

Stage-discharge relation is the relation between gage height and the amount of water flowing in a channel, expressed as volume per unit of time.

Control designates a feature downstream from the gage that determines the stage-discharge relation at the gage. This feature may be a natural constriction of the channel, a long reach of the channel, or an artificial structure.

Contents is the volume of water in a reservoir. Unless otherwise indicated, volume is computed on the basis of a level pool and does not include bank storage.

The drainage area of a stream at a specified location is that area, measured in a horizontal plane, which is so enclosed by a topographic divide that direct surface runoff from precipitation normally would drain by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

WSP is used as an abbreviation for "Water-Supply Paper" in references to previously published reports.

DOWNSTREAM ORDER OF LISTING GAGING STATIONS

Beginning with the series of reports for the water year ending September 30, 1951, the order of listing gaging-station records was changed. In this report, in a downstream direction along the main stem all stations on a tributary entering above a main-stem station are listed before that station. If a tributary enters between two main-stem stations, it is listed between them. A similar order is followed in listing stations on first rank, second rank, and other ranks of tributaries. To indicate the rank of any tributary on which a gaging station is situated and the stream to which it is immediately tributary, each indention in the listing of gaging stations in the table of contents of this report represents one rank. This downstream order and system of indention show which gaging stations are on tributaries between any two stations on a main stem and the rank of the tributary on which each gaging station is situated.

The order of listing used before the publication of the 1951 report listed first all stations on the main stem from headwaters toward mouth, then all stations on the uppermost tributary to the main stem from the tributary's source to mouth, and then all stations from source to mouth of the uppermost tributary to the tributary.

EXPLANATION OF DATA

The base data collected at gaging stations consist of records of stage and measurements of discharge. In addition, observations of factors affecting the stage-discharge relation, weather records, and other information are used to supplement base data in determining the daily flow. The records of stage are obtained either from direct readings on a nonrecording gage or from a water-stage recorder that gives a continuous record of fluctuations. Measurements of discharge are made with a current meter by the general methods adopted by the Geological Survey on the basis of experience in stream gaging since 1888. These methods are described in Water-Supply Paper 888 and are also outlined in standard textbooks on the measurement of stream discharge. Typical structures in use at gaging stations are shown in figure 1.



A. Colorado River near San Saba, Tex.



B. Rio Guadalupe at Box Canyon, near Jemez, N. Mex.



C. East Fork San Jacinto River near Cleveland, Tex.

FIGURE 1.—GAGING-STATION STRUCTURES.

