

INTRODUCTION

The passage of hurricane Eloise near the north coast of Puerto Rico caused torrential rains September 15, 16, and 17, 1975, producing devastating floods in the southwestern part of the island.

The U.S. Geological Survey, in cooperation with the Puerto Rico Department of Natural Resources, has undertaken the task of documenting this outstanding event. This report provides hydrologic and hydraulic data for the Guanajibo Valley that will aid planners and designers in making effective decisions in the development of its flood plain. These data were obtained from field observations by the U.S. Geological Survey and from interviews with residents in the study area.

The Guanajibo Valley (Fig. 1) in southwestern Puerto Rico has an area of about 70 km². The study area extends upstream from the mouth of the Rio Guanajibo about 30 km to Sabana Grande, about 27 km northwest of Ponce and includes the towns of San Gerónimo, Cabo Rojo, and Homigueros. The economy is mainly agriculture, and supports the principal crop, sugarcane, with abundant secondary vegetation. The average daily temperature ranges from 27°C in the summer to 24°C in the winter. The average annual precipitation ranges from 2500 mm in the Cordillera Central to 1778 mm in the foothills.

PRECIPITATION

Multiple Stations By To obtain inch-pound units multiply by 25.4

Station	Length	By
meter (m)	3.2808	foot (ft)
millimeter (mm)	0.0997	inch (in)
kilometer (km)	0.6214	mile (mi)
square kilometer (km ²)	0.3861	square mile (mi ²)
cubic centimeter per second (cc/sec)	35.31	cubic foot per second (cfs)
degrees Celsius (°C)	1.8°C = 32	degrees Fahrenheit (°F)

RIO GUANAJIBO BASIN

The Rio Guanajibo originates in the southwestern part of the Cordillera Central, about 10 km northwest of Sabana Grande. The river flows east past Sabana Grande, then turns to the west-northwest, flowing past San Gerónimo on the north, and empties into Bahía de Manzanillo on the Caribbean Sea.

The main tributaries of Rio Guanajibo originate in the southern slope of the Cordillera Central and flow in a southeasterly direction to the river. The tributary basins, in descending order of drainage area in km², are: Rio Rosero, 62.8; Rio Hicmeyer, 35.4; Rio Dey, 20.7; Rio Cruz, 18.9; Rio Cain, 16.4; and Rio Capote, 11.5. The drainage area on the north side of the basin consists of a small mountainous reach parallel to the river which does not contribute significant discharge to Rio Guanajibo during floods.

The drainage area of Rio Guanajibo is 329 km² at its mouth, and 311 km² at gaging station 50138000 (Fig. 1) operated by the U.S. Geological Survey.



FIGURE 1. Rio Guanajibo basin and study area.

FLOOD OF SEPTEMBER 16, 1975

The torrential rains from hurricane Eloise produced severe floods in the Guanajibo Valley. Precipitation at 10 stations in Puerto Rico during September 15-17, 1975, and the distribution of precipitation throughout the island are shown in Figure 2.

The entire Guanajibo Valley from Sabana Grande to the coast suffered its severest flooding since 1899. San Gerónimo, Cabo Rojo, Homigueros, and housing developments in the coastal lowlands suffered the most damage. Houses adjacent to the Rio Guanajibo, in subdivisions Santa María in San Gerónimo, were destroyed by the flood. After the floodwater receded, the U.S. Geological Survey recovered high-water marks on the flood plain and made no further measurements at the new Highway 104 bridge. A peak flood discharge of 3625 m³/s was computed.

Two bridges were destroyed by the floodwater—old Highway 2 bridge (B) 10 km north of Sabana Grande, and old Highway 119 bridge (C) on the south side of San Gerónimo. The latest bridge between San Gerónimo and Homigueros on Highway 114 (old Highway 2) was severely damaged.

