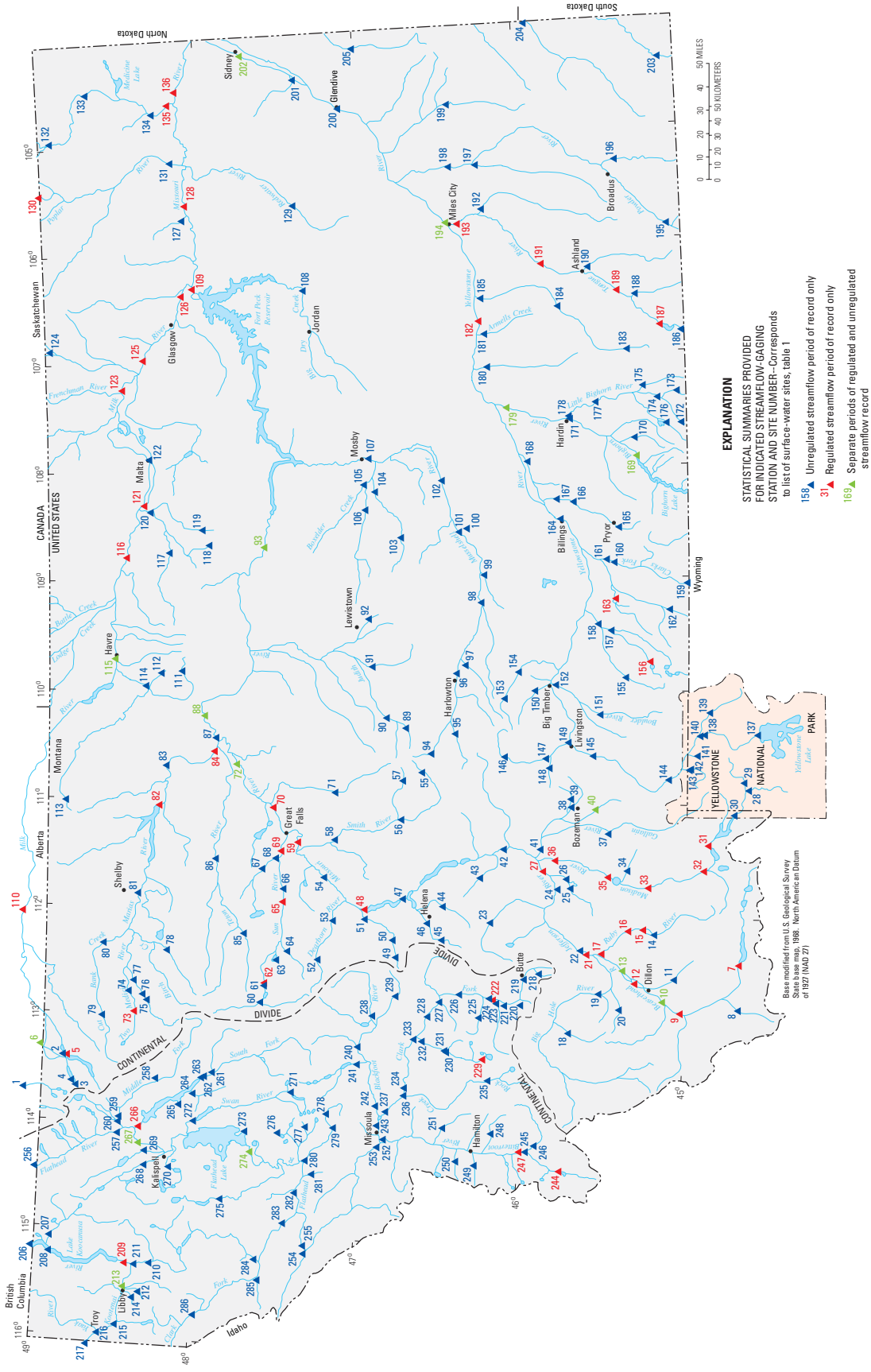

Figure 1. Location of selected streamflow-gaging stations.

Annual low flows are calculated based on a climatic year (March 1 to February 28); thus, the period of record for a climatic year generally is identified as one year less than for a water year. This climatic year—chosen to coincide with the spring, summer, and winter periods previously determined for Montana—is slightly different from the April 1-March 31 climatic year typically used for low-flow frequency analysis (Riggs, 1972). Differences in annual low-flow frequency resulting from the use of the two different climatic years were generally considered negligible because low flows in Montana commonly occur from late summer through winter. The program determines non-exceedance probability using only non-zero values of discharges and then uses a conditional adjustment probability to adjust the non-exceedance probability for zero flows in the record.

