MEAN ANNUAL RUNOFF AND PEAK FLOW ESTIMATES BASED ON CHANNEL GEOMETRY OF STREAMS IN NORTHEASTERN AND WESTERN MONTANA

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations Report 83-4046

Prepared in cooperation with the

U.S. BUREAU OF LAND MANAGEMENT, U.S. FOREST SERVICE, and

MONTANA DEPARTMENT OF NATURAL RESOURCES AND CONSERVATION

Front cover photograph: Looking upstream at Bear Creek near Essex, Montana, near streamflow-gaging station number 12356500.

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UNITED STATES DEPARTMENT OF THE INTERIOR

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CONTENTS

	Page
Abstract	1
Introduction	1
Data used	4
Streamflow data	4
Channel-geometry data	4
Basin-characteristics data	5
Method of analysis	12
Multiple regression techniques	12
Mean-annual-runoff analysis	13
Peak-discharge analysis	15
Discussion	15
Limitations of method	15
Accuracy appraisal	21
Illustrative examples	21
Conclusions	24
Selected references	25

ILLUSTRATIONS

Figure 1.	Map showing location of study area, region boundaries, and selected streamflow-gaging stations used for mean-annual-runoff analysis	2
2.	Map showing location of region boundaries and selected streamflow-gaging stations used for peak-discharge analysis	6
3.	Sketch showing best locations for measurement of channel-geometry features	8
4-7.	Photographs showing active-channel and bankfull widths on:	
	4. Rattlesnake Creek at Missoula, Montana	9
	5. Eightmile Creek near Florence, Montana	9
	6. Dayton Creek near Proctor, Montana	10
	7. East Fork Battle Creek near international boundary, Montana	10
8.	Photograph showing active-channel width on Willow Creek near Glasgow, Montana	11

TABLES

Table 1.	Streamflow characteristics at selected gaging stations	27
2.	Channel-geometry characteristics at selected gaging stations	35
3.	Basin characteristics at selected gaging stations	42
4.	Results of regression analysis for mean annual runoff using only channel-geometry characteristics	13
5.	Results of regression analysis for mean annual runoff in West Region	14
6.	Results of regression analysis for peak discharge using only channel-geometry characteristics	16
7.	Results of regression analysis for peak discharge using channel-geometry and basin characteristics	50
8.	Range of channel-geometry and basin characteristics	20

METRIC CONVERSION FACTORS

For those readers who may prefer to use the International System of units (SI) rather than inch-pound units, the conversion factors for the terms used in this report are listed below.

Multiply inch-pound unit	By	To obtain SI unit
acre-foot	1233	cubic meter
cubic foot per second	0.02832	cubic meter per second
foot	0.3048	meter
foot per mile	0.1894	meter per kilometer
inch	25.40	millimeter
inch per hour	0.007056	millimeter per second
mile	1.609	kilometer
square mile	2.590	square kilometer

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) by the equation:

$$°C = 5/9\ (°F - 32)$$

National Geodetic Vertical Datum of 1929 (NGVD of 1929): A geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called mean sea level. NGVD of 1929 is referred to as sea level in this report.

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ABSTRACT

Equations for estimating mean annual runoff and peak discharge from measurements of channel geometry were developed for western and northeastern Montana. The study area was divided into two regions for the mean-annual-runoff analysis, and separate multiple-regression equations were developed for each region. The active-channel width was determined to be the most important independent variable in each region. The standard error of estimate for the estimating equation using active-channel width was 61 percent in the Northeast Region and 38 percent in the West Region.

The study area was divided into six regions for the peak-discharge analysis, and multiple regression equations relating channel geometry and basin characteristics to peak discharges having recurrence intervals of 2, 5, 10, 25, 50, and 100 years were developed for each region. The standard errors of estimate for the regression equations using only channel width as an independent variable ranged from 35 to 105 percent. The standard errors improved in four regions as basin characteristics were added to the estimating equations.

INTRODUCTION

The purpose of this report is to provide methods for estimating mean annual runoff and peak discharges for ungaged streams in northeastern and western Montana. The estimating equations developed for this purpose are based on channel-geometry measurements at streamflow-gaging stations. This study investigated the active-channel and bankfull-channel methods. The channel width was measured, the mean depth was determined, and both were related to mean annual runoff and flood-frequency discharges. The location of the area studied is shown in figure 1. A recent report by Omang and others (1983) provides similar streamflow estimating equations for southeastern Montana.

Several studies completed since 1970 (Boner and Buswell, 1970; Dodge, 1972; Johnson and Omang, 1976; and Parrett and Omang, 1981) presented methods for estimating peak discharges, but none were based on channel-geometry measurements. The report by Boner and Buswell is the only previous report that provides estimating equations for mean annual runoff, and it also does not use channel geometry.

The accuracy of the estimating equations for peak discharge in this report generally is comparable to the accuracy of the equations presented in the report by Parrett and Omang (1981). The use of channel-geometry equations thus provides

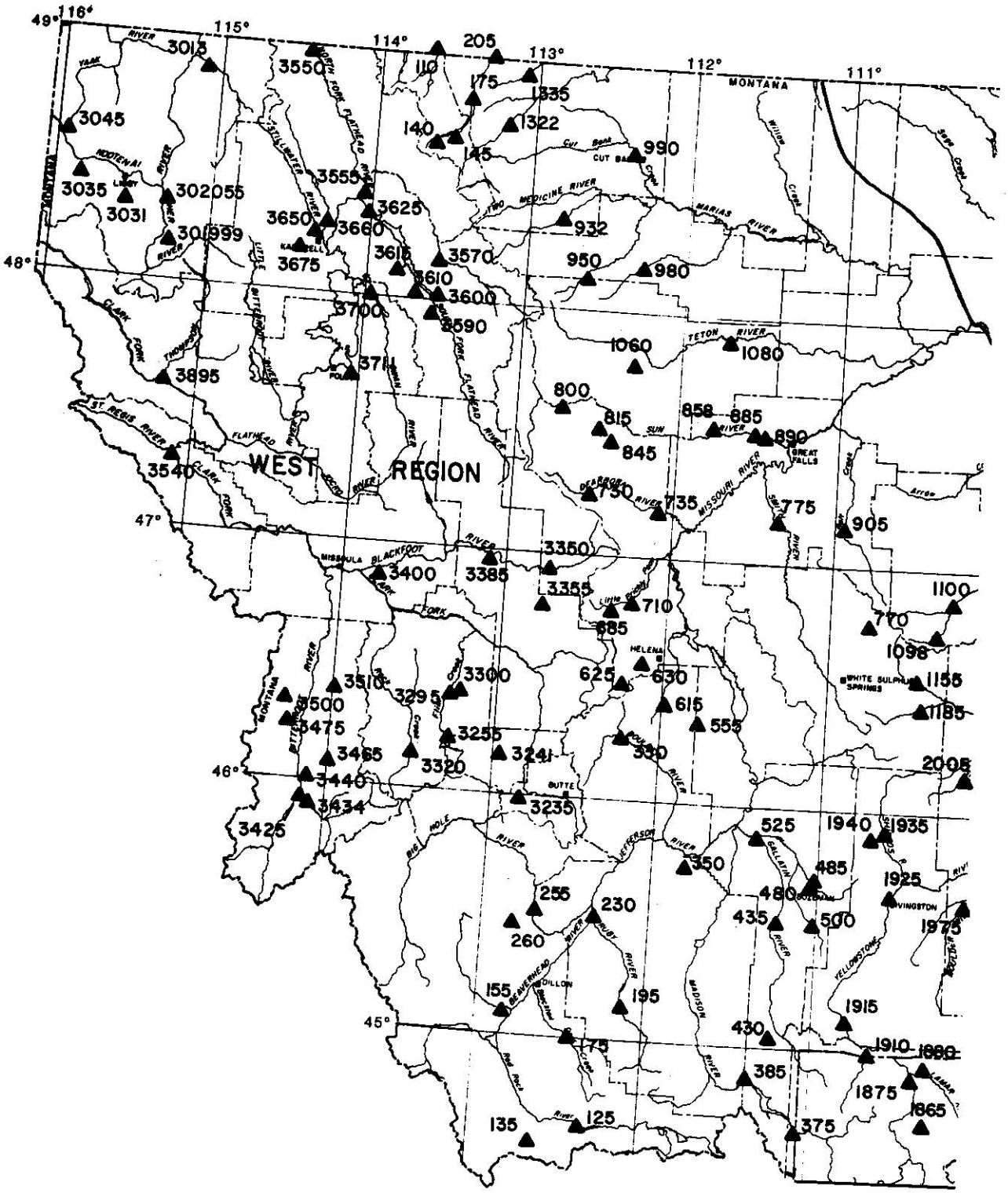
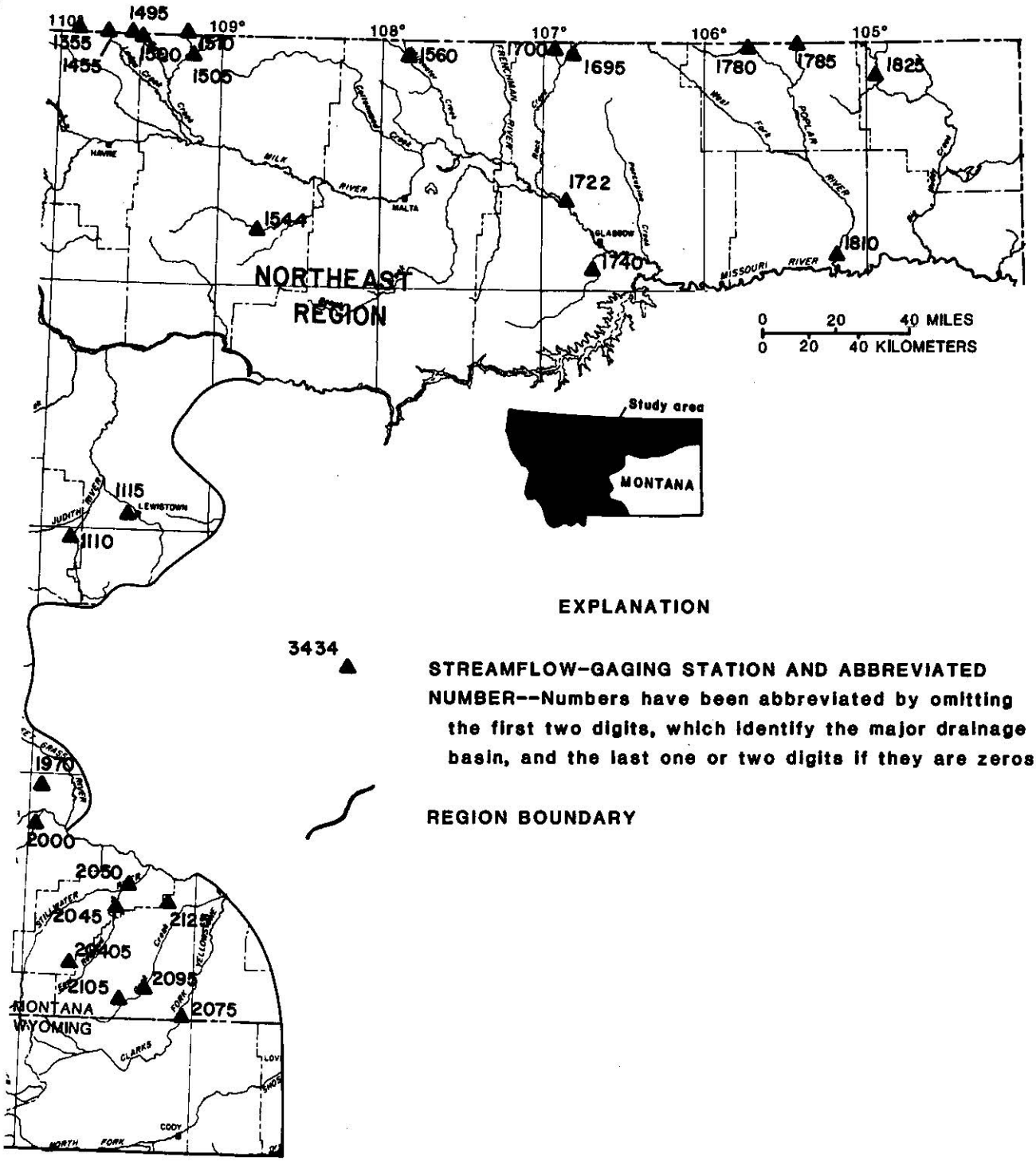


Figure 1.--Location of study area, region boundaries, and selected streamflow-



gaging stations used for mean-annual-runoff analysis.

a viable alternative to methods for peak-discharge prediction based solely on drainage-basin characteristics. The estimating equations for mean annual runoff in this report are considered to be more reliable than the equations in the report by Boner and Buswell (1970). The improved reliability probably is due largely to the additional streamflow-gaging data that have become available since 1970.

The estimating equations presented herein will be useful to hydraulic designers, land-use managers, water-rights administrators, and others who need to estimate streamflow. This report was prepared in cooperation with the U.S. Bureau of Land Management, the U.S. Forest Service, and the Montana Department of Natural Resources and Conservation.

DATA USED

Streamflow data

Values of mean annual runoff were computed using streamflow data from 126 streamflow-gaging stations with 10 or more years of continuous record. Data through the 1980 water year were used in the analysis. Gaging stations where the flows are substantially regulated or where large diversions significantly affect flows were generally not used in the analysis. Exceptions were made where the regulation or diversions began more than 10 years before the beginning of the streamflow record, so that the channel-geometry features were considered representative of the altered streamflow regimen. The location of the streamflow-gaging stations used in the mean-annual-runoff analysis is shown in figure 1. The mean annual runoff computed for each gaging station is listed in table 1 at the back of the report.

Peak discharges for recurrence intervals of 2, 5, 10, 25, 50, and 100 years were computed using data from 203 streamflow-gaging stations having 10 or more years of record of annual peak discharge. Most of the continuous-record stations used in the mean-annual-runoff analysis also were used in the peak-discharge analysis. In addition, data from crest-stage gages where only annual peak discharges are available were used in the analysis. The peak discharges used in this study were computed previously for the regional flood-frequency study by Parrett and Omang (1981) using procedures recommended by the U.S. Water Resources Council (1977). Streamflow data through the 1978 water year were used in the peak-discharge computations. The location of all streamflow-gaging stations used in the peak-discharge analysis is shown in figure 2, and the computed peak-discharges for the various recurrence intervals are listed in table 1.

Channel-geometry data

Channel-geometry features were measured by U.S. Geological Survey personnel from 1978 through 1980 at or near each streamflow-gaging station used in the mean annual runoff and peak-discharge analyses. Active-channel width was measured and an associated mean depth was determined at almost every site. Bankfull width was measured and an associated mean depth was determined at every site where the bankfull width was discernible. On some streams, particularly those that were deeply entrenched in the flood plain, the bankfull width was not well defined and consequently was not measured.

The active channel has been described by Hedman and Kastner (1977) as that part of the stream channel recently used to transport water and sediment at normal stages. The width of the active channel is measured where the stream banks abruptly change from steep to a more gently sloping surface. This change in slope commonly coincides with the lower limit of annual vegetation. A distinguishable vegetation line generally was used as the reference level for the active-channel width measured. In many instances, a prominent vegetation line or change in bank slope was found on only one side of the channel. In this situation, the width was measured from the distinguishing feature, level across the channel, to a point of intersection with the opposite streambank.

The bankfull channel was described by Riggs (1974) as that part of the stream channel bounded by the streamward edges of the flood plain or by the lower edge of permanent vegetation. On perennial streams, the upper extent of the bankfull-channel section corresponds to the bankfull stage at a narrow stream section described by Leopold and others (1964). At most of the sites in the study area, the distinguishing feature of the bankfull reference level was the abrupt change in bank slope from near vertical to near horizontal. This prominent flood-plain bench commonly was found on only one side of the channel.

On mountain streams typical of most of this study area, the bankfull channel is only slightly wider than the active channel. Channel geometry features were measured at the narrowest and most stable section of a stream. A sketch (fig. 3) modified from Lowham (1976) shows where the stable section normally occurs. Typical active-channel and bankfull sections in the mountainous regions of Montana are illustrated in figures 4 through 6. Active-channel and bankfull sections measured on plains streams in northeastern Montana are shown in figures 7 and 8. Values of the channel-geometry features measured at each gaging station used in the mean-annual-runoff analysis or the peak-discharge analysis are listed in table 2 at the back of the report.

Basin-characteristics data

Various drainage-basin characteristics were investigated for possible use in the development of estimating equations for mean annual runoff and for peak discharge. Basin characteristics tested include:

A	drainage area,
P	mean annual precipitation,
$F+10$	forest cover index,
$E/1000$	mean basin elevation index,
$HE+10$	basin high-elevation index,
$JAN+10$	mean January minimum temperature index,
L	main channel length,
S	main channel slope, and
$I24$	precipitation intensity index for a storm of 24 hours duration having an exceedance probability of 50 percent.

