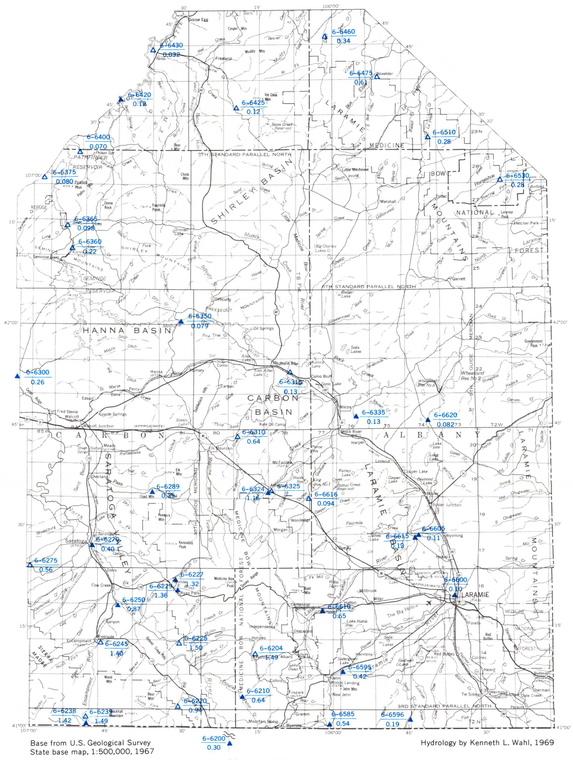
SURFACE WATER



Base from U.S. Geological Survey
State base map, 1:500,000, 1967

Hydrology by Kenneth L. Wahl, 1969

SCALE 1:750 000

5 0 5 10 15 20 25 MILES

5 0 5 10 15 20 25 KILOMETERS

EXPLANATION

△ 6-6430
▲ 0.032
Gaging station

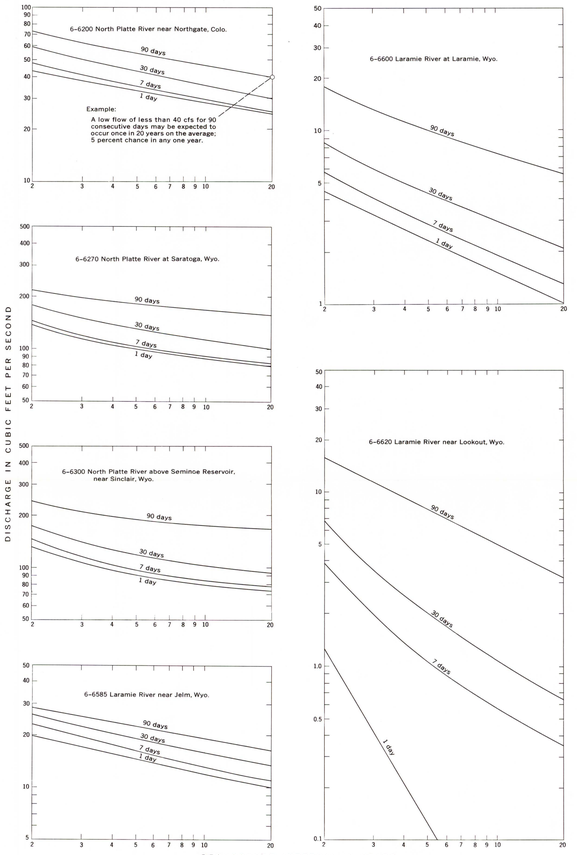
Open triangle indicates discontinued station. Upper number is station identification number; lower number is average discharge in cubic feet per second per square mile of drainage area.

MAP SHOWING LOCATION OF GAGING STATIONS

Selected streamflow characteristics at gaging stations.

