Extent of Areal Inundation of Riverine Wetlands Along Five River Systems in the Upper Hillsborough River Watershed, West-Central Florida

By B.R. Lewelling

In cooperation with the
Southwest Florida Water Management District

Scientific Investigations Report 2004-5133

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
Charles G. Groat, Director

U.S. Geological Survey, Reston, Virginia: 2004
For sale by U.S. Geological Survey, Information Services
Box 25286, Denver Federal Center
Denver, CO 80225

For more information about the USGS and its products:
Telephone: 1-888-ASK-USGS
World Wide Web: http://www.usgs.gov/

Suggested citation: Lewelling, B.R., 2004, Extent of Areal Inundation of Riverine Wetlands Along Five River Systems in the Upper Hillsborough River Watershed, West-Central Florida: U.S. Geological Survey Scientific Investigations Report 2004-5133, 49 p., plus appendixes.

CONTENTS

FIGURES

TABLES

Conversion Factors, Acronyms, Abbreviations, and Datums

	By	To obtain
acre	4047	square meter
foot (ft)	0.3048	meter
inch (in.)	25.4	millimeter
mile (mi)	1.609	kilometer
square mile (mi^2)	2.59	square kilometer
cubic foot per second (ft^3/s)	0.02832	cubic meter per second

days/yr	days per year
FEMA	Federal Emergency Management Agency
HEC-RAS	Hydrologic Engineering Center-River Analysis System
NWI	National Wetlands Inventory
SR	State Road
SWFWMD	Southwest Florida Water Management District
US	U.S. Highway
USACOE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
yr	year

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD of 1929); horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27).

Extent of Areal Inundation of Riverine Wetlands Along Five River Systems in the Upper Hillsborough River Watershed, West-Central Florida

By B.R. Lewelling

Abstract

Riverine and palustrine wetlands are a major ecological component of river basins in west-central Florida. Healthy wetlands are dependent, in part, upon the frequency and duration of periodic flooding or inundation. This report assesses the extent, area, depth, frequency, and duration of periodic flooding and the effects of potential surface-water withdrawals on wetlands along five river systems in the upper Hillsborough River watershed: Hillsborough and New Rivers, Blackwater and Itchepackesassa Creeks, and East Canal. Results of the study were derived from step-backwater analyses performed for each of the river systems using the U.S. Army Corps of Engineers Hydrologic Engineering Center-River Analysis System (HEC-RAS) one-dimensional model. Step-backwater analyses were performed based on daily mean discharges at the 10th, 50th, 70th, 80th, 90th, 95th, 99.5th, and 99.97th percentiles for selected periods. The step-backwater analyses computed extent of inundation, area of inundation, and hydraulic depth. An assessment of the net reduction of areal inundation for each of the selected percentile discharges was computed if 10 percent of the total river flow were diverted for potential withdrawals.

The extent of areal inundation at a cross section is controlled by discharge volume, topography, and the degree to which the channel is incised. Areal inundation can occur in reaches characterized by low topographic relief in the upper Hillsborough watershed during most, if not all, selected discharge percentiles. Most river systems in the watershed, however, have well defined and moderately incised channels that generally confine discharges within the banks at the 90th percentile. The greatest increase in inundated area along the five river systems generally occurred between the 95th to 99.5th percentile discharges. The decrease in inundated area that would result from a potential 10-percent discharge withdrawal at the five river systems ranged as follows: Hillsborough River, 7 to 940 acres (2.0 to 6.0 percent); and New River, 0.2 to 58.9 acres (0 to 11.9 percent); Blackwater Creek, 3.3 to 148 acres (2.2 to 9.4 percent); Itchepackesassa Creek, 1.0 to 104 acres (0.9 to 10.8 percent); and East Canal 0.7 to 34.6 acres (0.5 to 7.6 percent).

Introduction

Locating alternative sources of water supply to meet the demand of an increasing population is a major concern in west-central Florida. This need is further complicated by declining ground-water levels in the Upper Floridan aquifer, the principal source of supply in the area. Surface-water withdrawals from area rivers have become an increasingly important alternate supply source. The health of riverine wetlands depends, in part, upon the frequency and duration of periodic flooding or inundation. The U.S. Geological Survey (USGS), in cooperation with the Southwest Florida Water Management District (SWFWMD), evaluated the extent of areal inundation in the upper Hillsborough River watershed, and a potential range in areal inundation resulting from withdrawals of 10 percent of average daily discharges for the upper Hillsborough River and the New River, Blackwater and Itchepackesassa Creeks, and East Canal when flows exceed regulatory minimums.

Purpose and Scope

The purpose of this report is to present (1) the extent of areal inundation in an area that includes the upper Hillsborough River, New River, Blackwater Creek, Itchepackesassa Creek, and East Canal (fig. 1) based on selected long-term discharge record periods, and (2) the decrease in the extent of areal inundation when a potential diversion of 10 percent of that discharge occurs. Extent of areal inundation was determined for the 10th, 50th, 70th, 80th, 90th, 95th, 99.5th, and 99.97th percentiles when hydraulic conditions permitted. Percentiles used in this study for the four upper Hillsborough River long-term gaging stations, Morris Bridge, Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow, were based on the longest concurrent 17-year (yr) period (1984-2000). Percentiles for New River were based on the available 10-yr period,

Base from U.S. Geological Survey digital data, 1:200,000, 1972
Albers Equal-Area Conic projection
Standard Parallels 29°30′, and central meridian –83°00′

Figure 1. Location of study area including the Hillsborough and New Rivers, Blackwater and Itchepackesassa Creeks, and East Canal, west-central Florida.

1965-1974, at the New River near Zephyrhills gaging station. Percentiles for Blackwater Creek, Itchepackesassa Creek, and East Canal were based on the 29-yr period, 1973-2001, at the Blackwater Creek near Knights gaging station.

The U.S. Army Corps of Engineers (USACOE) Hydrologic Engineering Center-River Analysis System (HEC-RAS) one-dimensional step-backwater model (Warner and Brunner, 1998a,b) was used to compute water-surface elevations at cross sections for each river. These computed water-surface elevations were used to generate water-surface profiles, areal inundation width and acreage, and hydraulic depth (the ratio of the cross-sectional area to the surface width).

Previous Investigations

Johnson and others (1979) presented flood profiles based on the USGS E431 (Shearman, 1976) and the USACOE (HEC-2) step-backwater analyses along a 30.8-mile (mi) reach of the Hillsborough River from Structure-155 to United States (US) 98 and a 8.5-mi reach of the New River from the confluence with Hillsborough River to 1.5 mi upstream of State Road (SR) 54 (fig. 1). Johnson and others (1980) computed flood profiles using the USGS E431 step-backwater analysis along three Hillsborough River tributaries that included: (1) a 10.5-mi reach along Blackwater Creek from SR 39 to the center of section 33 near Galloway; (2) a 14-mi reach along Itchepackesassa Creek from the confluence with Blackwater Creek to Interstate Highway 4; and (3) a 4.9-mi reach along East Canal from the confluence with Itchepackesassa Creek to Interstate Highway 4. Harrison and others (1983) presented flood profiles based on the USGS E431 step-backwater analysis along a 11.4-mi reach of Trout Creek. Federal Emergency Management Agency (FEMA) (1989) presented a flood-insurance study in unincorporated areas of Hillsborough County that included flood profiles of reaches along the Hillsborough River and Blackwater Creek.

Description of the Study Area

The study area includes five river systems located in the upper Hillsborough River watershed: Hillsborough River and New River in southeastern Pasco and northeastern Hillsborough Counties; Blackwater Creek and Itchapackesassa Creek in eastern Hillsborough and western Polk Counties; and East Canal in eastern Hillsborough County (fig. 1). Unique physiographic characteristics (shape, gradient, and basin and channel length) affect the hydraulic conditions of the five river systems. Based on map delineation by the National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service (Cowardin and others, 1979) the channel and floodplain of the five study river systems have been classified as predominately lower perennial river bounded by inland forested wetlands or uplands.

The 28-mi-long upper Hillsborough River study reach, from Morris Bridge Road to the Withlacoochee-Hillsborough Overflow at US 98, can be characterized as a broad, hardwood floodplain with low topographic relief and frequent, widespread, and prolonged areal inundation. The extent of areal inundation of low-lying areas along the study reaches of the Hillsborough River can be large during relatively low-discharge conditions. The low-gradient channel along most of the middle and lower study reaches is moderately incised and slightly meandered. Most of the channel along the upper reach is either poorly defined or absent within a broad floodplain. Discharge along the extreme upper reach of the Hillsborough River is generally limited to crossover flow from the Withlacoochee River at the Withlacoochee-Hillsborough Overflow. Crossover during high-flow conditions occurs annually about 25 percent of the time, based on the study period 1984-2000.

New River is a major tributary to the upper Hillsborough River and drains an approximate 19.5-square mile (mi^2) area. The north-south trending channel is moderately incised and well defined along most of the 8.5-mi-long study reach. The study reach begins at the confluence with the Hillsborough River and ends approximately 1.5 mi upstream of SR 54. New River drains predominately pastureland with limited areas of residential development.

East-west trending Blackwater Creek is the largest tributary to the upper Hillsborough River, draining approximately a 113-mi^2 area. The headwaters to Blackwater Creek begin northwest of the city of Lakeland and drain westward 17.2 mi to the confluence with the Hillsborough River. Unique channel characteristics can be used to define both a lower and an upper Blackwater Creek study reach. Most of the lower reach channel, from the confluence with the Hillsborough River to SR 39, generally is deeply incised and slightly meandered. Most of the channel along the lower reach is natural and unaltered by channelization. In contrast, the upper reach channel, from SR 39 to the center of section 33 near Galloway, has been extensively channelized and straightened to enhance drainage. Much of the length along the upper channel banks are lined with spoil berms, excavated during ditching and channelization. Berms can restrict areal inundation in places, however numerous breaches provide flow access to the floodplain. During low-flow conditions, the Blackwater Creek channel in Polk County generally is dry. The Blackwater Creek watershed is predominately agricultural with limited development. Presently, Hillsborough County owns a large part of the western half of the upper Blackwater Creek watershed, which has been proposed for future well field development.

Itchepackesassa Creek is the largest tributary to Blackwater Creek and drains an approximate 57-mi^2 area. Much of Itchepackesassa Creek has been channelized to improve drainage. The Itchepackesassa Creek headwaters form west of the city of Lakeland and drain in a northwest direction to the confluence with Blackwater Creek. Discharge from the Lake Bonnet outfall structure is a principal source of water to Itchepackesassa Creek during low-flow conditions. At the confluence of Blackwater and Itchepackesassa Creeks, Itchepackesassa Creek has a 37-percent larger drainage area than Blackwater

Creek, and generally is either the sole source or the greatest source of discharge to Blackwater Creek during low-flow conditions.

East Canal is a major tributary to Itchepackesassa Creek that has been highly channelized. The north-south trending East Canal channel drains an approximate 13.4-mi^2 area from eastern Plant City to the confluence with Itchepackesassa Creek. During low-flow conditions, East Canal flow is predominantly treated wastewater discharged from Plant City at SR 582 (J.T. Trommer, U.S. Geological Survey, oral commun., 2001).

Methodology

Step-backwater analyses were performed for the Hillsborough River, New River, and Blackwater Creek river systems, based on specific record periods, using HEC-RAS. Analyses for Itchepackesassa Creek and East Canal river systems were performed in conjunction with the Blackwater Creek analyses. Step-backwater analyses were performed for each of the selected percentile discharges. Streamflow record periods used to calculate the discharge percentiles for the Hillsborough River, New River, and Blackwater Creek analyses were 17, 10, and 29 years, respectively. Discharge record for the Hillsborough River was based on a concurrent period at the four study gaging stations. New River and Blackwater Creek discharges were based on the available long-term record at their respective gaging stations.

Results of the step-backwater analyses were used to estimate water-surface elevation, extent of areal inundation, and hydraulic depth at each cross section. Area of inundation between adjacent cross sections, in acres, also was computed during each step-backwater analysis. The water-surface elevation computed at each cross section was used to generate water-surface profiles along the study reach. The computed water-surface elevation also was used to calculate the extent of areal inundation width, in feet, at each cross section, based on channel geometry and cross-sectional topography. Study reaches in this report are referenced from a downstream to upstream location, consistent with the direction in which the step-backwater analyses was performed.

Hydraulic properties and cross-sectional geometry data for the stream channels and floodplains were determined from three sources: (1) field surveys, (2) detailed aerial 1-foot (ft) topographic contour maps (scale 1:200), or (3) previous step-backwater analyses by Johnson and others (1979) and Johnson and others (1980). Cross-section geometry of the channel and floodplain are defined by coordinates of both the horizontal distance from the left bank (looking downstream) and the corresponding land-surface elevation (fig. 2). The land-surface elevations of the first and last horizontal coordinate were selected to contain the highest water-surface elevation computed at each cross section. Water-surface elevations computed in this study generally represent more frequently occurring discharge conditions. Maximum water-surface elevations rarely approached the highest estimated design elevation of previous step-backwater analyses for a 100-yr flood.

A reference distance of each cross-section location, measured in miles upstream from the mouth, was assigned to each cross section. This reference distance also served as the identification number for each cross section. Selection of the cross-section location along a reach was determined based on characteristics that best represented existing field conditions. Cross sections were divided into subareas that represented existing hydraulic conditions. Manning's roughness coefficient, *n*, was used to describe the degree of flow resistance of the channel and floodplain. The roughness coefficient is a function of bed material size, depth of flow, cross-sectional geometry,

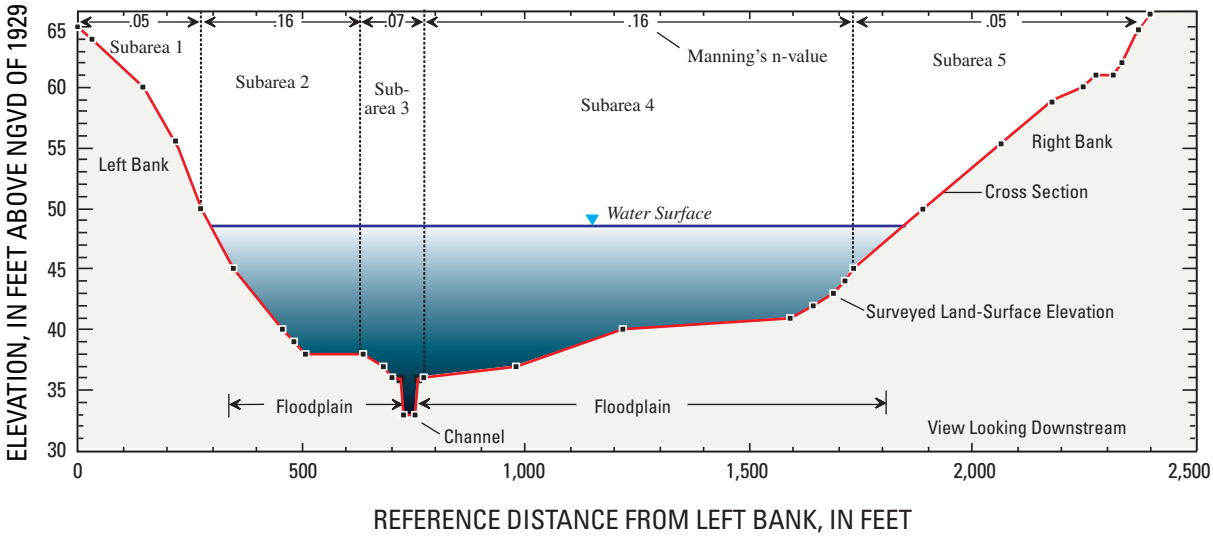


Figure 2. Example cross section showing Manning's *n*-values, subareas, and water-surface elevation.

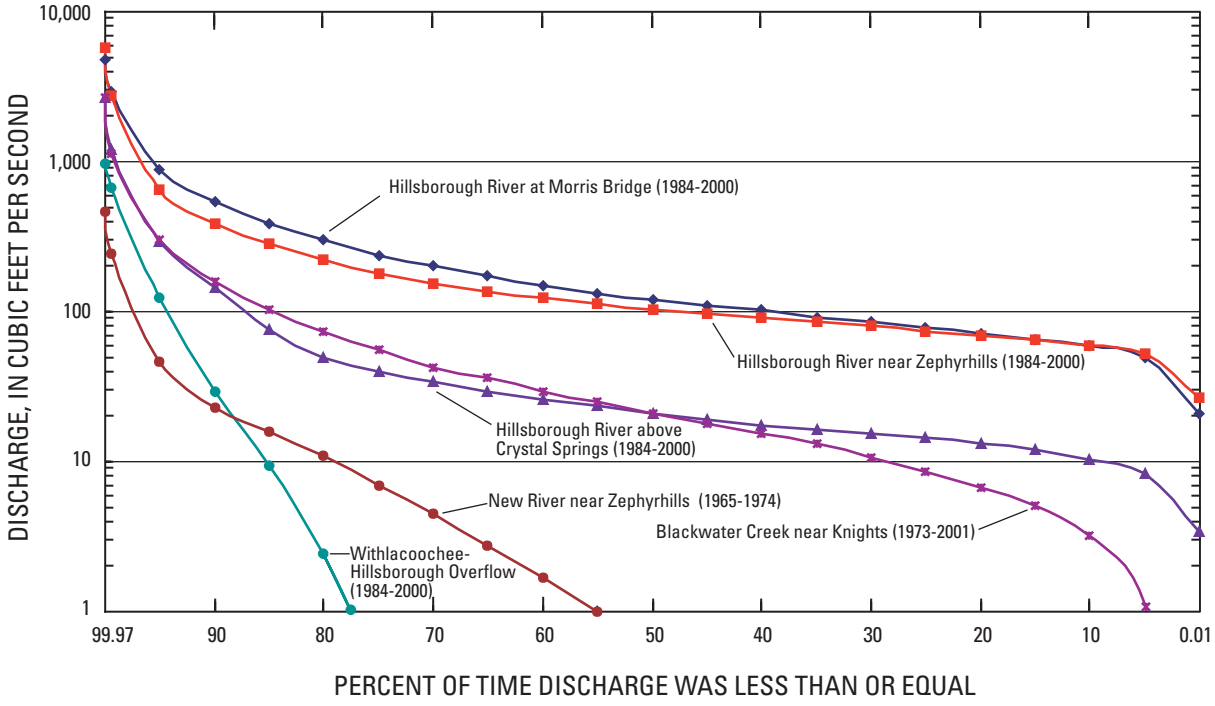


Figure 3. Duration curves of daily mean discharge at four upper Hillsborough River gaging stations for the concurrent period 1984-2000, the New River near Zephyrhills gaging station for the period 1965-1974, and the Blackwater Creek near Knights gaging station for the period 1973-2001.

type and density of vegetation, and degree of channel meandering. For example, Manning's roughness coefficients for the Hillsborough River ranged from 0.06 to 0.15 in the channel and from 0.11 to 0.23 in the floodplain. Roughness coefficients at cross sections ranged from sandy channels clear of vegetation and debris (0.06) to partially obstructed channels dominated by extensive aquatic vegetation, tree trunks, and exposed root systems (0.15).

Percentile discharges used for the Hillsborough River, New River, and Blackwater Creek step-backwater analyses were determined from duration analysis curves for the selected record periods. Duration analysis curves are cumulative frequency curves that indicate the percentage of time that the daily mean discharge was less than or equaled a specific period of time (fig. 3). Percentile discharges for the Hillsborough River were based on the longest available concurrent period of record at the Morris Bridge, Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow gaging stations (17-yr period, 1984-2000); New River on the available period of record at the New River near Zephyrhills gaging station (10-yr period, 1965-1974); and the Blackwater Creek near Knights gaging station on three Hillsborough River gaging stations: Morris Bridge, Zephyrhills, and Withlacoochee-Hillsborough Overflow (29-yr period, 1973-2001) (table 1). Although much longer record periods may exist at some gaging stations, the accuracy of the step-backwater analysis is improved when multiple gaging stations along a reach are used with concurrent record. The period of record used in the analysis does not necessarily represent pre- or post-developmental discharge characteristics within the watershed. The degree of climatic and/or anthropomorphic impacts represented in the analyses may vary greatly depending upon the period of record selected.

Differences in the shape of duration analysis curves reflect variations in precipitation, drainage, and seepage conditions for the selected period at a gaging station. A comparison of the differences in the shape of duration curves for the Hillsborough River near Zephyrhills gaging station for the study period, 1984-2000, is made using three selected periods (fig. 4.) These three examples used for comparison are: (1) the complete period of record, 1940-2001; (2) the period used for the New River analyses, 1965-1974; and (3) the Blackwater Creek analyses, 1973-2001. The shape of the duration curve for the 29-yr period (1973-2001) shows discharge conditions are similar to that of the overlapping 17-yr study period (1984-2000). The shape of the duration curve for the 62-yr period of record (1940-2001), and the 10-yr period (1965-1974) however, indicates consistently higher flows for most percentiles, except during extreme conditions. Based on a break in slope of a double-mass curve analysis of the long-term streamflow record at the Zephyrhills gaging station, a measured reduction in flow occurred both in 1945 and 1970 (J.T. Trommer, U.S. Geological Survey, written commun., 2002).

Table 1. Upper Hillsborough River watershed study gaging stations.

[mi^2, square miles; ft^3/s, cubic feet per second]

Map No. (fig. 1)	Station	Station No.[1]	Drainage area (mi^2)	Continuous period of record (water year[2])	Instantaneous peak		Minimum flow (ft^3/s)
					(ft^3/s)	Date	
1	Hillsborough River at Morris Bridge	02303330	375	1973-current year	5,200	12-15-1997	21
2	Hillsborough River near Zephyrhills	02303000	220	1940-current year	12,600	03-18-1960	27
3	Hillsborough River above Crystal Springs	02301990	82	1984-current year	2,700	12-13-1997	3.4
4	Withlacoochee-Hillsborough Overflow near Richland	02311000	[3]14.2	1960-current year	1,880	03-19-1960	0
5	New River near Zephyrhills[4]	02303100	15	1965-1974	269	09-12-1964	0
6	Blackwater Creek near Knights	02302500	101.6	1951-current year	5,400	03-18-1960	0
7	Itchepackesassa Creek near Moriczville	02302280	48.5	2000-2002	673	09-16-2001	0
8	Itchepackesassa Creek near Knights[5]	02302260	34	1982-1998	660	09-07-1988	0

[1]USGS downstream station order identification number.
[2]Water year is a 12-month period from October 1 through September 30.
[3]Drainage area is variable at high flow based on stage of Withlacoochee and Hillsborough River.
[4]Gaging station discontinued after 1974.
[5]Crest-stage gage.

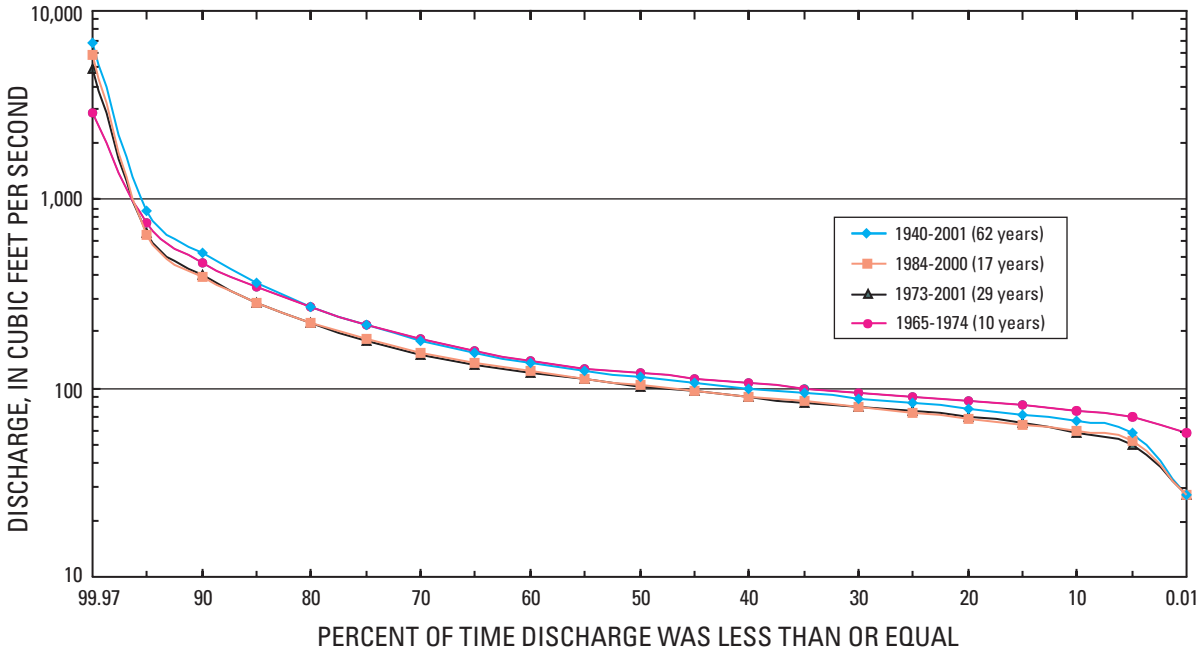


Figure 4. Comparison of duration curves of daily mean discharge for selected periods of record at the Hillsborough River near Zephyrhills gaging station.

Step-backwater analyses were performed for each of the selected percentile discharges, 10th, 50th, 70th, 80th, 90th, 95th, 99.5th, and 99.97th, when hydraulic conditions permitted. Percentile is a value on a scale of 0 to 100 that indicates the percentage of a streamflow distribution that is equal to or less than a specific discharge. For example, based on a selected streamflow record period, the 90th percentile discharge indicates that 90 percent of the flows are equal to or less than a specific discharge and 10 percent of the flows are greater. The 10th percentile discharge was omitted from the New River and Blackwater Creek analyses because flows were not sufficient to perform step-backwater analysis. The 99.97th percentile discharge was omitted from the New River analyses because of limited peak streamflow events during the record period (1965-1974).

A second step-backwater analysis was performed using 10 percent less discharge to estimate the effects on area of inundation that would result from a potential 10-percent surface-water withdrawal at each of the five river systems. A 10-percent reduction was applied to each of the selected percentile discharges. The analysis performed using 100 percent of the discharge was identified as the *existing* step-backwater analysis and the analysis performed using 10 percent less discharge was identified as the *potential* step-backwater analysis. Results of the existing and potential analyses were then compared to evaluate the effects of potential withdrawal. During the step-backwater analysis, the 10-percent reduction was implemented equally along each river reach. In actual practice, however, withdrawals from the river would not occur uniformly along the reaches, but at a specific location. The 10-percent reduction simulates flow conditions for the selected record period, which are in addition to any existing natural or anthropomorphic impacts.

Terminology used to simplify representation of results for this study was applied to all percentiles. The 10th percentile of daily mean discharge is identified as P_{10} discharge. The potential 10-percent withdrawal of the P_{10} discharge is identified as $P_{10\text{-}10}$ discharge. Computation of the P_{10} and $P_{10\text{-}10}$ discharges were omitted in the step-backwater analyses of New River, Blackwater Creek, Itchepackesassa Creek, and East Canal because of insufficient discharge to perform the analyses.

Water-surface profiles were computed from one cross section to the next by solving the energy equation with an iterative procedure called the standard step method (Warner and Brunner, 1998b). The energy equation is written as follows:

$$Y_2 + Z_2 + (\alpha_2 V_2^2)/2g = Y_1 + Z_1 + (\alpha_1 V_1^2)/2g + h_e \qquad (1)$$

where: ,

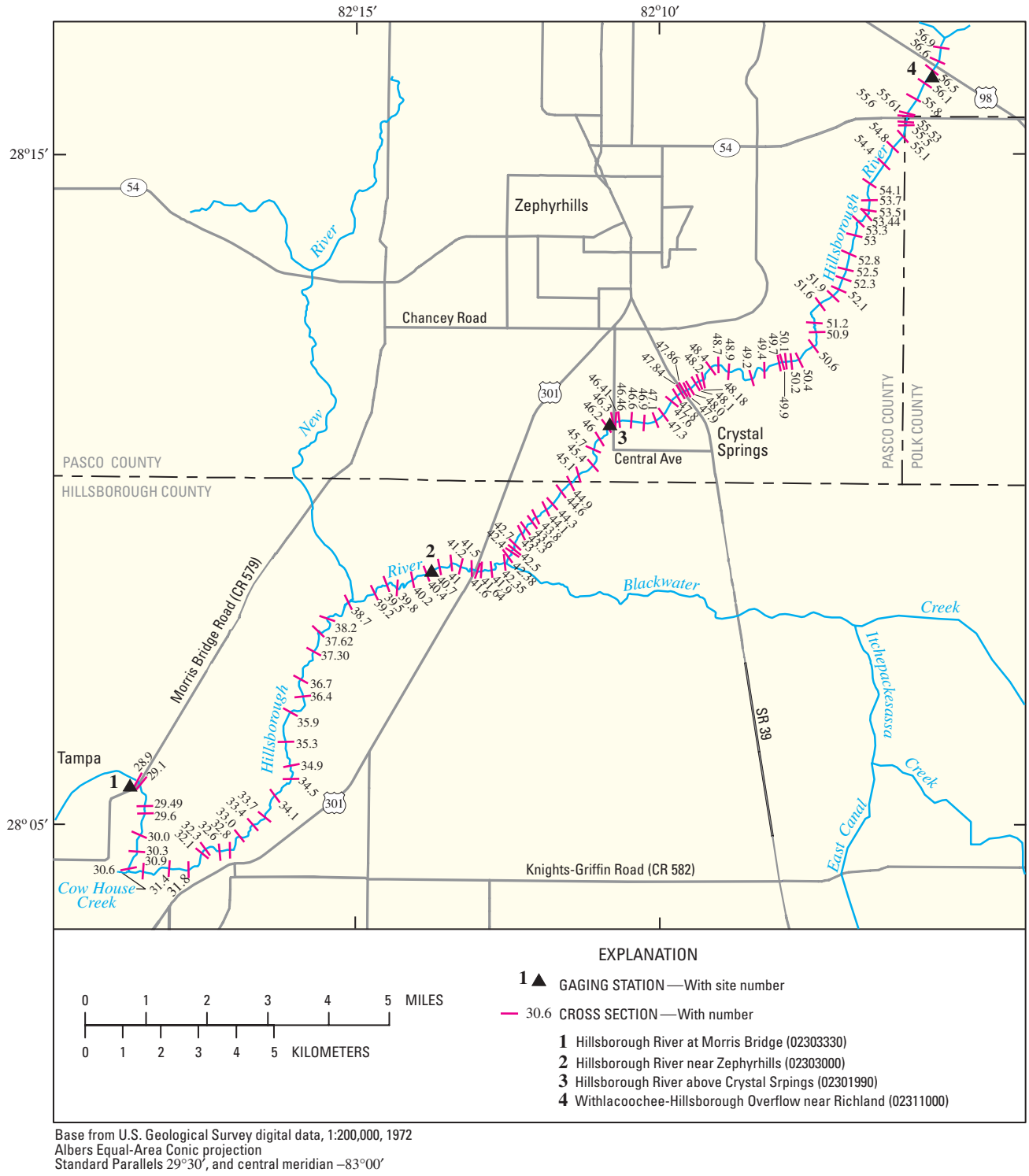
Y_1, Y_2 = depth of water at cross sections,
Z_1, Z_2 = elevation of the main channel inverts,
V_1, V_2 = average velocities (total discharge/total area flow),
α_1, α_2 = velocity weighting coefficients,
g = gravitational acceleration, and
h_e = energy head loss.

Energy losses were evaluated by friction and contraction/expansion. Computation of the step-backwater analyses began at the most downstream cross section (initial cross section) of the study reach. At the initial cross section, the known water-surface elevation (gage height) was determined for each of the selected percentile discharges, based on the established stage-discharge relation at the gage. During the step-backwater analysis computation, once the energy balance between the first and second cross sections was achieved, the analysis "steps" to the next upstream cross section and computes an energy balance between the second cross section and the next upstream cross section. This process continues in an upstream direction until the energy balance between the final two cross sections has been achieved.

Accuracy of the step-backwater analyses for the upper Hillsborough River was determined by comparing the rated (stage-discharge relation established at the gaging station) water-surface elevation with the computed (HEC-RAS) water-surface elevations at the three upstream gaged cross sections: Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow. The determination of accuracy was reduced, however, because of the limited number or absence of upstream gaged cross sections for New River, Blackwater and Itchepackesassa Creeks, and East Canal. Gaging stations with established stage-discharge relations used in this report are presented in table 1. Results of the step-backwater analyses were judged to be good when the computed water-surface elevation converges successfully within plus or minus 0.5 ft of the established stage-discharge relation at upstream gaged cross sections. The error range, plus or minus 0.5 ft, is based on the potential error range using the 1-ft aerial contour maps.

Hillsborough River

The upper Hillsborough River study watershed covers parts of southeastern Pasco, western Polk, and northeastern Hillsborough Counties, and drains about 375 mi^2 at the Morris Bridge gaging station (fig. 5). The 28-mi-long upper Hillsborough River study reach, from Morris Bridge Road to the Withlacoochee-Hillsborough Overflow at US 98, can be characterized as a broad, hardwood floodplain with low topographic relief and frequent, widespread, and prolonged areal inundation. The low-gradient channel along most of the middle and lower study reaches is moderately incised and slightly meandering. Most of the channel along the upper reach is either poorly defined or absent within a broad floodplain. Much of the channel is defined and controlled by karst outcropping. During high flows, an exchange of discharge may occur between the Hillsborough and Withlacoochee River watersheds at the Withlacoochee-Hillsborough Overflow. The contribution of flow from the Withlacoochee River is the primary source of water to the uppermost part of the Hillsborough River watershed during high-flow events. Overflow occurs about 25 percent of the time.



Base from U.S. Geological Survey digital data, 1:200,000, 1972
Albers Equal-Area Conic projection
Standard Parallels 29°30′, and central meridian –83°00′

Figure 5. Location of the Hillsborough River study reach and cross sections, and the Morris Bridge, Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow gaging stations, west-central Florida. (Location of the study area shown in figure 1).

The extent of areal inundation along the upper Hillsborough River can be large during relatively low discharges because of the low topographic relief. Four long-term USGS gaging stations were used in the step-backwater analyses of the upper Hillsborough River: (1) Morris Bridge at SR 579, (2) Zephyrhills at Hillsborough River State Park, (3) Crystal Springs at Crystal Springs Road and (4) Withlacoochee-Hillsborough Overflow at US 98 (fig. 5 and table 1).

Ground-water seepage discharging directly from numerous large and small spring vents and diffusely through channelbed sediments is a large source of flow in the river. In the upper Hillsborough River watershed, a substantial contribution of ground-water discharge is from the Upper Floridan aquifer, in addition to discharge contributions from both major and minor tributaries. Discharge from Crystal Springs, located about 2 mi west of the town of Crystal Springs, averaged 53.9 cubic feet per second (ft^3/s), based on 467 measurements made since 1923.

The upper Hillsborough River channel and floodplain were delineated by the NWI and are classified predominately as lower perennial river and inland forested wetlands, respectively (Cowardin and others, 1979). The inland forested wetlands that are present along the broad Hillsborough River floodplain are predominately mixed cypress and hardwoods. The length of the study floodplain corridor, from Morris Bridge Road to the Withlacoochee-Hillsborough Overflow, is bounded by uplands.

The shape of the discharge duration curves for three of the Hillsborough River gages: Morris Bridge, Zephyrhills, and Crystal Springs, indicate similar flow characteristics (fig. 3). The absence of zero flow at these sites can be attributed to the (1) large size of the gaged drainage areas, (2) depth of the incised channel, and (3) ground-water discharge that provides a sustained baseflow. The steeply shaped discharge duration curve for the Withlacoochee-Hillsborough Overflow, however, indicates high variability in flow, in which zero-flow days occur approximately 75 percent of the time. Although the drainage area at the Morris Bridge (375 mi^2) gaging station is 155 mi^2 larger than that at the Zephyrhills gaging station (220 mi^2), duration curves show that discharge at Morris Bridge for the concurrent period (1984-2000) is similar or less during both moderate- to low-flow and extreme high-flow conditions. Both the P_{10} and the $P_{99.97}$ percentile discharges calculated at the Morris Bridge gage were less than those calculated at the Zephyrhills gage. Three possible factors may account for a reduction in discharges at the Morris Bridge gage. First, diffuse and direct recharge losses occur from the channel and floodplain to the underlying aquifer. Additional recharge losses may also be the result of induced effects from ground-water pumping at area wellfields. Second, during high flows, discharge is naturally diverted from the Hillsborough River channel to the Cow House Creek distributary. This diversion allows water to discharge into the Tampa Bypass Canal or return to the Hillsborough River downstream from the Morris Bridge gage by way of a control structure. Third, losses from the large storage capacity of the broad floodplain along the reach between the Morris Bridge and Zephyrhills gages may effectively reduce discharge reaching the Morris Bridge gage. The step-backwater analyses were adjusted to correct for these losses by setting the initial discharges at the Morris Bridge gage and for all cross sections upstream to the Zephyrhills gaging station constant for the P_{10} and the $P_{99.97}$ percentiles. This adjustment was done for the following two reasons. First, computation during the step-backwater analysis requires that the channel maintains or decreases discharge to achieve an energy balance between downstream and upstream cross sections. Second, the extent of areal inundation at the Morris Bridge gaging station, based on the water-surface elevation at the P_{10} and $P_{99.97}$ percentile discharges, generally reflects the actual conditions at the gage.

Step-backwater analyses were performed using 122 cross sections along the 28-mi-long Hillsborough River study reach. The analyses began at the Morris Bridge gaging station (02303330) and terminated upstream of the Withlacoochee-Hillsborough Overflow gaging station (02311000) (fig. 5). Initial water-surface elevations, based on the selected percentile discharges, were determined from the stage-discharge relation developed at the Morris Bridge gage. Hillsborough River reaches downstream of the Morris Bridge gage were not included in the study because of variable backwater effects from the Tampa Reservoir and high-flow diversion at S-155 to the Tampa Bypass Canal.

During computation of the step-backwater analyses, discharges were proportionally reduced at selected upstream cross sections to adjust for the decrease in contributing drainage area (table 2). Water-surface profiles generated, for each percentile discharge, were based on the computed water-surface elevations at each of the 122 cross sections (fig. 6). Results of the step-backwater analyses were considered acceptable if the computed water-surface elevation converged within plus or minus 0.5 ft of the established stage-discharge relation (rated water-surface elevation) at the Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow gaging stations. The difference between the computed and the rated water-surface elevation for both the $P_{99.5}$ and $P_{99.97}$ discharges exceeded the 0.5 ft accuracy criterion at the Zephyrhills gage. This difference was likely the result of uncertainty (effects of the diversion to Cow House Creek between the Morris Bridge and Zephyrhills gages) associated with percentile discharges and water-surface elevations at the Morris Bridge gage during high flows, which were previously discussed.

