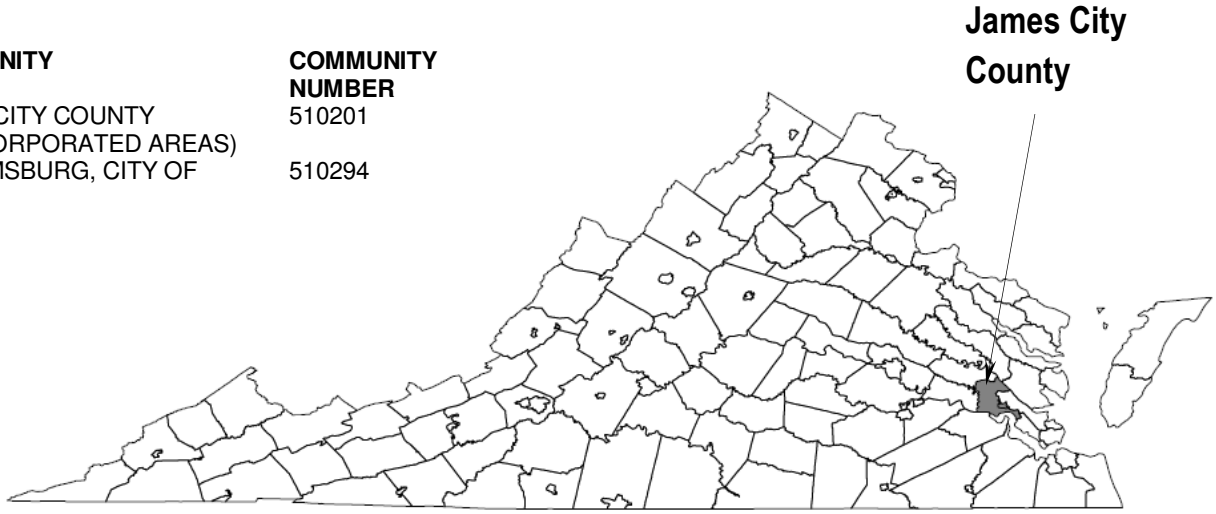
FLOOD INSURANCE STUDY

JAMES CITY COUNTY, VIRGINIA
AND INCORPORATED AREAS

COMMUNITY NAME	COMMUNITY NUMBER
JAMES CITY COUNTY (UNINCORPORATED AREAS)	510201
WILLIAMSBURG, CITY OF	510294



PRELIMINARY
MARCH 28, 2014

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
51095CV000B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

Part or all of this FIS report may be revised and republished at any time. In addition, part of this FIS report may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. It is, therefore, the responsibility of the user to consult with community officials and to check the community repository to obtain the most current FIS report components.

Initial FIS Report Effective Date: September 28, 2007

Revised FIS Report Dates: TDB – to incorporate new detailed coastal flood hazard analyses, to incorporate a Letter of Map Revision, and to update base map data

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 Purpose of Study	1
	1.2 Authority and Acknowledgments	1
	1.3 Coordination	2
2.0	AREA STUDIED	3
	2.1 Scope of Study	3
	2.2 Community Description	3
	2.3 Principal Flood Problems	4
	2.4 Flood Protection Measures	6
3.0	ENGINEERING METHODS	7
	3.1 Hydrologic Analyses	7
	3.2 Hydraulic Analyses	8
	3.3 Coastal Analysis	10
	3.4 Vertical Datum	16
4.0	FLOODPLAIN MANAGEMENT APPLICATIONS	17
	4.1 Floodplain Boundaries	17
	4.2 Floodways	17
5.0	INSURANCE APPLICATIONS	18
6.0	FLOOD INSURANCE RATE MAP	19
7.0	OTHER STUDIES	20
8.0	LOCATION OF DATA	20
9.0	BIBLIOGRAPHY AND REFERENCES	20

TABLE OF CONTENTS – continued

FIGURES

	Page
Figure 1 – Transect Schematic	12
Figure 2 – Transect Location Map	16-18
Figure 3 – Floodway Schematic	25

TABLES

Table 1 – Summary of Discharges	8-9
Table 2 – Summary of Stillwater Elevations	14
Table 3 – Transect Data	19-22
Table 4 – Floodway Data Table	24-28
Table 5 – Community Map History Table	31

EXHIBITS

Exhibit 1–	Flood Profiles	
	Chisel Run	01-02P
	East Tributary to Chisel Run	03P
	Long Hill Swamp	04-05P
	Powhatan Creek	06-08P
	Unnamed Tributary to Long Hill Swamp	09P
	West Tributary to Long Hill Swamp	10P
Exhibit 2–	Flood Insurance Rate Map Index	
	Flood Insurance Rate Maps	

FLOOD INSURANCE STUDY
JAMES CITY COUNTY AND INCORPORATED AREAS, VIRGINIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of James City County, including the City of Williamsburg, Independent City, Virginia; and the unincorporated areas of James City County, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the State (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgements

The sources of authority for this FIS are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to include the unincorporated areas of, and incorporated communities within, James City County in a countywide format. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

James City County (Unincorporated Areas):	The hydrologic and hydraulic analyses for the original riverine flooding sources presented in this study were prepared by the Soil Conservation Service during the preparation of a report entitled *Flood Hazard Analyses, Powhatan Creek and Tributaries.* This work was completed in December 1976. For the February 6, 1991 FIS, the hydrologic and hydraulic analyses for the tidal flooding sources in James City County were performed by the Norfolk District of the U.S. Army Corps of Engineers (USACE) for the Federal Emergency Management Agency (FEMA), under Interagency Agreement No. EMW-87-E2509, Project Order No. 3, Amendment No. 1. This work was completed in September 1988.

City of Williamsburg Independent City:	In the original FIS, the hydrologic analysis for Queen Creek, an estuary to the York River; and College Creek, Paper Mill Creek and the outlet to Tutters Neck Pond, estuaries to the James River were obtained from the FIS for the unincorporated areas of York County, Virginia (FEMA, 1988). The March 2, 1994 revision for the City of Williamsburg updated the corporate limits, added base flood elevations to change special flood hazard areas, changed zone designations, update map format and add special flood hazard areas previously shown in the FIS for the unincorporated areas of James City County, Virginia (FEMA, 1991).

The September 28, 2007 countywide FIS, no new hydrologic and hydraulic analyses were performed.

For this countywide revision, detailed coastal flood hazard analyses were performed for several flooding sources. The Federal Emergency Management Agency (FEMA), Region III office, initiated a study in 2008 to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay including its tributaries, and the Delaware Bay. The storm surge study was conducted for FEMA by the US Army Corps of Engineers (USACE) and its project partners under Project HSFE03-06-X-0023, "NFIP Coastal Storm Surge Model for Region III" and Project HSFE03-09-X-1108, "Phase II Coastal Storm Surge Model for FEMA Region III".

In addition, the following LOMR was incorporated:

Case No.: 12-03-2459P for the unincorporated areas of James City County.

For this revision, base map information shown on this FIRM was provided by the Commonwealth of Virginia through the Virginia Base Mapping Program (VBMP). The orthophotos were flown in 2009 at scales of 1":100' and 1":200'.

The projection used for the preparation of this FIRM was the North American Datum of 1983 (NAD 83) HARN (High Accuracy Reference Network) Virginia State Plane South coordinate system (FIPSZONE 4502). The horizontal datum was NAD 83 HARN, GRS80 spheroid. Differences in the datum and spheroid used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

The purpose of an initial Consultation Coordination Officer's (CCO) meeting is to discuss the scope of the FIS. A final CCO meeting is held to review the results of the study.

The initial Consultation Coordination Office (CCO) meeting for the February 6, 1991 pre-countywide FIS for James City County was held on June 17, 1986, and

attended by representatives of FEMA, the county and the USACE (the study contractor).

Contacts with various Federal and State agencies were made during the preparation of the study in order to minimize possible hydrologic and hydraulic conflicts. A search for basic data was made at all levels of government.

The results of the study were reviewed at the final CCO meeting held on February 28, 1990, and attended by representatives of FEMA, the county and the study contractor to review the results of the study. The final meeting for the City of Williamsburg was held on April 5, 1993, with representatives of the City of Williamsburg, the USACE, Norfolk District and FEMA. All problems raised at these meetings have been addressed.

The results of the September 28, 2007 countywide FIS were reviewed at the final CCO meeting held on January 23, 2007, and attended by representatives of FEMA, the Commonwealth of Virginia, James City County, City of Williamsburg, and Greenhorne & O'Mara Inc. All problems raised at that meeting have been addressed in this study.

For this revision, a RiskMAP Coordination meeting was held on April 6, 2011, and attended by representatives of FEMA, the Commonwealth of Virginia, James City County, and RAMPP. Another RiskMAP Coordination meeting was held on, February 14, 2012, and attended by representatives of FEMA, the Commonwealth of Virginia, the City of Williamsburg, USACE Norfolk District, and RAMPP.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the James City County, Virginia, including the incorporated community listed in Section 1.1.

The following riverine sources were studies by detailed methods within James City County: Chisel Run, from its confluence with Powhatan Creek to a point approximately 630 feet downstream of State Route 658; East Tributary to Chisel Run, from its confluence with Chisel Run to a point approximately 2,750 feet upstream of State Route 199; Long Hill Swamp, from its confluence with Powhatan Creek to a point approximately 2,240 feet upstream of State Route 199; Powhatan Creek, from its confluence with James River to the confluence of Chisel Run and Long Hill Swamp; Tributary 1 to West Tributary to Long Hill Swamp, from its confluence with West Tributary to Long Hill Swamp to a point approximately 3,600 feet upstream of the confluence; Tributary 2 to West Tributary to Long Hill Swamp, from its confluence with West Tributary to Long Hill Swamp to a point approximately 1,940 feet upstream of the confluence; Unnamed Tributary to Long Hill Swamp, from its confluence with Long Hill Swamp, to approximately 2,170 feet upstream of the confluence with Log Hill Swamp; and West Tributary to Log Hill Swamp, from its confluence with Long Hill Swamp to a point approximately 4,410 feet upstream of the Warhill trail.

The following flooding sources within the City of Williamsburg were studied by detailed methods: Queen Creek, an estuary to the York River; and College Creek, Paper Mill Creek and the outlet to Tutters Neck Pond, estuaries to the James River. Limits of detailed study are indicated on the FIRM (Exhibit 1).

For this countywide revision, tidal flooding from the York, James, and Chickahominy Rivers and their adjoining estuaries was studied by detailed methods. All areas within the county affected by tidal flooding were included in the detailed study. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Approximate analyses were used to study those areas having low development potential or minimal flood hazards. The scope and methods of study were proposed to and agreed upon by FEMA and James City County.

All or portions of the following flooding sourced were studied by approximate methods: Barnes Swamp, Bird Swamp, Chisel Run, Diascund Creek Reservoir, Edwards Swamp, Little Creek Reservoir, Mill Creek, Richardson Mill Pond, Skiffles Creek Reservoir, Ware Creek, West Tributary to Long Hill Swamp, East Tributary to Chisel Run, Long Hill Swamp, Skimino Creek, Barlows Pond and an unnamed tributary to Chisel Run.

Letter of Map Revision (LOMR) 12-03-2459P in James City County was incorporated into this revision.

2.2 Community Description

James City County and the City of Williamsburg are located in southeastern Virginia. The county is bordered by the unincorporated areas of New Kent County to the north; the unincorporated areas of Gloucester County to the northeast; the unincorporated areas of Surry County to the south; the unincorporated areas of York County, the City of Williamsburg, and the City of Newport News to the east; and the unincorporated areas of Charles City County to the west. The following flooding sources also border the county: the York River to the east, the James River to the south and the Chickahominy River to the west.

James City County encompasses an area of approximately 148 square miles, of which 34 square miles are water (Commonwealth of Virginia, 1974).

The population of James City County was 67,009 and 14,068 for the City of Williamsburg in 2010 (U.S. Census Bureau, 2010). Many residents are employed in the tourism and trade industries, stimulated by the many historical attractions in James City County. The floodplains of the county consist of scattered residential structures, businesses, croplands and forests. With the county's many miles of shoreline, increased pressure for development of the floodplains is expected.

The Powhatan Creek watershed comprises approximately 23 square miles of the Coastal Plain peninsula between the James and York Rivers in southeast Virginia. The James River is the southernmost basin of the Water Resources Council Mid-Atlantic Region. Powhatan Creek rises northwest of the City of Williamsburg and flows generally towards the south approximately 21 miles to its confluence with the James River. The main stem floodplain comprises approximately 2.2 square miles of predominately wooded swamp and tidal marsh. Tributary floodplains comprise another 0.47 square miles; these are also on relatively flat gradients. The upper perimeter of the watershed follows approximately along the100-foot contour.

James City County and the City of Williamsburg both enjoy a temperate climate, with moderate seasonal changes characterized by warm summers and cool winters. In the warmest month, July, the average high temperature is 89 degrees Fahrenheit (°F) and the average low temperature is 67°F. In the coolest month, January, the average high temperature is 49°F and the average low temperature is 28°F. Annual precipitation over the area averages approximately 49 inches per

year (The Weather Channel, 2005). There is some variation in the monthly averages; however, this rainfall is distributed uniformly throughout the year. Snowfall is infrequent, generally occurring in the light amounts and usually melting in a short period of time.

James City County is located in the Coastal Plain province between the York and James Rivers and is underlain primarily by clay, sand, marl and gravel strata. Elevations within the county range from sea level to approximately 140 feet.

2.3 Principal Flood Problems

Within the Powhatan Creek watershed, regularly spaced road fills act as dams and, in effect, convert portions of the floodplains into a series of floodwater- retarding reservoirs during the larger floods. Even moderate floods tend to cover the total floodplain in a network of shallow channels. Larger floods generally result in greater depths of flooding, with slight increases in the area inundated. Below State Route 31, approximately 3 miles upstream from the James River, tide stages rather than stream flows determine the maximum depth for a particular frequency.

The areas along the shoreline of James City County and the City of Williamsburg are vulnerable to tidal flooding from major storms, commonly referred to as hurricanes and nor'easters. Both storms produce winds that push large volumes of water against the shore.

