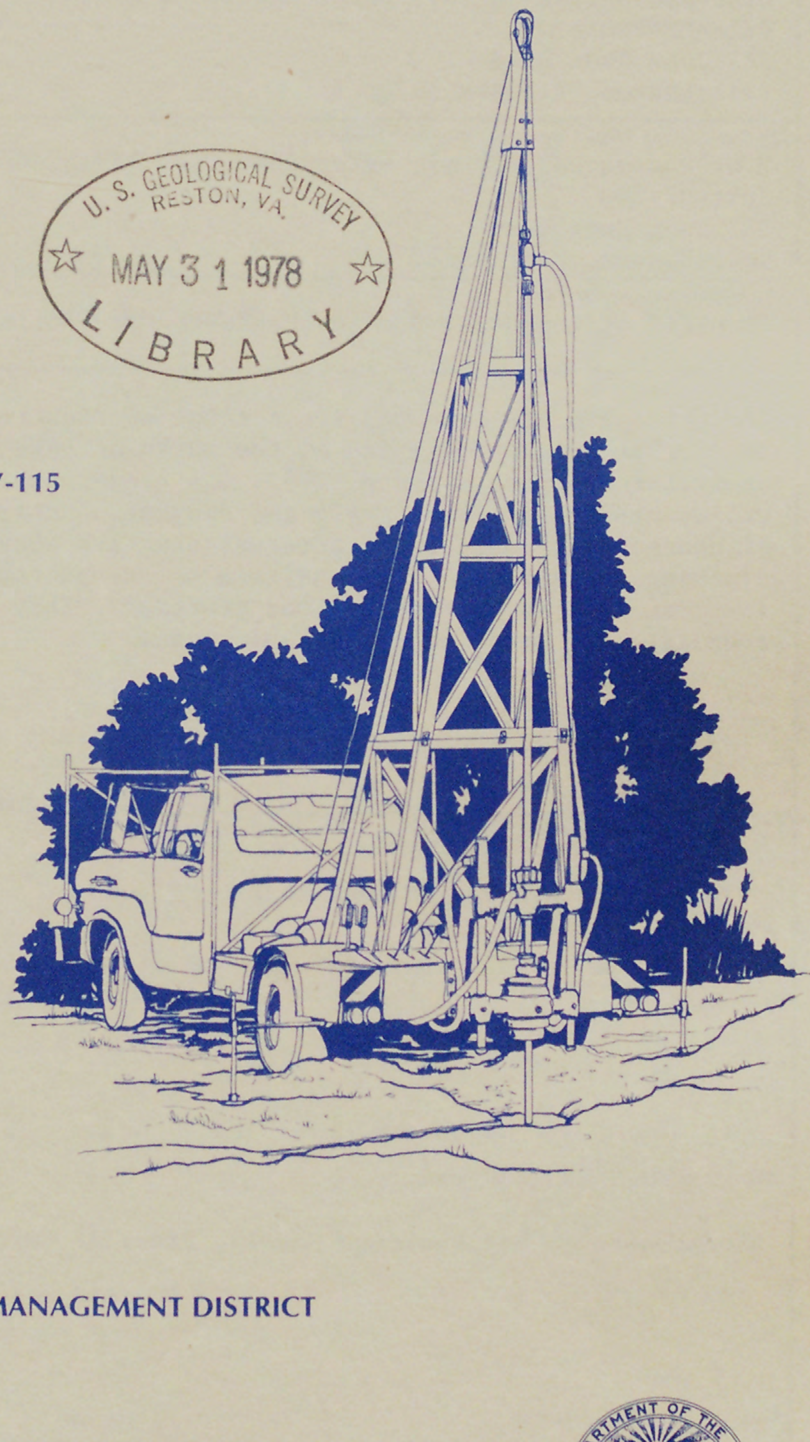
(200)
WRi
no.77-115
c.2 in process.

# FLOOD PROFILES FOR LOWER BROOKER CREEK, WEST-CENTRAL FLORIDA

U.S. GEOLOGICAL SURVEY
RESTON, VA.
MAY 31 1978
LIBRARY



U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 77-115

Prepared in cooperation with the
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

WRI 77-115 FLOOD PROFILES FOR LOWER BROOKER CREEK, WEST-CENTRAL FLORIDA

| BIBLIOGRAPHIC DATA SHEET | 1. Report No. | 2. | 3. Recipient's Accession No. |
|---|---|---|---|
| 4. Title and Subtitle<br>FLOOD PROFILES FOR LOWER BROOKER CREEK, WEST-CENTRAL FLORIDA | | | 5. Report Date<br>March 1978 |
| | | | 6. |
| 7. Author(s)<br>W. R. Murphy, Jr. | | | 8. Performing Organization Rept. No. USGS/WRI 77-115 |
| 9. Performing Organization Name and Address<br>U.S. Geological Survey, Water Resources Division<br>Suite F-240<br>325 John Knox Road<br>Tallahassee, Florida 32303 | | | 10. Project/Task/Work Unit No. |
| | | | 11. Contract/Grant No. |
| 12. Sponsoring Organization Name and Address<br>U.S. Geological Survey, Water Resources Division<br>Suite F-240<br>325 John Knox Road<br>Tallahassee, Florida 32303 | | | 13. Type of Report & Period Covered |
| | | | 14. |

15. Supplementary Notes

Prepared in cooperation with the Southwest Florida Water Management District

16. Abstracts

Flood heights are computed for a range of recurrence intervals for a 12.6 mile reach of Brooker Creek, beginning at the mouth at Lake Tarpon. A Geological Survey step-backwater computer program, E431, was used in these analyses using: (1) Stream and valley cross-section geometry and roughness data; (2) Recurrence interval flood-peak discharges; (3) Recurrence interval starting elevations; (4) Gaging station stage-discharge relations. Flood heights may be plotted versus distance above stream mouth and connected to construct flood profiles. They may also be used to indicate areas of inundation on detailed topographic maps.

17. Key Words and Document Analysis. 17a. Descriptors

*Flood plain zoning, *Flood plains, "Floods

17b. Identifiers/Open-Ended Terms

Brooker Creek, Hillsborough County, Pinellas County

17c. COSATI Field/Group

| 18. Availability Statement | 19. Security Class (This Report) | 21. No. of Pages |
|---|---|---|
| No restriction on distribution | UNCLASSIFIED | 28 |
| | 20. Security Class (This Page<br>UNCLASSIFIED | 22. Price |

# FLOOD PROFILES FOR LOWER BROOKER CREEK,

# WEST-CENTRAL FLORIDA

By W. R. Murphy, Jr.

---

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 77-115

Prepared in cooperation with the

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

March 1978

UNITED STATES DEPARTMENT OF THE INTERIOR

CECIL D. ANDRUS, Secretary

GEOLOGICAL SURVEY

W. A. Radlinski, Acting Director

---

For additional information write to:

U. S. Geological Survey
325 John Knox Road, Suite F-240
Tallahassee, Florida 32303

CONTENTS

## ILLUSTRATIONS



## TABLES

## CONVERSION FACTORS

For use of those readers who may prefer to use metric units rather than English units, the conversion factors for the terms used in this report are listed below:

| Multiply English unit | By | To obtain metric unit |
|---|---|---|
| $ft^3/s$ (cubic feet per second) | 0.02832 | $m^3/s$ (cubic meters per second) |
| ft (feet) | .3048 | m (meters) |
| mi (miles) | 1.609 | km (kilometers) |
| $mi^2$ (square miles) | 2.590 | $km^2$ (square kilometers) |
| ft/mi (feet per mile) | .1894 | m/km (meters per kilometer) |
| in (inches) | 25.40 | mm (millimeters) |

## GLOSSARY

Some of the technical terms used in this report are defined here for convenience. See Dalrymple (1960) and Langbein and Iseri (1960) for additional information regarding flood-frequency analysis and associated terminology.

