

Teton County Watersheds Hydrologic Analysis: Deep Creek, Muddy Creek, Teton River, and Sun River Teton County, MT

August 2021

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Document History

Document Location

Location

Revision History

Version Number	Version Date	Summary of Changes	Team/Author
01	06/11/2021	Initial Submittal	R. Anderson
02	08/20/2021	Response to review comments	R. Anderson

Client Distribution

Name	Title/Organization	Location



Cover Photo: Sun River Diversion Dam below Gibson Reservoir. Great Falls Tribune. Accessed at https://www.greatfallstribune.com/story/news/2018/05/03/gibson-dam-operator-keeps-watch-water-flood-concerns-rise/568782002/ on May 21, 2021.



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1. Executive Summary

Hydrologic analyses have been performed on gaged and ungaged portions of flooding sources in Teton County, MT. These hydrologic analyses will support future hydraulic analyses that will lead to updated floodplain mapping and development of other flood risk products to revise flood risk information to the communities within Teton County. The hydrologic analyses were performed to establish peak discharges for the 10%, 4%, 2%, 1% and 0.2% Annual Exceedance Probability flood events. Additionally, peak discharges were determined for a standard error of prediction above the 1% Annual Exceedance Probability event to demonstrate a level of uncertainty in the computed discharge values, and, ultimately, the calculated flood elevations. For FEMA-based flood risk products, this discharge value above the 1% Annual Exceedance Probability is known as the 1% Plus discharge. Peak discharges were determined on 81 flooding sources covering about 430 miles within the county. Intermediate flow change locations were identified on the flooding sources based on watershed characteristics to account for the features within the watershed that result in the changes in flow as the river flows downstream through the watershed. The flow nodes were located at significant tributaries and other substantial increases in drainage area which can account for flow increases along the river. These additional flow change locations (flow nodes) within the tributaries resulted in approximately 231 pour points along the flooding sources within the watershed.

Flood-frequency peak flow analyses were performed by USGS on 20 stream gages within or near Teton County (Siefken, et al., 2021). The flood-frequency peak flow analyses were performed using Bulletin 17C "Guidelines for Determining Flood Flow Frequency" (England et al., 2017) methodologies. For flooding sources without stream gages, the USGS water resources web application, StreamStats, was utilized to determine the peak discharge values based on regional regression equations for the 75 non-gaged flooding sources included in the analysis. StreamStats applies regional regression equations for a location of interest based on the Hydrologic Region and basin characteristics of the location. Flooding sources included in this hydrologic analysis are located within the Northwest or Northwest Foothills regions. The flow locations of interest were input to StreamStats output using basin characteristics derived from Digital Elevation Models developed from recently collected high-resolution LiDAR data. Discrepancies between StreamStats and LiDAR derived output were manually reviewed and the StreamStats results were adjusted as required to correct any StreamStats processed discrepancies.

The flow values were determined using methods that meet FEMA guidance and standards and are considered to be reliable for use in future flood risk products.

2. Introduction

Under contract to the State of Montana's Department of Natural Resources and Conservation (DNRC), Michael Baker International (Baker) has been tasked with preparing hydrologic data and documentation for floodplain studies within Teton County, MT, which includes portions of the Sun River, Teton River, Deep Creek, and Muddy Creek within Teton County and select tributaries (**Figure 1 through Figure 4**). The purpose of the hydrologic analyses is to provide new and updated hydrologic information that will be subsequently used in floodplain mapping activities within Teton County. The State of Montana is a Cooperating Technical Partner (CTP) with the US Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA), and this work is performed under Mapping Activity Statement (MAS) Number 2020-01, Teton Countywide Modernization Risk MAP Study.

This hydrologic analysis for the flooding sources within Teton County provides the results of peak-flow frequency analyses performed on stream gages within Teton County, as well as regression analyses for ungaged flooding sources within the county. **Table 1** lists information about the primary flooding sources included in this study.

The analysis also includes an evaluation of two instream impoundments (Gibson Reservoir and Sun River Diversion) and an investigation into two isolated areas appearing to be mapped as off-channel ponds (Unnamed Ponds 1 and 2). These reservoirs are reliant on peak-flow frequency analyses reported herein to describe the appropriate hydrologic input parameters for the future hydraulic analyses and floodplain mapping. As such, the results of hydrologic analyses for the impoundments and ponds are included in this report.



Legend

- Sun River Basin
 - Sun River and Tributaries
- County
- Town

- ---- Railroad
- Highway
- Major Road





0









SUN RIVER WATERSHED BASIN **OVERVIEW MAP FIGURE 1**



Legend

- Teton River Basin ----- Railroad Teton River and Highway Tributaries Major Road County Town
- MONTÁNA

0







15



TETON RIVER WATERSHED BASIN **OVERVIEW MAP FIGURE 2**





Legend

Muddy Creek Basin ------ Railroad Muddy Creek and Tributaries Highway Major Road County Town





0



DATA FRAME PROPERTIES: Coordinate System: NAD 1983 StatePlane Montana FIPS 2500 Projection: Lambert Conformal Conic Datum: North American 1983 Units: Meter 2.5 5 10



MUDDY CREEK WATERSHED BASIN **OVERVIEW MAP** FIGURE 4

Miles

Type of Study	Miles of Hydraulic Analysis					
Sun River and Tribs						
Enhanced	72.1					
Enhanced (with floodway)	3.1					
Teton River and Tribs						
Enhanced	235.8					
Enhanced (with floodway)	7.5					
Muddy Creek and Tribs						
Enhanced	107.7					
Enhanced (with floodway)	3.1					

Table 1. List of primary flooding sources included in the study area.

Figures 5 – 16 identify the location and indicate the extents of the sub-watersheds that are included in this hydrologic analysis.







DRAINAGE AREA AND RECOMMENDED 1% AEP DISCHARGES FOR SUN RIVER AND TRIBUTARIES **FIGURE 5**

3







DRAINAGE AREA AND RECOMMENDED 1% AEP DISCHARGES FOR SUN RIVER AND TRIBUTARIES **FIGURE 6**





CASCADE COUNTY

DRAINAGE AREA AND RECOMMENDED 1% AEP DISCHARGES FOR SUN RIVER AND TRIBUTARIES **FIGURE 7**

Map Date: 8/18/21

Miles

2







Map Date: 8/18/21









DRAINAGE AREA AND RECOMMENDED 1% AEP DISCHARGES FOR TETON RIVER AND TRIBUTARIES FIGURE 11

3









0

0.5

DISCHARGES FOR DEEP CREEK AND TRIBUTARIES FIGURE 12

2



Miles

3



Deep Creek and Major Road Tributaries

County

CASCADE COUNTY LEWIS AND CLARK COUNTY

POWELL

COUNTY

DATA FRAME PROPERTIES: Coordinate System: NAD 1983 StatePlane Montana FIPS 2500 Projection: Lambert Conformal Conic Datum: North American 1983 Units: Meter

0

0.5

FIGURE 13



2





Map Date: 8/18/21

3

Miles





Map Date: 8/18/21

2





DRAINAGE AREA AND RECOMMENDED 1% AEP DISCHARGES FOR MUDDY CREEK AND TRIBUTARIES FIGURE 16



Miles 3

2.1. Background Information and Existing Flood Hazards

As a participant in FEMA's CTP program, The State of Montana works in collaboration with FEMA to identify flood hazards and communicate flood risk to communities throughout the state, and to assist with administration of the National Flood Insurance Program (NFIP). In this role, the State also engages with communities to provide technical and community outreach resources related to implementation of the NFIP, the Montana Floodplain and Floodway Management Act (1971), and the Montana Code Annotated. Annually, the State identifies and prioritizes specific study and mapping projects and applies to FEMA for funding to implement these projects and other related program activities. The hydrologic evaluation of the Teton Countywide Modernization Risk MAP Study. The ultimate goal of the study is to provide new and updated flood hazard risk information to the communities within Teton County.

Existing flood hazard information within Teton County is dated and quite limited given the broad extent and considerable flood risk posed by the numerous flooding sources. Flood hazard information has been published by FEMA on Flood Insurance Rate Maps (FIRMs) for Teton County. With the exception of a short reach of the Teton River and Spring Creek in Choteau, the flooding sources within the Teton County study area are currently mapped as Zone A on the FIRMs.

2.2. Community Description

Teton County is located along Montana's Rocky Mountain Front on the East side of the Continental Divide where the plains transition to the Sawtooth Range of the Rocky Mountain Front. Teton County lies Southeast of Glacier National Park and is Northwest of Helena, MT. The four principal flooding sources in Teton County are Sun River, Teton River, Muddy Creek, and Deep Creek. These flooding sources originate in the higher mountains on the Western boundary of Teton County and flow east into the Foothills area where they ultimately flow into the Missouri River East of Teton County. Deep Creek and Muddy Creek flow into the Teton River before the Teton River flows out of Teton County. Other flooding sources in Teton County originate in smaller foothill watersheds and flow into one of the four principal flooding sources described above.

Irrigated agriculture is a major land use within Teton County and several significant impoundments are located in the county to provide storage for irrigation water delivery. The largest impoundment is Gibson Reservoir, an approximately 99,000 acre-ft reservoir on the Sun River immediately below the confluence of the North and South Fork Sun River in Lewis and Clark National Forest. Other significant impoundments include Pishkun, Bynum, Farmers, and Eureka Reservoirs.

Much of the soils in Teton County formed in glacial till or glacial outwash material. The soils are quite variable, from alluvium in and around stream channels and floodplains, to sand and silts, clays, shales, and loams (with and without high rock content), depending on the parent material. Poorly consolidated lake and streambed sediments overlay thick deposits of sedimentary rock from the Cambrian and Cretaceous age. Glaciation played a role in the distribution and patterns of erosion and

deposition of glacial material. Given the range in topography, various formations have been exposed in the Sawtooth Range, and eroded material have been deposited in the flatter foothills and plains areas.

Mean Annual Precipitation within Teton County varies considerably based on elevation. Mean Annual Precipitation for the City of Choteau is just over 10 inches per year, while the mountains near the continental divide in western Teton County can receive up to 60 inches of precipitation a year. The western (mountainous) portion of Teton County is located in the Northwest hydrologic region with the rest of the county in the Northwest Foothills hydrologic region. The flood characteristics of the Northwest hydrologic region is described as "Largest floods caused by runoff from rain associated with moist air masses from the Gulf of Mexico. Most annual peak flows are from snowmelt or snowmelt mixed with rain." The flood characteristics of the Northwest Foothills hydrologic regions are "Floods caused by snowmelt, large amounts of rain, or thunderstorms. Annual peak flows are more variable than those from similar-sized streams in the mountainous regions." (USGS 2018a).

Approximately 20 stream gages exist within or near Teton County that have peak flow records on flooding sources of interest. Effective flood hazard mapping data exists in paper formats within the county, with nearly all of the Special Flood Hazard Areas (SFHA) mapped using approximate methods (Zone A). A short reach the Teton River and Spring Creek within the City of Choteau are mapped as Zone AE with a Floodway. As a separate task to DNRC, Baker has digitized the effective flood hazard maps. The City of Choteau is the largest community in Teton County and is the county seat. Choteau is located along the Teton River and Spring Creek flows through Choteau prior to joining the Teton River. Fairfield, Power, Dutton, Bynum and Pendroy are other small communities within Teton County.

2.3. Flood History

2.3.1. Teton County

Historical accounts of flooding in Teton County, Montana date back to the early 1900s. They cover the upstream portions of the Missouri River watershed, which include but are not limited to the Muddy Creek, Teton River, Spring Creek, Deep Creek, and Sun River basins. Most recorded flood events in Teton County were reported to be the result of delayed, but increased snowmelt with additional peak flows resulting from heavy late season rainfall most often in May and June. Ice jams created by unusually cold winters added to the flooding extents in several, but not most cases.

Floods are often described with reference to a peak discharge or flow rate. The highest rate of flow to occur during a flood event is only one metric of the overall impact of a flood event. The duration of flooding, the volume of total runoff during the event, the height to which the water rises and the extents the runoff reaches in the floodplain are also factors that can vary with each flood. For example, a rainfall driven flood with a peak discharge of 10,000 cfs that lasts three days in summer could have drastically different impacts on the river and floodplain than a slow spring melt flood with the same peak discharge that takes place over three weeks, and is subjected to ice jams and reduced floodplain conveyance from snow and frozen soils. Thus, the anecdotal history provided below may not always include estimates of peak discharge, however, other observations lend important insight into the extent of damage, duration, and communities affected by these events.

2.3.1.1 Anecdotal Information

There are a few anecdotal accounts of flooding, many of which are available in historic newspaper articles. The largest known flood in Teton County occurred in 1964, and is reflected in the volume of published articles and reports covering the flooding. This flooding event had severe consequences in Teton County as well as numerous counties adjacent to and downstream of the county. Additional information is summarized in county and state documents.

The following accounts pertaining to the Teton County flooding sources have been summarized from the existing Teton County, Montana Unincorporated Areas (FEMA, 1983a) and the City of Choteau, Montana Teton County Flood Insurance Studies (FEMA, 1983b).

1948: The first significant flood of note was a result of what has turned out to be common annual symptoms along the Continental Divide in Montana. Cool spring temperatures delayed snowmelt in the mountains and above average rainfall in April and May along with the warmer temperatures in late May resulted in inordinately high stream flows. Heavy rain in mid-June throughout Teton County, among others, was the highest on record at the time and tipped the scales for streams already at bankfull. Some monthly rainfall totals included 11.13 inches at the Gibson Dam and 8.61 inches at Choteau. While no loss of life was reported, and despite the low population density throughout the rural counties, total losses were estimated above \$1 million – a substantial monetary loss for that time period.

1953: While damage in the Missouri River basin exceeded \$8.5 million, flood-control devices and irrigation efforts reduced peak flow rates enough to avoid any loss of life as a result of the substantial flooding during 1953. Delayed snowmelt and late season rainfall both contributed to the flood flows throughout Teton County and downstream regions as well. The Teton River was noted as relatively high compared to other nearby flooding sources and resulted in most damage being confined to the town of Choteau. The USGS reported that a peak rainfall in Choteau reached 1.29 in one day, and 0.86 inches in one hour. While the monetary losses increased from the last severe flooding event, advances in flood protection measures were directly responsible for avoiding the loss of life.

1964: In a sequence of events similar to those preceding the floods of 1948 and 1953, a combination of cool spring temperatures delaying snow melt until June and unusually heavy rainfall in the same month resulted in the most severe flooding event Teton County and Montana at large has seen to date. The USGS estimated that the flood had an annual exceedance probability of 0.5%, which classified it as a 200-year storm. The Sun River reported peak flow rates at 55,000 cfs where the previous record had been 32,300 cfs. Further, multiple dam failures resulted in the loss of 32 lives while the overall property losses across the affected areas were estimated above \$62 million. According to the effective FIS for Teton County, the Teton River registered a flow of 54,600 cfs, Deep Creek a flow of 41,800 cfs, and the inflow at Gibson Dam on the Sun River reached 60,000 cfs. The dam's crest reportedly overtopped by over 3 ft during this flooding event.



Photo 1. Two Medicine Dam on the Two Medicine River, 1964 (Great Falls Tribune, 2018)

1975: Again, the most frequent and consistent cause of flooding throughout Montana, a combination of above average snowpack with a delayed melt and late season rainfall resulted in an unusually large flooding event near the Continental Divide. According to the USGS report on the flooding, estimates of flood damage were about \$53 million. While flood damage was substantially less than that as a result of the 1964 flooding, the dollar amount for the damage in 1975 was comparatively similar. This indicates both an increase in property value in the affected areas as well as the influx of inhabitants.

2011: Unusually cold weather in the winter leading up to the spring of 2011 resulted in the buildup of river ice across most of the state. Beginning with persistent and widespread ice jamming issues, continued cold weather brought significant snow to the plains, which melted at the same time as the river ice, leading to substantial and widespread flooding issues. Rain in late May brought additional late season snow to the mountains, directly resulting in prolonged inundation for streams already strained by the original snowmelt and recent rain. Once again, a frequent victim of flood damage, the town of Sun River was inundated. The need for water releases from filled reservoirs to accommodate incoming runoff passed the flooding issue downstream, extending the period of flooding for many towns across the plains. This flooding through 2011 damaged numerous bank stabilization structures in the Deep Creek watershed, which as a tributary to the Missouri River exacerbated the flooding downstream as well.



Photo 2. Corey Low-Water Crossing Near Choteau, June 9, 2011 (Choteau Acantha, 2011)

2.3.2. Recorded Flow Data

The USGS currently operates (and has historically operated) numerous gaging stations within Teton County. Under an agreement with DNRC, USGS performed flood frequency analyses of select gages within (and adjacent to) Teton County with the intent of using the revised flood frequency results in hydraulic analyses and subsequent revisions to floodplain mapping within the County. The results of these analyses are presented in the following sections. The largest recorded discharge events for 20 of the stream gages representing the four primary flooding sources (Sun River, Teton River, Muddy Creek, and Deep Creek) and tributaries are presented in **Table 2**. **Figures 17 through 36** indicate peak flow events used in the peak-flow frequency analyses, and include peak flows directly measured at those gages and those used in record extension (MOVE.3) methodologies.

Station Name	Sun River near Augusta		Sun River below diversion dam, near Augusta		Sun River below Willow Creek near Augusta		
Station Number	06080000		06080900		06082200		
Period of Peak Flow Data	1890 – 1964		1964 – 2019		1964 – 2019		
Number of Peak Flow Records	27		18		16		
	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	
Largest Recorded	6/9/1964	59,700.	6/9/1964	59,700.	6/9/1964	46,700.	
Events	6/21/1916	32,300.	6/19/1975	32,000.	6/19/1975	34,000.	
	6/7/1908	20,000.	6/19/2018	10,500.	6/19/2018	13,300.	
	5/25/1917	18,700.	6/2/1972	8,910.	6/2/1972	10,000.	
	6/10/1918	11,900.	5/14/1976	8,470.	5/28/1971	7,650.	
Station Name	Sun River at Simms		Sun River at	Fort Shaw	Sun River near Vaughn		
Station Number	06085800		06086000		06078500		
Period of Peak Flow Data	1964 –	1964 – 2019		1913-1928		1934-2019	
Number of Peak Flow Records	38	3	16		86		
	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	
Largest Recorded	6/9/1964	50,000.	6/7/1908	27,200.	6/9/1964	53,500.	
Events	6/20/1975	37,900.	6/21/1916	20,000.	6/20/1975	32,600.	
	6/19/2018	18,100.	5/26/1917	16,400.	6/21/2018	18,200.	
	6/8/2011	13,900.	6/9/1909	12,000.	6/4/1953	17,900.	
	5/27/2019	11,900.	6/24/1907	10,900.	6/10/2011	14,800.	

Table 2. Peak flow data for select gages in Teton County

Station Name	South Fork Sun River near Augusta		North Fork Sun River near Augusta		Muddy Creek tributary near Power	
Station Number	06079000		06078500		06087900	
Period of Peak Flow Data	1911 - 2019		1911 – 2019		1963 - 1986	
Number of Peak Flow Records	11		38		17	
Largest Recorded	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)
Events	6/8/1964	28,800.	6/8/1964	51,100.	7/2/1966	620.
	6/19/2018	6,330.	5/19/1991	6,620.	10/15/1975	420.
	5/19/2008	4,370.	6/3/1948	4,840.	6/20/1975	350.
	6/1/2009	3,550.	5/20/1954	4,580.	3/17/1978	350.
	5/24/2014	3 <i>,</i> 380.	6/2/1956	4,170.	5/3/1964	284.
Station Name	Muddy Creek near Bynum		Bruce Coule near Ch	e tributary oteau	Beaver Cre Dam, nea	ek at Gibson ar Augusta
Station Number	06106500		06105800		06079600	
Period of Peak Flow Data	1913 - 1924		1963-2002		1959 – 1973	
Number of Peak Flow Records	10		40		15	
	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)
	6/21/1916	976.	6/9/1972	390.	6/8/1964	4,360.
Largest Recorded	5/26/1917	720.	9/18/1986	284.	5/26/1962	496.
Events	4/14/1920	519.	7/2/1966	247.	5/12/1960	458.
	6/27/1913	320.	6/10/1967	155.	5/30/1967	300.
	12/31/1917	152.	6/8/1964	148.	5/11/1970	215.

Station Name	Teton River below South Fork, near Choteau		Teton River at Strabane		Teton River near Dutton	
Station Number	06102500		06103000		06108000	
Period of Peak Flow Data	1948 - 2019		1908-1925		1955-2019	
Number of Peak Flow Records	30		18		65	
	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)
Largest Recorded	6/8/1964	54 <i>,</i> 600.	6/21/1916	3,810.	6/9/1964	71,300.
Events	6/19/2018	11,100.	5/26/1917	2,460.	6/20/1975	16,000.
	5/27/2019	3,560.	6/10/1908	2,300.	7/2/1966	8,580.
	5/26/2008	3,200.	6/2/1913	1,410.	5/28/2019	7,380.
	6/3/1948	2,780.	7/27/1909	1,080.	2/26/1986	7,290.
Station Name	Teton Rive	r at Loma	Deep Cre Chote	ek near eau	Kinley Coule	e near Dutton
Station Name Station Number	Teton River	r at Loma 8800	Deep Cre Chot 06106	ek near eau 6000	Kinley Coule	e near Dutton 08200
Station Name Station Number Period of Peak Flow Data	Teton River 06108 1998 -	r at Loma 8800 2019	Deep Cre Chot 06106 1911 –	ek near eau 5000 1964	Kinley Coule 0610 1963	e near Dutton 08200 1978
Station NameStation NumberPeriod of Peak Flow DataNumber of Peak Flow Records	Teton River 06108 1998 - 22	r at Loma 8800 2019	Deep Cre Chote 06106 1911 – 15	ek near eau 5000 1964	Kinley Coule 0610 1963	e near Dutton 08200 1978 L6
Station Name Station Number Period of Peak Flow Data Number of Peak Flow Records	Teton River 06108 1998 - 22 Date	r at Loma 800 2019 Peak Flow (cfs)	Deep Cre Chote 06106 1911 – 15 Date	ek near eau 5000 1964 5 Peak Flow (cfs)	Kinley Coule 0610 1963 Date	e near Dutton 08200 -1978 L6 Peak Flow (cfs)
Station Name Station Number Period of Peak Flow Data Number of Peak Flow Records	Teton River 06108 1998 - 22 Date 5/30/2019	r at Loma 8800 2019 Peak Flow (cfs) 6,520.	Deep Cre Chot 06106 1911 – 15 Date 6/8/1964	ek near eau 5000 1964 5 Peak Flow (cfs) 41,800.	Kinley Coule 0610 1963 1 Date 7/2/1966	e near Dutton 08200 -1978 L6 Peak Flow (cfs) 465.
Station Name Station Number Period of Peak Flow Data Number of Peak Flow Records	Teton River 06108 1998 - 22 Date 5/30/2019 8/22/1932	r at Loma 800 2019 Peak Flow (cfs) 6,520. 5,660.	Deep Cre Choto 06106 1911 – 15 Date 6/8/1964 6/21/1916	ek near eau 5000 1964 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Kinley Coule 0610 1963 Date 7/2/1966 5/7/1975	e near Dutton 08200 -1978 16 Peak Flow (cfs) 465. 153.
Station NameStation NumberPeriod of Peak Flow DataNumber of Peak Flow RecordsLargest Recorded Events	Teton River 06108 1998 - 22 Date 5/30/2019 8/22/1932 6/12/2011	r at Loma 3800 2019 Peak Flow (cfs) 6,520. 5,660. 3,910.	Deep Cre Chot 06106 1911 – 15 Date 6/8/1964 6/21/1916 5/26/1917	ek near eau 5000 1964 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Kinley Coule 0610 1963 1 Date 7/2/1966 5/7/1975 3/21/1969	e near Dutton 08200 -1978 L6 Peak Flow (cfs) 465. 153. 125.
Station Name Station Number Period of Peak Flow Data Number of Peak Flow Records	Teton River 06108 1998 - 22 Date 5/30/2019 8/22/1932 6/12/2011 6/24/2018	r at Loma 800 2019 Peak Flow (cfs) 6,520. 5,660. 3,910. 3,210.	Deep Cre Choto 06106 1911 - 15 Date 6/8/1964 6/21/1916 5/26/1917 5/21/1912	ek near eau 5000 1964 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	Kinley Coules 0610 1963 1963 1 2 2 2 2 2 2 2 3 2 1 9 6 3/18/1978	e near Dutton 08200 -1978 16 Peak Flow (cfs) 465. 153. 125. 122.

Station Name	Kinley Coulee tributary near Dutton		North Fork Muddy Creek near Bynum		
Station Number	06108300		06107000		
Period of Peak Flow Data	1963-1978		1913 - 1924		
Number of Peak Flow Records	16		11		
	Date	Peak Flow (cfs)	Date	Peak Flow (cfs)	
	7/2/1966	465.	6/21/1916	600.	
Largest Recorded	5/7/1975	153.	6/1/1917	352.	
Events	3/21/1969	125.	5/12/1920	212.	
	3/18/1978	122.	8/1/1915	118.	
	6/8/1964	76.	4/29/1922	102.	

Figure 17. USGS 06080000 Sun River near Augusta





Figure 18. USGS 06080900 Sun River below Diversion



















Figure 22. USGS 06089000 Sun River near Vaughn







Figure 24. USGS 06078500 North Fork Sun River near Augusta






Figure 26. USGS 06106500 Muddy Creek near Bynum

Figure 27. USGS 06105800 Bruce Coulee tributary near Choteau, Montana





Figure 28. USGS 06079600 Beaver Creek at Gibson Dam near Augusta

Figure 29. USGS 06102500 Teton River below South Fork, near Choteau









Figure 31. USGS 06108000 Teton River near Dutton





Figure 33. USGS 06106000 Deep Creek near Choteau





Figure 34. USGS 06108200 Kinley Coulee near Dutton







Figure 36. 06107000 North Fork Muddy Creek near Bynum

2.3.3. Teton County Flooding Sources

The flooding sources analyzed in this study include Sun River, Teton River, Muddy Creek, Deep Creek, and associated tributaries to those larger flooding sources. Although these flooding sources share many similarities, there is some variability in size, orientation, soil composition, land use and elevation as the tributaries flow out of the Mountainous Rocky Mountain Front and into the Foothills and Plains of Central Montana. While the predominant flood drivers for the contributing basins may not be strictly coincidental with those on the four larger flooding sources (Sun River, Teton River, Muddy Creek, and Deep Creek), a review of gaging data indicates that peak flows for all gage sites tend to occur in the May to June window, principally a function of snowmelt or rain-on-snow events. There is very little flow data available for the smaller tributaries that drain foothill regions in the county, but the limited data and anecdotal information suggest that these smaller foothills watersheds may be more susceptible to peak flow events that occur from more intense rainfall events arising from summertime thunderstorm events. The tributaries located further west (higher up in the watershed) in the system are more prone to flooding due to spring snowmelt, while the tributaries in the eastern portion of the system can experience floods due to thunderstorm bursts and heavy summer rains.

For example, the Bruce Coulee near Choteau (a foothills tributary to Deep Creek), has 20 of its 40 peak flow events occur outside the May-June window, with 15 of the flow events outside the May-June window occur in July, August, and September. Similarly, a foothills tributary to Muddy Creek near Power has 16 peak flow records for the gaged site and 8 of the 16 peak flow events occur outside the May – June window. In contrast with these two tributaries, only 4 of the 86 peak flow

records for the Sun River near Vaughn occur outside the May – June window (the remaining 4 peaks occurred in July).

3. Previous Studies

Hydrologic analyses for the flooding sources in Teton County are limited and primarily focused on USGS gage data on the larger rivers and creeks within the county.

The various sources of information are tied to previous FEMA flood insurance studies and data compiled by the USGS for stream gages within the watershed. A summary of the existing studies and documents are provided in the following sections.

3.1. Flood Insurance Studies

3.1.1. Teton County

An original Flood Insurance Study (FIS) for Teton County, Montana (Unincorporated Areas) was published effective by FEMA on January 18, 1983 (FEMA 1983a).

The 1983 FIS was based on existing and new hydrologic and hydraulic analyses performed on the Teton River and Spring Creek at Choteau to provide results using detailed study methods at Choteau. Information for the Sun River was derived from the Cascade County FIS and was produced using limited detailed study methods. Other mapped areas within the county were performed using approximate methods.

Summaries of discharge are reported at three locations on the Teton River (above Choteau, MT, at US Highway 287, and downstream of Deep Creek), Spring Creek (at Choteau), and on the Sun River (at Simms, MT). Flows for the Teton River in the Choteau area were determined by performing a regional analysis of 10 gaging stations within the area and drainage area vs. discharge plots were developed to provide a relationship that was used to determine the flood frequency values for the Teton River around Choteau.

Spring Creek at Choteau is complicated in that there are no stream gages on Spring Creek, and that during higher flows, the Teton River spills into Spring Creek. Two separate analyses were performed for the FIS at Spring Creek at Choteau. The first method applied a modified regional analysis similar to the Teton River used multipliers representing variability from the mean value for each recurrence interval flood. The second method utilized rainfall-runoff analysis of the Spring Creek basin. The results of the two analyses compared favorably and the modified regional analysis results were utilized in the FIS.

Flow information for the Sun River was taken from the Cascade County FIS, where discharges at Simms were determined using Log Pearson type III analyses of gage data at Augusta, MT (below Gibson Dam).

3.1.2. City of Choteau

Original Flood Insurance Studies (FIS's) for City of Choteau, Montana (Teton County) was published effective by FEMA on October 3, 1983 (FEMA 1983b). Summaries of discharge are reported at two locations on the Teton River near Choteau (above Choteau, MT, and at US Highway 287. The US Highway 287 site represents a reduction in Teton River flows due to flows spilling into Spring Creek. Summaries of discharge report one location on Spring Creek (at Choteau). The description of hydrologic methods provided in the City of Choteau FIS is exactly the same as reported in the Teton County (Unincorporated Areas) FIS as described in **Section 3.1.1** above.

4. Hydrologic Analyses and Results

Hydrologic analyses were performed to identify the peak flow discharge estimates for flood events corresponding to the 10%, 4%, 2%, 1%, 0.2%, and 1% 'plus' annual exceedance probability (AEP) at specific locations on gaged and ungaged flooding sources in Teton County, MT. The select tributaries are those that will be studied as part of the Teton Countywide Modernization Risk MAP Study. Peak flow discharge estimates were performed by USGS for select stream gages within Teton County watersheds using Bulletin 17C methodology. For ungaged sites, the peak flow discharge estimates were determined using regional regression equations published by USGS (Sando, et al., 2018b). The locations for these calculations establish or define flow change locations along the studied flooding sources and generally correspond to the junction of significant drainages or where intermediate flow changes are required due to significant changes in contributing drainage area between confluences. The analyses conducted to identify hydrologic characteristics at these locations were performed using a regional regression equation approach to determine peak flows or applying gaged data to an ungaged location - either a drainage-area ratio adjustment or logarithmic interpolation between gages (USGS SIR 2015-5109-F (Sando, et al., 2018a)).

As previously described, the primary flooding sources included in this study are within the Teton River and Sun River watersheds in Teton County, MT. This study, provides peak flow hydrologic characteristics for approximately 430 miles of flooding sources in Teton County. Bulletin 17C peak flow discharge analyses were performed on select gaged sites as described in **Section 4.1**. Peak flow hydrologic characteristics for ungaged enhanced study reaches were analyzed using regional regression analysis, described in **Section 4.2.1**, and study reaches with gage data applied the gaged data to ungaged locations as described in **Sections 4.2.2 and 4.2.3**.

Bulletin 17C flood-frequency peak discharge analyses were deemed to be the most appropriate analyses for gaged sites, as they utilized actual flow data for that reach and for many sites record extension methodologies (MOVE.3) were able to be used to extend gage locations with relatively shorter periods of gage data to improve the representation of peak flows at the gage site. When possible, the Bulletin 17C flood frequency results were further improved by weighting the flood-frequency analyses with regional regression data. Weighting was generally applied if the gage site was unregulated and assessments of the gaged peak flow data were in agreement with the peak flow data used to generate the regional regression equations.

For gaged streams containing one or more stream gages, the USGS Bulletin 17C flood-frequency analyses were coupled with methodologies to extrapolate or interpolate the gaged data to ungaged locations within the study reach using methodologies based on drainage-area ratios.

Regional regression analysis was selected as the best methodology to determine peak flows for flooding sources without stream gages due to the relative accuracy and practical feasibility for the ungaged tributaries within the County.

All the methods described above rely on a delineation of the upstream contributing drainage area to each flow change node. Basin delineation, characteristics, and peak flow estimation are all available through the StreamStats web application (McCarthy, et al. 2016). Given the reliance of the equations on these delineations and the low resolution of the StreamStats elevation source (30-meters), the delineation results were checked and corrected using manual delineation based on engineering judgement and use of a high-resolution digital elevation model (DEM), derived from LiDAR collected at a 3ft resolution. If the StreamStats delineations were inconsistent with the more accurate high-resolution data the StreamStats delineation was replaced by the revised sub-basin. Approximately 231 flow node locations were identified that required revisions to the StreamStats results.

4.1. USGS Stream Gage Analyses

Under an agreement with Montana DNRC, the USGS performed a peak-flow frequency analysis for select gages in or near Teton County, MT. This analysis included gages throughout the watershed and has been published as a USGS data release (Siefken, et al. 2021). The gage analyses performed by USGS utilized methods described in a methods document prepared by USGS (Sando and McCarthy, 2018a), and included at-station methodologies described in Bulletin 17C, the mixed-station record extension methodology Mixed-Station Maintenance of Variance Type 3 (MOVE.3), and regional regression equation weighting of at-station flood frequency analysis results. In general, gage stations were analyzed using the mixed-station record extension methodology Mixed-Station Maintenance of Variance Type 3 (MOVE.3) (those with short records, affected by flow regulation, or with large drainage areas (typically larger than 2,750 mi²)). Details of how USGS applied the MOVE.3 analysis to synthesize peak flow data are provided in detail in Chapter D of Montana StreamStats (Sando, et al. 2018a) and summarized below. The MOVE.3 methodology is based on correlation of concurrent peak-flow records for the target station (station with incomplete flow records) with one or more index stations (stations with peak flow records for one or more of the missing years of the target station). The procedure evaluates the strength of the relationship between peak discharges at target and index stations for the same year and adjusts the peaks for the index stations to fit the characteristics of the target station for the missing year data. Documentation regarding the application of the mixed-station MOVE.3 procedure is provided in the USGS data release (McCarthy, et al. 2016). For gaging stations where the MOVE.3 record extension was not appropriate, the sites were evaluated to determine if weighting the at-station results with regional regression equations developed by USGS would be appropriate to better represent the peak-flow flood frequency results at those sites. Appendix A provides the results of the USGS flood frequency analyses and indicates those sites that had MOVE.3 record extension included in the analyses and those sites where the atstation results had regional regression weighting applied. **Figures 37 and 38** indicate how flows change along the Sun River and Teton River based on drainage area within those watersheds.



Figure 37. Annual Exceedance Probabilities for Sun River flow gages evaluated by this study





Figure 38. Annual Exceedance Probabilities for Teton River flow gages evaluated by this study

4.1.1. 1%+ Peak Flow Estimates - Gaged Peak-Flow Frequency Analyses

FEMA flood risk products employ a method for determining peak discharge estimates for a standard error of prediction above the 1% AEP, known as the 1% Plus discharge. The purpose of the 1% plus analysis is to represent uncertainty within the hydrologic evaluation and potential underestimations in the resulting modeled flood elevations by using the upper confidence limits (84%) of the 1% AEP flood to compute higher flood discharge (FEMA 2012). Baker staff reviewed supplemental information provided by USGS (Siefken, et al., 2021) and incorporated the 1% plus results for the stream gages included in the USGS peak-flow flood frequency analyses.

4.1.2. Flow Change Node Locations

Flow change nodes typically fall into three types of placements throughout the study area. They were placed at the upstream extent of the enhanced study reach and at the downstream confluence of the study reach. In between the upper and lower extents, they occur when a significant tributary enters the study reach and created a significant increase in contributing drainage area or otherwise influenced contributing watershed conditions such that a relatively large change in flows could be expected. HUC-12 watershed boundaries were utilized as a tool to evaluate potential locations where a flow change location might be warranted, but not all flow changes occurred at HUC-12 boundaries and not all HUC-12 boundaries resulted in a flow change location. The flow change nodes were spaced such that each node provides a smooth flow transition from the adjacent upstream node.

4.2. Flood Frequency Estimates at Ungaged Sites

As previously described, a review of available peak-flow discharge data from gaging stations within Teton County and tributaries determined that refinement of hydrologic conditions along the study reach is required to properly represent changes in contributing drainage area and watershed characteristics along the study reach. For ungaged reaches, regional regression analyses were applied to the study reaches, and in many instances, multiple flow nodes were established along the study reach to better represent the changes in contributing drainage area and watershed conditions along the study reaches, so unreasonably large peak-flow values were not improperly applied to portions of the study reaches with significantly less contributing drainage areas. **Section 4.2.1** describes how regional regression equations were applied to ungaged study reaches.

There are 20 stream gages within the Teton County study area that the USGS performed peak-flow flood-frequency analyses on to determine the peak flow characteristics at those gage locations. However, these represent a relatively low density of the 430 mile study area, where a number of significant tributaries and large changes in contributing drainage area occur between the gage sites. As a result, an assessment was performed of the gaged peak-flow discharge results at the gaged locations, and intermediate flow change locations were identified where more gradual changes in peak-flow discharge values can be reasonably expected to occur between gage sites. Generally, these flow change locations were placed to corresponded to junctions of significant tributaries that were known or expected to result in significant changes to flow values. HUC-12 watersheds were used as a tool to screen these locations, but not every HUC-12 watershed necessitated a flow change location, nor was every flow change location located at a HUC-12 boundary. In many instances, flow change locations where located in the immediate vicinity (upstream, downstream, or both) of a community along the flooding source to best represent flow conditions through the community. A total of 231 flow change locations were placed within study area. When a flow change location was located between two stream gages, the two-site logarithmic interpolation method (Section 4.2.2) was utilized to determine the peak-flow discharge conditions at the ungaged site.

On gaged flooding sources with only one USGS stream gage or other locations above the uppermost stream gage or below the lowermost stream gage, the peak-flow discharge characteristics at ungaged flow node locations were determined by translating the gaged data to ungaged locations using drainage-area ratio adjustment (extrapolation). Six flow change locations on three gaged sites were identified and studied using this method.

4.2.1. Regional Regression Equations

The regional regression equation approach, developed by the U.S. Geological Survey (USGS) in cooperation with the Montana Department of Natural Resources and Conservation, was applied to the node locations to estimate peak-flow magnitudes associated with the 10, 4, 2, 1, and 0.2 percent annual exceedance probabilities. The methodology in this study relied on 537 gaging stations throughout the state of Montana that had a period of at least 10 years of systematic record, drainage area under 2,750 mi² and were unaffected by major regulation. Screening criteria also limited gages

to those that were representative of peak-flow frequencies and included a redundant gaging-station analysis to account for spatial autocorrelation. An ordinary least squares regression was used in the study to adjust the boundaries between eight predetermined hydrologic regions. Final regression equations were developed for each hydrologic region using either generalized least squares regression or weighted least squares regression. The detailed methodology of regional regression analysis is described in Chapter F of Montana StreamStats (Sando, et al. 2018a).

The watersheds studied in Teton County span two of the eight hydrologic regions in Montana (**Figure 39**), Northwest and Northwest Foothills regions. The mean standard error of prediction (SEP) for the 1% AEP discharges calculated by this method ranges from 13.6 percent in the Northwest region, to 65.8 percent in the Northwest Foothills region. For the nodes where the basin delineation in StreamStats was accepted, peak flow estimates are retrieved directly from the web application. Calculating flows for the nodes that were replaced required obtaining the explanatory variables using the high-resolution spatial delineations. Contributing drainage area to each node is the one common explanatory variable in flow calculation across all regions with the other basin characteristics varying by region. The process of calculating other explanatory variables is outlined in **Section 4.1.2**.



Figure 39: Montana Hydrologic Regions

In addition to the contributing drainage area, calculated as a feature of the basin polygons, the Northwest Foothills hydrologic region utilizes mean annual precipitation (P (in inches)) for flow calculations in the study area. These variable values were taken from corresponding StreamStats basin results.

When the contributing drainage area included two hydrologic regions, an area weighted percentage was applied based on the percentage of the watershed that is located in each watershed.

The regression equations vary for each of the five estimated recurrence intervals, with a consistent set of explanatory variables maintained within each hydrologic region outlined in **Table 3** (Sando, et al. 2018b). These equations were used to calculate the peak flow for all AEPs at all flow nodes on ungaged study reaches.

