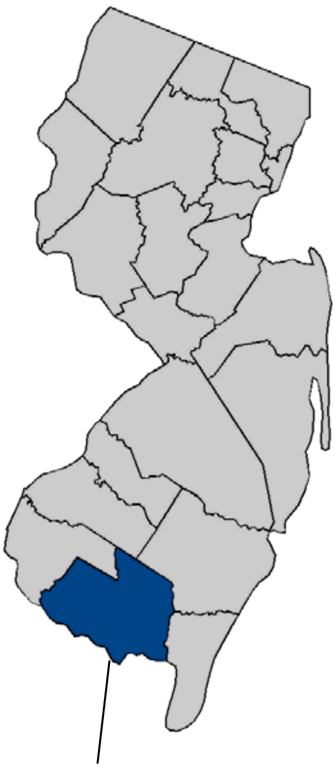
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 1



CUMBERLAND COUNTY, NEW JERSEY (All Jurisdictions)

COMMUNITY NAME	COMMUNITY NUMBER
BRIDGETON, CITY OF	**340165**
COMMERCIAL, TOWNSHIP OF	**340166**
DEERFIELD, TOWNSHIP OF	**340553**
DOWNE, TOWNSHIP OF	**340167**
FAIRFIELD, TOWNSHIP OF	**340168**
GREENWICH, TOWNSHIP OF	**340169**
HOPEWELL, TOWNSHIP OF	**340170**
LAWRENCE, TOWNSHIP OF	**340171**
MAURICE RIVER, TOWNSHIP OF	**340172**
MILLVILLE, CITY OF	**340173**
***SHILOH, BOROUGH OF**	**340123**
STOW CREEK, TOWNSHIP OF	**340174**
UPPER DEERFIELD, TOWNSHIP OF	**340175**
VINELAND, CITY OF	**340176**

***No Special Flood Hazard Areas Identified**

Preliminary: April 30, 2014

FLOOD INSURANCE STUDY NUMBER
340011CV000A
Version Number 2.1.1.0

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) 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 may be revised and republished at any time. In addition, part of this FIS may be revised by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS. 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 components.

Initial Countywide FIS Effective Date:

Revised Countywide FIS Date:

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FLOOD INSURANCE STUDY
CUMBERLAND COUNTY, NEW JERSEY (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Cumberland County, New Jersey, including: the Cities of Bridgeton, Millville, and Vineland; the Borough of Shiloh; and the Townships of Commercial, Deerfield, Downe, Fairfield, Greenwich, Hopewell, Lawrence, Maurice River, Stow Creek, and Upper Deerfield (hereinafter referred to collectively as Cumberland County).

Please note that on the effective date of this study, the Borough of Shiloh had no identified Special Flood Hazard Areas (SFHA); therefore has not been required to join the National Flood Insurance Program (NFIP). This does not preclude future determinations of SFHAs that could be necessitated by changed conditions affecting the community (i.e., annexation of new lands) or the availability of new scientific or technical data about flood hazards.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Cumberland County communities to update existing floodplain regulations as part of the Regular Phase of the NFIP, and by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in Title 44 of Code of Federal Regulations (CFR), Section 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 Acknowledgments

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 all jurisdictions within Cumberland 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.

Bridgeton, City of:	the hydrologic and hydraulic analyses from

the FIS report dated July 18, 1983, were prepared by the State of New Jersey, Department of Environmental Protection, Division of Water Resources, Bureau of Floodplain Management (NJDEP), under Contract No. S-90022 by Tippetts-Abbett-McCarthy-Stratton, Engineers and Architects, under subcontract to NJDEP for FEMA. That work was completed in March 1982.

Commercial, Township of:	the hydrologic and hydraulic analyses from the FIS report dated June 1, 1982, were prepared by Tippetts-Abbett-McCarthy-Stratton, Engineers and Architects, under subcontract to NJDEP for FEMA, under Contract No. S-90022. That work was completed in May 1981.
Deerfield, Township of:	the hydrologic and hydraulic analyses from the FIS report dated May 4, 1981, were prepared by Richard Browne Associates, Wayne, New Jersey for the Federal Insurance Administration (FIA), under Contract No. H-4806. That work was completed in December 1979.
Downe, Township of:	the hydrologic and hydraulic analyses from the FIS report dated April 1977, were prepared by U.S. Army Corps of Engineers (USACE), for the FIA, under Inter-Agency Agreement No. IAA-H-15-72, Project Order No. 13. That work was completed in August 1974.
Fairfield, Township of:	the hydrologic and hydraulic analyses from the FIS report dated August 3, 1992, were prepared by U.S. Geological Survey (USGS) for FEMA, under Inter-Agency Agreement No. EMW-85-E-1823 Project Order No. 23. That work was completed in June 1987. The hydrologic and hydraulic analysis for Rocaps Run was taken from the FIS for the City of Bridgeton.

Greenwich, Township of:	the hydrologic and hydraulic analyses from the FIS report dated August 3, 1992, were taken from the FIS for the Township of Fairfield. That work was completed in June 1987.
Hopewell, Township of:	the hydrologic and hydraulic analyses from the FIS report dated August 18, 1992, for the tidally controlled Cohansey River were taken from the FIS for the Township of Fairfield (FEMA, 1992). The hydrologic and hydraulic analyses for the remaining portion of the Cohansey River were taken from the FIS for the City of Bridgeton (FEMA, 1983).
Lawrence, Township of:	the hydrologic and hydraulic analyses from the FIS report dated August 18, 1992, were prepared by USGS for FEMA, under Inter-Agency Agreement No. EWM-85-E-1832 Project Order No 23. That work was completed in June 1987.
Maurice River, Township of:	the hydrologic and hydraulic analyses from the FIS report dated December 1976 were prepared by the USACE, Philadelphia District, for the FIA, under Inter-Agency Agreement No. IAA-H-16-75, Project Order No 10. That work was completed in November 1976.
Hamilton, Township of:	the hydrologic and hydraulic analyses from the FIS report dated September 1976, were prepared by the USACE, Philadelphia District, for the FIA, under Inter-Agency Agreement Nos. IAA-H-15-72, IAA-H-19-74, and IAA-H-16-75, Project Order Numbers 13, 18, and 22, respectively.
Millville, City of:	the hydrologic and hydraulic analyses from the FIS report dated December 15, 1981, were prepared by Richard Browne Associates, for FEMA, under Contract No. H-4806. That work was completed in January 1980.

Stow Creek, Township of:	the hydrologic and hydraulic analyses from the FIS report dated January 20, 1993, were taken from the FIS for the Township of Lower Alloways Creek, Salem County, NJ (FEMA, 1993).
Vineland, City of:	the hydrologic and hydraulic analyses from the FIS report dated January 5, 1982, were prepared by Richard Browne Associates, for FEMA, under Contract No. H-4806. That work was completed in January 1980.

The authority and acknowledgments for the Borough of Shiloh and Township of Upper Deerfield are not available because no FIS reports were ever published for those communities.

For the [*date*] FIS, updated coastal storm surge and wave height analysis were performed for the entirety of the shoreline within Cumberland County. In addition, floodplains for all riverine flooding sources studied by detailed methods in the county have been redelineated using updated topographic data provided to FEMA by USGS and NJDEP. Flood hazard areas previously assessed by approximate methods were reanalyzed throughout the county, with results mapped using the updated topographic data mentioned above. This work was performed under contract HSFEHQ-09-D-0369 by RAMPP, a joint venture of Dewberry, URS Group Inc., and ESP Associates for FEMA. This work was completed in March 2013.

Base map information for this FIRM was developed from high-resolution orthophotography provided by the State of New Jersey. This information was derived from digital orthophotos produced at a scale of 1:2,400 with a 1-foot pixel resolution from photography dated 2012.

The projection used for the production of this FIRM is New Jersey State Plane (FIPS 2900). The horizontal datum was the North American Datum of 1983 (NAD 83), GRS80 spheroid. Differences in the datum, spheroid, projection or State Plane zones 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

Consultation Coordination Officer's (CCO) meetings may be held for each jurisdiction in this FIS. An initial CCO meeting is typically held with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of an FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is typically held with representatives of FEMA, the community, and the study contractor to review the results of the study.

The dates of the initial and final CCO meetings held prior to the [*date*] FIS for each of the jurisdictions within Cumberland County are shown in Table 1, "Initial and Final CCO Meetings."

TABLE 1 – INITIAL AND FINAL CCO MEETINGS

Community	Initial CCO Date	Final CCO Date
Bridgeton, City of	January 11, 1978	January 18, 1983
Commercial, Township of	November 1, 1977	January 20, 1982
Deerfield, Township of	June 6, 1978	June 11, 1980
Downe, Township of	*	January 12, 1977
Fairfield, Township of	December 19, 1985	August 13, 1991
Greenwich, Township of	June 3, 1991[1]	August 13, 1991
Hopewell, Township of	May 29, 1991[1]	September 11, 1991
Lawrence, Township of	December 19, 1985	September 9, 1991
Maurice River, Township of	July 24, 1975	December 6, 1976
Millville, City of	June 2, 1978	July 27, 1981
Shiloh, Borough of	*	*
Stow Creek, Township of	August 28,1991	February 18,1992
Upper Deerfield, Township of	*	*
Vineland, City of	June 2, 1978	July 27, 1981

[1]Notified by letter
*Data not available

Initial CCO meetings for the [*date*] FIS were held on February 22, 2011 with representatives of the NJDEP, FEMA, RAMPP, and local officials. Flood Risk Review Meetings were held on December 11, 2013; with representatives from NJDEP, FEMA, RAMPP and local officials.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Cumberland County, New Jersey.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods. Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Blackwater Branch	Maurice River
Cedar Branch	Mill Creek-Indian Field Branch
Cohansey River	Petticoat Stream
Delaware Bay	Piney Branch
Jacksons Run	Scotland Run
Long Branch	Tuckahoe River
Manantico Creek	White Marsh Run
Manumuskin River	

Riverine flooding sources throughout the county have been studied by detailed methods at different times and, prior to this FIS, often on a community-by-community basis. Table 3, "Model Dates for Riverine Flooding Sources" represents the hydraulic modeling dates for the detailed study flooding sources in the county.

For the [*date*] FIS, updated coastal storm surge and wave height analysis have been performed for the entirety of the shoreline within Cumberland County.

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.

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analysis were used to study those areas having a low development potential or minimal flood hazards.

2.2 Community Description

Cumberland County is located in the southern part of New Jersey. It is bordered to the north by Atlantic, Gloucester, and Salem Counties; to the west by Salem County; and to the east by Atlantic and Cape May Counties. The county seat is Bridgeton.

Cumberland County was officially created in January 1748, formed by separation from Salem County. It is a multi-faceted community of diverse ethnic groups. Contribution from all of those ethnic groups has contributed to the cultural heritage of the communities that make up Cumberland County. The county is founded on a firm agricultural base that continues to flourish. Progress has brought the glass, canning, oyster, and clothing industries to the County; there is also a targeted industry sector that includes Health Care, Construction, Hospitality/Tourism, and Advanced Manufacturing (Cumberland County, New Jersey Official Government Web site, 2013).

According to the U.S. Census Bureau, the population for Cumberland County was estimated at 156,898 in 2010, with a land area of 483.70 square miles (U.S. Census Bureau 2010).

Southern New Jersey has a relatively mild climate, due to the influence of the Atlantic Ocean and the Gulf Stream, which results in longer summers and milder winters than areas further inland. Average annual precipitation is approximately 40 inches (New Jersey Weather Book; Rutgers, 1983). Storm-related floods are often a result of hurricanes moving up the Atlantic coast.

2.3 Principal Flood Problems

Past history of flooding in Cumberland County demonstrates that flooding can occur during any season of the year. However, most major floods have occurred in late summer, early fall, or during the winter as a result of tropical storms, hurricanes, or nor'easters. Nor'easters, like tropical storms and hurricanes, are cyclonic storms (tropical cyclones are low-pressure centers that typically from over tropical oceans; extratropical cyclones are low-pressure systems that occur outside of the tropics ; however, they normally occur in the winter. Extreme nor'easters are of larger lateral extent, lesser intensity, and longer duration than typical hurricanes.

Hurricanes and major storms have produced significant flooding conditions on the southern New Jersey coast in 1933, 1934, 1940, 1944, 1950, 1960, 1962, and 1975 (USACE, 1976). The storms of 1950 and 1962 produced tides of record for this area. The high tide elevations of the storms of 1933, 1940, 1944, and 1960 were not determined; however, the tide levels were below those of the previously mentioned storms. The November 1950 storm caused a high tide of record along Delaware Bay, 7.2 feet at the Breakwater gage. This storm resulted in extreme damage to areas of Cumberland County. The storm of March 1962 produced high tides of 7.9 feet at Lewes, Delaware, and 7.5 feet at Reedy Point, Delaware. This trend has continued to present times, most recently as a result of inundation and erosion from Hurricane Sandy, in 2012. Stormwater from Delaware Bay results in extensive erosion, property destruction, and damages to infrastructures (e.g., roads and bridges).

In the City of Bridgeton, the storms of 1934 and 1940 were accompanied by intense rainfall, which caused Sunset Lake to breach the dam at West Park Drive. This resulted in serious damage to the bridges on Washington Street, Commerce Street, and Broad Street. A sewage treatment plant and the water works north of the Washington Street Bridge were also damaged. On July 13, 1975, an intense storm caused the Raceway to overtop its banks near the city zoo, at the railroad trestle, and at the Canoehouse. Flooding was also reported in the vicinity of the intersection of Commerce Street and East Avenue. This flooding occurred because East Lake overtopped its banks as a result of insufficient detention capacity and inadequate outflow facilities.

TABLE 3 – MODEL DATES FOR RIVERINE FLOODING SOURCES

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Blackwater Branch	City of Vineland	January 1980
Cedar Branch	City of Vineland	January 1980
Cohansey River	City of Bridgeton	March 1982
	Township of Hopwell	March 1982
Delaware Bay	Township of Downe	March 2013
	Township of Fairfield	March 2013
	Township of Greenwich	March 2013
	Township of Hopewell	March 2013
	Township of Lawrence	March 2013
	City of Millville	March 2013
	Township of Stow Creek	March 2013
Jacksons Run	City of Bridgeton	March 1982
Long Branch	City of Vineland	January 1980
Manantico Creek	City of Vineland	January 1980
Manumuskin River	Township of Maurice River	November 1975
	City of Vineland	January 1980
Maurice River	Township of Commercial	May 1981
	Township of Deerfield	December 1979
	City of Millville	January 1980
	City of Vineland	January 1980
Mill Creek - Indian Field Branch	City of Bridgeton	March 1982
Petticoat Stream	City of Millville	January 1980
Piney Branch	City of Vineland	January 1980
Scotland Run	City of Vineland	January 1980
Tuckahoe River	Township of Maurice River	November 1976
White Marsh Run	City of Millville	January 1980

In the Township of Deerfield flood damage generally occurs because of inadequate interior drainage facilities. Because Deerfield is relatively undeveloped along the Maurice River, no severe damage occurs during flooding caused by the Maurice River.

The Township of Downe is subject to tidal flooding from Delaware Bay. The bay-front communities of Money's Island, Gandy's Beach, Fortescue Beach, and Raybin's Beach have been inundated by high tides in the past. High tides flow for miles inland, isolating Newport and Dividing Creek.

In the Townships of Fairfield, Greenwich, and Hopewell, analysis of flooding conditions on the Cohansey River showed that tidal inundation was more critical than fluvial flooding. On this basis, the most severe flooding along the river is more apt to occur as a result of abnormally high tides in the main stream and the lower tidal portions of the tributary streams than from fluvial flooding of the river itself.

In the Township of Lawrence, low-lying areas are subject to tidal flooding from Delaware Bay. The community of Bay Point has also been inundated by high tides in the past. High tides flow miles inland, isolating Jones Island and Sayre Neck.

The Township of Maurice River is subject to flooding from the Maurice River, Manumuskin River, Tuckahoe River, Manantico Creek, West Creek, Delaware Bay, and numerous small streams. The Maurice River, Manantico and West Creeks, and Delaware Bay are all subject to tidal flooding. A USGS stream gage located at the Tuckahoe River downstream of the Township of Maurice River at NJ Route 49, 3.7 miles west of Tuckahoe River, has been in operation since December 1969. Little data from or history of past floods are available for the other streams found within the township.
In the City of Millville, aside from large storms, the major flooding problems on White Marsh Run and Petticoat Stream occur from smaller, more frequent storms.

The Township of Stow Creek contains areas of tidal marsh that are subject to flooding. Flooding in the community generally occurs within close proximity to the streams. The low-lying areas of the township are subject to inundation by high tides from the Delaware Bay.

In the City of Vineland, aside from extremely large storms, the major flooding problems occur on the Blackwater, Piney, and Cedar Branches.

2.4 Flood Protection Measures

In the City of Bridgeton, shore protection measures have been utilized along the Cohansey River to provide protection against floods that result from abnormally high tides. Bulkheads have been installed along the river at Bridgeton. Earthen embankments were also constructed between the Cohansey River and Raceway, but have deteriorated from lack of maintenance. Timber bulkheads and mud banks were constructed by the county and individual property owners after the November 1950 storm. A siphon spillway was constructed at the Sunset Lake Dam after the 1940 storm, and a new dam was constructed at Mary Elmer Lake on Mill Stream.

In the Townships of Commercial and Maurice River, shore protection measures have been utilized along the Maurice River and the New Jersey shore areas to provide protection against floods that result from abnormally high tides generated in Delaware Bay. Bulkheads have been installed along the Maurice River at Millville, Mauricetown, Dorchester, Leesburg, and Shell Pile. Timber bulkheads and mud banks were constructed by the county and individual property owners after the November 1950 storm. Please see the Cumberland County, New Jersey Multi-Jurisdictional Hazard Mitigation Plan (November 16, 2009) http://www.co.cumberland.nj.us/filestorage/173/251/765/1906/2918/6284/Cumberland_HMP_Final_Draft_plan11122009.pdf.

Watershed work plans have been prepared jointly by the Townships of Commercial and Maurice River, along with other government agencies. These plans provide for flood protection as well as agricultural water management benefits in the Maurice River Cove and Riggins Ditch watersheds.

There are several dams on the Maurice River upstream of the Township of Deerfield. These include Willow Grove Lake on the Maurice River, Malaga Lake on Scotland Run, and Iona Lake on Still Run. The purpose of these dams is not flood control, though they have the effect of reducing flooding downstream of them, especially when their reservoirs are not full to capacity when a storm hits. There are protective measures in the form of land use regulations adopted by the Township of Deerfield that control building in the stream floodplains (USACE, 1977). No structural flood protection measures have been built or are planned within Deerfield itself.

In the Township of Fairfield, shore protection measures in the forms of bulkheads, earthen levees, and dikes have been employed to prevent flooding and erosion of the developed shoreline areas that may result from abnormally high tides. Bulkheads have been installed along the Cohansey River at Fairton. Earthen levees also have been constructed along parts of the river. Timber bulkheads and mud banks were constructed after the storm of November 1950. Dikes also have been constructed by individual property owners.