Basin characteristics determined to be important in the various estimating equations were drainage area, mean annual precipitation, forest cover index, mean basin elevation index, basin high-elevation index, main channel length, main channel slope, and precipitation intensity index. Drainage area is expressed in square miles

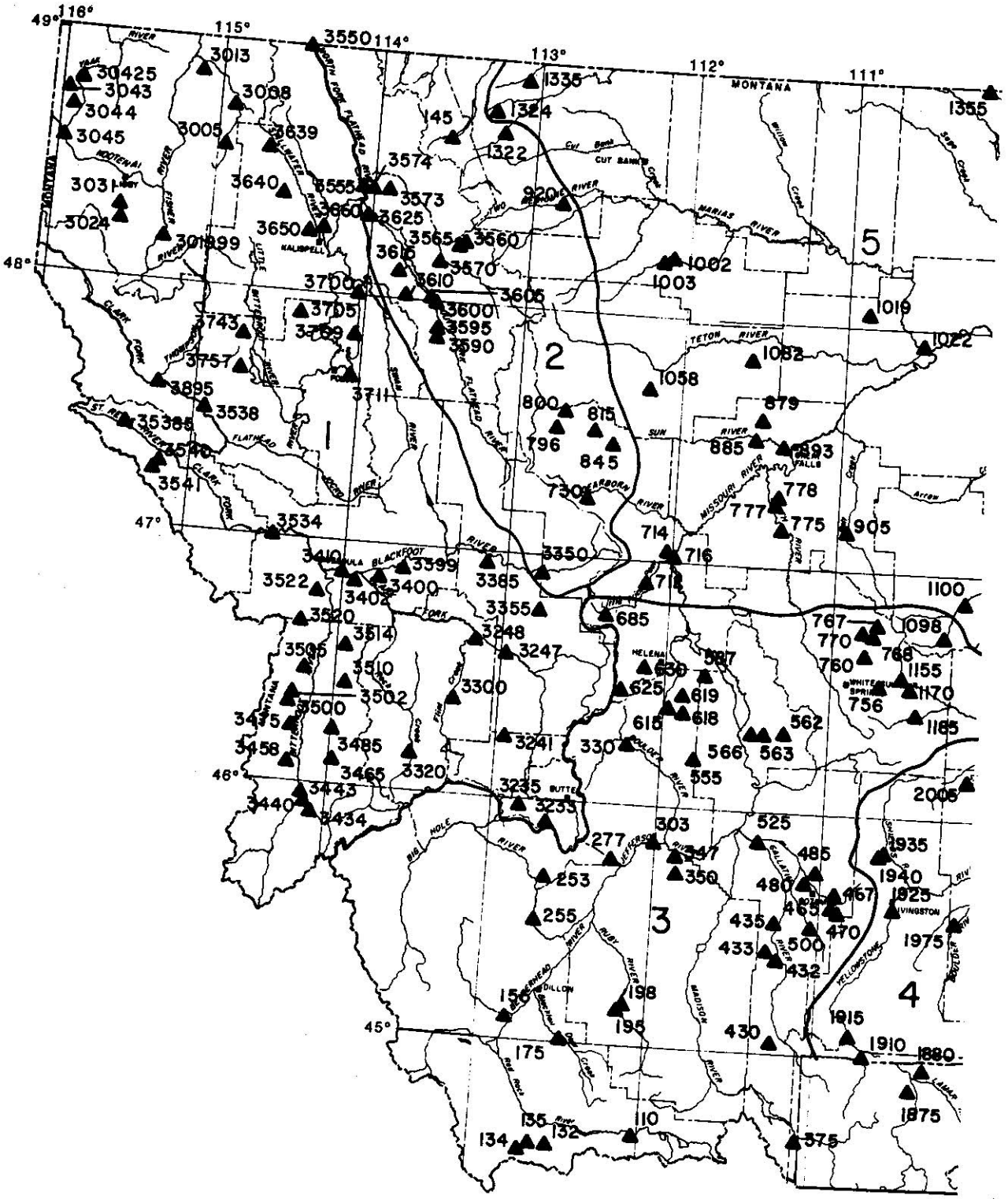
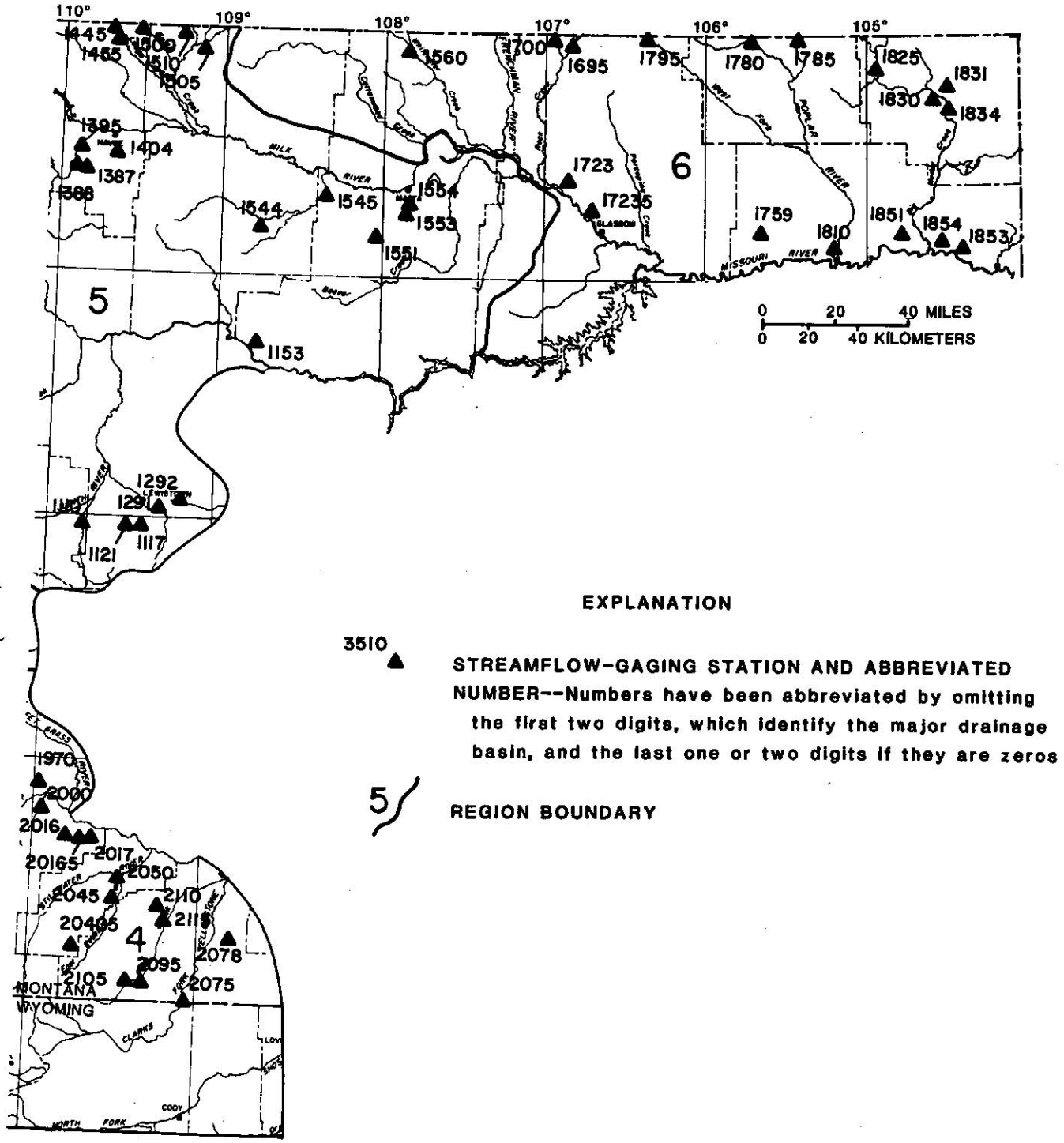


Figure 2.--Location of region boundaries and selected



streamflow-gaging stations used for peak-discharge analysis.

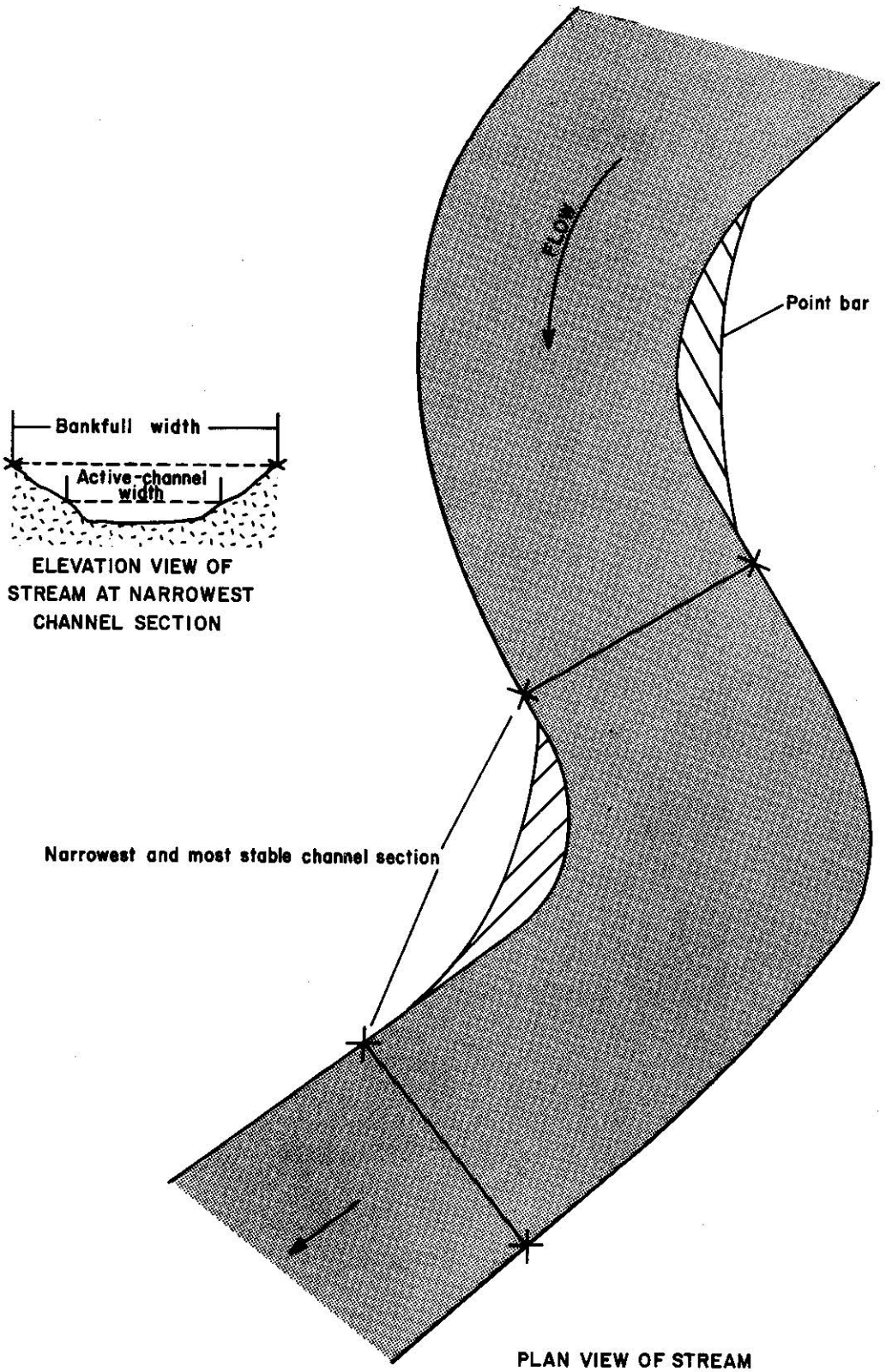


Figure 3.--Best locations for measurement of channel-geometry features.

Figure 4.--Active-channel and bankfull widths on Rattlesnake Creek at Missoula, Montana. Active-channel section (bottom line) is defined by limits of vegetation. Bankfull section (top line) is defined by change in slope. View is downstream. Site is near station 12341000.

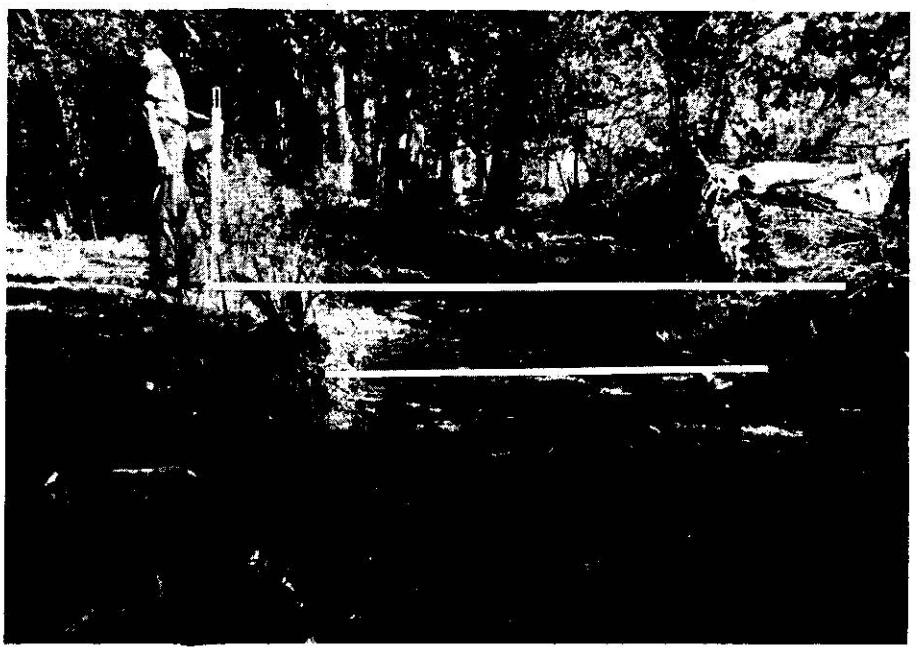


Figure 5.--Active-channel and bankfull widths on Eightmile Creek near Florence, Montana. Active-channel (bottom line) and bankfull (top line) sections are defined by changes in slope. View is upstream. Site is near station 12351400.

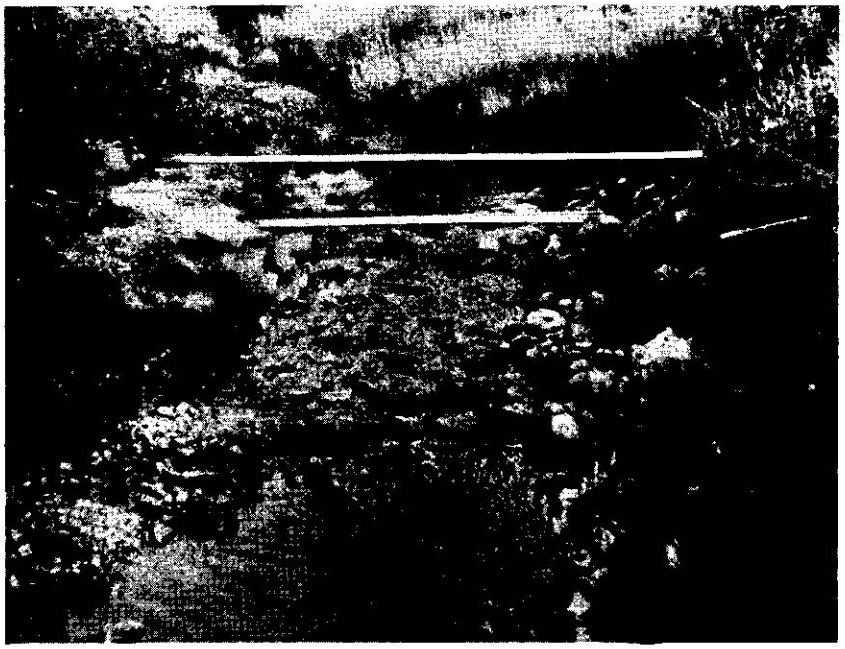


Figure 6.--Active-channel and bankfull widths on Dayton Creek near Proctor, Montana. Active-channel (bottom line) and bankfull (top line) sections are defined by changes in slope. View is upstream. Site is near station 12370500.

Figure 7.--Active-channel and bankfull widths on East Fork Battle Creek near international boundary, Montana. Active-channel (bottom line) and bankfull (top line) sections are defined by changes in slope. View is downstream. Site is near station 06150500.

Figure 8.--Active-channel width on Willow Creek near Glasgow, Montana. Section is defined by limits of vegetation. View is downstream. Site is near station 06174000.

and is determined for ungaged sites by planimetering the area outlined on the best scale topographic map available. Mean annual precipitation is the basin average, in inches, determined from the maps contained in the report by U.S. Soil Conservation Service (1977). The forest cover index is the percentage of the drainage basin covered by forest (*F*) plus 10; it is determined by planimetering the forested (green) areas shown on the best scale U.S. Geological Survey topographic maps, multiplying by 100, and dividing the result by the total basin drainage area. The value 10 is added to the percentage to ensure that values close to zero do not occur.

Mean basin elevation index is the mean basin elevation, in feet above sea-level datum (*E*) divided by 1,000. Mean basin elevation can be determined by using a transparent grid overlay on a topographic map. The basin elevation at each grid intersection is determined, and the mean basin elevation is calculated by averaging. The basin high-elevation index is the percentage of the total basin area above 6,000 feet sea-level datum (*HE*) plus 10. The percentage of basin area above 6,000 feet elevation can be determined by planimetering the drainage area above the 6,000-foot contour on a topographic map, multiplying by 100, and dividing the result by the total drainage area. The mean January minimum temperature index is the mean January minimum temperature in degrees Fahrenheit (*JAN*) plus 10. Mean January minimum temperatures are obtained from the U.S. Environmental Data Service (1971). Main channel length is the length of the main stream channel, in miles, from the outlet of the drainage basin to the basin divide. The main channel length is determined from the best scale topographic map, usually by measuring the distance with dividers. Main channel slope, in feet per mile, is determined from the main channel elevations determined at points 10 and 85 percent of the main channel

length. The difference in elevation at the two points is divided by 75 percent of the main channel length to obtain main channel slope. Precipitation intensity index is the precipitation intensity in inches per hour for a storm of 24 hours duration having a recurrence interval of 2 years. Precipitation intensity index is determined from maps published by the National Weather Service (1973). The values of the drainage-basin characteristics for each gaging station used in the analysis are listed in table 3 at the back of the report.

METHOD OF ANALYSIS

Multiple regression techniques

Equations for estimating mean annual runoff and peak discharges for various recurrence intervals were developed from multiple-regression analyses of streamflow, channel-geometry, and basin-characteristics data obtained at streamflow-gaging stations. The data were converted to logarithms to help ensure a linear relationship among the variables, and regression equations of the following form were derived:

$$\text{Log } Q = \log a + b_1 \log B + b_2 \log C + \ldots b_n \log N \qquad (1)$$

where Q (dependent variable) is either Q_A, the mean annual runoff in acre-feet, or Q_m, the annual peak discharge in cubic feet per second having a recurrence interval of m years;

a is the multiple-regression constant;

b_1, $b_2 \ldots b_n$ are the regression coefficients; and

B, C,... N are values of the channel-geometry and drainage-basin characteristics (independent variables).

Taking antilogarithms yields the following non-linear form of the regression equation:

$$Q = aB^{b_1}C^{b_2}\ldots N^{b_n} \qquad (2)$$

The regression analyses were performed by digital computer using Statistical Analysis System (SAS) programs (SAS Institute, Inc., 1979). These programs provide various statistical measures of the applicability of the derived regression equations such as standard errors of estimate, coefficients of determination (R^2), and tests for the significance of each independent variable.

Three sets of regression equations for estimating Q_A and Q_m were developed. One set considered only active-channel geometry characteristics (active-channel width, W_{AC}, and active-channel depth, D_{AC}) as independent variables. Another set considered only bankfull-channel geometry characteristics (bankfull width, W_{BF}, and bankfull depth, D_{BF}) as independent variables. The third set of regression equations used both basin characteristics and channel-geometry characteristics as independent variables.

In developing equations using both channel-geometry and basin characteristics, a "maximum R^2 improvement" routine for adding or deleting independent variables was used. This procedure determines the "best" one-variable model (largest R^2), the best two-variable model (greatest increase in R^2), and so forth until all independent variables have been added to the model. Variables may be deleted

and replaced by new variables at any step if a larger R^2 results. In this study, a variable was included in the model if the test statistic for significance was 5 percent or less. In general, the smaller the test statistic for significance, the more significant is the variable in the equation.

Mean-annual-runoff analysis

Because streams in eastern plains regions of Montana generally flow only on a seasonal basis, the regimen of streams in northeastern Montana commonly is markedly different from the regimen of streams in the mountainous, western part of the State. Accordingly, the study area was divided into the two regions shown in figure 1 before the regression analysis for mean annual runoff was begun. The Northeast Region contained 16 gaging stations, and the West Region contained 110 gaging stations. The results of the regression analysis using only channel-geometry characteristics as independent variables are summarized in table 4. In both regions the significance levels for active-channel width and bankfull width were less than 1 percent.

Table 4.--*Results of regression analysis for mean annual runoff using only channel-geometry characteristics*

Estimating equation	Average standard error of estimate (*SE*) (percent)	Coefficient of determination (R^2)
	Northeast Region	
$Q_A = 3.58\ W_{AC}^{2.633}$	61	0.757
$Q_A = 1.52\ W_{BF}^{2.105}$	77	.559
	West Region	
$Q_A = 128\ W_{AC}^{1.710}$	38	.932
$Q_A = 47.9\ W_{BF}^{1.846}$	42	.920

The regression equations in table 4 are substantially different for the two regions as might be expected. The average standard errors of estimate also differ significantly between regions, with the West Region having the better (smaller) standard errors. The larger standard errors in the Northeast Region are probably largely due to the greater variability of annual flows in this region. In neither region was active-channel depth or bankfull depth significant at the 5-percent level. In both regions, the active-channel width gave a better standard error of estimate than bankfull width.