Data for given *n*-day periods were computed independently for the annual and seasonal low-flow frequency tables. The presence of days with zero flow in the independent analyses resulted in some discharge values that did not consistently decrease with increasing recurrence interval or some discharge values for a given recurrence interval that did not consistently increase with increasing *n*-day period. These computed values were manually adjusted to produce consistent tabular results. In some instances, the computed seasonal low-flow values for a given *n*-day period and recurrence interval were less than the computed annual low-flow values. In these instances, seasonal low-flow values were manually increased to match the annual low-flow values.

Annual High-Flow Frequency

Annual high-flow frequency data are developed from annual series of the highest mean discharges for specified consecutive *n*-day consecutive periods within a water year. For example, an annual series of 3-day high flows consists of the highest mean discharge that occurs over any 3-day consecutive period during each year of record.

The Pearson Type III probability distribution was used to estimate high-flow frequency data (U.S. Geological Survey, 2002b). The Pearson Type III distribution is a three-parameter distribution, commonly applied to the base 10 logarithms of streamflow data, that requires estimates of the logarithms of the population mean, the standard deviation, and the skew coefficient. For high-flow frequency, the population values are assumed to be equal to the values computed from the station record, and streamflow magnitudes are determined for exceedance probabilities.

The annual high-flow frequency data indicate the highest mean discharges for consecutive periods of 1, 3, 7, 15, 30, 60, and 90 days. Results from the log Pearson Type III analyses are shown in the annual high-flow frequency table for recurrence intervals of 2, 5, 10, 25, 50, and 100 years. The table also presents exceedance probabilities of 50, 20, 10, 4, 2, and 1 percent, respectively. Exceedance probability (in decimal form, before conversion to percent) is the reciprocal of the recurrence interval, in years.

Each value of discharge in the annual high-flow table is the mean high flow within the year for a consecutive *n*-day period that can be expected to be exceeded, on average, once in any specified recurrence interval (every *y* years). Similarly, each value of discharge in the high-flow table has a specified *x*-percent probability of exceedance in any given year. For example, the high-flow value corresponding to the 3-day consecutive period and 100-year recurrence interval can be expected to be exceeded, on average, once every 100 years. Similarly, a high flow for a consecutive 3-day period and 1-percent exceedance probability has a 1-percent chance of being exceeded in any given year.

For any *n*-day period, discharges increase with increasing recurrence interval and decreasing exceedance probability. Conversely, for any given recurrence interval or exceedance probability, discharge decreases with increasing *n*-day periods. High-flow frequency data only were reported for recurrence intervals of twice the period of record or less (Parrett, 1997). For example, if the period of record is 25 years, the table shows high-flow data for recurrence intervals of 50 years or less. The symbol "--" is shown in the tables for recurrence intervals more than twice the period of record.

Flow Duration

Flow-duration data are developed from daily mean discharge values over the entire period of record, and the flow-duration tables are developed from these data (Searcy, 1959). The flow-duration data are not related to the sequence of flow events, but do include the full range of daily mean discharges at the station. For example, the discharge value on a flow-duration table that corresponds to a 10-percent exceedance is the value that was exceeded by 10 percent of the flow record without regard to when those days of exceedance occurred. The days of exceedance might not have been consecutive and might have occurred either in a single year or during several years (Ludwig, 1992).

Monthly and Annual Mean Discharges

The monthly and annual mean discharge tables show, for the period of record, the maximum and minimum mean values, the mean, the standard deviation from the mean, and the number of years of record. Data from this table are an indicator of the flow distribution throughout the year. The annual mean discharge tabulations for the period of record are based on a water year.

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.

