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AVERAGE ANNUAL RUNOFF IN THE WIND RIVER BASIN IN WYOMING

By

Roy E. Oltman and Hubert J. Tracy

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ABSTRACT

Average annual runoff from the mountain ranges bordering the Wind River Basin is large in amount and comparatively stable; average annual runoff from the arid plains region of the basin is very low and there are no perennial streams having their source in this region. A map of the basin was prepared that shows the distribution of average annual runoff in inches by means of isograms. The construction of the map was based on available streamflow records, climatologic records, and a developed precipitation-altitude relationship for the Wind River Mountains. Location of the isograms in the arid portion of the basin was based mainly on personal observation made on a field reconnaissance of the basin.

INTRODUCTION

The construction of a map showing average annual runoff in the Wind River Basin is made difficult by the lack of sufficient base data and the wide range of runoff within the basin. More than half of the basin has an average annual precipitation of less than 10 inches, and the resulting runoff is very low. In contrast, the area along the Wind River and Owl Creek Mountains receives heavy precipitation, the amount varying with altitude. Climatic data, with the exception of a few snow surveys along the flanks of the Wind River Range, are limited to records taken at a few points of low altitude in the valley. Stream-gaging station records of prime usefulness in delineating a runoff map in the basin are limited to points along the foot of the Wind River Range with the exception of a few recently established stations in the arid part of the basin. A runoff map of the Wind River Basin was constructed by making use of the limited stream-flow and climatic data with due regard to hydrologic principles. The estimates of runoff from ungaged arid areas were based partly on data noted on a field reconnaissance.

ACKNOWLEDGMENTS

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Indebtedness to the following persons or offices for the services listed is gratefully acknowledged:

District Office, Surface Water Branch, Denver, Colo., furnished gaging station records in advance of publication.

Mr. Henry W. Davis, Hydrographer, Bureau of Indian Affairs, furnished many unpublished gaging station records and gave valuable advice on the magnitude of irrigation diversions.

Mr. K. R. Melin, Technical Coordination Branch, Geological Survey, guided the authors on a 1-week trip through the basin and furnished helpful advice in estimating the runoff from arid parts of the basin.

Riverton Project Office, Bureau of Reclamation, furnished figures on annual diversions from the Wind River into the Wyoming Canal from 1926-48.

U. S. Weather Bureau Offices at Cheyenne, Wyo. and Kansas City, Mo., furnished computed normal water-content figures for the snow stakes operated by the Weather Bureau and the precipitation records for Oregon Trail Crossing and T-Cross Ranch stations.

BASE RUNOFF DATA

Many of the streams in the Wind River Basin have been gaged for a period of several years by the U. S. Geological Survey and the Bureau of Indian Affairs. The distribution of gaging stations is such (and this has been dictated by the need for information on irrigation supplies) that a fairly accurate knowledge of the annual runoff from streams draining the Wind River Mountain Range bordering the basin can be determined, but the runoff from the arid plains area of the basin must be estimated on the basis of past experience and climatic data. The locations of gaging stations used in this study are shown on plate 1, general map of the basin upon which the runoff isograms are plotted. Table 1 contains a list of annual runoff depths in inches for different streams of the basin that have been gaged at some time during the period 1918-48. The runoff in inches has been computed from the latest published drainage area figures; these are listed in the box with each stream name in table 1. Those gaging station records that are essentially records of net flow after substantial irrigation diversions have been omitted from table 1. Many of the annual runoff values listed in table 1 are partially estimated to complete the water year for some records at gages not operated during the winter months or to correct for unknown storage changes in reservoirs above the gaging station. Such partially estimated values are footnoted.

Method of Determining Average Annual Runoff

All the streams issuing from the Wind River Range show a marked similarity in runoff characteristics. Figure 1, a plot of the annual runoff values for all the gaged streams along the Wind River Range from 1918 to 1948, shows the generally good relationship of annual runoff measured at one station to that measured at other stations.

Because of their sparseness, all existing records of runoff were utilized. "Averages" listed in table 1 are the arithmetical averages of the figures in the column above.