Control structure as used in this report is a structure on a stream or canal that is used to regulate the flow or stage of the stream or to prevent the intrusion of salt water.

Drainage area of a stream at a specified location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the stream above the specified point.

Flood-frequency distribution is a graph showing flood magnitudes that will, on the average, be exceeded once within a specified number of years (Riggs, 1968). The Geological Survey uses the log-Pearson Type III distribution as a basis for determining flood-frequency relations. The method is described by the Water Resources Council (1976).

Flood-height is the elevation of the water surface above a selected datum plane. Mean sea level datum plane of 1929 is used in this study.

Flood profiles, as provided in this report, are plots of flood heights versus distance, measured in the upstream direction. Profiles show crests along the study reach for flood-peak discharges of specified recurrence intervals.

Gaging station is a particular site on a stream, canal, lake, or reservoir where systematic observation of gage height or discharge are obtained. The terms, gaging station and streamflow station are used interchangeably in this report.

Log-Pearson Type III analysis of annual peak discharges is performed using the logarithms of the peak discharges in computation of the mean, standard deviation, and skew coefficient of the distribution. A range of recurrence-interval peak discharges are computed extending beyond the period of record, providing estimates of recurrence-interval peak discharges as high as the 500-year flood.

Manning's roughness coefficient, n, is a factor used with open-channel flow equations and is a measure of channel boundary roughness. Typical values of roughness are tabulated for various boundary conditions in Barnes (1967) and other hydraulic texts. In studies such as this one, roughness coefficients are estimated from aerial photographs, available streamflow records and field site surveys.

Mean annual flood, a flood that may be expected to occur, on the average, once every 2.33-years, or has a 42.9 percent chance of being exceeded any year (Gumbel distribution with fixed skew of 1.139).

100-year flood is a flood discharge that has a 1 percent chance of being exceeded in any year.

Recurrence interval as applied to flood events such as flood-peak discharge is the average interval of time within which a flood of specfied magnitude will be exceeded at least once.

Stage-discharge relation is the relation between gage height (water level) and the volume of water per unit of time, flowing in a channel.

FLOOD PROFILES FOR LOWER BROOKER CREEK, WEST-CENTRAL FLORIDA

By

W. R. Murphy, Jr.

ABSTRACT

Flood profiles are included in this report for selected recurrence-interval floods for a 12.6-mile reach of lower Brooker Creek. Flood heights are provided for other recurrence-interval floods for which flood profiles were not presented.

The procedure for determining flood profiles, outlined in the report, is based on flood heights computed in a step-backwater analysis using the following data: 2-, 2.33-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence-interval flood-peak discharges; 106 stream-channel cross sections (including roughness coefficients); and stage-discharge relations. Computed flood heights are judged to be generally accurate to about ±0.5 foot.

Resulting flood-profile data can be used to delineate areal extent of flooding on topographic maps. This information can be used by local governmental agencies to control flood-plain development and minimize possible future flood losses.

# INTRODUCTION

Urban development is increasing on the lower Brooker Creek basin, particularly on waterfront property near Lake Tarpon just north of the rapidly-expanding Tampa Bay area. Some of this development is in flood-prone areas. Urban development (1977) consists mainly of single-family residences and condominiums and probably occupies less than 10 percent of the basin area.

Brooker Creek flood problems include depression and fluvial flooding and backwater flooding from Lake Tarpon (fig. 1). The Brooker Creek flood plain is broad and flat and contains numerous depressions, swamps, and low-lying areas. Flood-plain swamps and depressions are interconnected, contributing to flood-water detention and slow flood recession.

During the past 24 years, eight floods at the Brooker Creek near Tarpon Springs gaging station (site 2, fig. 2) reached or exceeded a stage of 12.0 ft above mean sea level (msl). These floods had recurrence intervals of 7 years or greater. The flood of March 17, 1960 was the most extreme of record; a peak discharge of 1600 $ft^3/s$ and a stage of 13.3 ft above mean sea level occurred. The stage was affected by hurricane debris.

Results of a recent Lake Tarpon area flood insurance study (Stanley D. Leach, U.S. Geological Survey, WRD, written commun., 1975) indicate that hurricane tides could drive seawater up the Lake Tarpon outfall canal, over control structure 551 gates (fig. 2) and raise Lake Tarpon to flood stages, causing backwater for several thousand feet upstream on lower Brooker Creek.

## Area Description

The Brooker Creek drainage basin is approximately 44 $mi^2$ in size and drains parts of Hillsborough, Pasco, and Pinellas Counties (fig. 1). Brooker Creek originates in northern Hillsborough County, flows southwesterly through two lakes and several swamps and depressions, and discharges into Lake Tarpon in Pinellas County. The basin contains a number of citrus groves and considerable pasture land.

The flood plain ranges in width from a few hundred feet to 2 mi. Topographic relief from the edge of the flood plain to the stream channel ranges from about 3 to 5 ft. Stream slope varies but averages about 2.5 ft/mi.

