Channel-Width Data, Regression Equations, and Peak-Flow Frequencies

In cooperation with Montana Department of Transportation

For the AMFM 19th Annual Conference, March 5-8, 2018, Great Falls, MT

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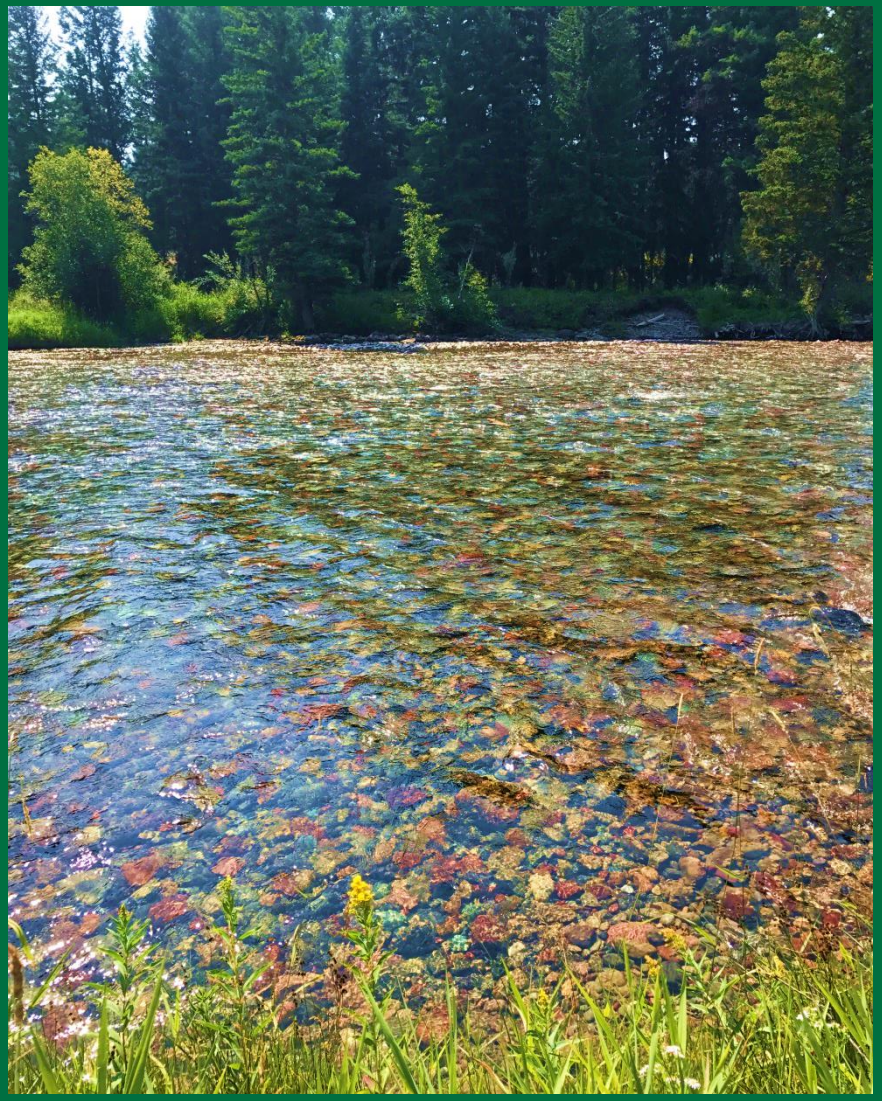
U.S. Department of the Interior
U.S. Geological Survey

Updating Regional Regression Equations using Channel-Width Data

- Historical on-site channel measurements
- New (2017) on-site measurements
- Consistent methods
- Measurements from aerial photographs
- Funded by Montana Department of Transportation Research Program



