PREPARED IN COOPERATION WITH THE
PUERTO RICO DEPARTMENT OF NATURAL RESOURCES

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

FLOOD OF SEPTEMBER 16, 1975, IN THE YAUCO VALLEY, PUERTO RICO

By

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DEPARTMENT OF THE INTERIOR

UNITED STATES GEOLOGICAL SURVEY

WATER RESOURCES INVESTIGATIONS
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INTRODUCTION

This report provides a record of the flood of September 16, 1975 in the Yauco area, and associated hydrologic data. These data can be used by planners and designers to make rational decisions in the land use of the Yauco Valley flood plain.

The Yauco Valley lies on the southwestern slopes of Puerto Rico about 26 km west of the city of Ponce. The Río Yauco flows in a narrow V-shaped bedrock valley below Lago Lucchetti, in its head-waters, to the town of Yauco. Just downstream of the town the valley widens forming a relatively flat alluviated floor seldom more than 1 km in width. About 1.5 km above its mouth the river spreads onto a narrow coastal plain. The economy in the area is mainly agricultural, mostly sugarcane, with some light industry. The town of Yauco lies on the southeastern slopes of a hill and is bordered by the Río Yauco on the east.

The continuous growth of the Yauco urban area has resulted in urban development into the flood plain. Part of this recently developed area is subject to flooding by the Río Yauco.

The climate is semiarid with a mean annual precipitation of about 890 mm on the coastal plain, and about 1780 mm in the mountains. The temperature ranges from 27°C in the winter to 29°C in summer.

Data are referred to in SI (International System) units. The SI units may be converted to inch-pound units by multiplying the units given by the factors shown:

Multiply SI units	By	To obtain inch-pound units
	Length	
meter (m)	3.2808	foot (ft)
millimeter (mm)	0.03937	inch (in)
kilometer (km)	0.6214	mile (mi)
	Area	
square kilometer (km^2)	0.3861	square mile (mi^2)
	Discharge	
cubic meter per second (m^3/s)	35.31	cubic foot per second (ft^3/s)
	Temperature	
degree Celsius (C°)	1.8 C° + 32	degree Fahrenheit (°F)

RÍO YAUCO BASIN

The Río Yauco Basin is located on the southern slopes of the Cordillera Central and is bordered on the east by the Río Guayanilla Basin,on the west by the Río Loco Basin, and on the north by the Río Grande de Añasco Basin. The Río Yauco flows in a southerly direction from the Cordillera Central through Lago Lucchetti reservoir, and empties into Bahía de Guayanilla on the Caribbean Sea (fig. 1).

An interconnected reservoir system was built between 1955 and 1956, with a combined capacity of about 24.6 hm^3 . This system drains about 101 km^2 of the Río Grande de Añasco Basin into the Lago Lucchetti reservoir by Tunnel, which also connects flow from 45 km^2 from the Río Yauco Basin. The storage capacity of Lago Lucchetti is 20.3 hm^3 . Water is diverted from Lago Lucchetti into Lago Loco for power generation and irrigation. Discharge from the drainage area of Río Grande de Añasco into the Yauco Basin is controlled by the capacity of the diversion tunnel (2.44 in diameter). During extraordinary floods the flow through the tunnel will not significantly increase the discharge in the Río Yauco Basin.

The effects that Lago Lucchetti may have on a flood cannot be predicted because the capacity of the reservoir is regulated for power generation and irrigation.

The total drainage area of Río Yauco basin contributing to floods is 124 km^2.