Photographs of selected sites in the Guanajibo area during the September 16, 1975 flood are shown in Figures 3-8. The photographs show the extent of the flood and the damage to the river and the surrounding area. A red arrow indicates the direction of the floodwater flow. A red circle indicates the location of a small mountainous reach parallel to the river which does not contribute significant discharge to Rio Guanajibo during floods.

PRECIPITATION OF SEPTEMBER 15-17, 1975 IN INCHES

NUMBER ON MAP	LOCATION	SEPT 15	SEPT 16	SEPT 17	TOTAL
1	ADIMITAS STATION	0.15	11.50	4.27	15.92
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	7.20	8.25	15.54
5	ENSENADA	0.05	5.41	10.30	15.76
6	HIMACAO	0.40	8.02	5.22	13.64
7	LAIAS SUBSTATION	0.29	3.10	12.26	15.65
8	MARICAO 2 SW	2.32	4.65	14.10	21.07
9	POUCE 4E	0.00	2.90	7.78	10.68
10	SABANA GRANDE 2 ENE	1.20	14.00	11.30	26.50

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.



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.



FIGURE 3. Flood height (noted by arrow) at old Highway 2 bridge (B), 10 km north of Sabana Grande, and old Highway 119 bridge (C) on the south side of San Gerónimo.

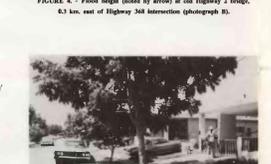


FIGURE 4. Flood height (noted by arrow) at old Highway 2 bridge, 6.1 km east of Highway 104 intersection (photograph F).

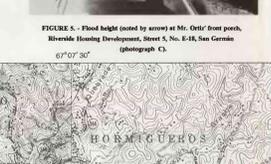


FIGURE 5. Flood height (noted by arrow) at Mr. Ortiz's front porch, Riverside Housing Development, Street 5, No. E-18, San Gerónimo (photograph G).



FIGURE 6. Flood height (noted by arrow) at Patrocinio Shell gas station, San Gerónimo (photograph D).



FIGURE 7. Flood height (noted by arrow) at first office of Central Banka Mill about 50 m. off access road and Highway 114 intersection (photograph H).

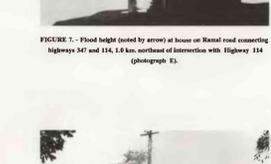


FIGURE 8. Flood height (noted by arrow) at house on Barroil road connecting highways 347 and 114, 1.6 km northeast of Highway 114 (photograph I).

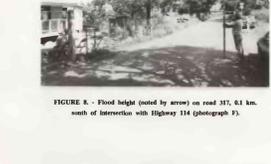


FIGURE 9. Flood height (noted by arrow) at Puerto Rico Energy Authority substation 'La Ascalet' at intersection of Highway 103 and Highway 114 (photograph J).



FIGURE 10. Flood height (noted by arrow) on road 377, 6.1 km south of intersection with Highway 114 (photograph F).



FIGURE 11. Flood height (noted by arrow) at abandoned house, San 5-2, Highway 114 (photograph O).



FIGURE 12. Flood height (noted by arrow) at old bascule valve 'Tabasco' about 0.5 km. west of Highway 347 and Highway 114 intersection (photograph L).



FIGURE 13. Flood height (noted by arrow) at Mr. Carro's house, No. 34, M-6, Madras Street, Guanajibo House, Mayaguez (photograph M).

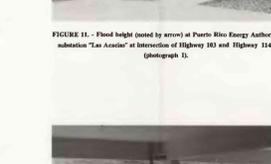


FIGURE 14. Flood height (noted by arrow) at water-treatment plant, R. Ramirez Public Street, Guanajibo House, Mayaguez (photograph N).