Hurricanes, with their high winds and heavy rainfall, are the most severe storms to which the county is subjected. The term "hurricane" is applied to an intense cyclonic storm originating in tropical or subtropical latitudes in the Atlantic Ocean just north of the equator. While hurricanes may affect the area from May through November, nearly 80 percent occur during the months of August, September and October with approximately 40 percent occurring during September.

Another type of storm can cause severe damage to the county is the nor'easter. This is also a cyclonic storm, and originates with little or no warning along the middle and northern Atlantic Coast. These storms occur most frequently in the winter months but may occur at any time. Accompanying winds are not of hurricane force, but are persistent, causing above-normal tides for long periods of time. The March 1962 nor'easter was one of the most severe to ever hit the county.

The amount and extent of damage caused by any tidal flood will depend upon the topography of the area flooded, rate of rise in floodwaters, depth and duration of flooding, exposure to wave action, and the extent to which damageable property has been placed in the floodplain. The depth of flooding during these storms depends upon the velocity, direction and duration of the wind; the size and depth of the body of water over which the wind is acting and the astronomical tide. The duration of flooding depends upon the duration of the tide-producing forces. Floods caused by a hurricane are usually of a much shorter duration than the ones caused by a nor'easter. Flooding from hurricanes rarely lasts more than one tidal cycle; however, flooding caused by nor'easters may last several days, during which the most severe flooding takes place at the time of the peak astronomical tide.

The timing or coincidence of the maximum storm surge with the normal high tide is an important factor in the consideration of flooding from tidal sources. The mean range of tide in the York River at West Point is 2.8 feet; mean range of tide is 2 feet in the James River at Jamestown Island. The range of tide may be

somewhat less in the connecting bays and inlets (U.S. Department of Commerce, 1987).

The area also contains estuaries of the York, James and Chickahominy Rivers that are subject to tidal flooding in their lower reaches but fluvial flooding on the upper reaches. Flooding on the upper reaches of these streams may be caused by heavy rains occurring at any time during the year. Flooding may also occur as a result of intense rainfall produced by local thunderstorms or tropical disturbances such as hurricanes, which move into the area from the Gulf or Atlantic coasts.

James City County has experienced major storms since the early settlement of the area. Historical accounts of severe storms in the area date back several hundred years. The following paragraphs discuss some of the large storms that have occurred in recent history.

August 23, 1933, Hurricane

The hurricane of August 23, 1933 was one of the most severe storms that ever occurred in the Middle Atlantic region. This tropical hurricane passed inland near Cape Hatteras on August 22, passed slightly west of Norfolk and continued towards the north accompanied by extreme high wind and tide. The storm surge in the bay and tidal estuaries were the highest of record and coincided with astronomical high tide. The water level reached a maximum of 8 feet in Hampton Roads (USACE, 1962).

October 15, 1954, Hurricane Hazel

Hurricane "Hazel," the second most destructive of recent hurricanes to strike the area, entered the mainland south of Wilmington, North Carolina, during the morning of October 15, 1954, and moved rapidly northward, passing over Norfolk and Fredericksburg in the early afternoon. The winds were from the east and southeast until the eye passed. When the eye passed, the winds shifted to the southwest with higher velocities. The hurricane surge was not as high as the August 1933 storm, although the tidal surge was superimposed on the normal high tide. In addition to the damage by tidal flooding, much damage was caused to roofs, communication lines and other structures by high wind. Damage of this nature is characteristic of that to be expected during hurricanes (USACE, 1962).

March 6 to 8, 1962, Nor'easter

One flood of major proportions in the area occurred during the nor'easter of March 6 to 8, 1962. Disastrous flooding and high waves occurred along the Atlantic seaboard from New York to Florida. This flood was unusual, even for a nor'easter, since it was caused by a low pressure cell that moved from south to north past Hampton Roads and then reversed its course, moving again to the south and bringing huge volumes of water and high waves. The maximum flood height occurred on the morning of March 7 and reached 7.4 feet in Hampton Roads (USACE, 1962).

September 16, 1999, Hurricane Floyd

An estimate of damage to public buildings and facilities due to Hurricane Floyd runs more than $700,000 in James City County. The biggest imprint Floyd left in James City County was a 150 foot-wide gap in Jamestown Road over Lake Powell. The breach of the dam on the lake's south side and heavy rainwater, which

caused the lake to rise 5 feet above normal, caused water to rush over Jamestown Road. The water tore apart the road, bringing water and sewer lines down as it collapsed.

September 18, 2003, Hurricane Isabel

A more recent tidal state of major proportions occurred during Hurricane Isabel, making landfall on September 18, 2003, along the Outer Banks of North Carolina and tracking northward through Virginia and up to Pennsylvania. At landfall, maximum sustained winds were estimated at 104 mph. Isabel weakened to a tropical storm by the time it moved into Virginia and lost tropical characteristics as it moved into Pennsylvania. The storm caused high winds, storm surge flooding, and extensive property damage throughout the Chesapeake Bay region. Within Virginia, ninety-nine communities were directly affected by Isabel. There were 39 deaths, two of which occurred in Poquoson, over a billion dollars in property damage, and almost two million electrical customers without power for many days. Historical maximum water level records were exceeded at several locations within the Chesapeake Bay. In general, maximum water levels in the lower Chesapeake Bay resembled those of the August 1933 hurricane, with storm surge occurring around the time of the predicted high tide. 50 homes were destroyed in Poquoson, with another 2,000 severely damaged, primarily due to flooding. Measurable beach erosion occurred from North Carolina to the Middle Peninsula and Northern Neck. Some communities along the Chesapeake Bay and its tributaries also experienced severe damage from wave action (Commonwealth of Virginia, 2003; National Weather Service, 2003; USACE, 2003).

August 29, 2006, Tropical Depression Ernesto

In late August 2006, Tropical Depression Ernesto caused significant damage in James City County. Five to eight inches of rainfall and winds reaching 60 to 70 mph were reported in central and eastern Virginia. Tidal flooding occurred on the York River where tides ran 4 to 5 feet above normal. Over six hundred homes were damaged or destroyed and 7 fatalities were reported due to the storm (Commonwealth of Virginia, 2009).

2.4 Flood Protection Measures

There are no existing flood control structures that would provide protection during major floods in James City County or the City of Williamsburg. There are several measures that have provided some protection against flooding. These include bulkheads, seawalls, jetties and nonstructural measures for floodplain management, such as zoning codes. The "Uniform Statewide Building Code," which went into effect in September 1973, states, "where a structure is located in a 100-year floodplain" the lowest floor of all future construction or substantial improvement to an existing structure...must be built at or above that level, except for nonresidential structures which may be floodproofed to that level" (Commonwealth of Virginia, 1973).

3.0 ENGINEERING METHODS

For the flooding sources studied by detail methods in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-Year period (recurrence interval) have been selected as having special significance for floodplain management and for flood

insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-Year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than one year are considered. For example, the risk of having a flood which equals or exceeds the 1-percent- annual-chance flood in any 50-year period is approximately 40 percent (four in ten); for any 90-year period, the risk increases to approximately 60 percent (six in ten). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak elevation-frequency relationships for the flooding source studied in detail affecting the community.

The original hydrologic analyses for Powhatan Creek, Long Hill Swamp, Chisel Run, West Tributary to Long Hill Swamp and East Tributary to Chisel Run were taken from a report entitles *Flood Hazard Analysis, Powhatan Creek and Tributaries,* prepared by the SCS (U.S. Department of Agriculture, 1976).

The peak flow rates were developed using the USACE's HEC-HMS (USACE, 2010). For the purposes of this analysis, a Type II synthetic rainfall distribution was utilized in conjunction with rainfall amounts from National Oceanic and Atmospheric Administration's (NOAA) National Climatic Data Center's *Precipitation-Frequency Atlas of the United States NOAA Atlas 14, Volume 2, Version 3* (NOAA, 2004). The peak discharge-drainage area relationships for James City County are shown in Table 1, Summary of Discharges.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
POWHATAN CREEK					
At Monticello Ave	12.60	4,520	9,430	12,400	21,460
At News Road	8.13	4,120	8,610	11,450	20,130
LONG HILL SWAMP					
Just upstream of confluence with Powhatan Creek	5.12	1,940	3,610	4,500	7,070
Just upstream of State Route 199	0.27	1,330	2,410	2,995	4,630

TABLE 1 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
CHISEL RUN					
Just upstream of confluence with Powhatan Creek	4.37	4,780	7,930	9,580	14,150
Just upstream of confluence of East Tributary to Chisel Run	2.92	3,780	6,170	7,410	10,850
At Longhill Road	1.71	1,970	3,340	4,060	6,060
At approximately 2,330 feet upstream of State Route 199	0.25	410	680	828	1,230
WEST TRIBUTARY TO LONG HILL SWAMP					
Just upstream of confluence with Long Hill Swamp	2.50	450	810	990	2,180
EAST TRIBUTARY TO CHISEL RUN					
Just upstream of confluence with Chisel Run	1.05	1,580	2,464	2,920	4,160
At approximately 2,280 feet upstream of State Route 199	0.44	730	1,150	1,370	1,960
UNNAMED TRIBUTARY TO LONG HILL SWAMP					
Just upstream of confluence with Long Hill Swamp	0.25	365	665	830	1,280

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data Table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

The original hydraulic analyses for Powhatan Creek, Long Hill Swamp, Chisel Run, West Tributary to Long Hill Swamp and East Tributary to Chisel Run were

taken from a report entitled *Flood Hazard Analysis, Powhatan Creek and Tributaries,* prepared by the SCS (U.S. Department of Agriculture, 1976).

Cross section data for the original backwater analyses were obtained by either field survey for from topographic maps furnished by James City County. Only limited surveys were conducted to determine elevations and dimensions of bridge openings, culverts and channels.

The hydraulic modeling for this floodplain study has been performed utilizing HEC-RAS. Cross-sectional data for the HEC-RAS model was developed with RiverCAD® from two (2) ft. topography for the Powhatan Creek Watershed generated from James City County's GIS data set (NAVD 88). The available contour data was amended with plan information for the bridge and culvert crossings across the Powhatan Creek obtained from the Virginia Department of Transportation (VDOT), directly from James City County and field surveyed topography. The road crossing data was provided by Virginia Department of Transportation.

Channel and overbank roughness coefficients (Manning's "n") were determined based on field inspection of the stream and additionally based on *Open-Channel Hydraulics* (Chow, 1959), and *Roughness Characteristics of Natural Channels* (USGS, 2005). Manning's "n" values in the channel for Powhatan Creek were estimated from 0.045 – 0.060, and overbank "n" values from 0.09 – 0.10, respectively.

The starting still water elevations (SWELs) at the downstream boundary for Powhatan Creek (confluence with James River) are based on still water elevations of the James River as shown in (FEMA, 1991). Starting water surface elevations were adopted from the FIS for the City of Norfolk (FEMA, 1984).

Qualifying bench marks (elevation reference marks) within a given jurisdiction that are cataloged by the National Geodetic Survey (NGS) and entered into the National Spatial Reference System (NSRS) as First or Second Order Vertical and have a vertical stability classification of A, B, or C are shown and labeled on the FIRM with their 6- character NSRS Permanent Identifier.

Bench marks cataloged by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation well (e.g., mounted in bedrock)

- Stability B: Monuments which generally hold their position/elevation well (e.g., concrete bridge abutment)

- Stability C: Monuments which may be affected by surface ground movement (e.g., concrete monument below frost line)

- Stability D: Mark of questionable or unknown stability (e.g., concrete monument above frost line, or steel witness post)

In addition to NSRS bench marks, the FIRM may also show vertical

control monuments established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description, and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, (Internet address www.ngs.noaa.gov).

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with this FIS and FIRMs. Interested individuals may contact FEMA to access this data. Hydraulic analyses, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding source studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline.

3.3 Coastal Analysis

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (USACE, 1975). The 3-foot wave has been determined as the minimum size wave capable of causing major damage to conventional wood frame veneer structures.

The methodology for analyzing the effects of wave heights associated with coastal storm surge flooding is described in a report prepared by the National Academy of Sciences (NAS, 1977). This method is based on three major concepts. First, depth-limited waves in shallow water reach maximum breaking height that is equal to 0.78 times the stillwater depth. The wave crest is 70 percent of the total wave height above the stillwater level. The second major concept is that wave height may be diminished by dissipation of energy due to the presence of obstructions, such as sand dunes, dikes and seawalls, buildings and vegetation. The amount of energy dissipation is a function of the physical characteristics of the obstruction and is determined by procedures prescribed in NAS Report. The third major concept is that wave height can be regenerated in open fetch areas due to the transfer of wind energy to the water. This added energy is related to fetch length and depth.

Figure 1 is a profile for a typical transect illustrating the effects of energy dissipation and regeneration on a wave as it moves inland. This figure shows the wave crest elevations being decreased by obstructions, such as buildings, vegetation, and rising ground elevations, and being increased by open, unobstructed wind fetches. Actual wave conditions in the county may not include all the situations illustrated in Figure 1, “Transect Schematic”.

