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UNITED STATES
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GEOLOGICAL SURVEY

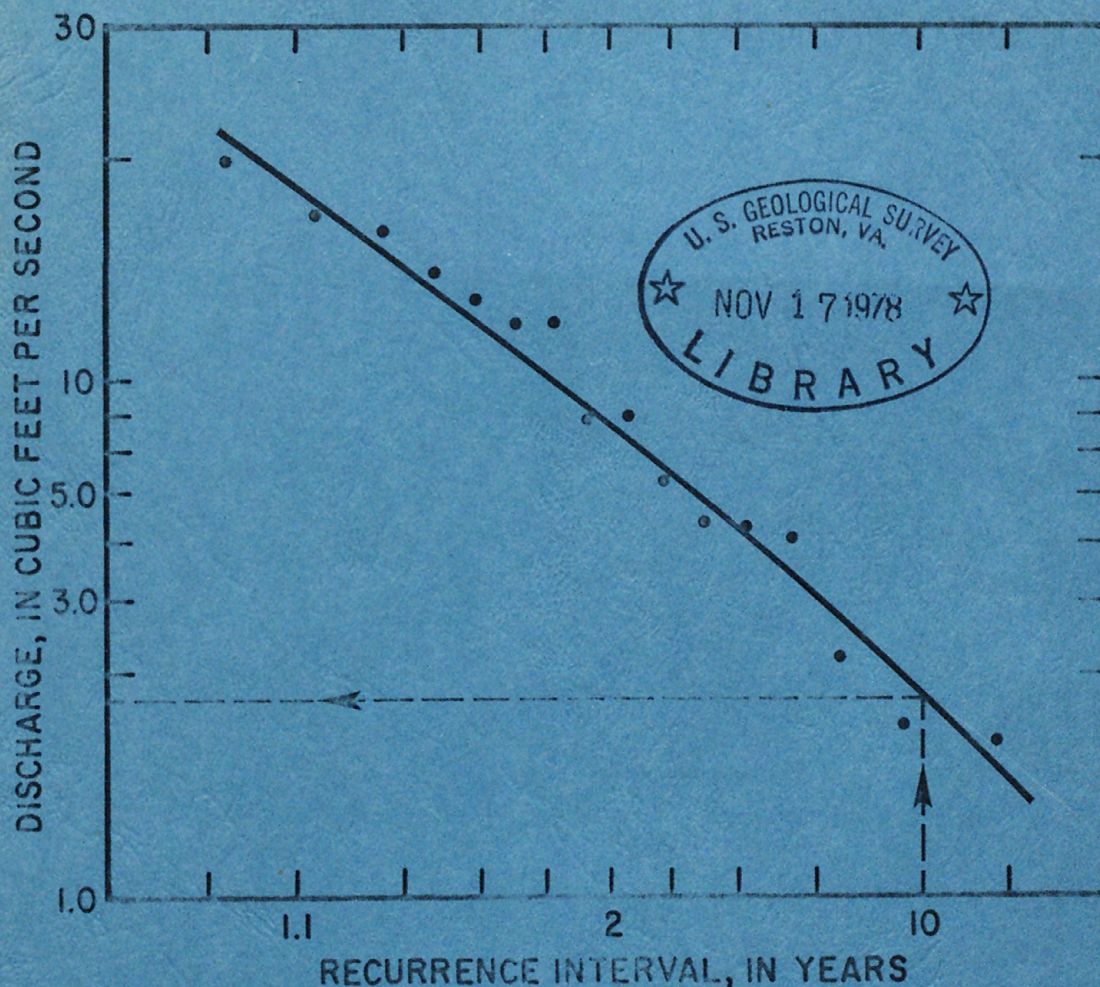
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ESTIMATES OF 7-DAY, 10-YEAR
MINIMUM FLOW AT SELECTED
STREAM SITES IN PUERTO RICO

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Open-File Report 78-583

Prepared in cooperation with the
Puerto Rico Environmental Quality Board

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By ^{most} E. D. Cobb, 1936-

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San Juan, Puerto Rico

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Conversion Factors

This report uses U.S. customary units. For those who are more familiar with, or have a need to use SI units (International units), this table is included and gives conversion factors with which to multiply the U.S. customary units to give the equivalent SI unit value. Conversion factors are shown to four significant figures but values in the text should be rounded to be consistent with the accuracy of the values shown in U.S. customary units.

<u>U.S. customary unit</u>	<u>Multiplication factor</u>	<u>SI unit</u>
<u>Length</u>		
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)
<u>Area</u>		
square miles (mi ²)	2.590	square kilometers (km ²)
<u>Flow</u>		
cubic feet per second (ft ³ /s)	0.02832	cubic meters per second (m ³ /s)

ESTIMATES OF 7-DAY, 10-YEAR MINIMUM FLOWS AT SELECTED STREAM SITES IN PUERTO RICO

by

E. D. Cobb

ABSTRACT

The 7-day, 10-year minimum flow of streams is used as an index for determining the capacity of streams to receive waste effluents. This index of flow was computed from streamflow records for 31 stream sites in Puerto Rico. In addition, there was a need for the 7-day, 10-year minimum flow at an additional 15 stream sites for which adequate streamflow data were not available. The flow index was estimated at these sites on the basis of available record, records at nearby sites, and comparisons with drainage areas.

INTRODUCTION

One of the needs identified by the Islandwide 208 project in Puerto Rico was a flow index of the capacity of selected streams to receive effluents. The flow index which was determined to meet the needs of the 208 project is the average low flow for seven consecutive days which has a recurrence interval of 10 years. This is referred to as the 7-day, 10-year low flow.

The purpose of this report is to provide 7-day, 10-year low flows for selected stream sites in Puerto Rico. The 7-day, 10-year low flow was computed from streamflow records for the 31 sites shown in figure 1. In addition, estimates were made at 15 sites shown in figure 2 where there were few or no streamflow records. The selection of stream sites was based on availability of data and on specific need for 7-day, 10-year low-flow estimates.

Each of the 31 sites shown in figure 1 has 10 or more years of continuous streamflow data. Most of the data presented in this report are for unregulated streams. Upstream regulation was imposed on some streams after sufficient natural-flow data were collected for this analysis. The analysis for some locations represents natural conditions, not necessarily 1978 conditions. Sites where later regulation occurs are noted. On a few streams,

