

YELLOWSTONE RIVER COMPACT COMMISSION

408 Federal Building

Helena, Montana

December 15, 1959

His Excellency Joseph J. Hickey
Governor of the State of Wyoming
Cheyenne, Wyoming

His Excellency J. Hugo Aronson
Governor of the State of Montana
Helena, Montana

His Excellency John E. Davis
Governor of the State of North Dakota
Bismarck, North Dakota

Sirs:

Pursuant to Article III of the Yellowstone River Compact, the Commission created according to the terms of said Compact makes the following eighth annual report:

The eighth annual meeting of the Yellowstone River Compact Commission was held by telephonic interconnection between Cheyenne, Wyoming and Helena, Montana on November 16, 1959. This means was employed when uncertainties of travel indicated members would have difficulty attending the scheduled meeting at Billings, Montana on November 17 without interference with business commitments on succeeding days. The duly constituted members were mutually recognized to be in attendance.

The Commissioners feel that allocable water uses in the several states during the year ending September 30, 1959 did not exceed the respective percentage shares. The determination of shares would be highly involved and the cost is not considered justified at the present level of water resources development. No questions of water use were referred to the Commission.

The annual flows of the Clarks Fork Yellowstone River at Edgar and Tongue River at Miles City were approximately average for their respective periods of record and substantially greater than in the previous water year. The flows of the Bighorn River at Big Horn and Powder River at Locate were approximately 75 percent of their averages.

The administrative expense of the Commission during the fiscal year ending June 30, 1959 was \$6,000, of which \$3,000 was borne by the federal government. The remaining \$3,000 was borne by contributions of \$1,500 each by the

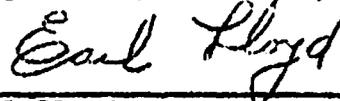
States of Montana and Wyoming. A budget of \$8,000 is in force for the fiscal year ending June 30, 1960. This will permit some gaging station repair and the construction of a cableway for discharge measurements of the Clarks Fork Yellowstone River immediately upstream from the mouth of Rock Creek. A tentative budget of \$8,000 was adopted for the succeeding fiscal year.

The Commissioner for Wyoming reported that the U. S. Steel Corporation has reached an agreement with the Little Popo Agie Irrigation District for a prior right to store 1,200 acre-feet of water in Christina Lake Reservoir for trans-basin diversion into Rock Creek of the North Platte River Basin when and if necessary. This succession of interest, acquired in the territorial water right adjudicated to Emile Granier with a priority of September 1888, has been recognized and amended by the Wyoming State Board of Control to that amount for mining and milling purposes. This right is intended to supplement water rights acquired by the U. S. Steel Corporation in the above Rock Creek for the Mining and milling of iron ore. No diversion took place in the current water year. The Commission's reports for 1957 and 1958 present the history and developments of this trans-basin diversion.

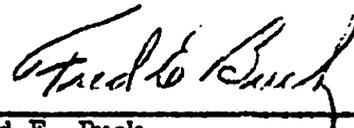
The Commission has arranged for the collection of stream-flow data and the continued assembly of water-right filings to aid in the active administration of the Compact when the need arises. Records of stream flow collected through support of the Commission and data on storage in reservoirs as supplied by various governmental agencies are summarized in appendices to this report. The graphic comparison of discharge may be helpful in visualizing the flow at the designated points with respect to uniform base periods.

Pertinent data and records are available in the files of the Commission maintained in the office of the U. S. Geological Survey at Helena, Montana.

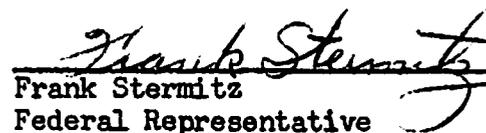
Respectfully submitted,



Earl Lloyd
Commissioner for Wyoming



Fred E. Buck
Commissioner for Montana



Frank Stermitz
Federal Representative

GENERAL REPORT

Rules and Regulations:

A minor change of wording was made in Article III A of the Rules and Regulations of the Yellowstone River Compact Commission at the eighth annual meeting through unanimous action. The change was made in the interest of clarification without modification of the apparent intent.

Cost:

The work of the Commission is financed through annual cooperative arrangements between the States of Montana and Wyoming and the United States of America.

The expense of the Commission during the fiscal year ending June 30, 1959 is given:

	<u>Total Cost</u>	<u>Borne by United States</u>	<u>Borne by Wyoming Montana</u>	
Gaging station operation and maintenance	\$5100			
Collection and assembly of data and administration	<u>\$900</u>	<u> </u>	<u> </u>	<u> </u>
Total	\$6000	\$3000	\$1500	\$1500

The budget for the fiscal year ending June 30, 1960 totals \$8,000, with the same proportionate sharing of costs. Usual operations are being conducted. In addition, a cableway will be constructed on the Clarks Fork Yellowstone River, a short distance above the mouth of Rock Creek. The miscellaneous data collected thereby will provide a means of relating the discharge records at Edgar to the flow at the point designated in the Compact.

A tentative amount of \$8,000 was budgeted for the fiscal year ending June 30, 1961. The construction of an auxiliary recording gage on the Bighorn River at Big Horn, Montana is planned as an aid to defining the flow during periods of backwater caused by the Yellowstone River.

The budgets of the Commission do not include the salaries and necessary expenses of the State representatives, nor the cost of the collection of hydrologic data which can be had from other sources.

Gaging Stations:

The planned discontinuance of Commission support of the gaging station on the Little Bighorn River near Crow Agency as of September 30, 1959 was affirmed. The five full years of concurrent record on the Little Bighorn River near Hardin has developed adequate correlative information for any probable studies of early records.

Discharge records were collected at the points of measurement designated in the Compact or as near thereto as the Commission deemed practical. Supplementary records consisted of six miscellaneous measurements of the Whitehorse Canal near Edgar and approximations of seasonal diversion, and daily discharge records of the Agency Canal near Hardin and the Little Bighorn River near Crow Agency. Auxiliary readings of a manual gage were utilized in defining the backwater conditions that prevailed on the Bighorn River at Big Horn during all of June and July. The relatively low stages of the Bighorn River during this period contributed to the disturbance of stage-discharge relations. An auxiliary recording gage is planned for the next fiscal year. The discharge records at the designated points of measurement are given in Appendix B.