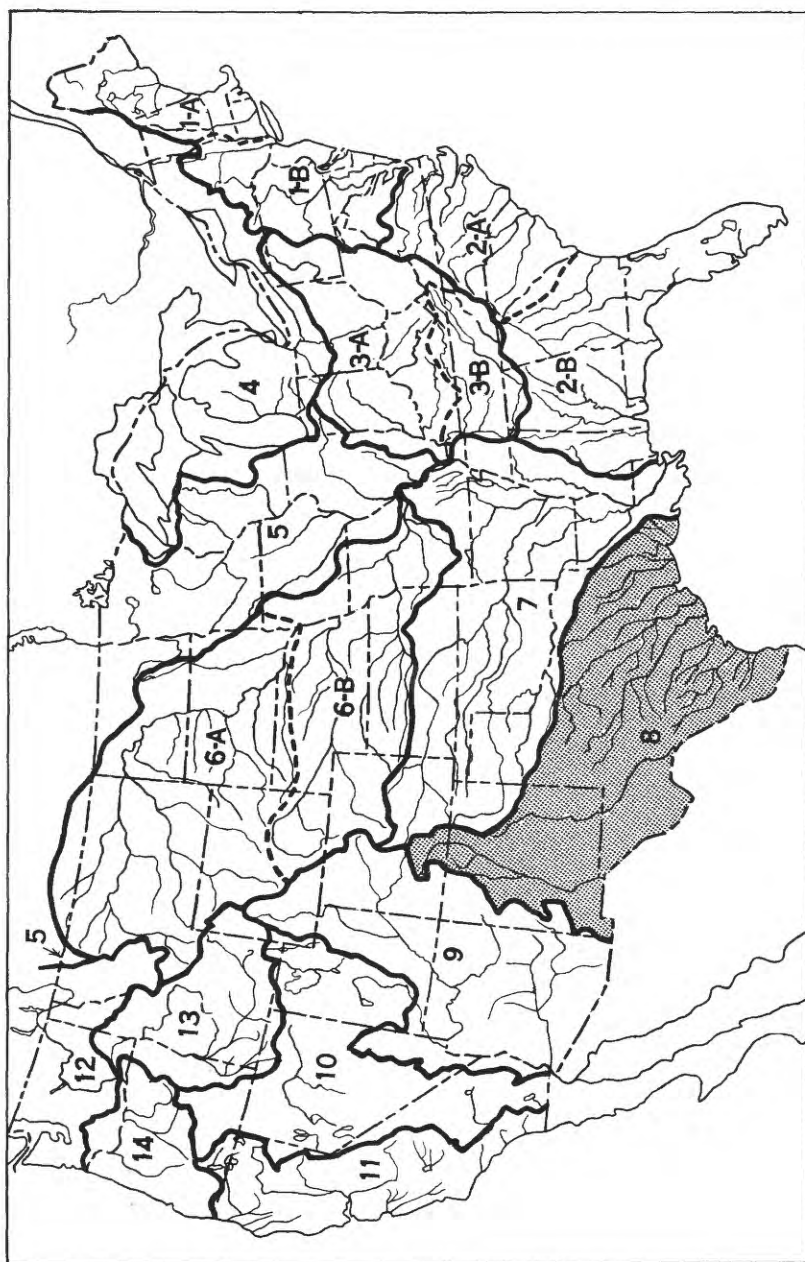


Figure 2.--Map of the United States showing areas covered by the 18 annual volumes on surface-water supply. The area covered by this report is shaded.

Water-supply papers and other publications of the Geological Survey containing data on the water resources of the United States may be purchased or consulted as follows:

1. Copies may be purchased from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., who will, on application, furnish lists giving prices. A list of Geological Survey publications may also be obtained by applying to the Director, Geological Survey, Washington, D. C.

2. Sets of the reports may be consulted in the libraries of the principal cities in the United States.

3. Sets are available for consultation in the offices of the Water Resources Division of the Geological Survey. Addresses of the offices in the area covered by this report are given on page 2.

Early records of the flow of streams in the United States are published in the reports listed below. In many of these reports records for years earlier than those indicated have been included for some streams.

Streamflow data for the years 1884-1901, in reports of the Geological Survey

(A = Annual Report; B = Bulletin)

Report	Character of data	Year
10th A, pt. 2	Descriptive information only.	
11th A, pt. 2	Monthly discharge and descriptive information.....	1884 to September 1890.
12th A, pt. 2	.....do.....	1884 to June 30, 1891.
13th A, pt. 3	.....do.....	1884-92.
14th A, pt. 2	Monthly discharge.....	1888-93.
B 151.....	Descriptions, measurements, gage heights, and ratings.....	1893-94.
16th A, pt. 2	Descriptive information only.	
B 140.....	Descriptions, measurements, gage heights, ratings, and monthly discharge.	1895.
WSP 11.....	Gage heights.....	1896.
16th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge..	1895-96.
WSP 15.....	Descriptions, measurements, and gage heights of streams east of the Mississippi River, and Missouri River and tributaries above Kansas River.	1897.
WSP 16.....	Descriptions, measurements, and gage heights of streams west of the Mississippi River, except Missouri River and tributaries above Kansas River.	1897.
19th A, pt. 4	Descriptions, measurements, ratings, and monthly discharge.	1897.
WSP 27.....	Measurements, ratings, and gage heights of streams east of the Mississippi River, and Missouri River and tributaries.	1898.
WSP 28.....	Measurements, ratings, and gage heights of streams west of the Mississippi River, except Missouri River and tributaries.	1898.
20th A, pt. 4	Monthly discharge.....	1898.
WSP 35 to 39.	Descriptions, measurements, gage heights, and ratings.....	1899.
21st A, pt. 4	Monthly discharge.....	1899.
WSP 47 to 52.	Descriptions, measurements, gage heights, and ratings.....	1899.
22d A, pt. 4.	Monthly discharge.....	1900.
WSP 65, 66.	Descriptions, measurements, gage heights, and ratings.....	1901.
WSP 75.....	Monthly discharge.....	1901.

