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ESTIMATES OF MONTHLY STREAMFLOW CHARACTERISTICS AT SELECTED SITES, WIND RIVER AND PART OF BIGHORN RIVER DRAINAGE BASINS, WYOMING

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In the text and tables of this report the definitions of two basin characteristics used as independent variables in the estimation equations are incorrect. The equations, however, are correct. The two basin characteristics are mean basin elevation (E) and maximum basin relief (BR).

In order to understand and apply the equations correctly, users of the report are advised to make the pen-and-ink changes listed below, which include a slight correction to the general form of the basin-characteristics regression equation. An alternative to making pen-and-ink changes is to trim and insert the attached sheets, which include the changes listed below.

1. Page 9, column 1. (1) Fourth line from bottom, *change definition* of mean basin elevation to read **"mean basin elevation, in feet per 10,000 feet above mean sea level"**. (2) Second line from bottom, *change definition* of maximum basin relief to read **"maximum basin relief, in feet."**

2. Page 9, column 2. (1) Line 3, after "elevation, in feet" *insert* **"per 10,000 feet."** (2) Line 8, after "(Lowham, 1988)" *insert* **", then dividing the average by 10,000."**. (3) Lines 15-16, after "Maximum" *insert* **"basin"** and *delete* **"per 10,000 feet"**. (4) Lines 18-19, after "in the basin" *delete* **", then dividing the difference by 10,000"**.

3. Page 9, column 2, equation 1. *Insert* "**log**" in front of X_1 and X_2.

4. Pages 12-13, table 3. (1) In headnote, *change the definition* of **E** to **"mean basin elevation, in feet per 10,000 feet above mean sea level,"**and *change the definition* of **BR** to **"maximum basin relief, in feet."** (2) *Divide* all measured characteristics in the column labeled **E** *by 10,000*. (3) *Multiply* all measured characteristics in the column labeled **BR** *by 10,000*.

5. Page 14, table 4 (headnote only). (1) *Change* **BR, maximum basin relief, in feet per 10,000 feet** *to* **BR, maximum basin relief, in feet**. (2) *Change* **E, mean basin elevation, in feet above sea level** *to* **E, mean basin elevation, in feet per 10,000 feet above mean sea level**. The equations listed in table 4 are correct as published.

6. Page 16, table 5. (1) In the column headings, *change* **Mean basin elevation (feet above sea level)** *to* **Mean basin elevation (feet per 10,000 feet above sea level)** *and* **Maximum basin relief (feet per 10,000 feet)** *to* **Maximum basin relief (feet)**. (2) *Change* the range of values in column 2 *from* **8,020–10,500** *to* **0.8020–1.0500**. (3) *Change* the range of values in column 4 *from* **0.131–0.787** *to* **1,310–7,870**.

Questions or comments may be directed to:

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Table 3. *Basin and climatic characteristics and channel widths for each gaging station and ungaged site in Wyoming, used in the basin-characteristics and channel-width methods*

[--, ungaged site; A, drainage area, in square miles; E, mean basin elevation, in feet per 10,000 feet above sea level; BSL, basin slope, in feet per mile; BP, basin perimeter, in miles; BR, maximum basin relief, in feet; P, mean annual precipitation, in inches; W, active channel width, in feet]