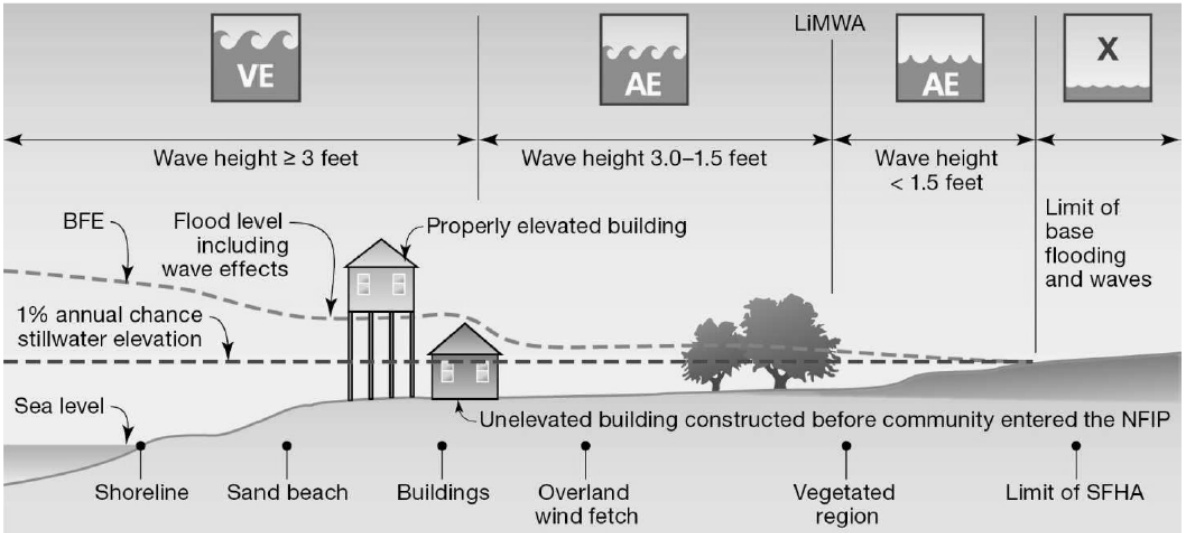


FIGURE 1 - TRANSECT SCHEMATIC

After analyzing wave heights along each transect, wave crest elevations were interpolated between transects. Various source data were used in the interpolation, including the topographic work maps, notes and photographs taken during field inspections, and engineering judgment. Controlling features affecting the wave crest elevations were identified and considered in relation to their positions at a particular transect and their variation between transects. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergo any major changes. The results of this analysis are summarized in Table 3.

Coastal analysis, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline. Users of the FIRM should be aware that coastal flood elevations are provided in Table 2, "Summary of Stillwater Elevations" table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

Development along the coast of James City County occurs along the York River, the Chickahominy River and the James River. Along the York River development is limited to a few subdivisions, with the remaining shoreline occupied by a U. S Naval facility (Camp Peary) and the York River State Park. Shorelines range from marshlands to woodlands atop of steep bluffs. Along the Chickahominy River development is generally limited, with most of the shoreline covered by extensive estuarine marshlands. Along the James River, from the Chicahominy River to Skiffes Creek, development is limited to moderate sized subdivisions on either side of the Colonial National Historic Park, with the remaining shoreline occupied by large estuarine marshlands. With the exception of the marshlands, ground slopes upward from shorelines, and in some areas with steep bluffs exceeding 50 feet, in height. There are no sand dunes along shoreline areas within the limits of the county.

An analysis was performed to establish the frequency peak elevation relationships for coastal flooding in James City County. The FEMA, Region III office, initiated a study in 2008 to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay including its tributaries, and the Delaware Bay. The study replaces outdated coastal storm surge stillwater elevations for all FISs in the study area, including James City County, VA, and serves as the basis for updated FIRMs. Study efforts were initiated in 2008 and concluded in 2012.

The storm surge study was conducted for FEMA by USACE and its project partners under Project HSFE03-06-X-0023, "NFIP Coastal Storm Surge Model for Region III" and Project HSFE03-09-X-1108, "Phase II Coastal Storm Surge Model for FEMA Region III". The work was performed by the Coastal Processes Branch (HF-C) of the Flood and Storm Protection Division (HF), U.S. Army Engineer Research and Development Center – Coastal & Hydraulics Laboratory (ERDC-CHL).

The end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics (Luettich et. al, 2008). ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating WAves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge (USACE, 2012.). The resulting model system is typically referred to as SWAN+ADCIRC (USACE, 2012). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields from three major flood events for the Region III domain: Hurricane Isabel, Hurricane Ernesto, and extratropical storm Ida. Model skill was accessed by quantitative comparison of model output to wind, wave, water level and high water mark observations.

The tidal surge in the York and James Rivers affect approximately 152 miles on the James City County coastline. The western and southern coastlines, from the City of Hampton corporate limits, northwest to the confluence of Skiffes Creek, are more prone to damaging wave action during high wind events due to the significant fetch over which winds can operate. The widths of tributaries, including the Chickahominy River narrow considerably. In these areas, the fetch over which winds can operate for wave generation is significantly less.

The storm-surge elevations for the 10-, 50-, 100-, and 500-year floods were determined for the James River, York River and Chickahominy River and are shown in Table 2, "Summary of Stillwater Elevations." The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects.

TABLE 2 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD*) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
JAMES RIVER				
At confluence of Chickahominy River	5.8	6.9	7.2	8.8
At Jamestown Ferry slip	5.6	6.7	7.1	8.5
At confluence of Skiffes Creek	5.5	6.6	7.0	8.0
YORK RIVER				
At confluence of Ware Creek	5.4	6.5	7.0	9.2
At confluence of Skimino Creek	5.2	6.3	6.7	8.4
CHICKAHOMINY RIVER				
At confluence of Diascund Creek	5.8	6.9	7.2	8.5
At State Route 5 Bridge	5.8	6.9	7.2	8.8

*North American Vertical Datum of 1988

The coastal analysis and mapping for James City County was conducted for FEMA by RAMPP under contract No. HSFEHQ-09-D-0369, Task Order HSFE03-09-0002. The coastal analysis involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave setup, wave height analysis and wave runup.

Wave heights were computed across transects that were located along coastal and inland bay areas of James City County, as illustrated on the FIRMs. The transects were located with consideration given to existing transect locations and to the physical and cultural characteristics of the land so that they would closely represent conditions in the locality.

Each transect was taken perpendicular to the shoreline and extended inland to a point where coastal flooding ceased. Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features, as illustrated in Figure 2, "Transect Location Map."

The stillwater elevations for a 1% annual chance event were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the Zone VE (area with velocity wave action) was computed at each transect.

Dune erosion was taken into account along both the Chesapeake Bay and Atlantic Ocean coastline. A review of the geology and shoreline type in James City County was made to determine the applicability of standard erosion methods, and FEMA's standard erosion methodology for coastal areas having primary frontal dunes, referred to as the "540 rule," was used (FEMA, 2007a). This methodology first evaluates the dune's cross-sectional profile to determine whether the dune has a reservoir of material that is greater or less than 540 square feet. If the reservoir

is greater than 540 square feet, the "retreat" erosion method is employed and approximately 540 square feet of the dune is eroded using a standardized eroded profile, as specified in FEMA guidelines. If the reservoir is less than 540 square feet, the "remove" erosion method is employed where the dune is removed for subsequent analysis, again using a standard eroded profile. The storm surge study provided the return period stillwater elevations required for erosion analyses. There are no sand dunes along shoreline areas within the limits of the county.

Wave height calculations used in this study flood the methodologies described in the FEMA guidance for coastal mapping (FEMA, 2007a). Wave setup results in an increased water level at the shoreline due to the breaking of waves and transfer of momentum to the water column during hurricanes and severe storms. For the James City County study, wave setup was determined directly from the coupled wave and storm surge model The total stillwater elevation (SWEL) with wave setup was then used for simulations of inland wave propagation conducted using FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) model Version 4.0 (FEMA, 2007b). WHAFIS is a one-dimensional model that was applied to each transect in the study area. The model uses the specified SWEL, the computed wave setup, and the starting wave conditions as input. Simulations of wave transformations were then conducted with WHAFIS taking into account the storm-induced erosion and overland features of each transect. Output from the model includes the combined SWEL and wave height along each cross-shore transect allowing for the establishment of base flood elevations (BFEs) and flood zones from the shoreline to points inland within the study area.

Wave runup is defined as the maximum vertical extent of wave uprush on a beach or structure. FEMA's 2007 Guidelines and Specifications require the 2-percent wave runup level be computed for the coastal feature being evaluated (cliff, coastal bluff, dune, or structure) (FEMA, 2007a). The 2-percent runup level is the highest 2-percent of wave runup affecting the shoreline during the 1-percent-annual-chance flood event. Each transect defined within the Region III study area was evaluated for the applicability of wave runup, and if necessary, the appropriate runup methodology was selected and applied to each transect. Runup elevations were then compared to WHAFIS results to determine the dominant process affecting BFEs and associated flood hazard levels. Based on wave runup rates, wave overtopping was computed following the FEMA 2007 Guidelines and Specifications.

Computed controlling wave heights at the shoreline range from 4.3 to 4.6 feet along the York River, from 3.5 to 4.9 feet along the James River where the fetch is long to a range of 1.5 to 3.6 feet along the Chickahominy River, where the fetch is short. The corresponding wave elevation at the shoreline varies from 9.8 to 10.2 feet NAVD along the York River, 9.3 to 10.5 feet NAVD along the James River and 8.3 feet to 9.7 feet NAVD along the Chickahominy River. Areas of marshland, along the Chickahominy River serve to reduce wave height transmitted inland. Areas of vegetation and development do not allow for much, in the way of wave regeneration, as they proceed inland.

Between transects, elevations were interpolated using topographic maps, land-use and land cover data, and engineering judgment to determine the aerial extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergo major changes. The Transect Data Table, Table 3, provides the Chesapeake Bay 10%, 2%, 1% and .2% annual chance stillwater elevations and the starting wave conditions for each transect