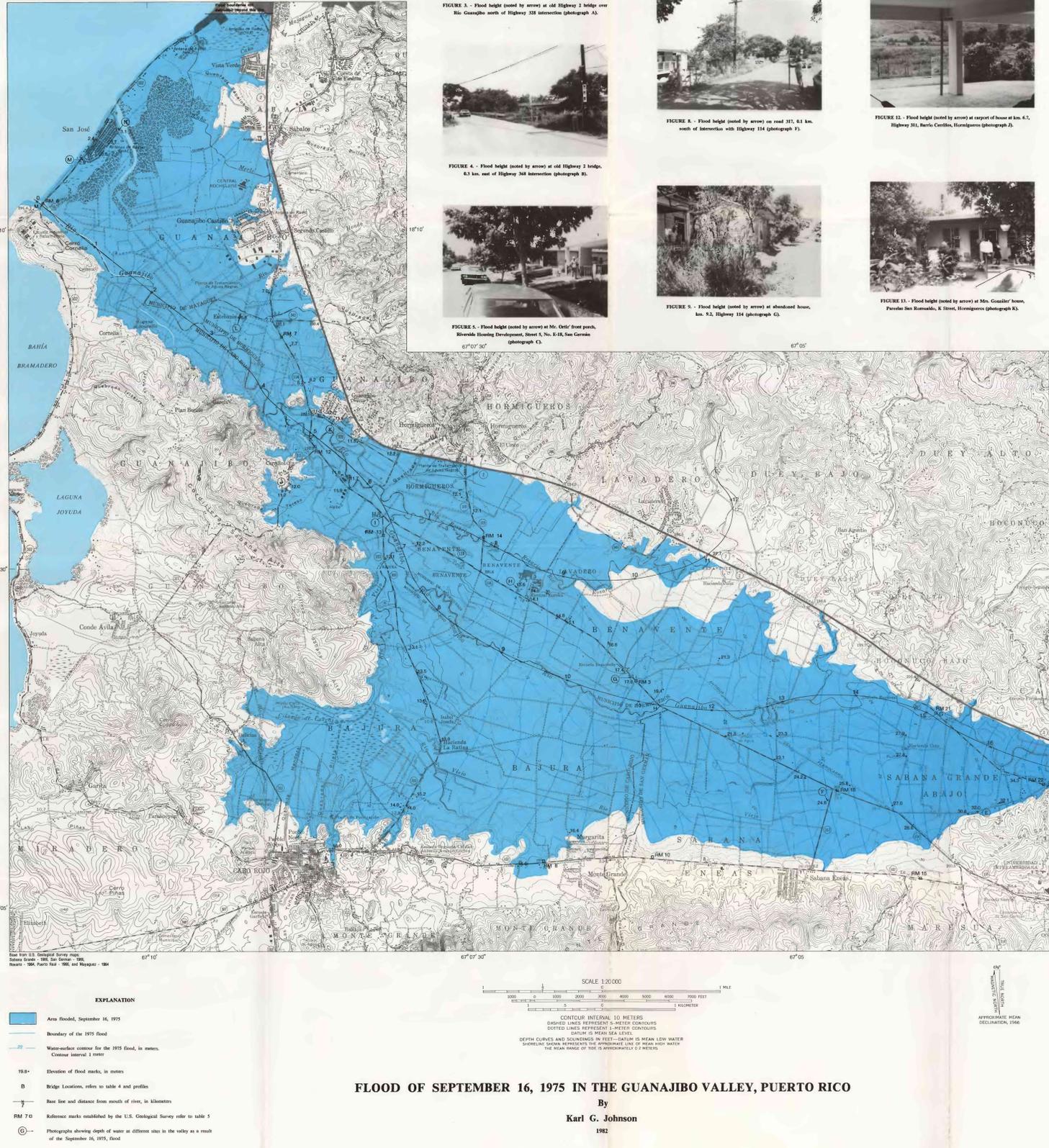
FIGURE 15. Flood height (noted by arrow) at Mr. Gonzalez's house, Perales San Romulo, K Street, Homigueros (photograph K).



FIGURE 16. Flood height (noted by arrow) at abandoned house, San 5-2, Highway 114 (photograph O).



FIGURE 17. Flood height (noted by arrow) at abandoned house, San 5-2, Highway 114 (photograph O).