The available runoff records at many of the stations listed in table 1 are for a short period; because of year-to-year variations in the runoff from any drainage area, it was necessary to adjust the short-term records to a long-term base. The period of years from 1918 to 1948 was used as the base. The lower gaging station on Bull Lake Creek was selected as the index station for runoff from the Wind River Range; because of the complete record from 1918 to 1948, and because of the central location of its drainage area along the range. The ratio of the annual runoff to the average for this station for the period 1918-48 was computed for each year and listed in the second column of table 1 under "index percent". These percentages were used to adjust the runoff from the other gaged areas for each year of record to make them comparable. This was done by dividing the listed annual runoff by the listed percentage for each year of runoff record and then taking the average of these quotients; the "adjusted average" is listed beneath the "average" in table 1.

The adjusted average runoff thus determined was corrected for irrigation diversions (as explained in the next section of this report) where these were sizeable, and the corrected averages were used in the construction of the runoff map. The map is based, therefore, on virgin flow; large return flows from irrigation, as in Fivemile Creek, were not considered.

The records for the streams issuing from the Wind River Range were adjusted as described above; the records for the streams in the other portions of the Wind River Basin were adjusted as described under "Precipitation Data" later in this report.

Irrigation Diversions

Accurate information on the quantity of irrigation diversions from streams in the Wind River Basin is not available for each year of the period 1918-48. The total number of acres irrigated in each major sub-basin can be obtained from Bureau of the Census publications for the years ending 1919, 1929, and 1939, and were given considerable weight in estimating probable net diversions above each gage in arriving at the irrigation adjustment listed in table 1. For many streams the probable net diversion was very small and was listed as zero. However, a few hundred acres may have been irrigated above the gaging station on such streams, but the crop raised was generally hay, and much of the applied water became return flow above the gage. The irrigation adjustment on a few of the streams listed in table 1 was estimated by noting the probable capacity of the one by-pass irrigation ditch. In general, the irrigation adjustments listed in table 1 represent a small proportion of the total runoff of the stream; any inaccuracy in the estimated adjustment will not make the adjusted runoff unreliable.