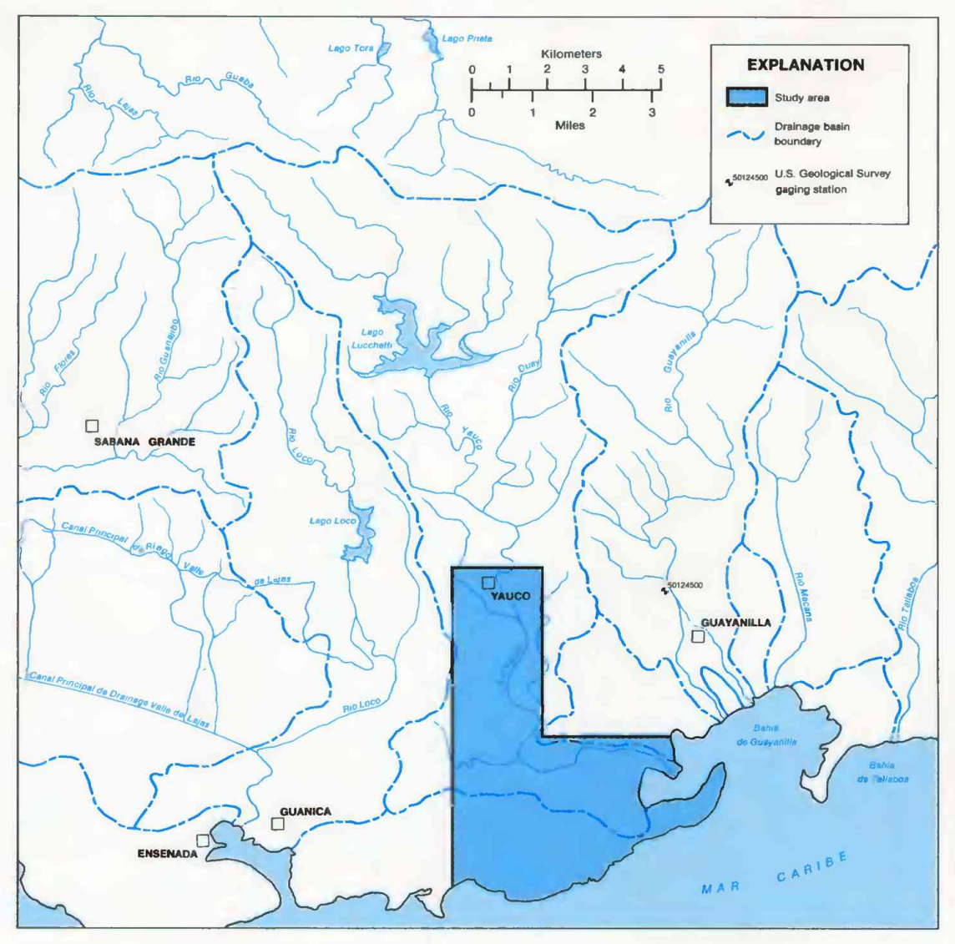
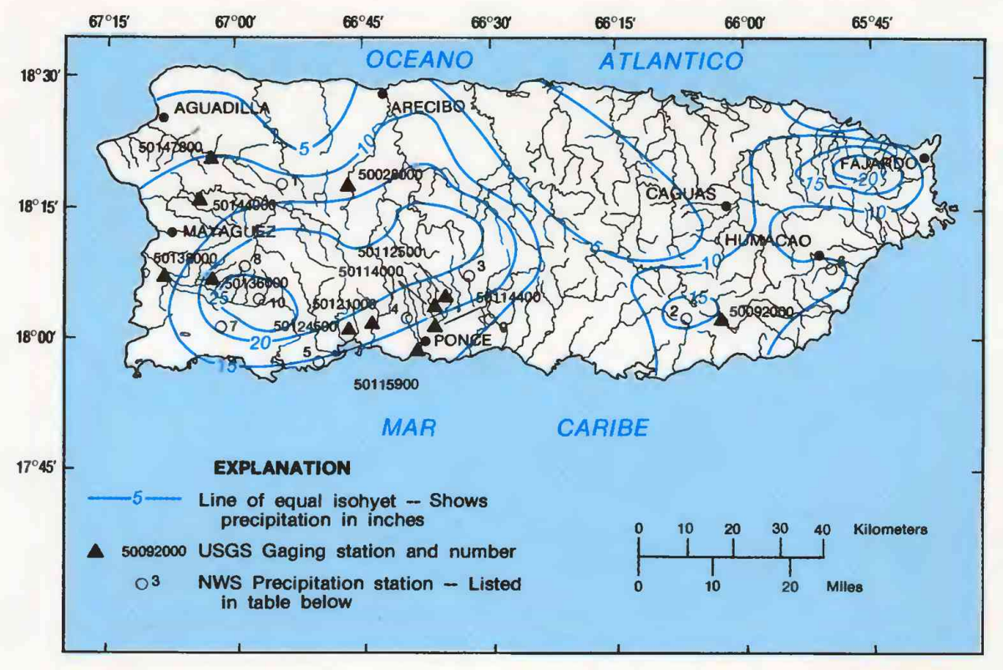


FIGURE 1. - Location of study area and Río Yauco basin.