[All stations are in Montana, except as indicated. Eight-digit station-identification numbers for routine surface-water sites represent the standard U.S. Geological Survey numbering systems for streamflow-gaging stations, wherein the first two digits indicate the major river basin and the remaining 6 digits indicate a downstream station order. Period of record is abbreviated to show only the first and last water years of data used. Abbreviations: U, unregulated or less than 20 percent of drainage area is regulated; R, regulated]

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
1	05011000	Belly River near Mountain View, Alberta	U	1912-78
2	05013700	St. Mary River above Swiftcurrent Creek, near Babb	U	1902-15
3	05014000	Grinnell Creek near Many Glacier	U	1949-78
4	05014500	Swiftcurrent Creek at Many Glacier	U	1912-2002
5	05017500	St. Mary River near Babb	R	1919-2002
6	05020500	St. Mary River at international boundary	U	1902-16
			R	1917-2002
7	06012500	Red Rock River below Lima Reservoir, near Monida	R	1940-2002
8	06013500	Big Sheep Creek below Muddy Creek, near Dell	U	1936-80
9	06015400	Beaverhead River near Grant	R	1963-84
10	06016000	Beaverhead River at Barretts	U	1908-63
			R	1964-2002
11	06017500	Blacktail Deer Creek near Dillon	U	1946-66
12	06018000	Beaverhead River near Dillon	R	1964-84
13	06018500	Beaverhead River near Twin Bridges	U	1935-63
			R	1964-2002
14	06019500	Ruby River above reservoir, near Alder	U	1938-2002
15	06020600	Ruby River below reservoir, near Alder	R	1963-2002
16	06021500	Ruby River at Laurin	R	1946-61
17	06023000	Ruby River near Twin Bridges	R	1940-81
18	06024590	Wise River near Wise River	U	1972-85
19	06025500	Big Hole River near Melrose	U	1924-2002
20	06026000	Birch Creek near Glen	U	1946-77
21	06026500	Jefferson River near Twin Bridges	R	1964-2002
22	06027000	Jefferson River near Silver Star	U	1910-39
23	06033000	Boulder River near Boulder	U	1929-2002
24	06034500	Jefferson River at Sappington	U	1900-63
25	06035000	Willow Creek near Harrison	U	1938-2002
26	06036500	Willow Creek near Willow Creek	U	1919-33
27	06036650	Jefferson River near Three Forks	R	1979-2002
28	06036905	Firehole River near West Yellowstone	U	1984-2002
29	06037000	Gibbon River near West Yellowstone	U	1913-96

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
30	06037500	Madison River near West Yellowstone	U	1913-2002
31	06038500	Madison River below Hebgen Lake, near Grayling	R	1939-2002
32	06038800	Madison River at Kirby Ranch, near Cameron	R	1959-2002
33	06040000	Madison River near Cameron	R	1952-71
34	06040300	Jack Creek near Ennis	U	1973-92
35	06041000	Madison River below Ennis Lake, near McAllister	R	1939-2002
36	06042500	Madison River near Three Forks	R	1929-50
37	06043500	Gallatin River near Gallatin Gateway	U	1930-2002
38	06048000	East Gallatin River at Bozeman	U	1939-61
39	06048500	Bridger Creek near Bozeman	U	1946-87
40	06050000	Hyalite Creek at Hyalite Ranger Station, near Bozeman	U	1900-51
			R	1952-95
41	06052500	Gallatin River at Logan	U	1900-2002
42	06054500	Missouri River at Toston	U[2]	1911-2002
43	06055500	Crow Creek near Radersburg	U	1901-90
44	06061500	Prickly Pear Creek near Clancy	U	1908-2002
45	06062500	Tenmile Creek near Rimini	U	1915-2002
46	06063000	Tenmile Creek near Helena	U	1908-54
47	06065500	Missouri River below Hauser Dam, near Helena	U[2]	1924-42
48	06066500	Missouri River below Holter Dam, near Wolf Creek	R	1953-2002
49	06068500	Little Prickly Pear Creek near Marysville	U	1913-33
50	06071000	Little Prickly Pear Creek near Canyon Creek	U	1909-25
51	06071300	Little Prickly Pear Creek at Wolf Creek	U	1962-2002
52	06073000	Dearborn River near Clemons	U	1921-53
53	06073500	Dearborn River near Craig	U	1946-2002
54	06074000	Missouri River at Cascade	U[2]	1902-15
55	06074500	Smith River near White Sulphur Springs	U	1923-36
56	06076690	Smith River near Fort Logan	U	1978-96
57	06077000	Sheep Creek near White Sulphur Springs	U	1941-73
58	06077500	Smith River near Eden	U	1951-70
59	06078200	Missouri River near Ulm	R	1957-2002
60	06078500	North Fork Sun River near Augusta	U	1911-93
61	06080000	Sun River near Augusta	U	1904-29
62	06080900	Sun River below diversion dam, near Augusta	R	1968-81
63	06081500	Willow Creek near Augusta	U	1905-25