In studies conducted prior to the negotiation of the Yellowstone River Compact, the partially-estimated discharge for the water years 1931-40 was considered to represent the critical low-flow years. To visualize the relation of the discharge during that base period to that of the current water year and the intervening years, a graphical presentation is given in Appendix B. This has been done for the four designated points of measurement on a monthly and annual basis through bar graphs. The three items shown are: (1) discharge for 1959, (2) discharge for 1931-40, (3) discharge for 1945-58 or a lesser period if data is lacking. The effect of storage developed since the 1931-40 period is evident in the monthly distribution of the flow of the Bighorn and Tongue Rivers. The climatic features of 1959 that might be helpful in interpreting the graphs are a marked deficiency of winter snows in the Bighorn Mountains of Wyoming, a delayed melt of mountain snows and generally deficient summer precipitation.

Diversions:

The Commissioners for Montana and Wyoming are in agreement that the water uses allocable under the Compact did not reach the pro-rata share in either state in the water year as a whole. This opinion was based on information of new water-right filings or permits, the general knowledge of the significance of developments since January 1, 1950 and the records of stream flow.

The Montana representative promised to furnish a short list of new filings since his last report of November, 1958. The Wyoming representative stated a biennial compilation of permits issued since December 1957 would be furnished early in 1960. These filings and permits provide an approximate guide to the Commission which realizes that diversions thereunder are subject to limits of local supply and the ability to use.

Storage:

In reservoirs completed after January 1, 1950:

Boysen Reservoir on the Wind River is the principal reservoir in this category, records for which are tabulated in Appendix C. Other reservoirs completed since January 1, 1950 are relatively small. Details of their operations have not been collected.

In reservoirs existing on January 1, 1950;

Compact allocations are affected by storage in these reservoirs only in so far as it is utilized for new developments. The extent of that use is known to be relatively minor. As a matter of information, the quantities in storage on month-ends in the larger reservoirs in this category are tabulated in Appendix D.

RULES AND REGULATIONS FOR ADMINISTRATION OF
THE YELLOWSTONE RIVER COMPACT

A compact, known as the Yellowstone River Compact between the States of Wyoming, Montana and North Dakota, having become effective on October 30, 1951 upon approval of the Congress of the United States, which apportions the waters of certain interstate tributaries of the Yellowstone River which are available after the appropriative rights existing in the States of Wyoming and Montana on January 1, 1950 are supplied, and after appropriative rights to the use of necessary supplemental water are also supplied as specified in the Compact, the following rules and regulations are adopted subject to the provisions for amendment, revision or abrogation as provided herein.

Article I. Collection of Water Records.

- A. It shall be the joint and equal responsibility of the members of the states of Wyoming and Montana to collect, cause to be collected or otherwise furnish records of tributary stream flow at the points of measurement specified in Article V (B) of the Compact, or as near thereto as is physically or economically feasible or justified.

1. Clarks Fork

The gaging station known as Clarks Fork at Edgar, Montana and which is located in SW $\frac{1}{4}$ sec. 24, T. 4 S., R. 24 E., shall temporarily be the point of measurement for the Clarks Fork, subject to whatever mutually agreeable corrections to the stream-flow records at this point as may be deemed practical to meet the terms of the Compact.

2. Bighorn River (exclusive of Little Bighorn River)

The gaging station known as the Bighorn River near Custer, Montana and located near the center of sec. 10, T. 4 N., R. 34 E., shall temporarily be the designated point of measurement on that stream. The flow of the Little Bighorn River as measured at the gaging station near Hardin, Montana and located in S $\frac{1}{2}$, SE $\frac{1}{4}$ sec. 18, T. 1 S., R. 34 E., shall be considered the point of measurement for that stream, except that if or when satisfactory records are not available, the records for the nearest upstream station with practical corrections for intervening inflow or diversion shall be used.

3. Tongue River

The gaging station known as the Tongue River at Miles City, Montana and located in SE $\frac{1}{4}$ sec. 23, T. 7 N., R. 47 E., shall temporarily be the point of measurement for that stream.

4. Powder River

The gaging station known as the Powder River near Locate, Montana and located in NE $\frac{1}{4}$ sec. 26, T. 8 N., R. 51 E., shall temporarily be the designated point of measurement for that stream.

- B. Records of total annual diversion in acre-feet above the points of measurement designated in the Compact for irrigation, municipal and industrial uses developed after January 1, 1950 shall be furnished by the members of the Commission for their respective states, at such time as the Commission deems necessary for interstate administration as provided by the terms of the Compact. Providing that if it be acceptable to the Commission, reasonable estimates thereof may be substituted.
- C. Annual records of the net change in storage in all reservoirs, not excluded under Article V (E) of the Compact, above the specified point of measurement specified in the Compact and completed after January 1, 1950, and the annual net change in reservoirs existing prior to January 1, 1950, which is used for irrigation, municipal and industrial purposes developed after January 1, 1950, shall be the primary responsibility of the member of the Commission in whose state such works are located; providing, such data is not furnished by federal agencies under the provisions of Article III (D) of the Compact, or, collected by the Commission.

Article II. Office and Officers.

- A. The office of the Commission shall be located, and be that of the United States Geological Survey in Helena, Montana.
- B. The Chairman of the Commission shall be the federal representative as provided in the Compact.
- C. The Secretary of the Commission shall be as provided for in Article III of these rules.
- D. The credentials of each member of the Commission shall be placed on file in the office of the Commission.

Article III. Secretary

- A. The Commission, subject to the approval of the Director of the United States Geological Survey, shall enter into cooperative agreements with the U. S. Geological Survey for such engineering and clerical services as may reasonably be necessary for the administration of the Compact. Said agreements shall provide that the Geological Survey shall:
1. Maintain and operate gaging stations at or near the points of measurement specified in Article V (A) of the Compact.
 2. Assemble factual information on stream flow, diversion and reservoir storage for the preparation of an annual report to the Governors of the signatory states.
 3. Make such investigations and reports as may be requested by the Commission in aid of its administration of the Compact.
 4. Act as Secretary to the Commission.