FLOOD OF SEPTEMBER 16, 1975

The passage of hurricane Eloise near the north coast of Puerto Rico caused torrential rains on September 15, 16, and 17, 1975, producing destructive floods in the southwestern part of the island. The magnitude of the September 16, 1975 flood was about the same as the previous maximum flood of record which occurred in 1899. Precipitation at 10 rainfall stations during September 15-17, 1975, and the distribution of precipitation through the island for this period are shown in figure 2.



NUMBER ON MAP	LOCATION	PRECIPITATION, OF SEPTEMBER 15-17, 1975 IN INCHES SEPT 15	SEPT 16	SEPT 17	TOTAL
1	ADJUNTAS SUBSTATION	0.15	11.99	4.87	17.01
2	CARITE PLANT NO. 1	0.05	10.05	6.85	16.95
3	CERRO MARAVILLA	0.46	16.00	2.37	18.83
4	CORRAL VIEJO	0.10	7.58	8.26	15.94
5	ENSENADA	0.05	5.41	10.30	15.76
6	HUMACAO	0.40	8.02	5.22	13.64
7	LAJAS SUBSTATION	0.29	3.10	12.26	15.65
8	MARICAO 2 SSW	2.32	6.05	14.10	22.47
9	PONCE 4E	0.00	2.90	7.78	10.68
10	SABANA GRANDE 2 ENE	1.20	14.00	11.50	26.70

FIGURE 2. - Map of Puerto Rico showing isohyets for September 15-17, 1975 locations of Selected Precipitation and stream-gaging stations, and table showing the precipitation for the selected stations.

Photographs of selected sites in the Yauco area during the September 16, 1975 flood are shown in figures 3 to 17. The photograph locations are are identified on the flood map by a circular symbol with an identifying letter and an arrow showing the direction in which the respective photograph was taken. A rod marked in feet and a black arrow is used to point out the depth of floodwaters on some photographs.

FIGURE 3. - Flood height (noted by arrow) at Tendal Street No. 1 (photograph A).

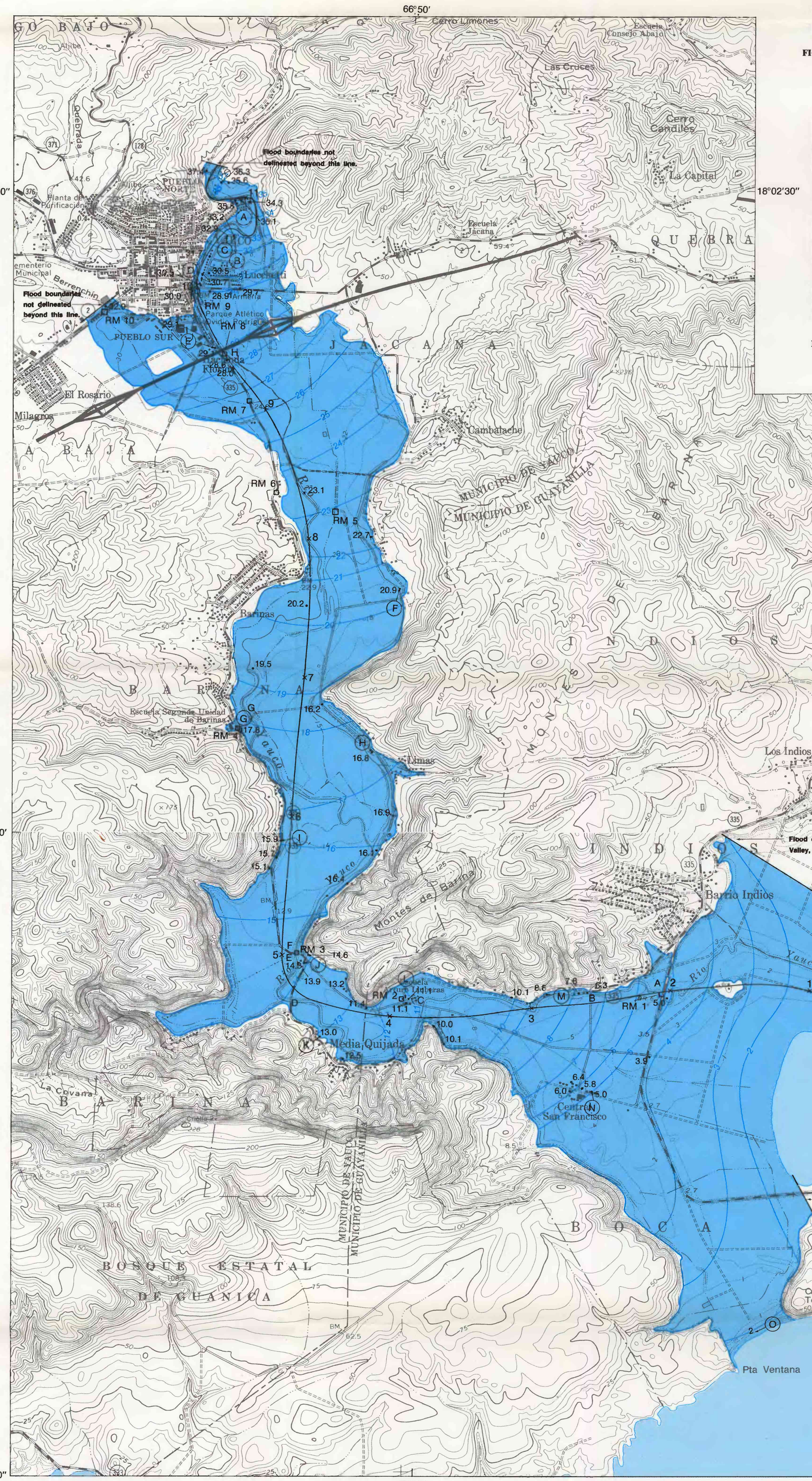
FIGURE 4. - Flood height (noted by arrow) at Lucchetti Urbanization Street 1, No. H-34 (photograph B).

