DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF PUBLIC WORKS

HYDROLOGIC INVESTIGATIONS
ATLAS HA–445

FLOODS IN PATILLAS—MAUNABO AREA, PUERTO RICO

Floods occurred on most streams in Puerto Rico during the period October 5–10, 1970. The greatest floods, however, occurred in an area east of a line extending from Arecibo to Ponce, which is the eastern two-thirds of Puerto Rico. Higher floods have occurred in other years in some areas but the floods of October 1970 were outstanding because of their duration and multiple peaks (fig. 1). The volume of runoff was extraordinarily large. The floods resulted from rainfall that totaled as much as 35 inches at some places during the 6-day period. The rainfall came mostly in intense bursts.

The floods caused severe property damage and loss of life in Puerto Rico. At least 16 lives were lost. Hundreds of homes were damaged or destroyed and about 12,000 people were evacuated to shelters. Damage to bridges, highways, public structures, and farmlands was reported by Civil Defense to be $65 million. Highway travel in many areas was severely restricted in the eastern two-thirds of Puerto Rico. Principal and secondary highways were blocked by inundation and landslides. The main highway between Ponce and Guayama was closed for nearly 3 weeks because of high water and washouts.

This atlas is one of a series of four that covers the south coast of Puerto Rico between Ponce and Maunabo. (See HA–446, 447 and 448, under "Selected References.") This atlas shows the water-surface profiles and areas inundated by the October 1970 flood and contains information pertaining to previous floods that are hydrologically significant. The report has been prepared to provide a technical basis on which individuals, organizations, and governmental agencies can make decisions leading to development on the flood plain compatible with the degree of flood risk.

The investigation is part of a program financed through a cooperative agreement between the Departamento de Obras Públicas, Commonwealth of Puerto Rico, Dr. Antonio Santiago Vázquez, Secretario, and the U.S. Geological Survey.

This atlas was prepared by Caribbean District, Water Resources Division, U.S. Geological Survey, with technical assistance from Karl G. Johnson.

Flood history.—The three major south-coast streams in the Patillas—Maunabo area for which information is given—Río Grande de Patillas, (including Río Chico), Río Jacaboa, and Río Maunabo—are shown in figure 2. The streams are described separately in a west-to-east sequence.

The larger streams of the southern slope rise on the Cordillera Central, which is the primary drainage divide of Puerto Rico. The channels are very steep in the mountains, and their slopes become progressively steep in the foothills and on the coastal plain. This is a common sequence for mountain streams, but it is significant in Puerto Rico because at no place between Ponce and Maunabo is the island divide more than 15 miles from Mar Caribe (Caribbean Sea). The peaks and main escarpment of the Cordillera Central range between 750 and 1200 meters (2,500 and 4,000 feet) above mean sea level.

The coastal plain has a slope of 19 to 50 meters per kilometer (30 to 80 feet per mile). Stream velocities during floods are high on the coastal plain.

Río Grande de Patillas and Río Chico.—Río Grande de Patillas and Río Chico are parallel and overflow a common flood plain for a distance of about 3 kilometers upstream from the mouth at Mar Caribe. Their total drainage areas are about 29 and 7.2 square miles, respectively. The foothills, which extend nearly to the sea, confine the flood-plain width to about one kilometer.

Lago Patillas is a major water storage facility in the Río Grande de Patillas basin, receiving water from 25.2 square miles (about three-fourths of the basin). Its nominal storage capacity of 14,100 acre-feet has a moderate attenuating effect on peak discharge of floods.

Profiles for the floods of August 1961 and October 1970 on Río Grande de Patillas are shown in figure 3 and the area inundated by the 1961 flood is delineated on the map. The flood of August 1961 was about 2 meters higher than the flood of October 1970.

The peak discharge of Río Grande de Patillas at the gaging station above Lago Patillas during the flood of October 1970 was 11,000 cfs (cubic feet per second)—an average of 624 cfs per square mile from 17.8 square miles of drainage area. The peak discharge was 9,000 cfs near the sea, which reflects the attenuating effect of both Lago Patillas and temporary storage in the lower valley.

Río Jacaboa.—Río Jacaboa is a small stream that rises in rugged foothills and flows in a relatively narrow valley throughout most of its length. Floods are destructive although inundated areas are not large. Río Jacaboa has a drainage area of about 5.2 square miles at its mouth at Mar Caribe. There are no reservoirs in the basin.