Topographic relief, channel gradient and depth, and discharge control the extent of areal inundation along the Hillsborough River. Many areas along the Hillsborough River have low topographic relief that result in widespread areal inundation for percentile discharges greater than P_{70}. For example, the extent of inundation at the Withlacoochee-Hillsborough Overflow (cross section 56.9) can range from more than 5,000 ft at the P_{90} discharge (26.9 ft^3/s) to about 6,700 ft at the $P_{99.97}$ discharge (970 ft^3/s) (fig. 7 and app. 1). The comparison of the maximum extent of areal inundation for each of the percentile discharges shown in figure 7 represents the maximum extent of left and right bank inundation, but does not show elevated areas along the cross section that may not be inundated. Therefore,

Table 2. Cross sections, drainage area, and percentile discharges used in step-backwater analyses based on the concurrent period 1984-2000 at Hillsborough River gaging stations: Morris Bridge, Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow.

[mi^2, square miles; --, undetermined]

Cross section No.	Drainage area (mi^2)	Discharge (cubic feet per second)							
		P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
[1]28.9-32.8	375	59.0	121	200	300	535	881	2,950	5,840
33-34.9	371	59.0	121	199	298	531	875	2,946	5,840
35.3-36.7	321	58.9	115	184	273	483	803	2,898	5,840
37.3-37.62	--	58.9	110	169	248	436	730	2,849	5,840
38.2	--	58.9	110	169	238	418	703	2,831	5,840
[2]39.2-[3]40.4	234	58.9	110	169	229	400	676	2,814	5,840
40.7-42.38	220	58.8	105	154	222	387	656	2,800	5,840
[4]42.4	218	58.3	104	153	220	383	650	2,775	5,787
42.5-44.9	105	13.3	26.8	43.5	64.2	183	374	1,537	3,419
45.1-45.4	95	12.0	24.2	39.4	58.0	166	338	1,390	3,093
45.7-46.0	88	11.2	22.6	36.7	54.1	154	315	1,295	2,882
[5]46.2-48.4	82	10.4	20.9	34.0	50.1	143	292	1,200	2,670
48.7-50.6	69	8.8	17.6	28.6	42.2	120	246	1,010	2,247
50.9-52.1	56	7.1	14.3	23.2	34.2	97.7	199	820	1,823
52.3-53.5	49	6.2	12.6	20.4	30.1	85.6	175	755	1,604
53.7-54.4	42.5	5.0	11.0	18.0	26.0	74.0	151	690	1,384
54.8-55.53	29.6	3.2	6	9.4	14.3	52.6	141	680	1,206
55.6-55.8	16.8	0	0	1.3	2.6	31.4	129	670	1,028
56.1	15.5	0	0	1.2	2.5	30.5	126	660	999
[6]56.5-56.9	14.2	0	0	1.2	2.5	26.9	122	660	970

[1]Hillsborough River at Morris Bridge gaging station.
[2]New River confluence.
[3]Hillsborough River near Zephyrhills gaging station.
[4]Blackwater Creek confluence.
[5]Hillsborough River above Crystal Springs gaging station.
[6]Withlacoochee-Hillsborough Overflow gaging station.

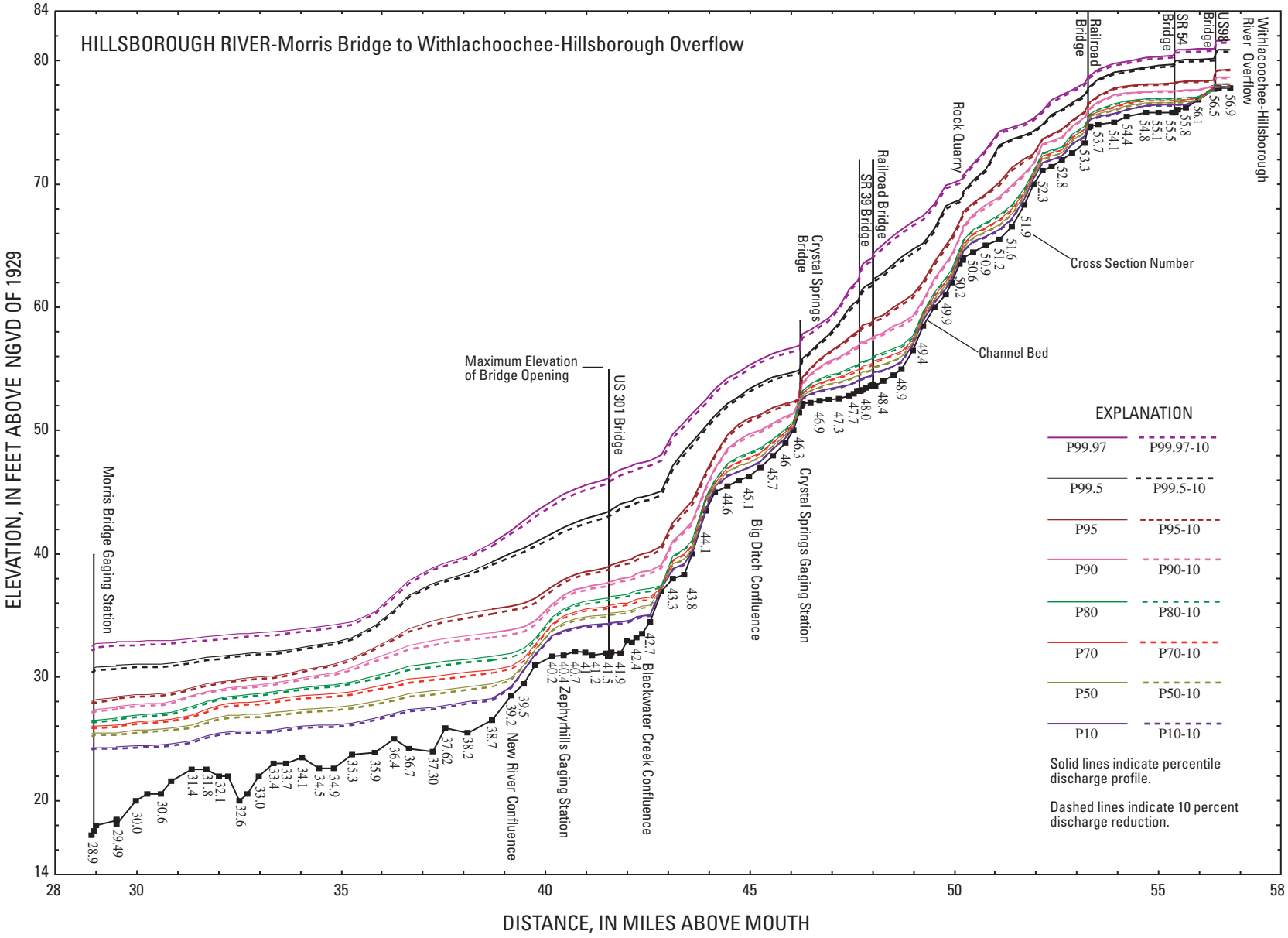


Figure 6. Hillsborough River water-surface profiles for the selected percentile discharges and the effects of a 10-percent discharge withdrawal, from the Morris Bridge to the Withlacoochee-Hillsborough Overflow gaging stations, based on the 17-year period 1984-2000.

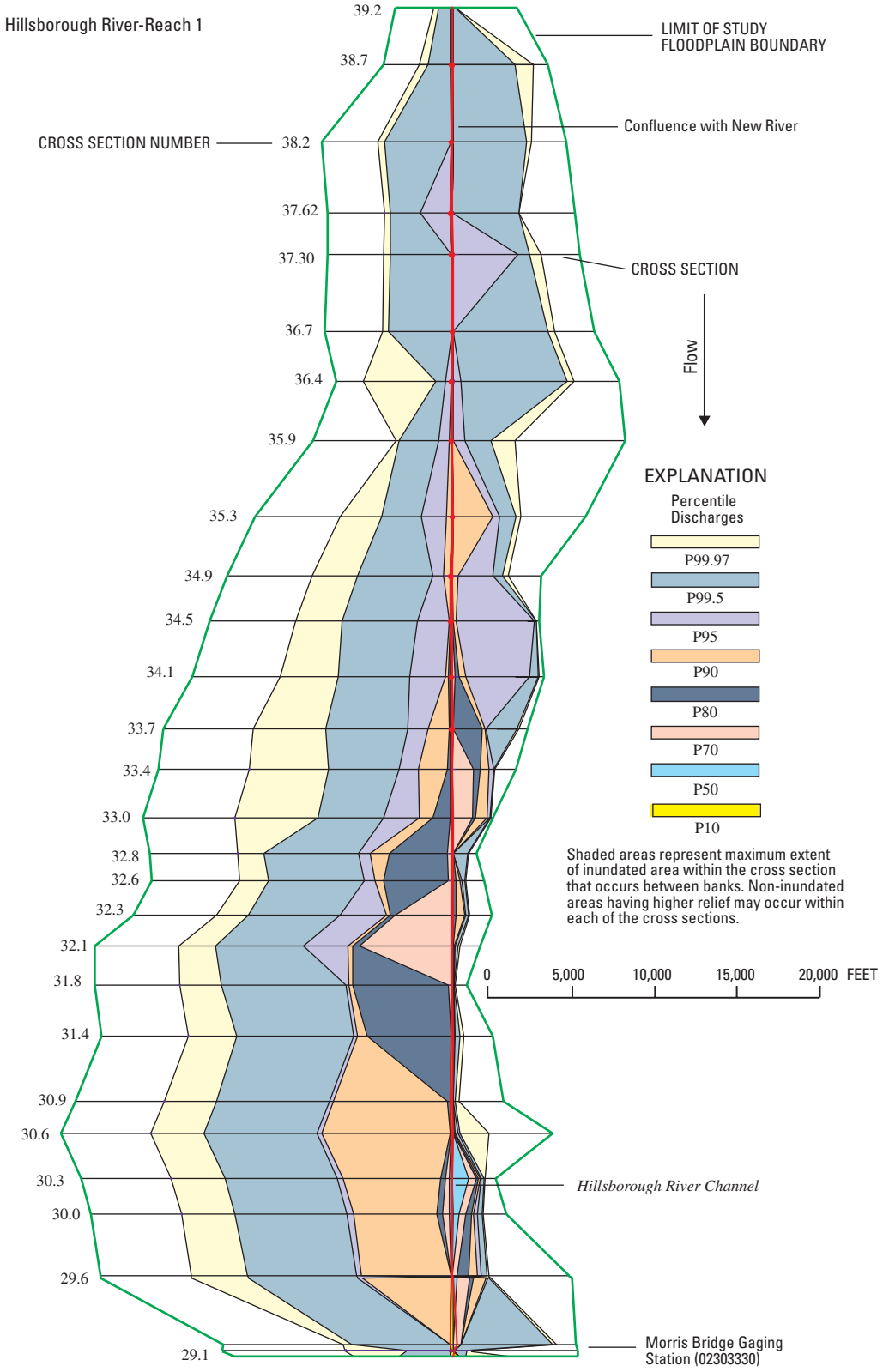


Figure 7. Extent of areal inundation along reaches 1-3 of the Hillsborough River study channel and floodplain for selected percentile discharge.

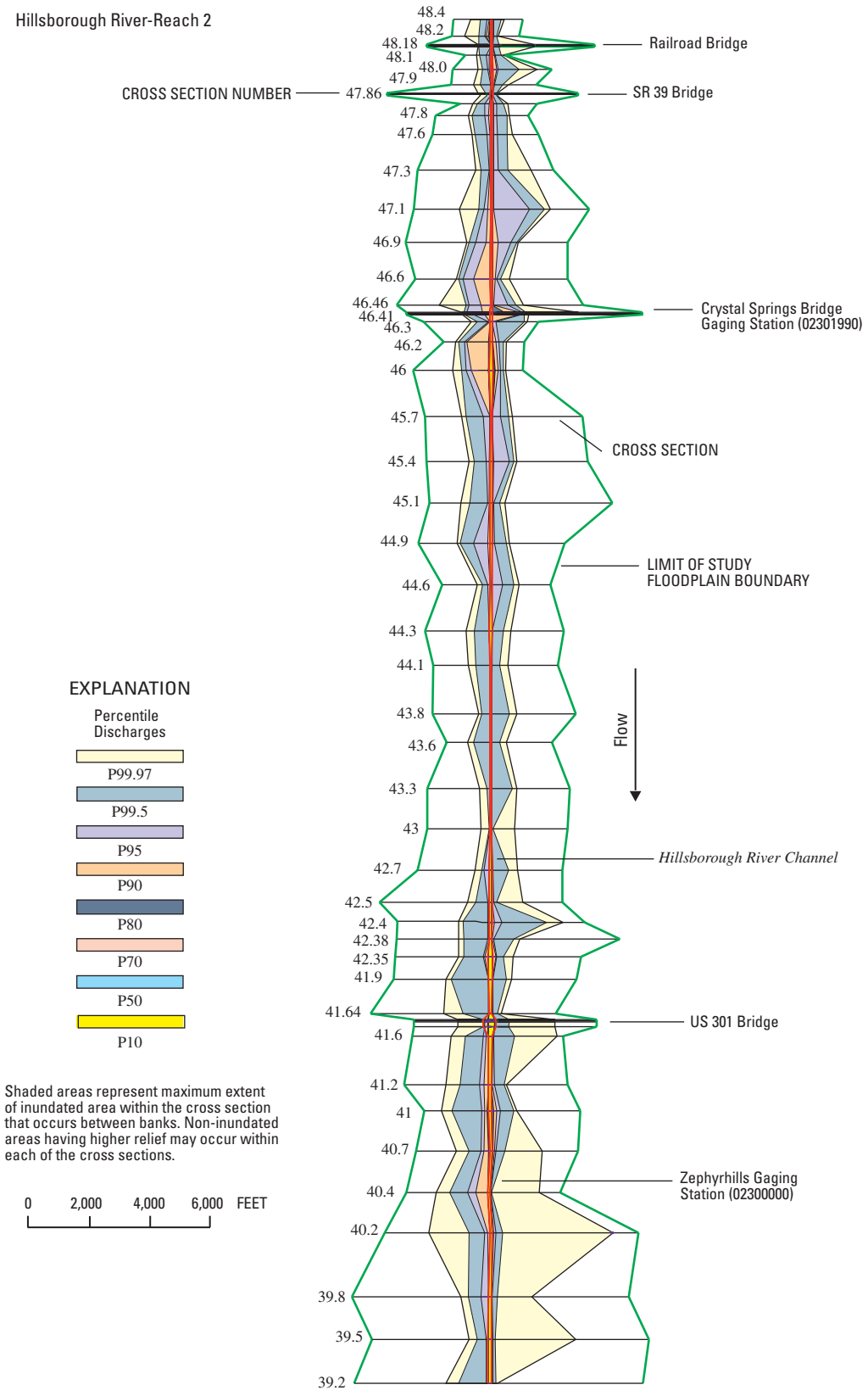


Figure 7. Extent of areal inundation along reaches 1-3 of the Hillsborough River study channel and floodplain for selected percentile discharge. (Continued)

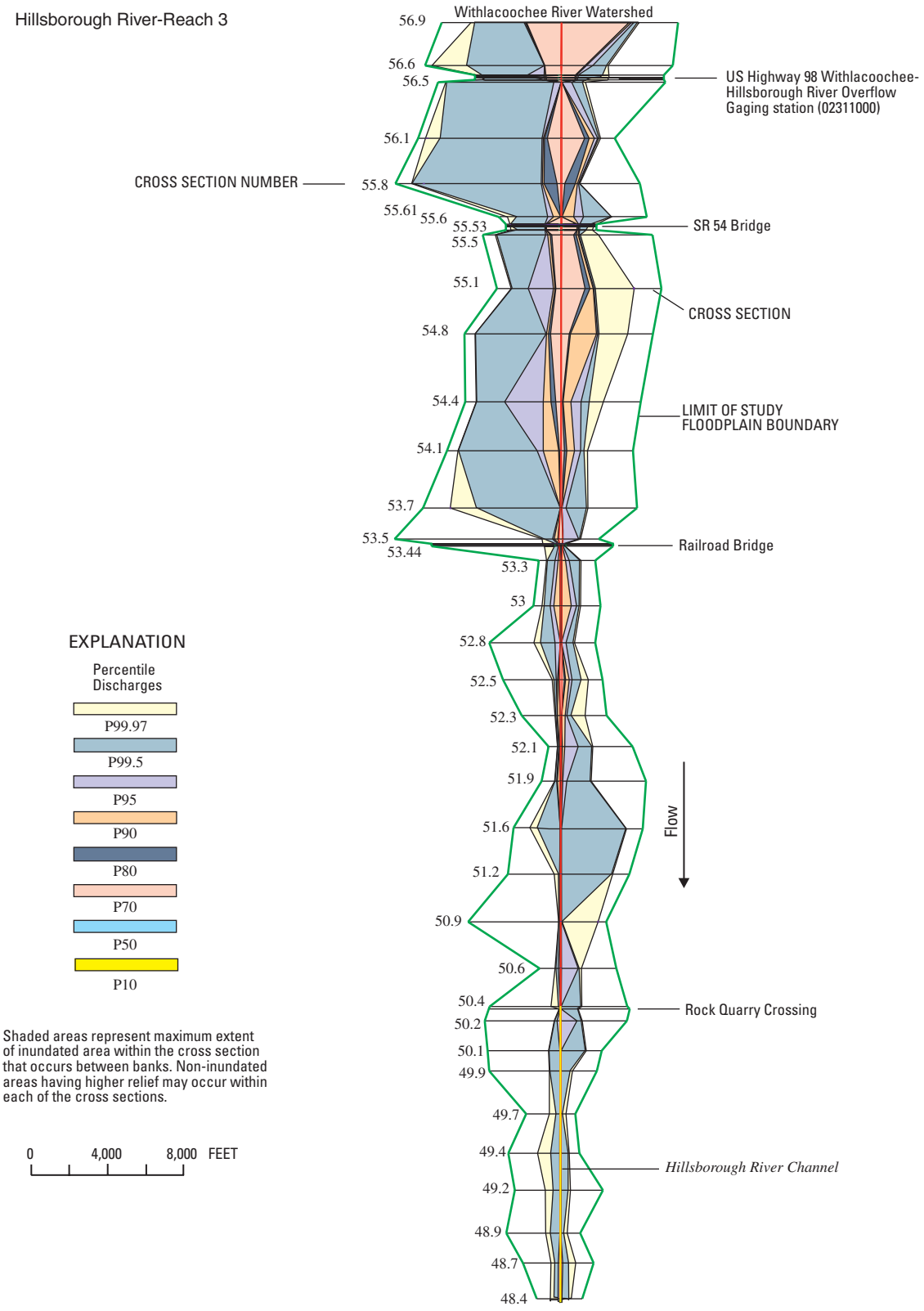


Figure 7. Extent of areal inundation along reaches 1-3 of the Hillsborough River study channel and floodplain for selected percentile discharge. (Continued)

because of this difference, the actual calculated extent of areal inundation of the 122 cross sections presented in appendix 1 may not agree with the width shown in figure 7. This difference is illustrated by the cross sections shown in figure 8a and 8b. The actual $P_{99.97}$ discharge inundation width for cross section 30 is 14,730 ft (app. 1), however, the width of inundation between left and right bank is about 18,000 ft (fig. 7). Because no non-inundated areas exist within the cross section in figure 8b, both the actual inundation width and the inundation width between left and right banks are the same. All figures in this report showing extent of areal inundation conform to this convention, and the appendices present the actual calculated width of inundation.

During the 17-yr study period, areal inundation along the Hillsborough River for the selected percentile discharges was highly variable from year to year (table 3). The number of days at the P_{50} discharge ranged from a minimum of 42 days (2000) to a maximum of 320 days (1984), with an average of 195 days per year (days/yr). The $P_{99.97}$ discharge, however, occurred for 2 days and only during 1998. During the study period, the P_{10}, P_{50}, P_{70}, and P_{80} discharges occurred annually, with frequencies ranging from 1 to 366 days/yr. Whereas, the P_{90} and P_{95} discharges occurred during 15 and 13 yrs of the 17-yr study period, for an average of 37 and 16 days/yr, respectively. The $P_{99.5}$ discharge occurred in less than one-half of the effected study years for an average of 2 days/yr.

The extent of areal inundation and an estimated mean number of days per year that selected percentile discharges will occur at two example Hillsborough River cross sections are compared in figure 8. The inundation width at cross section 30 (fig. 8a) can exceed 3,800 ft during the P_{90} discharge, which occurs on average 37 days/yr. In contrast, the inundation width at cross section 41 (fig. 8b) for the P_{90} discharge is less than 400 ft during that same period. Limited floodplain inundation along low-lying areas of the Hillsborough River study reach occurs during the P_{80} percentile discharge. During the study period, inundation at the P_{80} discharge occurs an average of 72 days/yr. Extensive inundation of the floodplain occurs at both the $P_{99.5}$ and $P_{99.97}$ percentile discharges; however, those discharges occurred in only 7 years and 1 year, respectively, in the 17-yr study period for an average of 2.2 and 0.1 days.

During the step-backwater analyses of the eight percentile discharges, hydraulic depths were computed at each cross section (app. 2). In areas where the upper Hillsborough River study reach channel is not well defined or incised, hydraulic depths can be considered an estimate of the floodplain depth only. Hydraulic depths generally are greatest at locations where reaches contract due to bridges, culverts, control structures, or natural topography. Comparisons of hydraulic depths are shown in example cross sections 30 and 41 (fig. 8a,b). Differences in hydraulic depths at the example cross sections may be attributed to the effect of topography, channel configuration, or slope. Mean hydraulic depths along the Hillsborough River study reach channel and floodplain ranged from approximately 1.4 (P_{10}) to 3.1 ($P_{99.97}$) ft (app. 2).

Inundated acreage along the Hillsborough River channel and floodplain was determined by summing the computed water-surface area between adjacent cross sections (app. 3). Area of inundation ranged from approximately 277 (P_{10}) to 16,350 ($P_{99.97}$) acres (fig. 9). The inundated area at the P_{90} discharge (about 2,800 acres) generally is confined to within the channel banks. Limited floodplain inundation, however, can occur for low-lying areas at the extreme lower and upper ends of the study reach during the P_{90} discharge. The inundated area at the P_{95}, $P_{99.5,}$ and $P_{99.97}$ discharges predominately include the floodplain at 4,600, 12,000, and 16,350 acres, respectively.

Loss of inundated area by a potential 10-percent discharge withdrawal from the Hillsborough River was estimated for each of the eight percentile discharges by comparing the difference between the *existing* step-backwater analyses (100 percent of the discharge) and the *potential* step-backwater analyses (discharges reduced by 10 percent). Except for differences in discharge and beginning water-surface elevations, identical hydraulic and geometric data were used for both step-backwater analyses. Accuracy of the *potential* step-backwater analyses, based on the difference between rated and computed water-surface elevations at the three upstream gages, were similar to the *existing* step-backwater analyses. All profiles converged successfully, except the $P_{99.5}$ and $P_{99.97}$ discharges at the Zephyrhills gage. The difference in water-surface profiles from the effects of a 10-percent discharge withdrawal are compared in figure 6. The water-surface elevation computed in the *potential* step-backwater analyses is lower at each cross section, thus limiting the extent of areal inundation. Based on the difference between the existing and potential step-backwater analyses, the estimated non-inundated area affected by surface-water withdrawals ranged from 7.0 (P_{10}) to 940 ($P_{99.5}$) acres (fig. 10 and app. 4). The largest percentage loss (16 percent) of inundated area (99 acres), however, occurred at the P_{70} discharge (fig. 9). An example of inundated area loss is compared in figure 10 between the P_{95} and $P_{95\text{-}10}$ discharge analyses. The greatest losses between the P_{95} and $P_{95\text{-}10}$ discharges were limited to a few topographically low-lying cross sections. Most of the losses occur uniformly at cross sections along much of the floodplain. Areas within the cross section having higher topographic relief may not be inundated. Cross section 30 in figure 8a shows an example of a non-inundated areas. Based on the record period (1984-2000), the P_{95} discharge occurred at least once a year during 13 yrs of the 17-yr study period for an average of 16 days (table 3).

New River

New River, a major tributary to the Hillsborough River, drains about 19.5 mi^2 in eastern Pasco and Hillsborough Counties (figs. 1 and 11). The 8.46-mi-long north-south trending study reach begins at the confluence with the Hillsborough River and ends approximately 1.5 mi upstream of SR 54. The study channel generally is well defined and moderately incised.

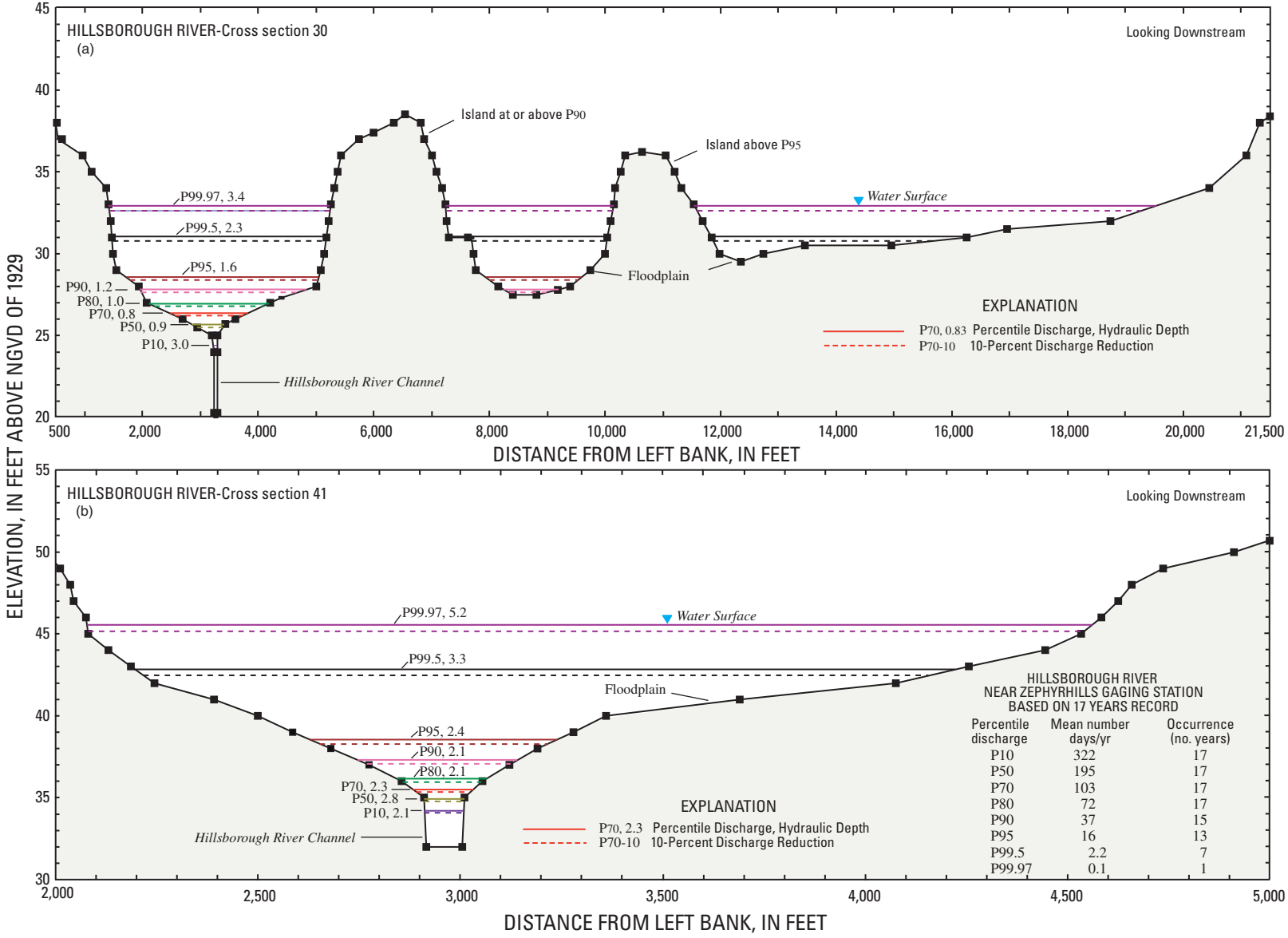


Figure 8. Estimated extent and frequency of areal inundation and hydraulic depth at Hillsborough River cross sections (a) 30 and (b) 41 for each of the selected percentile discharges and the potential 10-percent withdrawal in discharge, based on the 17-year period 1984-2000.

Table 3. Approximate number of days daily mean discharge equaled or exceeded the selected percentile discharges at the Hillsborough River near Zephyrhills gage, 1984-2000.

[P_{10}, 10th percentile discharge]

Year	Number of days per year							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
1984	366	320	188	121	42	5	0	0
1985	287	79	68	59	41	17	2	0
1986	365	276	144	88	36	9	0	0
1987	365	293	103	65	29	15	4	0
1988	366	216	111	83	46	17	6	0
1989	344	264	78	49	24	10	0	0
1990	356	129	47	19	0	0	0	0
1991	237	127	85	61	45	14	0	0
1992	295	107	70	50	16	0	0	0
1993	328	193	117	72	34	2	0	0
1994	305	157	93	76	48	27	1	0
1995	365	302	163	123	76	44	1	0
1996	362	290	175	112	56	19	0	0
1997	292	80	46	35	13	6	3	0
1998	365	303	212	182	146	96	20	2
1999	319	141	41	23	5	0	0	0
2000	164	42	7	1	0	0	0	0
Mean	322	195	103	72	37	16	2.2	0.1
Maximum	366	320	212	123	146	96	20	2
Minimum	164	42	7	1	0	0	0	0

The shape of the watershed is elongated. Land use is predominately mixed agricultural and rural residential. The New River channel is delineated on maps by the NWI as predominately bounded by either inland forested wetlands or uplands (Cowardin and others, 1979).

Percentile discharges used for the step-backwater analyses at New River were based on the continuous 10-yr (1965-1974) period at the New River near Zephyrhills gaging station (02303100) (table 1). The stage-discharge relation developed at the Zephyrhills gaging station was used to compare the computed water-surface elevations with the rated water-surface elevations at the gaged cross section. Extremes in daily mean discharge during the 10-yr period, ranged from zero (many years) to 269 ft^3/s (1964). Step-backwater analyses were performed using 66 cross sections along the 8.46-mi length of the New River study reach. The analyses were based on six of the percentile discharges (P_{50}, P_{70}, P_{80}, P_{90}, P_{95}, and $P_{99.5}$). The P_{10} discharge was omitted because of insufficient discharge to perform the analysis, and the $P_{99.97}$ discharge was not used because of insufficient high-flow record to calculate percentile. Water-surface profiles for the six selected percentile discharges were generated from the computed water-surface elevations at each of the 66 cross sections (fig. 12). The initial water-surface elevations at the mouth of New River were derived from the water-surface elevations computed at the confluence from a step-backwater analysis of the Hillsborough River for the same 10-yr period. Initial discharges at the mouth and at selected cross sections along the New River study reach were estimated based on the proportionality of drainage area with the Zephyrhills gaging station (table 4).

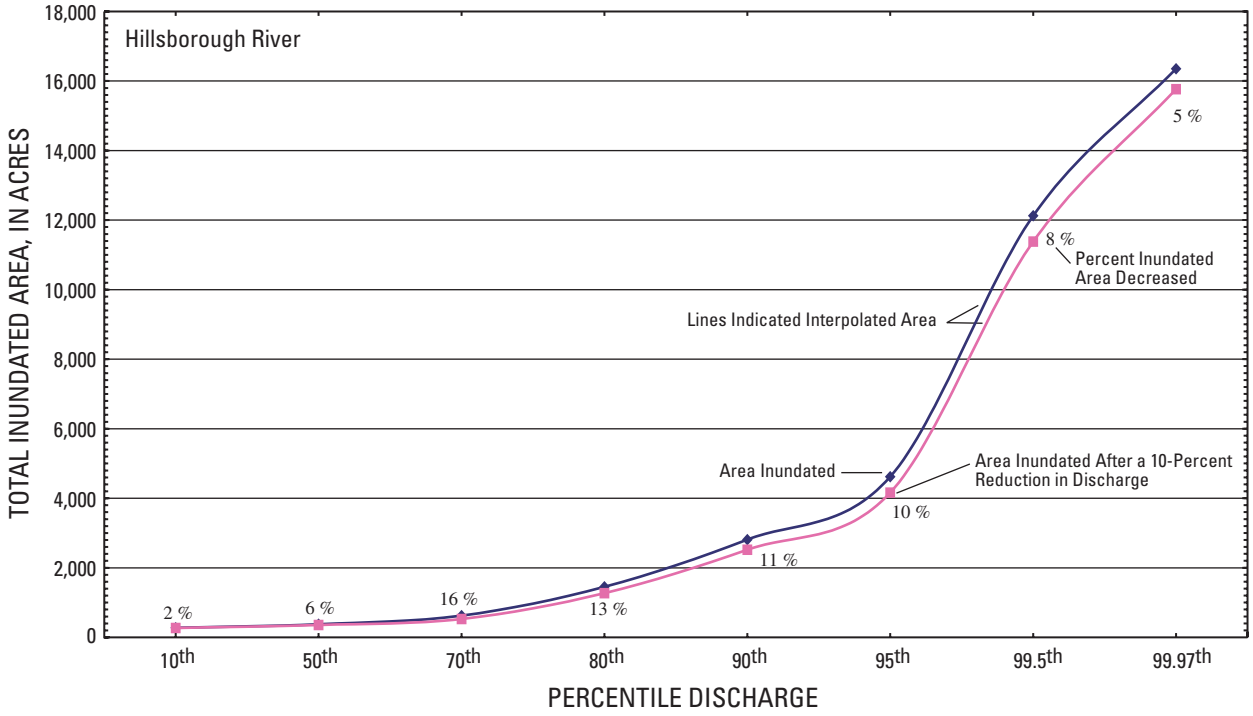


Figure 9. Estimated total inundated area along Hillsborough River for existing conditions and for a potential 10-percent discharge withdrawal, and percentage of inundated area decreased by a potential 10-percent discharge withdrawal for each of the selected percentile discharges.

The approximate number of days a percentile discharge occurred at the New River near Zephyrhills gaging station during the study period is shown in table 5. Based on the New River near Zephyrhills gage, most percentile discharges at or below the P_{90} discharge occur annually. The $P_{99.5}$ discharge occurred during 3 yrs of the 10-yr study period, for an average of 0.8 days.

The New River channel generally confines most discharges within its banks at or below the P_{90} discharge. Calculated maximum floodplain inundation can exceed 2,900 ft (cross section 1.83) during the $P_{99.5}$ discharge (fig. 13 and app. 5). Mean inundation width for the 66 cross sections along the reach ranged from about 17 (P_{50}) to 563 $P_{99.5}$) ft. Mean inundation at the P_{90} discharge (67 ft) was considered the width for a bankfull channel. An approximate twofold increase in mean inundation occurs from the P_{80} (31.9 ft) to the P_{90} (67 ft) discharge, and more than a three-fold increase from P_{95} (132 ft) to the $P_{99.5}$ (563 ft).

Hydraulic depths were computed at each cross section during the step-backwater analyses for each of the percentile discharges. Computed hydraulic depths for example cross section 1.17 are shown in figure 14. The mean hydraulic depth along the New River study reach channel and floodplain ranged from approximately 0.2 (P_{50}) to 1.6 ($P_{99.5}$) ft (app. 6).

Area of inundation along New River was computed for each percentile discharge (app. 7). Total acreage of inundated area along the New River channel and floodplain was calculated by summing the computed water-surface area between adjacent cross sections for each percentile discharge. Area of areal inundation ranged from 17.3 (P_{50}) to 489 ($P_{99.5}$) acres (fig. 15). The inundated area at the P_{95} discharges was 98.2 acres, which generally includes the bankfull channel and a limited number of low-lying cross sections. The inundated area at the $P_{99.5}$ discharge, however, predominately includes the floodplain at 489 acres.

Potential loss of inundated area was estimated for each percentile discharge by comparing the difference between the *existing* step-backwater analyses (100 percent of the discharge) and the *potential* step-backwater analyses (discharges reduced by 10 percent). Except for differences in discharge and beginning water-surface elevations, identical hydraulic and geometric data were used for both step-backwater analyses. The difference in water-surface profiles from the effects of a 10-percent discharge withdrawal are compared in figure 12. Based on the difference between the two step-backwater analyses, the estimated non-inundated area affected by surface-water withdrawals ranged from 0.2 (P_{50}) to 58.9 ($P_{99.5}$) acres (app. 8). The greatest effect of surface-water withdrawals to inundated area occurs between the $P_{99.5}$ and $P_{99.5\text{-}10}$ discharges, with a loss of 58.9 acres or 12 percent (fig. 15). An example of inundated area

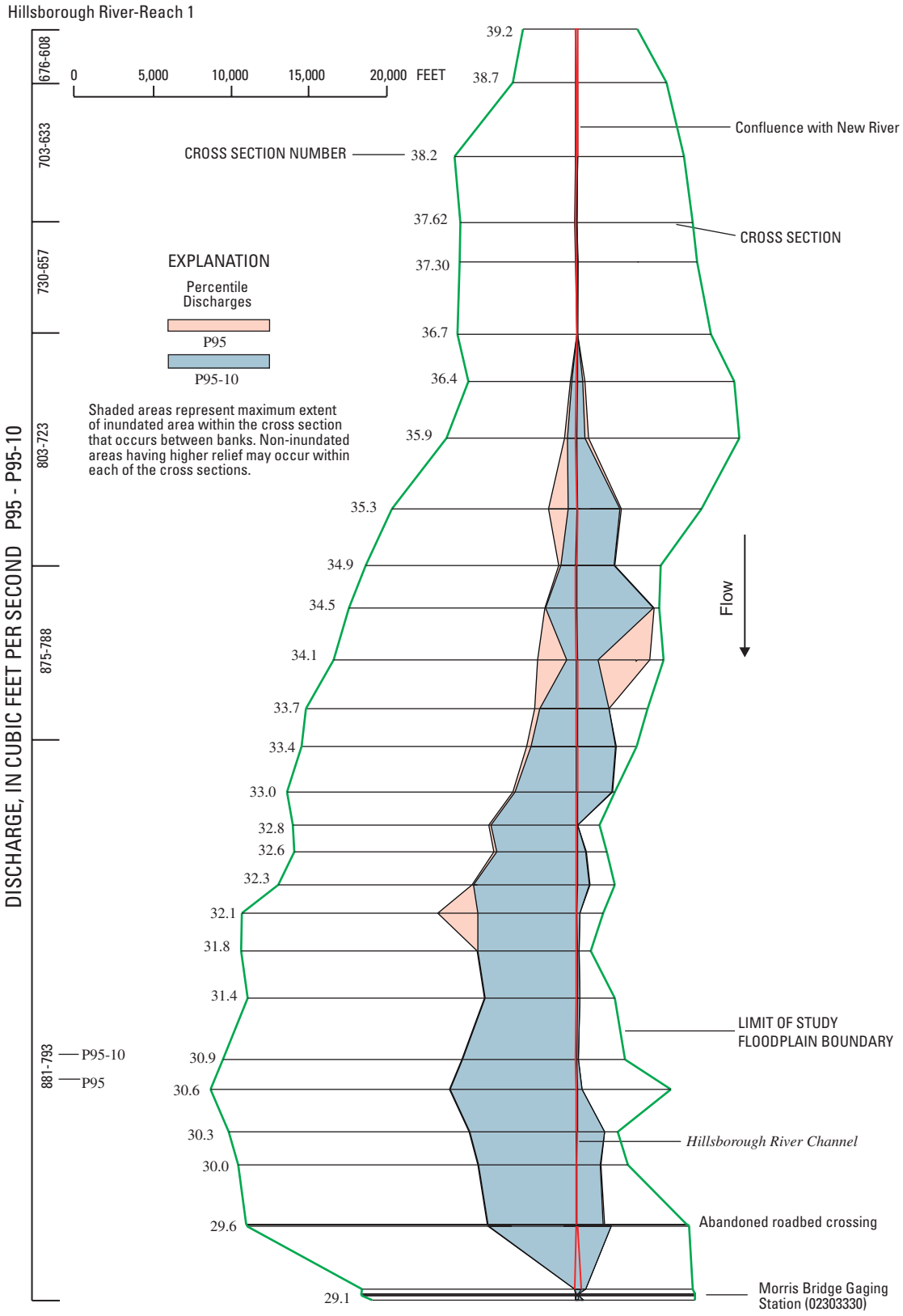


Figure 10. Example of extent of areal inundation along reaches 1-3 of the Hillsborough River study channel and floodplain for the P_{95} (existing conditions) and the $P_{95\text{-}10}$ (potential 10-percent discharge withdrawal) discharges.