In the City of Millville, timber bulkheads and mudbanks were constructed by the county and individual property owners after the storm of November 1950. In addition, the dams on the various lakes in the upper portions of the Maurice River basin, Willow Grove Lake, and Union Lake provide some protection from fluvial flooding.

The City of Vineland has adopted nonstructural measures of flood protection to aid in the prevention of future flood damage. These are in the form of land use regulations adopted by the City that control building in the stream floodplains.
A number of man-made structures commonly called agricultural or salt-hay levees have been identified in this county. The inventory of these structures is detailed in a report (South Jersey Levee Inventory, 2010) developed by the United States Department of Agriculture (USDA), National Resource Conservation Service (NRCS) for the NJDEP.

However, these structures were studied and found not to provide protection from the 1-percent annual chance flood. There is a potential that these structures may increase local flood hazard due to higher velocity flows during a large flood event as they overtop, and may lead to increased time of inundation by retaining flood waters for an extended period. Local conditions should be assessed for this potential for increased flood hazard and appropriate mitigation measures are recommended.

More information on the non-levee structures located in this county may be found in the “South Jersey Levee Inventory” published in November, 2010 by the NRCS and the NJDEP, Bureau of Dam Safety and Flood Control.

There are no other known structural flood protection measures in place in the Townships of Downe, Greenwich, Hopewell, Lawrence, or Stow Creek.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which 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 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Riverine Hydrologic Analyses

Prior to the [*date*], FIS the following hydrologic analyses were carried out to establish peak discharge-frequency relationships for each flooding source studied by detailed methods in the county. With the exceptions of the Borough of Shiloh (no flood hazard information have been identified) and the Township of Upper Deerfield (no FIS was produced) all other communities have a previously printed FIS report. The hydrologic analyses described in those reports have been compiled and are summarized below.

In the City of Bridgeton for the Cohansey River, Mill Creek/Indian Field Branch, and Jacksons Run, the peak discharges for the floods of 10-, 2-, and 1-percent-annual-chance flood recurrence intervals were developed using procedures outlined applying methods presented in Special Report 38 (NJDEP and USGS, 1974). This report presents regional flow equations that relate basin characteristics to peak flood discharges. The characteristics are basin size, channel slope, surface storage, and impervious cover. These parameters were determined from USGS topographic maps (USGS, 1972).

The 0.2-percent-annual-chance flood year flood discharges for Cohansey River, Mill Creek/Indian Field Branch and Jacksons Run were estimated by straight-line extrapolation of the respective log-probability graphs of peak discharges for the 10-, 50-, and 1-percent-annual-chance flood recurrence intervals.

For the Raceway, peak discharges for the selected recurrence intervals were based on the discharges determined for the Cohansey River using Special Report 38 and the combined results of the weir flow and/or pressure flow calculations for the three outlet structures on Sunset Lake, the drop culvert at the Raceway outlet, and the overbank flow that occurs over the left bank of the Raceway (NJDEP and USGS, 1974).

Elevations for Sunset Lake were determined from weir calculations using discharges determined with the procedures in Special Report 38 (USACE, 1973).

In the Township of Commercial, flood-flow frequency data for the Maurice River were based on the final estimates of discharges for the 10-, 2-, 1- and 0.2-percent-annual-chance floods as published in a USACE study (USACE, 1973). Peak discharge-frequency values for the selected recurrence intervals at various points along the Maurice River were obtained by extrapolation of the frequency drainage area-discharge developed in the USACE study (USACE, 1973).

In the Township of Deerfield, the peak discharges for the Maurice River were calculated using the USACE HEC-1 hydrograph computer package (USACE, 1973). HEC-1was utilized by the USACE's Hydrologic Engineering Center for the riverine modeling of the Philadelphia District's floodplain study in 1976 (USACE, 1976). The model: 1) separated the Maurice River into seven sub-basins of similar hydrologic and hydraulic characteristics; 2) developed flood hydrographs for each section; and 3) routed and combined these hydrographs down the river to Union Lake Dam. The entire model was calibrated by reproducing the hydrographs of selected storms of record as recorded at the USGS gage at Norma, New Jersey.

In the Township of Hopewell, for the Cohansey River, the peak discharges for the floods of 10-, 2-, 1-percent-annual-chance flood recurrence intervals were developed using procedures outlined applying methods presented in Special Report 38 (NJDEP and USGS, 1974). This report presents regional flow equations that relate basin characteristics to peak flood discharges. The characteristics are basin size, channel slope, surface storage, and impervious cover. These parameters were determined from USGS topographic maps (USGS, 1972).

The 0.2-percent-annual-chance flood discharges for the Cohansey River were estimated by straight-line extrapolation of the respective log-probability graphs of peak discharges for the 10-, 50- and 100-year floods.

In the Township of Maurice River, the hydrologic analyses for the Manumuskin and Tuckahoe Rivers consisted of historic hydrograph reconstitution using the HEC-1 computer model (USACE, 1973) and by a routing and combining process. Unit hydrographs were then developed. Hypothetical storms were generated, and resultant discharge hydrographs were developed to estimate runoff events at selected recurrence intervals. An alternative approach, which consisted of an extension of the regional frequency analysis (Regional Frequency Study, 1974), was also investigated. The results were compared and evaluated and final estimates of discharges for the 10-, 2-, 1-percent-annual-chance recurrence interval were adopted (Special Projects Memo No. 459). The peak flows of the 0.2-percent-annual-chance flood were obtained by extrapolating the discharge-frequency curves developed from peak flows of the more frequent flood events.

In the City of Millville the peak discharges for the Maurice River were calculated using the USACE HEC-1 hydrograph computer package (USACE, 1973). HEC-1was utilized by the USACE's Hydrologic Engineering Center for the riverine modeling of the Philadelphia District's floodplain study in 1976 (USACE, 1976). The model: 1) separated the Maurice River into seven sub-basins of similar hydrologic and hydraulic characteristics; 2) developed flood hydrographs for each section; and 3) routed and combined these hydrographs down the river to Union Lake Dam. The entire model was calibrated by reproducing the hydrographs of selected storms of record as recorded at the USGS gage at Norma, New Jersey.

Peak flows for White Marsh Run and Petticoat Stream were determined using the relationships contained in Special Report 38 (NJDEP and USGS, 1974). These relationships were developed through a statistical regression analysis of data collected at over 100 gages across New Jersey. The analysis accounts for urban development, natural retention created by lakes and swamps, stream slope, and drainage area. The relationships were extended to include the 0.2-percent-annual-chance flood interval.

In the City of Vineland, peak flows for Blackwater, Long, and Piney Branches were determined using the relationships contained in Special Report 38 (NJDEP and USGS, 1974). These relationships were developed through a statistical regression analysis of data collected at over 100 gages across New Jersey. This analysis accounts for urban development, natural retention created by lakes and swamps, stream slope, and drainage area. The relationships were extended to include the 0.2-percent-annual-chance.

The peak discharges for the Maurice River and Scotland Run were calculated using the USACE's HEC-1 flood hydrograph computer package (USACE, 1973). The model: 1) separated the Maurice River into seven sub-basins of similar hydrologic and hydraulic characteristics; 2) developed flood hydrographs for each section; and 3) routed and combined these hydrographs down the river to Union Lake Dam. The entire model was calibrated by reproducing the hydrographs of selected storms of record as recorded at the USGS gage at Norma, New Jersey.

The hydrologic analysis of the Manumuskin River was done by the USACE, Philadelphia District, for the FIS of the Township of Maurice River (FIA, 1976).

For Manantico Creek and Cedar Branch, peak discharges were based on a statistical analysis of peak discharges at USGS gage station no. 01412000 located just downstream of Vineland. This analysis was prepared by the USGS in May 1979 and involved a log-Pearson Type III analysis of 26 years of continuous record (USGS, unpublished). These flows were transposed to specific locations in the study area according to the relationship:

$$Q_S = Q_G \, (DA_S / DA_G)^{T}$$

Where DA_S and DA_G are the drainage areas at the specific site and the gage, respectively, ^{T} is the transfer coefficient, Q_G is the peak discharge at the gage for a particular flood and Q_S is the resulting peak discharge at the site. In this case, a transfer coefficient of 0.6 was used which is in agreement with various USGS gages in the area.

On Cedar Branch, floodwaters overtop Lincoln Street upstream of the outlet structure of the lake. The discharges used in the HEC-2 model through the outlet structure and the Lincoln Street bridge were computed by calculating the flow over Lincoln Street by manual methods and then balancing the resulting energy gradelines at the lake.

For the [*date*] FIS, no detailed riverine analysis was performed.

A summary of the drainage area-peak discharge relationships for all the streams studied by detailed methods is shown in Table 4, "Summary of Discharges."

TABLE 4 – SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
BLACKWATER BRANCH					
At Mouth	14.00	551	930	1,146	1,871
Downstream of Delsea Drive	10.83	540	912	1,128	1,849
Downstream of confluence of Piney Branch	9.38	476	809	1,003	1,651
Downstream of confluence of Long Branch	5.05	402	692	869	1,460
Upstream of confluence of Long Branch	3.92	271	476	601	1,023
CEDAR BRANCH					
At Manantico Road	5.91	330	566	703	1,200
At Maple Avenue	3.39	320	555	698	1,180
COHANSEY RIVER					
At City of Bridgeton downstream corporate limits	64.0	4,800	7,470	9,660	13,410
At City of Bridgeton upstream corporate limits	46.2	3,200	4,790	6,280	8,540
JACKSONS RUN					
At inlet of East Lake	1.6	300	510	600	880
At upstream City of Bridgeton corporate limits	1.0	180	325	400	620
LONG BRANCH					
At confluence with Blackwater Branch	1.43	215	373	469	785
MANANTICO CREEK					
At USGS gage no. 01412000	22.3	514	1,051	1,388	2,538
Downstream of Manantico Lake	20.64	491	1,003	1,325	2,423
At Dante Avenue	16.58	430	880	1,069	1,955
Downstream of confluence of Panther Branch	14.43	396	809	1,069	1,955

TABLE 4 – SUMMARY OF DISCHARGES (cont'd)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
MANUNUSKIN RIVER					
At State Route 49	29.4	450	1,100	1,580	3,800
Approximately 600 feet downstream of Mays Landing Road at Bennets Mill	11.6	250	630	890	2,200
Approximately 0.4 mile downstream of Atlantic-Cumberland County boundary	4.0	110	260	370	930
MAURICE RIVER					
At confluence with Delaware Bay	393	2,680	5,500	7,600	14,400
Downstream of confluence of Manantico Creek	335	2,500	5,200	7,100	13,300
Upstream of confluence of Manantico Creek	240.3	2,120	4,380	5,950	11,200
At Union Lake Dam	215.3	2,000	4,200	5,600	10,800
At confluence with Parvins Branch	190.7	1,800	3,850	5,200	10,000
Upstream of confluence of Parvins Branch	176.6	1,720	3,650	5,000	9,700
USGS gage 01411500 at Norma	113.0	1,300	2,700	3,600	7,300
Downstream face Willow Grove Lake	77.2	930	2,000	2,700	5,800
MILL CREEK/ INDIAN FIELD BRANCH					
At confluence with the Cohansey River	9.4	700	1,190	1,450	2,140
At upstream corporate limit of City of Egg Harbor	5.7	270	460	580	860
Upstream of Burlington Road	4.8	235	400	500	750
PETTICOAT STREAM					
At mouth	6.26	457	760	933	1,493
At Main Street in City of Millville	5.13	364	611	753	1,216
At 10th Street in City of Millville	2.74	212	362	449	735

TABLE 4 – SUMMARY OF DISCHARGES (cont'd)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT ANNUAL CHANCE	2-PERCENT ANNUAL CHANCE	1-PERCENT ANNUAL CHANCE	0.2-PERCENT ANNUAL CHANCE
PINEY BRANCH					
At confluence with Blackwater Branch	2.65	341	578	720	1,180
At North East Avenue	1.54	239	412	518	864
At North Valley Avenue	0.69	117	209	267	460
RACEWAY					
At confluence with the Cohansey River	N/A	940	1,350	1,960	2,880
At confluence with Muddy Run/ Eddy Run	N/A	940	1,350	1,960	2,880
At West Park Drive Bridge	N/A	640	840	1,360	2,000
SCOTLAND RUN					
At Willow Grove Lake	30.40	440	970	1,240	2,500
TUCKAHOE RIVER					
At Cumberland Avenue	8	160	360	500	1,100
WHITE MARSH RUN					
At Mouth	9.01	391	672	835	1,389
At Esibell Avenue	7.96	345	603	755	1,279
At Reick Avenue	6.52	303	536	679	1,164

The stillwater elevations (SWELs) for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods have been determined for all flooding sources studied by detailed methods, and are summarized in Table 5, "Summary of Stillwater Elevations."

TABLE 5 - SUMMARY OF STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SUNSET LAKE				
Entire Shoreline within the City of Bridgeton, Township of Hopewell and Township of Upper Deerfield	17.4	18.3	19.1	19.8
RACEWAY				
Entire Shoreline within City of Bridgeton	16.4	16.6	16.8	16.9

*North American Vertical Datum of 1988

3.2 Riverine 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 FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this FIS are based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Prior to the [*date*], FIS with the exceptions of the Borough of Shiloh (no flood hazard information have been identified) and the Township of Upper Deerfield (no FIS was produced) all other communities have a previously printed FIS report. The hydraulic analyses described in those reports have been compiled and are summarized below.

Water-surface profiles for floods of the selected recurrence intervals for Blackwater Branch, Cedar Branch, the Cohansey River, Jacksons Run, Long Branch, the Maurice River, Manantico Creek, Mill Creek/Indian Field Branch, the Manumuskin River, Petticoat Stream, Piney Branch, Scotland Run, the Tuckahoe River, and White Marsh Run were computed through use of the USACE HEC-2 step-backwater computer program (USACE, 1982).

For the Raceway, the water-surface elevations were determined by weir flow analysis. This method was used because the stream is perched and the left overbank area has lower flow lines than the main channel. Consequently, the left earthen embankment allows unconfined overflow to the floodplain of the Cohansey River.

Starting water-surface elevations for Blackwater Branch, the Cohansey River, Mill Creek/Indian Field Branch, Jacksons Run, Petticoat Stream, and White Marsh Run were determined using the slope/area method.

Water-surface elevations of floods of the selected recurrence intervals for the area of shallow flooding located on Jacksons Run were taken from a rating curve developed from hand calculations. These calculations were done for the culvert that extends from a point downstream of Irving Avenue upstream to Orchard Street.

The starting water-surface elevations for the Maurice River were determined from known elevations at the Union Lake Dam; Manantico Creek was determined beginning at Manantico Lake Dam; and Scotland Run was begun at the crest of Willow Grove Lake Dam.

Starting elevations for the Manumuskin River were taken from the tidal elevations. Starting elevations for the Tuckahoe River were obtained using critical depth downstream of the Township of Maurice River boundary.

Starting water-surface elevations for Long Branch were started at the coincident Blackwater Branch elevations.

A separate HEC-2 computer model was set up for the area near the confluence of Piney and Blackwater Branches. This “interflow” model was needed because floodwaters from these streams cross the drainage divide just upstream of North-East Boulevard in the City of Vineland and therefore the two streams essentially flow as one. The starting water-surface elevations for this model are the coincident elevations on Blackwater Branch, while the discharges are those calculated on Blackwater Branch just downstream of the Piney Branch confluence. Starting water-surface elevations for Blackwater and Piney Branches upstream of the “interflow” area are those calculated in the “interflow” model.

For the [*date*] FIS, there were no detailed riverine sources that were restudied.

***Approximate* (A) “A Zones”:** This category is assigned where “unnumbered” A Zones are shown on the effective maps, but the anticipated level of development does not warrant the collection of field survey; or where communities have requested an approximate study where there was currently no study at all. The desktop analysis approach to be applied to approximate studies is defined in Appendix C, Section 4.3 of FEMA’s *Guidelines and Specifications for Flood Hazard Mapping Partners*. The level of effort includes orthophoto collection, LiDAR and stream breakline collection, use of engineering drawing plans and DOT studies (where appropriate and available), nomination of flow rates, and the development of HEC-RAS hydraulic models.

Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 6, "Manning's "n" Values."

TABLE 6 – MANNING'S "n" VALUES

Stream	Channel "n"	Overbank "n"
Blackwater Branch	0.100	0.035
Cedar Branch	0.065-0.100	0.030-0.032
Cohansey River	0.030-0.045	0.050-0.120
Jacksons Run	0.035-0.050	0.040-0.100
Long Branch	0.100	0.035
Manantico Creek	0.080-0.100	0.030-0.032
Manumusskin River	0.050-0.130	0.050-0.130
Maurice River	0.022-0.100	0.040-0.100
Mill Creek/Indian Field Branch	0.015-0.045	0.020-0.120
Petticoat Stream	0.035	0.080
Piney Branch	0.010-0.080	0.035
Scotland Run	0.100	0.040
Tuckahoe River	0.050	0.120-0.130
White Marsh Run	0.030-0.040	0.055-0.100

Qualifying benchmarks 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.

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

In addition to NSRS benchmarks, 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 benchmarks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at 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 FIRM. Interested individuals may contact FEMA to access this data.

3.3 Coastal Analysis

Prior to the [*date*] FIS, each jurisdiction within Cumberland County, with the exceptions of the Borough of Shiloh and the Township of Upper Deerfield, has a previously printed FIS report. Note that the jurisdictions with previous analysis are now superseded by the revised coastal hydrologic analysis

For the [*date*] FIS, an analysis was performed to establish the frequency peak elevation relationships for coastal flooding in Cumberland County. The FEMA Region III office initiated a study in 2008 to update the coastal storm surge elevations within Virginia, Maryland, Delaware, and the District of Columbia, including the Atlantic Ocean, Chesapeake Bay and its tributaries, and Delaware Bay. Those portions of the State of New Jersey along Delaware Bay, although part of FEMA Region II, were included as part of the analysis. The study replaces outdated coastal storm surge SWELs for all FISs in the study area, including Cumberland County, and serves as the basis for updated FIRMs. Study efforts were initiated in 2010 and concluded in 2013.

Coastal analysis, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of flood elevations for the selected recurrence intervals along the shoreline. Users of the FIRM should be aware that coastal flood elevations are provided in Table 7, “Summary of Coastal Stillwater Elevations” 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 is sparse along Cumberland County’s entire shoreline with the exception of a few widely dispersed shorefront developments. The entire coastline is comprised of estuarine marshlands with elevations varying from sea level to approximately 10 feet referenced to the North American Vertical Datum of 1988 (NAVD88). Behind the shoreline, the marshland continues until gradually being replaced by higher elevation agricultural and residential areas of the county.

The storm surge study was conducted for FEMA by the 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 III 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 and 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 ADCIRC+SWAN (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 II domain: Hurricane Isabel, Hurricane Ernesto, and extratropical storm Ida. Model skill was assessed by quantitative comparison of model output to wind, wave, water level, and high-water mark observations.

The tidal surge from Delaware Bay affects the entire Cumberland County shoreline. The entire southwestern coastline, from West Creek to Stow Creek, is more prone to damaging wave action during high wind events because of the significant fetch over which winds can operate. Behind the coastline, the marshlands gently rise in elevation and narrow considerably as they converge with upland agricultural and residential areas. In this area, the fetch over which winds can operate for wave generation is significantly less.