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Channel Widths

Might be easier to see for ephemeral streams

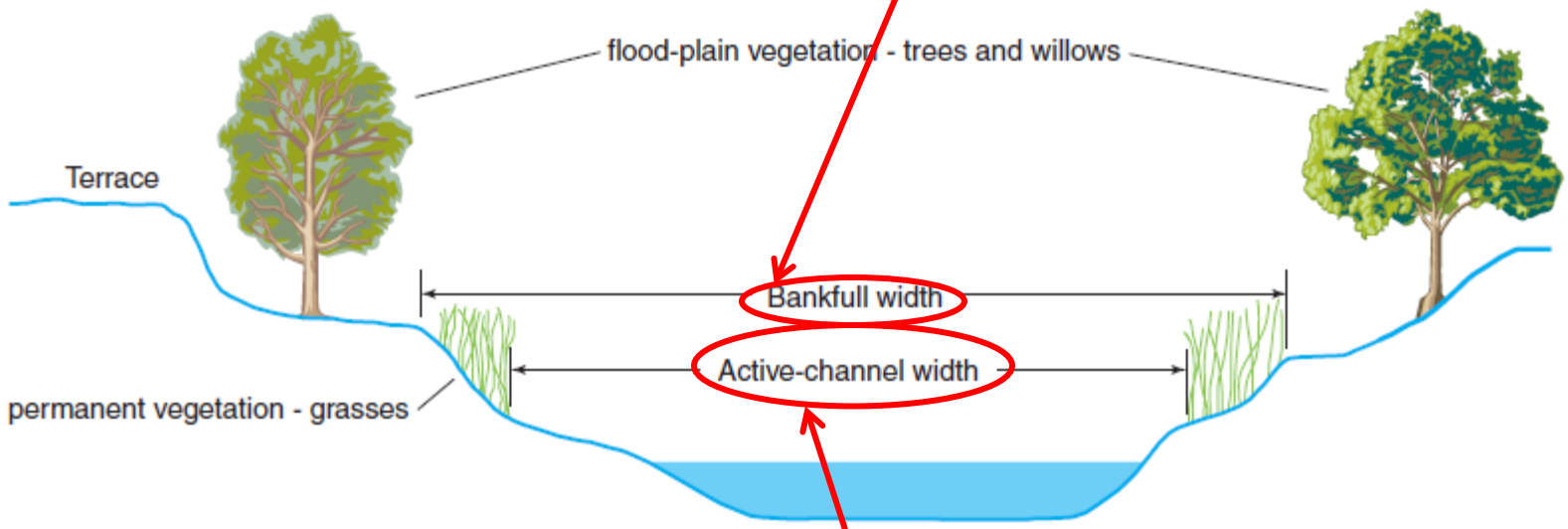

Figure 7. Typical stream cross section showing active-channel and bankfull widths.