A regression analysis using both channel-geometry and basin characteristics for the Northeast Region resulted in the following equation:

$$Q_A = 7.56\ W_{AC}^{1.370}\ A^{0.536} \tag{3}$$

The coefficient of determination (R^2) for this equation was 0.834 and the average standard error of estimate (SE) was 52 percent. The level of significance was 4 percent for W_{AC} and 3 percent for A. No other independent variables were found to be significant at the 5-percent level.

The estimating equation using both active-channel width and drainage area apparently is better than the equation using only active-channel width because of the reduced standard error of estimate. The improvement may be misleading, however, because active-channel width and drainage area are correlated. An estimating equation with two correlated independent variables may not provide any more reliable estimates than an equation with only one of the variables included.

The results of the regression analysis using both channel-geometry and basin characteristics in the West Region are given in table 5. The table is arranged to show the effects of adding each new independent variable to the equation using the "maximum R^2 improvement" routine. As new independent variables are added to the equation, the average standard error of estimate is reduced a small amount (table

Table 5.--*Results of regression analysis for mean annual runoff in West Region*

[Independent variable: W_{AC}, active-channel width; F+10, forest cover index; A, drainage area; P, mean annual precipitation. Level of significance of regression coefficient: ****, less than 0.1 percent; ***, 0.1 -1.0 percent; **, 1.0 - 2.0 percent; *, 2.0 - 5.0 percent]

Mean annual runoff (cubic feet per second)	Independent variable				Regression constant (a)	Regression coefficient				Coefficient of determination (R^2)	Average standard error of estimate (SE) (percent)
	W_{AC}	F+10	A	P		b_1	b_2	b_3	b_4		
Q_A	X	--	--	--	128	1.715****	--	--	--	0.932	38
Q_A	X	X	--	--	72.1	1.703****	0.144**	--	--	.936	36
Q_A	X	X	X	--	60.0	1.541****	.197***	0.115***	--	.941	35
Q_A	X	X	X	X	33.6	1.394****	.172***	.2000****	0.2370*	.943	34

5). Thus, the estimating equation using four independent variables is not significantly better than the equation using only active-channel width.

Peak-discharge analysis

An initial peak-discharge regression analysis using only channel geometry characteristics was made for the entire study area. The regression residuals (difference between actual peak discharges and computed peak discharges) then were plotted on a map and used as a basis for separating the study area into the six regions shown in figure 2. The boundaries for the regions were located on topographic divides or prominent geographic features if possible. An attempt also was made to match the same regional boundaries used in the study by Parrett and Omang (1981), although complete agreement was not possible. The physiography and climate of the regions as described by Parrett and Omang thus are considered to be generally applicable to the regions used in this report.

Separate multiple-regression analyses then were made for each of the six regions. The results of the regression analysis using only channel-geometry characteristics as independent variables are given in table 6. The estimating equations based on channel geometry generally have smaller standard errors in the mountainous regions (I, II, III, and IV) than in the plains regions (V and VI). The difference in standard error between the equations using active-channel width and the equations using bankfull width is generally insignificant.

Equations for estimating peak discharges using channel-geometry characteristics and basin charactertistics were developed for the mountainous regions (I, II, III, and IV). No meaningful equations using both channel-geometry characteristics and basin characteristics could be derived for Regions V and VI. The results of the analysis using channel-geometry and basin characteristics are given in table 7 at the back of the report. As more independent variables are added to the estimating equations the standard error generally is decreased significantly. However, the improved correlation may be misleading whenever drainage area (A) or main channel length (L) are the significant basin characteristics, as was noted for the mean-annual-runoff analysis. Also, the negative coefficient for main channel slope (S) that occurs in several regions appears to result from a negative correlation between drainage area and main channel slope. Thus, the reader is cautioned to carefully consider each case individually and not to automatically select the estimating equation with the smallest standard error.

DISCUSSION

Limitations of method

Because multiple-regression equations do not define actual physical relationships, their use as estimating equations is most valid when limited to the range in variable values used to derive the equations. The range of channel-geometry and basin characteristics used for the mean-annual-runoff analysis and the peak discharge analysis are given in table 8.

Perhaps the most stringent restriction on the use of channel geometry to estimate streamflow is the necessity to visit the site and measure the channel geometry. Making a reliable measurement of stream channel width and depth requires

Table 6.--*Results of regression analysis for peak discharge using only channel-geometry characteristics*

Region	Estimating equation	Average standard error of estimate (SE) (percent)	Coefficient of determination (R^2)
	Active-channel width		
I	$Q_2 = 1.15\ W_{AC}^{1.735}$	53	0.936
	$Q_5 = 2.45\ W_{AC}^{1.639}$	48	.940
	$Q_{10} = 3.61\ W_{AC}^{1.589}$	48	.936
	$Q_{25} = 5.38\ W_{AC}^{1.538}$	50	.928
	$Q_{50} = 6.97\ W_{AC}^{1.504}$	52	.919
	$Q_{100} = 8.75\ W_{AC}^{1.474}$	55	.910
	Bankfull width		
	$Q_2 = 0.295\ W_{BF}^{1.965}$	54	.935
	$Q_5 = 0.677\ W_{BF}^{1.857}$	48	.942
	$Q_{10} = 1.04\ W_{BF}^{1.800}$	47	.940
	$Q_{25} = 1.61\ W_{BF}^{1.742}$	48	.933
	$Q_{50} = 2.14\ W_{BF}^{1.704}$	50	.926
	$Q_{100} = 2.74\ W_{BF}^{1.670}$	52	.917
	Active-channel width		
II	$Q_2 = 0.635\ W_{AC}^{1.891}$	48	.954
	$Q_5 = 1.68\ W_{AC}^{1.763}$	39	.964
	$Q_{10} = 3.02\ W_{AC}^{1.680}$	36	.966
	$Q_{25} = 5.46\ W_{AC}^{1.608}$	35	.965
	$Q_{50} = 9.56\ W_{AC}^{1.476}$	43	.942
	$Q_{100} = 16.9\ W_{AC}^{1.476}$	43	.942

Table 6.--*Results of regression analysis for peak discharge using only channel-geometry characteristics*--Continued

Region	Estimating equation	Average standard error of estimate (*SE*) (percent)	Coefficient of determination (R^2)
	Bankfull width		
II	$Q_2 = 0.153\ W_{BF}^{2.104}$	44	0.964
	$Q_5 = 0.449\ W_{BF}^{1.958}$	36	.967
	$Q_{10} = 0.859\ W_{BF}^{1.864}$	38	.965
	$Q_{25} = 1.63\ W_{BF}^{1.784}$	39	.955
	$Q_{50} = 2.99\ W_{BF}^{1.704}$	39	.955
	$Q_{100} = 5.48\ W_{BF}^{1.636}$	50	.932
	Active-channel width		
III	$Q_2 = 0.869\ W_{AC}^{1.756}$	49	.933
	$Q_5 = 2.74\ W_{AC}^{1.555}$	48	.918
	$Q_{10} = 4.99\ W_{AC}^{1.451}$	54	.889
	$Q_{25} = 9.59\ W_{AC}^{1.334}$	63	.835
	$Q_{50} = 14.6\ W_{AC}^{1.260}$	71	.786
	$Q_{100} = 21.2\ W_{AC}^{1.193}$	79	.733
	Bankfull width		
	$Q_2 = 0.202\ W_{BF}^{2.013}$	53	.924
	$Q_5 = 0.768\ W_{BF}^{1.778}$	55	.900
	$Q_{10} = 1.54\ W_{BF}^{1.656}$	61	.867
	$Q_{25} = 3.30\ W_{BF}^{1.519}$	70	.809
	$Q_{50} = 5.39\ W_{BF}^{1.432}$	78	.760
	$Q_{100} = 8.36\ W_{BF}^{1.353}$	85	.707

Table 6.--*Results of regression analysis for peak discharge using only channel-geometry characteristics*--Continued

Region	Estimating equation	Average standard error of estimate (*SE*) (percent)	Coefficient of determination (R^2)
	Active-channel width		
IV	$Q_2 = 1.57\ W_{AC}^{1.662}$	46	0.937
	$Q_5 = 8.37\ W_{AC}^{1.372}$	38	.937
	$Q_{10} = 20.8\ W_{AC}^{1.213}$	39	.915
	$Q_{25} = 56.7\ W_{AC}^{1.038}$	45	.857
	$Q_{50} = 109\ W_{AC}^{0.923}$	51	.789
	$Q_{100} = 199\ W_{AC}^{0.817}$	58	.701
	Bankfull width		
	$Q_2 = 0.283\ W_{BF}^{1.957}$	46	.936
	$Q_5 = 1.96\ W_{BF}^{1.626}$	35	.945
	$Q_{10} = 5.62\ W_{BF}^{1.443}$	35	.929
	$Q_{25} = 17.9\ W_{BF}^{1.243}$	42	.877
	$Q_{50} = 38.3\ W_{BF}^{1.111}$	48	.816
	$Q_{100} = 76.9\ W_{BF}^{0.990}$	55	.726
	Active-channel width		
V	$Q_2 = 4.06\ W_{AC}^{1.412}$	90	.774
	$Q_5 = 17.5\ W_{AC}^{1.238}$	72	.796
	$Q_{10} = 37.4\ W_{AC}^{1.146}$	68	.787
	$Q_{25} = 84.0\ W_{AC}^{1.045}$	68	.751
	$Q_{50} = 141\ W_{AC}^{0.979}$	72	.710
	$Q_{100} = 226\ W_{AC}^{0.919}$	77	.658

Table 6.--*Results of regression analysis for peak discharge using only channel-geometry characteristics*--Continued

Region	Estimating equation	Average standard error of estimate (*SE*) (percent)	Coefficient of determination (R^2)
	Bankfull width		
V	$Q_2 = 0.815\ W_{BF}^{1.700}$	105	0.715
	$Q_5 = 3.99\ W_{BF}^{1.504}$	77	.744
	$Q_{10} = 9.20\ W_{BF}^{1.396}$	73	.739
	$Q_{25} = 22.6\ W_{BF}^{1.277}$	72	.706
	$Q_{50} = 40.6\ W_{BF}^{1.197}$	74	.665
	$Q_{100} = 68.6\ W_{BF}^{1.125}$	79	.614
	Active-channel width		
VI	$Q_2 = 9.81\ W_{AC}^{1.334}$	88	.693
	$Q_5 = 34.8\ W_{AC}^{1.297}$	63	.790
	$Q_{10} = 64.1\ W_{AC}^{1.275}$	58	.808
	$Q_{25} = 117\ W_{AC}^{1.249}$	58	.800
	$Q_{50} = 173\ W_{AC}^{1.231}$	61	.781
	$Q_{100} = 237\ W_{AC}^{1.216}$	65	.758
	Bankfull width		
	$Q_2 = 3.54\ W_{BF}^{1.387}$	79	.675
	$Q_5 = 13.7\ W_{BF}^{1.331}$	58	.770
	$Q_{10} = 27.2\ W_{BF}^{1.288}$	56	.768
	$Q_{25} = 55.0\ W_{BF}^{1.235}$	60	.727
	$Q_{50} = 85.9\ W_{BF}^{1.195}$	65	.681
	$Q_{100} = 126\ W_{BF}^{1.160}$	71	.633

Table 8.--*Range of channel-geometry and basin characteristics*

	Active-channel width (W_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Active-channel depth (D_{AC}) (feet)	Drainage area (A) (square miles)	Forest-cover (F) (per-cent)	Mean annual precipi-tation (P) (inches)	Mean channel slope (S) (feet per mile)	Mean basin elevation (E) (feet)	Basin above 6,000 feet eleva-tion (HE) (per-cent)	Mean channel length (L) (miles)
Average annual runoff										
Northeast Region	11-56	16-59	--	60.2-3,174	--	--	--	--	--	--
West Region	9.0-290	14-325	--	3.47-3,551	3.9-100	12-95	--	--	--	--
Peak discharge										
Region I	3.0-165	5.0-190	--	1.16-2,290	15.0-100	12-79	13.4-1,011	3,760-7,600	--	2.3-116.9
Region II	2.5-290	4.5-325	--	.14-1,663	--	15-95	8.09-1,610	5,120-6,460	--	--
Region III	3.0-223	6.0-260	0.3-3.0	1.48-2,476	--	--	--	4,770-8,320	--	--
Region IV	4.0-270	8.0-300	--	7.61-3,551	13-95.7	--	17.2-304	4,420-9,560	0-100	--
Region V	1.0-76	2.5-98	--	--	--	--	--	--	--	--
Region VI	4.0-56	8.0-59	--	--	--	--	--	--	--	--

some onsite training and experience. In addition, the cost and effort involved in a trip to the site may not be justified for preliminary or reconnaissance-level flow investigations. However, onsite stream investigations generally reveal anomalies in the regimen of streams that would not otherwise be discovered. In this respect, onsite investigations are a positive aspect of the channel-geometry method.

The regression equations were derived from gaging-station data on streams where major basin changes have not occurred or where the changes occurred so long ago that the channel geometry has had time to adjust to the altered streamflows. Thus, the equations may not be valid in recently urbanized or logged areas or where streamflows are regulated.

Stream reaches where channel-geometry measurements may be impossible or may provide misleading estimates of flow include:

1. Braided channels
2. Small streams which are entirely vegetated with no well-defined channel
3. Channels with bedrock exposed in either the bed or banks
4. Reaches with large pools or steep inclines
5. Channels that have had recent large floods or construction work

The equation for estimating peak discharge commonly will yield markedly different answers in adjoining regions. Therefore, a reader may be faced with a dilemma if peak discharges need to be estimated for a site near or on a regional boundary or for a stream that crosses regional boundaries. Unfortunately, there is no easy resolution of the problem. The discharges could be estimated using both sets of equations for the two adjoining regions and hydrologic judgment used to select the better set, or the discharges from the two sets could be averaged.

Accuracy appraisal

The accuracy of a regression equation generally is measured by the standard error of estimate. The standard error of estimate is the standard deviation of the distribution (assumed normal) of residuals about the regression line. The standard error of estimate thus is a measure of how well the regression line fits the data used to derive the line and is not necessarily a measure of how well the equation can be used to estimate or predict from data not used in the regression analysis.

To evaluate whether the standard error of estimate is a reliable measure of the prediction accuracy of the regression equations, a split-sample analysis was made using mean-annual-runoff data from the West Region. Thus, a random sample of 42 of the 110 streamflow-gaging sites in the West Region was used to derive a regression equation relating mean annual runoff to active-channel width. The equation thus derived was used to estimate mean annual runoff at the 68 sites not used to derive the equation. The standard deviation of the residuals (differences between the estimated and actual mean-annual-runoff values) at the 68 sites is considered to be a true measure of the standard error of prediction. In this instance, the standard deviation of the residuals was the same as the standard error of estimate using all 110 sites in the regression analysis (38 percent). The standard error of estimate thus is considered to be a reliable indicator of the prediction accuracy of the regression equation for mean annual runoff. A split-sample analysis was not made for peak discharges because of the smaller number of gaging stations in each of the six regions.

The standard errors of estimate for mean annual runoff determined in this study are slightly larger than the standard errors of estimate computed for the mean-annual-runoff analysis by Boner and Buswell (1970). The regression equations developed by Boner and Buswell are not considered to be as reliable as the equations developed in this study, however, because of the limited amount of gaging-station data used in the 1970 analysis.

The standard errors of estimate for peak discharges determined in this study generally are equivalent to the standard errors of estimate determined in the flood-frequency study by Parrett and Omang (1981). The two methods thus are considered to be equally reliable, and each can be used to supplement or check the other.

Illustrative examples

The general procedure for using channel geometry to estimate mean annual runoff and peak discharges at ungaged sites is shown by the following examples:

Example 1.

A road designer needs to determine the peak discharge for a 25-year recurrence interval (Q_{25}) at an ungaged stream crossing in Region I. The site was visited, and the channel was found to be reasonably uniform and stable. The measured active-channel width was 8.0 feet and the measured bankfull width was 12 feet. From table 6, the estimating equations for Region I are:

$Q_{25} = 5.38\ W_{AC}^{1.538}$ and $Q_{25} = 1.61\ W_{BF}^{1.742}$

Solving for Q_{25} using each equation yields:

$$Q_{25} = 5.38\ (8.0)^{1.538} = 5.38\ (24.49) = 132 \text{ cubic feet per second}$$

$$Q_{25} = 1.61\ (12)^{1.742} = 1.61\ (75.85) = 122 \text{ cubic feet per second}$$

In this instance, the results are almost the same for the two different widths. The width used can be the one most easily identifiable and measurable (generally active-channel width).

Example 2.

An estimate of mean annual runoff and peak discharge for a recurrence interval of 100 years is required for an ungaged site in Region III. The active-channel width was measured as 7.0 feet, and the bankfull width was measured as 10 feet. From topographic maps, the drainage area (A) is 4.00 square miles and the mean basin elevation (E) is 5,900 feet.

The mean-annual-runoff estimating equations from table 4 are:

$Q_A = 128\ W_{AC}^{1.710}$ and $Q_A = 47.9\ W_{BF}^{1.846}$

Inserting the measured widths and solving for Q_A gives:

$$Q_A = 128\ (7.0)^{1.710} = 128\ (27.87) = 3{,}570 \text{ acre-feet}$$

$$Q_A = 47.9\ (10)^{1.846} = 47.9\ (70.15) = 3{,}360 \text{ acre-feet}$$

Again, the results of the two equations are almost the same. The estimate using active-channel width probably would be used because the standard error of estimate is somewhat smaller.

From table 6, the channel-geometry equations for Q_{100} are:

$Q_{100} = 21.2\ W_{AC}^{1.193}$ and $Q_{100} = 8.36\ W_{BF}^{1.353}$

Solving for Q_{100} using the measured widths gives:

$$Q_{100} = 21.2\ (7.0)^{1.193} = 21.2\ (10.19) = 216 \text{ cubic feet per second}$$

$$Q_{100} = 8.36\ (10)^{1.353} = 8.36\ (22.54) = 188 \text{ cubic feet per second}$$

The results from the two estimating equations are again very close. To refine the estimate, the equation in table 7 using both active-channel width and the mean basin elevation index could be used.

$$
\begin{aligned}
Q_{100} &= 3{,}010\ W_{AC}^{1.310}\ (E/1000)^{-2.796} \\
&= 3{,}010\ (7.0)^{1.310}\ (5.90)^{-2.796} \\
&= 3{,}010\ (12.80)\ (0.0070) \\
&= 269 \text{ cubic feet per second}
\end{aligned}
$$

Adding the last significant variable (A) shown in the equations in table 7 and again solving for Q_{100} yields:

$$
\begin{aligned}
Q_{100} &= 7{,}630\ W_{AC}^{0.697}\ (E/1000)^{-3.089}\ A^{0.368} \\
&= 7{,}630\ (7.0)^{0.697}\ (5.90)^{-3.089}\ (4.00)^{0.368} \\
&= 7{,}630\ (3.882)\ (0.0042)\ (1.666) \\
&= 207 \text{ cubic feet per second}
\end{aligned}
$$

The standard error of estimate is smaller for the equation using W_{AC} and E (71 percent) than for either equation using only channel geometry (79 and 85 percent). The standard error of estimate for the equation using W_{AC}, E, and A is smaller yet, but the improvement may be misleading because W_{AC} and A are highly correlated. Thus, the best estimate for Q_{100} in this instance is probably the 269 ft^3/s determined from W_{AC} and E.

Example 3.