REGRESSION EQUATIONS FOR ESTIMATING PEAK- FLOW AT UNGAGED SITES												
Regression equation for indicated Q _{AEP}	Number of streamflow- gaging stations (n) ¹	σ_{δ}^2 (log units)	MVP (log units)	SEP (%)	SEM (%)	Pseudo or adjusted <i>R</i> ² (%)						
Northwest hydrologic region ²												
Q ₁₀ = 69.8 A ^{0.808}	32	0.019	0.021	34.4	32.5	88.4						
$Q_4 = 132 \ A^{0.771}$	32	0.000	0.002	9.11	0.00	89.4						
$Q_2 = 223 \ A^{0.732}$	32	0.000	0.002	11.3	0.00	88.0						
$Q_1 = 371 \ A^{0.695}$	32	0.000	0.004	13.6	0.00	84.4						
Q _{0.2} = 1,171 A ^{0.614}	32	0.000	0.007	19.3	0.00	67.0						
Nort	hwest Foothills hy	drologic	region ²									
$Q_{10} = 0.916 A^{0.433} P^{1.83}$	31	0.042	0.052	56.4	50.2	88.5						
$Q_4 = 3.24 \ A^{0.451} \ P^{1.57}$	31	0.039	0.050	55.2	48.1	88.7						
$Q_2 = 7.60 \ A^{0.469} \ P^{1.38}$	31	0.044	0.056	59.1	51.0	87.5						
Q ₁ = 16.3 A ^{0.487} P ^{1.20}	31	0.053	0.068	65.8	56.7	85.4						
$Q_{0,2} = 76.6 A^{0.530} P^{0.844}$	31	0.088	0.111	89.5	76.9	78.5						

Table 3: Regression equations for estimating peak-flow at ungaged sites

 $[Q_{AEP}, peak-flow magnitude, in cubic feet per second, for annual exceedance probability (AEP) in percent; n, number of streamflow-gaging stations used in developing regression equations for indicated hydrologic region; <math>\sigma_{6}^{2}$, model error variance; MVP, mean variance of prediction; SEP, mean standard error of prediction; SEM, mean standard error of model; Pseudo R², pseudo coefficient of determination presented for generalized least squares regression analysis; Adjusted R², adjusted coefficient of determination presented for weighted least squares regression analysis; A, contributing drainage area, in square miles; P, mean annual precipitation, in inches; E₅₀₀₀, percentage of basin above 5,000 feet elevation; SLP₃₀, percentage of basin with slope greater than 30 percent; ET_{SPR}, Mean spring (March–June) evapotranspiration, in inches per month] ¹The number of streamflow-gaging stations used in the Q_{66.7} regression equation for a region might differ from the number of streamflow-gaging stations used in all other regression equations in that region because of streamflow-gaging stations with unreported Q_{66.7} values (table 1–2; Sando et al. 2018b), which is discussed further in Sando et al., 2018b. ²Regression equations were developed using generalized least squares regression analyses.

4.2.1.1 1%+ Peak Flow Estimates - Regional Regression Equations

In addition to the recurrence intervals described in **Section 4.2.1**, FEMA flood risk products employ a method for determining peak discharge estimates for a standard error of prediction above the 1% AEP, known as the 1% plus discharge. This 1% plus discharge was calculated by adding the associated mean Standard Error of Prediction (SEP) to the 1% discharge. This calculation was made for regional

regression equations at nodes delineated by both methods, as the 1% plus discharge is not returned by the StreamStats web application (Sando et al., 2018c).

4.2.2. Two-site Logarithmic Interpolation

At ungaged sites located between two gaging stations on the same river, Chapter F of USGS Scientific Investigations Report 2015-5019 (Sando, et al. 2018b) provides a methodology to estimate peak-flow frequencies using linear interpolation of the logarithms of peak-flow frequencies at the two gages using the logarithm of the drainage areas as the basis for the interpolation. The flow change locations between two gaging stations on the Sun River and Teton River utilize this methodology. The SIR cautions that this method may produce unreliable results if the two gaging stations have different peak flow characteristics caused by substantially different periods of records. The MOVE.3 analysis performed by USGS (Sando et al., 2018c) minimizes the potential for this cause of unreliability given the record extension methodology. Results are presented in **Appendix A**. **Equation 1:**

$$logQ_{AEP,U} = logQ_{AEP,G1} + \left[\frac{(logQ_{AEP,G2} - logQ_{AEP,G1})}{(logDA_{G2} - logDA_{G1})}\right](logDA_{U} - logDA_{G1})$$

where:

$egin{array}{l} Q_{AEP,U} \ Q_{AEP,G1} \end{array}$	is the AEP-percent peak flow at ungaged site <i>U</i> , in cubic feet per second; is the AEP-percent peak flow for the upstream gaging station <i>G1</i> , in cubic feet per second;
$Q_{AEP,G2}$	is the AEP-percent peak flow at the downstream gaging station <i>G2</i> , in cubic feet per second;
DA_{G2}	is the drainage area at the downstream gaging G2, in square miles;
DA_{G1}	is the drainage area at the upstream gaging station G1, in square miles; and
D_{AU}	is the drainage area at ungaged site <i>U</i> , in square miles.

4.2.3. Estimating Peak-Flow Frequencies at an Ungaged Site on a Gaged Stream

USGS SIR 20155019 Chapter F (Sando et al. 2018b) provides the methodology for estimating the peakflow frequency when an ungaged site is close to a gaging station on the same river. The drainagearea ratio adjustment methodology is provided in Chapter F and is provided below. This method was utilized to estimate the peak-flow frequencies on gaged flooding sources in the study area. As noted in SIR 20155019, this method is appropriate for ungaged sites on large streams where regression equations are not applicable (e.g. drainage area out of the range of applicability), and results may not be reliable if the ratio of drainage areas (DA_U/DA_G) is outside the range of 0.5 to 1.5. Except as noted in **Section 4.4**, all applications of this methodology on the ungaged sites on flooding sources with stream gages meet these criteria. Results are summarized in **Appendix A**.

Equation 2:

$$Q_{AEP,U} = Q_{AEP,G} \left(\frac{DA_U}{DA_G}\right)^{exp_{AEP}}$$

Where:

$Q_{AEP,U}$	is the AEP-percent peak flow for ungaged site <i>U</i> , in cubic feet per second;
$Q_{AEP,G}$	is the AEP-percent peak flow for gaging station G, in cubic feet per second;
DA_U	is the drainage area at ungaged site <i>U</i> , in square miles;
DA_G	is the drainage area at gaging station G, in square miles;
<i>exp</i> _{AEP}	is the regression coefficient for an OLS regression relating the log of the AEP-percent
	peak flow to the log of the drainage area within each location (SIR 20155019 Chapter F
	Table 5).

4.3. Ponds, Closed Basins, and other Water Bodies

Scoping information and effective floodplain maps indicate two small disconnected and unnamed ponds are mapped as Zone A (Approximate) in the upper reaches of the Sun River watershed. This

study intended to apply a 2019 Michael Baker guidance document (*Recommendations for the Treatment of Reservoirs and Closed Basin Lakes for Flood Studies in Montana*; MBI 2019) to the hydrology at these locations. A detailed assessment was made of these two locations using terrain data derived from hi-resolution Light Detection and Ranging (LiDAR) data and visual inspection of aerial photo-imagery to determine stage-storage characteristics at these locations. The results of these assessments indicate that neither location mapped as disconnected pond provides any significant storage beyond potential shallow flooding under sheet flow conditions. Thus, the methodology described in the 2019 Michael Baker guidance document is not appropriate to describe the hydrology at these sites, and the contributing drainage area to these locations was delineated and regional regression equations were applied to determine peak flow flood events through these locations should a riverine hydraulic analysis be performed at the locations.

Two significant instream impoundments are located on the Sun River: Gibson Reservoir (99,100 acreft total storage) located near the upper extent of the Sun River study area and Sun River Diversion (minimal storage) located approximately 2.5 miles below Gibson Dam. In accordance with FEMA guidance as summarized in the 2019 Baker guidance document, these impoundments are located within riverine systems with sufficient gage data to perform hydrologic analyses that reflect the impoundment's effects on flows within the system. Also, these impoundments are controlled systems with a record of consistent operation that supports use of the gage data to define the impoundment hydrology.

4.4. Gaged/Ungaged Sites with Special Circumstances

In most cases, AEP flow values at ungaged locations of gaged streams can be determine using **Equation 2**. USGS recommendations suggest results may be unreliable if **Equation 2** is applied at ungaged sites where the ratio of ungaged to gaged drainage areas outside the range of 0.5 to 1.5. Analyses of flow data for the upper reaches of Deep Creek above Choteau (at Nunemaker Coulee and upstream) indicate that it is most appropriate to apply **Equation 2** outside the range of 0.5 to 1.5 drainage area ratios. The justification for this determination is because the stream gage used to determine the upstream flow values (USGS 06106000 Deep Creek near Choteau, MT) incorporates recorded peak flow information within Deep Creek and includes an estimate of the June 1964 flood in the peak-flow frequency analysis and is more conservative than regression equations.

The Muddy Creek flooding source contains one stream gage within the study area (USGS 06106500 Muddy Creek near Bynum, MT). There are only 10 years of peak flow data for this gage, and the period of record is 1913 to 1924 and does not include any of the significant flood events that occurred in 1953, 1964, and 1975. Thus, it is determined that regional regression equations are more appropriate to describe peak-flow flood conditions along the entire Muddy Creek study reach than the USGS stream gage. North Fork Muddy Creek near Bynum, MT (USGS 06107000) also only has data for the same period of record as the Muddy Creek gage and does not include peak flow values from significant flood events. Thus, values from regional regression equations will be applied to North Fork Muddy Creek.

The USGS reports peak-flow flood frequency results for two gages on the Sun River that have flow data at approximately the same location along the Sun River. USGS gage 06080000 (Sun River near Augusta, MT) has a period of record of 1890 to 1929 which includes 27 peak flow records. This period of record occurs before closure of Gibson Dam, but does include an estimate of the 1964 flood

event in the peak-flow frequency analysis. Thus, USGS gage 06080000 represents unregulated flow conditions on the Sun River and can be applied to unregulated flow conditions upstream of Gibson Dam. USGS gage 06089000 (Sun River below diversion dam, near Augusta, MT) records flow at approximately the same location as 06080000 and has a period of record from 1968 to 2019 with 18 peak flow records and includes an estimate of the 1964 flood event. Thus, 06089000 represents post- closure of Gibson Dam and regulated flow conditions downstream of the dam. Additionally, MOVE.3 record extension methods were utilized by USGS in peak-flow frequency analyses for this site which increases the number of peak flows utilized in the analysis to 86 peak flow records. Thus, as indicated by the sharp drop in **Figure 37**, the apparent discontinuity in flow conditions at the beginning of the plot illustrates the effect of flow regulation on Sun River peak flows by Gibson Dam.

5. Summary/Discussion

5.1. Peak Flow Frequency Analysis

This peak flow frequency analysis was performed for approximately 430 miles of flooding sources within Teton County, MT. The peak flow frequency analyses were performed for the flows that correspond to the 10%, 4%, 2%, 1%, and 0.2% AEPs. In addition to these AEPs, the 1% plus discharge value was determined at each flow node, which incorporates a standard error of prediction into the 1% AEP calculations. These peak flows were calculated using the State of Montana regression equations. The standard error of prediction for the peak flow rates for the 1% annual-exceedanceprobability event ranges from 13.6% in the Northwest hydrologic region to 65.8% in the Northwest Foothills hydrologic region. The peak flows for approximately 231 flow nodes are provided in Appendix A. Figures 5 through 16 indicate the flow change locations and recommended 1% AEP flow values for use in hydraulic modeling and subsequent floodplain mapping. It is anticipated that hydraulic modeling for floodplain study purposes would conservatively apply flow values from a flow node to the immediate upstream reach until the next upstream flow node. For many of the tributary watersheds, a flow node was placed at the upstream extents of the reach. While this uppermost flow node is not expected to be applied directly to floodplain study hydraulic analyses (because it would generally be applied to the reach upstream of the node), it does provide an indication of the relative magnitude of flow in reaches above the study and is useful for comparison purposes.

Comparisons have been made between USGS regression equation results (StreamStats) and peakflow frequency results at the gage sites in the study area. The results are presented in **Table 4**. There is considerable variability exists between the regression equation and gage analysis results, and a discussion about the variability follows.

The regression equation results for the Muddy Creek gages (Muddy Creek and North Fork Muddy Creek near Bynum) yield high results for the 1% AEP flood than gage analyses. The reason for the difference is the relatively short period of record at the gage sites, the fact that the gage sites do not include the 1964 flood event (nor other significant flood events of 1953 and 1975), and the observed data do not fit the Pearson Type III distribution very well. Thus, regression equation results are applied to Muddy Creek and North Fork Muddy Creek study reaches.

The Teton River gage data tend to provide larger 1% AEP estimates than regression equation results. The peak-flow frequency analyses for Teton River gaged data include estimates of the 1964 flood and incorporate that historic flood in the 1% AEP estimates. Thus, the gage analyses are considered a better representation of peak flow characteristics on the Teton River through the study reach.

For the Sun River gage sites, the gage data for locations below Gibson Dam tend to provide results that are lower than regional regression equation results. Baker provided comments to DNRC and USGS noting that MOVE3 analyses for Sun River gaged sites appear reasonable but on the low side of estimates given the departure from plotting positions and identified that the MOVE3 results have two flood events exceeding the 1% AEP discharge and the 1964 flood exceeding 0.2% AEP discharge. During follow up discussions (Siefken email 5/25/2021) USGS provided additional justification for use of MOVE3 results and the peak-flow flood frequency results as published by USGS are incorporated into this study. Additional discussion may be considered based on future results of hydraulics analyses along the Sun River.

Flow nodes with contributing drainage areas less than or equal to one square mile are identified by italics in the table in **Appendix A**. Flooding sources from drainages less than or equal to one square mile are not recommended for further study unless it is determined on a case-by-case basis that these drainages should receive additional consideration.

Main Drainage	Source	Drainage Area	10-percent	4-percent	2-percent	1-percent	0.2-percent
main Drainage	Jource	Dramage Area	AEP flood	AEP flood	AEP flood	AEP flood	AEP flood
Muddy Crook	StreamStats	72.1	2,030	3,330	4,760	6,660	14,400
Widduy Cleek	USGS wymt_ffa_2019	72.1	1,300	2,560	3,840	5,390	11,200
Muddy Creek	StreamStats	53.9	1,480	2,480	3,590	5,050	10,900
Widduy Creek	USGS wymt_ffa_2019	55.8	711	1,420	2,150	3,010	6,040
Toton Pivor	StreamStats	110.3	3,120	4,960	6,970	9,750	21,000
Teton Kiver	USGS wymt_ffa_2019	110	4,620	9,070	14,600	23,000	63,000
Teton River	StreamStats	122.5	3,420	5,400	7,550	10,500	22,400
recontriver	USGS wymt_ffa_2019	124	3,180	7,460	13,500	22,700	63,600
Toton Pivor	StreamStats	1238	8,930	14,200	19,600	26,500	53,100
Teton River	USGS wymt_ffa_2019	1238	4,710	9,960	16,600	26,800	74,500
Deen Creek	StreamStats	269	4,470	7,200	10,000	13,600	27,500
Deep cleek	USGS wymt_ffa_2019	269	3,680	7,770	12,900	20,800	57,100
Sup Pivor	StreamStats	259	6,210	9,570	13,000	17,600	35,500
Sun river	USGS wymt_ffa_2019	259	4,950	8,390	13,200	21,200	69,400
Sup Pivor	StreamStats	609	12,400	18,500	24,400	32,000	60,100
Sunniver	USGS wymt_ffa_2019	609	16,500	19,600	26,000	34,100	63,300
Sup Pivor	StreamStats	610	12,400	18,500	24,400	32,000	60,100
Sun river	USGS wymt_ffa_2019	610	11,900	17,400	22,400	28,200	45,300
Sup Pivor	StreamStats	814	15,700	23,200	30,100	39,100	71,700
Sun River	USGS wymt_ffa_2019	814	11,600	16,900	22,000	28,100	47,400
	StreamStats	1296	20,300	29,900	38,500	49,400	88,400
Sull River	USGS wymt_ffa_2019	1296	12,800	19,000	24,800	31,500	52,100
Sun River Sun River Sun River Sun River Sun River	StreamStats	20.8	812	1,370	2,060	3,060	7,550
Sun Kiver	USGS wymt_ffa_2019	20.8	542	1,060	1,670	2,560	6,410

 Table 4: Comparison of peak-flow flood frequency results at gaged sites and regression equation results (StreamStats).

5.2. Study Comparison with Effective FIS

There are five locations in this study that have corresponding peak flow values reported in the effective FIS. **Table 5** provides a comparison between the effective FIS flows and those revised by this study. A discussion of the flow differences is included in the text following the table. Note that the locations provided in the table and discussion below are drawn from the effective FIS Summary of Discharge tables for Teton County, Unincorporated Areas (equivalent values are reported for the Teton River and Spring Creek in the City of Choteau FIS). Some general notes relevant to the comparisons:

 Where the FIS Summary of Discharge table reports the results at a USGS gage site, the revised peak flow frequency results from this study are compared against the FIS results and differences in results are noted and discussed below. Note that minor differences in contributing drainage area at gage locations are documented and reflect minor differences between the contributing drainage area published in USGS stream gage data and the drainage area calculation methods produced in this study using high resolution terrain data and detailed delineation methods.

- In general, differences in reported peak flow values at gage sites between the FIS and this study are a function of analyses of longer period of record (this study utilizes peak flow values up through 2019). Differences can also be attributed to differences in peak flow frequency methods and how they are applied between Bulletin 17A (previous studies) and Bulletin 17C (this study). Differences between the two methods include application of record extension methods (e.g. MOVE3), implementing specific historic flood peaks as perception thresholds over discontinuous flow records, or weighting the at-site peak flow frequency analysis with regional regression equations.
- Two additional study methods are reported in the effective FIS to determine peak flow flood frequency values. These include developing drainage area discharge curves from 10 nearby stream gages and utilizing rainfall runoff methodology.
- This study primarily draws on updated peak flow frequency analyses for gages in the watershed with data through 2019; and for ungaged sites, utilizes the most recent USGS regional regression equations published as Montana StreamStats in 2016.
- Note that flow change locations (pour points) in this study were established based on criteria described in Section 4.1.2. In many instances, these flow change locations do not line up exactly with the locations identified in the FIS. The primary reasons for this are described in criteria for establishing flow change locations and are also a result of the locations and extents of new enhanced studies within Teton County that in most cases do not directly correspond to studies documented in the effective FIS. However, there is generally a flow change location established in this study that is relatively close to the location reported in the effective FIS Summary of Discharges table to allow a comparison between the results and discussion of differences. These sites are indicated by a Baker code that has an abbreviation for the flooding source followed by river station number (e.g. TR-90.1 represents the Teton River at River Station 90.1 miles which is 90.1 miles from the Teton County Choteau County line (at US 287 near Choteau)).
- The comparison discussions focus on changes to the 1% AEP flow values. In many cases only limited data are available in the effective FIS's regarding flows of other recurrence intervals.
 Table 5 denotes the flow values that are not reported in the associated FIS with a "(1)" in the flow field to indicate the data were not reported. Additionally, Table 5 does not include the 1%-plus flow value generated in this study, as no previous study produced a 1%-plus flow value. Appendix A provides a complete list of all flow values produced in this study for all AEP's, including the 1%-plus.

Table 5. Comparison of peak flow values from effective FIS to results from this study.

Delver Nede (en		Peak Flow (cfs)							
Baker Node (or	Location Description	Book Flood Froquency Source	Drainage	10% Annual	4% Annual	2% Annual	1% Annual	0.2% Annual	Mathadalamy
cocod cito)	Location Description	reak noou nequency source	Area (mi ²)	Chance	Chance	Chance	Chance	Chance	Wethodology
gageu site)				10-year	25-year	50-year	100-year	500-year	
TD 00 7	Tatan Dianahan Chatan	USGS 2021 Peak Flow Analysis	164	3,342	7,737	13,857	23,181	64,884	Linear interpolation between Dutton and Strabane gages
TR-99.7	Teton River above Choteau	Teton County Effective FIS (Effective 1983)	221	3,400	(1)	10,000	16,000	45,800	Regression Analyses performed on 10 gages in the general area.
		USGS 2021 Peak Flow Analysis	181	3,397	7,831	13,977	23,342	65,312	Linear interpolation between Dutton and Strabane gages
TR-90.1	Teton River at US 287	Teton County Effective FIS (Effective 1983)	221	3,400	(1)	9,540	15,200	38,100	Regression Analyses performed on 10 gages in the general area. Reduction in flow due to overflow into Spring Creek drainage
	USGS 2021 Peak Flow Analysis	475	4,003	8,837	15,238	25,019	69,777	Linear interpolation between Dutton and Strabane gages	
TR-85.2	Teton River downstream of Deep Creek	Teton County Effective FIS (Effective 1983)	447	5,000	(1)	14,040	21,200	62,500	Regression Analyses performed on 10 gages in the general area. Reduction in flow due to overflow into Spring Creek drainage
	Cup Diver at Cintra	USGS 2021 Peak Flow Analysis	1,296	12,800	19,000	24,800	31,500	52,100	MOVE3 record extension. From 38 peak flow events at-site to 86 events.
0363 06085800	Sun River at Simms	Teton County Effective FIS (Effective 1983)	1,224	12,000	(1)	24,500	38,000	100,000	LPIII Analysis (Bulletin 17A) from 26 yrs of record.
		Regression Analyses	5.6	213	398	591	822	1,670	StreamStates regression equations.
SPC-3-5.3 Spring Creek at Choteau	Teton County Effective FIS (Effective	5.6	375	(1)	1,100	1,700	8,075	Rainfall-runoff methods. Cross checked against regional runoff methods, found to be close enough to appropriately represent flood risk from Spring Cr. May require incorporation of Teton River overflows into	
		1983)							Spring Creek.
Notes:	(1) data not provided								

5.3. Future Studies

Many flooding sources within Teton County have a high degree of interaction with other flooding sources within the study area. These interactions may include distinct flow splits from one flooding source to another or have flow exchanges within shared floodplains that result in flows entering or leaving an adjacent flooding source in overbank flows. Another complicating factor is much of the land use within the study area is irrigated agriculture with a complex network if irrigation ditches, canals, diversion structures, and storage facilities. The results of this study report the contribution of each flooding source's drainage basin to flow nodes within the study area. Future studies under the Hydraulic Data Capture task will apply the contributing basin flows provided in this report and define the locations and magnitude of flow exchanges through the study area based on channel and floodplain topography and conveyance characteristics, hydraulic structures, and other factors that influence the distribution of flows through the study area. As a result, the flow values due to these interactions between flooding sources may result in the calculated flows at flow nodes listed in this analyses that vary from those determined from the Hydraulic Data Capture task. This is not uncommon for studies under similar conditions.

5.4. FEMA Guidance and Standards

All flow values were determined using methods that meet FEMA guidance and standards. The results of this study will be used to produce revised flood hazard mapping in Teton County.

6. References

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Appendix A.

Table of Discharges

HYDROLOGY NODE DISCHARGE TABLE													
					Pea	ak Discharge (cfs) f	or Annual Exceedan	ce Probability Flow	'S				
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%			
				Muddy (Creek								
Farmers Coulee (RRE) ¹	47.9814	-111.9376	FC-1-0.0	34.2	472	911	1,390	2,010	3,330	4,380			
Tributary to Muddy Creek 1 (RRE) ¹	47.9697	-112.0030	TMC-1-0.0	0.72	83	151	217	292	484	548			
	47.9910	-112.0400	FC-2-0.0	28.8	500	944	1,420	2,010	3,330	4,250			
Farmers Coulee 2 (RRE) ¹	47.9920	-112.0562	FC-2-1.2	27.2	493	928	1,400	1,970	3,270	4,150			
	47.9997	-112.0652	FC-2-2.4	27.0	492	926	1,390	1,960	3,250	4,130			
Brady Canal (RRE) ¹²	47.9579	-112.0681	BDC-0.0	0.04	23	39	54	68	113	113			
Tributary to Muddy Creek 2 (RRE) ¹²	47.9738	-112.0899	TMC-2-0.0	0.86	91	166	239	323	536	608			
Tributary to Muddy Creek 3 (RRE) ¹	47.9856	-112.1366	TMC-3-0.1	2.03	135	248	362	497	824	967			
	47.9859	-112.1536	JC-2-0.0	49.6	600	1,150	1,760	2,530	4,200	5,540			
Jones Creek 2 (RRE) ¹	47.9964	-112.1823	JC-2-2.3	41.3	555	1,060	1,620	2,320	3,850	5,030			
	47.9999	-112.2214	JC-2-5.8	32.2	512	971	1,470	2,090	3,470	4,460			
_	47.9850	-112.1787	FOC-0.0	37.7	502	967	1,480	2,130	3,530	4,660			
Factor Crook (BBE)1	47.9739	-112.2221	FOC-4.6	20.0	375	716	1,090	1,550	2,570	3,300			
Poster Creek (RRE)	47.9654	-112.2501	FOC-8.0	15.8	343	650	981	1,390	2,310	2,930			
	47.9635	-112.2660	FOC-9.2	14.6	333	630	949	1,340	2,220	2,820			
Tributary to Foster Creek 1 (RRE) ¹²	47.9744	-112.2218	TFCO-1-0.0	0.08	32	57	78	101	167	172			
Tributary to Foster Creek 2 (RRE) ¹²	47.9639	-112.2654	TFCO-3-0.0	0.18	47	82	115	152	252	267			
Farmers Ditch (RRE) ¹	47.9798	-112.1907	FD-0.0	15.1	350	659	990	1,390	2,310	2,910			
East Canal (RRE) ¹	47.9825	-112.2328	EC-0.0	1.6	119	218	318	435	721	840			
Tributary to Muddy Creek 4 (RRE) ¹²	47.9781	-112.2851	TMC-4-0.0	0.17	46	81	113	149	247	260			
Miller Creek (RRE) ¹	47.9889	-112.3381	MLC-0.1	45.3	971	1,710	2,520	3,550	5,400	7,660			
North Fork Muddy Crook (PRE)13	47.9919	-112.3574	BLC-0.1	53.9	1,480	2,480	3,590	5,050	6,900	10,900			
North Fork Muddy Creek (RRE)-	48.0010	-112.3661	BLC-1.3	53.7	1,480	2,480	3,580	5,030	6,870	10,900			
Tributany to Muddy Crook E (DDE)1	47.9917	-112.3764	TMC-5-0.0	11.0	368	668	993	1,400	2,210	3,000			
Tribulary to Muddy Creek 5 (RRE)-	47.9924	-112.3846	TMC-5-0.5	10.9	365	665	988	1,390	2,200	2,970			
Clark Fark Muddy Crook (DDE)1	47.9612	-112.5045	CFMC-0.0	23.3	919	1,540	2,280	3,330	3,920	7,940			
	47.9602	-112.5063	CFMC-0.2	10.3	491	844	1,280	1,910	2,260	4,790			
Blindhorse Creek (RRE) ¹	47.9604	-112.5060	BHC-0.0	13.0	587	1,000	1,510	2,240	2,630	5,570			
Rinker Creek (RRE) ¹	47.9743	-112.5531	RC-0.0	8.2	382	669	1,040	1,600	1,820	4,260			

		НҮ	OROLOG	SY NODE	DISCHAR	RGE TABL	E			
					Pe	eak Discharge (cfs) fo	or Annual Exceedar	nce Probability Flow	/S	
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%
Stream Muddy Creek (RRE) ¹³ Spenser Coulee (RRE) ¹ Flat Coulee (RRE) ¹	47.9296	-111.7756	MC-0.0	426	3,550	6,010	8,640	12,100	18,700	25,700
	47.9812	-111.9372	MC-16.4	335	3,520	5,880	8,380	11,600	17,500	24,400
	47.9833	-111.9989	MC-24.2	291	3,470	5,770	8,200	11,300	16,800	23,600
	47.9695	-112.0030	MC-26.9	290	3,460	5,730	8,160	11,300	16,800	23,600
	47.9584	-112.0697	MC-36.8	284	3,470	5,760	8,170	11,300	16,800	23,600
	47.9728	-112.0894	MC-39.4	278	3,480	5,760	8,180	11,300	16,700	23,600
	47.9850	-112.1371	MC-44.5	272	3,440	5,710	8,100	11,200	16,600	23,300
	47.9851	-112.1542	MC-46.4	221	3,380	5,560	7,850	10,800	15,500	22,400
	47.9853	-112.1787	MC-50.2	180	3,320	5,410	7,620	10,500	14,600	21,700
	47.9821	-112.2321	MC-55.0	176	3,310	5,390	7,590	10,400	14,400	21,600
	47.9730	-112.2773	MC-58.0	175	3,300	5,370	7,560	10,400	14,400	21,500
Muddy Creek (RRE) ¹³	47.9751	-112.2835	MC-58.4	175	3,300	5,360	7,560	10,400	14,400	21,500
	47.9890	-112.3369	MC-62.6	126	2,900	4,710	6,640	9,170	12,100	19,200
	47.9911	-112.3378	MC-62.8	126	2,900	4,710	6,630	9,160	12,100	19,200
	47.9922	-112.3477	MC-63.7	126	2,900	4,700	6,630	9,160	12,100	19,200
	47.9911	-112.3575	MC-64.3	72.1	2,030	3,330	4,760	6,660	8,570	14,400
	47.9916	-112.3758	MC-65.2	60.6	1,870	3,070	4,390	6,190	7,610	13,700
	47.9705	-112.4836	MC-72.9	53.0	1,720	2,820	4,070	5,780	6,840	13,000
	47.9625	-112.4998	MC-74.4	51.4	1,680	2,760	3,990	5,690	6,670	12,900
	47.9620	-112.5048	MC-74.8	28.0	1,040	1,740	2,570	3,760	4,370	8,920
	47.9689	-112.5264	MC-76.8	27.1	1,010	1,690	2,500	3,670	4,210	8,820
	47.9707	-112.5345	MC-77.6	26.6	992	1,660	2,460	3,630	4,140	8,760
	47.9748	-112.5523	MC-79.3	18.0	721	1,230	1,850	2,770	3,150	6,910
				Teton F	River					
Spenser Coulee (RRE) ¹	47.9256	-111.4155	SPCO-0.0	13.1	284	545	828	1,180	2,520	1,960
	47.9402	-111.4327	FLC-1-0.0	32.2	379	751	1,170	1,720	3,890	2,850
	47.9583	-111.4216	FLC-1-2.3	28.9	363	717	1,120	1,630	3,670	2,700
Flat Coulee (RRE) ¹	47.9619	-111.4203	FLC-2.7	15.9	281	548	845	1,220	2,680	2,020
	47.9651	-111.4202	FLC-3.0	15.7	279	545	840	1,210	2,660	2,010
	47.9694	-111.4224	FLC-3.5	9.73	226	439	670	960	2,060	1,590
	47.9872	-111.4238	FLC-6.1	8.36	212	410	625	892	1,900	1,480
Iributary to Flat Coulee 1 (RRE) ¹	47.9587	-111.4218	TFC-1-0.0	7.81	205	396	603	861	1,830	1,430
Tributary to Flat Coulee 2 (RRE) ¹	47.9614	-111.4201	TFC-2-0.0	5.02	169	325	490	694	1,450	1,150
	47.9615	-111.4111	TFC-2-0.6	4.92	168	322	486	687	1,430	1,140
Tributary to Flat Coulee 3 (RRE) ¹	47.9697	-111.4215	TFC-3-0.0	5.84	182	350	529	750	1,580	1,240
	47.9742	-111.4153	TFC-3-0.6	5.72	181	347	524	743	1,560	1,230

		HYI	DROLOG	GY NODE I	DISCHAR	RGE TABL	E			
					Pe	eak Discharge (cfs) f	or Annual Exceedan	ice Probability Flow	'S	
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%
Kinnerely Coulee (RRE) ¹	47.9448	-111.4845	KC-0.0	59.6	543	1,070	1,680	2,460	5,620	4,080
Railroad Coulee (RRE) ¹	47.9264	-111.7542	RRC-0.1	19.2	339	655	1,000	1,430	3,110	2,370
Trail Coulee (RRE) ¹	47.9122	-111.8407	TRCO-0.0	9.57	253	483	728	1,030	2,160	1,710
Tributary to Teton River 1 (RRE) ¹	47.9059	-111.9049	TTR-1-0.0	1.02	94	172	250	340	652	564
Spring Coulee (RRE) ¹	47.8659	-112.0080	SC-1-0.0	53.5	542	1,060	1,650	2,400	5,410	3,980
Teton Ditch (RRE) ¹	47.8555	-112.0199	TD-0.0	22.8	414	788	1,190	1,690	3,610	2,800
Tributany to Toton Piver 2 (PPE) ¹	47.8450	-112.0281	TTR-2-0.0	11.9	287	547	825	1,170	2,460	1,940
	47.8405	-112.0253	TTR-2-0.5	11.7	285	543	819	1,160	2,440	1,920
Camble Coules (PPE) ¹	47.8432	-112.0303	GC-0.0	18.0	341	655	996	1,420	3,050	2,350
	47.8409	-112.0408	GC-0.8	17.9	341	654	994	1,420	3,040	2,350
Tributary to Teton River 3 (RRE) ¹	47.8206	-112.0668	TTR-3-0.0	5.52	205	385	573	801	1,630	1,330
	47.7889	-112.1832	CAC-0.0	11.6	303	571	855	1,200	2,500	1,990
Cashman Coulee (RRE) ¹	47.7863	-112.1948	CAC-0.7	11.1	299	562	841	1,180	2,450	1,960
Casiman Coulee (KKE)	47.7995	-112.2137	CAC-2.2	8.31	268	501	744	1,040	2,120	1,720
	47.8063	-112.2128	CAC-2.7	8.13	266	496	737	1,030	2,090	1,710
	47.7869	-112.1323	SPC-1-0.1	9.90	270	511	767	1,080	2,250	1,790
-	47.7922	-112.1392	SPC-1-1.4	8.48	253	477	715	1,000	2,070	1,660
	47.8088	-112.1714	SPC-2-4.4	7.02	234	440	656	918	1,880	1,520
	47.8133	-112.1811	SPC-3-5.3	5.56	213	398	591	822	1,670	1,360
	47.8207	-112.1881	SPC-5-5.4	5.35	210	392	581	808	1,630	1,340
Spring Crook (BPE)12	47.8366	-112.1951	SPC-5-7.2	3.86	183	340	501	693	1,380	1,150
Spring Creek (KKE)	47.8577	-112.2200	SPC-5-10.2	3.36	173	321	471	649	1,280	1,080
	47.8626	-112.2295	SPC-5-10.9	3.12	168	311	455	627	1,230	1,040
	47.8644	-112.2395	SPC-5-11.7	1.95	137	252	366	499	963	827
	47.8679	-112.2454	SPC-5-12.3	1.68	129	236	342	465	891	771
	47.8722	-112.2539	SPC-5-12.9	1.11	108	196	282	381	716	632
	47.8746	-112.2655	SPC-5-13.6	0.80	94	169	242	325	602	539
Tributany to Toton Biyor 4 (BBE)1	47.8584	-112.2751	TTR-4-0.0	8.60	287	532	787	1,090	2,210	1,810
	47.8504	-112.2788	TTR-4-0.7	6.15	250	460	676	932	1,850	1,550
Tributany to Toton Biyer 5 (PPE)1	47.8664	-112.3161	TTR-5-0.0	14.4	399	736	1,090	1,510	3,050	2,500
	47.8640	-112.3368	TTR-5-1.6	13.5	392	721	1,060	1,470	2,960	2,440
	47.8815	-112.3622	MDC-0.0	15.6	470	852	1,250	1,720	3,500	2,810
McDonald Creek (PPE)1	47.8765	-112.3960	MDC-2.3	13.7	452	814	1,190	1,640	3,310	2,670
	47.8738	-112.4010	MDC-2.6	12.2	437	783	1,140	1,570	3,150	2,550
	47.8633	-112.4292	MDC-4.3	9.87	404	721	1,040	1,430	2,870	2,310
Tributary to McDonald Creek 1 (RRE) ¹²	47.8768	-112.3959	TMDC-1-0.0	0.87	117	206	290	382	687	633

	HYDROLOGY NODE DISCHARGE TABLE													
					Pe	eak Discharge (cfs) fo	or Annual Exceedar	nce Probability Flow	S					
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%				
	47.8753	-112.4069	TDMC-1-0.7	0.58	99	172	240	314	553	521				
	47.8734	-112.4151	TMDC-1-1.6	0.27	72	123	168	217	369	360				
Tributary to McDonald Creek 2 (RRE) ¹²	47.8741	-112.4146	TMDC-2-0.0	0.05	34	56	75	93	147	155				
Tributary to McDonald Creek 3 (RRE) ¹	47.8737	-112.4001	TMDC-3-0.0	1.28	139	245	347	461	843	764				
	47.8825	-112.6340	SFTR-0.0	27.7	1,020	1,710	2,540	3,730	9,000	4,240				
	47.8722	-112.6691	SFTR-2.4	25.6	958	1,610	2,390	3,530	8,570	4,010				
South Fork Teton River (RRE) ¹	47.8718	-112.6893	SFTR-3.5	22.8	872	1,470	2,200	3,260	7,980	3,700				
	47.8686	-112.7244	SFTR-5.4	19.4	765	1,300	1,950	2,910	7,220	3,310				
	47.8687	-112.7439	SFTR-6.6	15.9	652	1,110	1,690	2,540	6,400	2,890				
	47.8888	-112.7242	MNFTR-0.0	8.93	409	714	1,110	1,700	4,490	1,930				
Middle North Fork Teton River (RRE) ¹	47.8906	-112.7470	MNFTR-1.3	7.96	373	653	1,020	1,570	4,180	1,780				
	47.8895	-112.7646	MNFTR-2.3	6.28	308	544	856	1,330	3,620	1,510				
Jones Creek (RRE) ¹	47.9157	-112.7442	JC-1-0.0	7.93	372	651	1,010	1,560	4,170	1,770				
West Fork North Fork Teton River (RRE) ¹	47.9574	-112.8087	WFNFTR-0.0	13.2	561	964	1,470	2,230	5,700	2,530				
	47.8830	-112.6347	NFTR-1-0.0	80.9	2,430	3,900	5,560	7,860	17,400	8,930				
	47.8830	-112.6688	NFTR-1-2.1	76.6	2,320	3,740	5,340	7,560	16,800	8,590				
	47.8893	-112.7233	NFTR-1-5.1	63.5	2,000	3,240	4,650	6,640	15,000	7,540				
	47.9155	-112.7448	NFTR-1-7.6	52.3	1,710	2,790	4,040	5,800	13,300	6,590				
North Fork Teton River (RRE) ¹	47.9253	-112.7687	NFTR-1-9.0	41.6	1,420	2,340	3,420	4,950	11,600	5,620				
	47.9473	-112.7981	NFTR-3-11.9	38.0	1,320	2,180	3,200	4,650	10,900	5,280				
	47.9567	-112.8076	NFTR-3-12.9	35.1	1,240	2,050	3,020	4,400	10,400	5,000				
	47.9584	-112.8086	NFTR-3-13.0	21.9	845	1,430	2,140	3,170	7,790	3,600				
	47.9763	-112.8097	NFTR-3-14.4	17.4	702	1,200	1,810	2,700	6,770	3,070				
	47.9241	-111.4088	TR-0.0	1,396	4,750	10,200	17,300	28,100	79,100	51,800				
Teton River	47.9262	-111.4161	TR-0.5	1,382	4,750	10,200	17,200	28,000	78,700	51,600				
Dutton to Loma (GI) ¹	47.9404	-111.4341	TR-2.8	1,342	4,740	10,100	17,100	27,700	77,600	50,800				
	47.9447	-111.4854	TR-9.9	1,258	4,720	10,000	16,700	27,000	75,100	49,200				
	47.9303	-111.5529	TR-18.3	1,238	4,710	9,960	16,600	26,800	74,500	48,800				
	47.9295	-111.5663	TR-19.4	1,236	4,710	9,960	16,600	26,800	74,500	48,800				
	47.9267	-111.7544	TR-40.0	1,130	4,710	9,930	16,500	26,600	74,000	48,900				
	47.9292	-111.7741	TR-42.1	702	4,690	9,740	16,100	25,900	71,600	49,200				
Chotopy to Dutton (CI) ¹³	47.9126	-111.8414	TR-49.7	677	4,690	9,730	16,100	25,800	71,400	49,200				
	47.9059	-111.9067	TR-56.5	656	4,690	9,720	16,000	25,700	71,300	49,200				
	47.8649	-112.0080	TR-68.9	575	4,680	9,670	15,900	25,500	70,600	49,300				
	47.8553	-112.0184	TR-70.5	551	4,680	9,650	15,900	25,500	70,400	49,300				
	47.8446	-112.0284	TR-72.1	538	4,680	9,640	15,900	25,400	70,300	49,300				