FIGURE 5. - Flood height (noted by arrow) at Lucchetti Urbanization Street 1, No. H-35 (photograph C).

FIGURE 6. - Flood height (noted by arrow) at Lucchetti Urbanization Street 1, No. H-1 (photograph D).

FIGURE 7. - Flood height (noted by arrow) at Calle Santo Domingo No. Sur 1 at Yauco (photograph E).

FIGURE 8. - Flood height (noted by arrow) in the back of house of Sra. Rivera at Barrio Limas (photograph F).



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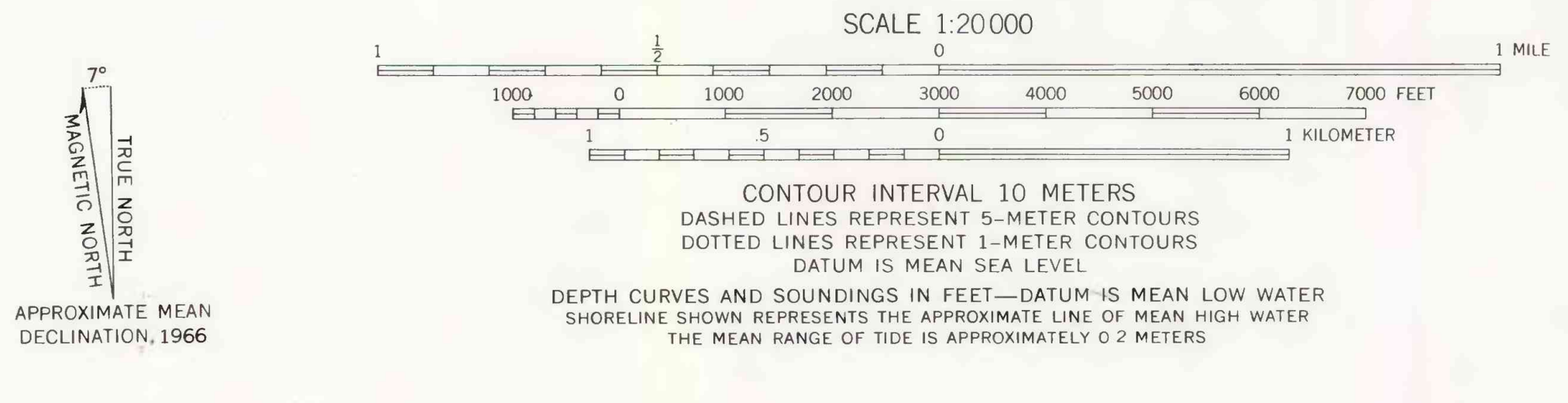

CONTOUR INTERVAL 10 METERS
DASHED LINES REPRESENT 5-METER CONTOURS
DOTTED LINES REPRESENT 1-METER CONTOURS
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 0 2 METERS

EXPLANATION

🟦	Area flooded, September 16, 1975
—	Boundary of the 1975 flood
—12—	Water-surface contour for the 1975 flood in meters. Contour interval 1 meter
.10.1	Elevation of flood marks, in meters
F	Bridge locations, refers to table 2 and profile
2	Base line and distance from mouth of river, in kilometers
RM 2 □	Reference marks established by the U.S. Geological Survey refer to table 3.
←(H)	Photographs showing depth of water at different sites in the valley as a result of the September 16, 1975 flood

FIGURE 9. - Flood height (noted by arrow) inside of garage of house beside baseball park at Bo. Barinas (photograph G).