Might be easier to see for perennial streams

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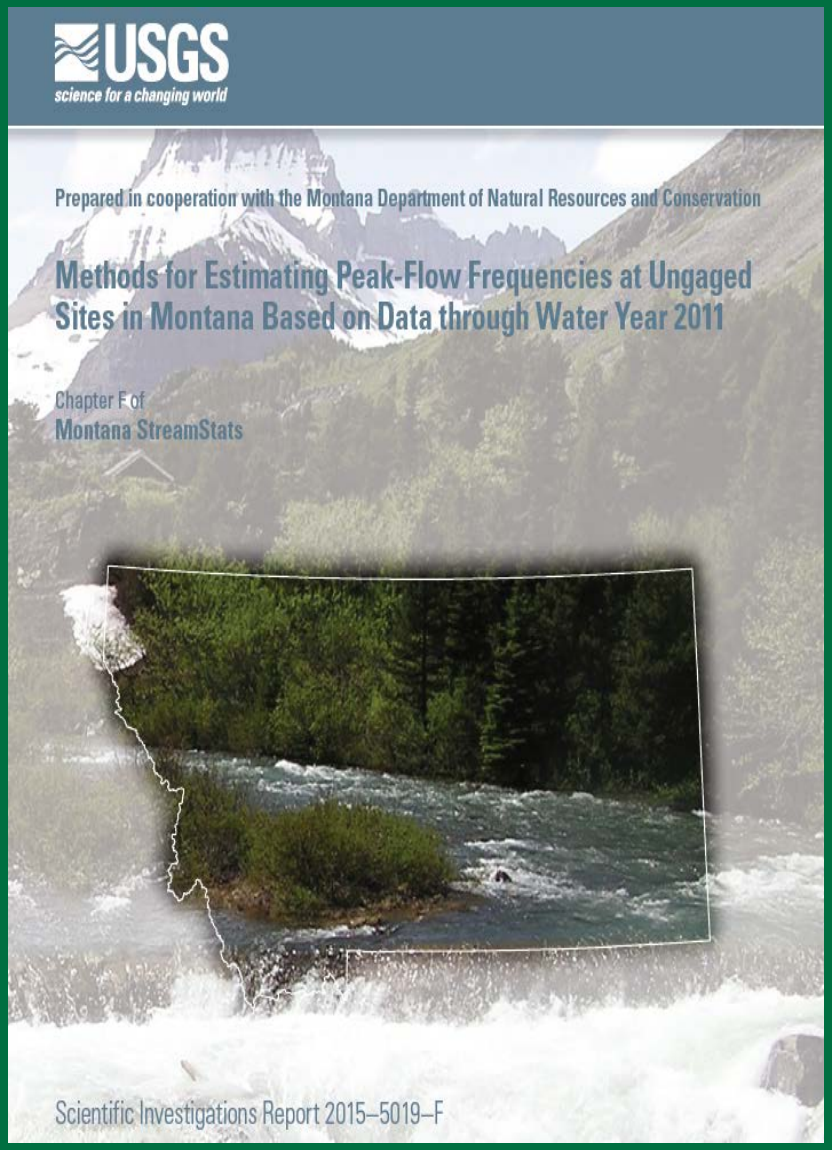
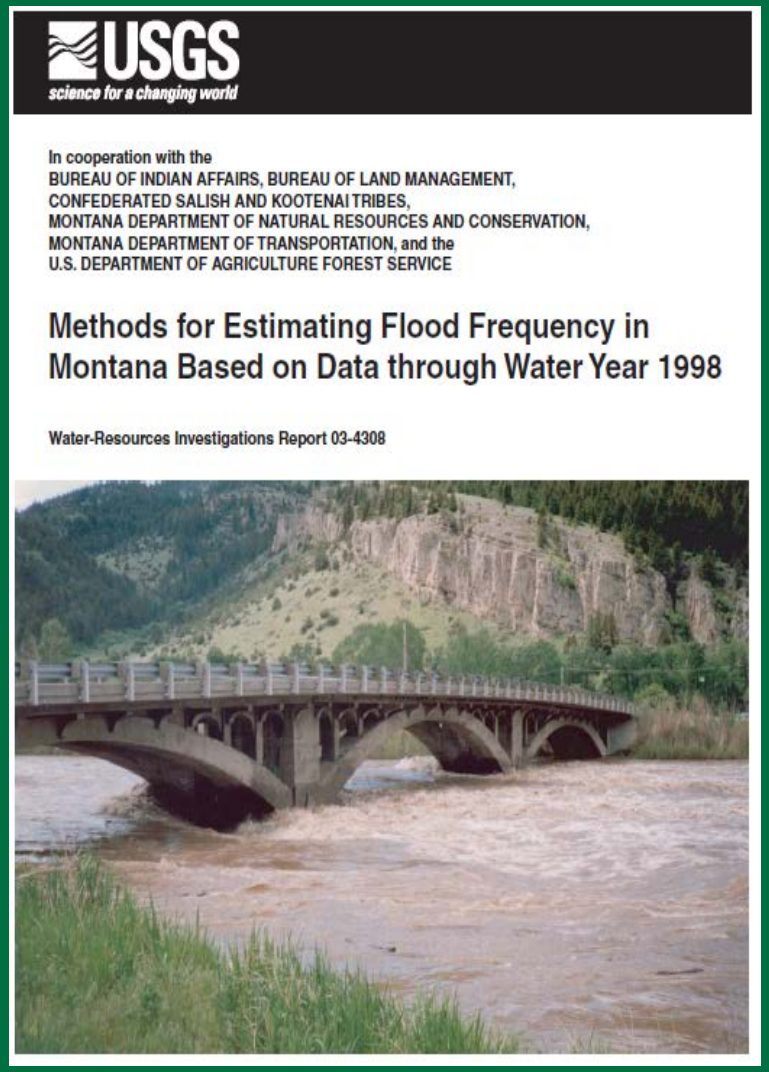
Current Regression Equations



