DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

FOLIO OF THE
POWDER RIVER BASIN, WYOMING
MAP I–847–B

DEFINITION OF TERMS

Terms related to streamflow and other hydrologic data, in this report are defined as follows:

Acre-foot (acre-ft). – The quantity of water required to cover 1 acre to a depth of 1 foot and is equivalent to 43,560 cubic feet or 325, 851 gallons.

Annual volume. – The volume of flow for a water year.

Average annual volume. – The arithmetic average of the annual volumes of all complete water years of the specified period whether or not they are consecutive.

Runoff. – That part of the precipitation that appears in surface streams and is unaffected by artificial diversion, storage, or other works of man.

Streamflow. – The discharge that occurs in a natural channel. The term "streamflow" applies to discharge whether or not it is affected by diversion or regulation.

10-yr. annual minimum volume. – The annual volume that is exceeded 90 percent of the years.

INTRODUCTION

The purpose of this report is to present streamflow data for the region in a format that is easy to visualize and assimilate by anyone confronted with land-use planning and decision making associated with the development of natural resources.

The map shows the average annual volume of flow and the 10-year annual minimum volumes for selected streams in northeastern Wyoming and southeastern Montana. The color and pattern widths along a stream indicate the approximate flows, in acre-feet. Most of the volumes shown are based upon the published records of stream-gaging stations operated in the area by U.S. Geological Survey. Volumes were extrapolated between stream-gaging stations on the basis of drainage area. Records were not adjusted for reservoir storage, irrigation diversion, or other losses and, therefore, represent actual streamflow rather than surface runoff. Some error is introduced by the extrapolation procedure and the scale used. Also, the mapped volume at a given point on a stream does not reflect a decreased flow due to any diversion at or near that point. The user should be aware of these sources of inaccuracy in the map. The average volumes of flow and period of record for stations shown on the map are listed in table 1.

The few gaging station records in the plains area were supplemented by estimating the flow at selected ungaged sites. The dimensions of a channel have been shown to be a reliable tool for estimating the average volume of flow carried by the channel (Hedman, 1970; Emmett, 1972). The relationship of the channel cross-sectional area below the flood-plain level (bankfull area discussed by Emmett, 1972) to average annual volume was used to estimate the average annual volumes which are shown in table 2.

TABLE 1. – Streamflow volumes at gaged sites

Map key	Station No.	Drainage area (square miles)	Stream type[1]	Records used	Streamflow volumes (acre-ft) Average annual	Lowest annual volume of record[2]	10-yr. annual minimum[3]
A1	3092	46	P	1961–70	25,210		
A2	3095	450	P	1949–70	51,950		
A3	3110	24.5	P	1946–70	10,430		
A4	3115	106	P	1940–70	23,550		
A5	3125	980	P	1938–70	93,460	41,700	51,400
A6	3130	1,150	P	1938–39			
				1950–69	26,230		
A7	3170	6,050	P	1930–70	196,300	50,900	92,600
A8	3245	8,088	P	1929–70	325,300	78,900	152,800
A9	3265	13,194	P	1938–70	434,700	57,500	174,500
B1	3145	51.7	P	1949–70	12,900		
B2	3150	174	P	1950–68	12,520		
B3	3155	82.7	P	1942–70	16,010		
B4	3164	945	P	1963–70	32,390		
C1	3185	120	P	1897–99			
				1917–27			
				1938–70	44,990		
C2	3200	60	P	1943–70	26,300		
C3	3205	33.6	P	1947–57			
				1959–70	30,570		
C4	3210	69.4	P	1951–70	54,050		
C5	3215	36.8	P	1951–70	26,880		
C6	3230	118	P	1940–70	61,510		
C7	3235	267	P	1950–70	58,830		
C8	3240	1,110	P	1939–70	129,700		
D2	3255	1,974	P	1947–53			
				1957–70	24,050		
E1	2965	32.4	P	1949–57	23,400		
E2	2970	85	P	1945–70	57,090		
E3	2980	204	P	1918–29			
				1940–70	135,500		
E4	2985	25.1	P	1951–53			
				1955–70	9,130		
E5	2995	37.8	P	1945–70	21,210		
E6	3060	894	P	1938–57	292,000	138,700	181,700
E7	3075	1,770	------	1939–70	322,400	111,500	183,200
E8	3085	5,370	P	1938–41			
				1946–70	293,400	41,400	112,900
F1	3005	20.1	P	1953–70	23,180		
F2	3015	24.4	P	1953–70	24,780		
F3	3020	120	P	1929–70	57,670		
F4	3035	55	P	1941–70	45,860		
F5	3055	392	P	1941–70	131,100		
G1	3340	904	P	1912–13			
				1915–25			
				1928–32			
				1935–69	55,930	1,400	12,000
G2	3345	1,970	P	1903–06			
				1956–70	88,390	3,400	30,400
G3	3346.3	1,092	P	1959–70	55,210		
G4	3350	587	P	1938–70	28,690		
H1	3860	2,070	E	1948–54			
				1956–70	17,970		
H2	3865	5,270	E	1948–70	40,350	4,300	7,800
H3	3940	1,320	P	1944–70	22,970		
I1	4265	1,670	P	1943–70	15,210		
I2	4275	2,000	------	1951–70	12,480	1,300	3,700
I3	4285	3,280	P	1946–70	57,530	5,570	20,000
I4	4305	471	P	1929–31			
				1954–70	24,130		
M1	3090	48,253	P	1922–23			
				1928–70	8,071,000	4,445,000	5,589,000