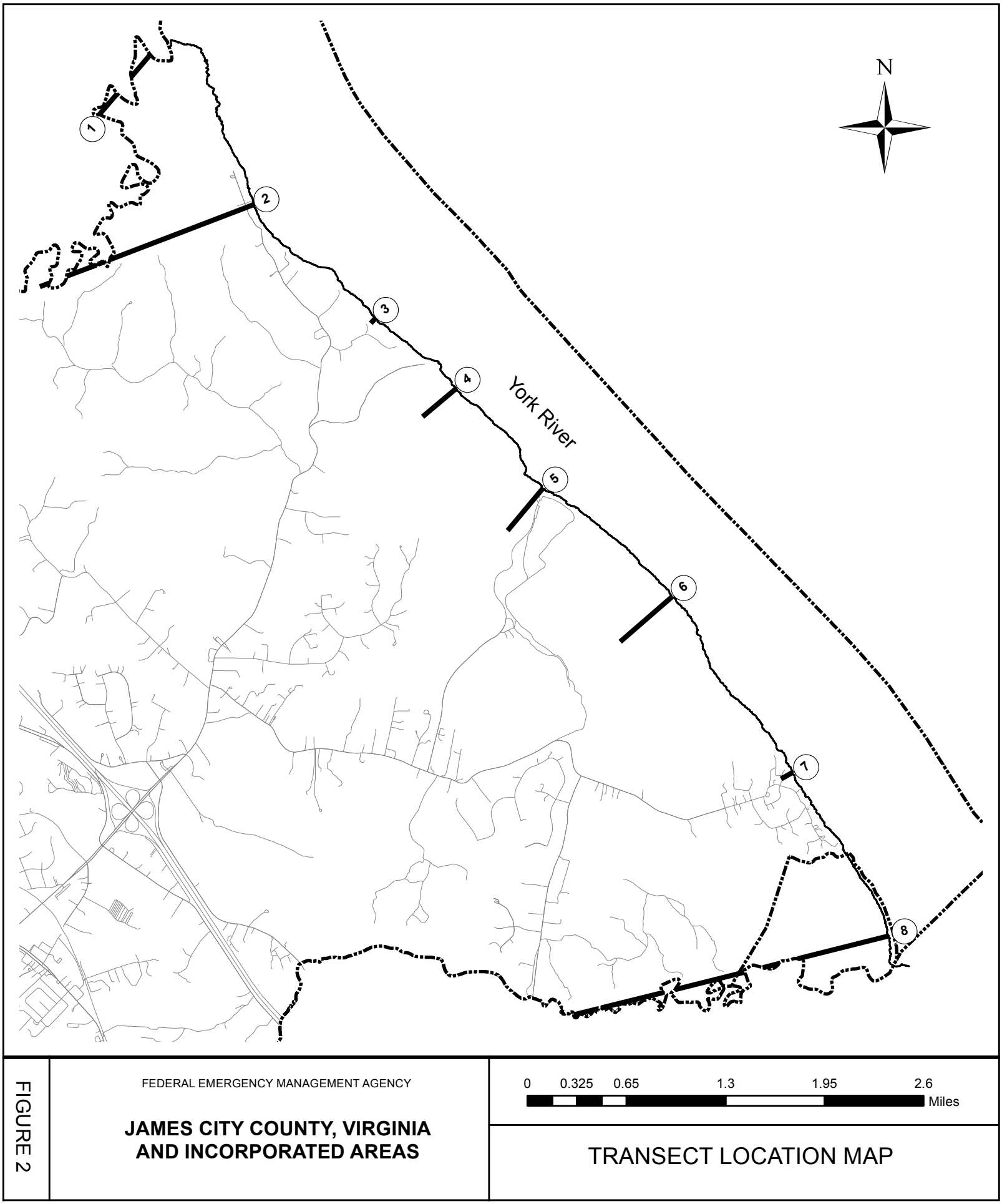


FIGURE 2 - TRANSECT LOCATION MAP

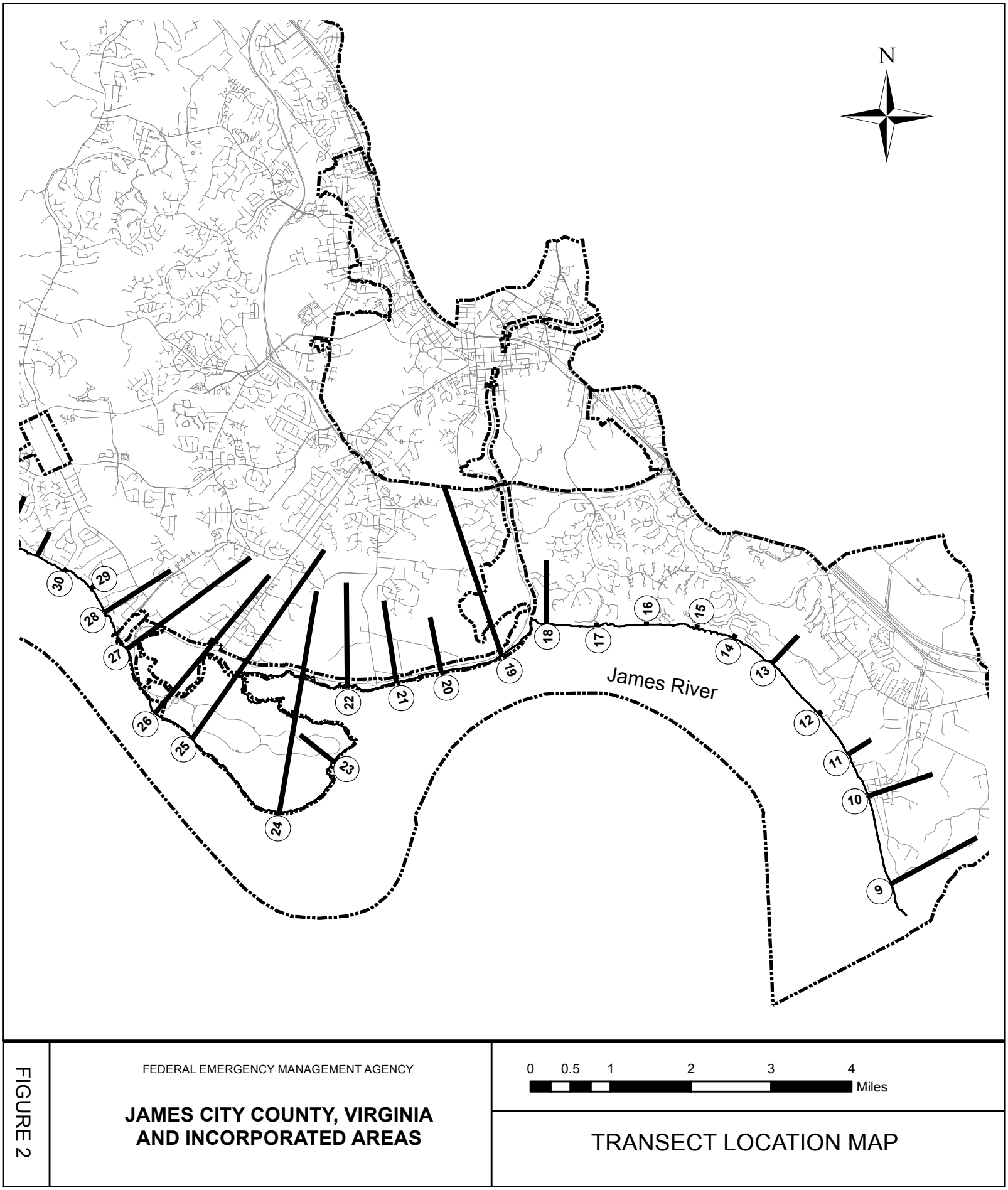


FIGURE 2 - TRANSECT LOCATION MAP

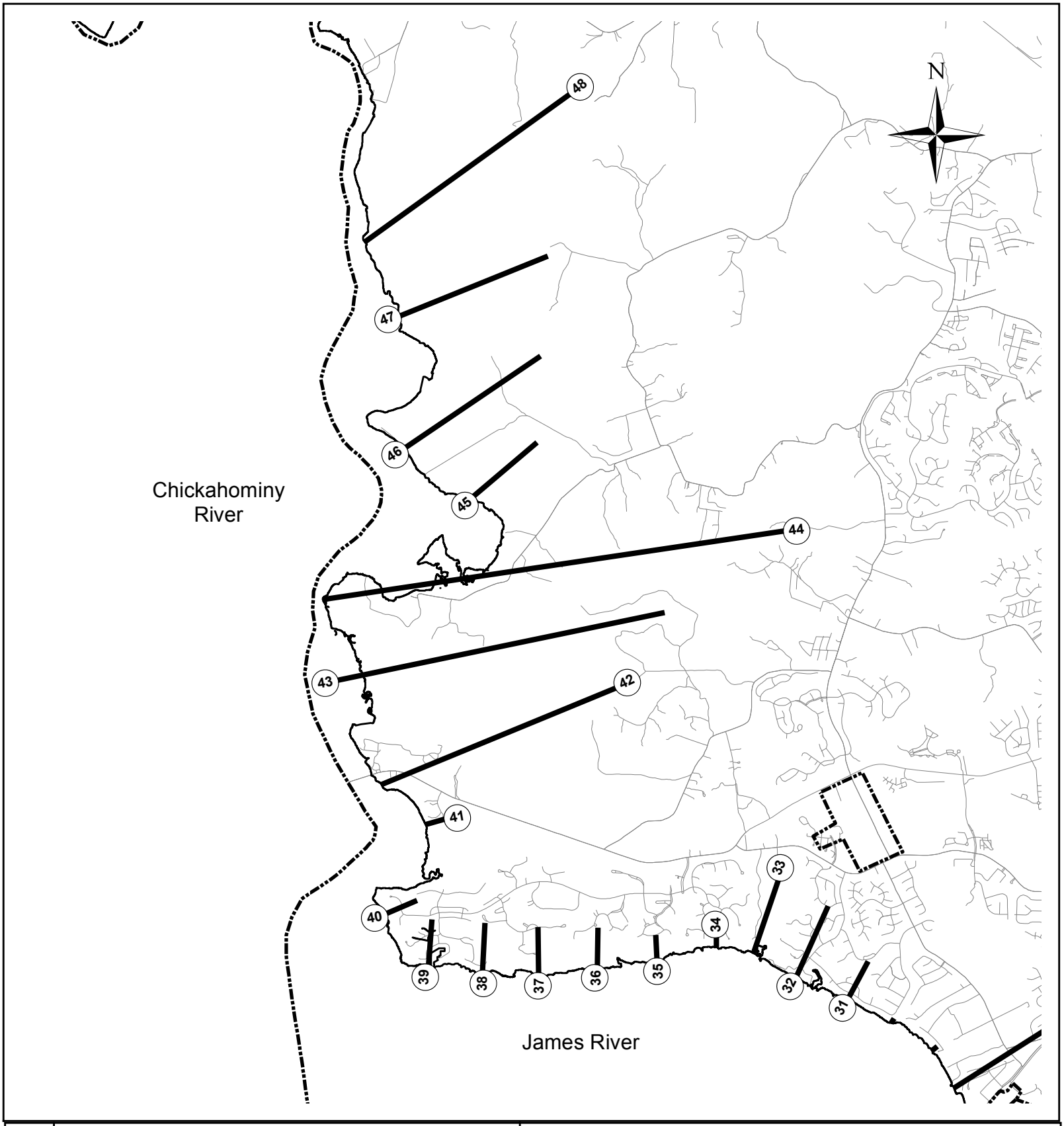


FIGURE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VIRGINIA AND INCORPORATED AREAS

0 0.425 0.85 1.7 2.55 3.4 Miles

TRANSECT LOCATION MAP

FIGURE 2 - TRANSECT LOCATION MAP - continued

TABLE 3 - TRANSECT DATA

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft **NAVD88**) Range of Stillwater Elevations (ft **NAVD88**)			
		Coordinates	Significant Wave Height H_s (**ft**)	Peak Wave Period T_p (**sec**)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
YORK RIVER	**1**	**N 37.45827 W -76.75752**	**4.5**	**3.4**	**5.4**	**6.5**	**7.0**	**9.2**
YORK RIVER	**2**	**N 37.44259 W -76.74685**	**5.2**	**3.5**	**5.4**	**6.5**	**6.9**	**9.0**
YORK RIVER	**3**	**N 37.43155 W -76.73259**	**4.9**	**3.3**	**5.3**	**6.4**	**6.9**	**8.8**
YORK RIVER	**4**	**N 37.42474 W -76. 72313**	**4.6**	**3.3**	**5.3**	**6.4**	**6.8**	**8.7**
YORK RIVER	**5**	**N 37.41506 W -76.71303**	**4.6**	**3.2**	**5.3**	**6.4**	**6.8**	**8.6**
YORK RIVER	**6**	**N 37.40453 W -76.69785**	**4.8**	**3.3**	**5.2**	**6.3**	**6.7**	**8.5**
YORK RIVER	**7**	**N 37.38763 W -76.68384**	**5.2**	**3.4**	**5.2**	**6.3**	**6.7**	**8.4**
YORK RIVER	**8**	**N 37.37189 W -76.67280**	**5.4**	**3.5**	**5.2**	**6.3**	**6.7**	**8.4**
JAMES RIVER	**9**	**N 37.17543 W -76.61443**	**4.2**	**3.0**	**5.4**	**6.5**	**6.9**	**8.1**
JAMES RIVER	**10**	**N 37.19135 W -76.61955**	**4.0**	**2.9**	**5.4**	**6.4**	**6.9**	**8.2**
JAMES RIVER	**11**	**N 37.19900 W -76.62344**	**3.9**	**2.8**	**5.4**	**6.4**	**6.8**	**8.3**
JAMES RIVER	**12**	**N 37.20647 W -76.62996**	**3.7**	**2.7**	**5.4**	**6.4**	**6.9**	**8.4**
JAMES RIVER	**13**	**N 37.21574 W -76.64025**	**3.5**	**3.1**	**5.4**	**6.4**	**6.8**	**8.5**

TABLE 3 - TRANSECT DATA – continued

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft **NAVD88**) Range of Stillwater Elevations (ft **NAVD88**)			
		Coordinates	Significant Wave Height H_s (**ft**)	Peak Wave Period T_p (**sec**)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
JAMES RIVER	**14**	**N 37.22022 W -76.64888**	**3.8**	**2.9**	**5.4**	**6.4**	**6.9**	**8.6**
JAMES RIVER	**15**	**N 37.22228 W -76.65715**	**3.8**	**2.9**	**5.5**	**6.5**	**6.9**	**8.7**
JAMES RIVER	**16**	**N 37.22308 W -76.66849**	**5.1**	**3.3**	**5.5**	**6.5**	**6.9**	**8.7**
JAMES RIVER	**17**	**N 37.22301 W -76.67973**	**4.8**	**3.3**	**5.5**	**6.5**	**6.9**	**8.6**
JAMES RIVER	**18**	**N 37.22350 W -76.69111**	**4.9**	**3.4**	**5.5**	**6.6**	**7.0**	**8.5**
JAMES RIVER	**19**	**N 37.21798 W -76.70126**	**5.1**	**3.7**	**5.5**	**6.6**	**7.0**	**8.5**
JAMES RIVER	**20**	**N 37.21525 W -76.71504**	**5.0**	**3.8**	**5.5**	**6.6**	**7.0**	**8.6**
JAMES RIVER	**21**	**N 37.21350 W -76.72516**	**4.9**	**3.9**	**5.6**	**6.7**	**7.0**	**8.6**
JAMES RIVER	**22**	**N 37.21326 W -76.73631**	**4.5**	**3.7**	**5.6**	**6.7**	**7.1**	**8.7**
JAMES RIVER	**23**	**N 37.19951 W -76.73981**	**6.3**	**4.1**	**5.6**	**6.7**	**7.1**	**8.4**
JAMES RIVER	**24**	**N 37.19053 W -76.75218**	**5.8**	**4.1**	**5.6**	**6.7**	**7.1**	**8.3**
JAMES RIVER	**25**	**N 37.20409 W -76.77149**	**4.8**	**3.3**	**5.6**	**6.8**	**7.1**	**8.4**
JAMES RIVER	**26**	**N 37.20879 W -76.77988**	**4.6**	**3.2**	**5.6**	**6.8**	**7.1**	**8.4**
JAMES RIVER	**27**	**N 37.22050 W -76.78588**	**4.3**	**3.1**	**5.6**	**6.7**	**7.2**	**8.4**

TABLE 3 - TRANSECT DATA – continued

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft **NAVD88**) Range of Stillwater Elevations (ft **NAVD88**)			
		Coordinates	Significant Wave Height H_s (**ft**)	Peak Wave Period T_p (**sec**)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
JAMES RIVER	**28**	**N 37.22719 W -76.79078**	**3.9**	**2.9**	**5.6**	**6.7**	**7.1**	**8.5**
JAMES RIVER	**29**	**N 37.23149 W -76.59244**	**3.8**	**2.8**	**5.6**	**6.7**	**7.1**	**8.5**
JAMES RIVER	**30**	**N 37.23476 W -76.79964**	**3.9**	**2.9**	**5.6**	**6.7**	**7.1**	**8.6**
JAMES RIVER	**31**	**N 37.23760 W -76.80584**	**4.2**	**3.0**	**5.7**	**6.7**	**7.1**	**8.6**
JAMES RIVER	**32**	**N 37.24014 W -76.81321**	**4.4**	**3.1**	**5.7**	**6.8**	**7.1**	**8.6**
JAMES RIVER	**33**	**N 37.24308 W -77.81923**	**4.2**	**3.1**	**5.7**	**6.8**	**7.1**	**8.7**
JAMES RIVER	**34**	**N 37.24384 W -76.82463**	**3.9**	**3.0**	**5.7**	**6.8**	**7.1**	**8.7**
JAMES RIVER	**35**	**N 37.24242 W -76.83316**	**4.5**	**3.2**	**5.7**	**6.8**	**7.2**	**8.7**
JAMES RIVER	**36**	**N 37.24169 W -76.84177**	**5.5**	**3.6**	**5.7**	**6.8**	**7.2**	**8.7**
JAMES RIVER	**37**	**N 37.24095 W -76.85015**	**5.3**	**3.7**	**5.7**	**6.9**	**7.2**	**8.7**
JAMES RIVER	**38**	**N 37.24131 W -76.85828**	**5.5**	**3.7**	**5.7**	**6.9**	**7.2**	**8.7**
JAMES RIVER	**39**	**N 37.24227 W -76.86600**	**5.2**	**3.7**	**5.7**	**6.9**	**7.2**	**8.7**
JAMES RIVER	**40**	**N 37.24833 W -76.87209**	**4.7**	**3.4**	**5.7**	**6.9**	**7.2**	**8.8**

TABLE 3 - TRANSECT DATA – continued

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft **NAVD88**) Range of Stillwater Elevations (ft **NAVD88**)			
		Coordinates	Significant Wave Height H_s (**ft**)	Peak Wave Period T_p (**sec**)	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
CHICKAHOMINY RIVER	**41**	**N 37.25848 W -76.86610**	**3.4**	**2.5**	**5.7**	**6.9**	**7.2**	**8.9**
CHICKAHOMINY RIVER	**42**	**N 37.26319 W -76.87234**	**2.3**	**2.6**	**5.8**	**6.9**	**7.2**	**8.9**
CHICKAHOMINY RIVER	**43**	**N 37.27523 W -77.87849**	**2.5**	**2.6**	**5.8**	**6.9**	**7.2**	**8.9**
CHICKAHOMINY RIVER	**44**	**N 37.28458 W -76.88027**	**2.6**	**2.7**	**5.8**	**6.9**	**7.2**	**8.8**
CHICKAHOMINY RIVER	**45**	**N 37.29599 W -76.85853**	**2.4**	**2.2**	**5.8**	**6.9**	**7.2**	**8.8**
CHICKAHOMINY RIVER	**46**	**N 37.30179 W -76.86826**	**2.2**	**2.5**	**5.8**	**6.9**	**7.2**	**8.9**
CHICKAHOMINY RIVER	**47**	**N 37.31694 W -76.86879**	**2.8**	**2.4**	**5.8**	**6.9**	**7.2**	**8.9**
CHICKAHOMINY RIVER	**48**	**N 37.32562 W -76.87338**	**2.1**	**2.6**	**5.8**	**6.9**	**7.2**	**8.9**

3.4 Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum used for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the completion of the NAVD 88, many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in differences in base flood elevations across the corporate limits between the communities.