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
64	06084500	Elk Creek at Augusta	U	1905-25
65	06085800	Sun River at Simms	R	1966-2002
66	06086000	Sun River at Fort Shaw	U	1912-28
67	06088300	Muddy Creek near Vaughn	U	1968-2002
68	06088500	Muddy Creek at Vaughn	U	1925-2002
69	06089000	Sun River near Vaughn	R	1934-2002
70	06090300	Missouri River near Great Falls	R	1953-2002
71	06090500	Belt Creek near Monarch	U	1951-83
72	06090800	Missouri River at Fort Benton	U	1900-52
			R	1953-2002
73	06091700	Two Medicine River below South Fork, near Browning	R	1977-2002
74	06092000	Two Medicine River near Browning	U	1907-77
75	06092500	Badger Creek near Browning	U	1951-80
76	06093200	Badger Creek below Four Horns Canal, near Browning	U	1974-2002
77	06093500	Badger Creek near Family	U	1907-25
78	06098000	Dupuyer Creek near Valier	U	1912-37
79	06098500	Cut Bank Creek near Browning	U	1918-2002
80	06099000	Cut Bank Creek at Cut Bank	U	1905-2002
81	06099500	Marias River near Shelby	U	1902-2002
82	06101500	Marias River near Chester	R	1956-2002
83	06102000	Marias River near Brinkman	U	1922-55
84	06102050	Marias River near Loma	R	1960-2002
85	06106000	Deep Creek near Choteau	U	1911-25
86	06108000	Teton River near Dutton	U	1954-2002
87	06109000	Missouri River at Loma	U	1935-50
88	06109500	Missouri River at Virgelle	U	1935-52
			R	1953-2002
89	06109800	South Fork Judith River near Utica	U	1958-79
90	06110000	Judith River near Utica	U	1920-76
91	06111000	Ross Fork Creek near Hobson	U	1946-62
92	06111500	Big Spring Creek near Lewistown	U	1932-57
93	06115200	Missouri River near Landusky	U	1934-52
			R	1953-2002
94	06115500	North Fork Musselshell River near Delpine	U	1940-80
95	06118500	South Fork Musselshell River above Martinsdale	U	1942-80

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
96	06120500	Musselshell River at Harlowton	U	1907-2002
97	06122000	American Fork below Lebo Creek, near Harlowton	U	1946-67
98	06123500	Musselshell River near Ryegate	U	1946-80
99	06125700	Big Coulee Creek near Lavina	U	1957-72
100	06126470	Halfbreed Creek near Klein	U	1978-91
101	06126500	Musselshell River near Roundup	U	1946-2002
102	06127500	Musselshell River at Musselshell	U	1928-2002
103	06127900	Flatwillow Creek near Flatwillow	U	1911-56
104	06128200	Flatwillow Creek near Winnett	U	1921-51
105	06129000	Box Elder Creek near Winnett	U	1930-72
106	06129500	McDonald Creek at Winnett	U	1930-56
107	06130500	Musselshell River at Mosby	U	1929-2002
108	06131000	Big Dry Creek near Van Norman	U	1940-2002
109	06132000	Missouri River below Fort Peck Dam, at Fort Peck	R	1945-2002
110	06134500	Milk River at Milk River, Alberta	R	1917-2002
111	06137400	Big Sandy Creek at reservation boundary, near Rocky Boy	U	1982-2002
112	06137570	Boxelder Creek near Rocky Boy	U	1976-97
113	06137580	Sage Creek near Whitlash	U	1977-90
114	06138500	Big Sandy Creek near Box Elder	U	1927-39
115	06140500	Milk River at Havre	U	1900-16
			R	1917-2002
116	06154100	Milk River near Harlem	R	1960-2002
117	06154400	Peoples Creek near Hays	U	1967-2002
118	06154410	Little Peoples Creek near Hays	U	1972-2002
119	06154430	Lodge Pole Creek at Lodge Pole	U	1987-2001
120	06154550	Peoples Creek below Kuhr Coulee, near Dodson	U	1918-2002
121	06155030	Milk River near Dodson	R	1982-2002
122	06155500	Milk River at Malta	U	1902-16
123	06164510	Milk River at Juneberg Bridge, near Saco	R	1978-2002
124	06169500	Rock Creek below Horse Creek, near international boundary	U	1916-2002
125	06172000	Milk River near Vandalia	R	1917-87
126	06174500	Milk River at Nashua	R	1940-2002
127	06176500	Wolf Creek near Wolf Point	U	1908-92
128	06177000	Missouri River near Wolf Point	R	1945-2002
129	06177500	Redwater River at Circle	U	1929-2002