Article IV. Budget

- A. At the annual meeting of each even numbered year or prior thereto, the Commission shall adopt a budget for operation during the ensuing biennium beginning July first. Such budget shall set forth the total cost of construction, maintenance and operation of gaging stations, the cost of engineering and clerical aid, and other necessary expenses excepting the salaries and personal expenses of the Commissioners. On odd-numbered years revisions of the budget shall be considered.
- B. It shall be the obligation of the Commissioners of the States of Montana and Wyoming to endeavor to secure from the Legislature of their respective states sufficient funds with which to meet the obligations of this Compact, except insofar as provided by the federal government.

Article V. Meetings

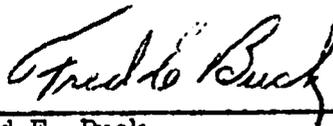
An annual meeting of the Commission shall be held on the third Tuesday of each November at some mutually agreeable point in the Yellowstone River Basin for consideration of the annual report for the water year ending the preceding September 30th, and for

the transaction of such other business consistent with its authority; provided that by unanimous consent of the Commission the date and place of the annual meeting may be changed. Other meetings as may be deemed necessary shall be held at a time and place set by mutual agreement, for the transaction of any business consistent with its authority.

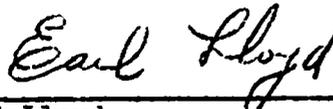
No action of the Commission shall be effective until approval by the Commissioners for the States of Wyoming and Montana.

Article VI. Amendments, Revisions and Abrogations.

The Rules and Regulations of the Commission may be amended or revised by a unanimous vote at any meeting of the Commission.



Fred E. Buck
Commissioner for Montana



Earl Lloyd
Commissioner for Wyoming

Attested:



Frank Stermitz
Federal Representative

Adopted November 17, 1953
Amended November 16, 1959

MONTHLY SUMMARY OF DISCHARGE

Clarks Fork Yellowstone River at Edgar, Montana

Location.--Lat 45°28', long 108°50', in SW $\frac{1}{4}$ sec. 24, T. 4 S., R. 23 E., on right bank just downstream from highway bridge, half a mile east of Edgar and 6 miles upstream from Rock Creek.

Drainage area.--2,070 sq mi, approximately.

Records available.--July 1921 to September 1959.

Gage.--Water-stage recorder. Altitude of gage is 3,440 ft (by barometer). Prior to Sept. 18, 1940, chain gage and Sept. 18, 1940, to Aug. 31, 1953, wire-weight gage, at same site and datum.

Average discharge.--26 years (1930-31, 1934-59), 1,039 cfs (752,000 acre-ft per year).

Extremes.--Maximum discharge during year, 9,450 cfs June 16 (gage height, 8.16 ft); minimum 178 cfs Dec. 8, result of freezeup.

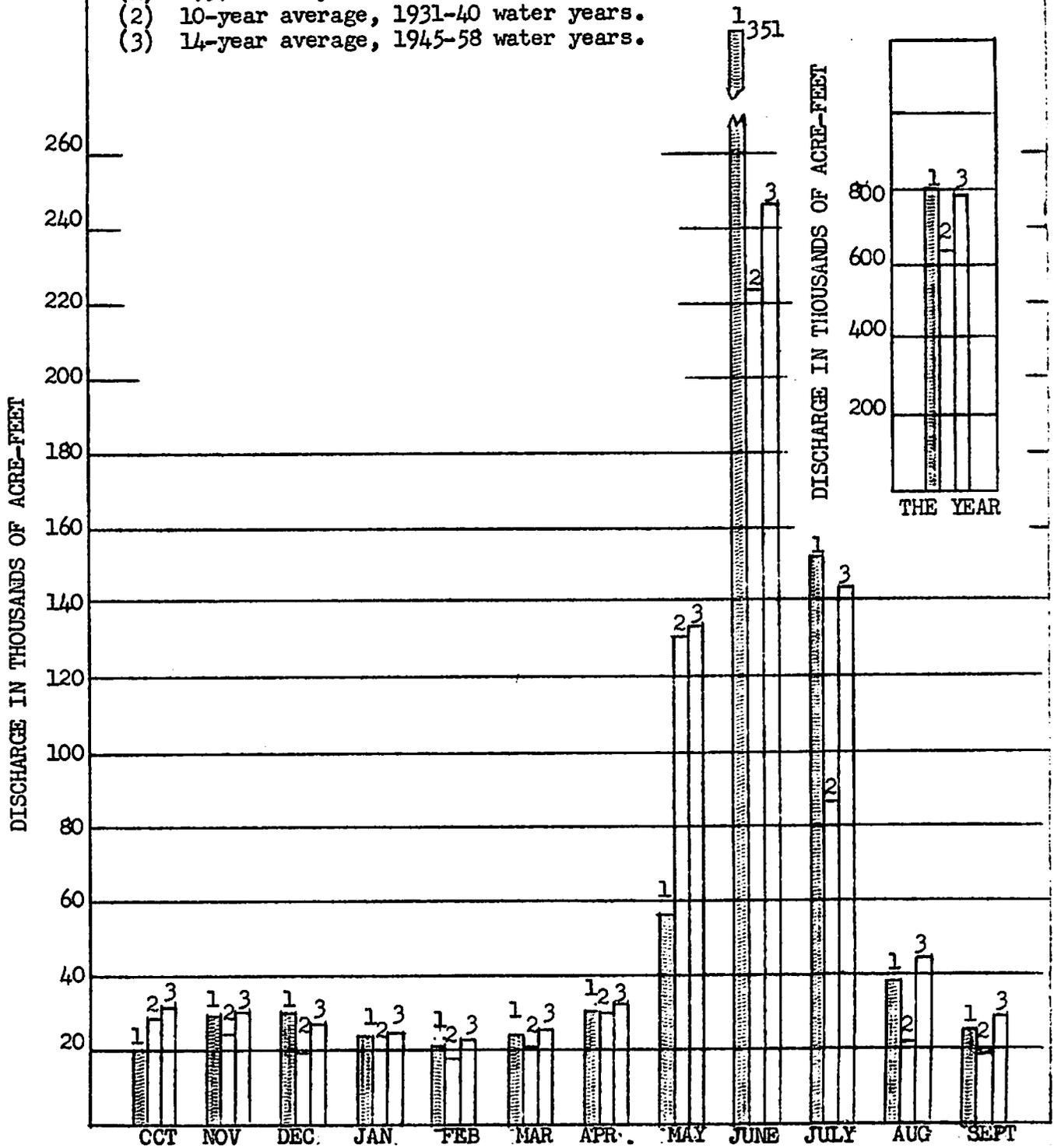
1921-59: Maximum discharge observed, 10,900 cfs June 2, 1936 (gage height, 8.62 ft); minimum observed, 41 cfs July 25, 1931.