For the September 28, 2007 countywide FIS, effective information was converted from NGVD29 to NAVD88. The average conversion factor was -0.978 feet

NGVD 29 - 0.978 = NAVD 88

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242
http://www.ngs.noaa.gov/

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. Therefore, each FIS provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-percent-annual-chance, 2-percent-annual chance, 1-percent-annual-chance, and 0.2-percent-annual-chance flood elevations; delineations of the 1-percent-annual-chance and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway to assist communities in developing floodplain management measures. This information is presented on the FIRM and in many components of the FIS report, including Summary of Stillwater Elevations Table, and Transect Data Table. Users should reference the data presented in the FIS report as well as additional information that may be available at the local map repository before making flood elevation and/or floodplain boundary determinations.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps. For the tidal flooding sources studied in detail, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using topographic maps at scales of 1:24,000 and 1"=200' with contour intervals of 5 and 10 feet (USGS and James City County, 1988).

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). On this map, the 1-percent-annual-chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A and AE), and the 0.2-percent-annual-chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown

due to limitations of the map scale and/or lack of detailed topographic data.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones (USACE, 1975). The 3-foot wave has been determined the minimum size wave capable of causing major damage to conventional wood frame of brick veneer structures. The one exception to the 3-foot wave criteria is where a primary frontal dune exists. The limit the coastal high hazard area then becomes the landward toe of the primary frontal dune or where a 3-foot or greater breaking wave exists, whichever is most landward. The coastal high hazard zone is depicted on the FIRMs as Zone VE, where the delineated flood hazard includes wave heights equal to or greater than three feet. Zone AE is depicted on the FIRMs where the delineated flood hazard includes wave heights less than three feet. A depiction of how the Zones VE and AE are mapped is shown in Figure 1.

Post-storm field visits and laboratory tests have confirmed that wave heights as small as 1.5 feet can cause significant damage to structures when constructed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour which can cause damage to Zone AE-type construction in these coastal areas. To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE (see Figure 1).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS report were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations have been tabulated for selected cross sections (Table 4, Floodway Data). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary has

been shown.

The area between the floodway and 1-percent-annual-chance floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 1-percent-annual-chance flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3, "Floodway Schematic".

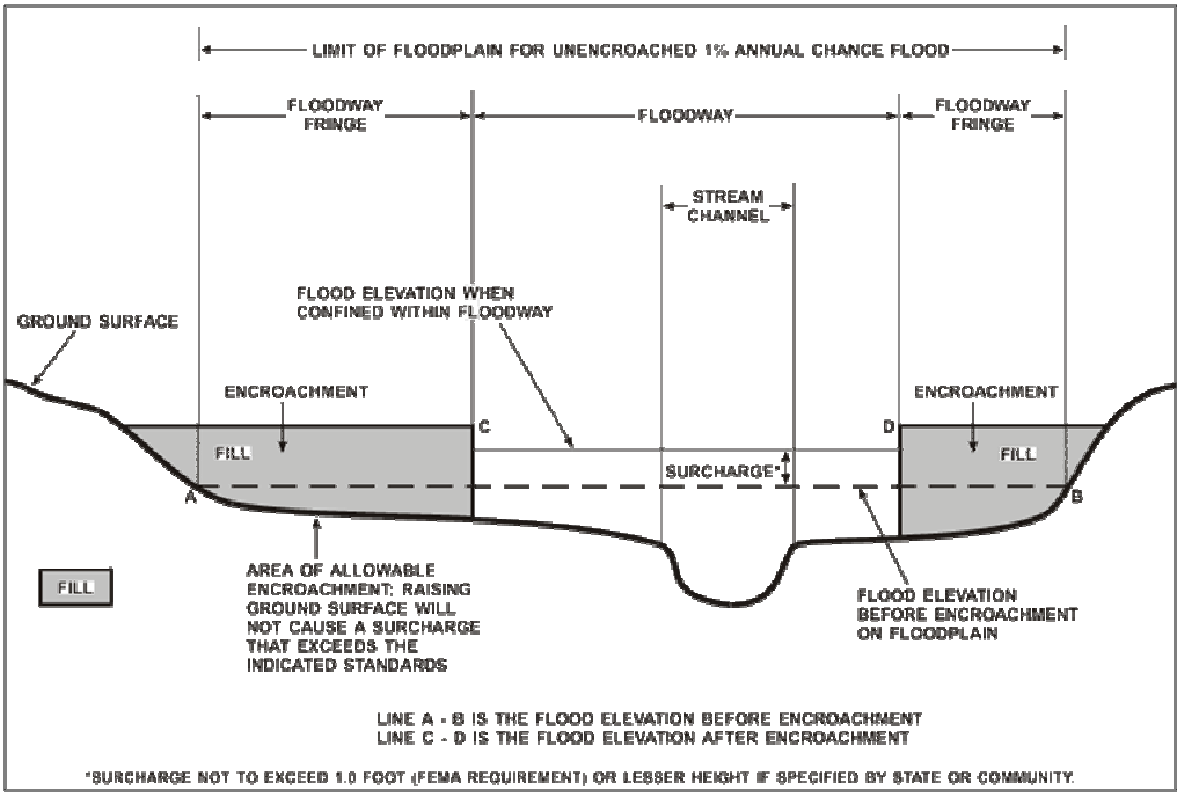


FIGURE 3- FLOODWAY SCHEMATIC

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
CHISEL RUN								
A	640[1]	700	3,810	2.5	33.4	30.8[3]	31.3	0.5
B	3,220[1]	420	3,000	3.2	36.6	36.6	37.1	0.5
C	4,825[1]	440	3,690	2.6	40.4	40.4	40.8	0.4
D	5,940[1]	370	2,780	2.7	41.3	41.3	41.8	0.5
E	8,560[1]	260	1,410	2.9	43.1	43.1	43.6	0.5
F	10,230[1]	300	2,240	1.5	49.0	49.0	49.0	0.0
G	11,640[1]	280	1,900	0.9	53.0	53.0	53.3	0.3
H	13,800[1]	90	390	3.6	58.7	58.7	59.2	0.5
I	16,540[1]	52	100	8.1	87.9	87.9	87.9	0.0
EAST TRIBUTARY TO CHISEL RUN								
A	480[2]	240	940	3.1	41.3	39.0[4]	39.2	0.2
B	1,185[2]	330	1,910	1.5	41.8	41.8	42.0	0.2
C	3,640[2]	84	355	3.8	55.4	55.4	56.3	0.9

[1]Feet above confluence with Powhatan Creek
[2]Feet above confluence with Chisel Run
[3]Elevation computed without consideration of backwater effects from Powhatan Creek
[4]Elevation computed without consideration of backwater effects from Chisel Run

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA
AND INCORPORATED AREAS

FLOODWAY DATA

CHISEL RUN –
EAST TRIBUTARY TO CHISEL RUN

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
LONG HILL SWAMP								
A	750[1]	340	1,180	3.8	33.4	29.6[3]	29.9	0.3
B	1,770[1]	480	2,860	1.6	33.4	32.3[3]	32.8	0.5
C	4,100[1]	460	2,930	1.5	35.9	35.9	36.5	0.6
D	5,440[1]	210	1,180	3.0	37.8	37.8	38.3	0.5
E	7,490[1]	390	2,390	1.5	45.5	45.5	45.8	0.3
F	10,620[1]	310	2,190	1.4	51.5	51.5	52.2	0.7
G	11,790[1]	210	2,200	0.8	55.6	55.6	56.3	0.7
H	13,180[1]	185	1,250	1.4	55.8	55.8	56.5	0.7
POWHATAN CREEK								
A	19,290[2]	1,230	8,930	1.2	10.9	10.9	10.9	0.0
B	21,090[2]	1,000	5,430	2.0	11.2	11.2	11.2	0.0
C	25,550[2]	1,010	9,770	1.1	17.1	17.1	17.5	0.4
D	27,535[2]	1,340	11,140	1.1	17.6	17.6	17.9	0.3
E	32,230[2]	1,190	8,140	1.5	21.2	21.2	21.6	0.4
F	34,370[2]	1,360	8,810	1.3	22.2	22.2	22.5	0.3
G	39,910[2]	860	7,880	1.1	27.1	27.1	27.4	0.3
H	43,090[2]	1,650	12,190	1.0	27.9	27.9	28.2	0.3
I	44,975[2]	710	5,780	2.2	29.5	29.5	29.7	0.2
J	48,400[2]	600	4,670	2.6	32.1	32.1	32.3	0.2

[1]Feet above confluence with Powhatan Creek
[2]Feet above confluence with James River
[3]Elevation computed without consideration of backwater effects from Powhatan Creek

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA
AND INCORPORATED AREAS

FLOODWAY DATA

LONG HILL SWAMP – POWHATAN CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION (FEET NAVD88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
UNNAMED TRIBUTARY TO LONG HILL SWAMP								
A	290	190	440	1.9	45.7	42.6[2]	42.6	0.0
B	880	190	210	3.9	45.7	43.1[2]	43.1	0.0
C	1,650	100	130	6.5	47.3	47.3	47.3	0.0
D	2,170	76	130	6.2	51.7	51.7	51.7	0.0
WEST TRIBUTARY TO LONG HILL SWAMP								
A	300	220	600	1.7	36.9	35.0[2]	35.1	0.1
B	1,590	360	2,470	0.4	42.4	42.4	43.0	0.6
C	3,320	260	1,300	0.7	42.5	42.5	43.1	0.6
D	3,980	560	3,450	0.2	50.0	50.0	50.1	0.1
E	6,120	230	960	0.8	50.1	50.1	50.1	0.0
F	8,040	165	678	2.9	56.7	56.7	56.9	0.2

[1]Feet above confluence with Long Hill Swamp
[2]Elevation computed without consideration of backwater effects from Long Hill Swamp

TABLE 4

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA
AND INCORPORATED AREAS

FLOODWAY DATA

UNNAMED TRIBUTARY TO LONG HILL SWAMP – WEST TRIBUTARY TO LONG HILL SWAMP

5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or base flood depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance floodplains that are determined in the FIS by detailed methods. In most instances, whole- foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent-annual- chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

Zone AO is the flood insurance rate zone that corresponds to the areas of 1-percent-annual-chance shallow flooding (usually sheet flow on sloping terrain) where average depths are between 1 and 3 feet. Average whole-foot depths derived from the detailed hydraulic analyses are shown within this zone.

Zone AR

Zone AR is the flood insurance risk zone that corresponds to an area of special flood hazard formerly protected from the 1-percent-annual-chance flood event by a flood-control system that was subsequently decertified. Zone AR indicates that the former flood-control system is being restored to provide protection from the 1-percent-annual-chance or greater flood event.

Zone A99

Zone A99 is the flood insurance zone that corresponds to areas of the 1-percent-annual- chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No BFEs or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no BFEs are shown within this zone.

Zone VE

Zone VE is the flood insurance rate zone that corresponds to the 1-percent-annual-chance coastal floodplains that have additional hazards associated with storm waves. Whole-foot BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1- percent-annual-chance flooding where average depths are less than 1 foot, areas of 1- percent-annual-chance flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 1-percent-annual-chance flood by levees. No BFEs or depths are shown within this zone.

Zone X (Future Base Flood)

Zone X (Future Base Flood) is the flood insurance risk zone that corresponds to the 1-percent-annual-chance floodplains that are determined based on future-conditions hydrology. No BFEs or base flood depths are shown within this zone.

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use the zones and BFEs in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent-annual-chance floodplains, floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of James City County. Historical data relating to the maps prepared for each community, are presented in Table 5, "Community Map History."

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
James City County (Unincorporated Areas)	July 18, 1975	September 24, 1982	February 6, 1991	
Williamsburg, City of (Independent City)	March 28, 1975	None	November 20, 1981	March 2, 1994

TABLE 5

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA
AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

Because it is based on more up-to-date analyses, this FIS supersedes the previously printed FIS for James City County, Virginia (FEMA, 2007).

This study is authoritative for purposes of the Flood Insurance Program and the data presented here either supersede or are compatible with previous determinations.

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, FEMA Region III, One Independence Mall, Sixth Floor, 615 Chestnut Street, Philadelphia, Pennsylvania 19106-4404.

9.0 BIBLIOGRAPHY AND REFERENCES

Chow, Ven Te, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

Commonwealth of Virginia, An Assessment: Virginia's Response to Hurricane Isabel, Richmond, Virginia, December 2003.