		HYI	OROLOG	SY NODE	DISCHAR	GE TABL	E			
					Pe	ak Discharge (cfs) f	or Annual Exceedar	nce Probability Flow	'S	
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%
	47.8422	-112.0293	TR-72.4	520	4,680	9,630	15,900	25,400	70,200	49,400
	47.8202	-112.0676	TR-76.6	507	4,680	9,620	15,800	25,300	70,000	49,400
	47.7862	-112.1331	TR-85.2	475	4,670	9,600	15,800	25,200	69,700	49,400
	47.7909	-112.1732	TR-89.2	193	4,640	9,270	15,000	23,800	65,500	50,000
	47.7894	-112.1838	TR-90.1	181	4,640	9,250	15,000	23,700	65,200	50,100
	47.8593	-112.2755	TR-99.7	164	4,630	9,210	14,900	23,600	64,800	50,100
	47.8822	-112.3628	TR-105.6	127	4,630	9,120	14,700	23,200	63,600	50,300
	47.8831	-112.6120	TR-121.4	110	4,620	9,070	14,600	23,000	63,000	50,400
				Deep C	reek					
Tributary to Deep Creek 1 (RRE) ¹²	47.7694	-112.1928	TDPC-1-0.0	0.10	38	65	90	117	194	199
	47.7528	-112.2464	DOC-0.0	29.1	498	941	1,420	2,010	3,330	4,260
Dog Creek (RRE) ¹	47.7536	-112.2507	DOC-0.3	22.4	454	851	1,280	1,790	2,970	3,740
Bruce Coulee (RRE) ¹	47.7459	-112.2562	BC-0.0	14.3	382	709	1,050	1,460	2,420	2,980
	47.7392	-112.2793	WWC-0.0	88.2	2,230	3,660	5,190	7,240	9,660	15,300
Willow Creek (RRE) ⁺	47.7469	-112.3356	WWC-4.9	85.5	2,210	3,620	5,150	7,170	9,490	15,300
Nunemaker Coulee (RRE) ¹	47.7312	-112.3188	NMC-0.0	17.6	488	887	1,300	1,820	2,960	3,730
Tributary to Deep Creek 2 (RRE) ¹	47.7311	-112.3320	TDPC-2-0.0	21.5	688	1,200	1,780	2,550	3,630	5,720
Tributary to Deep Creek 3 (RRE) ¹	47.7243	-112.3472	TDPC-3-0.1	1.68	149	267	381	511	847	952
Tributary to Deep Creek 4 (RRE) ¹²	47.7206	-112.3616	TDPC-4-0.0	0.56	93	163	228	299	496	531
Tributary to Deep Creek 5 (RRE) ¹	47.7102	-112.3882	TDPC-5-0.0	4.76	275	488	707	969	1,550	1,940
Quidey Creek (RRE)1	47.7106	-112.3877	QC-0.0	17.3	552	979	1,450	2,060	3,080	4,540
Quigley Creek (KKE)-	47.7103	-112.3887	QC-0.1	12.6	468	828	1,230	1,770	2,570	3,980
Battle Creek (RRE) ¹	47.7136	-112.5883	BTC-0.0	15.4	637	1,090	1,650	2,490	2,830	6,290
Deen Grach	47.7898	-112.1719	DPC-0.0	279	3,750	7,920	13,100	21,200	39,400	58,200
Deep Creek Below Choteau (GI) ¹³	47.7695	-112.1932	DPC-3.1	277	3,740	7,890	13,100	21,100	39,300	58,000
	47.7520	-112.2395	DPC-6.7	269	3,680	7,770	12,900	20,800	38,700	57,100
	47.7524	-112.2456	DPC-7.1	238	3,450	7,290	12,100	19,500	36,300	53,400
	47.7460	-112.2565	DPC-7.9	223	3,340	7,060	11,700	18,900	35,100	51,700
	47.7385	-112.2782	DPC-10.6	134	2,560	5,420	9,000	14,500	26,900	39,300
	47.7321	-112.3193	DPC-15.2	114	2,350	4,990	8,270	13,300	24,700	36,000
Deep Creek	47.7307	-112.3329	DPC-16.7	91.8	2,100	4,460	7,400	11,900	22,100	32,100
Above Choteau (GI) ²	47.7250	-112.3475	DPC-17.4	83.2	1,990	4,240	7,030	11,300	21,000	30,400
	47.7205	-112.3612	DPC-19.2	81.0	1,970	4,180	6,940	11,100	20,700	30,000
	47.7108	-112.3878	DPC-23.7	61.8	1,710	3,640	6,030	9,670	18,000	26,000
	47.7143	-112.5885	DPC-45.8	37.9	1,320	2,830	4,690	7,500	13,900	20,000

		HYI	OROLOG	GY NODE	DISCHAR	GE TABL	E			
					Ре	ak Discharge (cfs) f	or Annual Exceeda	nce Probability Flow	S	
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%
				Sun R	iver					
	47.5296	-111.9223	BCC-0.0	65.2	637	1,240	1,920	2,780	4,610	6,230
	47.5302	-111.9241	BCC-0.1	59.5	619	1,200	1,850	2,680	4,440	5,960
	47.5317	-111.9310	BCC-0.6	58.3	616	1,190	1,840	2,660	4,410	5,910
Big Coulee Creek (RRE) ¹	47.5405	-111.9517	BCC-2.9	53.8	602	1,160	1,790	2,580	4,280	5,690
	47.5442	-111.9645	BCC-4.0	41.5	556	1,060	1,620	2,320	3,850	5,040
	47.5569	-111.9668	BCC-5.6	39.5	549	1,050	1,600	2,280	Noticity Flows 1% plus 2,780 4,610 2,680 4,440 2,680 4,440 2,660 4,410 2,580 4,280 2,320 3,850 2,280 3,780 2,270 3,760 684 1,130 678 1,120 308 511 270 448 246 408 183 303 565 937 1,120 1,860 1,110 1,840 392 650 2,500 4,130 2,490 4,120 2,490 4,120 2,490 4,120 2,490 4,120 3,220 3,860 46 522 540 613 491 558 72 82 545 648 90 103 1,830 2,080	4,930
	47.5569	-111.9732	BCC-6.0	39.2	548	1,050	1,590	2,270		4,910
Tributary to Big Coulee Creek 1 (BBE) ¹	47.5306	-111.9240	TBCC-1-0.0	4.30	174	328	489	684	1,130	1,390
	47.5364	-111.9261	TBCC-1-0.6	4.23	173	325	485	678	1,120	1,380
	47.5315	-111.9306	TBCC-2-0.0	0.87	85	155	226	308	511	590
Tributary to Big Coulee Creek 2 (BBE) ¹²	47.5293	-111.9316	TBCC-2-0.2	0.66	75	138	199	270	448	510
	47.5285	-111.9341	TBCC-2-0.3	0.55	69	126	182	246	408	461
Tributary to Big Coulee Creek 3 (RRF) ¹	47.5253	-111.9359	TBCC-2-0.6	0.30	53	96	137	183	303	335
Tributary to Big Coulee Creek 3 (RRE) ¹	47.5408	-111.9517	TBCC-3-0.0	2.91	147	275	407	565	937	1,130
Duck Creek (BBE) ¹	47.5446	-111.9653	DC-0.0	11.3	273	522	789	1,120	1,860	2,370
	47.5492	-111.9701	DC-0.5	11.2	272	519	786	1,110	1,840	2,350
Tributary to Big Coulee Creek 4 (RRE) ¹	47.5572	-111.9665	TBCC-4-0.0	1.37	106	196	286	392	650	760
	47.5092	-112.1071	SSC-0.0	41.6	624	1,170	1,770	2,500	4,130	5,350
School Section Coulee (BBE) ¹	47.5126	-112.1227	SSC-1.2	41.4	623	1,170	1,770	2,500	4,130	5,330
	47.5168	-112.1288	SSC-1.8	41.1	622	1,170	1,770	2,490	4,120	5,320
	47.5211	-112.1345	SSC-2.4	40.9	621	1,170	1,760	2,490	4,120	5,300
Cutting Shed Coulee (RRE) ¹	47.5257	-112.2995	CSC-0.0	24.1	866	1,470	2,180	3,220	3,860	7,760
Tributary to Sun River 1 (RRE) ¹²	47.5451	-112.3303	TSR-1-0.0	0.05	6.1	13	25	46	52	184
Tributary to Sun River 2 (BRE) ¹	47.6069	-112.4312	TSR-2-0.0	1.72	73	200	331	540	613	1,630
	47.6093	-112.4312	TSR-2-0.2	1.50	97	180	299	491	558	1,500
Tributary to Sun River 3 (RRE) ¹²	47.6088	-112.4320	TSR-3-0.0	0.10	10	22	40	72	82	276
Tributary to Sun River 4 (RRE) ¹	47.6359	-112.6107	TSR-4-0.0	2.25	134	247	404	652	741	1,930
Tributary to Sun River 5 (RRE) ¹	47.6226	-112.6544	TSR-5-0.0	1.75	109	203	335	546	620	1,650
Tributary to Sun River 6 (RRE) ¹	47.6216	-112.6633	TSR-6-0.0	1.94	119	220	362	588	668	1,760
Tributary to Sun River 7 (RRE) ¹²	47.6191	-112.7127	TSR-7-0.1	0.13	14	28	50	90	103	336
Hannan Gulch (RRE) ¹	47.6175	-112.7330	HG-0.0	9.90	445	773	1,190	1,830	2,080	4,790
Blacktail Gulch (RRE) ¹	47.6075	-112.7536	BLG-0.0	10.5	465	806	1,240	1,900	2,160	4,950
Mortimer Gulch (RRE) ¹	47.6152	-112.7691	MG-0.0	2.65	153	280	455	730	829	2,130
Unnamed Pond 1 (RRE) ¹²	47.6450	-112.6785	UP-1-0.0	0.68	51	98	168	283	321	923
Unnamed Pond 2 (RRE) ¹²	47.6506	-112.8453	UP-2-0.0	0.48	38	75	130	222	254	742

HYDROLOGY NODE DISCHARGE TABLE													
					Pea	ak Discharge (cfs) f	or Annual Exceedan	ce Probability Flow	S				
Stream	Latitude	Longitude	Node ID	Drainage Area (mi²)	10%	4%	2%	1%	1% plus	0.20%			
Sun River	47.5070	-111.9054	SR-0.0	1,299	12,800	19,000	24,800	31,500	41,500	52,200			
Below Simms (GI) ¹³	47.5016	-111.9319	SR-1.7	1,296	12,800	19,000	24,800	31,500	41,500	52,100			
	47.5058	-111.9442	SR-2.4	1,295	12,800	19,000	24,800	31,500	41,500	52,100			
	47.5087	-112.1059	SR-12.7	1,151	12,500	18,400	24,100	30,600	40,700	50,900			
	47.5121	-112.1234	SR-14.1	1,149	12,500	18,400	24,000	30,600	40,700	50,800			
Sun River	47.5074	-112.2826	SR-23.2	1,040	12,200	18,000	23,400	29,800	40,000	49,800			
Below Willow Creek to Simms (GI) ¹³	47.5192	-112.2919	SR-24.2	844	11,700	17,100	22,200	28,400	38,700	47,800			
	47.5255	-112.3002	SR-24.9	818	11,600	16,900	22,000	28,100	38,500	47,400			
	47.5448	-112.3312	SR-27.2	816	11,600	16,900	22,000	28,100	38,500	47,400			
	47.5471	-112.3674	SR-29.9	814	11,600	16,900	22,000	28,100	38,500	47,400			
	47.5597	-112.4045	SR-32.5	702	11,800	17,200	22,200	28,200	38,800	46,300			
	47.6064	-112.4322	SR-37.1	692	11,800	17,200	22,200	28,200	38,800	46,200			
Cure Divers	47.6200	-112.5021	SR-41.2	667	11,800	17,200	22,300	28,200	38,800	45,900			
Sun River	47.6439	-112.5637	SR-46.6	648	11,800	17,300	22,300	28,200	38,900	45,700			
	47.6355	-112.6113	SR-49.8	628	11,900	17,300	22,400	28,200	38,900	45,500			
	47.6225	-112.6553	SR-52.5	619	11,900	17,400	22,400	28,200	39,000	45,400			
	47.6185	-112.6921	SR-55.4	610	11,900	17,400	22,400	28,200	39,000	45,300			
Sure Diver	47.6210	-112.7067	SR-56.2	609	11,900	17,400	22,400	28,200	39,000	45,300			
Suri River	47.6168	-112.7327	SR-59.7	590	11,700	17,100	22,000	27,700	38,300	44,500			
	47.6072	-112.7541	SR-61.1	576	11,500	16,900	21,700	27,400	37,800	43,900			
Sun River	47.6090	-112.8001	SR-63.9	537	15,400	18,400	24,400	31,900	36,100	59,200			
Above Gibson (GI) ¹	47.6120	-112.8271	SR-65.6	521	15,200	18,100	24,000	31,500	35,600	58,200			
North Fork Cup Divor (CI)13	47.6306	-112.8570	NFSR-0.2	266	5,050	8,550	13,400	21,600	36,200	70,500			
	47.6399	-112.8593	NFSR-1.0	259	4,950	8,390	13,200	21,200	35,600	69,400			

1. Method of analysis is indicated as RRE: Regional regression equation GI: Gage Interpolation

2. Italicized values indicate subbasins with a drainage area of less than or equal to 1 square mile

3. Values in **bold** indicate values reported at the gaging station

Appendix B.

USGS Peak-flow Frequency Results

Table 1-1. Information on streamgages for which peak-flow frequency analyses are reported. [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. NAD 83, North American Datum of 1983; --, not applicable; U, unregulated; ND, not determined; R, regulated]

Streamgage identification number	Streamgage name	Latitude, in decimal degrees (NAD 83)	Longitude, in decimal degrees (NAD 83)	Type of streamgage ¹	Contributing drainage area, in square miles	Data combination ²	Data correction ³	Regulation status ⁴ as of 2014	Number of recorded pea flows	k Water years of recorded peak flows	Number of unregulated peak-flow records	Water years of unregulated peak-flow records	Number of regulated peak-flow records	Water years of regulated peak-flow records	Percentage of drainage basin regulated by dams (2014)	Regulation status for reported at-site peak-flow frequency analyses
06078500	North Fork Sun River near Augusta, Montana	47.6399	-112.8593	CONT	259			U	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	0		0	U
06079000	South Fork Sun River near Augusta, Montana	47.6286	-112.8658	CONT	251			U	11	1911-1912, 1964, 2008-2009, 2014-2019	11	1911-1912, 1964, 2008-2009, 2014-2019	0		0	U
06079600	Beaver Creek at Gibson Dam, near Augusta, Montana	47.6023	-112.7575	CSG	20.8			U	15	1959-1973	15	1959-1973	0		0	U
06080000	Sun River near Augusta, Montana	47.6209	-112.7070	CONT	609		YES	R (MAJ-dam)	27	1890, 1905-1929, 1964	24	1890, 1905-1927	3	1928-1929, 1964	91	R
06080900	Sun River below diversion dam, near Augusta, Montana	47.6185	-112.6921	CONT	610			R (MAJ-dam)	18	1964, 1968-1980, 2016-2019	0	**	18	1964, 1968-1980, 2016-2019	91	R
06082200	Sun River below Willow Creek near Augusta, Montana	47.5471	-112.3674	CONT	814			R (MAJ-dam)	16	1964, 1968-1975, 2013-2019	0	**	16	1964, 1968-1975, 2013-2019	80	R
06085800	Sun River at Simms, Montana	47.5016	-111.9319	CONT	1,296			R (MAJ-dam)	38	1964, 1966-1979, 1997-2019	0	**	38	1964, 1966-1979, 1997-2019	55	R
06086000	Sun River at Fort Shaw, Montana	47.5134	-111.8155	CONT	1,395	YES		R (MAJ-dam)	16	1913-1928	15	1913-1927	1	1928	52	R
06087900	Muddy Creek tributary near Power, Montana	47.7557	-111.7296	CSG	3.81		YES	U	17	1963-1978, 1986	17	1963-1978, 1986	0		0	U
06089000	Sun River near Vaughn, Montana	47.5258	-111.5110	CONT	1,774			R (MAJ-dam)	87	1934-2019	0		87	1934-2019	42	R
06102500	Teton River below South Fork, near Choteau, Montana	47.8831	-112.6120	CONT	110			U	30	1948-1954, 1964, 1998-2019	30	1948-1954, 1964, 1998-2019	0		0	U
06103000	Teton River at Strabane, Montana	47.8788	-112.4595	CONT	124		YES	U	18	1908-1925	18	1908-1925	0		1	U
06105800	Bruce Coulee tributary near Choteau, Montana	47.7351	-112.2527	CSG	1.84			U	40	1963-2002	40	1963-2002	0		0	U
06106000	Deep Creek near Choteau, Montana	47.7520	-112.2395	CONT	269			U	15	1911-1924, 1964	15	1911-1924, 1964	0		2	U
06106500	Muddy Creek near Bynum, Montana	47.9911	-112.3575	CONT	72.1			U	10	1913-1918, 1920, 1922-1924	10	1913-1918, 1920, 1922-1924	0		1	U
06107000	North Fork Muddy Creek near Bynum, Montana	47.9919	-112.3574	CONT	55.8			U	11	1913-1917, 1919-1924	11	1913-1917, 1919-1924	0		2	U
06108000	Teton River near Dutton, Montana	47.9303	-111.5529	CONT	1,238			U	65	1955-2019	65	1955-2019	0	-	2	U
06108200	Kinley Coulee near Dutton, Montana	47.8428	-111.5917	CSG	14.4			U	16	1963-1978	16	1963-1978	0	-	0	U
06108300	Kinley Coulee tributary near Dutton, Montana	47.8428	-111.5521	CSG	2.96			U	16	1963-1978	16	1963-1978	0	-	0	U
06108800	Teton River at Loma, Montana	47.9327	-110.5144	CONT	1,900	YES	YES	U	22	1998-2019	22	1998-2019	0	-	7	U

IMderections for type of meanings are defined as follows:
ONF: continuous meanings or particular defined as follows:
ONF: continuous meanings or particular defined as follows:
ONF: continuous and particular defined as follows:
Data controls methods:
Data controls met

Table 1–2. Information on analyses combining peak-flow records for two or more closely located streamgages on the same channel [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends.]

	Р	rimary streamgage			Secondary streamgag		Combined characteristics		
Streamgage identification number	Streamgage name	Contributing drainage area, in re square miles	Number of ecorded peak Water years of recorded peak flows	Streamgage identification number	Streamgage name	Drainage area, in Sumbe square miles flow	r of peak Water years of recorded peak flows s	Combined number of recorded peak flows	Water years of combined peak-flow records
06086000 Sun River at Fort Shaw,	, Montana	1,395	16 1913-1928	06087500 Sun River at Sun	River, Montana	1,428	1906-1912	23 1	906-1928
06108800 Teton River at Loma, M	Iontana	1,900	22 1998-2019	06108500 Teton River near	Fort Benton, Montana	1,879 4	1929-1932	26 1	929-1932, 1998-2019

Table 1–3. Information on data correction and flow interval representation of specific peak-flow records.

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends.]

Streamgage identification number	Streamgage name	Water year	Recorded peak flow, in cubic feet per second	Type of flow interval	Lower interval value, in cubic feet per second	Upper interval value, in cubic feet per second	
06080000	Sun River near Augusta, Montana	1964	59,700	PEAK > STATED VALUE	59,700	INF	Lower interval from measurement
06087900	Muddy Creek tributary near Power, Montana	1986	190	EXCLUSION (OPPORTUNISTIC)	0	INF	Correction of opportunistic peak af
06103000	Teton River at Strabane, Montana	1964		PEAK > STATED VALUE	54,600	INF	Lower interval value from upstream
06108800	Teton River at Loma, Montana	1964		PEAK > STATED VALUE	81,300	INF	Lower interval value from upstream

Comments

of 1964 peak (included attenuation from Gibson Reservoir) after the end of systematic record an measurement of 1964 peak an measurement of 1964 peak
Table 1-4. Documentation regarding analytical procedures for peak-flow frequency analyses.

O6078500.00 North Fork Sam River near Augusta, Montana 259 U At-site 38 1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019 upper tail 3.526 0.180 Station 4.331 4.331 2,720 FIXED 06078500.03 North Fork Sam River near Augusta, Montana 259 U RE wid	0 14 YES - 0 0 YES - 0 0 YES . 0 0 YES . 0 3 YES 0 7 YES 0 1 YES 0 1 YES 0 13 YES 0 4 YES	YES YES YES YES YES YES YES
$0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \$		 YES YES YES YES YES YES
0607900.00 $04b f s k u R iver en Augusta, Montana 251 U A s i u 110 + 191 + 192 + 964 + 200 +$	0 0 YES 0 0 YES 0 0 YES 0 0 3 YES 0 7 YES 0 1 YES 0 13 YES 0 4 YES	YES YES YES YES YES YES YES
0607900.01 $08th$ Fok Sun River and Augusta, Montana 251 U RE wid $ -$ </td <td></td> <td> YES YES YES YES YES</td>		 YES YES YES YES YES
0607960.0 Bave Creek at Gibson Dam, near Augusta, Montana 20.8 U Atsite 15 $1959-1973$ $ 20.8$ 0.49 $Weighted$ 1.11 0.40 $Bullein 17b^5$ 0.505 $ MGBT$ $0607960.0.3$ Bave Creek at Gibson Dam, near Augusta, Montana 20.8 U RE wid $ -$ <td>0 0 YES - - - 0 0 YES . - - 0 3 YES 0 7 YES 0 1 YES 0 13 YES 0 4 YES</td> <td>YES YES YES YES YES YES</td>	0 0 YES - - - 0 0 YES . - - 0 3 YES 0 7 YES 0 1 YES 0 13 YES 0 4 YES	YES YES YES YES YES YES
0607960.03 Bave Creek at Gibson Dam, near Augusta, Montana 20.8 U RE wid $ -$ <t< td=""><td></td><td>- YES YES YES YES YES YES</td></t<>		- YES YES YES YES YES YES
0608000.0 0 mixer advagata, Montana 609 U $Atsine$ 27 1890 , 1905 , 1920 , 1964 $ 3.863$ 0.294 $Weighted$ 1.215 0.412 $Bullein 17b^5$ 0.544 $ MGBT$ 0608000.02 $0mixer advagata, Montana$ 609 U $RE wd$ $ -$	0 0 YES 0 3 YES 0 7 YES 0 1 YES 0 13 YES 0 4 YES	YES YES YES YES YES
0608000.03 $0m$ River ar Augusta, Montana 600 U RE wid $ -$ <td>Image: Constraint of the system Image: Constand of the system Image: Constando</td> <td> YES YES YES YES</td>	Image: Constraint of the system Image: Constand of the system Image: Constando	 YES YES YES YES
0608900.1Sun River below diversion dam, near Augusta, Montana 610 $R(AA-dam)$ $At-site$ 18 $1964, 1968-1980, 2016-2019$ reg 3.74 0.26 $Station$ 1.218 NA $$ 1.217 $2,620$ $FIXED$ 0608900.11 Sun River below diversion dam, near Augusta, Montana 610 $R(AA-dam)$ $MOVE3$ 86 $1934-2019$ reg 3.640 0.318 $Station$ 0.198 NA $$ 0.198 100 $MGBT$ 06082200.10 Sun River below Willow Creek near Augusta, Montana 814 $R(AA-dam)$ $At-site$ 16 $1964, 1968-1975, 2013-2019$ $$ 3.640 0.376 $Weighted$ 0.90 0.362 Bullein 17B ⁵ 0.202 $1,080$ $MGBT$ 06082200.11 Sun River below Willow Creek near Augusta, Montana 814 $R(AA-dam)$ $MOVE3$ 8 $194-1095-1079, 1997-2019$ $$ 3.640 0.376 $Weighted$ 0.90 0.362 Bullein 17B ⁵ 0.262 $1,800$ $MGBT$ 06085200.10 Sun River Below Willow Creek near Augusta, Montana 16 $1964-1079, 1997-2019$ $$ 3.640 0.360 $Weighted$ 0.610 0.362 $Bullein 17B5$ 0.262 $1,800$ $MGBT$ 06085200.10 Sun River Allow Montana 16 $1964-1079, 1997-2019$ $$ 3.648 0.360 $Weighted$ 0.210 0.323 $Bullein 17B5$ 0.246 $1,480$ $MGBT$ 06085200.10 Sun Fired Simma, Montana 16 $1602-$	0 3 YES 0 7 YES 0 1 YES 0 13 YES 0 4 YES	YES YES YES YES
0608990.11 Sun River below diversion dam, near Augusta, Montana 610 $R(MAJ-dam)$ $MOVE3$ 86 $1934-2019$ reg 3.66 0.318 $Station$ 0.198 NA $$ 0.198 1510 $MGBT$ 06082200.10 Sun River below Willow Creek near Augusta, Montana 814 $R(MAJ-dam)$ $At-site$ 16 $1964, 1968-1975, 2013-2019$ $$ 3.640 0.376 $Weighted$ 0.900 0.362 $Bulletin 17B^5$ 0.202 $1,080$ $MGBT$ 06082200.11 Sun River below Willow Creek near Augusta, Montana 814 $R(MAJ-dam)$ $MOVE3$ 86 $1934-2019$ $$ 3.694 0.278 $Weighted$ 0.607 0.362 $Bulletin 17B^5$ 0.202 $1,080$ $MGBT$ 06085200.11 Sun River at Summs, Montana 1.296 $R(MAJ-dam)$ $At-site$ 364 $1946, 1966-1979, 1997-2019$ $$ 3.648 0.366 $Weighted$ 0.211 0.323 $Bulletin 17B^5$ 0.246 $1,480$ $MGBT$ 05085800.11 Sun First Stimms, Montana 1.906 $R(MJ-dam)$ $At-site$ 364 1.964 0.366 $Weighted$ 0.211 0.323 $Bulletin 17B^5$ 0.246 $1,480$ $MGBT$ 050055800.116 Sun First Stimms, Montana 1.906 $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 1206$ $1.902, 120$	0 7 YES 0 1 YES 0 13 YES 0 4 YES	YES YES YES
06082200.10 Sum River below Willow Creek near Augusta, Montana 814 R (MAJ-dam) At-site 16 1964, 1968-1975, 2013-2019 3.640 0.376 Weighted 0.090 0.362 Bulletin 178 ⁵ 0.202 1,080 MGBT 06082200.11 Sum River below Willow Creek near Augusta, Montana 814 R (MAJ-dam) MOVE3 86 1934-2019 3.640 0.278 Weighted 0.607 0.362 Bulletin 178 ⁵ 0.535 2480 MGBT 05085800.10 Sum River at Summs, Montana 1.296 R (MAJ-dam) At-site 38 1964, 1966-1979, 1997-2019 3.648 0.366 Weighted 0.201 0.323 Bulletin 178 ⁵ 0.246 1,480 MGBT 05085800.11 Sum River at Summs, Montana 1.090 R (MJ-dam) At-site 38 1964, 1966-1979, 1997-2019 3.648 0.366 Weighted 0.211 0.323 Bulletin 178 ⁵ 0.246 1,480 MGBT 050055800.11 Sum River at Summs, Montana 10.921 10.921 10.921 10.921 10.921 10.921 10.921 10.921	0 1 YES 0 13 YES 0 4 YES	YES YES YES
O6082200.11 Sun River below Willow Creek near Augusta, Montana 814 R (MAJ-dam) MOVE3 86 1934-2019 3.694 0.278 Weighted 0.607 0.362 Bulletin 17B ⁵ 0.535 2480 MGBT 06082200.11 Sun River at Simms, Montana 1,296 R (MAJ-dam) At-site 38 1964, 1966-1979, 1997-2019 3.648 0.366 Weighted 0.211 0.323 Bulletin 17B ⁵ 0.246 1,480 MGBT 06085800.10 Sin River at Simms, Montana 1,296 R (MAJ-dam) At-site 38 1964, 1966-1979, 1997-2019 3.648 0.366 Weighted 0.211 0.323 Bulletin 17B ⁵ 0.246 1,480 MGBT	0 13 YES 0 4 YES	YES
O6085800.10 Sun River at Simms, Montana 1,296 R (MAJ-dam) At-site 38 1964, 1966-1979, 1997-2019 3.648 0.366 Weighted 0.211 0.323 Bulletin 17B ⁵ 0.246 1,480 MGBT	0 4 YES	VES
		110
06085800.11 Sun River at Simms, Montana 1,296 R (MAJ-dam) MOVES 86 1934-2019 3.685 0.324 Weighted 0.226 0.323 Bulletin 17B 0.248 1,880 MGBT	0 10 YES	YES
06086000.00 Sun River at Fort Shaw, Montana 1,395 U At-site 22 1906-1927 3.861 0.243 Weighted 0.506 0.311 Bulletin 17B ⁵ 0.418 MGBT	0 0 YES	YES
<u>06086000.03</u> Sun River at Fort Shaw, Montana 1,395 U RRE wtd		
06087900.00 Muddy Creek tributary near Power, Montana 3.81 U At-site 16 1963-1978, 1986 2.078 0.516 Weighted -0.838 0.316 Bulletin 17B ⁵ -0.178 19 MGBT	1 0	
06087900.03 Muddy Creek tributary near Power, Montana 3.81 U RRE wtd		
06089000.10 Sun River near Vaughn, Montana 1,774 R (MAJ-dam) At-site 86 1934-2019 upper tail 3.740 0.252 Station 0.998 0.998 3,370 FIXED	0 18 YES	YES
06102500.00 Teton River below South Fork, near Choteau, Montana 110 U At-site 30 1948-1954, 1964, 1998-2019 upper tail 2.983 0.428 Station 1.491 1.491 MGBT	0 0 YES	YES
06102500.01 Teton River below South Fork, near Choteau, Montana 110 U MOVE3 72 1948-2019 upper tail 3.088 0.430 Station 0.906 0.906 MGBT	0 0 YES	YES
06103000.00 Teton River at Strabane, Montana 124 U At-site 18 1908-1925 upper tail 2.878 0.438 Station 2.548 2.548 MGBT	0 0 YES	YES
06105800.00 Bruce Coulee tributary near Choteau, Montana 1.84 U At-site 40 1963-2002 1.654 0.453 Weighted 0.056 0.388 Bulletin 17B ⁵ 0.137 MGBT	0 0	
06105800.03 Bruce Coulee tributary near Choteau, Montana 1.84 U RRE wtd		
06106000.00 Deep Creek near Choteau, Montana 269 U At-site 15 1911-1924, 1964 2.827 0.560 Weighted 0.949 0.389 Bulletin 17B ⁵ 0.469 MGBT	0 0 YES	YES
O6106000.03 Deep Creek near Choteau, Montana 269 U RRE wid		
06106500.00 Muddy Creek near Bynum, Montana 72.1 U At-site 10 1913-1918, 1920, 1922-1924 1.993 0.745 Weighted -0.320 0.457 Bulletin 17B ⁵ 0.111 MGBT	0 0 YES	YES
06106500.03 Muddy Creek near Bynum, Montana 72.1 U RRE wtd		
06107000.00 North Fork Muddy Creek near Bynum, Montana 55.8 U At-site 11 1913-1917, 1919-1924 1.902 0.569 Weighted -0.506 0.457 Bulletin 17B ⁵ 0.013 MGBT	0 0 YES	YES
06107000.03 North Fork Muddy Creek near Bynum, Montana 55.8 U RRE wtd		
06108000.00 Teton River near Dutton, Montana 1.238 U At-site 65 1955-2019 upper tail 2.943 0.563 Station 0.511 0.511 MGBT	0 0 YES	YES
06108000.01 Teton River near Dutton, Montana 1.238 U MOVE3 72 1948-2019 upper tail 2.941 0.553 Station 0.503 0.503 MGBT	0 0 YES	YES
06108200.00 Kinley Coulee near Dutton, Montana 14.4 U At-site 16 1963-1978 upper tail 1.320 1.170 Weighted -0.415 0.300 Bulletin 17B ⁵ -0.022 5 FIXED	2 3	
06108200.03 Kinley Coulee near Dutton, Montana 14.4 U RRE wtd		
06108300.00 Kinley Coulee tributary near Dutton, Montana 2.96 U At-site 16 1963-1978 1.014 1.013 Weighted -0.106 0.293 Bulletin 17B ⁵ 0.109 1 MGBT	2 0	
06108300.03 Kinley Coulee tributary near Dutton, Montana 2.96 U RRE wtd		
06108800.00 Teton River at Loma, Montana 1,900 U At-site 26 1929-1932, 1998-2019 2.818 0.663 Weighted 1.249 0.119 Bulletin 17B ⁵ 0.297 MGBT	0 0 YES	YES
Of 108800.03 Teton River at Loma, Montana 1,900 U R.E. wtd <th< td=""><td></td><td></td></th<>		

¹The streamgage identification number and analysis designation is defined by XXXXXXXAB,

where, XXXXXXX is the streamgage identification number;

A is the regulation status for the analysis period; and B is the type of peak-flow frequency analysis.

Values of A (regulation status) are defined as:

A = 0, unregulated; A = 1, regulated by major regulation; and

A = 2, total; that is, the combined unregulated and regulated peak-flow records for streamgages with peak-flow records before and after the start of regulation (see footnote 2).

Values of B (type of peak-flow frequency analysis) are defined as:

B = 0, at-site peak-flow frequency analysis conducted on recorded data; B = 0, at-site peak-flow frequency analysis conducted on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure;

B = 2, peak-flow frequency analysis determined from regional regression equations (RREs); RRE frequency results not presented in this report; and B = 3, at-site peak-flow frequency analysis weighted with results from RREs; distributional parameters not available for RRE weighted frequency analyses.

²Abbreviations for regulation status are defined as follows:

"Abbreviations for regulation status are defined as follows: U, unregulated, where the cumulative drainage area percam from all dams is less than 20 percent of the drainage area of the streamgage. R (MAJ-cham): major dam regulation, where a single upstream dam has a drainage area that exceeds 20 percent of the drainage area of the streamgage. R (MAJ-cham): major diversion canal regulation, where a large diversion canal is known to be located on the channel upstream from the streamgage. R (MIAJ-cham): miori dam regulation, where the cumulative drainage area of all upstream dam has a drainage area of the streamgage, but no single upstream dam has a drainage area of the streamgage. R (MIN-dams): miori dam regulation, where the cumulative drainage area of all upstream dam dams exceeds 20 percent of the drainage area of the streamgage, but no single upstream dam has a drainage area of the streamgage. Total: the combined unregulated peak-flow records for streamgages with peak-flow frequency analysis is provided in cases where major regulation affects less than 50 percent of the drainage area of the streamgage and there is uncertainty in the effects of regulation on specific peak-flow characteristics. Also, the "Total" peak-flow frequency analysis is provided in cases of minor dam entertiants. regulation.

³Abbreviations for type of frequency analysis are defined as follows: At-site: peak-flow frequency analysis on recorded data. RRE wid: the at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). MOVE.3: peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure.

⁴Standard Bulletin 17C (England and others, 2019) procedures are considered to be the use of the multiple Grubbs-Beck low-outlier test (MGBT) for identifying PILFs. In cases where either the station skew or a manual (analyst-selected) PILF threshold was used, the peak-flow frequency analysis was considered to deviate from standard Bulletin 17C procedures are defined as follows: reg: the peak-flow records are affected by major dam or canal regulation; upper tail: the probability plots of the peak-flow records deviate from typical patterns in the upper tail of the frequency curve, generally because of mixed population characteristics; and lower tail: the probability plots of the peak-flow records deviate from typical patterns in the lower tail of the frequency curve at high annual exceedance probabilities (greater than about 50.0 percent).

⁵U.S. Interagency Advisory Council on Water Data, 1982, Guidelines for determining flood flow frequency: Hydrology Subcommittee, Bulletin 17B, appendixes 1–14, 28 p.

Table 1–5. Documentation of user-defined perception thresholds for peaks represented as flow intervals (excluding missing data periods) in applicable peak-flow frequency analyses. [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. U, unregulated; --, not applicable]

Streamgage identification number and analysis designation ¹	r Streamgage name	Regulation status for analysis ²	Number of peak flows used in the analysis	Water years of peak flows used in the analysis	Perception threshold period, in water years	Lower bound of perceptible range, in cubic feet per second	Upper bound of perceptible range, in cubic feet per second	Water year of peak flow used for historical perception threshold	Peak flow used for historical perception threshold, in cubic feet per second	Comments
06078500.00	North Fork Sun River near Augusta, Montana	U	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	1905-1910	51,100	INF	1964	51,100	1964 HISTORICAL PERIOD
06078500.00	North Fork Sun River near Augusta, Montana	U	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	1913-1945	51,100	INF	1964	51,100	1964 HISTORICAL PERIOD
06078500.00	North Fork Sun River near Augusta, Montana	U	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	1969-1988	51,100	INF	1964	51,100	1964 HISTORICAL PERIOD
06078500.00	North Fork Sun River near Augusta, Montana	U	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	1994-2007	51,100	INF	1964	51,100	1964 HISTORICAL PERIOD
06078500.00	North Fork Sun River near Augusta, Montana	U	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	2010-2013	51,100	INF	1964	51,100	1964 HISTORICAL PERIOD
06079000.00	South Fork Sun River near Augusta, Montana	U	11	1911-1912, 1964, 2008-2009, 2014-2019	1905-1910	28,800	INF	1964	28,800	1964 HISTORICAL PERIOD
06079000.00	South Fork Sun River near Augusta, Montana	U	11	1911-1912, 1964, 2008-2009, 2014-2019	1913-2007	28,800	INF	1964	28,800	1964 HISTORICAL PERIOD
06079000.00	South Fork Sun River near Augusta, Montana	U	11	1911-1912, 1964, 2008-2009, 2014-2019	2010-2013	28,800	INF	1964	28,800	1964 HISTORICAL PERIOD
06079600.00	Beaver Creek at Gibson Dam, near Augusta, Montana	U	15	1959-1973	1917-1958	4,360	INF	1964	4,360	1964 HISTORICAL PERIOD
06079600.00	Beaver Creek at Gibson Dam, near Augusta, Montana	U	15	1959-1973	1974-2019	4,360	INF	1964	4,360	1964 HISTORICAL PERIOD
06080000.00	Sun River near Augusta, Montana	U	27	1890, 1905-1929, 1964	1895-1904	59,700	INF	1964	59,700	1964 HISTORICAL PERIOD
06080000.00	Sun River near Augusta, Montana	U	27	1890, 1905-1929, 1964	1930-2019	59,700	INF	1964	59,700	1964 HISTORICAL PERIOD
06080900.10	Sun River below diversion dam, near Augusta, Montana	R (MAJ-dam)	18	1964, 1968-1980, 2016-2019	1895-1929	32,300	INF	1916	32,300	1916 HISTORICAL PERIOD
06080900.10	Sun River below diversion dam, near Augusta, Montana	R (MAJ-dam)	18	1964, 1968-1980, 2016-2019	1930-1967	32,000	INF	1975	32,000	1975 HISTORICAL PERIOD
06080900.10	Sun River below diversion dam, near Augusta, Montana	R (MAJ-dam)	18	1964, 1968-1980, 2016-2019	1981-2015	32,000	INF	1975	32,000	1975 HISTORICAL PERIOD
06080900.11	Sun River below diversion dam, near Augusta, Montana	R (MAJ-dam)	86	1934-2019	1895-1929	32,300	INF	1916	32,300	1916 HISTORICAL PERIOD
06080900.11	Sun River below diversion dam, near Augusta, Montana	R (MAJ-dam)	86	1934-2019	1930-1933	32,000	INF	1975	32,000	1975 HISTORICAL PERIOD
06082200.10	Sun River below Willow Creek near Augusta, Montana	R (MAJ-dam)	16	1964, 1968-1975, 2013-2019	1895-1967	34,000	INF	1975	34,000	1975 HISTORICAL PERIOD
06082200.10	Sun River below Willow Creek near Augusta, Montana	R (MAJ-dam)	16	1964, 1968-1975, 2013-2019	1976-2012	34,000	INF	1975	34,000	1975 HISTORICAL PERIOD
06082200.11	Sun River below Willow Creek near Augusta, Montana	R (MAJ-dam)	86	1934-2019	1895-1933	34,000	INF	1975	34,000	1975 HISTORICAL PERIOD
06085800.10	Sun River at Simms, Montana	R (MAJ-dam)	38	1964, 1966-1979, 1997-2019	1895-1965	37,900	INF	1975	37,900	1975 HISTORICAL PERIOD
06085800.10	Sun River at Simms, Montana	R (MAJ-dam)	38	1964, 1966-1979, 1997-2019	1980-1996	37,900	INF	1975	37,900	1975 HISTORICAL PERIOD
06085800.11	Sun River at Simms, Montana	R (MAJ-dam)	86	1934-2019	1895-1933	37,900	INF	1975	37,900	1975 HISTORICAL PERIOD
06086000.00	Sun River at Fort Shaw, Montana	U	22	1906-1927	1895-1905	27,200	INF	1908	27,200	1908 HISTORICAL PERIOD
06089000.10	Sun River near Vaughn, Montana	R (MAJ-dam)	86	1934-2019	1895-1908	53,500	INF	1964	53,500	1964 HISTORICAL PERIOD
06089000.10	Sun River near Vaughn, Montana	R (MAJ-dam)	86	1934-2019	1909-1933	32,600	INF	1975	32,600	1975 HISTORICAL PERIOD
06102500.00	Teton River below South Fork, near Choteau, Montana	U	30	1948-1954, 1964, 1998-2019	1895-1947	54,600	INF	1964	54,600	1964 HISTORICAL PERIOD
06102500.00	Teton River below South Fork, near Choteau, Montana	U	30	1948-1954, 1964, 1998-2019	1955-1997	54,600	INF	1964	54,600	1964 HISTORICAL PERIOD
06102500.01	Teton River below South Fork, near Choteau, Montana	U	72	1948-2019	1895-1947	54,600	INF	1964	54,600	1964 HISTORICAL PERIOD
06103000.00	Teton River at Strabane, Montana	U	18	1908-1925	1895-1907	54,600	INF	1964	54,600	1964 HISTORICAL PERIOD
06103000.00	Teton River at Strabane, Montana	U	18	1908-1925	1926-2019	54,600	INF	1964	54,600	1964 HISTORICAL PERIOD
06106000.00	Deep Creek near Choteau, Montana	U	15	1911-1924, 1964	1895-1910	41,800	INF	1964	41,800	1964 HISTORICAL PERIOD
06106000.00	Deep Creek near Choteau, Montana	U	15	1911-1924, 1964	1925-2019	41,800	INF	1964	41,800	1964 HISTORICAL PERIOD
06106500.00	Muddy Creek near Bynum, Montana	U	10	1913-1918, 1920, 1922-1924	1919	976	INF	1916	976	1916 HISTORICAL PERIOD
06106500.00	Muddy Creek near Bynum, Montana	U	10	1913-1918, 1920, 1922-1924	1921	976	INF	1916	976	1916 HISTORICAL PERIOD
06107000.00	North Fork Muddy Creek near Bynum, Montana	U	11	1913-1917, 1919-1924	1918	600	INF	1916	600	1916 HISTORICAL PERIOD
06108000.00	Teton River near Dutton, Montana	U	65	1955-2019	1895-1954	71,300	INF	1964	71,300	1964 HISTORICAL PERIOD
06108000.01	Teton River near Dutton, Montana	U	72	1948-2019	1895-1947	71,300	INF	1964	71,300	1964 HISTORICAL PERIOD
06108800.00	Teton River at Loma, Montana	U	26	1929-1932, 1998-2019	1895-1928	81,300	INF	1964	81,300	1964 HISTORICAL PERIOD
06108800.00	Teton River at Loma, Montana	U	26	1929-1932, 1998-2019	1933-1997	81,300	INF	1964	81,300	1964 HISTORICAL PERIOD

Streamgage identification numbe and analysis designation¹

Streamgage name

Regulation status for Number of peak flows analysis² used in the analysis

Water years of peak flows used in the analysis

Perception threshold period, in water years

Lower bound of perceptible range, in cubic feet per second

Upper bound of perceptible range, in used for historical cubic feet per second perception threshold

¹The streamgage identification number and analysis designation is defined by XXXXXXXAB,

where,

XXXXXXXX is the streamgage identification number;

A is the regulation status for the analysis period; and B is the type of peak-flow frequency analysis.