No.	Station name	Drainage area (sq mi)	Records available	Mean annual discharge (cfs)			Annual minimum daily discharge (cfs)			Maximum discharge (cfs)	Factors affecting natural flow
				Average	Range	Exceeded 90 percent of years	Range	Recurrence interval 2-year	Recurrence interval 20-year		
6-6200	North Platte River near Northgate, Colo.	1,431	1904, 1915–65	430	123 – 873	230	19 – 90	43	24	6,720	Transbasin diversions, diversions for irrigation.
6-6204	Douglas Creek above Keystone, Wyo.	22.1	1955–65	33.0	24.3 – 42.4	25	1.4– 3.1	(a)	(a)	865	Only minor diversions.
6-6210	Douglas Creek near Foxpark, Wyo..	120	[b]1946–63	76.7	33.1 – 112	40	2.4– 6.5	4.5	2.0	1,630	Do.
6-6220	Big Creek at Big Creek Ranger Station, Wyo.	106	[c]1911, 1912–24	99.2	56.6 – 157	57	(a)	(a)	(a)	1,300	Transbasin diversions.
6-6225	French Creek near French, Wyo.....	59.6	1909–24	89.4	59.9 – 132	61	(a)	(a)	(a)	1,680	Diversions for irrigation.
6-6227	North Brush Creek near Saratoga, Wyo.	37.4	1960–	49.2	36.4 – 67.9	(a)	6.4– 8.3	7.2	(a)	1,120	No regulation or diversion.
6-6229	South Brush Creek near Saratoga, Wyo.	22.8	1960–	31.0	18.6 – 45.9	(a)	0.8– 4.7	2.8	(a)	559	Transbasin diversion.
6-6238	Encampment River above Hog Park Creek, near Encampment, Wyo.	72.7	1964–	103	80.6 – 125	(a)	10 – 16	(a)	(a)	1,680	No regulation or diversion.
6-6239	Encampment River near Encampment, Wyo.	105	1956–64	156	112 – 222	(a)	(a)	(a)	(a)	2,290	Do.
6-6245	Encampment River at Encampment, Wyo.	211	1900, 1909–24, 1928–32	295	125 – 495	180	(a)	(a)	(a)	4,680	Diversions for irrigation.
6-6250	Encampment River at mouth, near Encampment, Wyo.	265	1940–	230	129 – 337	145	8.0– 40	24	9.0	4,510	Transbasin diversions, diversions for irrigation.
6-6270	North Platte River at Saratoga, Wyo.	2,840	1903–06, 1909–	1,141	330 –2,210	680	38 –262	138	80	18,000	Do.
6-6275	Jack Creek at Mathers Ranch, near Saratoga, Wyo.	41.2	1913–24	23.2	14.4 – 37.9	15	0 –(a)	(a)	(a)	334	Diversions for irrigation.
6-6289	Pass Creek near Elk Mountain, Wyo.	91.5	1957–	31.9	20.2 – 44.1	20	1.5– 4.7	3.6	(a)	854	Do.
6-6300	North Platte River above Seminoe Reservoir, near Sinclair, Wyo.	[a]4,061	1939–	1,044	467 –1,814	640	70 –212	133	74	14,500	Transbasin diversions, diversions for irrigation.
6-6310	Medicine Bow River near Medicine Bow, Wyo.	190	1911–17, 1919–24	122	64.3 – 212	65	0 – 4.0	0	0	2,810	Several small reservoirs, diversions for irrigation.
6-6315	Medicine Bow River above Rock Creek, near Medicine Bow, Wyo.	[a]401	1951–63	52.4	13.4 – 109	14	0	0	0	1,340	Diversions for irrigation, several small reservoirs.
6-6324	Rock Creek above King Canyon Canal, near Arlington, Wyo.	62.9	1954–	72.7	48.1 – 107	52	(a)	(a)	(a)	(a)	No regulation or diversion.
6-6325	Rock Creek at Arlington, Wyo.....	64.5	1910–18, 1939–65	72.3	41.5 – 141	47	1.0– 16	5.6	2.6	1,720	Diversions for irrigation.