Commonwealth of Virginia, Department of Emergency Management, Virginia Hurricane History, Virginia's Emergency Website 2009.

Commonwealth of Virginia, Division of State Planning and Community Affairs, Data Summary – James City County and City of Williamsburg, Richmond, Virginia, September 1974.

Commonwealth of Virginia, Virginia Base Map Program Orthophotography – 2009 (VA State Plane South), Richmond, Virginia, 2010.

Commonwealth of Virginia, Virginia Uniform Statewide Building Code, Article 8, Part C, Section 872.6, September 1973.

Federal Emergency Management Agency, Atlantic Ocean and Gulf of Mexico Update Coastal Guidelines Update. Washington, D.C., 2007.

Federal Emergency Management Agency, Flood Insurance Study, James City County, Virginia Unincorporated Areas, Washington, D.C. February 6, 1991.

Federal Emergency Management Agency, Flood Insurance Study, York County, Virginia Unincorporated Areas, Washington, D.C. December 16, 1988.

Federal Emergency Management Agency. Wave Height Analysis for Flood Insurance Studies (WHAFIS), Version 4.0. Washington, D.C., August 2007.

Luettich, R. A. and J.J Westerink. A (Parallel) Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC). Version 45.12. February 6, 2008. University of North Carolina at Chapel Hill, Institute of Marine Sciences. Morehead City, NC.

National Academy of Sciences, Methodology for Calculating Wave Action Effects Associated with Storm Surges, Galveston, Texas, and June 1977.

The Weather Channel, http://www.weather.com/weather/wxclimatology/monthly/graph/USVA0832?locid=USVA0832&from=search, accessed April 2005

National Weather Service, Preliminary Post Storm Report…Hurricane Isabel, Wakefield, Virginia, October 9, 2003.

U.S. Army Core of Engineers. ERDC/CHL TR11-X. FEMA Region 3 Storm Surge Study Coastal Storm Surge Analysis: Modeling System Validation Submission No.2. US Army Corps of Engineers, 2012.

U.S. Army Corps of Engineers, Galveston District, Guidelines for Identifying Coastal High Hazard Zones, Galveston, Texas, June 1975.

U.S. Army Corps of Engineers, Galveston District, March 1962 Storm on the Coast of Virginia, Norfolk, Virginia, August 10, 1962.

U. S. Army Corps of Engineers, Hydrologic Engineering Center. (January 2010). HEC-RAS River Analysis System Users Manual and HEC-RAS River Analysis System Hydraulic Reference Manual, Version 4.1.

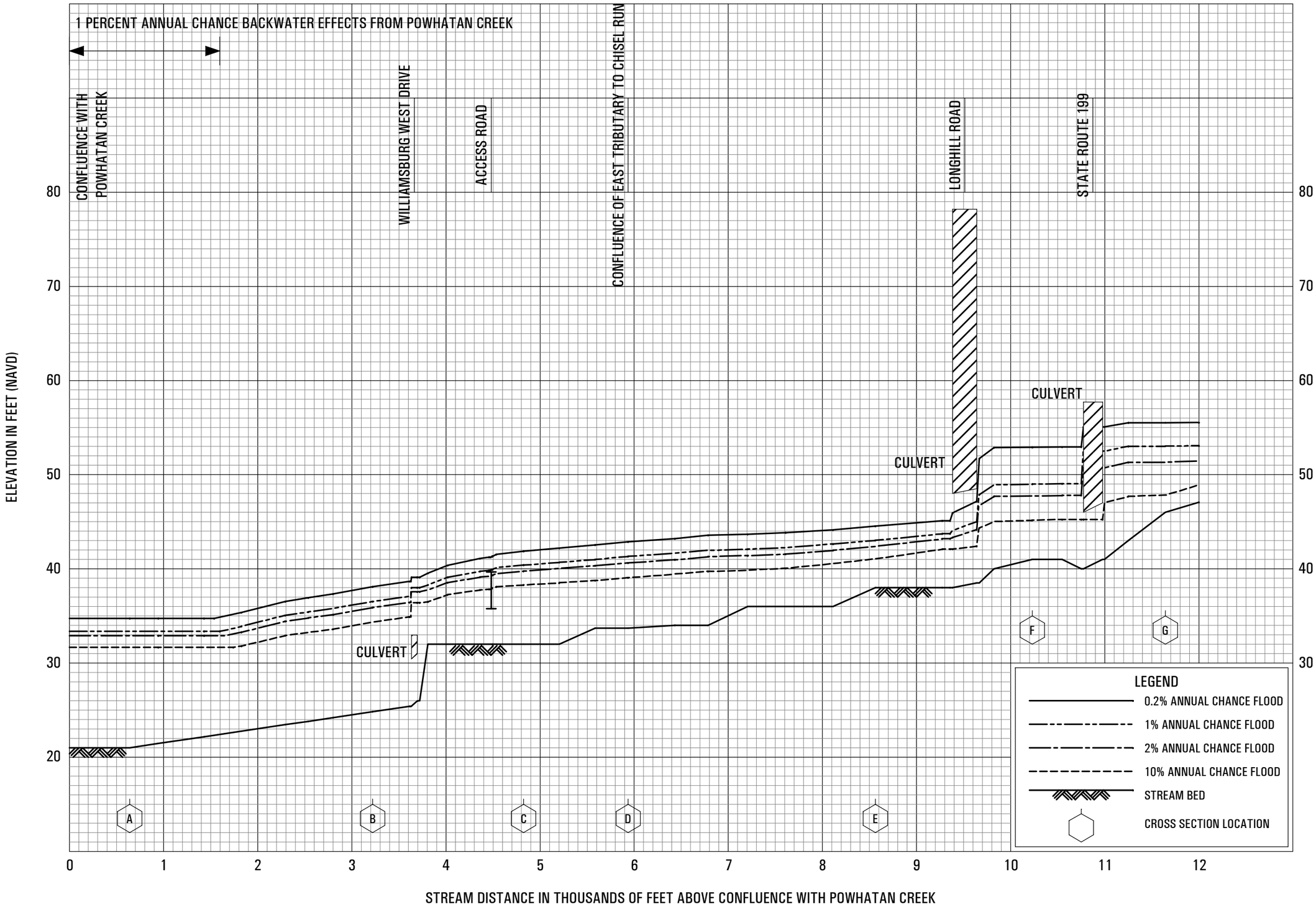
U. S. Army Corps of Engineers, Hydrologic Engineering Center. (August 2010). HEC-HMS Hydrologic Modeling System Release Notes, Version 3.5.

U.S. Army Corps of Engineers, Norfolk District, Corps' diverse missions highlighted during Hurricane Isabel, Engineer Update Article, October 2003.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Atlas 14, Precipitation-Frequency Atlas of the United States, Washington, D.C., 2004.

U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Tide Tables 1988, High and Low Water Predictions, East Coast of North and South America Including Greenland, Washington, D.C., 1987.

U.S. Census Bureau, "Profile of General Population and Housing Characteristics: 2010, (Table) DP-1, 2010 Demographic Profile Data" published April 1, 2011, Internet address: www.census.gov.



FLOOD PROFILES

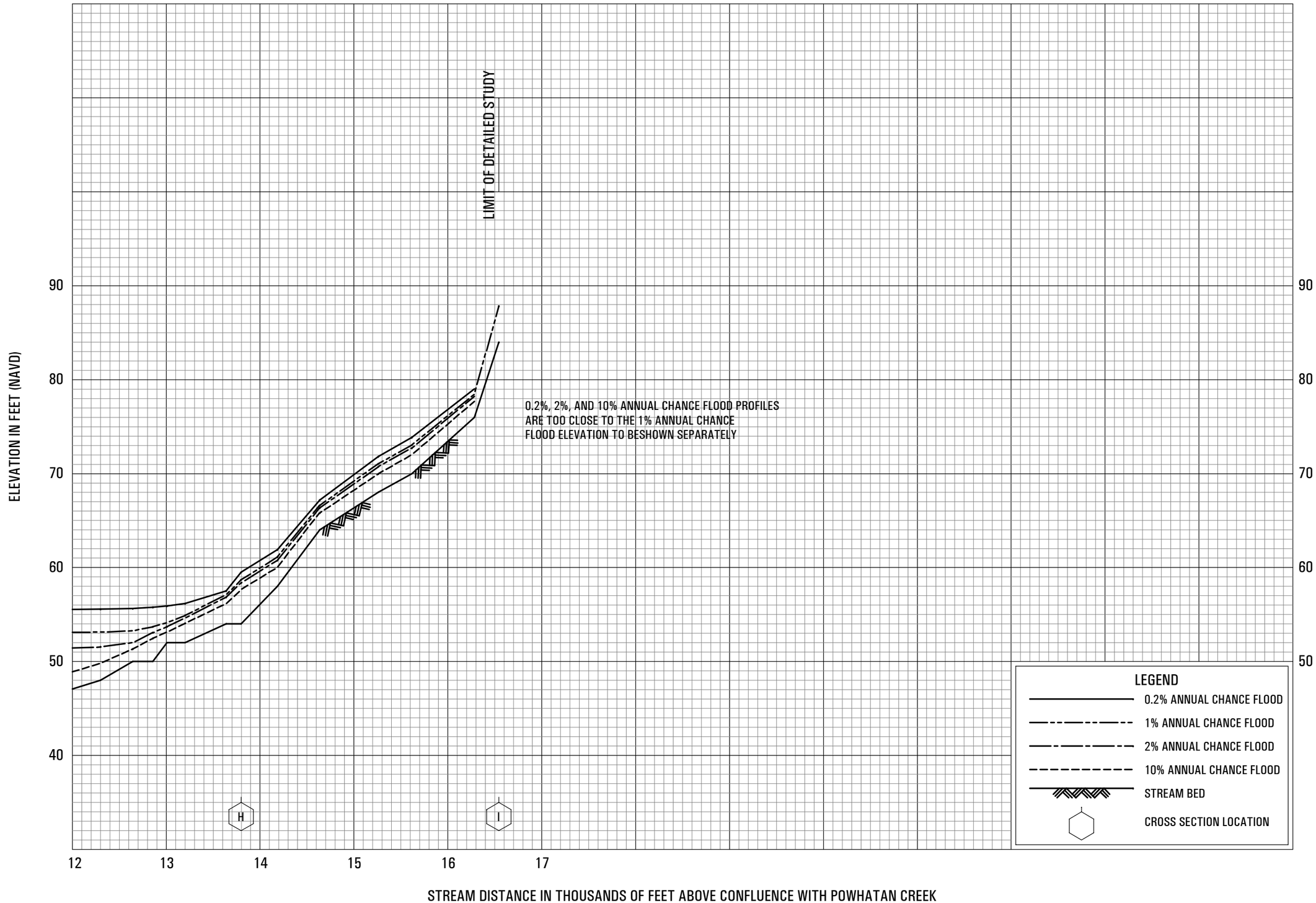
CHISEL RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

01P



FLOOD PROFILES

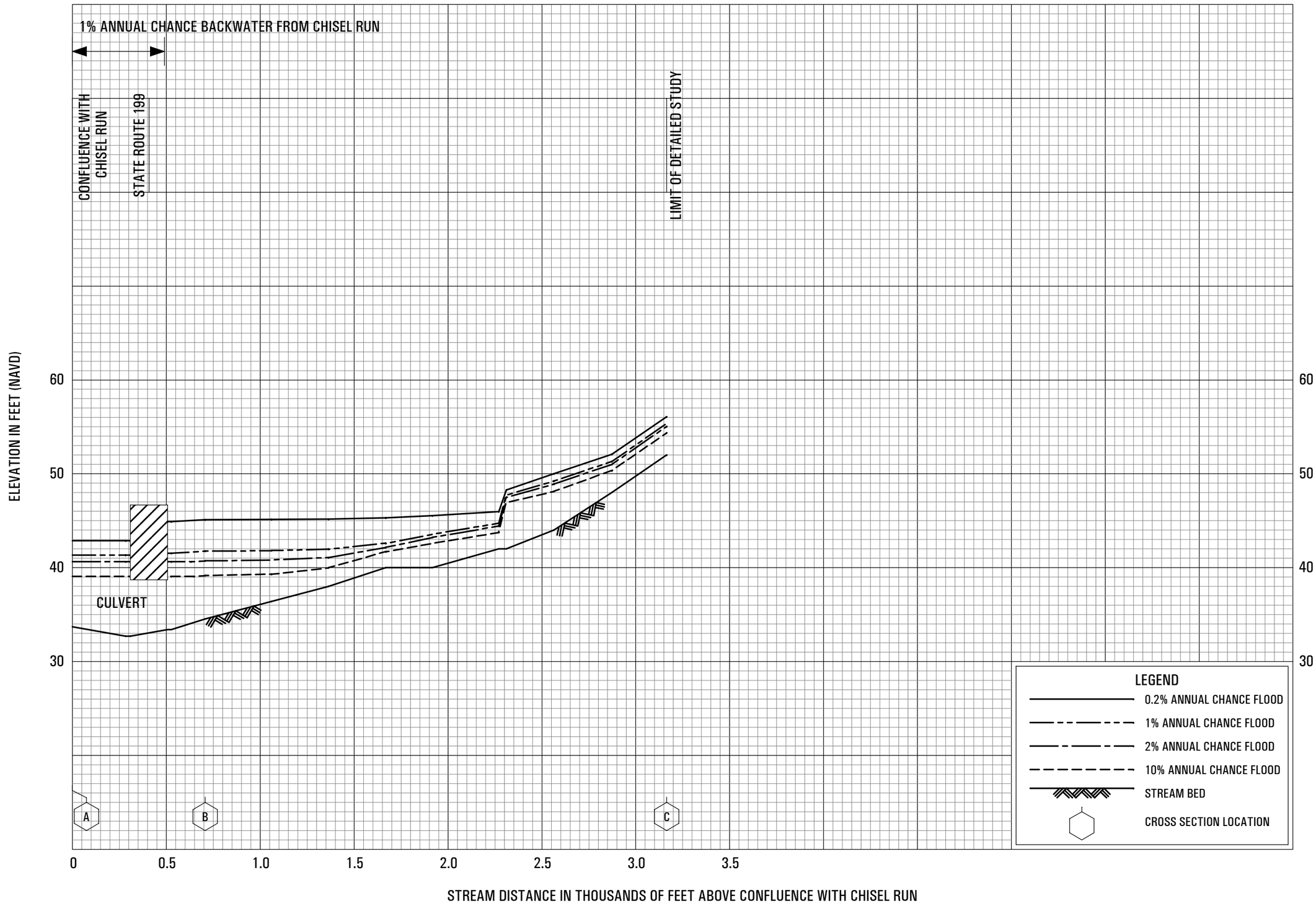
CHISEL RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