Values of A (regulation status) are defined as:

A = 0, unregulated;

A = 1, regulated by major regulation; and

A = 2, total; that is, the combined unregulated and regulated peak-flow records for streamgages with peak-flow records before and after the start of regulation (see footnote 2).

Values of B (type of peak-flow frequency analysis) are defined as:

B = 0, at-site peak-flow frequency analysis conducted on recorded data;

B = 1, peak-flow frequency analysis conducted on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure;

B = 2, peak-flow frequency analysis determined from regional regression equations (RREs); RRE frequency results not presented in this report; and

B = 3, at-site peak-flow frequency analysis weighted with results from RREs; distributional parameters not available for RRE weighted frequency analyses.

²Abbreviations for regulation status are defined as follows:

U, unregulated, where the cumulative drainage area upstream from all dams is less than 20 percent of the drainage area of the streamgage.

R (MAJ-dam): major dam regulation, where a single upstream dam has a drainage area that exceeds 20 percent of the drainage area of the streamgage.

R (MAJ-canal): major diversion canal regulation, where a large diversion canal is known to be located on the channel upstream from the streamgage.

R (MIN-dams): minor dam regulation, where the cumulative drainage area of all upstream dams exceeds 20 percent of the drainage area of the streamgage. Total: the combined unregulated and regulated peak-flow records for streamgages with peak-flow records before and after the start of regulation, . The "Total" peak-flow frequency analysis is provided in cases where major regulation affects less than 50 percent of the drainage area of the streamgage and there is uncertainty in the effects of regulation on specific peak-flow characteristics. Also, the "Total" peak-flow frequency analysis is the only peak-flow frequency analysis provided in cases of minor dam regulation.

Water year of peak flow Peak flow used for historical perception threshold, in cubic feet per second

Comments

Table 1–6. Documentation regarding the Maintenance of Variance Type III (MOVE.3) record extension procedure for selected streamgages.

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. SEP, standard error of prediction, in percent; --, not applicable]

								Index streamgage(s) used for synthesis of peak streamflows								
Streamgage identification number	Streamgage Name	Contributing drainage area, in square miles	Number of recorded peak flows	Water years of recorded peak flows	Number of years requiring synthesis of peak flows	Water years requiring synthesis of peak flows	Percentage of record synthesized	Streamgage identification number	Streamgage Name	Contributing drainage area, in square miles	Number of peak flows synthesized based on this streamgage	Number of concurrent recorded peak flows for target and index streamgages	Pearson correlation coefficient for concurrent data for target and index streamgage	Weighted average Pearson correlation coefficient ¹	Estimated standard error of MOVE.3 analysis, in percent ²	Effective record length for the synthesized peak flows
06080900	Sun River below Diversion Dam near Augusta, Montana	610	18	1964, 1968-1980, 2016- 2019	68	1934-1963, 1965-1967, 1981-2015	79.1	06089000	Sun River near Vaughn, Montana	1,774	68	18	0.98	0.98	24.8	46.4
06082200	Sun River below Willow Creek near Augusta, Montana	814	16	1964, 1968-1975, 2013- 2019	70	1934-1963, 1965-1967, 1976-2012	81.4	06085800	Sun River at Simms, Montana Sun River near Vaughn.	1,296 1,774	22 48	16 16	0.99	0.99	20.7 20.7	19.1 36.3
06085800	Sun River at Simms, Montana	1,296	38	1964, 1966-1979, 1997-	48	1934-1963, 1965, 1980-	55.8	06089000	Montana Sun River near Vaughn,	1,774	48	38	0.99	0.99	18.6	41.7
				2019		1996			Montana							
06102500	Teton River below South Fork, near Choteau, Montana	110	30	1948-1954, 1964, 1998- 2019	42	1955-1963, 1965-1997	58.3	06108000	Teton River near Dutton, Montana	1,238	42	23	0.92	0.92	56.1	18.8
06108000	Teton River near Dutton, Montana	1,238	65	1955-2019	7	1948-1954	9.7	06102500	Teton River below South Fork, near Choteau, Montana	110	7	23	0.92	0.92	89.8	4.5

¹The weighted average Pearson correlation coefficient was determined by multiplying the number of peak flows synthesized based on an index streamgage times the Pearson correlation coefficient for the index streamgage. The resultant products then were summed and divided by the total number of synthesized peak flows.

²A standard error was calculated based on an ordinary least squares (OLS) formulation of the analysis. That OLS standard error was adjusted to an estimated MOVE.3 formulation by multiplying times the following adjustment factor (Wilbert O. Thomas, Michael Baker International, written commun., November 2016): AF = 2/(1+p),

where,

AF is the adjustment factor; and

 ρ is the weighted average Pearson correlation coefficient.

Table 1–7. Peak-flow frequency results.

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. U, unregulated; R, regulated; -, not applicable; MOVE3, Maintenance of Variance Extension Type III record extension; RRE wtd, regional regression equation weighted]

Streamgage Type of peak- identification number Type of peak- Regulation status for and analysis Type of peak- flow Number of peak Frequency analysis and analysis Streamgage name drainage area, in square miles flow flow Water years of peak flows used in the analysis incorporates historical designation ¹ square miles analysis ² frequency analysis analysis flow analysis flow sused in the analysis information? (if Yes, see Table 1: 5 for additional information) 66.7 50 42.9 20 10 4 2 1	0.5 0.2	84 percent confidence Analyses considered by U.S. level for the 1 percent Geological Survey to be most annual exceedance appropriate for flood-plain probability peak flow mapping purposes ⁴
06078500 00 North Fork Sun River near Augusta, Montana 259 U At-site 38 1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019 YES 2.840 2.900 3.600 4.950 8.390 13.200 21.200	35,000 69,400	35,600 YES
06078500.03 North Fork Sun River near Augusta, Montana 259 U RRE wid 2.840 2.900 3.610 5.090 9.470 13.000 17.800	24,400 36,700	19,800
0607200.00 South Fork Sun River near Augusta, Montana 251 U At-site 11 1911-1912, 1964, 2008-2009, 2014-2019 YES 2,460 3,240 3,640 5,830 8,180 12,000 15,600 19,900	25,100 33,500	28,200 YES
0607200100 3 South Fork Sun River near Augusta, Montana 251 U RRE wid 2,460 3,210 3,590 5,530 7,310 9,480 12,900 17,500	23,500 34,700	19,300
06079500.00 Beaver Creek at Gibson Dam, near Augusta, Montana 20.8 U At-site 15 1959-1973 YES 68 109 134 301 542 1,060 1,670 2,560	3,850 6,410	4,590 YES
06079600.03 Beaver Creek at Gibson Dam, near Augusta, Montana 20.8 U RRE wtd 77 126 156 365 678 1,350 2,030 3,020	4,480 7,460	3,490
0608000.00 Sun River near Augusta, Montana 609 U At-site 27 1890, 1905-1929, 1964 YES 5,200 6,860 7,740 12,600 17,900 26,800 35,400 45,900	58,700 80,200	62,300
0608000.03 Sun River near Augusta, Montana 609 U RRE wtd 5,200 6,840 7,700 12,200 16,500 19,600 26,000 34,100	44,600 63,300	38,600
0608000.10 Sun River below diversion dam, near Augusta, Montana 610 R (MAJ-dam) At-site 18 1964, 1968-1980, 2016-2019 YES 3,760 4,700 5,220 8,300 12,100 19,100 26,600 36,800	50,500 76,000	53,000
	34,800 45,300	39,000 YES
Joint Constraint 814 R (MAJ-dam) At-site 16 1964, 1968-1975, 2013-2019 YES 2,940 4,240 4,960 8,960 13,500 21,100 28,300 37,100	47,800 65,200	49,300
Operation Sun River below Willow Creek near Augusta, Montana 814 R (MAJ-dam) MOVE3 86 1934-2019 YES 3,600 4,670 5,240 8,280 11,600 22,000 28,100	35,400 47,400	38,500 YES
De085800.10 Sun River at Simms, Montana 1,296 R (MAJ-dam) At-site 38 1964, 1966-1979, 1997-2019 YES 3,010 4,300 5,000 8,940 13,400 20,800 28,000 36,800	47,400 64,800	49,400
Jogo85800.11 Sun River at Simms, Montana 1,296 R (MAJ-dam) MOVE3 86 1934-2019 YES 3,430 4,700 5,370 8,980 12,800 19,000 24,800 31,500	39,400 52,100	41,500 YES
Jogo86000.0 Sun River at Fort Shaw, Montana 1,395 U At-site 22 1906-1927 YES 5,540 6,980 7,710 11,400 15,200 20,800 31,500	38,000 48,100	46,000
	37,800 49,300	42,500
06087900.00 Muddy Creek tributary near Power, Montana 3.81 U At-site 16 1963-1978, 1986 74 124 153 328 536 890 1,220 1,620	2,100 2,830	3,490
06087900.03 Muddy Creek tributary near Power, Montana 3.81 U RRE wtd 61 100 122 241 360 562 770 1,020	1,360 1,900	1,620 YES
	41,600 58,900	45,200 YES
Openation Teton River below South Fork, near Choteau, Montana 110 U At-site 30 1948-1954, 1964, 1998-2019 YES 544 760 895 1,900 3,580 7,950 14,300 25,400	45,000 94,500	52,000
O6102500.01 Teton River below South Fork, near Choteau, Montana 110 U MOVE3 72 1948-2019 YES 72 1,060 1,260 9,070 14,600 23,000	35,800 63,000	50,400 YES
Of 103000.00 Teton River at Strabane, Montana 124 U At-site 18 1908-1925 YES 418 523 598 1,260 2,650 7,400 16,500 37,200	84,800 255,000	79,400
0610300.03 Teton River at Strabane, Montana 124 U RRE wtd 424 556 655 1,560 3,180 7,460 13,500 22,700	36,600 63,600	39,800 YES
06105800.00 Bruce Coulee tributary near Choteau, Montana 1.84 U At-site 40 1963-2002 28 44 53 108 174 293 413 565	755 1,080	954
<u>06105800.03</u> Brue Coulee tributary near Choteau, Montana 1.84 U RE wtd 27 43 52 105 170 287 405 550	736 1,040	813 YES
<u>0610600.00</u> Deep Creek near Choteau, Montana 269 U At-site 15 1911-1924, 1964 YES 357 607 764 1,910 3,680 7,770 12,900 20,800	32,500 57,100	38,700 YES
O6106000.3 Deep Creek near Choteau, Montana 269 U RE wid 356 600 751 1,780 3,200 6,070 9,350 13,800	20,100 32,000	21,100
<u>06106500.00</u> Muddy Creek near Bynum, Montana 72.1 U At-site 10 1913-1918, 1920, 1922-1924 YES 46 95 130 413 904 2,110 3,690 6,110	9,750 17,300	27,200
<u>06106500.03</u> Muddy Creek near Bynum, Montana 72.1 U RRE wtd 66 144 197 634 1,300 2,560 3,840 5,390	7,510 11,200	9,450 YES
<u>06107000.00</u> North Fork Muddy Creek near Bynum, Montana 55.8 U At-site 11 1913-1917, 1919-1924 YES 45 80 101 240 429 797 1,100 1,710	2,380 3,550	5,000
<u>06107000.03</u> North Fork Muddy Creek near Bynum, Montana 55.8 U RRE wtd 54 101 130 358 711 1,420 2,150 3,010	4,160 6,040	5,010 YES
<u>06108000.00</u> Teton River near Dutton, Montana 1,238 U At-site 65 1955-2019 YES 462 785 990 2,500 4,870 10,500 17,600 28,800	45,800 82,000	52,700
<u>06108000.01</u> Teton River near Dutton, Montana 1,238 U MOVE3 72 1948-2019 YES 466 785 986 2,440 4,710 9,960 16,600 26,800	42,100 74,500	48,800 YES
<u>06108200.00</u> Kinley Coulee near Dutton, Montana 14. U At-site 16 1963-1978 21 34 202 655 2,280 5,100 10,500	20,300 45,100	89,700
<u>06108200.03</u> Kinley Coulee near Duttion, Montana 14.4 U RRE wid 31 46 176 358 708 1,100 1,610	2,340 3,700	2,810 YES
<u>06108300.00</u> Kinley Coulee tributary near Dutton, Montana 2.96 U At-site 16 1963-1978 3.7 9.9 15 72 210 667 1,420 2,820	5,320 11,600	16,600
<u>06108300.03</u> Kinley Coulee tributary near Dutton, Montana 2.96 U RRE wtd 5.4 14 20 79 167 335 515 743	1,060 1,630	1,290 YES
<u>06108800.00</u> Teton River at Loma, Montana 1,900 U At-site 26 1929-1932, 1998-2019 YES 321 610 801 2,310 4,850 11,000 19,200 31,800	51,200 92,400	60,400 YES
<u>06108800.03</u> Teton River at Loma, Montana 1,900 U RRE wid 332 626 818 2,270 4,480 9,420 15,500 24,200	37,200 63,100	38,000

¹The streamgage identification number and analysis designation is defined by XXXXXXXAB,

where, XXXXXXXX is the streamgage identification number;

A is the regulation status for the analysis period; and B is the type of peak-flow frequency analysis.

Values of A (regulation status) are defined as:

A = 0, unregulated; A = 1, regulated by major regulation; and

A = 2, total; that is, the combined unregulated and regulated peak-flow records for streamgages with peak-flow records before and after the start of regulation (see footnote 2).

Values of B (type of peak-flow frequency analysis) are defined as: B = 0, at-site peak-flow frequency analysis conducted on recorded data;

B = 0, are site peak-flow frequency analysis conducted on recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure;
 B = 2, peak-flow frequency analysis determined from regional regression equations (RREs); RRE frequency results not presented in this report; and
 B = 3, at-site peak-flow frequency analysis weighted with results from RREs; distributional parameters not available for RRE weighted frequency analyses.

²Abbreviations for regulation status are defined as follows:

U, unregulated, where the cumulative drainage area upstream from all dams is less than 20 percent of the drainage area of the streamgage.

R (MAJ-dam): major dam regulation, where a single upstream dam has a drainage area that exceeds 20 percent of the drainage area of the streamgage. R (MAJ-canal): major diversion canal regulation, where a large diversion canal is known to be located on the channel upstream from the streamgage.

R (MTV-catal), major unvestion regulation, where a rate drained regulation and regulation and regulation. The "Total" beak-flow frequency analysis is provided in cases of the streamgage and there is uncertainty in the effects of regulation on specific peak-flow characteristics. Also, the "Total" peak-flow frequency analysis is the only peak-flow frequency analysis is provided in cases of minor dam regulation. The "Total" peak-flow frequency analysis is provided in cases of minor dam regulation.

³Abbreviations for type of frequency analysis are defined as follows: At-site: peak-flow frequency analysis on recorded data.

REE with the at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). MOVE.3: peak-flow frequency analysis on combined recorded and synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure.

⁴ For a given store approximation of the selection process among different streamgage peak-flow dataset and hydroclimatic regime; and (2) the adequacy of representation of the streamgage peak-flow characteristics and hydroclimatic regime in the development of the regional regression equations (RREs). If a streamgage is affected by major dam regulation and the streamgage peak-flow dataset includes pre- and post-regulation effects on the geak flows also was considered in the selection process. If a Maintenance of Variance Extension Type III (MOVE.3) record extension analysis is presented for a streamgage, that analysis is considered in the selection process. appropriate."

ty,	in	percent

Table 1–8. Variance of peak-flow frequency estimates.

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. U, unregulated; R, regulated; --, not applicable; MOVE3, Maintenance of Variance Extension Type III record extension; RRE wtd, regional regression equation weighted]

							_			Variance	e, in base 10 log	arithm, for indic	ated annual exce	eedance probabil	ity, in percent		
Streamgage identification number and analysis designation ¹	Streamgage name	Contributing drainage area, in square miles	Regulation status for analysis ²	Type of peak- flow frequency f analysis ³	Number of peak flows used in the analysis	Water years of peak flows used in the analysis	Frequency analysis incorporates historical information? (if Yes, see Table 1-5 for additional information)	66.7	50	42.9	20	10	4	2	1	0.5	0.2
<u>06078500.00</u> N	Jorth Fork Sun River near Augusta, Montana	259	U	At-site	38	1911-1912, 1946-1968, 1989-1993, 2008-2009, 2014-2019	YES		0.0027	0.0019	0.0007	0.0030	0.0099	0.0186	0.0313	0.0487	0.0800
<u>06078500.03</u> N	Jorth Fork Sun River near Augusta, Montana	259	U	RRE wtd					0.0026	0.0019	0.0007	0.0026	0.0009	0.0013	0.0019	0.0026	0.0038
<u>06079000.00</u> S	outh Fork Sun River near Augusta, Montana	251	U	At-site	11	1911-1912, 1964, 2008-2009, 2014-2019	YES	0.0082	0.0088	0.0092	0.0107	0.0123	0.0152	0.0183	0.0225	0.0278	0.0368
<u>06079000.03</u> S	outh Fork Sun River near Augusta, Montana	251	U	RRE wtd				0.0078	0.0081	0.0084	0.0087	0.0077	0.0009	0.0013	0.0018	0.0025	0.0036
<u>06079600.00</u> ^B	Beaver Creek at Gibson Dam, near Augusta, Montana	20.8	U	At-site	15	1959-1973	YES	0.0161	0.0176	0.0184	0.0222	0.0264	0.0351	0.0450	0.0583	0.0753	0.1039
<u>06079600.03</u> ^B	Beaver Creek at Gibson Dam, near Augusta, Montana	20.8	U	RRE wtd				0.0146	0.0152	0.0154	0.0150	0.0118	0.0018	0.0027	0.0038	0.0052	0.0075
<u>06080000.00</u> S	un River near Augusta, Montana	609	U	At-site	27	1890, 1905-1929, 1964	YES	0.0033	0.0037	0.0039	0.0048	0.0059	0.0084	0.0114	0.0155	0.0208	0.0298
<u>06080000.03</u> ^S	un River near Augusta, Montana	609	U	RRE wtd				0.0032	0.0036	0.0037	0.0044	0.0046	0.0013	0.0019	0.0028	0.0038	0.0056
<u>06080900.10</u> S	un River below diversion dam, near Augusta, Montana	610	R (MAJ-dam)	At-site	18	1964, 1968-1980, 2016-2019	YES	0.0033	0.0056	0.0067	0.0091	0.0090	0.0098	0.0129	0.0196	0.0306	0.0527
<u>06080900.11</u> S	un River below diversion dam, near Augusta, Montana	610	R (MAJ-dam)	MOVE3	86	1934-2019	YES	0.0013	0.0014	0.0014	0.0017	0.0023	0.0039	0.0060	0.0087	0.0123	0.0183
<u>06082200.10</u> S	un River below Willow Creek near Augusta, Montana	814	R (MAJ-dam)	At-site	16	1964, 1968-1975, 2013-2019	YES	0.0102	0.0099	0.0099	0.0097	0.0095	0.0100	0.0114	0.0140	0.0180	0.0256
<u>06082200.11</u> S	un River below Willow Creek near Augusta, Montana	814	R (MAJ-dam)	MOVE3	86	1934-2019	YES	0.0009	0.0010	0.0011	0.0016	0.0023	0.0041	0.0064	0.0097	0.0139	0.0212
<u>06085800.10</u> ^S	un River at Simms, Montana	1,296	R (MAJ-dam)	At-site	38	1964, 1966-1979, 1997-2019	YES	0.0040	0.0041	0.0042	0.0048	0.0055	0.0074	0.0098	0.0133	0.0181	0.0264
<u>06085800.11</u> S	un River at Simms, Montana	1,296	R (MAJ-dam)	MOVE3	86	1934-2019	YES	0.0014	0.0014	0.0015	0.0019	0.0025	0.0042	0.0063	0.0092	0.0128	0.0191
<u>06086000.00</u> S	un River at Fort Shaw, Montana	1,395	U	At-site	22	1906-1927	YES	0.0027	0.0029	0.0030	0.0040	0.0055	0.0088	0.0124	0.0170	0.0228	0.0321
<u>06086000.03</u> ^S	un River at Fort Shaw, Montana	1,395	U	RRE wtd				0.0027	0.0028	0.0029	0.0038	0.0050	0.0076	0.0104	0.0140	0.0185	0.0258
<u>06087900.00</u> ^M	Auddy Creek tributary near Power, Montana	3.81	U	At-site	16	1963-1978, 1986		0.0205	0.0179	0.0176	0.0201	0.0258	0.0377	0.0501	0.0656	0.0840	0.1131
<u>06087900.03</u> ^M	Auddy Creek tributary near Power, Montana	3.81	U	RRE wtd				0.0182	0.0154	0.0149	0.0152	0.0169	0.0208	0.0257	0.0322	0.0401	0.0538
<u>06089000.10</u> S	un River near Vaughn, Montana	1,774	R (MAJ-dam)	At-site	86	1934-2019	YES	0.0006	0.0009	0.0011	0.0017	0.0025	0.0052	0.0092	0.0153	0.0238	0.0390
<u>06102500.00</u> T	eton River below South Fork, near Choteau, Montana	110	U	At-site	30	1948-1954, 1964, 1998-2019	YES	0.0050	0.0097	0.0118	0.0173	0.0206	0.0323	0.0514	0.0821	0.1263	0.2080
<u>06102500.01</u> T	eton River below South Fork, near Choteau, Montana	110	U	MOVE3	72	1948-2019	YES	0.0026	0.0034	0.0037	0.0052	0.0082	0.0169	0.0281	0.0437	0.0641	0.0991
<u>06103000.00</u> T	eton River at Strabane, Montana	124	U	At-site	18	1908-1925	YES	0.0060	0.0117	0.0154	0.0304	0.0384	0.0513	0.0707	0.1037	0.1538	0.2509
<u>06103000.03</u> T	eton River at Strabane, Montana	124	U	RRE wtd				0.0059	0.0110	0.0141	0.0237	0.0270	0.0332	0.0428	0.0580	0.0786	0.1147
<u>06105800.00</u> B	Bruce Coulee tributary near Choteau, Montana	1.84	U	At-site	40	1963-2002		0.0057	0.0057	0.0058	0.0074	0.0104	0.0171	0.0243	0.0335	0.0448	0.0630
<u>06105800.03</u> ^B	Bruce Coulee tributary near Choteau, Montana	1.84	U	RRE wtd				0.0055	0.0054	0.0055	0.0066	0.0086	0.0126	0.0167	0.0220	0.0285	0.0394
<u>06106000.00</u> D	Deep Creek near Choteau, Montana	269	U	At-site	15	1911-1924, 1964	YES	0.0223	0.0242	0.0252	0.0298	0.0346	0.0444	0.0554	0.0703	0.0893	0.1215
<u>06106000.03</u> D	Deep Creek near Choteau, Montana	269	U	RRE wtd				0.0197	0.0200	0.0202	0.0203	0.0205	0.0231	0.0276	0.0341	0.0424	0.0573
<u>06106500.00</u> M	Juddy Creek near Bynum, Montana	72.1	U	At-site	10	1913-1918, 1920, 1922-1924	YES	0.0588	0.0560	0.0565	0.0689	0.0906	0.1337	0.1776	0.2315	0.2956	0.3964
<u>06106500.03</u> ^M	Juddy Creek near Bynum, Montana	72.1	U	RRE wtd				0.0442	0.0382	0.0368	0.0338	0.0334	0.0368	0.0437	0.0536	0.0662	0.0887
<u>06107000.00</u> N	lorth Fork Muddy Creek near Bynum, Montana	55.8	U	At-site	11	1913-1917, 1919-1924	YES	0.0323	0.0308	0.0312	0.0384	0.0505	0.0743	0.0984	0.1279	0.1629	0.2177
<u>06107000.03</u> N	North Fork Muddy Creek near Bynum, Montana	55.8	U	RRE wtd				0.0271	0.0242	0.0238	0.0237	0.0248	0.0286	0.0344	0.0425	0.0526	0.0706
<u>06108000.00</u> T	eton River near Dutton, Montana	1,238	U	At-site	65	1955-2019	YES	0.0052	0.0059	0.0062	0.0081	0.0119	0.0215	0.0331	0.0488	0.0688	0.1022
<u>06108000.01</u> ^T	eton River near Dutton, Montana	1,238	U	MOVE3	72	1948-2019	YES	0.0046	0.0051	0.0054	0.0071	0.0106	0.0196	0.0304	0.0448	0.0632	0.0938
<u>06108200.00</u> K	Cinley Coulee near Dutton, Montana	14.4	U	At-site	16	1963-1978			0.1048	0.0959	0.1116	0.1645	0.2658	0.3620	0.4743	0.6024	0.7964
<u>06108200.03</u> K	Cinley Coulee near Dutton, Montana	14.4	U	RRE wtd					0.0540	0.0484	0.0397	0.0376	0.0398	0.0463	0.0561	0.0688	0.0917
<u>06108300.00</u> K	Cinley Coulee tributary near Dutton, Montana	2.96	U	At-site	16	1963-1978		0.0769	0.0681	0.0687	0.0905	0.1259	0.1930	0.2601	0.3424	0.4406	0.5958
<u>06108300.03</u> K	Linley Coulee tributary near Dutton, Montana	2.96	U	RRE wtd				0.0526	0.0424	0.0405	0.0368	0.0353	0.0377	0.0440	0.0536	0.0658	0.0880
<u>06108800.00</u> T	eton River at Loma, Montana	1,900	U	At-site	26	1929-1932, 1998-2019	YES	0.0180	0.0187	0.0193	0.0229	0.0282	0.0398	0.0528	0.0700	0.0916	0.1274
<u>06108800.03</u> T	eton River at Loma, Montana	1,900	U	RRE wtd				0.0164	0.0162	0.0164	0.0172	0.0188	0.0232	0.0289	0.0367	0.0465	0.0634

Streamgage identification number and analysis designation

Streamgage name

Type of peak- Number of peak Contributing Regulation status for 2 flow frequency flows used in the drainage area, in analysis² square miles analysis³ analysis

Water years of peak flows used in the analysis

Frequency analysis incorporates historical information? (if Yes, see Table 1-5 for additional 42.9 66.7 50 information)

¹The streamgage identification number and analysis designation is defined by XXXXXXAB, where. XXXXXXXX is the streamgage identification number;

A is the regulation status for the analysis period; and B is the type of peak-flow frequency analysis.

Values of A (regulation status) are defined as:

A = 0, unregulated;

A = 0, the guarded, A = 1, regulated by major regulation; and A = 2, total; that is, the combined unregulated and regulated peak-flow records for streamgages with peak-flow records before and after the start of regulation (see footnote 2).

Values of B (type of peak-flow frequency analysis) are defined as:

B = 0, at-site peak-flow frequency analysis conducted on recorded data;

B = 1, peak-flow frequency analysis conducted on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure;

B = 2, peak-flow frequency analysis determined from regional regression equations (RREs); RRE frequency results not presented in this report; and

B = 3, at-site peak-flow frequency analysis weighted with results from RREs; distributional parameters not available for RRE weighted frequency analyses.

²Abbreviations for regulation status are defined as follows:

U, unregulated, where the cumulative drainage area upstream from all dams is less than 20 percent of the drainage area of the streamgage.

R (MAJ-dam): major dam regulation, where a single upstream dam has a drainage area that exceeds 20 percent of the drainage area of the streamgage.

R (MAI-canal): major diversion canal regulation, where a large diversion canal is known to be located on the channel upstream from the streamgage. R (MIN-dams): minor dam regulation, where the cumulative drainage area of all upstream dams exceeds 20 percent of the drainage area of the streamgage. Total: the combined unregulated peak-flow records for streamgages with peak-flow records before and after the start of regulation, . The "Total" peak-flow frequency analysis is provided in cases where major regulation affects less than 50 percent of the drainage area of the streamgage and there is uncertainty in the effects of regulation on specific peak-flow characteristics. Also, the "Total" peak-flow frequency analysis is the

only peak-flow frequency analysis provided in cases of minor dam regulation.

³Abbreviations for type of frequency analysis are defined as follows: At-site: peak-flow frequency analysis on recorded data.

RRE wtd: the at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

MOVE.3: peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure.

Variance, in base 10 logarithm, for indicated annual exceedance probability, in percent	

20	10	4	2	1	0.5	0.2

te: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various sim sistency among the various similarly structured frequ nce and to maintain or nalysis worksheets. Also, not all table columns are applicable for each frequ ng the Even if a table column is milarly structu

06078500 North Fork Sun River near Augusta, Montana

Analysis for unregulated period of record

Analysis pe

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	Analysis pe	riod of record,	water years: 1	905 - 2019		
At-s	site peak-flow f	requency anal	sis conducted	on recorded d	ata	
Table 1-2	Table 1-3	Table 1-4	Table 1-5	Table 1-6	Table 1-7	Table 1-8
October 1 throug	nh September 30 a	nd is designated b	y the year in which	it ends. PILF; pote	ntially influential lo	w flow; MGBT, mu

06078500 North Fork Sun River near Augusta, Montana Analysis for unregulated period of record

Analysis period of record, water years: 1905 - 2019

Gage height, in feet

15.82

8.71 7.03

6.77

 $\begin{array}{c} 6.73\\ 8.24\\ 6.44\\ 6.48\\ 6.49\\ 6.28\\ 6.07\\ 5.90\\ 6.31\\ 6.00\\ 5.92\\ 5.88\\ 5.61\\ 5.71\\ 5.58\\ 5.61\\ 5.71\\ 5.53\\ 5.63\\ 5.63\\ 5.63\\ 5.61\\ 7.497\\ 4.97\\ \end{array}$

--7.18

--5.11 6.72 4.57 4.56 3.57 6.15 5.86

Peak-flow

designation

in analysis7

Peak flow qualification

codes⁶

At-site peak-flow frequency analysis conducted on recorded data

PILF

[Water year is test; -- not app month period fro or not available] Water year is the 12-month period from October 1 through September 30 and is design which it ends; -, not applicable or not available.] Peak-flow data4 Ranked (largest to smallest) peak-flow data⁴ Number of Contributing drainage area, in square miles PILF Type of PILF threshold, in threshold¹ cubic feet per second Type of peakrecorded peak flows used in the Gage height, in feet Skew type Peak flow, in cubic feet per Peak flow qualification Peak-flow Peak flow, in cubic feet per flow Water Water used in analysis Date⁵ designation in analysis⁷ Date⁵ frequency year year second codes⁶ second analysis analysis 6/8/1964 1911 6/3/1911 2,390 1964 51,100 PILF ... ---259 Statio FIXED 2.720 At-site 1912 1946 1947 1948 1949 1950 1951 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1967 1968 1999 1990 1991 1992 2009 2014 2009 2014 2017 2018 5/20/1912 2,280 2,190 PILF PILF 5/19/1991 6,620 4,840 38 5/28/1946 Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent 50 42.9 20 10 4 2 1.0 0.5 6/3/1948 0.2 66.7 6.28 7.03 5.33 6.00 5.88 5.11 6.44 6.77 5.58 6.73 5.92 5.61 6.48 5.63 6.07 5.71 4.56 5/9/1947 3,520 5/20/1954 4,580 4,170 4,120 3,990 3,920 3,520 3,400 3,370 3,370 3,370 3,370 3,3100 2,950 2,920 2,920 2,830 2,830 69,400 8,390 21,200 35,000 2,840 2,900 3,600 4,950 6/3/1948 5/15/1949 6/5/1950 6/5/1950 5/15/1952 6/3/1953 5/20/1954 5/21/1955 5/21/1955 6/10/1958 6/15/1959 6/4/1960 5/27/1961 5/25/1962 6/8/1964 6/11/1965 4,840 2,720 3,340 3,170 2,140 3,990 4,580 2,900 4,170 3,330 2,830 3,960 2,660 3,400 2,830 1,680 51,100 3,370 2,810 6/2/1956 5/8/2018 6/3/1953 5/23/2008 5/9/1947 5/27/1961 6/11/1965 5/31/1967 6/5/1950 5/21/1957 6/16/1951 11/11/1989 5/11/1989 Upper and 90-pe et per secc in percer als, in cub ercent 0.2 302,000 42.9 20 4,610 61,200 66.7 16,300 31,600 120,000 3,220 3,190 PILF 1,810 1,930 3,350 4,260 6,330 8,780 12,300 17,300 27,400 1,000,0 PILF 100,000 5/21/1955 6/10/1958 5/25/1962 PILF 4.56 15.82 5.90 5.50 6.31 5.17 5/29/1966 5/29/1966 2,810 5/31/1967 6/3/1968 3,370 2,600 5/15/1949 2,720 2,660 PILF 6/4/1960 10,0 5/11/1989 2,950 5.48 6/3/1968 2,600 5.64 8.71 3.57 11/11/1989 5/19/1991 4/30/1992 3,100 6,620 1,470 5/24/2014 6/3/1911 5/6/2017 2,470 2,390 2,380 2,280 2,190 2,140 2,140 2,140 1,680 1,470 1,380 1,160 PILF 4/30/1992 5/15/1993 5/23/2008 5/31/2009 5/24/2014 3/16/2015 5/9/2016 5/6/2017 5/8/2018 5/26/2019 5/8/2017 5/20/1912 5/28/1946 5/15/1952 5/26/2019 5/31/2009 6/5/1963 4/30/1992 3/16/2015 5/9/2016 2,920 3,920 2,110 2,470 1,380 1,160 2,380 4,120 2,140 5.13 6.49 4.57 6.15 5.86 7.18 8.24 6.72 PILF PILF PILF PILF PILF 1.000 75 60 40 20 10

tiple Grubbs-Beck



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown. skew; 66.7 p



Figure 2. Annual peak flows and perception thresholds.