6-6335	Rock Creek below Rock River, Wyo.	218	1940–42, 1951– 1959–	28.6	9.71– 53.7	10	0 – 4.0	0	0	1,490	Diversions for irrigation, several small reservoirs.
6-6350	Medicine Bow River above Seminoe Reservoir near Hanna, Wyo.	[d]1,942	1939–	153	43.7 – 271	78	1.1– 16	6.4	0.9	6,590	Do.
6-6360	North Platte River above Pathfinder Reservoir, Wyo.	[d]7,652	1913–39	1,654	431 –3,160	870	20 –265	143	42	18,800	Diversions for irrigation.
6-6365	Sage Creek above Pathfinder Reservoir, Wyo.	190	1915–25	18.6	6.08– 31.4	8.2	0 –(a)	(a)	(a)	1,180	Do.
6-6375	Sand Creek near Alcova, Wyo.....	51.0	1915–24	4.08	1.82– 11.1	(a)	0	0	0	(a)	Do.
6-6400	Canyon Creek near Alcova, Wyo...	97.1	1915–24	6.84	1.29– 16.5	(a)	0	0	0	(a)	Do.
6-6420	North Platte River at Alcova, Wyo.	[d]10,112	[c]1904–05, 1934–	1,185	711 –1,855	(a)	(a)	(a)	(a)	13,400	Regulated by Seminoe, Pathfinder, and Alcova Reservoirs.
6-6425	Bates Creek near Freeland, Wyo....	118	1940–41, 1945–51	13.6	8.81– 17.9	(a)	(a)	(a)	(a)	600	Regulated by Bates Creek Reservoir.
6-6430	Bates Creek near Alcova, Wyo.....	393	1916–24, 1935–61	12.6	3.10– 30.0	3.8	0 – 0.3	0	0	[a]4,000	Diversions for irrigation, several small reservoirs.
6-6460	Deer Creek in canyon, near Glenrock, Wyo.	139	1946–51	47.1	35.7 – 63.8	(a)	1.3– 2.8	2.3	(a)	855	Diversions for irrigation.
6-6475	Box Elder Creek at Boxelder, Wyo.	63.0	1946–51, 1961–67	38.4	20.0 – 58.8	21	0 – 0.6	0	0	4,530	Minor diversions for irrigation.
6-6510	West Fork La Bonte Creek near La Bonte, Wyo.	20.6	1946–51	5.67	2.78– 9.74	(a)	(a)	0.1	(a)	171	Diversions for irrigation.
6-6530	Horseshoe Creek near Esterbrook, Wyo.	45.5	1946–51	12.6	8.58– 19.5	(a)	0 – 0.2	(a)	(a)	195	Do.
6-6585	Laramie River near Jelm, Wyo.....	294	1904–05, 1910–	159	56.3 – 340	91	9.2– 27	20	10	4,200	Transbasin diversions, diversions for irrigation.
6-6595	Laramie River and Pioneer Canal near Woods, Wyo.	434	1912–24, 1926–27, 1931–	183	64.9 – 389	100	10 – 35	21	10	5,060	Do.
6-6596	Sand Creek near Tie Siding, Wyo...	39.9	1957–	7.54	4.56– 12.8	4.6	0 – 0.8	0.1	0	253	Do.
6-6600	Laramie River at Laramie, Wyo....	[d]920	1933–	96.9	25.4 – 223	32	0.8– 10	4.4	1.0	3,250	Transbasin diversions, storage reservoirs, diversions for irrigation.
6-6605	Laramie River at Two Rivers, Wyo.	[d]1,036	1908–27, 1932–	111	17.0 – 326	41	0 – 22	3.0	0	3,930	Do.
6-6610	Little Laramie River near Filmore, Wyo.	156	1902–03, 1911–26, 1932–	101	32.7 – 184	62	1.0– 19	12	5.5	3,450	Diversions for irrigation, several small reservoirs.
6-6615	Little Laramie River at Two Rivers, Wyo.	[d]318	[c]1903, 1910–27, 1933–	42.7	4.10– 116	14	0 – 1.0	0	0	2,440	Diversions for irrigation, numerous small reservoirs.
6-6616	Dutton Creek near McFadden, Wyo.	19.9	1958–63	1.87	0.85– 2.72	(a)	0	0	0	186	Minor diversion for irrigation.
6-6620	Laramie River near Lookout, Wyo..	[d]1,571	1912–17, 1921–27, 1932–	128	15.9 – 397	47	0 – 19	1.3	0	3,340	Transbasin diversions, diversions for irrigation, numerous storage reservoirs.