Reports on surface-water supply containing records from 1899 to date for drainage basins in this report are listed below. The data for any particular gaging station will, in general, be found in the reports covering the years during which the station was maintained.

Numbers of water-supply papers containing results of stream measurements in Western Gulf of Mexico basins, 1899-1954

Year	WSP	Year	WSP	Year	WSP	Year	WSP	Year	WSP
1899	37	1911	308	1923	568	1934	763	1945	1038
1900	50	1912	328	1924	588	1935	788	1946	1058
1901	66, 75	1913	358	1925	608	1936	808	1947	1088
1902	84	1914	388	1926	628	1937	828	1948	1118
1903	99	1915	408	1927	648	1938	858	1949	1148
1904	132	1916	438	1928	668	1939	878	1950	1178
1905	174	1917	458	1929	688	1940	898	1951	1212
1906	210	1918	477	1930	703	1941	928	1952	1242
1907-8	248	1919-20	508	1931	718	1942	958	1953	1282
1909	268	1921	528	1932	733	1943	978	1954	1342
1910	288	1922	548	1933	748	1944	1008		

The records at most of the stations discussed in these reports extend over many years. Discharge measurements at many points other than regular gaging stations have been made each year and are published under "Miscellaneous discharge measurements" at the end of

Records of discharge collected by agencies other than the Geological Survey--Continued

Stream	Location	Period	Collected by	Remarks
Rio Grande.....	At Leasburg Dam, at Selden, N. Mex.	1919-54	Bureau of Reclamation.	Unpublished.
Do.....	At Matamoros, Tamaulipas, Mexico.	1931-54*	International Boundary & Water Commission.	Published in bulletins of International Boundary & Water Commission.
Do.....	At upper Presidio station, Tex.	1926-54†	....do.....	Do.
Do.....	At lower Presidio station, Tex.	1926-54†	....do.....	Do.
Do.....	Below Progreso Pump, Tex.	1953-54	....do.....	Do.
Do.....	Near Rio Grande City, Tex.	1924-54††	....do.....	Do.
Do.....	At Roma, Tex.....	1931-54	....do.....	Do.
Do.....	Near Villa Guerrero, Coahuila, Mexico.	1953-54	....do.....	Do.
Do.....	Below San Benito, Tex.	1953-54	....do.....	Do.
Rio Salado.....	At Guerrero, Tamaulipas, Mexico.	1900-1913,††	....do.....	Do.
Do.....	At Las Tortillas, Tamaulipas, Mexico.	1924-54	....do.....	Do.
Rio San Diego...	Jimenez, Coahuila, Mexico.	1924-54	....do.....	Records for 1924-28 published in H. Doc. 359, 71st Cong., 2d sess.; records for 1932-52 published in bulletins of International Boundary & Water Commission.
Rio San Juan....	Above Rio Grande City, Tex.	1946-54	International Boundary & Water Commission.	Published in bulletins of International Boundary & Water Commission.
Do.....	Below Rio Grande City, Tex.	1946-54	....do.....	Do.
Rio San Rodrigo.	Near El Moral, Coahuila, Mexico.	1922-54	....do.....	Records for 1923-24 and 1927-28 published in H. Doc. 359, 71st Cong., 2d sess.; records for 1932-53 published in bulletins of International Boundary & Water Commission.
San Felipe Creek	Near Del Rio, Tex.....	1931-54	....do.....	Published in bulletins of International Boundary & Water Commission.
Terlingua Creek.	Near Terlingua, Tex....	1932-54	....do.....	Do.
West Side Canal.	At Mesilla Dam, near Mesilla Park, N. Mex.	1916-18, 1920-54	Bureau of Reclamation.	Unpublished.