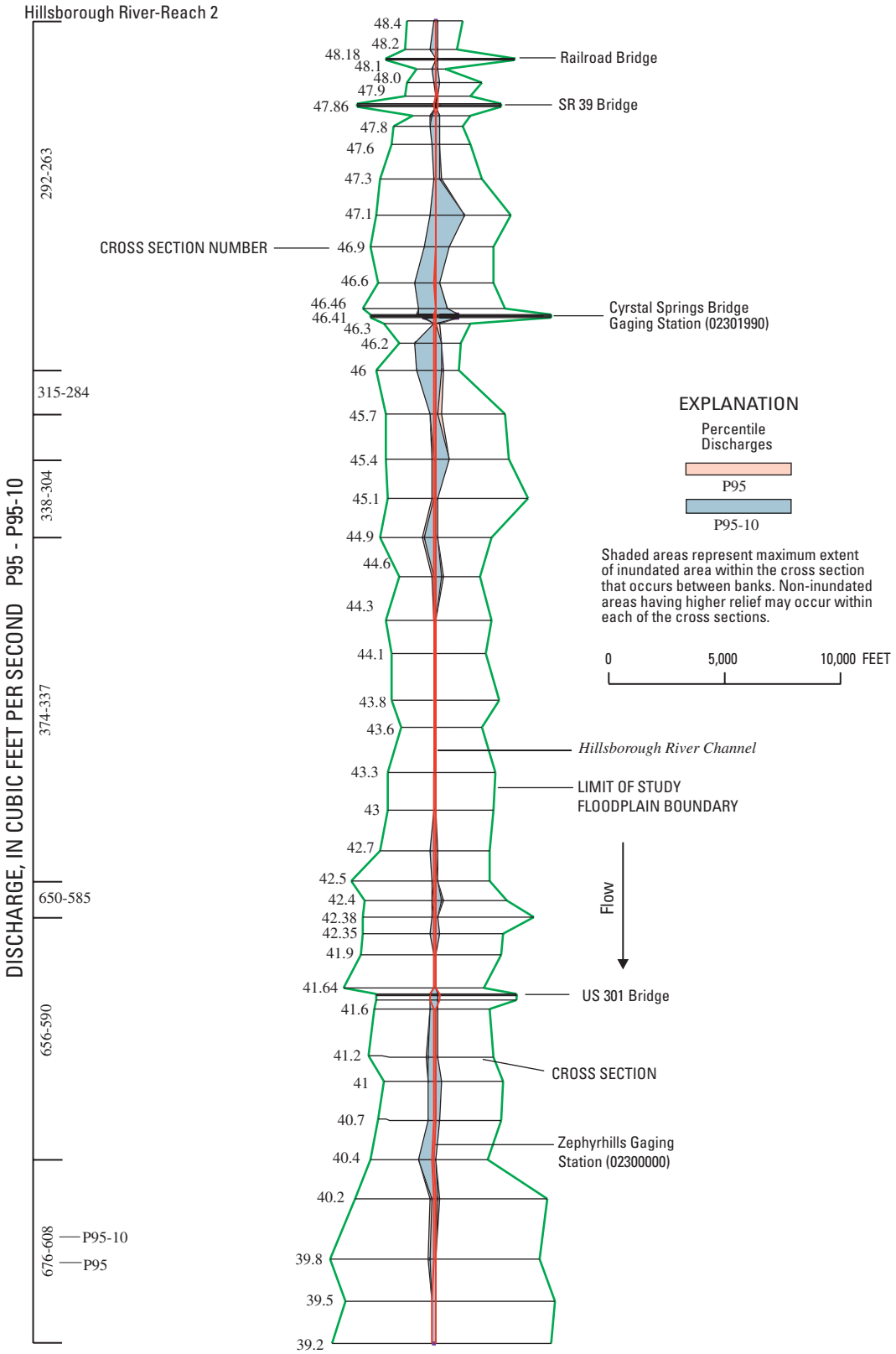


Figure 10. Example of extent of areal inundation along reaches 1-3 of the Hillsborough River study channel and floodplain for the P_{95} (existing conditions) and the P_{95-10} (potential 10-percent discharge withdrawal) discharges. (Continued)

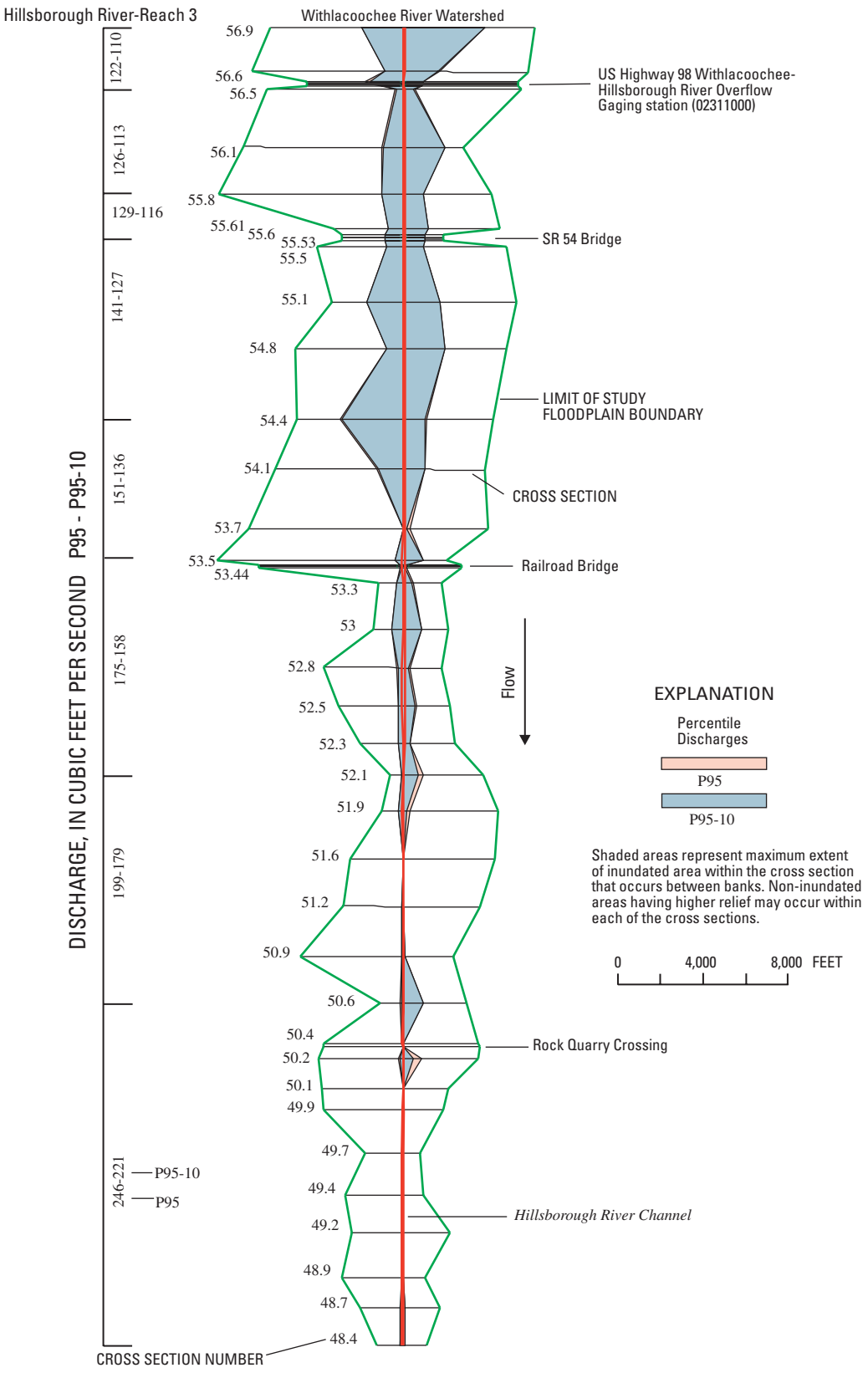
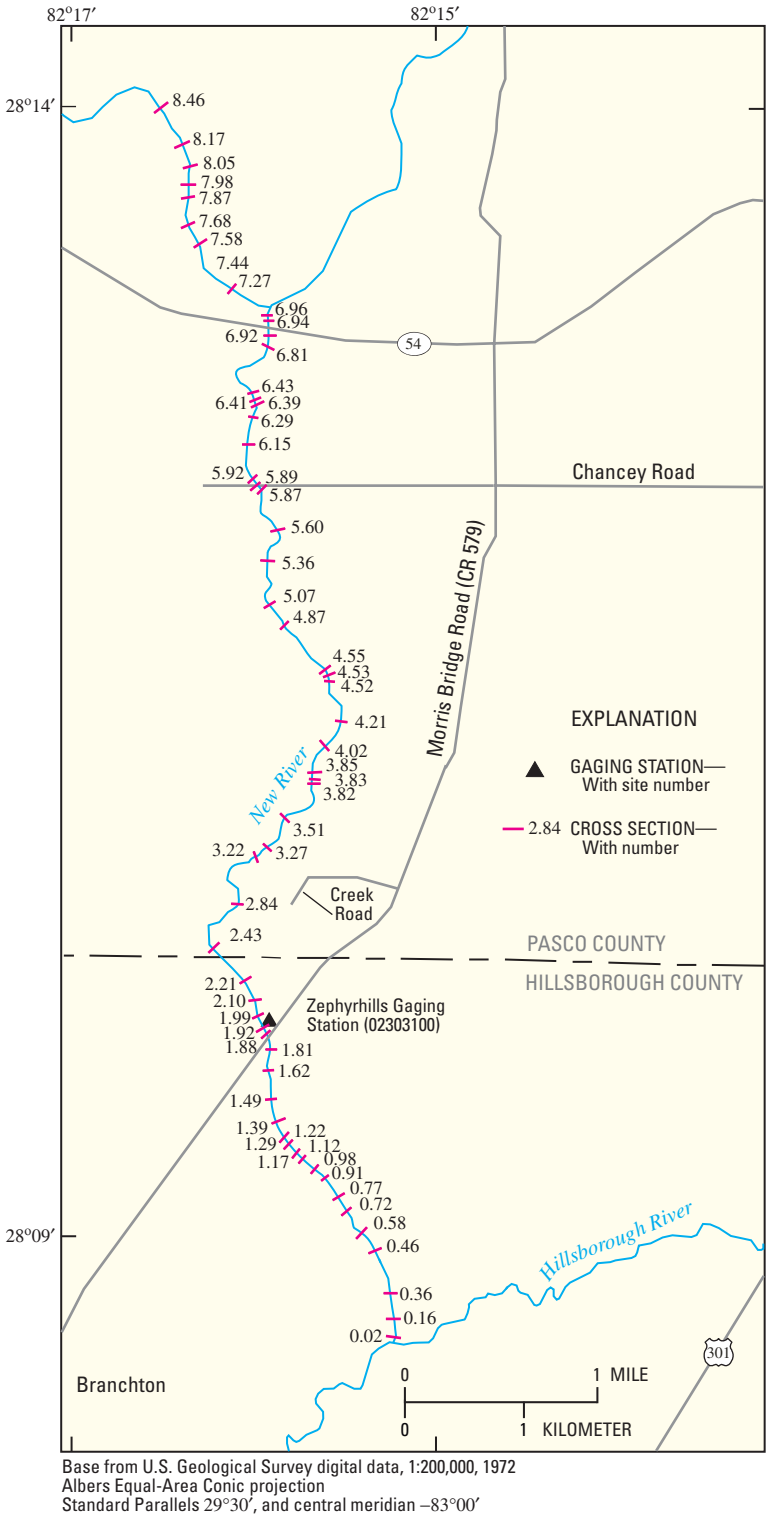


Figure 10. Example of extent of areal inundation along reaches 1-3 of the Hillsborough River study channel and floodplain for the P_{95} (existing conditions) and the $P_{95\text{-}10}$ (potential 10-percent discharge withdrawal) discharges. (Continued)



Base from U.S. Geological Survey digital data, 1:200,000, 1972
Albers Equal-Area Conic projection
Standard Parallels 29°30′, and central meridian –83°00′

Figure 11. Location of the New River study reach and cross sections, and the Zephyrhills gaging station, west-central Florida. (Location of the study area shown on figure 1).

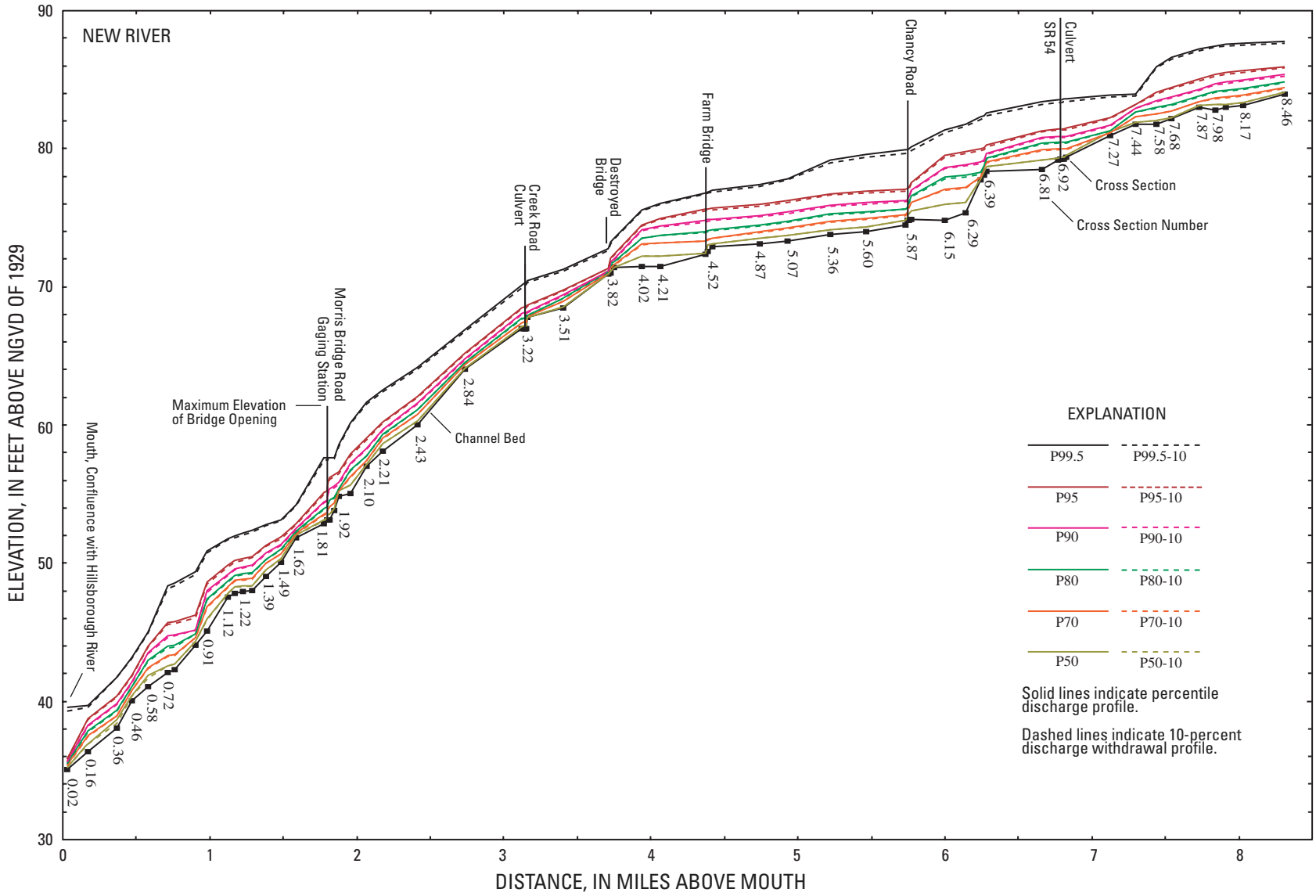


Figure 12. New River water-surface profiles for six selected percentile discharges and the effects of a 10-percent discharge withdrawal, from the mouth to cross section 8.46, based on the 10-year period 1965-1974.

Table 4. Cross sections, drainage area, and percentile discharges used in step-backwater analyses based on the period 1965-1974 at the New River near Zephyrhills gaging station.

[mi^2, square miles]

Cross section No.	Drainage area (mi^2)	Discharge (cubic feet per second)					
		P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
[1]0.02-0.46	19.5	0.7	5.1	12.6	26.3	53.0	269
0.58-1.83	17.5	0.6	4.5	11	23	46.4	241
[2]1.85-1.83	15	0.5	3.8	9.4	19.7	39.8	207
5.36-6.96	13	0.4	3.3	8.2	17.1	34.5	179
7.27-8.46	6	0.2	1.5	3.8	7.9	15.9	82.6

[1]Confluence of Hillsborough River and New River.

[2]New River near Zephyrhills gaging station (02303100) at Morris Bridge Road.

Table 5. Approximate number of days daily mean discharge equaled or exceeded the selected percentile discharges at the New River near Zephyrhills gaging station, 1965-1974.

[P_{50}, 50th percentile discharge]

Year	Number of days per year					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
1965	71	31	21	17	15	6
1966	189	63	35	19	8	0
1967	62	29	18	13	7	1
1968	115	55	38	27	12	0
1969	107	47	33	22	12	0
1970	153	61	37	22	12	1
1971	41	7	0	0	0	0
1972	24	0	0	0	0	0
1973	87	21	9	3	0	0
1974	86	28	18	12	5	0
Mean	94	34	21	14	7.1	0.8
Maximum	189	63	38	27	15	6
Minimum	21	0	0	0	0	0

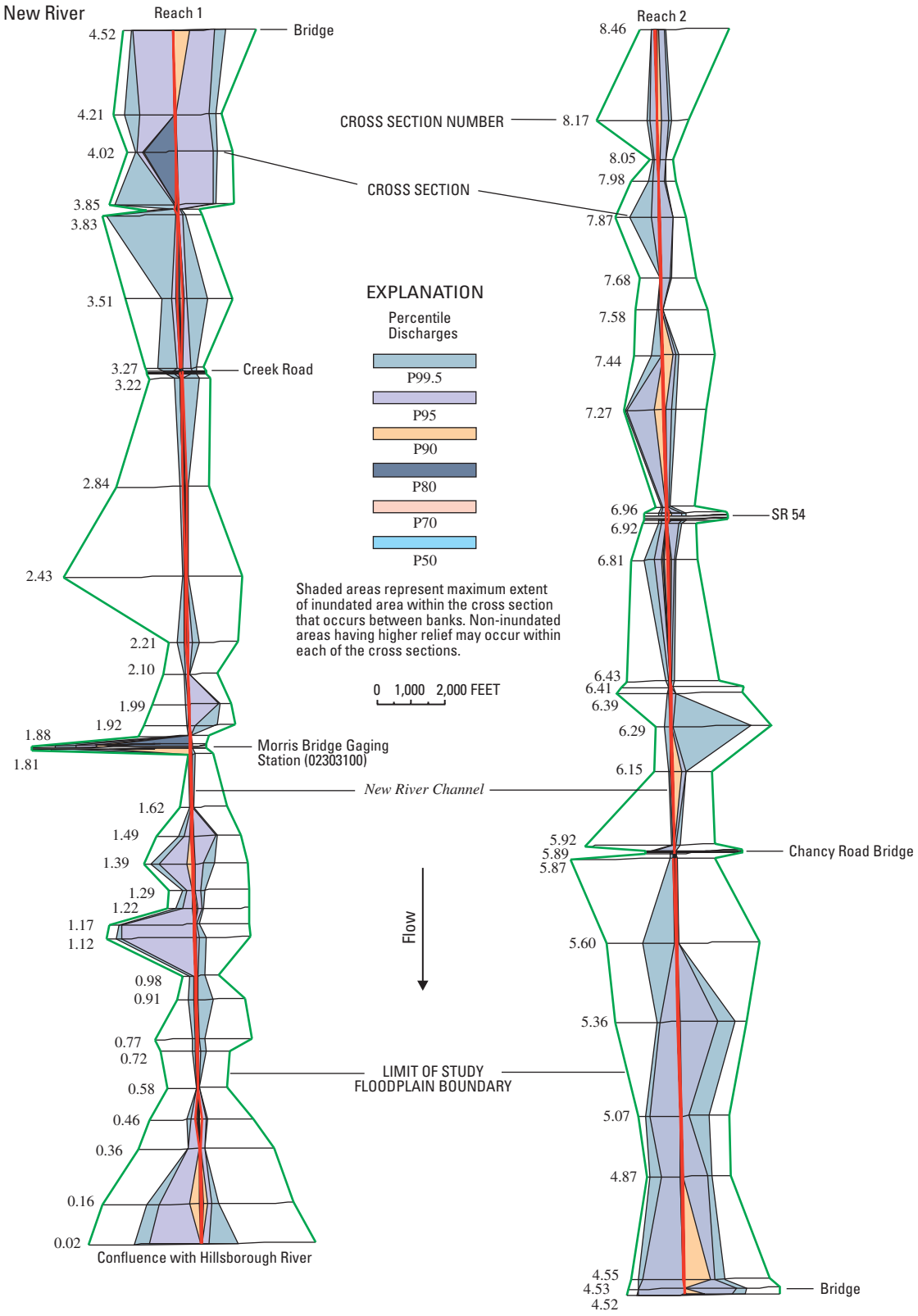


Figure 13. Extent of areal inundation along reaches 1 and 2 of the New River study channel and floodplain for selected percentile discharges.

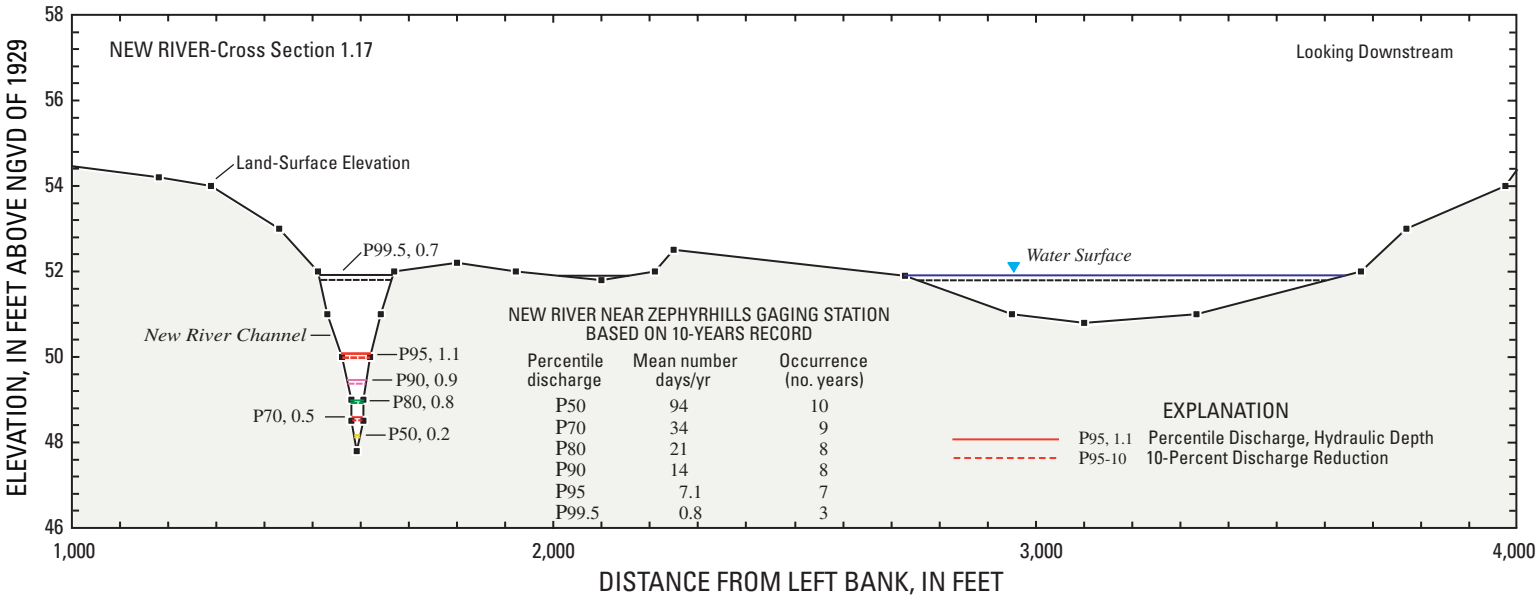


Figure 14. Estimated extent and frequency of areal inundation and hydraulic depth at New River cross section 1.17 for six of the selected percentile discharges and the potential 10-percent withdrawal in discharge, based on the 10-year period 1965-1974.

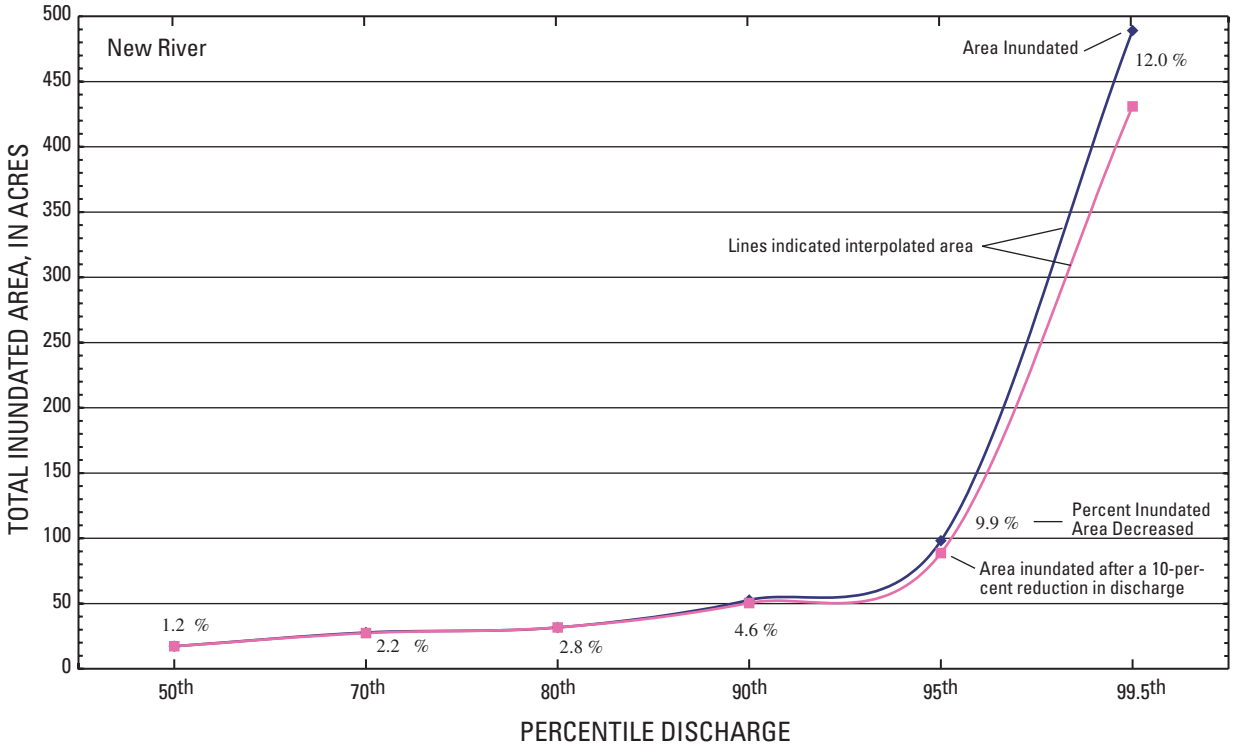


Figure 15. Estimated total inundated area along New River for existing conditions and for a potential 10-percent discharge withdrawal, and percentage of inundated area decreased by a potential 10-percent discharge withdrawal for each of the selected percentile discharges.

loss was compared between the $P_{99.5}$ and $P_{99.5\text{-}10}$ discharges (fig. 16). Losses between the $P_{99.5}$ and $P_{99.5\text{-}10}$ discharges generally are uniform along the reaches, except at a limited number of low-lying cross sections. Areas within the cross section having higher topographic relief may not be inundated. Cross section 1.17 in figure 14 shows an example of a non-inundated areas. Based on the record period (1965-1974), the $P_{99.5}$ discharge occurred during 3 yrs of the 10-yr study period, for an average of 0.8 days/yr (table 5).

Blackwater Creek

Blackwater Creek, the largest tributary to the Hillsborough River, drains about 113 mi^2 in northwestern Polk and northeastern Hillsborough Counties (figs. 1 and 17). Blackwater Creek generally flows in a westerly direction for 17.2 mi, from the headwaters northwest of the city of Lakeland to its confluence with the Hillsborough River. Approximately the upper two-thirds of the Blackwater Creek study reach has been channelized to improve drainage. The channel along the lower one-third of the study reach is predominately natural, from the mouth to an area directly downstream of SR 39. Much of the channel is moderately incised and well defined, containing most low to moderate discharges within the banks. The width of the floodplain is relatively narrow and generally uniform in width along the length of the channel. Much of the Blackwater study reach is delineated on NWI maps as inland forested wetlands, except for the upper one-quarter, which is delineated as upland (Cowardin and others, 1979). The Blackwater Creek watershed has a drainage area of approximately 101.6 mi^2 at the Blackwater Creek near Knights gaging station (02302500), located 0.2 mi upstream of SR 39. Discharge data have been collected by the USGS continuously at the Knights gage since 1951. Extremes in daily mean discharge at the gaging station for the record period (1951-2002) ranged from zero (many days) to 5,400 ft^3/s (1960).

Step-backwater analyses were performed using 114 cross sections along the Blackwater Creek study reach, from the confluence with the Hillsborough River to cross section 16.6 (0.5 mi west of Galloway Road) (fig. 17). The analyses for Blackwater Creek included the P_{50}, P_{70}, P_{80}, P_{90}, P_{95}, $P_{99.5}$, and $P_{99.97}$ percentile discharges, based on the 29-yr period, 1973-2001, at the Knights gaging station. The analysis for the P_{10} percentile discharge was not performed because of insufficient discharge at the Knights gaging station (fig. 3). Discharges used in the analyses were reduced at selected cross sections, based on proportionality of contributing drainage area with that of the Knights gaging station (table 6). Initial water-surface elevations at the mouth of Blackwater Creek were estimated from the water-surface elevations computed at the confluence with Blackwater Creek during a Hillsborough River analysis (cross section 42.4), based on the same 29-yr period.

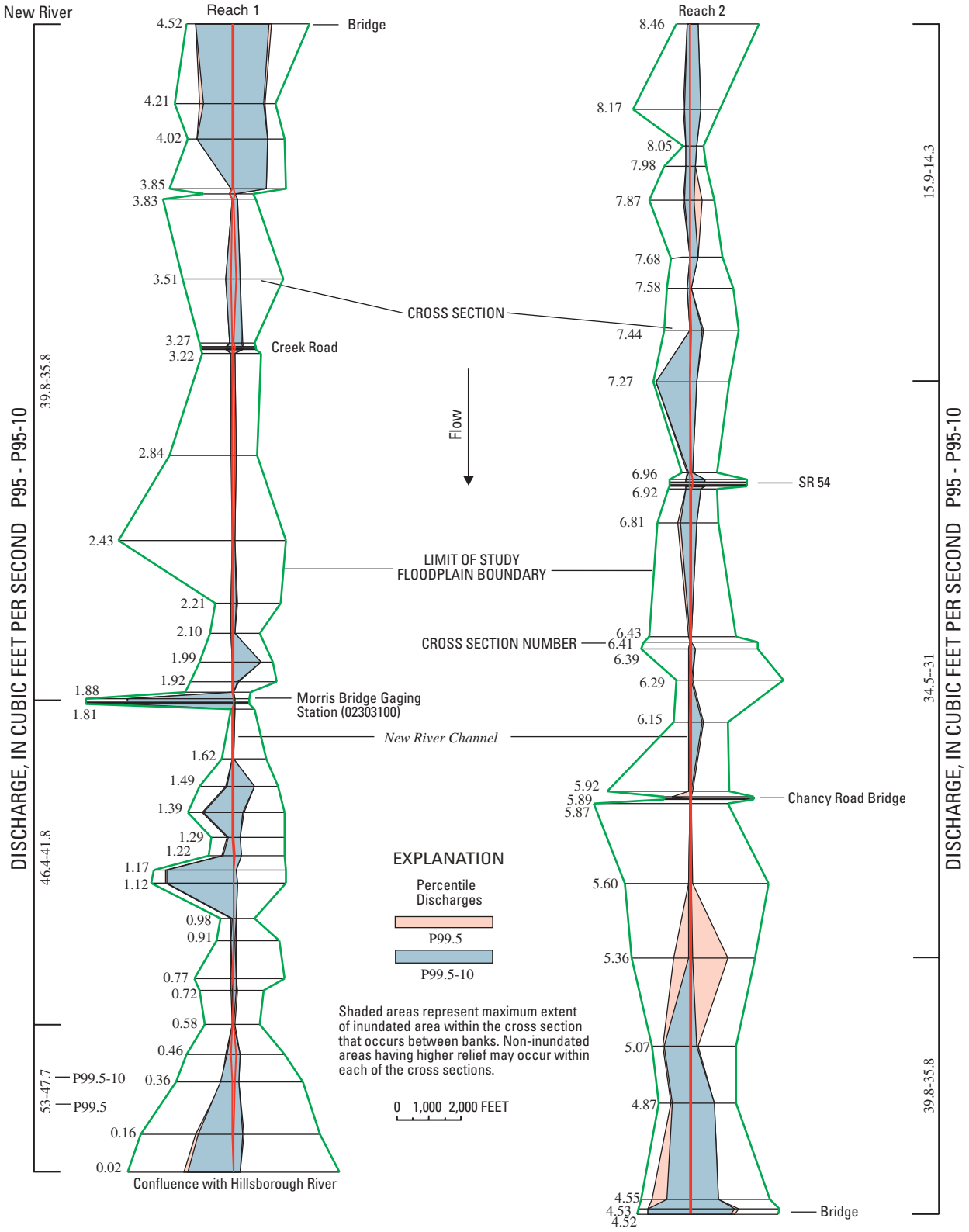
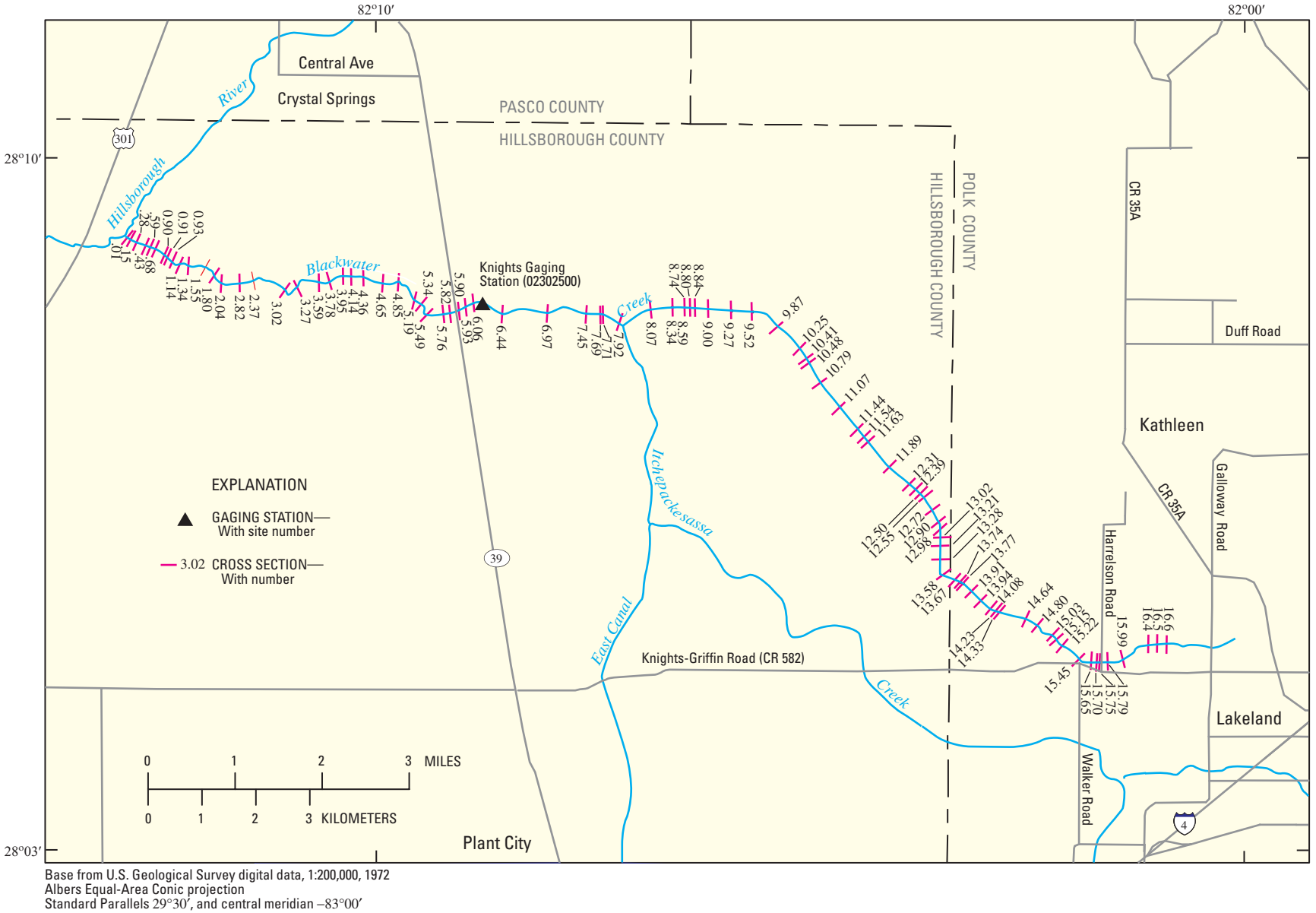


Figure 16. Example of extent of areal inundation along reaches 1 and 2 of the New River study channel and floodplain for the $P_{99.5}$ (existing conditions) and the $P_{99.5\text{-}10}$ (potential 10-percent discharge withdrawal) discharges.