Table 1.—Measured annual runoff in inches of gaged streams in Wind River Basin

Water year	Index percent *	Stream and drainage area																
		Wind River (233 sq.mi.)	Dinwoody Creek (114 sq.mi.)	Dry Creek (57 sq.mi.)	Meadow Creek (55 sq.mi.)	Willow Creek (50 sq.mi.)	Bull Lake Creek (178 sq.mi.)	Bull Lake Creek (222 sq.mi.)	Middle Popo Agie River (84 sq.mi.)	North Popo Agie River (99 sq.mi.)	North Popo Agie River (140 sq.mi.)	Little Popo Agie River (108 sq.mi.)	Little Popo Agie River (331 sq.mi.)	Little Wind River (118 sq.mi.)	North Fork Little Wind River (127 sq.mi.)	Beaver Creek (118 sq.mi.)	Badwater Creek (178 sq.mi.)	Badwater Creek (794 sq.mi.)
1918	119		e 22.6					21.3	e 15.8									
1919	72		17.6					12.9	9.5									
1920	118		18.8					21.0	19.8									
1921	135		21.6					24.0	e 27.0					20.0	18.0			
1922	136		21.4		e 2.9	e 6.0		24.2	e 22.0					18.9	14.5			
1923	131		22.7		e 3.7	e 7.8		23.4	e 23.0					18.9	17.3			
1924	121		21.1					21.6	e 25.0					20.7	21.9			
1925	118		21.2	14.2		e 4.9		21.0						16.5	14.4			
1926	96		18.9	11.2		e 4.0		17.1						15.2	12.8			
1927	126		19.2	12.7		e 5.5		22.4						16.7	15.4			
1928	121		19.7	12.8		e 6.9		21.5						16.2	16.0			
1929	80		16.3	8.4		e 4.3		14.3						11.6	9.4			
1930	112			11.2		e 6.2		20.0						14.0	12.6			
1931	68			10.0		e 6.3		12.2						8.4	8.4			
1932	103			11.0		e 5.4		18.4						13.6	12.1			
1933	104			11.0		e 5.1		18.6						14.0	11.0			
1934	61			5.0		e 1.9		10.9						7.3	6.3			
1935	93			9.8		e 4.3		16.6						16.1	14.4			
1936	94			9.4		e 3.2		16.8						14.8	10.6			
1937	103			e 8.5		e 5.3		e 18.4						e 15.2	12.0			
1938	76			e 10.1		e 3.8		e 13.5										
1939	64			e 7.2		e 2.8		11.4			5.4		2.1			e 1.1		
1940	52			e 4.3		e 1.1		9.2			2.9		1.0			0.8		
1941	85			e 10.2	e 3.4	e 6.0		15.1			8.5		3.4		e 11.6	1.9		
1942	91			e 10.4	e 2.7	e 5.5	21.0	16.2			9.8		3.0		e 12.5			
1943	127			e 12.0	e 3.7	e 7.4	27.9	22.7			15.0		4.4		e 18.5			
1944	102			e 13.1	e 4.0	e 8.0	23.7	18.2			13.0		4.5		e 17.6			
1945	94			e 11.6	e 3.2	e 5.6	22.8	16.7			12.0		4.5		e 14.2			
1946	75	9.1		e 8.5	e 2.2	e 3.4	18.1	13.3		14.0	8.3		2.9		e 12.5		0.5	
1947	130	11.6		e 16.0	e 3.5	e 7.4	28.0	23.2		22.0	14.9	14.3	6.1		e 18.8		0.7	
1948	94	10.4		e 13.2	e 3.3	e 4.8	20.6	16.8		12.9	7.2	8.1	3.1		e 11.9		0.4	0.4
Average		10.4	20.1	10.5	3.3	5.1	23.2	17.8	20.3	16.3	9.7	11.2	3.5	15.2	13.8	1.3	0.5	0.4
Adjusted average		10.7	18.0	11.1	3.1	5.2	23.0	17.8	16.8	16.4	10.2	9.8	3.7	14.3	13.2	1.8	0.5	0.5
Irrigation adjustment		0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	1.5	1.5	0.8	0.2	0.1	0.1
Adjusted for irrigation		10.8	18.0	11.1	3.1	5.2	23.0	17.8	16.8	16.4	11.7	9.8	4.9	15.8	14.0	2.0	0.6	0.6