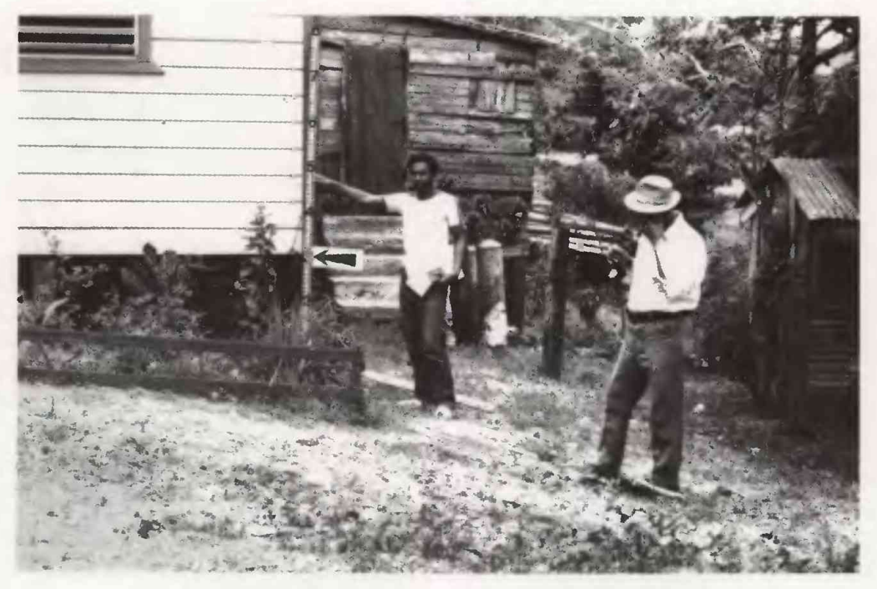

FIGURE 10. - Flood height (noted by arrow) on back of house of Sra. Báez at Hacienda San Rafael, Bo. Limas (photograph H).

FIGURE 11. - Flood height (noted by arrow) in front of house of Sr. Cervoni at Highway 335, km. 8.3, Bo. Barinas (photograph I).

FIGURE 12. - Flood height (noted by arrow) on house near old Gallera Barinas at Bo. Media Quijada (photograph J).

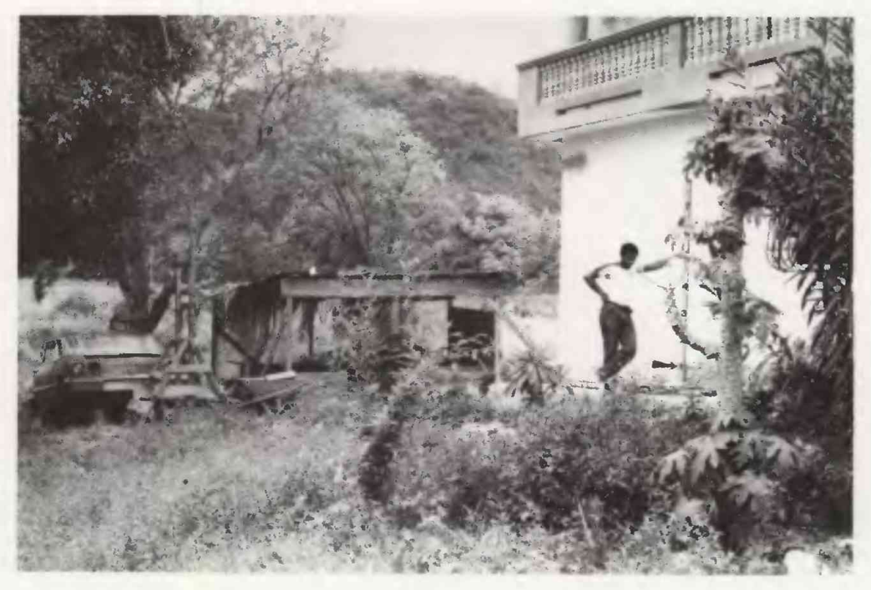

FIGURE 13. - Flood height (noted by arrow) on Colmado Edmundo López, Bo. Media Quijada (photograph K).