Remarks.--Records good except those for periods of ice effect, which are poor. Upstream diversions for irrigation of about 41,500 acres, of which 840 acres lie below the station. In addition, about 6,300 acres of land lying above station are irrigated by diversions from the adjoining Rock Creek basin. The following discharge measurements were made of the Whitehorse Canal near point of diversion about 3 miles downstream in SW $\frac{1}{4}$ sec. 1, T. 4 S., R. 23 E: Oct. 2, 1958, 16.7 cfs; May 22, 1959, 19.9 cfs; June 11, 44.5 cfs; July 16, 42.6 cfs; Aug. 12, 22 cfs; Sept. 9, 20 cfs; Oct. 2, 1959, 6 cfs. On basis of discharge measurements and an irrigator's statement of canal operation, the seasonal diversion is estimated at about 8,000 acre-feet.

<u>Month</u>	Second-			<u>Mean</u>	<u>Runoff in Acre-feet</u>
	<u>foot days</u>	<u>Maximum</u>	<u>Minimum</u>		
October 1958	10,307	405	285	332	20,440
November	14,718	653	348	491	29,190
December	14,998	659	220	484	29,750
January 1959	11,960	470	300	386	23,720
February	10,705	410	360	382	21,230
March	12,243	450	352	395	24,280
April	15,356	684	344	512	30,460
May	28,391	1,300	615	916	56,310
June	178,888	9,230	712	5,963	350,800
July	76,300	3,980	1,050	2,461	151,300
August	19,229	1,040	364	620	38,140
September 1959	12,612	570	302	420	25,020
Water year 1958-59	405,707	9,230	220	1,112	800,600

CLARKS FORK YELLOWSTONE RIVER
AT EDGAR, MONT.

- (1) 1959 water year.
- (2) 10-year average, 1931-40 water years.
- (3) 14-year average, 1945-58 water years.



Comparison of discharge during 1959 water year with average discharge for water years 1931-40 and 1945-58.

MONTHLY SUMMARY OF DISCHARGE

Little Bighorn River near Crow Agency, Montana

Location.--Lat 45°34', long 107°27', in E $\frac{1}{2}$ SE $\frac{1}{2}$ sec. 13 T. 3 S., R. 34 E., on right bank at Chicago, Burlington & Quincy Railroad bridge, 2 miles south of Crow Agency and 17 miles upstream from mouth.

Drainage area.--1,190 sq mi, approximately.

Records available.--April 1912 to September 1924, August 1928 to December 1932, April 1938 to September 1959 (few winter records in earlier years). March 1905 to June 1906 at site at Crow Agency, 2 miles downstream, records not equivalent because Crow Agency ditch diverts water between the two sites. October 1914 to September 1940, published as Little Horn River near Crow Agency.

Gage.--Water-stage recorder. Datum of gage is 3,045 ft above mean sea level, datum of 1929. April 11, 1912 to Sept. 30, 1918, staff or chain gage; Oct. 1 1918, to Sept. 30, 1924, Aug. 26, 1928, to Sept. 30, 1930, water-stage recorder; Oct. 1, 1930, to Dec. 5, 1932, Apr. 1, 1938 to May 6, 1947, wire-weight or chain gage; all at same site and datum.

Average discharge.--23 years (1928-29, 1931-32, 1938-59), 256 cfs (185,300 acre-feet per year).

Extremes.--Maximum daily discharge during year, 1300 cfs Mar. 18; maximum gage height, 8.17 ft Mar. 2 (backwater from ice); minimum discharge, 45 cfs Sept. 14 (gage height, 4.00 ft).

1912-24, 1928-32, 1938-59: Maximum discharge observed, 6,200 cfs July 23, 1923 (gage height, 14.0 ft); no flow July 28 to Aug. 6, 1921.

Remarks.--Records good except those for periods of ice effect or no gage-height record, which are poor. Diversions for irrigation of about 13,700 acres above station.

Month	Second-foot days	Maximum	Minimum	Mean	Runoff in Acre-feet
October 1958	3,283	182	66	106	6,510
November	3,996	158	90	133	7,930
December	3,955	155	100	129	7,840
January 1959	3,530	140	90	114	7,000
February	2,710	140	80	96.8	5,380
March	12,825	1,300	150	414	25,440
April	6,535	350	153	218	12,960
May	9,104	381	226	294	13,060
June	22,846	1,170	339	762	45,310
July	6,369	420	108	205	12,630
August	4,022	148	105	130	7,980
September 1959	3,938	183	97	131	7,810
Water year 1958-59	83,113	1,300	66	228	164,800

MONTHLY SUMMARY OF DISCHARGE

Agency Canal at Crow Agency, Montana

Location.--Lat 45°35'55", long 107°27'15", near center of sec. 1, T. 3 S., R. 34 E., on downstream right abutment of bridge at intersection of U. S. Highway No. 87 and the main street of Crow Agency, a third of a mile downstream from headgate.

Records available.--Fragmentary records for 1953-59.

Gage.--Staff gage read twice daily during canal operation. Some recorder record during 1953.

Extremes.--Maximum daily discharge during year, 103 cfs June 18; no flow Oct. 18 to May 3.

Remarks.--Canal operated Oct. 1-17 and May 4 to Sept. 30 for irrigation of about 3,500 acres of land. Records fair because of backwater from operation of check gates downstream from gage.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-feet</u>
October 1958	118.5	51	0	3.82	235
May 1959	628	51	0	20.3	1,250
June	2,305	103	50	76.8	4,570
July	2,120	74	54	68.4	4,200
August	2,281	75	68	73.6	4,520
September 1959	<u>1,761</u>	<u>74</u>	<u>42</u>	<u>58.7</u>	<u>3,490</u>
Water year 1958-59	9,213.5	103	0		18,260

MONTHLY SUMMARY OF DISCHARGE

Little Bighorn River near Hardin, Montana

Location.--Lat $45^{\circ}44'$, long $107^{\circ}34'$, on line between SE $\frac{1}{4}$ sec. 18 and NE $\frac{1}{4}$ sec. 19, T. 1 S., R. 34 E., on right bank 425 ft upstream from county road bridge, about a quarter of a mile upstream from mouth, and 2.4 miles east of Hardin.