e partially estimated

* ratio in percent of annual Bull Lake Creek runoff to average runoff 1918-48

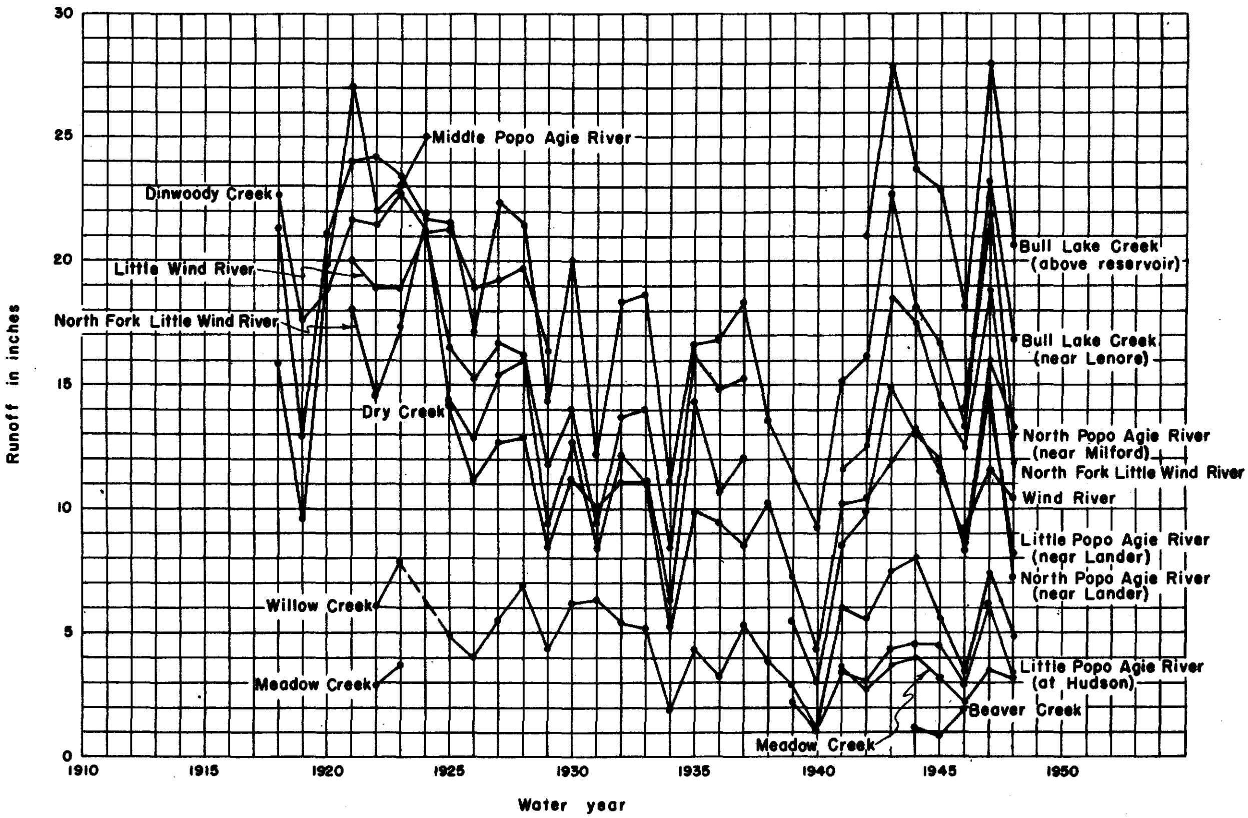

Figure 1.--Comparison of runoff measured at points along Wind River Range.

PRECIPITATION DATA

Table 2 contains a list of the water-year precipitation totals for stations in or near the basin, as determined from publications of the U. S. Weather Bureau.1/ The periods of record are scattered at some of the stations and no attempt has been made to complete missing years by estimate. Column two of table 2 lists the ratio, in percent, of the Lander annual water-year precipitation to the average annual for the period 1918-48. These ratios were used as a guide in estimating the average annual runoff for the two stations on Badwater Creek. The precipitation data listed in table 2 were helpful in estimating the average annual runoff from the arid plains in the basin.

Records of snow stake readings, taken by the Weather Bureau at points in the mountains of the Wind River Range for the period 1915-41, are published,2/ as are records of snow surveys taken on a cooperative basis by Federal and State agencies from 1936 to 1949.3/ The data from the snow stake and snow survey determinations are valuable as a guide in estimating the precipitation at high altitude along the Wind River Range. Table 3 contains a summary of the snow stake and snow survey data available in the basin.

Areal Variation of Precipitation

Four correlations were made to determine the degree of representation of precipitation data for one point in estimating the precipitation on the surrounding area. The base station used was Lander and correlations of annual precipitation were made with stations at Dubois, Middle Fork, Riverton, and Ervay with resulting coefficients of correlation of 0.34, 0.60, 0.81, and 0.70 respectively. These results may be interpreted to indicate that annual precipitation, measured at a point in the arid plains region of the basin, may be representative of a sizeable area adjacent to that point, but that there is relatively poor relationship between plains precipitation and foothill precipitation.

1 U. S. Department of Commerce, Weather Bureau, Climatological Data, Wyoming.

2 Idem.

3 U. S. Department of Agriculture, Soil Conservation Service and Colorado Agricultural Experiment Station, Federal-State Cooperative Snow Surveys and Irrigation Water Forecasts for Missouri-Arkansas Drainage Basin.

Table 2.—Annual precipitation records of stations in or adjacent to Wind River Basin