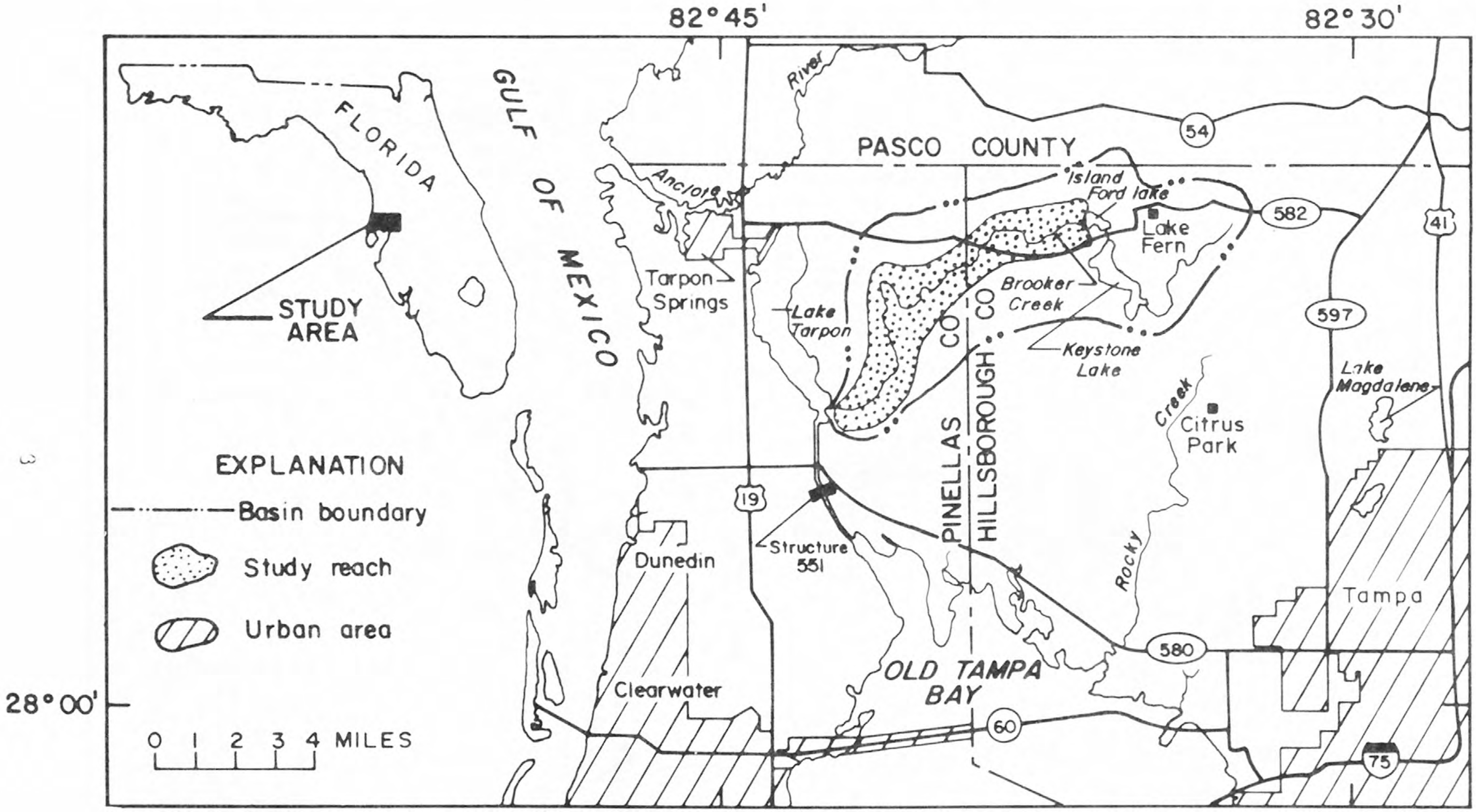



Figure 1.--Location of the Brooker Creek study reach.

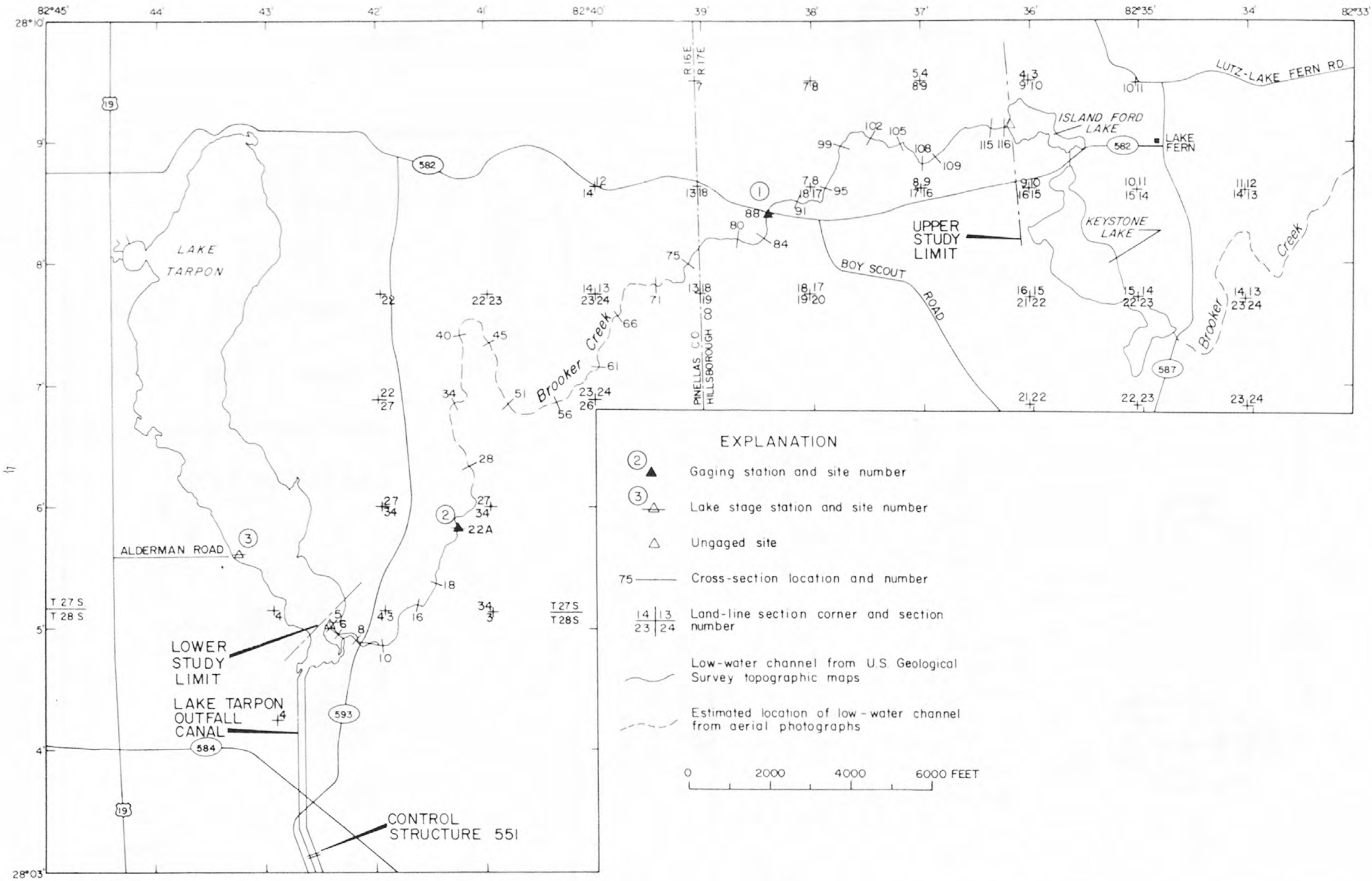



FIGURE 2.--LOWER BROOKER CREEK STUDY REACH AND APPROXIMATE CROSS-SECTION LOCATIONS.

Lake Tarpon has a normal surface area of about 4 $mi^2$ at elevation 2 ft above mean sea level, is urbanized along most of its shoreline and has a controlled outlet to Old Tampa Bay (fig. 1). Lake Tarpon outfall canal and control structure 551 were completed in 1971 and aid in alleviating Lake Tarpon fresh-water flooding.

Average annual rainfall for the basin is about 55 in, most of which falls June through September. Significant flooding results from thunderstorms, tropical depressions, and hurricanes which bring large amounts of rainfall in short time periods.

## Purpose and Scope

The purpose of this report is to provide information concerning probable flooding along Brooker Creek upstream from Lake Tarpon in northeast Pinellas County to Island Ford Lake outlet in northwest Hillsborough County, a 12.6-mi reach (fig. 2).

Flood data provided includes recurrence-interval flood heights and profiles for areas affected by fluvial flooding and by Lake Tarpon backwater. Flood heights for fluvial flooding are computed in a step-backwater analysis and lake-affected flood heights are taken from existing stage-frequency data for Lake Tarpon.