FIGURE 14. - Flood height (noted by arrow) at San Francisco Cooperative Superet, Bo. Media Quijada (photograph L).

FIGURE 15. - Flood height (noted by arrow) at house of Sra. Soltero at Highway 335, km. 5.5, Bo. Indios (photograph M).

FIGURE 16. - Flood height (noted by arrow) on abandoned house at Central San Francisco (photograph N).

FIGURE 17. - Punta Ventana, water was flowing about 1 meter deep over beach section (photograph O).

FLOOD HISTORY

Historical records and interviews with residents in the area subject to flooding by the Río Yauco indicate that extensive flooding has occurred at least five times since 1867. No record was recovered to determine the magnitude of the 1867 flood. The floods in order of magnitude since 1899 are September 16, 1975, August 8, 1899, September 13, 1928, and September 18, 1960. The stage and approximate discharge of selected floods are shown in table 1. Figure 18 presents a graphic analysis of data in table 1.

Table 1.--Floods on the Río Yauco at Escuela Arturo Lluveras

Date	Elevation above mean sea level, meters	Peak discharge, cubic meters per second
Aug. 8, 1899	10.9	1190
Sept. 13, 1928	9.9	510
Sept. 18, 1960	9.5	283
Nov. 11, 1961	8.8	82
April 28, 1962	8.4	51
Sept. 27, 1963	8.9	93
July 21, 1968	8.6	62
Sept. 16, 1975	11.0	1260

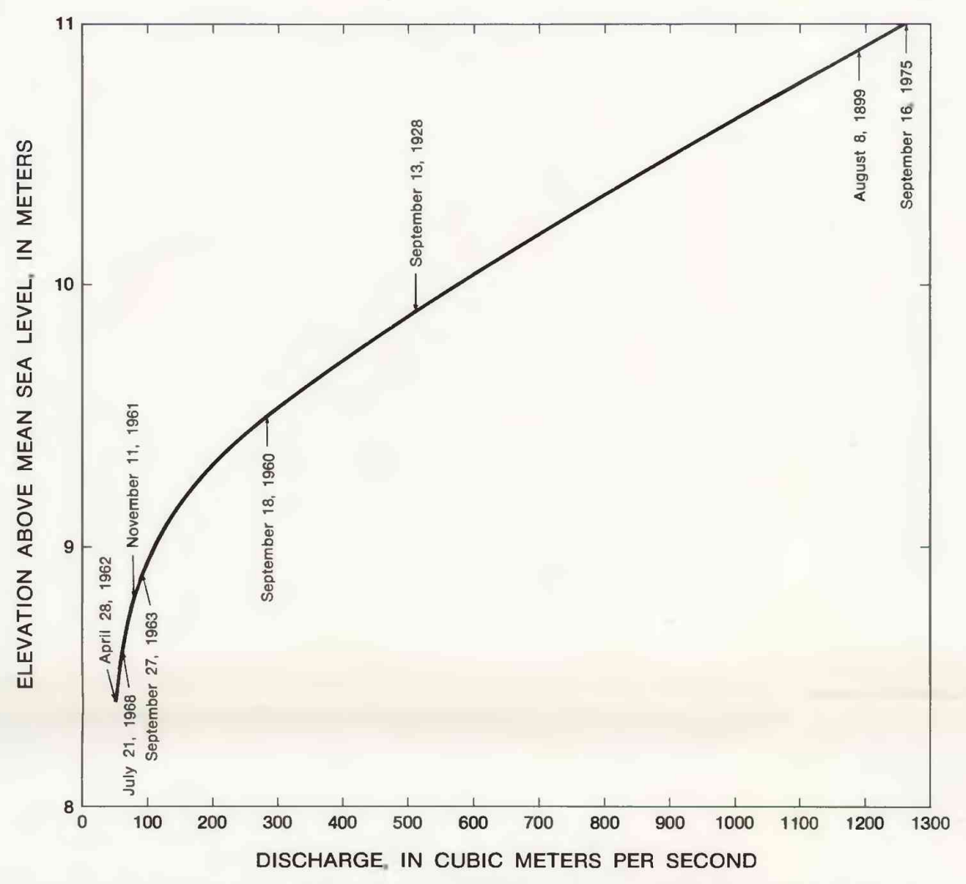

FIGURE 18. - Stage-discharge relation of Río Yauco at Escuela Arturo Lluveras.