Water Year	Ratio of Lander precipitation to Lander average (percent)	Precipitation in inches									
		Diversion Dam	Dubois	Ervay	Fort Washakie	Lander	Pavillion	Riverton	Salt Creek	Thermopolis	Middle Fork
1918	93	-	10.24	15.20	-	13.05	-	-	-	-	18.68
1919	53	-	-	10.16	-	7.47	-	7.39	-	-	10.58
1920	127	-	-	18.85	-	17.88	-	-	-	-	-
1921	138	11.98	-	-	-	19.58	-	-	-	-	-
1922	83	6.70	-	15.17	-	11.61	-	-	-	-	-
1923	141	13.09	-	23.43	-	19.90	-	17.25	17.23	23.94	-
1924	118	9.93	7.22	14.71	-	16.72	9.69	9.83	9.89	13.88	19.12
1925	60	8.87	8.15	19.26	-	8.46	9.14	9.94	12.65	12.62	11.65
1926	92	5.75	8.24	19.03	-	12.90	8.21	10.65	14.95	17.84	20.53
1927	104	11.25	-	17.61	-	14.72	12.04	10.21	15.55	15.67	17.13
1928	72	8.29	7.88	13.35	-	10.12	5.70	7.39	13.42	11.39	15.19
1929	122	10.33	5.09	19.57	-	17.24	7.01	9.30	19.24	-	23.61
1930	124	12.73	9.70	22.82	17.10	17.58	13.12	10.30	14.92	-	20.89
1931	92	10.62	7.47	16.58	14.76	12.97	7.72	7.62	13.85	9.66	15.39
1932	62	6.88	9.20	12.41	10.24	8.78	5.23	6.20	14.43	10.76	13.21
1933	107	8.90	7.89	17.29	12.49	15.13	9.16	9.86	18.39	12.28	18.28
1934	77	6.31	8.46	10.85	9.77	10.89	6.35	6.59	10.46	7.25	12.72
1935	99	9.31	6.49	14.00	12.57	13.98	6.86	8.97	14.38	8.03	18.88
1936	83	8.45	7.87	15.01	11.55	11.74	6.42	7.24	7.63	6.37	18.90
1937	121	9.21	8.33	23.24	14.33	17.08	9.71	10.97	15.10	15.32	22.00
1938	84	8.73	9.65	16.11	9.85	11.80	8.68	9.38	11.67	12.80	17.44
1939	79	7.77	8.34	14.16	10.41	11.04	8.45	8.10	-	9.17	15.02
1940	75	9.70	8.56	16.20	9.97	10.51	7.82	7.82	-	10.93	15.68
1941	134	12.33	15.28	22.96	15.54	18.94	12.20	13.21	-	16.95	23.94
1942	102	8.30	9.68	17.43	12.14	14.41	8.73	9.99	-	-	16.53
1943	104	7.22	-	-	10.38	14.66	7.12	10.60	-	-	19.44
1944	138	14.75	-	-	17.32	19.57	15.04	12.07	-	-	22.42
1945	112	13.10	15.09	-	13.56	15.75	14.07	11.78	-	-	20.36
1946	82	8.87	8.89	-	10.47	11.50	9.57	9.09	-	10.78	17.21
1947	141	15.54	11.37	-	19.03	19.91	14.38	12.77	-	14.74	29.63
1948	83	10.75	8.82	-	10.38	11.76	8.58	7.48	-	16.91	16.60

Table 3.--Snow stake and snow survey data available for Wind River Basin

Stake number or survey name	Elevation (feet)	Period of record	Location: Section	Location: Township	Location: Range	Average seasonal water content at end of March (inches)
325	10,400		15	31N	102W	11.67
326	8,900		7	31N	101W	5.46
327	7,600		34	32N	101W	6.25
328	6,900		23	32N	101W	2.16
349	9,600		11	43N	107W	10.69
350	9,000		11	43N	107W	9.53
351	8,500		27	43N	107W	7.41
352	8,100		24	43N	107W	5.81
353	10,000		14	41N	108W	10.63
354	8,800		18	41N	107W	8.46
355	8,600		16	41N	107W	8.01
356	8,500		6	41N	107W	6.89
357	9,100		24	44N	110W	18.69
358	7,750		3	42N	109W	9.08
359	8,500		4	42N	109W	9.83
360	8,900		8	42N	109W	9.42
Brooks Lake	9,200	1936-47	23	44N	110W	19.7
Blue Ridge	9,500	1940-47	23	31N	101W	9.3
Du Noir	8,750	1941-47	27	42N	108W	9.5
Mosquito Park Ranger Sta.	9,500	1941-44,46,47	23	25N	3W	8.1
St. Lawrence Ranger Station	9,000	1941-44,47	26	1N	4W	7.4
Sawmill Glade	8,500	1940-47	3	31N	101W	5.4
Sheridan Creek Ranger Sta.	7,500	1936-47	3	42N	109W	6.0
South Pass	9,000	1940-47	13	30N	101W	11.8
T-Cross Ranch	8,000	1941-47	1	43N	107W	6.4

Variation of Precipitation with Altitude

The annual runoff from drainage basins on the slopes of the high mountains bordering the basin is largely dependent on the annual precipitation falling upon these basins. No records of annual precipitation for the regions of medium and high altitude within the basin are available; therefore, it was necessary to compute the probable precipitation at these altitudes from all available information. The following paragraphs of this section contain the computation procedure used in the determination of the amount of annual precipitation at altitudes along the Wind River Range.

Figure 2, a plot of the average annual precipitation for stations Lander, Riverton, and Middle Fork (for the period of continuous record, 1924-48) against altitude in feet above sea-level, shows the rapid increase of annual precipitation with increase in altitude. Three snow surveys just south of Middle Fork weather station have been used in estimating the precipitation at altitudes between 8,500 feet and 9,500 feet to extend the graph to the higher altitudes. They are: Sawmill Glade, Blue Ridge, and South Pass. The method of extension used is described in the following discussion.