## Cooperation

Information on flood-prone areas is needed by local governments to facilitate flood-plain management in the basin. The Southwest Florida Water Management District has long recognized the need for flood-plain management information, and in 1973 entered into a cooperative program with the U.S. Geological Survey to define probable flood levels along principal streams in west-central Florida, including Brooker Creek.

Land-surface elevation data for 106 stream channel cross sections and photo-base topographic maps used in the study were provided by the Southwest Florida Water Management District.

The author gratefully acknowledges assistance from J. F. Turner, Jr., and M. A. Lopez, U.S. Geological Survey, in the development of areal flood-frequency relations and in revising significant parts of this report.

## METHOD OF ANALYSIS

Brooker Creek flood profiles cover channel reaches affected by upstream fluvial and by backwater flooding from Lake Tarpon. Fluvial area flood profiles are based on flood heights computed for flood-peak discharges of selected recurrence intervals. Flood profiles are defined by plotting computed flood heights against distance above Brooker Creek mouth and connecting the plotted points. The stages of Lake Tarpon for selected recurrence intervals are projected horizontally upstream to the intersection of fluvial profiles of common recurrence intervals. Resulting study reach profiles represent extreme flood conditions considering both fluvial and lake flooding.

Fluvial area flood heights are computed in a hydraulic analysis using the Geological Survey step-backwater model (Shearman, 1976). The model is similar to a procedure described by Chow (1959) and Posey (1950). Using a selected recurrence-interval flood-peak discharge and corresponding water-surface elevation, a velocity head is calculated for the downstream cross section, and a water-surface elevation is assumed at the next upstream cross section. Head losses between the downstream and upstream cross sections due to friction are calculated, and an energy balance is computed. If the energy balance is not within selected tolerance limits, the assumed upstream water-surface elevation is adjusted, and energy calculation and balance tests are repeated until an acceptable balance is achieved. The procedure is repeated for remaining upstream cross-section pairs to the upstream end of the study reach.

Step-backwater computations are verified by use of stage-discharge ratings available at gaging stations located along the study reach. These stations are summarized in the following table along with the Lake Tarpon stage station:

| Site number | Gaging station | Location | Drainage area ($mi^2$) | Period of record |
|---|---|---|---|---|
| 1 | Brooker Creek near Lake Fern (cross section 88)[a]. | 6 mi northwest of Citrus Park and 6.5 mi above mouth. | 15.2 | 1971-76 |
| 2 | Brooker Creek near Tarpon Springs (cross section 22A)[a]. | 1.9 mi above mouth and 5 mi southeast of Tarpon Springs. | 27.5 | 1951-76 |
| 3 | Lake Tarpon near Tarpon Springs. | 4.2 mi southeast of Tarpon Springs. | 60.0 | 1946-76 |

[a]See figure 2.

## AREAL FLOOD-FREQUENCY RELATIONS

Areal flood-frequency relations used in the study are based on results of a regional flood study of records for 20 long-term streamflow stations in the west-central Florida area (fig. 3). All area stations having at least 20 years of record were used in the study; station locations are shown in figure 3.

Flood-frequency distributions were obtained for each station in a log-Pearson Type III analysis using Water Resources Council (1976) guidelines and a generalized map skew coefficient of -0.05. Regional flood relations were developed in a multiple linear-regression analysis of selected recurrence-interval flood-peak discharges (from the log-Pearson Type III distributions) and selected basin parameters. Basin parameters used in the regression include drainage area, stream length and slope, and percent of basin as lake and swamp area. All parameters were significant at the 95 percent level. Range in basin parameters used are summarized in the following table:

| Basin Parameter | Range |
|---|---|
| Drainage area | 9.0 to 1367 $mi^2$ |
| Length | 6.2 to 140 mi |
| Slope | 1.2 to 5.0 ft/mi |
| Lake and swamp area | 4.5 to 28.7 percent |

Regional flood relations, standard errors of estimate, and multiple correlation coefficients obtained in the regression study are summarized in table 1. The average standard error of estimate for regional flood relations is 25.8 percent. The average multiple correlation coefficient is 0.98.

The standard error of estimate (Ezekiel, 1950) is the standard deviation of residuals about the regression line; the multiple correlation coefficient indicates the degree of linear relationship between discharges and basin parameters used. A complete discussion of multiple linear regression analysis is given by Bryant (1960). Application of regression analysis in a similar hydrologic study is given by Rabon (1971).