The flood of October 1970 is delineated on the map, and the profile of the flood is shown in figure 4.

Río Maunabo.—Río Maunabo rises on the southeastern prong of the Cordillera Central and flows approximately parallel to it. The basin primarily is bounded by mountains. The drainage area is about 18.5 square miles. There are no reservoirs in the basin.

The August 1935 flood, about 1 meter higher than that of October 1970, is delineated on the map. The September 1954 flood may have been slightly higher than the August 1935 flood. Profiles for the floods of August 1935 and October 1970 are shown in figure 5.

The peak discharge of Río Maunabo at the inland edge of the alluvium during the flood of October 1970 was 7,400 cfs—an average of 1,090 cfs per square mile from 6.8 square miles—one of the higher runoff rates determined for the 1970 flood. At a site farther downstream in the alluvial valley (drainage area 12.7 square miles) a peak discharge of 4,900 cfs was determined, indicating the attenuation of floodflow produced by temporary storage in the lower valley.

Flood discharge.—The rate of discharge of a stream is the volume of flow that passes a particular location in a given period of time. Discharge rates usually are expressed in units of cubic feet per second (cfs). Peak discharge, the maximum discharge attained during a flood, generally occurs at the time of the maximum height (stage) of the flood, but if a stream is affected by variable backwater, the time of the peak discharge may not coincide with that of the maximum stage.

Flood height.—The height of a flood usually is stated in terms of gage height or stage, which is the elevation of the water surface above a selected datum plane. Elevations shown on the map and flood profiles are in meters above mean sea level.

Extent of flooding.—The flood boundaries on the map were delineated using flood profiles based on elevations of floodmarks. Boundaries were defined by plotting the flood profile elevation on the map and interpolating between the contours where necessary. The flood boundaries were verified by field investigation.

Flood boundaries shown provide a historic record characteristic of channel conditions existing when the floods occurred. The inundation pattern of future floods may be affected by changes in channel conditions, waterway openings at highways, changes in runoff characteristics of the streams caused by increased urbanization, and other cultural changes. Protective works built after the floods shown may reduce the frequency of flooding in the area, but will not necessarily eliminate future flooding.

Flood profiles.—The abrupt changes in the profiles shown at some road crossings indicate the difference in water-surface elevations at the upstream and downstream sides of channel constrictions. The drop in water surface through constrictions during future floods may be different from that shown on the profiles.

A base line marked in kilometers along each principal stream is shown on the map. Base lines appearing on the map correspond to those shown for the flood profiles.

Water-surface contours.—Water-surface contours are imaginary lines of equal water-surface elevation, based on floodmark elevations. Generally they are at right angles to the direction of flow. Obstructions to flow, such as sugarcane or manmade obstacles and the expanding widths of valleys cause irregularities in the contours.

Depth of flooding.—The depth of flooding at any point can be determined by subtracting the ground elevation at the point from the flood elevation indicated by the profile or by the water-surface contour line. The approximate ground elevation can be determined from ground contours shown on the map, although more accurate elevations can be obtained by leveling to nearby bench marks.

Additional information and copies of this hydrologic atlas.—Additional information on floods in the Patillas–Maunabo area can be obtained from the U.S. Geological Survey in San Juan, Puerto Rico, and from the Sección de Control de Inundaciones of the P.R. Departamento de Obras Públicas in Santurce, Puerto Rico, and from the reports listed in the references. Copies of this hydrologic atlas can be obtained from U.S. Geological Survey in Washington, D.C., and from División de Mapas, Topografía y Fotogrametría of the P.R. Departamento de Obras Públicas in Santurce, Puerto Rico.

SELECTED REFERENCES

Haire, W. J., 1970, Floods in Guayama area, Puerto Rico: U.S. Geol. Survey Hydrol. Inv. Atlas HA–446.

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Hickenlooper, I. J., and Lopez, M. A., 1967, Floods in the Ponce area, Puerto Rico: U.S. Geol. Survey Hydrol. Inv. Atlas HA–261.

Kipple, F. P., and others, 1968, Water Records of Puerto Rico, 1958–63: Ft. Buchanan, P.R., U.S. Geol. Survey, Water Resources Div., 353 p.