[a] Not determined.
[b] Prior to diversions to Lake Owen.
[c] Gage heights or discharge measurements only.
[d] Contributing drainage area.
[e] Maximum daily discharge.



FREQUENCY CURVES OF ANNUAL LOWEST MEAN DISCHARGE FOR SELECTED PERIODS OF CONSECUTIVE DAYS

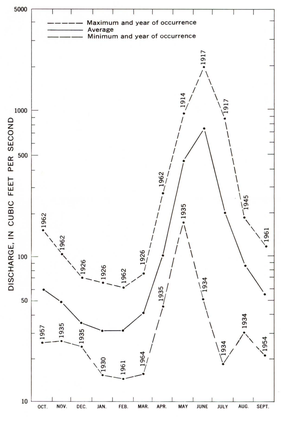
STREAMFLOW

Streamflow varies with respect to both time and geographic location. The time variation at a particular site is caused by changes in precipitation, vegetation, temperature, and consumptive use by man. The plot of variation in mean monthly discharges of the Laramie River near Jelm, Wyo., demonstrates the time variation at a point. Although relative magnitudes will differ, the seasonal runoff pattern at this site is generally indicative of streams in the area. The areal variations in streamflow are influenced primarily by the physical and climatic characteristics of the drainage basins. Wahl (1970) found drainage area, area of lakes and ponds, mean basin elevation, forested area, mean annual precipitation, and latitude to be significantly related to streamflow in the mountainous parts of this area. The geographic variation in streamflow in the area is indicated by the selected streamflow characteristics shown in the table. Station locations are shown on the map.

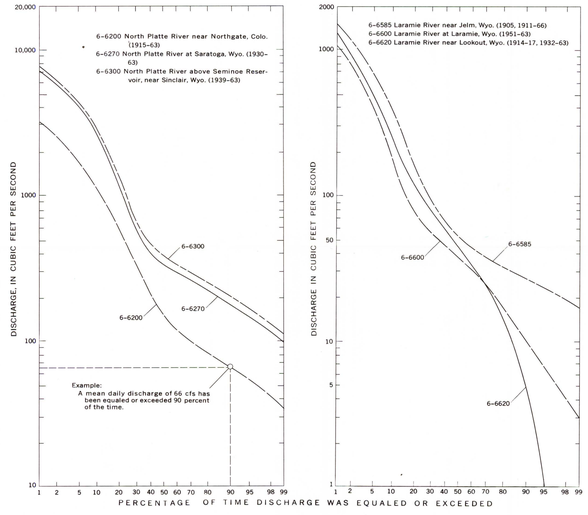
Low-flow data are useful in determining the adequacy of a stream to supply municipal, industrial, and supplemental irrigation water demands and to maintain water quality.

Low-flow frequency curves show the magnitude and frequency of average annual minimum flow for periods of specified length. The curves represent the flow which can be maintained if sufficient storage is provided to eliminate variations in discharge within the periods. For the 1-day flow, only enough storage to eliminate diurnal fluctuations would be required.

Flow-duration curves show the distribution of daily discharges for the period for which the curve is compiled without regard to the chronologic sequence of flow. If the period for which the duration curve is prepared represents long-term flow of the stream, the curve may be used to predict the distribution of flow.



VARIATION IN MONTHLY MEAN DISCHARGE OF LARAMIE RIVER NEAR JELM, WYOMING (1912–67)



DURATION CURVES OF DAILY FLOW FOR SELECTED GAGING STATIONS

RELATION OF GROUND WATER TO SURFACE WATER

There is, in most places, a free exchange of water between streams and flood-plain deposits to the extent that any significant change in the quantity in one will be reflected in the other. The relation between ground water in other formations and the water in streams is not as easily identified in most places. Rocks of Unit 7 contriubute water to streams in the Saratoga valley and the Shirley Basin. The increase in discharge of 20 cfs (cubic feet per second) in the Encampment River between Encampment and Baggot Rocks is attributed to ground-water discharge from Unit 7. The upper reach of the North Platte River is incised partly into rocks of this unit and contribution of ground water by this unit to the flow of the river is probably appreciable. Several small perennial streams that head in the rocks of Unit 7 in the Shirley Basin receive discharge from ground water.

No areas were identified during this study where perennial streams lose water to bedrock formations. The most prevalent condition is typified by that in the Laramie Basin. There, the areal relations of water in bedrock to water in the Little Laramie and Laramie Rivers indicate that bedrock underlying the flood plain of these rivers is not sufficiently permeable to measurably affect the flow of the Laramie River by either increasing or decreasing discharge.

REFERENCES CITED

Matthai, H.F., 1968, Magnitude and frequency of floods in the United States, Part 6-B. Missouri River Basin below Sioux City, Iowa: U.S. Geol. Survey Water-Supply Paper 1680. 491 p.