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
130	06178500	East Poplar River at international boundary	R	1976-2002
131	06181000	Poplar River near Poplar	U	1908-2002
132	06182500	Big Muddy Creek at Daleview	U	1947-72
133	06183450	Big Muddy Creek near Antelope	U	1979-2002
134	06185000	Big Muddy Creek near Culbertson	U	1908-22
135	06185110	Big Muddy Creek near mouth, near Culbertson	R	1982-92
136	06185500	Missouri River near Culbertson	R	1941-2002
137	06186500	Yellowstone River at Yellowstone Lake outlet, Yellowstone National Park, Wyo.	U	1927-2002
138	06187500	Tower Creek at Tower Falls, Yellowstone National Park, Wyo.	U	1922-43
139	06187950	Soda Butte Creek near Lamar Ranger Station, Yellowstone National Park, Wyo.	U	1989-2002
140	06188000	Lamar River near Tower Falls Ranger Station, Yellowstone National Park, Wyo.	U	1923-2002
141	06189000	Blacktail Deer Creek near Mammoth, Yellowstone National Park, Wyo.	U	1938-93
142	06190500	Gardner River at Mammoth, Yellowstone National Park, Wyo.	U	1922-39
143	06191000	Gardner River near Mammoth, Yellowstone National Park, Wyo.	U	1939-2002
144	06191500	Yellowstone River at Corwin Springs	U	1910-2002
145	06192500	Yellowstone River near Livingston	U	1900-2002
146	06193000	Shields River near Wilsall	U	1935-57
147	06193500	Shields River at Clyde Park	U	1921-67
148	06194000	Brackett Creek near Clyde Park	U	1921-57
149	06195600	Shields River near Livingston	U	1979-2002
150	06197000	Big Timber Creek near Big Timber	U	1912-24
151	06197500	Boulder River near Contact	U	1910-84
152	06200000	Boulder River at Big Timber	U	1947-2002
153	06200500	Sweet Grass Creek above Melville	U	1913-69
154	06201000	Sweet Grass Creek below Melville	U	1907-52
155	06202510	Stillwater River above Nye Creek, near Nye	U	1980-91
156	06204050	West Rosebud Creek near Roscoe	R	1965-2002
157	06204500	Rosebud Creek near Absarokee	U	1935-70
158	06205000	Stillwater River near Absarokee	U	1910-2002
159	06207500	Clarks Fork Yellowstone River near Belfry	U	1921-2002
160	06208500	Clarks Fork Yellowstone River at Edgar	U	1921-2002
161	06208800	Clarks Fork Yellowstone River near Silesia	U	1970-87
162	06209500	Rock Creek near Red Lodge	U	1932-2002
163	06212500	Red Lodge Creek below Cooney Reservoir, near Boyd	R	1938-2002
164	06214500	Yellowstone River at Billings	U	1904-2002

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
165	06216000	Pryor Creek at Pryor	U	1921-2002
166	06216500	Pryor Creek near Billings	U	1911-54
167	06216900	Pryor Creek near Huntley	U	1979-2001
168	06217750	Fly Creek at Pompeys Pillar	U	1969-81
169	06287000	Bighorn River near St. Xavier	U	1935-64
			R	1965-2002
170	06287500	Soap Creek near St. Xavier	U	1911-73
171	06288500	Bighorn River near Hardin	U	1904-33
172	06289000	Little Bighorn River at State line, near Wyola	U	1939-2002
173	06290000	Pass Creek near Wyola	U	1935-2002
174	06290500	Little Bighorn River below Pass Creek, near Wyola	U	1939-2002
175	06291000	Owl Creek near Lodge Grass	U	1939-92
176	06291500	Lodge Grass Creek above Willow Creek Diversion, near Wyola	U	1939-2002
177	06293500	Little Bighorn River near Crow Agency	U	1912-60
178	06294000	Little Bighorn River near Hardin	U	1953-2002
179	06294500	Bighorn River above Tullock Creek, near Bighorn	U	1945-64
			R	1965-2002
180	06294940	Sarpy Creek near Hysham	U	1973-84
181	06294995	Armells Creek near Forsyth	U	1974-95
182	06295000	Yellowstone River at Forsyth	R	1977-2002
183	06295113	Rosebud Creek at reservation boundary, near Kirby	U	1980-2002
184	06295250	Rosebud Creek near Colstrip	U	1975-2002
185	06296003	Rosebud Creek at mouth, near Rosebud	U	1975-2002
186	06306300	Tongue River at State line, near Decker	U	1960-2002
187	06307500	Tongue River at Tongue River Dam, near Decker	R	1939-2002
188	06307600	Hanging Woman Creek near Birney	U	1973-95
189	06307616	Tongue River at Birney Day School Bridge, near Birney	R	1980-2002
190	06307740	Otter Creek at Ashland	U	1973-95
191	06307830	Tongue River below Brandenberg Bridge, near Ashland	R	1974-2002
192	06308400	Pumpkin Creek near Miles City	U	1973-86
193	06308500	Tongue River at Miles City	R	1938-2002
194	06309000	Yellowstone River at Miles City	U	1922-65
			R	1966-2002
195	06324500	Powder River at Moorhead	U	1929-2002
196	06325500	Little Powder River near Broadus	U	1947-72