[1] P, perennial; E, ephemeral.
[2] Lowest annual volume for the indicated period of record. The lowest annual volume and the 10-year annual minimum volumes are shown for major streams only.
[3] The annual volume is less than the indicated volume an average of once in 10 years.

STREAMFLOW VARIABILITY

Both perennial and ephemeral streams occur in this region. Perennial streams are those that flow the year around, and in this region most of them arise in the Bighorn Mountains and the Black Hills with their flows being sustained by snowmelt and ground-water discharge. Ephemeral streams are dry much of the year, but they flow in response to spring snowmelt or rainstorms large enough to cause runoff. Most of the ephemeral streams occur in the plains area between the Bighorn Mountains and the Black Hills. There are also many streams in the plains area that exhibit both perennial and ephemeral characteristics. They are perennial in that they contain water throughout the year–in pools with little or no flow. However, like ephemeral streams, most of their flow results from spring snowmelt and rainstorms.

Excluding the Yellowstone River, most of the water in the region is carried by the Tongue and Powder Rivers which arise in the Bighorn Mountains. Relatively small volumes of water are contributed by the streams rising in the plains. These differences in streamflow within the region are caused by variations in the climate, the rock and soil types, and the land use, in addition to variations in water use. The mountain areas produce the most flow because of high precipitation. In this region some of the mountain areas receive as much as 10 inches (254 mm) more precipitation per year than the plains area. In the plains area different rock and soil types and topography affect the amount of streamflow more than precipitation does. Clayey soils resulting from the weathering of shale produce more runoff per inch of precipitation than the more permeable sandy and loamy soils derived from sandstone, or baked shale (clinker). Regardless of the soil type, rolling plains areas produce less streamflow than the steep broken areas found adjacent to parts of some streams. Rangeland that is heavily grazed produces more streamflow than similar lightly grazed rangeland with good grass cover or hay land. Small reservoirs for stock water and erosion control withhold significant amounts of water from streams in many parts of the region.

WATER LAW AND WATER USE

Laws concerning use of water and water rights have been formulated by legislation and numerous court cases and, therefore, are very complex. Congressional legislation of 1866 recognized the right of the individual States to govern the use of water within their boundaries and to establish the procedures for acquisition of water rights (Clark, 1967). In eight Western States, including Montana and Wyoming, water rights are based exclusively on the doctrine of prior appropriations. Thus, when streamflow is not sufficient to fulfill all rights, the oldest rights receive first consideration. Under this doctrine, water rights can be bought, sold, or traded irrespective of land ownership. The United States Government claims the rights of all unappropriated surface waters in the States (Clark, 1967). Records of water rights are kept by the Wyoming State Engineer and the Montana Department of Natural Resources and Conservation in their respective States.

