

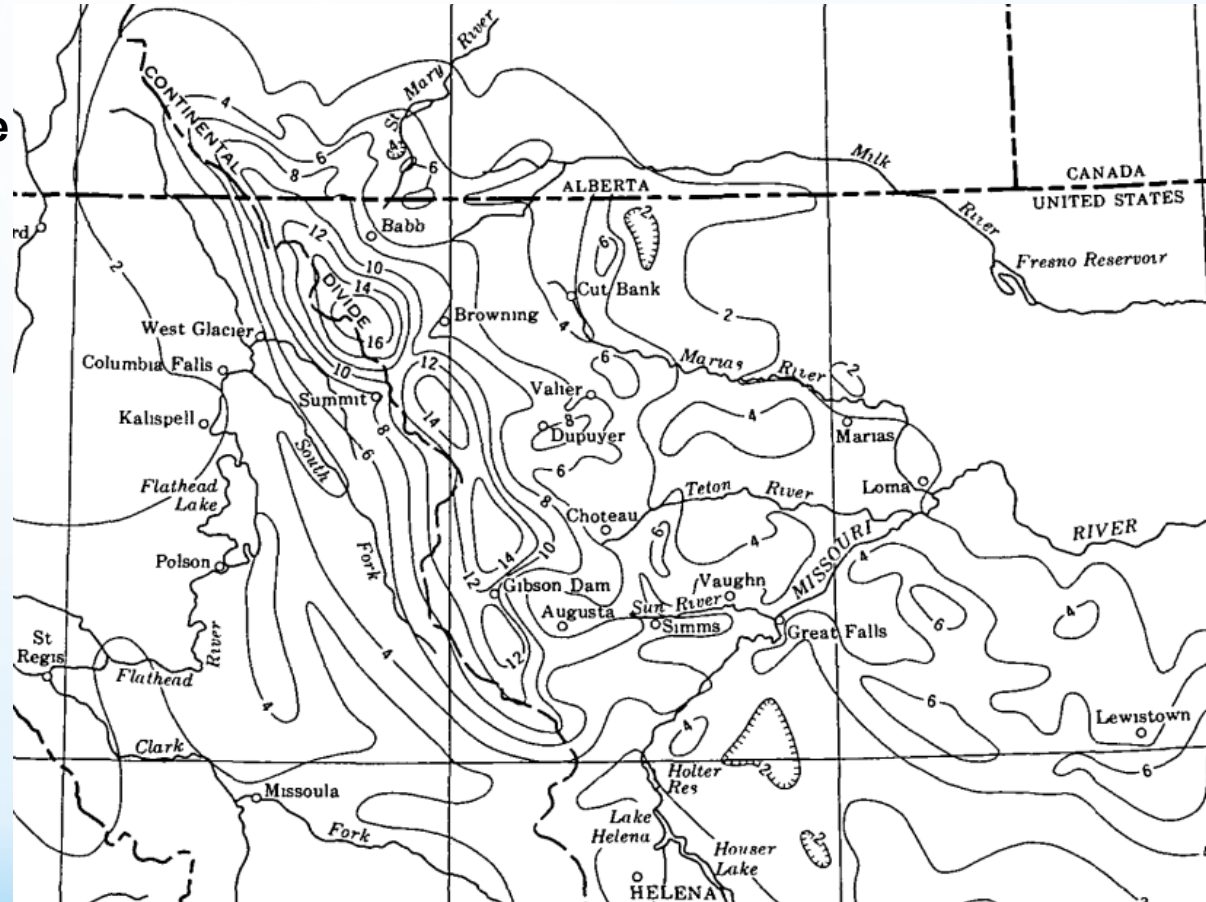


**1964 Northwest Montana Flood 60th  
Anniversary  
Study of an Extreme Flood Event**

Montana AWRA  
Whitefish, MT  
October 11, 2024  
**Seth Siefken, PE**  
**U.S. Geological Survey**

# 1964 Flood – June 7 and 8 Extreme Rain-on-Snow Event

- Heavy rain fell on high-elevation snowpack along the continental divide from southern Alberta to central Montana
- Orographic effects contributed to precipitation along continental divide
- 8.81 inches measured at Gibson Dam
- Up to 14.5 inches measured in unofficial observations
- Heaviest precipitation estimated as >16 inches