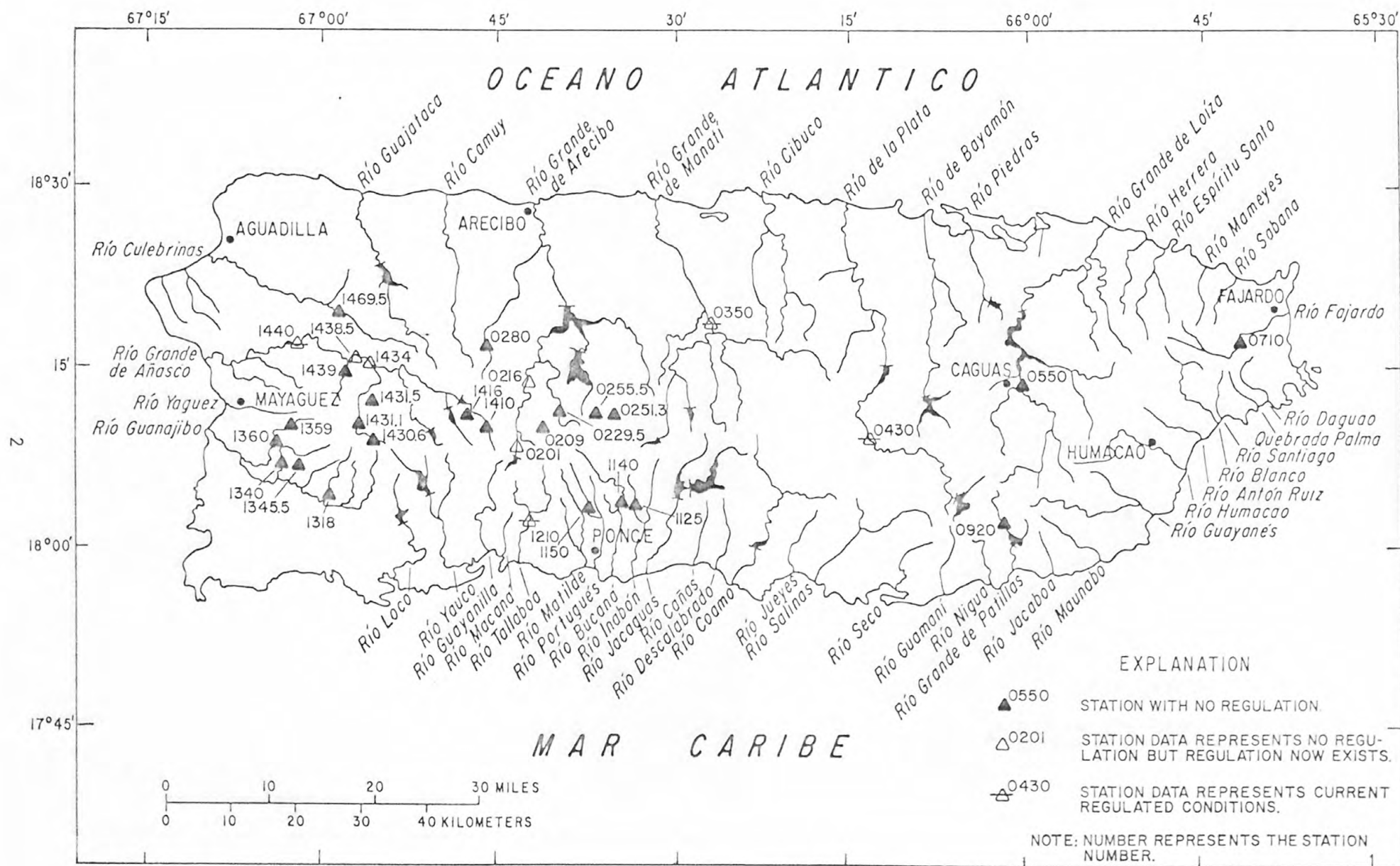


Figure 1.--Location of stations for which 7-day, 10-year minimum flows were computed.

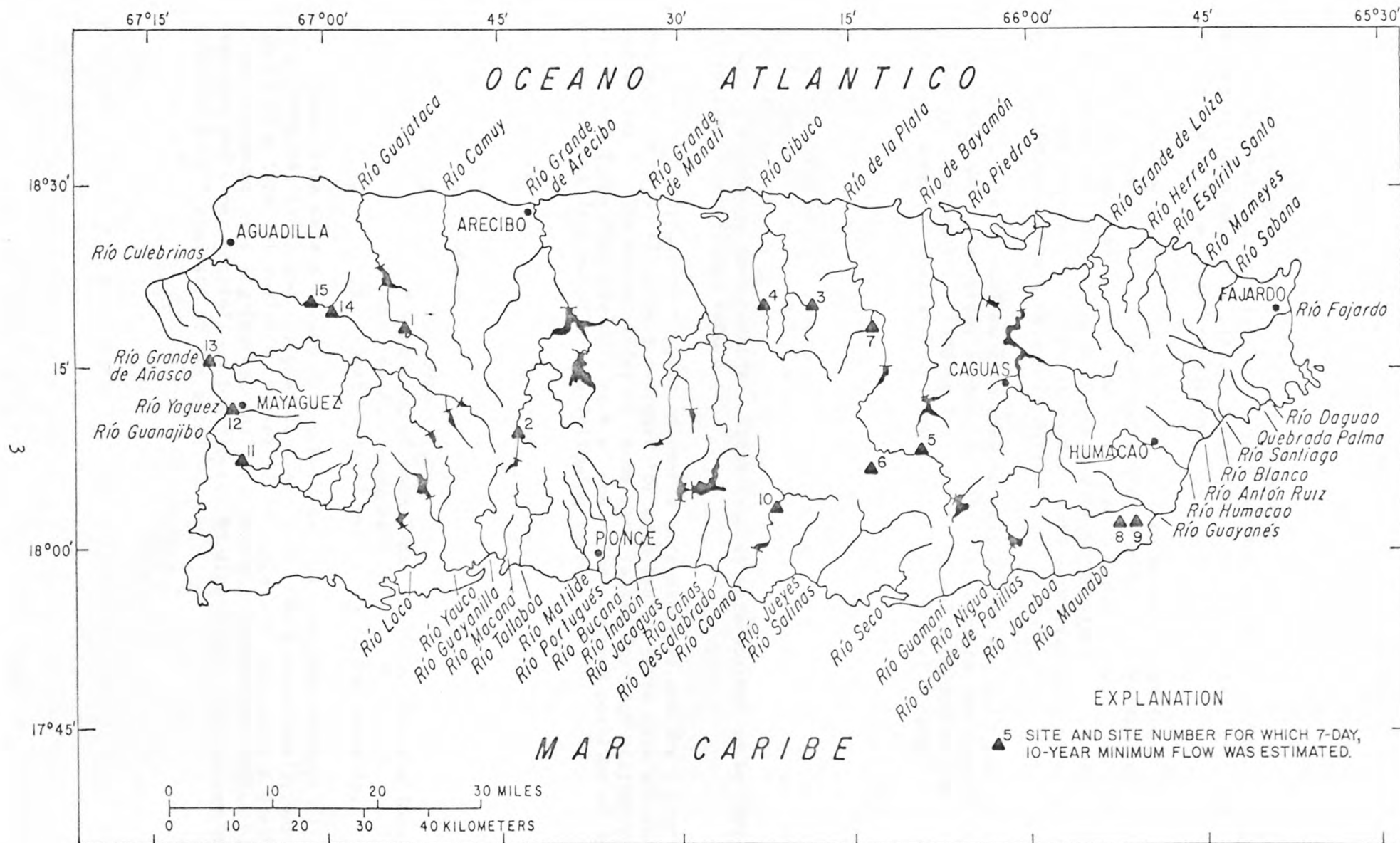


Figure 2.--Location of sites for which 7-day, 10-year minimum flows were estimated.

regulation has occurred throughout the period of record. If it was estimated that the regulation was fairly constant for the period of streamflow record and is representative of present conditions, the data were analyzed and noted as representing regulated conditions.