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
197	06326300	Mizpah Creek near Mizpah	U	1975-86
198	06326500	Powder River near Locate	U	1938-2002
199	06326600	O'Fallon Creek near Ismay	U	1977-92
200	06327500	Yellowstone River at Glendive	U	1900-34
201	06329200	Burns Creek near Savage	U	1958-86
202	06329500	Yellowstone River near Sidney	U	1911-65
			R	1966-2002
203	06334000	Little Missouri River near Alzada	U	1911-69
204	06334630	Box Elder Creek at Webster	U	1961-73
205	06336500	Beaver Creek at Wibaux	U	1938-84
206	12300000	Kootenay River at Newgate, British Columbia	U	1931-72
207	12301300	Tobacco River near Eureka	U	1959-2002
208	12301500	Kootenai River near Rexford	U	1929-71
209	12301933	Kootenai River below Libby Dam, near Libby	R	1973-2002
210	12302000	Fisher River near Jennings	U	1951-70
211	12302055	Fisher River near Libby	U	1968-2002
212	12302500	Granite Creek near Libby	U	1933-70
213	12303000	Kootenai River at Libby	U	1911-72
			R	1973-91
214	12303100	Flower Creek near Libby	U	1960-93
215	12303500	Lake Creek at Troy	U	1945-96
216	12304500	Yaak River near Troy	U	1956-2002
217	12305000	Kootenai River at Leonia, Idaho	U	1929-71
218	12323240	Blacktail Creek at Butte	U	1989-2002
219	12323250	Silver Bow Creek below Blacktail Creek, at Butte	U	1984-2002
220	12323500	German Gulch Creek near Ramsay	U	1955-69
221	12323600	Silver Bow Creek at Opportunity	U	1988-2002
222	12323750	Silver Bow Creek at Warm Springs	R	1972-2002
223	12323770	Warm Springs Creek at Warm Springs	U	1984-2002
224	12323800	Clark Fork near Galen	U	1988-2002
225	12324100	Racetrack Creek below Granite Creek, near Anaconda	U	1957-73
226	12324200	Clark Fork at Deer Lodge	U	1979-2002
227	12324590	Little Blackfoot River near Garrison	U	1972-2002
228	12324680	Clark Fork at Goldcreek	U	1977-2002
229	12325500	Flint Creek near Southern Cross	R	1941-2002