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

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TABLE 1. Summary of flood discharges in the southwestern basin.

No.	Stream and place of determination	Station no.	Drainage area, km ²	Date	Discharge, cubic meters per second	Maximum previously known discharge	Minimum during Sept. 16, 1975, flood discharge
1	Rio Tabasco at Basal	1125	25.1	Oct. 9, 1970	241	9.60	198
2	Rio Carroles near Ponce	1140	46.1	Oct. 9, 1970	319	5.62	434
3	Rio Peroteague near Ponce	1150	22.8	Oct. 9, 1970	301	13.2	371
4	Rio Tabasco at Ponce	1210	62.7	Sept. 21, 1928	991	15.8	666
5	Rio Guanajibo at Cayaguilla	1245	53.9	Aug. 8, 1899	1,100	20.4	434
6	Rio Guanajibo near Homigueros	1280	311	Sept. 1, 1979	1,560	4.82	3,620
7	Rio Rosero at Rosero	1360	45.6	May 17, 1963	184	4.04	957
8	Rio Cruz de Alcaná near San Sebastián	1440	347	Oct. 26, 1971	375	2.36	3,960
9	Rio Capote at Río de las Mulas	1478	184	Oct. 21, 1972	957	5.20	1,950

FIGURE 18. Flood height (noted by arrow) at old bascule valve 'Tabasco' about 0.5 km. west of Highway 347 and Highway 114 intersection (photograph L).



FIGURE 13. Flood height (noted by arrow) at Mr. Carro's house, No. 34, M-6, Madras Street, Guanajibo House, Mayaguez (photograph M).



FIGURE 14. Flood height (noted by arrow) at water-treatment plant, R. Ramirez Public Street, Guanajibo House, Mayaguez (photograph N).

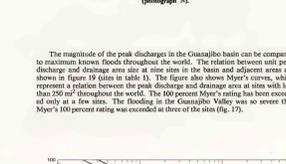


FIGURE 15. Flood height (noted by arrow) at Mr. Gonzalez's house, Perales San Romulo, K Street, Homigueros (photograph K).

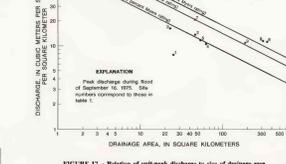


FIGURE 16. Flood height (noted by arrow) at abandoned house, San 5-2, Highway 114 (photograph O).



FIGURE 17. Flood height (noted by arrow) at abandoned house, San 5-2, Highway 114 (photograph O).

TABLE 2. Peak peaks of Rio Guanajibo at Highway 347 bridge (formerly Highway 119) at kilometer 18.33 along the baseline of San Gerónimo, P.R.

Date of flood	Water surface elevation, in meters above MSL
August 6, 1899	42.8
September 13, 1920	42.8
August 4, 1942	41.3
September 23, 1952	41.5
September 5-6, 1954	41.4
March 6, 1958	40.5
December 3-4, 1960	41.6
May 17, 1963	41.1
July 30, 1963	41.2
November 27, 1966	39.6
September 16, 1975	63.0

A continuous stage record surface-water station, 50138000, was established in January 1977 by the U.S. Geological Survey at Highway 114 (formerly Highway 2) about 1.9 km west of Homigueros (km 4.95 on the baseline on the topographic map). Annual peak flows from 1973 to 1979 are shown in table 1, and the stage-discharge relation of the station is shown in figure 18.

FIGURE 19. Peak peaks of Rio Guanajibo at Highway 347 bridge (formerly Highway 119) at kilometer 18.33 along the baseline of San Gerónimo, P.R.

TABLE 3. Annual peaks at U.S. Geological Survey gaging station 50138000, Rio Guanajibo near Homigueros, P.R.