Estimates of the 7-day, 10-year low flow were made at the 15 locations having inadequate or no streamflow records where it was determined that a special need existed for the low-flow index. These estimates were based on comparisons of flows at stream-gaging sites in the same stream basin or with sites in nearby basins. Some streamflow data were available at some, but not all, of the sites where data were estimated.

Much of the streamflow data used in this report was collected by the Puerto Rico Water Resources Authority. This is noted in the station information in Supplement 1. Funding for this study was provided by the Puerto Rico Environmental Quality Board and the U.S. Geological Survey.

COMPUTATIONS AT GAGED SITES

Only data for continuous streamflow records of 10 or more years were used. Some of the records obtained by the Puerto Rico Water Resources Authority were based on once- or twice-daily readings of a staff gage and on numerous discharge measurements. These records were assumed to be representative of continuous record.

Data for each calendar year of record were examined and the lowest seven consecutive days' flows were averaged for each year. These data are shown in Supplement 1. The annual 7-day minimums were ranked for each station with the lowest 7-day flow having a rank of one. The plotting position of each 7-day flow was determined by the following formula:

$$P = \frac{M}{N + 1}$$

where

P = probability

M = ranking of each 7-day low flow with the lowest
being ranked as 1

N = total years' of data used in the analysis.

These data were analyzed by two methods: (1) log Pearson type III analysis (Matalas, 1963) and (2) graphical analysis. Only occasionally was the log-Pearson type III analysis considered adequate. In all cases a graphical check was made. The log-Pearson analysis is often inadequate because of geologic and other controls on low flows. No single distribution can be expected to fit the data at all sites.

The graphical analysis was performed by plotting the flows versus probability for each annual 7-day low flow on log-probability paper. A line of best fit, as determined by the analyst, was then drawn through the data points. The 7-day, 10-year low flow as determined from the graph is equal to the flow at a probability of 0.10. The 7-day, 10-year minimum flows which were computed for selected stream sites in Puerto Rico are listed in table 1.

Better estimates of the 7-day, 10-year low flows at gaged sites will be possible when additional data become available. Greater reliability and consistency will also be obtained when a more detailed low-flow analysis is made giving consideration to duration periods of other than the 7 days used here.

ESTIMATES AT UNGAGED SITES

Estimates were required at stream sites where less than 10 years of continuous data were available. Generally the estimates at the ungaged sites reported herein are poor. None of these sites were visited in the field for this study. If an unusual condition exists at one of these sites and is not represented at the site used in making the estimate, that condition may cause additional error in the estimate. It should be noted that a lone field observation may not reveal any factors which would create unusual low-flow characteristics.

All of the unregulated 7-day, 10-year low flows obtained at gaged sites were regressed against drainage areas. This resulted in an equation as follows:

$$M_{7,10} = 0.30 A^{1.02}$$

where $M_{7,10}$ = 7-day, 10-year low flow in ft^3/s and

A = drainage area in mi^2 .

The standard error of estimate of this equation is 0.207 log units or about 50 percent.

The results of this equation were considered in each estimate but because of basin differences, additional factors were also considered. These additional factors were usually the primary factor in the estimate. Following are the bases for each estimate by site.

Table 1.--Computed 7-day, 10-year minimum flows for selected sites.

Station no.	Station name	Drainage area, mi ²	Discharge, ft ³ /s
50 0201 00	Río Vacas nr Adjuntas	6.03	3.3 (a)
50 0209 00	Río Pellejas nr Adjuntas	2.34	1.2
50 0216 00	Río Grande de Arecibo upstream from Utuado	35.2	13. (a)
50 0229 50	Río Viví nr Adjuntas	3.21	1.1
50 0251 30	Río Saliente upstream from Río Salientito at Coabey	5.68	.6
50 0255 50	Río Jauca nr La Pica	4.16	1.7
50 0280 00	Río Tanamá nr Utuado	18.4	11.
50 0350 00	Río Grande de Manatí at Ciales	128.	32. (b)
50 0430 00	Río de la Plata at Proyecto La Plata	54.8	3.8 (b)
50 0550 00	Río Grande de Loíza at Caguas	89.8	14.
50 0710 00	Río Fajardo nr Fajardo	14.9	4.5
50 0920 00	Río Grande de Patillas nr Patillas	18.3	5.0
50 1125 00	Río Inabón at Real Abajo	9.70	1.5
50 1140 00	Río Cerrillos nr Ponce	17.8	2.9
50 1150 00	Río Portugués nr Ponce	8.82	1.5
50 1210 00	Río Tallaboa at Peñuelas	24.2	.3 (b)
50 1318 00	Río Cupeyes nr San Germán	4.24	1.4
50 1340 00	Río Duey above Río Hoconuco nr San Germán	7.99	1.2

Table 1.--Computed 7-day, 10-year minimum flows for selected sites--
continued.

Station no.	Station name	Drainage, area, mi ²	Discharge, ft ³ /s
50 1345 50	Río Hoconuco nr Pico	4.44	1.2
50 1359 00	Río Rosario at Las Vegas	11.9	5.0
50 1360 00	Río Rosario at Rosario	17.6	7.2
50 1410 00	Río Yahuecas nr Adjuntas	15.4	6.5
50 1416 00	Río Guayo at mouth nr Lares	10.0	1.7
50 1430 60	Río Lajas nr Maricao	3.03	1.2
50 1431 10	Río Guaba nr Maricao	11.2	6.3
50 1431 50	Río Bucarabones nr Las Marías	9.12	3.3
50 1434 00	Río Grande de Añasco downstream from Río Guaba nr Hacienda Espino	100.	34. (a)
50 1438 50	Río Grande de Añasco upstream from Río Arenas nr Las Marías	118.	51. (a)
50 1439 00	Río Arenas at mouth nr Las Marías	5.95	2.9
50 1440 00	Río Grande de Añasco nr San Sebastián	94.3	37. (b)
50 1469 50	Río Culebrinas at San Sebastián	16.5	4.8

(a) Discharge represents unregulated conditions. However, some regulation exists in 1978 and the value is not representative of 1978 conditions. See the individual station description for details.

(b) Discharge represents some regulation of flow. See the individual station description for details.

Site 1.--Río Guajataca downstream from Que. Anón at Lares

Gaging station 50 0105 00, Río Guajataca at Lares, drainage area = 3.16 mi^2 (8.18 km^2), for which some discharge measurements were available, was considered to be the most representative station for estimating flows at site 1. The discharge measurements at station 50 0105 00 were regressed with concurrent flows at station 50 1410 00, Río Yahuecas near Adjuntas. The 7-day, 10-year flow for station 50 1410 00 was then entered into the regression to obtain an estimate of the 7-day, 10-year flow at station 50 0105 00. The 7-day, 10-year low flow for site 1 was then determined by adjusting the low-flow index estimate at station 50 0105 00 by the ratio of the drainage areas. In this case the resultant flow agreed closely with the flow computed from the regression equation.

Site 2.--Río Cidra near Adjuntas

Gaging station 50 0203 00, Río Cidra at Adjuntas, drainage area = 6.85 mi^2 (17.7 km^2), for which some flow data are available, was considered to be the most representative station for estimating flows at site 2. Flows at this station were regressed with concurrent flows at the gaged site, station 50 0209 00, Río Pellejas near Adjuntas. The remainder of the analysis was similar to that for site 1.