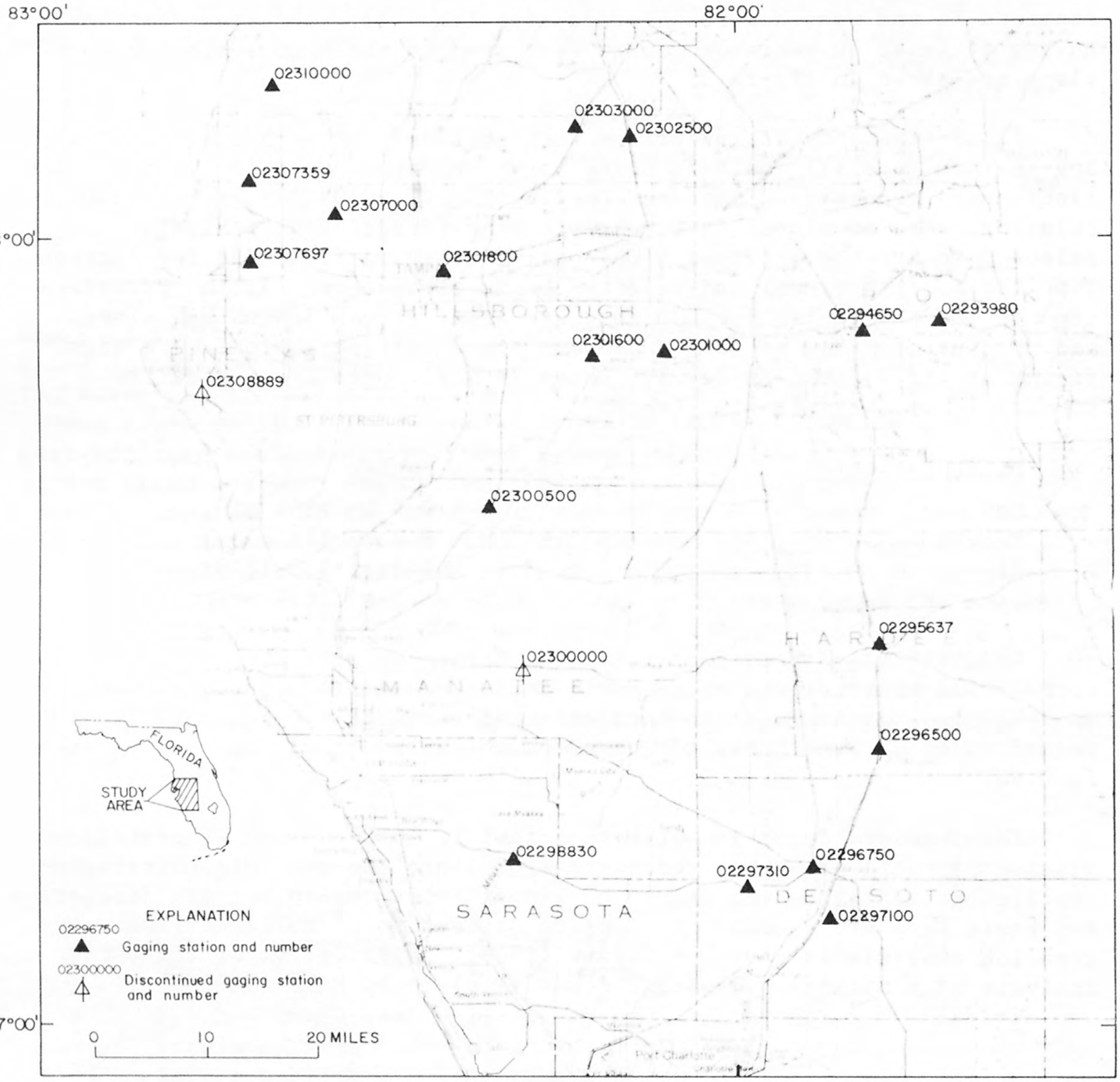



FIGURE 3.--LOCATION OF GAGING STATIONS USED IN MULTIPLE LINEAR REGRESSION ANALYSIS.

Table 1. -- Equations resulting from multiple linear regression analysis.

| Areal flood-frequency equations | Average standard error of estimate | Multiple correlation coefficient | Equivalent years of record |
|---|---|---|---|
| $Q_2 = 23.281\ A^{0.817}\ L^{0.184}\ S^{0.546}\ P^{-0.446}$ | 27.3 | 0.97 | 7 |
| $Q_5 = 38.994\ A^{.688}\ L^{.400}\ S^{.582}\ P^{-.450}$ | 23.7 | .98 | 13 |
| $Q_{10} = 49.88\ A^{.624}\ L^{.516}\ S^{.601}\ P^{-.453}$ | 23.0 | .98 | 18 |
| $Q_{25} = 64.269\ A^{.557}\ L^{.642}\ S^{.620}\ P^{-.458}$ | 23.4 | .98 | 24 |
| $Q_{50} = 74.817\ A^{.515}\ L^{.724}\ S^{.634}\ P^{-.461}$ | 24.6 | .98 | 27 |
| $Q_{100} = 85.507\ A^{.479}\ L^{.799}\ S^{.645}\ P^{-.465}$ | 26.1 | .97 | 28 |
| $Q_{200} = 95.940\ A^{.446}\ L^{.869}\ S^{.656}\ P^{-.468}$ | 27.8 | .97 | 29 |
| $Q_{500} = 109.901\ A^{.407}\ L^{.954}\ S^{.668}\ P^{-.472}$ | 30.4 | .97 | 29 |

A - Drainage area in square miles.

S - Main-channel slope, in feet per mile is the average slope of the main channel between points 10 and 85 percent of the distance upstream from the gaging site to the basin border.

L - Main channel length in miles from gaging site to basin divide.

P - Percentage of drainage basin as lakes and swamps.

Areal flood-frequency relations are based on weighted flood-frequency distributions determined for two gaging stations and for two ungaged locations in the Brooker Creek study reach. Gaging stations include Brooker Creek near Tarpon Springs (site 2, fig. 2) and Brooker Creek near Lake Fern (site 1, fig. 2). The ungaged sites were selected at the upper and lower ends of the study reach at 9.8 $mi^2$ and 44 $mi^2$ drainage area, respectively. The Tarpon Springs station distribution used is a weighted average of the log-Pearson Type III and regional estimates. Because of the short streamflow record period for the Lake Fern station, a distribution was determined by correlation with the Tarpon Springs station. The procedure is described in Water Resources Council (1976) and is referred to as a two-station comparison. The Lake Fern distribution was weighted with the regression estimates.

Weighting factors used include years of record for log-Pearson Type III distributions, and equivalent years of record for regression estimates. Equivalent years of records (table 1) for regression estimates were determined in a procedure described by Hardison (1969). The weighting procedure is described by the Water Resources Council (1976) and is referred to as weighting of independent estimates.

Regression estimates determined for the ungaged sites were adjusted using ratios of weighted station estimates to regional estimates for the nearest Brooker Creek gaging station.

Areal flood-frequency relations were developed by plotting weighted flood-peak discharges of selected recurrence intervals for gaged and ungaged sites versus respective drainage areas on a logrithmic graph. Smooth curves were drawn through plotted points of equal recurrence interval to define areal relations shown in figure 4.