02P



FLOOD PROFILES

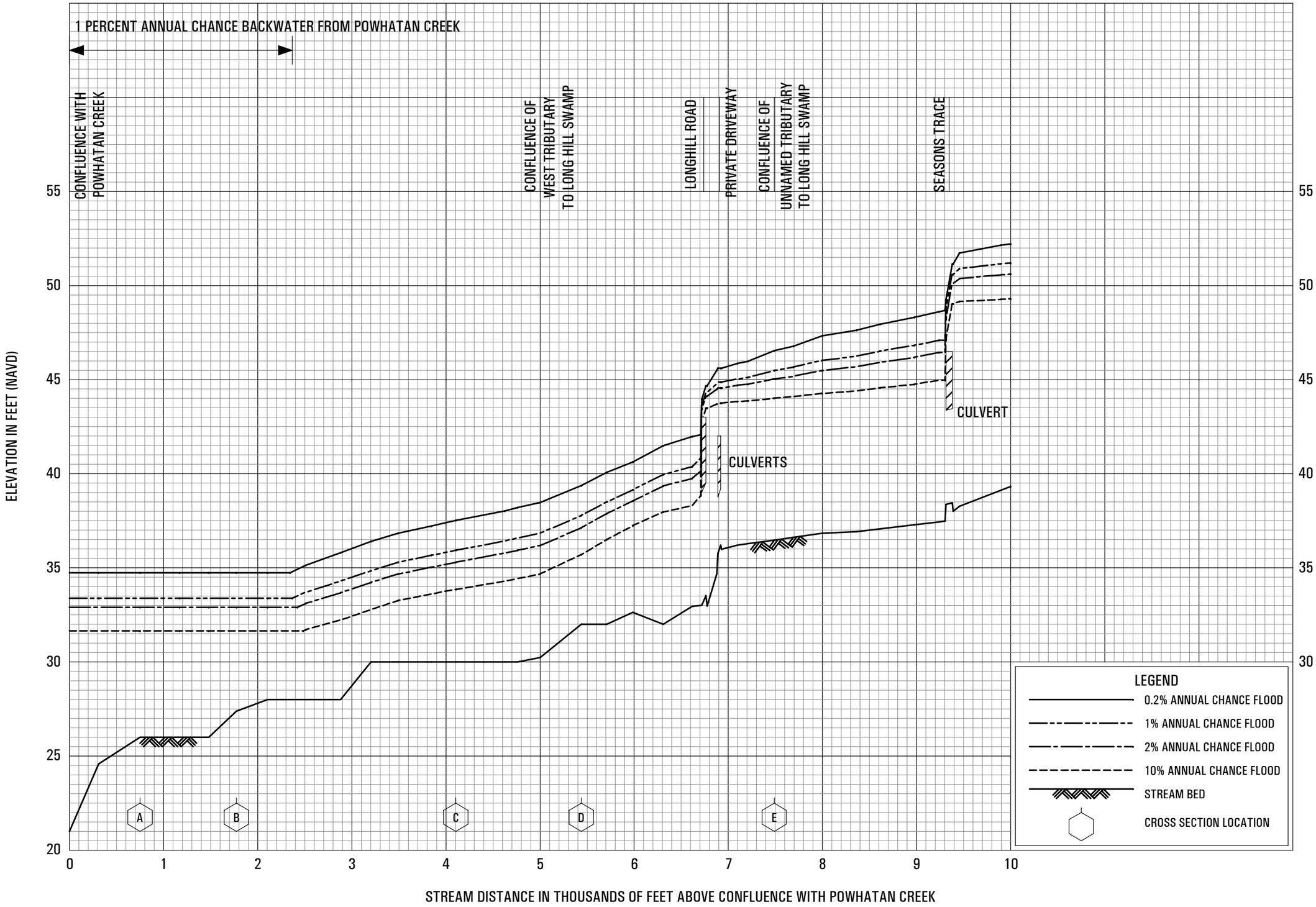
EAST TRIBUTARY TO CHISEL RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