# 1964 Flood - Effect

- Extensive flooding on both sides of the continental divide from southern Canada south to central Montana



*Flooding of Woodland Park, east side of Kalispell, June 1964. Photo by Guest Photo.*

# 1964 Flood - Effect

- Extensive flooding on both sides of the continental divide from southern Canada south to central Montana
- Largest flood ever recorded on many rivers in Montana



*Flooding on Marias River near Shelby, MT, June 1964. Photo by Montana Highway Department.*



*Flooding of Woodland Park, east side of Kalispell, June 1964. Photo by Guest Photo.*

# 1964 Flood - Effect

- Extensive flooding on both sides of the continental divide from southern Canada south to central Montana
- Largest flood ever recorded on many rivers in Montana
- Failure of Two Medicine Dam and Swift Dam
- 35 fatalities



*Flooding of Woodland Park, east side of Kalispell, June 1964. Photo by Guest Photo.*

*Two Medicine Dam after 1964 flood. Photo by U.S Bureau of Reclamation.*

# 1964 Flood – Precedents

Many previous large floods have been recorded along the U.S. and Canadian portions of the continental divide, although most were confined to the eastern side, and none were as damaging in Montana as the 1964 flood

## Selected Historic Floods

- 1876
- 1885
- 1887
- 1899
- 1902
- 1908
- 1916
- 1953



*Belly River in flood, 1902. A partially submerged building is visible at left. Courtesy of Galt Museum (19891046021-074b)*



*Railroad bridge following the 1908 Oldman River flood. Courtesy of Galt Museum (19750115000-007)*

# 1885 Flood on Sun River

*Information courtesy of our history contractor, Cassidy Vander Voort*

- Flooding at Sun River was “so great was it that the valley was almost entirely inundated.” (The River Press, June 24, 1885)
- “Every ranch the valley, excepting those of R.S. Ford, Mrs. Ford, Wm. Muleahy, and Mr. Healy, were wholly, or in part, submerged.” (The River Press, June 24, 1885)
- The town of Sun River was submerged in three to four feet of water from the flood (Great Falls Tribune, June 18, 1885)

*Article from The River Press, June 24, 1885  
describing recent flooding on Sun River*

Delayed Correspondence.

SUN RIVER, June 13th, 1885.

Editors of the River Press:

He who says it dosen't rain in Montana is liable to err. It has rained in torrents hereabouts, of late. On the 11th inst., the fall exceeded any known by the oldest inhabitants, so great was it that the yalley was almost entirely inundated. The growing crops must have suffered greatly from its effects. The farms of Messrs. Vaughn, Reinicke, Furnell, [Murray and Dunn, were completely covered by water. The roads are in a deplorable condition. All of the smaller bridges and culyerts are washed out, and the roads otherwise cut up badly. We learn that the water entered the basement floor of several residences, causing the families to move a story higher, and damaging carpets, etc. A telephone dispatch from Ulidia says the Missouri river at that point is seven miles wide.

# 1964 Flood on Sun River

*Inundation of the town of Sun River on June 10, 1964. Peak of 1964 flood occurred June 9.*

*The town of Sun River was completely flooded, and 100 residents evacuated. Photo by U.S. Bureau of Reclamation from Boner and Stermitz (1964).*