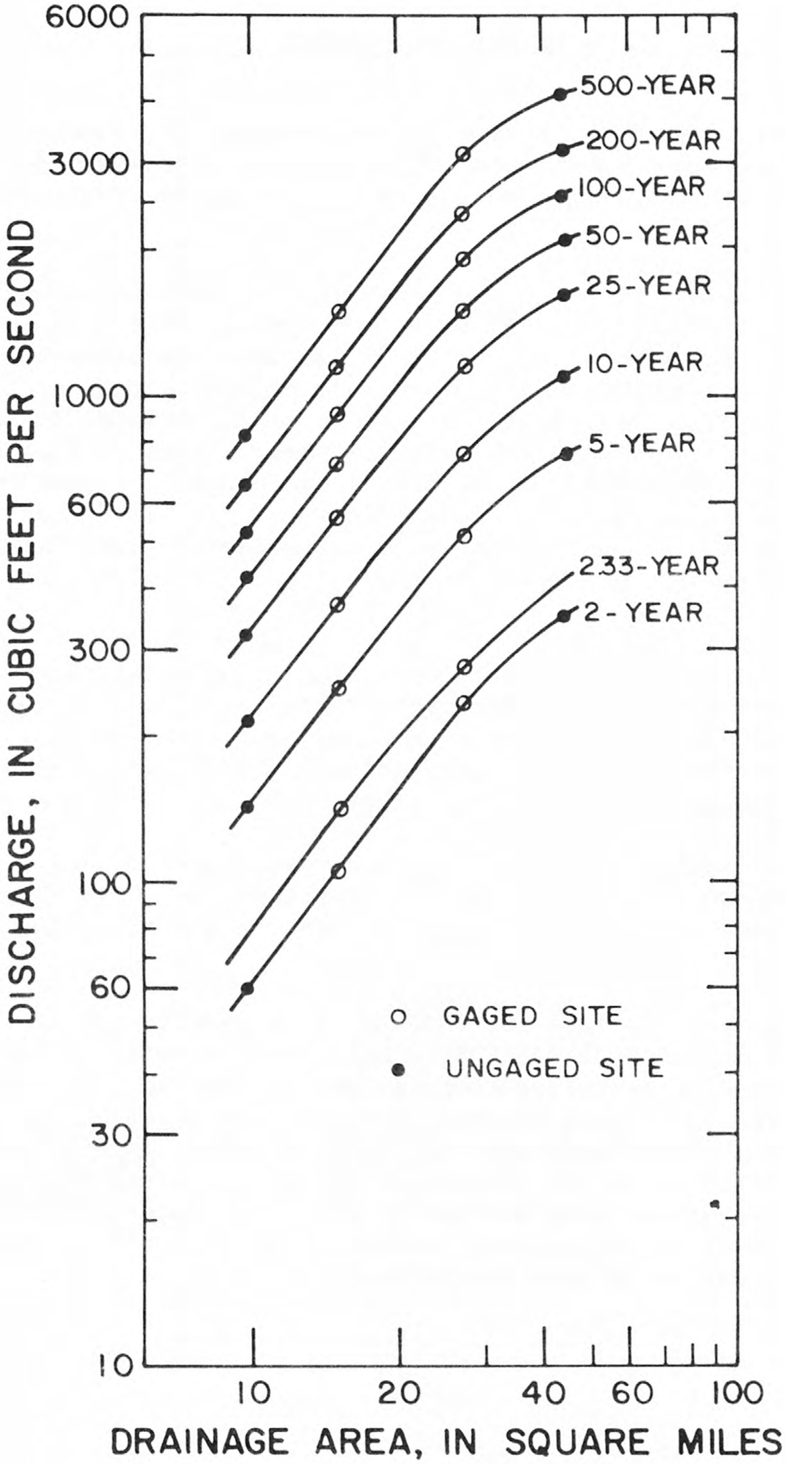



Figure 4 -- Areal flood-frequency relations for Brooker Creek study reach

## FLOOD-HEIGHT COMPUTATION

Flood heights were computed for the study reach using measured land-surface elevation data for 106 stream channel cross-sections and recurrence-interval flood-peak discharges taken from areal flood-frequency relations shown in figure 4.

Stream and valley cross-section data used in the step-backwater analysis were scaled from detailed photo-base topographic maps and taken from results of field surveys. The stream and valley roughness coefficients used were estimated using photo-base topographic maps and results of field surveys. The photo-base topographic maps furnished by the Southwest Florida Water Management District, have scales of 1:2400 and 1:4800 with 1 and 2 ft contour intervals, respectively. Approximate location of 29 cross sections selected for use in profile definition are indicated on figure 2. The 29 cross sections selected adequately define changes in profile slope. Average distance between the 106 cross sections is about 630 ft.

Beginning profile flood heights were taken from a relation of annual peak stages observed at the Brooker Creek near Tarpon Springs gaging station and corresponding Lake Tarpon stages, using recurrence-interval flood heights for the Tarpon Springs station. Stage-discharge data, including rating extensions used in the study, are listed in table 2.

As profile computations progressed upstream, reduced peak discharges were used to compensate for drainage area decreases of 10 to 32 percent. Drainage areas used to obtain selected frequency peak discharges are listed in table 3.

Stage-discharge relations for Brooker Creek near Tarpon Springs (site 2, fig. 2) and Brooker Creek near Lake Fern (site 1, fig. 2) were used in verifying step-backwater computations. Computed flood heights and peak discharges used were plotted on respective stage-discharge relations. Roughness coefficients were adjusted to match computed and observed flood heights for the ratings as defined by streamflow measurements. Rating extensions were defined by plotting higher discharges, used in step-backwater computations, against computed profile flood heights. Rating extension data are noted in table 2.

Table 3. -- Brooker Creek drainage areas used in determining areal flood-frequency discharges for step-backwater computations.

(All cross sections used in study are not shown on figure 2.)

| Cross section numbers | Drainage area used, $mi^2$ |
|---|---|
| [a]5 - 8 | 44.0 |
| 10 - 16 | 38.0 |
| 17 - [b]22A | 27.5 |
| 23 - 42 | 24.8 |
| 43 - 56 | 21.7 |
| 57 - 70 | 18.8 |
| 71 - [c]88 | 15.2 |
| 91 - 107 | 11.7 |
| 109 - [d]116 | 9.8 |

a Brooker Creek at mouth at Lake Tarpon.
b Brooker Creek near Tarpon Springs gaging station (site 2, fig. 2).
c Brooker Creek near Lake Fern gaging station (site 1, fig. 2).
d Brooker Creek at Island Ford Lake outlet.

## FLOOD PROFILES

Computed flood heights listed in table 4 and Lake Tarpon stage-frequency data were used to determine flood profiles for selected recurrence intervals. Profiles are shown in figure 5 for the study reach under 1977 development and hydrologic conditions.

Lake Tarpon flood heights, used to define flood profiles in the lower study reach affected by backwater, include Lake Tarpon stage-frequency data (Stanley D. Leach, U.S. Geol. Survey, WRD, written commun., 1975) summarized in the following table:

| Recurrence interval, years | Lake Tarpon stage, feet above mean sea level |
|---|---|
| 2.33 | 3.0 |
| 5 | 3.6 |
| 10 | 4.2 |
| 25 | 5.2 |
| 50 | 6.2 |
| 100 | 7.0 |
| 200 | 7.3 |
| 500 | 7.6 |

These data are based on Lake Tarpon stage records available for the period 1946-75 (site 3, fig. 2).

The Federal Insurance Administration flood insurance study of the Lake Tarpon area indicated that the greatest threat of lake flooding would be from wind-driven tides, associated with hurricanes. Because wind-driven tides will probably precede fluvial flooding on lower Brooker Creek, fluvial flooding and tide affected Lake Tarpon flooding were considered separately. Lake Tarpon flood heights were extended horizontally upstream (until exceeded by the Brooker Creek fluvial flood profile for the same recurrence interval) to define flood profiles in backwater affected areas of the lower study reach.

The flood data shown in table 4 may be used to delineate Brooker Creek flood boundaries on topographic maps. Accuracy of computed flood heights listed in table 4 depends on the accuracy of many hydrologic input parameters; the most important ones include: cross-section data, roughness coefficients, and recurrence-interval flood-peak discharge data. Computed flood heights summarized in table 4 are judged to be generally accurate to within $\pm 0.5$ ft.

Table 4. -- Computed flood heights, in feet above mean sea level, for selected recurrence-interval flood-peak discharges, in years, at 29 cross sections on Brooker Creek from mouth to Island Ford Lake outlet.