† Records for earlier years published in Geological Survey water-supply papers. See also pages 87 and 88, Water Bulletin No. 16 - International Boundary & Water Commission.

* Records for earlier years published in Geological Survey water-supply papers as Rio Grande near Brownsville, Tex. See also pages 87 and 88, Water Bulletin No. 16 - International Boundary & Water Commission.

†† See also pages 87 and 88, Water Bulletin No. 16 - International Boundary & Water Commission. **Note.**--In addition to the gaging stations listed above, the International Boundary & Water Commission collects and publishes records of discharge in floodways in the lower Rio Grande Valley and records of diversions from the Rio Grande for irrigation and municipal use.

The Agricultural Research Service of the United States Department of Agriculture has been collecting records of runoff near Waco, Tex., from 3 areas of less than 200 acres each beginning in 1936, from 4 areas of about 4 acres and 10 areas of 20 to 1,100 acres, from 1938-43 and 1946-54, and near Albuquerque, N. Mex., beginning in 1938, from 3 areas of less than 210 acres.

HYDROLOGIC CONDITIONS

The water year 1954 was characterized by deficient runoff and severe drought conditions over most of the Western Gulf of Mexico basins. There was some relief at times throughout the water year due to some record-breaking floods in scattered areas throughout the area covered by this report. Phenomenal flooding in the Devils River watershed and in Tower Pecos River during June produced an estimated peak flow of 900,000 cfs on the Rio Grande at Del Rio compared with the previous maximum of 600,000 cfs in 1932. During September record-low flows were equaled or exceeded in Texas and Louisiana. The key gaging station North Concho River near Carlsbad, Tex. was dry from July 21 to September 30. For those key gaging stations in the area covered by this report, a comparison of the monthly and yearly mean discharges during the 1954 water year with the median for the 25-year period (1921-45) is shown in figure 3 on the following page.