# Subsequent Major Floods along the Rocky Mountain Front

- 1975
- 1995
- 2002
- 2018



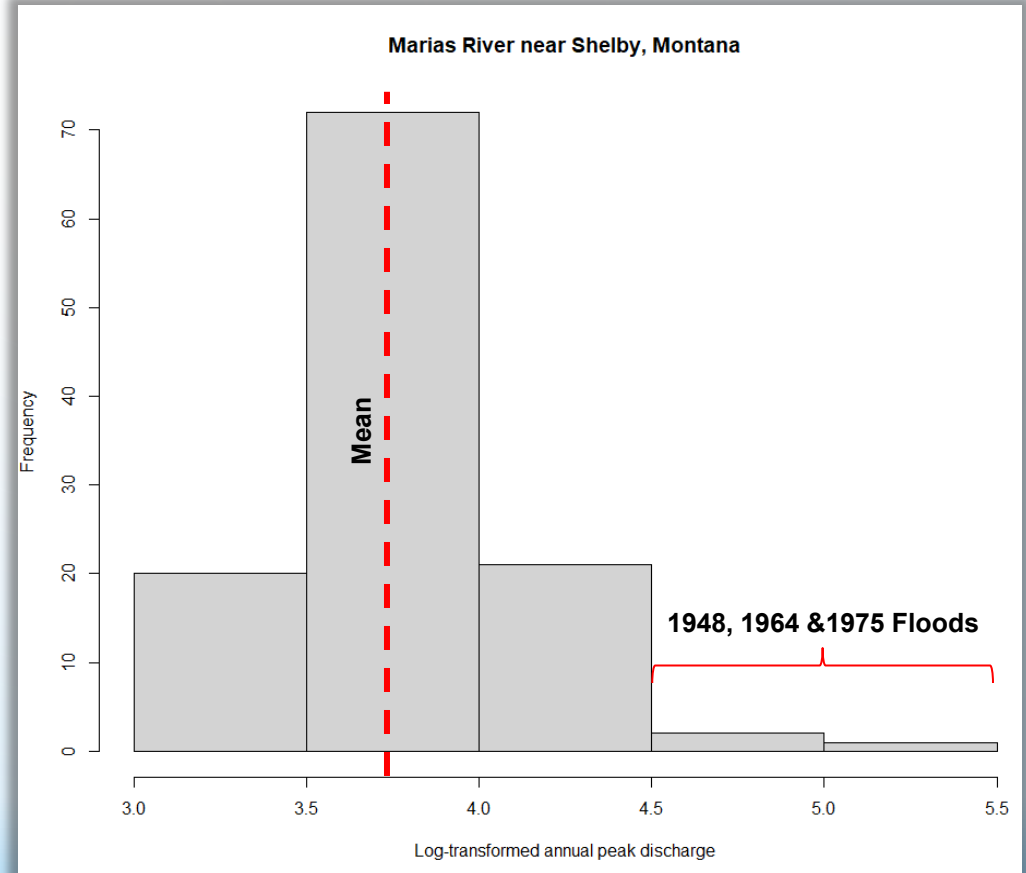
*2018 flood in Augusta, MT. Photo by USGS.*