An estimate for Q_{50} is required for an ungaged stream site in northeastern Montana in Region V near the boundary between Regions V and VI. The site is visited, and an active-channel width of 11 feet is measured. A reliable measure of bankfull width cannot be made.

From table 6, the estimating equation for Region V is:

$$
\begin{aligned}
Q_{50} &= 141\ W_{AC}^{0.979} \\
&= 141\ (11)^{0.979} \\
&= 141\ (10.46) \\
&= 1{,}470 \text{ cubic feet per second}
\end{aligned}
$$

Because the site is close to the regional boundary, the estimating equation for Region VI is also used as follows:

$$
\begin{aligned}
Q_{50} &= 173\ W_{AC}^{1.231} \\
&= 173\ (11)^{1.231} \\
&= 173\ (19.14) \\
&= 3{,}310 \text{ cubic feet per second}
\end{aligned}
$$

To help choose between the two significantly different estimates, the basin characteristics are measured and the appropriate equation in the report by Parrett and Omang (1981, p. 15, East-Central Plains Region) is used to calculate Q_{50} as follows:

$$Q_{50} = 1{,}460\ A^{0.47}(E/1000)^{-0.99}\ G_f$$

$$Q_{50} = 1{,}460\ (47.0)^{0.47}(3.20)^{-0.99}(1.0)$$

$$= 1{,}460\ (6.11)(0.316)(1.0)$$

$$= 2{,}820 \text{ cubic feet per second}$$

Because the result from the equation using basin characteristics is closer to the 3,310 cubic feet per second calculated from the Region VI channel-geometry equation, the Region VI equation is assumed to be applicable in this instance.

CONCLUSIONS

Multiple-regression equations for estimating mean annual runoff from channel-geometry characteristics were developed for two regions in northeastern and western Montana. In the Northeast Region the standard errors of estimate were 61 percent for the estimating equation using active-channel width and 77 percent for the estimating equation using bankfull width. When drainage area was added to the estimating equation using active-channel width, the standard error of estimate improved to 52 percent.

In the West Region, the standard errors of estimate were 38 percent for the equations for mean annual runoff using active-channel width and 42 percent using bankfull width. The improvement in standard error of estimate was insignificant in the West Region when basin characteristics were added to the estimating equation using active-channel width. A split-sample test in the West Region indicated that the standard error of estimate was an accurate measure of the standard error of prediction.

Multiple-regression equations for estimating peak discharges for recurrence intervals of 2, 5, 10, 25, 50, and 100 years were derived for six regions in northeastern and western Montana. The standard errors of estimate for the estimating equations using only active-channel width ranged from 35 to 90 percent. The standard errors of estimate for the equations using only bankfull width ranged from 35 to 105 percent. The addition of basin characteristics to the estimating equations resulted in smaller standard errors in four regions.

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Table 1.--*Streamflow characteristics at selected gaging stations*

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
05011000	Belly River nr Mountain View, Alberta	44	223,041	---	---	---	---	---	---
05014000	Grinnell Creek nr Many Glacier, Mont.	29	18,901	---	---	---	---	---	---
05014500	Swiftcurrent Creek at Many Glacier, Mont.	66	104,279	1,010	1,310	1,510	1,900	3,300	6,700
05017500	St. Mary River nr Babb, Mont.	46	569,914	---	---	---	---	---	---
05020500	St. Mary River at international boundary, Mont.	64	507,636	---	---	---	---	---	---
06011000	Red Rock River nr Lakeview, Mont.	28	---	711	932	1,070	1,220	1,330	1,430
06012500	Red Rock River bl Lima Reservoir, nr Monida, Mont.	48	103,555	---	---	---	---	---	---
06013200	Traux Creek nr Lima, Mont.	15	---	5	19	37	75	116	170
06013400	Muddy Creek nr Dell, Mont.	15	---	62	115	156	213	258	305
06013500	Big Sheep Creek bl Muddy Cr, nr Dell, Mont.	26	47,070	345	522	639	784	890	994
06015500	Grasshopper Creek nr Dillon, Mont.	23	37,367	391	681	893	1,180	1,400	1,620
06017500	Blacktail Deer Creek nr Dillon, Mont.	18	39,105	196	284	341	410	461	509
06019500	Ruby River ab Reservoir, nr Alder, Mont.	42	128,900	936	1,200	1,370	1,560	1,690	1,830
06019800	Idaho Creek nr Alder, Mont.	19	---	21	38	50	68	82	96
06023000	Ruby River nr Twin Bridges, Mont.	20	141,935	---	---	---	---	---	---
06025300	Moose Creek nr Divide, Mont.	15	---	101	143	170	204	229	253
06025500	Big Hole River nr Melrose, Mont.	57	841,474	7,230	10,400	12,400	14,700	16,300	17,900
06026000	Birch Creek nr Glen, Mont.	28	21,290	180	260	320	390	460	---
06027700	Fish Creek nr Silverstar, Mont.	20	---	135	190	227	274	309	344
06030300	Jefferson River trib. No. 2 nr Whitehall, Mont.	22	---	11	41	82	171	275	423
06033000	Boulder River nr Boulder, Mont.	41	87,623	1,100	1,760	2,250	2,930	3,480	4,070
06034700	Sand Creek at Sappington, Mont.	15	---	25	163	437	1,260	2,490	4,610
06035000	Willow Creek nr Harrison, Mont.	42	28,822	221	346	438	567	671	782
06037500	Madison River nr West Yellowstone, Mont.	58	354,114	1,320	1,620	1,800	2,000	2,140	2,270
06038500	Madison River bl Hebgen Lake, nr Grayling, Mont.	71	720,539	---	---	---	---	---	---
06043000	Taylor Creek nr Grayling, Mont.	10	70,895	777	926	1,010	1,120	1,190	1,250
06043200	Squaw Creek nr Gallatin Gateway, Mont.	17	---	266	397	490	613	709	808
06043300	Logger Creek nr Gallatin Gateway, Mont.	20	---	15	24	30	38	44	51
06043500	Gallatin River nr Gallatin Gateway, Mont.	53	589,466	5,310	7,060	8,120	9,370	10,200	11,100
06046500	Rocky Creek nr Bozeman, Mont.	22	---	374	598	768	1,010	1,200	1,420
06046700	Pitcher Creek nr Bozeman, Mont.	16	---	13	31	49	81	112	150

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
06047000	Bear Canyon nr Bozeman, Mont.	18	---	146	234	302	396	474	557
06048000	East Gallatin River at Bozeman, Mont.	22	61,336	542	823	1,030	1,310	1,540	1,780
06048500	Bridger Creek nr Bozeman, Mont.	24	26,504	288	459	590	774	925	1,090
06050000	Hyalite Creek at Hyalite Ranger Station, nr Bozeman, Mont.	48	48,519	367	525	634	778	889	1,000
06052500	Gallatin River at Logan, Mont.	64	766,161	4,870	6,570	7,670	9,030	10,000	11,000
06055500	Crow Creek nr Radersburg, Mont.	15	---	514	743	906	1,120	1,300	1,470
06056200	Castle Creek trib. nr Ringling, Mont.	15	---	20	31	38	49	58	67
06056300	Cabin Creek nr Townsend, Mont.	19	---	14	38	62	106	150	205
06056600	Deep Creek bl North Fork Deep Creek, nr Townsend, Mont.	16	---	206	326	418	550	658	776
06058700	Mitchell Gulch nr East Helena, Mont.	20	---	16	56	109	220	347	522
06061500	Prickly Pear Creek nr Clancy, Mont.	45	35,267	264	414	522	664	775	890
06061800	Crystal Creek nr East Helena, Mont.	15	---	12	26	40	64	86	112
06061900	McClellan Creek at City Diversion Dam, nr East Helena, Mont.	16	---	149	261	350	480	587	705
06062500	Tenmile Creek nr Rimini, Mont.	66	12,745	223	373	480	619	725	831
06063000	Tenmile Creek nr Helena, Mont.	46	19,697	259	484	663	919	1,130	1,350
06068500	Little Prickly Pear Creek nr Marysville, Mont.	19	18,611	145	258	348	479	589	709
06071000	Little Prickly Pear Creek nr Canyon Creek, Mont.	13	34,905	---	---	---	---	---	---
06071200	Lyons Creek nr Wolf Creek, Mont.	16	---	99	235	367	593	808	1,070
06071400	Dog Creek nr Craig, Mont.	16	---	73	229	415	784	1,180	1,710
06071600	Wegner Creek at Craig, Mont.	19	---	110	282	460	776	1,090	1,470
06073000	Dearborn River nr Clemons, Mont.	26	84,003	1,140	2,000	2,750	4,300	6,200	10,500
06073500	Dearborn River nr Craig, Mont.	24	157,867	---	---	---	---	---	---
06075600	Fivemile Creek nr White Sulphur Springs, Mont.	15	---	13	25	35	52	66	84
06076000	Newland Creek nr White Sulphur Springs, Mont.	22	---	13	26	39	60	81	106
06076700	Sheep Creek nr Neihart, Mont.	19	---	59	96	123	161	191	223
06076800	Nuggett Creek nr Neihart, Mont.	15	---	9	15	21	30	38	47
06077000	Sheep Creek nr White Sulphur Springs, Mont.	31	23,101	208	303	372	467	542	622
06077500	Smith River nr Eden, Mont.	18	244,766	1,940	3,330	4,470	6,170	7,640	9,280
06077700	Smith River trib. nr Eden, Mont.	15	---	3	12	25	60	107	182
06077800	Goodman Coulee nr Eden, Mont.	20	---	83	242	422	764	1,120	1,580
06079600	Beaver Creek at Gibson Dam, nr Augusta, Mont.	15	---	119	276	450	800	1,350	2,500

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
06080000	Sun River nr Augusta, Mont.	37	593,811	6,400	9,600	12,000	17,100	24,500	38,000
06081500	Willow Creek nr Augusta, Mont.	20	20,059	150	350	540	890	1,250	1,470
06084500	Elk Creek at Augusta, Mont.	20	68,361	855	2,190	3,450	5,450	7,200	9,160
06085800	Sun River at Simms, Mont.	13	397,564	---	---	---	---	---	---
06087900	Muddy Creek trib. nr Power, Mont.	16	---	143	300	442	668	873	1,110
06088500	Muddy Creek at Vaughn, Mont.	43	91,968	636	1,220	1,780	2,750	3,690	4,880
06089000	Sun River nr Vaughn, Mont.	46	530,809	---	---	---	---	---	---
06089300	Sun River trib. nr Great Falls, Mont.	19	---	72	192	321	555	792	1,090
06090500	Belt Creek nr Monarch, Mont.	29	136,866	1,530	2,550	3,400	4,690	5,820	7,120
06092000	Two Medicine River nr Browning, Mont.	43	---	3,600	5,200	6,700	9,900	15,500	29,000
06093200	Badger Creek bl Four Horns Canal, nr Browning, Mont.	29	166,557	---	---	---	---	---	---
06095000	Birch Creek nr Dupuyer, Mont.	30	115,141	---	---	---	---	---	---
06098000	Dupuyer Creek nr Valier, Mont.	25	35,629	490	1,340	2,450	5,100	8,700	14,000
06099000	Cut Bank Creek at Cut Bank, Mont.	38	141,935	1,880	3,680	5,220	7,610	9,700	12,100
06100200	Heines Coulee trib. nr Valier, Mont.	16	---	6	27	60	143	250	413
06100300	Lone Man Coulee nr Valier, Mont.	19	---	56	248	542	1,250	2,140	3,470
06101900	Dead Indian Coulee nr Fort Benton, Mont.	15	---	8	48	122	328	623	1,110
06102200	Marias River trib. at Loma, Mont.	17	---	16	57	112	231	367	557
06105800	Bruce Coulee nr Choteau, Mont.	16	---	68	163	257	417	571	758
06106000	Deep Creek nr Choteau, Mont.	13	50,981	565	1,310	2,030	3,250	4,390	5,770
06108000	Teton River nr Dutton, Mont.	26	121,659	1,580	4,710	8,180	14,500	20,900	28,900
06108200	Kinley Coulee nr Dutton, Mont.	16	---	23	185	546	1,730	3,650	7,130
06109800	South Fork Judith River nr Utica, Mont.	20	16,438	232	455	647	944	1,210	1,500
06110000	Judith River nr Utica, Mont.	56	39,684	469	814	1,060	1,390	1,630	1,880
06111000	Ross Fork nr Hobson, Mont.	14	10,138	533	1,080	1,580	2,350	3,040	3,840
06111500	Big Spring Creek nr Lewistown, Mont.	25	76,761	---	---	---	---	---	---
06111700	Mill Creek nr Lewistown, Mont.	19	---	14	35	56	94	133	181
06112100	Cottonwood Creek nr Moore, Mont.	17	---	326	767	1,210	2,000	2,770	3,730
06115300	Duval Creek nr Landusky, Mont.	16	---	61	220	423	838	1,290	1,900
06115500	North Fork Musselshell River nr Delpine, Mont.	36	8,835	85	155	212	293	362	437
06117000	Checkerboard Creek at Delpine, Mont.	10	---	49	104	153	232	304	387
06118500	South Fork Musselshell River ab Martinsdale, Mont.	38	66,116	737	1,220	1,620	2,210	2,730	3,300
06129100	North Fork McDonald Creek trib. nr Heath, Mont.	16	---	11	26	42	71	100	135

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record [1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
06129200	Alkali Creek nr Heath, Mont.	15	---	24	101	216	493	843	1,370
06132200	South Fork Milk River nr Babb, Mont.	18	---	380	790	1,200	2,100	3,400	6,200
06132400	Dry Fork Milk River nr Babb, Mont.	17	---	216	700	1,290	2,500	3,810	5,580
06133500	North Fork Milk River ab St. Mary Canal, nr Browning, Mont.	39	---	292	752	1,230	2,100	2,960	4,030
06135500	Sage Creek at Q Ranch, nr Wild Horse, Alberta	38	7,461	613	1,200	1,660	2,310	2,830	3,380
06138700	South Fork Spring Coulee nr Havre, Mont.	19	---	15	70	156	362	619	998
06138800	Spring Coulee nr Havre, Mont.	15	---	34	138	285	610	993	1,530
06139500	Big Sandy Creek nr Assinniboine, Mont.	21	---	372	1,200	2,190	4,100	6,110	8,720
06140400	Bullhook Creek nr Havre, Mont	15	---	103	276	456	769	1,070	1,440
06144500	Lodge Creek at international boundary	41	---	1,320	2,770	3,970	5,680	7,070	8,550
06145500	Lodge Creek bl McRae Creek, at international boundary	27	22,505	798	2,640	4,830	9,070	13,500	19,200
06150000	Woodpile Coulee nr international boundary	44	2,210	383	1,040	1,660	2,660	3,530	4,510
06150500	East Fork Battle Creek nr international boundary	44	2,117	341	812	1,220	1,810	2,300	2,820
151000	Lyons Creek at international boundary	44	1,804	221	520	779	1,160	1,470	1,810
06154400	Peoples Creek nr Hays, Mont.	13	14,194	387	1,230	2,200	4,000	5,820	8,100
06154500	Peoples Creek nr Dodson, Mont.	21	---	879	1,990	2,970	4,470	5,760	7,200
06155100	Black Coulee nr Malta, Mont.	12	---	74	144	200	279	343	410
06155300	Disjardin Coulee nr Malta, Mont.	23	---	29	91	158	278	395	535
06155400	Taylor Coulee nr Malta, Mont.	18	---	9	43	92	200	321	485
06156000	Whitewater Creek nr international boundary	51	3,317	165	940	2,120	4,730	7,660	11,500
06169500	Rock Creek bl Horse Creek, nr international boundary	32	17,040	1,070	2,410	3,540	5,170	6,490	7,890
06170000	McEachern Creek at international boundary	53	7,794	634	2,320	3,990	6,450	8,390	10,300
06172200	Buggy Creek nr Tampico, Mont.	10	3,896	---	---	---	---	---	---
06172300	Unger Creek nr Vandalia, Mont.	21	---	85	421	906	1,940	3,100	4,620
06172350	Mooney Coulee nr Tampico, Mont.	15	---	39	124	217	379	532	712
06174000	Willow Creek nr Glasgow, Mont.	27	43,812	---	---	---	---	---	---
06175900	Wolf Creek trib. No. 2 nr Wolf Point, Mont.	24	---	108	423	811	1,550	2,310	3,240
06178000	Middle Fork Poplar River at international boundary	48	13,450	818	2,220	3,650	6,090	8,390	11,100
06178500	East Poplar River at international boundary	48	11,680	701	1,850	2,890	4,460	5,770	7,160
06179500	West Fork Poplar River at international boundary	20	---	218	959	1,940	3,920	6,020	8,690

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
06181000	Poplar River nr Poplar, Mont.	43	99,934	3,800	11,700	20,100	34,400	47,900	63,600
06182500	Big Muddy Creek at Daleview, Mont.	24	11,369	1,030	2,580	4,000	6,180	8,050	10,100
06183000	Big Muddy Creek at Plentywood, Mont.	19	---	1,120	2,550	3,780	5,590	7,090	8,690
06183100	Box Elder Creek nr Plentywood, Mont.	19	---	92	172	232	313	375	437
06183400	Spring Creek at Highway 16, nr Plentywood, Mont.	19	---	84	365	739	1,490	2,280	3,290
06185100	Big Muddy Creek trib. nr Culbertson, Mont.	15	---	41	187	385	791	1,230	1,780
06185300	Missouri River trib. No. 4 nr Culbertson, Mont.	15	---	314	645	909	1,280	1,580	1,880
06185400	Missouri River trib. No. 5 nr Culbertson, Mont.	16	---	55	214	409	781	1,160	1,620
06186500	Yellowstone River at Yellowstone Lake outlet, Yellowstone National Park	54	933,442	4,780	6,260	7,150	8,200	8,940	9,640
06187500	Tower Creek at Tower Falls, Yellowstone National Park	21	34,180	310	467	578	728	845	967
06188000	Lamar River nr Tower Falls Ranger Station, Yellowstone National Park	47	600,329	8,400	10,500	11,700	13,200	14,300	15,300
06191000	Gardiner River nr Mammoth, Yellowstone National Park, Mont.	34	159,315	1,124	1,510	1,760	2,060	2,270	2,480
06191500	Yellowstone River at Corwin Springs, Mont.	74	2,253,586	17,400	22,000	24,700	27,800	29,800	31,800
06192500	Yellowstone River nr Livingston, Mont.	55	2,724,290	20,600	25,400	28,300	31,500	33,800	35,900
06193500	Shields River at Clyde Park, Mont.	38	115,141	1,060	1,800	2,390	3,250	3,970	4,770
06194000	Brackett Creek nr Clyde Park, Mont.	25	20,132	211	392	548	791	1,010	1,260
06197000	Big Timber Creek nr Big Timber, Mont.	11	55,688	674	1,220	1,710	2,510	3,260	4,150
06197500	Boulder River nr Contact, Mont.	25	277,353	3,740	4,570	5,090	5,740	6,210	6,680
06200000	Boulder River at Big Timber, Mont.	31	446,083	5,950	7,400	8,330	9,490	10,300	11,200
06200500	Sweet Grass Creek ab Melville, Mont.	43	62,640	945	1,370	1,700	2,150	2,510	2,910
06201600	Bridger Creek nr Greycliff, Mont.	16	---	140	564	1,200	2,740	4,720	7,770
06201650	Work Creek nr Reed Point, Mont.	16	---	104	395	807	1,750	2,900	4,580
06201700	Hump Creek nr Reed Point, Mont.	19	---	40	123	228	447	696	1,040
06204050	West Rosebud Creek nr Roscoe, Mont.	15	93,417	747	1,240	1,620	2,180	2,640	3,160
06204500	Rosebud Creek nr Absarokee, Mont.	35	294,733	2,310	3,250	3,910	4,780	5,460	6,160
06205000	Stillwater River nr Absarokee, Mont.	45	701,711	6,600	8,490	9,710	11,300	12,400	13,500
06207500	Clarks Fork Yellowstone River nr Belfry, Mont.	59	690,124	7,640	9,160	10,100	11,100	11,900	12,600