Date	Discharge, cubic meters per second	Elevation, meters sea level	Recurrence interval in years
September 5, 1975 ¹	32	6.07	—
November 3, 1974 ²	125	7.00	1.1
September 16, 1975	3,620	10.93	60
October 31, 1976	38	6.02	—
November 27, 1966	213	6.51	1.3
October 31, 1979	213	6.46	1.4
September 1979	1,500	9.10	10

¹Flood of September 16, 1975, eroded channel. Points not plotted in figure 18.
²Channel was eroded.

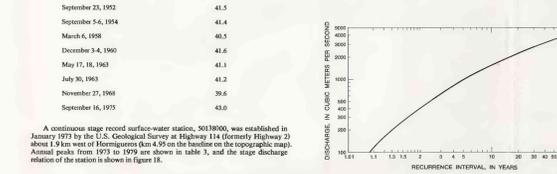


FIGURE 11. Relation of unit-peak discharge to size of drainage area of the southwestern basin during the September 16, 1975 flood.

TABLE 4. Elevation of bridges over Rio Guanajibo in the study area.

Map symbol	Stationing along baseline, in kilometers	Location of bridge	Elevation, in meters above mean sea level	Top of deck	Low beam
A	29.9	May 356	92.0	96.1	—
B ¹	28.9	Old Hwy 2	67.4	81.5	—
C ²	24.6	Old Railroad	63.1	62.1	—
D ³	23.3	Hwy 2	57.4	57.0	—
E ⁴	20.1	Hwy 19	46.6	45.5	—
F ⁵	19.1	Hwy 300	42.0	41.1	—
G ⁶	15.3	Hwy 347	31.1	30.8	—
H ⁷	11.8	Hwy 114	19.2	18.4	—
J ⁸	6.6	Hwy 114	10.8	9.8	—
K ⁹	4.9	Hwy 114	1.1	7.2	—
L	4.6	Hwy 800	15.1	13.1	—
M	0.1	Hwy 102	3.0	1.5	—

¹Destroyed by September 16, 1975 flood.
²Destroyed by October 9, 1970 flood.
³Severely damaged by September 16, 1975 flood.

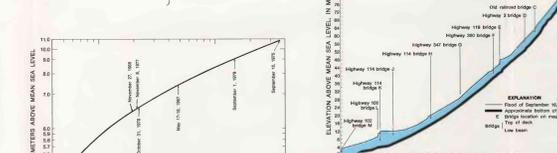


FIGURE 18. Stage-discharge relation of Rio Guanajibo near Homigueros, P.R., station 50138000.

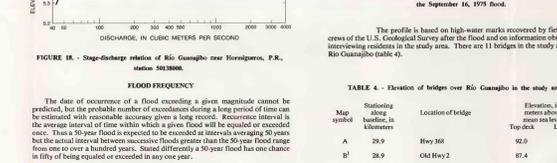


FIGURE 28. Water surface profile of Rio Guanajibo during the September 16, 1975 flood.

The profile is based on high-water marks recovered by field survey crews of the U.S. Geological Survey after the flood and on information obtained by interviewing residents in the study area. There are 11 bridges in the study area over Rio Guanajibo (table 4).

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

All elevations shown in this study are referred to mean sea level datum. Permanent reference marks established previously by the U.S. Geological Survey (HA-450) in conjunction with the area were established near and in this study (table 5).

SELECTED REFERENCES

Hain, N.J., 1972. Floods in the Rio Guanajibo Valley, southwestern Puerto Rico: U.S. Geological Survey Hydrologic Investigation Atlas HA-456.

Hickmeyer, J.J., 1968. Floods in the Mayaguez area of Puerto Rico: U.S. Geological Survey Hydrologic Investigation Atlas HA-286.

López, M.A., Cabal-Dierya, Eloy, and E.D. Cobb, 1979. Floods in Puerto Rico: Magnitude and frequency: U.S. Geological Survey Water Resources Investigations 79-141, 17p.

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

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DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

WATER RESOURCES INVESTIGATIONS
OPEN-FILE REPORT
81-405

TABLE 5. Reference marks established by the U.S. Geological Survey in the Guanajibo Valley.