*2002 flood on Swiftcurrent Creek near Many Glacier, MT. Photo by USGS.*

# Computing Risk of Extreme Floods – Problem of Asymmetry

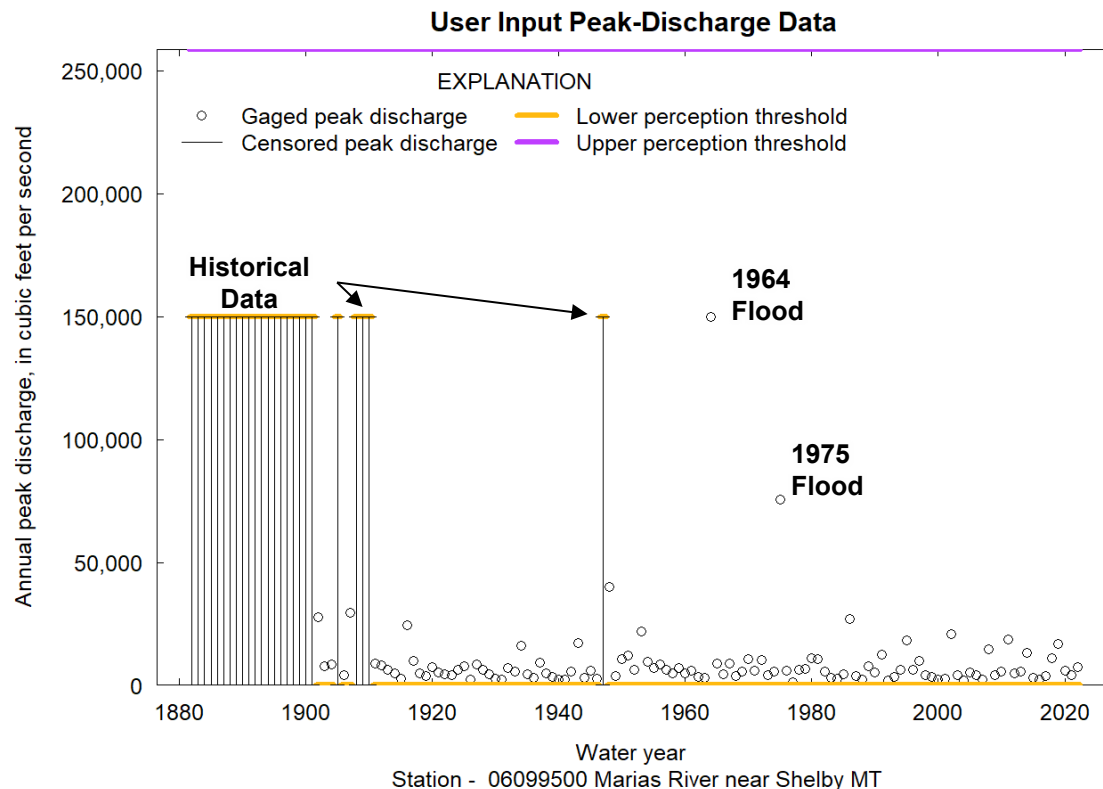
- Floods are not symmetrically distributed about the mean
- Probability of extremely large annual flood is not equal to probability of extremely small annual flood
- Increases uncertainty in flood frequency estimates
- Best way to reduce uncertainty is by incorporating **additional information** about when there was or was *not* an extremely large flood



# Analysis with Historical Flood Information

## Marias River near Shelby, Montana (streamgauge 06099500)

- 1964 is largest measured flood
- Know that 1964 flood was the largest since at least 1881 based written accounts of 1964 and 1908 floods
- This gives information back to 1881, even for years without streamgauge data



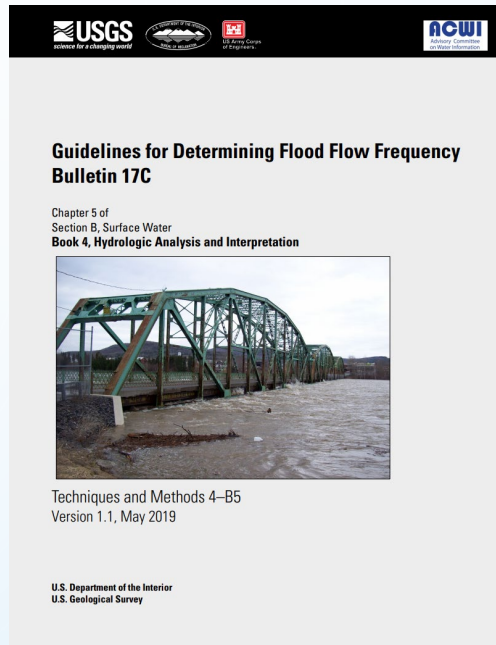
# Analysis with Historical Flood Information

## Guidelines for Determining Flood Flow Frequency Bulletin 17C

- Uses the Expected Moments Algorithm (EMA) (Cohn and others, 1997)
- Iteratively fits probability distribution using discrete observations and interval data

$$\mu_{i+1} = \frac{\overbrace{\sum_1^{n_e} X}^{\text{discrete data}} + \overbrace{n_c E[X | X_{lower} \leq X \leq X_{upper}; \hat{\mu}_i, \hat{\sigma}_i, \hat{\gamma}_i]}^{\text{interval data}}}{n_e + n_c}$$