Consideration of the monthly mean temperatures at Middle Fork indicated the months during which snow melt would not likely occur. The Middle Fork precipitation was totaled for the period from November 1 until the end of the spring month just before the month of rapid snow melt. This gave a figure of the accumulated precipitation at Middle Fork that could be compared with the results of the snow surveys. The assumption was made (based upon temperature studies and empirical evaporation formulas) that evaporation from the snow at the higher altitudes was negligible during the winter months. Data for the comparison are listed in table 4. The water content value from the snow survey in each year was divided by the Middle Fork corresponding accumulated precipitation to give a ratio, expressed as a percentage, for the increase of precipitation with altitude for the winter months. The assumption was made that this ratio computed for an approximate period of a half-year holds true for an entire year, on an average. The ratios were averaged for the period 1941-48, and the result was used to compute an average annual precipitation for the altitude of the snow survey based on the average annual Middle Fork precipitation for the period 1924-48. These values are plotted on figure 2. The relationship, determined for the section across the Wind River Range and passing through Riverton and Lander, results in an annual precipitation of about 50 inches at an altitude of 12,000 feet. The slope of the line of relationship gives an increase of precipitation of 6 inches per 1,000 feet increase in altitude. The relationship of precipitation and altitude determined for the section Riverton-Lander-Middle Fork and up to the crest of the divide is applicable only for that immediate vicinity.

An investigation of other areas of mountainous terrain was made to determine if there were some groupings of Weather Bureau stations that would give a series of observations, starting in the valley floor and extending up the mountain slope to a point near the crest.

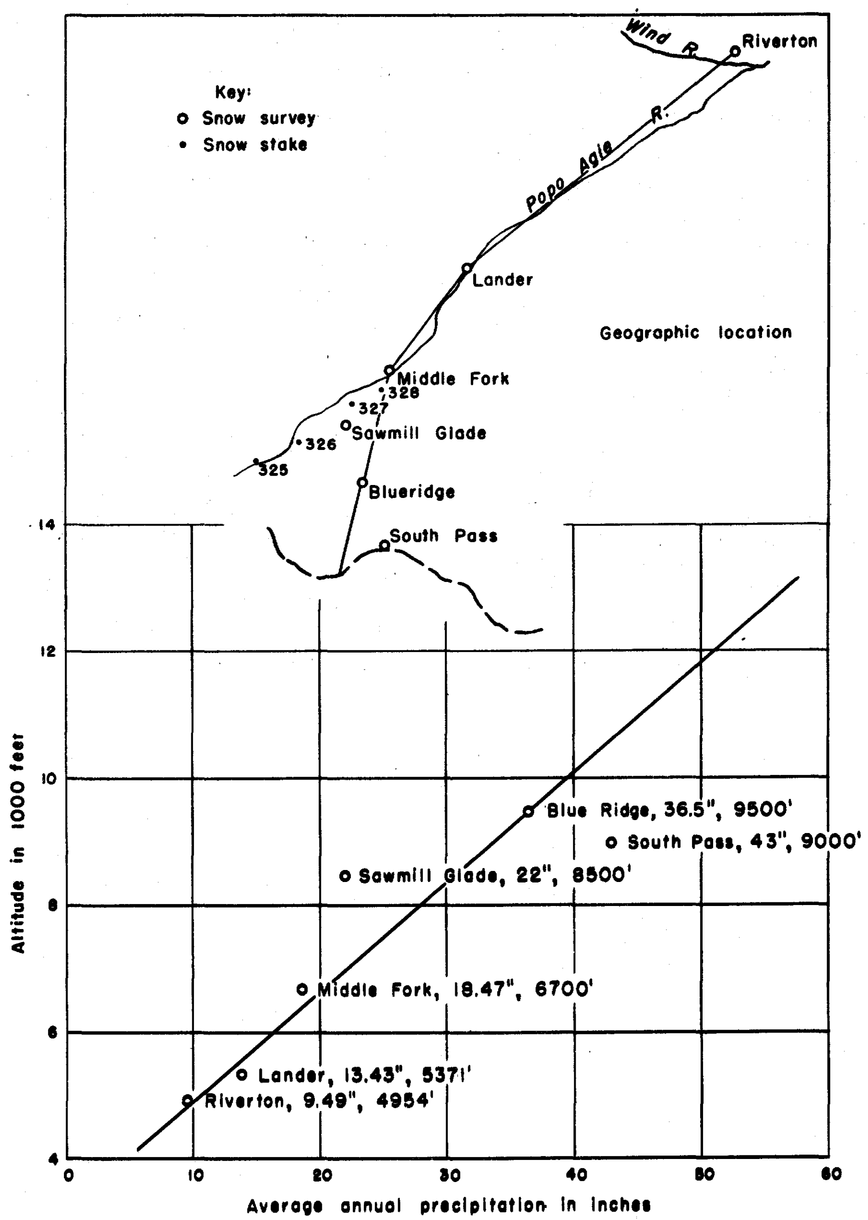

Figure 2.--Precipitation increase with altitude for section thru Riverton-Lander.