Table 1-1

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nual

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXELY FILE Intreshold based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

¹Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was identified as a potentially influential low flow;
 PLF: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References

England, J.F., Jr., Ochn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Builetin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/mr485.

p., mus./uur.org/10.3133/m485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018) : U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

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06078500 North Fork Sun River near Augusta, Monta
Analysis for unregulated period of record

2019 ression equations

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 000/2000 Horder Fork Sum River frear Augusta, Montal

 Analysis for unregulated period of record
 Analysis period of record

 Analysis period of record, water years: 1905 - 2019
 Analysis period of record, water years: 1905 - 201

 Al-site peak flow frequency analysis weighted with regional regression equations
 At-site peak flow frequency analysis weighted with regional regression equations

 Table 1-1
 Table 1-2
 Table 1-3
 Table 1-5
 Table 1-7
 Table 1-8

 [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; ---, not applicable or not available]
 [Water years is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; ---, not applicable or not available]
 [Water years is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; ---, not applicable or not available]

· ·····)	-
Analysis period of record, water years: 1905 -	20
At site peak flow from oney enclusis weighted with regional	00

	Number of											Peak-flo	ow data⁴				Rank	ed (largest to sma	allest) peak-flow d	ata ⁴	
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PIL threshold ¹	PILF F threshold, in cubic feet pe second	n er		flow flow frequency analysis ²	K-		Water year	Date⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis
	,									1911	6/3/1911	2,390			PILF	1964	6/8/1964	51,100		15.82	
259			FIXED	2,720			RRE wtd			1912	5/20/1912	2,280			PILF	1991	5/19/1991	6,620		8.71	
	Peak flow	w, in cubic fee	t per second,	for indicated a	nnual exceeda	ance probability	(bold values),	in percent		1946	5/28/1946	2,190			PILF	1948	6/3/1948	4,840		7.03	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1947	5/9/1947	3,520		6.28		1954	5/20/1954	4,580		6.77	
-	2,840	2,900	3,610	5,090	9,470	13,000	17,800	24,400	36,700	1948	6/3/1948	4,840		7.03		1956	6/2/1956	4,170		6.73	
Upper	and lower 90-p	percent confid	ence intervals	s, in cubic feet p	per second, fo	r indicated ann	ual exceedance	e probability, ir	percent	1949	5/15/1949	2,720		5.33		2018	5/8/2018	4,120		8.24	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1950	6/5/1950	3,340		6.00		1953	6/3/1953	3,990		6.44	
	3,190	3,220	4,580	6,910	10,600	15,000	21,100	29,600	46,500	1951	6/16/1951	3,170		5.88		1959	6/15/1959	3,960		6.48	
- "	1,860	1,980	3,360	4,410	8,500	11,400	15,200	20,100	29,100	1952	5/15/1952	2,140		5.11	PILF	2008	5/23/2008	3,920		6.49	
										1953	6/3/1953	3,990		6.44		1947	5/9/1947	3,520		6.28	
										1954	5/20/1954	4,580		6.77		1961	5/27/1961	3,400		6.07	
100,000									_	1955	5/21/1955	2,900		5.58		1965	6/11/1965	3,370		5.90	
5									1	1956	6/2/1956	4,170		6.73		1967	5/31/1967	3,370		6.31	
_										1957	5/21/1957	3,330		5.92		1950	6/5/1950	3,340		6.00	
2										1958	6/10/1958	2,830		5.61		1957	5/21/1957	3,330		5.92	
8									• ,	1959	6/15/1959	3,960		6.48		1951	6/16/1951	3,170		5.88	
S -										1960	6/4/1960	2,660		5.63	PILF	1990	11/11/1989	3,100		5.64	
e										1961	5/27/1961	3,400		6.07		1989	5/11/1989	2,950		5.48	
d L										1962	5/25/1962	2,830		5.71		1993	5/15/1993	2,920		5.13	
60										1963	6/5/1963	1,680		4.56	PILF	1955	5/21/1955	2,900		5.58	
5										1964	6/8/1964	51,100		15.82		1958	6/10/1958	2,830		5.61	
id i										1965	6/11/1965	3,370		5.90		1962	5/25/1962	2,830		5.71	
5										1966	5/29/1966	2,810		5.50		1966	5/29/1966	2,810		5.50	
·= 10.000									_	1967	5/31/1967	3,370		6.31		1949	5/15/1949	2,720		5.33	
9									1	1968	6/3/1968	2,600		5.17	PILF	1960	6/4/1960	2,660		5.63	PILF
arc										1989	5/11/1989	2,950		5.48		1968	6/3/1968	2,600		5.17	PILF
- 5									-	1990	11/11/1989	3.100		5.64		2014	5/24/2014	2.470		4.97	PILF
<u>s</u> –							// •		-	1991	5/19/1991	6.620		8.71		1911	6/3/1911	2,390			PILF
¥ -									-	1992	4/30/1992	1.470		3.57	PILF	2017	5/6/2017	2.380		7.18	PILF
ea										1993	5/15/1993	2,920		5.13		1912	5/20/1912	2,280			PILE
<u>e</u> -				- 00	and the second s					2008	5/23/2008	3,920		6.49		1946	5/28/1946	2,190			PILF
ua			0.000	000000						2009	5/31/2009	2,110		4.57	PII F	1952	5/15/1952	2,140		5.11	PILE
F -			0000	•					-	2005	5/24/2014	2,110		4 97	PILE	2019	5/26/2019	2 140		6.72	PILE
₹		~	0							2014	3/16/2015	1,380		6.15	PILE	2009	5/31/2009	2,110		4.57	PILE
		0								2016	5/9/2016	1 160		5.86	PILE	1963	6/5/1963	1,680		4.56	PILE
4 000		0								2010	5/6/2017	2 380		7 18	DILE	1905	4/30/1992	1,300		3.57	DILE
1,000 -									-	2017	5/8/2017	4 120		8.24	1161	2015	3/16/2015	1 380		6 15	DILE
	00.5 05	0.5	90	75 60	40	20	10 E	1	0.2	2018	5/0/2018	2,140		6 72	DILE	2015	5/10/2015 E/0/2016	1,300		5.15	DUE
	<i>55.5</i> 90	Stati	Ann on - 06078	ual exceedar 500.03 North	ice probabil Fork Sun Ri	ity, in percen ver near Aug	t usta. Montan	a	¥.2	2013	5/20/2019	2,140		0.72	THEF	2010	3/3/2010	1,100	-	5.00	1 ILF

- Confidence limits ---- Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF Explanation:

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-alte: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE:3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

⁵Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is ⁸available at the NWIS website: <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u> ⁷Definitions of peak-flow designations used in analysis include: Histori: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was odlentified of the manalysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Note: Not all foctinoles are applicable for a given frequency analysis. Even if a foctinole is not applicable for a given frequency analysis, it is retained in the worksheed for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for a given frequency analysis. Even if a table column is not applicable for a given frequency analysis, it is retained in the worksheed for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for a given frequency analysis. Even if a table columns is not applicable for a given frequency analysis. Kontana Constrained on the worksheed for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis conducted on record of concord Constrained on the structured frequency analysis period of record water years: 1905 - 2019 Analysis period of record water years: 1905 - 2019 Analysis period of record data At-site peak-dow frequency analysis conducted on recorded data At-site

	Number of											Peak-fit	ow data '				Ranke	ed (largest to sma	illest) peak-flow d	ata	
Contributing drainage area, in square miles	recorded peak flows used in the	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			Type of peal flow frequency analysis ²	K-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	anaryono									1911	6/3/1911	2,740	1			1964	6/8/1964	28,800	7	-	Historic
251	11	Weighted	MGBT				At-site			1912	5/20/1912	2,350	1			2018	6/19/2018	6,330		7.34	
	Peak flow	r, in cubic feet	per second, fo	or indicated and	nual exceedar	nce probability	(bold values),	in percent		1964	6/8/1964	28,800	7		Historic	2008	5/19/2008	4,370		6.35	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	2008	5/19/2008	4,370		6.35		2009	6/1/2009	3,550		5.81	
2,460	3,240	3,640	5,830	8,180	12,000	15,600	19,900	25,100	33,500	2009	6/1/2009	3,550		5.81		2014	5/24/2014	3,380		5.69	
Upper a	and lower 90-pe	ercent confide	nce intervals, i	n cubic feet pe	r second, for	indicated annu	ual exceedance	e probability, i	n percent	2014	5/24/2014	3,380		5.69		2017	6/2/2017	3,000		5.36	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	2015	6/2/2015	1,810		4.36		2019	5/27/2019	2,870		5.26	
3,600	4,770	5,390	8,740	12,400	19,000	26,000	35,900	49,900	78,100	2016	5/9/2016	1,710		4.25		1911	6/3/1911	2,740	1		
1,720	2,260	2,540	3,920	5,280	7,310	9,070	11,100	13,300	16,800	2017	6/2/2017	3,000		5.36		1912	5/20/1912	2,350	1		
										2018	6/19/2018	6,330		7.34		2015	6/2/2015	1,810		4.36	
100 000										2019	5/27/2019	2,870		5.26		2016	5/9/2016	1,710		4.25	



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew, PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 65.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PLF thresholds include:
¹MGB1* PLF threshold based on a systematic peak flow relected by the peak-flow frequency nanyet.
²Definitions of types of PLF threshold based on a systematic peak flow relected by the peak-flow frequency nanyet.
²Definitions of types of peak-fow frequency analysis include:
³MOVES: Peak-flow frequency analysis and encoded and synthesized data: synthesized data from Maintenance of Variance Extension
Type III (MVCE): proceed sension procedure,
³REE data: The at-let peak-flow frequency analysis are completed with results from regional regression equations (RREs) from Sando and others
(2018).
³Fload-frequency results not reported because of too many values less than the PLF threshold used in the at-late analysis.
⁴Fload-dow data in value of zone are not plotted in fload and a peak flow, the month, day, or both are unknown.
⁴Fload-dow data in value of zone are not plotted in fload and a systematic value is interpreted. A list of codes and definitions is
waitable at the NVW website:
¹Tool-fload data (equine) results in the systematic record and is included in the analysis.
¹Tool-fload data (equine) results on cleaded from the systematic record and is included in the analysis.
¹Tool-fload data (equine) from data (equine) from data (equine) results on the repose is streamflow value is the interpreted.
¹Tool-fload data (equine) results on the repose is streamflow value is the interpreted.
¹Tool-fload data (equine) results in the result is included:
¹Tool-fload data (equine) results on the repose is streamflow value is the interpreted because of too many values is the result of the systematic record and was of insufficient magnitude to date interpreted from the analysis include:
¹Tool-fload data (equine) results include:

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	Number of											Peak-flo	ow data ⁴				Ranke	ed (largest to sma	illest) peak-flow of	jata	
Contributing drainage area, in square miles	recorded peak flows used in the	Skew type used in analysis	Type of PILF threshold ¹	PILF F threshold, in cubic feet per second			Type of pea flow frequency analysis ²	ik-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	unuiyoio									1911	6/3/1911	2,740	1	-		1964	6/8/1964	28,800	7	-	Historic
251			MGBT				RRE wtd			1912	5/20/1912	2,350	1			2018	6/19/2018	6,330	-	7.34	
	Peak flow	in cubic fee	t per second, f	for indicated an	nual exceed	ance probabilit	/ (bold values	, in percent		1964	6/8/1964	28,800	/		Historic	2008	5/19/2008	4,370		6.35	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	2008	5/19/2008	4,370		6.35		2009	6/1/2009	3,550	-	5.81	
2,460	3,210	3,590	5,530	7,310	9,480	12,900	17,500	23,500	34,700	2009	6/1/2009	3,550		5.81		2014	5/24/2014	3,380		5.69	
Upper a	nd lower 90-pe	ercent confide	ence intervals,	in cubic feet pe	er second, fo	r indicated ann	ual exceedan	ce probability	, in percent	2014	5/24/2014	3,380	-	5.69		2017	6/2/2017	3,000		5.36	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	2015	6/2/2015	1,810		4.36		2019	5/27/2019	2,870	-	5.26	
3,550	4,640	5,190	7,930	10,200	10,600	14,800	20,500	28,400	43,600	2016	5/9/2016	1,710	-	4.25		1911	6/3/1911	2,740	1		
1,730	2,270	2,540	3,870	5,200	8,480	11,300	14,800	19,500	27,700	2017	6/2/2017	3,000	-	5.36		1912	5/20/1912	2,350	1		
										2018	6/19/2018	6,330		7.34		2015	6/2/2015	1,810		4.36	
- 000,000 										2019	5/27/2019	2,870	-	5.26		2016	5/9/2016	1,710	-	4.25	



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew, PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 56 prevent or less are shown.

Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Quibbs-Beck Test as specified in Bulletin 17C (England and others, 2019); MGBT: PILF threshold calculated by using the multiple Quibbs-Beck Test as specified in Bulletin 17C (England and others, 2019); Pilentitors of type of pash-flow tegenary analysis include: Ar-site: Peak-flow frequency analysis concented data; MOVE3: Peak-flow frequency analysis concented and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3): Pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active piece piece flow frequency analysis was weighted with results from transformations from Sando and other REV ext. The active piece flow active piece piec

nRF wit. The at-side peak-flow frequency analysis was weighted with results from regional regression equations (HREs) from Sanoo and unuer (2016). "Rood-frequency results not reported because of too many values less than the PLF threshold used in the at-life analysis. "Rood-frequency results not reported because of too many values less than the PLF threshold used in the at-life analysis. "Backford and and a value of zero are not plotted in figures "In cases where the month, day, or both are not plotted in figures "In cases where the month, day, or both are not plotted in figures "In cases where the month, day, or both are not plotted in figures "In cases where the month, day, or both are not plotted in figures "Dualification continuon" (PLC and PLC) "Dualification continuon" (PLC) "Dualification context of the systematic record and is included in the analysis; Opportunist: "The peak flow was identified as a plottalish influential low flow; (PLF): The peak flow was identified as a plottalish influential low flow; (PLF): The peak flow was identified as a plottalish influential low flow; Synthesized. The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Anderences: England, J.F. Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Velleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guide and Comparison of the strain of the strai

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Date⁵

Peak-flow data

Peak flow, in cubic feet per second codes⁶

Water year

Ranked (largest to smallest) peak-flow d

Peak flow qualification codes⁶

2,Bd Bd --

Peak-flow designation in analysis⁷

Gage height, in feet

2.45 2.28 1.16 0.93 0.85 0.78 0.78 0.71 0.51 0.37 1.16 0.42 0.41 0.78

Peak flow, in cubic feet per second

Date⁵

er 30 and is designated by the year in which it ends; --, not applicable or not available.

Peak-flow designation in analysis⁷



0/0/1939	110		0.70	1504	0/0/1904	4,300
5/12/1960	458		2.28	1962	5/26/1962	496
5/7/1961	55		0.37	1960	5/12/1960	458
5/26/1962	496		2.45	1967	5/30/1967	300
5/25/1963	122		0.85	1970	5/11/1970	215
6/8/1964	4,360		-	1963	5/25/1963	122
6/11/1965	75		0.71	1959	6/6/1959	110
5/29/1966	40		0.41	1972	5/15/1972	76
5/30/1967	300		1.16	1965	6/11/1965	75
	50	2,Bd	1.16	1971	6/3/1971	75
	42	Bd	0.42	1961	5/7/1961	55
5/11/1970	215		0.93	1968		50
6/3/1971	75		0.51	1969		42
5/15/1972	76		0.48	1966	5/29/1966	40
3/17/1973	40		0.78	1973	3/17/1973	40

Gage height, in feet

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew, PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 6.7 percent or less are show.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PLIF thresholds include: MGB1: PLIF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FXED: PLIF threshold based on a systematic pask flow selected by the peak-flow frequency analyst: "Definitions of types of peak-low trequency analysis include: MOVES: Peak-low frequency marks on combined necoded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MVCE): proord sension procedure, RRE wit: The at-site peak-flow trequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ¹Flood-frequency results not reported because of too many values less than the PLF threshold used in the at-ale analysis. ¹Flood-frequency results not reported because of too many values less than the PLF threshold used in the at-ale analysis. ¹Flood-frequency results not reported because of too many values less than the PLF threshold used in the at-ale analysis. ¹Flood-frequency results not reported because of too many values less than the PLF threshold used in the at-ale analysis. ¹Flood-frequency results not reported because of too many values less than the PLF threshold used in the at-ale analysis. ¹Flood-frequency results not reported because of too many values less than the PLF. Threshold to report. ¹Countification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is wallable at the NVM website. ¹Too flood the special conditions that may affect how the peak streamflow value is interpreted. A list of codes and final filter the peak flow was synthesized using filter the systematic record and was of insufficient magnitude to PUF. The peak flow was synthesized using Maintenance of Variance Extension. ¹Too filter the peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Note: Not all bothones are applicable for each frequency analysis. Even if a bothone is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis. The retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis. The retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each for each for a given frequency-analysis worksheets. Also, not all table columns are applicable for each for each for each for each for a given frequency analysis worksheets. Also, not all table columns are applicable for each fo

	Number of											Peak-flo	w data4				Ranke	ed (largest to sma	llest) peak-flow o	iata ^f	
Contributing drainage area in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of P threshole	PILF ILF threshold d ¹ cubic fe per seco	, in et nd		Type of pe flow frequency analysis ²	ak- /		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
20.0	,		MODT				005			1959	6/6/1959	110		0.78		1964	6/8/1964	4,360	-		
20.8	Book flow	in cubic foo	MGB1		appual avood	anco probabili	RRE WID) in percent		1960	5/12/1960	458	-	2.28		1962	5/26/1962	496	-	2.45	
66.7	50 Feak IIOw	42.9	20	10 100	4	2 anice probabili	1.0	0.5	0.2	1962	5/26/1962	496	-	2 45		1967	5/30/1967	300	-	1 16	
77	126	156	365	678	1 350	2 030	3 020	4 480	7 460	1963	5/25/1963	122		0.85		1970	5/11/1970	215		0.93	
Upper a	and lower 90-pe	ercent confide	ence interva	Is, in cubic fee	t per second, fo	r indicated an	nual exceedan	ce probability,	in percent	1964	6/8/1964	4,360				1963	5/25/1963	122		0.85	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1965	6/11/1965	75		0.71		1959	6/6/1959	110		0.78	
126	206	255	588	1,020	1,590	2,470	3,820	5,900	10,400	1966	5/29/1966	40		0.41		1972	5/15/1972	76		0.48	
48	79	98	230	448	1,150	1,670	2,390	3,410	5,390	1967	5/30/1967	300		1.16		1965	6/11/1965	75		0.71	
										1968		50	2,Bd	1.16		1971	6/3/1971	75		0.51	
										1969		42	Bd	0.42		1961	5/7/1961	55	-	0.37	
100,000 -										1970	5/11/1970	215	-	0.93		1968		50	2,Bd	1.16	
										1971	6/3/1971	75	-	0.51		1969		42	ва	0.42	
										1972	5/15/19/2	76	-	0.48		1966	5/29/1966	40		0.41	
discharge in cubic feet per sect 00001							1														
Yeo Innuny	99.5 9 Explanati	8 95 Station on: — Con	90 A - 0607960	75 nnual exceed	i0 40 dance probat Creek at Gib	20 bility, in perc son Dam, ne Gaged Peak Guive EMA 6	10 5 ent ar Augusta, I uscharge A	1 Montana Historic Peak	0.2 0.2 Skew(G)												
analysis skew,	PILF(LO), Pot	entially Influe	ntial Low Fl	ow (low outlie). For regional	regression wei	ghted analyse	s, only annual	exceedance												

Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Quibbs-Beck Test as specified in Bulletin 17C (England and others, 2019); MGBT: PILF threshold calculated by using the multiple Quibbs-Beck Test as specified in Bulletin 17C (England and others, 2019); Pilentitors of type of pash-flow tegenary analysis include: Ar-site: Peak-flow frequency analysis concented data; MOVE3: Peak-flow frequency analysis concented and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3): Pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active pieak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and other REV ext. The active piece piece flow frequency analysis was weighted with results from transformations from Sando and other REV ext. The active piece flow active piece piec

nRF wit. The at-side peak-flow frequency analysis was weighted with results from regional regression equations (HREs) from Sanoo and unuer (2016). "Rood-frequency results not reported because of too many values less than the PLF threshold used in the at-life analysis. "Rood-frequency results not reported because of too many values less than the PLF threshold used in the at-life analysis. "Backford and and a value of zero are not plotted in figures "In cases where the month, day, or both are not plotted in figures "In cases where the month, day, or both are not plotted in figures "In cases where the month, day, or both are not plotted in figures "In cases where the month, day, or both are not plotted in figures "Dualification continuon" (PLC and PLC) "Dualification continuon" (PLC) "Dualification context of the systematic record and is included in the analysis; Opportunist: "The peak flow was identified as a plottalish influential low flow; (PLF): The peak flow was identified as a plottalish influential low flow; (PLF): The peak flow was identified as a plottalish influential low flow; Synthesized. The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

06080000 Sun River near Augusta, Montana 06080000 Sun River near Augusta, Montana

Analysis for unregulated period of record

		-	-						
	Analysis	period	of record,	water	years:	1890 -	2019		
14			and an end of the second se			d	be a la se de set	- 4 - 4 -	

Analysis for unregulated period of record Analysis period of record, water years: 1890 - 2019 At-site peak-flow frequency analysis conducted on recorder

Peak-flow

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Gage

Peak flow

Peak-flow data4

Peak flow in

orded data

Ranked (largest to smallest) peak-flow data⁴

Peak flow

Gage

Peak-flow

Peak flow in

At-site peak-flow frequency analysis conducted on recorded data

 Table 1-1
 Table 1-2
 Table 1-3
 Table 1-4
 Table 1-5
 Table 1-6
 Table 1-7
 Table 1-8

 [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PLEF; potentially influential low flow; MGBT, multiple Grubbs-Beck
 Table 1-6
 Table 1-7
 Table 1-8

Contributing drainage area, in square miles	Number of recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			Type of pea flow frequency analysis ²	ık-		W y
609	27	Weighted	MGBT				At-site			- 19
	Peak flov	w, in cubic fee	t per second, fo	or indicated ann	ual exceeda	ance probability	(bold values),	in percent		19
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	- 19
5,200	6,860	7,740	12,600	17,900	26,800	35,400	45,900	58,700	80,200	- 19
Upper a	and lower 90-p	percent confid	ence intervals, i	in cubic feet pe	r second, fo	r indicated anni	ual exceedanc	e probability, in	percent	19
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	- 19
6,560	8,740	9,910	16,500	24,200	38,600	54,900	78,400	112,000	182,000	19
4,180	5,450	6,110	9,680	13,400	19,000	23,900	29,500	35,800	45,400	19
										19



ear	Date⁵	cubic feet per second	qualification codes ⁶	height, in feet	designation in analysis ⁷	vvater year	Date ⁵	cubic feet per second	qualification codes ⁶	height, in feet	designatio
890	5/9/1890	4,080				1964	6/9/1964	59,700	7	15.70	Historic
905	6/6/1905	4,070				1916	6/21/1916	32,300		11.40	
906	6/5/1906	2,320				1908	6/7/1908	20,000			
907	6/2/1907	6,530				1917	5/25/1917	18,700		8.20	
908	6/7/1908	20,000				1918	6/10/1918	11,900		6.02	
909	6/3/1909	7,030				1927	6/9/1927	11,400		5.95	
910	5/8/1910	5,040				1928	5/23/1928	10,700		5.60	
911	6/15/1911	5,690				1913	5/24/1913	9,830			
912	5/21/1912	5,670				1925	5/20/1925	7,920		4.60	
913	5/24/1913	9,830				1922	6/5/1922	7,350		4.40	
914	5/17/1914	4,570				1921	5/26/1921	7,280		4.40	
915	5/1/1915	3,850				1924	5/15/1924	7,150		4.40	
916	6/21/1916	32,300		11.40		1909	6/3/1909	7,030			
917	5/25/1917	18,700		8.20		1907	6/2/1907	6,530			
918	6/10/1918	11,900		6.02		1920	6/15/1920	6,130		3.90	
919	5/28/1919	4,670		3.40		1911	6/15/1911	5,690			
920	6/15/1920	6,130		3.90		1912	5/21/1912	5,670			
921	5/26/1921	7,280		4.40		1929	5/24/1929	5,290		3.60	
922	6/5/1922	7,350		4.40		1923	6/12/1923	5,250		3.60	
923	6/12/1923	5,250		3.60		1910	5/8/1910	5,040			
924	5/15/1924	7,150		4.40		1919	5/28/1919	4,670		3.40	
925	5/20/1925	7,920		4.60		1914	5/17/1914	4,570			
926	4/30/1926	3,540		2.80		1890	5/9/1890	4,080			
927	6/9/1927	11,400		5.95		1905	6/6/1905	4,070			
928	5/23/1928	10,700		5.60		1915	5/1/1915	3,850			
929	5/24/1929	5,290		3.60		1926	4/30/1926	3,540		2.80	
964	6/9/1964	59,700	7	15.70	Historic	1906	6/5/1906	2,320			

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: https://nwis.waterdata.usps.gov/nwis/peak?help

⁷Definitions of peak-flow designations used in analysis include: Historic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; PILF: The peak flow was identified as a potentially influential low flow; Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

06080000 Sun River near Augusta, Montana

Analysis for unregulated period of record

Analysis period of record, water years: 1890 - 2019	
- I. Constant for a second	

90 75 60 40 20 10 5 Annual exceedance probability, in percent Station - 06080000.03 Sun River near Augusta, Montana

Explanation: - Confidence limits - Fitted Frequency Curve • Gaged Peak Discharge 🔺 Historic Peak O PILF Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

06080000 Sun River near Augusta, Montana	
Analysis for unregulated period of record	

Analysis period of record, water years: 1890 - 2019 At-site peak flow frequency analysis weighted with regional regression equations

At-site peak flow frequency analysis weighted with regional regression equations Table 1-1 Table 1-8

[Water year is the	12-month period fro	m October 1 thro	ugh September 3	0 and is designate	d by the year in w	hich it ends. PILF;	potentially influenti	al low flow; MGBT	, multiple Grubbs-Beck												
test; not applicat	ble or not available]									[Water year is the	12-month period from	October 1 through Se Peak-fle	ptember 30 and is dee ow data ⁴	signated by the ye	ear in which it ends;, not ap	oplicable or not avail	able.] Rank	ed (largest to sma	allest) peak-flow o	lata ⁴	
Contributing drainage area, in square miles	recorded peak flows used in the	Skew type used in analysis	Type of PIL threshold ¹	PILF F threshold, i cubic feet p second	in er		Type of pea flow frequency analysis ²	ak-		Water year	Date⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	anarysis						-			1890	5/9/1890	4,080				1964	6/9/1964	59,700	7	15.70	Historic
609			MGBT				RRE wtd			1905	6/6/1905	4,070				1916	6/21/1916	32,300		11.40	
	Peak flo	w, in cubic fee	et per second,	for indicated a	innual exceed	ance probability	(bold values),	in percent		1906	6/5/1906	2,320				1908	6/7/1908	20,000			
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1907	6/2/1907	6,530				1917	5/25/1917	18,700		8.20	
5,200	6,840	7,700	12,200	16,500	19,600	26,000	34,100	44,600	63,300	1908	6/7/1908	20,000				1918	6/10/1918	11,900		6.02	
Upper	r and lower 90-	percent confic	lence intervals	s, in cubic feet	per second, fo	or indicated ann	ual exceedanc	e probability, ir	n percent	1909	6/3/1909	7,030				1927	6/9/1927	11,400		5.95	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1910	5/8/1910	5,040				1928	5/23/1928	10,700		5.60	
6,540	8,680	9,810	15,800	21,500	22,600	30,700	41,900	56,700	84,800	1911	6/15/1911	5,690				1913	5/24/1913	9,830			
4,190	5,460	6,110	9,530	12,800	17,100	22,000	28,000	35,500	48,200	1912	5/21/1912	5,670				1925	5/20/1925	7,920		4.60	
										1913	5/24/1913	9,830				1922	6/5/1922	7,350		4.40	
										1914	5/17/1914	4,570				1921	5/26/1921	7,280		4.40	
100,000 —										1915	5/1/1915	3,850				1924	5/15/1924	7,150		4.40	
									/ 1	1916	6/21/1916	32,300		11.40		1909	6/3/1909	7,030			
-										1917	5/25/1917	18,700		8.20		1907	6/2/1907	6,530			
Ę ī										1918	6/10/1918	11,900		6.02		1920	6/15/1920	6,130		3.90	
ő										1919	5/28/1919	4,670		3.40		1911	6/15/1911	5,690			
8 -										1920	6/15/1920	6,130		3.90		1912	5/21/1912	5,670			
- e							•	_///		1921	5/26/1921	7,280		4.40		1929	5/24/1929	5,290		3.60	
<u>5</u>							· ·			1922	6/5/1922	7,350		4.40		1923	6/12/1923	5,250		3.60	
e										1923	6/12/1923	5,250		3.60		1910	5/8/1910	5,040			
5									1	1924	5/15/1924	7,150		4.40		1919	5/28/1919	4,670		3.40	
- g										1925	5/20/1925	7,920		4.60		1914	5/17/1914	4,570			
5					/					1926	4/30/1926	3,540		2.80		1890	5/9/1890	4,080			
10,000 -										1927	6/9/1927	11,400		5.95		1905	6/6/1905	4,070			
- 6					///					1928	5/23/1928	10,700		5.60		1915	5/1/1915	3,850			
- S										1070	5/24/1020	5 200		3.60		1026	4/30/1926	3 540		2.80	

6/9/1964

1964

0.2

59,700

7

15.70 Historic

6/5/1906

2,320

1906

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

•

98 95

²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: https://nwis.waterdata.usgs.gov/nwis/peak?help

⁷Definitions of peak-flow designations used in analysis include: Historic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; PILF: The peak flow was identified as a potentially influential ow flow; Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Annual peak discharge, in cubic feet per second

1,000

99.5

06080900 Sun River below diversion dam, near Augusta, Montana 06080900 Sun River below diversion dam, near Augusta, Montana

0.2 76,000

Analysis for regulated period of record

Analysis period of record, water years: 1895 - 2019

r 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent 42.9 20 10 4 2 1.0 0.5 0.2 7,420 11,800 17,000 28,000 43,300 71,800 126,000 279,000

Type of peak-

At-site

flow frequency analysis

Analysis for regulated period of record

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on red orded data

At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> n October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MGBT, multiple Grubbs-Beck Table 1-1 r is the 12-[Water year is the 12-month period fro test; - not applicable or not available]

 Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent

 50
 42.9
 20
 10
 4
 2
 1.0
 0.5

 700
 5.220
 8.300
 12.100
 19.100
 26.600
 36.800
 50.500

Skew type used in analysis Type of PILF threshold¹ threshold¹ threshold¹ threshold¹ threshold¹ threshold¹ threshold

FIXED

_			Peak-flo	ow data*				Rank	ed (largest to sma	llest) peak-flow d	ata*	
	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
-	1964	6/9/1964	59,700	5,7		Historic	1964	6/9/1964	59,700	5,7		Historic
	1968	6/10/1968	2,620	5	7.59		1975	6/19/1975	32,000	5	19.00	
	1969	6/6/1969	3,630	5	8.04		2018	6/19/2018	10,500	5	11.96	
	1970	6/5/1970	7,350	5	10.01		1972	6/2/1972	8,910	2,5	11.35	
	1971	5/29/1971	7,820	5	10.78		1976	5/14/1976	8,470	5	11.11	
	1972	6/2/1972	8,910	2,5	11.35		1971	5/29/1971	7,820	5	10.78	
	1973	5/30/1973	562	5	5.14	PILF	1970	6/5/1970	7,350	5	10.01	
	1974	6/17/1974	7,210	5	10.08		1974	6/17/1974	7,210	5	10.08	
	1975	6/19/1975	32,000	5	19.00		1978	6/7/1978	6,330	5	9.96	
	1976	5/14/1976	8,470	5	11.11		1980	5/26/1980	5,430	5	9.36	
	1977	5/12/1977	536	5	4.92	PILF	1979	5/27/1979	5,380	5	9.38	
	1978	6/7/1978	6,330	5	9.96		2019	5/27/2019	5,070	5	9.06	
	1979	5/27/1979	5,380	5	9.38		2017	6/2/2017	3,840	5	8.30	
	1980	5/26/1980	5,430	5	9.36		1969	6/6/1969	3,630	5	8.04	
	2016	5/28/2016	1,110	5	5.74	PILF	1968	6/10/1968	2,620	5	7.59	
	2017	6/2/2017	3,840	5	8.30		2016	5/28/2016	1,110	5	5.74	PILF
	2018	6/19/2018	10,500	5	11.96		1973	5/30/1973	562	5	5.14	PILF
	2019	5/27/2019	5,070	5	9.06		1977	5/12/1977	536	5	4.92	PILF



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

Number of

recorded peak flows used in the

analysis

18

4,700

Station

Contributing drainage area, in square miles

610

Upper and lower 66.7 50 5,260 6,660

66.7 3,760

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include:

"Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on coorded data; MOVE3: Peak-flow frequency analysis on coorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: https://nwis.waterdata.usgs.gov/nwis/peak?help

⁷Definitions of peak-flow designations used in analysis include: Historic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; PILF: The peak flow was identified as a potentially influential low flow;

Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Referenc

e: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consiste in if a table column is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis alysis worksheets. Also, not all table columns are applicable for each freque

Date

Peak-flow data

Peak flow

qualification

codes⁶

Peak flow, in cubic feet per

second

10,500

4,100

4,350 1,640

10,700

3,110 1,520

612

7,260 9,800 3,600 4,350 5,620 7,000 13,900 3,960 8,180 5,690 3,760 17,700

7,300 4,940 7,140

8,020

8,580 6,650

4,340

4,820 7,470

2,010

59,700 6,520 3,570 11,500 2,620 3,630 7,350 7,820 8,910 562 7,210 32,000 8,470 536 6,330

5.380

5,430

13,300

5,500

3,050

2,410

2,960

4,360 3,060

742

4,940 4,290 6,720

1,200 4,210 3,220 5,120 4,700 7,180 3,390 3,960 2,290 909 5,090 3,200 1,510 3,410

5,940

2,010

7,540

3,800

2,650

14,500

6,080

2,310

2010

2011 2012

2013

6/9/1964

6/10/1968

6/10/1968 6/6/1969 6/5/1970 5/29/1971 6/2/1972 5/30/1973 6/17/1974 6/19/1975 5/14/1976 5/12/1977 6/7/1978 5/27/1979

5/26/1980

06080900 Sun River below diversion dam, near Augusta, Montana usta, Montana

Analysis for regulated period of record	
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Analysis p

IS	period of	record,	water	years: 18	395 -	2019		
٠v	analysis	conduct	ed on	recorded	and	synthesized (data	

06080900 Sun River below diversion dam, near Aug	usta, N
Analysis for regulated period of record	
Analysis period of record, water years: 1895	- 2019

Peak-flow

designation in analysis⁷

Synthesized

Synthesized

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Synthesized PILF

5.74

8.30 11.96 9.06

5

PILF, Synthesized

--7.59 8.04 10.01 10.78 11.35 5.14 10.08 19.00 11.11 4.92 9.96

9.38

9.36

5,7

5

5

Gage height, in feet

Peak-flow frequency analysis conducted on recorded and synthesized data

Water

year

1964

1975

1953

2011

1948

1949 1999 2017

1963 2007

1937

1940 2004 1992

Date⁵

6/9/1964

6/19/1975

6/19/2018

6/2/1972

5/14/1976

5/29/1971

6/5/1970

6/17/1974

6/7/1978

5/26/1980 5/27/1979

5/27/2019

6/2/2017

6/6/1969

6/10/1968

5/28/2016

--5/30/1973 5/12/1977

Ranked (largest to smallest) peak-flow data⁴

Peak flow qualification

codes⁶

5,7

5

5

2,5

5

5

5

5

5

5 5

5

5

5

5

5

Peak flow, in cubic feet per

second

59,700

32,000

17,700

14,500

13,900

13,300 11,500

10,700

10,500 9,800 8,910 8,580 8,470 8,180 8,020 7,820 7,540 7,470 7,350

7.300

7,260 7,210

7,180

7,140

7,000

6,720

6,650 6,520

6,330

6,080 5,940 5,690 5,620 5,500 5,430 5,380

5,380 5,120 5,090 5,070 4,940 4,940 4,820 4,700 4,360

4.350

4.350

4,340

4,290

4,210

4,100

3,960

3,960 3,840

3,800

3,760 3,630

3,600 3,570 3,410 3,390 3,220 3,200 3,200 3,110 3,060 2,990 2,960 2,650 2,650 2,630 2,620 2,620 2,410 2,310

2,290

2,010 2,010

1,640

1,520 1,510

1,200

Gage height, in feet

19.00

---11.96

11.35

11.11

10.78

10.01

10.08

--9.96

--9.36 9.38

9.06

-

8.30

8.04

7.59

5.74

--

--5.14 4.92

Peak-flow

designation in analysis⁷

Historic

Synthesized

Synthesized

Synthesized

Synthesized

Synthesized

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Synthesized

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PILF PILF, Synthesiz

PILF, Synthesiz PILF, Synthesiz PILF PILF

Peak-flow frequency analysis conducted on recorded and synthesized data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential la Table 1-8 I low flow; MGBT, multiple Grubbs-Beck Table 1-1 is the 12-[Water year is the 12-month period from test; -- not applicable or not available]



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), a skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabili 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

- 2,630 2,990 1,110 3,840 10,500 5,070 2014 2015 2016 2017 2018 2019 5/28/2016 6/2/2017 6/19/2018 5/27/2019
- "Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

³Flc ency results not reported because of too many values less than the PILF threshold used in the at-site analysis

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: https://nwis.waterdata.usgs.gov/nwis/peak?help

⁷Definitions of peak-flow designations used in analysis include: Historic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to

determine nonexceedance during an ungaged period; PILF: The peak flow was identified as a potentially influential low flow;

Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis, it a factor for each frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis. Even if a table column is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets.

06082200 Sun River below Willow Creek near Augusta, Montana 06082200 Sun River below Willow Creek near Augusta, Montana

r is the 12-

Number of

Analysis for regulated period of record

orded data

[Water year is the 12-month period from test; - not applicable or not available]

Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorder

Analysis for regulated period of record Analysis period of record Analysis period of record Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-7</u> <u>Table 1-8</u> month period from October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MOBT, multiple Grubbs-Beck or not available] [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; -, not applicable or not available.

Type of peak-

flow frequency

		Peak-flo	ow data ⁴			Ranked (largest to smallest) peak-flow data ⁴							
Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow Gage qualification height, codes ⁶ in feet		Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷		
1964	6/9/1964	46,700	5,7	16.16	Historic	1964	6/9/1964	46,700	5,7	16.16	Historic		
1968	6/10/1968	2,840	5	4.46		1975	6/19/1975	34,000	5	11.50			
1969	6/7/1969	3,000	5	4.40		2018	6/19/2018	13,300	5	7.82			
1970	6/6/1970	6,380	5	6.06		1972	6/2/1972	10,000	5	7.33			
1971	5/28/1971	7,650	5	6.69		1971	5/28/1971	7,650	5	6.69			
1972	6/2/1972	10,000	5	7.33		1974	6/16/1974	6,910	5	6.18			
1973	5/26/1973	409	5	2.39	PILF	1970	6/6/1970	6,380	5	6.06			
1974	6/16/1974	6,910	5	6.18		2019	5/27/2019	6,090	5	5.75			
1975	6/19/1975	34,000	5	11.50		2017	6/2/2017	4,450	5	5.03			
2013	6/9/2013	3,010	5	4.22		2015	6/3/2015	3,770	5	4.49			
2014	6/25/2014	3,140	5	4.27		2014	6/25/2014	3,140	5	4.27			
2015	6/3/2015	3,770	5	4.49		2013	6/9/2013	3,010	5	4.22			
2016	5/28/2016	1,080	5	3.22		1969	6/7/1969	3,000	5	4.40			
2017	6/2/2017	4,450	5	5.03		1968	6/10/1968	2,840	5	4.46			
2018	6/19/2018	13,300	5	7.82		2016	5/28/2016	1,080	5	3.22			
2019	5/27/2019	6,090	5	5.75		1973	5/26/1973	409	5	2.39	PILF		





Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXELY FILE Intensional based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

p. https://doi.org/10.3133/tm4B5.
Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015-5019-F, 30 p., https://doi.org/10.3133/sir20155019F.

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency are applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis nalysis worksheets. Also, not all table columns are applicable for each frequency ng the

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Analysis

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06082200 Sun River below Willow Creek near Augusta, Montana	а
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Peak-flow

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[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Peak flow

qualification

codes⁶

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Gage height, in feet

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--4.22

4.27 4.49 3.22 5.03 7.82 5.75

Peak-flow data

Peak flow, in cubic feet per

second

10,700

4,200

4,450

1,690

10,900

3,190 1,570

636 7,390 9,960 3,690 4,450 5,740 7,130 14,100 4,050 8,320 5,810 3,850 17,900

7,430 5,050 7,270 8,160

8,730 6,780

4,440

4,920

7,600

2,070

46,700 6,650 3,330

9,100 2,840 3,000 6,380 7,650 10,000 409 6,910 34,000 9,630 326 6,780

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6.810

13,500

5,620

3,130 2,480

3,040

4,460 3,140

770

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1,940

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6/9/2013

6/25/2014 6/3/2015 5/28/2016

6/2/2017 6/19/2018 5/27/2019

2010

2011 2012

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6/7/1969 6/6/1970 5/28/1971 6/2/1972 5/26/1973 6/16/1974 6/19/1975

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Peak-flow frequency analysis conducted on recorded and synthesized data

Water

year

1964

1975

1953

1948 1981

1991

1980 1959 1978

2003

1999

2006

1935

2010 1963 2007

1937

1940 2004 1992

Date⁵

6/9/1964

6/19/1975

6/19/2018

6/2/1972

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6/16/1974

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5/27/2019

6/2/2017

6/3/2015

6/25/2014

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6/9/2013 6/7/1969 6/10/1968

5/28/2016

5/26/1973

Ranked (largest to smallest) peak-flow data⁴

Peak flow qualification

codes⁶

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Peak flow, in cubic feet per

second

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10,700

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7,390 7,270 7,270

7,210

7,130

6,910

6,850

6,810

6,780

6,780

6,650 6,380 6,090 5,810 5,740 5,620 5,350 5,230 5,050 5,040 4,920 4,810 4,500 4,480 4,460

4,450

4,450 4,450 4,440

4,380 4,310

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4,230

4,210

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2,840 2,580

2,480

2,130

2,070 1,940

1,690

1,570 1,530

Gage height, in feet

16.16

11.50

7.82

7.33

6.69

--6.18

--6.06 5.75

5.03

4.49

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4.22 4.40 4.46

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Peak-flow

designation in analysis⁷

Historic

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Peak-flow frequency analysis conducted on recorded and synthesized data
<u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u>
from October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MGBT, multiple Grubbs-Beck lel Table 1-1 is the 12-[vvater year is the 12-month period fro test; -- not applicable or not available]

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$\frac{1}{2} 1000 \left[\begin{array}{c} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1500 \end{array} \right] \begin{array}{c} 0 \\ 1500 \\ 1500 \\ 1500 \end{array} \begin{array}{c} 0 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 1500 \\ 2000 \\ 2$	100 ≥ 1. Annua PILF(LO) recent or 50,000 40,000 100 100 100 100 100 100 100	99.5 Explana al peak flows , Potentially less are show	98 95 Station - tion: — com (probability plo influential Low I wn. Gaged peak di Historic peak Censored pea Note: horizont	90 Annu 06082200.1 noence imits — titing positions) Flow (low outlie ischarge k discharge al bars represe	75 60 Lal exceedant Sun River b - Fittsa Frequen and peak-flow I γ). For regional Δ Δ	40 20 E probabili elow Willow 20 Curve • requency cur regression w	20 ty, in percer v Creek near Gaged Peak Di ve. EMA, Expr eighted analys	10 5 tt Augusta, Mi scharge A F ected Moments ses, only annu	1 ontana Histonc Peak O s Algorithm; Sk al exceedance	PILF rew(G), analysis probabilities of
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1500 1520 1540 1560 1500 2000 2020 Station - 6652200.11	100	99.5 Explana al peak flows , Potentially less are show	98 95 Station - tion: — Com (probability plo influential Low I vn. Gaged peak di Historic peak C Censored pea Note: horizont	90 Annu 06082200.1 noence imits titing positions) Flow (low outlie ischarge k discharge al bars represe	75 60 Ial exceedant Sun River b = Fitted Frequent and peak-flow ir). For regional Δ nt perception th C C C C C C C C C C C C C	40 ee probabilit elow Willow sy curve • requency cur regression w	20 ty, in percer v Creek near Gaged Peak Di ve. EMA, Expression relighted analys	10 5 tt Augusta, Mi scharge A F ected Moments sess, only annu	1 Instore Peak O S Algorithm; Sk al exceedance	FILF rew(G), analysis probabilities of
view year station - 6602200.11 2. Annual peak flows and perception thresholds.	1.00 Internet interne	99.5 Explana al peak flows), Potentially I less are show	98 95 Station - tion: — Com (probability plo nfluential Low I m. Gaged peak di Historic peak d Censored pea Note: horizont	90 Anni 06082200.1' ncence limits — titing positions) Flow (low outlie lischarge k discharge k discharge a bars represe	75 60 Isal exceedance Sum River but and peak-flow the r). For regional Δ nt perception th c c c c c c c c c c c c c	40 20 probabiliti alow Willow alow Willow alow Willow requency curr regression w rescholds 0 0 0 0 0 0 0 0 0 0 0 0 0	20 ty, in percer (Creek near Gaged Peak D) ve. EMA, Expression eighted analys 0 0 0 0 0 0 0 0 0 0 0 0 0	10 5 tt Augusta, M. scnarge F ected Moments ese, only annu	i ontana IIIstone Peak O S Algorithm; Sk al exceedance	0.2 PILF rew(G), analysis probabilities of
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2. Annual peak flows and perception thresholds.	1. Annuu PiLF(LO) rrcent or 50,000 40,000 900 900 900 900 900 900 900 900 90	99.5 Explana al peak flows , Potentially less are show	98 95 Station - tion: — com (probability plo influential Low I vn. Gaged peak di Historic peak Censored pea Note: horizont 1520	90 Annu 06082200.1 hoence limits — titing positions) Flow (low outlie k discharge al bars represe al bars represe 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	75 60 Ial exceedant Sun River b - Fittas Frequent and peak-flow i γ). For regional A nt perception th C C C C C C C C C C C C C	40 40 ex probabilit low Willow ay curve • requency cur regression w	20 ty, in percen- (Creek near Gaged Peak D) ve. EMA, Expression television television Composition Co	10 5 tt Augusta, Mi scharge A F ected Moments sess, only annu	1 International Action of the second	PILF rew(G), analysis probabilities of
a randon peda noris ena perception un estrutis.	1000	99.5 Explana al peak flows), Potentially less are show	98 95 Station - tion: — Com (probability ploi nfluential Low Iv rn. Gaged peak di Historic peak d Censored pea Note: horizont	90 Annu 06082200.1 ⁻ Incence limits titing positions) Flow (low outlie ischarge itscharge k discharge a bars represe ischarge ischarge ischarge stational intervention ischarge ischarge stational intervention ischarge stational intervention ischarge ischarge stational intervention ischarge stational interventional interventional intervention ischarge stational interventional interventinterventional interventional interventi	75 60 Isla exceedance Sum River by Finad Prequence and peak-flow r). For regional Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ	40 40 40 40 40 40 40 40 40 40	20 ty, in percer v Creek near Gaged Peak DI ve. EMA, Expression eighted analys	10 5 tt Augusta, M. scharge F escled Moments esc, only annu- go 	i stone Peak O Algorithm: Sk al exceedance	0.2 PILF tew(G), analysis probabilities of
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	1. Annua 1. Ann	99.5 Explana al peak flows a	98 95 Station - tion: — Com (probability ploi nfluential Low Iv row Iv Gaged peak Mole: horizont 1920 192	90 Anni 06082200.1 Incence limits	75 60 Ial exceedance Sum River by Finade Prequence and peak-flow r). For regional Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ Δ	40 40 er probabilit jequency cur regression w	20 ty, in percer v Creek near Gaged Peak DI ve. EMA, Expression relighted analys	10 5 tt Augusta, Mi scharge A F ected Moments ses, only annu	i store Peak O Algorithm; Sk al exceedance	0.2 PILF tew(G), analysis probabilities of

- Confidence limits — Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF Explanation:



¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data;

AL-site: Peak-flow frequency analysis on combined recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE widt: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Orable flow data with a write or frequency frequency for the site of the sit

⁴Peak-flow data with a value of zero are not plotted in figures.