Site 3.--Río Corozal at Corozal and Site 4.--Río Morovis at Morovis

Gaging station 50 0383 20, Río Cibuco below Corozal, drainage area = 15.1 mi^2 (39.1 km^2), for which streamflow data are available, was considered to be the most representative station for estimating flow at sites 3 and 4. Flows at this station were regressed with concurrent flows at the gaged site, station 50 0350 00, Río Grande de Manatí at Ciales. The remainder of the analysis was similar to that for site 1.

Site 5.--Río de la Plata near Cayey

Gaging station 50 0430 00, Río de la Plata at Proyecto La Plata, drainage area = 54.8 mi^2 (141.9 km^2), is located on the same stream as site 5 and only a short distance away. The 7-day, 10-year low flow was estimated by adjustment of the low-flow index at station 50 0430 00 by the ratio of the drainage areas.

Site 6.--Río de Aibonito at Aibonito and Site 7.--Río Guadiana at Naranjito

The 7-day, 10-year low flow at station 50 0430 00, Río de la Plata at Proyecto La Plata, drainage area = 54.8 mi^2 (141.9 km^2), was adjusted by the ratio of drainage areas at sites 6 and 7 to that at station 50 0430 00. Nearly equal weight was given to the regional regression for both of these sites.

Site 8.--Caño de Santiago at Yabucoa
and Site 9.--Caño de Santiago near Central Roig

Gaging station 50 0828 00, Río Guayanés near Colonia Laura, drainage area = 4.69 mi^2 (12.15 km^2), for which some streamflow data are available, was considered to be the most representative station for estimating flow at sites 8 and 9. Flows at these stations were regressed with concurrent flows at the gaged site, station 50 0920 00, Río Grande de Patillas near Patillas. The remainder of the analysis was similar to that for site 1. A small amount of weight was given to the regional regression.

Site 10.--Río Coamo near Coamo

Some data are available for this site which is also identified as station 50 1065 00. Concurrent data at this site, and those for station 50 1140 00, Río Cerrillos near Ponce, were regressed. The 7-day, 10-year low flow for site 10 was then determined from the regression.

Site 11.--Río Rosario at Hormigueros

The 7-day, 10-year low flow for station 50 1360 00, Río Rosario at Rosario, drainage area = 17.6 mi^2 (45.6 km^2), was adjusted by the ratio of the drainage area at site 11 to that at station 50 1360 00 to obtain an estimate at site 11.

Site 12.--Río Yaguez at Mayaguez

The 7-day, 10-year low flow for station 50 1359 00, Río Rosario at Las Vegas, drainage area = 11.9 mi^2 (30.8 km^2), was adjusted by the ratio of the drainage area at site 12 to that at station 50 1359 00 to obtain an estimate at site 12.

Site 13.--Río Grande de Añasco near Añasco

The 7-day, 10-year low flow for station 50 1440 00, Río Grande de Añasco near San Sebastián, drainage area = 94.3 mi^2 (244.2 km^2), was adjusted by the ratio of the drainage areas at site 13 to that at station 50 1440 00 to obtain an estimate at site 13.

Site 14.--Río Culebrinas at San Sebastián
and Site 15.--Río Culebrinas near Central La Plata

The 7-day, 10-year low flow at station 50 1469 50, Río Culebrinas at San Sebastián, drainage area 16.5 mi^2 (42.7 km^2), was adjusted by the ratio of the drainage areas at sites 14 and 15 to that at station 50 1469 50 to obtain estimates at sites 14 and 15. The estimate at site 14 is considered as accurate as that computed for station 50 1469 50.

The estimated 7-day, 10-year minimum flow for the 15 specified sites in Puerto Rico is listed in table 2.

Table 2.--Estimated 7-day, 10-year minimum flows for ungaged sites.

Site no.	Site name	Drainage area, mi ²	Discharge, ft ³ /s
1.	Río Guajataca downstream from Quebrada Anón at Lares	4.85	1.5
2.	Río Cidra upstream from Río Vacas nr Adjuntas	7.88	5.9
3.	Río Corozal at Corozal	9.8	2.8
4.	Río Morovis at Morovis	4.69	1.3
5.	Río de la Plata downstream from Quebrada Santo Domingo nr Cayey	46.4	3.2
6.	Río de Aibonito at Aibonito	5.9	1.0
7.	Río Guadiana at Naranjito	7.88	1.5
8.	Caño de Santiago at Highway 3 at Yabucoa	3.6	2.0
9.	Caño de Santiago nr Central Roig	4.9	2.5
10.	Río Coamo nr Coamo	46.0	1.9
11.	Río Rosario at Hormigueros	24.0	9.8
12.	Río Yaguez at Mayaguez	13.2	5.6
13.	Río Grande de Añasco at mouth nr Añasco	181.	71
14.	Río Culebrinas at San Sebastián	16.6	4.8
15.	Río Culebrinas nr Central La Plata	32.4	9.4

SELECTED REFERENCES

Matalas, N. C., 1963, Probability distribution of low flows: U.S. Geological Survey Professional Paper 434-A, 27 p.

Riggs, H. C., 1968, Some statistical tools in hydrology: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 4, Chapter A1, 39 p.

_____, 1972, Low-flow investigations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 4, Chapter B1, 18 p.

Regulation by the

since 1941

SUPPLEMENT 1

Year

Minimum

1941

1942

10.3

1943

Station information and annual 7-day minimum flows.

1944

10.6

1945

9.7

1946

12.1

1947

1.2

1948

8.29

50 0201 00 Río Vacas near Adjuntas, P.R.

LOCATION.--Lat 18°08'20", long 66°44'02", 1.1 mi (1.77 km) southwest of Adjuntas.

DRAINAGE AREA.--6.03 mi² (15.6 km²).

RECORD.--Twice-daily staff-gage readings 1925 through 1937.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Regulation by Lago Garzas (storage: 4,700 acre-ft, 5.795 hm³) since 1941.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1925	10.3	1932	2.68
1926	5.75	1933	6.26
1927	10.6	1934	8.55
1928	3.77	1935	7.21
1929	12.1	1936	6.00
1930	4.25	1937	6.31
1931	8.20		

50 0209 00 Río Pellejas near Adjuntas, P.R.

LOCATION.--Lat 18°10'59", long 66°41'16", 2.8 mi (4.5 km) northwest of Adjuntas.

DRAINAGE AREA.--2.34 mi² (6.06 km²).

RECORD.--Once- or twice-daily staff-gage readings February 1924 through 1945.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1924	4.25 (a)	1935	2.59
1925	4.06	1936	2.13
1926	3.42	1937	2.40
1927	3.08	1938	.32
1928	1.34	1939	1.81
1929	2.00	1940	3.71
1930	2.21	1941	3.97
1931	5.09	1942	4.80
1932	1.47	1943	3.09
1933	2.24	1944	2.30
1934	2.56	1945	3.00

(a) Minimum observed for the year.

50 0216 00 Río Grande de Arecibo upstream from Utuado, P.R.

LOCATION.--Lat 18°14'09", long 66°43'07", 0.2 mi (0.3 km) downstream
from Río Pellejas and 2.5 mi (4.0 km) southwest of Utuado.