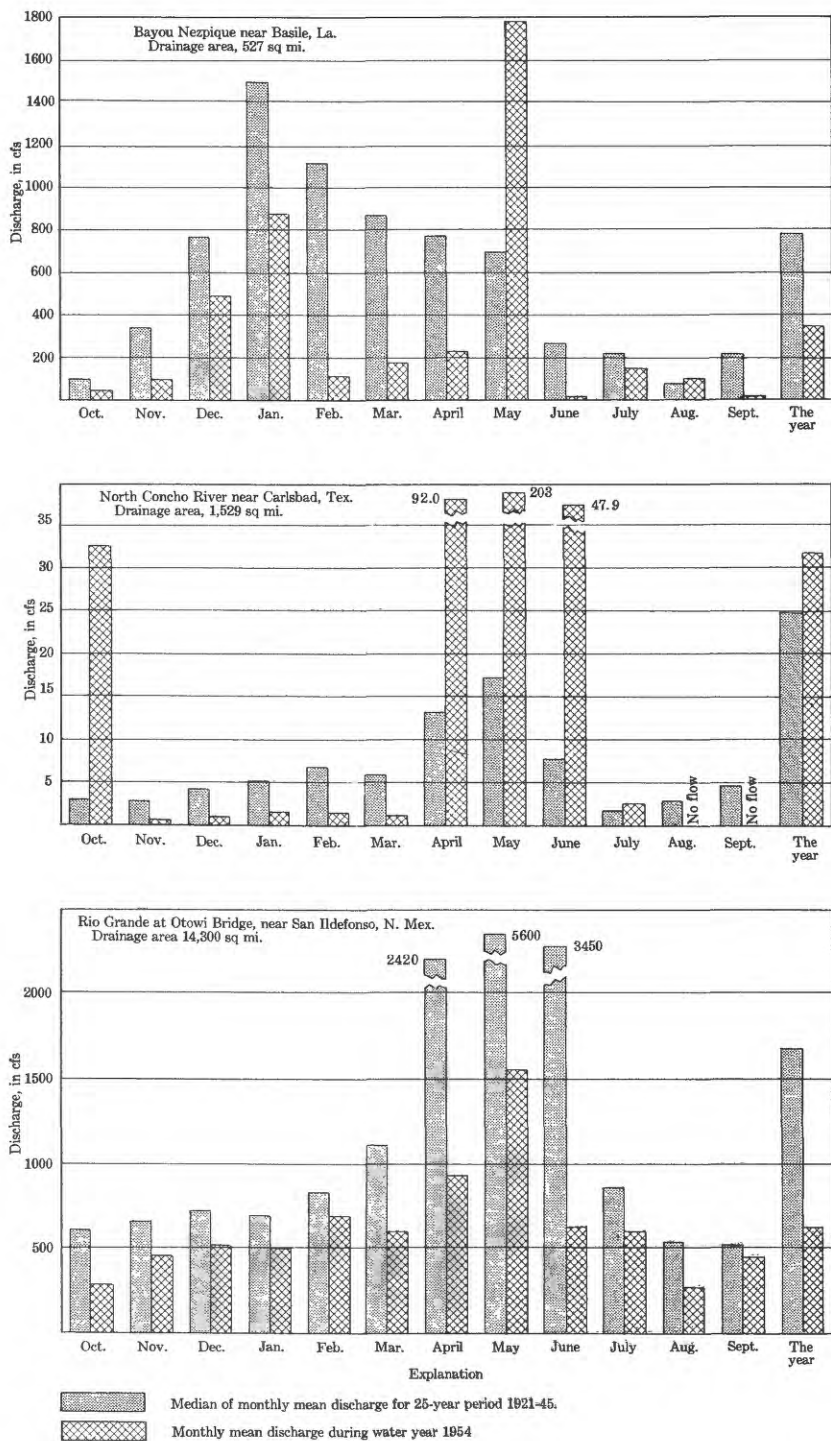


Figure 3. Comparison of discharge at three key gaging stations during 1954 water year with median discharge for 25-year period.

Sabinal River near Sabinal, Tex.

Location.--Lat 29°30', long. 99°29', on right bank 470 ft upstream from low-water crossing on old Sabinal-Utopia road, 3.5 miles downstream from Onion Creek, and 12 miles north of Sabinal, Uvalde County.

Drainage area.--206 sq mi.

Records available.--October 1942 to September 1954.

Gage.--Water-stage recorder. Datum of gage is 1,131.20 ft above mean sea level, datum of 1929.

Average discharge.--12 years, 20.1 cfs.

Extremes.--Maximum discharge during year, 15,800 cfs May 24 (gage height, 14.18 ft); no flow at times.

1942-54: Maximum discharge, that of May 24, 1954; no flow at times.

Flood of July 2, 1932, reached a stage of about 29.9 ft, from information by local residents (discharge, 72,000 cfs, by slope-area determination, at Sabinal, 12 miles downstream from gage).

Remarks.--Records good. No diversion above station.

Rating table, water year 1953-54 (gage height, in feet, and discharge, in cubic feet per second)

1.1	0	2.0	195
1.2	1.4	2.5	420
1.3	8.6	3.0	710
1.4	21	4.0	1,460
1.6	60	5.0	2,420
1.8	120	6.0	3,560