⁴Peak-flow data with a value of zero are not plotted in figures.
⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website.
¹Toefinitions of peak-flow designations used in analysis include:
¹Toefinitions of peak-flow designations used in analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period:
¹Toe peak flow was identified as a potentially influential low flow;
¹Swithesizeri. The peak flow was use surfueirs using Maintenance of Variance Evtension Tune III record extension.
¹

esized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension. Synth

References

England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/m486.

p., muss./uoi.org/10.3133/m485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

06085800 Sun River at Simms, Montana

Analysis for regulated period of record	
Analysis period of record, water years: 1895 - 2019	

060858	00 Sun Rive	r at Simms,	Montana	
Analy	sis for regula	ated period of	f record	

Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorded data

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; -, not applicable or not available.]

 AL-site peak-flow frequency analysis conducted on recorded data

 Table 1-1
 Table 1-2
 Table 1-3
 Table 1-4
 Table 1-5
 Table 1-6
 Table 1-7
 Table 1-8

 [Water years in the 12-month period from Occloser 1 through September 30 and is designated by the year in which It endplates in one available]
 Table 1-7
 Table 1-8
 Table 1-6
 Table 1-7
 Table 1-8

								Peak-flow data ⁴						Ranked (largest to smallest) peak-flow data ⁴							
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PII threshold	PILF F threshold, cubic feet p second	in per		I ype of pea flow frequency analysis ²	K-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	,									1964	6/9/1964	50,000	7	13.70	Historic	1964	6/9/1964	50,000	7	13.70	Historic
1,296	38	Weighted	MGBT	1,480			At-site			1966	5/30/1966	3,350		5.37		1975	6/20/1975	37,900		12.48	
	Peak flo	ow, in cubic te	et per second	for indicated a	annual exceeda	ince probability	(bold values),	in percent		1967	6/1/1967	9,610		7.79		2018	6/19/2018	18,100		10.96	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1968	6/11/1968	2,940		4.93		2011	6/8/2011	13,900		9.87	
3,010	4,300	5,000	8,940	13,400	20,800	28,000	36,800	47,400	64,800	- 1969	//1/1969	2,940		6.68		2019	5/2//2019	11,900		9.27	
Upper	and lower 90-	-percent confid	dence interval:	s, in cubic feet	per second, to	r indicated ann	ual exceedance	e probability, ir	1 percent	1970	6/6/19/0	6,420		6.51		1976	5/15/19/6	10,200		7.88	
66.7	50	42.9	20	10	4	2 10 700	1.0	0.5	0.2	19/1	5/29/19/1	7,630		7.15		1972	6/2/19/2	9,840		8.04	
3,840	5,520	6,430	11,700	17,800	29,400	42,700	62,500	92,000	154,000	1972	6/2/19/2	9,840		8.04	DU 5	1967	6/1/1967	9,610		7.79	
2,330	3,370	3,900	6,860	10,100	15,100	19,600	24,700	30,500	39,100	19/3	1/15/19/3	400	2	3.30	PILF	2008	5/26/2008	8,130		8.08	
										1974	6/17/1974	37,000		10.14		19/1	5/29/19/1	7,030		7.15	
1,000,000 _F			_				1 1			1975	6/20/19/5	10,200		12.40		2012	6/7/2012	7,600		7.07	
E									-	1970	5/15/19/0	10,200		7.00	DULE	1997	6/13/199/	7,530		7.30	
F									-	1079	6/7/1079	7 060		6.77	FILE	1978	6/6/1070	6,420		6.51	
-									-	1978	E/27/1070	4,600		6.06		1970	6/17/1074	6,420		7.14	
ii										1979	6/12/1007	7,520		7.26		2002	6/24/2002	5,400		6.46	
g 100,000										1997	7/1/1008	3,070		5.27		1070	5/27/1070	4 600		6.06	
a l										1999	6/5/1000	4 310		6.00		2009	6/1/2009	4,580		6.21	
jet i	T 7									2000	6/10/2000	2 570		4.80		2003	5/27/2003	4,000		5.88	
5										2000	6/14/2001	2,070		2.57	DILE	1000	6/5/1000	4,400		6.00	
- <u>-</u>									-	2001	6/24/2002	5 510		6.46	110	2006	6/12/2006	4,010		5.07	
.⊑ 10.000										2002	5/27/2002	4 400		5.88		2000	6/2/2000	3 980		5.99	
in de										2003	5/11/2004	1 480		3 73		2005	5/18/2005	3 700		5.33	
in the second se						-			=	2005	5/18/2005	3 700		5.72		1966	5/30/1966	3,350		5.37	
- Iis									-	2005	6/12/2006	4 290		5.97		2015	6/4/2015	3 100		5.35	
÷.									-	2000	5/20/2007	1,900		4.16		1998	7/4/1998	3.070		5.27	
≞ 1000										2008	5/26/2008	8,130		8.08		1968	6/11/1968	2,940		4.93	
E			-						-	2009	6/1/2009	4.580		6.21		1969	7/1/1969	2,940		6.68	
q E										2010	6/6/2010	2,100		4.33		2014	6/25/2014	2.830		5.00	
F		0								2011	6/8/2011	13,900		9.87		2013	6/9/2013	2.800		4.98	
-									-	2012	6/7/2012	7.600		7.87		2000	6/10/2000	2.570		4.80	
100						1	1 1			2013	6/9/2013	2,800		4.98		2010	6/6/2010	2,100		4.33	
100 2	9.5 98	95	90	75 60	40	20	10 5	1	0.2	2014	6/25/2014	2.830		5.00		2007	5/20/2007	1,900		4.16	
				Annual exceed	ance probability,	in percent				2015	6/4/2015	3,100		5.35		2004	5/11/2004	1.480		3.73	
			5	tation - 0608580	0.10 Sun River	at Simms MT				2016	5/28/2016	1,090		3.60	PILF	2016	5/28/2016	1,090		3.60	PILF
	EXPLAN	ATION			A	ALYSIS INFO:				2017	6/2/2017	3,980		5.99		2001	6/14/2001	606		2.57	PILF
	Fitted fr	equency curve			Pe	akfq v 7.3 run 3/	5/2021 7:16:36 Al	м		2018	6/19/2018	18,100		10.96		1973	1/15/1973	400	2	3.30	PILF
	PILF (LC)) threshold			0.3	246 = Skew (G): 1	eu skew option Multiple Grubbs.I	Beck		2019	5/27/2019	11,900		9.27		1977	5/11/1977	294		2.73	PILF
	Confide A Historic Gaged p	nce limits: 5 per peaks beak discharge	rcent lower, 95	percent upper		Zeroes not disp Censored flows Gaged peaks be	blayed s below PILF (LO) elow PILF (LO) Th	Threshold													

 Confidence limits: 5 perce
 Historic peaks
 Gaged peak discharge
 PILF (LO)
 Censored peak discharge Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not lotted in floures.

¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the v Even if a table column is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. ncy-analysis worksheets. Also, not all table columns are applicable for each frequency various similarly structured freque

Date

Water

year

1934

1935

1936 1937

1938

Peak-flow data

Peak flow

qualification

codes⁶

Peak flow, in cubic feet per

second

11,600

4,120

4,390

1,500

11,800

3,040 1,390 511 7,700 10,700 3,570 4,390 5,820 7,400 15,700 3,960 8,780 5,890 3,740 20,500 7,740 5,050 7,560

8,590

9,250

06085800 Sun River at Simms, Montana

	Anal	ysi	s f	or	regulated	period	of record	

	Analysis pe	riod of record,	water years: 1	895 - 2019			
Peak-flo	w frequency ar	alysis conduct	ed on recorded	d and synthesiz	ed data		
Table 1-2	Table 1-3	Table 1-4	Table 1-5	Table 1-6	Table 1-7	Table 1-8	
n October 1 throug	gh September 30 a	nd is designated by	y the year in which	it ends. PILF; pote	ntially influential lo	w flow; MGBT, multiple	Grubbs-Beck

06085800 Sun River at Simms, Montana
Analysis for regulated period of record
Analysis period of record, water years: 1895 - 2019

Peak-flow

designation in analysis⁷

Synthesized

Synthesized

Synthesized

Synthesized Synthesized

Synthesized

Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized Synthesized

Synthesized

, Synthesized

Synthesized PILF, Synthesized

Synthesized PILF, Synthesized PILF, Synthesized

Gage height, in feet

...

Peak-flow frequency analysis conducted on recorded and synthesized data

Water

year

1964

1975

1953

2018

Date⁵

6/9/1964

6/20/1975

6/19/2018

6/8/2011 5/27/2019

--5/15/1976 6/2/1972 6/1/1967

5/26/2008

5/29/1971

6/7/2012

6/13/1997

Ranked (largest to smallest) peak-flow data⁴

Peak flow qualification

codes⁶

7

Peak flow, in cubic feet per

second

50,000

37,900

20,500

18,100

15,700

15,000 13,900 11,900 11,800 10,700 10,200 9,840 9,610 9,250 8,780 8,780 8,780 8,130 7,940 7,740

7.700

7,630 7,600

7,560

7,530 7,400

7,070

7,060 7,030

6,990

6,840 6,420 5,890 5,820 5,680 5,510 5,250 5,050 5,040 4,910 4,780 4,600 4,580 4,410

4,400

4.390

4,390

4,380

4,320

4,310

4,290

4,230 4,120

3,980 3,960 3,740

3,700 3,570 3,350 3,160 3,070 3,070 2,990 2,980 2,940 2,940 2,940 2,880 2,830

2,800 2,570

2,300

2,100 1,900 1,880

1,500

1,480 1,390 1,090

1,070 631

2

Gage height, in feet

12.48

10.96

9.87

9.27

--7.88 8.04 7.79

8.08

7.15 7.87

7.36

6.77

--6.51 7.14

--

6.46

6.06 6.21

5.88

6.00

5.97

5.99

5.72

5.37

5.35 5.27

--

--4.93 6.68

5.00

4.98 4.80

4.33

4.16

3.73

--3.60

2.57

3.30 2.73

Peak-flow

designation in analysis⁷

Historic

Synthesized

Synthesized

Synthesized

Synthesized Synthesized Synthesized

Synthesized Synthesized Synthesized

Synthesized Synthesized

Synthesized

Synthesized

Synthesized

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PILF PILF, Synthesiz PILF, Synthesiz PILF PILF, Synthesiz PILF PILF

[Water year is the 12-month period from test; -- not applicable or not available] Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.] Number of Contributing drainage area, PILF Type of peakrecorded peak flows used in the Skew type used in analysis Type of PILF Type of PILF threshold, in cubic feet per second flow frequency in square miles second analysis analysis 1,296 86 Weighted MGBT 1,880 MOVE 86 Peak flow, in cubic 50 42.9 c feet per second, for indicated annual exceedance probability (bold values), in percent 20 10 4 2 1.0 0.5 66.7 0.2 3,430 12,800 24,800 31,500 19,000 52,100 8,980 4,700 5,370 39,400
 Upper and lowe

 66.7
 50

 3,980
 5,490

 90-percent confidence intervals, in cubic feet per second,

 42.9
 20
 10
 4

 6,300
 10,800
 16,100
 26,200
 , for indicated annual exceedance probability, 2 1.0 0.5 37,300 52,600 73,800 , in percent 0.2 114,000 16,100 2,930 4,030 4,590 7,570 10,600 15,000 18,700 22,700 27,000 33,200 1,000,000 second per feet ubic .= 10.000 discharge peak 1,000 ° ° ° Annual 0 100 -99.5 0 75 6 Annual exceed Station - 06085800 98 95 90

Explanation: - Confidence limits -Fitted Fre

Figure 1. Annual peak flows (probability plotting positions) and peak-skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regi 66.7 percent or less are shown. skew; 66.7 p



Figure 2. Annual peak flows and perception thresholds.

Table 1-1 is the 12-

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data;

AL-site: Peak-flow frequency analysis on combined recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE widt: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Orable flow data with a write or frequency frequency for the site of the sit

²Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 <u>https://www.waterdata.usgs.gov/nwis/peak?help</u>
 ⁷Definitions of peak-flow designations used in analysis include:
 Historic: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungage period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Swittesized: The neak flow was synthesized: using Maintenance of Variance Extension Type III record extension.

esized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension. Synth

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

p., muss./uoi.org/10.3133/m485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

	1555		0,000			Synchesized	1047	
	1960		4,380			Synthesized	1991	
	1961		4,910			Synthesized	1978	6/7/1978
	1962		7,940			Synthesized	1980	
	1963		1 880			Synthesized	1050	
	1064	6/0/1064	50,000	7	12 70	Historic	1065	
	1964	0/9/1904	50,000	1	13.70	HISTORIC	1905	 c /c /a070
	1965		0,040			Synthesizeu	1970	0/0/19/0
	1966	5/30/1966	3,350		5.37		1974	6/1//19/4
	1967	6/1/1967	9,610		7.79		1951	
	1968	6/11/1968	2,940		4.93		1946	
	1969	7/1/1969	2,940		6.68		1982	
	1970	6/6/1970	6.420		6.51		2002	6/24/2002
0 40 20 10 5 1 02	1971	5/29/1971	7 630		7 15		1995	
lance probability, in percent	1072	6/2/1972	9.840		8.04		1955	
11 Sun River at Simms Montana	1072	1/15/1072	3,040	2	2.20	DULE	1000	
	1975	1/15/19/5	400	2	3.30	PILP	1989	
	1974	6/1//19/4	6,400		7.14		1961	
quency Curve 🔍 Gaged Peak Discharge 🔺 Historic Peak 🖸 PILF	1975	6/20/1975	37,900		12.48		1996	
	1976	5/15/1976	10,200		7.88		1979	5/27/1979
ow frequency curve, EMA, Expected Moments Algorithm; Skew(G), analysis	1977	5/11/1977	294		2.73	PILF	2009	6/1/2009
onal regression weighted analyses, only annual exceedance probabilities of	1978	6/7/1978	7,060		6.77		1986	
0 0 0 0	1979	5/27/1979	4,600		6.06		2003	5/27/2003
	1980	-,,	7 030			Synthesized	1936	-,,
	1980		15,000			Synthesized	1930	
	1981		15,000			Synthesized	1945	
	1982		5,680			Synthesized	1960	
	1983		2,980			Synthesized	1990	
	1984		2,300			Synthesized	1999	6/5/1999
	1985		2,880			Synthesized	2006	6/12/2006
on thresholds	1986		4.410			Synthesized	1993	
	1987		2,990			Synthesized	1935	
	1088		631			PILE Synthesized	2017	6/2/2017
	1000		E 040			Cupth spinod	1040	0/2/2017
	1989		5,040			Synthesized	1949	
	1990		4,320			Synthesized	1952	
	1991		7,070			Synthesized	2005	5/18/2005
	1992		1,070			PILF, Synthesized	1944	
	1993		4,230			Synthesized	1966	5/30/1966
	1994		3,160			Synthesized	1994	
	1995		5.250			Synthesized	2015	6/4/2015
	1996		4 780			Synthesized	1998	7/4/1998
00 9	1007	6/13/1007	7 530		7 36	-,	1030	., .,
2 n n 0 0 1	1009	7/4/1000	2,070		F 07		1007	
	1998	7/4/1998	3,070		5.27		1987	
0 1 0 0 0 0 7 0 0 7 0 0 0 1 0 0 0 0 0 0	1999	6/5/1999	4,310		6.00		1983	
1980 2000 2020	2000	6/10/2000	2,570		4.80		1968	6/11/1968
1000 2000 2020	2001	6/14/2001	606		2.57	PILF	1969	7/1/1969
	2002	6/24/2002	5,510		6.46		1985	
	2003	5/27/2003	4,400		5.88		2014	6/25/2014
	2004	5/11/2004	1,480		3.73	PILE	2013	6/9/2013
	2005	5/18/2005	3 700		5 72		2000	6/10/2000
	2005	6/12/2005	4 200		5.07		1094	0/10/2000
	2000	0/12/2000	4,250		3.57		1564	c /c /2010
	2007	5/20/2007	1,900		4.16		2010	6/6/2010
	2008	5/26/2008	8,130		8.08		2007	5/20/2007
	2009	6/1/2009	4,580		6.21		1963	
	2010	6/6/2010	2,100		4.33		1937	
	2011	6/8/2011	13,900		9.87		2004	5/11/2004
Fest as specified in Bulletin 17C (England and others, 2019)	2012	6/7/2012	7,600		7.87		1940	
he neak-flow frequency analyst	2013	6/9/2013	2,800		4.98		2016	5/28/2016
	2014	6/25/2014	2,830		5.00		1002	-,,,,,,,,,,
	2014	6/4/2015	2,000		5.00 5.2F		1000	
	2013	5/20/2015	3,100		0.00	DU 5	1700	c/a a /2004
tnesized data; synthesized data from Maintenance of Variance Extension	2016	5/28/2016	1,090		3.00	PILF	2001	6/14/2001
	2017	6/2/2017	3,980		5.99		1941	
results from regional regression equations (RREs) from Sando and others	2018	6/19/2018	18,100		10.96		1973	1/15/1973
	2019	5/27/2019	11,900		9.27		1977	5/11/1977
s than the PILE threshold used in the at-site analysis								

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis. Even if a table columns is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. Also, not all table columns are applicable for each frequency analysis. Even if a table columns are applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets.

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 1927 At-site peak-flow frequency analysis conducted on recorder

ded data

UDUGBUUU Sun River at Fort Shaw, Montana Analysis for unregulated period of record Analysis period of record, water years: 1895 - 1927 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential tow flow; MGBT, multiple Grubbe-Beck test – not applicable or not available]

test; not applicab	le or not available]		-3 P	g	-, ,		,			[Water year is the	12-month period from	October 1 through Sep	ptember 30 and is desi	gnated by the ye	ar in which it ends;, not app	licable or not availabl	le.]				
	Number of											Peak-fle	ow data ⁴				Rank	ked (largest to sma	illest) peak-flow d	ata4	
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PIL threshold ¹	PILF F threshold, ir cubic feet pe second	r r		flow flow frequency analysis ²	к-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	unuiyolo									1906	6/5/1906	3,000		5.80	Combined	1908	6/7/1908	27,200		13.40	Combined
1,395	22	Weighted	MGBT				At-site			1907	6/24/1907	10,900		9.60	Combined	1916	6/21/1916	20,000			
	Peak flov	v, in cubic fee	t per second,	for indicated ar	nual exceed	ance probability	y (bold values),	in percent		1908	6/7/1908	27,200		13.40	Combined	1917	5/26/1917	16,400			
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1909	6/9/1909	12,000		10.20	Combined	1909	6/9/1909	12,000		10.20	Combined
5,540	6,980	7,710	11,400	15,200	20,800	25,800	31,500	38,000	48,100	1910	5/11/1910	4,600		7.10	Combined	1907	6/24/1907	10,900		9.60	Combined
Upper	and lower 90-p	ercent confid	ence intervals	, in cubic feet p	er second, fo	r indicated ann	ual exceedance	e probability, ir	n percent	1911	6/11/1911	5,940		7.80	Combined	1913	5/29/1913	10,900			
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1912	5/22/1912	8,000		8.60	Combined	1927	6/9/1927	10,200		10.32	
6,800	8,660	9,630	15,000	21,400	33,700	47,700	67,600	96,000	152,000	1913	5/29/1913	10,900				1918	6/11/1918	9,660			
4,510	5,680	6,260	9,100	11,700	15,400	18,400	21,400	24,700	29,300	1914	5/17/1914	4,380				1912	5/22/1912	8,000		8.60	Combined
										1915	5/2/1915	4,280				1922	6/5/1922	7,280			
1 000 000										1916	6/21/1916	20,000				1925	5/20/1925	6,490		8.82	
1,000,000							1 1			1917	5/26/1917	16,400				1921	5/26/1921	6,440			
-										1918	6/11/1918	9,660				1920	6/16/1920	6,120			
									1	1919	5/23/1919	4,280				1924	5/17/1924	5,950			
u										1920	6/16/1920	6.120				1911	6/11/1911	5,940		7.80	Combined
CO										1921	5/26/1921	6.440				1923	5/26/1923	4.830			
S.										1922	6/5/1922	7.280				1910	5/11/1910	4,600		7.10	Combined
Je too too										1923	5/26/1923	4.830				1914	5/17/1914	4,380			
8 100,000 E								/		1924	5/17/1924	5,950				1915	5/2/1915	4,280			
i i									1	1925	5/20/1925	6.490		8.82		1919	5/23/1919	4.280			
5										1926	4/30/1926	3,280		6.90		1926	4/30/1926	3,280		6.90	
<u> </u>										1927	6/9/1927	10.200		10.32		1906	6/5/1906	3.000		5.80	Combined



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include: AL-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure: RRE wd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: https://nwis.waterdata.usgs.gov/nwis/peak?help

⁷Definitions of peak-flow designations used in analysis include: Historic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; PILF: The peak flow was identified as a potentially influential low flow; Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

06086000 Sun River at Fort Shaw, Montana

06086000 Sun River at Fort Shaw, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 1927 At-site peak flow frequency analysis weighted with regional regression equations

UCUBOUUD Sun River at Fort Shaw, Montana Analysis for unregulated period of record Analysis period of record ywater years: 1895 - 1927 At-site peak flow frequency analysis weighted with regional regression equations <u>Table 1-1</u> Table 1-2, Table 1-3, Table 1-4, Table 1-5, Table 1-6, Table 1-7, Table 1-8, [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential low flow; MGBT, n test; - not applicable or not available]

ch it ends. PILF; potentially influential low flow; MGBT, multiple Grubbs-Beck		
	Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends:	not applicable or not available.]

	Number of											Peak-flow data ⁴					Ranked (largest to smallest) peak-flow data ⁴					
Contributing drainage area in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PIL threshold ¹	PILF F threshold, in cubic feet per second			Type of peal flow frequency analysis ²	k-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	
										1906	6/5/1906	3,000		5.80	Combined	1908	6/7/1908	27,200		13.40	Combined	
1,395			MGBT				RRE wtd			1907	6/24/1907	10,900		9.60	Combined	1916	6/21/1916	20,000				
	Peak flo	w, in cubic fee	t per second,	for indicated ann	nual exceeda	ince probability	(bold values), i	in percent		1908	6/7/1908	27,200		13.40	Combined	1917	5/26/1917	16,400		-		
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1909	6/9/1909	12,000		10.20	Combined	1909	6/9/1909	12,000		10.20	Combined	
5,430	6,790	7,490	10,900	14,300	19,700	24,700	30,600	37,800	49,300	1910	5/11/1910	4,600		7.10	Combined	1907	6/24/1907	10,900		9.60	Combined	
Uppe	and lower 90-	percent confid	ence intervals	, in cubic feet pe	er second, for	r indicated ann	ual exceedance	e probability, ir	n percent	1911	6/11/1911	5,940		7.80	Combined	1913	5/29/1913	10,900				
66./	50	42.9	20	10	4	2	1.0	0.5	0.2	1912	5/22/1912	8,000		8.60	Combined	1927	6/9/192/	10,200		10.32		
6,660	8,400	9,320	14,200	19,800	30,200	41,600	57,000	78,400	119,000	1913	5/29/1913	10,900				1918	6/11/1918	9,660			Complete et al.	
4,430	5,540	6,090	8,750	11,200	14,800	17,900	21,300	25,300	30,900	1914	5/1//1914	4,380				1912	5/22/1912	8,000		8.60	Combined	
										1915	5/2/1915	4,280				1922	6/5/1922	7,280				
										1916	6/21/1916	20,000				1925	5/20/1925	6,490		8.82		
1,000,000	-									1917	5/20/191/	0,400				1921	5/26/1921	6,440				
										1918	6/11/1918	9,000				1920	6/16/1920	6,120				
σ									-	1919	5/25/1919	4,200				1924	5/1//1924	5,950			Combined	
5										1920	6/16/1920 E/26/1021	6,120				1911	E/26/1022	3,940		7.00	combined	
9									-	1921	6/5/1022	7 290				1923	5/20/1923	4,030	-	7 10	Combined	
<u> </u>									-	1922	C/2C/1022	1,200				1014	5/11/1910	4,000		7.10	combined	
be										1923	5/20/1923	4,030				1015	E/2/101E	4,300				
Te constant										1924	5/17/1924	6,400				1010	5/2/1915	4,200	-			
<u>e</u> 100,000										1925	4/20/1925	2 280		6.00		1015	4/20/1026	2,200		6.00		
ğ									1 1	1920	6/0/1027	10 200		10.30		1920	6/5/1906	3,200		5.80	Combined	
Tin Cin										1927	0/3/132/	10,200		10.32		1900	0/3/1900	3,000		5.00	combined	
,i																						
peak discharge																						



- Confidence limits - Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF Explanation:

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: https://nwis.waterdata.usgs.gov/nwis/peak?help

⁷Definitions of peak-flow designations used in analysis include: Historic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; PILF: The peak flow was identified as a potentially influential ow flow; Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, It is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-Even if a table column is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. 06087900 Muddy Creek tributary near Power, Montana 06087900 Fundation (Constraint) ncy-analysis worksheets. Also, not all table columns are applicable for each frequency analysis.

06087900 Muddy Creek tributary near Power, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak-flow frequency analysis conducted on recorder

orded data

UDUD / SUU MIUDIGY Licek tributary near Power, Montana Analysis for unregulated period of record Analysis period of record, water years: 1903-1978 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow; MGBT, multiple Grubbs-Beck. <u>text - not applicable or not available]</u>

Contributing drainage area, in square miles	Number of recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			Type of pea flow frequency analysis ²	K-	
3.81	16	Weighted	MGBT	19.0			At-site		
	Peak flow	v, in cubic fee	t per second, fo	or indicated annu	ual exceeda	nce probability	(bold values),	in percent	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2
74	124	153	328	536	890	1,220	1,620	2,100	2,830
Upper a	and lower 90-p	ercent confide	ence intervals, i	n cubic feet per	second, for	indicated annu	al exceedance	probability, in	percent
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2
124	210	261	628	1,220	2,700	4,700	7,920	13,100	25,000
37	71	90	196	312	488	632	780	929	1,120

		Peak-flo	ow data ⁴				Rank	ed (largest to sma	allest) peak-flow d	ata⁴	
Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
1963	7/10/1963	19		1.15		1966	7/2/1966	620		5.41	
1964	5/3/1964	284		2.26		1976	10/15/1975	420		2.52	
1965	6/17/1965	130		2.27		1975	6/20/1975	350		2.39	
1966	7/2/1966	620		5.41		1978	3/17/1978	350		2.49	
1967	6/10/1967	62		1.73		1964	5/3/1964	284		2.26	
1968	8/15/1968	130		1.94		1970	5/11/1970	265		2.24	
1969	6/28/1969	170		2.04		1986	2/25/1986	190	0	4.16	Opportunistic
1970	5/11/1970	265		2.24		1974	1/15/1974	175		2.06	
1971	5/20/1971	26		1.24		1969	6/28/1969	170		2.04	
1972	3/13/1972	100	2	2.80		1965	6/17/1965	130		2.27	
1973	6/15/1973	45		1.64		1968	8/15/1968	130		1.94	
1974	1/15/1974	175		2.06		1972	3/13/1972	100	2	2.80	
1975	6/20/1975	350		2.39		1967	6/10/1967	62		1.73	
1976	10/15/1975	420		2.52		1973	6/15/1973	45		1.64	
1977		0	Bm		PILF	1971	5/20/1971	26		1.24	
1978	3/17/1978	350		2.49		1963	7/10/1963	19		1.15	
1986	2/25/1986	190	0	4.16	Opportunistic	1977		0	Bm		PILF



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3:) record extension procedure; RRE wd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

06087900 Muddy Creek tributary near Power, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 Al-site peak flow frequency analysis weighted with regional regression equations Table 1-2 Table 1-3 Table 1-4 Table 1-5 Table 1-6 Table 1-7 Table 1-8 n October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow; MGBT, multiple Grubbe-Beck

06087900 Muddy Creek tributary near Power, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak flow frequency analysis weighted with regional regress

ion equations

Ranked (largest to smallest) peak-flow data⁴

Table 1-1 [Water year is the 12-month period fro test; -- not applicable or not available] [Water year is the 12-month period from October 1 through September 30 and i ated by the year in which it ends; --, not applicable or not available.] Peak-flow data4 Number of Contributing drainage area, in square miles Skew type PILF used in Type of PILF threshold, in threshold¹ cubic feet per second Type of peak-Peak flow, in cubic feet per second recorded peak flows used in the analysis Gage height, in feet Peak flow qualification Peak-flow flow frequency Water Water designation in analysis⁷ Date⁵ year year codes⁶ analysis 3.81 MGBT 19.0 RRE wtd

Vater year	Date⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
1963	7/10/1963	19		1.15		1966	7/2/1966	620		5.41	
1964	5/3/1964	284		2.26		1976	10/15/1975	420		2.52	
1965	6/17/1965	130		2.27		1975	6/20/1975	350		2.39	
1966	7/2/1966	620		5.41		1978	3/17/1978	350		2.49	
1967	6/10/1967	62		1.73		1964	5/3/1964	284		2.26	
1968	8/15/1968	130		1.94		1970	5/11/1970	265		2.24	
1969	6/28/1969	170		2.04		1986	2/25/1986	190	0	4.16	Opportunistic
1970	5/11/1970	265		2.24		1974	1/15/1974	175		2.06	
1971	5/20/1971	26		1.24		1969	6/28/1969	170		2.04	
1972	3/13/1972	100	2	2.80		1965	6/17/1965	130		2.27	
1973	6/15/1973	45		1.64		1968	8/15/1968	130		1.94	
1974	1/15/1974	175		2.06		1972	3/13/1972	100	2	2.80	
1975	6/20/1975	350		2.39		1967	6/10/1967	62		1.73	
1976	10/15/1975	420		2.52		1973	6/15/1973	45		1.64	
1977		0	Bm		PILF	1971	5/20/1971	26		1.24	
1978	3/17/1978	350		2.49		1963	7/10/1963	19		1.15	
1986	2/25/1986	190	0	4.16	Opportunistic	1977		0	Bm		PILF



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXEL: FILF Interstool based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

⁵Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is ⁸available at the NWIS website: <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u> ⁷Definitions of peak-flow designations used in analysis include: Histori: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was odlentified of the manalysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References

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06089000 Sun River near Vaughn, Montana

Analysis for regulated period of record

sis period of record,	water years:	1895 - 2019	
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06089000 Sun River near Vaughn, Montana

Analysis for regulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorder orded data

Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorded data Table 1-2 Table 1-3 Table 1-4 Table 1-5 Table 1-6 Table 1-7 Table 1-8 n October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow; MGBT, multiple Grubbs-Beck Table 1-1 [Water year is the 12-month period from test; - not applicable or not available]





Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments A skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and oth FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXELY FILE Intreshold based on a systematic peak now selected by the peak-now irrequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

⁵Irood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
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 <u>https://www.waterdata.usps.gov/nwis/peak/fleep</u>
 ⁷Definitions of peak-flow das collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was identified as a potentially influential low flow;
 PILF: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

p. https://doi.org/10.3133/tm485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018) : U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

	[Water year is the	12-month period from	October 1 through Sep Peak-flc	tember 30 and is desig ww.data ⁴	gnated by the yea	ar in which it ends; —, not ap	licable or not available	e.] Rank	ed (largest to sma	allest) neak-flow d	ata ⁴	
	Water	6	Peak flow, in	Peak flow	Gage	Peak-flow	Water	-	Peak flow, in	Peak flow	Gage	Peak-flow
	year	Date [°]	cubic feet per second	qualification codes ⁶	height, in feet	designation in analysis ⁷	year	Date ⁵	cubic feet per second	qualification codes ⁶	height, in feet	designation in analysis ⁷
	1934	6/8/1934	11,000		9.50		1964	6/9/1964	53,500		23.40	
percent	1936	5/16/1936	4,830		5.02		2018	6/21/2018	18,200		9.64	
0.5 0.2	1937	6/19/1937	1,940		2.74	PILF	1953	6/4/1953	17,900		16.38	
41,600 58,900	1938	6/24/1938	11,200		9.56		2011	6/10/2011	14,800		8.29	
obability, in percent	1939	5/19/1939	3,530		4.05		1948	6/6/1948	14,300		13.48	
0.5 0.2	1940	6/1/1940	1,810		2.63	PILF	1981	5/24/1981	13,700		15.45	
26 800 34 100	1941	5/28/1941	7 780		7 18	PILF	1987	6/24/1938	12,000		9.56	
20,000 04,100	1942	6/16/1943	10,300		10.48		1934	6/8/1934	11,000		9.50	
	1944	6/19/1944	4,050		4.60		1943	6/16/1943	10,300		10.48	
	1945	6/7/1945	4,830		5.00		1972	6/3/1972	10,000			
	1946	5/30/1946	6,130		6.05		2019	5/28/2019	9,820		6.66	
	1947	5/11/1947	7,520		13.48		1958	5/13/1958	9,100		10.92	
	1949	5/30/1949	4.420		5.75		1950	6/18/1950	8,700		9.50	
	1950	6/18/1950	8,700		9.50		1957	5/22/1957	8,540		10.33	
/	1951	6/17/1951	6,200				2008	5/27/2008	8,060		5.81	
2	1952	5/17/1952	4,210		5.23		1962	5/27/1962	7,990		9.99	
	1953	6/4/1953	17,900		16.38		1954	5/22/1954	7,820		9.15	
	1954	5/22/1954	7,820		9.15		1942	5/28/1942	7,780		7.18	
	1956	6/4/1956	7.660		8.96		1956	6/4/1956	7,660		8.96	
	1957	5/22/1957	8,540		10.33		1971	5/30/1971	7,620		9.01	
	1958	6/13/1958	9,100		10.92		1947	5/11/1947	7,520			
	1959	6/16/1959	7,170		8.77		1991	5/22/1991	7,240		10.55	
	1960	6/5/1960	4,820				1980	5/27/1980	7,200		10.14	
	1961	5/1/1961 5/27/1062	5,310 7 990		6.30 a aa		1959	6/10/1959 6/17/1065	7,170		ស.// ខ្លួន1	
	1963	6/7/1963	2,350		3.52	PILE	1903	6/7/1970	6,680		7.82	
	1964	6/9/1964	53,500		23.40		2012	6/7/2012	6,600		5.43	
	1965	6/17/1965	7,040		8.81		2006	6/11/2006	6,460	2,R	5.35	
1 0.2	1966	5/31/1966	4,010		5.31		1951	6/17/1951	6,200			
	1967	6/19/1967	12,000		11.80		1946	5/30/1946	6,130		6.05	
	1968	6/29/1968	2 950		0.40	PILE	1978	6/18/1974	6,110		0.03 8.83	
	1970	6/7/1970	6.680		7.82		1982	6/18/1982	6.010		9.07	
or (MSE sub G)	1971	5/30/1971	7,620		9.01		1995	6/7/1995	5,620		9.05	
	1972	6/3/1972	10,000				2002	6/11/2002	5,590		8.64	
eshold	1973	6/20/1973	698		1.86	PILF	1955	5/23/1955	5,440		6.74	
shold	1974	6/18/19/4	6,100		8.83		1989	5/12/1989	5,430		8.22	
	1976	5/15/1976	8,850		11.41		1961	6/1/1961	5,310		6.30	
gorithm: Skew(G), analysis	1977	7/25/1977	681		1.93	PILF	1996	6/6/1996	5,190		8.27	
exceedance probabilities of	1978	6/8/1978	6,110		8.83		1986	5/31/1986	4,840		7.61	
	1979	5/28/1979	5,400		7.68		1936	5/16/1936	4,830		5.02	
	1980	5/27/1980	7,200		10.14		1945	6/7/1945	4,830		5.00	
	1981	5/24/1981 6/18/1982	6.010		15.45		1960	6/5/1960	4,820		7 20	
	1983	5/28/1983	3,470		5.50		1993	5/18/1993	4,680		7.62	
	1984	6/22/1984	2,780		4.40	PILF	1935	5/25/1935	4,570		4.85	
	1985	5/26/1985	3,370		5.23		1949	5/30/1949	4,420		5.75	
	1986	5/31/1986	4,840		7.61		1999	6/6/1999	4,420		7.08	
	1987	5/2/1987	3,480		5.57	DUE	2009	6/2/2009	4,250		4.58	
	1966	5/12/1080	5 / 30		2.00	PILF	1952	6/10/10//	4,210		5.25	
	1990	6/1/1990	4,760		7.29		1966	5/31/1966	4,010		5.31	
	1991	5/22/1991	7,240		10.55		2017	6/15/2017	4,000		4.39	
	1992	6/17/1992	1,450		2.57	PILF	2005	5/18/2005	3,850		4.33	
	1993	5/18/1993	4,680		7.62		1998	7/4/1998	3,830		6.13	
	1994	5/14/1994	3,050		5.54 9.05		1994	5/14/1994	3,050		5.54 4.21	
	1995	6/6/1996	5,020		9.05		1939	5/2//2005	3,520		4.21	
	1997	6/13/1997	7,700		11.45		1987	5/2/1987	3,480		5.57	
	1998	7/4/1998	3,830		6.13		1983	5/28/1983	3,470		5.50	
	1999	6/6/1999	4,420		7.08		1968	6/10/1968	3,410		5.48	
	2000	6/10/2000	2,650		4.33	PILF	2015	6/3/2015	3,400		4.11	
	2001	8/1/2001	1,120		2.71	PILF	1985	5/26/1985	3,370		5.23	DUC
	2002	5/27/2002	3,620		4.21		2010	6/25/2010	3,040		4.03	PILF
	2004	6/8/2004	1,800		3.29	PILF	1969	6/29/1969	2,950			PILF
	2005	5/18/2005	3,850		4.33		1984	6/22/1984	2,780		4.40	PILF
	2006	6/11/2006	6,460	2,R	5.35		2013	6/9/2013	2,670		3.79	PILF
	2007	5/21/2007	2,350		3.61	PILF	2000	6/10/2000	2,650		4.33	PILF
	2008	5/27/2008	8,060		5.81		1963	6/7/1963	2,350		3.52	PILF
	2009	6/2/2009	4,250		4.58	DILE	2007	5/21/2007	2,350		3.61	PILF
	2010	6/10/2010	14,800		3.90 8.29	11LF	1937	6/1/193/	1,340		2.74	PILF
ners. 2019);	2012	6/7/2012	6,600		5.43		2004	6/8/2004	1,800		3.29	PILF
, == ,,	2013	6/9/2013	2,670		3.79	PILF	1992	6/17/1992	1,450		2.57	PILF
	2014	6/25/2014	3,020		4.03	PILF	2016	5/29/2016	1,180		2.91	PILF
	2015	6/3/2015	3,400		4.11		2001	8/1/2001	1,120		2.71	PILF
e of Variance Extension	2016	5/29/2016	1,180		2.91	PILF	1988	7/6/1988	927		2.05	PILF
s) from Sando and others	2017	6/15/2017 6/21/2018	4,000		4.39 9.64		1941	6/30/1941 6/20/1972	698		 1.86	PILF
-, canac and outers	2019	5/28/2019	9,820		6.66		1977	7/25/1977	681		1.93	PILF
	_015	-,,,,,,,,,,	-,		0.00			.,,,	50.			