Reference mark no. (see topographic map)	Elevation above mean sea level, in meters	Description
6	3.23	At bridge over Rio Guanajibo at mouth, Highway 102, kilometer 7.4. Chalked square painted red on left upstream side of bridge on top of abutment.
7	5.41	At culvert over Quindia in San Juan Traves Highway 114 kilometer 2.1 at Valle Formosa subdivision, 200 mm red hollow concrete on left downstream side of headwall.
8	15.58	At culvert on Highway 102, kilometer 2.63 and 2.1 kilometers east of Cabo Rojo. A brass disk stamped U.S. Geological Survey set in concrete on north side of culvert headwall.
10	23.04	At culvert on Highway 102, kilometer 4.1 and 4.7 kilometers east of Cabo Rojo. A brass disk stamped U.S. Geological Survey set in concrete on south side between two openings of culvert.
12	7.47	At culvert on Highway 114, kilometer 4.1 and 2.2 kilometers west of Homigueros. A brass disk stamped U.S. Geological Survey set in concrete on northeast corner of culvert.
13	8.93	At culvert on Highway 102, kilometer 0.3 and 1.2 kilometers west of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on southeast side of culvert.
14	13.06	At bridge over Rio Rosero on Highway 398, kilometer 1.1 east of 1.5 kilometers west of Homigueros. A brass disk stamped U.S. Geological Survey set in concrete on upstream left abutment.
3	16.39	At small culvert on Highway 114 (old Highway 2), kilometer 9.4 and 4.0 kilometers southeast of Homigueros. Chalked square painted red on top of wingwall.
18	23.87	At small culvert on Highway 114 (old Highway 2), kilometer 12.75 and 4.0 kilometers west of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on north side of culvert.
15	32.82	At culvert on Highway 102, kilometer 7.8 and 2.2 kilometers west of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on top of upstream left abutment.
21	31.15	At bridge over Rio Guanajibo on Highway 347, kilometer 2.3 and 4.4 kilometers west of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on upstream left corner of bridge abutment.
22	33.85	At culvert on Highway 347, kilometer 2.3 and 2.2 kilometers west of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on south side of upstream headwall.
23	40.73	At small culvert on Highway 347, kilometer 0.3 and 1.1 kilometers north of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on upstream headwall.
20	41.79	At bridge over Rio Cain on new Highway 2, between kilometer posts 177.5 and 177.4 and 2.3 kilometers south of San Gerónimo. A brass disk stamped U.S. Geological Survey set in concrete on downstream left abutment.
19	46.94	At bridge over Rio Guanajibo on new Highway 119, kilometer 6.4. A brass disk stamped U.S. Geological Survey set on sidewalk of upstream right corner of bridge.
20	57.79	At bridge over the Guanajibo on Highway 102 kilometer 200.6 and 3.8 kilometers east of San Gerónimo. Chalked square painted red on left downstream side of bridge on top of abutment.
29	100.28	At concrete bench in front of Traves La Boca on Highway 306, kilometer 1.8 and 2 kilometers southeast of Sabana Grande. A brass disk stamped U.S. Geological Survey set in concrete on west side of bench.

Based on this magnitude and frequency relation, frequency of occurrences were assigned to the historical data recovered at the gaging station (table 3).

FLOOD PROFILE

The flood profile of the September 16, 1975 flood for the Rio Guanajibo is shown in figure 20. It includes about 30 km of stream channel from mouth to Sabana Grande. The profile is referred to the baseline on the flood map. The baseline, and therefore the profile, are not confined to the configuration of the channel but follow a smoother path along the flood plain in the general direction of the floodflow.

At small culvert on Highway 114 (old Highway 2), kilometer 9.4 and 4.0 kilometers southeast of Homigueros, chalked square painted red on top of wingwall.

At culvert on Highway 102, kilometer 7.8 and 2.2 kilometers west of San Gerónimo. A brass disk stamped U.S. Geological