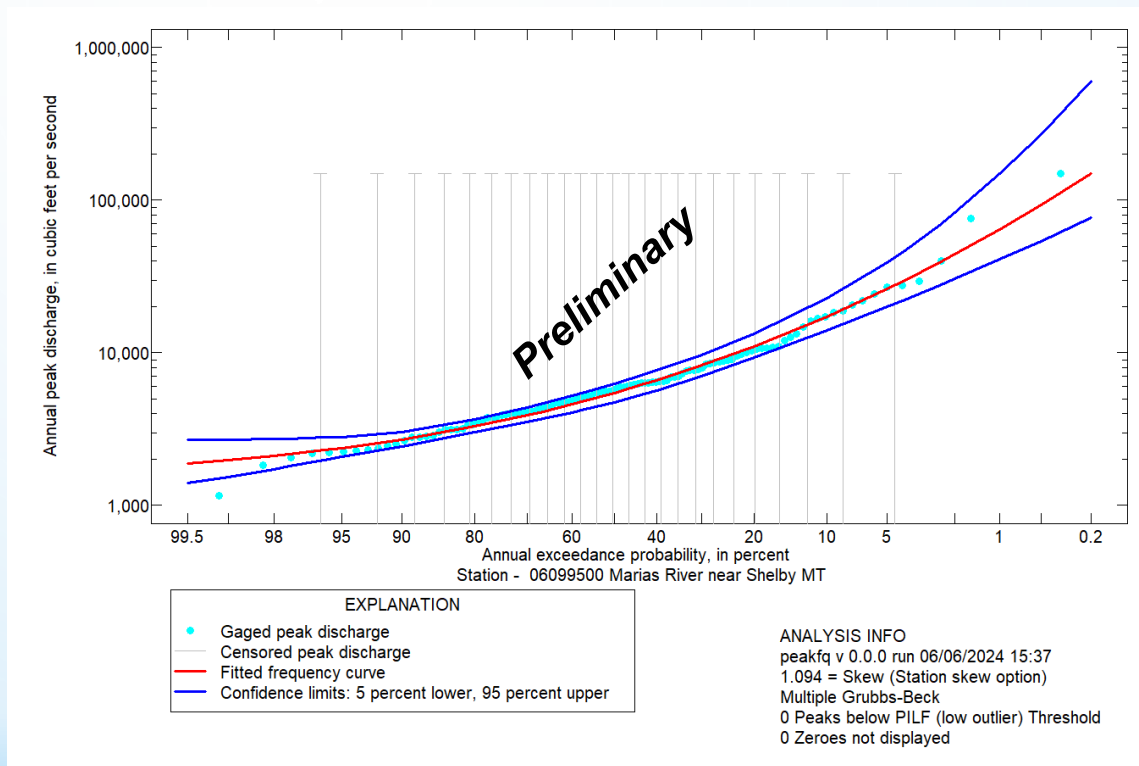
Bulletin 17C Equation 7-2  
(modified)



# Analysis with Historical Flood Information

## Marias River near Shelby, Montana (streamgauge 06099500)

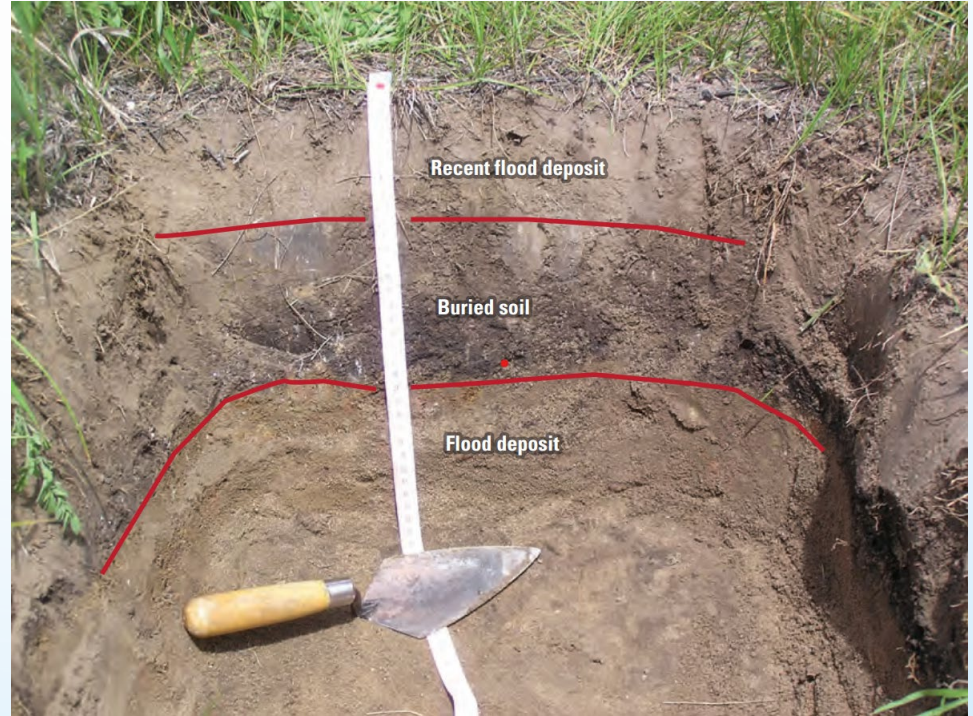
- Know that 1964 flood was largest since at least 1881
- 1908 flood not measured, but smaller than 1964 flood discharge
- Flood frequency analysis incorporates this information for more realistic analysis than using streamgauge data alone