Base from U.S. Geological Survey digital data, 1:200,000, 1972
Albers Equal-Area Conic projection
Standard Parallels 29°30′, and central meridian –83°00′

Figure 17. Location of the Blackwater Creek study reach and cross sections, and the Knights gaging station, west-central Florida. (Location of study area shown in figure 1).

Table 6. Cross sections, drainage area, and percentile discharges used in step-backwater analyses based on the period 1973-2001 at Blackwater Creek near Knights gaging station.

[mi^2, square miles]

Cross section No.	Drainage area (mi^2)	Discharge, in cubic feet per second						
		P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
[1]0.01-0.91	113.0	23.4	47.5	82.7	178	334	1,270	3,003
0.93-1.55	112.7	23.3	47.4	82.5	177	333	1,267	2,995
1.80-2.04	111.5	23.1	46.9	81.8	176	330	1,255	2,967
2.37-3.02	110.6	22.9	46.5	81	174	327	1,243	2,939
3.27-4.14	107.4	22.3	45.3	78.9	170	317	1,188	2,854
4.36-4.85	105.0	21.7	44.1	76.9	165	310	1,180	2,790
5.19-5.93	103.2	21.4	43.4	75.6	163	305	1,161	2,745
[2]6.06-6.44	101.6	21	42.7	74.4	160	300	1,124	2,700
6.97-7.71	97.2	20.1	40.9	71.3	153	287	1,094	2,586
[3]7.92-7.92	93	19.2	39.1	68.1	146	275	1,045	2,471
8.07-9.00	36	7.4	16.1	26.4	56.7	106	405	957
9.27-10.41	29	6	12.2	21.3	45.7	85.8	321	772
10.45-11.62	22.1	4.6	9.3	16.2	34.8	65.3	248	587
11.63-12.90	14.7	3	6.1	10.7	22.9	43	164	387
12.98-14.64	7	1.4	2.9	5.1	11	20.7	78.7	186
14.8-16.5	4.1	0.9	1.7	3	6.5	12.3.	46.6	110
16.6-16.6	1.3	0.3	0.5	1	2	3.8	14.6	34.5

[1]Mouth Blackwater Creek.

[2]Blackwater Creek near Knights gaging station.

[3]Confluence of Blackwater Creek and Itchepackesassa Creek.

Water-surface profiles were generated during the step-backwater analyses from the computed water-surface elevation at each of the 114 cross sections (fig. 18). In addition to the water-surface profiles, results of the computed water-surface elevations were used to determine the extent of areal inundation, acreage of inundation, and hydraulic depth at each cross section.

The number of days per year a percentile discharge occurred at the Knights gaging station was variable. The P_{50}, P_{70}, P_{80}, and P_{90} discharges occurred every year, and ranged from 1 (P_{90}) to 305 (P_{50}) days (table 7). The $P_{99.5}$, and $P_{99.97}$ discharges were rare during the 29-yr period, occurring during only 8 yrs and 1 yr, respectively, with mean durations of 1.1 and less than 0.1 days, respectively.

Maximum floodplain inundation can exceed 5,900 ft (cross section 5.89) during the $P_{99.97}$ discharge (fig. 19 and app. 9). Mean inundation width for the 114 cross sections range from 36 (P_{50}) to 833 ($P_{99.97}$) ft. The incised channel generally confined most discharges at or below the P_{95} discharge. Mean inundation width along the study channel at the P_{95} discharge (105 ft) may approximate the bankfull channel width. The largest increase in extent of mean inundation occurs during the transition from channel to floodplain at the $P_{99.5}$ (364 ft) to the $P_{99.97}$ (833 ft) discharge.

Percentile discharges at or below the P_{95} discharge were confined within the channel and those above inundate the floodplain (cross section 9.0, fig. 20a). At cross section 9.0, the P_{95} discharge was confined within the channel at a width of approximately 44 ft. The P_{95} discharge occurred during 27 yrs of the 29-yr study period, for an average of 20 days/yr (table 7). The moderately incised channel contains flow for most percentile discharges. At the $P_{99.5}$ discharge, however, widespread inundation occurs in the study reach floodplain during 8 yrs of the 29-yr study period, for an average of approximately 1.1 days/yr.

Maximum hydraulic depths for Blackwater Creek ranged from 2.5 (P_{50}) to 9.6 ($P_{99.97}$) ft , and a mean depth of 1.5 (P_{95} discharge) ft , which generally was confined to the channel (app. 10). Hydraulic depths along Blackwater Creek typically are deepest in the reach above the mouth, because the channel is more incised, has a steeper gradient, and greater contributing drainage area in this part of the study reach. Conversely, the upper reaches are generally poorly incised within an area of low relief.

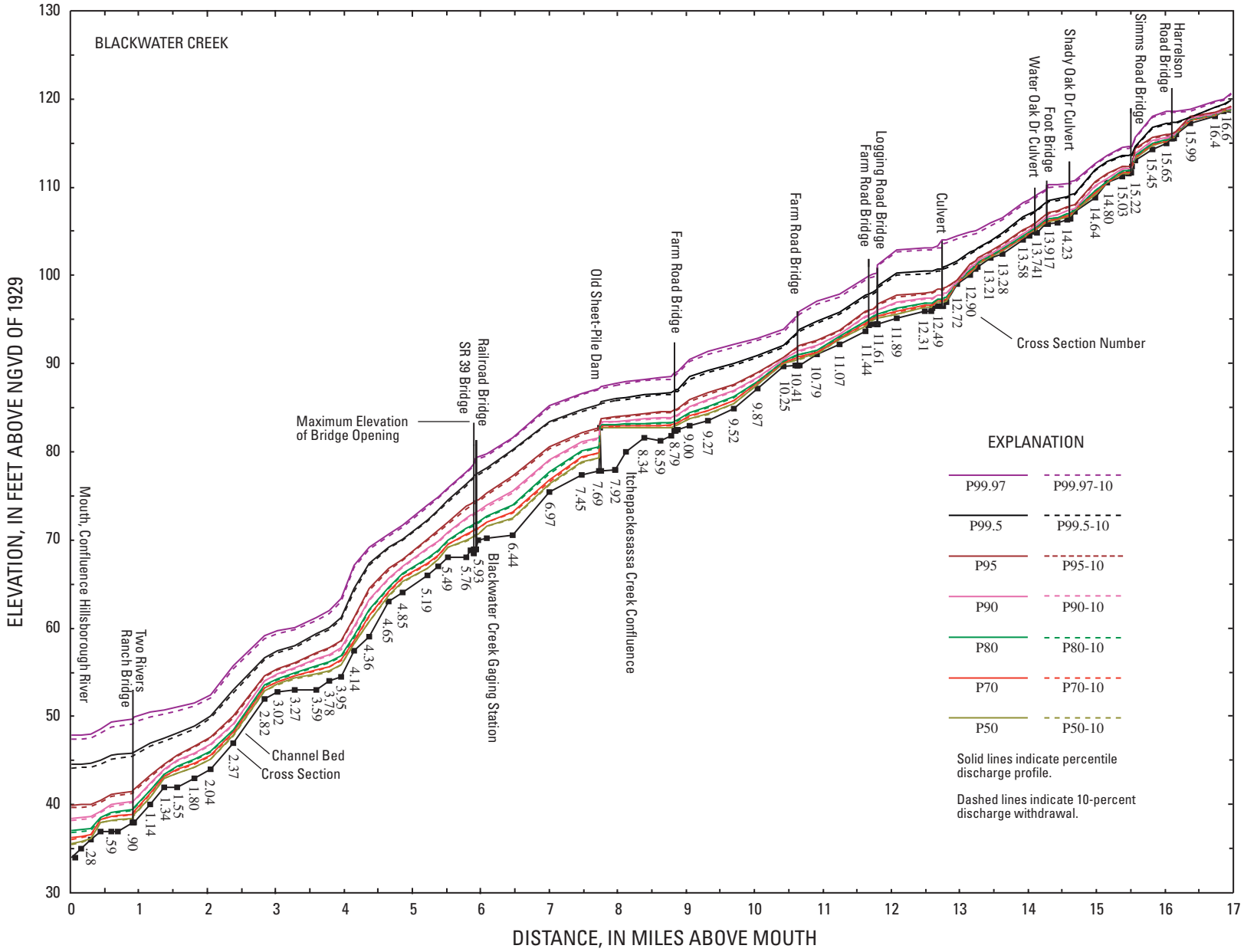


Figure 18. Blackwater Creek water-surface profiles for selected percentile discharges and the effects of a 10-percent discharge withdrawal, from the confluence with the Hillsborough River to cross section 16.6, based on the 29-year period 1973-2001.

Table 7. Approximate number of days daily mean discharge equaled or exceeded the percentile discharges at Blackwater Creek near Knights, 1973-2001.

[P_{50}, 50-percentile discharge; <, less than]

Year	Number of days per year						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
1973	237	124	59	25	16	0	0
1974	209	90	40	22	16	0	0
1975	119	76	46	23	17	0	0
1976	205	131	71	39	25	0	0
1977	148	44	20	8	4	0	0
1978	198	96	51	23	16	0	0
1979	200	133	83	59	42	2	0
1980	228	95	28	10	5	0	0
1981	107	51	25	6	1	0	0
1982	182	129	77	28	18	0	0
1983	253	191	128	74	54	0	0
1984	288	182	83	24	16	0	0
1985	80	65	40	18	12	1	0
1986	186	89	43	21	15	0	0
1987	223	110	52	22	15	3	0
1988	213	125	70	33	18	6	2
1989	175	77	34	20	12	0	0
1990	138	82	32	5	0	0	0
1991	140	96	68	32	19	0	0
1992	134	92	62	31	17	0	0
1993	202	142	87	42	24	0	0
1994	204	130	85	52	34	2	0
1995	305	181	111	65	49	0	0
1996	254	167	83	36	21	0	0
1997	122	71	43	16	9	4	0
1998	301	241	175	105	78	14	0
1999	182	84	27	7	1	0	0
2000	100	41	17	1	0	0	0
2001	87	72	47	22	14	1	0
Mean	187	111	62	30	20	1.1	<0.1
Maximum	305	241	175	105	78	14	2
Minimum	80	41	17	1	0	0	0

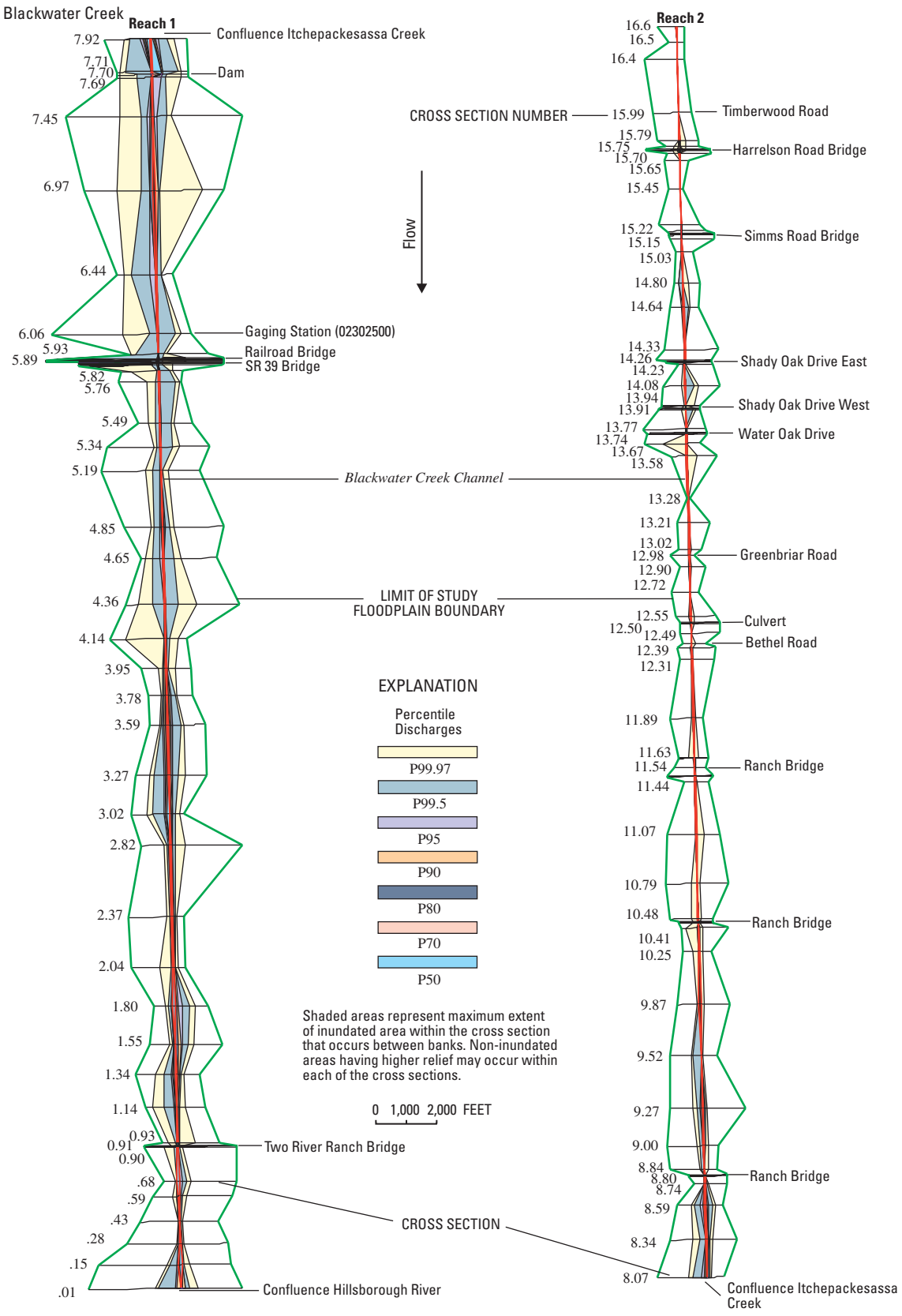


Figure 19. Extent of areal inundation along reaches 1 and 2 of the Blackwater Creek study channel and floodplain for selected percentile discharges.

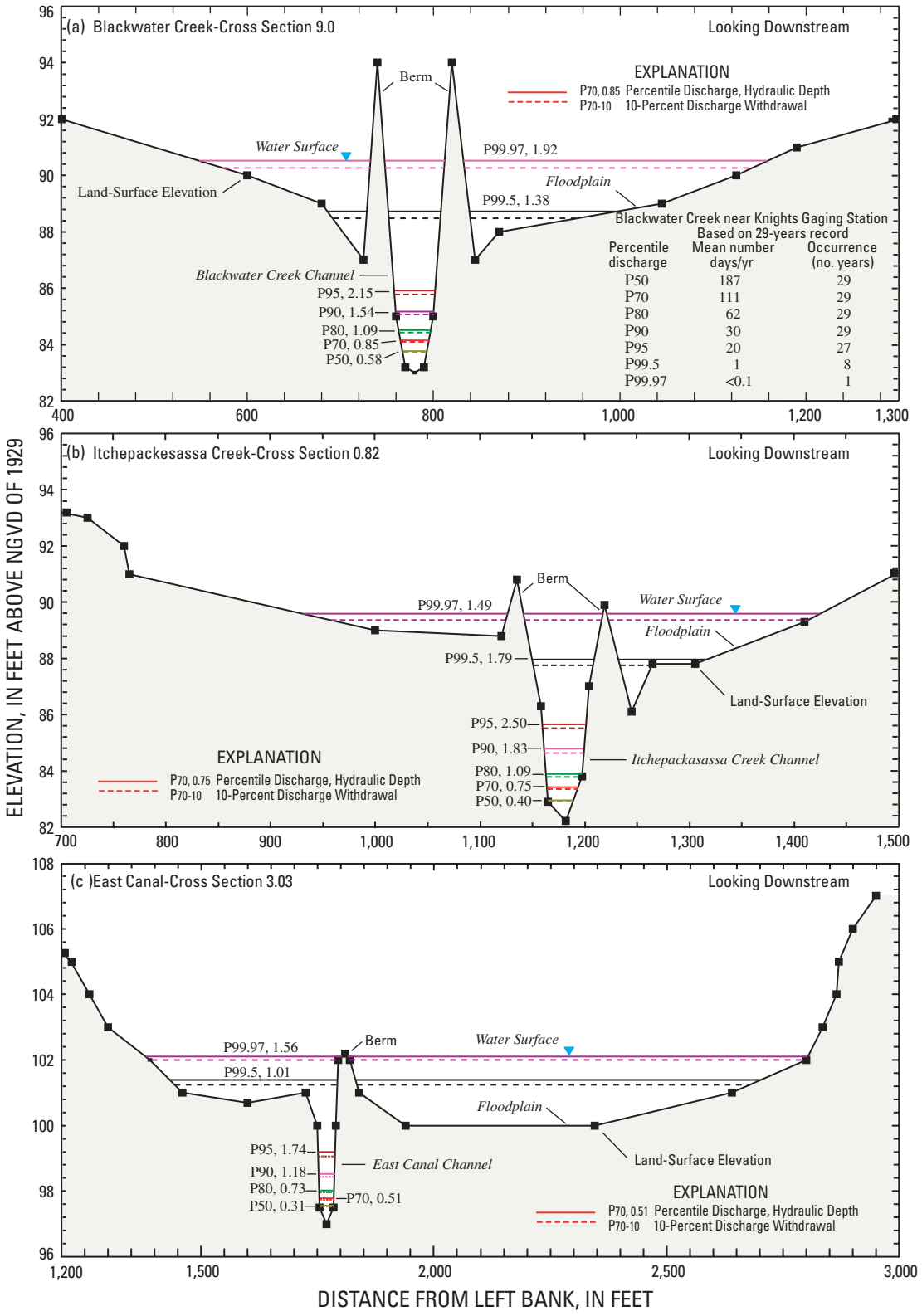


Figure 20. Estimated extent and frequency of areal inundation and hydraulic depth at (a) Blackwater Creek, 9.0, (b) Itchepackesassa Creek, 0.82, and (c) East Canal, 3.03 cross sections for each of the selected percentile discharges and the potential 10-percent withdrawal in discharge, based on the period 1973-2001.

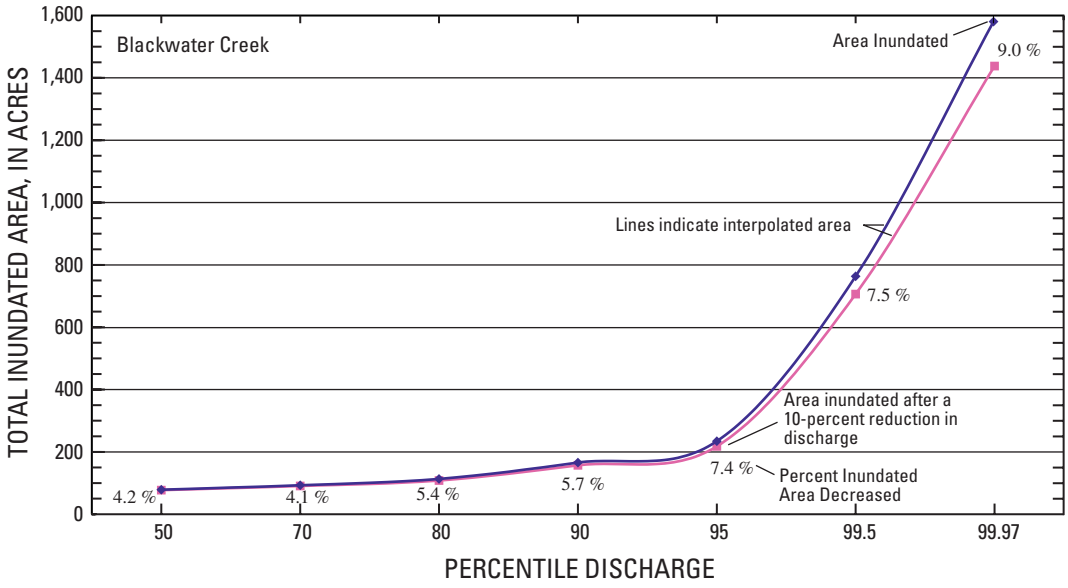


Figure 21. Estimated total inundated area along Blackwater Creek, from the confluence with the Hillsborough River to cross section 16.6, for each of the selected percentile discharges and for a 10-percent discharge withdrawal, based on the period 1973-2001.

Total inundated area within the channel and floodplain ranged from approximately 80 (P_{50}) to 1,500 ($P_{99.97}$) acres for the selected percentile discharges (fig. 21 and app. 11). Inundated area at and below the P_{95} discharge generally was confined to within the channel (figs. 19 and 20a). A total of 228 acres at the P_{95} discharge were inundated, generally consisting of that area confined to within the bankfull channel. Inundation at both the $P_{99.5}$ and $P_{99.97}$ discharges predominately includes the floodplain area at 744 and 1,552 acres, respectively.

Inundation losses resulting from the effects of a 10-percent reduction in discharge were assessed along Blackwater Creek. The difference in inundated area, between *existing* and *potential* step-backwater analyses using discharges reduced by 10 percent, ranged from 3.3 (P_{50}) to 148 ($P_{99.97}$) acres (app. 12). Inundated area losses based on the difference between the P_{95} and the $P_{95\text{-}10}$ discharges, which are generally confined within the channel, totaled 16.8 acres. The greatest loss of inundated area occurred for the difference between the $P_{99.97}$ and the $P_{99.97\text{-}10}$ discharges at 148 acres. An example of the effects from a 10-percent discharge withdrawal during the $P_{99.97}$ and the $P_{99.97\text{-}10}$ discharges is shown in figure 22. Areas within the cross section having higher topographic relief may not be inundated. Cross section 9 in figure 20a shows an example of non-inundated areas.

Itchepackesassa Creek

Itchepackesassa Creek, the largest tributary to Blackwater Creek, drains about 57 mi^2 in northeastern Hillsborough and northwestern Polk Counties. The approximate 11.6-mi-long creek generally flows in a northwesterly direction, from Lake Bonnet, at the west side of the city of Lakeland, to the confluence with Blackwater Creek (figs. 1 and 23). Itchepackesassa Creek and many of its tributaries have been extensively channelized to improve drainage. Most of the channel along the study reach is moderately incised and typically well defined, confining all but the highest discharges within the banks.

Step-backwater analyses for the Itchepackesassa Creek study reach were based on seven percentile discharges, P_{50}, P_{70}, P_{80}, P_{90}, P_{95}, $P_{99.5}$, and $P_{99.97}$. The step-backwater analyses used 49 cross sections along the 11.6-mi-long study reach, from the confluence with Blackwater Creek to Interstate Highway 4. Discharges used in the analyses were calculated based on the proportionality of drainage area with that of the Blackwater Creek near Knights gaging station for the 29-yr period, 1973-2001 (table 8). Water-surface profiles were generated from water-surface elevations computed at each of the 49 cross sections during the step-backwater analyses (fig. 24). Extent of areal inundation and hydraulic depth at the cross sections also

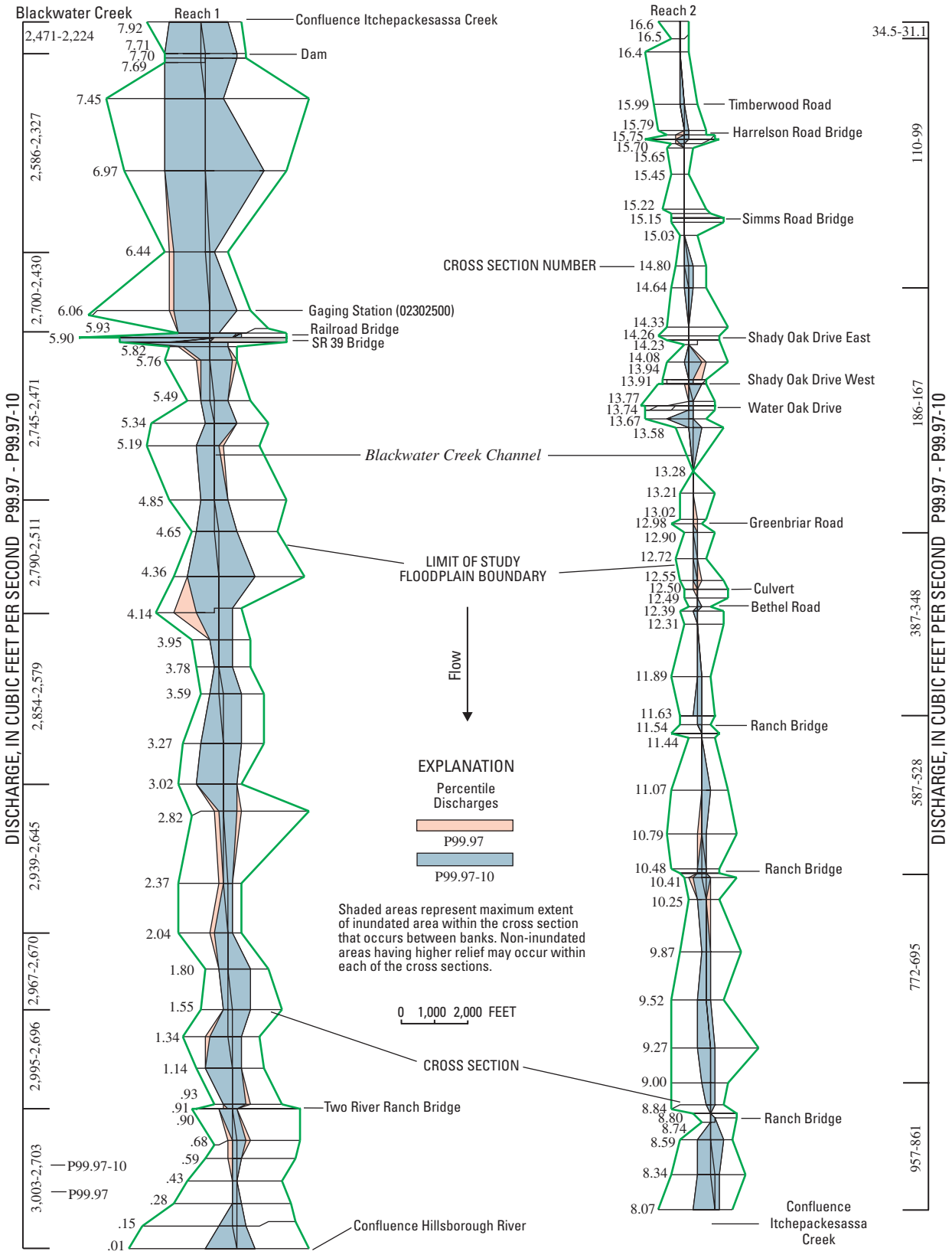


Figure 22. Example of extent of areal inundation along reaches 1 and 2 of the Blackwater Creek study channel and floodplain for the $P_{99.97}$ (existing conditions) and the $P_{99.97\text{-}10}$ (potential 10-percent discharge withdrawal) discharges.

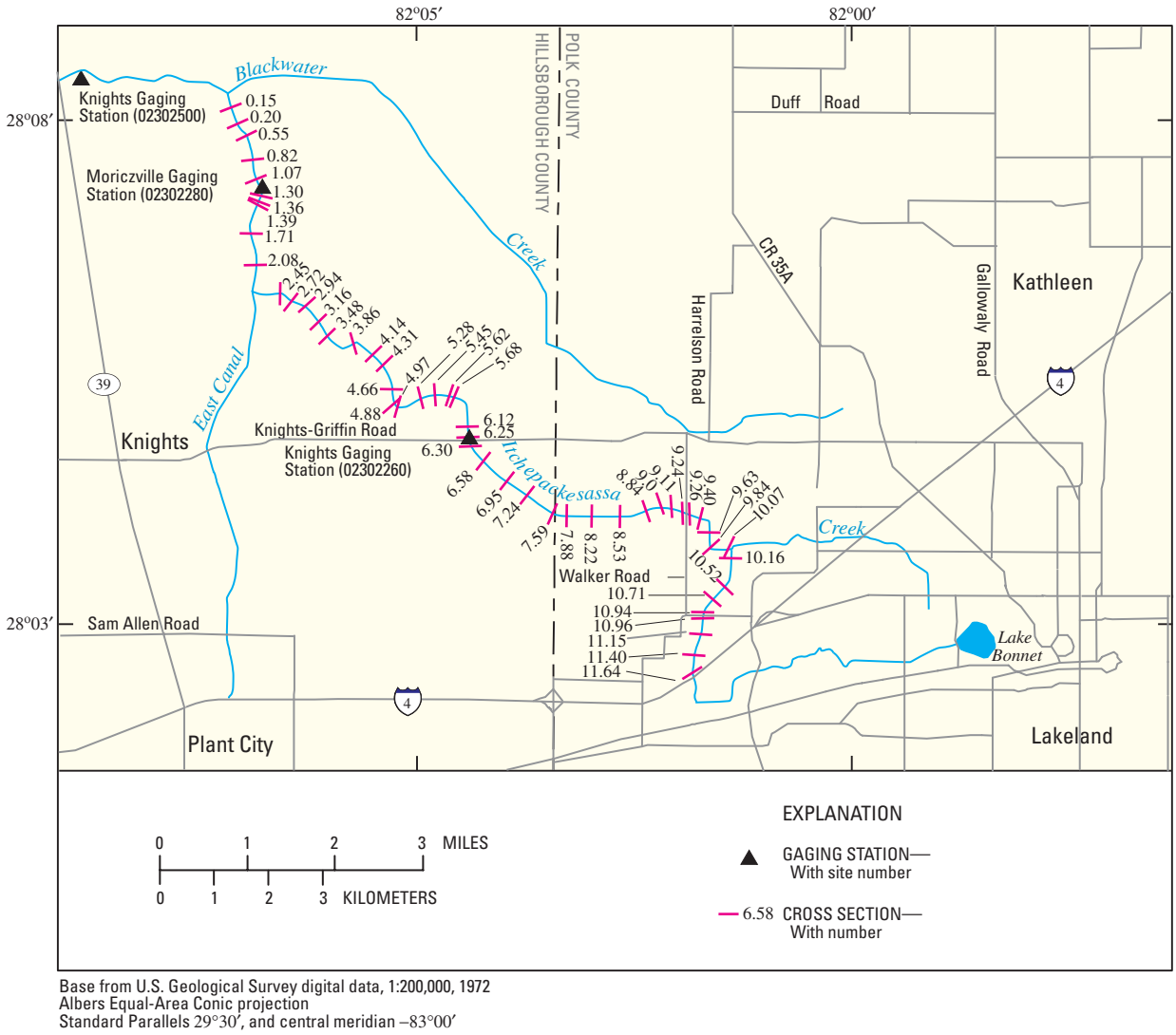


Figure 23. Location of the Itchepackesassa Creek study reach and cross sections, and the Moriczville and Knights gaging stations, west-central Florida. (Location of the study area shown in figure 1).

were based on the computed water-surface elevations for the selected percentile discharges. Accuracy of the step-backwater analyses were determined by comparing results of the computed water-surface elevations with rated water-surface elevations at the Itchepackesassa Creek near Moriczville (02302280) and the Itchepackesassa Creek near Knights (02302260) gaging stations. The computed water-surface elevations for percentile discharges converged successfully within plus or minus 0.5 ft of the established stage-discharge relation at the Moriczville and Knights gaging stations.

Estimated floodplain inundation can exceed 4,700 ft (cross section 9.26) during $P_{99.97}$ discharges (app. 13). Mean inundation width for the 49 cross sections along the study reach ranged from 28 (P_{50}) to 793 ($P_{99.97}$) ft. The moderately incised channel of the study reach generally confines most flows below the $P_{99.5}$ discharge, except for a limited number of low-lying cross sections (figs. 20b and 25). Mean width at the P_{95} discharge (64 ft) was considered the mean width of the bankfull channel. The increase in the extent of mean areal inundation from the P_{95} to the $P_{95.5}$ discharge and from the $P_{95.5}$ to the $P_{99.97}$ discharge are similar. In example cross section 0.82, discharges below $P_{99.5}$ generally were confined within the channel, and those above can inundate the floodplain (fig. 20b). The approximate mean number of days that inundation of the floodplain occurred at the $P_{99.5}$ discharge was 1.1 days, which occurred during 8 yrs of the 29-yr period, based on the frequency at the downstream Blackwater Creek near Knights gaging station (table 7).

Table 8. Cross sections, drainage area, and percentile discharges used in the Itchepackesassa Creek step-backwater analyses, based on the period 1973-2001, at Blackwater Creek near Knights gaging station.

[mi^2, square miles; --, not determined]

Cross section No.	Drainage area (mi^2)	Discharge, in cubic feet per second						
		P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
0.15-2.45	57	11.8	24	41.7	90	168	641	1,515
2.72	39.8	8.2	16.7	29.1	63	118	447	1,058
2.94-3.48	--	8.0	16.3	28.4	61.1	115	436	1,031
3.86-4.14	37.8	7.8	15.9	27.7	60	112	425	1,005
4.31-4.88	--	7.3	14.9	25.9	55.7	105	398	941
4.97-6.63	33	6.8	13.9	24.2	52	97.4	371	877
5.64-7.59	--	5.7	11.7	20.3	43.7	82	312	737
7.88-9.25	22.5	4.7	9.5	16.5	35.4	66.4	253	598
9.26-10.52	--	4	8.2	14.3	30.7	57.6	219	518
10.71-11.64	16.5	3.4	6.9	12.1	26	49	185	438

Hydraulic depths below the $P_{99.5}$ discharge generally were confined within the channel. Mean hydraulic depths along the reach ranged from 0.5 to 3.0 ft, and maximum depths ranged from 1.6 to 8.0 ft (app. 14). Because of the increase in cross-sectional area at the transition from the channel to floodplain in example cross section 0.82, the hydraulic depth of 2.5 ft at the P_{95} discharge is greater than the 1.79 ft at the $P_{99.5}$ discharge (fig. 20b).

Total inundated area within the channel and floodplain ranged from 33.5 (P_{50}) to 966 ($P_{99.97}$) acres (fig. 26, app. 15). Inundated acreage at or below the P_{95} discharge generally was confined within the channel, except at two adjacent cross sections in a low-lying area near the mouth (fig. 25). The inundated acreage at the P_{95} discharges, which largely included the area within the channel, was approximately 86 acres. The inundated area at both the $P_{99.5}$ and $P_{99.97}$ discharges predominately include the floodplain at 339 and 966 acres, respectively.

The difference in inundated area, between the *existing* and the *potential* step-backwater analyses, ranged from 1.0 (P_{50}) to 104 ($P_{99.97}$) acres (app. 16). Loss of inundated area at or below the $P_{95\text{-}10}$ discharge generally occurred within the channel and ranged from approximately 1.0 to 6.0 acres. The greatest loss occurred at the $P_{99.97\text{-}10}$ discharge with 104 acres (fig. 27).

East Canal

East Canal drains about 13.4 mi^2 from south of Plant City to its confluence with Itchepackesassa Creek (fig. 1 and 28). The 4.9-mi-long north-south trending study reach starts at the confluence with Itchepackesassa Creek and ends at Interstate Highway 4. The East Canal study reach is highly channelized, generally deeply incised, and well defined.

Step-backwater analyses were performed based on seven percentile discharges, P_{50}, P_{70}, P_{80}, P_{90}, P_{95}, $P_{99.5}$, and $P_{99.97}$. Water-surface profiles were generated from water-surface elevations computed at the 46 cross sections during the step-backwater analyses (fig. 29). Water-surface elevations also were used to compute the extent of areal inundation and hydraulic depth at each of the 46 cross sections. The proportionality of drainage area to discharge at the Blackwater near Knights gaging station for the period, 1973-2001, was used to determine the percentile discharges used in the East Canal analyses (table 9).

Estimated maximum floodplain inundation can exceed 2,200 ft (cross section 2.44) during $P_{99.97}$ discharges (app. 17). Mean inundation width for the 46 cross sections along the reach ranged from 21 (P_{50}) to 451 ($P_{99.97}$) ft. The incised channel generally confines most flows within the banks at or below the P_{95} discharge, except at the low-lying cross section 3.03 (figs. 20c and 30). The mean inundation width at the P_{95} discharge (43 ft) was considered the bankfull channel. The greatest increase in extent of mean areal inundation occurred between the P_{95} (43 ft) to the $P_{99.5}$ (177 ft) discharges (app. 17). This increase in mean areal inundation may reflect the transition from channel to floodplain. Example cross section 3.03 shows that discharges below P_{95} are confined to the channel, and those above may inundate the floodplain (fig. 20c). Based on the Blackwater near Knights gaging station (table 7), the approximate mean number of days that inundation of the floodplain occurs at the P_{95} discharge is 20 days. The P_{95} discharge occurred during 27 yrs of the 29-yr study period.

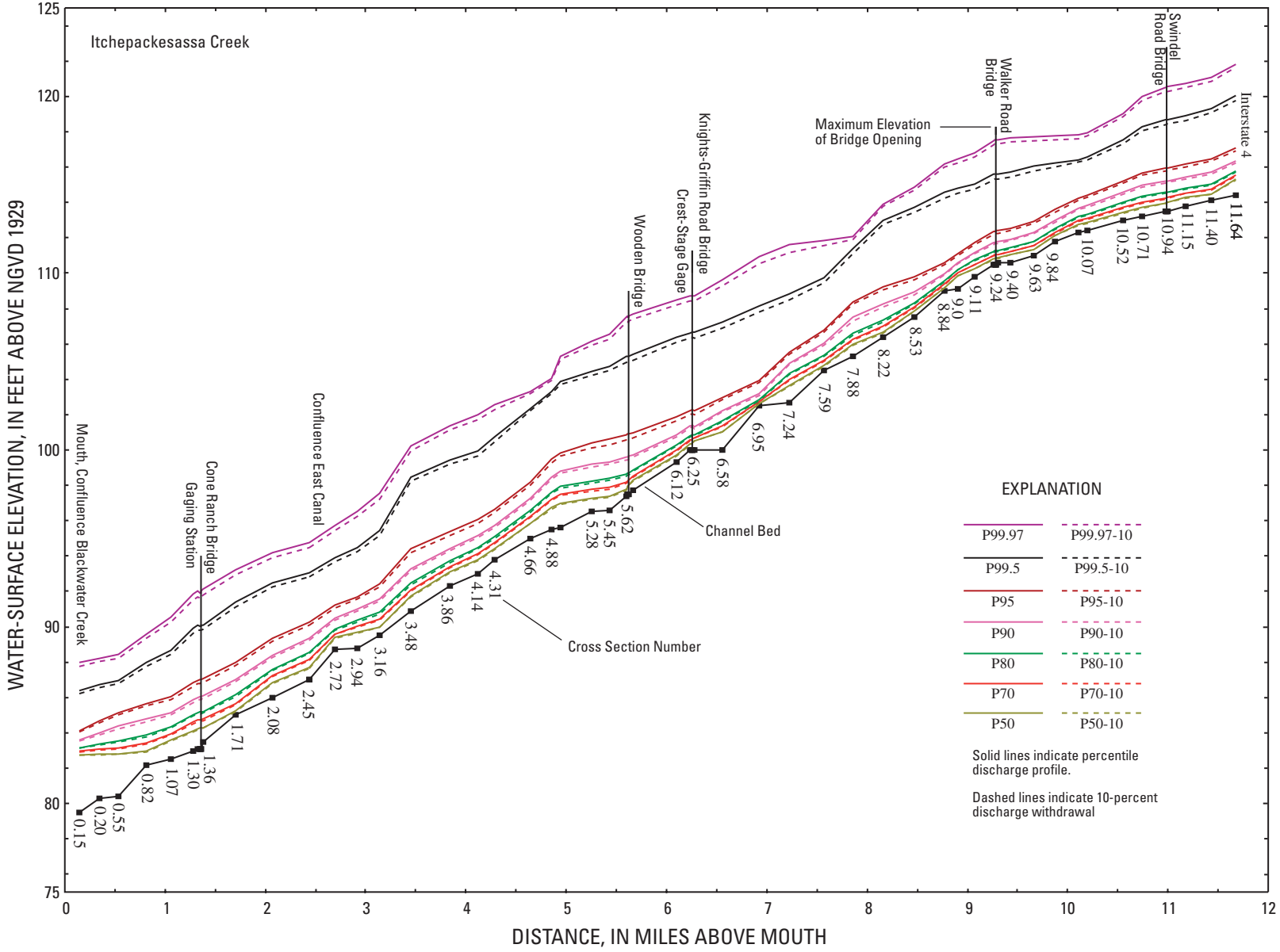


Figure 24. Itchepackesassa Creek water-surface profiles for the selected percentile discharges and the effects of a 10-percent discharge withdrawal, from the confluence with Blackwater Creek to Interstate 4, based on the 29-year period 1973-2001.