| Cross section number or location | Distance above mouth, in feet | Recurrence interval, in years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 2.33 | 5 | 10 | 25 | 50 | 100 | 200 | 500 |
| 5 | 0 | 3.2 | 3.3 | [1]3.6 | [1]4.2 | [1]5.2 | [1]6.2 | [1]7.0 | [1]7.3 | 7.9 |
| 6 | 570 | 4.3 | 4.5 | 5.2 | 5.7 | 6.2 | [1]6.2 | [1]7.0 | [1]7.3 | 8.2 |
| 8 | 1770 | 5.2 | 5.4 | 6.0 | 6.6 | 7.0 | 7.3 | 7.6 | 8.0 | 8.6 |
| 10 | 3300 | 6.8 | 7.1 | 8.1 | 8.7 | 9.2 | 9.5 | 9.8 | 10.2 | 10.5 |
| [2]Sec. 3W., T.28S., R.16E. | 4000 | - | - | - | - | - | - | - | - | - |
| [2]Sec. 34S., T.27S., R.16E. | 5600 | - | - | - | - | - | - | - | - | - |
| 16 | 6300 | 7.0 | 7.2 | 8.2 | 8.8 | 9.3 | 9.6 | 9.9 | 10.2 | 10.5 |
| 18 | 7500 | 9.8 | 10.0 | 10.4 | 10.6 | 10.9 | 11.1 | 11.3 | 11.4 | 11.6 |
| [3]22A | 10,700 | 11.6 | 11.6 | 12.0 | 12.1 | 12.6 | 12.8 | 13.0 | 13.3 | 13.6 |
| [2]Sec. 27S., T.27S., R.16E. | 12,900 | - | - | - | - | - | - | - | - | - |
| 28 | 14,300 | 13.5 | 13.6 | 14.2 | 14.7 | 15.2 | 15.5 | 15.8 | 16.1 | 16.4 |
| 34 | 17,900 | 14.9 | 15.1 | 15.7 | 16.1 | 16.6 | 16.9 | 17.2 | 17.4 | 17.7 |
| [2]Sec. 22S., T.27S., R.16E. | 18,750 | - | - | - | - | - | - | - | - | - |
| 40 | 21,500 | 15.0 | 15.1 | 15.7 | 16.2 | 16.7 | 17.0 | 17.3 | 17.5 | 17.9 |
| 45 | 24,500 | 15.7 | 15.9 | 16.5 | 16.9 | 17.4 | 17.7 | 18.0 | 18.3 | 18.7 |
| [2]Sec. 23W., T.27S., R.16E. | 24,500 | - | - | - | - | - | - | - | - | - |
| [2]Sec. 26N., T.27S., R.16E. | 27,600 | - | - | - | - | - | - | - | - | - |
| 51 | 28,100 | 17.0 | 17.2 | 17.8 | 18.2 | 18.7 | 19.0 | 19.3 | 19.6 | 19.9 |
| 56 | 31,100 | 19.3 | 19.4 | 19.8 | 20.1 | 20.5 | 20.8 | 21.0 | 21.2 | 21.5 |
| [2]Sec. 23S., T.27S., R.16E. | 31,400 | - | - | - | - | - | - | - | - | - |
| 61 | 34,100 | 21.2 | 21.2 | 21.6 | 21.8 | 22.1 | 22.4 | 22.6 | 22.8 | 23.0 |
| [2]Sec. 24W., T.27S., R.16E. | 34,850 | - | - | - | - | - | - | - | - | - |
| 66 | 37,100 | 22.2 | 22.3 | 22.6 | 22.8 | 23.1 | 23.3 | 23.5 | 23.7 | 23.9 |
| [2]Sec. 13S., T.27S., R.16E. | 38,200 | - | - | - | - | - | - | - | - | - |
| 71 | 40,100 | 23.3 | 23.5 | 24.1 | 24.5 | 24.9 | 25.2 | 25.5 | 25.7 | 26.0 |
| 75 | 42,500 | 24.2 | 24.4 | 25.0 | 25.4 | 25.8 | 26.2 | 26.5 | 26.8 | 27.0 |
| [2]Sec. 18W., T.27S., R.17E. | 44,550 | - | - | - | - | - | - | - | - | - |

Table 4. -- Computed flood heights, in feet above mean sea level, for selected recurrence-interval flood-peak discharges, in years, at 29 cross sections on Brooker Creek from mouth to Island Ford Lake outlet (continued).

| Cross section number or location | Distance above mouth, in feet | Recurrence interval, in years | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2 | 2.33 | 5 | 10 | 25 | 50 | 100 | 200 | 500 |
| 80 | 45,300 | 27.4 | 27.6 | 27.8 | 28.1 | 28.4 | 28.7 | 28.9 | 29.1 | 29.4 |
| 84 | 47,700 | 29.0 | 29.2 | 29.8 | 30.2 | 30.6 | 30.9 | 31.2 | 31.4 | 31.7 |
| [4]88 | 49,970 | 30.0 | 30.3 | 31.1 | 31.6 | 32.0 | 32.3 | 32.6 | 32.8 | 33.1 |
| 91 | 51,900 | 30.3 | 30.6 | 31.4 | 31.9 | 32.5 | 32.9 | 33.3 | 34.9 | 35.1 |
| [2]Sec. 17W., T.27S., R.17E. | 52,580 | - | - | - | - | - | - | - | - | - |
| [2]Sec. 8S., T.27S., R.17E. | 53,500 | - | - | - | - | - | - | - | - | - |
| 95 | 53,900 | 31.7 | 31.9 | 32.5 | 32.9 | 33.4 | 33.7 | 34.0 | 35.0 | 35.2 |
| 99 | 56,300 | 33.8 | 34.1 | 34.8 | 35.3 | 35.7 | 36.0 | 36.3 | 36.5 | 36.8 |
| 102 | 58,100 | 36.0 | 36.2 | 36.7 | 37.1 | 37.5 | 37.7 | 38.0 | 38.2 | 38.4 |
| 105 | 59,900 | 36.6 | 36.8 | 37.5 | 37.9 | 38.4 | 38.6 | 38.8 | 39.0 | 39.3 |
| [2]Sec. 9W., T.27S., R.17E. | 61,100 | - | - | - | - | - | - | - | - | - |
| 108 | 61,700 | 37.9 | 38.0 | 38.5 | 38.8 | 39.2 | 39.4 | 39.6 | 39.8 | 40.1 |
| 109 | 62,300 | 38.5 | 38.6 | 39.0 | 39.3 | 39.6 | 39.8 | 40.0 | 40.2 | 40.4 |
| 115 | 65,900 | 39.4 | 39.5 | 39.8 | 40.0 | 40.2 | 40.5 | 40.7 | 40.9 | 41.1 |
| 116 | 66,500 | 40.5 | 40.6 | 40.9 | 41.2 | 41.4 | 41.6 | 41.8 | 42.0 | 42.3 |

1 Lake Tarpon flood heights shown are applicable in backwater affected areas of lower study reach.
2 Land section line (east, north, south, or west), township and range, at intersection with Brooker Creek.
3 Brooker Creek near Tarpon Springs gaging station (site 2, fig. 2).
4 Brooker Creek near Lake Fern gaging station (site 1, fig. 2, State Road 582).