The storm-surge elevations for the 10-, 2-, 1- and 0.2-percent-annual-chance floods were determined for Delaware Bay and are shown in Table 7, “Summary of Coastal Stillwater Elevations.” The analysis reported herein reflects the stillwater elevations resulting from tidal and wind setup effects.

TABLE 7 – SUMMARY OF COASTAL STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (feet NAVD*) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
DELAWARE BAY				
At confluence of West Creek	5.7	6.9	8.3	11.9
At confluence of the Maurice River	5.6	6.7	7.8	11.7
At False Egg Island Point	6.6	7.8	8.4	10.5
At Bay Point	5.3	7.5	8.8	11.4
At confluence of the Cohansey River	7.2	8.2	8.9	11.7
At confluence of Stow Creek	6.6	7.7	8.6	11.0

*North American Vertical Datum of 1988

3.4 Wave Height Analysis

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 (Methodology for Calculating Wave Action Effects Associated with Storm Surges, 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 from 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 as wind energy transfers to the water. This added energy is related to fetch length and depth.

The coastal analysis and mapping for Cumberland County was conducted for FEMA by RAMPP under contract No. HSFEHQ-09-D-0369, Task Order HSFE02-09-J-0001. The coastal analysis involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave setup, wave height analysis and wave runup.

Starting wave conditions (offshore) were derived from the two-dimensional ADCIRC+SWAN model developed for Delaware Bay. Wave heights were then computed across transects defined for coastal areas of Cumberland County. The transects are 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.

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 undergoes major changes. The transect data table, Table 8**,** provides Delaware Bay 10-, 2-, 1- and 0.2-percent-annual-chance SWELs and the starting wave conditions for each transect.

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. The SWELs for a 1-percent-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. Along the open coast where a primary frontal dune was identified, the Zone VE designation applies to all areas seaward of the landward toe of the dune feature. The landward toe of the primary frontal dune is defined as the point where the ground profile changes from relatively steep to relatively mild.

Dune erosion was taken into account along selected areas of the Delaware Bay coastline. A review of the geology and shoreline type in Cumberland 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's Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update (2007a). 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 SWELs required for erosion analysis. Each cross-shore transect was analyzed for erosion, when applicable.

Wave height calculations and methodologies used in this study are described in FEMA's Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update (2007a). Wave setup is the increase in mean water level above the still water level due to momentum transfer to the water column by waves that are breaking or otherwise dissipating their energy (Dean et al., 2005). For the Cumberland County study, wave setup was determined directly from the coupled wave and storm surge model. The total SWEL, including wave setup, was 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 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 Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update (2007a) 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 elevation exceeded by 2-percent of incoming waves affecting the shoreline during the 1-percent-annual-chance flood event. Each transect defined within the Region II 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 elevations, wave overtopping was computed following FEMA Guidelines and Specifcations.

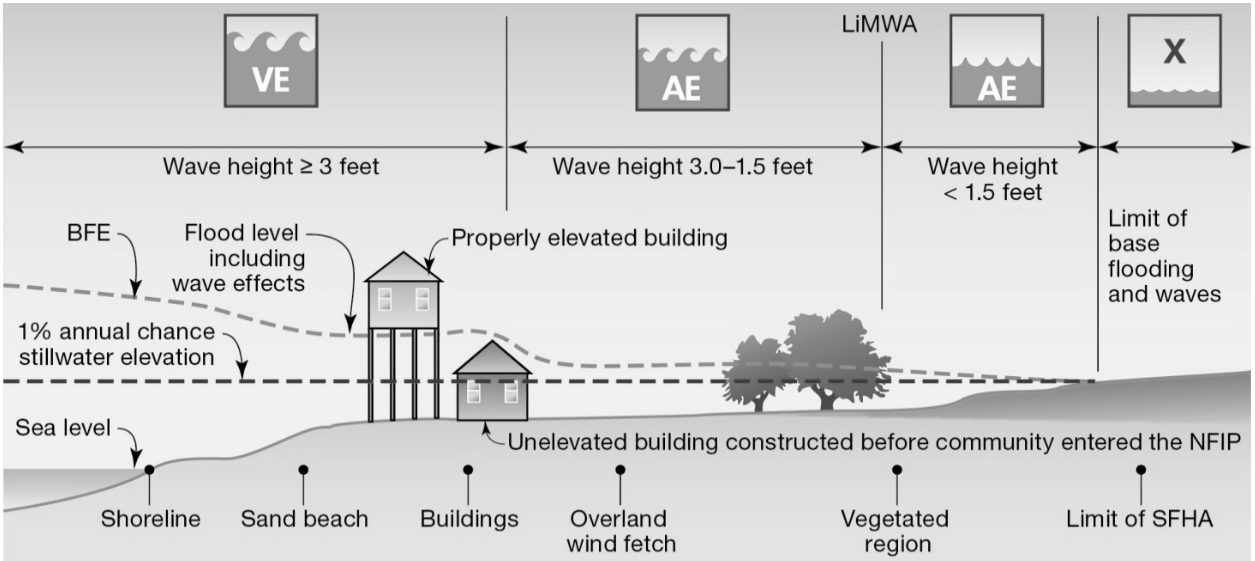
Controlling wave heights, which are used to determine BFEs for the one-percent annual chance event, ranged from 3.2 feet to 12.3 feet at the shoreline. The corresponding wave elevation at the shoreline varies from 2.0 feet NAVD88 to 7.7 feet NAVD88. Vertical reinforced structures such as seawalls and bulkheads can serve to reduce wave height.

Areas of coastline subject to significant wave attack are referred to as coastal high hazard areas. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard areas (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 of 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 area 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 designed 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 (Procedure Memorandum No. 50 - Policy and Procedures for Identifying and Mapping Areas Subject to Wave Heights Greater than 1.5 feet as an Informational Layer on Flood Insurance Rate Maps) on identifying and mapping the breaking 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA currently 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).

Transects represent the locations where the overland wave height analysis was modeled and are placed with consideration given to topography, land use, shoreline features and orientation, and the available fetch distance. Each transect was placed to capture the dominant wave direction, typically perpendicular to the shoreline and extended inland to a point where coastal flooding ceased. Along each transect, wave heights were computed considering the combined effects of changes in ground elevation, obstructions, and wind contributions. Transects were placed along the shoreline along all sources of primary flooding in the county, as illustrated on the FIRMs and in the “Transect Location Map” provided in Figure 2. Transects also represent locations visited during field reconnaissance to assist in parameterizing obstructions and observing shore protection features.

Figure 2, “Transect Location Map,” illustrates the location of each transect. Along each transect, wave envelopes were computed considering the combined effects of changes in ground elevation, vegetation, and physical features. 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 undergoes major changes.



<u>FIGURE 1: TRANSECT SCHEMATIC</u>

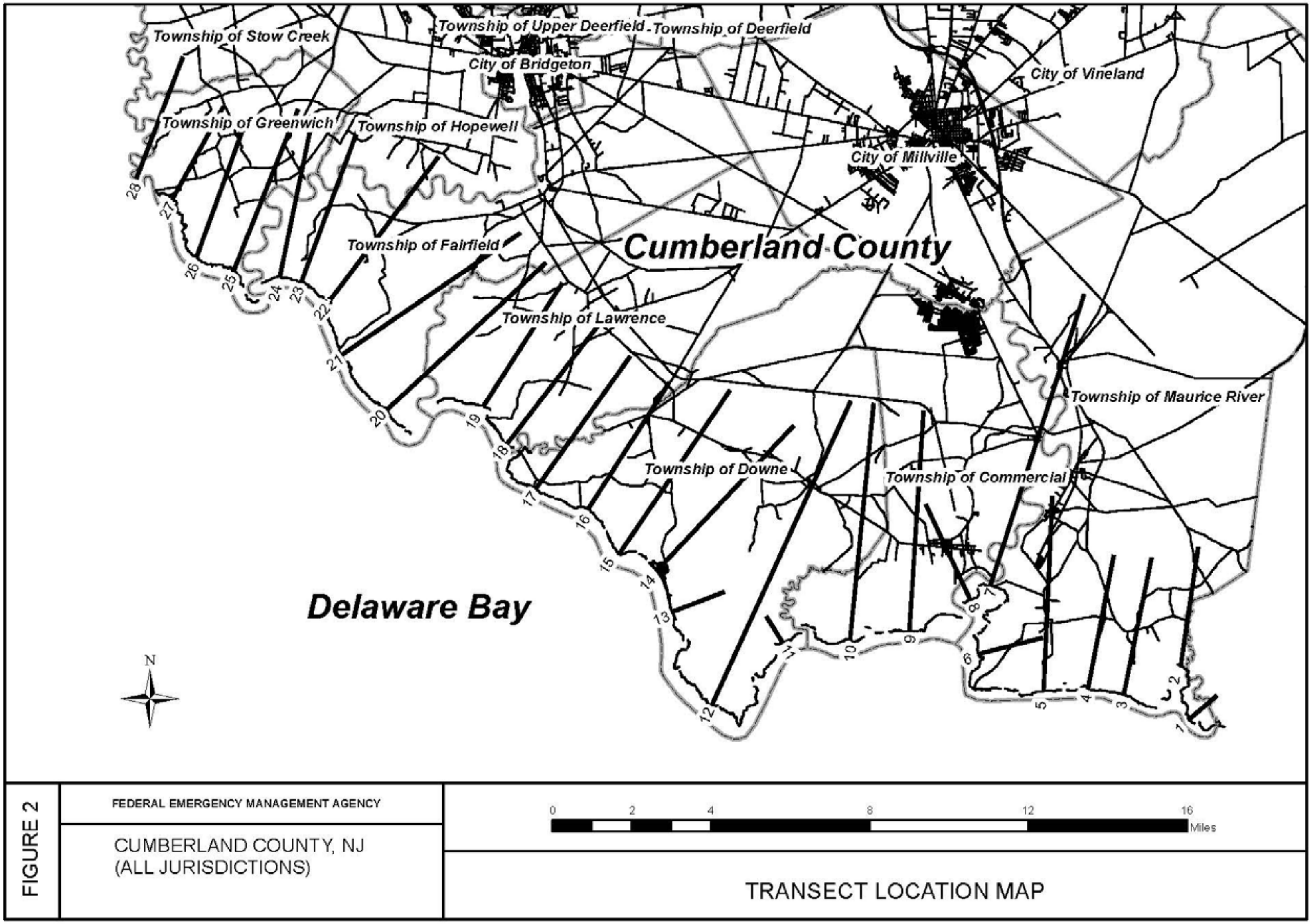


FIGURE 2: TRANSECT LOCATION MAP

<u>TABLE 8 – TRANSECT DATA TABLE</u>

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
Delaware Bay	1	N 39.180912 W -74.925350	3.4	6.0	5.7 5.4-5.7	6.9 6.5-6.9	8.3 8.2-8.3	11.9 11.9-11.9
Delaware Bay	2	N 39.200610 W -74.928746	2.0	6.6	5.7 4.9-5.7	6.5 6.1-6.5	8.4 8.3-8.6	12.2 11.8-12.2
Delaware Bay	3	N 39.190482 W -7955696	5.6	4.4	5.6 5.0-5.6	6.9 6.0-7.0	8.6 8.1-8.6	11.8 11.7-11.9
Delaware Bay	4	N 39.193025 W -74.972452	5.7	4.6	5.4 5.1-5.4	6.7 6.0-6.7	8.6 8.0-8.6	11.5 11.5-12.0
Delaware Bay	5	N 39.192378 W -74.993398	6.7	5.7	6.4 5.1-6.4	7.7 6.2-7.7	8.6 7.0-8.6	12.1 10.4-12.1
Delaware Bay	6	N 39.206696 W -75.023467	4.3	6.5	5.9 5.4-5.9	7.1 6.5-7.1	8.5 7.7-8.5	11.6 11.4-11.6
Delaware Bay	7	N 39.231736 W -75.071134	2.6	2.7	5.5 5.1-5.5	6.6 6.1-6.7	7.8 6.5-7.8	11.6 9.7-11.7
Delaware Bay	8	N 39.226264 W -75.026591	2.9	2.9	5.6 5.3-5.6	6.7 6.6-6.8	7.8 7.8-8.2	11.7 11.7-12.4
Delaware Bay	9	N 39.215452 W -75.055942	5.6	6.2	6.5 4.5-6.5	7.8 5.2-7.8	8.6 6.1-8.6	12.0 9.8-12.4
Delaware Bay	10	N 39.213142 W -75.083744	5.8	6.1	6.6 4.5-6.6	7.8 5.2-7.8	8.7 6.1-8.7	11.8 9.8-12.3

<u>TABLE 8 – TRANSECT DATA TABLE (cont'd)</u>

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting 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
Delaware Bay	11	N 39.212471 W -75.115579	4.9	5.9	6.3 5.3-6.3	7.5 5.7-7.5	8.6 7.2-8.6	11.3 10.4-11.3
Delaware Bay	12	N 39.190074 W -75.149208	7.7	6.9	6.6 4.9-6.6	7.8 5.2-7.8	8.4 6.1-8.4	10.5 9.8-10.5
Delaware Bay	13	N 39.224408 W -75.167113	4.7	4.9	6.7 5.3-6.7	7.8 6.4-7.8	8.6 7.0-8.6	10.9 10.3-10.9
Delaware Bay	14	N 39.239594 W -75.174044	5.3	5.7	6.7 4.6-6.7	7.9 5.7-7.9	8.6 6.5-8.6	11.2 10.4-11.2
Delaware Bay	15	N 39.245907 W -75.191532	6.3	5.3	6.8 4.8-6.8	7.9 6.0-7.9	8.7 6.8-8.7	11.2 10.6-11.2
Delaware Bay	16	N 39.262712 W -75.205714	6.0	5.2	6.8 4.8-6.8	8.0 5.8-8.0	8.7 6.6-8.7	11.5 10.5-11.5
Delaware Bay	17	N 39.270676 W -75.225925	6.7	5.7	6.8 4.4-6.8	8.0 5.5-8.0	8.7 6.1-8.7	11.3 10.3-11.3
Delaware Bay	18	N 39.286976 W -75.243449	4.9	6.8	6.7 4.5-6.7	7.8 5.6-7.8	8.7 6.7-8.7	11.3 10.5-11.3
Delaware Bay	19	N 39.301490 W -75.253711	4.5	5.8	6.3 5.4-6.3	7.5 5.9-7.5	8.8 6.8-8.8	11.4 10.4-11.4
Delaware Bay	20	N 39.300811 W -75.299023	4.9	6.6	6.8 5.1-6.8	7.9 6.1-7.9	8.7 6.7-8.7	11.1 10.5-11.3

TABLE 8 – TRANSECT DATA TABLE (cont'd)

Flood Source	Transect	Starting Wave Conditions for the 1% Annual Chance			Starting 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
Delaware Bay	21	N 39.320927 W -75.320314	4.8	6.6	7.0 5.2-7.0	8.1 6.2-8.1	8.8 6.9-8.8	11.3 10.7-11.7
Delaware Bay	22	N 39.248322 W -75.324730	3.1	6.4	6.9 6.3-7.0	8.1 7.3-8.1	8.8 8.0-8.8	11.6 11.3-11.7
Delaware Bay	23	N 39.347992 W -75.338470	5.2	6.1	7.0 6.6-7.0	8.2 7.9-8.2	8.9 8.5-8.9	11.7 11.2-11.9
Delaware Bay	24	N 39.350331 W -75.348640	5.3	5.8	7.1 6.8-7.1	8.2 8.0-8.2	8.9 8.6-8.9	11.7 11.4-11.7
Delaware Bay	25	N 39.352352 W -75.370494	5.0	6.1	6.2 6.2-7.0	7.4 7.4-8.2	8.8 7.9-8.8	10.9 10.8-11.7
Delaware Bay	26	N 39.357865 W -75.387594	5.1	6.1	7.1 6.5-7.1	8.2 7.5-8.2	8.8 8.2-8.8	11.2 11.2-11.8
Delaware Bay	27	N 39.379373 W -75.398475	4.2	5.9	7.1 5.4-7.1	8.2 6.4-8.2	8.8 7.0-8.8	11.4 10.8-11.8
Delaware Bay	28	N 39.386930 W -75.415217	3.6	5.7	6.6 4.2-6.6	7.7 5.2-7.7	8.6 5.7-8.6	11.0 10.4-11.0

3.5 Vertical Datum

All FISs 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 in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of NAVD88, many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in the [*date*] FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in base flood elevations across the corporate limits between the communities.

Prior versions of the FIS report and FIRM were referenced to NGVD29. When a datum conversion is effected for an FIS report and FIRM, the Flood Profiles, and BFEs reflect the new datum values. To compare structure and ground elevations to 1-percent-annual-chance flood elevations shown in the FIS and on the FIRM, the subject structure and ground elevations must be referenced to the new datum values

As noted above, the elevations shown in the [*date*] FIS report and on the FIRM for Cumberland County are referenced to NAVD88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD29 by applying a standard conversion factor. The conversion factor to NAVD88 is -1.109. The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users who wish to convert the elevations in this FIS to NGVD29 should apply the stated conversion factor(s) to elevations shown on the Flood Profiles and supporting data tables in the FIS report associated with the riverine data, which are shown at a minimum to the nearest 0.1 foot.

NGVD29 = NAVD88 +1.109

For more information on NAVD88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Spatial Reference System Division, National Geodetic Survey, NOAA, Silver Spring Metro Center, 1315 East-West Highway, Silver Spring, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The NFIP encourages State and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent-annual-chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent-annual-chance flood elevations; delineations of the 1- and 0.2-percent-annual-chance floodplains; and 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data tables (for riverine data), and Summary of Stillwater Elevation tables. Users should reference the data presented in the FIS as well as additional information that may be available at the local community 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 county. For the streams studied in detail, 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.

For the [*date*] FIS, Light Detection and Ranging (LiDAR) data were provided as classified American Society of Photogrammetry and Remote Sensing (ASPRS) LiDAR data exchange format (LAS) files for Cumberland County. Data were uploaded into Environmental Systems Research Institute, Inc. (ESRI) file geodatabases (FGDBs) as multi-point feature classes with elevation attributes based on Class 2 bare earth points. An ESRI Terrain dataset was generated and spatially constrained to the data extent for the county.

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. Where applicable (for riverine data), the New Jersey Flood Hazard Area Design Flood (NJFHADF) is equal to the 1-percent-annual-chance- flood plus an additional 25% in flow, and not to exceed the 0.2-percent-annual-chance flood. NJFHADF boundary is to regulated disturbance to the land vegetation within flood hazard area of a body of water. This regulation is set forth by the State of New Jersey Flood Hazard Area Control Act Rules N.J.A.C. 7:13, and is administrated by New Jersey Department of Environmental Protection (NJDEP). 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.

In areas where a wave height analysis was performed, the A and V zones were divided into whole-foot elevation zones based on the average wave crest elevation in that zone. Where the map scale did not permit delineating zones at 1 foot intervals, larger increments were used and the coastal annual-chance is a Stillwater only value and not the official BFE. Users of the FIRM should be aware that coastal flood elevations are provided in Table 7, “Summary of Coastal Stillwater Elevations” 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.