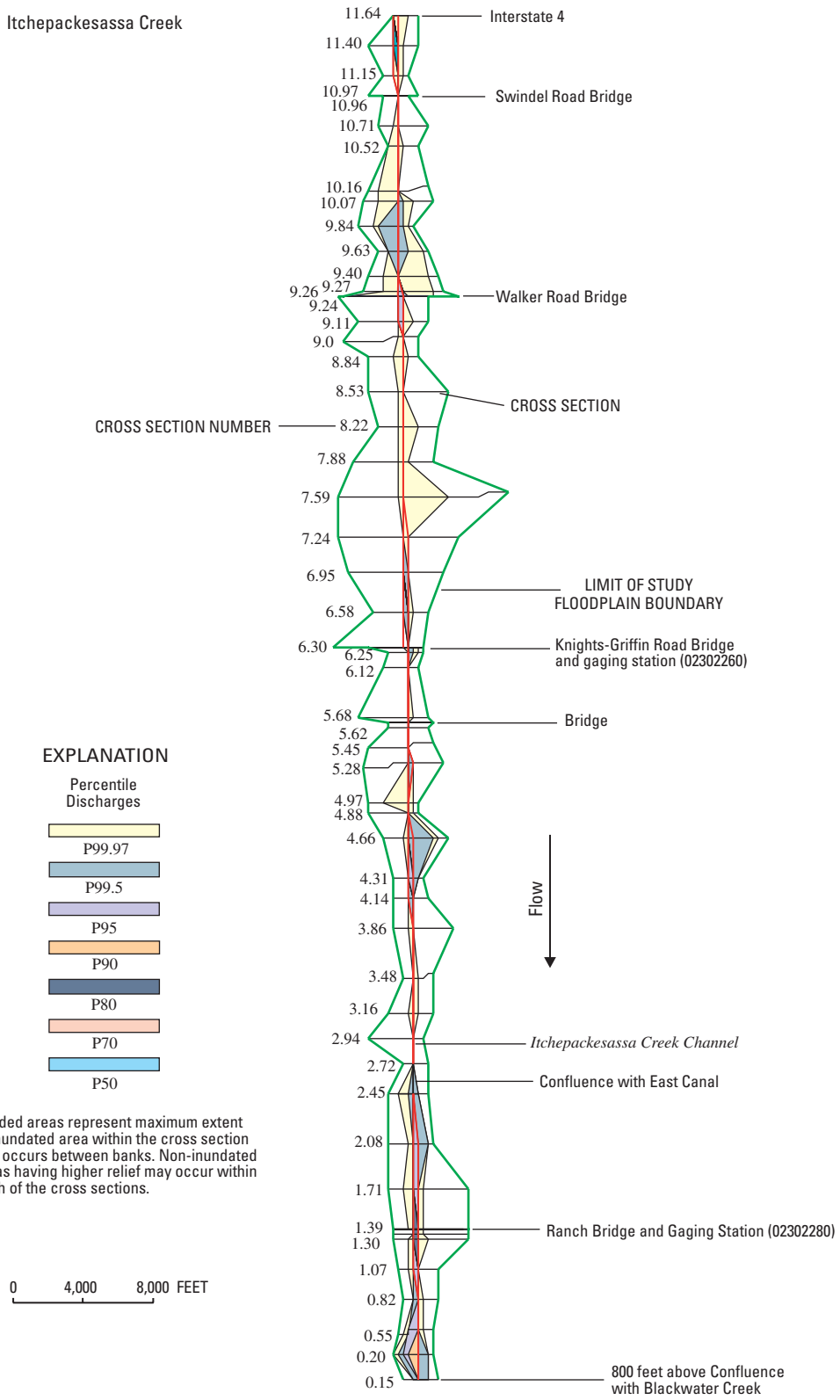


Figure 25. Extent of areal inundation along Itchepackesassa Creek study channel and floodplain for selected percentile discharges.

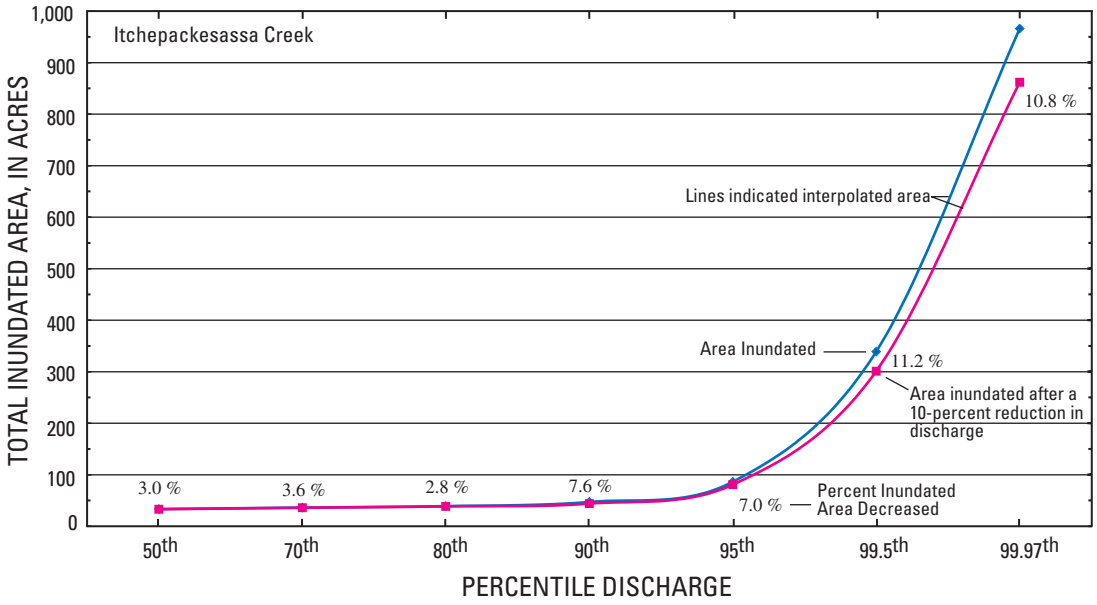


Figure 26. Estimated total inundated area along Itchepackesassa Creek, from the mouth at the confluence with Blackwater Creek to Interstate 4, for each of the selected percentile discharges and for a 10-percent discharge withdrawal, based on the 29-year period 1973-2001.

Hydraulic depths at or below the P_{95} discharge generally were confined within the channel. Mean hydraulic depths ranged from approximately 0.3 to 2.2 ft, and maximum depths ranged from 0.8 (P_{50}) to 4.8 ($P_{99.97}$) ft (app. 18). In example cross section 3.03, the hydraulic depths at the P_{95} discharge were confined to the channel. The P_{95} discharge occurs on average for about 20 days during 27 yrs of the 29-yr period, based on conditions at the Blackwater near Knights gaging station (table 7 and fig. 20c).

Total inundated area within the channel and floodplain ranged from 12.4 (P_{50}) to 378 ($P_{99.97}$) acres (fig. 31 app. 19). The inundated acreage at the P_{95} discharges was approximately 35 acres, which predominantly includes that area confined within the bankfull channel. Whereas, the $P_{99.5}$ and $P_{99.97}$ discharges generally include inundated areas along the floodplain at 153 and 378 acres, respectively.

Loss of inundated area, between the *existing* and the *potential* step-backwater analyses ranged from 0.7 (P_{50}) to 34.6 ($P_{99.97}$) acres (app. 20). Loss of inundated area at or below the $P_{95\text{-}10}$ discharge generally occurred within the channel and ranged from 0.7 to 2.4 acres. An example of the effects of a *potential* 10-percent discharge withdrawal (16.5 acres) for the $P_{99.5}$ discharge is shown in figure 32.

Summary

Inland forested wetlands are a major ecological component of river basins in west-central Florida. Healthy wetlands are dependent, in part, upon the frequency and duration of periodic inundation. This report assesses the extent, area, depth, frequency, and duration of periodic inundation and the effects of potential consumptive surface-water withdrawals on the Hillsborough and New Rivers, Blackwater and Itchepackesassa Creeks, and East Canal. Results of the study were based on step-backwater analyses performed for each of the river systems using the U.S. Army Corps of Engineers HEC-RAS (Hydrologic Engineering Center-River Analysis System) one-dimensional model. Step-backwater analyses of mean daily discharges for the 10th, 50th, 70th, 80th, 90th, 95th, 99.5th, and 99.97th percentiles were used to compute lateral extent of areal inundation, area of inundation, and hydraulic depth. The 10th and 99.97th percentile discharges were omitted for selected analyses because of limiting hydrologic conditions. Percentile discharges selected for the Hillsborough River study reach were determined based on the longest concurrent daily mean discharge record (17-yr period, 1984-2000) at the four long-term steamflow gaging stations: Morris Bridge, Zephyrhills, Crystal Springs, and Withlacoochee-Hillsborough Overflow.

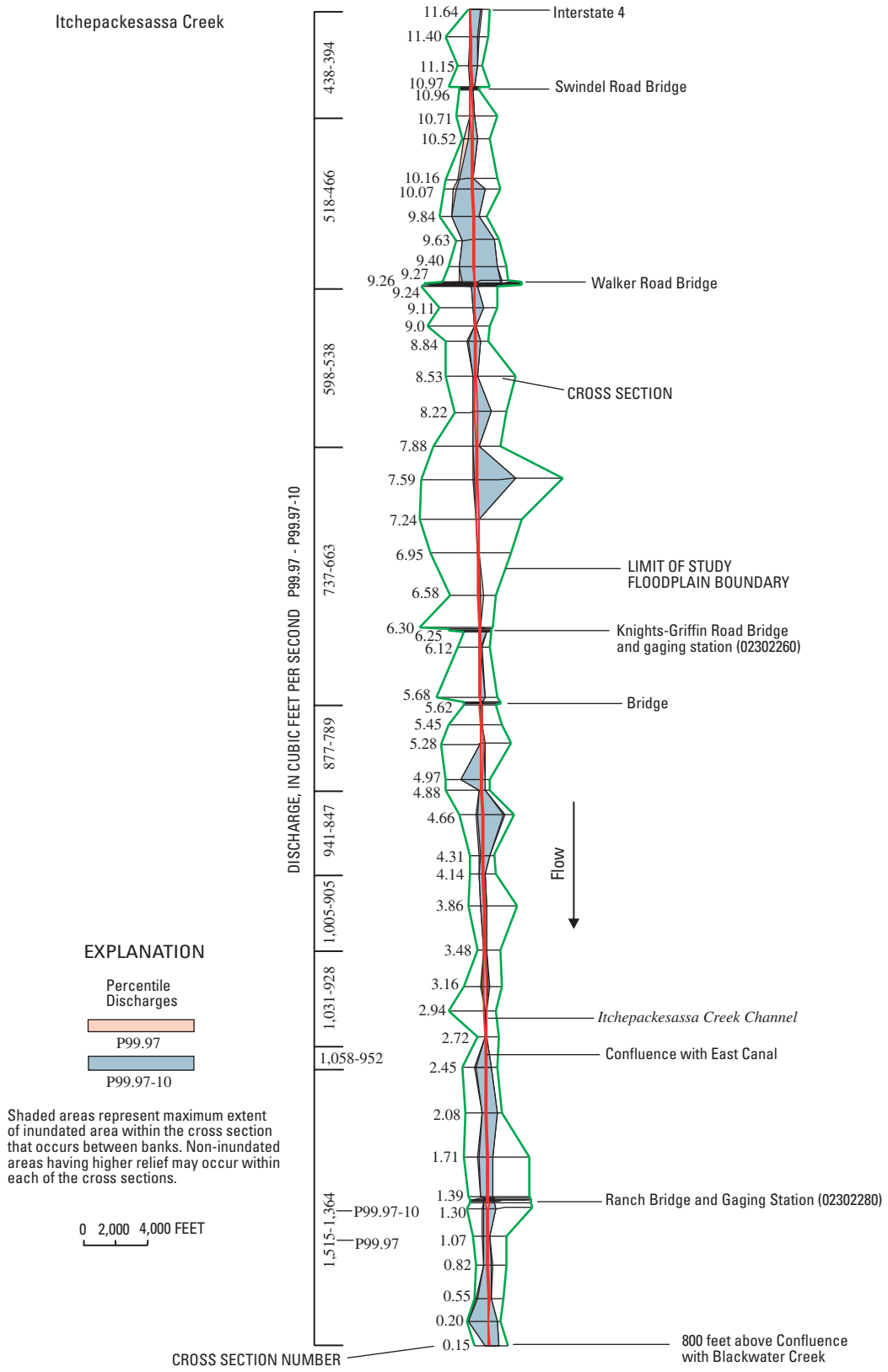


Figure 27. Example of extent of areal inundation along the Itchepackesassa Creek study channel and floodplain for the $P_{99.97}$ (existing conditions) and the $P_{99.97\text{-}10}$ (potential 10-percent discharge withdrawal) discharges.

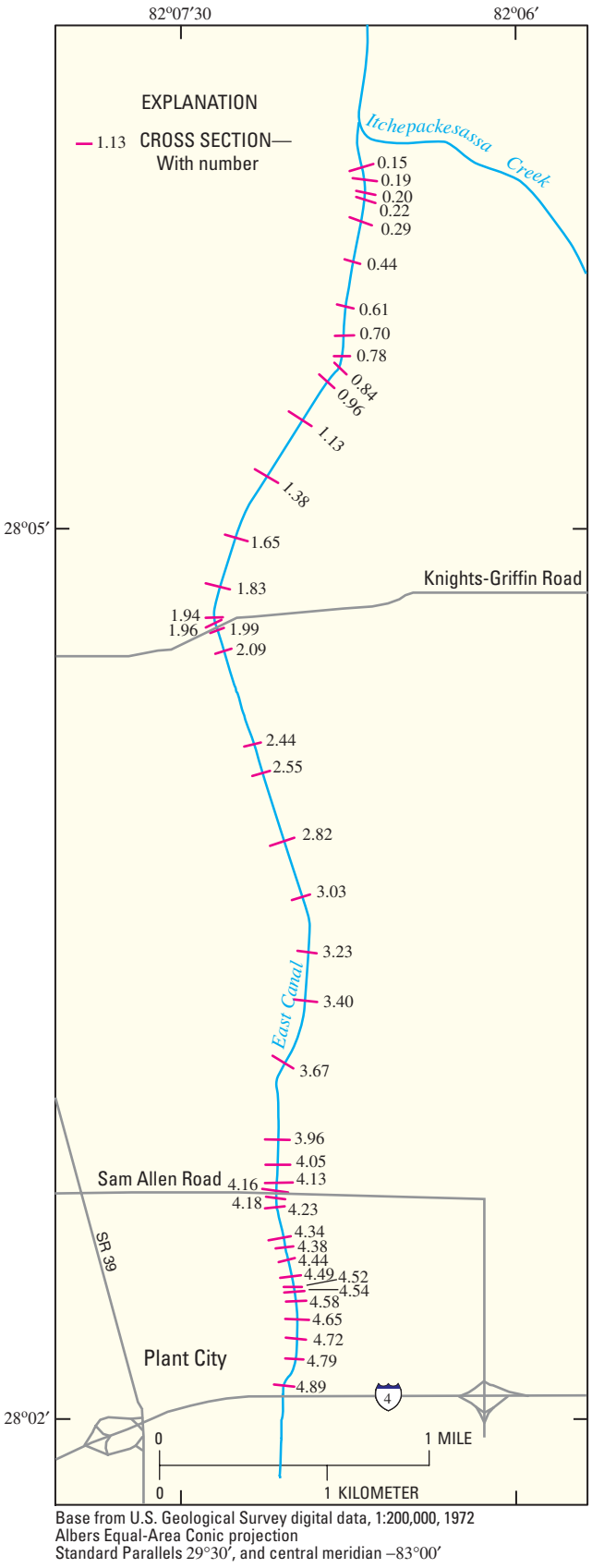


Figure 28. Location of the East Canal study reach and cross sections, west-central Florida. (Location of the study area shown in figure 1).

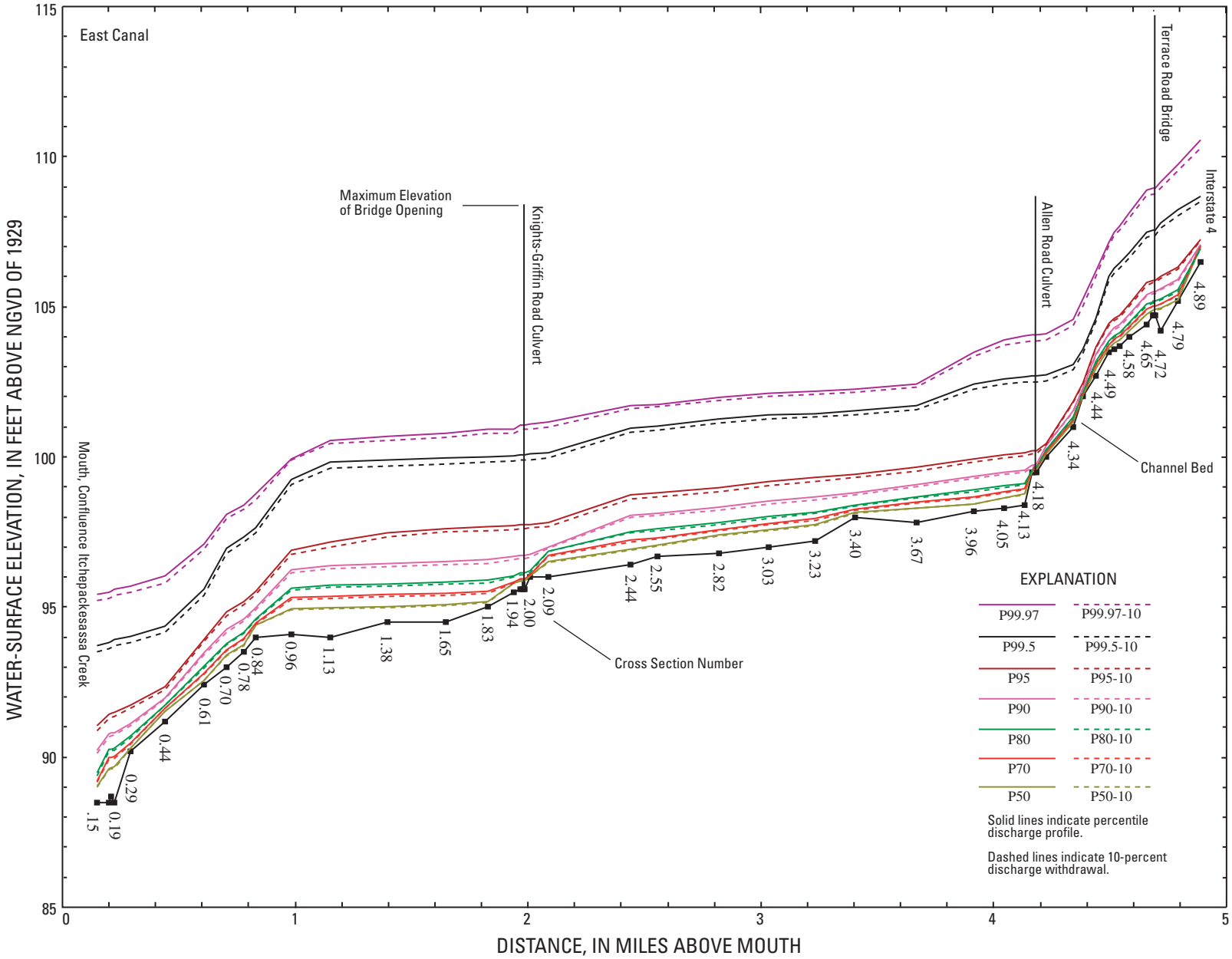


Figure 29. East Canal water-surface profiles for the selected percentile discharges and the effects of a 10-percent discharge withdrawal, from the confluence with Itchepackesassa Creek to Interstate 4, based on the 29-year study period 1973-2001.

Table 9. Cross sections, drainage area, and percentile discharges used in the East Canal step-backwater analyses, based on the period 1973-2001, at Blackwater Creek near Knights gaging station.

[mi^2, square miles; --, not determined]

Cross section No.	Drainage area (mi^2)	Discharge, in cubic feet per second						
		P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
0.15	13.4	2.8	5.6	9.8	21	40	151	356
0.19-0.96	--	2.4	5	8.7	18.7	35	133	315
1.13-1.96	10.3	2.1	4.3	7.5	16	30	116	274
1.99-2.44	--	1.9	4	6.9	14.8	27.8	106	250
2.55-3.03	8.5	1.8	3.6	6.2	13	25	96	226
3.23-3.96	--	1.4	2.8	4.8	10.3	19.3	73.6	174
4.05-4.79	4.6	1	1.9	3.4	7.2	13.6	52	122

Percentile discharges for New River were based on the available 10-yr period, 1965-1974, at the New River near Zephyrhills gaging station. Percentile discharges for Blackwater Creek, Itchepackesassa Creek, and East Canal were based on the 29-yr period, 1973-2001, at the Blackwater Creek near Knights gaging station. Discharges at the 99.5th and 99.97th percentiles generally occur once every 5 to 10 yrs. Assessment of the net reduction of areal inundation was compared between existing and potential step-backwater analysis (10 percent of the total river flow was diverted for potential withdrawals).

The Hillsborough River watershed drains a 375-mi^2 area in southeastern Pasco, western Polk, and northeastern Hillsborough Counties. The low-gradient channel generally is poorly incised and not well defined. Widespread inundation of the inland forested wetlands, which dominate the length of the Hillsborough floodplain, occurs at discharges associated with the 80th percentile. Discharges at the 80th percentile generally occur about 72 days annually for the Hillsborough River. During the study period, the maximum extent of inundation was about 15,600 ft in width, and the mean inundation width along the channel ranged from approximately 98 to 4,800 ft. The inundated area along the Hillsborough River study reach ranged from about 280 to 16,300 acres. The mean hydraulic depth ranged from 1.4 to 3.1 ft, with a maximum depth of 8.9 ft. Loss of inundated area from a potential 10-percent reduction in discharge ranged from 7 to 940 acres.

New River drains 19.5 mi^2 in eastern Pasco and Hillsborough Counties. The New River channel is generally well defined and moderately incised. Most discharges at or below the 90th percentile are contained within the banks of the channel. Discharges at the 50th percentile occur about 94 days annually and discharges at the 90th percentile occur most years for about 14 days annually. The maximum extent of areal inundation along New River was approximately 2,900 ft in width, and the mean inundation width ranged from approximately 17 to 560 ft. Total inundated area ranged from about 17 to 490 acres. Mean hydraulic depth ranged from 0.2 to 1.6 ft, with a maximum depth of 4.6 ft. Losses of inundated area from a potential 10-percent reduction in discharge ranged from 0.2 to 59 acres.

Blackwater Creek, the largest tributary to the Hillsborough River, drains about 113 mi^2 in northwestern Polk and northeastern Hillsborough Counties. The channel along the lower one-third of the study reach is predominately natural, from the mouth to directly downstream of SR 39. Most of the channel is moderately incised and well defined, confining most discharge within the banks at or below the 95th percentile. Step-backwater analyses were performed at 114 cross sections. Maximum areal inundation width was about 6,000 ft, and the mean inundation width along the channel ranged from approximately 36 to 800 ft. Inundation along the Blackwater Creek study reach ranged from about 80 to 1,500 acres. The mean hydraulic depth ranged from 0.5 to 2.8 ft, with a maximum depth of 9.6 ft. Loss of inundated area from a 10-percent reduction in discharge ranged from 3.3 to 148 acres.

Itchepackesassa Creek, the largest tributary to Blackwater Creek, drains about 57 mi^2 in northeastern Hillsborough and northwestern Polk Counties. The 11.6-mi-long creek generally flows in a northwesterly direction, from its headwaters at Lake Bonnet, to its confluence with Blackwater Creek. Itchepackesassa

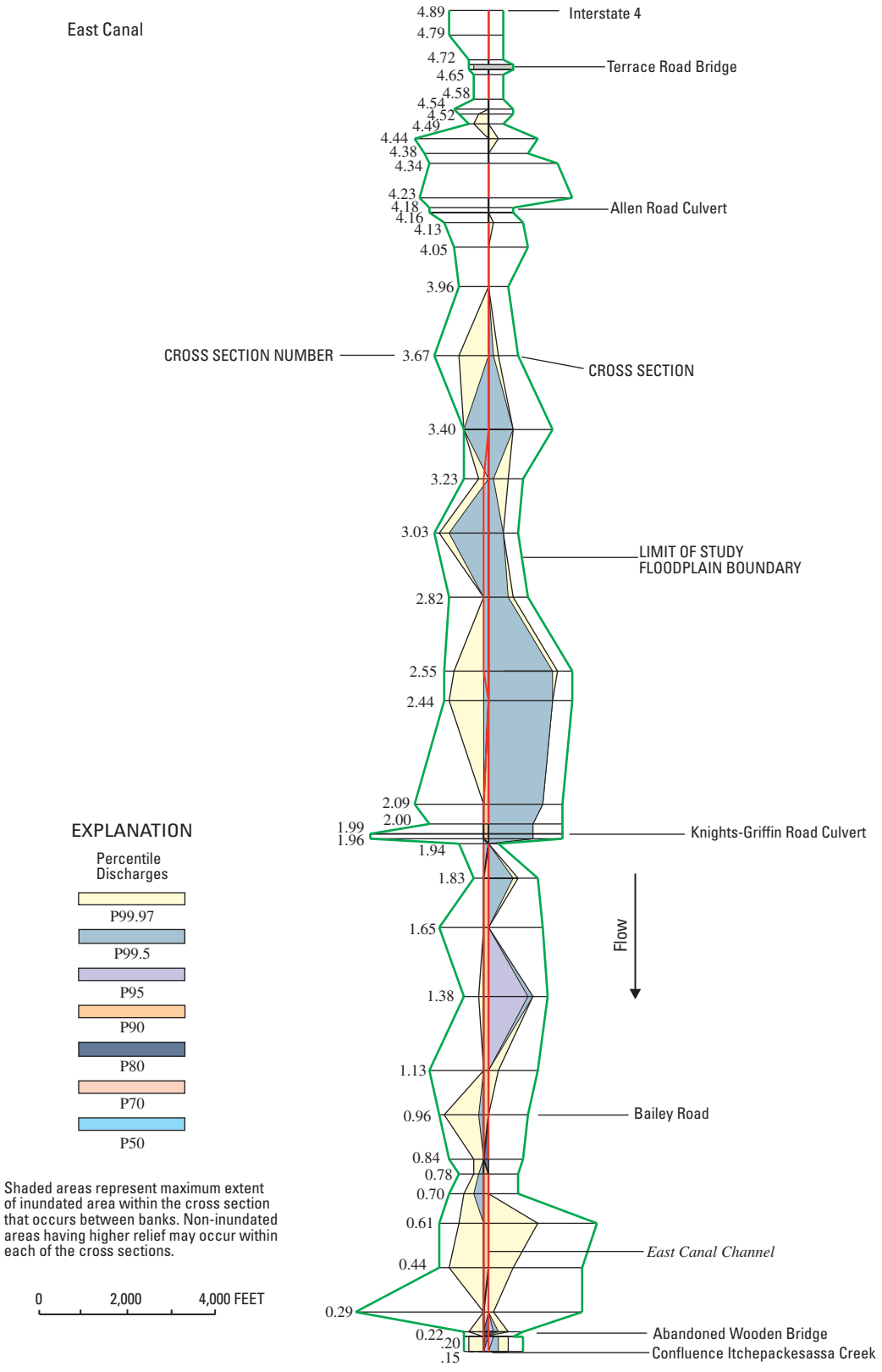


Figure 30. Extent of areal inundation along East Canal study channel and floodplain for selected percentile discharges.

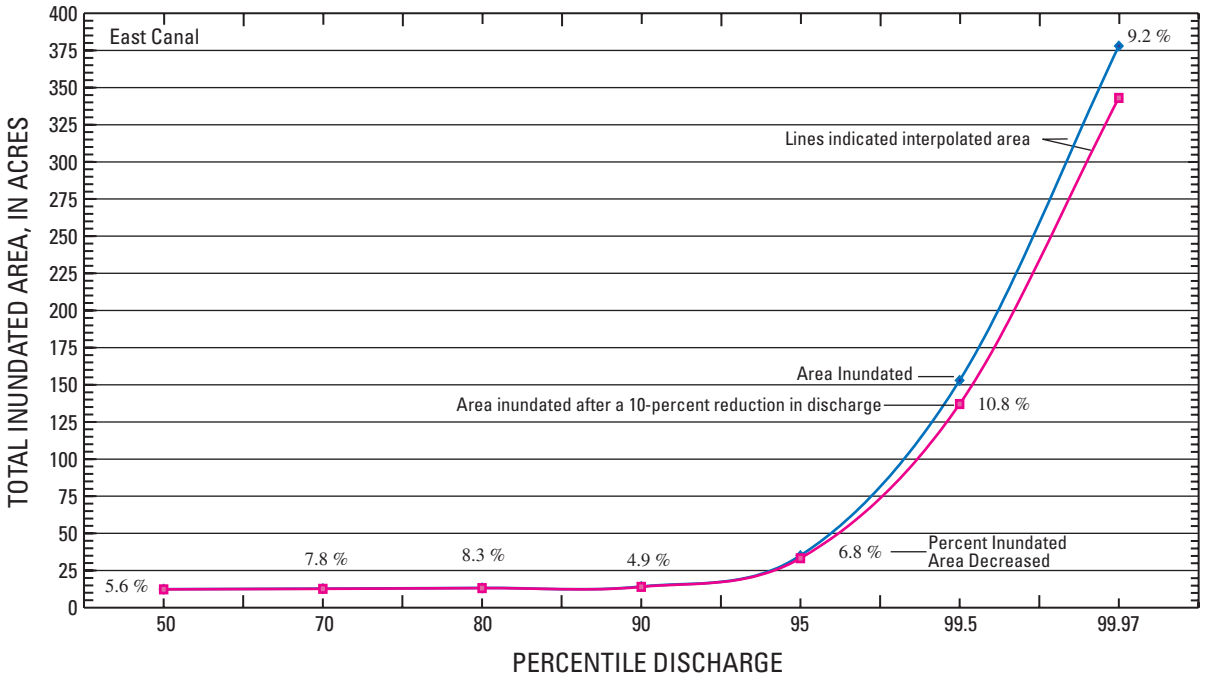


Figure 31. Estimated total inundated area along East Canal, from the mouth at the confluence with Itchepackesassa Creek to Interstate 4, for each of the selected percentile discharges and for a 10-percent discharge withdrawal, based on the 29-year period 1973-2001.

Creek and many of its tributaries have been extensively channelized to improve drainage. The channel along the study reach typically is moderately incised and well defined, confining all but the highest discharges within the banks. Discharges at or below the 99.5th percentile generally are contained within the banks of the channel. Discharges at the 50th percentile occur about 190 days annually, and discharges at the 95th percentile occur during most years for about 20 days. Maximum areal inundation along Itchepackesassa Creek was about 4,700 ft in width, and the mean inundation width along the channel ranged from approximately 30 to 800 ft. Total inundated area ranged from about 34 to 970 acres. Mean hydraulic depth ranged from 0.5 to 3.0 ft, with a maximum depth of 8.0 ft. Loss of inundated area from a 10-percent reduction in discharge ranged from 1.0 to 104 acres.

East Canal drains about 13.4 mi^2 from south of Plant City to the confluence with Itchepackesassa Creek. The 4.9-mi-long study reach begins at the confluence with Itchepackesassa Creek and ends at Interstate 4. The East Canal study reach generally is highly channelized, deeply incised, and well defined. Maximum areal inundation width was about 2,200 ft, and the mean inundation width along the channel ranged from approximately 21 to 450 ft. Total inundated area along the Blackwater Creek study reach ranged from about 12 to 400 acres. The mean hydraulic depth ranged from 0.3 to 2.2 ft, with a maximum depth of 4.8 ft. Loss of inundated area from a 10-percent reduction in discharge ranged from 0.7 to 34.6 acres.

Selected References

Cowardin, L.M., Carter, Virginia, Golet, F.C., and LaRoe, E.T., 1979, Classification of wetlands and deepwater habitats of the United States: U.S. Fish and Wildlife Service, FWS/OBS-79/31, 103 p.

Federal Emergency Management Agency, 1989, Flood insurance study, Hillsborough County, unincorporated areas: Federal Insurance Administration, 56 p.

Harrison, Thomas, Arnold, David, and Brass, N.B., Jr., 1983, Floodplain information on Trout Creek: Brooksville, Fla., Southwest Florida Water Management District, 18 p.

Johnson, Malcolm, Hubbell, Peter, and Brass, N.B., Jr., 1979, Flood plain information on the Hillsborough River watershed, Hillsborough River and New River: Brooksville, Fla., Southwest Florida Water Management District, 25 p.

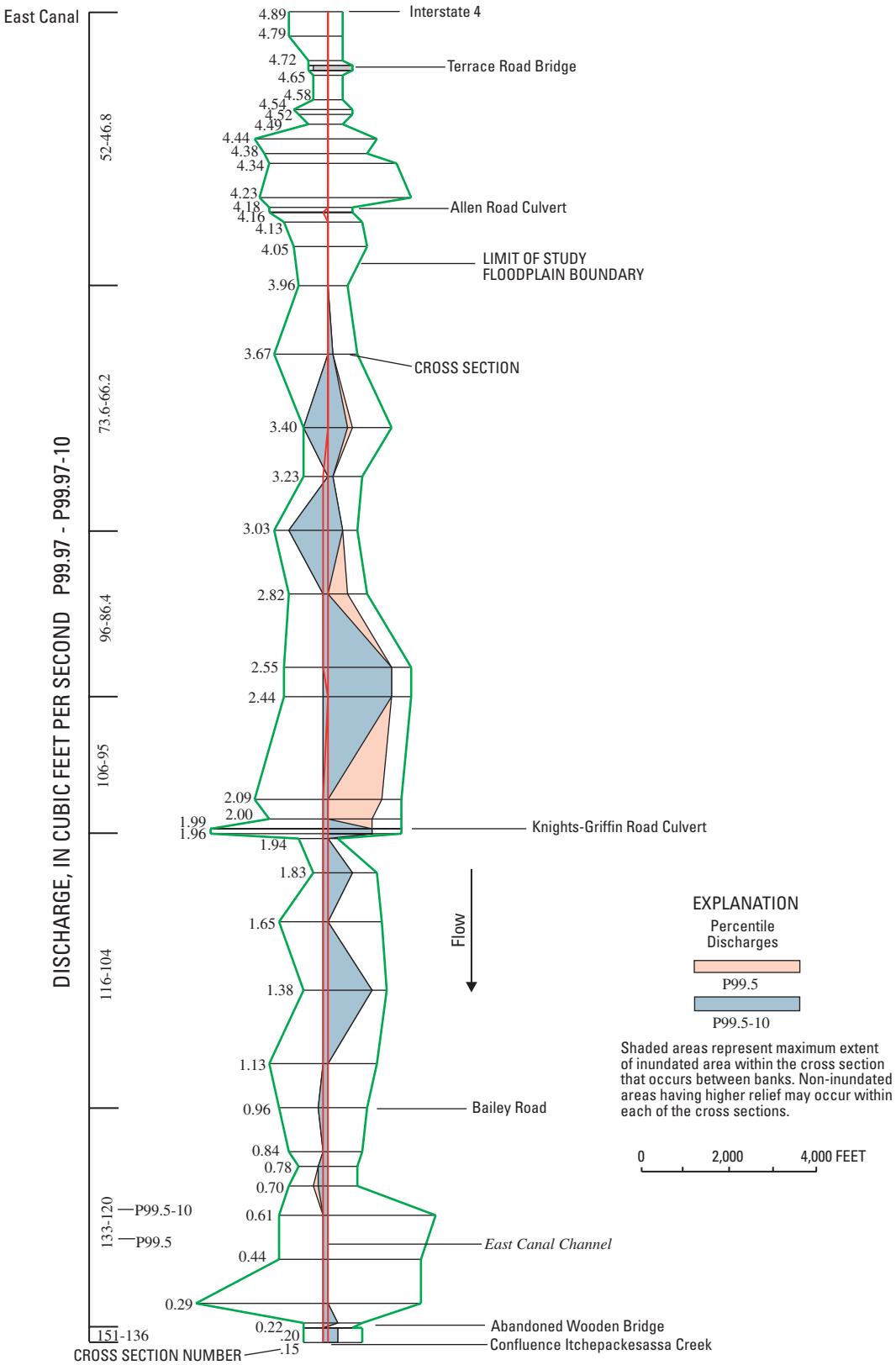


Figure 32. Example of extent of areal inundation along East Canal study channel and floodplain for the $P_{99.5}$ (existing conditions) and the $P_{99.5\text{-}10}$ (potential 10-percent discharge withdrawal) discharges.

Johnson, Malcolm, Hubbell, Peter, McCallister, Scott, and Brass, N.B., Jr., 1980, Flood plain information on the Blackwater Creek watershed, Blackwater Creek, East Canal, and Itchepackesassa Creek: Brooksville, Fla., Southwest Florida Water Management District, 19 p.

Murphy, W.R., Jr., 1978, Flood profiles for Cypress Creek, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 78-8, 29 p.

Murphy, W.R., Jr., Hammett, K.M., and Reeter, C.V., 1978, Flood profiles for Peace River, south-central Florida: U.S. Geological Survey Water-Resources Investigations Report 78-57, 35 p.

Robertson, A.F., 1978, Flood profiles of the Alafia River, west-central Florida: U.S. Geological Survey Water-Resources Investigations Report 77-74, 21 p.

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

Stamey, T.C., 1985, Frequency and duration of flooding of Grove Creek near Kenansville, North Carolina, for present and proposed restored channel conditions: U.S. Geological Survey Water-Resources Investigations Report 85-4298, 52 p.