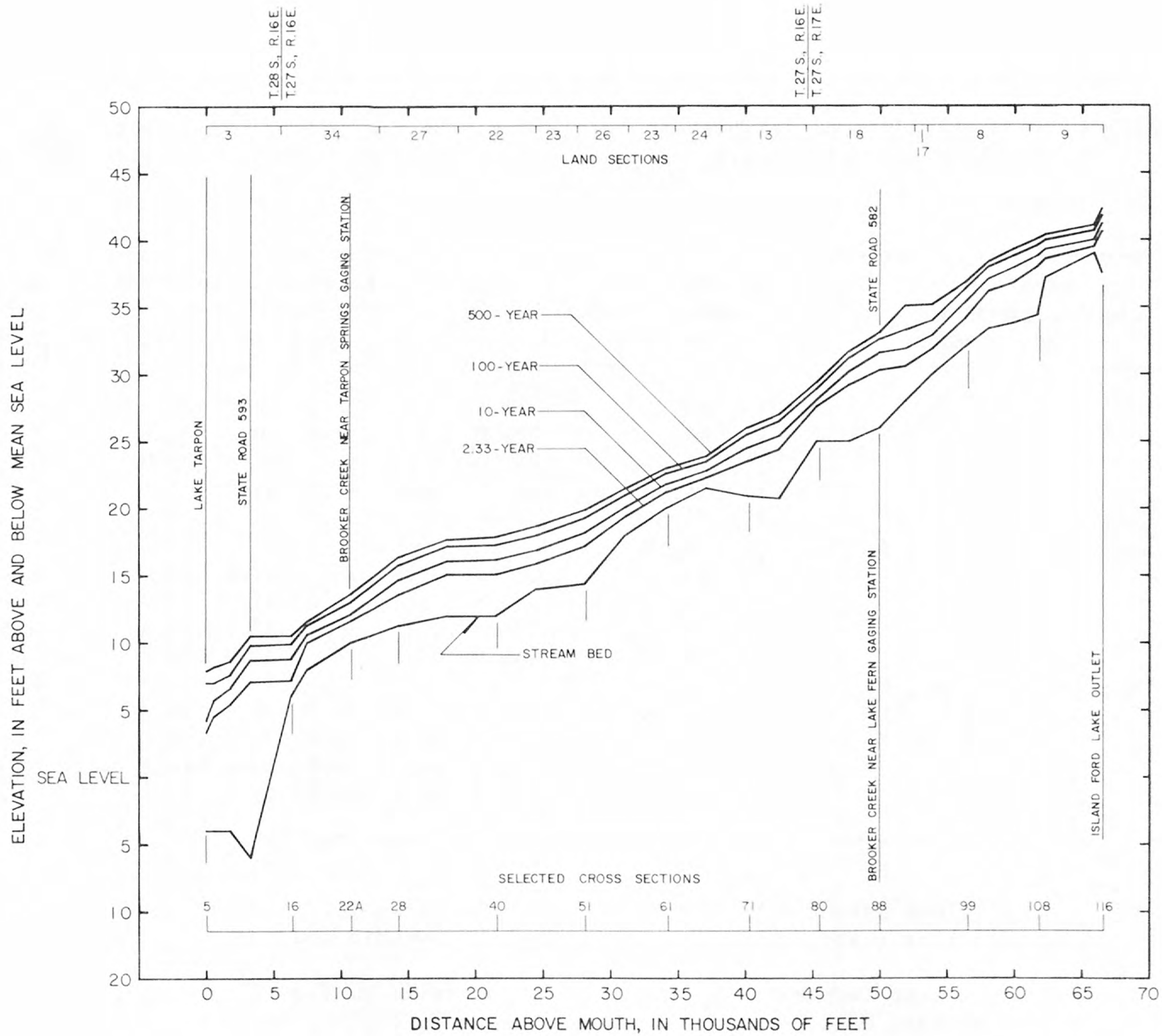



FIGURE 5.--PROFILES FOR THE 2.33-, 10-, 100-, AND 500-YEAR FLOODS FOR LOWER BROOKER CREEK.

Land-section line, township, and range locations are listed in table 4 and shown on figure 5 for user convenience.

Future urbanization and other man-made changes in the basin may change flood-peak discharges and flood-profile elevations for the specified recurrence intervals. Therefore, flood information presented in this report may not be entirely applicable under future development conditions.

## SUMMARY

Brooker Creek, located in west-central Florida, flows generally west and southwest from Keystone and Island Ford Lakes in Hillsborough County and into Lake Tarpon in Pinellas County. Urban development is increasing in Brooker Creek basin, particularly on water-front property near Lake Tarpon. Some of this development is located in or near low-lying areas of Brooker Creek basin that are subject to flooding, especially during large regional storms.

Flood profiles were determined as part of this study for a 12.6-mi reach of lower Brooker Creek. Areal flood-frequency relations used for the study reach were determined using gaging station annual flood-peak discharges and regional flood information. Fluvial flood heights having 2-, 2.33-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence intervals were determined using the U.S. Geological Survey step-backwater model. Computed flood heights were used in determining fluvial-flood profiles for selected recurrence intervals. Lake Tarpon stage-frequency data were used in determining flood profiles of the lower Brooker Creek study reach affected by backwater from Lake Tarpon. Flood profiles developed represent the extreme flood condition in the study reach considering both fluvial and backwater flooding.

Flood heights provided as part of this report can be used to delineate the areal extent of flooding on topographic maps. Computed flood heights are judged to be accurate to $\pm$0.5 ft. These data represent current basin conditions and may not be entirely applicable after further urban development and land modification.

## SELECTED REFERENCES


Bailey, J. F., and Ray, H. A., 1966, Definition of stage-discharge relation in natural channels by step-backwater analysis: U.S. Geol. Survey Water-Supply Paper 1869-A, 24 p.

Barnes, H. H., 1967, Roughness characteristics of natural channels: U.S. Geol. Survey Water-Supply Paper 1849, 213 p.

Barnes, H. H., Jr., and Golden, H. G., 1966, Magnitude and frequency of floods in the United States, Part 2-B. South Atlantic Slope and Eastern Gulf of Mexico basins, Ogeechee River to Pearl River: U.S. Geol. Survey Water-Supply Paper 1674, 409 p.

Boyer, M. C., 1964, Streamflow measurement, in Chow, V. T., Handbook of applied hydrology, New York, McGraw-Hill Book Co., Inc., Section 15, p. 32.

Bryant, Edward C., 1960, Statistical analysis: New York, McGraw-Hill, 321 p.

Chow, V. T., 1959, Open channel hydraulics: New York, McGraw-Hill, p. 106-109, 265-268.

Dalrymple, Tate, 1960, Flood-frequency analysis: U.S. Geol. Survey Water-Supply Paper 1543-A, 80 p.

Ezekiel, M., 1950, Methods of correlation analysis, 2d ed.: New York, John Wiley and Sons, Inc., 531 p.

Hardison, C., 1969, Accuracy of streamflow characteristics: U.S. Geol. Survey Prof. Paper 650-D, p. D210-D214.

Langbein, W. B., and Iseri, K. T., 1960, General introduction and hydrologic definitions: U.S. Geol. Survey Water-Supply Paper 1541-A, 29 p.

Linsley, R. K., Kohler, M. A., and Paulhus, J. L. H., 1958, Hydrology for engineers: New York, McGraw-Hill, 689 p.

Posey, C. J., 1950, Gradually varied channel flow, in Rouse, H., ed., Engineering hydraulics: New York, John Wiley and Sons, p. 625-629.

Rabon, James W., 1971, Evaluation of streamflow-data program in Florida: U.S. Geol. Survey Open-File Report 70008, 70 p.

Riggs, H. C., 1968, Frequency curves: U.S. Geol. Survey Techniques Water-Resources Inv., Book 4, Chap. A2, 15 p.

Shearman, J. O., 1976, Computer program E431 user's manual, Open-File Report, 76-499, 175 p.

U. S. Soil Conservation Service, 1966, Methods of flow-frequency analysis, in Notes on hydrologic activities: U.S. Soil Conserv. Service, Bull. 13, 42 p.

U. S. Water Resources Council, 1976, Guidelines for determining flood-flow frequency: U.S. Water Resources Council, Bull. 17, Washington, U.S. Govt. Printing Office.



*U.S. GOVERNMENT PRINTING OFFICE: 1978-745-572/747. Region 4.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
325 John Knox Rd--Suite F240
Tallahassee, Florida 32303

POSTAGE AND FEES PAID
U.S. DEPARTMENT OF THE INTERIOR
INT. 413

U.S. MAIL

USGS LIBRARY - RESTON
3 1818 00106095 1

**FIRST CLASS**