Table 4.--Computation of annual precipitation at altitude south of Lander, Wyo. based on snow surveys

Water year	Middle Fork Precipitation							Blue Ridge water content, (inches)	South Pass water content, (inches)	Sawmill Glade water content, (inches)	Percent of Middle Fork		
	Nov	Dec	Jan	Feb	Mar	Apr	Sum				Blue Ridge	South Pass	Sawmill Glade
1941	2.01	0.83	0.02	0.62	2.58	6.01	12.07	13.8	14.0	10.9	114	116	91
1942	0.43	0.92	0.75	0.92	1.04		4.06	7.1	8.7	5.2	175	215	128
1943	2.55	0.08	2.85	0.21	1.13		6.82	17.1	19.9	9.3	250	292	136
1944	0.59	1.50	1.03	1.11	2.65	6.31	13.19	19.3	17.0	15.0	146	129	114
1945	1.52	0.55	0.54	0.60	1.57	5.60	10.38	17.4	18.1	13.5	168	174	130
1946	1.43	0.44	0.44	0.18	1.52		4.01	9.0	13.8	4.1	225	345	102
1947	1.23	0.18	0.36	0.59	1.18		3.54	11.2	13.9	4.5	316	393	127
1948	1.38	0.84	1.59	1.01			4.82	9.3	9.2	6.0	193	191	125
Average percent, 1941-48											198	232	119
Computed precipitation based on Middle Fork precipitation 1924-48											36.5"	43.0"	22.0"

Such a group was found in Idaho: Kellog, altitude 2,305 feet; Avery, altitude 2,500 feet; Wallace, altitude 2,770 feet; and Roland, altitude 4,150 feet. These station-average annual precipitations, plotted against altitude, give a linear relationship with a slope of 12 inches precipitation increase per 1,000 feet increase in altitude. Lee 4/ found an indicated increase of 5 inches per 1,000 feet in the mountains west of Owens Valley in California with a linear relationship between precipitation and altitude.

The foregoing facts are mentioned to indicate that substantial evidence exists to warrant the assumption of linear increase of precipitation with increasing altitude, and that the 50-inch precipitation computed for 12,000 feet has some verification.

A study based on Ft. Washakie precipitation records and snow surveys gave a similar increase of precipitation with increasing altitude as for the section Lander-Middle Fork, and a study made for the western end of the basin based on Dubois and T-Cross Ranch precipitation data and snow surveys indicates that the precipitation increase with altitude is nearly 12 inches per 1,000 feet. The above graphs of precipitation variation with altitude are combined for comparison on figure 3.

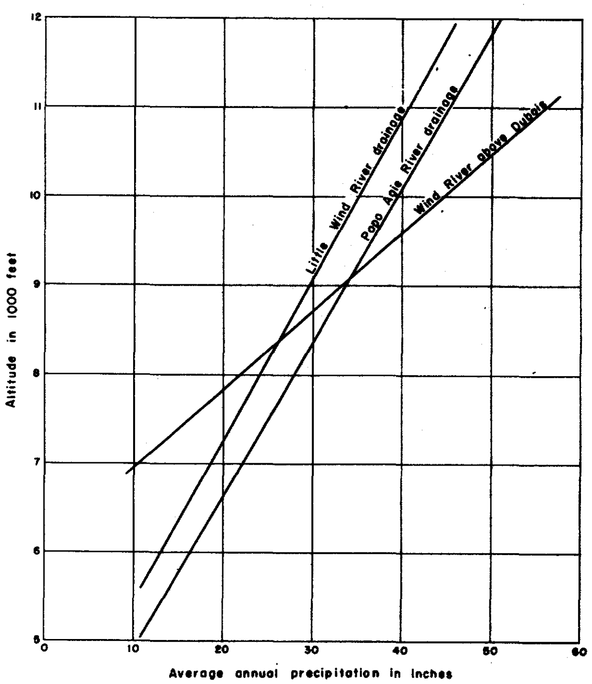

Figure 3.--Comparison of precipitation-altitude graphs for sections of Wind River Range.