Discharge, in cubic feet per second, water year October 1953 to September 1954

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	*0	12	9.7	6.0	3.1	0.8	(*)	0	7.7	18	9.7	
2	0	8.6	11	6.0	3.1	.8		0	6.8	13	7.7	
3	0	8.6	9.7	6.0	3.1	.8		0	5.2	14	6.0	
4	0	21	8.6	5.2	2.5	.8		0	*4.4	14	5.2	
5	.2	16	8.6	5.2	2.5	1.4		0	4.4	14	4.4	
6	*3.1	12	7.7	4.4	2.5	2.0		0	4.4	13	3.7	
7	.4	9.7	7.7	4.4	2.5	2.0		0	3.7	13	3.1	
8	0	8.6	8.6	4.4	2.0	2.0		0	3.7	12	2.0	
9	0	8.6	8.6	5.2	2.0	2.0		0	3.7	12	.8	
10	0	8.6	8.6	4.4	2.0	1.4		0	3.7	11	.8	
11	0	8.6	8.6	3.7	2.0	1.4		0	3.7	11	.2	
12	0	*9.7	9.7	3.7	2.0	.8		0	4.4	9.7	.1	
13	0	8.6	9.7	4.4	2.0	.4		0	3.7	9.7	0	
14	0	8.6	8.6	4.4	2.0	.2		*0	3.7	8.6	0	
15	0	8.6	7.7	4.4	2.0	.2		0	5.2	8.6	0	
16	0	8.6	7.7	3.7	2.0	.2		0	6.0	8.6	0	
17	0	11	7.7	3.7	2.0	0		0	5.2	7.7	0	
18	0	11	7.7	3.7	2.0	0		0	3.7	7.7	0	
19	0	11	7.7	3.7	2.0	0		0	4.4	6.8	0	
20	0	8.6	*7.7	*3.7	2.0	0		0	7.7	6.8	0	
21	0	8.6	7.7	3.1	2.0	0		0	5.2	6.8	0	
22	0	8.6	7.7	3.1	2.0	0		0	3.7	6.8	0	
23	5.6	8.6	7.7	3.1	2.0	.1		48	3.1	6.0	0	
24	110	8.6	7.7	3.1	*1.4	.1		*2470	2.5	5.2	0	
25	122	8.6	7.7	3.1	1.4	.1		247	2.5	*4.4	0	
26	300	8.6	6.8	3.1	1.4	0		38	*223	4.4	0	
27	*32	8.6	6.8	3.1	1.4	0		22	113	4.4	0	
28	18	8.6	6.8	3.1	.8	0	(*)	17	36	5.2	0	
29	13	9.7	6.8	3.1	-	0		13	24	6.0	0	
30	11	8.6	6.8	3.1	-	0		9.7	20	5.2	0	
31	14	-	6.8	3.1	-	0	-	7.7	-	7.7	*0	-
Total	629.3	295.1	250.9	124.4	57.7	17.5	0	2,872.4	528.4	281.5	43.7	0
Mean	20.3	9.84	8.09	4.01	2.06	0.56	0	92.7	17.6	9.07	1.41	0
Ac-ft	1,250	585	498	247	114	35	0	5,700	1,050	558	87	0

Calendar year 1953: Max 300 Min 0 Mean 4.23 Ac-ft 3,060
 Water year 1953-54: Max 2,470 Min 0 Mean 14.2 Ac-ft 10,120

Peak discharge (base, 4,000 cfs).--Oct. 25 (11:30 p.m.) 4,210 cfs (6.52 ft); May 24 (2:30 a.m.) 15,800 cfs (14.18 ft).

* Discharge measurement or observation of no flow made on this day.

Sabinal River at Sabinal, Tex.

Location.--Lat 29°19', long. 99°29', near center of span at downstream side of bridge on U. S. Highway 90, about 1,000 ft downstream from Southern Pacific Lines railroad bridge, 0.8 mile west of Sabinal, Uvalde County, and 6.5 miles upstream from Ranchero Creek.

Drainage area.--247 sq mi.

Records available.--September 1952 to September 1954.

Gage.--Wire-weight gage read once daily, more often during floods. Datum of gage is 882.17 ft above mean sea level, datum of 1929.

Extremes.--Maximum discharge during year, 15,900 cfs May 24 (gage height, 19.56 ft, from Floodmark), from rating curve extended above 3,500 cfs on basis of slope-area determination of peak flow; no flow at times.
1952-54: Maximum discharge, that of May 24, 1954; no flow at times.

Remarks.--Records good. Small diversions for irrigation above station.