Warner, J.C., and Brunner, G.W., 1998a, HEC-RAS River Analysis System: U.S. Army Corps of Engineers Hydrologic Engineering Center, Hydraulic Application Guide, version 2.2, CPD-70, 283 p.

Warner, J.C., and Brunner, G.W., 1998b, HEC-RAS River Analysis System: U.S. Army Corps of Engineers Hydrologic Engineering Center, Hydraulic Reference Manual, version 2.2, CPD-69, 251 p.

White, W.A., 1970, The geomorphology of the Florida Peninsula: Tallahassee, Florida Bureau of Geology Bulletin No. 51, 164 p.

Appendixes 1-20

Appendix 1. Extent of inundation at cross sections along the Hillsborough River for selected percentile discharges. [--, no flow]

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet							
28.9	241	264	275	287	307	327	3,822	7,189
[1]28.99	153	161	165	172	184	196	3,155	7,267
29	Morris Bridge							
29.01	153	161	165	173	185	196	3,197	7,312
29.1	156	173	246	315	429	525	4,116	8,628
29.49	64	295	1,088	1,352	2,728	4,543	10,393	15,434
29.5	19	19	21	29	45	1,540	7,014	13,717
29.6	50	54	321	1,042	2,156	5,195	10,819	15,323
30.0	71	572	1,366	2,069	3,820	4,983	10,913	14,730
30.3	79	1,175	1,847	2,261	4,144	5,062	10,870	14,633
30.6	98	100	151	236	3,825	4,694	10,526	14,542
30.9	97	100	132	320	3,133	3,691	9,463	13,341
31.4	91	93	95	774	1,820	2,294	8,336	12,001
31.8	61	64	255	2,366	3,076	3,398	9,813	12,850
32.1	64	69	1,275	2,277	3,086	3,558	10,364	13,150
32.3	79	85	343	1,390	3,502	4,596	11,576	13,944
32.6	96	100	275	2,295	3,913	5,493	11,794	13,588
32.8	92	95	331	1,832	4,462	5,702	12,229	13,888
33.0	81	83	359	2,549	4,067	6,407	10,341	15,359
33.4	68	69	690	1,972	4,257	5,712	9,920	14,720
33.7	81	84	146	296	3,428	4,738	11,143	15,635
34.1	76	79	319	645	1,269	4,504	11,689	15,253
34.5	111	115	119	193	418	6,364	11,347	14,149
34.9	88	89	89	90	887	3,566	8,710	11,739
35.3	58	63	66	69	1,153	4,677	8,073	10,846
35.9	74	76	77	79	236	1,525	5,516	7,167
36.4	63	65	66	68	123	923	3,360	7,057
36.7	63	64	66	67	69	70	6,577	8,436
37.30	87	89	91	92	95	198	5,147	6,543
37.62	87	89	90	92	94	178	5,261	6,099
38.2	83	84	86	87	89	126	4,338	6,090
38.7	92	94	95	97	99	140	3,929	5,353
39.2	107	110	113	116	121	221	1,223	1,676
39.5	114	115	117	120	127	212	596	1,467
39.8	89	91	93	96	103	365	938	2,148
40.2	75	77	78	80	181	350	1,114	3,008
[2]40.4	78	82	85	92	320	645	1,347	2,116
40.7	82	84	109	156	349	481	1,179	1,996
41	97	100	151	222	395	611	2,029	2,485
41.2	95	96	97	99	265	467	1,440	2,000
41.5	106	108	109	134	214	327	1,591	3,269
41.55	106	131	150	171	293	342	832	3,173
41.57	US 301 Bridge							
41.6	108	132	152	173	295	345	863	3,182
41.64	85	86	88	89	110	148	1,127	1,898
41.9	99	101	102	103	105	140	1,813	2,160
42.35	138	142	145	149	365	450	1,299	1,785
42.38	67	70	73	76	96	188	1,623	2,005
42.4	87	90	93	96	185	452	2,739	3,425
42.5	77	80	83	86	119	190	686	1,829
42.7	83	86	89	92	99	299	871	1,400
43	47	47	48	48	51	54	123	1,120

Appendix 1. Extent of inundation at cross sections along the Hillsborough River for selected percentile discharges. [--, no flow]

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet							
43.3	56	57	58	58	60	63	813	1,225
43.6	56	56	57	57	58	60	863	1,266
43.8	47	47	48	48	50	57	913	1,250
44.1	61	62	62	63	64	78	777	1,312
44.3	94	94	94	95	96	109	942	1,461
44.6	39	40	40	41	55	491	1,016	1,360
44.9	72	74	75	76	161	676	1,516	1,708
45.1	70	73	76	79	106	206	1,000	1,449
45.4	65	69	73	77	130	743	1,286	1,557
45.7	46	48	51	57	86	349	1,374	1,657
46	107	156	191	236	657	1,129	1,376	1,735
46.2	65	67	86	154	956	1,133	1,460	1,678
46.3	63	65	66	68	69	232	1,546	1,814
[3]46.4	66	68	69	88	1,126	1,561	1,964	2,172
46.405	Crystal Springs Bridge							
46.41	67	69	89	503	1,227	1,827	2,025	2,497
46.46	43	45	47	48	422	1,269	1,628	2,745
46.6	67	69	71	89	699	1,112	1,379	1,740
46.9	45	47	49	82	395	1,134	1,554	1,694
47.1	58	60	61	63	181	694	2,151	2,973
47.3	54	56	57	59	128	302	901	1,814
47.6	34	36	38	40	128	357	1,063	1,313
47.7	50	53	56	58	182	410	1,152	1,350
47.8	41	42	43	44	157	378	865	1,134
47.84	28	30	31	33	55	80	312	541
47.85	SR 39 Bridge							
47.86	28	30	32	33	58	83	379	626
47.9	47	48	48	49	78	129	724	1,163
48.0	54	58	63	67	241	329	1,192	1,934
48.1	44	45	47	49	171	277	711	879
48.16	25	31	36	42	61	77	655	818
48.17	Railroad Bridge							
48.18	26	32	37	42	62	78	659	832
48.2	49	68	101	134	218	280	586	1,095
48.4	38	40	42	44	50	199	781	1,092
48.7	53	54	55	56	66	224	725	1,278
48.9	46	47	47	47	48	50	695	1,110
49.2	46	46	47	47	48	68	781	1,309
49.4	45	45	46	46	48	94	900	1,653
49.7	46	46	47	47	48	48	337	867
49.9	46	47	47	47	48	49	1,046	1,193
50.1	45	46	46	46	48	50	1,864	1,963
50.2	42	42	43	44	47	1,028	1,371	1,460
50.3	31	32	32	33	35	38	912	996
50.4	34	42	49	55	58	60	1,153	1,389
50.6	43	44	45	46	75	1,035	1,213	1,369
50.9	44	46	47	49	71	86	171	2,046
51.2	32	34	37	45	72	92	2,760	3,042
51.6	28	29	31	32	44	64	4,596	5,012
51.9	44	52	60	69	269	531	1,814	1,898
52.1	39	43	47	108	259	999	1,784	1,844
52.3	45	52	59	65	402	507	790	1,543

Appendix 1. Extent of inundation at cross sections along the Hillsborough River for selected percentile discharges.
[--, no flow]

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet							
52.5	90	186	273	355	632	830	1,416	1,871
52.8	38	47	54	60	84	576	1,683	2,090
53	55	69	80	101	915	1,386	1,815	1,998
53.3	49	61	71	80	396	743	1,674	1,794
53.4	24	36	59	80	155	241	510	1,075
53.42	Railroad Bridge							
53.44	68	87	102	116	175	298	548	1,159
53.5	146	190	226	259	451	626	1,506	1,909
53.7	66	68	70	71	77	299	3,720	5,481
54.1	44	65	258	422	1,275	2,247	5,409	6,010
54.4	42	49	330	649	1,439	2,144	4,862	6,014
54.8	511	740	953	1,140	1,586	1,787	3,214	5,548
55.1	830	1,184	1,515	1,816	2,066	2,179	3,358	3,986
55.5	627	875	1,121	1,339	1,575	1,716	3,409	4,522
55.53	1,520	1,548	1,578	1,604	1,702	1,802	3,608	4,245
55.55	SR 54 Bridge							
55.6	--	--	--	1,608	1,706	1,809	4,037	4,391
55.61	--	--	--	49	1,055	1,846	3,767	4,620
55.8	--	--	--	1,643	1,802	1,936	6,261	7,748
56.1	--	--	--	2,318	2,645	2,872	6,810	7,173
56.5	--	--	--	47	49	925	6,494	7,234
[4]56.52	--	--	--	1,506	1,640	1,832	5,299	6,476
56.54	US 98 Bridge							
56.56	--	--	--	1,528	1,678	2,640	6,217	6,593
56.6	--	--	--	2,057	2,254	2,519	6,573	8,716
56.9	--	--	--	5,329	5,484	5,679	6,094	6,729
Mean	97.7	127	196	455	833	1,322	3,475	4,782
Maximum	1,520	1,548	1,848	5,329	5,484	6,407	12,229	15,635
Minimum	19	19	21	29	35	38	123	541

[1]Hillsborough River at Morris Bridge gaging station.
[2]Hillsborough River near Zephyrhills gaging station.
[3]Hillsborough River above Crystal Springs gaging station.
[4]Withlacoochee-Hillsborough River Overflow gaging station.

Appendix 2. Hydraulic depth at cross sections along the Hilsborough River for selected percentile discharges.

[--, no flow}

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet							
28.9	3.5	4.3	4.7	5.0	5.4	5.9	1.8	2.4
[1]28.99	4.3	5.2	5.7	5.9	6.3	6.7	1.2	1.8
29	Morris Bridge							
29.01	4.3	5.2	5.7	5.9	6.3	6.7	1.2	2.0
29.1	4.2	4.9	3.9	3.5	3.2	3.4	2.1	2.5
29.49	4.3	1.3	0.8	1.1	1.2	1.4	2.2	3.1
29.5	5.4	6.5	6.5	5.1	3.9	0.7	1.3	2.2
29.6	4.9	5.7	1.1	0.7	1.0	1.0	2.1	3.2
30.0	3.0	0.9	0.8	1.0	1.2	1.6	2.3	3.4
30.3	3.6	0.6	0.9	1.3	1.3	1.8	2.4	3.5
30.6	3.6	4.8	3.7	2.8	0.6	1.1	2.0	3.1
30.9	2.7	3.9	3.6	1.8	0.7	1.2	1.9	3.0
31.4	1.8	3.0	3.8	0.7	1.0	1.3	1.6	2.7
31.8	2.4	3.5	1.2	0.6	1.1	1.6	2.0	3.0
32.1	2.7	3.7	0.5	0.7	1.1	1.6	1.9	3.0
32.3	3.0	4.1	1.4	0.7	0.8	1.1	1.9	3.1
32.6	4.8	5.9	2.8	0.5	0.9	1.1	2.0	3.3
32.8	4.1	5.3	2.1	0.6	0.8	1.2	2.0	3.3
33.0	3.5	4.8	1.4	0.5	0.9	1.1	2.3	2.9
33.4	2.7	4.0	0.6	0.7	0.8	1.1	2.2	2.8
33.7	2.8	4.0	3.0	2.0	0.6	0.9	1.9	2.6
34.1	2.4	3.7	1.4	1.2	1.2	0.6	1.6	2.5
34.5	3.1	4.4	5.3	3.8	2.3	0.5	1.7	2.6
34.9	3.1	4.5	5.6	6.3	0.9	0.8	1.6	2.4
35.3	2.3	3.5	4.4	5.1	0.6	0.5	1.6	2.4
35.9	2.7	3.9	5.0	5.8	2.6	0.8	1.3	2.0
36.4	2.0	3.3	4.3	5.2	3.8	1.1	1.6	1.7
36.7	3.0	4.2	5.3	6.2	7.7	8.9	1.0	1.8
37.30	3.2	4.4	5.5	6.5	8.1	4.7	2.1	2.8
37.62	1.6	2.8	4.0	5.0	6.7	4.5	1.9	2.9
38.2	2.5	3.7	4.7	5.8	7.5	6.8	1.4	2.2
38.7	1.8	2.9	4.0	5.0	6.8	6.3	1.1	2.2
39.2	0.7	1.4	2.4	3.3	5.0	4.0	3.3	4.1
39.5	1.1	1.4	1.9	2.7	4.3	3.9	4.3	3.1
39.8	0.8	1.2	1.6	2.0	3.3	1.9	4.0	3.3
40.2	1.5	2.0	2.5	3.0	2.0	2.1	3.2	2.8
[2]40.4	1.8	2.3	2.8	3.1	1.5	1.7	4.2	4.7
40.7	1.8	2.4	2.4	2.2	1.8	2.4	3.4	4.2
41	2.1	2.8	2.3	2.1	2.1	2.4	3.3	5.2
41.2	2.4	3.1	3.6	4.2	2.2	2.3	3.4	4.8
41.5	2.3	3.1	3.7	3.6	3.2	3.2	3.1	3.3
41.55	1.7	2.1	2.4	2.8	2.5	3.4	6.3	8.2
41.57	US 301 Bridge							
41.6	1.7	2.1	2.4	2.8	2.6	3.4	6.4	8.3
41.64	2.3	3.1	3.7	4.3	4.6	4.5	2.6	3.8
41.9	2.5	3.3	3.9	4.6	5.8	5.6	2.9	5.0
42.35	1.5	2.3	2.9	3.5	2.3	3.2	4.2	5.4
42.38	1.8	2.5	3.0	3.6	4.0	3.2	2.5	4.7
42.4	1.6	2.3	2.9	3.5	2.6	2.1	3.0	4.9
42.5	1.4	2.1	2.7	3.3	3.5	3.4	4.2	3.6
42.7	0.6	1.3	1.9	2.5	3.8	2.2	3.8	4.6
43	0.2	0.2	0.3	0.4	2.0	3.4	4.2	2.0

Appendix 2. Hydraulic depth at cross sections along the Hilsborough River for selected percentile discharges. (Continued)

[--, no flow}

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet							
43.3	0.8	1.1	1.5	1.8	2.9	4.3	1.5	3.2
43.6	0.9	1.3	1.7	2.1	3.5	5.1	1.7	3.1
43.8	0.1	0.4	0.7	1.1	2.5	3.7	1.8	3.3
44.1	0.1	0.8	0.9	1.1	1.9	2.5	2.1	3.0
44.3	0.5	0.5	0.8	1.0	1.9	2.7	2.1	3.1
44.6	0.7	1.2	1.5	1.7	2.3	0.7	2.4	3.6
44.9	0.7	1.1	1.4	1.8	1.6	1.1	2.3	3.9
45.1	0.7	1.1	1.4	1.7	2.5	2.2	2.0	3.0
45.4	0.5	0.8	1.1	1.4	1.8	1.1	2.7	4.0
45.7	0.5	0.7	0.9	1.1	1.8	1.0	2.1	3.5
46	0.4	0.5	0.6	0.7	0.8	1.4	3.4	4.4
46.2	0.3	0.4	0.4	0.4	0.6	1.3	3.2	4.6
46.3	0.3	0.5	0.6	0.7	0.9	0.4	1.8	3.4
[3]46.4	0.3	0.4	0.5	0.6	0.7	1.2	2.5	4.3
46.405	Crystal Springs Bridge							
46.41	0.4	0.5	0.6	0.4	0.9	1.5	3.0	5.1
46.46	0.4	0.6	0.8	1.0	0.2	0.5	1.8	2.7
46.6	0.6	0.9	1.1	1.1	0.5	0.7	1.8	3.0
46.9	0.8	1.1	1.3	1.0	0.6	0.6	1.7	3.1
47.1	0.8	1.2	1.5	1.8	1.2	0.7	1.3	2.1
47.3	0.9	1.3	1.6	1.9	1.7	1.4	1.6	1.7
47.6	0.9	1.3	1.6	1.9	1.3	1.2	1.9	2.9
47.7	0.9	1.3	1.6	2.0	1.4	1.4	2.1	3.2
47.8	0.8	1.2	1.6	2.0	1.3	1.3	2.3	3.2
47.84	0.8	1.2	1.6	1.9	2.3	2.6	1.9	3.4
47.85	SR 39 Bridge							
47.86	0.9	1.3	1.6	2.0	2.3	2.7	2.1	4.0
47.9	0.9	1.3	1.8	2.2	2.6	2.6	2.1	2.9
48.0	0.8	1.2	1.5	1.9	1.5	2.2	2.2	3.0
48.1	0.8	1.2	1.6	2.0	1.6	2.0	2.9	4.2
48.16	0.7	1.0	1.2	1.5	2.4	3.1	3.0	3.9
48.17	Railroad Bridge							
48.18	0.8	1.0	1.3	1.5	2.4	3.1	3.1	4.1
48.2	1.1	1.2	1.1	1.3	2.1	2.8	3.7	3.7
48.4	0.9	1.3	1.7	2.1	3.4	1.7	2.4	3.7
48.7	0.7	1.2	1.6	2.1	3.4	1.9	2.6	3.3
48.9	0.6	1.0	1.4	1.8	3.6	5.2	2.0	3.1
49.2	0.3	0.5	0.7	1.0	2.6	3.1	2.5	3.2
49.4	0.5	0.7	0.9	1.1	2.0	1.8	2.3	3.0
49.7	0.4	0.7	0.9	1.2	2.3	3.6	1.1	2.1
49.9	0.6	0.8	1.1	1.4	2.5	3.9	1.8	3.2
50.1	0.3	0.5	0.8	1.0	2.2	3.5	2.0	3.5
50.2	0.5	0.7	0.9	1.1	2.0	0.3	2.0	3.4
50.3	0.6	0.9	1.1	1.4	2.4	3.4	0.9	2.3
50.4	0.4	0.5	0.7	0.9	2.0	3.0	0.9	1.9
50.6	0.8	1.1	1.4	1.7	1.8	0.8	2.4	3.4
50.9	0.7	1.1	1.4	1.7	2.3	2.8	2.8	1.1
51.2	0.7	1.1	1.4	1.5	2.1	2.7	0.8	1.8
51.6	0.6	1.0	1.3	1.6	2.5	2.9	1.1	1.9
51.9	0.4	0.6	0.8	0.9	0.9	1.3	1.9	2.8
52.1	0.4	0.6	0.7	0.4	0.6	0.6	1.9	2.9
52.3	0.4	0.6	0.8	0.9	0.4	0.8	1.5	1.6

Appendix 2. Hydraulic depth at cross sections along the Hilsborough River for selected percentile discharges. (Continued)

[--, no flow}

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet							
52.5	0.6	0.5	0.5	0.6	0.9	1.2	1.9	2.5
52.8	0.2	0.5	0.6	0.8	1.2	0.5	1.4	2.2
53	0.5	0.7	0.8	0.8	0.5	0.7	1.8	2.7
53.3	0.4	0.7	0.8	1.0	0.5	0.6	1.3	2.2
53.4	0.1	0.2	0.3	0.3	0.7	0.8	1.4	2.2
53.42	Railroad Bridge							
53.44	0.3	0.4	0.4	0.5	0.8	0.8	1.4	2.3
53.5	0.3	0.4	0.5	0.5	0.7	0.9	1.3	1.9
53.7	0.6	0.8	1.0	1.1	1.6	0.6	0.7	1.1
54.1	0.6	0.6	0.3	0.4	0.5	0.8	1.2	1.7
54.4	0.5	0.7	0.2	0.2	0.6	0.9	1.3	1.7
54.8	0.2	0.3	0.4	0.5	0.9	1.4	1.8	1.6
55.1	0.2	0.3	0.4	0.5	1.0	1.5	2.1	2.5
55.5	0.2	0.3	0.4	0.5	1.0	1.5	2.2	2.3
55.53	0.5	0.7	0.8	1.0	1.6	2.3	3.8	4.5
55.55	SR 54 Bridge							
55.6	--	--	--	1.0	1.6	2.3	4.0	4.9
55.61	--	--	--	0.8	0.3	0.8	2.1	2.5
55.8	--	--	--	0.1	0.7	1.4	1.4	1.9
56.1	--	--	--	0.1	0.7	1.3	2.3	3.0
56.5	--	--	--	0.0	0.2	0.3	0.9	1.6
[4]56.52	--	--	--	0.1	0.6	1.1	2.3	3.1
56.54	US 98 Bridge							
56.56	--	--	--	0.2	0.7	1.4	2.9	3.7
56.6	--	--	--	0.2	0.6	1.2	1.6	1.9
56.9	--	--	--	0.2	0.7	1.3	2.8	3.2
Mean	1.4	1.91	1.92	1.9	2.1	2.2	2.2	3.1
Maximum	5.4	6.5	6.5	6.5	8.1	8.9	6.4	8.3
Minimum	0	0	0	0	0.2	0.3	0.7	1.1

[1]Hillsborough River at Morris Bridge gaging station.
[2]Hillsborough River near Zephyrhills gaging station.
[3]Hillsborough River above Crystal Springs gaging station.
[4]Withlacoochee-Hillsborough River Overflow gaging station.

Appendix 3. Acreage of areal inundation between adjacent cross sections along Hillsborough River.

[--, no flow}

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres							
28.9	Initial Cross Section							
28.99	0.9	1.0	1.0	1.1	1.1	1.2	16.0	33.2
29	Morris Bridge							
29.01	0.3	0.3	0.3	0.3	0.3	0.4	1.9	4.1
29.1	0.7	0.8	0.9	1.1	1.4	1.7	16.8	36.6
29.49	6.7	13.5	36.9	46.1	87.7	142.4	412.8	684.2
29.5	0.0	0.2	0.6	0.8	1.6	3.5	10.0	16.7
29.6	0.0	0.0	0.2	0.6	1.3	3.9	10.2	16.7
30.0	3.4	17.1	45.3	83.9	155.6	259.0	539.7	741.0
30.3	2.4	24.8	46.1	62.6	118.4	150.1	331.3	448.6
30.6	3.7	23.6	36.3	44.7	133.1	162.3	350.0	475.9
30.9	2.9	3.0	4.3	7.8	81.8	98.9	233.4	326.8
31.4	5.6	5.8	6.6	28.6	126.1	152.3	451.1	642.1
31.8	3.5	3.6	7.6	65.3	101.7	118.3	376.0	514.8
32.1	2.3	2.4	23.4	70.0	92.9	104.9	302.7	389.8
32.3	2.0	2.1	23.0	52.1	93.0	115.2	312.5	386.1
32.6	2.8	3.0	9.3	54.2	108.2	147.7	345.1	406.9
32.8	2.4	2.5	7.6	51.7	105.0	140.4	300.6	343.9
33.0	2.8	2.9	9.6	57.5	110.7	156.1	289.2	373.6
33.4	3.4	3.4	18.2	74.6	134.9	194.3	320.5	472.7
33.7	2.7	2.8	14.8	39.9	130.9	176.0	349.2	498.8
34.1	3.8	3.9	10.7	21.3	104.9	203.6	499.7	671.1
34.5	4.7	4.9	9.9	18.2	35.6	228.5	496.5	642.3
34.9	4.1	4.2	4.3	5.4	20.2	150.2	281.5	356.4
35.3	4.0	4.2	4.3	4.4	45.4	180.7	367.0	493.5
35.9	4.5	4.8	4.9	5.1	45.5	200.8	435.7	576.8
36.4	3.8	3.9	4.0	4.0	9.7	65.4	236.8	379.3
36.7	2.9	3.0	3.0	3.1	4.2	20.1	197.3	307.6
37.30	5.3	5.4	5.4	5.6	5.7	9.2	388.6	497.9
37.62	3.4	3.5	3.5	3.6	3.7	7.1	191.4	232.4
38.2	5.4	5.5	5.6	5.7	5.8	8.2	191.6	242.9
38.7	6.2	6.3	6.4	6.5	6.7	9.0	213.6	295.0
39.2	Confluence of Hillsborough River and New River							
39.5	3.9	4.0	4.1	4.2	4.4	7.4	29.4	50.2
39.8	3.5	3.6	3.6	3.7	4.0	8.1	19.2	41.6
40.2	4.2	4.2	4.3	4.4	6.3	13.0	33.9	85.5
40.4	2.5	2.6	2.7	2.8	7.6	14.8	36.1	75.3
40.7	2.7	2.8	3.1	3.9	9.5	15.6	34.2	55.0
41	2.9	3.0	4.0	5.6	10.6	15.4	44.2	61.6
41.2	2.0	2.0	2.5	3.2	6.6	10.7	35.1	45.9
41.5	3.9	4.0	4.0	4.4	7.3	11.0	38.4	66.3
41.55	0.8	0.9	1.0	1.2	1.9	2.4	7.0	17.4
41.57	US 301 Bridge							
41.6	0.6	0.7	0.8	1.0	1.7	1.9	3.4	9.3
41.64	0.4	0.5	0.6	0.6	0.9	1.1	4.6	11.7
41.9	2.5	2.6	2.6	2.7	2.9	3.8	30.1	41.5
42.35	2.2	2.2	2.3	2.3	4.0	4.9	26.2	32.4
42.38	1.4	1.5	1.5	1.5	3.0	4.0	16.4	22.1
42.4	1.1	1.1	1.1	1.2	2.0	4.8	28.6	36.1
42.5	1.3	1.4	1.4	1.5	2.2	4.0	19.7	29.7
42.7	2.0	2.1	2.2	2.3	2.6	4.7	13.4	27.6
43	2.2	2.2	2.3	2.3	2.5	5.3	13.5	33.5

Appendix 3. Acreage of areal inundation between adjacent cross sections along Hillsborough River. (Continued)

[--, no flow}

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres							
43.3	1.7	1.7	1.7	1.7	1.8	1.9	8.8	20.8
43.6	2.1	2.1	2.1	2.1	2.2	2.2	15.1	21.9
43.8	1.2	1.2	1.2	1.2	1.3	1.3	22.6	30.6
44.1	2.1	2.1	2.2	2.2	2.2	2.5	21.5	32.3
44.3	2.1	2.2	2.2	2.2	2.2	2.6	21.1	34.2
44.6	2.4	2.5	2.5	2.5	2.8	8.5	25.7	36.6
44.9	1.9	1.9	1.9	2.0	3.2	13.6	28.2	33.9
45.1	2.3	2.4	2.4	2.5	4.0	12.1	33.7	42.1
45.4	2.3	2.4	2.5	2.6	3.7	13.3	30.6	40.0
45.7	2.0	2.2	2.3	2.5	3.9	19.5	44.3	53.2
46	2.8	3.6	4.2	5.0	12.1	23.8	43.5	53.6
46.2	2.0	2.5	3.0	4.1	17.4	24.3	30.1	36.1
46.3	1.0	1.1	1.2	1.8	8.2	10.7	22.2	25.8
46.4	0.3	0.4	0.3	0.4	2.7	4.5	9.0	10.3
46.405	Crystal Springs Bridge							
46.41	0.1	0.1	0.2	0.5	1.3	1.8	2.0	2.3
46.46	0.3	0.3	0.4	2.0	5.2	8.9	10.7	14.9
46.6	1.1	1.2	1.2	1.4	12.2	25.0	30.7	45.9
46.9	1.7	1.7	1.8	2.5	14.9	30.8	40.4	47.7
47.1	1.4	1.4	1.5	1.9	6.8	21.4	43.6	54.3
47.3	1.7	1.8	1.8	1.9	4.3	13.8	42.1	65.0
47.6	1.3	1.3	1.4	1.4	3.7	9.5	28.2	44.9
47.7	0.6	0.7	0.7	0.8	2.3	5.8	16.7	20.1
47.8	0.4	0.4	0.5	0.5	1.6	3.6	9.1	11.1
47.84	0.2	0.3	0.3	0.3	0.7	1.5	3.8	5.4
47.85	SR 39 Bridge							
47.86	0.1	0.1	0.1	0.1	0.1	0.2	0.7	0.9
47.9	0.3	0.3	0.3	0.3	0.5	0.7	3.6	5.8
48.0	0.6	0.6	0.6	0.7	1.9	2.7	11.3	18.3
48.1	0.6	0.6	0.6	0.7	2.4	3.6	11.1	16.4
48.16	0.2	0.3	0.3	0.3	0.7	1.2	4.7	5.6
48.17	Railroad Bridge							
48.18	0.0	0.1	0.1	0.1	0.1	0.2	1.2	1.5
48.2	0.3	0.3	0.4	0.5	0.7	0.8	2.6	4.0
48.4	1.1	1.3	1.6	2.0	2.9	5.1	14.5	22.8
48.7	1.3	1.4	1.4	1.4	1.7	6.4	21.6	34.4
48.9	1.2	1.2	1.2	1.3	1.4	3.1	15.5	26.1
49.2	1.6	1.6	1.6	1.6	1.7	2.0	23.5	38.8
49.4	1.4	1.4	1.4	1.4	1.4	2.3	22.3	36.4
49.7	1.5	1.5	1.5	1.5	1.5	2.2	17.3	34.9
49.9	1.6	1.6	1.6	1.6	1.6	1.7	23.2	34.6
50.1	0.7	0.7	0.8	0.8	0.8	0.8	19.1	20.6
50.2	1.1	1.1	1.1	1.1	1.2	11.9	35.7	37.8
50.3	0.3	0.3	0.3	0.3	0.4	2.7	5.5	6.0
50.4	0.1	0.1	0.1	0.1	0.1	0.1	2.9	3.2
50.6	1.2	1.3	1.5	1.6	2.1	17.4	37.5	43.4
50.9	1.6	1.6	1.7	1.8	2.5	17.3	20.7	51.8
51.2	1.5	1.6	1.6	1.8	2.5	3.0	43.9	75.6
51.6	1.1	1.1	1.2	1.4	2.0	2.5	99.7	110.0
51.9	1.4	1.5	1.7	1.9	5.6	10.4	108.6	117.4
52.1	1.1	1.3	1.5	2.4	6.9	20.0	47.1	49.0
52.3	1.1	1.2	1.3	2.1	8.0	17.5	29.7	38.9

Appendix 3. Acreage of areal inundation between adjacent cross sections along Hillsborough River. (Continued)

[--, no flow}

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres							
52.5	1.9	3.4	4.8	6.0	14.8	19.2	31.6	49.0
52.8	1.9	3.3	4.6	5.8	9.9	19.4	42.7	54.6
53	1.4	1.7	2.0	2.4	14.9	29.5	53.6	63.1
53.3	1.9	2.4	2.8	3.3	23.7	38.4	62.6	67.9
53.4	0.4	0.6	0.7	0.9	3.1	5.6	12.4	16.7
53.42	Railroad Bridge							
53.44	0.1	0.1	0.2	0.2	0.3	0.5	0.9	1.3
53.5	0.4	0.5	0.6	0.6	1.1	1.6	3.5	5.3
53.7	2.7	3.2	3.6	4.0	6.0	11.3	61.0	82.9
54.1	2.5	3.0	6.7	9.9	27.0	50.8	187.0	236.5
54.4	1.7	2.1	8.4	14.8	36.5	58.6	136.2	159.4
54.8	13.6	19.3	31.1	43.1	73.1	95.2	193.6	277.6
55.1	21.6	30.8	39.4	47.2	58.3	63.3	103.9	150.4
55.5	27.4	38.6	49.4	59.0	68.0	72.6	123.9	155.8
55.53	4.9	5.6	6.2	6.8	7.5	8.1	16.1	20.1
55.55	SR 54 Bridge							
55.6	--	--	--	3.6	3.8	3.9	7.7	8.7
55.61	--	--	--	4.9	8.2	10.8	24.1	28.0
55.8	--	--	--	22.0	36.9	48.6	133.6	165.6
56.1	--	--	--	72.1	81.0	87.6	232.9	265.5
56.5	--	--	--	52.1	59.3	83.6	296.1	320.6
56.52	--	--	--	1.8	1.9	3.2	13.5	15.7
56.54	US 98 Bridge							
56.56	--	--	--	2.3	2.5	3.1	7.6	8.6
56.6	--	--	--	16.0	17.5	22.9	56.3	67.3
56.9	--	--	--	127.0	133.1	141.1	216.3	262.6
Total	277	379	624	1,454	2,812	4,621	12,126	16,350

Appendix 4. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Hillsborough River.

[Blanks indicate no decrease in inundated acreage; --, no flow]

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres							
28.9	Initial Cross Section							
28.99	0.01	0.01	0.01	0.02	0.02	0.02	1.26	0.71
29	Morris Bridge							
29.01							0.11	0.05
29.1	0.01	0.01	0.15	0.05	0.06	0.03	1.53	0.99
29.49	0.07	6.17	3.73	2.60	16.74	9.53	33.07	19.66
29.5		0.13	0.05	0.05	0.33	0.29	0.99	0.47
29.6			0.09	0.11	0.35	0.20	1.02	0.47
30	0.18	3.44	9.45	10.72	26.42	10.11	44.39	17.69
30.3	0.08	3.37	5.07	4.35	14.17	4.91	32.65	10.97
30.6	0.01	1.99	3.29	2.39	14.10	4.71	32.78	12.76
30.9	0.01	0.01	0.36	2.30	7.72	3.31	22.67	10.03
31.4		0.02	0.23	20.52	9.45	4.44	35.71	19.00
31.8	0.02	0.02	2.08	19.48	4.85	2.21	22.00	14.59
32.1	0.02	0.02	8.76	6.52	3.92	4.05	21.96	10.39
32.3	0.01	0.03	9.35	5.24	4.10	8.26	24.08	9.67
32.6	0.02	0.02	3.04	28.42	6.66	10.82	20.25	9.19
32.8	0.01	0.02	1.11	33.08	10.91	6.57	12.79	7.18
33	0.01	0.02	4.37	13.48	12.38	4.49	9.39	27.95
33.4			14.77	4.28	22.74	7.78	11.66	59.82
33.7	0.01	0.02	11.63	2.83	21.05	10.48	22.32	34.68
34.1	0.02	0.02	3.35	2.45	8.61	61.78	37.21	9.42
34.5	0.02	0.04	2.29	2.30	4.26	63.78	44.59	8.00
34.9	0.01	0.01	0.01	0.59	6.66	8.81	16.66	3.25
35.3	0.01	0.03	0.04	0.01	21.12	46.08	8.44	4.55
35.9	0.03	0.03	0.04	0.04	21.03	75.81	9.73	23.71
36.4	0.01	0.02	0.01	0.02	3.38	16.57	9.73	31.64
36.7	0.02	0.02	0.02	0.02	1.06	3.74	12.57	17.25
37.3	0.01	0.02	0.02	0.02	0.03	3.21	16.26	18.35
37.62	0.01	0.00	0.02	0.02	0.02	3.11	5.03	7.07
38.2	0.01	0.03	0.02	0.02	0.02	1.68	8.38	9.64
38.7	2.28	2.38	2.48	2.56	2.72	5.03	209.62	291.06
39.2	Confluence of Hillsborough River and New River							
39.5	0.01	0.01	0.03	0.04	0.05	1.20	1.72	6.03
39.8		0.02	0.01	0.02	0.05	1.19	1.21	7.93
40.2	0.02	0.01	0.02	0.04	0.47	1.70	2.61	13.98
40.4	0.01	0.02	0.03	0.04	1.23	1.54	2.61	8.57
40.7	0.02	0.03	0.18	0.23	1.29	1.25	3.73	5.62
41	0.01	0.01	0.40	0.55	1.02	0.99	4.15	3.27
41.2		0.01	0.15	0.25	0.75	0.89	2.11	0.86
41.5	0.02	0.02	0.03	0.15	0.67	0.80	2.31	6.02
41.55	0.02	0.02	0.02	0.07	0.14	0.12	0.55	1.23
41.57	US 301 Bridge							
41.6	0.01	0.02	0.02	0.03	0.09	0.06	0.30	0.18
41.64	0.01	0.01	0.02	0.01	0.04	0.04	0.57	0.50
41.9	0.01	0.01	0.01	0.02	0.08	0.18	2.24	2.22
42.35		0.02	0.01	0.01	0.34	0.18	1.03	1.14
42.38	0.02	0.01	0.01	0.01	0.36	0.13	1.13	1.04
42.4		0.00	0.01	0.01	0.59	0.43	2.18	0.79
42.5	0.01	0.01	0.02	0.02	0.41	0.32	0.97	0.93
42.7	0.01	0.02	0.02	0.03	0.12	0.42	0.60	1.34

Appendix 4. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Hillsborough River. (Continued)

[Blanks indicate no decrease in inundated acreage; --, no flow]

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres							
43		0.01	0.01	0.01	0.03	0.54	0.97	3.14
43.3		0.01	0.01	0.01	0.01	0.01	1.45	1.52
43.6				0.01	0.01	0.01	1.96	0.54
43.8					0.01	0.08	2.35	0.94
44.1			0.01	0.01	0.01	0.13	2.10	1.57
44.3					0.01	0.20	1.67	1.77
44.6				0.01	0.07	1.60	1.30	1.43
44.9			0.01	0.01	0.69	2.38	0.63	0.77
45.1	0.01	0.01	0.01	0.01	0.77	1.62	0.97	0.95
45.4	0.01	0.02	0.03	0.03	0.45	1.10	1.20	1.07
45.7	0.01	0.03	0.04	0.06	0.62	2.27	1.14	1.69
46	0.02	0.08	0.19	0.21	4.36	1.52	0.87	1.71
46.2	0.03	0.06	0.21	0.33	3.20	0.42	0.42	0.99
46.3			0.09	0.18	0.15	1.18	0.49	0.44
46.40		0.01	0.01	0.02	0.11	0.71	0.16	0.15
46.405	Crystal Springs Bridge							
46.41			0.01	0.18	0.04	0.10	0.01	0.11
46.46				0.80	0.72	0.28	0.23	0.87
46.6		0.01	0.02	0.05	4.36	0.31	0.55	0.99
46.9			0.03	0.28	2.90	1.69	0.41	1.35
47.1	0.01	0.02	0.01	0.18	1.75	3.55	0.78	1.56
47.3			0.02	0.01	0.47	3.14	1.59	3.36
47.6	0.00	0.02	0.01	0.01	0.56	0.94	2.06	2.47
47.7	0.01	0.00	0.01	0.02	0.42	0.57	0.83	0.41
47.8				0.01	0.24	0.31	0.34	0.26
47.84		0.01	0.01	0.00	0.08	0.14	0.28	0.21
47.85	SR 39 Bridge							
47.86					0.01	0.01	0.04	0.03
47.9				0.01	0.04	0.04	0.27	0.25
48				0.01	0.10	0.13	1.22	0.67
48.1			0.01	0.01	0.16	0.19	1.10	0.51
48.16					0.05	0.07	0.14	0.29
48.17	Railroad Bridge							
48.18				0.01	0.01	0.01	0.01	0.12
48.2	0.01	0.01	0.02	0.02	0.02	0.02	0.11	0.08
48.4	0.01	0.06	0.09	0.09	0.08	0.41	1.16	0.50
48.7	0.01	0.01	0.01	0.01	0.08	0.98	1.95	1.46
48.9					0.04	0.37	1.50	1.58
49.2			0.01	0.01	0.01	0.29	1.06	3.37
49.4					0.01	0.81	0.79	1.68
49.7					0.01	0.60	2.53	0.44
49.9					-0.01	0.01	2.98	0.57
50.1					0.01	0.00	0.21	0.22
50.2				0.01	0.01	4.53	0.25	0.27
50.3						0.97	0.18	0.10
50.4							0.09	0.05
50.6	0.01	0.02	0.04	0.02	0.41	0.24	0.35	0.66
50.9	0.02	0.01	0.01	0.02	0.43	0.23	0.35	1.12
51.2		0.02	0.04	0.04	0.07	0.07	2.00	1.47
51.6	0.01	0.00	0.03	0.05	0.06	0.14	3.33	1.12
51.9	0.02	0.04	0.05	0.05	0.63	2.35	2.08	0.55

Appendix 4. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Hillsborough River. (Continued)

[Blanks indicate no decrease in inundated acreage; --, no flow]

Cross section No.	Percentiles							
	P_{10}	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres							
52.1	0.01	0.03	0.03	0.80	0.75	4.53	0.21	0.29
52.3	0.02	0.03	0.04	0.68	0.47	2.51	0.42	1.57
52.5	0.02	0.26	0.31	0.37	0.62	0.62	1.23	2.82
52.8	0.03	0.25	0.30	0.36	0.44	1.99	1.57	1.17
53	0.03	0.05	0.06	0.22	1.34	2.11	1.59	0.45
53.3	0.04	0.07	0.09	0.31	2.50	1.31	0.95	0.59
53.4	0.02	0.04	0.04	0.04	0.33	0.45	0.16	0.81
53.42	Railroad Bridge							
53.44			0.01	0.02	0.01	0.04	0.03	0.08
53.5		0.02	0.02	0.02	0.03	0.12	0.17	0.24
53.7	0.07	0.08	0.09	0.09	0.14	2.19	3.08	3.00
54.1	0.02	0.31	0.83	0.89	3.40	3.80	30.59	7.71
54.4	0.03	0.24	1.65	1.66	2.98	3.08	18.49	4.87
54.8	0.70	1.01	3.08	2.89	2.00	4.09	6.90	8.70
55.1	1.15	1.66	1.90	1.73	0.47	0.68	3.05	2.37
55.5	1.42	2.05	2.36	2.18	0.42	0.62	2.94	4.49
55.53	0.09	0.12	0.13	0.12	0.06	0.05	0.30	0.57
55.55	SR 54 Bridge							
55.6	--	--	--	0.01	0.02	0.01	0.28	0.11
55.61	--	--	--	0.02	0.34	0.06	1.44	0.74
55.8	--	--	--	1.89	1.55	0.23	17.28	5.19
56.1	--	--	--	2.63	0.80	0.29	19.40	5.29
56.5	--	--	--	0.03	0.65	3.20	15.15	2.95
56.52	--	--	--		0.01	0.21	0.95	0.36
56.54	US 98 Bridge							
56.56	--	--	--		0.01	0.14	0.27	0.20
56.6	--	--	--	0.05	0.08	0.95	1.84	1.19
Total	7.0	24.9	98.8	186	297	464	940	860

Appendix 5. Extent of inundation at cross sections along New River for selected percentile discharges.