AVERAGE ANNUAL WATER LOSS

Figure 4 presents a graph of the variation of the average annual water loss with altitude for the Wind River Range north slope. The graph is not applicable for the south slopes of the Owl Creek Mountains, as the losses are greater there because of the more direct exposure to sunshine. The loss variation graph was determined from the precipitation obtained from the previously described precipitation-altitude graphs (using the value of precipitation corresponding to the mean drainage basin altitude) and the measured runoff at the gage. The loss-altitude graph is a composite curve, drawn through the plotted points, determined in that manner for all the streams of the north slope of the Wind River Range.

VARIATION OF RUNOFF WITH ALTITUDE

The previously discussed precipitation-altitude graphs are linear above 9,000 feet; therefore, runoff, the residual, varies as a straight line with altitude above that elevation. This relationship is true if the assumptions outlined in the previous discussion of the variation of precipitation with altitude are true. In this study the runoff has been considered to vary directly and linearly with altitude above elevations of 8,500 feet. On this basis topography determines the spacing of the isograms for areas of high altitude.

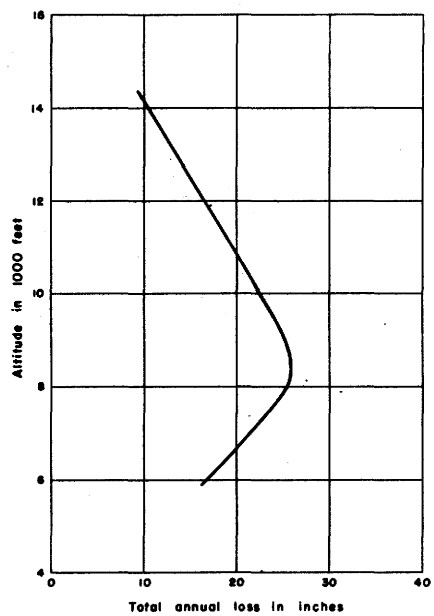

Figure 4.--Composite average annual loss variation with altitude along north side Wind River Range.

TOPOGRAPHY

A map of the 1,000-foot contours of elevation above sea-level was prepared for this study to aid in the spacing of the isograms. Data for construction of the contours were obtained from Geological Survey quadrangle maps, the Riverton Project Map,6/ the Casper sheet of World Aeronautical Charts, and an aerial mosiac. The contour map is only approximately accurate for the areas not covered by

4 Lee, C. H., An intensive study of the water resources of a part of Owens Valley, California: Water-Supply Paper 294, pl. 8, 1912.

6 U. S. Department of Interior, Bureau of Reclamation, Riverton Irrigation Project, 1939.

regular quadrangle maps, but it is of sufficient accuracy for this study. The contour map of the basin is presented on plate 2.

PLOTTING OF ISOGRAMS

The isograms plotted along the slopes of the Wind River Range were spaced according to the topography with the quantitative amount determined by the precipitation-altitude and loss-altitude graphs applicable for the region. The results were checked against measured runoff on individual drainage areas. The slope drainage from the Owl Creek Mountains into the Wind River Basin has not been gaged; isograms were located along this region in quantitative amount by estimate based on the runoff from South Fork Owl Creek, and the spacing was governed by topography. Isograms for the low-altitude, arid part of the basin were estimated on the basis of a few scattered records, by a field reconnaissance, and by the aid of topography and climatic data. The complete average annual runoff map for the Wind River Basin is shown on plate 1. Isograms of 0.25, 0.50, 1.0, 3.0, 5.0, 10.0, 15.0, 20.0, 30.0, and 40.0 inches have been chosen for the plot, as they give a representative spacing. The area within the 0.25 inch isogram has average annual runoff less than 0.25 inch, but is believed to have more than 0.10 inch average annual runoff generally.

ACCURACY OF MAP

A figure of average annual runoff computed for the drainage area above Boysen Dam by planimetering the areas bounded by the isograms on plate 1 agrees very well with the long-term average runoff measured at the Thermopolis gage after suitable irrigation diversion corrections are made. The runoff map is considered to be of good accuracy in expressing the average annual runoff from the mountains bordering the basin and of fair accuracy in the arid part of the basin.