Drainage area.--1,290 sq mi, approximately.

Records available.--June 1953 to September 1959.

Gage.--Water-stage recorder. Altitude of gage is 2,880 ft (by barometer).
Prior to Oct. 7, 1953, wire-weight gage on bridge 425 ft downstream at different datum.

Average discharge.--6 years, 207 cfs (149,900 acre-ft per year).

Extremes.--Maximum discharge during year, 1,950 cfs Mar. 18 (gage height 7.60 ft; maximum gage height, 9.80 ft Mar. 14 (backwater from ice); minimum discharge, 50 cfs July 24 (gage height 3.08 ft).

1953-59: Maximum discharge, 2,990 cfs June 19, 1957, (gage height, 8.00ft) maximum gage height, 11.16 ft Mar. 20, 1956 (backwater from ice); minimum discharge, 4.2 cfs Aug. 10, 1956.

Remarks.--Records good except those for periods of ice effect, which are poor. Diversions for irrigation of about 17,000 acres above station.

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-feet</u>
October 1958	3,514	196	64	113	6,970
November	4,061	155	85	135	8,050
December	4,020	150	85	130	7,970
January 1959	3,655	145	95	118	7,250
February	2,755	130	85	98.4	5,460
March	15,593	1,690	160	503	30,930
April	6,729	347	158	224	13,350
May	8,865	367	225	286	17,580
June	21,345	1,030	332	712	42,340
July	5,606	485	60	181	11,120
August	3,399	131	32	110	6,740
September 1959	<u>3,518</u>	<u>172</u>	<u>77</u>	<u>117</u>	<u>6,980</u>
Water year 1958-59	83,060	1,690	60	228	164,700

MONTHLY SUMMARY OF DISCHARGE

Bighorn River at Bighorn, Montana

Location.--Lat $46^{\circ}08'50''$, Long $107^{\circ}27'20''$, in NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 33, T. 5 N., R. 34 E., on right bank just downstream from bridge on U. S. Highway 10, three-quarters of a mile upstream from mouth, 1 mile southwest of Bighorn, and 4 miles east of Custer.

Drainage area.--23,100 sq mi, approximately.

Records available.--May 1945 to September 1959. Published as "near Custer" 1945-55.

Gage.--Water-stage recorder. Altitude of gage is 2,690 ft (by barometer). Prior to Oct. 7, 1955, water-stage recorder at site 4 miles upstream at different datum (May 11 to Dec. 6, 1945, wire-weight gage at same datum).

Average discharge.--14 years, 3,792 cfs (2,745,000 acre-ft per year).

Extremes.--Maximum discharge observed during year, 11,100 cfs July 2; maximum gage height, 7.31 ft Dec. 13 (backwater from ice); minimum daily discharge, 858 cfs July 16; minimum gage height, 1.34 ft July 31.

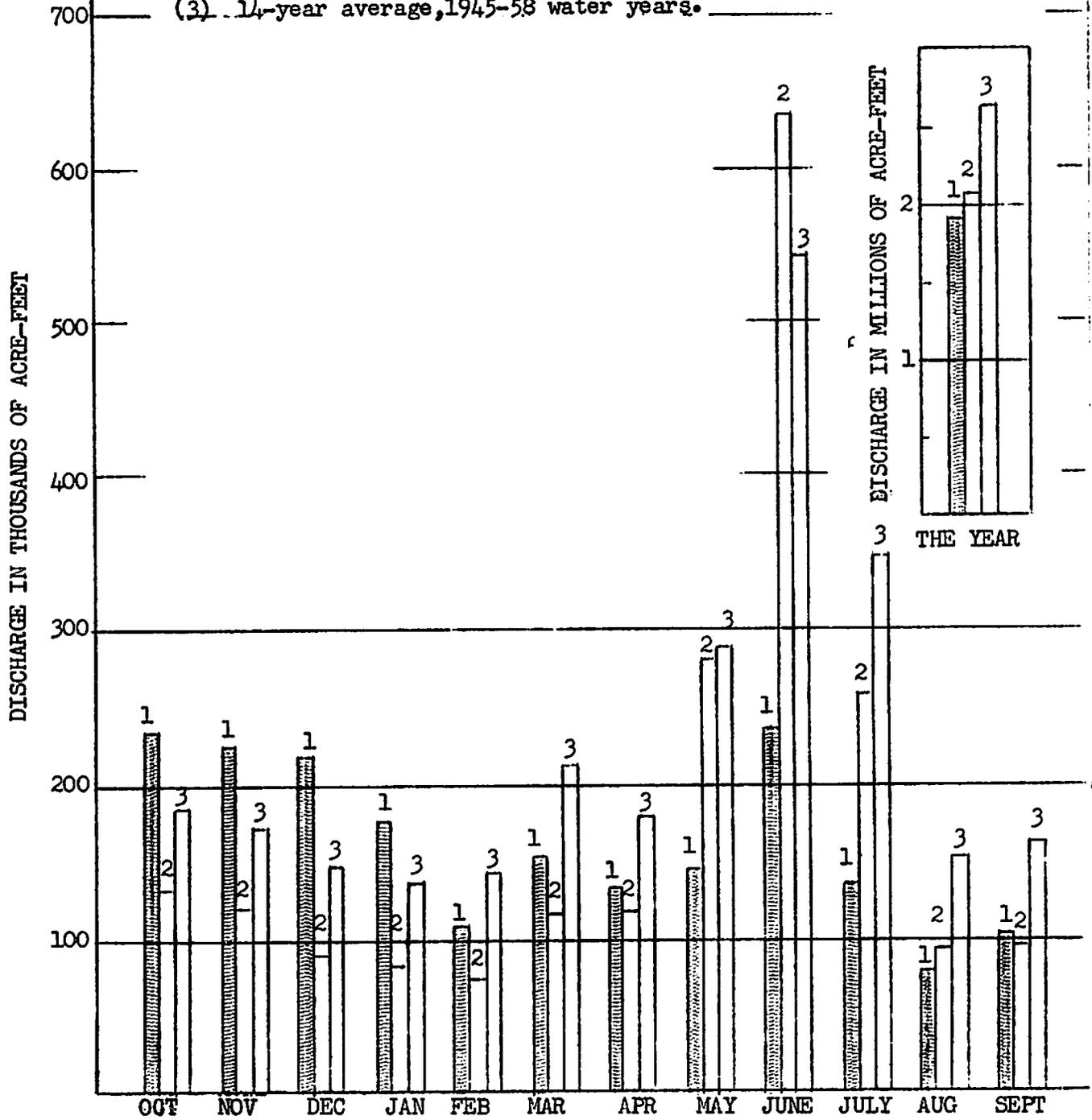
1945-59: Maximum discharge, 26,200 cfs June 24, 1947 (gage height 8.79 ft site and datum then in use), from rating curve extended above 12,500 cfs by logarithmic plotting; maximum gage height recorded, 10.65 ft, Mar. 20, 1947 (ice jam), site and datum then in use; minimum discharge, 756 cfs Dec. 13, 1949.