	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Feet					
0.02	6	15	22	27	30	1,727
0.16	4	28	36	128	517	1,491
0.36	13	18	25	32	40	500
0.46	6	28	39	61	152	453
0.58	6	11	17	22	28	59
0.72	8	13	14	15	37	171
0.77	19	33	34	34	35	131
0.91	2	5	7	9	17	138
0.98	4	9	17	29	45	130
1.12	8	22	34	54	89	1,099
1.17	16	24	28	44	68	1,309
1.22	39	40	55	97	147	572
1.29	8	22	27	29	70	396
1.39	10	19	25	34	231	1,270
1.49	20	44	60	80	106	880
1.62	22	22	22	23	23	52
1.81	30	32	33	35	38	97
1.83	6	9	11	13	1,334	2,932
1.84	Morris Bridge					
1.85	9	11	13	1,415	1,889	2,880
1.88	13	26	28	30	33	44
1.92	9	9	11	21	28	206
1.99	9	16	17	18	20	581
2.10	6	17	21	22	23	102
2.21	18	28	34	40	50	219
2.43	9	23	30	31	33	74
2.84	29	35	39	45	60	142
3.22	31	35	39	44	56	101
3.24	53	59	65	83	134	511
3.245	Camp Road Culvert					
3.25	53	59	65	85	137	553
3.27	28	31	33	42	58	410
3.51	45	154	67	200	229	446
3.82	21	36	53	39	44	176
3.83	37	49	66	69	82	168
3.85	45	47	51	53	57	550
4.02	7	12	17	201	262	1,428
4.21	18	22	25	27	30	1,488
4.52	8	18	23	29	151	1,873
4.53	10	20	22	25	27	1,094
4.55	28	30	34	44	267	1,807
4.87	25	35	47	64	83	1,162
5.07	18	22	24	36	61	619
5.36	17	23	31	44	61	635
5.60	34	40	44	50	58	82
5.87	14	34	55	61	62	65
5.88	4	8	13	21	30	40
5.889	Chancy Road Bridge					
5.89	7	13	18	23	31	61
5.92	2	5	7	9	11	79
6.15	5	10	15	25	88	388
6.29	8	20	23	26	29	75
6.39	10	23	31	35	41	186

Appendix 5. Extent of inundation at cross sections along New River for selected percentile discharges. (Continued)

Cross section No.	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Feet					
6.41	19	26	27	30	36	59
6.43	6	14	16	18	25	59
6.81	14	29	99	171	244	501
6.92	28	35	38	41	50	426
6.925	43	71	82	93	162	525
6.93	SR 54 Culvert					
6.94	43	71	82	93	163	533
6.96	22	31	40	49	57	121
7.27	17	12	22	27	261	1,123
7.44	14	16	17	18	105	190
7.58	11	12	13	14	16	105
7.68	10	11	12	13	16	213
7.87	14	15	17	19	23	302
7.98	9	9	12	17	34	267
8.05	12	14	18	24	78	293
8.17	11	14	17	22	136	476
8.46	16	19	24	52	92	291
	17.4	26.7	31.9	67.0	132	563
	53	154	99	1,415	1,889	2,932
	2	5	7	9	11	40

Appendix 6. Hydraulic depth at cross sections along New River for selected percentile discharges.

Cross section No.	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Feet					
0.02	0.06	0.2	0.2	0.3	0.5	1.5
0.16	0.09	0.6	0.8	0.4	0.3	0.9
0.36	0.32	0.5	0.7	0.9	1.3	0.5
0.46	0.08	0.4	0.5	0.6	0.6	1.1
0.58	0.41	0.7	0.9	1.1	1.4	1.4
0.72	0.25	0.8	1.5	2.2	1.4	1.7
0.77	0.23	0.7	1.4	2.1	3.1	2.3
0.91	0.13	0.3	0.4	0.6	1.2	1.6
0.98	0.45	0.9	0.9	1.0	1.2	1.7
1.12	0.13	0.4	0.6	0.8	1.0	0.8
1.17	0.24	0.5	0.8	0.9	1.1	0.7
1.22	0.34	0.8	0.9	0.9	1.1	1.3
1.29	0.16	0.4	0.8	1.2	0.9	1.2
1.39	0.25	0.5	0.6	0.9	0.3	1.0
1.49	0.14	0.4	0.5	0.7	1.0	0.8
1.62	0.10	0.2	0.3	0.5	0.9	1.1
1.81	0.17	0.6	0.9	1.4	1.9	2.4
1.83	0.09	0.4	0.7	1.1	1.5	1.8
1.84	Morris Bridge					
1.85	0.31	0.7	1.0	1.6	1.7	1.8
1.88	0.05	0.4	0.8	1.5	2.2	2.6
1.92	0.21	0.2	0.3	0.5	1.1	0.7
1.99	0.30	0.7	1.1	1.5	2.0	0.5
2.10	0.07	0.2	0.5	1.0	1.7	1.6
2.21	0.22	0.5	0.7	0.9	1.2	1.3
2.43	0.15	0.4	0.6	1.0	1.5	2.0
2.84	0.12	0.3	0.5	0.6	0.8	1.6
3.22	0.10	0.4	0.6	0.9	1.1	1.8
3.24	0.15	0.4	0.7	1.1	1.6	3.2
3.245	Camp Road Culvert					
3.25	0.16	0.5	0.8	1.1	1.6	3.3
3.27	0.02	0.1	0.1	0.3	0.6	1.0
3.51	0.02	0.3	0.1	0.6	0.9	1.6
3.82	0.03	0.1	0.6	0.2	0.4	0.8
3.83	0.13	0.3	0.6	0.6	0.7	1.1
3.85	0.03	0.2	0.4	0.6	0.8	0.5
4.02	0.57	1.0	1.0	0.3	0.5	0.6
4.21	0.68	1.4	1.8	2.3	2.6	0.8
4.52	0.04	0.7	1.2	1.6	0.8	0.6
4.53	0.21	0.4	1.0	1.6	2.2	0.4
4.55	0.17	0.6	1.1	1.5	0.7	0.7
4.87	0.24	0.6	0.9	1.2	1.7	0.9
5.07	0.22	0.7	1.1	1.3	1.4	0.6
5.36	0.25	0.7	1.0	1.2	1.6	0.6
5.60	0.19	0.7	1.1	1.6	2.2	3.8
5.87	0.15	0.4	0.6	1.1	1.9	4.6
5.88	0.15	0.3	0.5	0.8	1.2	3.4
5.889	Chancy Road Bridge					
5.89	0.26	0.5	0.7	0.9	1.3	3.4
5.92	0.30	0.6	0.8	1.1	1.3	1.1
6.15	0.58	1.1	1.5	1.5	0.8	1.7
6.29	0.35	0.9	1.6	2.2	2.8	2.4
6.39	0.03	0.1	0.4	1.1	1.8	1.4
6.41	0.13	0.3	0.5	0.8	1.5	2.8
6.43	0.13	0.3	0.6	0.8	1.1	2.1
6.81	0.36	0.7	0.5	0.6	0.9	1.9
6.92	0.12	0.7	1.1	1.5	1.7	0.9
6.925	0.08	0.7	1.1	1.5	2.0	3.9
6.93	SR 54 Culvert					
6.94	0.08	0.7	1.1	1.5	2.0	3.9
6.96	0.12	0.5	0.8	1.1	1.4	2.1
7.27	0.12	0.1	0.2	0.5	0.2	1.2
7.44	0.12	0.5	0.8	1.1	0.4	0.8
7.58	0.28	0.7	1.1	1.5	1.8	0.8
7.68	0.06	0.5	1.0	1.4	1.7	0.9
7.87	0.17	0.4	0.7	1.1	1.6	0.8
7.98	0.41	0.8	1.1	1.2	1.1	1.2
8.05	0.24	0.7	1.0	1.2	0.8	1.6
8.17	0.18	0.6	1.0	1.2	0.6	1.4
8.46	0.12	0.4	0.7	0.7	0.8	1.5
Mean	0.2	0.5	0.8	1.1	1.3	1.6
Maximum	0.7	1.4	1.8	2.3	3.1	4.6
Minimum	0.02	0.1	0.1	0.2	0.2	0.4

Appendix 7. Acreage of areal inundation between adjacent cross sections along New River.

	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Acres					
0.02						
0.16	0.09	0.37	0.50	1.3	4.43	25.42
0.36	0.21	0.56	0.73	1.87	6.72	24.36
0.46	0.11	0.29	0.4	0.59	1.21	6.01
0.58	0.09	0.27	0.38	0.57	1.24	3.65
0.72	0.11	0.19	0.25	0.3	0.51	1.76
0.77	0.07	0.12	0.12	0.13	0.19	0.8
0.91	0.19	0.33	0.35	0.37	0.44	2.31
0.98	0.03	0.07	0.13	0.2	0.31	1.33
1.12	0.1	0.26	0.43	0.69	1.12	10.23
1.17	0.07	0.13	0.17	0.28	0.45	6.91
1.22	0.19	0.22	0.29	0.49	0.74	6.48
1.29	0.19	0.25	0.33	0.51	0.88	4.03
1.39	0.1	0.23	0.3	0.37	1.74	9.59
1.49	0.18	0.39	0.52	0.69	2.07	13.01
1.62	0.27	0.41	0.52	0.64	0.81	5.82
1.81	0.59	0.62	0.63	0.66	0.7	1.6
1.83	0.05	0.05	0.06	0.06	1.65	3.66
1.84						
1.85	0.01	0.02	0.02	0.67	1.12	4.65
1.88	0.04	0.07	0.07	3.29	4.38	6.64
1.92	0.05	0.08	0.09	0.12	0.14	0.62
1.99	0.08	0.11	0.13	0.18	0.22	2.81
2.10	0.1	0.21	0.25	0.27	0.29	4.37
2.21	0.16	0.32	0.38	0.43	0.51	2.18
2.43	0.38	0.73	0.92	1.02	1.18	3.8
2.84	0.74	1.12	1.35	1.48	1.81	3.81
3.22	1.42	1.63	1.83	2.09	2.62	4.92
3.24	0.08	0.1	0.11	0.13	0.19	0.6
3.245						
3.25	0.06	0.06	0.07	0.09	0.15	0.61
3.27	0.06	0.07	0.07	0.1	0.15	0.71
3.51	1.09	2.75	1.49	3.52	4.1	11.49
3.82	1.21	3.48	2.19	4.26	4.79	9.95
3.83	0.07	0.1	0.14	0.12	0.15	0.4
3.85	0.09	0.11	0.14	0.14	0.15	0.82
4.02	0.6	0.68	0.78	3.17	4.01	23.27
4.21	0.2	0.27	0.33	1.73	2.21	23.31
4.52	0.49	0.72	0.83	0.97	2.88	47.47
4.53	0.02	0.04	0.06	0.06	0.21	3.4
4.55	0.07	0.09	0.09	0.12	0.51	5
4.87	1.04	1.26	1.56	2.05	6.87	55.15
5.07	0.49	0.65	0.79	1.1	1.56	18.72
5.36	0.61	0.79	0.96	1.31	1.88	18.64
5.60	0.75	0.93	1.07	1.26	1.5	7.29
5.87	0.77	1.18	1.6	1.78	1.92	2.33
5.88	0.01	0.04	0.06	0.08	0.08	0.1
5.889						
5.89	0.01	0.01	0.02	0.02	0.03	0.04
5.92	0.01	0.02	0.02	0.04	0.05	0.15
6.15	0.11	0.21	0.3	0.44	1.19	5.4
6.29	0.11	0.27	0.33	0.44	0.97	3.75
6.39	0.11	0.27	0.35	0.39	0.44	1.48

Appendix 7. Acreage of areal inundation between adjacent cross sections along New River. (Continued)

Cross section No.	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Acres					
6.41	0.03	0.06	0.06	0.07	0.09	0.28
6.43	0.03	0.04	0.05	0.06	0.07	0.15
6.81	0.47	0.99	2.17	3.36	4.61	9.23
6.92	0.29	0.44	0.88	1.34	1.87	6.02
6.925	0.04	0.06	0.07	0.08	0.12	0.54
6.93						
6.94	0.13	0.2	0.24	0.26	0.47	1.52
6.96	0.07	0.12	0.15	0.18	0.28	0.91
7.27	0.71	0.77	1.14	1.42	5.49	21.16
7.44	0.32	0.28	0.41	0.46	3.82	14.03
7.58	0.21	0.24	0.25	0.28	0.94	2.3
7.68	0.13	0.14	0.15	0.16	0.19	1.83
7.87	0.28	0.3	0.33	0.36	0.45	5.59
7.98	0.15	0.17	0.2	0.26	0.39	3.92
8.05	0.08	0.09	0.12	0.16	0.45	2.25
8.17	0.18	0.21	0.26	0.33	1.49	5.32
8.46	0.47	0.58	0.69	1.29	4.02	13.3
	17.3	27.8	31.7	52.7	98.2	489

Appendix 8. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along New River.

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Acres					
0.02	Initial cross section above confluence at Hillsborough River					
0.16		0.01	0.02	0.21	0.9	1.7
0.36		0.03	0.02	0.28	1.4	0.4
0.46		0.01	0.02	0.09	0.1	0.0
0.58		0.01	0.01	0.08	0.1	0.2
0.72	0.01		0.01	0.01	0.0	0.1
0.77						0.1
0.91	0.01	0.01				0.2
0.98			0.01	0.01		0.1
1.12		0.02	0.03	0.06	0.1	0.8
1.17	0.01			0.02		1.0
1.22	0.01		0.03	0.04		1.0
1.29	0.00	0.01	0.02	0.03	0.1	0.2
1.39				0.01	0.4	0.5
1.49	0.01	0.02	0.03	0.03	0.4	0.6
1.62	0.03	0.01	0.01	0.02	0.0	0.2
1.81						0.2
1.83	0.01	0.00	0.01	0.00	0.1	0.1
1.84						
1.85				0.03	0.1	1.2
1.88		0.01		0.14	0.2	0.2
1.92			0.01	0.01		0.1
1.99				0.01		0.3
2.10	0.01			0.01		0.4
2.21		0.01	0.01	0.01		0.3
2.43		0.02	0.01	0.02		0.5
2.84		0.03	0.01	0.01	0.1	0.1
3.22			0.02	0.05	0.1	0.3
3.24		0.01	0.01	0.01		0.1
3.245						
3.25						0.1
3.27		0.01		0.02		0.1
3.51		0.07		0.07	0.1	0.7
3.82		0.10		0.06	0.1	0.6
3.83			0.03			
3.85			0.02			0.1
4.02		0.01		0.10	0.3	1.8
4.21				0.05	0.2	2.7
4.52		0.01	0.01	0.02	0.3	8.0
4.53			0.01			0.7
4.55	0.01			0.01	0.1	1.2
4.87		0.01	0.05	0.07	0.8	8.4
5.07	0.01	0.02	0.02	0.06	0.1	2.0
5.36		0.01	0.02	0.07	0.1	9.7
5.60		0.01	0.02	0.03		5.0
5.87	0.01	0.03	0.06	0.01		
5.88			0.01			
5.889						
5.89	0.01					
5.92				0.01		

Appendix 8. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along New River. (Continued)

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles					
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$
	Acres					
6.15		0.01	0.02	0.01	0.3	0.3
6.29		0.02	0.01	0.03	0.2	0.1
6.39			0.01	0.01		0.1
6.41						
6.43				0.01		
6.81	0.01	0.04	0.17	0.19	0.2	0.9
6.92			0.05	0.07	0.1	0.6
6.925						
6.93						
6.94	0.01		0.01			0.1
6.96		0.01	0.01	0.01		0.1
7.27	0.01		0.03	0.04	1.1	0.8
7.44			0.01	0.01	0.7	0.5
7.58				0.01		0.4
7.68	0.01	0.01				0.4
7.87						1.0
7.98			0.01	0.01		0.5
8.05			0.01	0.01	0.1	0.1
8.17	0.01	0.01	0.01	0.02	0.2	0.2
8.46		0.01	0.01	0.15	0.4	0.7
	0.2	0.6	0.9	2.4	9.7	58.9

Appendix 9. Extent of inundation at cross sections along Blackwater Creek for selected percentile discharges.

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
0.01	42	45	52	399	513	1,515	2,092
.15	150	154	159	206	285	658	1,113
.28	76	81	87	108	142	204	386
.43	50	52	53	60	78	130	246
.59	73	77	86	143	168	296	702
.68	123	127	133	156	266	533	788
.90	69	79	88	104	116	272	869
.904	Two Rivers Ranch Bridge						
.91	56	71	80	92	100	128	543
.93	64	66	68	75	87	199	1,267
1.14	43	66	91	138	195	771	1,526
1.34	122	175	233	350	394	832	1,394
1.55	60	69	167	328	411	764	1,144
1.80	96	136	187	310	538	1,041	1,417
2.04	58	78	100	117	136	198	857
2.37	77	93	100	113	130	265	459
2.82	58	70	81	106	162	380	1,029
3.02	181	241	269	312	397	1,084	1,609
3.27	93	133	169	297	456	1,148	1,711
3.59	92	150	226	340	461	975	1,167
3.78	60	87	132	261	355	638	752
3.95	39	57	79	103	135	287	835
4.14	13	16	23	49	83	246	2,351
4.36	27	29	30	33	46	1,210	2,796
4.65	26	43	53	85	240	1,059	1,713
4.85	46	48	70	149	252	764	1,093
5.19	34	35	36	38	88	518	1,111
5.34	53	54	56	60	100	749	1,218
5.49	27	31	35	58	90	729	1,234
5.76	30	35	41	50	60	992	1,565
5.82	22	29	38	54	73	644	1,996
5.86	29	35	54	91	131	566	3,717
5.875	SR 39 Bridge						
5.88	27	36	56	93	134	1,628	4,257
5.89	28	37	56	93	134	2,114	5,932
5.894	Railroad Bridge						
5.90	29	39	58	96	137	1,057	5,530
5.93	32	33	35	38	46	1,311	1,758
6.06	36	38	40	45	55	978	2,756
6.44	33	34	36	39	48	1,177	1,740
6.97	11	17	35	85	139	706	2,162
7.45	41	,46	64	227	435	1,216	2,457
7.69	49	53	55	60	107	780	2,054
7.70	35	53	75	108	147	842	2,099
7.71	110	126	140	173	216	1,104	2,129
7.92	314	379	455	628	855	1,805	2,375
8.07	44	45	78	180	317	866	1,220
8.34	23	27	32	42	63	354	953
8.59	49	51	104	209	412	985	1,293

Appendix 9. Extent of inundation at cross sections along Blackwater Creek for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
8.74	23	24	24	25	27	65	152
8.79	31	34	37	42	44	50	56
8.796	Ranch Bridge						
8.80	32	34	38	42	44	50	56
8.84	21	22	23	25	27	81	347
9.00	26	30	34	41	44	209	575
9.27	45	48	64	138	209	392	766
9.52	5	7	10	15	19	43	551
9.87	44	47	51	57	66	96	335
10.25	10	14	17	23	24	30	249
10.41	45	51	57	66	75	91	805
10.45	24	25	26	27	29	39	294
10.454	Bridge						
10.46	25	25	26	27	29	50	401
10.48	25	25	26	28	29	37	399
10.79	35	36	37	39	41	49	361
11.07	15	16	17	20	23	40	304
11.44	13	17	21	26	29	32	84
11.48	26	28	29	31	32	33	33
11.484	Ranch Bridge						
11.49	27	28	30	31	32	33	33
11.54	13	14	15	18	21	33	56
11.61	29	31	32	35	40	53	104
11.62	Logging Road Bridge						
11.63	29	31	33	36	40	56	470
11.89	12	14	16	19	23	36	114
12.31	17	20	24	33	44	87	126
12.39	31	32	32	34	35	46	164
12.42	5	6	8	17	25	38	167
12.49	21	21	22	23	24	29	57
12.497	Culvert						
12.50	21	22	22	23	25	30	211
12.55	25	26	26	27	29	35	247
12.72	12	11	11	12	14	27	37
12.90	17	19	21	24	29	60	125
12.98	14	14	18	24	32	61	103
13.02	18	18	19	19	20	22	58
13.21	30	30	31	31	32	35	40
13.28	7	7	7	8	8	10	13
13.58	20	20	21	22	24	30	445
13.67	20	21	21	24	27	41	282
13.74	20	20	21	21	22	25	28
13.741	Water Oak Drive Culvert						
13.75	20	21	21	21	22	25	28
13.77	3	4	4	6	8	17	39
13.91	16	16	17	17	18	245	756
13.917	Shady Oak Drive West Culvert						
13.92	16	16	17	17	17	19	639
13.93	15	15	15	16	16	19	110

Appendix 9. Extent of inundation at cross sections along Blackwater Creek for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
13.937	Culvert						
13.94	15	15	15	16	16	19	473
14.08	14	15	18	22	27	511	912
14.23	9	9	10	11	12	28	158
14.24	16	17	18	21	23	31	51
14.249	Shady Oak Drive East Culvert						
14.25	16	17	18	21	24	32	56
14.26	16	17	18	21	24	32	57
14.33	6	8	10	10	12	17	43
14.64	13	15	17	22	27	327	486
14.80	15	15	16	18	21	210	358
15.03	12	13	13	15	16	23	27
15.12	31	31	31	31	32	33	34
15.14	15	9	20	31	31	32	33
15.149	Sims Road Bridge						
15.15	20	23	29	31	31	32	33
15.17	10	10	10	10	10	13	14
15.22	4	4	4	5	7	7	20
15.45	6	8	10	12	14	18	24
15.65	14	14	14	15	16	21	40
15.70	20	20	21	22	25	88	305
15.72	24	25	27	30	47	307	651
15.725	Harrelson Road Bridge						
15.73	24	26	28	31	52	313	655
15.75	13	14	16	19	22	35	445
15.79	6	8	9	12	20	35	403
15.99	12	14	14	15	15	15	19
16.4	26	26	27	28	30	36	43
16.5	9	13	14	14	14	17	18
16.6	18	18	18	18	19	19	20
Mean	36	42	52	76	105	364	833
Maximum	314	379	455	628	855	2,114	5,932
Minimum	3	4	4	5	7	7	13

Appendix 10. Hydraulic depth at cross sections along Blackwater Creek for selected percentile discharges.

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
0.01	1.05	1.64	2.1	1.1	2.2	3.6	5.5
.15	0.78	1.37	2.0	2.7	3.3	4.1	5.1
.28	0.14	0.55	1.2	2.2	2.9	6.0	5.6
.43	0.96	1.22	1.4	1.9	2.6	5.2	5.3
.59	1.14	1.50	1.7	1.8	2.6	4.8	4.2
.68	1.22	1.62	2.0	2.5	2.4	4.6	6.1
.90	0.41	0.82	1.2	1.9	2.8	5.8	9.6
.904	Two Rivers Ranch Bridge						
.91	0.48	0.70	1.0	1.8	2.8	6.0	8.1
.93	0.82	1.17	1.5	2.2	3.0	3.8	2.5
1.14	0.43	0.60	0.8	1.1	1.6	2.3	4.0
1.34	0.50	0.55	0.6	0.8	1.3	2.7	4.1
1.55	0.89	1.13	0.7	0.8	1.2	2.6	4.1
1.80	0.60	0.80	1.0	1.2	1.2	2.4	4.1
2.04	0.75	0.91	1.1	1.7	2.3	3.5	2.2
2.37	0.43	0.65	0.9	1.4	2.0	3.2	3.9
2.82	0.64	0.80	1.0	1.2	1.2	2.0	2.2
3.02	0.45	0.60	0.8	1.2	1.4	1.9	3.3
3.27	0.52	0.63	0.7	0.8	1.0	1.8	3.1
3.59	0.92	0.92	1.0	1.3	1.6	2.3	3.6
3.78	0.58	0.82	0.9	1.1	1.5	2.6	4.0
3.95	1.10	1.15	1.3	1.7	2.1	2.7	2.3
4.14	0.44	0.62	0.9	1.1	1.6	2.4	1.0
4.36	1.33	1.89	2.4	3.3	3.4	1.3	1.9
4.65	0.33	0.60	1.0	1.4	1.1	1.5	2.0
4.85	1.04	1.44	1.3	1.2	1.4	1.9	2.7
5.19	0.79	1.31	1.9	2.9	1.8	1.8	1.9
5.34	0.78	1.20	1.7	2.7	2.5	1.2	2.1
5.49	0.65	0.93	1.2	1.5	1.8	1.6	2.0
5.76	1.77	2.11	2.5	3.1	3.7	1.3	2.0
5.82	0.99	1.36	1.6	2.2	2.8	1.3	1.3
5.86	1.17	1.59	1.6	1.9	2.4	3.4	4.8
5.875	SR 39 Bridge						
5.88	0.95	1.27	1.4	1.8	2.4	3.5	5.2
5.89	1.21	1.48	1.5	1.9	2.4	2.6	4.4
5.894	Railroad Bridge						
5.90	1.58	1.74	1.7	2.0	2.5	2.7	4.5
5.93	0.67	1.31	1.9	2.9	3.6	1.2	2.5
6.06	0.94	1.37	1.9	2.8	3.6	1.3	1.5
6.44	1.43	2.08	2.8	4.0	4.8	1.8	2.3
6.97	0.46	0.70	1.0	1.4	2.0	1.8	1.7
7.45	1.24	1.70	1.7	1.1	1.3	2.4	2.6
7.69	0.78	1.31	1.8	2.7	2.3	1.5	2.0
7.70	0.21	0.26	0.3	0.4	0.5	1.2	1.9
7.71	2.23	2.12	2.1	1.9	1.9	1.3	2.1
7.92	0.94	0.95	1.0	1.0	1.1	2.2	3.3
8.07	2.46	2.62	1.6	1.0	1.0	1.9	2.9
8.34	0.57	0.68	0.8	1.1	1.3	1.0	1.5
8.59	1.42	1.58	1.0	0.9	1.0	1.9	3.1
8.74	0.68	0.91	1.2	1.7	2.3	2.6	2.0
8.79	0.33	0.56	0.8	1.3	1.9	3.8	5.3
8.796	Ranch Bridge						
8.80	0.37	0.58	0.8	1.3	1.9	3.8	5.3

Appendix 10. Hydraulic depth at cross sections along Blackwater Creek for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
8.84	0.48	0.69	0.9	1.4	1.9	1.8	1.4
9.00	0.56	0.81	1.1	1.5	2.1	1.4	1.9
9.27	0.73	1.10	1.2	1.1	1.4	2.7	2.9
9.52	0.31	0.47	0.7	1.1	1.5	2.1	1.5
9.87	0.33	0.48	0.6	0.9	1.3	2.6	1.6
10.25	0.18	0.24	0.3	0.4	0.6	1.7	0.7
10.41	0.51	0.67	0.8	1.1	1.4	2.7	0.9
10.45	0.40	0.62	0.9	1.2	1.6	2.5	3.4
10.454	Bridge						
10.46	0.46	0.69	0.9	1.3	1.7	2.3	3.6
10.48	0.48	0.70	0.9	1.3	1.8	3.0	1.0
10.79	0.12	0.30	0.5	1.0	1.5	3.3	1.0
11.07	0.49	0.59	0.7	0.9	1.1	2.3	0.9
11.44	0.27	0.47	0.7	1.0	1.4	3.1	2.4
11.48	0.21	0.31	0.5	0.9	1.4	3.2	5.2
11.484	Ranch Bridge						
11.49	0.25	0.35	0.5	0.9	1.4	3.2	5.2
11.54	0.43	0.57	0.7	1.0	1.3	2.3	2.8
11.61	0.63	0.87	1.1	1.6	2.1	3.9	5.8
11.62	Logging Road Bridge						
11.63	0.64	0.88	1.1	1.6	2.2	4.3	1.1
11.89	0.37	0.63	0.9	1.3	1.8	3.2	2.3
12.31	0.32	0.45	0.6	0.9	1.2	2.5	3.9
12.39	0.41	0.62	0.9	1.4	1.9	3.5	2.3
12.42	0.16	0.20	0.3	0.6	0.9	2.7	1.6
12.49	0.45	0.65	0.8	1.3	1.9	4.2	6.8
12.497	Culvert						
12.50	0.52	0.74	1.0	1.5	2.1	4.5	1.2
12.55	0.11	0.31	0.5	1.0	1.6	3.5	1.2
12.72	0.27	0.13	0.2	0.3	0.4	1.9	3.8
12.90	0.23	0.39	0.5	0.7	0.9	1.4	2.5
12.98	0.14	0.17	0.3	0.4	0.6	1.3	2.5
13.02	0.16	0.26	0.4	0.5	0.8	1.8	1.7
13.21	0.12	0.17	0.3	0.5	0.7	1.8	3.5
13.28	0.33	0.46	0.6	0.8	1.0	1.9	3.0
13.58	0.12	0.20	0.3	0.6	0.9	2.1	0.4
13.67	0.15	0.21	0.3	0.5	0.7	1.7	0.8
13.74	0.17	0.25	0.4	0.6	0.9	2.2	3.8
13.741	Water Oak Drive Culvert						
13.75	0.18	0.27	0.4	0.6	0.9	2.2	3.9
13.77	0.23	0.30	0.4	0.5	0.7	1.3	1.6
13.91	0.22	0.33	0.5	0.8	1.1	2.4	4.0
13.917	Shady Oak Drive West Culvert						
13.92	0.24	0.36	0.5	0.8	1.1	2.5	4.2
13.93	0.26	0.38	0.5	0.8	1.1	2.5	4.1
13.937	Culvert						
13.94	0.32	0.43	0.6	0.9	1.2	2.6	4.4
14.08	0.24	0.34	0.5	0.7	0.9	0.6	1.6
14.23	0.33	0.47	0.6	0.9	1.2	1.3	0.7
14.24	0.26	0.39	0.6	0.8	1.2	2.3	3.6
14.249	Shady Oak Drive East Culvert						
14.25	0.32	0.44	0.6	0.9	1.3	2.4	3.8
14.26	0.33	0.45	0.6	0.9	1.2	2.0	2.2

Appendix 10. Hydraulic depth at cross sections along Blackwater Creek for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
14.33	0.09	0.12	0.1	0.2	0.6	1.5	1.5
14.64	0.36	0.51	0.7	1.0	1.2	0.2	0.7
14.80	0.05	0.07	0.2	0.5	0.9	0.7	0.9
15.03	0.30	0.43	0.6	0.7	1.0	1.7	2.3
15.12	0.05	0.16	0.3	0.5	0.8	2.0	2.9
15.14	0.07	0.05	0.1	0.3	0.6	1.8	2.7
15.149	Sims Road Bridge						
15.15	0.10	0.11	0.1	0.3	0.6	1.8	2.7
15.17	0.03	0.04	0.1	0.1	0.2	1.2	2.0
15.22	0.26	0.34	0.5	0.7	0.9	1.0	1.2
15.45	0.21	0.27	0.4	0.5	0.8	1.6	2.4
15.65	0.16	0.23	0.4	0.6	0.9	1.8	1.9
15.70	0.03	0.03	0.1	0.2	0.5	0.7	1.1
15.72	0.13	0.17	0.2	0.3	0.4	1.3	2.6
15.725	Harrelson Road Bridge						
15.73	0.14	0.18	0.2	0.3	0.4	1.3	2.6
15.75	0.15	0.19	0.3	0.3	0.5	1.2	0.5
15.79	0.04	0.06	0.1	0.1	0.2	0.9	0.5
15.99	0.13	0.16	0.2	0.4	0.5	0.5	1.1
16.4	0.10	0.14	0.2	0.3	0.5	0.9	1.4
16.5	0.03	0.05	0.1	0.1	0.2	0.6	1.2
16.6	0.24	0.30	0.4	0.5	0.7	1.3	2.1
Mean	0.5	0.7	0.9	1.2	1.5	2.3	2.8
Maximum	2.5	2.6	2.8	4.0	4.8	6.0	9.6
Minimum	0.03	0.03	0.1	0.1	0.2	0.2	0.4

Appendix 11. Acreage of areal inundation between adjacent cross sections along Blackwater Creek.

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres						
0.01	Initial cross section above confluence with Hillsborough River						
.15	1.8	1.8	1.9	3.9	4.8	10.9	16.6
.28	1.8	1.9	2	2.5	3.3	6.5	11.4
.43	1.1	1.1	1.2	1.4	1.8	2.7	5.1
.59	1.2	1.3	1.3	1.8	2.1	3.2	6.6
.68	1.1	1.2	1.3	1.6	2.1	3.7	6.8
.90	2.5	2.7	2.8	3.3	4.4	8.2	16
.904	Two Rivers Ranch Bridge						
.91	0.1	0.1	0.1	0.1	0.1	0.2	0.4
0.93	0.1	0.1	0.2	0.2	0.2	0.4	2.6
1.14	1.5	1.8	2	2.5	3.3	10	28.8
1.34	2.1	2.8	3.6	5	5.9	15.1	27
1.55	2	2.6	4	6.7	7.7	15	23.7
1.80	2.3	2.8	4.6	8	11.7	21.9	31.2
2.04	2.2	3.1	4.1	6	9.8	17.7	28.9
2.37	2.6	3.2	3.7	4.2	4.7	8	21.7
2.82	3.8	4.5	4.9	5.7	7.1	13.3	28.4
3.02	2.4	3.1	3.4	4.1	5.2	12.9	22.1
3.27	3.3	4.3	5	6.4	8.9	23.8	33.5
3.59	3.3	4.9	6.6	10.6	15.1	34.4	46.5
3.78	1.7	2.5	3.6	5.9	8	15.6	18.5
3.95	0.9	1.3	1.9	3.1	4.1	7.7	13
4.14	0.6	0.8	1.1	1.6	2.2	5.3	30
4.36	0.5	0.6	0.7	1	1.5	16	56.2
4.65	1	1.2	1.5	2.1	4.9	36.5	72.3
4.85	0.8	1.1	1.4	2.6	5.4	19.5	30
5.19	1.8	1.9	2.2	3.5	6	22.1	37.1
5.34	0.8	0.8	0.9	0.9	1.3	6.2	11
5.49	0.7	0.8	0.8	1.1	1.7	12	19.8
5.76	0.9	1	1.2	1.6	2.2	26.7	41.9
5.82	0.2	0.3	0.3	0.4	0.6	6.6	14.3
5.86	0.2	0.1	0.2	0.4	0.5	2.7	13.1
5.875	SR 39 Bridge						
5.88	0	0.1	0.2	0.2	0.3	3.1	11
5.89	0.1	0	0	0.1	0.1	1	2.9
5.894	Railroad Bridge						
5.90	0	0.1	0.1	0.1	0.2	1.7	4.7
5.93	0.1	0.1	0.2	0.2	0.3	3.1	9.3
6.06	0.5	0.6	0.5	0.7	0.8	17.4	34.4
6.44	1.6	1.6	1.8	1.9	2.3	49.7	104.6
6.97	1.4	1.7	2.3	3.9	5.9	55.4	113.8
7.45	1.5	1.8	2.7	8.1	14.5	47.9	114.5
7.69	1.4	1.5	1.8	4.3	8.1	29.6	66.3
7.70	0.1	0.1	0.1	0.1	0.2	1.9	4.7
7.71	0.1	0.2	0.3	0.4	0.5	2.2	4.9
7.92	5.4	6.4	7.5	10.1	13.5	36.8	57.1
8.07	Ranch Bridge						
8.34							
8.59	1	1.2	2	3.7	7.1	20	33.5
8.74	0.7	0.7	1.2	2.2	4	9.7	13.3
8.79	0.2	0.2	0.2	0.2	0.3	0.4	0.7
8.796	Confluence with Itchepackesassa Creek						
8.80	0	0	0	0.1	0	0	0.1

Appendix 11. Acreage of areal inundation between adjacent cross sections along Blackwater Creek. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres						
8.84	0.1	0.2	0.1	0.1	0.2	0.3	0.9
9.00	0.5	0.5	0.6	0.7	0.7	2.9	9.2
9.27	1.1	1.2	1.6	2.8	4	9.5	21
9.52	1.2	1.3	1.7	3.5	5.2	10	30.3
9.87	1	1.2	1.3	1.6	1.8	3	18.8
10.25	1.3	1.4	1.5	1.8	2.1	2.9	12.7
10.41	0.6	0.6	0.8	0.9	1	1.2	10.8
10.45	0.1	0.2	0.1	0.2	0.2	0.2	2.3
10.454	Bridge						
10.46	0	0	0.1	0	0.1	0.1	0.2
10.48	0.1	0.1	0	0.1	0	0.1	0.9
10.79	0.9	0.9	1	1	1.1	1.3	11.6
11.07	1	1.1	1.1	1.2	1.3	1.9	13.5
11.44	0.7	0.7	0.9	1	1.2	1.6	8.9
11.48	0.1	0.1	0.1	0.2	0.2	0.2	0.2
11.484	Ranch Bridge						
11.49	0	0.1	0	0	0	0	0.1
11.54	0.1	0.1	0.2	0.2	0.2	0.2	0.3
11.61	0.2	0.2	0.2	0.2	0.2	0.4	0.6
11.62	Logging Road Bridge						
11.63	0	0	0	0	0.1	0	0.2
11.89	0.7	0.8	0.8	0.9	1	1.6	9.8
12.31	0.7	0.8	1	1.3	1.7	3.1	6.1
12.39	0.3	0.3	0.3	0.4	0.4	0.7	1.5
12.42	0	0	0.1	0.1	0.1	0.1	0.6
12.49	0.2	0.2	0.1	0.2	0.2	0.3	1
12.497	Culvert						
12.50	0.1	0.1	0.2	0.2	0.3	0.3	1.2
12.55	0.2	0.2	0.1	0.1	0.1	0.1	1.3
12.72	0.4	0.4	0.4	0.4	0.5	0.7	2.8
12.90	0.3	0.3	0.4	0.4	0.4	0.9	1.7
12.98	0.1	0.2	0.2	0.3	0.3	0.6	1.1
13.02	0.1	0	0.1	0.1	0.1	0.2	0.4
13.21	0.6	0.6	0.5	0.5	0.6	0.7	1.1
13.28	0.3	0.4	0.4	0.4	0.4	0.4	0.6
13.58	0.5	0.5	0.5	0.6	0.6	0.8	9.2
13.67	0.2	0.2	0.3	0.2	0.3	0.3	4
13.74	0.2	0.2	0.1	0.2	0.2	0.3	8.7
13.741	Water Oak Drive Culvert						
13.75	0	0	0	0	0	0	0
13.77	0.1	0	0.1	0.1	0.1	0.1	0.2
13.91	0.1	0.2	0.2	0.2	0.2	2.3	6.8
13.917	Shady Oak Drive West Culvert						
13.92	0	0	0	0	0	0.2	0.8
13.93	0.1	0	0	0	0	0	0.6
13.937	Culvert						
13.94	0	0.1	0	0	0	0	0.2
14.08	0.2	0.2	0.3	0.3	0.4	4.2	10.9
14.23	0.2	0.2	0.2	0.3	0.4	5	9.9
14.24	0.1	0.1	0.1	0.1	0	0.1	0.2
14.249	Shady Oak Drive East Culvert						
14.25	0	0	0	0	0	0.1	0.1
14.26	0	0	0	0	0.1	0	0

Appendix 11. Acreage of areal inundation between adjacent cross sections along Blackwater Creek. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres						
14.33	0.1	0.1	0.1	0.2	0.1	0.2	0.4
14.64	0.3	0.4	0.5	0.5	0.7	6.1	9.5
14.80	0.3	0.3	0.4	0.4	0.5	5.4	8.4
15.03	0.4	0.4	0.4	0.5	0.5	2.8	4.9
15.12	0.2	0.2	0.2	0.2	0.3	0.3	0.3
15.14	0.1	0.1	0.1	0.1	0.1	0.1	0.1
15.149	Sims Road Bridge						
15.15	0	0	0	0.1	0	0.1	0
15.17	0.1	0.1	0.1	0	0.1	0	0.1
15.22	0	0	0	0.1	0	0.1	0.1
15.45	0.1	0.2	0.2	0.2	0.3	0.4	0.7
15.65	0.3	0.3	0.3	0.4	0.4	0.5	0.7
15.70	0.1	0.1	0.1	0.1	0.1	0.3	1.1
15.72	0	0	0.1	0	0.1	0.5	1.1
15.725	Harrelson Road Bridge						
15.73	0.1	0.1	0	0.1	0	0.2	0.4
15.75	0	0	0.1	0	0.1	0.4	1.3
15.79	0.1	0	0	0.1	0.1	0.1	1.9
15.99	0.2	0.3	0.3	0.3	0.5	0.6	4.9
16.4	0.9	0.9	1	1	1	1.2	1.4
16.5	0.2	0.3	0.3	0.3	0.3	0.4	0.4
16.6	0.2	0.2	0.2	0.2	0.2	0.2	0.3
Total	77.8	91.9	112	162	228	744	1,552

Appendix 12. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Blackwater Creek.