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured freque Even if a table column is not applicable for a given frequency-analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. ncy-analysis worksheets. Also, not all table columns are applicable for each frequency analysis.

06102500 Teton River below South Fork, near Choteau, Montana 06102500 Teton River below South Fork, near Choteau, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019

iysis period of record, water years: 1895 - 2019	
k-flow frequency analysis conducted on recorded data	

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorded data

Peak-flow

designation in analysis⁷ Historic

At-site peak-flow frequency analysis conducted on recorded data

 Table 1-1
 Table 1-2
 Table 1-3
 Table 1-4
 Table 1-5
 Table 1-6
 Table 1-7
 Table 1-8

 [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PLEF; potentially influential low flow; MGBT, multiple Grubbs-Beck
 Table 1-6
 Table 1-7
 Table 1-8

test; - not applicab	le or not available]				-, ,		,,			[Water year is the 1	2-month period from	October 1 through Sep	tember 30 and is desi	gnated by the ye	ar in which it ends;, not app	licable or not availab	le.]			
	Number of											Peak-flo	ow data ⁴				Rank	ed (largest to sma	allest) peak-flow d	data4
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, ir cubic feet pe second	ו זי		Type of pea flow frequency analysis ²	ak- /		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet
- 110	00	01-11	MODT				A 14 -			1948	6/3/1948	2,780		5.32		1964	6/8/1964	54,600	/	
110	30	Station	MGBI				At-site			1949	5/30/1949	515		4.92		2018	6/19/2018	11,100		9.01
66.7	Peak tio	w, in cubic ree	et per second, 1	for indicated an	nual exceeda	ance probabilit	y (bold values),	in percent	0.2	1950	6/21/1950	1,570		6.02		2019	5/2//2019	3,560		7.29
66.7 E44	50	42.9	20	2.590	7 050	14 200	25 400	45.000	0.2	1951	6/15/1951	1,230		3.72		2008	5/20/2008	3,200		7.11 E 22
344	700 and lawar 00 i	090	1,900	3,000	7,950	14,300	25,400	45,000	94,500	1952	5/20/1952	493		4.73		1948	6/3/1948	2,760		5.32
66 7	and lower 90-	12 0	20	10 CUDIC TEEL P						1955	E/20/10E4	2,400		5.21		2011	6/3/1955	2,400		0.07
770	1 1 70	1 42.5	2 200	6 500	16 900	27 200	0.0	221 000	974 000	1954	6/9/106A	54 600	7	5.51	Historic	1050	6/21/1050	1,500		6.02
407	525	1,420	1 160	0,350	4 190	6 400	05,000	12 800	22,000	1904	C /10 /1000	54,000	'	E 01	historic	1930	6/17/2002	1,370		6.02
427	535	600	1,100	2,130	4,160	0,420	9,510	13,800	22,000	1998	6/16/1998 6/E/1000	657		5.21		2002	6/17/2002	1,200		5.70
										2000	6/0/2000	257		4.07		1951	E/20/10E4	1,230		5.21
1,000,000	1 1 1		1 1 1		1 1 1		1 1	_		2000	6/3/2000	525		4.57		2000	5/20/1934	099		5.77
E										2001	6/17/2001	1 280		5.78		2003	6/6/2012	748		5.86
F										2002	E/20/2002	1,200		5.21		2012	E/24/2012	740		5.00
-									-	2003	5/50/2003	270		4.97		2014	5/24/2014	730		5.69
5 100,000									-	2004	6/0/2004	5/5		5.12		2013	6/1/2013	724		5.65
sec	- T	TTTTT								2005	5/20/2005	533		5 11		1000	6/5/1000	657		5 35
be								/ /	-	2000	6/5/2007	385		4.89		1998	6/18/1008	608		5 21
at a									_	2007	E /26 /2007	3 200		7.11		2002	E/20/2002	903		5.21
5 10.000										2000	5/31/2000	088		5.77		2005	6/4/2005	547		5.13
<u>a</u> '									1	2005	6/21/2000	431		5 30		2005	5/20/2005	533		5 11
Ĕ.										2010	6/7/2011	1 000		7.22		2000	6/A/2001	525		5.22
â						and the second se			-	2011	6/6/2012	748		5.86		10/0	5/30/10/0	515		1 92
E 1000						- All and a second s				2012	5/14/2012	724		5.68		1952	5/20/1952	493		4.52
lisee					- Contraction of the Contraction				-	2013	5/24/2013	736		5.00		2015	5/20/2015	433		5.09
ž i										2014	5/29/2015	433		5.09		2015	6/21/2010	431		5.30
ã I		-							-	2015	5/9/2016	281		4 74		2007	6/5/2007	385		4 89
										2010	6/1/2017	706		5.65		2007	6/6/2004	379		4.05
- W									-	2017	6/19/2018	11 100		9.00		2004	6/9/2004	357		4.07
F										2010	5/27/2019	3 560		7 29		2000	5/9/2016	281		4 74
10	9.5 98	95	90 7	5 60	40	20	10 5	1	0.2	2013	5/27/2025	0,000		1.20		2010	5/5/2020	201		
· ·				- ov Annual oxcooda	nco probability	in percent														

Annual exceedance probability, in percent Station - 06102500.00 Teton River bl South Fork nr Choteau MT Station - 06102500.00 EXPLANATION - Fitted frequency: curve - Confidence limits : 5 percent lower, 95 percent upper Historic peaks Geged peak discharge - Censored peak discharge outh -ork m C notesu M1 Peaktry X J J run J/5/201 7:16:36 AM EMA using Station Skew option 149 JSRew (G): Disci – Mean Sq Error (MSE sub G) 0 Zeroes not displayed 0 Zeroes not displayed 0 Gaged peaks below PILF (LO) Threshold 0 Gaged peaks below PILF (LO) Threshold •

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finances.

¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

06102500 Teton River below South Fork, near Choteau, Montana 06102500 Teton River below South Fork, near Choteau, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019

ary 313	periou	or record, we	noi youis. io	55 - 2015		
uency	analys	is conducted	on recorded	and synth	esized data	1

06102500 Teton River below South Fork, near Choteau, Me
Analysis for unregulated period of record
Analysis period of record, water years: 1895 - 2019

Peak-flow frequency analysis conducted on recorded and synthesized data

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 Table1-1
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 Table1-8

 Water years in the Tamoth period from October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MGBT, multiple Grubbs-Beck
 Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Number of			Peak-flo	ow data ⁴				Rank	ed (largest to sma	allest) peak-flow o	lata ⁴	
Contributing recorded Skew type Type of PILF threshold in flow flow applying threshold in thresh	Water	Date ⁵	Peak flow, in cubic feet per	Peak flow qualification	Gage height,	Peak-flow designation in	Water vear	Date⁵	Peak flow, in cubic feet per	Peak flow qualification	Gage height,	Peak-flow designation
miles used in the analysis second analysis ²	,		second	codes	in feet	analysis'	,		second	codes	in feet	in analysis'
140 70 Station MORT	1948	6/3/1948	2,780		5.32		1964	6/8/1964	54,600	7		Historic
Peak flow in cubic feet per second for indicated annual exceedance probability (hold values) in percent	1949	6/21/1949	1 570		4.92		2018	6/19/2018	11 100		9.01	Synthesized
66.7 50 42.9 20 10 42.9 10 0 0.5 0.2	1951	6/15/1951	1,230		5.72		1966		7,920			Synthesized
722 1,060 1,260 2,620 4,620 9,070 14,600 23,000 35,800 63,000	1952	5/20/1952	493		4.73		1986		6,920			Synthesized
Upper and lower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent	1953	6/3/1953	2,400		6.87		1978		4,500			Synthesized
66.7 50 42.9 20 10 4 2 1.0 0.5 0.2	1954	5/20/1954	1,210		5.31	Cunthesized	1969		3,770			Synthesized
900 1,450 1,750 4,010 0,050 20,000 44,400 97,000 215,000 025,000 52,0000 52,0000 52,000 52,000 52,000 52,000 52,000 52,000 52,000 52,00	1955		1,380			Synthesized	2019	5/2//2019	3,560		7.29	Synthesized
	1957		1,450			Synthesized	1979		3,320			Synthesized
	1958		1,670			Synthesized	2008	5/26/2008	3,200		7.11	
1,000,000	1959		1,310			Synthesized	1967		2,890			Synthesized
	1960		1,050			Synthesized	1980	 6/2/1049	2,840			Synthesized
	1962		1.380			Synthesized	1948	0/3/1948	2,760			Synthesized
	1963		1,340			Synthesized	1981		2,550			Synthesized
9 100,000	1964	6/8/1964	54,600	7		Historic	1953	6/3/1953	2,400		6.87	
	1965		2,370			Synthesized	1965		2,370			Synthesized
	1965		2,890			Synthesized	1976		2,100			Synthesized
	1968		638			Synthesized	1982		2,060			Synthesized
	1969		3,770			Synthesized	1989		1,940			Synthesized
	1970		1,550			Synthesized	2011	6/7/2011	1,900		7.23	
	1971		2,070			Synthesized	1995		1,860			Synthesized
	1972		435			Synthesized	1996		1,670			Synthesized
	1974		817			Synthesized	1950	6/21/1950	1,570		6.02	Synthesized
se la	1975		13,300			Synthesized	1997		1,560			Synthesized
× · · · · · · · · · · · · · · · · · · ·	1976		2,100			Synthesized	1970		1,550			Synthesized
	1977		498			Synthesized	1957		1,450			Synthesized
	1978		3,320			Synthesized	1955		1,380			Synthesized
	1980		2,840			Synthesized	1963		1,340			Synthesized
e	1981		2,550			Synthesized	1959		1,310			Synthesized
	1982		2,060			Synthesized	2002	6/17/2002	1,280		5.78	
10	1983		460			Synthesized	1951	6/15/1951	1,230		5.72	
	1984		455			Synthesized	1954	5/20/1954	1,210			Synthesized
Annual exceedance probability, in percent	1986		6,920			Synthesized	1960		1,050			Synthesized
Station - 06102500.01 Teton River below South Fork, near Choteau, Montana	1987		598			Synthesized	2009	5/31/2009	988		5.77	
	1988		237			Synthesized	1990		903			Synthesized
Explanation: — Confidence limits — Fitted Frequency Curve • Gaged Peak Discharge 🔺 Historic Peak O PILF	1989		1,940			Synthesized	1974		817			Synthesized
Figure 1, Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm: Skew(G), analysis	1991		3,530			Synthesized	2012	6/6/2012	748		5.86	Synthesized
skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of	1992		284			Synthesized	2014	5/24/2014	736		5.71	
66.7 percent or less are shown.	1993		754			Synthesized	2013	5/14/2013	724		5.68	
	1994		663			Synthesized	2017	6/1/2017	706		5.65	Synthesized
	1996		1,810			Synthesized	1994	6/5/1999	657		5.35	Synthesizeu
	1997		1,560			Synthesized	1968		638			Synthesized
some — A Histolic peak discharge –	1998	6/18/1998	608		5.21		1998	6/18/1998	608		5.21	
 Vote boilt point and bars represent perception thresholds 	1999	6/5/1999	657		5.35		2003	5/30/2003	608		5.21	Construction of
	2000	6/9/2000	357		4.97		1987		598			Synthesized
	2002	6/17/2002	1,280		5.78		2005	6/4/2005	547		5.13	Synthesized
	2003	5/30/2003	608		5.21		2006	5/20/2006	533		5.11	
= 30,000	2004	6/6/2004	379		4.87		2001	6/4/2001	525		5.22	
"Br	2005	6/4/2005	547		5.13		1949	5/30/1949	515		4.92	Custhesized
	2006	6/5/2007	385		4.89		1977	5/20/1952	490		4 73	Synthesized
	2008	5/26/2008	3,200		7.11		1983		460			Synthesized
	2009	5/31/2009	988		5.77		1985		455			Synthesized
₹	2010	6/21/2010	431		5.30		1973		435			Synthesized
	2011	6/7/2011	1,900		7.23		2015	5/29/2015	433		5.09	
	2012	5/14/2013	724		5.68		2010	6/5/2010	385		5.50 4.89	
Comparison of the second of th	2014	5/24/2014	736		5.71		2004	6/6/2004	379		4.87	
1900 1920 1940 1950 1980 2000 2020 Wide vaar	2015	5/29/2015	433		5.09		2000	6/9/2000	357		4.97	
** a con y and station - 06102500.01	2016	5/9/2016	281		4.74		1984		320			Synthesized
	2017	6/1/2017	706		5.65		1992	 E /0 /2016	284			Synthesized
Figure 2. Annual neak flows and nercention thresholds.	2018	5/27/2018	3.560		7.29		1988	2/3/2010	281		4.74	Synthesized
		-,,+0	-,									

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

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¹⁷Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴⁷Peak-flow data with a value of zero are not polted in figures.
 ⁵¹In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹⁷Definitions of peak-flow dasignations used in analysis include:
 ¹⁸Istoric: The peak flow was collected outside of the saystematic record and is included in the analysis;
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 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

p. https://doi.org/10.3133/tm485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

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Table 1-1 [Water year is the 12-month period from test; – not applicable or not available]

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorder orded data

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> n October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow; MGBT, multiple Grubbs-Beck Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available. Type of peak-Wa ye





		Peak-flo	w data ⁴				Ranke	ed (largest to sma	llest) peak-flow d	ata4	
Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
1908	6/10/1908	2,300				1916	6/21/1916	3,810		7.80	
1909	7/27/1909	1,080				1917	5/26/1917	2,460		6.45	
1910	5/4/1910	525				1908	6/10/1908	2,300			
1911	5/16/1911	820		5.10		1913	6/2/1913	1,410		5.80	
1912	5/22/1912	925		5.40		1909	7/27/1909	1,080			
1913	6/2/1913	1,410		5.80		1912	5/22/1912	925		5.40	
1914	6/4/1914	415		4.76		1911	5/16/1911	820		5.10	
1915	5/9/1915	430		4.75		1925	5/21/1925	642		4.06	
1916	6/21/1916	3,810		7.80		1918	6/10/1918	636		4.25	
1917	5/26/1917	2,460		6.45		1910	5/4/1910	525			
1918	6/10/1918	636		4.25		1924	6/16/1924	502		4.06	
1919	5/23/1919	217		2.82		1920	6/15/1920	432		3.70	
1920	6/15/1920	432		3.70		1915	5/9/1915	430		4.75	
1921	5/20/1921	396		3.59		1914	6/4/1914	415		4.76	
1922	6/5/1922	412		3.74		1922	6/5/1922	412		3.74	
1923	6/16/1923	252		3.24		1921	5/20/1921	396		3.59	
1924	6/16/1924	502		4.06		1923	6/16/1923	252		3.24	
1925	5/21/1925	642		4.06		1919	5/23/1919	217		2.82	

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Number of

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXELY FILE Intensional based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/md455.

p. https://doi.org/10.3133/tm4B5.
Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015-5019-F, 30 p., https://doi.org/10.3133/sir20155019F.

0.2

06103000 Teton River at Strabane, Montana

90 75 60 40 20 10 5 Annual exceedance probability, in percent Station - 06103000.03 Teton River at Strabane, Montana

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

- Confidence limits - Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF

06103000 Teton River at Strabane, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak flow frequency analysis weighted with regional regression equations

Uo 1U3UUU Teton River at Strabane, Montana Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak flow frequency analysis weighted with regional regression equations <u>Table 1-1</u> Table 1-2, Table 1-3, Table 1-4, Table 1-5, Table 1-6, Table 1-7, [Water year is the 12-month period from October 1 through September 30 and is designated by year in which it ends. PILF; potentially influential low test, – not applicable or not available] Table 1-8

	Number of											Peak-flo	ow data ⁴				Rank	ed (largest to sma	llest) peak-flow d	ata ⁴	
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet pe second	r		Type of pea flow frequency analysis ²	K-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	,									1908	6/10/1908	2,300				1916	6/21/1916	3,810		7.80	
124			MGBT				RRE wtd			1909	7/27/1909	1,080				1917	5/26/1917	2,460		6.45	
	Peak flow	w, in cubic fee	t per second, fe	or indicated an	nual exceeda	ance probability	(bold values),	in percent		1910	5/4/1910	525				1908	6/10/1908	2,300			
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1911	5/16/1911	820		5.10		1913	6/2/1913	1,410		5.80	
424	556	655	1,560	3,180	7,460	13,500	22,700	36,600	63,600	1912	5/22/1912	925		5.40		1909	7/27/1909	1,080			
Upper	Upper and lower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent								n percent	1913	6/2/1913	1,410		5.80		1912	5/22/1912	925		5.40	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1914	6/4/1914	415		4.76		1911	5/16/1911	820		5.10	
622	987	1,220	3,090	6,350	15,400	30,200	57,800	109,000	241,000	1915	5/9/1915	430		4.75		1925	5/21/1925	642		4.06	
321	398	449	915	1,770	3,830	6,230	9,250	13,000	18,400	1916	6/21/1916	3,810		7.80		1918	6/10/1918	636		4.25	
										1917	5/26/1917	2,460		6.45		1910	5/4/1910	525			
										1918	6/10/1918	636		4.25		1924	6/16/1924	502		4.06	
1.000.000										1919	5/23/1919	217		2.82		1920	6/15/1920	432		3.70	
.,										1920	6/15/1920	432		3.70		1915	5/9/1915	430		4.75	
-										1921	5/20/1921	396		3.59		1914	6/4/1914	415		4.76	
p î									1	1922	6/5/1922	412		3.74		1922	6/5/1922	412		3.74	
8									/ 1	1923	6/16/1923	252		3.24		1921	5/20/1921	396		3.59	
102										1924	6/16/1924	502		4.06		1923	6/16/1923	252		3.24	
100 000										1925	5/21/1925	642		4.06		1919	5/23/1919	217		2.82	
ă .50,000										1020	-,, 1020	512		1.00			2, 23, 23 23			2.02	



¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXEL: FILF Interstool based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

⁵Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is ⁸available at the NWIS website: <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u> ⁷Definitions of peak-flow designations used in analysis include: Histori: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was odlentified of the manalysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

cubic feet

peak discharge, in (

Annual

10,000 =

1,000

100 -99.5

98 95

Explanation:

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency–Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/mr485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; -, not applicable or not available.]

Note: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given frequency analysis, it is retained in the worksheet for convenience and to maintain consistency among the various similarly structured frequency-analysis worksheets. 06105800 Bruce Coulee tributary near Choteau, Montana 06105800 Bruce Coulee tributary near Choteau, Montana alysis worksheets. Also, not all table columns are applicable for each frequency analysis.

Analysis for unregulated period of record

is	period	of record,	water	years:	1963 -	2002				

06105800 Bruce Coulee tributary near Choteau, Montana

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

 Analysis for unregulated period of record

 Analysis period of record, water years: 1963 - 2002

 At-site peak-flow frequency analysis conducted on recorded data

 <u>Table 1-1</u>
 <u>Table 1-2</u>

 Table 1-3
 <u>Table 1-4</u>

 Table 1-5
 <u>Table 1-6</u>

 Table 1-7
 <u>Table 1-8</u>

 [Water years in the Znomth period from October 1 through September 30 and is designated by the year in which it ends

 text_- not applicable or not available)

Analysis for unregulated period of record	
Analysis period of record water years: 1963 - 200	2

At-site peak-flow frequency analysis conducted on recorded data

Contributing Number of PILI drainage area. recorded Skew type Type of PILF threshol										Peak-flo	w data ⁴				Rank	ed (largest to sma	llest) peak-flow d	ata ⁴			
drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			flow flow frequency analysis ²			Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
										1963	6/28/1963	18	2	0.65		1972	6/9/1972	390		5.06	
1.84	40	Weighted	MGBT				At-site			1964	6/8/1964	148		1.76		1986	9/18/1986	284		2.73	
	Peak flow	v, in cubic feet	per second, t	or indicated anni	lal exceedanc	ce probability (I	bold values), in	n percent		1965	6/16/1965	140		1.90		1966	//2/1966	247		3.50	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1966	//2/1966	247		3.50		1967	6/10/1967	100		2.44	
28	44	53	108	1/4	293	413	505	/55	1,080	1967	6/10/1967	155		2.44		1964	6/8/1964	148		1.76	
Upper	and lower 90-p	ercent contide	nce intervais,	in cubic feet per	second, for in		a exceedance p	probability, in		1968	9/21/1968	15		0.54		1978	//2/19/8	142		2.37	
20	50	42.5	156	292	4	072	1.600	2 500	4 910	1909	7/12/1070	105		1.94		1903	6/21/1001	140		10.00	
30	39	12	70	122	105	973	1,000	2,590	4,610	1970	2/12/1071	20		1.04		1991	6/21/1991	135		2.00	
21	33	40	15	123	195	230	330	411	550	1971	6/0/1072	390		5.06		1973	6/30/19/3	120		2.00	
										1073	4/25/1973	12		0.49		1970	7/13/1970	105		1.84	
10,000 E		1 1	1 1	1 1 1	1 1 1	1	1	1 1		1974	8/13/107/	50		1.08		1987	7/18/1987	99		2 17	
E										1975	6/19/1975	120		2.00		2001	7/31/2001	91		6.75	
F										1976	5/4/1976	37		0.93		1980	5/25/1980	70		2.06	
- E								/		1977	4/5/1977	52		1 15		1995	5/12/1995	67		5.28	
LOO CON										1978	7/2/1978	142		2.37		1985	8/16/1985	60		2.02	
ຶ່ສ 1,000 -										1979	6/18/1979	10		1.34		1977	4/5/1977	52		1 15	
a F							/			1980	5/25/1980	70		2.06		1974	8/13/1974	50		1.08	
F g							/ /			1981	5/24/1981	43		1.84		1981	5/24/1981	43		1.84	
5									-	1982	6/30/1982	110		2.22		1984	6/21/1984	43		1.58	
- 1									-	1983	7/10/1983	40		1.85		1969	3/26/1969	40		0.92	
- 100 -									_	1984	6/21/1984	43		1.58		1983	7/10/1983	40		1.85	
la la					- second					1985	8/16/1985	60		2.02		1976	5/4/1976	37		0.93	
eg –				-						1986	9/18/1986	284		2.73		1997	6/11/1997	37		3.60	
- Sp									-	1987	7/18/1987	99		2.17		1992	7/21/1992	32		3.39	
¥ F									-	1988	5/30/1988	5		2.04		1971	2/13/1971	30		0.83	
10 ∟										1989	8/26/1989	11		2.50		1990	5/25/1990	29		3.25	
E F		//	_							1990	5/25/1990	29		3.25		1993	8/21/1993	26		3.08	
a E		/								1991	6/21/1991	135		10.00		1994	5/19/1994	22		2.94	
-		-							-	1992	7/21/1992	32		3.39		1996	3/10/1996	21		2.90	
									-	1993	8/21/1993	26		3.08		1998	6/17/1998	19		2.85	
1								1 1		1994	5/19/1994	22		2.94		1963	6/28/1963	18	2	0.65	
9	.5 98	95 90	0 7	5 60	40	20 10	5	1	0.2	1995	5/12/1995	67		5.28		2002	6/10/2002	18		2.80	
			,	Annual exceedance	probability, in p	percent				1996	3/10/1996	21		2.90		1968	9/21/1968	15		0.54	
			Station - 06	105800.00 Bruce (Coulee Tributary	y near Choteau N	ИТ			1997	6/11/1997	37		3.60		1973	4/25/1973	12		0.49	
	EXPLANAT	ION			ANAL	YSIS INFO:				1998	6/17/1998	19		2.85		2000	7/8/2000	12		2.52	
	Fitted free	luency curve			Peak	fq v 7.3 run 3/5/2	021 7:16:36 AM			1999	8/11/1999	9.6		2.41		1989	8/26/1989	11		2.50	
	Gaged per	e imits: 5 perci ak discharge	ent lower, 95 pe	acent upper	0.137	' = Skew (G); Mu	Itiple Grubbs-Be	ck		2000	7/8/2000	12		2.52		1979	6/18/1979	10		1.34	
	Dageapor				0 Ze	eroes not display	yed			2001	7/31/2001	91		6.75		1999	8/11/1999	9.6		2.41	
					0 C 0 G	ensored flows b aged peaks belo	elow PILF (LO) TI w PILF (LO) Thre	hreshold eshold		2002	6/10/2002	18		2.80		1988	5/30/1988	5		2.04	

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE3:) record extension procedure; RRE wd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
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 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.



Analysis for unregulated period of record Analysis period of record, water years: 1963 - 2002

halysis period of record, water years: 1963 - 2002	
frequency analysis weighted with regional regression equations	

06105800 Bruce Coulee tributary near Choteau, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 2002 k flow frequency analysis weighted with regional regression equations

		Analysis pe	nou or record,	water years. Is	903 - 2002			Analysis period of record, water years. 1903 - 200
	At-site peal	k flow frequenc	y analysis wei	ghted with regio	onal regressio	n equations		At-site peak flow frequency analysis weighted with regional regr
Table 1	-1 Table 1-2	Table 1-3	Table 1-4	Table 1-5	Table 1-6	Table 1-7	Table 1-8	
[Water year is the 12-month per	od from October 1 throu	gh September 30 a	Ind is designated I	by the year in which	n it ends. PILF; po	k		
test; not applicable or not avail	lable]							[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends;, not applicable or not available.]

Contribution in the second analysis Description in the second analysis Description in the second analysis Pack for in the second analysis Peck		Number of									Peak-fle	ow data ⁴				Rank	ed (largest to sma	allest) peak-flow d	/ata ⁴				
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Contributing rainage area in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PIL threshold ¹	PILF F threshold, in cubic feet per second			flow flow frequency analysis ²			Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis	
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $,									1963	6/28/1963	18	2	0.65		1972	6/9/1972	390		5.06		
$\frac{1}{98} pr. n + 1 \\ pr. n$	1.84			MGBT				RRE wtd			1964	6/8/1964	148		1.76		1986	9/18/1986	284		2.73		
$\frac{1}{90} \cdot \frac{1}{90} $		Peak flow	w, in cubic fee	et per second,	for indicated ann	ual exceedance	e probability	(bold values), in	percent		1965	6/16/1965	140		1.90		1966	//2/1966	247		3.50		
$\frac{1}{9} y = x + y + y + y + y + y + y + y + y + y +$	66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1966	//2/1966	247		3.50		1967	6/10/1967	155		2.44		
$\frac{1}{92} \frac{1}{22} \frac{1}{32} \frac{1}{39} \frac{1}{184} \frac{1}{228} \frac{1}{199} \frac{1}{286} \frac{1}{110} \frac{1}{110$	27	43	52	105	1/U	287	405	550	736	1,040	1967	6/10/1967	155		2.44		1964	6/8/1964	148		1.76		
$\frac{37}{20} + \frac{69}{27} + \frac{69}{48} + \frac{148}{28} + \frac{148}{28} + \frac{147}{140} + \frac{110}{144} + \frac{148}{2664} + \frac{197}{2664} + \frac{191}{142} + \frac{191}$	66 7	1 and lower 90-		20							1968	9/21/1908	15		0.54		1978	//2/19/8 c/1c/10c5	142		2.37		
$\frac{1}{92} \frac{3}{92} \frac{3}{93} \frac{1}{79} \frac{1}{22} \frac{3}{99} \frac{1}{79} \frac{1}{22} \frac{3}{99} \frac{1}{79} \frac{1}{22} \frac{1}{99} \frac{1}{286} \frac{1}{944} \frac{1}{284} \frac{1}{294} \frac{1}$	00.7	50	42.5	149	259	4	747	1.110	1.640	2.690	1969	3/20/1909	40		0.92		1905	6/10/1905	140		1.90		
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	20	37	20	140	200	400	269	245	1,640	2,000	1970	2/12/19/0	105		1.04		1991	6/21/1991	135		2.00		
10,000 10,000	20	JZ	39	70	123	199	200	343	434	304	1971	2/13/13/1	200		0.03 E.06		1973	6/20/1002	120		2.00		
1000 10000 10000 10000 10000 10000 10000											1972	0/9/19/2	390		5.06		1982	7/12/1070	105		2.22		
0.000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0											1975	4/25/19/5 9/12/1074	12		1.09		1970	7/15/19/0	105		1.04		
Degr 1	10,000 =									-	1974	6/10/1075	120		2.00		2001	7/20/1987	01		6.75		
Dependent 1	E									3	1975	E/4/1076	27		2.00		1090	E /2E /1090	70	-	2.06		
000 1 1 197 7/1/197 142 - 1,27 1935 8/1/1935 00 - 202 000 1 1978 7/1/1978 142 - 1,27 1935 8/1/1935 00 - 202 1979 6/1/1979 6/1/1979 6/1/1970 7/1/1970 142 - 1,27 1935 8/1/1935 00 - 202 1979 6/1/1970 1970 6/1/1970 7/1/1970 7 - 106 197 6/1/1970 116 - 116 1980 5/2/1980 70 - 126 1984 6/2/1984 43 - 188 1992 6/3/1982 110 - 222 1984 6/2/1984 43 - 188 1984 6/2/1/1984 43 - 158 1986 8/16/1985 60 - 202 197 7/2/1/198 30 - 0.83 1984 6/2/1/1984 43 - 2.04 1970 6/1/1/1997 37 -											1970	3/4/15/0 4/5/1077	52		1 15		1980	5/23/1980 E/12/100E	67		5.00		
and the first second se										/ 1	1979	7/2/1078	1/2		2 37		1995	8/16/1985	60		2.02		
$ \frac{1}{1000} + \frac{1}{10000} + \frac{1}{10000000000000000000000000000000000$											1979	6/18/1070	10		1 3/		1977	1/5/1077	52		1 15		
a nul	4 000										1090	E/2E/1020	70		2.06		1074	9/12/1074	50		1.10		
by of the set of t	1,000 F										1980	5/23/1980	/0		2.00		1974	5/24/1081	43		1.00		
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10 1001 6/2/1/1991 135 10.00 1994 5/19/1994 22 2.94 10 1992 7/21/1992 32 3.98 1996 3/10/1996 21 2.94 1992 7/21/1992 32 3.98 1996 6/28/1963 18 2 0.65 1994 5/19/194 22 2.94 1963 6/28/1963 18 2 0.65 1995 5/12/1995 67 5.28 2002 6/10/2002 18 0.54 1996 3/10/1996 21 2.85 2001 7/8/2000 1997 37 3.60 1968 9/21/1988 15 0.54 1997 6/11/1997 37 3.60 1973 4/25/1973 12 0.54 1997 6/11/1997 37 2.85 2000 7/8/2000 12 2.85 2000 7/8/2000 12 2.52										1	1990	5/25/1990	29		3.25		1993	8/21/1993	26		3.08		
Image: Note of the second s					••••					1	1991	6/21/1991	135		10.00		1994	5/19/1994	22		2 94		
G 1993 8/21/1993 26 - 3.08 1998 6/17/1998 19 - 2.85 1994 5/19/1994 22 - 2.94 1963 6/28/1963 18 2 0.65 1995 5/12/1995 5/12/1995 67 - 5.28 2002 6/10/2002 18 - 0.49 1996 3/10/1996 21 - 2.80 1968 9/21/1968 15 - 0.54 1997 6/11/1997 37 - 3.60 1973 4/25/1973 12 - 0.49 1997 6/11/1987 199 9.6 - 2.85 2000 7/8/2000 12 - 2.52 99.5 98 95 90 75 60 40 20 10 5 1 0.2 2000 7/8/200 12 - 2.52 99.5 98 95 90 75 60 40 20 10 5 1 0.2 2000 7/8/2000 12 - 2.52	10										1992	7/21/1992	32		3.39		1996	3/10/1996	21		2.01		
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1 1	2										1996	3/10/1996	21		2.90		1968	9/21/1968	15		0.54		
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Image: Station - OstoSB00 28 Bruce Coules tributary near Choteau. Montana 2000 7/8/2000 12 2.50 7/9/2000 12 2.50 7/9/2000 12 2.50 99.5 98 95 90 75 60 40 20 10 5 1 0.2 2000 7/8/2000 12 2.52 1979 6/8/1979 10 1.34 Station - Osf05800.038 Bruce Coules tributary near Choteau. Montana 2001 7/31/2001 91 2.41 1989 8/12/1999 1.34 Station - Osf05800.038 Bruce Coules tributary near Choteau. Montana 2001 7/31/2001 91 - 6.75 1999 8/11/1999 9.6 - 2.41	1										1998	6/17/1998	19		2.85		2000	7/8/2000	12		2.52		
99.5 98 95 90 75 60 40 20 10 5 1 0.2 2000 7/8/2000 12 2.52 1979 6/18/1979 10 1.34 Annual exceedance probability, in percent 2001 7/31/2001 91 6.75 1999 8/11/1999 9.6 2.41 Station - 06105800.03 Bruce Coule et ributary mean Choteau, Montana 2002 6/10/2002 18 2.40	1°E										1999	8/11/1999	9.6		2.00		1989	8/26/1989	11		2.50		
Annual exceedance probability, in percent 2001 7/31/2001 91 6.75 1999 8/11/1999 9.6 2.41 Station - 06105800.03 Bruce Coulee tributary near Choteau. Montana 2002 6/(0/2002 18 2.80 1000 5/20/1900 5 2.04		99.5 98	95	90	75 60	40	20 1	0 5	1	0.2	2000	7/8/2000	12		2.52		1979	6/18/1979	10		1.34		
Station - 06105800.03 Bruce Coulee tributary near Choteau Montana 2007 6/0/2002 18 - 2.80 1000 E/20/1353 5.0 - 2.41		55.5 50	55	Annı	al exceedance	probability	in percent				2000	7/31/2000	91		6.75		1999	8/11/1999	9.6		2.41		
			Statio	on - 0610580	0.03 Bruce Co	ulee tributar	v near Cho	teau. Montana	1		2001	6/10/2002	18		2.80		1999	5/30/1099	5.0		2.41		

🗕 Confidence limits 🗕 Fitted Frequency Curve 🏮 Gaged Peak Discharge 🔺 Historic Peak O PILF Explanation:

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-alte: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE:3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

⁵Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is ⁸available at the NWIS website: <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u> ⁷Definitions of peak-flow designations used in analysis include: Histori: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was odlentified of the manalysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

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06106000 Deep Creek near Choteau, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> n October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MGBT, multiple Grubbs-Beck Table 1-1 is the 12-[Water year is the 12-month period fro test; - not applicable or not available]

06106000 Deep Creek near Choteau, Montana Analysis for unregulated period of record

Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on rerded data

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.] Peak-flow data Ranked (largest to smallest) peak-flow data⁴ Number of PILF Type of peakrecorded peak flows used in the Skew type used in analysis Uppe of PILF threshold, in threshold¹ threshold¹ cubic feet per second Gage height, in feet Gage height, in feet Peak flow, in cubic feet per Peak flow qualification Peak-flow Peak flow, in cubic feet per Peak flow qualification Peak-flow flow frequency Water Water designation in analysis⁷ Date Date⁵ designation in analysis⁷ year year second codes⁶ second codes⁶ second analysis analysis 5/16/1911 1911 582 7.30 1964 6/8/1964 41,800 Historic 7 8.40 7.45 6.50 6.60 Weighted MGBT At-site 1912 5/21/1912 1,460 1916 6/21/1916 3,700 10.50
 Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent

 50
 42.9
 20
 10
 4
 2
 1.0
 0.5
 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1964 5/30/1913 5/25/1914 644 212 1917 1912 1920 1913 1911 1921 1921 1922 1923 1924 1915 1914 1919 5/26/1917 2,150 9.10 8.40 **0.2** 57,100 5/21/1912 1,460 1,420 7,770 12,900 20,800 1,910 3,680 32,500 260 3,700 2,150 477 84 1,420 490 465 361 304 41,800 8.35 7.45 7.30 7.15 7.10 6.85 6.70 6.60 6.50 5.93 764 7/26/1915 4/13/1920 7/26/1915 6/21/1916 5/26/1917 1/1/1918 3/23/1919 4/13/1920 5/19/1921 6/10/1922 7/8/1923 6/9/1924 6/8/1964 4/13/1920 5/30/1913 5/16/1911 5/19/1921 1/1/1918 6/10/1922 7/8/1923 6/9/1924 7/26/1915 5/25/1914 3/23/1919 Upper and lower 66.7 50 659 1,140
 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent

 42.9
 20
 10
 4
 2
 1.0
 0.5
 0.2

 1,450
 3,750
 7,480
 17,200
 31,900
 59,600
 113,000
 269,000
 10.50 9.10 7.10 5.93 8.35 7.15 7.10 6.85 6.70 644 582 490 477 465 361 304 260 212 84 337 420 988 1,790 3,380 5,130 7,510 10,700 16,600 7 Histori



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXELY FILE Intreshold based on a systematic peak now selected by the peak-now irrequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

⁵Irood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website: <u>https://www.waterdata.usps.gov/nwis/peak/fleep</u> ⁷Definitions of peak-flow das collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was identified as a potentially influential low flow; PILF: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Contributing drainage area, in square miles

269

66.7

199

357

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

p., https://doi.org/10.3133/tm4B5. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018) : U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

06106000 Deep Creek near Choteau, Montana

06106000 Deep Creek near Choteau, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak flow frequency analysis weighted with regional regression equations

Uo 105000 Deep Creek near Choteau, Montana Analysis for unregulated period of record Analysis period of record, water years: 1895-2019 At-site peak flow frequency analysis weighted with regional regression equations <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential test; - not applicable or not available] Table 1-8 multiple Grubbs-Beck

ot available		-8		-, ,	,	,,		,	[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends;, not applicable or not available.]													
umber of										llest) peak-flow da	v data ⁴											
ecorded ak flows ed in the	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second		Type of peak- flow frequency analysis ²					Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷		
naryolo									1911	5/16/1911	582		7.30		1964	6/8/1964	41,800	7		Historic		
		MGBT				RRE wtd			1912	5/21/1912	1,460		8.40		1916	6/21/1916	3,700		10.50			
Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent										5/30/1913	644		7.45		1917	5/26/1917	2,150		9.10			
50	42.9	20	10	4	2	1.0	0.5	0.2	1914	5/25/1914	212		6.50		1912	5/21/1912	1,460		8.40			
600	751	1,780	3,200	6,070	9,350	13,800	20,100	32,000	1915	7/26/1915	260		6.60		1920	4/13/1920	1,420		8.35			
lower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent									1916	6/21/1916	3,700		10.50		1913	5/30/1913	644		7.45			
50	42.9	20	10	4	2	1.0	0.5	0.2	1917	5/26/1917	2,150		9.10		1911	5/16/1911	582		7.30			
060	1,320	3,100	5,510	10,800	17,600	28,100	45,200	84,400	1918	1/1/1918	477		7.10		1921	5/19/1921	490		7.15			
351	439	1,040	1,850	3,380	4,940	6,820	9,270	13,300	1919	3/23/1919	84		5.93		1918	1/1/1918	477		7.10			
									1920	4/13/1920	1,420		8.35		1922	6/10/1922	465		7.10			
									1921	5/19/1921	490		7.15		1923	7/8/1923	361		6.85			
									1922	6/10/1922	465		7.10		1924	6/9/1924	304		6.70			
								/ 1	1923	7/8/1923	361		6.85		1915	7/26/1915	260		6.60			
									1924	6/9/1924	304		6.70		1914	5/25/1914	212		6.50			
									1964	6/8/1964	41,800	7		Historic	1919	3/23/1919	84		5.93			

Explanation:

Number of recorded peak flows used in the analysis

Contributing drainage area, in square miles

269

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXEL: FILF Interstool based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

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References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency–Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/mr485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

– Confidence limits – Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF

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[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak-flow frequency analysis conducted on recorder ded data

Ub1Ub3UU Muddy Creek near Bymm, Montana Analysis for unregulated period of record Analysis period of record Analysis period of record, water years: 1913 - 1924 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends.