DRAINAGE AREA.--35.2 mi² (91.2 km²).

RECORD.--Once- or twice-daily staff-gage readings 1931 through 1941.

REMARKS.--Records obtained by P.R. Water Resources Authority. Minor
regulation from Lago Garzas (storage: 4,700 acre-ft,
5,795 hm³) after November 1941.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1931	51.2	1937	31.0
1932	23.7	1938	21.4
1933	38.2	1939	6.51
1934	32.2	1940	54.6
1935	32.7	1941	38.2
1936	18.9		

50 0229 50 Río Viví near Adjuntas, P.R.

LOCATION.--Lat 18°11'33", long 66°40'45", 3.5 mi (5.6 km) northeast of Adjuntas.

DRAINAGE AREA.--3.21 mi² (8.31 km²).

RECORD.--Once- or twice-daily staff-gage readings 1926 through 1945.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1926	0.63	1936	3.60
1927	7.10	1937	1.94
1928	8.70	1938	2.50
1929	3.10	1939	1.74
1930	7.21	1940	2.20
1931	.66	1941	3.05
1932	6.00	1942	3.93
1933	1.63	1943	4.28
1934	2.75	1944	1.60
1935	3.71	1945	4.10

50 0251 30 Río Saliente upstream from Río Salientito at Coabey, P.R.

LOCATION.--Lat 18°12'18", long 66°33'27", about 0.5 mi (0.8 km) upstream
from Highway 144 and 2.6 mi (4.2 km) southeast of Jayuya.

DRAINAGE AREA.--5.68 mi² (14.7 km²).

RECORD.--Once- or twice-daily staff-gage readings 1926 through 1943.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1926	0.68	1935	3.60
1927	.79	1936	5.01
1928	1.54	1937	.21
1929	3.90	1938	2.01
1930	1.93	1939	1.96
1931	5.08	1940	4.82
1932	8.48	1941	2.00
1933	5.23	1942	4.47
1934	2.34	1943	3.73

50 0255 50 Río Jauco near La Pica, P.R.

LOCATION.--Lat 18°10'47", long 66°38'35", 1.4 mi (2.3 km) north of
La Pica.

DRAINAGE AREA.--4.16 mi² (10.8 km²).

RECORD.--Once- or twice-daily staff-gage readings 1926 through 1930,
1933 through 1944, and 1947.

REMARKS.--Records obtained by P.R. Water Resources Authority

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1926	3.04	1937	4.36
1927	1.66	1938	3.93
1928	12.1	1939	4.10
1929	1.89	1940	6.25
1930	5.71	1941	3.43
--	--	1942	5.00
1933	1.67	1943	2.28
1934	1.80	1944	2.77
1935	2.06	--	--
1936	2.13	1947	3.23

50 0280 00 Río Tanamá near Utuado, P.R.

LOCATION.--Lat 18°18'02", long 66°46'58", on Highway 111, 1.2 mi (1.9 km) upstream from natural tunnel, 1.5 mi (2.4 km) northeast of Angeles, and 5.8 mi (9.3 km) northwest of Utuado.

DRAINAGE AREA.--18.4 mi² (47.7 km²).

RECORD.--Continuous record 1960 through 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1960	16.3	1969	21.0
1961	22.3	1970	16.1
1962	17.1	1971	23.9
1963	12.6	1972	11.9
1964	12.4	1973	10.1
1965	10.6	1974	11.1
1966	23.1	1975	11.9
1967	11.3	1976	12.9
1968	13.0		

50 0350 00 Río Grande de Manatí at Ciales, P.R.

LOCATION.--Lat 18°19'26", long 66°27'36", 0.8 mi (1.3 km) downstream from Quebrada Saliente, 1.1 mi (1.8 km) upstream from Quebrada Valés, and 1.2 mi (1.93 km) southeast of Ciales.

DRAINAGE AREA.--128 mi² (332 km²), excludes 6.0 mi² (15.5 km²) upstream from Lagos El Guineo and de Matrullas.

RECORD.--Continuous record 1947 through 1952 and 1961 through 1976.

REMARKS.--Record for 1947 through 1952 obtained by P.R. Water Resources Authority. Minor regulation from Lagos El Guineo (storage: 1,860 acre-ft, 2.293 hm³) since 1931 and de Matrullas (storage: 3,000 acre-ft, 3,699 hm³) since 1934.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1947	51.0	1966	69.1
1948	33.3	1967	37.3
1949	46.4	1968	42.3
1950	81.3	1969	93.4
1951	81.9	1970	61.9
1952	75.5	1971	56.3
--	--	1972	54.0
1961	49.4	1973	38.9
1962	57.4	1974	25.0
1963	83.7	1975	37.1
1964	35.9	1976	47.1
1965	37.0		

50 0430 00 Río de la Plata at Proyecto La Plata, P.R.

LOCATION.--Lat $18^{\circ}09'37''$, long $66^{\circ}13'44''$, at Highway 173, and 0.4 mi
(0.6 km) northeast of Proyecto La Plata.

DRAINAGE AREA.-- 54.8 mi^2 (141.9 km^2), excludes 8.2 mi^2 (21.2 km^2) upstream
from Carite Reservoir, the flow of which is diverted out
of the basin.

RECORD.--Continuous record 1960-76.

REMARKS.--Some regulation from Carite Reservoir (storage: 11,300 acre-ft,
 $13,933 \text{ hm}^3$) since 1913.

Annual 7-day minimum flow, ft^3/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1960	11.6	1969	19.4
1961	15.1	1970	7.3
1962	36.3	1971	12.3
1963	20.4	1972	8.3
1964	10.6	1973	6.3
1965	6.1	1974	3.3
1966	17.0	1975	6.3
1967	4.2	1976	10.2
1968	3.4		

50 0550 00 Río Grande de Loíza at Caguas, P.R.

LOCATION.--Lat $18^{\circ}14'35''$, long $66^{\circ}00'35''$ at Highway 189 (previously Highway 30) 1.2 mi (1.9 km) downstream from Río Turabo, and 1.8 mi (2.9 km) east of the Plaza de Caguas.

DRAINAGE AREA.--89.8 mi² (232.6 km²).

RECORD.--Continuous record 1960 through 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1960	36.1	1969	35.4
1961	55.7	1970	26.6
1962	75.6	1971	62.4
1963	39.9	1972	52.6
1964	30.7	1973	42.6
1965	23.1	1974	13.9
1966	46.7	1975	18.6
1967	21.7	1976	56.9
1968	11.0		

50 0710 00 Río Fajardo near Fajardo, P.R.

LOCATION.--Lat 18°17'56", long 65°41'42", at Highway 976, 1.1 mi (1.8 km) northeast of Colonia Paraiso, and 3.3 mi (5.3 km) southwest of Fajardo.

DRAINAGE AREA.--14.9 mi² (38.6 km²).

RECORD.--Continuous record 1962 through 1976.

REMARKS.--Low flows affected by diversion and slight regulation upstream by the Fajardo filtration plant.

Annual 7-day minimum flow, ft ³ /s			
<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1962	14.1	1970	10.4
1963	15.0	1971	10.0
1964	11.1	1972	10.7
1965	10.6	1973	7.2
1966	14.0	1974	4.2
1967	7.3	1975	9.7
1968	3.4	1976	9.8
1969	19.1		

50 0920 00 Río Grande de Patillas near Patillas, P.R.