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2).

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 in this FIS 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. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study.

The floodways presented in this FIS 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 are tabulated for selected cross sections (Table 9). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

No floodways were computed for Manumuskin River, Scotland Run and Tuckahoe River.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 9 for certain downstream cross sections of Mill Creek/Indian Field Branch are lower than the regulatory flood elevations in that area, which must take into account the 1-percent-annual-chance flooding caused by backwater from other sources.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 9, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

FLOODING SOURCE		FLOODWAY			BASE 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
BLACKWATER BRANCH								
A	1,725	90	407	2.8	57.7	57.7	57.9	0.2
B	1,945	110	506	2.3	58.5	58.5	58.5	0.0
C	3,850	150	717	1.6	59.8	59.8	59.8	0.0
D	5,450	200	451	2.5	60.3	60.3	60.5	0.2
E	7,080	150	501	2.3	63.3	63.3	63.3	0.0
F	7,340	256	882	1.3	64.2	64.2	64.2	0.0
G	9,700	60	234	4.8	65.9	65.9	66.1	0.2
H	12,175	230	935	1.2	68.2	68.2	68.2	0.0
I	13,880	130	367	3.1	69.6	69.6	69.8	0.2
J	14,760	62	595	1.9	77.8	77.8	77.8	0.0
K	16,330	70	679	1.5	77.8	77.8	78.0	0.2
L	17,380	150	1,031	1.0	77.9	77.9	78.0	0.1
M	18,680	400	1,420	0.7	78.0	78.0	78.2	0.2
N	22,530	80	558	1.2	81.1	81.1	81.2	0.1
O	23,440	328	858	0.8	82.8	82.8	82.9	0.1
P	24,900	237	424	2.0	83.4	83.4	83.6	0.2
Q	26,630	399	676	1.3	86.7	86.7	86.9	0.2
R	28,000	402	753	0.8	88.0	88.0	88.2	0.2
S	30,180	167	282	2.1	91.3	91.3	91.5	0.2

[1] Feet above confluence with Maurice River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

BLACKWATER BRANCH

FLOODING SOURCE		FLOODWAY			BASE 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
CEDAR BRANCH								
A	250[1]	300	1,211	0.6	64.1	64.1	64.1	0.0
B	1,580[1]	255	564	1.2	64.2	64.2	64.3	0.1
C	2,875[1]	32	85	8.2	65.0	65.0	65.2	0.2
D	4,630[1]	350	1,221	0.6	70.0	70.0	70.0	0.0
E	5,980[1]	122	310	2.3	70.0	70.0	70.2	0.2
F	9,140[1]	300	599	1.2	76.2	76.2	76.3	0.1
G	11,000[1]	300	915	0.8	77.3	77.3	77.5	0.2
H	12,235[1]	200	247	2.8	78.1	78.1	78.2	0.1
COHANSEY RIVER								
A	170[2]	590	1,045	9.2**	*	-6.5**	-6.5**	0.0**
B	2,220[2]	490	1,751	5.5**	*	-2.8**	-2.8**	0.0**
C	5,600[2]	680	2,873	3.4**	*	0.5**	0.5**	0.0**
D	8,710[2]	195	1,691	4.9**	*	1.9**	1.9**	0.0**
E	9,700[2]	126	1,232	6.7**	*	2.4**	2.4**	0.0**
F	10,420[2]	80	916	9.0**	*	3.1**	3.1**	0.0**
G	10,870[2]	117	1,194	6.9**	*	4.2**	4.3**	0.1**
JACKSONS RUN								
A	1,980[3]	110	547	1.1	37.7	37.7	37.9	0.2
B	2,380[3]	40	182	2.2	37.9	37.9	38.1	0.2
C	2,795[3]	240	1,862	0.2	50.1	50.1	50.1	0.0
D	2,990[3]	240	2,545	0.2	50.9	50.9	50.9	0.0
E	3,815[3]	184	1,605	0.2	50.9	50.9	50.9	0.0
F	4,785[3]	154	734	0.5	51.0	51.0	51.0	0.0
G	6,740[3]	123	314	1.3	56.6	56.6	56.8	0.2

[1] Feet above confluence with Manantico Creek
[2] Feet above confluence of Rocaps Run
[3] Feet above confluence with East Lake

*Data superseded by updated coastal analysis
**Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

CEDAR BRANCH – COHANSEY RIVER – JACKSONS RUN

FLOODING SOURCE		FLOODWAY			BASE 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 BRANCH								
A	850[1]	176	181	2.6	89.8	89.8	90.0	0.2
MANANTICO CREEK								
A	44,718[2]	885	5,653	0.2	53.9	53.9	54.0	0.1
B	45,500[2]	450	1,859	0.7	53.9	53.9	54.0	0.1
C	46,250[2]	200	385	3.4	53.9	53.9	54.0	0.1
D	47,570[2]	268	699	1.9	54.7	54.7	54.9	0.2
E	48,890[2]	140	542	2.1	55.1	55.1	55.3	0.2
F	50,250[2]	121	526	2.2	55.6	55.6	55.8	0.2
G	50,810[2]	150	786	1.5	59.0	59.0	59.0	0.0
H	51,640[2]	150	492	2.4	59.2	59.2	59.2	0.0
I	52,170[2]	190	915	1.3	61.2	61.2	61.2	0.0
J	53,110[2]	400	1,433	0.8	61.9	61.9	62.0	0.1
K	54,540[2]	500	1,116	1.0	62.2	62.2	62.4	0.2

[1] Feet above confluence with Blackwater Branch

[2] Feet above confluence with the Maurice River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

LONG BRANCH – MANANTICO CREEK

FLOODING SOURCE		FLOODWAY			BASE 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
MAURICE RIVER								
A	7,890	*	15,160	0.5***	**	-1.1**	-1.1**	0.0**
B	27,710	*	11,149	0.7***	**	-1.0**	-1.0**	0.0**
C	45,550	*	11,434	0.7***	**	-1.0**	-1.0**	0.0**
D	61,690	*	11,595	0.6***	**	-1.0**	-1.0**	0.0**
E	70,750	*	7,167	1.0***	**	-0.9**	-0.9**	0.0**
F	80,930	*	6,006	1.2***	**	-0.8**	-0.8**	0.0**
G	90,820	*	9,160	0.8***	**	-0.7**	-0.7**	0.0**
H	96,401	700	1,773	4.0***	**	-5.7**	-5.5**	0.2**
I	100,561	790	3,373	1.8***	**	-4.2**	-4.0**	0.2**
J	103,881	400	1,786	3.3***	**	-3.5**	-3.4**	0.1**
K	108,681	350	2,175	2.7***	**	-2.0**	-1.9**	0.1**
L	112,611	790	2,401	2.5***	**	-0.9**	-0.9**	0.0**
M	115,161	440	2,403	2.5***	**	0.0**	0.0**	0.0**
N	117,921	200	1,487	4.0***	**	0.7**	0.7**	0.0**
O	118,881	224	1,488	4.0***	**	1.1**	1.1**	0.0**
P	121,361	190	1,664	3.4***	**	2.1**	2.1**	0.0**
Q	121,761	134	1,991	2.8***	**	2.2**	2.4**	0.2**
R	122,681	145	1,484	3.8***	**	2.3**	2.5**	0.2**
S	122,821	145	1,487	3.8***	**	2.3**	2.5**	0.2**
T	123,161	140	1,515	3.7***	**	2.5**	2.7**	0.2**
U	123,581	150	1,623	3.4***	**	2.6**	2.8**	0.2**
V	124,221	150	1,150	4.9***	**	2.6**	2.8**	0.2**
W	125,701	268	1,304	4.3***	**	3.7**	3.8**	0.1**
X	126,461	246	1,319	4.2***	**	4.3**	4.5**	0.2**
Y	126,741	262	1,414	4.0***	**	4.5**	4.7**	0.2**
Z	127,181	230	813	6.9***	**	4.8**	5.0**	0.2**
AA-AJ	***	***	***	***	***	***	***	***

[1] Feet above confluence with Delaware Bay
*Floodway coincident with channel banks
**Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.
***Data not available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

MAURICE RIVER

FLOODING SOURCE		FLOODWAY			BASE 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
MILL CREEK/ INDIAN FIELD BRANCH								
A	765[1]	120	385	3.8**	*	2.3**	2.3**	0.0**
B	1,080[1]	67	263	5.5**	*	2.7**	2.7**	0.0**
C	1,450[1]	26	208	7.0	8.7	8.7	8.7	0.0
D	2,250[1]	700	2,107	0.7	12.7	12.7	12.7	0.0
E	2,760[1]	315	1,879	0.8	12.8	12.8	12.8	0.0
F	7,460[1]	395	4,176	0.1	39.5	39.5	39.5	0.0
G	8,160[1]	280	1,962	0.3	39.5	39.5	39.5	0.0
H	9,240[1]	100	336	1.7	39.5	39.5	39.5	0.0
I	9,920[1]	90	247	2.0	44.6	44.6	44.6	0.0
PETTICOAT STREAM								
A	1,300[2]	27	151	6.2	8.6	8.6	8.8	0.2
B	2,185[2]	70	159	5.9	12.1	12.1	12.2	0.1
C	2,705[2]	315	1,564	0.6	16.9	16.9	16.9	0.0
D	4,415[2]	99	231	3.3	19.0	19.0	19.1	0.1
E	6,175[2]	511	4,044	0.2	30.1	30.1	30.3	0.2
F	6,710[2]	386	3,012	0.3	30.1	30.1	30.3	0.2
G	7,435[2]	127	983	0.8	30.1	30.1	30.3	0.2
H	8,080[2]	66	442	1.7	32.4	32.4	32.6	0.2
I	8,335[2]	220	1,918	0.4	35.6	35.6	35.8	0.2
J	9,000[2]	160	1,297	0.6	35.6	35.6	35.8	0.2
K	9,580[2]	100	807	0.9	35.6	35.6	35.8	0.2
L	10,005[2]	112	947	0.6	36.9	36.9	37.1	0.2
M	11,030[2]	288	1,718	0.3	37.0	37.0	37.2	0.2
N	11,920[2]	179	632	1.0	37.0	37.0	37.2	0.2
O	12,395[2]	210	1,772	0.3	39.1	39.1	39.3	0.2
P	13,655[2]	80	297	1.5	39.3	39.3	39.5	0.2

[1] Feet above confluence with the Cohansey River
[2] Feet above confluence with Maurice River
[3] Elevation computed without consideration of backwater effects from the Delaware River

*Data superseded by updated coastal analysis
**Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

MILL CREEK/ INDIAN FIELD BRANCH – PETTICOAT STREAM

FLOODING SOURCE		FLOODWAY			BASE 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
PINEY BRANCH								
A	2,320[1]	150	460	1.3	81.3	81.3	81.4	0.1
B	4,000[1]	447	1,225	0.4	81.5	81.5	81.7	0.2
C	4,825[1]	400	1.122	0.5	83.2	83.2	83.3	0.1
D	5,600[1]	194	500	1.0	83.4	83.4	83.5	0.1
E	6,500[1]	67	154	3.4	84.2	84.2	84.3	0.1
F	7,200[1]	257	459	0.6	85.0	85.0	85.2	0.2
WHITE MARSH RUN								
A	2,595[2]	140	486	1.7	9.9	9.9	9.9	0.0
B	3,795[2]	70	128	6.5	16.6	16.6	16.7	0.1
C	4,055[2]	205	374	2.2	21.0	21.0	21.0	0.0
D	4,915[2]	345	360	2.1	22.5	22.5	22.7	0.2
E	5,060[2]	325	280	2.7	23.5	23.5	23.6	0.1
F	6,125[2]	100	284	3.2	26.0	26.0	26.0	0.0
G	6,685[2]	243	289	2.6	27.5	27.5	27.6	0.1
H	6,940[2]	353	869	0.9	31.2	31.2	31.2	0.0
I	7,950[2]	72	310	2.4	31.4	31.4	31.5	0.1
J	8,150[2]	220	1,371	0.6	36.6	36.6	36.6	0.0
K	9,770[2]	292	1,102	0.7	36.6	36.6	36.7	0.1
L	10,550[2]	292	934	0.8	36.7	36.7	36.8	0.1
M	11,295[2]	85	166	4.6	36.8	36.8	36.9	0.1
N	12,400[2]	98	188	3.6	41.9	41.9	42.1	0.2
O	12,940[2]	186	431	1.6	44.2	44.2	44.4	0.2

[1] Feet above confluence with Blackwater Branch
[2] Feet above confluence with the Maurice River

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

FLOODWAY DATA

PINEY BRANCH – WHITE MARSH RUN

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 by more than 1.0 foot at any point. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this study. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 3.

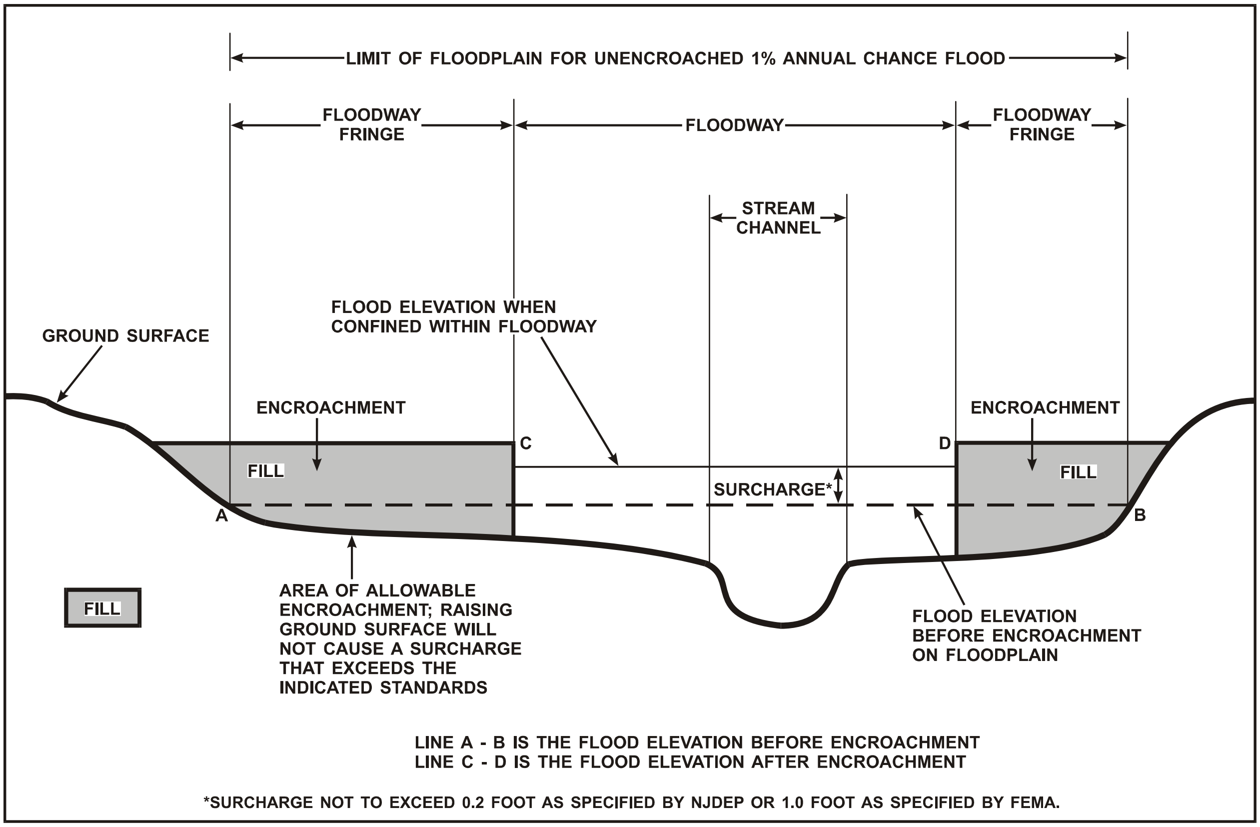


FIGURE 3: FLOODWAY SCHEMATIC

5.0 INSURANCE APPLICATIONS

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. The 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 base flood elevations or 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 base flood elevations 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 base flood elevations 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. Some Zone AO have been designated in areas with high flood velocities such as alluvial fans and washes.

Zone AR

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 rate 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 base flood elevations 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 base flood elevations 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 base flood elevations 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, and to 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 base flood elevations or 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 base flood elevations or average depths. Insurance agents use the zones and base flood elevations 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 are shown where applicable. The current FIRM presents flooding information for the entire geographic area of Cumberland County. Previously, separate Flood Hazard Boundary Maps and/or FIRMs were prepared for each identified flood-prone jurisdiction within the county.

This FIRM also includes flood hazard information that was presented separately on Flood Boundary and Floodway Maps (FBFMs), where applicable. Historical data relating to the maps prepared for each community, up to and including this FIS, are presented in Table 10, "Community Map History."

7.0 OTHER STUDIES

FISs and FIRMs have been prepared for Gloucester County, New Jersey (All Jurisdictions) (FEMA 2010), FISs and FIRMs are currently in production for Atlantic County, New Jersey (All Jurisdictions) and Cape May County, New Jersey (All Jurisdictions) and Salem County, New Jersey (All Jurisdictions).

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Cumberland County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS Reports, FHBMs, FBFMs, and FIRMs for all jurisdictions within Cumberland County.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Bridgeton, City of	May 1, 1974	April 30, 1976	January 18,1984	
Commercial, Township of	August 23, 1974	March 19, 1976	December 1, 1982	
Deerfield, Township of	February 7, 1975	None	November 4, 1981	
Downe, Township of	April 20, 1973	None	February 15, 1978	
Fairfield, Township of	May 10, 1974	August 6, 1976	November 19, 1982	August 3, 1992
Greenwich, Township of	November 5, 1976	None	March 11, 1983	August 3, 1992
Hopewell, Township of	August 9, 1974	None	December 15, 1978	August 18, 1992
Lawrence, Township of	October 18, 1974	February 27, 1976	November 26, 1982	August 18, 1992
Maurice River, Township of	May 31, 1974	July 16, 1976	January 19, 1978	September 17, 1982 July 15, 1992
Millville, City of	January 14, 1977	None	June 15, 1982	
[1,2]Shiloh, Borough of	August 9, 1974 July 26, 1974	None	December 15, 1978 June 15, 1979	
Stow Creek, Township of	July 26, 1974	June 25, 1976	June 15, 1979	January 20, 1993
Upper Deerfield, Township of	August 2, 1974	None	March 25, 1983	
Vineland, City of	May 4, 1973	July 22, 1977	July 5, 1982	

[1] No Special Flood Hazard Areas Identified

[2] This community did not have a FIRM prior to the first countywide FIRM for Cumberland County

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

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, 26 Federal Plaza, Room 1337, New York, New York 10278.