The primary use of water from streams in this region is for irrigation of hayfields on the bottom lands along rivers and main tributaries. Approximately 121,000 acres (490 km^2) are irrigated from the Tongue and Powder Rivers and their tributaries in Wyoming alone. Additional small amounts of water are used by livestock, coal power plants, oil fields, and municipal and domestic users. Some streams are regulated by reservoirs, and there is some transbasin diversion of water.

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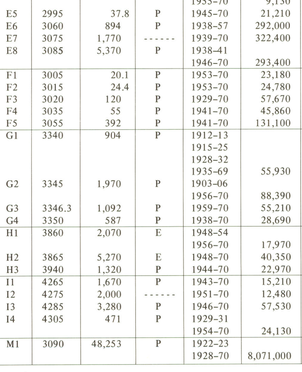
TABLE 2. – Estimated streamflow volumes at ungaged sites

Map key	Site name	Drainage area (square miles)	Stream type[1]	Estimated average volume (acre-ft)
A10	South Fork Powder River near Powder River, Wyo	262	P	6,580
D1	Little Powder River near Weston, Wyo	206	P	5,580
G5	Little Missouri near New Haven, Wyo	250	E	[2] 16,000
G6	Box Elder Creek near Hammond, Mont	66	E	4,340
G7	Little Beaver Creek near Ekalaka, Mont	135	P	7,100
H4	Dry Fork Cheyenne River near Bill, Wyo	334	E	6,080
H5	Antelope Creek near Bill, Wyo	704	E	8,590
H6	Stockade Beaver Creek near Spencer Siding, Wyo	188	P	11,950
I5	Belle Fourche River south of Gillette, Wyo	342	P	1,740
I6	Donkey Creek near Rozet, Wyo	199	P	[2] 2,130
I7	Donkey Creek below Moorcroft, Wyo	265	P	[2] 2,830
J1	Pumpkin Creek near Volborg, Mont	374	E	17,600
J2	Pumpkin Creek near Miles City, Mont	666	E	8,760
J3	Otter Creek near Otter, Mont	168	P	1,750
J4	Otter Creek near Ashland, Mont	595	P	9,500
J5	Hanging Woman Creek near Birney, Mont	327	P	[2] 4,860
K1	Sarpy Creek near Hysham, Mont	375	E	15,200
K2	Armell's Creek near Forsyth, Mont	331	P	9,270
K3	Rosebud Creek near Forsyth, Mont	1,260	P	25,950
K4	Rosebud Creek at Busby, Mont	299	P	8,660
K5	O'Fallon Creek near Ismay, Mont	669	P	28,960
K6	O'Fallon Creek near Mildred, Mont	1,376	P	29,200
L1	Mizpah Creek near Olive, Mont	371	P	6,580
L2	Mizpah Creek near Mizpah, Mont	847	P	16,100