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
06207800	Bluewater Creek nr Bridger	11	---	110	313	550	1,020	1,520	2,200
06209500	Rock Creek nr Red Lodge, Mont.	46	126,004	1,210	1,710	2,060	2,510	2,860	3,210
06210500	West Fork Rock Creek nr Red Lodge, Mont.	10	48,157	586	977	1,270	1,660	1,970	2,290
06211000	Red Lodge Creek ab Cooney Reservoir, nr Boyd, Mont.	42	---	574	1,200	1,780	2,720	3,580	4,600
06211500	Willow Creek nr Boyd, Mont.	42	---	250	563	879	1,440	1,990	2,700
06212500	Red Lodge Creek bl Cooney Reservoir, nr Boyd, Mont.	43	73,864	---	---	---	---	---	---
12300500	Fortine Creek nr Trego, Mont.	23	---	737	1,130	1,420	1,820	2,140	2,480
12300800	Deep Creek nr Fortine, Mont.	20	---	138	191	226	272	306	340
12301300	Tobacco River nr Eureka, Mont.	22	195,523	1,580	2,190	2,580	3,070	3,430	3,780
12301999	Wolf Creek nr Libby, Mont.	10	50,836	579	1,360	2,100	3,310	4,420	5,710
12302055	Fisher River nr Libby, Mont.	13	363,528	---	---	---	---	---	---
12302400	Shaughnessy Creek nr Libby, Mont.	20	---	12	30	48	78	106	139
12303100	Flower Creek nr Libby, Mont.	20	19,407	225	325	391	474	536	597
12303500	Lake Creek at Troy, Mont.	12	373,667	---	---	---	---	---	---
12304250	Whitetail Creek nr Yaak, Mont.	15	---	29	46	58	74	87	100
12304300	Cyclone Creek nr Yaak, Mont.	19	---	133	182	213	252	280	308
304400	Fourth of July Creek nr Yaak, Mont.	15	---	164	248	306	382	439	497
12304500	Yaak River nr Troy, Mont.	24	643,778	7,590	9,820	11,200	12,800	14,000	15,100
12323300	Smith Gulch nr Silverbow, Mont.	20	---	21	50	77	123	165	214
12323500	German Gulch Creek nr Ramsay, Mont.	14	15,135	188	295	370	469	545	623
12324100	Racetrack Creek bl Granite Creek, nr Anaconda, Mont.	16	42,798	360	484	563	660	731	800
12324700	Clark Fork trib. nr Drummond, Mont.	21	---	43	82	115	164	207	256
12324800	Morris Creek nr Drummond, Mont.	15	---	8	14	18	23	28	32
12325500	Flint Creek nr Southern Cross, Mont.	40	20,783	---	---	---	---	---	---
12329500	Flint Creek at Maxville, Mont.	39	72,271	---	---	---	---	---	---
12330000	Boulder Creek at Maxville, Mont.	41	34,470	375	553	677	840	965	1,090
12332000	Middle Fork Rock Creek nr Phillipsburg, Mont.	43	89,072	912	1,240	1,440	1,670	1,830	1,980
12335000	Blackfoot River nr Helmville, Mont.	13	254,904	2,110	3,730	5,010	6,850	8,380	10,000
12335500	Nevada Creek ab Reservoir, nr Finn, Mont.	41	27,880	504	915	1,250	1,730	2,130	2,560
12338500	Blackfoot River nr Ovando, Mont.	23	619,157	5,230	8,210	10,500	13,600	16,200	18,900
12339900	West Twin Creek nr Bonner, Mont.	20	---	94	156	202	264	314	365
12340000	Blackfoot River nr Bonner, Mont.	44	1,195,588	9,360	14,000	16,900	20,400	22,900	25,200
12340200	Marshall Creek nr Missoula, Mont.	15	---	17	26	33	41	47	54

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
12341000	Rattlesnake Creek at Missoula, Mont.	10	---	1,310	1,740	2,000	2,310	2,530	2,740
12342500	West Fork Bitterroot River nr Conner, Mont.	39	209,282	---	---	---	---	---	---
12343400	East Fork Bitterroot River nr Conner, Mont.	16	197,696	1,930	2,820	3,380	4,050	4,530	5,000
12344000	Bitterroot River nr Darby, Mont.	43	672,745	6,390	8,850	10,400	12,300	13,600	14,900
12344300	Burke Gulch nr Darby, Mont.	21	---	8	14	19	24	29	33
12345800	Camas Creek nr Hamilton, Mont.	16	---	148	209	248	294	327	359
12346500	Skalkaho Creek nr Hamilton, Mont.	27	67,709	656	853	974	1,120	1,220	1,320
12347500	Blodgett Creek nr Corvallis, Mont.	22	51,053	607	765	856	959	1,030	1,090
12348500	Willow Creek nr Corvallis, Mont.	19	---	105	137	156	178	194	209
12350000	Bear Creek nr Victor, Mont.	18	47,795	701	894	1,010	1,140	1,230	1,320
12350200	Gash Creek nr Victor, Mont.	16	---	109	159	191	231	259	287
12350500	Kootenai Creek nr Stevensville, Mont.	22	---	808	1,060	1,210	1,380	1,500	1,620
12351000	Burnt Fork Bitterroot River nr Stevensville, Mont.	24	34,977	339	507	619	761	865	969
12351400	Eightmile Creek nr Florence, Mont.	16	---	47	79	102	132	156	180
12352000	Lolo Creek ab Sleeman Creek, nr Lolo, Mont.	12	---	1,520	1,840	2,020	2,230	2,380	2,510
12352200	Hayes Creek nr Missoula, Mont.	15	---	10	25	39	62	82	105
12353400	Negro Gulch nr Alberton, Mont.	15	---	30	69	104	158	206	260
12353800	Thompson Creek nr Superior, Mont.	18	---	72	115	145	184	213	242
12353850	East Fork Timber Creek nr Haugan, Mont.	15	---	34	55	69	86	99	113
12354000	St. Regis River nr St. Regis, Mont.	17	420,013	4,190	6,080	7,310	8,820	9,920	11,000
12354100	North Fork Little Joe Creek nr St. Regis, Mont.	15	---	173	245	290	346	385	423
12355000	North Fork Flathead River at Flathead, British Columbia	50	689,400	7,430	10,300	12,100	14,300	16,000	17,600
12355500	North Fork Flathead River nr Columbia Falls, Mont.	49	2,158,721	20,600	26,300	30,000	35,200	39,500	44,500
12356000	Skyland Creek nr Essex, Mont.	25	---	160	225	275	380	620	1,100
12356500	Bear Creek nr Essex, Mont.	12	---	410	620	800	1,040	1,560	2,350
12357000	Middle Fork Flathead River at Essex, Mont.	22	772,679	9,800	14,000	17,000	22,000	27,000	34,500
12357300	Moccasin Creek nr West Glacier, Mont.	17	---	130	235	335	515	820	1,400
12357400	Middle Fork Flathead River trib. at West Glacier, Mont.	15	---	2	5	9	15	22	32
12359000	South Fork Flathead River at Spotted Bear Ranger Station, nr Hungry Horse, Mont.	17	1,401,250	15,300	18,900	21,000	24,000	26,000	30,000
12359500	Spotted Bear River nr Hungry Horse, Mont.	10	---	3,700	4,450	4,900	5,500	6,000	6,900

Table 1.--*Streamflow characteristics at selected gaging stations*--Continued

Station No.	Station name	Years of record[1]	Mean annual runoff (acre-feet)	Peak discharge, in cubic feet per second, for indicated recurrence interval, in years					
				Q_2	Q_5	Q_{10}	Q_{25}	Q_{50}	Q_{100}
12360000	Twin Creek nr Hungry Horse, Mont.	11	87,623	1,400	1,950	2,310	2,890	3,050	4,100
12361000	Sullivan Creek nr Hungry Horse, Mont.	25	162,936	1,860	2,430	2,800	3,210	3,600	4,100
12361500	Graves Creek nr Hungry Horse, Mont.	11	97,762	1,290	1,880	2,290	2,820	3,230	3,650
12362500	South Fork Flathead River nr Columbia Falls, Mont.	52	2,577,285	25,000	34,500	40,200	47,500	53,700	61,500
12363900	Rock Creek nr Olney, Mont.	15	---	15	24	32	44	53	64
12364000	Logan Creek at Tally Lake, nr Whitefish, Mont.	10	---	454	874	1,220	1,740	2,170	2,650
12365000	Stillwater River nr Whitefish, Mont.	28	242,594	1,520	2,500	3,170	4,020	4,650	5,270
12366000	Whitefish Creek nr Kalispell, Mont.	29	138,315	820	1,090	1,250	1,450	1,580	1,720
12367500	Ashley Creek nr Kalispell, Mont.	19	22,304	---	---	---	---	---	---
12370000	Swan River nr Bigfork, Mont.	58	843,646	5,250	6,590	7,360	8,250	8,850	9,410
12370500	Dayton Creek nr Proctor, Mont.	20	---	38	79	115	172	222	280
12370900	Teepee Creek nr Polson, Mont.	15	---	8	19	29	48	65	88
12371100	Hellroaring Creek nr Polson, Mont.	15	4,808	28	58	84	126	163	206
12374300	Mill Creek nr Niarada, Mont.	15	---	89	165	227	318	395	478
375700	Garden Creek nr Hot Springs, Mont.	15	---	25	49	68	96	119	144
12389500	Thompson River nr Thompson Falls, Mont.	24	346,873	2,690	4,270	5,360	6,740	7,770	8,780

[1]For gaging stations with both continuous flow record and peak discharge record, the years of record pertain to the continuous flow record only.

Table 2.--*Channel-geometry characteristics at selected gaging stations*

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
05011000	Belly River nr Mountain View, Alberta	105	2.0	135	4.0
05014000	Grinnell Creek nr Many Glacier, Mont.	25	2.0	35	4.0
05014500	Swiftcurrent Creek at Many Glacier, Mont.	45	2.0	62	5.0
05017500	St. Mary River nr Babb, Mont.	165	3.0	180	8.0
05020500	St. Mary River at international boundary, Mont.	160	2.5	170	5.5
06011000	Red Rock River nr Lakeview, Mont.	77	1.1	87	2.0
06012500	Red Rock River bl Lima Reservoir, nr Monida, Mont.	60	2.5	---	---
06013200	Traux Creek nr Lima, Mont.	3.0	.3	6.0	1.4
06013400	Muddy Creek nr Dell, Mont.	5.5	1.8	10	2.8
06013500	Big Sheep Creek bl Muddy Creek, nr Dell, Mont.	27	2.0	33	4.0
06015500	Grasshopper Creek nr Dillon, Mont.	31	1.3	40	2.8
06017500	Blacktail Deer Creek nr Dillon, Mont.	21	1.4	37	3.4
06019500	Ruby River ab reservoir, nr Alder, Mont.	44	2.6	---	---
06019800	Idaho Creek nr Alder, Mont.	5.5	.7	9.0	2.7
06023000	Ruby River nr Twin Bridges, Mont.	48	3.0	59	5.5
06025300	Moose Creek nr Divide, Mont.	13	.9	19	2.9
06025500	Big Hole River nr Melrose, Mont.	223	1.5	260	7.5
06026000	Birch Creek nr Glen, Mont.	22	1.1	28	2.6
06027700	Fish Creek nr Silverstar, Mont.	17	1.1	23	3.6
06030300	Jefferson River trib. No. 2 nr Whitehall, Mont.	6.0	.5	11	1.5
06033000	Boulder River nr Boulder, Mont.	45	1.5	60	3.5
06034700	Sand Creek at Sappington, Mont.	6.0	.5	8.0	.8
06035000	Willow Creek nr Harrison, Mont.	23	1.5	---	---
06037500	Madison River nr West Yellowstone, Mont.	85	1.6	94	4.1
06038500	Madison River bl Hebgen Lake, nr Grayling, Mont.	105	2.5	120	4.5
06043000	Taylor Creek nr Grayling, Mont.	39	1.5	44	3.0
06043200	Squaw Creek nr Gallatin Gateway, Mont.	25	1.4	---	---
06043300	Logger Creek nr Gallatin Gateway, Mont.	8.0	1.0	---	---
06043500	Gallatin River nr Gallatin Gateway, Mont.	102	2.5	120	5.5
06046500	Rocky Creek nr Bozeman, Mont.	27	1.2	37	2.7
06046700	Pitcher Creek nr Bozeman, Mont.	5.0	.3	10	1.3
06047000	Bear Canyon nr Bozeman, Mont.	13	.7	18	2.0
06048000	East Gallatin River at Bozeman, Mont.	35	1.4	46	3.4
06048500	Bridger Creek nr Bozeman, Mont.	22	1.9	---	---

Table 2.--*Channel-geometry characteristics at selected gaging stations*--Continued

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
06050000	Hyalite Creek at Hyalite Ranger Station, nr Bozeman, Mont.	33	1.1	42	4.1
06052500	Gallatin River at Logan, Mont.	150	3.0	170	6.0
06055500	Crow Creek nr Radersburg, Mont.	30	1.2	38	3.2
06056200	Castle Creek trib. nr Ringling, Mont.	5.5	.6	8.0	1.6
06056300	Cabin Creek nr Townsend, Mont.	7.0	.6	12	2.6
06056600	Deep Creek bl North Fork Deep Creek, nr Townsend, Mont.	21	1.1	29	2.0
06058700	Mitchell Gulch nr East Helena, Mont.	9.0	.2	---	---
06061500	Prickly Pear Creek nr Clancy, Mont.	27	1.4	31	3.2
06061800	Crystal Creek nr East Helena, Mont.	7.0	.6	10	1.6
06061900	McClellan Creek at City Diversion Dam, nr East Helena, Mont.	20	.6	28	2.6
06062500	Tenmile Creek nr Rimini, Mont.	16	.8	25	2.5
06063000	Tenmile Creek nr Helena, Mont.	26	1.0	33	2.2
06068500	Little Prickly Pear Creek nr Marysville, Mont.	14	1.7	24	2.8
06071000	Little Prickly Pear Creek nr Canyon Creek, Mont.	24	1.0	37	2.5
06071200	Lyons Creek nr Wolf Creek, Mont.	11	1.1	16	1.7
06071400	Dog Creek nr Craig, Mont.	11	.5	15	1.3
06071600	Wegner Creek at Craig, Mont.	14	.5	18	1.5
06073000	Dearborn River nr Clemons, Mont.	54	2.5	83	3.0
06073500	Dearborn River nr Craig, Mont.	69	2.3	85	4.0
06075600	Fivemile Creek nr White Sulphur Springs, Mont.	4.0	.4	8.5	2.5
06076000	Newland Creek nr White Sulphur Springs, Mont.	7.0	1.0	12	---
06076700	Sheep Creek nr Neihart, Mont.	12	1.1	25	2.4
06076800	Nuggett Creek nr Neihart, Mont.	3.0	1.0	9.0	1.9
06077000	Sheep Creek nr White Sulphur Springs, Mont.	26	1.5	33	3.0
06077500	Smith River nr Eden, Mont.	76	1.5	98	5.0
06077700	Smith River trib. nr Eden, Mont.	1.0	.1	2.5	.4
06077800	Goodman Coulee nr Eden, Mont.	5.5	.6	11	2.4
06079600	Beaver Creek at Gibson Dam, nr Augusta, Mont.	17	1.0	24	2.5
06080000	Sun River nr Augusta, Mont.	160	1.8	193	7.3
06081500	Willow Creek nr Augusta, Mont.	20	1.5	35	3.5
06084500	Elk Creek at Augusta, Mont.	46	1.5	50	3.5
06085800	Sun River at Simms, Mont.	165	2.5	180	4.5
06087900	Muddy Creek trib. nr Power, Mont.	3.0	.4	5.5	.6

Table 2.--*Channel-geometry characteristics at selected gaging stations*--Continued

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
06088500	Muddy Creek at Vaughn, Mont.	45	2.5	60	5.5
06089000	Sun River nr Vaughn, Mont.	200	0.0	255	---
06089300	Sun River trib. nr Great Falls, Mont.	10	.7	18	0.9
06090500	Belt Creek nr Monarch, Mont.	62	1.8	---	---
06092000	Two Medicine River nr Browning, Mont.	164	2.6	185	6.6
06093200	Badger Creek bl Four Horns Canal, nr Browning, Mont.	90	2.0	95	5.0
06095000	Birch Creek nr Dupuyer, Mont.	52	1.8	105	5.0
06098000	Dupuyer Creek nr Valier, Mont.	22	.7	33	1.5
06099000	Cut Bank Creek at Cut Bank, Mont.	88	1.0	108	3.4
06100200	Heines Coulee trib. nr Valier, Mont.	1.0	.3	4.0	1.0
06100300	Lone Man Coulee nr Valier, Mont.	6.5	.7	14	1.6
06101900	Dead Indian Coulee nr Fort Benton, Mont.	2.0	.3	---	---
06102200	Marias River trib. at Loma, Mont.	5.0	.4	14	1.4
06106000	Deep Creek nr Choteau, Mont.	49	1.0	60	4.0
06108000	Teton River nr Dutton, Mont.	72	1.9	84	6.0
06108200	Kinley Coulee nr Dutton, Mont.	10	.3	17	1.0
06109800	South Fork Judith River nr Utica, Mont.	21	1.8	25	---
06110000	Judith River nr Utica, Mont.	37	2.0	42	3.5
06111000	Ross Fork nr Hobson, Mont.	24	2.0	35	2.0
06111500	Big Spring Creek nr Lewistown, Mont.	29	2.5	36	2.5
06111700	Mill Creek nr Lewistown, Mont.	3.0	.9	5.0	1.0
06112100	Cottonwood Creek nr Moore, Mont.	26	1.0	30	2.8
06115300	Duval Creek nr Landusky, Mont.	8.0	.3	14	1.5
06115500	North Fork Musselshell River nr Delpine, Mont.	15	1.5	19	2.5
06117000	Checkerboard Creek at Delpine, Mont.	16	.9	20	2.5
06118500	South Fork Musselshell River ab Martinsdale, Mont.	45	1.6	56	---
06129100	North Fork McDonald Creek trib. nr Heath, Mont.	2.5	.5	8.0	1.0
06129200	Alkali Creek nr Heath, Mont.	5.0	.5	9.0	2.0
06132200	South Fork Milk River nr Babb, Mont.	45	1.0	---	---
06132400	Dry Fork Milk River nr Babb, Mont.	9.5	.8	12	3.3
06133500	North Fork Milk River ab St. Mary Canal, nr Browning, Mont.	23	2.2	---	---
06135500	Sage Creek at Q Ranch, nr Wild Horse, Alberta	15	1.3	32	4.2
06138700	South Fork Spring Coulee nr Havre, Mont.	8.0	.3	---	---

Table 2.--*Channel-geometry characteristics at selected gaging stations*--Continued