- Sando, Sando, McCarthy, and Dutton, 2016
- Regional Regression Equations based on Basin Characteristics
- Channel Width-data NOT included

Previous Regression Equations



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science for a changing world

In cooperation with the
BUREAU OF INDIAN AFFAIRS, BUREAU OF LAND MANAGEMENT,
CONFEDERATED SALISH AND KOOTENAI TRIBES,
MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION,
MONTANA DEPARTMENT OF TRANSPORTATION, and the
U.S. DEPARTMENT OF AGRICULTURE FOREST SERVICE

Methods for Estimating Flood Frequency in Montana Based on Data through Water Year 1998

Water-Resources Investigations Report 03-4308

- Parrett and Johnson, 2004
- Included Regression Equations based on Channel Width
- Also weighting option for basin characteristics and channel width

Why?

- Previous studies – can be more reliable
- Basin characteristics complex
- Channel formed by prevailing streamflow
- Floods

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06006000 Red Rock Creek above Lakes, near Lakeview

Methods Parrett and Johnson, 2004

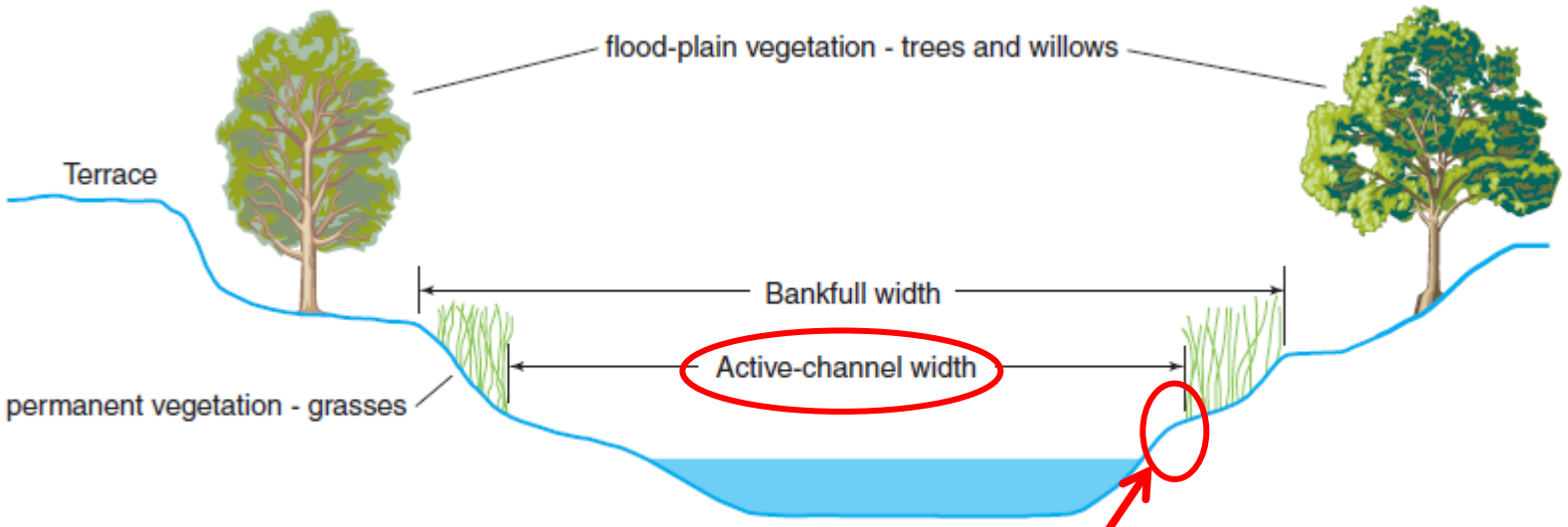

Figure 7. Typical stream cross section showing active-channel and bankfull widths.

- Osterkamp and Hedman (1977)
- Prevailing discharges
- Break in the relatively steep bank of the active channel to a more gently sloping surface beyond the channel edge
- The break in slope normally coincides with the lower limit of permanent vegetation – or a change in vegetation.

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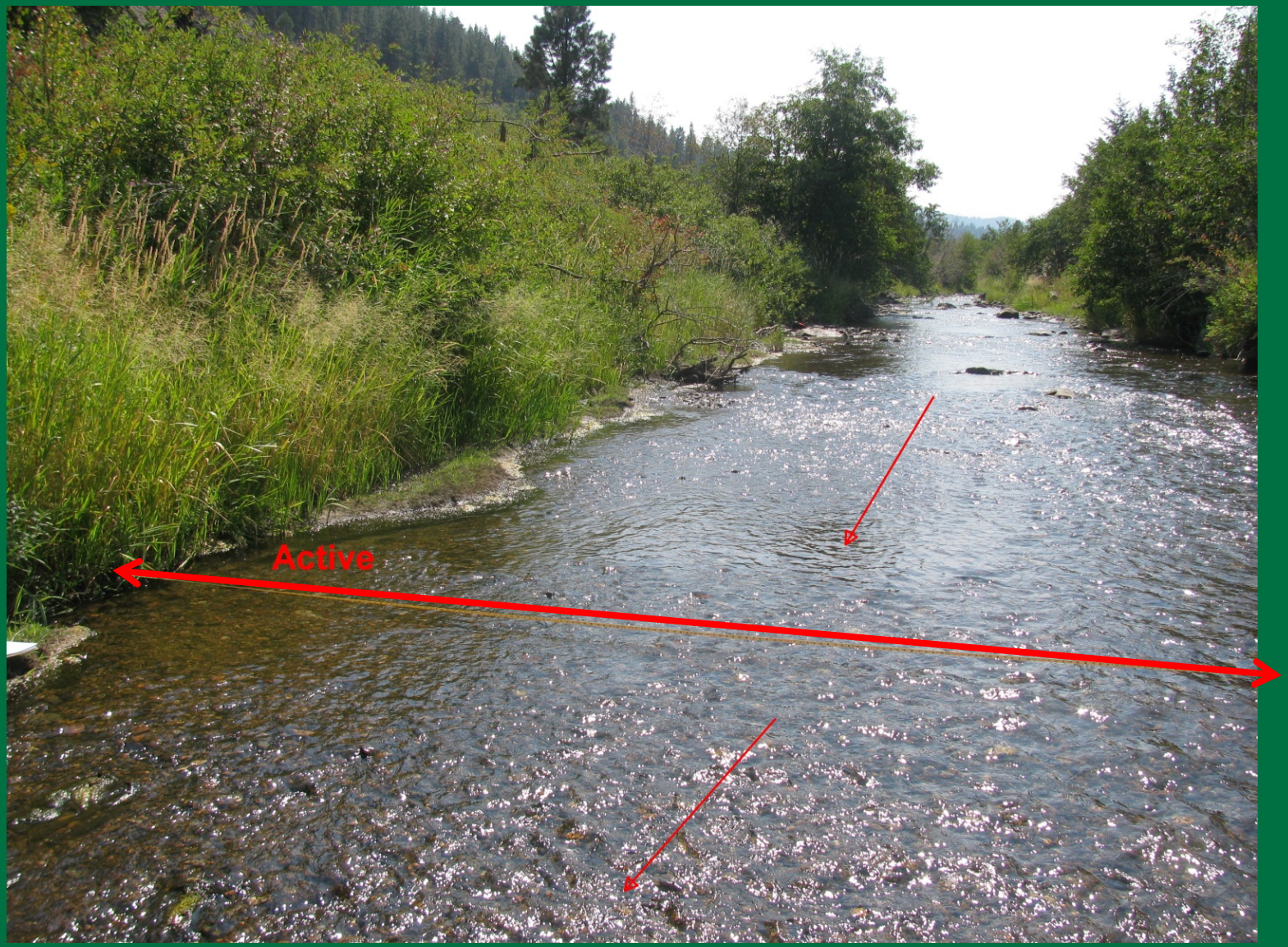
Active Channel Width