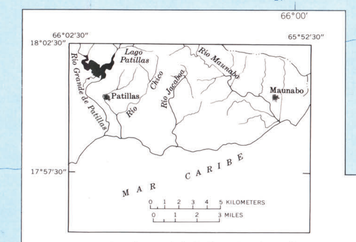

FIGURE 2.—*Streams in the Patillas—Maunabo area for which flood information is provided.*

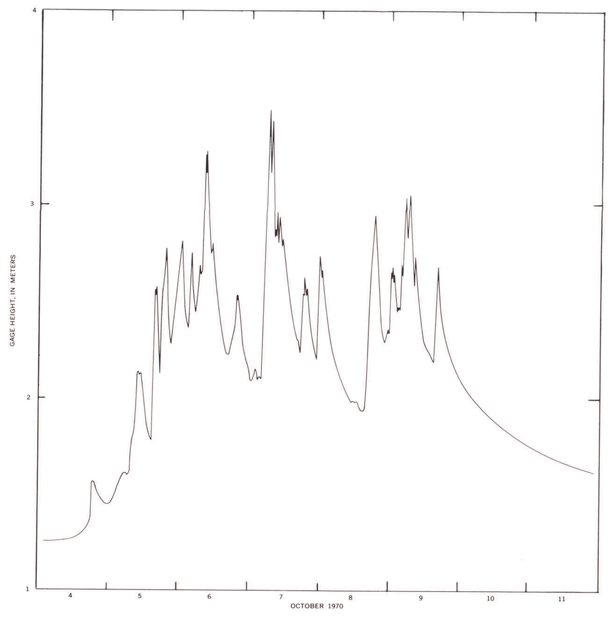

FIGURE 1.—*Stage hydrograph of Río Grande de Patillas October 4–11, 1970, showing multiple peaks, typical of the 1970 flood on streams in the eastern two-thirds of Puerto Rico.*

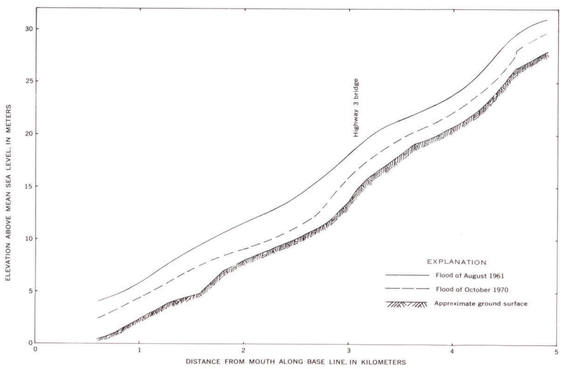

FIGURE 3.—*Flood profiles, Río Grande de Patillas.*

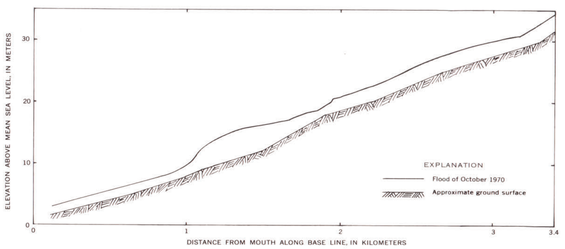

FIGURE 4.—*Flood profile, Río Jacaboa.*

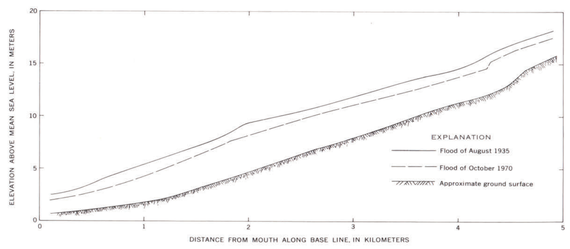

FIGURE 5.—*Flood profiles, Río Maunabo.*

EXPLANATION

- Area flooded
- Boundary of flood
- Water-surface contour for flood, in meters. Contour interval varies — 15 —
- Floodmark elevation, in meters, and year of flood — 4.7(1970) —
- Base line and distance from mouth of river, in kilometers — ✕ — 5

Photograph courtesy of EL MUNDO newspaper.

A common scene along the southern coast of Puerto Rico during the floods of October 1970.

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FLOODS IN PATILLAS-MAUNABO AREA, PUERTO RICO

By

William J. Haire

SCALE 1:20 000

1 .5 0 1 2 KILOMETERS

1 ½ 0 1 MILE

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

1971

For sale by U.S. Geological Survey, price $1.00

Base from U.S. Geological Survey
topographic quadrangles