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
06138800	Spring Coulee nr Havre, Mont.	11	.6	20	1.7
06139500	Big Sandy Creek nr Assinniboine, Mont.	51	1.8	---	---
06140400	Bullhook Creek nr Havre, Mont.	11	.8	17	---
06144500	Lodge Creek at international boundary	23	3.0	36	5.5
06145500	Lodge Creek bl McRae Creek at, international boundary	22	1.4	---	---
06150000	Woodpile Coulee nr international boundary	11	1.5	16	3.0
06150500	East Fork Battle Creek nr international boundary	15	2.9	32	6.3
06151000	Lyons Creek at international boundary	17	1.6	23	2.7
06154400	Peoples Creek nr Hays, Mont.	28	.8	53	---
06154500	Peoples Creek nr Dodson, Mont.	22	3.3	---	---
06155100	Black Coulee nr Malta, Mont.	5.0	.9	9.0	2.4
06155300	Disjardin Coulee nr Malta, Mont.	4.0	.5	8.5	1.6
06155400	Taylor Coulee nr Malta, Mont.	4.0	.5	10	1.1
06156000	Whitewater Creek nr international boundary	17	1.0	28	---
06169500	Rock Creek bl Horse Creek, nr international boundary	26	2.0	41	---
06170000	McEachern Creek at international boundary	21	2.0	36	---
06172200	Buggy Creek nr Tampico, Mont.	16	.8	---	---
06172300	Unger Creek nr Vandalia, Mont.	8.0	1.0	14	3.0
06172350	Mooney Coulee nr Tampico, Mont.	4.0	.3	8.0	.6
06174000	Willow Creek nr Glasgow, Mont.	20	2.0	50	6.4
06175900	Wolf Creek trib. No. 2 nr Wolf Point, Mont.	4.0	.3	9.0	.6
06178000	Middle Fork Poplar River at international boundary	21	.6	---	---
06178500	East Poplar River at international boundary	22	1.0	59	3.0
06179500	West Fork Poplar River at international boundary	30	1.0	---	---
06181000	Poplar River nr Poplar, Mont.	56	1.4	---	---
06182500	Big Muddy Creek at Daleview, Mont.	16	2.0	33	5.0
06183000	Big Muddy Creek at Plentywood, Mont.	24	1.2	---	---
06183100	Box Elder Creek nr Plentywood, Mont.	6.0	.3	11	.8
06183400	Spring Creek at Highway 16, nr Plentywood, Mont.	8.5	.5	14	1.0
06185100	Big Muddy Creek trib. nr Culbertson, Mont.	5.0	.3	10	.8
06185300	Missouri River trib. No. 4 nr Culbertson, Mont.	4.0	.2	8.0	.8
06185400	Missouri River trib. No. 5 nr Culbertson, Mont.	4.0	.3	8.0	.9
06186500	Yellowstone River at Yellowstone Lake outlet, Yellowstone National Park	156	---	186	---

Table 2.--*Channel-geometry characteristics at selected gaging stations*--Continued

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
06187500	Tower Creek at Tower Falls, Yellowstone National Park	23	---	29	---
06188000	Lamar River nr Tower Falls Ranger Station, Yellowstone National Park	120	2.5	135	6.0
06191000	Gardiner River nr Mammoth, Yellowstone National Park	44	1.5	55	3.0
06191500	Yellowstone River at Corwin Springs, Mont.	240	---	260	---
06192500	Yellowstone River nr Livingston, Mont.	270	3.5	300	6.0
06193500	Shields River at Clyde Park, Mont.	68	.9	75	4.4
06194000	Brackett Creek nr Clyde Park, Mont.	23	.9	31	2.9
06197000	Big Timber Creek nr Big Timber, Mont.	42	2.0	65	6.0
06197500	Boulder River nr Contact, Mont.	80	2.5	95	6.0
06200000	Boulder River at Big Timber, Mont.	120	2.5	140	6.0
06200500	Sweet Grass Creek ab Melville, Mont.	47	1.8	56	3.0
06201600	Bridger Creek nr Greycliff, Mont.	24	.7	32	2.0
06201650	Work Creek nr Reed Point, Mont.	20	1.0	31	4.0
06201700	Hump Creek nr Reed Point, Mont.	4.0	.7	8.0	1.1
06204050	West Rosebud Creek nr Roscoe, Mont.	47	1.8	60	5.8
06204500	Rosebud Creek nr Absarokee, Mont.	105	2.0	130	5.0
06205000	Stillwater River nr Absarokee, Mont.	140	2.0	163	5.5
06207500	Clarks Fork Yellowstone River nr Belfry, Mont.	150	0.0	---	---
06207800	Bluewater Creek nr Bridger, Mont.	10	2.0	23	6.0
06209500	Rock Creek nr Red Lodge, Mont.	65	1.5	80	3.5
06210500	West Fork Rock Creek nr Red Lodge, Mont.	40	1.5	60	3.5
06211000	Red Lodge Creek ab Cooney Reservoir, nr Boyd, Mont.	30	2.3	46	8.3
06211500	Willow Creek nr Boyd, Mont.	26	2.0	38	5.0
06212500	Red Lodge Creek bl Cooney Reservoir, nr Boyd, Mont.	38	1.8	55	8.8
12300500	Fortine Creek nr Trego, Mont.	22	1.0	29	3.0
12300800	Deep Creek nr Fortine, Mont.	16	1.0	18	2.0
12301300	Tobacco River nr Eureka, Mont.	48	1.7	58	4.7
12301999	Wolf Creek nr Libby, Mont.	40	1.4	47	2.9
12302055	Fisher River nr Libby, Mont.	111	2.4	130	6.0
12302400	Shaughnessy Creek nr Libby, Mont.	7.0	.6	11	1.6
12303100	Flower Creek nr Libby, Mont.	17	1.1	24	3.1
12303500	Lake Creek at Troy, Mont.	70	1.3	78	4.3
12304250	Whitetail Creek nr Yaak, Mont.	9.0	.5	17	2.0
12304300	Cyclone Creek nr Yaak, Mont.	9.0	1.0	22	2.7

Table 2.--*Channel-geometry characteristics at selected gaging stations*--Continued

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
12304400	Fourth of July Creek nr Yaak, Mont.	13	.8	21	2.8
12304500	Yaak River nr Troy, Mont.	136	1.4	176	6.4
12323300	Smith Gulch nr Silverbow, Mont.	3.0	.2	5.5	.5
12323500	German Gulch Creek nr Ramsay, Mont.	20	1.6	---	---
12324100	Racetrack Creek bl Granite Creek, nr Anaconda, Mont.	22	1.1	28	3.1
12324700	Clark Fork trib. nr Drummond, Mont.	4.0	.2	10	.6
12324800	Morris Creek nr Drummond, Mont.	3.0	.4	5.0	1.4
12325500	Flint Creek nr Southern Cross, Mont.	12	.7	18	1.1
12329500	Flint Creek at Maxville, Mont.	28	1.9	35	3.0
12330000	Boulder Creek at Maxville, Mont.	28	1.5	32	4.5
12332000	Middle Fork Rock Creek nr Phillipsburg, Mont.	56	1.2	71	2.7
12335000	Blackfoot River nr Helmville, Mont.	100	2.3	120	5.0
12335500	Nevada Creek ab Reservoir, nr Finn, Mont.	28	.8	36	2.8
12338500	Blackfoot River nr Ovando, Mont.	150	3.0	180	7.0
12339900	West Twin Creek nr Bonner, Mont.	15	1.0	22	3.0
12340000	Blackfoot River nr Bonner, Mont.	150	3.0	190	6.0
12340200	Marshall Creek nr Missoula, Mont.	6.0	.8	9.0	1.8
12341000	Rattlesnake Creek at Missoula, Mont.	39	1.7	48	4.2
12342500	West Fork Bitterroot River nr Conner, Mont.	60	2.0	78	5.0
12343400	East Fork Bitterroot River nr Conner, Mont.	70	1.5	90	4.5
12344000	Bitterroot River nr Darby, Mont.	148	2.0	184	4.0
12344300	Burke Gulch nr Darby, Mont.	3.0	.3	5.5	1.2
12345800	Camas Creek nr Hamilton, Mont.	15	.5	20	2.0
12346500	Skalkaho Creek nr Hamilton, Mont.	34	1.3	44	3.3
12347500	Blodgett Creek nr Corvallis, Mont.	30	1.3	38	2.8
12348500	Willow Creek nr Corvallis, Mont.	17	.8	21	2.3
12350000	Bear Creek nr Victor, Mont.	41	1.8	47	3.8
12350200	Gash Creek nr Victor, Mont.	11	.4	16	1.4
12350500	Kootenai Creek nr Stevensville, Mont.	38	1.6	46	3.6
12351000	Burnt Fork Bitterroot River nr Stevensville, Mont.	20	1.0	28	2.0
12351400	Eightmile Creek nr Florence, Mont.	10	.7	16	2.7
12352000	Lolo Creek ab Sleeman Creek, nr Lolo, Mont.	51	1.0	60	4.0
12352200	Hayes Creek nr Missoula, Mont.	4.0	.5	7.5	1.0
12353400	Negro Gulch nr Alberton, Mont.	8.0	.5	13	1.5

Table 2.--*Channel-geometry characteristics at selected gaging stations*--Continued

Station No.	Station name	Active-channel width (W_{AC}) (feet)	Active-channel depth (D_{AC}) (feet)	Bank-full width (W_{BF}) (feet)	Bank-full depth (D_{BF}) (feet)
12353800	Thompson Creek nr Superior, Mont.	9.0	0.7	14	2.5
12353850	East Fork Timber Creek nr Haugan, Mont.	8.0	.8	12	2.8
12354000	St. Regis River nr St. Regis, Mont.	130	2.5	136	6.5
12354100	North Fork Little Joe Creek nr St. Regis, Mont.	16	.9	21	2.4
12355000	North Fork Flathead River at Flathead, British Columbia	120	2.0	145	5.0
12355500	North Fork Flathead River nr Columbia Falls, Mont.	225	3.0	270	7.0
12356000	Skyland Creek nr Essex, Mont.	19	1.0	28	3.0
12356500	Bear Creek nr Essex, Mont.	25	1.2	36	3.2
12357000	Middle Fork Flathead River at Essex, Mont.	172	1.7	192	4.7
12357300	Moccasin Creek nr West Glacier, Mont.	16	1.2	22	3.2
12357400	Middle Fork Flathead River trib. at West Glacier, Mont.	2.5	.3	4.5	.8
12359000	South Fork Flathead River at Spotted Bear Ranger Station, nr Hungry Horse, Mont.	178	1.5	200	5.5
12359500	Spotted Bear River nr Hungry Horse, Mont.	65	2.9	105	5.9
12360000	Twin Creek nr Hungry Horse, Mont.	41	1.5	59	4.5
12360500	Lower Twin Creek nr Hungry Horse, Mont.	32	1.5	44	3.5
12361000	Sullivan Creek nr Hungry Horse, Mont.	63	1.4	78	3.4
12361500	Graves Creek nr Hungry Horse, Mont.	40	1.0	60	3.0
12362500	South Fork Flathead River nr Columbia Falls, Mont.	290	4.0	325	7.5
12363900	Rock Creek nr Olney, Mont.	6.0	1.0	8.0	2.0
12364000	Logan Creek at Tally Lake, nr Whitefish, Mont.	47	1.0	67	2.0
12365000	Stillwater River nr Whitefish, Mont.	70	6.0	85	12.0
12366000	Whitefish Creek nr Kalispell, Mont.	64	1.6	82	4.6
12367500	Ashley Creek nr Kalispell, Mont.	26	1.0	38	3.5
12370000	Swan River nr Bigfork, Mont.	165	1.0	185	4.0
12370500	Dayton Creek nr Proctor, Mont.	11	.6	14	1.6
12370900	Teepee Creek nr Polson, Mont.	6.0	.7	10	2.5
12371100	Hellroaring Creek nr Polson, Mont.	9.0	1.5	14	3.5
12374300	Mill Creek nr Niarada, Mont.	13	.7	21	4.7
12375700	Garden Creek nr Hot Springs, Mont.	8.0	.5	12	2.5
12389500	Thompson River nr Thompson Falls, Mont.	95	3.5	---	5.0

Table 3.--*Basin characteristics at selected gaging stations*

Station No.	Station name	Drainage area (*A*) (square miles)	Mean annual precipitation (*P*) (inches)	Forest cover (*F*) (percent)	Mean basin elevation (*E*) (feet above sea level)	Basin above 6,000 foot elevation (*HE*) (percent)	Mean January temperature (*JAN*) (degrees Fahrenheit)	Mean channel length (*L*) (miles)	Mean channel slope (*S*) (feet per mile)	24-hour precipitation intensity (*I24*) (inches per hour)
05011000	Belly River nr Mountain View, Alberta	121	65	59.8	5,920	46.0	4	22.6	23.7	2.0
05014000	Grinnell Creek nr Many Glacier, Mont.	3.47	95	47.4	6,530	72.0	8	2.30	1,560	2.1
05014500	Swiftcurrent Creek at Many Glacier, Mont.	31.4	95	58.1	6,460	64.0	8	7.10	283	2.1
05017500	St. Mary River nr Babb, Mont.	278	71	66.0	6,170	53.0	6	24.7	36.4	2.2
05020500	St. Mary River at international boundary, Mont.	469	59	57.0	5,790	39.0	7	39.8	12.7	2.0
06011000	Red Rock River nr Lakeview, Mont.	323	22	29.2	7,330	100.0	1	37.0	16.6	1.3
06012500	Red Rock River bl Lima Reservoir, nr Monida, Mont.	570	21	21.8	7,180	100.0	0	57.8	4.60	1.4
06013200	Traux Creek nr Lima, Mont.	4.06	15	2.8	7,240	100.0	3	3.10	592	1.2
06013400	Muddy Creek nr Dell, Mont.	62.7	16	24.0	7,840	99.0	4	18.7	95.0	1.7
06013500	Big Sheep Creek bl Muddy Creek, nr Dell, Mont.	280	19	31.0	8,010	99.0	4	23.1	75.2	1.6
06015500	Grasshopper Creek nr Dillon, Mont.	348	19	30.0	7,050	94.0	4	42.0	46.0	1.3
06017500	Blacktail Deer Creek nr Dillon, Mont.	312	12	18.8	7,210	96.0	3	34.7	36.5	1.4
06019500	Ruby River ab Reservoir, nr Alder, Mont.	538	18	28.8	7,280	91.0	6	39.5	53.3	1.3
019800	Idaho Creek nr Alder, Mont.	11.0	19	52.0	7,010	83.0	6	9.80	263	1.3
06023000	Ruby River nr Twin Bridges, Mont.	935	19	32.0	7,060	83.0	1	78.2	35.5	1.3
06025300	Moose Creek nr Divide, Mont.	41.4	18	73.0	7,050	97.0	4	13.0	144	1.4
06025500	Big Hole River nr Melrose, Mont.	2,476	23	65.3	7,140	91.0	2	113	15.4	1.4
06026000	Birch Creek nr Glen, Mont.	36.0	12	86.8	7,690	97.0	4	12.8	207	1.5
06027700	Fish Creek nr Silverstar, Mont.	39.5	19	77.0	7,030	80.0	5	13.8	197	1.6
06030300	Jefferson River trib. No. 2, nr Whitehall, Mont.	4.50	12	17.0	5,440	31.0	2	5.60	317	1.2
06033000	Boulder River nr Boulder, Mont.	381	19	89.1	6,640	80.0	4	31.3	66.0	1.5
06034700	Sand Creek at Sappington, Mont.	9.41	11	.0	4,770	.0	13	4.00	233	1.2
06035000	Willow Creek nr Harrison, Mont.	83.8	27	52.5	6,930	70.7	14	20.6	130	1.3
06037500	Madison River nr West Yellowstone, Mont.	420	24	93.8	7,920	99.0	2	38.9	34.2	1.4
06038500	Madison River bl Hebgen Lake, nr Grayling, Mont.	905	38	90.0	7,650	100.0	2	62.8	21.2	1.3
06043000	Taylor Creek nr Grayling, Mont.	98.0	40	60.5	8,320	99.0	4	16.0	138	1.5
06043200	Squaw Creek nr Gallatin Gateway, Mont.	40.4	35	95.0	7,440	98.0	12	11.7	205	1.7
06043300	Logger Creek nr Gallatin Gateway, Mont.	2.48	30	99.0	7,120	87.0	12	3.70	970	1.8
06043500	Gallatin River nr Gallatin Gateway, Mont.	825	37	83.3	7,960	95.0	12	59.5	16.8	1.6

Table 3.--*Basin characteristics at selected gaging stations*--Continued

Station No.	Station name	Drainage area (*A*) (square miles)	Mean annual precipitation (*P*) (inches)	Forest cover (*F*) (percent)	Mean basin elevation (*E*) (feet above sea level)	Basin above 6,000 foot elevation (*HE*) (percent)	Mean January temperature (*JAN*) (degrees Fahrenheit)	Mean channel length (*L*) (miles)	Mean channel slope (*S*) (feet per mile)	24-hour precipitation intensity (*I24*) (inches per hour)
06046500	Rocky Creek nr Bozeman, Mont.	49.0	27	62.4	6,110	55.0	8	13.2	96.0	1.6
06046700	Pitcher Creek nr Bozeman, Mont.	2.33	21	50.0	5,680	15.0	8	3.10	245	1.3
06047000	Bear Canyon nr Bozeman, Mont.	17.0	28	88.5	6,690	92.0	8	5.80	256	1.8
06048000	East Gallatin River at Bozeman, Mont.	148	26	65.0	6,210	51.0	8	18.7	143	1.5
06048500	Bridger Creek nr Bozeman, Mont.	62.5	33	73.9	6,540	62.0	8	12.3	91.4	1.9
06050000	Hyalite Creek at Hyalite Ranger Station, nr Bozeman, Mont.	48.2	36	87.8	7,710	97.0	8	16.0	70.8	2.0
06052500	Gallatin River at Logan, Mont.	1,795	27	60.3	6,820	64.0	9	98.7	37.8	1.5
06055500	Crow Creek nr Radersburg, Mont.	78.0	25	89.5	6,980	86.0	4	14.9	219	1.5
06056200	Castle Creek trib. nr Ringling, Mont.	2.59	22	.0	6,380	80.0	5	2.96	302	1.4
06056300	Cabin Creek nr Townsend, Mont.	12.6	26	76.0	6,990	44.0	5	6.30	307	1.4
06056600	Deep Creek bl North Fork Deep Creek, nr Townsend, Mont.	87.7	24	75.0	6,170	61.0	0	14.2	131	1.4
06058700	Mitchell Gulch nr East Helena, Mont.	8.09	15	45.0	5,000	12.0	5	6.40	302	1.4
06061500	Prickly Pear Creek nr Clancy, Mont.	192	19	83.5	5,660	34.0	5	20.8	157	1.3
06061800	Crystal Creek nr East Helena, Mont.	3.77	19	100.0	5,830	38.9	4	2.90	355	1.3
06061900	McClellan Creek at City Diversion Dam, nr East Helena, Mont.	33.2	19	96.0	5,980	47.0	6	8.80	212	1.5
06062500	Tenmile Creek nr Rimini, Mont.	32.7	24	97.3	6,580	86.2	9	8.80	260	1.3
06063000	Tenmile Creek nr Helena, Mont.	102	20	75.4	5,600	39.5	8	19.8	135	1.3
06068500	Little Prickly Pear Creek nr Marysville, Mont.	44.4	12	97.1	5,900	55.0	9	6.20	255	1.4
06071000	Little Prickly Pear Creek nr Canyon Creek, Mont.	183	23	70.0	5,840	43.0	8	15.1	83.8	1.3
06071200	Lyons Creek nr Wolf Creek, Mont.	29.4	27	77.0	5,270	13.0	10	11.0	143	1.6
06071400	Dog Creek nr Craig, Mont.	15.9	13	4.0	4,090	.0	12	6.25	84.4	1.6
06071600	Wegner Creek at Craig, Mont.	35.0	17	68.0	4,610	3.0	12	15.9	119.0	1.7
06073000	Dearborn River nr Clemons, Mont.	123	37	91.3	6,230	76.0	0	21.8	33.7	2.0
06073500	Dearborn River nr Craig, Mont.	325	28	55.0	5,330	31.0	13	46.3	50.3	1.9
06075600	Fivemile Creek nr White Sulphur Springs, Mont.	6.00	19	33.0	5,980	45.0	9	7.50	121	1.4
06076000	Newland Creek nr White Sulphur Springs, Mont.	6.74	25	97.0	6,380	81.0	8	4.70	182	1.4
06076700	Sheep Creek nr Neihart, Mont.	5.22	29	82.0	7,210	99.0	8	3.30	281	2.0
06076800	Nuggett Creek nr Neihart, Mont.	1.48	29	93.0	7,190	99.0	8	2.60	590	1.7
06077000	Sheep Creek nr White Sulphur Springs, Mont.	54.4	30	95.5	6,910	94.0	8	10.9	85.4	1.9
06077500	Smith River nr Eden, Mont.	1,594	23	43.3	5,840	35.6	9	107	20.0	1.8
06077700	Smith River trib. nr Eden, Mont.	1.44	15	.0	3,840	.0	10	2.20	255	1.6