06061500 Prickly Pear Creek near Clancy

Methods ▪ Parrett and Johnson, 2004

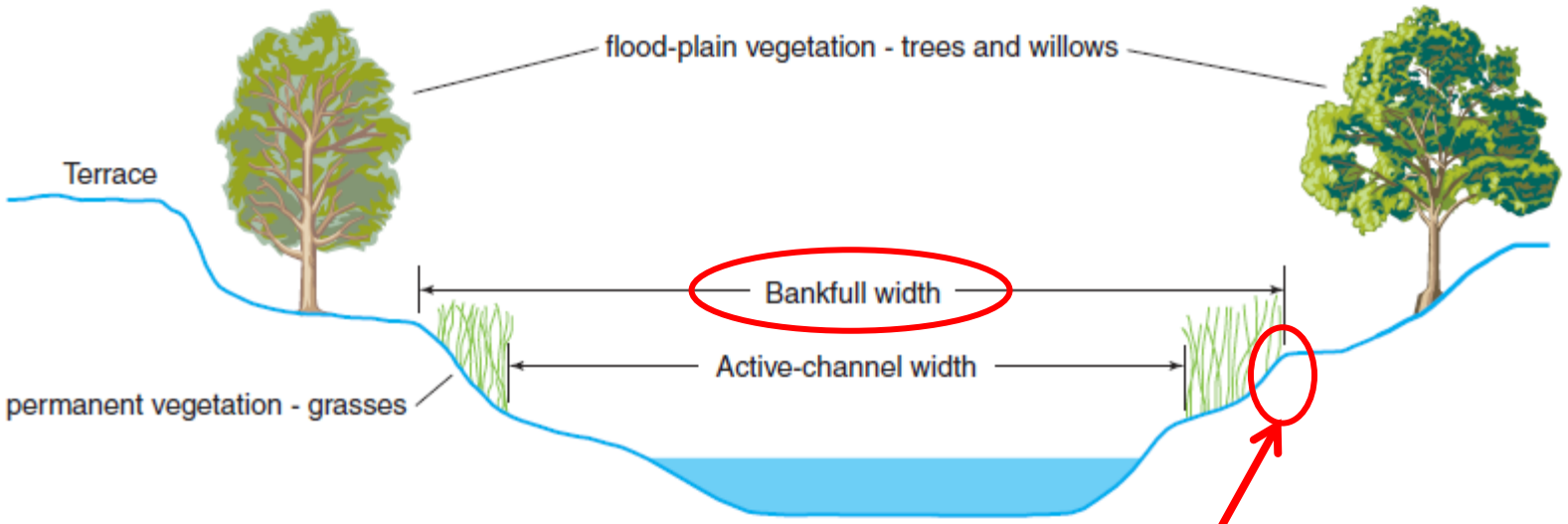


Figure 7. Typical stream cross section showing active-channel and bankfull widths.

- Riggs (1974)
- Tops of the banks of the main channel
- Flood plain and the channel intersect
- Usually distinguished by an abrupt change in slope from near-vertical to horizontal
- ~ Wolman (1955) where overbank flooding occurs for perennial streams

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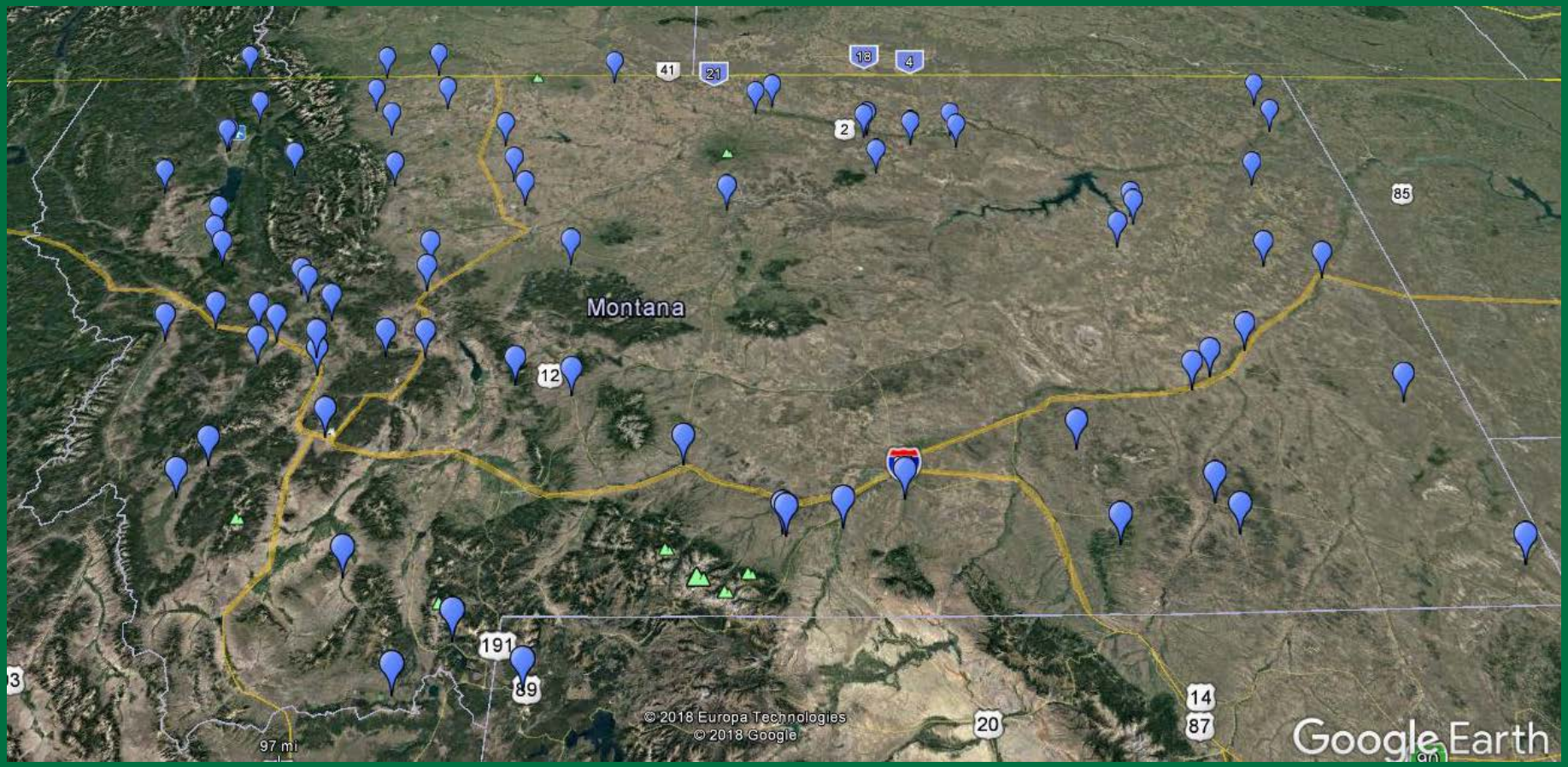
Bankfull Channel Width

