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FLOODS IN AND NEAR THE CHARLOTTE AMALIE AREA, ST. THOMAS, U.S. VIRGIN ISLANDS

by W.J. Haire and K.G. Johnson

Introduction

This report provides information that will aid administrators, planners, engineers, and others concerned with development in areas subject to flooding in and near Charlotte Amalie on the south coast of St. Thomas. More specifically, this information is useful to those responsible for formulating flood-plain regulations that would minimize flood damage.

The report is based on data collected from people who live or work in the area and from field investigations by the U.S. Geological Survey. During the field work several U.S. Geological Survey bench marks were installed, and their description, location and elevation above mean sea level are provided in table 1. All elevations given are in feet above mean sea level.

The U.S. Virgin Islands consist of more than 40 islands and cays located above 1,100 miles east-southeast of Miami, Florida and about 50 miles east of Puerto Rico (fig. 1). The islands form part of the Antilles Island Arc, which separates the Atlantic Ocean from the Caribbean Sea. St. Thomas is the second largest of the group with a land area of 32 square miles; it ranges from 1 to 3 miles wide and is about 14 miles long.

St. Thomas is characterized by rugged terrain and all important streams head in the volcanic uplands that form a central ridge the length of the island. The ridge ranges from about 500 to 1,550 feet above mean sea level and the steep slopes cause rapid runoff. In the uplands, streambeds are strewn with rocks that range in size from small cobbles to large boulders. On the scattered coastal plains, stream gradients are gentle, the valleys broader, few boulders are found, and deposits of sand and gravel are common. With the exception of a few narrow beaches, most of the land subject to flooding is in the area of Charlotte Amalie.

Most of the streamflow on St. Thomas results from direct runoff, therefore, the streams usually cease to flow several hours to a day or two after rainfall stops. Floodwaters also recede rapidly and inundation often lasts less than a day.

The mean range of tide is only 0.8 foot and the effect of tides on the extent of flooding in the shore areas is negligible.

Occurrence of Floods

Little historical information is available regarding floods on St. Thomas; however, investigations revealed that at least four severe floods have occurred since 1867, when a tidal wave reportedly caused damages of disastrous proportion. These floods occurred on October 9, 1916, May 8, 1960, March 1, 1969, and October 7, 1970, and are described briefly below in order of magnitude. Data were not available to determine discharge from each flood so the order of magnitude was judged from evidence on depth of inundation. There may have been other floods prior to 1916, but no information is available on which to base that determination. Information provided in this report is for those areas most subject to flooding--Harry S. Truman Airport, Frenchtown, and Charlotte Amalie (fig. 2).

The largest flood was that of May 8, 1960, and is commonly known by residents as the "Great Mother's Day Flood". Intense rain fell on the entire island and the U.S. Weather Bureau recorded a 2-day total of 13.25 inches at Charlotte Amalie. Roads and trails washed out in many places over the island; damaged to public property has been estimated to be $700,000. No estimate for damage to private property is available but many homes and businesses in the Charlotte Amalie area were flooded with considerable losses resulting. The Frenchtown area and much of Harry S. Truman Airport were inundated as well.

The second largest flood occurred on October 9, 1916, and was caused by a hurricane of great intensity, the center of which passed over the U.S. Virgin Islands. Little is remembered by residents about the resulting flood except that it was extremely destructive. Sufficient data cannot be recovered to define the boundaries of the flood, but the areas reportedly hardest hit were Charlotte Amalie, Frenchtown, and the present airport area.

The flood of March 1, 1969 resulted from 6.30 inches of rain that fell in 24 hours; most of the rain, however, fell in a much shorter time. Boulders and debris carried by flood waters blocked culverts and roads over much of the island. Debris and silt left by the flood contributed considerably to the damage. Many places in Charlotte Amalie and Frenchtown were inundated, and water on the runway necessitated closing the airport for a short period of time.

The fourth largest flood occurred on October 7, 1970 and was about the same magnitude as the 1969 flood. In 4 days, 10.53 inches of rain from a slow-moving tropical depression fell at Charlotte Amalie. The heaviest rain occurred on the afternoon and night of October 7; the U.S. Weather Bureau recorded 6.70 inches for the 24 hours ending at 0800 on October 8. Severe flooding occurred during the evening of the 7th. Heavy runoff caused landslides and severe damage to roads and buildings. Once again, floods damaged Charlotte Amalie and Frenchtown. The airport was forced to close for a short time, and a small child drowned in that area.

Flood Frequency

The occurrence of a flood of a given magnitude cannot be predicted, but the probable number of such floods during a long period of time can be estimated with reasonable accuracy. The frequency of occurrence (recurrence interval) is the average interval of time within which a given flood will be exceeded once. For example, two floods of at least the magnitude of a 50-year flood can be expected to occur in a 100-year period, on the average. Stated differently, a 50-year flood has 1 chance in 50 of being exceeded in any one year.