9.0 BIBLIOGRAPHY AND REFERENCES

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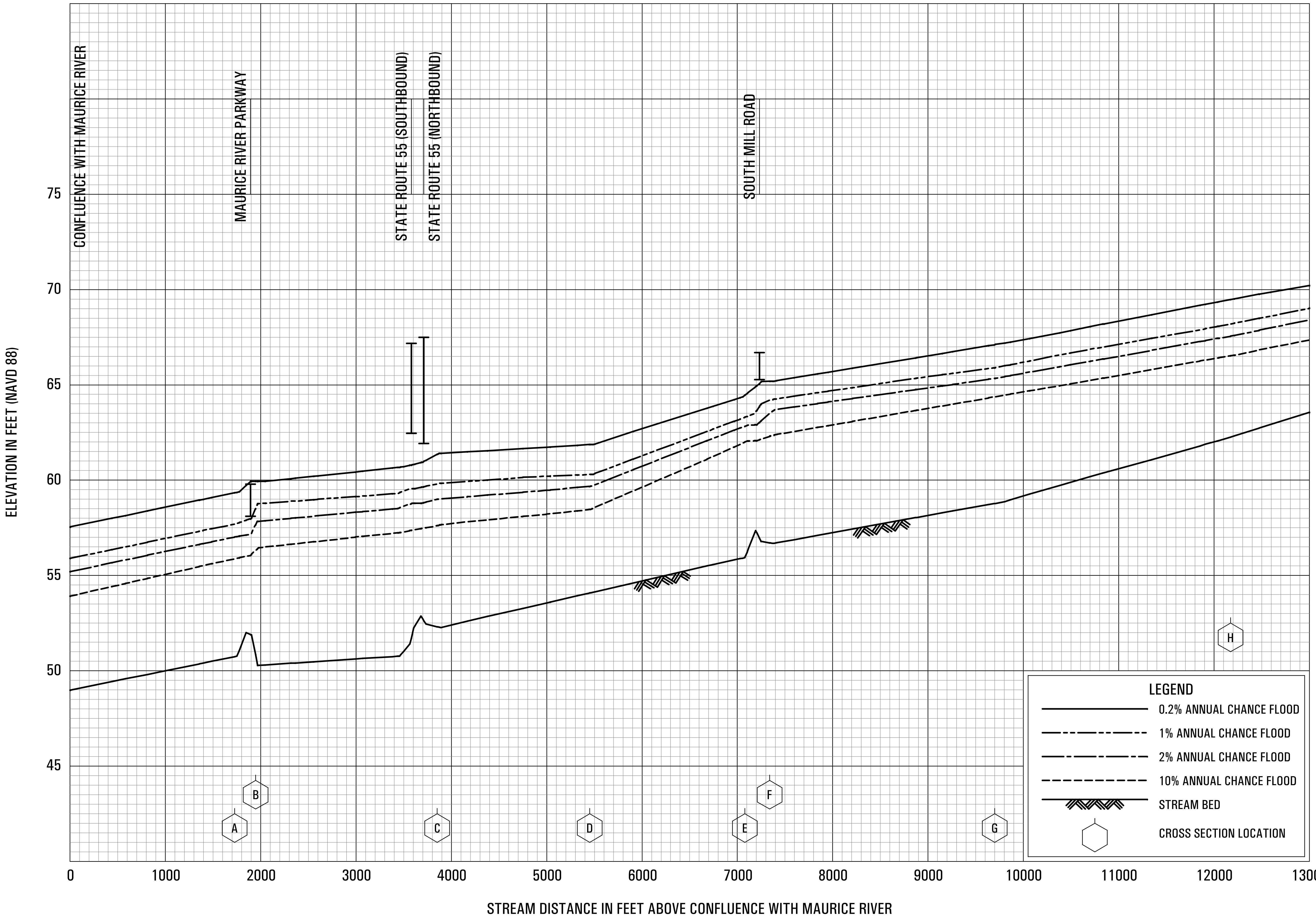


FLOOD PROFILES

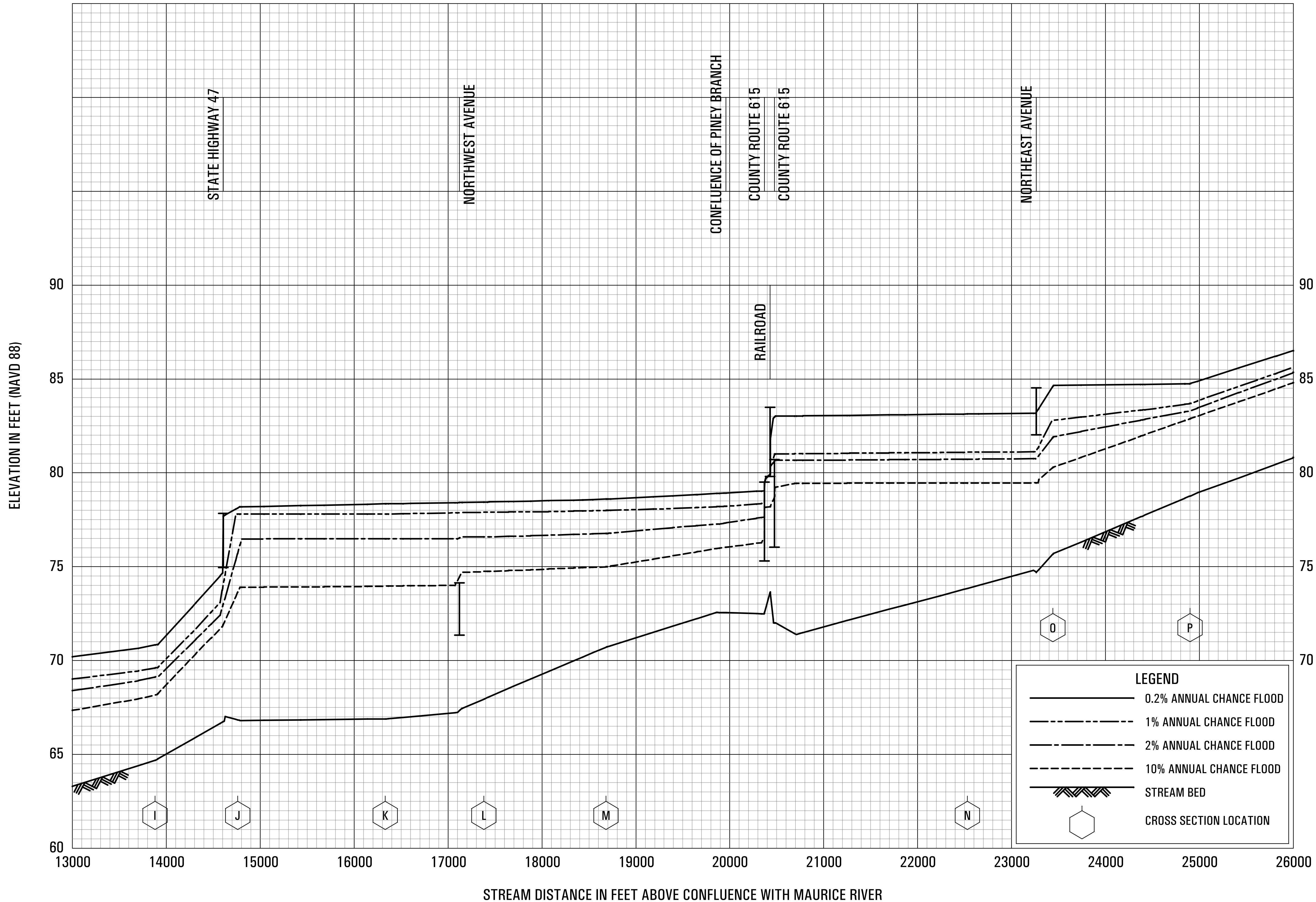
BLACKWATER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

01P



FLOOD PROFILES

BLACKWATER BRANCH

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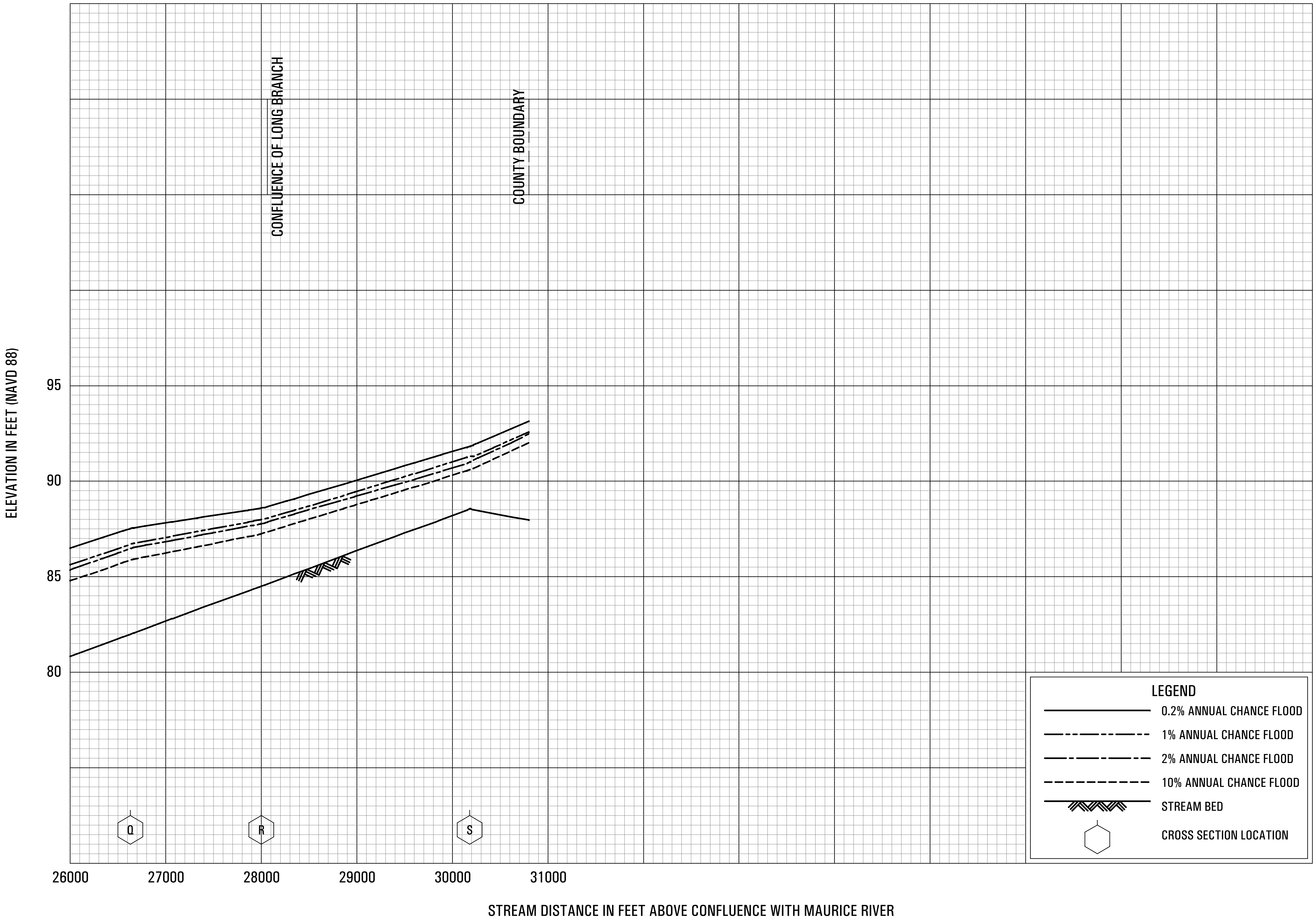
CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



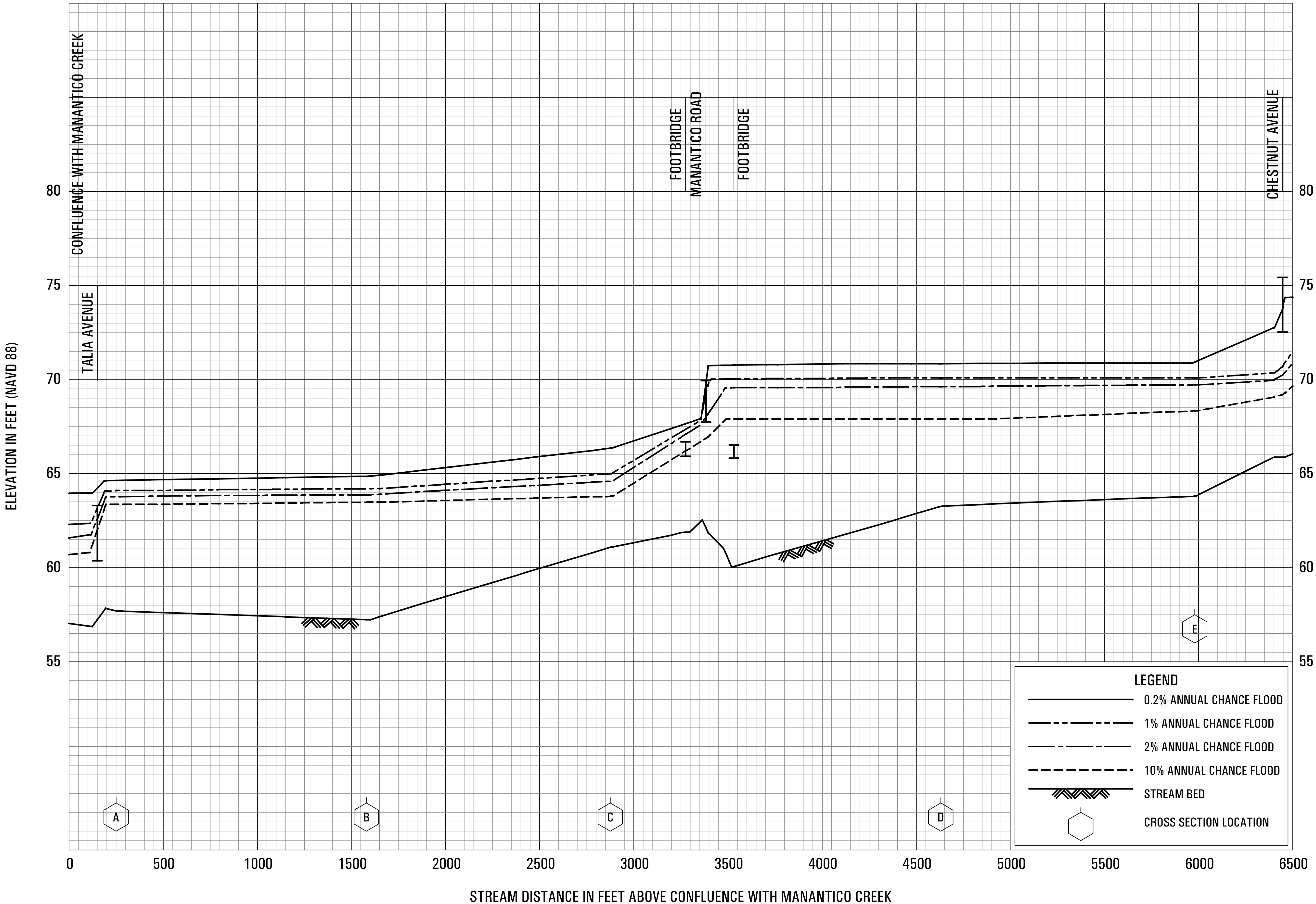
FLOOD PROFILES

BLACKWATER BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

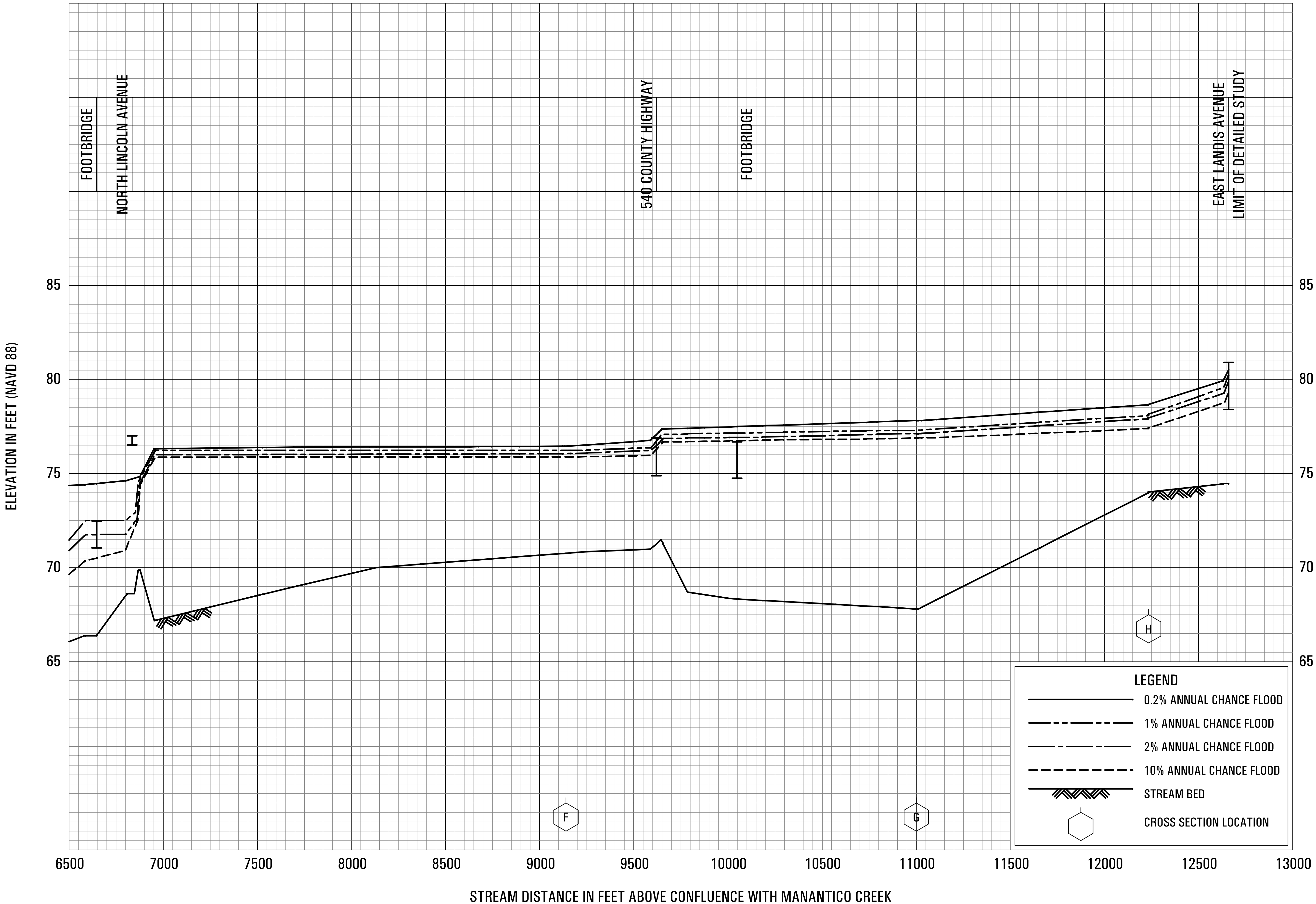
CEDAR BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