06177820 Horse Creek Trib near Richey

Channel Measurement Locations



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Best place to measure channel widths

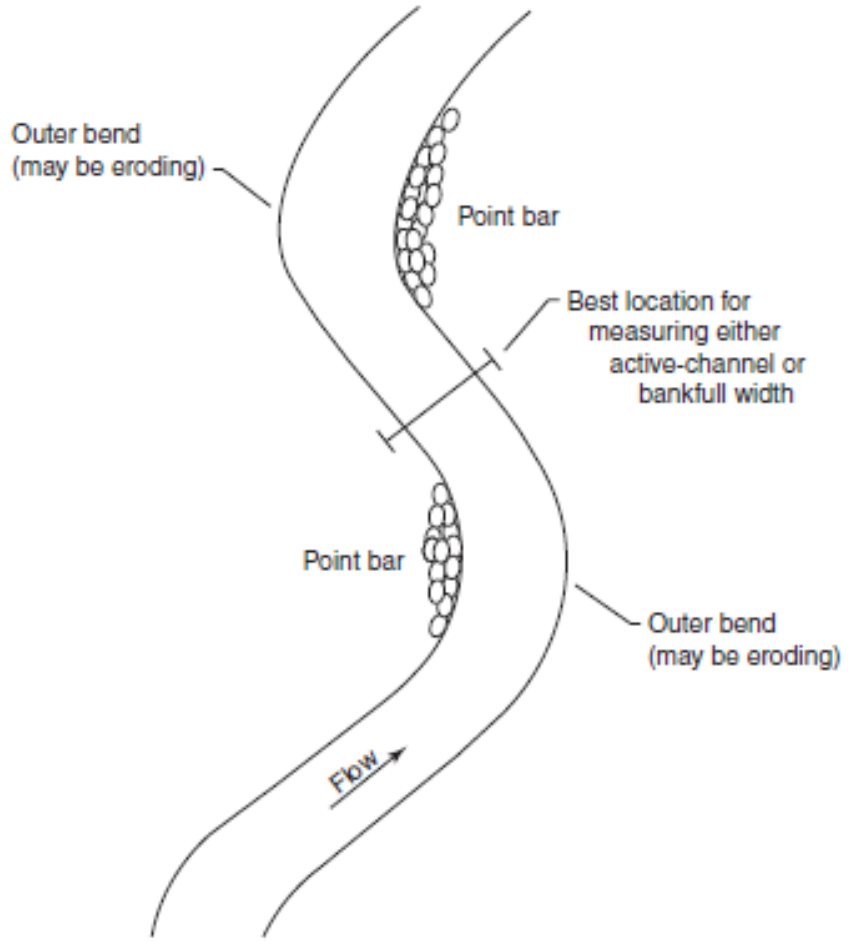

Figure 8. Typical alluvial stream (plan view) showing best location for measuring channel width.