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres						
0.01	Initial cross section above confluence with Hillsborough River						
.15	0.1			0.2	0.1	0.8	0.5
.28			0.1	0.2	0.2	0.7	0.6
.43				0.1		0.1	0.4
.59	0.1	0.1		0.1	0.1	0.2	1.3
.68			0.1		0.1	0.1	1.5
.90				0.2	0.2	0.6	1.5
.904	Two Rivers Ranch Bridge						
.91	0.1		0.1				0.2
0.93							0.9
1.14	0.1	0.1		0.1	0.2	1.3	4.1
1.34	0.2	0.1	0.2	0.2	0.2	1.5	1.2
1.55		0.1	0.3	0.5	0.2	0.9	1.4
1.80	0.1		0.4	0.5	0.7	1	2.1
2.04		0.2	0.3	0.2	0.7	0.7	1.9
2.37	0.1		0.1	0.1	0.1	0.6	2.4
2.82	0.3	0.1	0.1	0.1	0.3	0.5	3.5
3.02	0	0.1		0.2	0.2	0.7	1.4
3.27	0.1	0.2	0.2	0.2	0.6	1.4	0.5
3.59	0.2	0.3	0.3	0.6	1.0	1.7	0.9
3.78	0.1	0.2	0.3	0.4	0.5	0.6	0.3
3.95			0.2	0.1	0.1	0.4	0.5
4.14	0.1	0.1	0.1	0.2	0.2	0.6	11.7
4.36					0.1	1.4	15.7
4.65	0.1		0.1	0.1	0.6	2.1	4.1
4.85			0.1	0.2	0.7	0.8	1.9
5.19	0.1	0.1	0.1	0.2	1.1	1.1	2.4
5.34			0.1		0.3	0.6	0.5
5.49				0.1	0.2	1.2	0.8
5.76					0.1	1.1	2.2
5.82					0.1	0.3	0.8
5.86				0.1			1.0
5.875	SR 39 Bridge						
5.88			0.1			0.4	1.0
5.89				0.1		0.1	0.2
5.894	Railroad Bridge						
5.90						0.2	0.3
5.93			0.1		0.1	0.1	0.8
6.06		0.1		0.1		0.7	1.7
6.44			0.1		0.2	2.6	6.5
6.97		0.1	0.2	0.3	0.7	2.9	7.1
7.45		0.1	0.3	0.8	1.9	2.5	6.3
7.69	0.1	0.1	0.3	0.5	1.2	1.8	2.5
7.70						0.2	0.2
7.71			0.1	0.1	0.1	0.4	0.2
7.92	0.1	0.1	0.2	0.4	0.7	4.2	1.4
8.07	Ranch Bridge						
8.34	Confluence with Itchepackesassa Creek						
8.59			0.2	0.3	0.6	1.6	1.5
8.74		0.1	0.1	0.2	0.4	0.5	0.7
8.79	0.1					0.1	0.2

Appendix 12. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Blackwater Creek. (Continued)

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres						
8.796							
8.80							0.1
8.84		0.1					0.1
9.00			0.1			0.6	1.0
9.27			0.1	0.2	0.3	1.4	1.5
9.52	0.1		0.3	0.3	0.2	0.9	2.1
9.87		0.1			0.1	0.2	1.7
10.25	0.1					0.2	3.4
10.41				0.1	0.1		1.4
10.45							0.2
10.454	Bridge						
10.46					0.1		0.1
10.48				0.1		0.1	0.1
10.79					0.1		4.1
11.07						0.1	6.0
11.44	0.1		0.1				2.6
11.48					0.1		
11.484	Ranch Bridge						
11.49		0.1					0.1
11.54			0.1		0.1		
11.61							0.2
11.62	Logging Road Bridge						
11.63					0.1		
11.89		0.1				0.1	0.8
12.31						0.1	1.0
12.39	0.1	0.1		0.1		0.1	0.1
12.42							0.1
12.49	0.1	0.1		0.1			0.2
12.497	Culvert						
12.50					0.1	0.1	0.7
12.55	0.1	0.1					1.0
12.72						0.1	1.9
12.90							0.1
12.98				0.1		0.1	
13.02	0.1		0.1				0.1
13.21		0.1					0.3
13.28							0.1
13.58				0.1		0.1	3.8
13.67			0.1				1.4
13.74	0.1						2.4
13.741	Water Oak Drive Culvert						
13.75							
13.77				0.1	0.1		0.1
13.91		0.1	0.1			0.4	0.6
13.917	Culvert						
13.92							
13.93	0.1						0.1
13.937	Shady Oak Drive West Culvert						
13.94		0.1					0.1
14.08						0.4	3.8
14.23					0.1	0.5	1.6

Appendix 12. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Blackwater Creek. (Continued)

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Acres						
14.24		0.1	0.1	0.1			0.1
14.249	Shady Oak Drive East Culvert						
14.25						0.1	
14.26					0.1		
14.33				0.1			
14.64					0.1	5.1	0.6
14.80			0.1	0.1		3.1	0.5
15.03		0.1				0.2	0.6
15.12						0.1	
15.14		0.1					
15.149	Sims Road Bridge						
15.15						0.1	
15.17	0.1	0.1					
15.22							0.1
15.45							
15.65				0.1	0.1	0.1	
15.70							0.1
15.72					0.1	0.1	0.1
15.725	Harrelson Road Bridge						
15.73						0.1	
15.75							0.2
15.79	0.1						0.5
15.99		0.1			0.1		1.1
16.4	0.1						
16.5						0.1	
16.6							
Total	3.3	3.8	6.1	9.3	16.8	55.9	148

Appendix 13. Extent of inundation at cross sections along Itchepackesassa Creek for selected percentile discharges.

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
0.15	49	56	62	74	80	691	876
0.20	32	42	54	168	940	1,575	1,760
0.55	36	37	37	38	345	638	879
0.82	25	30	35	39	43	145	508
1.07	31	34	36	40	45	196	457
1.30	17	20	22	27	39	304	851
1.34	34	36	39	44	92	249	718
1.36	34	36	39	44	93	248	705
1.366	Cone Ranch Bridge and Gaging Station (02302280)						
1.37	34	36	39	44	95	252	734
1.39	39	41	44	64	106	472	723
1.71	21	24	26	29	36	316	835
2.08	28	33	41	57	164	784	917
2.45	17	19	21	35	69	311	1,039
2.72	26	30	32	35	41	61	79
2.94	24	25	27	30	40	88	142
3.16	18	20	23	27	37	83	498
3.48	18	18	19	21	23	162	244
3.86	25	26	27	28	31	46	369
4.14	21	23	26	31	36	163	434
4.31	21	24	25	27	28	248	635
4.66	14	14	15	16	18	1,482	1,809
4.88	18	25	26	27	29	54	313
4.97	17	19	21	24	29	61	806
5.28	29	32	35	40	54	191	210
5.45	18	19	21	23	25	51	80
5.62	26	28	29	33	40	65	120
5.63	20	26	29	37	43	60	179
5.638	Cone Ranch Wooden Bridge						
5.64	25	26	27	30	34	60	179
5.68	21	22	24	28	34	116	365
6.12	21	22	23	25	29	76	162
6.25	26	27	28	30	33	319	510
6.27	53	54	54	55	56	340	542
6.278	Knights-Griffin Road Bridge and Gaging Station (02302260)						
6.28	53	54	54	55	56	341	543
6.30	8	11	13	17	21	51	109
6.58	30	31	31	32	34	55	284
6.95	21	22	22	25	31	59	79
7.24	24	27	30	35	41	68	174
7.59	19	22	24	30	35	56	2,729
7.88	20	20	21	27	34	62	410
8.22	21	21	22	25	28	96	1,121
8.53	39	40	43	49	58	97	250
8.84	28	28	28	29	29	59	800
9.0	22	25	26	27	29	55	124
9.11	26	26	26	27	28	35	325
9.24	33	34	34	35	36	52	438
9.25	64	65	65	66	66	356	4,694
9.259	Walker Road Bridge						
9.26	64	65	65	66	66	372	4,742
9.27	43	44	44	45	47	74	1,389

Appendix 13. Extent of inundation at cross sections along Itchepackesassa Creek for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
9.40	36	36	37	38	39	50	2,081
9.63	26	27	27	28	29	865	2,062
9.84	17	18	19	21	24	1,500	1,819
10.07	22	22	23	25	27	139	1,982
10.16	23	24	25	28	31	53	1,027
10.52	22	24	25	28	32	43	800
10.71	23	25	27	30	35	52	190
10.94	48	52	54	60	66	85	133
10.95	49	52	55	60	66	85	134
10.958	Swindell Road Bridge						
10.96	50	52	55	60	66	85	136
10.97	13	19	26	33	41	63	170
11.15	33	34	36	40	47	118	598
11.40	22	23	24	28	31	44	461
11.64	15	18	20	23	24	30	710
	Interstate Highway 4						
	28	30	32	38	64	242	793
	64	65	65	168	940	1,575	4,742
	8	11	13	16	18	30	79

Appendix 14. Hydraulic depth at cross sections along Itchepackesassa Creek for selected percentile discharges.

	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
0.15	1.1	1.1	1.2	1.4	1.8	1.0	2.4
0.20	1.3	1.2	1.2	0.7	0.6	2.0	3.4
0.55	1.6	1.9	2.3	3.2	0.8	1.7	2.7
0.82	0.4	0.8	1.2	2.0	2.7	1.8	1.6
1.07	0.7	1.0	1.3	2.1	2.7	1.8	2.3
1.30	0.8	1.1	1.4	1.9	2.1	1.5	1.7
1.34	0.7	1.1	1.4	2.1	1.7	2.6	2.3
1.36	0.7	1.1	1.4	2.1	1.7	3.8	6.0
1.366	Cone Ranch Bridge and Gaging Station (02302280)						
1.37	0.7	1.1	1.5	2.1	1.7	3.9	6.1
1.39	0.8	1.2	1.6	1.8	1.9	2.0	3.4
1.71	0.3	0.7	1.2	2.0	2.6	1.5	1.7
2.08	0.7	0.9	1.1	1.6	1.2	2.2	3.8
2.45	0.6	0.9	1.2	1.3	1.4	1.5	1.7
2.72	0.3	0.5	0.7	1.2	1.8	3.4	4.4
2.94	0.8	1.1	1.3	1.8	2.0	2.7	3.6
3.16	0.4	0.8	1.1	1.6	1.9	2.9	1.1
3.48	0.6	0.9	1.2	1.9	2.8	1.6	2.6
3.86	0.4	0.7	1.0	1.6	2.4	4.6	1.6
4.14	0.7	0.9	1.1	1.6	2.2	2.1	2.4
4.31	0.3	0.5	0.9	1.5	2.2	1.1	1.9
4.66	0.8	1.1	1.4	1.9	2.6	0.5	1.5
4.88	0.5	0.8	1.1	1.9	2.8	4.2	1.1
4.97	1.0	1.3	1.6	2.2	2.8	4.0	0.9
5.28	0.7	1.1	1.4	2.1	2.6	3.3	4.8
5.45	0.7	1.1	1.5	2.3	3.3	4.3	4.4
5.62	0.3	0.7	1.1	1.9	2.7	5.0	4.9
5.63	0.2	0.4	0.8	1.5	2.5	5.3	7.8
5.638							
5.64	0.3	0.5	0.9	1.7	2.7	4.4	7.0
5.68	0.4	0.6	0.9	1.6	2.5	2.6	2.6
6.12	0.4	0.6	0.9	1.4	2.1	3.1	3.2
6.25	0.3	0.5	0.7	1.2	1.9	1.1	2.6
6.27	0.4	0.5	0.8	1.3	2.2	5.7	7.9
6.278							
6.28	0.4	0.6	0.8	1.3	2.2	5.7	8.0
6.30	0.2	0.3	0.4	0.7	1.4	3.3	3.1
6.58	0.6	0.9	1.2	1.7	2.4	4.4	1.7
6.95	0.1	0.2	0.3	0.6	1.2	3.7	5.4
7.24	0.6	0.8	1.1	1.5	1.8	3.5	3.0
7.59	0.1	0.4	0.6	1.1	1.7	3.2	1.5
7.88	0.6	0.9	1.2	1.7	2.1	3.1	0.9
8.22	0.3	0.5	0.8	1.6	2.4	2.8	1.2
8.53	0.4	0.5	0.7	1.2	1.8	4.0	2.4
8.84	0.2	0.3	0.5	0.9	1.6	3.2	1.1
9.0	0.4	0.5	0.7	1.0	1.5	3.1	2.9
9.11	0.3	0.6	0.8	1.2	1.7	4.2	1.1
9.24	0.3	0.5	0.7	1.2	1.7	3.4	1.3
9.25	0.3	0.4	0.7	1.1	1.7	3.7	5.4
9.259							
9.26	0.3	0.5	0.7	1.2	1.8	3.7	5.4
9.27	0.2	0.4	0.6	1.1	1.6	3.4	0.7

Appendix 14. Hydraulic depth at cross sections along Itchepackesassa Creek for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
9.40	0.4	0.6	0.7	1.2	1.7	3.9	1.1
9.63	0.3	0.5	0.8	1.2	1.8	0.6	1.7
9.84	0.3	0.4	0.6	1.0	1.5	0.6	2.1
10.07	0.4	0.6	0.8	1.2	1.7	0.9	0.8
10.16	0.4	0.6	0.8	1.2	1.6	2.5	0.7
10.52	0.4	0.6	0.9	1.3	1.8	3.2	0.7
10.71	0.5	0.7	1.0	1.4	1.9	3.3	2.0
10.94	0.3	0.6	0.8	1.4	1.9	3.8	3.9
10.95	0.3	0.6	0.9	1.4	2.0	3.8	4.5
10.958							
10.96	0.4	0.6	0.9	1.4	2.0	3.8	4.5
10.97	0.3	0.4	0.5	1.0	1.5	3.1	2.2
11.15	0.4	0.7	0.9	1.4	1.9	2.1	1.8
11.40	0.4	0.6	0.8	1.3	1.9	3.6	0.8
11.64	0.4	0.5	0.8	1.2	1.8	3.9	1.0
	Interstate Highway 4						
	0.5	0.7	1.0	1.5	2.0	3.0	2.9
	1.6	1.9	2.3	3.2	3.3	5.7	8.0
	0.1	0.2	0.3	0.6	0.6	0.5	0.7

Appendix 15. Acreage of areal inundation between adjacent cross sections along Itchepackesassa Creek.

	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
0.15							
0.20	1	1.2	1.4	2.9	12.3	27.3	31.8
0.55	0.7	0.9	1	2.3	14.6	25.1	29.8
0.82	1.1	1.1	1.2	1.3	6.6	13.3	23.4
1.07	0.8	0.9	1.1	1.2	1.3	4.8	13.9
1.30	0.6	0.8	0.8	0.9	1.2	7.0	17.5
1.34	0.2	0.1	0.1	0.2	0.4	1.5	4
1.36	0	0.1	0.1	0.1	0.1	0.5	1.3
1.366							
1.37	0.1	0.1	0.1	0.1	0.2	0.2	0.5
1.39	0.1	0.1	0.1	0.1	0.2	0.9	1.7
1.71	1.2	1.2	1.3	1.8	2.8	15.3	30.1
2.08	1.1	1.3	1.5	1.9	4.4	24.1	38.3
2.45	1	1.2	1.4	2.1	5.2	24.5	43.8
2.72							
2.94	0.7	0.8	0.8	0.9	1.1	2.0	3
3.16	0.5	0.6	0.7	0.7	1	2.3	8.4
3.48	0.7	0.7	0.8	1	1.2	4.6	14.1
3.86	1	1	1	1.1	1.3	5.0	14.2
4.14	0.8	0.9	0.9	1	1.1	3.5	12.4
4.31	0.4	0.4	0.5	0.6	0.6	4.2	11.1
4.66	0.8	0.9	0.9	0.9	1	33.2	48.7
4.88	0.4	0.5	0.5	0.6	0.6	20.3	28
4.97	0.2	0.2	0.3	0.3	0.4	0.6	6.5
5.28	0.8	1	1	1.2	1.5	4.8	18.6
5.45	0.5	0.5	0.6	0.6	0.8	2.5	3
5.62	0.5	0.5	0.5	0.6	0.7	1.2	2.1
5.63	0	0.1	0.1	0.1	0.1	0.1	0.2
5.638							
5.64	0	0	0	0	0	0.0	0.1
5.68	0.2	0.1	0.1	0.2	0.2	0.5	1.5
6.12	1.1	1.2	1.3	1.4	1.7	4.7	11.7
6.25	0.4	0.4	0.4	0.4	0.4	3.1	5.3
6.27	0.1	0.1	0.1	0.1	0.1	0.8	1.2
6.278							
6.28	0	0	0	0.1	0.1	0.1	0.1
6.30	0.1	0.1	0.1	0.1	0.1	0.4	0.8
6.58	0.6	0.7	0.8	0.8	0.9	1.8	7
6.95	1.2	1.2	1.2	1.3	1.5	2.6	8.2
7.24	0.8	0.9	0.9	1	1.3	2.2	4.5
7.59	0.9	1	1.2	1.4	1.6	2.6	61.3
7.88	0.7	0.7	0.7	1	1.2	2.1	56.6
8.22	0.7	0.8	0.8	0.9	1.1	2.8	27.7
8.53	1.1	1.2	1.3	1.4	1.6	3.7	26.2
8.84	1.2	1.2	1.3	1.4	1.6	2.9	19.1
9.0	0.4	0.4	0.4	0.5	0.5	0.9	7.1
9.11	0.5	0.5	0.5	0.5	0.5	0.9	4.1
9.24	0.7	0.7	0.7	0.7	0.8	0.9	8.8
9.25	0.1	0.1	0.1	0.1	0.1	0.4	4.4
9.259							
9.26	0.1	0.1	0.1	0.1	0.1	0.3	2.8
9.27	0.1	0.1	0.1	0.1	0.1	0.4	5.6
9.40	0.6	0.7	0.7	0.7	0.6	1.0	27.4

Appendix 15. Acreage of areal inundation between adjacent cross sections along Itchepackesassa Creek. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
9.63	0.9	0.8	0.8	0.9	1	10.9	46.3
9.84	0.5	0.6	0.6	0.6	0.6	29.3	50.3
10.07	0.6	0.6	0.6	0.7	0.8	23.0	53.7
10.16	0.2	0.2	0.3	0.3	0.3	0.8	20.5
10.52	1	1	1.1	1.2	1.3	2.1	38.9
10.71	0.5	0.6	0.6	0.6	0.8	1.1	11.5
10.94	1	1.1	1.1	1.3	1.4	1.9	4.5
10.95	0.1	0	0.1	0.1	0.1	0.1	0.2
10.958							
10.96	0	0.1	0	0.1	0.1	0.1	0.1
10.97	0.1	0	0.1	0	0	0.1	0.2
11.15	0.5	0.6	0.6	0.8	1	2.0	8.3
11.40	0.8	0.9	1	1	1.2	2.4	16
11.64	0.5	0.6	0.6	0.8	0.8	1.1	17.3
	Interstate Highway 4						
	33.5	36.4	39.0	47.1	86.2	339	966

Appendix 16. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Itchepackesassa Creek.

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
0.15							
0.20		1.1		1.1	0.7	0.8	0.4
0.55		0.9	0.1	1	0.8	0.6	0.4
0.82	0.1	1.1		0.1	0.3	1.3	1.1
1.07		0.9				1.1	1.1
1.30		0.8			0.2	1	2.2
1.34	0.1	0.1				0.2	0.5
1.36		0.1					0.1
1.366							
1.37	0.1	0.1			0.1		
1.39		0.1				0.1	0.2
1.71		1.2		0.1	0.4	1.1	4.7
2.08		1.2	0.1	0.1	0.9	1.4	5.4
2.45		1.2		0.2	1	3.4	4
2.72							
2.94		0.8				0.1	
3.16		0.5	0.1		0.1	0.2	3.5
3.48		0.8		0.1	0.1	0.3	5.3
3.86		1				0.3	1.4
4.14		0.8	0.1	0.1	0.1	0.5	1
4.31		0.5				1.1	0.9
4.66	0.1	0.8	0.1			2.7	2.6
4.88		0.5				0.6	1.1
4.97		0.3		0	0.1		0.4
5.28		0.9		0	0.1	0.1	1.1
5.45		0.6		0	0.1	0.1	0.2
5.62		0.4		0	0.1	0	0.1
5.63		0.1		0.1	0	0	0
5.638							
5.64							0.1
5.68	0.1	0.1				0.1	0.1
6.12		1.2			0.1	0.8	1.3
6.25	0.1	0.4				2.1	0.3
6.27		0.1				0.4	
6.278							
6.28					0.1		
6.30		0.1					0.1
6.58		0.7	0.1			0.2	2.9
6.95	0.1	1.2		0.1		0.1	3.3
7.24		0.8			0.1	0.1	0.9
7.59		1		0.1	0	0.1	4.3
7.88		0.8		0.1	0	0.3	4.6
8.22		0.7	0.1		0	0.3	2.7
8.53		1.2			0.1	0.3	1.3
8.84		1.2	0.1			0.2	2.6
9.0	0.1	0.5		0.1			1.1
9.11		0.5				0.1	0.7

Appendix 16. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along Itchepackesassa Creek. (Continued) (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
9.24		0.7			0.1	0.1	2
9.25					0	0.2	0.2
9.259							
9.26		0.2				0.2	0.1
9.27		0.1				0.2	0.7
9.40		0.6	0.1	0.1	0	0.1	6.7
9.63		0.9			0.1	3.1	3.2
9.84		0.5				6.5	0.8
10.07		0.6			0.1	4.6	2.9
10.16		0.2	0.1			0.2	2.7
10.52		1.1					10.6
10.71		0.5				0.1	4.2
10.94		1.1				0.1	0.5
10.95	0.1			0.1			0.1
10.958							
10.96		0.1			0.1		
10.97	0.1		0.1				0.1
11.15		0.6		0.1	0.1	0.2	0.5
11.40		0.9				0.2	2.1
11.64		0.6				0.1	2.6
	Interstate Highway 4						
	1.0	1.3	1.1	3.6	6.0	38	104

Appendix 17. Extent of inundation at cross sections along East Canal for selected percentile discharges.

	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
.15	4	5	6	12	22	300	794
0.19	6	10	12	17	70	303	811
0.20	23	24	24	24	25	41	60
0.22	7	10	13	18	76	306	834
0.29	20	21	22	24	28	39	149
0.44	21	22	22	24	25	34	645
0.61	21	22	23	24	27	33	830
0.70	21	23	26	30	34	285	480
0.78	32	34	36	40	46	230	277
0.84	7	8	9	11	14	23	201
0.96	8	8	9	9	40	355	922
1.13	20	22	23	26	29	36	282
1.38	27	27	28	29	625	1,076	1,264
1.65	26	27	28	29	35	52	69
1.83	28	29	31	33	49	608	759
1.94	17	17	18	19	20	22	30
1.96	48	49	50	55	65	245	524
1.98	Knights-Griffin Road Culvert						
1.99	48	49	50	55	65	247	805
2.00	40	40	40	41	42	73	477
2.09	26	27	28	28	31	155	415
2.44	16	17	18	19	21	220	2,259
2.55	35	36	37	39	41	338	2,207
2.82	17	18	19	21	25	193	387
3.03	30	31	32	34	37	1,192	1,411
3.23	21	23	24	26	29	102	605
3.40	30	31	31	32	33	980	1,075
3.67	22	22	23	23	24	118	833
3.96	16	16	16	17	17	19	20
4.05	20	21	21	22	23	26	28
4.13	15	16	17	18	20	30	130
4.16	34	34	34	35	38	53	63
4.17	Allen Road Culvert						
4.18	35	35	35	36	38	53	63
4.23	23	23	23	23	23	24	25
4.34	16	16	16	17	17	18	20
4.38	19	19	19	19	19	20	37
4.44	19	19	19	20	20	22	226
4.49	11	12	12	13	13	24	235
4.52	17	17	17	18	19	27	142
4.54	16	16	17	18	19	28	36
4.58	12	13	14	17	20	32	44

Appendix 17. Extent of inundation at cross sections along East Canal for selected percentile discharges. (Continued)

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
4.65	12	15	17	19	22	32	51
4.68	17	18	20	23	27	46	66
4.687	Terrace Road Bridge						
4.69	17	18	20	23	27	46	67
4.72	9	9	9	10	12	22	39
4.79	19	19	20	21	21	24	27
4.89	7	7	6	7	8	12	27
	Interstate Highway 4						
	21	22	22	24	43	177	451
	48	49	50	55	625	1,192	2,259
	4	5	6	7	8	12	20

Appendix 18. Hydraulic depth at cross sections along East Canal.

	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
.15	0.26	0.34	0.53	0.79	1.03	1.68	1.76
0.19	0.66	0.71	0.80	1.01	0.60	1.74	1.77
0.20	0.29	0.63	0.90	1.40	2.04	3.02	3.69
0.22	0.66	0.72	0.81	1.03	0.60	1.80	1.80
0.29	0.08	0.24	0.44	0.81	1.31	2.84	1.44
0.44	0.31	0.41	0.51	0.71	1.01	2.42	0.73
0.61	0.15	0.34	0.55	0.93	1.31	2.40	0.27
0.70	0.34	0.47	0.60	0.93	1.38	0.65	1.57
0.78	0.22	0.39	0.57	0.94	1.39	1.23	2.15
0.84	0.19	0.24	0.34	0.61	0.96	2.24	0.67
0.96	0.77	1.07	1.35	1.82	0.69	0.89	1.21
1.13	0.84	1.11	1.37	1.85	2.43	3.82	0.88
1.38	0.48	0.83	1.18	1.81	0.50	1.76	2.71
1.65	0.53	0.87	1.22	1.84	2.52	3.22	3.59
1.83	0.15	0.45	0.80	1.42	1.80	1.14	2.15
1.94	0.31	0.31	0.50	1.08	2.02	3.59	3.79
1.96	0.25	0.32	0.47	0.98	1.84	3.06	4.48
1.98							
1.99	0.25	0.32	0.48	0.98	1.84	3.07	4.50
2.00	0.05	0.06	0.15	0.68	1.67	2.12	1.06
2.09	0.45	0.64	0.78	0.88	1.57	0.82	1.19
2.44	0.48	0.73	0.98	1.43	1.95	0.84	0.66
2.55	0.20	0.42	0.68	1.17	1.76	1.00	0.80
2.82	0.46	0.59	0.77	1.15	1.63	0.66	0.99
3.03	0.31	0.49	0.70	1.14	1.70	0.89	1.56
3.23	0.28	0.42	0.61	1.02	1.54	1.25	0.72
3.40	0.14	0.24	0.38	0.75	1.32	0.68	1.45
3.67	0.49	0.65	0.82	1.18	1.69	1.06	0.74
3.96	0.24	0.44	0.66	1.08	1.65	3.75	4.79
4.05	0.29	0.44	0.65	1.05	1.60	3.59	4.73
4.13	0.18	0.30	0.48	0.86	1.36	2.74	1.48
4.16	0.03	0.05	0.07	0.18	0.64	2.89	4.43
4.17							
4.18	0.08	0.11	0.15	0.24	0.65	2.89	4.44
4.23	0.11	0.17	0.24	0.37	0.44	2.49	3.96
4.34	0.16	0.23	0.32	0.51	0.83	1.82	3.25
4.38	0.05	0.09	0.15	0.27	0.44	1.40	2.09
4.44	0.25	0.34	0.46	0.66	0.90	1.66	0.61
4.49	0.12	0.21	0.33	0.56	0.84	1.54	0.43
4.52	0.20	0.29	0.40	0.63	0.92	1.92	0.85
4.54	0.19	0.29	0.40	0.62	0.91	1.93	2.71
4.58	0.19	0.27	0.38	0.57	0.80	1.82	2.57
4.65	0.25	0.33	0.44	0.70	1.00	2.01	2.39
4.68	0.18	0.28	0.40	0.64	0.91	1.74	3.11
4.687							
4.69	0.20	0.29	0.41	0.64	0.91	1.75	3.12
4.72	0.63	0.74	0.88	1.14	1.37	1.97	2.12
4.79	0.04	0.15	0.33	0.64	1.06	2.60	3.96
4.89	0.29	0.31	0.23	0.32	0.45	1.36	1.92
	Interstate Highway 4						
	0.29	0.42	0.58	0.91	1.26	1.99	2.20
	0.84	1.11	1.37	1.85	2.52	3.82	4.79
	0.03	0.05	0.07	0.18	0.44	0.65	0.27

Appendix 19. Acreage of areal inundation between adjacent cross sections along East Canal.

	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
.15							
0.19	0.03	0.04	0.05	0.08	0.24	1.44	4.23
0.20	0.02	0.02	0.02	0.03	0.05	0.19	0.5
0.22	0.02	0.03	0.04	0.04	0.1	0.32	0.82
0.29	0.12	0.13	0.14	0.18	0.45	1.53	4.26
0.44	0.38	0.4	0.41	0.43	0.48	0.66	6.89
0.61	0.42	0.44	0.46	0.49	0.52	0.67	15.07
0.70	0.24	0.25	0.27	0.31	0.35	1.76	8.04
0.78	0.24	0.26	0.28	0.33	0.36	2.48	3.65
0.84	0.13	0.13	0.15	0.16	0.19	0.84	1.62
0.96	0.14	0.15	0.16	0.19	0.51	3.57	10.61
1.13	0.28	0.31	0.32	0.36	0.72	4.23	12.72
1.38	0.7	0.73	0.77	0.83	10.01	17.02	23.54
1.65	0.79	0.81	0.83	0.87	10.19	17.42	20.1
1.83	0.6	0.62	0.64	0.67	0.92	7.27	9.13
1.94	0.31	0.32	0.33	0.36	0.47	4.01	5
1.96	0.12	0.11	0.12	0.12	0.14	0.51	1.06
1.98							
1.99	0.11	0.12	0.12	0.13	0.15	0.56	1.52
2.00	0.1	0.1	0.1	0.11	0.13	0.37	1.47
2.09	0.32	0.32	0.33	0.33	0.35	1.07	4.12
2.44	0.93	0.96	0.99	1.03	1.12	8.09	57.7
2.55	0.35	0.37	0.37	0.4	0.44	3.84	30.75
2.82	0.84	0.86	0.9	0.97	1.06	8.54	41.69
3.03	0.61	0.63	0.66	0.72	0.8	17.96	23.32
3.23	0.62	0.65	0.67	0.72	0.79	16.3	24.96
3.40	0.53	0.55	0.57	0.6	0.65	11.17	17.37
3.67	0.83	0.85	0.85	0.88	0.92	16.47	28.56
3.96	0.57	0.57	0.58	0.6	0.62	1.98	11.86
4.05	0.3	0.3	0.3	0.31	0.32	0.36	0.38
4.13	0.18	0.19	0.2	0.2	0.21	0.28	0.82
4.16	0.1	0.11	0.11	0.12	0.13	0.18	0.41
4.17							
4.18	0.08	0.08	0.08	0.08	0.08	0.12	0.15
4.23	0.14	0.14	0.14	0.14	0.16	0.19	0.21
4.34	0.27	0.27	0.27	0.27	0.27	0.29	0.31
4.38	0.09	0.09	0.1	0.1	0.1	0.1	0.15
4.44	0.13	0.13	0.12	0.13	0.13	0.14	0.85
4.49	0.1	0.1	0.11	0.11	0.11	0.16	1.59
4.52	0.04	0.04	0.04	0.04	0.05	0.07	0.52
4.54	0.04	0.05	0.04	0.05	0.05	0.08	0.24
4.58	0.07	0.07	0.08	0.09	0.1	0.15	0.21
4.65	0.11	0.13	0.15	0.16	0.19	0.28	0.42
4.68	0.05	0.05	0.06	0.07	0.08	0.14	0.21
4.687							
4.69	0.02	0.02	0.02	0.02	0.03	0.03	0.03
4.72	0.04	0.04	0.04	0.05	0.06	0.1	0.17
4.79	0.13	0.13	0.14	0.15	0.15	0.21	0.3
4.89	0.14	0.15	0.15	0.15	0.17	0.21	0.31
Total	12.4	12.8	13.3	14.2	35.1	153	378

Appendix 20. Decrease of inundated acreage resulting from a potential 10-percent discharge withdrawal at cross sections along East Canal.

[Blanks indicate no decrease in inundated acreage]

Cross section No.	Percentiles						
	P_{50}	P_{70}	P_{80}	P_{90}	P_{95}	$P_{99.5}$	$P_{99.97}$
	Feet						
.15							
0.19	0.03	0.04	0.05		0.04	0.04	0.53
0.20	0.02			0.03	0.05		
0.22		0.03	0.04	0.04		0.02	0.12
0.29	0.02	0.03	0.04		0.05	0.03	0.56
0.44				0.03		0.06	2.29
0.61	0.02	0.04	0.06		0.02		10.07
0.70	0.04			0.01	0.05	0.66	5.24
0.78						0.58	0.05
0.84	0.03	0.03	0.05	0.06		0.04	0.22
0.96	0.04	0.05	0.06		0.21	0.77	1.11
1.13		0.01			0.12	0.83	1.72
1.38			0.07	0.03	0.61	0.12	2.74
1.65		0.01			0.59	0.12	0.9
1.83		0.02	0.04		0.02	0.27	0.23
1.94	0.01	0.02	0.03		0.07	0.11	0.2
1.96	0.02	0.01	0.02	0.02		0.01	0.06
1.98							
1.99	0.01	0.02		0.03	0.05	0.06	0.22
2.00				0.01	0.03	0.17	0.17
2.09			0.03	0.03		0.67	0.82
2.44	0.03	0.06			0.02	3.19	2.3
2.55	0.05		0.07		0.04	0.34	0.55
2.82		0.06		0.07		2.94	1.29
3.03	0.01			0.02	0.1	2.36	0.62
3.23	0.02	0.05		0.02		0.6	0.66
3.40	0.03		0.07			0.77	0.47
3.67	0.03	0.05			0.02	1.07	0.56
3.96			0.08		0.02	0.28	0.26
4.05				0.01	0.02		
4.13					0.01		0.12
4.16		0.01	0.01	0.02	0.03	0.08	0.01
4.17							
4.18		0.08					
4.23	0.04					0.09	0.01
4.34			0.07	0.07			0.01
4.38		0.09					0.05
4.44	0.03			0.03	0.03		0.05
4.49			0.01		0.01	0.06	0.09
4.52	0.04	0.04	0.04	0.04	0.05		0.12
4.54				0.05			0.04
4.58	0.07	0.07	0.08			0.05	0.01
4.65							0.02
4.68	0.05	0.05	0.06			0.04	0.01
4.687							
4.69	0.02	0.02		0.02	0.03	0.03	0.03
4.72			0.04	0.05	0.06		
4.79	0.03	0.03	0.04				0.1
4.89	0.04	0.05		0.05		0.01	0.01
Total	0.7	1.0	1.1	0.7	2.4	16.5	34.6