Table 3.--*Basin characteristics at selected gaging stations*--Continued

Station No.	Station name	Drainage area (*A*) (square miles)	Mean annual precipitation (*P*) (inches)	Forest cover (*F*) (percent)	Mean basin elevation (*E*) (feet above sea level)	Basin above 6,000 foot elevation (*HE*) (percent)	Mean January temperature (*JAN*) (degrees Fahrenheit)	Mean channel length (*L*) (miles)	Mean channel slope (*S*) (feet per mile)	24-hour precipitation intensity (*I24*) (inches per hour)
06077800	Goodman Coulee nr Eden, Mont.	21.8	15	2.0	4,020	.0	6	14.2	53.7	1.7
06079600	Beaver Creek at Gibson Dam, nr Augusta, Mont.	20.3	29	89.0	6,030	50.0	12	10.1	145	2.1
06080000	Sun River nr Augusta, Mont.	609	42	85.5	6,330	70.0	10	29.8	42.6	2.0
06081500	Willow Creek nr Augusta, Mont.	96.1	21	24.1	5,080	16.4	12	18.1	77.9	1.7
06084500	Elk Creek at Augusta, Mont.	157	21	37.6	5,170	20.5	11	19.8	55.4	1.7
06085800	Sun River at Simms, Mont.	1,320	29	47.0	5,410	38.0	12	85.0	24.8	1.6
06087900	Muddy Creek trib. nr Power, Mont.	3.15	13	1.0	3,840	.0	11	2.60	28.9	1.6
06088500	Muddy Creek at Vaughn, Mont.	314	12	3.9	3,840	.0	16	31.6	15.2	1.6
06089000	Sun River nr Vaughn, Mont.	1,854	24	35.0	4,960	27.0	13	116	20.8	1.6
06089300	Sun River trib. nr Great Falls, Mont.	21.1	13	.0	3,510	.0	15	6.80	49.0	1.7
06090500	Belt Creek nr Monarch, Mont.	368	25	88.3	6,190	56.0	6	35.4	60.2	2.1
06092000	Two Medicine River nr Browning, Mont.	317	36	42.0	5,600	36.9	12	43.0	27.6	1.8
06093200	Badger Creek bl Four Horns Canal, nr Browning, Mont.	152	37	53.0	5,830	45.0	12	31.6	56.5	1.8
06095000	Birch Creek nr Dupuyer, Mont.	105	41	59.0	6,080	59.0	12	26.5	63.0	1.9
06098000	Dupuyer Creek nr Valier, Mont.	137	25	27.5	5,040	16.0	8	27.8	67.3	1.8
06099000	Cut Bank Creek at Cut Bank, Mont.	1,065	19	10.2	4,460	5.6	8	75.7	25.6	1.6
06100200	Heines Coulee trib. nr Valier, Mont.	0.60	13	.0	3,910	.0	9	1.10	50.0	1.5
06100300	Lone Man Coulee nr Valier, Mont.	14.1	13	.0	3,890	.0	9	7.90	39.0	1.5
06101900	Dead Indian Coulee nr Fort Benton, Mont.	2.85	11	.0	3,340	.0	7	2.60	92.3	1.4
06102200	Marias River trib. at Loma, Mont.	1.62	12	0.0	2,830	0.0	7	2.90	150	1.6
06106000	Deep Creek nr Choteau, Mont.	223	21	13.6	4,910	18.0	12	32.2	107	1.8
06108000	Teton River nr Dutton, Mont.	1,307	18	11.1	4,470	14.2	10	108	20.4	1.6
06108200	Kinley Coulee nr Dutton, Mont.	9.67	13	.0	3,700	.0	10	6.70	34.0	1.5
06109800	South Fork Judith River nr Utica, Mont.	58.7	21	93.4	6,640	94.0	6	12.7	126	2.0
06110000	Judith River nr Utica, Mont.	328	24	81.0	6,540	71.0	7	24.0	72.8	1.9
06111000	Ross Fork nr Hobson, Mont.	337	17	5.3	4,640	2.0	8	32.8	40.6	1.6
06111500	Big Spring Creek nr Lewistown, Mont.	20.9	19	29.0	4,730	.0	9	8.72	87.9	1.6
06111700	Mill Creek nr Lewistown, Mont.	3.14	22	74.0	4,630	.0	8	3.50	42.0	1.8
06112100	Cottonwood Creek nr Moore, Mont.	47.9	29	62.0	5,840	45.0	9	22.0	85.9	2.2
06115300	Duval Creek nr Landusky, Mont.	3.31	13	.0	3,110	.0	3	5.00	42.3	1.3
06115500	North Fork Musselshell River nr Delpine, Mont.	31.4	21	52.4	6,120	77.0	9	13.2	131	1.7
06117000	Checkerboard Creek at Delpine, Mont.	23.9	21	50.0	6,340	77.0	8	11.5	118	1.5

Table 3.--*Basin characteristics at selected gaging stations*--Continued

Station No.	Station name	Drainage area (*A*) (square miles)	Mean annual precipitation (*P*) (inches)	Forest cover (*F*) (percent)	Mean basin elevation (*E*) (feet above sea level)	Basin above 6,000 foot elevation (*HE*) (percent)	Mean January temperature (*JAN*) (degrees Fahrenheit)	Mean channel length (*L*) (miles)	Mean channel slope (*S*) (feet per mile)	24-hour precipitation intensity (*I24*) (inches per hour)
06118500	South Fork Musselshell River ab Martinsdale, Mont.	287	20	46.6	6,110	60.0	10	23.8	58.7	1.7
06129100	North Fork McDonald Creek trib. nr Heath, Mont.	2.24	20	.0	4,750	.0	8	1.80	223	1.8
06129200	Alkali Creek nr Heath, Mont.	3.76	18	29.6	4,570	.0	8	4.80	222	1.8
06132200	South Fork Milk River nr Babb, Mont.	68.6	36	43.9	5,470	11.7	8	16.3	100	1.9
06132400	Dry Fork Milk River nr Babb, Mont.	17.4	28	22.0	5,130	.0	7	12.4	67	1.9
06133500	North Fork Milk River ab St. Mary Canal, nr Browning, Mont.	61.8	21	.0	4,850	.0	8	13.5	34.6	1.6
06135500	Sage Creek at Q Ranch, nr Wild Horse, Alberta	175	13	.0	3,200	.0	-1	34.9	19.2	1.6
06138700	South Fork Spring Coulee nr Havre, Mont.	6.47	13	.0	3,100	.0	4	4.30	152	2.0
06138800	Spring Coulee nr Havre, Mont.	17.8	13	.0	3,090	.0	4	9.60	83.3	1.9
06139500	Big Sandy Creek nr Assinniboine, Mont.	1,805	12	2.0	3,200	.0	4	73.7	17.8	1.8
06140400	Bullhook Creek nr Havre, Mont.	39.6	15	4.0	3,220	.0	5	12.8	99.0	1.8
06144500	Lodge Creek at international boundary	753	13	14.0	3,480	.0	-1	70.5	13.3	1.6
06145500	Lodge Creek bl McRae Creek, at international boundary	818	13	.0	3,490	.0	-1	71.6	14.0	1.6
06150000	Woodpile Coulee nr international boundary	60.2	12	0.0	2,950	0.0	-1	22.4	11.9	1.6
06150500	East Fork Battle Creek nr international boundary	89.5	12	.0	3,000	.0	-1	19.0	14.0	1.6
06151000	Lyons Creek at international boundary	66.7	12	.0	3,000	.0	-1	20.2	26.3	1.6
06154400	Peoples Creek nr Hays, Mont.	220	16	.0	3,570	.0	3	46.4	26.4	1.7
06154500	Peoples Creek nr Dodson, Mont.	670	15	2.7	3,500	.0	2	74.9	20.5	1.7
06155100	Black Coulee nr Malta, Mont.	7.03	13	.0	2,550	.0	1	6.70	11.9	1.6
06155300	Disjardin Coulee nr Malta, Mont.	4.84	13	.0	2,470	.0	0	4.65	57.5	1.6
06155400	Taylor Coulee nr Malta, Mont.	3.89	12	.0	2,530	.0	0	4.50	74.0	1.6
06156000	Whitewater Creek nr international boundary	458	12	.0	2,820	.0	-2	36.3	18.3	1.6
06169500	Rock Creek bl Horse Creek, nr international boundary	328	13	.0	2,870	.0	-5	43.3	12.3	1.6
06170000	McEachern Creek at international boundary	182	13	.0	2,830	.0	-5	26.3	20.2	1.6
06172200	Buggy Creek nr Tampico, Mont.	105	12	.0	2,770	.0	-4	26.0	35.9	1.7
06172300	Unger Creek nr Vandalia, Mont.	11.1	12	.0	2,560	.0	-3	11.7	51.7	1.8
06172350	Mooney Coulee nr Tampico, Mont.	14.3	13	.0	2,410	.0	-3	12.3	33.5	1.8
06174000	Willow Creek nr Glasgow, Mont.	538	12	.0	2,400	.0	0	40.2	12.9	1.8
06175900	Wolf Creek trib. No. 2 nr Wolf Point, Mont.	6.54	12	.0	2,470	.0	-6	6.06	72.7	1.7
06178000	Middle Fork Poplar River at international boundary	362	14	.0	2,950	.0	-5	39.2	15.3	1.7

Table 3.--*Basin characteristics at selected gaging stations*--Continued

Station No.	Station name	Drainage area (*A*) (square miles)	Mean annual precipitation (*P*) (inches)	Forest cover (*F*) (percent)	Mean basin elevation (*E*) (feet above sea level)	Basin above 6,000 foot elevation (*HE*) (percent)	Mean January temperature (*JAN*) (degrees Fahrenheit)	Mean channel length (*L*) (miles)	Mean channel slope (*S*) (feet per mile)	24-hour precipitation intensity (*I24*) (inches per hour)
06178500	East Poplar River at international boundary	534	16	.0	2,800	.0	-5	56.4	5.90	1.8
06179500	West Fork Poplar River at international boundary	139	13	.0	3,000	.0	-5	23.2	11.5	1.7
06181000	Poplar River nr Poplar, Mont.	3,174	12	.0	2,730	.0	-4	145	6.43	1.7
06182500	Big Muddy Creek at Daleview, Mont.	279	15	.0	2,510	.0	-4	35.1	11.4	1.8
06183000	Big Muddy Creek at Plentywood, Mont.	850	14	.0	2,460	.0	-4	77.4	6.40	1.8
06183100	Box Elder Creek nr Plentywood, Mont.	9.40	14	.0	2,380	.0	-4	4.80	38.9	1.9
06183400	Spring Creek at Highway 16, nr Plentywood, Mont.	16.9	14	.0	2,330	.0	-4	10.3	51.9	1.9
06185100	Big Muddy Creek trib. nr Culbertson, Mont.	7.38	13	.0	2,110	.0	-3	5.80	34.5	1.6
06185300	Missouri River trib. No. 4 nr Culbertson, Mont.	11.6	14	.0	2,170	.0	-3	6.30	41.7	1.6
06185400	Missouri River trib. No. 5 nr Culbertson, Mont.	3.67	14	.0	2,210	.0	-3	3.70	119	1.6
06186500	Yellowstone River at Yellowstone Lake outlet, Yellowstone National Park	1,006	27	70.6	8,680	99.0	0	68.5	32.4	1.5
06187500	Tower Creek at Tower Falls, Yellowstone National Park	50.4	28	95.7	8,340	99.0	0	12.9	165	1.4
88000	Lamar River nr Tower Falls Ranger Station, Yellowstone National Park	660	34	79.2	7,400	91.0	1	42.6	17.2	1.4
06191000	Gardiner River nr Mammoth, Yellowstone National Park	202	30	79.2	7,940	98.0	2	.00	176	1.4
06191500	Yellowstone River at Corwin Springs, Mont.	2,623	33	78.2	8,440	96.0	4	130	25.3	1.4
06192500	Yellowstone River nr Livingston, Mont.	3,551	28	72.8	8,350	89.0	6	179	23.1	1.5
06193500	Shields River at Clyde Park, Mont.	543	20	30.6	6,090	44.1	12	37.9	56.3	1.3
06194000	Brackett Creek nr Clyde Park, Mont.	57.9	26	60.8	6,140	60.0	10	15.7	111	1.8
06197000	Big Timber Creek nr Big Timber, Mont.	74.9	25	42.9	6,680	59.0	16	13.1	304	2.2
06197500	Boulder River nr Contact, Mont.	226	37	65.3	8,510	91.0	13	30.8	104	2.3
06200000	Boulder River at Big Timber, Mont.	523	30	57.9	7,570	75.0	17	55.2	55.6	2.2
06200500	Sweet Grass Creek ab Melville, Mont.	63.8	33	48.7	7,630	75.0	13	20.2	106	2.2
06201600	Bridger Creek nr Greycliff, Mont.	61.5	19	45.0	5,320	12.0	14	18.5	103	1.4
06201650	Work Creek nr Reed Point, Mont.	32.5	16	13.0	4,630	.0	13	11.8	111	1.4
06201700	Hump Creek nr Reed Point Mont.	7.61	15	23.0	4,420	.0	13	6.00	131	1.4
06204050	West Rosebud Creek nr Roscoe, Mont.	52.1	55	16.0	9,560	100.0	10	11.4	186	2.2
06204500	Rosebud Creek nr Absarokee, Mont.	394	32	29.0	7,890	66.1	12	35.9	123	2.0

Table 3.--*Basin characteristics at selected gaging stations*--Continued

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06205000	Stillwater River nr Absarokee, Mont.	975	32	54.6	7,220	53.0	10	60.0	73.3	2.1
06207500	Clarks Fork Yellowstone River nr Belfry, Mont.	1,154	17	60.9	7,430	80.0	12	75.6	76.3	1.2
06207800	Bluewater Creek nr Bridger, Mont.	28.1	15	14.0	4,860	.0	12	10.3	173	1.5
06209500	Rock Creek nr Red Lodge, Mont.	124	40	40.0	9,540	99.0	10	20.2	243	2.4
06210500	West Fork Rock Creek nr Red Lodge, Mont.	66.9	36	60.0	9,120	100.0	6	20.9	191	2.4
06211000	Red Lodge Creek ab Cooney Reservoir, nr Boyd, Mont.	143	22	30.0	5,710	23.6	8	26.9	98.0	1.9
06211500	Willow Creek nr Boyd, Mont.	53.3	20	15.3	4,730	8.1	8	22.6	91.1	1.9
06212500	Red Lodge Creek bl Cooney Reservoir, nr Boyd, Mont.	210	21	24.0	5,380	18.0	8	29.6	84.4	1.9
12300500	Fortine Creek nr Trego, Mont.	112	29	98.0	4,550	1.0	9	18.3	87.6	1.6
12300800	Deep Creek nr Fortine, Mont.	18.9	49	92.0	5,010	30.0	8	10.6	311	1.7
12301300	Tobacco River nr Eureka, Mont.	440	33	97.8	4,170	5.0	10	40.2	36.4	1.6
12301999	Wolf Creek nr Libby, Mont.	216	27	100.0	4,100	.0	8	29.4	33.5	1.7
12302055	Fisher River nr Libby, Mont.	838	32	92.0	4,100	.0	10	66.4	26.4	1.7
12302400	Shaughnessy Creek nr Libby, Mont.	1.16	60	97.0	3,760	.0	10	2.30	760	1.6
12303100	Flower Creek nr Libby, Mont.	11.1	79	96.2	5,240	43.9	12	5.90	636	1.4
12303500	Lake Creek at Troy, Mont.	210	67	95.8	4,080	9.0	14	27.5	31.6	1.9
12304250	Whitetail Creek nr Yaak, Mont.	2.48	37	96.7	4,220	.0	14	3.30	617	1.6
12304300	Cyclone Creek nr Yaak, Mont.	5.73	65	95.0	4,610	.0	14	5.10	506	1.6
12304400	Fourth of July Creek nr Yaak, Mont.	7.84	68	89.0	4,520	.0	14	5.10	478	1.6
12304500	Yaak River nr Troy, Mont.	766	43	97.0	5,050	22.0	14	65.0	32.9	1.7
12323300	Smith Gulch nr Silverbow, Mont.	4.85	12	24.1	6,060	55.0	5	5.90	136	1.2
12323500	German Gulch Creek nr Ramsay, Mont.	40.6	18	88.3	6,930	88.0	8	8.70	315	1.5
12324100	Racetrack Creek bl Granite Creek, nr Anaconda, Mont.	39.50	35	94.7	7,600	93.0	12	12.7	105	1.7
12324700	Clark Fork trib. nr Drummond, Mont.	4.61	15	15.0	4,820	6.0	8	4.80	292	1.2
12324800	Morris Creek nr Drummond, Mont.	12.6	18	60.0	5,430	19.0	8	8.20	237	1.4
12325500	Flint Creek nr Southern Cross, Mont.	52.6	24	84.0	6,800	100.0	12	8.60	116	1.7
12329500	Flint Creek at Maxville, Mont.	208	20	68.0	6,220	59.0	11	30.0	77.9	1.6
12330000	Boulder Creek at Maxville, Mont.	71.3	31	98.0	6,980	83.0	12	13.5	89.1	1.6
12332000	Middle Fork Rock Creek nr Phillipsburg, Mont.	123	36	93.3	7,180	89.0	8	20.2	78.9	1.6
12335000	Blackfoot River nr Helmville, Mont.	481	15	94.6	5,890	47.0	3	47.7	25.2	1.6
12335500	Nevada Creek ab Reservoir, nr Finn, Mont.	116	23	74.4	5,880	36.0	4	15.7	111	1.4