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Channel widths from aerial photographs

- Measured for ~540 stations
- 1-meter NAIP Imagery
- July/August 2015

06024450 Big Hole River bl Big Lake Cr at Wisdom MT

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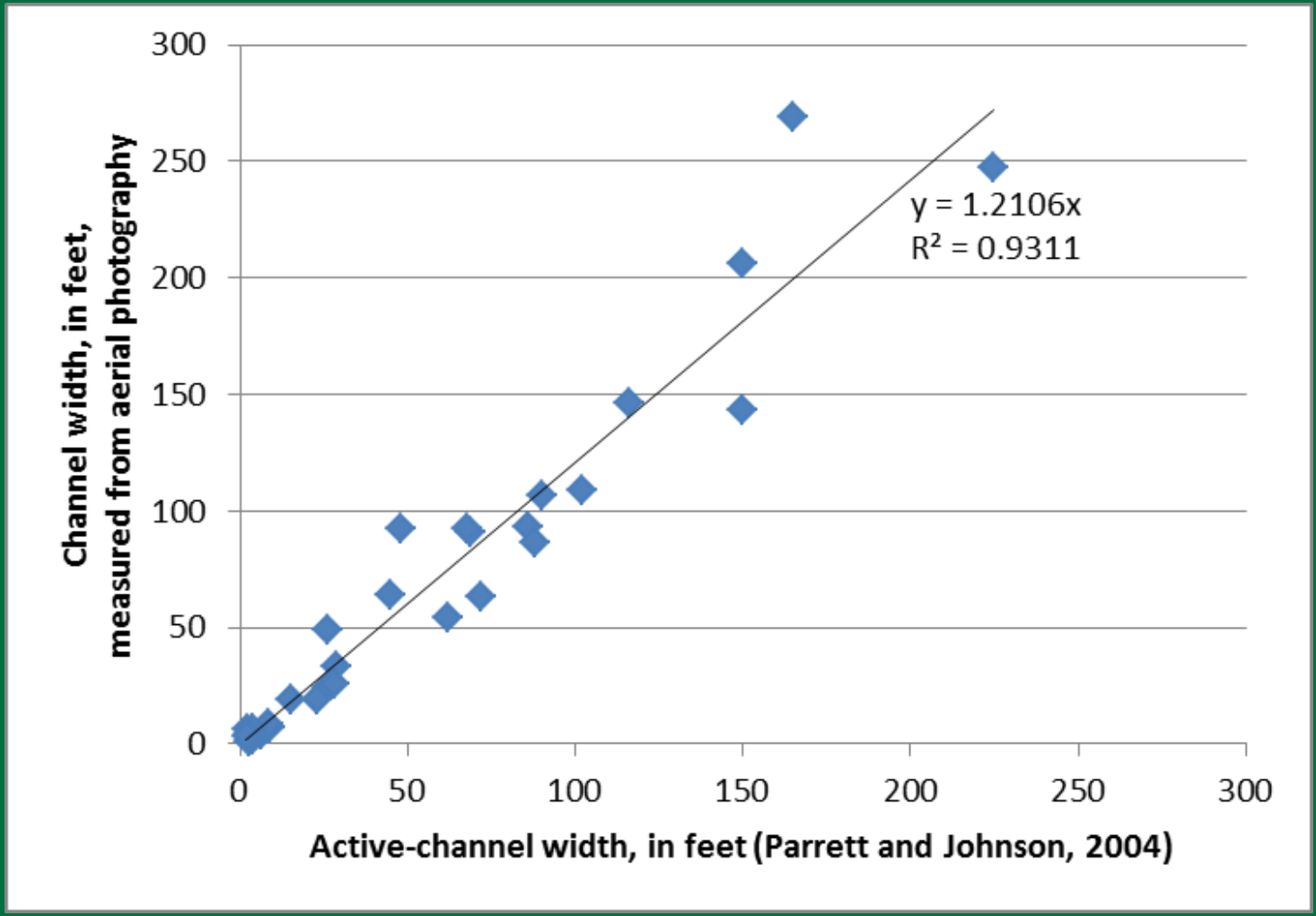
Initial Feasibility Analysis