04P



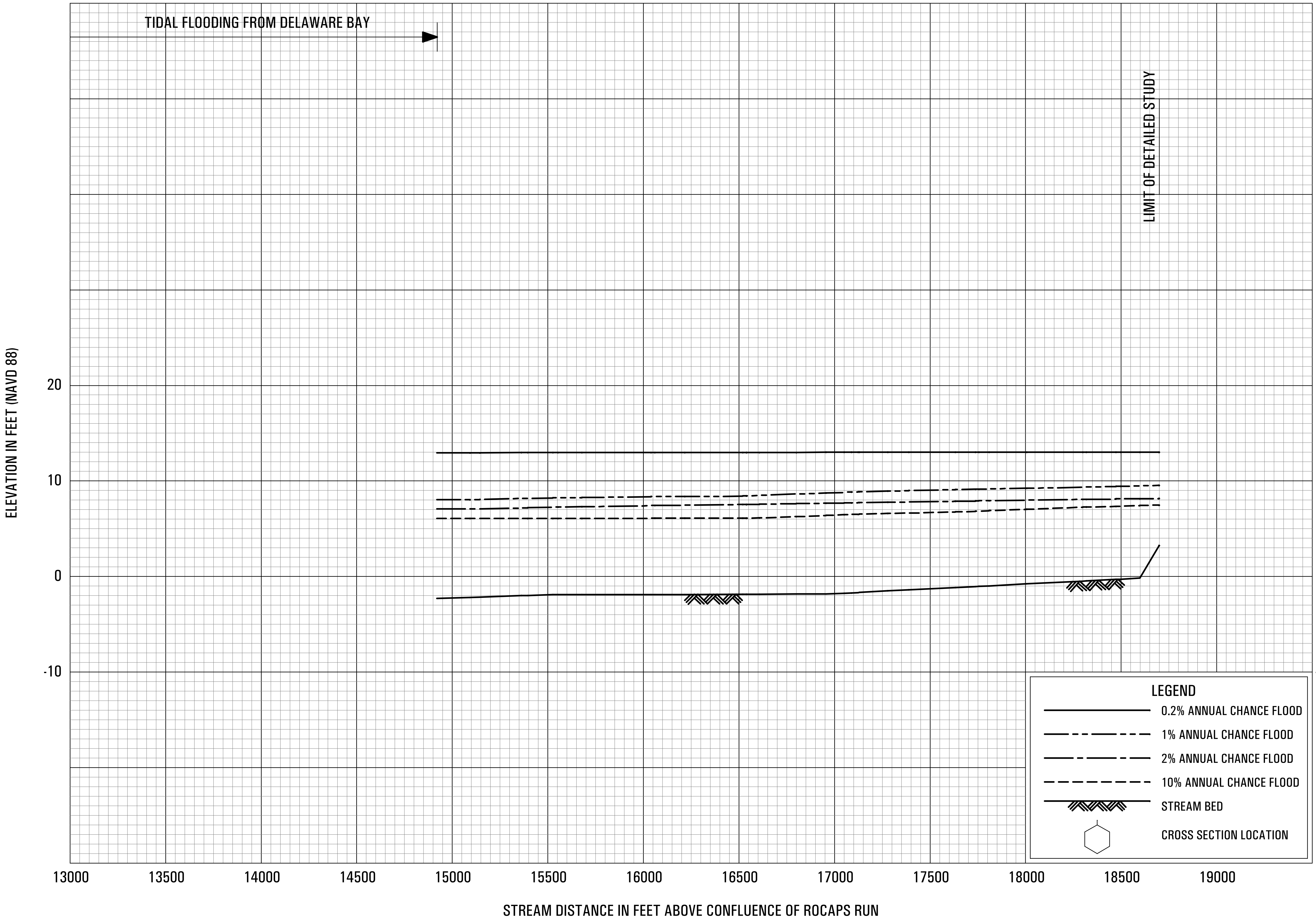
FLOOD PROFILES

CEDAR BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

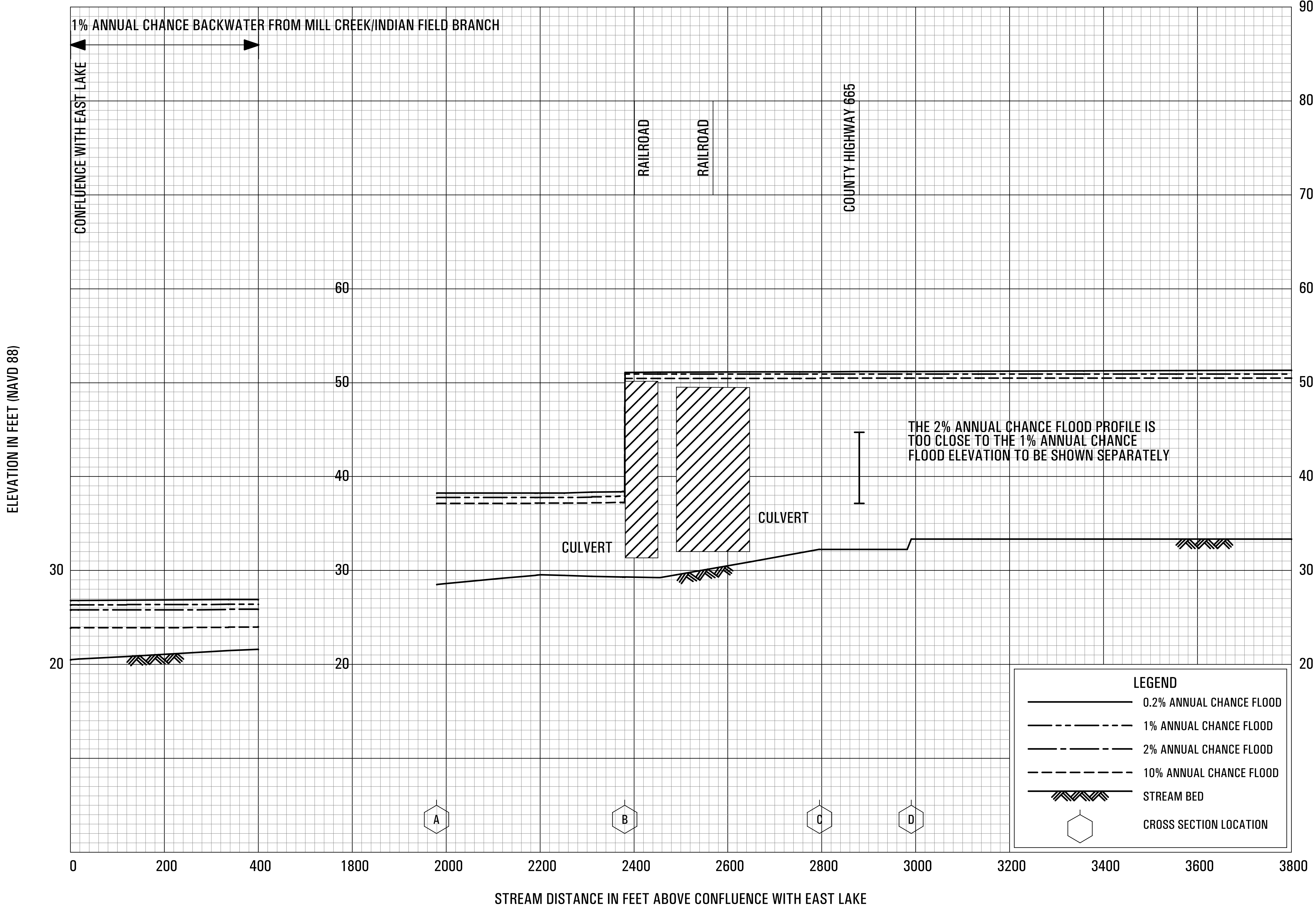
COHANSEY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

06P



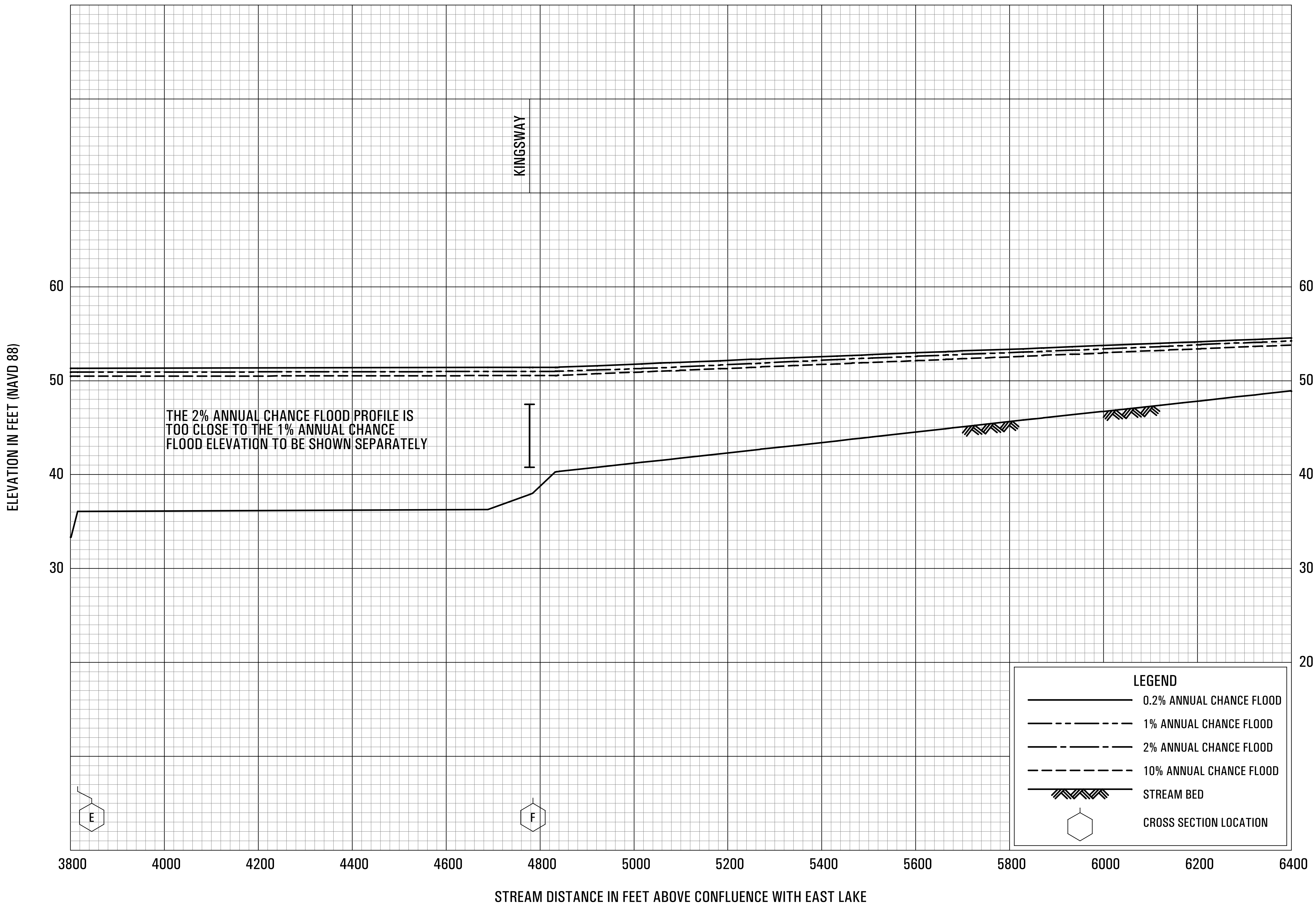
FLOOD PROFILES

JACKSONS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

JACKSONS RUN

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CUMBERLAND COUNTY, NJ

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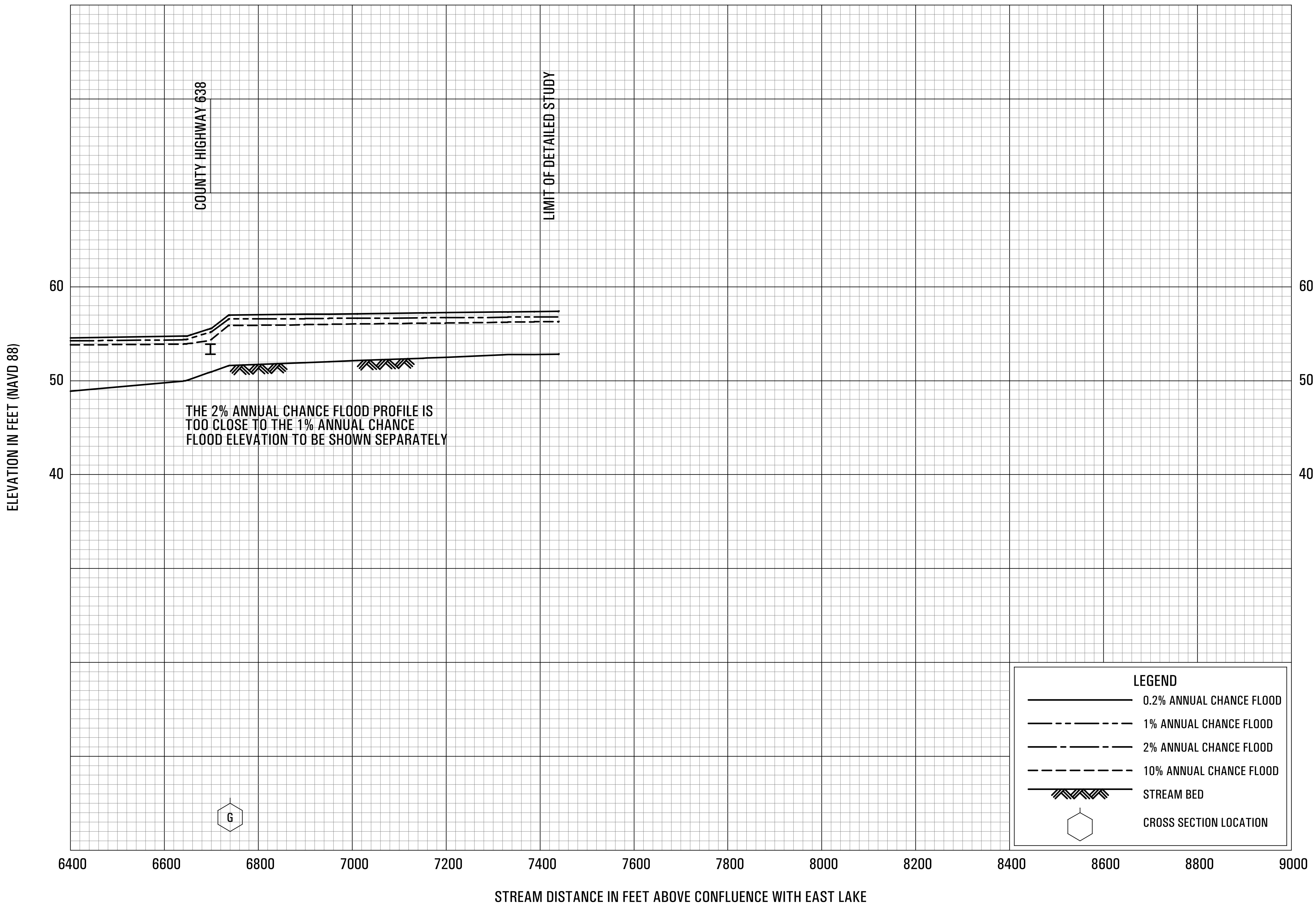


FLOOD PROFILES

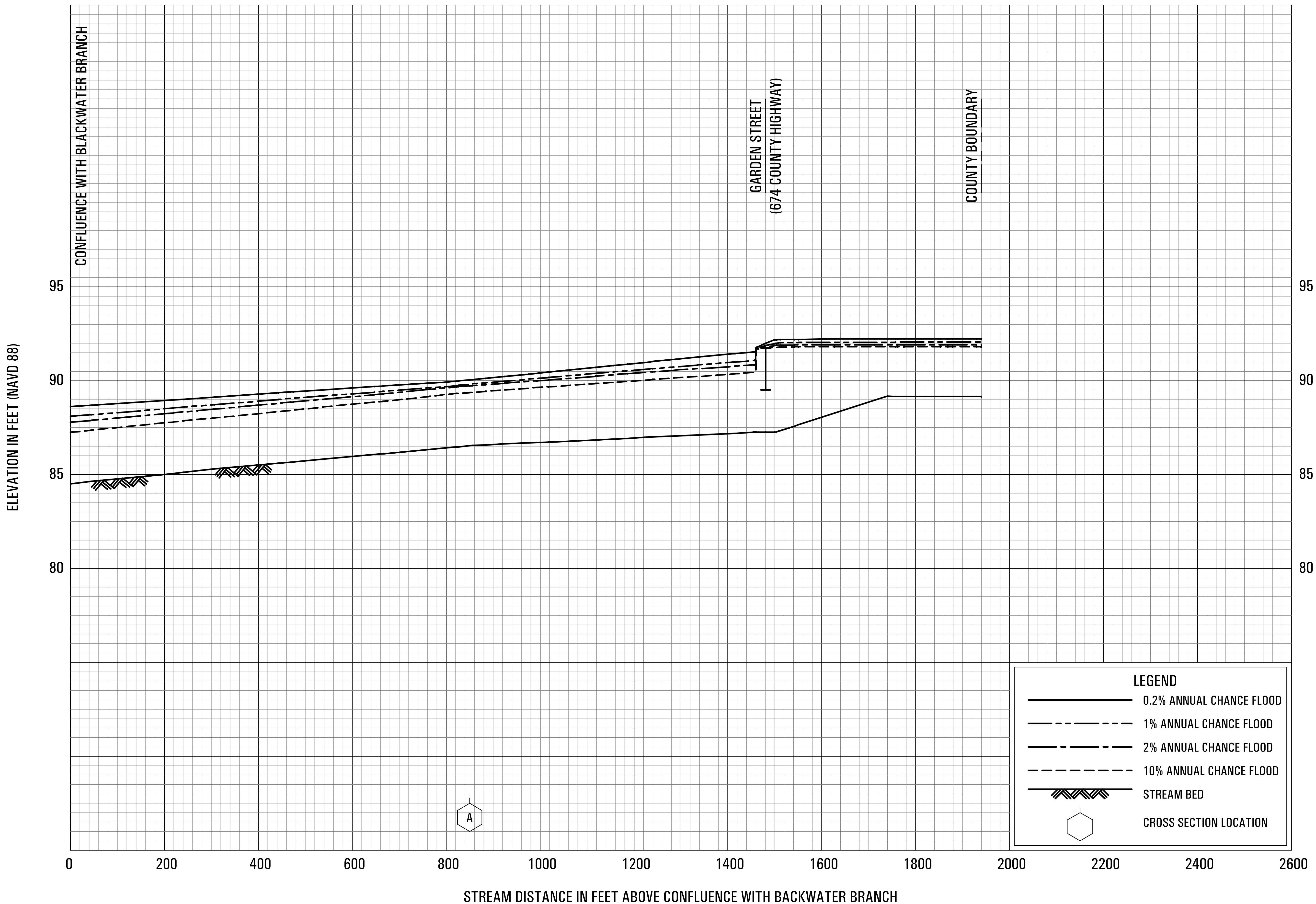
JACKSONS RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