The record of floods in St. Thomas is fragmentary and not enough data are available to determine either a stage-frequency or a discharge-frequency relationship. Marks from floods prior to 1960 were not found; however, historical records and information from local residents indicated that major flooding occurred four times during the 57-year period from 1916 to 1972. Listed below is the year of occurrence, rank, and the estimated recurrence interval for each flood. (Rank is the order of magnitude of the flood; the largest flood has rank 1, the second largest has rank 2, and so forth.)

Date	Rank	Estimated recurrence interval (years)
1960	1	56
1916	2	28
1969	3	19
1970	4	14

Although little can be gleaned from this information, the three areas most subject to flooding on St. Thomas probably can be expected to be inundated to an extent greater than that of the 1970 flood about once in a 14-year period, on the average.

Rainfall Frequency

Rainfall-frequency information (U.S. Weather Bureau, 1961) is presented in this report as an indication of the size of the storms that caused the four floods described previously, but rainfall frequency is not intended to be used as a substitute for flood frequency.

The greater the intensity of a storm, the rarer its occurrence or the greater its recurrence interval. The intensity of rate of rainfall is expressed in inches per hour, and 1 inch of rain distributed over 1 acre of land in 1 hour is approximately equivalent to 1 cubic foot per second of water. Rainfall records used here are of totals accumulated in 3-, 6-, and 24-hour periods. The largest quantity of rain that fell in a 3-hour period during the storm that caused the flood of May 8, 1960 was 5.4 inches--figure 5 shows that this intensity of rainfall has a recurrence interval greater than 100 years. Figure 8 shows that the largest 6-hour total rainfall during the same storm, 8.07 inches, also has a recurrence interval greater than 100 years. It is believed by the authors that the frequency of the total rainfall during 3- and 6-hour periods is probably more comparable to frequency of flooding in St. Thomas than frequency of rainfall during a 24-hour period. This is because most of the rain from storms usually falls in a few hours. The rain before and after these short periods contributes to a flood to a considerably lesser extent because runoff to sea is rapid. Figure 7 shows the frequency of the largest 24-hour total rainfall that occurred during the four floods, for purposes of comparison.

Flood Profiles

The maximum elevation of the water surface during the flood of March 1, 1969 at Harry S. Truman Airport, Frenchtown, and Charlotte Amalie are shown in figures 3, 4, and 6; the locations of the base lines are shown on maps A, B, and C, respectively. The base lines, used to determine the distance upstream from the mouth, are not the thalwegs but follow a smoother path along the valleys, and conform to the general direction of flow during floods. Abrupt changes in the profiles indicate the difference in water-surface elevations at the upstream and downstream sides of channel constrictions. The drop in water surface through constrictions, during other floods, may be different from that shown. Not enough data are available to define the profiles of the other floods.

Inundated Areas

The areas inundated by the 1969 flood are shown on maps A, B, and C; U.S. Geological Survey personnel preserved floodmarks in these areas immediately after the flood. The flood boundaries were delineated using profiles based on elevations of these floodmarks. Boundaries were defined by plotting flood-profile elevations on the map and interpolating between the contours, where necessary.

The data indicate that the 1969 flood was about 0.4 foot lower than the 1960 flood and about 0.3 foot higher than the 1970 flood. No data are available for comparison with the 1916 flood. Because the floods of 1960, 1969, and 1970 were nearly the same elevation, the 1969 flood (as shown) may be representative of the extent of all three floods. Although the differences in water-surface elevations of these floods may seem small, the differences in the corresponding discharges could be large.

Flood boundaries shown reflect the channel and flood-plain conditions during the flood. The inundation from other floods may be affected by changes in channel conditions, alteration of waterway openings at highways, changes in runoff characteristics of the stream caused by increased urbanization, and other cultural developments. Protective works built after the flood shown may reduce the frequency of flooding in the area, but will not necessarily eliminate future flooding.

Water-surface contours based on elevations of floodmarks are imaginary lines representing equal elevations of water surface. Generally, they are at a right angle to the direction of flow. Obstructions to flow, either natural or man made, and the variations in valley widths cause irregularities in the contours. Water-surface contours are also shown on maps A, B, and C.

The depth of flooding at any point for the 1969 flood can be determined by subtracting the ground elevation 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 figures. Elevation of the ground and of the water surface at any point can be estimated by interpolation between contour lines. More accurate elevations can be obtained by leveling to one of the reference marks shown on the maps and described in table 1.

Acknowledgments

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Additional Information

Supporting data and computations relating to this report are in the files of the U.S. Geological Survey, San Juan, Puerto Rico.

Reference

U.S. Weather Bureau, 1961, Generalized estimates of probable maximum precipitation and rainfall-frequency data for Puerto Rico and Virgin Islands: U.S. Dept. Commerce, Tech. Paper No. 42, 94 p.

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