Remarks.--Records good except those for periods of ice effect, which are poor. Diversions for irrigation of about 465,000 acres above station. Major regulation by 14 reservoirs in Wyoming and 1 in Montana with combined usable capacity of about 1,400,000 acre ft (see Appendices C and D).

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-feet</u>
October 1958	121,110	4,850	3,140	3,907	240,200
November	117,210	4,230	3,620	3,907	232,500
December	114,320	4,000	3,300	3,688	226,800
January 1959	91,850	3,800	1,650	2,963	182,200
February	56,900	2,900	1,450	2,032	112,900
March	89,460	3,800	2,090	2,886	177,400
April	72,920	3,470	1,740	2,431	144,600
May	81,620	3,660	1,860	2,633	161,900
June	140,590	6,540	2,270	4,686	278,900
July	73,242	9,940	858	2,363	145,300
August	42,940	1,780	1,020	1,385	85,170
September 1959	<u>55,500</u>	<u>2,840</u>	<u>1,210</u>	<u>1,850</u>	<u>110,100</u>
Water year 1958-59	1,057,622	9,940	858	2,898	2,098,000

BIGHORN RIVER AT BIG HORN, MONT.
 MINUS
 LITTLE BIGHORN RIVER NEAR CROW AGENCY, MONT.

- (1) 1959 water year.
- (2) 10-year average, 1931-40 water years.
- (3) 14-year average, 1945-58 water years.



Comparison of discharge during 1959 water year with average discharge for water years 1931-40 and 1945-58.

MONTHLY SUMMARY OF DISCHARGE

Tongue River at Miles City, Montana

Location.--Lat. 46°21', long 105°48', in SE $\frac{1}{4}$ sec. 23, T. 7 N., R. 47 E.; on right bank, 4 miles south of Miles City and 8 miles upstream from mouth.

Drainage area.--5,380 sq mi, approximately.

Records available.--April 1938 to April 1942, April 1946 to September 1959. Published as "near Miles City" April 1938 to April 1942. Not equivalent to records published as "near Miles City" May 1929 to September 1932.

Gage.--Water-stage recorder. Altitude of gage is 2,370 ft (by barometer). April 1938 to April 1942, wire-weight gage at site 8 miles upstream at different datum.

Average discharge.--15 years (1938-39, 1940-41, 1946-59), 381 cfs (275,800 acre-ft per year).

Extremes.--Maximum discharge during year, 5,400 cfs Mar. 13 (gage height, 6.53 ft); maximum gage height, 7.30 ft Mar. 10 (ice jam); minimum discharge, 51 cfs July 20.

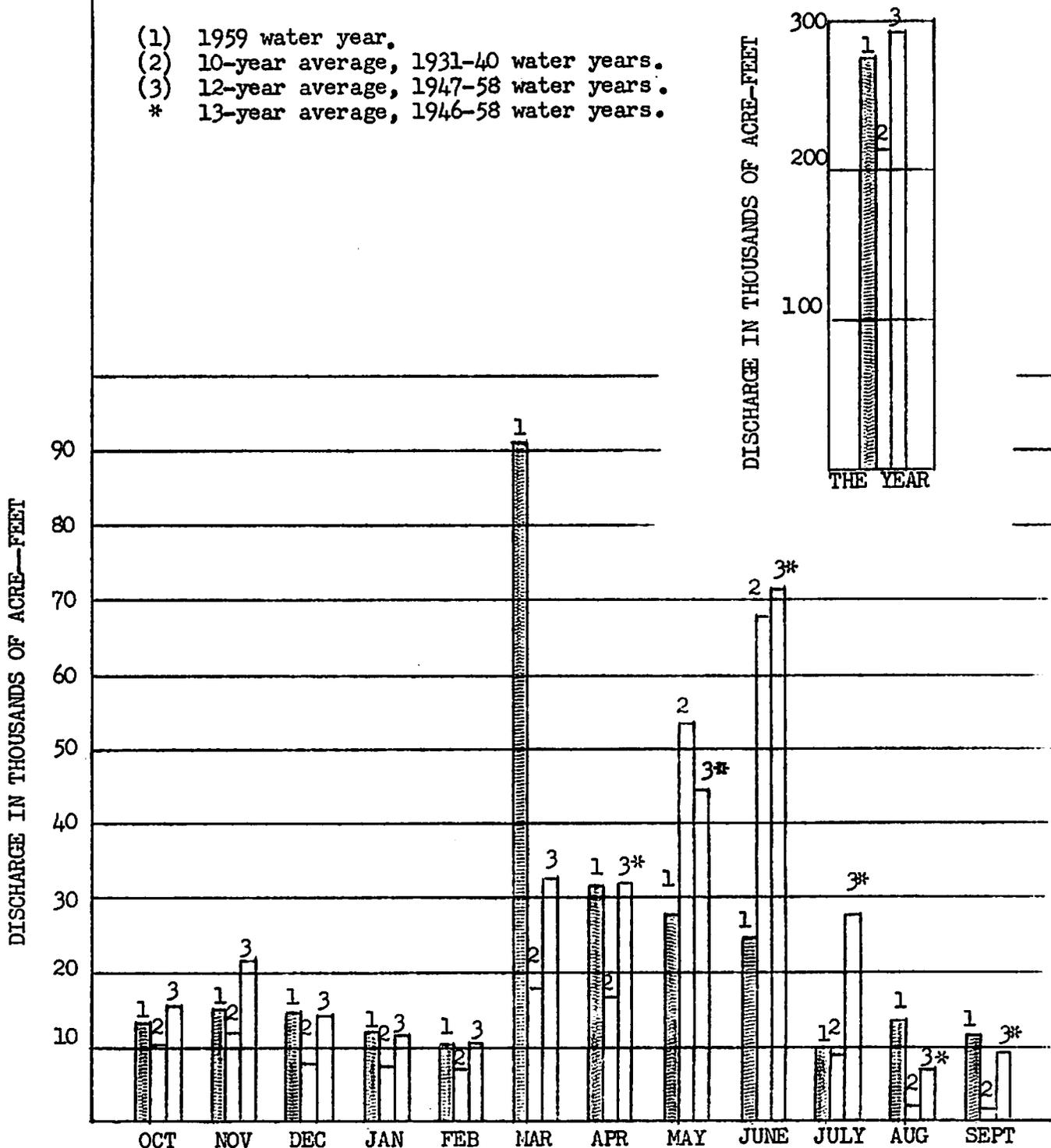
1938-42, 1946-59: Maximum discharge, 12,000 cfs Mar. 6, 1949 (gage height 10.6 ft), float measurement; maximum gage height, 11.80 ft Mar. 6, 1949 (ice jam); no flow July 9-19, Aug. 13, 14, Sept. 28, 1940.