LOCATION.--Lat 18°02'04", long 66°01'58", at footbridge upstream from
Lago Patillas, 1.2 mi (1.9 km) northwest of Patillas Dam, and
2.2 mi (3.5 km) northwest of Patillas.

DRAINAGE AREA.--18.3 mi² (47.4 km²).

RECORD.--Continuous record 1966 through 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1966	16.7	1972	10.9
1967	7.5	1973	5.9
1968	5.0	1974	7.3
1969	10.1	1975	12.0
1970	11.6	1976	15.9
1971	14.9		

50 1125 00 Río Inabón at Real Abajo, P.R.

LOCATION.--Lat 18°05'10", long 66°33'46", on private road off Highway 511 at Hacienda La Concordia, 0.4 mi (0.6 km) upstream from diversion canal, 0.5 mi (0.8 km) north of Real Abajo, and 6.1 mi (9.8 km) northeast of Plaza Degetau in Ponce.

DRAINAGE AREA.--9.70 mi² (25.1 km²).

RECORD.--Continuous record 1965 through 1969 and 1972 through 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1965	2.2	1972	3.8
1966	3.1	1973	1.5
1967	1.5	1974	1.9
1968	2.9	1975	2.0
1969	6.0	1976	2.4
--	--		
--	--		

50 1140 00 Río Cerrillos near Ponce, P.R.

LOCATION.--Lat 18°04'22", long 66°34'53", 0.2 mi (0.3 km) upstream from road ford, 2.3 mi (3.7 km) upstream from Quebrada Ausubo, and 4.6 mi (7.4 km) northeast of Plaza Degetau in Ponce.

DRAINAGE AREA.--17.8 mi² (46.1 km²).

RECORD.--Continuous record 1965 through 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1965	4.3	1971	10.4
1966	7.2	1972	5.4
1967	3.1	1973	2.7
1968	4.0	1974	3.8
1969	9.3	1975	3.8
1970	4.4	1976	5.8

50 1150 00 Río Portugués near Ponce, P.R.

LOCATION.--Lat 18°04'45", long 66°38'03", at Highway 503, 4.7 mi (7.6 km)
north of Plaza Degetau in Ponce.

DRAINAGE AREA.--8.82 mi² (22.84 km²).

RECORD.--Continuous record 1965 through 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1965	2.6	1971	3.9
1966	3.1	1972	2.7
1967	1.8	1973	1.3
1968	2.4	1974	1.8
1969	4.3	1975	2.9
1970	3.1	1976	2.4

50 1210 00 Río Tallaboa at Peñuelas, P.R.

LOCATION.--Lat 18°03'02", long 66°43'19", at Highway 132 and 0.6 mi (1.0 km) south of Peñuelas.

DRAINAGE AREA.--24.2 mi² (62.7 km²).

RECORD.--Continuous record 1959 through 1970.

REMARKS.--Natural flow of stream affected by transbasin diversion from Lago Garzas since 1941 and by storage reservoirs, power development and diversions for public water supply and irrigation.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1959	2.37	1965	0.10
1960	1.10	1966	1.19
1961	10.8	1967	.54
1962	7.00	1968	.80
1963	.84	1969	4.00
1964	1.40	1970	4.41

50 1318 00 Río Cupeyes near San Germán, P.R.

LOCATION.--Lat 18°04'44", long 67°00'29", 100 ft (30 m) upstream from
confluence with Río Guanajibo and 2.4 mi (3.9 km) east of
San Germán.

DRAINAGE AREA.--4.24 mi² (10.98 km²).

RECORD.--Daily staff-gage readings 1934 through 1948.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1934	2.68	1942	2.13
1935	3.27	1943	4.10
1936	2.52	1944	1.16
1937	1.89	1945	2.12
1938	2.03	1946	2.96
1939	1.90	1947	1.98
1940	1.43	1948	3.10
1941	1.93		

50 1340 00 Río Duey above Río Hoconuco near San Germán, P.R.

LOCATION.--Lat 18°07'18", long 67°04'32", at unimproved road 1,000 ft (300 m) upstream from confluence with Río Hoconuco, about 0.5 mi (0.8 km) upstream from Highway 2, and 3.3 mi (5.3 km) northwest of San Germán.

DRAINAGE AREA.--7.99 mi² (20.69 km²).

RECORD.--Daily staff-gage readings 1936 through 1947.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1936	1.41	1942	3.53
1937	1.65	1943	6.08
1938	1.19	1944	3.21
1939	2.47	1945	3.72
1940	1.43	1946	4.55
1941	1.27	1947	3.49

50 1345 50 Río Hoconuco near Pico, P.R.

LOCATION.--Lat $18^{\circ}07'06''$, long $67^{\circ}03'32''$, at unimproved road, about 1.4 mi
(2.3 km) upstream from confluence with Río Duey, and 1.3 mi
(2.1 km) southwest of Pico.

DRAINAGE AREA.--4.44 mi² (11.50 km²).

RECORD.--Daily staff-gage readings 1936 through 1945 and 1947.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft ³ /s			
<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1936	1.22	1942	2.23
1937	1.72	1943	2.09
1938	1.49	1944	2.11
1939	2.13	1945	1.64
1940	1.85	--	--
1941	1.29	1947	2.80

50 1359 00 Río Rosario at Las Vegas, P.R.

LOCATION.--Lat 18°11'10", long 67°02'08", 0.4 mi (0.6 km) downstream from Highway 105 and 3.6 mi (5.8 km) west of Maricao.

DRAINAGE AREA.--11.9 mi² (30.8 km²).

RECORD.--Daily staff-gage readings 1927 through 1944 and 1946 through 1947.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1927	5.23	1938	5.29
1928	6.86	1939	10.6
1929	11.9	1940	5.67
1930	8.31	1941	6.67
1931	5.44	1942	9.16
1932	5.46	1943	13.9
1933	6.60	1944	8.50
1934	10.1	--	--
1935	12.6	1946	10.5
1936	4.96	1947	10.0
1937	4.91		

50 1360 00 Río Rosario at Rosario, P.R.

LOCATION.--Lat 18°10'24", long 67°04'27", 500 ft (150 m) downstream from
ford, 550 ft (170 m) downstream from Quebrada Figueroa, and
0.8 mi (1.3 km) northeast of Rosario.

DRAINAGE AREA.--17.6 mi² (45.6 km²).

RECORD .--Daily staff-gage readings 1936 through 1945 and 1947 through 1948.

Continuous record 1961 through 1962, 1964 through 1965, and 1976.

REMARKS.--Records obtained by P.R. Water Resources Authority through 1965
and by the U.S.G.S. in 1976.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1936	6.50	1947	9.10
1937	8.48	1948	8.00
1938	8.00	--	--
1939	14.7	1961	17.3
1940	11.8	1962	9.69
1941	9.11	--	--
1942	16.5	1964	10.4
1943	16.4	1965	7.10
1944	9.63	--	--
1945	10.7	1976	9.26
--	--		

50 1410 00 Río Yahuecas near Adjuntas, P.R.