Preliminary information, not for citation or distribution.

# Extending Records further with Paleoflood Investigations

- Paleoflood investigations use geologic evidence to obtain data on floods up to several thousand years in the past
- Few of these investigations have been done in Montana
- Study on Dry Creek in the Mission Mountains used ash deposit to estimate upper bound on floods back to 6,800 years before present (Parrett and Jarrett, 2000)
- Additional paleoflood studies would provide more data to inform flood risk analysis in Montana

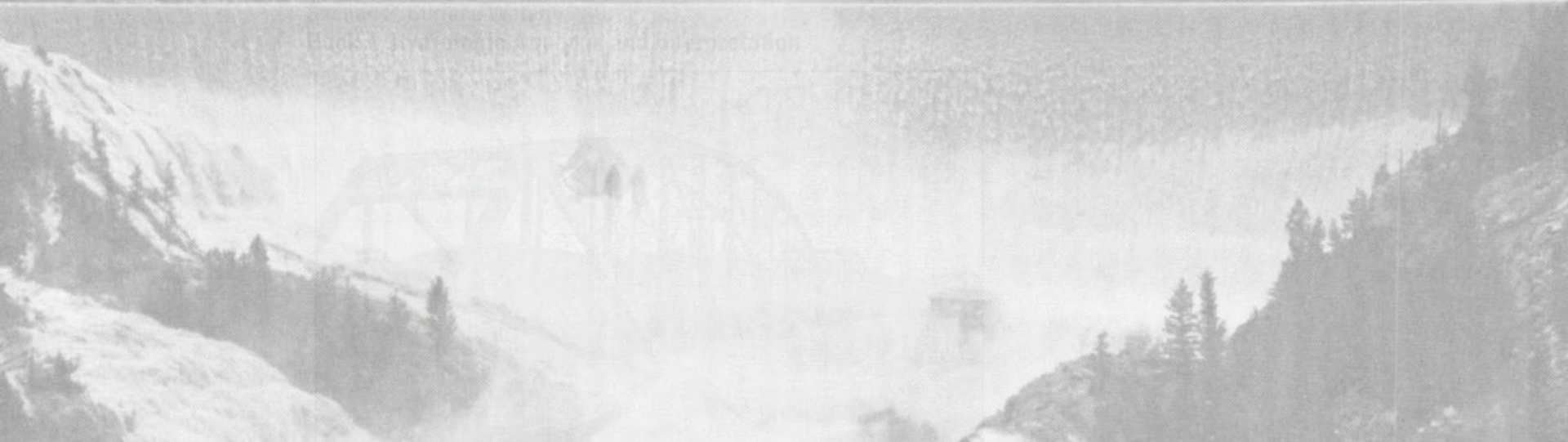


*Soil layers showing evidence of two floods, one recent, one much older on Kettle Creek in Colorado. Photograph by Jeanne Godaire, Bureau of Reclamation published in Harden and others (2021).*



Guidelines for Designing Preliminary Frequency  
Bulletin 17C

**Questions?**  
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Background: Sun River flowing over Gibson Dam, June 1964. Photo by U.S. Forest Service.

U.S. Department of the Interior  
U.S. Geological Survey

This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.