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
230	12329500	Flint Creek at Maxville	U	1941-2002
231	12330000	Boulder Creek at Maxville	U	1939-2002
232	12331500	Flint Creek near Drummond	U	1948-2002
233	12331600	Clark Fork at Drummond	U	1973-83
234	12331900	Clark Fork near Clinton	U	1979-94
235	12332000	Middle Fork Rock Creek near Philipsburg	U	1938-2002
236	12334510	Rock Creek near Clinton	U	1973-2002
237	12334550	Clark Fork at Turah Bridge, near Bonner	U	1985-2002
238	12335000	Blackfoot River near Helmville	U	1941-54
239	12335500	Nevada Creek above reservoir, near Helmville	U	1939-2002
240	12338500	Blackfoot River near Ovando	U	1940-63
241	12339450	Clearwater River near Clearwater	U	1975-92
242	12340000	Blackfoot River near Bonner	U	1900-2002
243	12340500	Clark Fork above Missoula	U	1929-2002
244	12342500	West Fork Bitterroot River near Conner	R	1941-2002
245	12343400	East Fork Bitterroot River near Conner	U	1956-2002
246	12343500	East Fork Bitterroot River at Conner	U	1910-57
247	12344000	Bitterroot River near Darby	R	1941-2002
248	12346500	Skalkaho Creek near Hamilton	U	1949-2002
249	12347500	Blodgett Creek near Corvallis	U	1947-69
250	12350000	Bear Creek near Victor	U	1938-59
251	12351000	Burnt Fork Bitterroot River near Stevensville	U	1920-62
252	12352500	Bitterroot River near Missoula	U	1900-2002
253	12353000	Clark Fork below Missoula	U	1930-2002
254	12354000	St. Regis River near St. Regis	U	1910-2002
255	12354500	Clark Fork at St. Regis	U	1911-2002
256	12355000	Flathead River at Flathead, British Columbia	U	1929-2002
257	12355500	North Fork Flathead River near Columbia Falls	U	1911-2002
258	12357000	Middle Fork Flathead River at Essex	U	1940-64
259	12357500	Middle Fork Flathead River at West Glacier	U	1911-48
260	12358500	Middle Fork Flathead River near West Glacier	U	1940-2002
261	12359000	South Fork Flathead River at Spotted Bear Ranger Station, near Hungry Horse	U	1948-67
262	12359800	South Fork Flathead River above Twin Creek, near Hungry Horse	U	1965-2002
263	12360000	Twin Creek near Hungry Horse	U	1948-67
264	12361000	Sullivan Creek near Hungry Horse	U	1949-77

Table 1. Selected streamflow-gaging stations in Montana and adjacent areas and period of record used in study.—Continued

Site number (fig. 1)	Station number	Station name	Streamflow condition	Period of record for analysis (water year)[1]
265	12361500	Graves Creek near Hungry Horse	U	1948-67
266	12362500	South Fork Flathead River near Columbia Falls	R	1952-99
267	12363000	Flathead River at Columbia Falls	U	1922-51
			R	1952-2002
268	12365000	Stillwater River near Whitefish	U	1931-2002
269	12366000	Whitefish River near Kalispell	U	1928-2002
270	12367500	Ashley Creek near Kalispell	U	1931-74
271	12369200	Swan River near Condon	U	1973-92
272	12370000	Swan River near Bigfork	U	1922-2002
273	12371100	Hell Roaring Creek near Polson	U	1917-37
274	12372000	Flathead River near Polson	U	1907-51
			R	1952-2002
275	12374250	Mill Creek above Bassoo Creek, near Niarada	U	1982-2002
276	12375900	South Crow Creek near Ronan	U	1982-2002
277	12377150	Mission Creek above reservoir, near St. Ignatius	U	1982-2002
278	12381400	South Fork Jocko River near Arlee	U	1982-2002
279	12383500	Big Knife Creek near Arlee	U	1910-2002
280	12388200	Jocko River at Dixon	U	1990-2002
281	12388400	Revais Creek below West Fork, near Dixon	U	1983-2002
282	12388700	Flathead River at Perma	U	1984-2002
283	12389000	Clark Fork near Plains	U	1911-2002
284	12389500	Thompson River near Thompson Falls	U	1911-2002
285	12390700	Prospect Creek at Thompson Falls	U	1956-2002
286	12391400	Clark Fork below Noxon Rapids Dam, near Noxon	U	1960-2002

[1]Number of years used for analysis are occasionally more than the total number of years in the period of record. See section "Statistical Summaries of Streamflow" of this report.

[2]Dam or powerplant upstream from station considered to have minimal effect on streamflow.

Statistical Summaries of Streamflow

Station descriptions provided in the following tables are based on data available at the time each station was in operation and may not accurately reflect streamflow conditions in 2002 or reporting standards. The period of record included in the station descriptions might not include all years in which data were recorded at the station, and thus, might not coincide with the period of record used for analysis (table 1). For example, the station description for Big Sheep Creek below Muddy Creek, near Dell (station 06013500, site number 8) indicates that the last year of record was 1979. However, daily flow record was collected at this site for several days in water year 1980, and that record was used for determination of the duration of the daily mean flows at this site. Accordingly, the period of record for analysis presented in table 1 shows the last year of record collection at this station to be 1980.