Remarks.--Records good except those for periods of ice effect, which are poor. Diversions for irrigation of about 90,000 acres above station. Flow regulated by Tongue River Reservoir (Appendix C) and many small reservoirs (combined capacity, about 15,000 acre-ft).

<u>Month</u>	<u>Second-foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-feet</u>
October 1958	6,687	1,280	58	216	13,260
November	7,684	403	181	256	15,240
December	7,518	486	190	243	14,910
January 1959	6,115	220	170	197	12,130
February	5,355	240	165	191	10,620
March	45,973	4,250	250	1,483	91,190
April	16,091	624	344	536	31,920
May	13,943	579	260	450	27,660
June	12,563	702	162	419	24,920
July	4,925	225	55	159	9,770
August	6,838	247	133	221	13,560
September 1959	<u>5,797</u>	<u>238</u>	<u>135</u>	<u>193</u>	<u>11,500</u>
Water year 1958-59	139,489	4,250	55	382	276,700

TONGUE RIVER AT MILES CITY, MONT.

- (1) 1959 water year.
- (2) 10-year average, 1931-40 water years.
- (3) 12-year average, 1947-58 water years.
- * 13-year average, 1946-58 water years.



Comparison of discharge during 1959 water year with average discharge for water years 1931-40 and 1947-58.

MONTHLY SUMMARY OF DISCHARGE

Powder River near Locate, Montana

Location.--Lat $46^{\circ}26'$, long $105^{\circ}18'$, in NE $\frac{1}{4}$ sec. 26, T. 8 N., R. 51 E., on right bank 50 ft downstream from bridge on U. S. Highway 12 at present site of Locate (5 miles west of former site of Locate), 3 miles upstream from Locate Creek, and 25 miles east of Miles City.

Drainage area.--13,200 sq mi, approximately.

Records available.--March 1938 to September 1959.

Gage.--Water-stage recorder and wire-weight gage. Prior to July 11, 1947, wire-weight gage at bridge 50 ft upstream at same datum.

Average discharge.--21 years, 606 cfs (438,700 acre-ft per year).

Extremes.--Maximum discharge during year, 15,600 cfs Mar. 22 (gage height, 7.95 ft); maximum gage height, 8.31 ft Mar. 18 (backwater from ice); minimum discharge observed, 0.7 cfs Aug. 22,

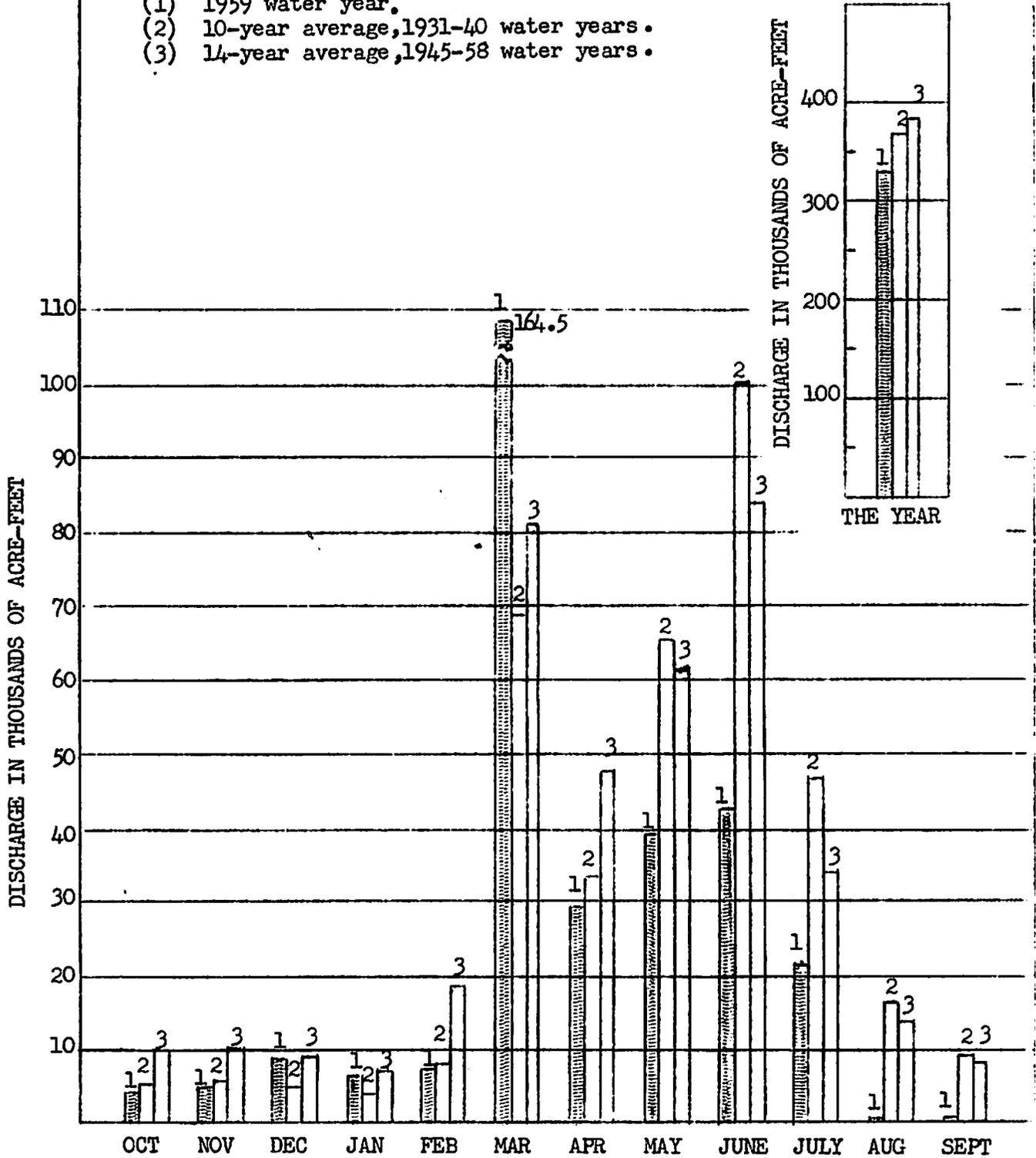
1938-59: Maximum discharge observed, 31,000 cfs Feb. 19, 1943 (gage height, 11.23 ft), from rating curve extended above 17,000 cfs; no flow Jan. 16 to Feb. 12, Feb. 22-24, 1950.