Discharge, in cubic feet per second, water year October 1953 to September 1954

Day	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	*0.5	1.8	1.8	1.1	0.4	0.4	0.2	0.2	1.1	1.2	1.6	0.4
2	.5	1.8	.9	1.1	.4	.4	*.2	.1	.9	1.2	1.6	*.3
3	1.8	1.8	.6	1.1	.4	.4	.2	0	*.9	1.2	1.6	.3
4	20	1.6	.7	1.1	.4	.4	.1	.1	.9	1.2	1.4	.3
5	3.1	1.4	.6	1.1	.4	.3	.1	.1	.8	1.2	1.4	.3
6	.2	1.4	27	1.1	.4	.3	.1	.1	.9	1.2	1.4	.3
7	.2	1.4	2.6	1.1	.4	.3	.1	0	.8	1.2	1.4	.2
8	.2	1.4	.8	1.1	.4	.3	.1	0	.8	1.2	1.4	.2
9	.2	1.4	.8	1.1	.4	.3	.1	.1	.8	1.2	1.4	.2
10	.2	1.4	.8	1.1	.4	.3	.1	0	.6	1.2	1.2	.2
11	.2	1.4	.8	.8	.4	.3	.1	.1	.7	1.2	1.2	.2
12	.3	*1.4	.8	.7	.4	.2	.2	*.1	.7	1.1	1.2	.1
13	.3	1.4	.8	.7	.4	.2	.2	0	.8	.9	1.2	.1
14	.3	1.2	.8	.8	.4	.2	.3	0	.8	.8	1.1	.1
15	.3	1.1	.8	.7	.3	.1	.2	0	1.2	.8	.9	.1
16	.3	1.4	.8	.6	.3	.1	.2	0	.9	.9	1.1	.1
17	.3	2.1	.8	.5	.4	.1	.2	0	.9	.9	.9	.1
18	.3	2.1	*.9	.6	.4	.1	.2	0	.9	.8	.8	.1
19	.4	2.0	.9	.6	.4	.1	.1	0	.9	1.1	.7	.1
20	.4	2.0	.9	.6	.4	.1	*.1	0	.9	.9	.7	.1
21	.4	1.8	1.1	*.6	.4	.1	.1	0	.9	.8	.6	.1
22	.4	1.8	1.1	.5	.4	.1	.1	0	.9	.7	.6	.1
23	.5	1.6	1.1	.5	.4	.1	.1	0	.9	.8	.5	.1
24	.7	1.4	1.2	.5	.4	.1	.1	*3730	.9	.7	.5	.1
25	.9	1.2	1.1	.5	.4	.1	.1	278	.9	.8	.5	.1
26	*233	1.1	1.1	.4	.4	.1	.1	48	1.4	*.8	.5	0
27	*36	1.1	1.1	.4	*.4	.2	.1	7.1	63	.8	.5	.1
28	6.3	1.1	1.1	.4	.4	.3	.2	*1.6	23	.7	.5	0
29	3.8	.9	1.1	.4	-	.3	.1	.9	3.9	1.6	.4	0
30	3.4	.9	1.1	.4	-----	.2	*.3	.8	3.9	1.6	.4	.1
31	2.1	-----	1.1	.4	-----	.1	-----	1.1	-----	1.8	.4	-----
Total	319.5	44.4	57.1	22.6	11.0	6.6	4.4	4,068.4	116.9	32.5	29.6	4.5
Mean	10.3	1.48	1.84	0.73	0.39	0.21	0.15	131	3.90	1.05	0.95	0.15
Ac-ft	634	86	113	45	22	13	8.7	8,070	232	64	59	8.9

Calendar year 1953: Max 397 Min 0 Mean 2.38 Ac-ft 1,720
Water year 1953-54: Max 3,730 Min 0 Mean 12.9 Ac-ft 9,360

Peak discharge (base, 1,500 cfs).--May 24 (about 5 a.m.) 15,900 cfs (19.56 ft).

* Discharge measurement made on this day.

** Field estimate made on this day.