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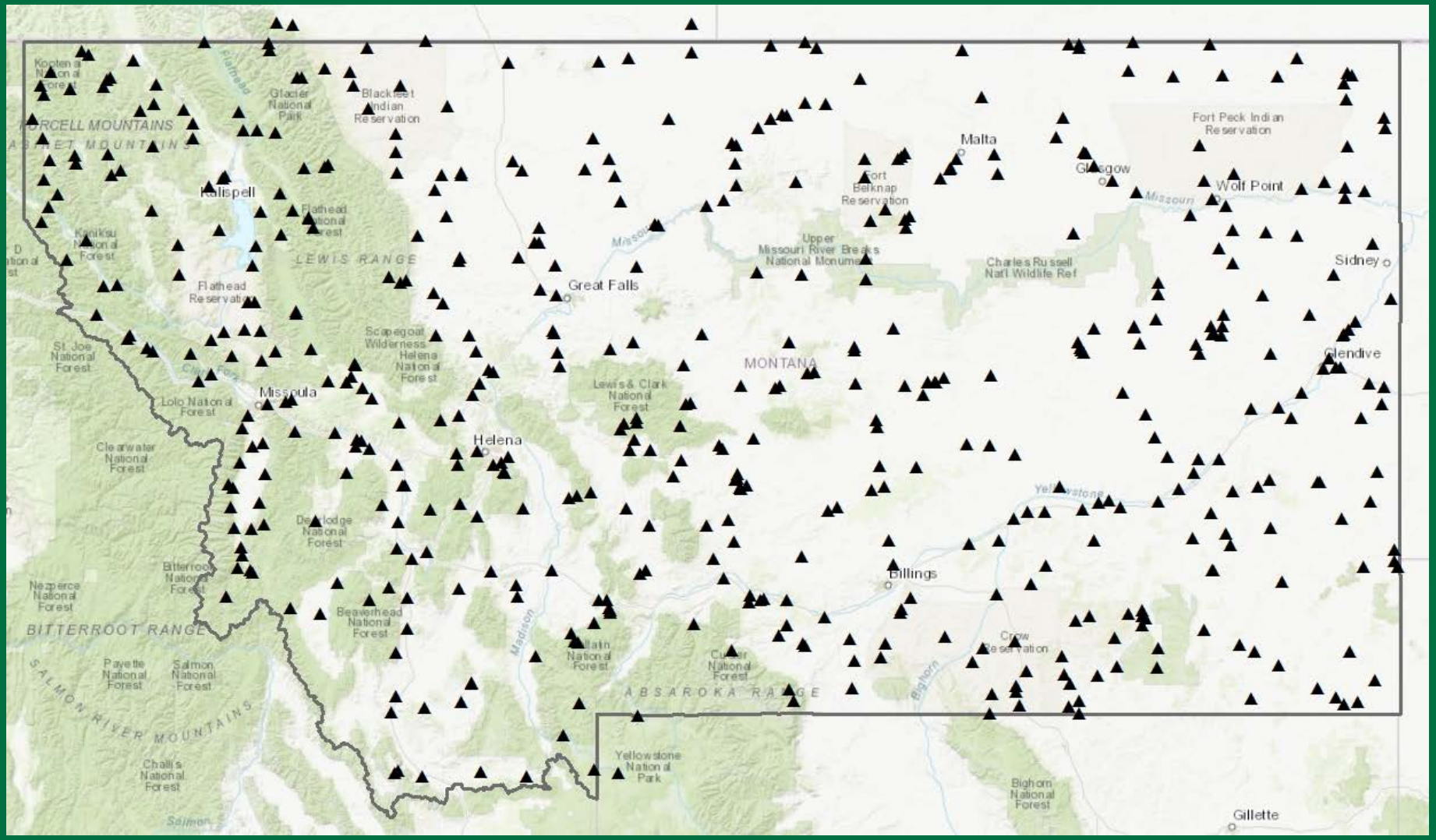
Measurements from Aerial Photographs



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Schedule

- ✓ Field training w/Chuck Parrett July 2017
- ✓ Field measurements August – December 2017
- Currently analyzing data
- Publication by July 2019
- Report + Data Release

USGS

References

VOL. 13, NO. 2 WATER RESOURCES RESEARCH APRIL 1977

Variation of Width and Discharge for Natural High-Gradient Stream Channels

W. R. OSTERKAMP AND E. R. HEDMAN

U.S. Geological Survey, Lawrence, Kansas 66045

Standardized measurements of width at gaging stations on high-gradient stream channels show that a power function relation, indicative of static allometric growth, exists between width and average discharge in the downstream direction. Results are in close agreement with studies by Leopold and Maddock (1953) and confirm their '*b*' exponent. Workers currently using active channel width measurements as a means of estimating average discharge from ungaged basins should consider 2.0 as a standard exponent of the regression relation.

Innovative studies of channel width stability as a function of water and silt in transport were made by *Kennedy* [1895], working with canals in India, and by *Lacey* [1930], working with both rivers and canals. The relation of natural alluvial channel width to discharge in the downstream direction, however, was first described by *Leopold and Maddock* [1953].

The upper limit is defined by a break in the relatively steep bank slope of the active channel to a more gently sloping surface beyond the channel edge. The break in slope normally coincides with the lower limit of permanent vegetation so that the

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Osterkamp, W.R., and Hedman, E.R., 1977, Variation of width and discharge for natural high-gradient stream channels: Water Resources Research, v. 13, no. 2, p. 256-258.

Flash flood potential from channel measurements

H. C. Riggs

Abstract. Discharge measurements of flash floods add to hydrological knowledge and provide information needed for protection from future floods. But planning for protection cannot be postponed until a serious flood has occurred at each site. Thus methods of estimating flood potential at ungauged sites are needed. A promising method utilizes (1) a relation between a flood characteristic and stream channel size based on data at gauging stations, and (2) channel size measurements at ungauged sites at which flood characteristics are to be estimated.

The method is described and demonstrated using data on ephemeral and perennial streams. The flood characteristics used are the 10-year or the 50-year floods. Channel size is represented by the top width of a cross section; the top of the cross section is variously defined by channel bars, by breaks in bank slope, or by the lower limit of permanent vegetation.

In semiarid regions this method produces better results than regression on basin characteristics. Floods of higher recurrence intervals can be approximated as a multiple of the 10-year flood.

Riggs, H.C., 1974, Flash flood potential from channel measurements, in Flash Floods Symposium, Paris, 1974: International Association of Hydrological Sciences Proceedings, no. 112, p. 52-56.

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