LOCATION.--Lat 18°12'19", long 66°48'01", 1.0 mi (1.6 km) downstream from
the confluence of Río Limaní and Río Guilarte, and 6.2 mi
(10.0 km) northwest of Adjuntas.

DRAINAGE AREA.--15.4 mi² (39.9 km²).

RECORD .--Continuous record 1946 through 1964.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1947	7.93	1956	11.7
1948	7.71	1957	6.09
1949	7.83	1958	6.90
1950	10.8	1959	6.33
1951	9.57	1960	8.04
1952	14.1	1961	9.57
1953	7.74	1962	8.00
1954	11.6	1963	7.10
1955	11.1	1964	8.11

50 1416 00 Río Guayo at mouth near Lares, P.R.

LOCATION.--Lat 18°13'23", long 66°49'56", 1,000 ft (300 m) upstream from the confluence with Río Yahuecas and about 6.5 mi (10.5 km) southeast of Lares.

DRAINAGE AREA.--10.0 mi² (25.9 km²).

RECORD.--Daily staff-gage readings 1925, 1927, and 1929 through 1945.

Continuous record 1949 and 1951 through 1953.

REMARKS.--Records obtained by P.R. Water Resources Authority. Major regulation and diversion from Lago Guayo (storage: 17,400 acre-ft, 21.454 hm³) since 1956.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1925	0.90	1939	4.84
--	--	1940	4.44
1927	16.0	1941	4.31
--	--	1942	5.36
1929	8.75	1943	4.93
1930	3.50	1944	3.16
1931	3.32	1945	4.71
1932	2.00	--	--
1933	2.00	1949	2.29
1934	2.00	--	--
1935	3.50	1951	3.91
1936	4.20	1952	9.57
1937	1.62	1953	4.76
1938	4.20		

50 1430 60 Río Lajas near Maricao, P.R.

LOCATION.--Lat 18°10'04", long 66°57'34", 0.6 mi (1.0 km) upstream from
confluence with Río Bonelli, and 1.8 mi (2.9 km) southeast of
Maricao.

DRAINAGE AREA.--3.03 mi² (7.85 km²).

RECORD.--Once- or twice-daily staff-gage readings 1936 through 1946.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1936	1.17	1942	1.83
1937	1.25	1943	1.92
1938	1.80	1944	1.20
1939	1.91	1945	2.80
1940	2.23	1946	2.86
1941	1.98		

50 1431 10 Río Guaba near Maricao, P.R.

LOCATION.--Lat 18°11'17", long 66°57'23", 0.3 mi (0.5 km) downstream from
confluence with Río Lajas, and 1.6 mi (2.6 km) east of Maricao.

DRAINAGE AREA.--11.2 mi² (29.0 km²).

RECORD .--Once- or twice-daily staff-gage readings 1927 through 1940 and
1942 through 1946.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1927	9.34	1937	6.40
1928	8.63	1938	8.96
1929	8.93	1939	8.94
1930	6.79	1940	7.07
1931	6.30	--	--
1932	8.09	1942	7.39
1933	5.87	1943	11.0
1934	6.31	1944	8.34
1935	11.3	1945	8.74
1936	7.17	1946	10.4

50 1431 50 Río Bucarabones near Las Marías, P.R.

LOCATION.--Lat 18°13'27", long 66°56'41", 300 ft (90 m) upstream from
confluence with Río Guaba, about 1,400 ft (430 m) upstream
from Highway 124, and 2.2 mi (3.5 km) southeast of Las Marías.

DRAINAGE AREA.--9.12 mi² (23.62 km²).

RECORD.--Daily staff-gage readings 1928 through 1932, 1934 through 1942,
and 1944 through 1945.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1928	3.39	1937	3.64
1929	7.75	1938	3.83
1930	8.59	1939	5.03
1931	7.39	1940	3.22
1932	8.24	1941	4.23
--	--	1942	3.78
1934	6.85	--	--
1935	11.2	1944	4.00
1936	4.30	1945	5.74

50 1434 00 Río Grande de Añasco downstream from Río Guaba near Hacienda Espino, P.R.

LOCATION.--Lat 18°15'39", long 66°56'13", 0.5 mi (0.8 km) downstream from Río Guaba, 1.1 mi (1.8 km) northwest of Hacienda Espino, and 3.8 mi (6.1 km) east of Las Marías.

DRAINAGE AREA.--100 mi² (259 km²).

RECORD.--Once- or twice-daily staff-gage readings 1927 through 1929 and 1931 through 1946.

REMARKS.--Records obtained by P.R. Water Resources Authority. Transbasin diversion to Río Yauco basin for hydroelectric power and irrigation of flow above Lagos Guayo, Yahuecas, and Prieto (combined usable storage: 17,300 acre-ft, 21.331 hm³) since 1955. Limited storm runoff is contributed to basin by 3.5 mi (9.1 km²) upstream from Lago Toro since 1955. The flows shown for this station represent natural conditions.

Annual 7-day minimum flow, ft ³ /s			
<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1927	55.1	1937	36.1
1928	60.9	1938	54.0
1929	82.2	1939	69.6
--	--	1940	81.9
1931	52.0	1941	69.5
1932	24.8	1942	76.9
1933	89.9	1943	89.5
1934	34.5	1944	59.0
1935	93.4	1945	67.3
1936	61.4	1946	55.0

50 1438 50 Río Grande de Añasco upstream from Río Arenas near Las Marías,
P.R.

LOCATION.--Lat $18^{\circ}16'49''$, long $67^{\circ}00'18''$, 800 ft (240 m) upstream from
Río Arenas, and 2.0 mi (3.2 km) northwest of Las Marías.

DRAINAGE AREA.--118 mi² (306 km²).

RECORD.--Once- or twice-daily staff-gage readings 1932 through 1933, 1935
through 1941, and 1944 through 1945.

REMARKS.--Records obtained by P.R. Water Resources Authority. Diversions
and regulation same as for station 50 1434 00. The flows shown
for this station represent natural conditions.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1932	86.9	1939	87.9
1933	88.7	1940	105
--	--	1941	54.0
1935	99.0	--	--
1936	53.9	1944	68.1
1937	71.8	1945	81.0
1938	76.6		

50 1439 00 Río Arenas at mouth near Las Marías, P.R.

LOCATION.--Lat 18°16'42", long 67°00'25", 1,000 ft (300 m) upstream from
confluence with Río Grande de Arecibo, and 1.9 mi (3.1 km)
northwest of Las Marías plaza.

DRAINAGE AREA.--5.95 mi² (15.41 km²).

RECORD.--Once- or twice-daily staff-gage readings 1925 through 1945.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1925	6.47	1936	7.42
1926	4.74	1937	3.75
1927	6.20	1938	3.73
1928	7.31	1939	7.97
1929	2.82	1940	5.78
1930	4.92	1941	2.12
1931	4.26	1942	8.29
1932	5.01	1943	8.31
1933	8.15	1944	3.50
1934	7.37	1945	4.30
1935	8.19		

50 1440 00 Río Grande de Añasco near San Sebastián, P.R.

LOCATION.--Lat $18^{\circ}17'00''$, long $67^{\circ}03'02''$, at Highway 108, 4.4 mi (7.1 km) northwest of Las Marías, and 5.4 mi (8.7 km) southwest of San Sebastián.