Site	Station name	Station number	A	E	BSL	BP	BR	P	W
1	Wind River near Dubois[1]	06218500	232	0.8920	1,010	76.5	4,450	20	54
2	Horse Creek near Dubois	06219500	119	.8730	1,090	56.9	4,700	15	39
3	Jakeys Fork near Dubois	--	51.6	.9900	1,380	38.5	6,040	23	48
4	Torrey Creek near Dubois	--	66.0	.9850	1,450	40.0	6,480	21	35
5	Bear Creek near Dubois	--	63.9	.9210	1,330	45.8	4,810	23	28
6	Wiggins Fork near Dubois	--	211	.9660	1,890	85.4	5,750	20	81
7	East Fork Wind River near Dubois[1]	06220500	427	.9140	1,490	105	6,030	20	124
8	Red Creek near Wilderness	--	15.0	.8880	1,500	20.6	5,360	16	7
9	Dinwoody Creek above Lakes, near Burris[1]	06221400	88.2	1.0500	1,570	49.1	7,200	25	74
12	Dry Creek near Burris[1]	06222500	53.7	1.0100	1,480	45.8	6,580	22	34
13	Meadow Creek near Crowheart	--	41.7	.8920	1,300	39.8	6,320	17	16
14	Crow Creek near Tipperary[1]	06222700	30.2	.9950	1,610	28.7	3,640	18	24
15	Willow Creek near Crowheart[1]	06223500	55.4	.8720	1,150	38.1	5,930	17	17
16	Bull Lake Creek above Bull Lake[1]	06224000	187	1.0300	1,690	74.5	7,870	25	116
18	Dry Creek near Tipperary	--	24.6	.8970	1,120	25.6	4,690	16	14
19	South Fork Little Wind River above Washakie Reservoir, near Fort Washakie[1]	06228350	90.3	1.0230	1,450	50.3	6,080	25	65
20	North Fork Little Wind River near Fort Washakie	06228800	112	.9990	1,330	57.4	6,610	23	62
21	Sage Creek above Norkok Meadows	06229680	115	.7170	757	49.8	5,640	13	14
22	Trout Creek near Fort Washakie	06229900	16.1	.9620	1,290	21.0	5,030	16	13
23	Crooked Creek near Fort Washakie	--	12.6	.7700	1,270	22.2	4,020	15	5
24	Mill Creek above Ray Canal outlet	06230190	15.8	.6470	508	21.8	3,200	14	6
25	Middle Popo Agie River below The Sinks, near Lander[1]	06231600	87.5	.9920	1,400	54.3	7,040	20	61
26	Squaw Creek near Lander	--	23.5	.6890	1,350	28.9	4,620	15	12
27	Baldwin Creek near Lander	--	27.9	.7850	1,060	34.0	5,740	15	13
28	North Popo Agie River near Milford[1]	06232000	98.4	.9890	1,940	67.7	6,650	22	58
29	Little Popo Agie River near Lander[1]	06233000	125	.8020	1,090	59.2	7,050	18	46
38	South Fork Owl Creek near Anchor[1]	06260000	85.5	.9530	1,480	61.1	6,000	21	37
39	Red Creek near Embar	--	24.6	.7290	1,220	27.0	4,150	14	10
40	Mud Creek near Minnesela	--	76.6	.6380	1,010	41.0	4,400	14	12
43	Wood River at Sunshine[1]	06275000	194	.9100	1,320	68.6	6,110	20	50
47	Sweetwater River near South Pass City[1]	06637550	177	.8660	1,070	69.6	4,890	16	33
48	Rock Creek above Rock Creek Reservoir[1]	06637750	9.07	.8990	778	14.9	1,900	17	15
49	Slate Creek near Atlantic City[1]	06637900	5.92	.8620	572	13.2	1,310	16	9
51	Pine Creek above Fremont Lake[1]	09196500	75.8	1.0200	1,660	41.3	6,200	23	67

Table 3. *Basin and climatic characteristics and channel widths for each gaging station and ungaged site in Wyoming, used in the basin-characteristics and channel-width methods—Continued*

Site	Station name	Station number	A	E	BSL	BP	BR	P	W
52	Pole Creek below Little Half Moon Lake, near Pinedale[1]	09198500	87.5	1.0000	1,130	45.8	5,590	22	62
53	East Fork River near Big Sandy[1]	09203000	79.2	.9580	1,130	49.9	4,590	22	56
54	Pacific Creek at Moran[1]	13011500	169	.8160	902	76.6	3,780	30	85
55	Buffalo Fork above Lava Creek, near Moran[1]	13011900	323	.9270	1,250	101	4,600	29	131

[1] Streamflow-gaging station used for regression analysis

Table 4. *Results of basin-characteristics regression analysis*

[R^2, coefficient of determination; Q.90, 70, 50, and 10, monthly mean discharge exceeded 90, 70, 50, and 10 percent of the time during a specified month, in cubic feet per second; Qm, monthly mean streamflow for specified month, in cubic feet per second; A, drainage area, in square miles; P, mean annual precipitation, in inches; BSL, basin slope, in feet per mile; BR, maximum basin relief, in feet; E, mean basin elevation, in feet per 10,000 feet above sea level]

Table 5. *Application range of the estimation equations used in the basin-characteristics and channel-width methods*