FLOOD FREQUENCY

The date of occurrence of a flood of a given magnitude cannot be predicted, but the probable number of exceedances during a long period of time can be estimated with reasonable accuracy given a long record. Recurrence interval is the average interval of time within which a given flood will be equaled or exceeded once. Thus a 50-year flood is expected to be exceeded at intervals averaging 50 years but the actual interval between successive floods greater than the 50-year flood may range from one to over a hundred years. Stated differently a 50-year flood has one chance in fifty of being equaled or exceeded in any one year.

The record of floods on the Río Yauco is fragmentary and not of sufficient length to determine a reliable flood-frequency relation. However, the September 16, 1975 and the August 8, 1899 floods, of about the same magnitude, occurred during a 75-year period.

FLOOD PROFILES

The flood profile for the September 16, 1975 flood for the Río Yauco is shown in figure 19. It is referenced to the arbitrary baseline shown on the flood map. The baseline, and therefore the profile, is not confined to the configuration of the channel but follows a smoother path along the flood plain in the general direction of the floodflow. The profile is based on high-water marks recovered by field survey crews of the U.S. Geological Survey after the flood. Information was also obtained from residents in the study area. There are nine bridges in the study area over the Río Yauco (table 2).

Table 2.--Elevation of bridges over the Río Yauco in the study area

Map symbol	Stationing along baseline, in kilometers	Location of bridge	Elevation, in meters (mean sea level) Top deck	Low beam
A	2.04	Access road to Punta Verraco	7.3	6.2
B	2.57	Access road to Central San Francisco	7.1	6.3
C	3.75	Access road to Central San Francisco	9.9	8.5
D	4.70	Highway 335	10.5	10.2
E	4.99	Highway 335 old bridge	13.5	12.1
F	5.00	Highway 335 new bridge	13.9	13.4
G	6.70	Access road to Barrio Lima	15.4	15.1
H	9.52	New Highway 2	28.1	27.5
I	10.00	Old Highway 2	31.8	30.3

All elevations shown in the study are referenced to mean sea level datum. Permanent reference marks were established at selected points throughout the study area (table 3) and are shown on the flood map.

Table 3.--Reference marks established by the U.S. Geological Survey in the Yauco study area

Reference mark number (see map)	Elevation, mean sea level, meters	Description of location
RM-1	7.53	Chiseled square painted orange on top of right abutment of bridge over Río Yauco on access road to Punta Verraco.
RM-2	9.85	Chiseled square on top of northeast side of concrete stairs of San Francisco Cooperative Superette at Barrio Media Quijada.
RM-3	14.09	Chiseled square on downstream side of sidewalk on center of bridge, new Highway 335 over Río Yauco.
RM-4	19.09	Chiseled square painted red on top of downstream side of culvert headwall in front of Escuela Segunda Unidad de Barinas.
RM-5	22.24	Chiseled square painted red on top of irrigation canal wall about 1 m of water-pump outlet.
RM-6	25.68	Chiseled square painted orange at middle on downstream side of headwall of culvert on old Highway 335.
RM-7	24.56	Chiseled square painted red on top of manhole on left downstream side of culvert over Quebrada Berrenchín on Highway 335.
RM-8	29.30	Chiseled square painted orange on top of downstream side handrail at new Highway 2 bridge over Río Yauco.
RM-9	31.74	Standard tablet embedded in concrete stamped 51-Y-1934 on southwest end of abutment of old Highway 2 bridge over Río Yauco.
RM-10	32.94	Chiseled square painted orange on top of concrete handrail base on right upstream side of culvert over Quebrada Berrenchín at old Highway 2.

WATER-SURFACE CONTOURS

Water-surface contours are based on the elevation of high-water marks recovered after the September 16, 1975 flood. These contours represent equal elevations of the water surface and are normal to the direction of flow. Obstruction to the flow, such as sugarcane and manmade obstacles, caused irregularities in the shape of the contours. The approximate depth of flooding at any point in the inundated area can be estimated by subtracting the ground elevation (contour) from the water-surface elevation (contour). Intermediate estimates of depth can be obtained by interpolation.

INUNDATED AREA

The area inundated by the September 16, 1975 flood has been delineated on a topographic map with a 10-m contour interval, scale 1:20,000. The flood boundaries were delineated using the high-water marks and field inspection of the flooded area immediately after the flood, and by aerial photos taken by the Puerto Rico Highway Authority on September 24, 1975, eight days after the flood.