DRAINAGE AREA.-- 94.3 mi^2 (244.2 km^2), does not include 36.2 mi^2 (93.8 km^2) which contributes only during high floods, and 3.5 mi^2 (9.1 km^2) which contributes only part of its storm runoff.

RECORD.--Continuous record 1964 through 1976.

REMARKS.--Transbasin diversion to Río Yauco basin for hydroelectric power and irrigation of flow above Lagos Guayo, Yahuecas, and Prieto (combined usable storage: 17,300 acre-ft, 21.331 hm^3) since 1955. Limited storm runoff is contributed to basin by 3.5 mi^2 (9.1 km^2) upstream from Lago Toro.

Annual 7-day minimum flow, ft^3/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1964	66	1971	68
1965	44	1972	77
1966	35	1973	46.4
1967	62	1974	51.4
1968	40	1975	49.1
1969	41	1976	67.4
1970	78		

50 1469 50 Río Culebrinas at San Sebastián, P.R.

LOCATION.--Lat 18°20'04", long 66°59'38", 800 ft (240 m) upstream from
Highway 109 at San Sebastián.

DRAINAGE AREA.--16.5 mi² (42.7 km²).

RECORD.--Once-or twice-daily staff-gage readings 1927 through 1935 and
1937 through 1945.

REMARKS.--Records obtained by P.R. Water Resources Authority.

Annual 7-day minimum flow, ft³/s

<u>Year</u>	<u>Discharge</u>	<u>Year</u>	<u>Discharge</u>
1927	15.1	1937	13.7
1928	9.80	1938	3.72
1929	12.8	1939	5.31
1930	9.48	1940	7.24
1931	9.48	1941	16.6
1932	8.05	1942	9.40
1933	7.80	1943	8.96
1934	8.86	1944	5.89
1935	9.01	1945	5.26
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SUPPLEMENT 2

Information for sites where 7-day, 10-year minimum flows were estimated.

Site 1.--Río Guajataca downstream from Quebrada Anón at Lares, P.R.

LOCATION.--Lat 18°18'06", long 66°52'27", downstream from Quebrada Anón at Lares.

DRAINAGE AREA.--4.85 mi² (12.56 km²).

Site 2.--Río Cidra upstream from Río Vacas near Ajuntas, P.R.

LOCATION.--Lat 18°10'52", long 66°43'52", upstream from Río Vacas, about 150 ft (45 m) upstream from Highway 135 and 1.4 mi (2.3 km) northwest from Adjuntas plaza.

DRAINAGE AREA.--7.88 mi² (20.41 km²).

Site 3.--Río Corozal at Corozal, P.R.

LOCATION.--Lat 18°20'53", long 66°19'08", 0.8 mi (1.3 km) west-northwest from the Corozal plaza and at a road crossing.

DRAINAGE AREA.--9.8 mi² (25.4 km²).

Site 4.--Río Morovis at Morovis, P.R.

LOCATION.--Lat 18°19'50", long 66°24'59", at trail crossing 0.6 mi (1.0 km) west-northwest from the Morovis plaza.

DRAINAGE AREA.--4.69 mi² (12.15 km²).

SITE 5.--Río de la Plata downstream from Quebrada Santo Domingo near Cayey, P.R.

LOCATION.--Lat 18°08'08", long 66°10'09", downstream from Quebrada Santo Domingo and 1.5 mi (2.4 km) north of Cayey plaza.

DRAINAGE AREA.--46.4 mi² (120.2 km²).

Site 6.--Río de Aibonito at Aibonito, P.R.

LOCATION.--Lat 18°09'05", long 66°16'39", 0.2 mi (0.3 km) west-southwest of intersection of Highways 718 and 725 and 1.0 mi (1.6 km) northwest of Aibonito plaza.

DRAINAGE AREA.--5.9 mi² (15.3 km²).

Site 7.--Río Guadiana at Naranjito, P.R.

LOCATION.--Lat 18°18'10", long 66°14'05", downstream from Quebrada Anones and 0.7 mi (1.1 km) east of Naranjito plaza.

DRAINAGE AREA.--7.88 mi² (20.41 km²).

Site 8.--Caño de Santiago at Highway 3 at Yabucoa, P.R.

LOCATION.--Lat 18°03'21", long 65°52'33", at Highway 3, and 0.4 mi (0.6 km) northeast of Yabucoa.

DRAINAGE AREA.--3.6 mi² (9.3 km²).

Site 9.--Caño de Santiago near Central Roig, P.R.

LOCATION.--Lat 18°03'36", long 65°50'43", downstream from Zanja Barra, about 1.4 mi (2.3 km) upstream from mouth, 1.9 mi (3.1 km) east of Central Roig, and 2.3 mi (3.7 km) east of Yabucoa.

DRAINAGE AREA.--4.9 mi² (12.7 km²).

Site 10.--(U.S.G.S. station 50 1065 00) Río Coamo near Coamo, P.R.

LOCATION.--Lat 18°03'52", long 66°22'10" at Highway 153, 1.5 mi (2.4 km) south of Coamo.

DRAINAGE AREA.--46.0 mi² (119.1 km²).

Site 11. (U.S.G.S. station 50 1366 00)--Río Rosario at Hormigueros, P.R.

LOCATION.--Lat $18^{\circ}07'44''$, long $67^{\circ}07'25''$, at Highway 319, 0.9 mi (1.4 km) south of Hormigueros plaza.

DRAINAGE AREA.-- 24.0 mi^2 (62.2 km^2).

Site 12. (U.S.G.S. station 50 1390 00)--Río Yaguez at Mayaguez, P.R.

LOCATION.--Lat $18^{\circ}12'27''$, long $67^{\circ}08'27''$, at old Highway 2, on Post Street, and 0.4 mi (0.6 km) north of Mayaguez plaza.

DRAINAGE AREA.-- 13.2 mi^2 (34.2 km^2).

Site 13.--Río Grande de Añasco at mouth near Añasco, P.R.

LOCATION.--Lat $18^{\circ}16'08''$, long $67^{\circ}11'18''$, at mouth, 3.3 mi (5.3 km) west-southwest of Añasco.

DRAINAGE AREA.-- 181 mi^2 (466 km^2), does not include 36.2 mi^2 (93.8 km^2) which contributes only during high floods and 3.5 mi^2 (9.1 km^2) which contributes only part of its storm runoff.

Site 14. (U.S.G.S. station 50 1470 00)--Río Culebrinas at San Sebastián, P.R.

LOCATION.--Lat $18^{\circ}20'08''$, long $66^{\circ}59'46''$, at Highway 109, 0.4 mi (0.6 km) southwest of San Sebastián, and 0.9 mi (1.4 km) upstream from Río Guatemala.

DRAINAGE AREA.-- 16.6 mi^2 (43.0 km^2).

Site 15.--Río Culebrinas near Central La Plata, P.R.

LOCATION.--Lat $18^{\circ}20'47''$, long $67^{\circ}01'22''$, upstream from Río Sonador, 0.7 mi (1.1 km) west-southwest of Central La Plata, and 2.1 mi (3.4 km) west of San Sebastián.

DRAINAGE AREA.-- 32.4 mi^2 (83.9 km^2).