Remarks.--Records good except those for periods of ice effect, which are poor. Diversions for irrigation of about 52,000 acres above station. Some regulation by tributary reservoirs with combined usable capacity of 36,800 acre-ft.

<u>Month</u>	<u>Second foot days</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Runoff in Acre-ft</u>
October 1958	2,033.5	475	3.2	65.6	4,030
November	2,514	130	30	83.8	4,990
December	4,507	169	82	145	8,940
January 1959	3,235	145	70	104	6,420
February	3,665	155	110	131	7,270
March	82,945	12,200	130	2,676	164,500
April	14,849	950	358	495	29,450
May	19,775	960	391	638	39,220
June	21,380	2,100	326	713	42,410
July	11,005	1,630	28	355	21,830
August	252.3	44	0.7	8.14	500
September 1959	<u>339.5</u>	<u>68</u>	<u>1.3</u>	<u>11.3</u>	<u>673</u>
Water year 1958-59	166,500.3	12,200	0.7	456	330,200

POWDER RIVER NEAR LOCATE, MONT.

- (1) 1959 water year.
- (2) 10-year average, 1931-40 water years.
- (3) 14-year average, 1945-58 water years.



Comparison of discharge for 1959 water year with average discharge for water years 1931-40 and 1945-58.

RESERVOIRS COMPLETED AFTER JANUARY 1, 1950

BOYSEN RESERVOIR

Water-stage recorder at dam on Wind River, about 21 miles south of Thermopolis, Wyoming. Reservoir formed by earth-fill dam, construction of which began in 1947. Storage began October 11, 1951. Dead storage, 62,000 acre-feet at elevation 4657.0. Usable contents, 758,000 acre-feet at elevation 4725.0 (top of gates). Crest of dam at elevation 4758.

Records given herein represent usable contents. Water is used for irrigation and power development. Allocation for flood control provided. Data furnished by U. S. Bureau of Reclamation.

Extremes.--Maximum usable contents during year, 603,500 acre-feet Oct. 1; minimum, 273,800 acre-feet Feb. 7, 8.

1953-59: Maximum usable contents, 857,400 acre-feet, July 5, 1957; minimum, 189,800 acre-feet March 18, 19, 1956.

<u>Month</u>	<u>Water-Surface elevation in feet</u>	<u>*Contents in Acre-feet</u>	<u>Change in contents during month in acre-feet</u>
September 30, 1958	4,716.72	606,200	
October 31	4,711.31	518,200	- 88,000
November 30	4,705.82	436,300	- 81,900
December 31	4,699.64	353,800	- 82,500
January 31, 1959	4,692.86	276,300	- 77,500
February 28	4,692.85	276,200	- 100
March 31	4,694.87	298,100	+ 21,900
April 30	4,693.40	282,100	- 16,000
May 31	4,693.38	281,900	- 200
June 30	4,706.06	439,800	+ 157,900
July 31	4,705.53	432,200	- 7,600
August 31	4,703.94	409,800	- 22,400
September 30, 1959	4,702.08	384,800	- 25,000
Water year 1958-59			- 221,400

* Does not include dead storage of 62,000 acre-feet

RESERVOIRS IN EXISTENCE ON JANUARY 1, 1950

The extent, if any, of the use of reservoirs in this category which may be subject to Compact allocations was not determined. As a matter of hydrologic interest, the month-end contents in acre-feet of four reservoirs are given. The first three reservoirs are in the Bighorn River Basin in Wyoming and data on contents were furnished by the U. S. Bureau of Reclamation. Tongue River Reservoir in Montana is operated under the supervision of the Montana State Water Conservation Board which agency furnished operating data.

Contents in Acre-feet

	<u>Bull Lake</u>	<u>Pilot Butte Reservoir</u>	<u>Buffalo Bill Reservoir</u>	<u>a/Tongue River b/ Reservoir</u>
September 30, 1958	80,500	4,400	93,000	24,700
October 31	73,200	5,600	36,200	16,700
November 30	70,700	6,200	35,400	15,700
December 31, 1958	65,700	6,000	34,700	15,600
January 31, 1959	56,300	6,200	44,200	15,400
February 28	49,000	9,700	57,700	18,900
March 31	45,500	12,100	73,100	31,500
April 30	40,000	17,900	104,200	24,500
May 31	38,100	24,600	104,900	30,600
June 30	103,700	20,000	405,400	62,700
July 31	110,000	11,540	439,900	56,600
August 31	77,800	5,200	354,000	30,000
September 30, 1959	57,300	3,400	303,900	15,000

a/ Contents based upon sedimentation surveys of October, 1948

b/ Contents generally interpolated from readings made six or less days prior to month end.