03P



FLOOD PROFILES

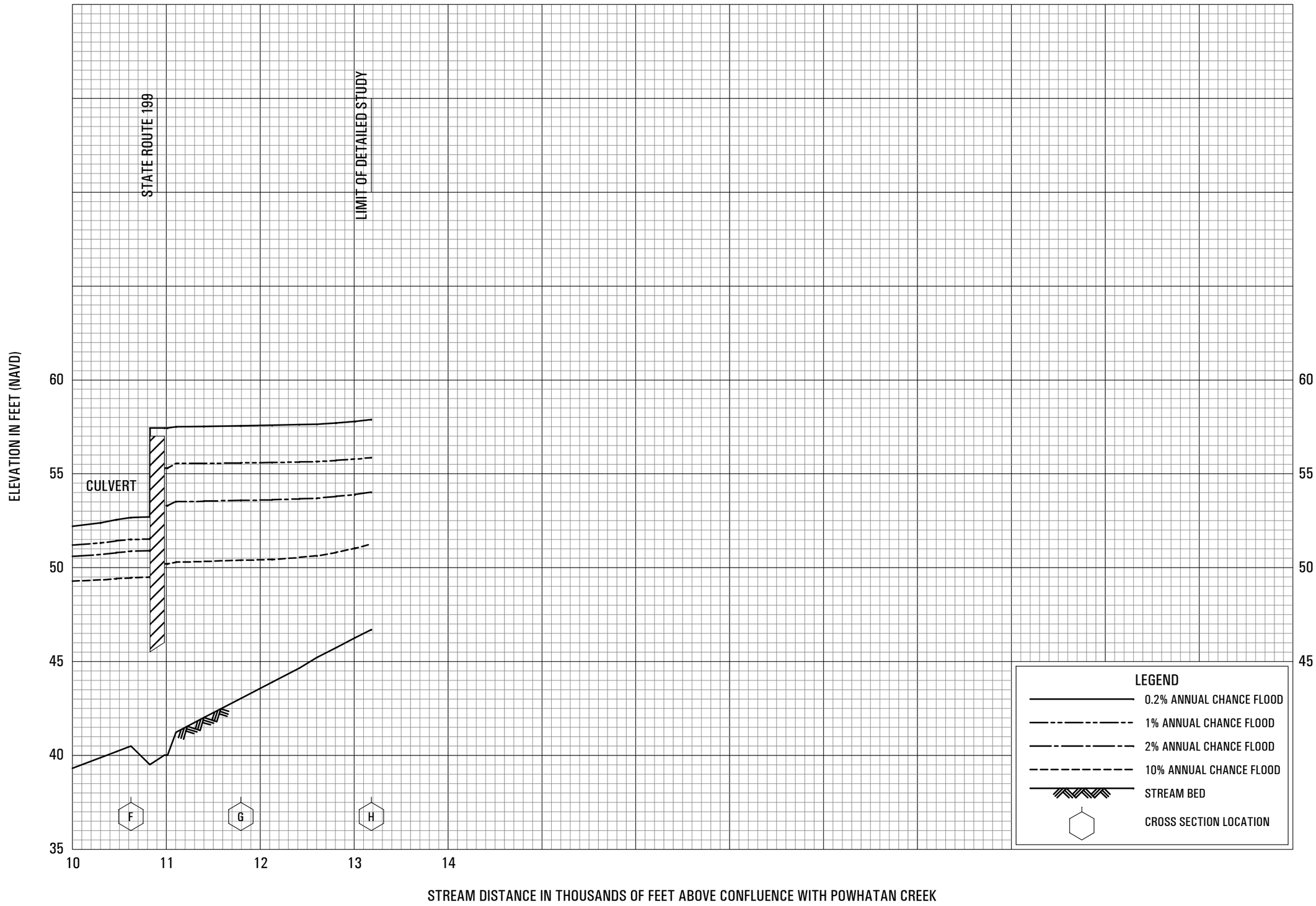
LONG HILL SWAMP

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

04P



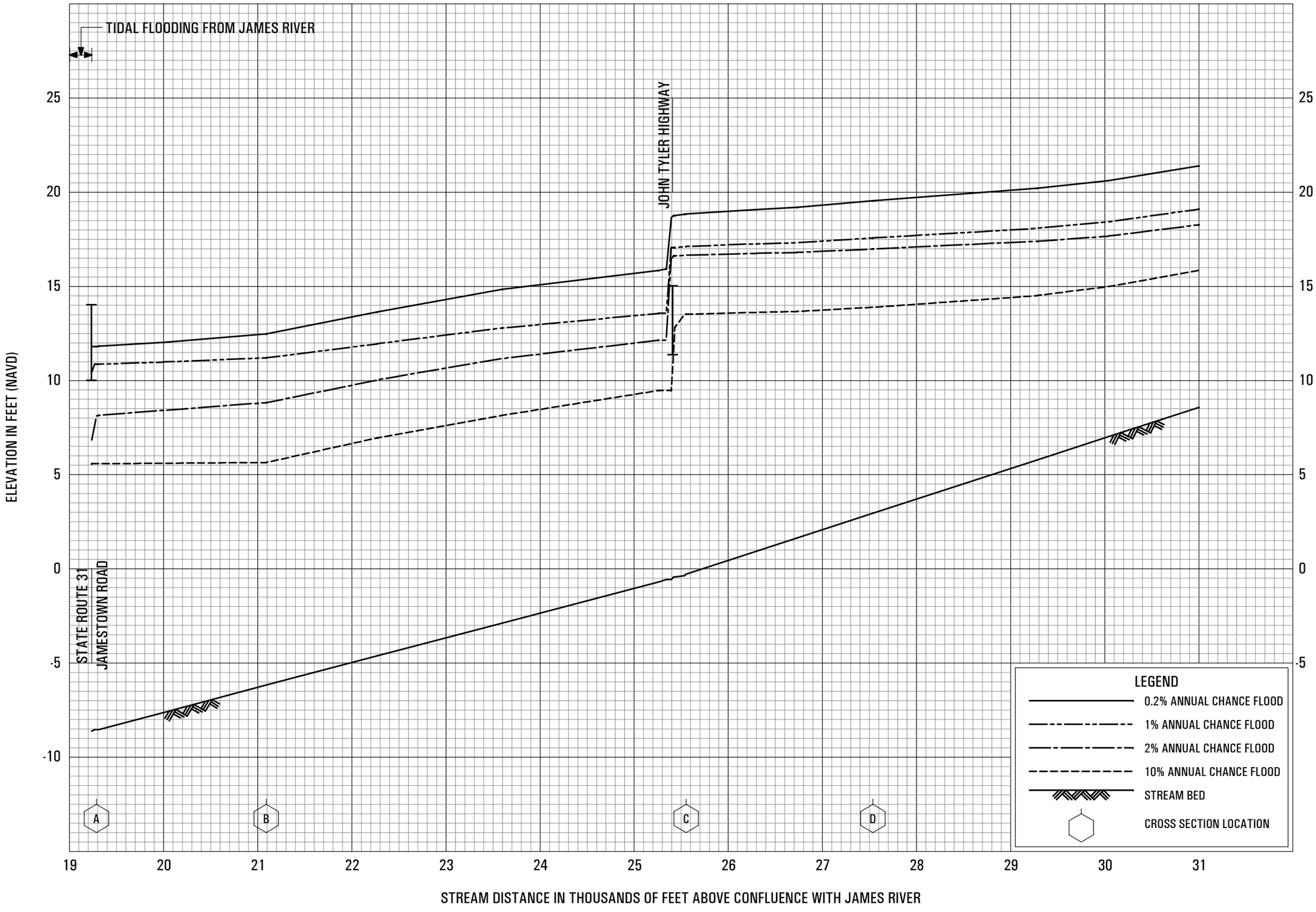
FLOOD PROFILES

LONG HILL SWAMP

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS



FLOOD PROFILES

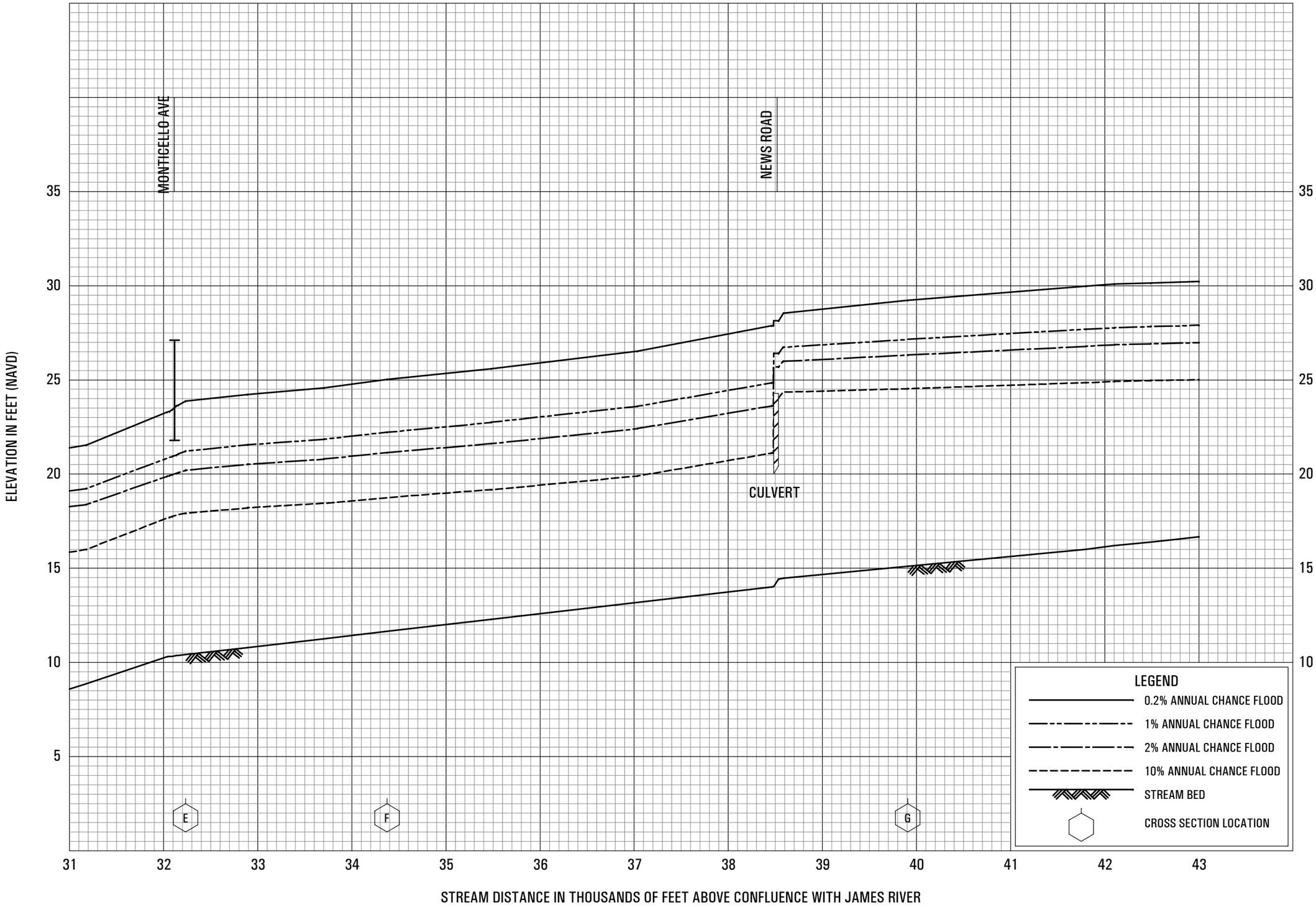
POWHATAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

06P



FLOOD PROFILES

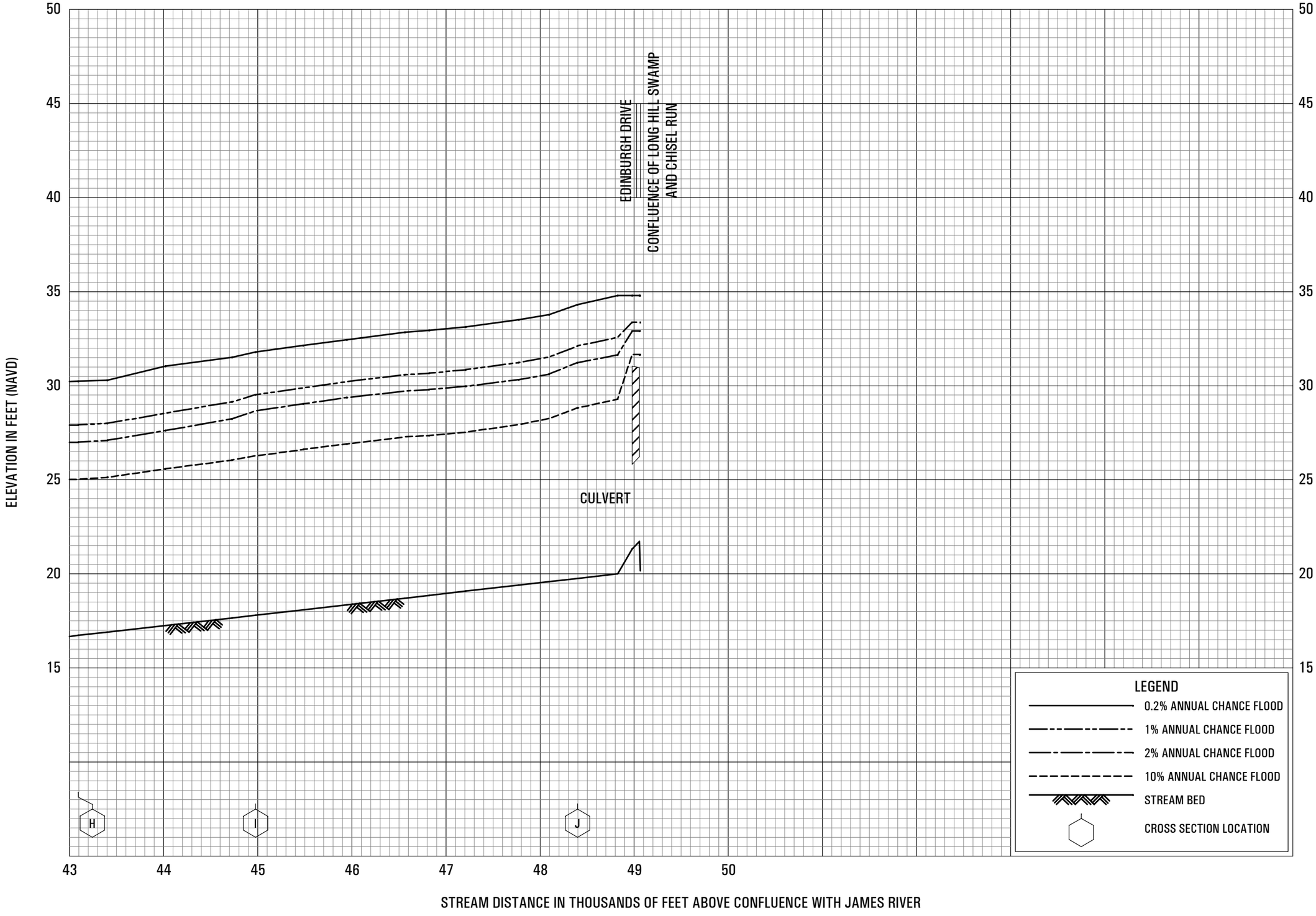
POWHATAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

07P



FLOOD PROFILES

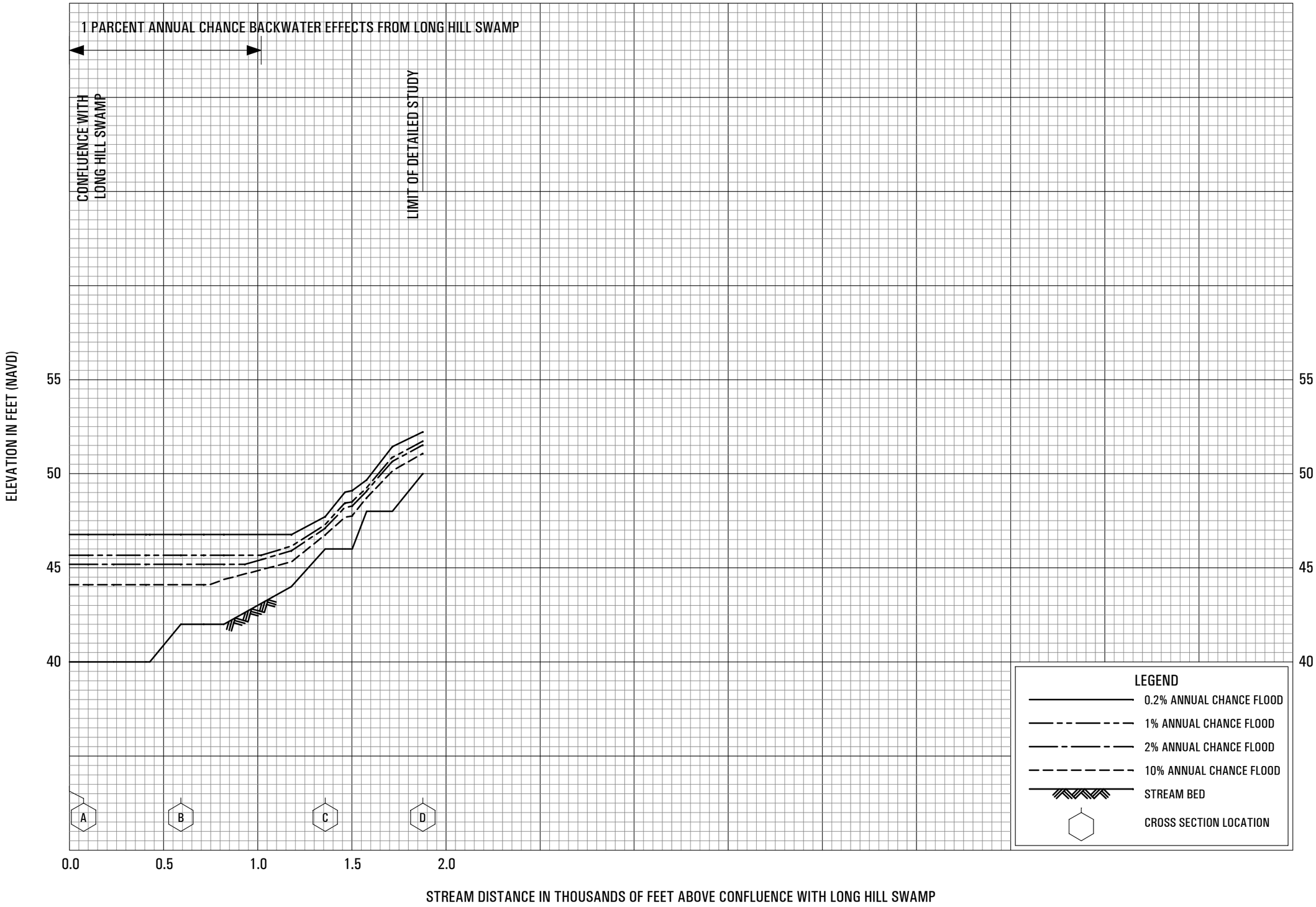
POWHATAN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS

08P



FLOOD PROFILES

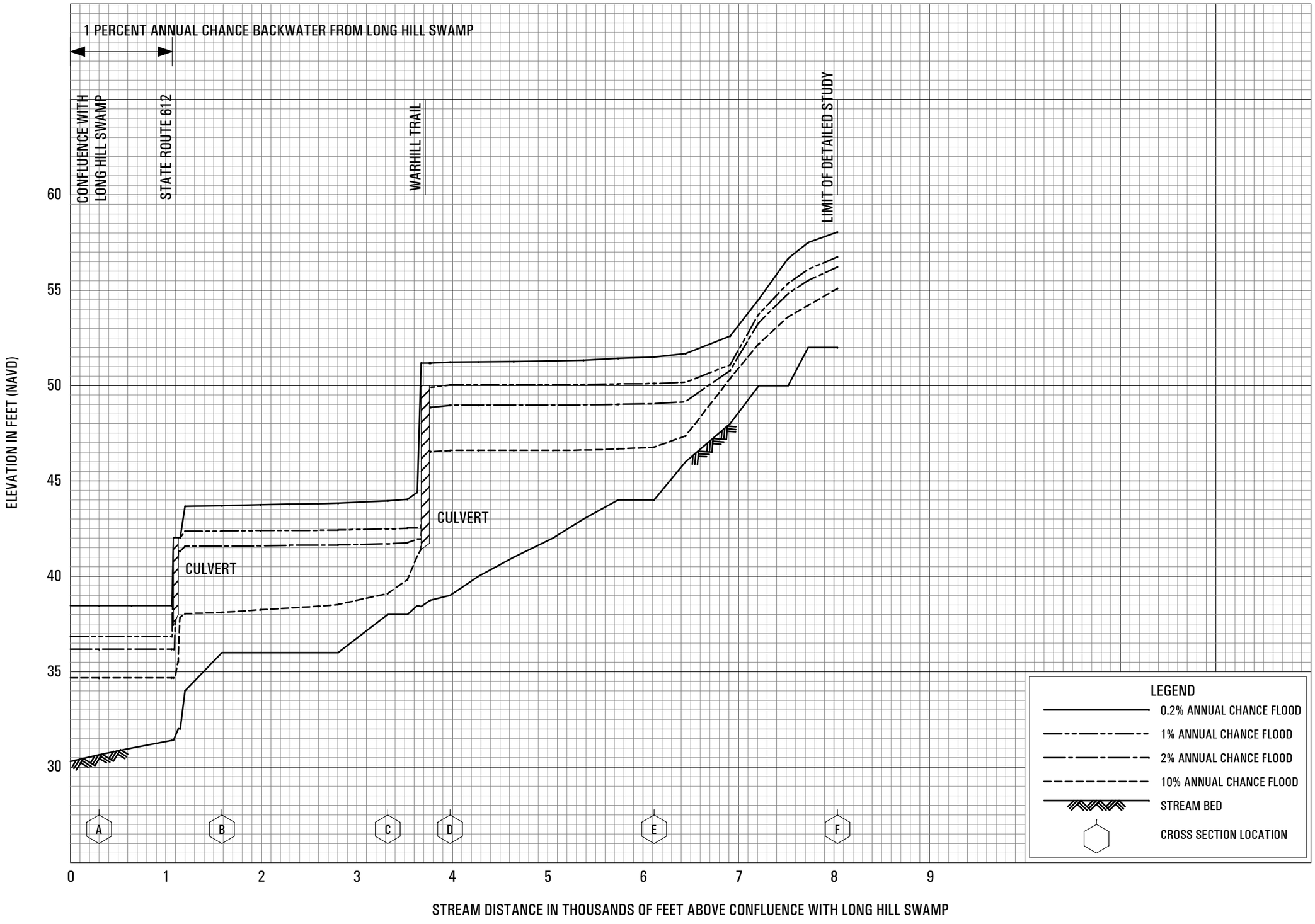
UNNAMED TRIBUTARY TO LONG HILL SWAMP

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

(AND INCORPORATED AREAS)

09P



FLOOD PROFILES

WEST TRIBUTARY TO LONG HILL SWAMP

FEDERAL EMERGENCY MANAGEMENT AGENCY

JAMES CITY COUNTY, VA

AND INCORPORATED AREAS