Table 3.--*Basin characteristics at selected gaging stations*--Continued

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12338500	Blackfoot River nr Ovando, Mont.	1,274	29	83.4	5,760	37.0	2	79.7	13.4	1.6
12339900	West Twin Creek nr Bonner, Mont.	7.33	24	62.0	5,430	27.0	10	5.50	557	1.5
12340000	Blackfoot River nr Bonner, Mont.	2,290	29	87.5	5,710	35.0	10	116	14.8	1.6
12340200	Marshall Creek nr Missoula, Mont.	5.63	23	84.0	4,870	14.0	12	4.84	441	1.5
12341000	Rattlesnake Creek at Missoula, Mont.	79.7	34	88.1	5,730	52.6	13	20.6	135	1.4
12342500	West Fork Bitterroot River nr Conner, Mont.	317	36	95.0	6,610	90.0	8	25.0	66.8	1.6
12343400	East Fork Bitterroot River nr Conner, Mont.	381	32	95.2	6,450	61.0	10	35.3	67.9	1.6
12344000	Bitterroot River nr Darby, Mont.	1,049	22	95.4	6,490	61.0	10	47.2	35.3	1.7
12344300	Burke Gulch nr Darby, Mont.	6.50	20	80.0	5,490	23.0	13	4.70	423	1.4
12345800	Camas Creek nr Hamilton, Mont.	5.05	75	76.0	7,090	79.0	14	5.50	771	2.1
12346500	Skalkaho Creek nr Hamilton, Mont.	87.8	36	99.0	6,800	82.0	13	12.9	186	1.6
12347500	Blodgett Creek nr Corvallis, Mont.	26.4	73	92.3	6,730	67.0	14	12.3	172	2.2
12348500	Willow Creek nr Corvallis, Mont.	22.4	33	89.0	6,370	63.0	14	7.50	551	1.6
12350000	Bear Creek nr Victor, Mont.	26.8	76	99.0	6,430	68.0	13	11.8	278	2.1
12350200	Gash Creek nr Victor, Mont.	3.37	70	86.1	6,770	79.0	13	3.50	1,011	1.9
12350500	Kootenai Creek nr Stevensville, Mont.	28.9	76	69.0	6,350	65.0	13	10.5	302	2.1
12351000	Burnt Fork Bitterroot River nr Stevensville, Mont.	74.0	32	82.8	6,570	70.0	13	16.7	171	1.6
12351400	Eightmile Creek nr Florence, Mont.	20.6	20	86.5	5,590	35.0	13	8.30	302	1.4
12352000	Lolo Creek ab Sleeman Creek, nr Lolo, Mont.	250	52	97.8	5,430	33.3	12	30.9	47.4	1.2
12352200	Hayes Creek nr Missoula, Mont.	4.16	33	79.0	4,540	3.0	12	4.60	516	1.5
12353400	Negro Gulch nr Alberton, Mont.	8.02	33	81.6	4,760	8.0	12	4.30	580	2.0
12353800	Thompson Creek nr Superior, Mont.	12.2	43	86.8	4,720	13.0	14	9.10	416	2.3
12353850	East Fork Timber Creek nr Haugan, Mont.	2.72	58	89.0	4,320	.0	12	3.40	590	2.0
12354000	St. Regis River nr St. Regis, Mont.	303	52	99.0	4,520	1.0	12	37.1	45.0	2.0
12354100	North Fork Little Joe Creek nr St. Regis, Mont.	14.7	56	89.0	4,870	2.0	12	10.8	227	2.0
12355000	North Fork Flathead River at Flathead, B.C.	450	55	97.7	6,010	47.0	3	42.0	31.7	1.6
12355500	North Fork Flathead River nr Columbia Falls, Mont.	1,548	26	87.3	5,120	29.0	10	99.0	8.09	1.7
12356000	Skyland Creek nr Essex, Mont.	8.37	47	93.0	6,000	48.0	7	5.50	266	1.9
12356500	Bear Creek nr Essex, Mont.	20.7	51	74.4	5,770	32.2	8	8.10	215	1.8

Table 3.--*Basin characteristics at selected gaging stations*--Continued

Station No.	Station name	Drainage area (*A*) (square miles)	Mean annual precipitation (*P*) (inches)	Forest cover (*F*) (percent)	Mean basin elevation (*E*) (feet above sea level)	Basin above 6,000 foot elevation (*HE*) (percent)	Mean January temperature (*JAN*) (degrees Fahrenheit)	Mean channel length (*L*) (miles)	Mean channel slope (*S*) (feet per mile)	24-hour precipitation intensity (*I24*) (inches per hour)
12357000	Middle Fork Flathead River at Essex, Mont.	510	52	87.0	5,900	46.0	7	60.0	36.7	1.9
12357300	Moccasin Creek nr West Glacier, Mont.	2.38	57	81.0	5,620	41.0	8	3.00	1,610	1.6
12357400	Middle Fork Flathead River trib. at West Glacier, Mont.	0.14	39	76.0	3,580	.0	8	0.60	356	1.8
12359000	South Fork Flathead River at Spotted Bear Ranger Station, nr Hungry Horse, Mont.	958	52	88.8	6,130	57.0	7	76.5	25.3	1.9
12359500	Spotted Bear River nr Hungry Horse, Mont.	184	56	91.9	6,000	55.5	6	29.8	64.6	2.0
12360000	Twin Creek nr Hungry Horse, Mont.	47.0	53	83.3	5,300	57.0	7	15.4	121	1.8
12360500	Lower Twin Creek nr Hungry Horse, Mont.	22.4	56	68.6	5,490	30.4	6	8.90	128	1.9
12361000	Sullivan Creek nr Hungry Horse, Mont.	71.3	35	80.0	5,510	38.0	7	13.0	124	1.9
12361500	Graves Creek nr Hungry Horse, Mont.	27.0	67	94.4	5,430	42.0	8	9.00	328	1.9
12362500	South Fork Flathead River nr Columbia Falls, Mont.	1,663	37	85.7	5,780	53.0	8	125	13.1	1.9
12363900	Rock Creek nr Olney, Mont.	3.61	35	88.0	4,470	17.0	12	3.30	846	1.6
12364000	Logan Creek at Tally Lake, nr Whitefish, Mont.	183	28	100.0	4,910	6.0	12	20.3	59.1	1.7
12365000	Stillwater River nr Whitefish, Mont.	524	31	97.5	4,320	3.0	12	50.5	19.8	1.7
12366000	Whitefish Creek nr Kalispell, Mont.	170	37	86.8	4,170	11.0	11	36.9	52.3	1.6
12367500	Ashley Creek nr Kalispell, Mont.	201	24	78.0	4,670	.0	15	25.3	46.4	1.8
12370000	Swan River nr Bigfork, Mont.	671	23	89.8	5,020	26.0	14	84.5	36.3	1.7
12370500	Dayton Creek nr Proctor, Mont.	20.9	20	94.0	4,370	.0	18	6.80	175	1.7
12370900	Teepee Creek nr Polson, Mont.	2.55	52	89.0	5,460	45.0	18	4.10	900	1.8
12371100	Hellroaring Creek nr Polson, Mont.	6.22	48	90.0	5,210	37.0	16	5.20	746	1.8
12374300	Mill Creek nr Niarada, Mont.	28.2	27	91.0	4,510	7.0	15	8.70	254	1.8
12375700	Garden Creek nr Hot Springs, Mont.	3.29	19	94.0	4,180	.0	17	3.70	543	2.0
12389500	Thompson River nr Thompson Falls, Mont.	642	41	99.0	4,710	5.0	18	48.7	21.9	1.8

Table 7.--Results of [illegible]ion analysis for peak discharge using channel-geometry and basin characteristics

[Independent variable: W_{BF}, bankfull width; A, drainage area; F+10, forest cover index; P, mean annual precipitation; S, mean channel slope; E/1000, mean basin elevation; L, mean channel length; W_{AC}, active-channel width; JAN+10, mean January minimum temperature; D_{AC}, active-channel depth. Level of significance of regression coefficient: ****, less than 0.1 percent; ***, 0.1 - 1.0 percent; **, 0.1 - 2.0 percent; *, 2.0 - 5.0 percent]

Flow characteristic (cubic feet per second)	Independent variable										Regression constant	Regression coefficient										Coefficient of determination (R^2)	Average standard error of estimate, in percent
	W_{BF}	A	F+10	P	S	E/1000	L	W_{AC}	JAN+10	D_{AC}	(a)	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}		
												Region 1											
Q_2	X	-	-	-	-	-	-	-	-	-	0.295	**** 1.965	--	--	--	--	--	--	--	--	--	0.935	54
Q_2	X	-	-	-	-	X	-	-	-	-	.057	**** 1.930	--	--	--	--	*** 1.054	--	--	--	--	.943	51
Q_2	X	-	-	-	-	X	X	-	-	-	.068	**** 1.593	--	--	--	--	*** 1.084	** 0.373	--	--	--	.950	48
Q_2	X	X	X	X	-	-	-	-	-	-	66.1	**** 1.193	**** 0.460	**** -0.891	**** 0.881	--	--	--	--	--	--	.962	42
Q_5	X	-	-	-	-	-	-	-	-	-	.677	**** 1.857	--	--	--	--	--	--	--	--	--	.942	48
Q_5	X	X	-	-	-	-	-	-	-	-	1.17	**** 1.463	*** .220	--	--	--	--	--	--	--	--	.951	44
Q_5	-	X	X	-	-	-	-	X	-	-	66.0	--	* .158	**** -.755	--	--	--	--	**** 1.476	--	--	.959	40
Q_5	-	X	X	X	-	-	-	X	-	-	31.9	**** --	**** .384	**** -1.040	**** .643	--	--	--	**** 1.112	--	--	.970	35
Q_{10}	X	-	-	-	-	-	-	-	-	-	1.04	**** 1.800	--	--	--	--	--	--	--	--	--	.940	47
Q_{10}	X	X	-	-	-	-	-	-	-	-	1.88	**** 1.377	** .236	--	--	--	--	--	--	--	--	.952	42
Q_{10}	-	X	X	-	-	-	-	X	-	-	107	--	** .178	**** -.770	--	--	--	--	**** 1.394	--	--	.960	39
Q_{10}	-	X	X	X	-	-	-	X	-	-	57.1	--	**** .372	**** -1.014	*** .551	--	--	--	**** 1.082	--	--	.968	35
Q_{25}	X	-	-	-	-	-	-	-	-	-	1.61	**** 1.742	--	--	--	--	--	--	--	--	--	.933	48
Q_{25}	X	-	-	-	X	-	-	-	-	-	24.3	**** 1.427	--	--	--	**** -.319	--	--	--	--	--	.949	42
Q_{25}	-	X	X	-	-	-	-	X	-	-	175	--	*** .194	**** -.788	--	--	--	--	**** 1.318	--	--	.955	40
Q_{25}	X	X	X	X	-	-	-	-	-	-	21.2	**** 1.114	**** .388	**** -.809	*** .494	--	--	--	--	--	--	.962	37
Q_{50}	X	-	-	-	-	-	-	-	-	-	2.14	**** 1.704	--	--	--	--	--	--	--	--	--	.926	50
Q_{50}	X	-	-	-	X	-	-	-	-	-	41.5	**** 1.360	--	--	--	**** -.349	--	--	--	--	--	.945	43
Q_{50}	-	-	X	-	X	-	-	X	-	-	959	--	--	*** -.700	--	*** -.262	--	--	**** 1.353	--	--	.950	41
Q_{50}	X	X	X	X	-	-	-	-	-	-	32.8	**** 1.095	**** .378	**** -.799	** .429	--	--	--	--	--	--	.956	39

Table 7.--*Results of regression analysis for peak discharge using channel-geometry and basin characteristics*--Continued

Flow characteristic (cubic feet per second)	Independent variable										Regression constant	Regression coefficient										Coefficient of determination (R^2)	Average standard error of estimate, in percent
	W_{BF}	A	F+10	P	S	E/1000	L	W_{AC}	JAN+10	D_{AC}	(a)	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}		
															Region I--Continued								
Q_{100}	X	-	-	-	-	-	-	-	-	-	2.75	**** 1.670	--	--	--	--	--	--	--	--	--	.917	52
Q_{100}	X	-	-	-	X	-	-	-	-	-	64.0	**** 1.305	--	--	--	**** -.370	--	--	--	--	--	.939	45
Q_{100}	-	-	X	-	X	-	-	X	-	-	1,430	--	--	*** -.698	--	*** -.285	--	--	**** 1.303	--	--	.944	43
															Region II								
Q_2	X	-	-	-	-	-	-	-	-	-	.153	**** 2.104	--	--	--	--	--	--	--	--	--	.964	44
Q_2	X	-	-	X	-	-	-	-	-	-	.026	**** 2.113	--	--	* .470	--	--	--	--	--	--	.972	39
Q_2	-	X	-	X	-	-	-	X	-	-	.064	--	*** .361	--	*** .917	--	--	--	**** 1.221	--	--	.977	34
Q_5	-	-	-	-	-	-	-	X	-	-	1.75	--	--	--	--	--	--	--	**** 1.760	--	--	.968	38
Q_5	-	X	-	X	-	-	-	X	-	-	.567	--	*** .395	--	*** .622	--	--	--	**** 1.023	--	--	.981	30
Q_{10}	-	-	-	-	-	-	-	X	-	-	3.10	--	--	--	--	--	--	--	**** 1.678	--	--	.968	36
Q_{10}	-	X	-	-	-	-	-	X	-	-	6.08	--	* .213	--	--	--	--	--	**** 1.273	--	--	.974	33
Q_{10}	-	X	-	X	-	-	-	X	-	-	1.93	--	*** .386	--	* .445	--	--	--	**** .953	--	--	.980	30
Q_{25}	-	-	-	-	-	-	-	X	-	-	5.53	--	--	--	--	--	--	--	**** 1.607	--	--	.966	36
Q_{25}	-	X	-	-	-	-	-	X	-	-	13.0	--	*** .271	--	--	--	--	--	**** 1.091	--	--	.976	30
Q_{50}	-	-	-	-	-	-	-	X	-	-	9.53	--	--	--	--	--	--	--	**** 1.538	--	--	.963	35
Q_{50}	-	X	-	-	-	-	-	X	-	-	20.9	--	** .249	--	--	--	--	--	**** 1.064	--	--	.973	31
Q_{50}	-	X	-	-	X	-	-	X	-	-	5.17	--	*** .416	--	--	* .242	--	--	**** .963	--	--	.980	28
Q_{100}	-	-	-	-	-	-	-	X	-	-	16.5	--	--	--	--	--	--	--	**** 1.478	--	--	.943	43
Q_{100}	-	-	-	-	-	X	-	X	-	-	.771	--	--	--	--	--	**** 2.068	--	**** 1.351	--	--	.958	38
															Region III								
Q_2	-	-	-	-	-	-	-	X	-	-	.869	--	--	--	--	--	--	--	**** 1.756	--	--	.933	49
Q_2	-	-	-	-	-	-	-	X	-	X	1.61	--	--	--	--	--	--	--	**** 1.533	--	**** .549	.949	43
Q_2	-	X	-	X	-	-	-	X	-	-	.195	--	**** .452	--	*** 0.714	--	--	--	**** .919	--	--	.958	39

Table 7.--*Results of regression analysis for peak discharge using channel-geometry and basin characteristics*--Continued

Flow characteristic (cubic feet per second)	Independent variable										Regression constant	Regression coefficient										Coefficient of determination (R^2)	Average standard error of estimate, in percent
	W_{BF}	A	$F+10$	P	S	$E/1000$	L	W_{AC}	$JAN+10$	D_{AC}	(a)	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}		
													Region III--Continued										
Q_5	-	-	-	-	-	-	-	X	-	-	2.74	--	--	--	--	--	--	--	**** 1.555	--	--	.918	48
Q_5	-	X	-	-	-	-	-	X	-	-	3.92	--	**** .320	--	--	--	--	--	**** 1.011	--	--	.940	41
Q_5	-	X	-	-	-	-	-	X	X	-	.455	--	**** .369	--	--	--	--	--	**** .945	** 0.774	--	.949	39
Q_{10}	-	-	-	-	-	-	-	X	-	-	4.99	--	--	--	--	--	--	--	**** 1.451	--	--	.889	54
Q_{10}	-	X	-	-	-	-	-	X	-	-	7.13	--	*** .321	--	--	--	--	--	**** .904	--	--	.914	47
Q_{10}	-	X	-	-	-	-	-	X	X	-	.778	--	**** .372	--	--	--	--	--	**** .836	* .796	--	.924	45
Q_{10}	-	X	-	-	-	X	-	X	X	-	7.65	--	**** .389	--	--	--	* -1.150	--	**** .854	* .717	--	.931	43
Q_{25}	-	-	-	-	-	-	-	X	-	-	9.59	--	--	--	--	--	--	--	**** 1.334	--	--	.835	63
Q_{25}	-	X	-	-	-	-	-	X	-	-	13.7	--	*** .319	--	--	--	--	--	**** .792	--	--	.861	58
Q_{25}	-	X	-	-	-	X	-	X	-	-	574	--	**** .359	--	--	--	*** -2.084	--	**** .812	--	--	.888	52
Q_{50}	-	-	-	-	-	-	-	X	-	-	14.6	--	--	--	--	--	--	--	**** 1.260	--	--	.786	71
Q_{50}	-	-	-	-	-	X	-	X	-	-	886	--	--	--	--	--	*** -2.319	--	**** 1.357	--	--	.822	65
Q_{50}	-	X	-	-	-	X	-	X	-	-	2,230	--	*** .364	--	--	--	**** -2.609	--	**** .750	--	--	.858	58
Q_{100}	-	-	-	-	-	-	-	X	-	-	21.2	--	--	--	--	--	--	--	**** 1.193	--	--	.733	79
Q_{100}	-	-	-	-	-	X	-	X	-	-	3,010	--	--	--	--	--	*** -2.796	--	**** 1.310	--	--	.780	71
Q_{100}	-	X	-	-	-	X	-	X	-	-	7,630	--	*** .368	--	--	--	**** -3.089	--	*** .697	--	--	.826	63
													Region IV										
Q_2	X	-	-	-	-	-	-	-	-	-	.283	**** 1.957	--	--	--	--	--	--	--	--	--	.936	46
Q_2	X	-	X	-	-	-	-	-	-	-	.054	**** 1.779	--	* .606	--	--	--	--	--	--	--	.946	42
Q_2	-	-	X	-	-	-	-	X	-	X	.487	--	--	*** .632	--	--	--	--	**** 1.208	--	*** .848	.964	34
Q_5	X	-	-	-	-	-	-	-	-	-	1.96	**** 1.626	--	--	--	--	--	--	--	--	--	.945	35
Q_5	X	-	-	-	X	-	-	-	-	-	21.9	**** 1.440	--	--	--	*** -.359	--	--	--	--	--	.969	27

Table 7.--*Results of regression analysis for peak discharge using channel-geometry and basin characteristics*--Continued

Flow characteristic (cubic feet per second)	Independent variable										Regression constant	Regression coefficient										Coefficient of determination (R^2)	Average standard error of estimate, in percent
	W_{BF}	A	F+10	P	S	E/1000	L	W_{AC}	JAN+10	D_{AC}	(a)	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8	b_9	b_{10}		
												Region IV--Continued											
Q_{10}	X	-	-	-	-	-	-	-	-	-	5.62	**** 1.443	--	--	--	--	--	--	--	--	--	.929	35
Q_{10}	X	-	-	-	X	-	-	-	-	-	87.0	**** 1.233	--	--	--	**** -.407	--	--	--	--	--	.967	24
Q_{25}	X	-	-	-	-	-	-	-	-	-	17.9	**** 1.243	--	--	--	--	--	--	--	--	--	.877	42
Q_{25}	X	-	-	-	X	-	-	-	-	-	391	**** 1.006	--	--	--	**** -.459	--	--	--	--	--	.938	30
Q_{50}	(No meaningful equations derived using both channel geometry and basin characteristics)																						
Q_{100}	(No meaningful equations derived using both channel geometry and basin characteristics)																						