	Number of									Peak-flow data ⁴							Ranked (largest to smallest) peak-flow data ⁴						
Contributing drainage area, in square miles	recorded peak flows used in the	Skew type used in analysis	Type of PILI threshold ¹	PILF F threshold, in cubic feet per second		Type of peak- flow frequency analysis ²				Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷		
	anarysis									1913	6/27/1913	320				1916	6/21/1916	976					
72.1	10	Weighted	MGBT				At-site			1914	6/14/1914	12				1917	5/26/1917	720					
	Peak flow	v, in cubic fee	t per second,	for indicated ann	nual exceeda	nce probability	(bold values),	in percent		1915	8/2/1915	6				1920	4/14/1920	519					
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1916	6/21/1916	976				1913	6/27/1913	320					
46	95	130	413	904	2,110	3,690	6,110	9,750	17,300	1917	5/26/1917	720				1918	12/31/1917	152					
Upper	Upper and lower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent										12/31/1917	152				1924	6/9/1924	96		3.60			
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1920	4/14/1920	519				1923	7/8/1923	43		2.76			
115	246	344	1,420	4,520	19,300	55,600	156,000	426,000	1,570,000	1922	6/11/1922	31		2.47		1922	6/11/1922	31		2.47			
16	36	50	158	329	693	1,090	1,590	2,220	3,240	1923	7/8/1923	43		2.76		1914	6/14/1914	12					
										1924	6/9/1924	96		3.60		1915	8/2/1915	6					



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

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¹⁷Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website:
 https://mwis.waterdata.usgs.gov/mwis/peak?help
 ⁷Definitions of peak-flow designations used in analysis include:
 https://wis.waterdata.usgs.gov/mwis/peak?help
 ⁷Definitions of peak-flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

06106500 Muddy Creek near Bynum, Montana

Us 10050U Muddy Creek near Bynum, Montana Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak flow frequency analysis weighted with regional regression equations <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential kw flow; MGBT, multiple Grubbs-Beck test; – not applicable or not available]

06106500 Muddy Creek near Bynum, Montana

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak flow frequency analysis weighted with regional regression equations

	Number of											Peak-flo	w data⁴				Ranked (largest to smallest) peak-flow data ⁴						
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			Type of peak flow frequency analysis ²	/pe of peak- flow frequency analysis ²			Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷		
										1913	6/27/1913	320				1916	6/21/1916	976					
72.1			MGBT				RRE wtd			1914	6/14/1914	12				1917	5/26/1917	720					
Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent											8/2/1915	6				1920	4/14/1920	519					
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1916	6/21/1916	976				1913	6/27/1913	320					
66	144	197	634	1,300	2,560	3,840	5,390	7,510	11,200	1917	5/26/1917	720				1918	12/31/1917	152					
Upper and lower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent									1918	12/31/1917	152				1924	6/9/1924	96		3.60				
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1920	4/14/1920	519				1923	7/8/1923	43		2.76			
148	311	423	1,360	2,780	5,660	9,090	14,000	21,700	38,100	1922	6/11/1922	31		2.47		1922	6/11/1922	31		2.47			
27	66	93	320	671	1,300	1,850	2,420	3,100	4,040	1923	7/8/1923	43		2.76		1914	6/14/1914	12					
										1924	6/9/1924	96		3.60		1915	8/2/1915	6					



Explanation: – Confidence limits – Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

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FIXEL: FILF Intreshold based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not plotted in finures.

⁵Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is ⁸available at the NWIS website: <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u> ⁷Definitions of peak-flow designations used in analysis include: Histori: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was odlentified of the manalysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.
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06107000 North Fork Muddy Creek near Bynum, Montana

UD 1U/UUU NOTIT FOTK MUIddy Creek near Bynum, Montana Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak-flow frequency analysis conducted on recorded dat <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow; MGBT, multiple Grubbes-Beck test_ - not application or not available]

06107000 North Fork Muddy Creek near Bynum, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak-flow frequency analysis conducted on recorder

rded data

test; - not applicab	not applicable or not available]									[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends;, not applicable or not available.]											
	Number of											Peak-fle	ow data ⁴		Ranked (largest to smallest) peak-flow data ⁴						
Contributing drainage area, in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			Type of peak flow frequency analysis ²	-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
	anaryoro									1913	4/7/1913	91		3.30		1916	6/21/1916	600		5.85	
55.8	11	Weighted	MGBT				At-site			1914	10/13/1913	40		2.70		1917	6/1/1917	352		5.03	
Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent								1915	8/1/1915	118		3.35		1920	5/12/1920	212		4.26			
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1916	6/21/1916	600		5.85		1915	8/1/1915	118		3.35	
45	80	101	240	429	797	1,190	1,710	2,380	3,550	1917	6/1/1917	352		5.03		1922	4/29/1922	102		3.70	
Upper	and lower 90-p	percent confid	ence intervals,	in cubic feet per	r second, for	indicated annu	al exceedance	probability, ir	n percent	1919	11/13/1918	9		3.12		1924	6/8/1924	92		3.55	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1920	5/12/1920	212		4.26		1913	4/7/1913	91		3.30	
90	161	208	601	1,400	3,970	8,360	17,200	34,400	84,500	1921	5/7/1921	9		2.88		1923	7/9/1923	68		3.50	
20	39	50	119	205	353	488	639	805	1,040	1922	4/29/1922	102		3.70		1914	10/13/1913	40		2.70	
										1923	7/9/1923	68		3.50		1919	11/13/1918	9		3.12	
100.000 -										1924	6/8/1924	92		3.55		1921	5/7/1921	9		2.88	



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

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 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency–Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/mr485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

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0510//000 North Fork Muday Creek near Bynum, Montana Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak flow frequency analysis weighted with regional regression equations <u>Table 1-2</u> Table 1-3 Table 1-4 Table 1-5 Table 1-6 Table 1-7. n October 1 through September 30 and is designated by the year in which it ends. PILF: potentially influentia

06107000 North Fork Muddy Creek near Bynum, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1913 - 1924 At-site peak flow frequency analysis weighted with regional regress ion equations

ted by the year in which it ends; --, not applicable or not available.]

Table 1-8 w flow; MGBT, multiple Grubbs-Beck

[Water year is the 12-month period from October 1 through September 30 and

2-month period fro e or not available] [Water year is th test; -- not applic Ranked (largest to smallest) peak-flow data⁴ Number of recorded peak flows used in the analysis Peak-flow data Contributing drainage area, in square miles Skew type PILF used in Type of PILF threshold, in threshold¹ cubic feet per second Type of peak-Peak-flow designation in analysis⁷ Gage height, in feet Gage height, in feet Peak flow, in cubic feet per Peak flow qualification Peak-flow Peak flow, in cubic feet per Peak flow qualification flow frequency Water designation in analysis⁷ Water Date⁵ Date⁵ year year second codes66 second codes⁶ analysis 4/7/1913 6/21/1916 1913 91 3.30 1916 600 5.85 ---RRE wtd ---55.8 MGBT 1914 1915 1916 1917 1919 1920 1921 1922 1923 1924 10/13/1913 40 118 2.70 3.35 5.85 5.03 3.12 4.26 2.88 3.70 3.50 3.55 1917 1920 1915 1922 1924 1913 1923 1914 1919 1921 6/1/1917 5/12/1920 352 212 5.03 4.26 3.35 3.70 3.55 3.30 3.50 2.70 3.12 2.88
 Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent

 50
 42.9
 20
 10
 4
 2
 1.0
 0.5
 8/1/1915 6/21/1916 0.2 **66.7** 600 352 8/1/1915 118 102 92 91 68 40 9 9 ---8/1/1913 4/29/1922 6/8/1924 4/7/1913 7/9/1923 10/13/1913 11/13/1918 5/7/1921 6/1/1917 11/13/1918 5/12/1920 5/7/1921 4/29/1922 7/9/1923 6/8/1924
 IO1

 Upper and lowe

 66.7
 50

 101
 455
 3,010 1,420 6,040 r 90-percent co 358 2,150 ,16 als, in cubi et per sec 0.5 0.5 11,100 9 212 nte 20 690 for indi in percer 0.2 18,900 7,260 **10** 1,410 2,940 242 9 102 68 92 27 54 71 204 409 800 1,150 1,520 1,960 2,550



Confidence limits — Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF Explanation:

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

Table 1-1

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^aFlood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
 ^aPeak-flow data with a value of zero are not plotted in figures.
 ^bIn cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ^bQualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NWIS website:
 <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u>
 ^bDefinitions of peak-flow designations used in analysis include:
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 Opportunistic: The peak flow was excluded from the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PULF: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

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Date

7/17/1955

8/4/1956

5/23/1957

6/21/1958

3/19/1959

5/4/1960 6/1/1961 5/28/1962 6/9/1964 6/17/1963 7/2/1966 6/14/1967 9/24/1968 3/19/1969 6/15/1970 6/15/1970 6/10/1972 4/17/1973 6/24/1974 6/20/1975 5/6/1976

3/20/1978

3/7/1979 5/26/1980

5/24/1981

7/1/1982 5/13/1983

5/15/1984

9/19/1985 2/26/1986 5/30/1987 5/30/1987 3/24/1989 5/31/1990 6/22/1991 6/22/1991 6/2/1991 5/21/1994 6/8/1995 3/13/1996 5/27/1997 6/18/1998 6/5/1999 6/3/2000 4/10/2001

3/16/2003

5/25/2004

6/6/2005

6/11/2006

4/21/2007 5/27/2008 5/5/2009

5/5/2009 5/30/2010 6/10/2011 6/8/2012 6/21/2013 6/21/2014 6/7/2015 5/25/2016 3/16/2017 6/21/2018 5/28/2019

3,000 2,490 2,180

1,690 276 178

70 1,220

1,050

1,2

--1,2

6.39

6.01

5.35 2.57

2.20 2.64 11.52 2.10 3.02 2.10 5.04 3.69 7.77 2.27 3.50 3.22 5.62 5.40 3.79 3.08 1.98 2.42 7.07 3.82 2.42 2.22 2.66

3.66

--5.21 4.87

3.19 9.23 2.71 3.25 3.88 2.76 2.18 4.07 9.83 12.15

Water

year

1955

1956

06108000 Teton River near Dutton, Montana

Analysis IO	unieguiateu perioù oi	record
Analysis period o	f record, water years:	1895 - 2019

06108000 Teton River	near Dutton,	Monta	na
Analysis for unregul	ated period of	record	ł
Apply aid pariod of record	water waara	1005	20

period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on rec orded data

Gage height, in feet

20.48

14.80

12.00

12.15

11.52

9.83 8.30 9.23

7.77

6.22 6.39 11.60 7.07 6.01 6.50 5.47 7.62 5.35 5.04 5.62 5.04 5.62 5.40 5.96 5.21 5.20 5.96

4.87

7.06

3.69 3.79 3.82 4.07 4.88 3.88 3.66 3.50 3.22 3.09 3.08 3.02

3.19

3.25 2.65

2.57

2.64 3.89 2.66

2.42 2.76 2.71 2.20 2.22 2.27 2.10 1.98 2.18

Peak-flow

designation in analysis⁷

Peak flow, in cubic feet per

second

71,300

16,000

8,580

7,380

7,290

4,720 4,340 4,240 3,500 3,230 2,540 2,300 2,240 2,240 2,240 2,240 2,240 1,730 1,700 1,690 1,570

1,490 1,440

1,310

1,220 1,210

1,200

272

258 247

5/27/2008 5/27/1997

6/15/1970

5/23/1957 5/5/2009 7/17/1955 3/19/1959 8/4/1956 5/4/1960 5/31/1990 6/18/1988 3/16/2003 3/16/2003 3/16/2003 3/16/2017 6/24/1974 6/21/214 6/21/2014 6/21/2014

6/5/1999 5/30/1987 6/1/1961

5/30/2010

6/21/2013

4/7/1977

5/13/1983

9/19/1985 4/17/1973

6/6/2005

6/6/2005 4/10/2001 6/7/2015 6/8/2012 5/15/1984 5/25/2004 6/17/1992 6/30/1988 6/3/2000 5/25/2016 4/21/2007

Peak flow qualification

codes⁶

-

1,2

--1,2

----------2

2

1,2

Al-site peak-flow frequency analysis conducted on recorded data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MGBT, mu Table 1-1 Itiple Grubbs-Beck is the 12-[Water year is the test; - not application of the test is not application of the test is t month period fro or not available]





Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analys skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities o 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

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²Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
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 PILF: The peak flow was identified as a potentially influential low flow;
 Swittesized: The neak flow was synthesized: using Maintenance of Variance Extension Type III record extension.

esized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension. Synth

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm4B5.

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[Water year is the 12-month period from October 1 through September 30 and is design ated by the year in which it ends; --, not applicable or not available. Ranked (largest to smallest) peak-flow data⁴ Peak-flow data Gage height, in feet Peak flow, in cubic feet per Peak flow Peak-flow Water qualification designation in analysis⁷ Date⁵ year second codes⁶ 1,040 1964 6/9/1964 ____ 875 1975 6/20/1975 1966 2019 1986 1,100 1,310 7/2/1966 5.96 5/28/2019 975 744 376 1,040 1,000 2,000 8,580 2,540 410 3,500 1,200 1,700 2,300 2,502 2/26/1986 6/21/2018 3/20/1978 6/10/2011 --7.06 20.48 6.50 12.00 6.22 3.09 3/19/1969 6/22/1991 3/7/1979 6/14/1967 5/26/1980 6/10/1972 6/11/2002 5/24/1981 6/17/1965 5/6/1976 6/2/1971 7/1/1982 3/24/1989 6/8/1995 3/13/1996 1,2 2 ----------5.96 7.62 11.60 3.89 4.88 14.80 5.47 2.65 16.000 1,730 304 4,340 8.30 6/21/1958

quency analysis, it is retained in the worksheet for cor and to maintain consistency among the various simil ite: Not all footnotes are applicable for each frequency analysis. Even if a footnote is not applicable for a given freq en if a table column is not applicable for a given frequency analysis, it is retained in the worksheet for convenience

Date

Water

year

1948

06108000 Teton River near Dutton, Montana

Table 1-8 flow; MGBT, m

iple Grubbs-Beck

Analysis for unregulated period of record

Analysis period of record, water years: 1895 - 2019													
Peak-flow frequency analysis conducted on recorded and synthesized data													
Table 1-2	Table 1-3	Table 1-4	Table 1-5	Table 1-6	Table 1-7								
October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential low													

06108000 Teton River near Dutton, Montana
Analysis for unregulated period of record
Analysis period of record, water years: 1895 - 2019

Peak-flow

designation in analysis⁷

Synthesized

Synthesized

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Peak flow

qualification

codes⁶

Gage height, in feet

...

Peak-flow data

Peak flow, in cubic feet per

second

2,990

216

1,490 1,440

1,210 611

384 124 211

2,240

4,720 7,380

1,2 ------------

3.08 1.98 2.42 7.07

3.82 2.22 2.66 3.66

5.21 4.87 3.19 9.23 2.71 3.25 3.88 2.76 2.18 4.07

9.83

12.15

3/13/1996

5/27/1997

6/18/1998

6/5/1999

6/3/2000

4/10/2001

6/11/2002

3/16/2003 5/25/2004

6/6/2005 6/11/2006 4/21/2007 5/27/2008 5/5/2009 5/30/2010 6/10/2011 6/8/2012 6/21/2013 6/21/2015 5/25/2016 3/16/2017

6/21/2018 5/28/2019

Peak-flow frequency analysis conducted on recorded and synthesized data

Water

year

1964

1975

1966 2019 1986

Date⁵

6/9/1964

6/20/1975

7/2/1966

5/28/2019

2/26/1986

6/21/2018 3/20/1978 6/10/2011

3/19/1969 6/22/1991 3/7/1979

6/14/1967 5/26/1980

6/10/1972 6/11/2002 5/24/1981 6/17/1965 5/6/1976

6/2/1971 7/1/1982 3/24/1989

6/8/1995

3/13/1996 6/21/1958

5/27/2008

5/27/1997 6/15/1970

5/23/1957 5/5/2009 7/17/1955 5/28/1962 2/7/1963 3/19/1959 8/4/1956

--5/4/1960 5/31/1990 6/18/1998 3/16/2003 3/16/2017 6/24/1974 6/21/2014 6/11/2006 9/7/1993

5/21/1994

9/24/1968

6/5/1999

5/30/1987

6/1/1961

5/30/2010

6/21/2013 4/7/1977 5/13/1983 9/19/1985 4/17/1973 6/6/2005

4/10/2001

--6/7/2015 6/8/2012 5/15/1984 5/25/2004 6/17/1992 6/30/1988 6/3/2000 5/25/2016 4/21/2007

Ranked (largest to smallest) peak-flow data⁴

Peak flow qualification

codes⁶

-

1,2

1,2 ----------

2

2

Peak flow, in cubic feet per

second

71,300

16,000

8,580

7,380

7,290

4,720 4,340 4,240 3,500 3,200 2,540 2,540 2,380 2,240 2,380 2,240 2,180 2,000 1,730 1,700 1,570

1,490 1,440 1,310

1,230

1,220 1,210

379

376 360 322

92 70

1,2

Gage height, in feet

20.48

14.80

12.00

12.15

11.52

9.83 8.30 9.23

7.77

6.22 6.39

11.60 7.07 6.01 6.50 5.47 7.62 5.35 5.04 5.62 5.40 5.96

5.21

5.20 5.96

--4.87

7.06

3.69 3.79 3.82 4.07 4.88 3.88 3.66 3.50 3.22 3.09 3.08 3.02

--3.19 3.25 2.65 2.57 2.64 3.89 2.66

2.42

2 76

2.71 2.20 2.22 2.27 2.10 1.98 2.18

Synth

Peak-flow

designation in analysis⁷

Synthesized

Synthes

Synthes Synthes

[Water year is th test; - not applic e or not available Number of Contributing drainage area, PILF Type of peakrecorded peak flows used in the Skew type used in analysis Type of PILF Type of PILF threshold, in cubic feet per second flow frequency in square miles second analysis analysis 1,238 Statio MGBT MOVE
 Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent

 50
 42.9
 20
 10
 4
 2
 1.0
 0.5
 66.7 0.2 16,600 9,960 26,800 4,710 42,10 74,500 466 78 2,440 Upper and low 66.7 50 609 1,040
 90-percent confidence intervals, in cubic feet per second

 42.9
 20
 10
 4

 1,320
 3,500
 7,470
 19,600
 exceedance probability 1.0 0.5 83,900 173,000 in percent for indicated an 0.2 451,000 40,500 356 734 1,780 3,240 6,150 9,320 13,600 19,200 29,100 588 1,000,000 second 100.000 per feet cubic 10,000 -





Figure 2. Annual peak flows and perception thresholds.

Table 1-1

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

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p., mps.//uoi.org/10.3133/tm485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p. https://doi.org/10.3133/sir20155019F.

*Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
*Peak-Row data with a value of zero are not polletad in figures.
⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
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Historic: The peak flow was collected outside of the systematic record and is included in the analysis;
Opportunistic: The peak flow was collected period.
PILF: The peak flow was identified as a potentially influential low flow;
Swithesizet: The peak flow was identified as a potentially winfluence of Variance Extension Twee III record extension.

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Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak-flow frequency analysis conducted on recorder rded data

06108200 Kinley Coulee near Dutton, Montana Analysis for unregulated period of record Analysis period of record ywater years: 1963 - 1978 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PLF; potentially influential low flow; MGBT, mutast, – not applicable or not available]

A available	1								Water year is the 12-month period from October 1 anough dependent of and is designated by the year in which it ends,, not applicable of not available.]													
mber of	er of DILE Type of peak-										Peak-flo	ow data ⁴				Ranked (largest to smallest) peak-flow data ⁴						
corded ak flows ed in the	Skew type used in analysis	Type of PILF threshold ¹	PILF threshold, in cubic feet per second			Type of pea flow frequency analysis ²	ık- '		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷		
alysis									1963		0	Bm		PILF	1966	7/2/1966	2,070		10.72			
16	Weighted	FIXED	5.00			At-site			1964	6/21/1964	364		8.00		1964	6/21/1964	364		8.00			
Peak fle	ow, in cubic fee	t per second, fo	or indicated ann	nual exceeda	nce probability	y (bold values),	in percent		1965	6/16/1965	24		1.39		1973	8/24/1973	278		6.34			
50	42.9	20	10	4	2	1.0	0.5	0.2	1966	7/2/1966	2,070		10.72		1975	5/7/1975	205		4.96			
21	34	202	655	2,280	5,100	10,500	20,300	45,100	1967	5/7/1967	20		1.31		1969	3/20/1969	182		4.45			
ower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent						1968	9/21/1968	1		0.58	PILF	1978	3/18/1978	133		3.49						
50	42.9	20	10	4	2	1.0	0.5	0.2	1969	3/20/1969	182		4.45		1974	1/16/1974	30		1.54			
56	100	1,090	5,940	53,400	276,000	1,380,000	6,610,000	44,700,000	1970	6/13/1970	1		0.63	PILF	1976	3/19/1976	30		1.52			
1.0	3.7	63	189	522	966	1,640	2,600	4,420	1971	2/13/1971	5	2	2.01		1965	6/16/1965	24		1.39			
									1972	3/18/1972	1		0.37	PILF	1967	5/7/1967	20		1.31			
									1973	8/24/1973	278		6.34		1971	2/13/1971	5	2	2.01			
1									1974	1/16/1974	30		1.54		1968	9/21/1968	1		0.58	PILF		
									1975	5/7/1975	205		4.96		1970	6/13/1970	1		0.63	PILF		
									1976	3/19/1976	30		1.52		1972	3/18/1972	1		0.37	PILF		
									1977		0	Bm		PILF	1963		0	Bm		PILF		
									1978	3/18/1978	133		3.49		1977		0	Bm		PILF		



Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Number of

recorded peak flows used in the analysis

Contributing drainage area, in square miles

66.7

14.4

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXELY FILE Intensional based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures.

¹⁷Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
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 ⁷Definitions of peak-flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
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References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/md455.

p. https://doi.org/10.3133/tm485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018) : U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

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Water

year

1963

06108200 Kinley Coulee near Dutton, Montana

06108200 Kinley Coulee near Dutton, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak flow frequency analysis weighted with regional regress

sion equations

Water

year

1966

Date⁵

7/2/1966

6/21/1964 8/24/1973

5/7/1975

5//19/5 3/20/1969 3/18/1978 1/16/1974 3/19/1976 6/16/1965 5/7/1967 2/13/1971 9/21/1968 6/13/1970 3/18/1972

Peak-flow

designation in analysis⁷

PILF

PILF

PILF

PILF

PILF

Ranked (largest to smallest) peak-flow data⁴

Peak flow qualification

codes⁶

------2

Bm Bm

Peak flow, in cubic feet per

second

2,070

364 278

5

Gage height, in feet

10.72

8.00 6.34 4.96 4.45 3.49 1.54 1.52 1.39 1.31 2.01 0.58 0.63 0.37 -

PILF PILF PILF PILF PILF

Peak-flow

designation in analysis⁷

Analysis for unregulated period of record Analysis period of record, water years; 1963 - 1978 Analysis period of record, water years; 1963 - 1978 Al-site peak flow frequency analysis weighted with regional regression equations Table 1-2, Table 1-3, Table 1-4, Table 1-5, Table 1-6, Table 1-7, October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential Table 1-1 2-month period fro e or not available]



Date⁵

6/21/1964

6/16/1965

6/16/1965 7/2/1966 5/7/1967 9/21/1968 3/20/1969 6/13/1970 2/13/1970 2/13/1971 3/18/1972 8/24/1973 1/16/1974 5/7/1975 3/19/1976

3/18/1978

Peak flow, in cubic feet per

second

364

24 2,070

20

. 182

1 5

133

Peak-flow data

Peak flow qualification

codes⁶

Bm

2

Bm

Gage height, in feet

8.00

1.39 10.72

1.31 0.58 4.45 0.63 2.01 0.37 6.34 1.54 4.96 1.52

3.49



Explanation:

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

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^aFlood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.
 ^aPeak-flow data with a value of zero are not plotted in figures.
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 PULF: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

References

Keterences: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm485.
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06108300 Kinley Coulee tributary near Dutton, Montana

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak-flow frequency analysis conducted on recorded

rded data

Analysis for unregulated period of record Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak-flow frequency analysis conducted on recorded data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> n October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow, MGBT, multiple Grubbs-Beck Table 1-1 is the 12-[Water year is the 12-month period from test; - not applicable or not available] Number of Skew type used in analysis Used in used in threshold¹ Contributing drainage area, Type of peakrecorded peak flows used in the Wate year flow frequency in square miles analysis² analysis Weighted MGBT 1.00 At-site 16
 Peak flow, in cubic feet per second, for indicated annual exceedance probability (bold values), in percent

 50
 42.9
 20
 10
 4
 2
 1.0
 0.5
 66.7 **0.2** 11,600 2,820 667 1,420 5,320
 Upper and lower 90-percent confidence intervals, in cubic feet per second, for indicated annual exceedance probability, in percent

 66.7
 50
 42.9
 20
 10
 4
 2
 1.0
 0.5
 0.2

 10
 29
 46
 309
 1,380
 8,740
 33,000
 118,000
 414,000
 2,110,000
 26 67 178 324 542 852 1,440 10,000 100,00 iđi 10,00 1,00 neak 100 Innual

		Peak-flo	ow data ⁴			Ranked (largest to smallest) peak-flow data ⁴									
Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷				
1963	9/16/1963	18		1.28		1966	7/2/1966	465		14.77					
1964	6/8/1964	76		2.98		1975	5/7/1975	153		4.83					
1965	3/31/1965	7		1.43		1969	3/21/1969	125		3.97					
1966	7/2/1966	465		14.77		1978	3/18/1978	122		3.86					
1967	5/7/1967	25		1.59		1964	6/8/1964	76		2.98					
1968	6/9/1968	2		0.61		1967	5/7/1967	25		1.59					
1969	3/21/1969	125		3.97		1976	3/19/1976	23		1.53					
1970	7/13/1970	7		0.88		1963	9/16/1963	18		1.28					
1971	2/13/1971	2	2	1.96		1965	3/31/1965	7		1.43					
1972		0	Bm		PILF	1970	7/13/1970	7		0.88					
1973	2/22/1973	1				1968	6/9/1968	2		0.61					
1974		0	Bm		PILF	1971	2/13/1971	2	2	1.96					
1975	5/7/1975	153		4.83		1973	2/22/1973	1							
1976	3/19/1976	23		1.53		1977	6/10/1977	1		0.64					
1977	6/10/1977	1		0.64		1972		0	Bm		PILF				
1978	3/18/1978	122		3.86		1974		0	Bm		PILF				



40

20

ility, in percent Tributary near Dutton MT

10

Industry near Dutton MI ANLYSIS NFC: Peakfory 7.3 run 3/5/2021 7:16:37 AM EMA using Weighted Skew option 0.109 – Skew (G); Multiple Grubbs-Beck 2 Zeroes not displayed 0 Censored flows below PILF (LO) Threshold 0 Gaged packs below PILF (LO) Threshold



75

EXPLANATION Fitted frequency curve PILF (LO) threshold Confidence limits: 5 percent lower, 95 percent upper Gaged peak discharge

Annual exceedance proba Station - 06108300.00 Kinley Coulee

Figure 2. Annual peak flows and perception thresholds.

99.5

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EXPLANATION

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/md455.

p. https://doi.org/10.3133/tm485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018) : U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

FIXELY FILE Intensional based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not loited in finures. ¹Flood-frequency results not reported because of too many values less than the PILE threshold used in the at-site analysis.
 ⁴Peak-flow data with a value of zero are not plotted in figures.
 ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.
 ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is available at the NVIS website:
 ¹Definitions of peak-flow designations used in analysis include:
 ¹Istoric: The peak flow was collected outside of the systematic record and is included in the analysis;
 Opportunistic: The peak flow was collected outside of the analysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period;
 PILF: The peak flow was identified as a potentially influential low flow;
 Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

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sion equations

UC1U3300 Kinley Coulee tributary near Dutton, Montana Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak flow frequency analysis weighted with regional regression equations Table 1-1 Table 1-2 Table 1-3 Table 1-4 Table 1-5 Table 1-6 Table 1-7 [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential I test; – not applicable or not available] Table 1-8

									Peak-flo	ow data⁴		Ranked (largest to smallest) peak-flow data ⁴							
Type of PILF threshold, in threshold ¹ cubic feet per second				Type of peal flow frequency analysis ²	(-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	
							1963	9/16/1963	18		1.28		1966	7/2/1966	465		14.77		
MGBT	1.00			RRE wtd			1964	6/8/1964	76		2.98		1975	5/7/1975	153		4.83		
per second,	for indicated ann	ual exceedar	ce probability	(bold values), i	n percent		1965	3/31/1965	7		1.43		1969	3/21/1969	125		3.97		
20	10	4	2	1.0	0.5	0.2	1966	7/2/1966	465		14.77		1978	3/18/1978	122		3.86		
79	167	335	515	743	1,060	1,630	1967	5/7/1967	25		1.59		1964	6/8/1964	76		2.98		
nce intervals	ce intervals, in cubic feet per second, for indicated annual exceedance probability, in percent					1968	6/9/1968	2		0.61		1967	5/7/1967	25		1.59			
20	10	4	2	1.0	0.5	0.2	1969	3/21/1969	125		3.97		1976	3/19/1976	23		1.53		
173	358	730	1,190	1,870	2,950	5,300	1970	7/13/1970	7		0.88		1963	9/16/1963	18		1.28		
39	85	167	243	326	427	570	1971	2/13/1971	2	2	1.96		1965	3/31/1965	7		1.43		
							1972		0	Bm		PILF	1970	7/13/1970	7		0.88		
							1973	2/22/1973	1				1968	6/9/1968	2		0.61		
						_	1974		0	Bm		PILF	1971	2/13/1971	2	2	1.96		
							1975	5/7/1975	153		4.83		1973	2/22/1973	1				
							1976	3/19/1976	23		1.53		1977	6/10/1977	1		0.64		
							1977	6/10/1977	1		0.64		1972		0	Bm		PILE	
							1070	2/10/1070	100		2.00		1074		0	D.m.		DULC	



95 90 75 60 40 20 10 5 Annual exceedance probability, in percent Station - 06108300.03 Kinley Coulee tributary near Dutton, Montana

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

FIXEL: FILF Intreshold based on a systematic peak now selected by the peak-now frequency analyst. ²Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on recorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd: The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018). ³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁴Peak-flow data with a value of zero are not plotted in finures.

⁵Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ⁶Peak-flow data with a value of zero are not plotted in figures. ⁶In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown. ⁶Qualification codes indicate special conditions that may affect how the peak streamflow value is interpreted. A list of codes and definitions is ⁸available at the NWIS website: <u>https://nwis.waterdata.usgs.gov/nwis/peak/help</u> ⁷Definitions of peak-flow designations used in analysis include: Histori: The peak flow was collected outside of the systematic record and is included in the analysis; Opportunistic: The peak flow was odlentified of the manalysis because it is outside of the systematic record and was of insufficient magnitude to determine nonexceedance during an ungaged period; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Contributing drainage area, in square miles

66.7

2 10,000.0

1.000.0

100.0 =

10.0

1.0 Annual

0.1

99.5

peak discharge, in cubic feet per second

2.96

Skew type used in analysis

95

98

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency–Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/mr485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

Number of recorded peak flows used in the analysis Peak flow, in cubic feel
50
42.9
 14
 20

 Upper and lower 90-percent confide

 66.7
 50
 42.9

 12
 31
 40

Analysis for unregulated period of record Analysis period of record, water years: 1963 - 1978 At-site peak flow frequency analysis weighted with regional regress

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06108800 Teton River at Loma, Montana

Analysis for unregulated period of re

Analysis it	or unregulated period of record	
Analysis period	l of record, water years: 1895 - 2	019

06108800 Teton River at Loma, Montana Analysis for unregulated period of record

[Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends; --, not applicable or not available.]

Analysis period of record, water years: 1895 - 2019 At-site peak-flow frequency analysis conducted on re rded data

Gage height, in feet

8.95

8.52

7.51

5.87

5.59

4.28

3.72 3.59 6.98 3.70 3.65 3.31 3.41 2.89 3.17 2.77 2.79 2.58 2.52 2.70 2.28 2.26

--

codes⁶

2

1

2

Peak-flow

designation in analysis⁷

Combined

Combined

Combined Combined

Alt-site peak-flow frequency analysis conducted on recorded data <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-6</u> <u>Table 1-7</u> <u>Table 1-8</u> October 1 through September 30 and is designated by the year in which it ends. PLF: potentially influential low flow; MGBT, multiple Grubbs-Beck Table 1-1 is the 12-[Water year is the 12-month period fro test; -- not applicable or not available]





Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.



Figure 2. Annual peak flows and perception thresholds.

¹Definitions of types of PILF thresholds include: MGBT: PILF threshold calculated by using the multiple Grubbs-Beck Test as specified in Bulletin 17C (England and others, 2019); FIXED: PILF threshold based on a systematic peak flow selected by the peak-flow frequency analyst.

²Definitions of type of peak-flow frequency analysis include:

"Definitions of type of peak-flow frequency analysis include: At-site: Peak-flow frequency analysis on coorded data; MOVE3: Peak-flow frequency analysis on combined recorded and synthesized data; synthesized data from Maintenance of Variance Extension Type III (MOVE.3) record extension procedure; RRE wtd. The at-site peak-flow frequency analysis was weighted with results from regional regression equations (RREs) from Sando and others (2018).

uency results not reported because of too many values less than the PILF threshold used in the at-site analysis. ³Flo

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

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Combined: The peak flow was recorded at a closely located streamgage on the same channel. Information on combining records of multiple streamgages is presented in table 1–2; Synthesized: The peak flow was synthesized using Maintenance of Variance Extension Type III record extension.

Innual

References: England, J.F., Jr., Cohn, T.A., Faber, B.A., Stedinger, J.R., Thomas, W.O., Jr., Veilleux, A.G., Kiang, J.E., and Mason, R.R., Jr., 2019, Guidelines for determining flood flow frequency—Bulletin 17C (ver. 1.1, May 2019): U.S. Geological Survey Techniques and Methods, book 4, chap. B5, 148 p., https://doi.org/10.3133/tm485. Sando, Roy, Sando, S.K., McCarthy, P.M., and Dutton, D.M., 2018, Methods for estimating peak-flow frequencies at ungaged sites in Montana based on data through water year 2011 (ver. 1.1, February 2018): U.S. Geological Survey Scientific Investigations Report 2015–5019–F, 30 p., https://doi.org/10.3133/sir20155019F.

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06108800 Teton River at Loma, Montana

06108800 Teton River at Loma, Montana

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Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak flow frequency analysis weighted with regional regression equations

Uo110350UU 1eton River at Loma, Montana Analysis for unregulated period of record Analysis period of record, water years: 1895 - 2019 At-site peak flow frequency analysis weighted with regional regression equations <u>Table 1-1</u> <u>Table 1-2</u> <u>Table 1-3</u> <u>Table 1-4</u> <u>Table 1-5</u> <u>Table 1-5</u> <u>Table 1-7</u> <u>Table 1-8</u> [Water year is the 12-month period from October 1 through September 30 and is designated by the year in which it ends. PILF; potentially influential kw flow; MGBT, multiple Grubbs-Beck test; – not applicable or not available]

										Peak-flo	ow data [*]		Ranked (largest to smallest) peak-flow data ⁴								
Contributing drainage area in square miles	recorded peak flows used in the analysis	Skew type used in analysis	Type of PIL threshold ¹	PILF F threshold, in cubic feet per second	·		Type of peal flow frequency analysis ²	k-		Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷	Water year	Date ⁵	Peak flow, in cubic feet per second	Peak flow qualification codes ⁶	Gage height, in feet	Peak-flow designation in analysis ⁷
1 000			MORT				PPE with			1929	2/10/1929	000			Combined	2019	9/30/2019	5,520	2	0.95	Combined
1,500	Peak flo	v in cubic fee	at ner second	for indicated and		ce probabilit	(bold values)	in nercent		1930	6/30/1931	700		-	Combined	2011	6/12/2011	3,000	-	8.52	combined
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	1932	8/22/1932	5 660	2		Combined	2011	6/24/2011	3 2 1 0		7.51	
332	626	818	2.270	4 480	9.420	15.500	24,200	37,200	63,100	1998	7/4/1998	477		3.65	combined	2010	6/13/2002	2,000		5.87	
Uppe	r and lower 90-	percent confid	ence intervals	in cubic feet pe	er second. for	indicated ann	ual exceedance	e probability.	in percent	1999	6/3/1999	1.650		5.59		1999	6/3/1999	1.650		5.59	
66.7	50	42.9	20	10	4	2	1.0	0.5	0.2	2000	3/12/2000	127		2.70		1930	2/19/1930	970	1		Combined
547	1,030	1,350	3,790	7,620	17,000	30,100	51,700	88,500	177,000	2001	4/12/2001	158		2.79		2008	5/29/2008	924		4.28	
201	384	504	1,390	2,680	5,310	8,200	11,900	16,900	25,700	2002	6/13/2002	2,000		5.87		1931	6/30/1931	700			Combined
										2003	3/16/2003	500	2	6.98		1929	6/10/1929	668			Combined
										2004	3/14/2004	98		2.28		2009	5/7/2009	639		3.72	
1,000,000									_	2005	6/9/2005	236		2.77		2007	3/6/2007	559		3.59	
										2006	6/14/2006	399		3.31		2003	3/16/2003	500	2	6.98	
_										2007	3/6/2007	559		3.59		2017	3/18/2017	488		3.70	
5]	2008	5/29/2008	924		4.28		1998	7/4/1998	477		3.65	
2										2009	5/7/2009	639		3.72		2006	6/14/2006	399		3.31	
% 100,000										2010	6/1/2010	319		2.89		2014	6/23/2014	379		3.41	
Je le	-									2011	6/12/2011	3,910		8.52		2010	6/1/2010	319		2.89	
*								//		2012	3/13/2012	145		2.58		2015	6/2/2015	295		3.17	
je .										2013	6/23/2013	145		2.52		2005	6/9/2005	236		2.77	
. <mark>2</mark> 40.000									-	2014	6/23/2014	379		3.41		2001	4/12/2001	158		2.79	
g 10,000										2015	6/2/2015	295		3.17		2012	3/13/2012	145		2.58	
ĉ	-									2016	5/27/2016	81		2.26		2013	6/23/2013	145		2.52	
-										2017	3/18/2017	488		3.70		2000	3/12/2000	127		2.70	
6									-	2018	6/24/2018	3,210		7.51		2004	3/14/2004	98		2.28	
1.000										2019	5/30/2019	6,520		8.95		2016	5/27/2016	81		2.26	
Annual peak disc.	-	•																			

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0.2

99.5 98 95 90 90 75 60 40 20 10 Annual exceedance probability, in percent Station - 06108800.03 Teton River at Loma, Montana 5

- Confidence limits - Fitted Frequency Curve 🔹 Gaged Peak Discharge 🔺 Historic Peak O PILF Explanation:

Figure 1. Annual peak flows (probability plotting positions) and peak-flow frequency curve. EMA, Expected Moments Algorithm; Skew(G), analysis skew; PILF(LO), Potentially Influential Low Flow (low outlier). For regional regression weighted analyses, only annual exceedance probabilities of 66.7 percent or less are shown.

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10

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³Flood-frequency results not reported because of too many values less than the PILF threshold used in the at-site analysis.

⁴Peak-flow data with a value of zero are not plotted in figures.

⁵In cases where the month, day, or both are not present in the date of a peak flow, the month, day, or both are unknown.

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