09P



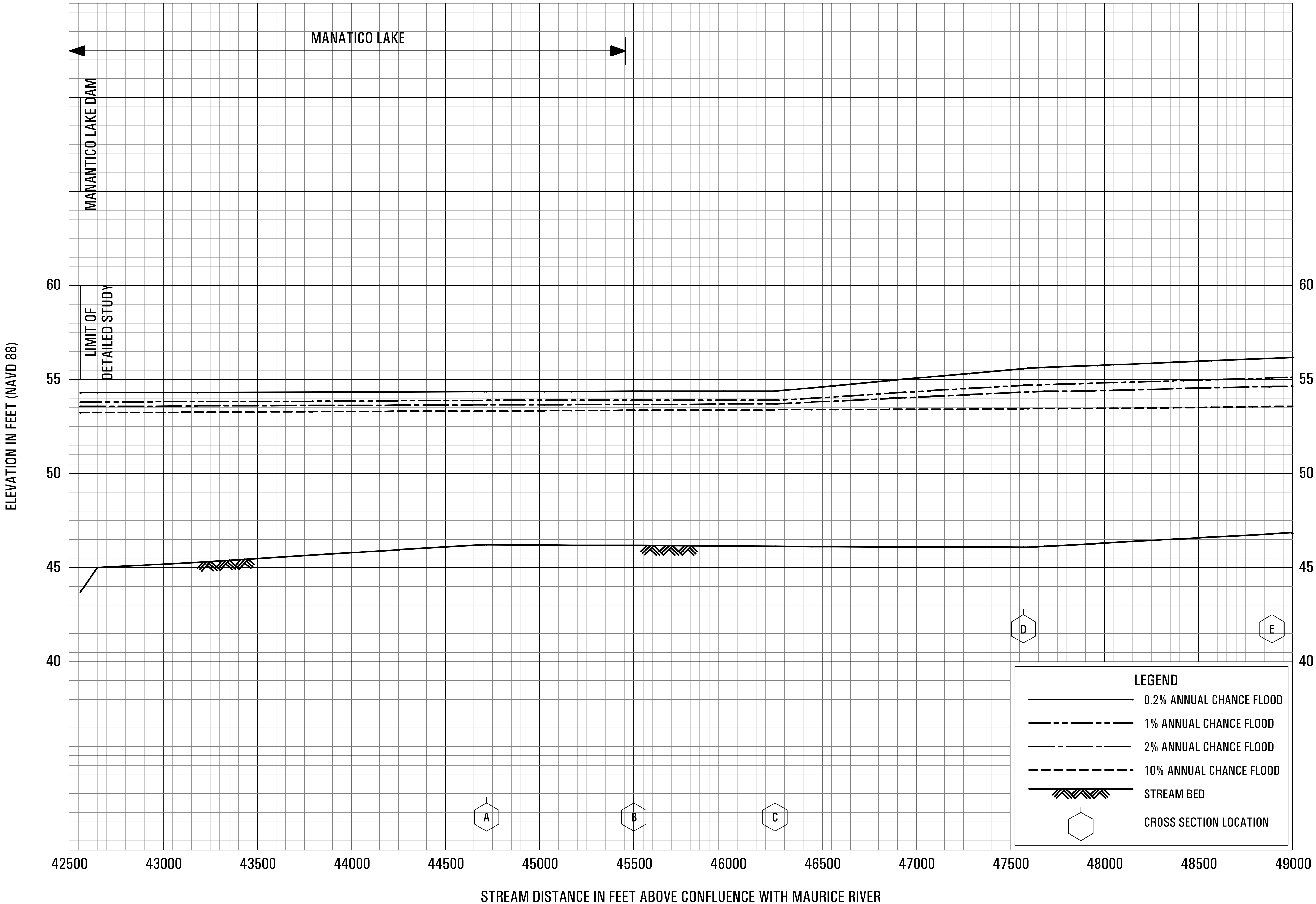
FLOOD PROFILES

LONG BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

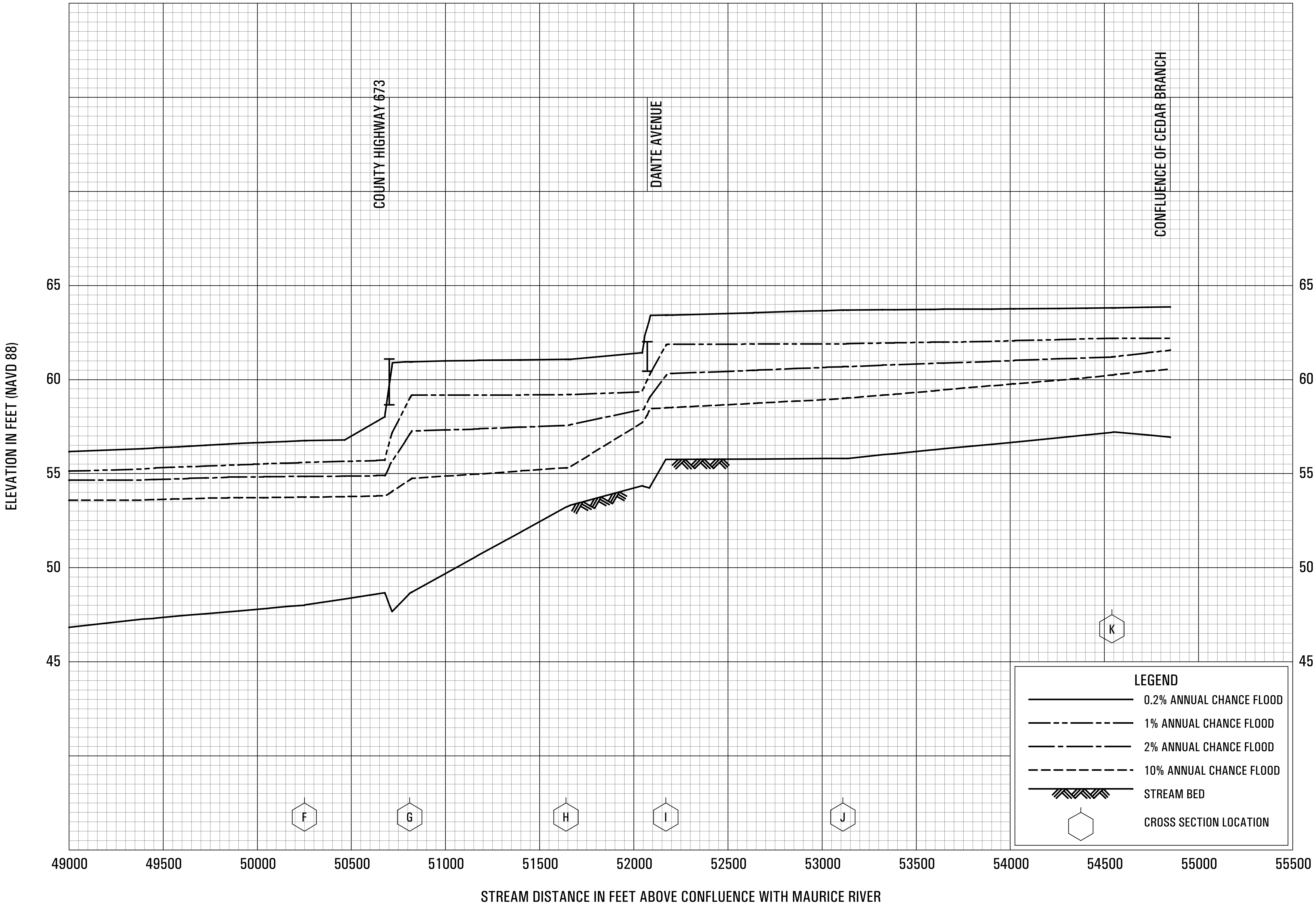
(ALL JURISDICTIONS)



FLOOD PROFILES

MANANTICO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
CUMBERLAND COUNTY, NJ
(ALL JURISDICTIONS)