Drainage area (square miles)	Mean basin elevation (feet per 10,000 feet above sea level)	Basin slope (feet per mile)	Maximum basin relief (feet)	Mean annual precipitation (inches)	Active channel width (feet)
5.92–427	0.8020–1.0500	572–1,940	1,310–7,870	16–30	9–131

A common base period, 1941-90, was developed using streamflow records from 38 continuous-record streamflow-gaging stations (fig. 2). The longest continuous streamflow record, Green River at Warren Bridge, near Daniel (site 50), ranged from 1934 to 1990. The earliest continuous streamflow records started in 1918 (sites 10 and 17). Except for 1924 and 1925, the record for site 17, Bull Lake near Lenore, is continuous through 1990. However, a dam was constructed at the mouth of Bull Lake in 1938 making the streamflow record after 1938 unsuitable for this study. Record-extension procedures were run on five ephemeral streams (sites 30, 31, 35-37) that are on or adjacent to the Wind River Indian Reservation. To extend records for the five ephemeral streams, ephemeral streams to the north and east of the study area (fig. 1) were used as base stations. The extended records for the five ephemeral streams were used to compute the monthly statistics for those five sites, but were not used to develop the basin-characteristics and channel-width methods. The streamflow characteristics developed from the extended record are listed in table 14 at the back of this report.

METHODS FOR ESTIMATING MONTHLY STREAMFLOW CHARACTERISTICS

Four statistical techniques were used to estimate monthly streamflow characteristics at ungaged sites and at streamflow-gaging stations with fewer than 5 years of record. The methods used to estimate streamflow data at each site of interest are identified in table 1 and are described as follows.

Basin Characteristics

Basin characteristics considered for this study were determined by examining characteristics used in streamflow studies in Montana (Parrett and Johnson, 1989; Parrett and others, 1989; and Parrett and Cartier, 1990) and in Wyoming (Lowham, 1988). Five physical-basin characteristics and one climatic characteristic were chosen as potential independent variables. The variables chosen were drainage area, in square miles; mean basin elevation, in feet per 10,000 feet above sea level; basin slope, in feet per mile; basin perimeter, in miles; maximum basin relief, in feet and mean annual precipitation, in inches. Drainage area, in square miles, was measured by a planimeter or digitizer on the best available topographic maps. Mean basin elevation, in feet per 10,000 feet above sea level was measured on 1:250,000 scale topographic maps. The measurements were made by laying a grid over the map, determining the elevation for at least 25 evenly spaced intersections within the basin, and averaging those elevations (Lowham, 1988), then dividing the average by 10,000. Basin perimeter, in miles, was determined by measuring the length of drainage area boundary (Craig and Rankl, 1978). Basin slope, in feet per mile, was determined by measuring the lengths, in miles, of elevation contour lines within the drainage boundary, multiplying by the contour interval, in feet, and dividing by the drainage area, in square miles (Lowham, 1988). Maximum basin relief, in feet, was determined by computing the difference between the elevation of the channel at the gage and the elevation of the highest point in the basin. Mean annual precipitation, in inches, was determined from Lowham, 1988, plate 1b. Correlation analysis indicated a correlation coefficient of 0.98 between basin perimeter and drainage area; therefore, basin perimeter was not used as an independent variable in this study. The data for drainage area, mean basin elevation, basin slope, basin perimeter, maximum basin relief, and mean annual precipitation for selected streamflow-gaging stations and ungaged sites of interest are listed in table 3.

The basin-characteristics method is based on a linear-regression model with multiple variables. For each of the 21 streamflow-gaging stations used in the method, the calculated monthly streamflow characteristics, the four physical-basin characteristics, and the one climatic characteristic were transformed into logarithmic space. All of the possible subsets of independent variables were calculated by using the following regression equation:

$$\log Q_{xx} = \log a + b_1 \cdot \log X_1 + b_2 \cdot \log X_2 + \ldots + b_n \cdot \log X_n \quad (1)$$

where

Q_{xx} is the monthly mean streamflow, in cubic feet per second, exceeded 90, 70, 50, and 10 percent of the time for the 50 years of record (Q.90, Q.70, Q.50, Q.10), or the mean monthly streamflow (Qm);

a is the multiple-regression constant;

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

$X_1, X_2, \ldots X_n$ are the independent explanatory variables.