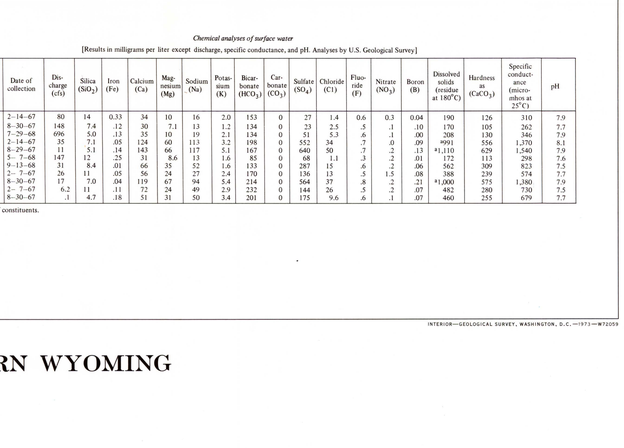
Wahl, K.L., 1970, A proposed streamflow data program for Wyoming: U.S. Geol. Survey open-file rept., 48 p.

QUALITY OF SURFACE WATER

The graphs showing the relation between dissolved solids and discharge illustrate that the quality of water in streams that head in the mountains is fairly uniform in the upper reaches. (See North Platte River near Northgate, 6-6200.) This water is a calcium bicarbonate type with a dissolved-solids concentration less than 300 mg/l (milligrams per liter).

Water used for irrigation in excess of that consumed by evaporation and transpiration percolates down through the soil and commonly returns to the stream. As the water moves through the soil, calcium sulfate and sodium sulfate in the soil may go into solution and, in addition, some of the calcium already in solution may be exchanged for sodium so that the water returning to the stream tends to be a sodium sulfate type. Therefore, in the lower reaches where return flows are a significant part of the stream discharge, the water in the stream is usually a calcium sulfate or calcium sodium sulfate type. (See analyses for station numbers 6-6350 and 6-6605.) An exception is the Little Laramie River (6-6615). The water in the river remained a calcium bicarbonate type. The maximum dissolved-solids concentration was about 480 mg/l for the 1967 and 1968 water years. There is a net loss of water from the stream between stations 6-6610 and 6-6615, and the chemical analyses for station 6-6615 indicate there is little return flow to the stream.

Water in the lower reaches of a stream contains the lowest dissolved solids when discharge is large due to runoff from rainfall or snowmelt. Runoff from these sources is low in dissolved solids and dilutes the water in the stream.



RELATION OF DISCHARGE TO DISSOLVED SOLIDS

Chemical analyses of surface water

[Results in milligrams per liter except discharge, specific conductance, and pH. Analyses by U.S. Geological Survey.]

Station No.	Date of collection	Discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C)	Hardness as ($CaCO_3$)	Specific conductance (micromhos at 25°C)	pH
6-6200	2-14-67	80	14	0.33	34	10	16	2.0	153	0	27	1.4	0.6	0.3	0.04	190	126	310	7.9
6-6200	8-30-67	148	7.4	.12	30	7.1	13	1.2	134	0	23	2.5	.5	.1	.10	170	105	262	7.7
6-6300	7-29-68	696	5.0	.13	35	10	19	2.1	134	0	51	5.3	.6	.1	.00	208	130	346	7.9
6-6350	2-14-67	35	7.1	.05	124	60	113	3.2	198	0	552	34	.7	.0	.09	*991	556	1,370	8.1
6-6350	8-29-67	11	5.1	.14	143	66	117	5.1	167	0	640	50	.7	.2	.13	*1,110	629	1,540	7.9
6-6600	5- 7-68	147	12	.25	31	8.6	13	1.6	85	0	68	1.1	.3	.2	.01	172	113	298	7.6
6-6600	9-13-68	31	8.4	.01	66	35	52	1.6	133	0	287	15	.6	.2	.06	562	309	823	7.5
6-6605	2- 7-67	26	11	.05	56	24	27	2.4	170	0	136	13	.5	1.5	.08	388	239	574	7.7
6-6605	8-30-67	17	7.0	.04	119	67	94	5.4	214	0	564	37	.8	.2	.21	*1,000	575	1,380	7.9
6-6615	2- 7-67	6.2	11	.11	72	24	49	2.9	232	0	144	26	.5	.2	.07	482	280	730	7.5
6-6615	8-30-67	.1	4.7	.18	51	31	50	3.4	201	0	175	9.6	.6	.1	.07	460	255	679	7.7

*Calculated from sum of constituents.

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WATER RESOURCES OF THE LARAMIE, SHIRLEY, HANNA BASINS AND ADJACENT AREAS, SOUTHEASTERN WYOMING

By
Marlin E. Lowry, Samuel J. Rucker, IV, and Kenneth L. Wahl

1973