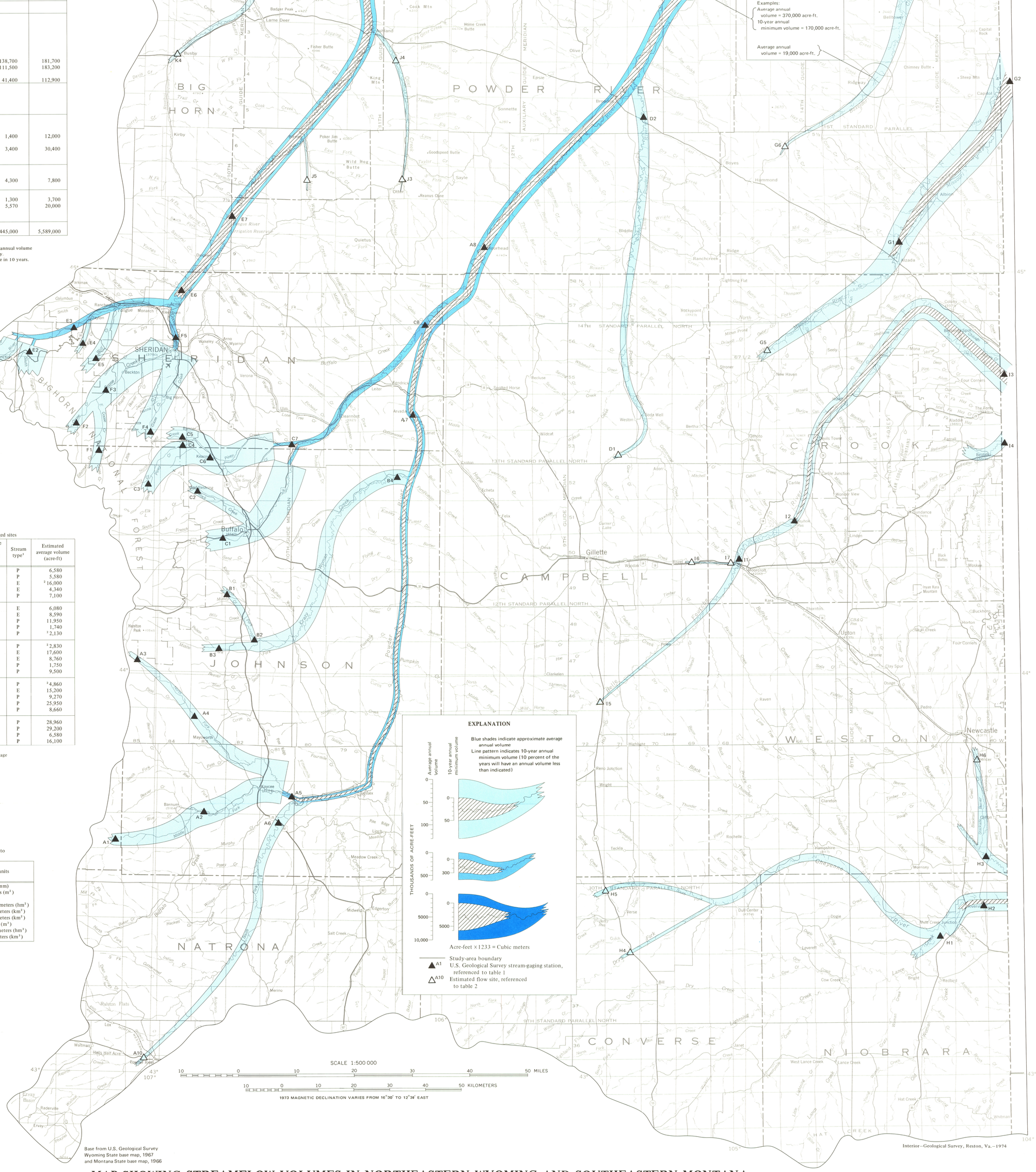
[1] P, perennial; E, ephemeral.
[2] Estimated from source-area runoff values based on data from small drainage basins having climate, soils, and topography similar to ungaged basins.

TABLE 3. – Factors for converting English units to International System (SI) units

English units	Conversion factor (multiply by)	SI units
Inches (in.)	25.4	Millimeters (mm)
Acres	4047	Square meters (m^2)
	.4047	Hectares (ha)
	.4047	Square hectometers (hm^2)
	.004047	Square kilometers (km^2)
Square miles	2.59	Square kilometers (km^2)
Acre-feet (acre-ft)	1233	Cubic meters (m^3)
	1.233×10^{-3}	Cubic hectometers (hm^3)
	1.233×10^{-6}	Cubic kilometers (km^3)



LOCATION OF STUDY AREA



MAP SHOWING STREAMFLOW VOLUMES IN NORTHEASTERN WYOMING AND SOUTHEASTERN MONTANA

By
D. G. Frickel and L. M. Shown

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