COOPERATION AND ACKNOWLEDGMENTS

This report was prepared under a cooperative agreement between the Puerto Rico Department of Natural Resources and the U.S. Geological Survey.

ADDITIONAL INFORMATION

Additional information related to this report can be obtained from the U.S. Geological Survey, San Juan District Office, G.P.O. Box 4424, San Juan, Puerto Rico 00936.

SELECTED REFERENCES

Fields, F.K., 1971, Floods in the Guayanilla-Yauco area, Puerto Rico: U.S. Geological Survey Hydrologic Investigations Atlas HA-414.

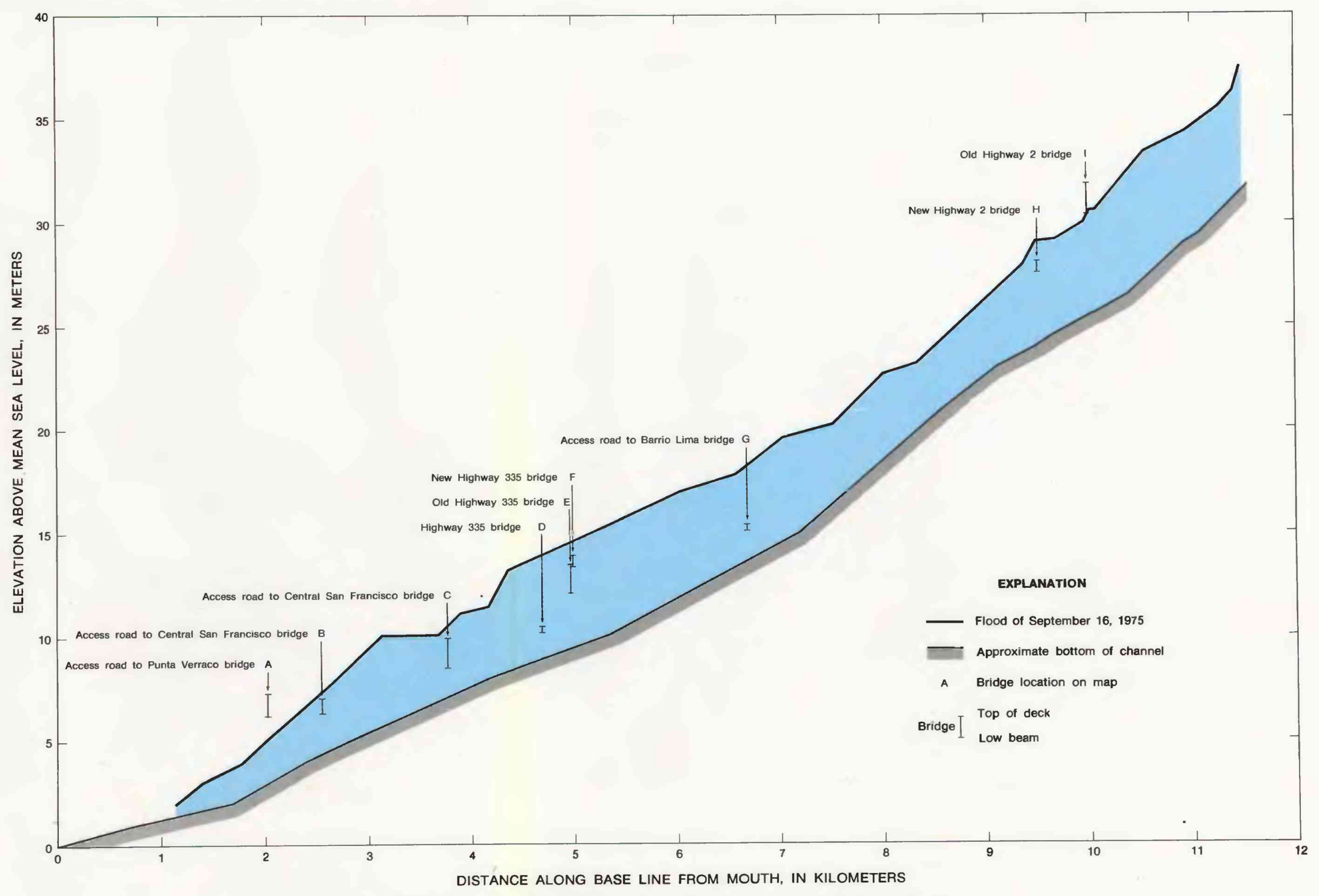

FIGURE 19. - Profile of Río Yauco during the September 16, 1975 flood.

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