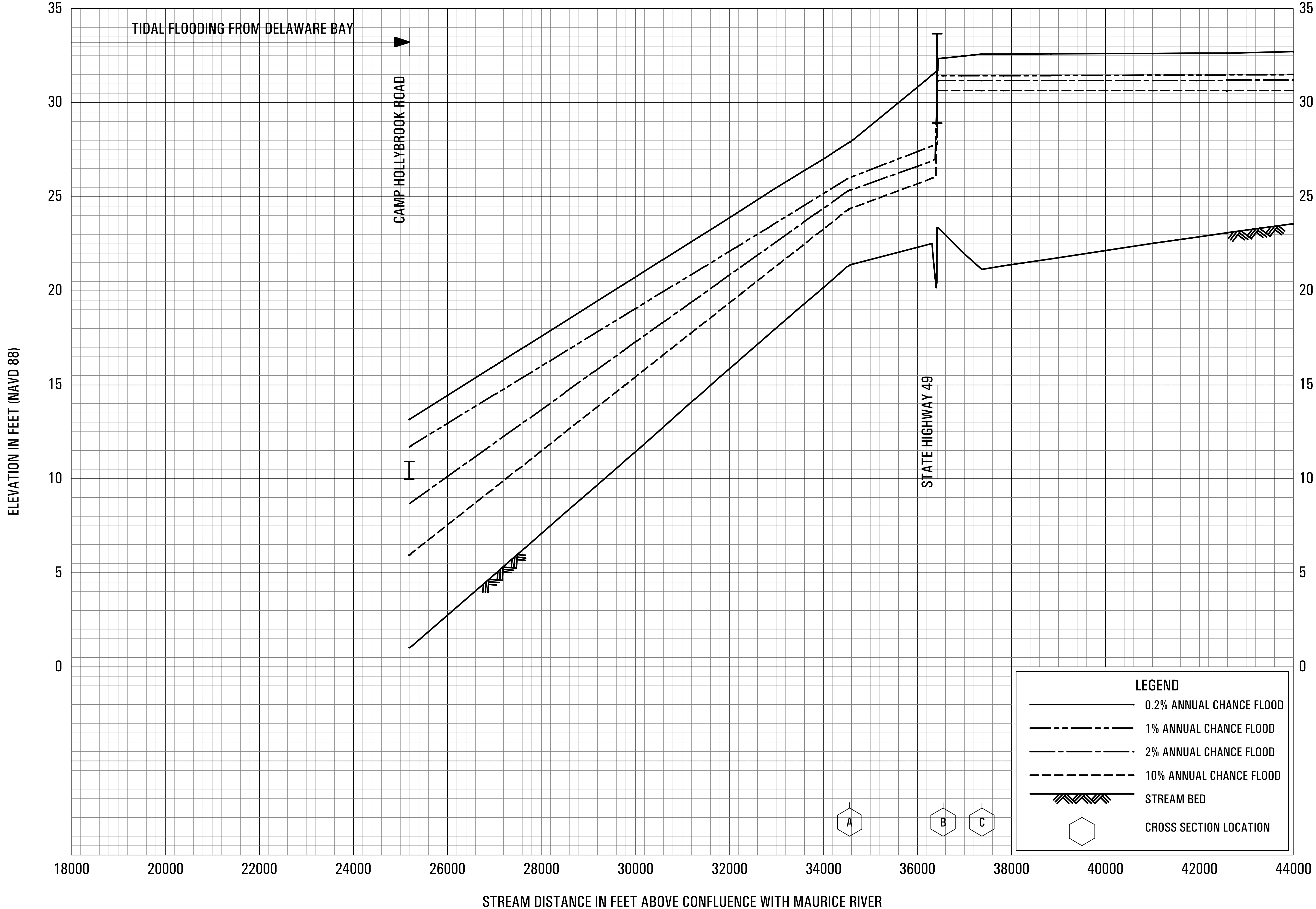
FLOOD PROFILES

MANANTICO CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



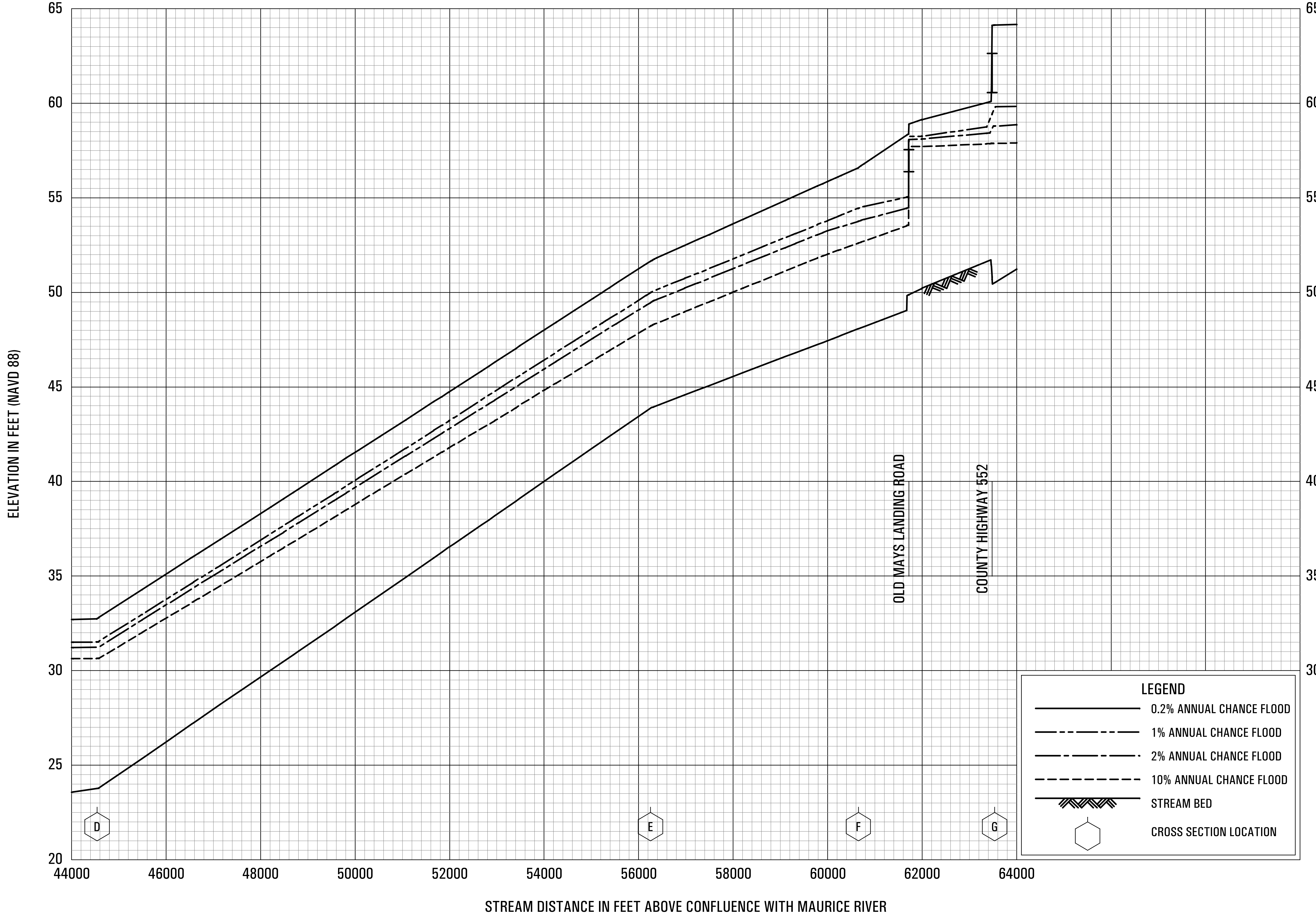
FLOOD PROFILES

MANUMUSKIN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



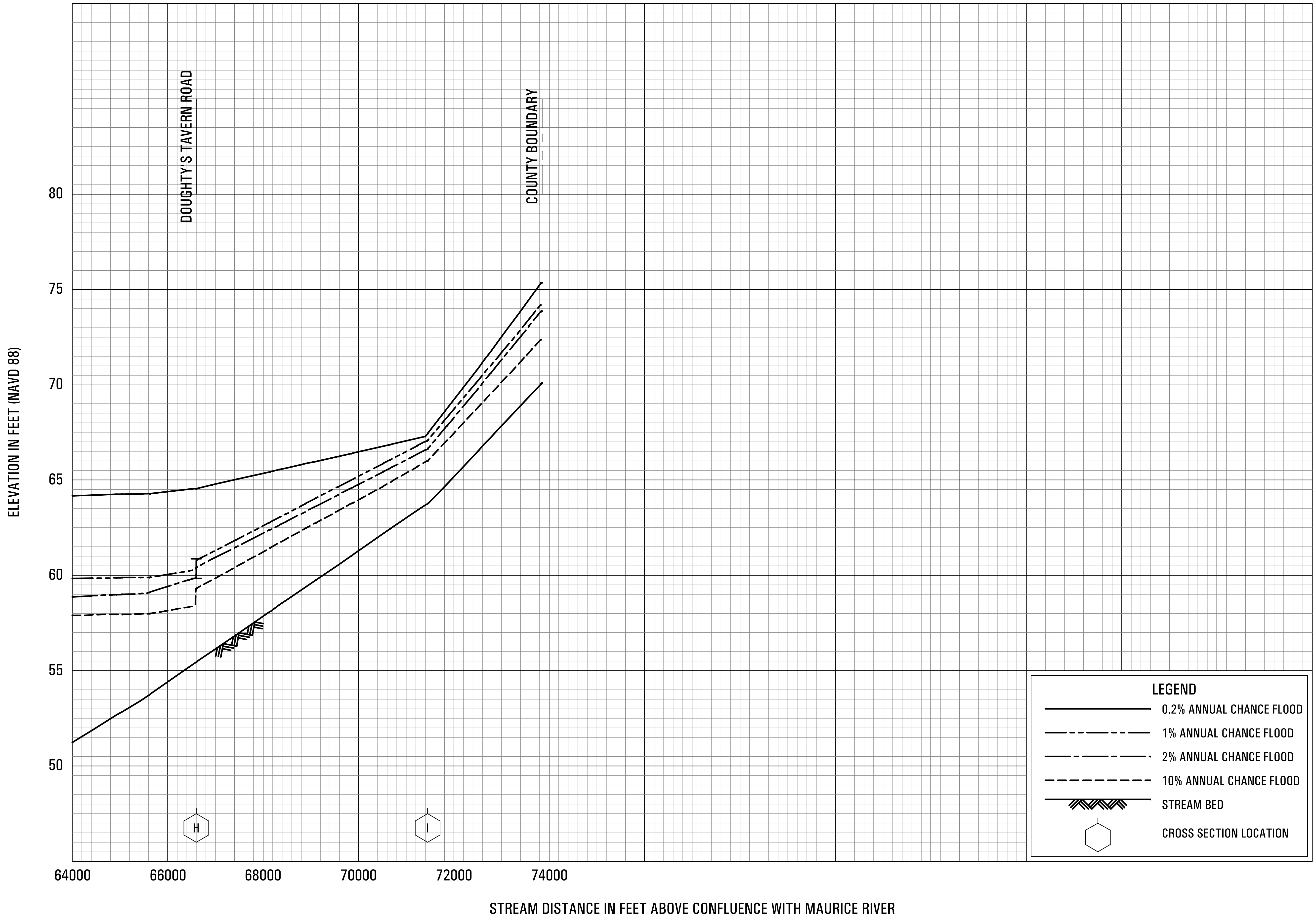
FLOOD PROFILES

MANUMUSKIN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



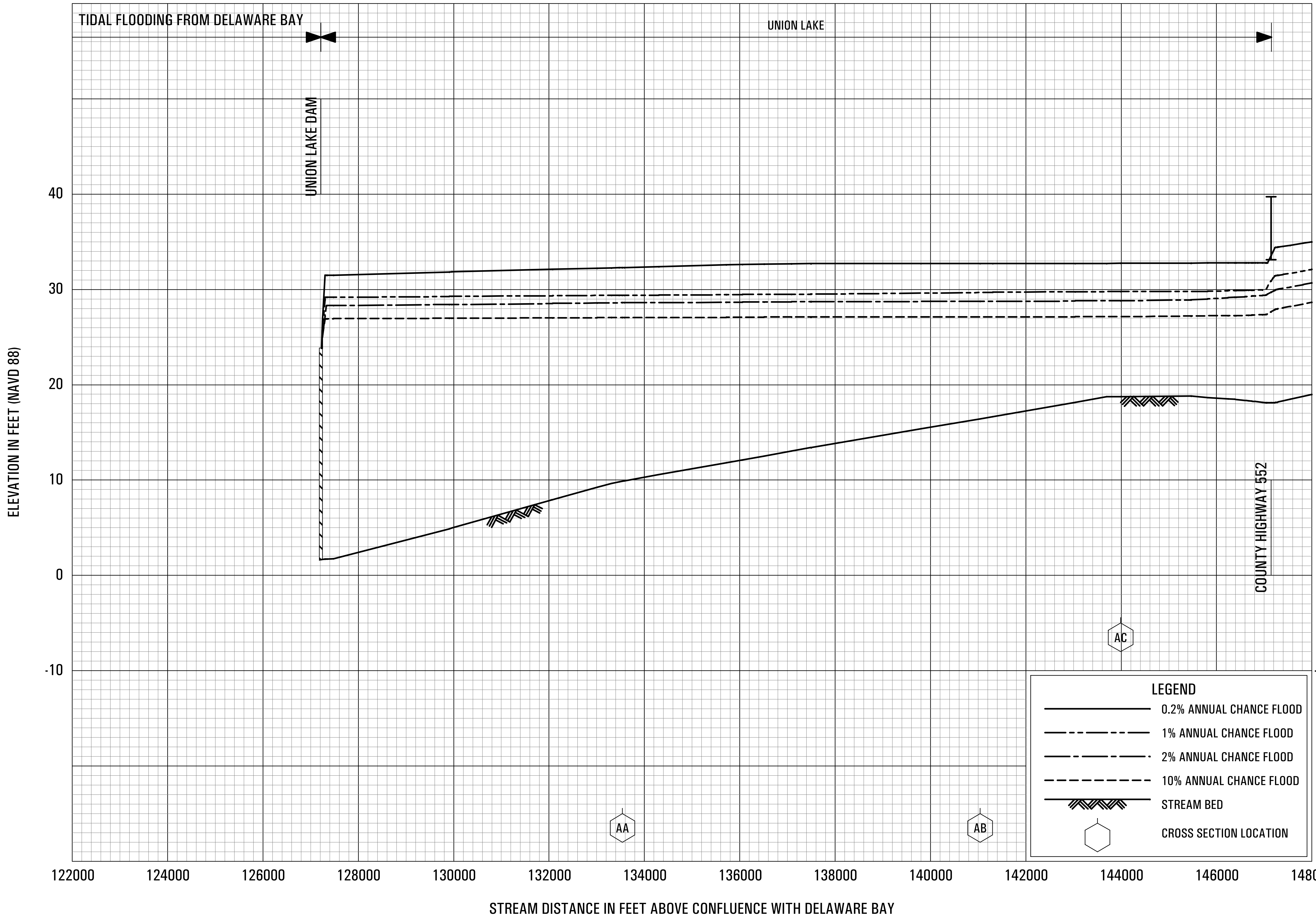
FLOOD PROFILES

MANUMUSKIN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

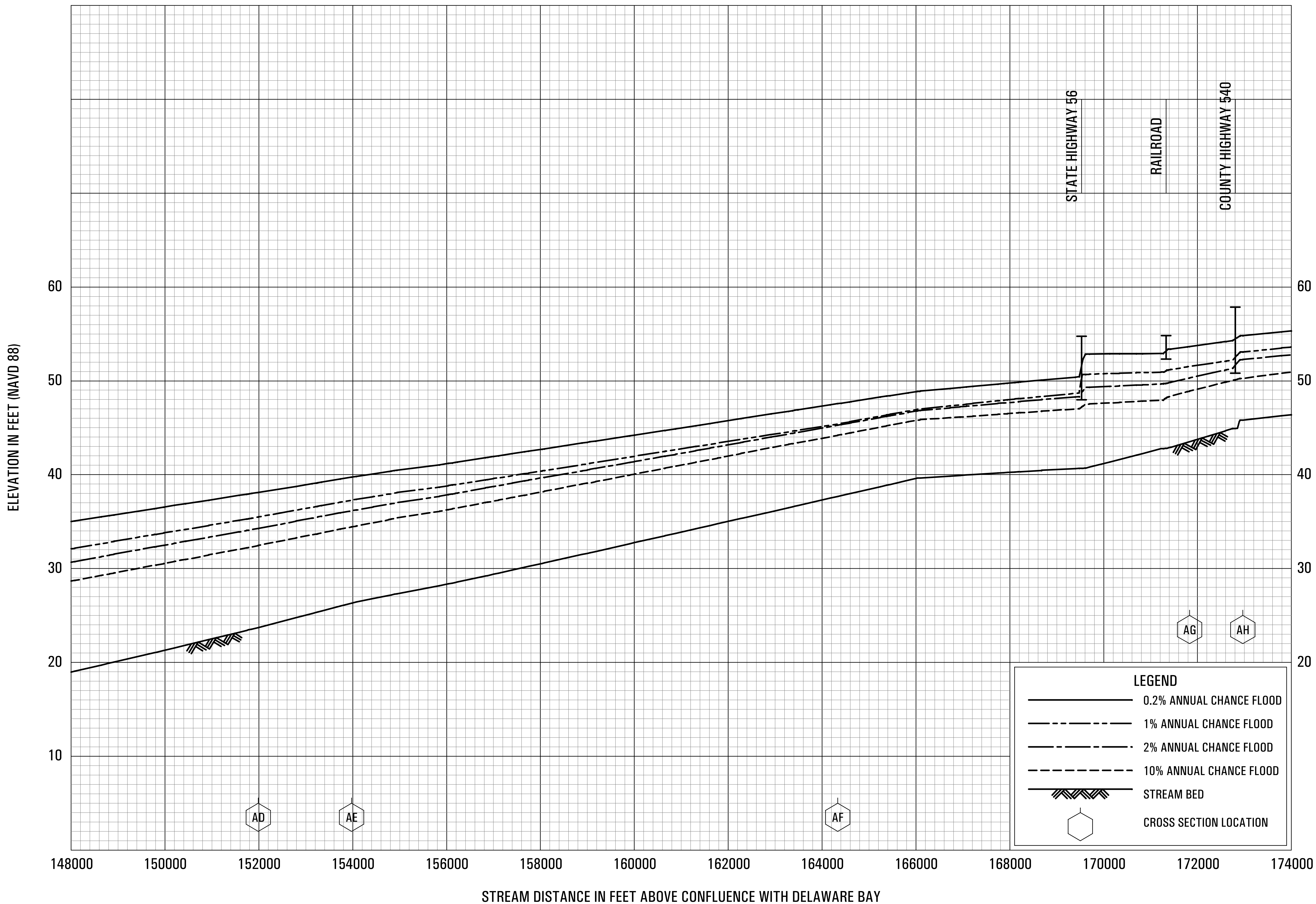
MAURICE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

16P



FLOOD PROFILES

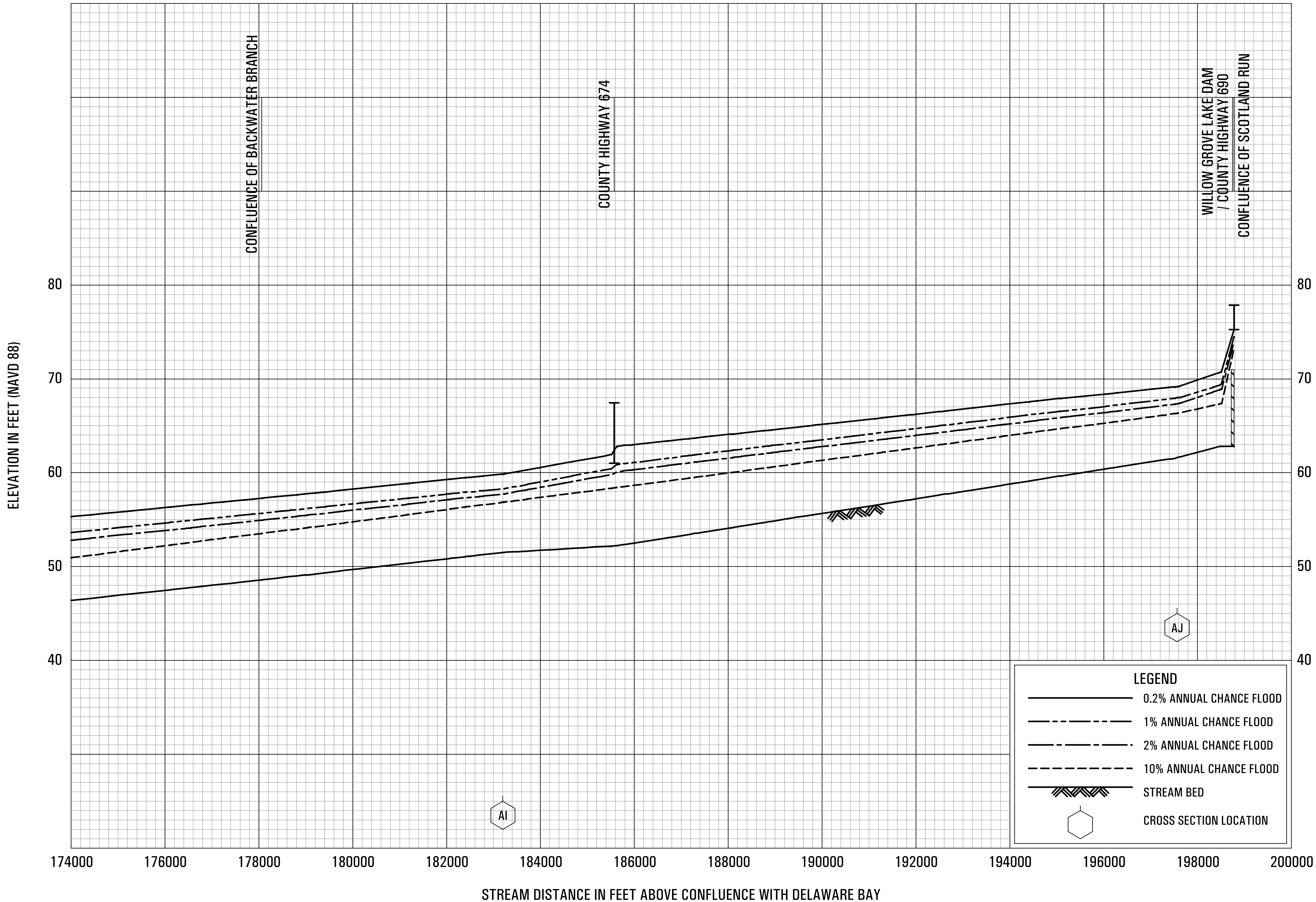
MAURICE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

17P



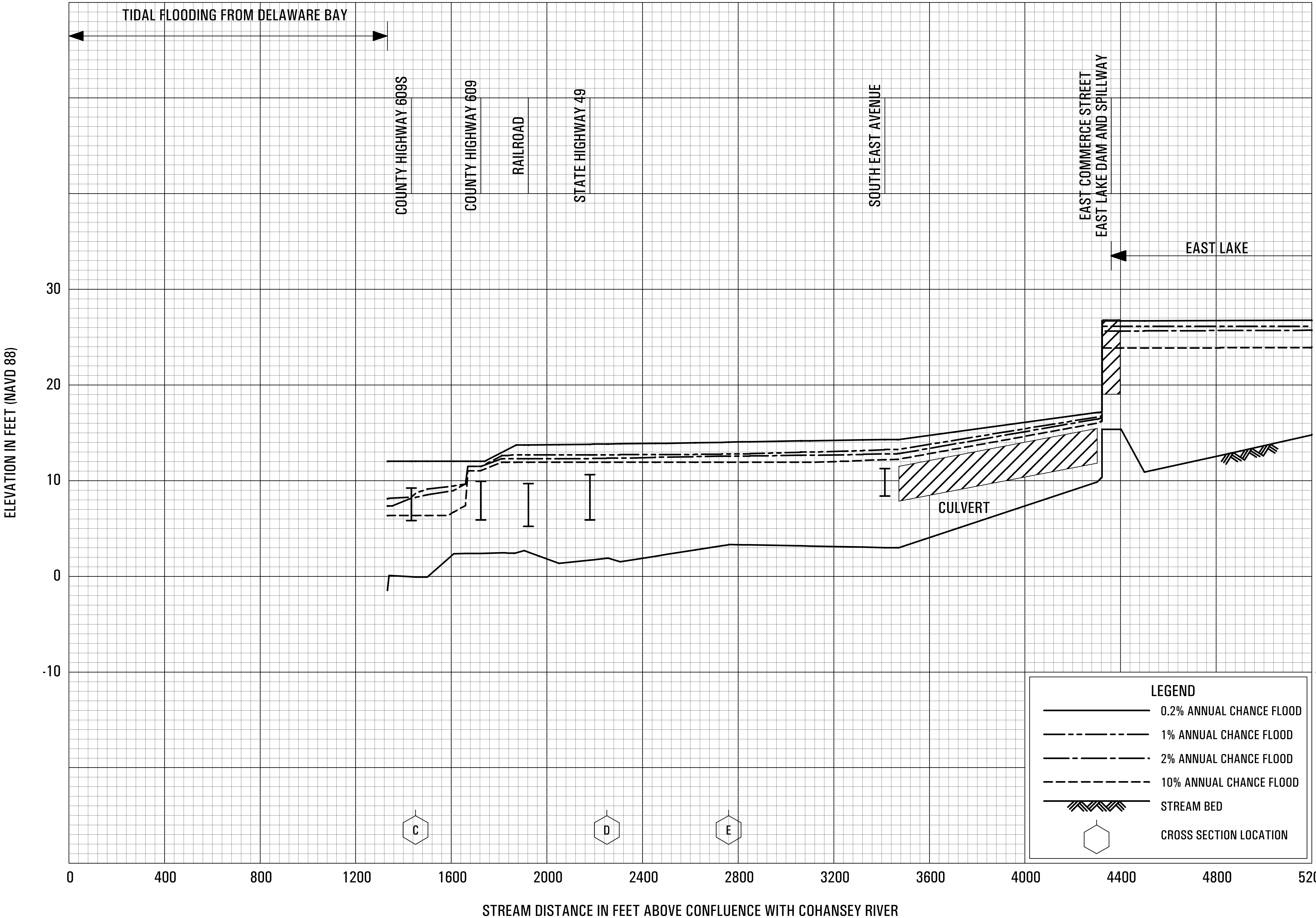
FLOOD PROFILES

MAURICE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



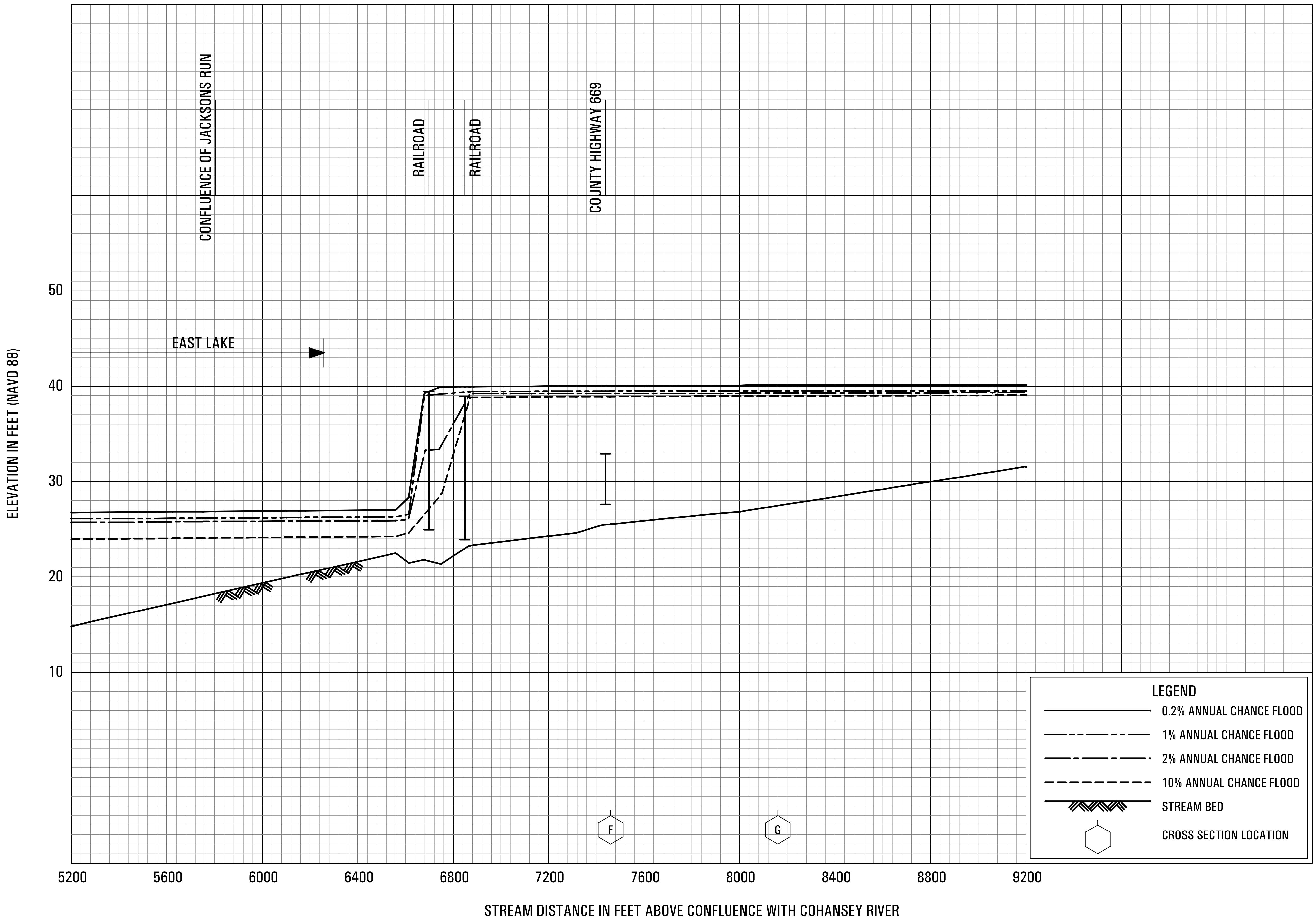
FLOOD PROFILES

MILL CREEK/INDIAN FIELD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



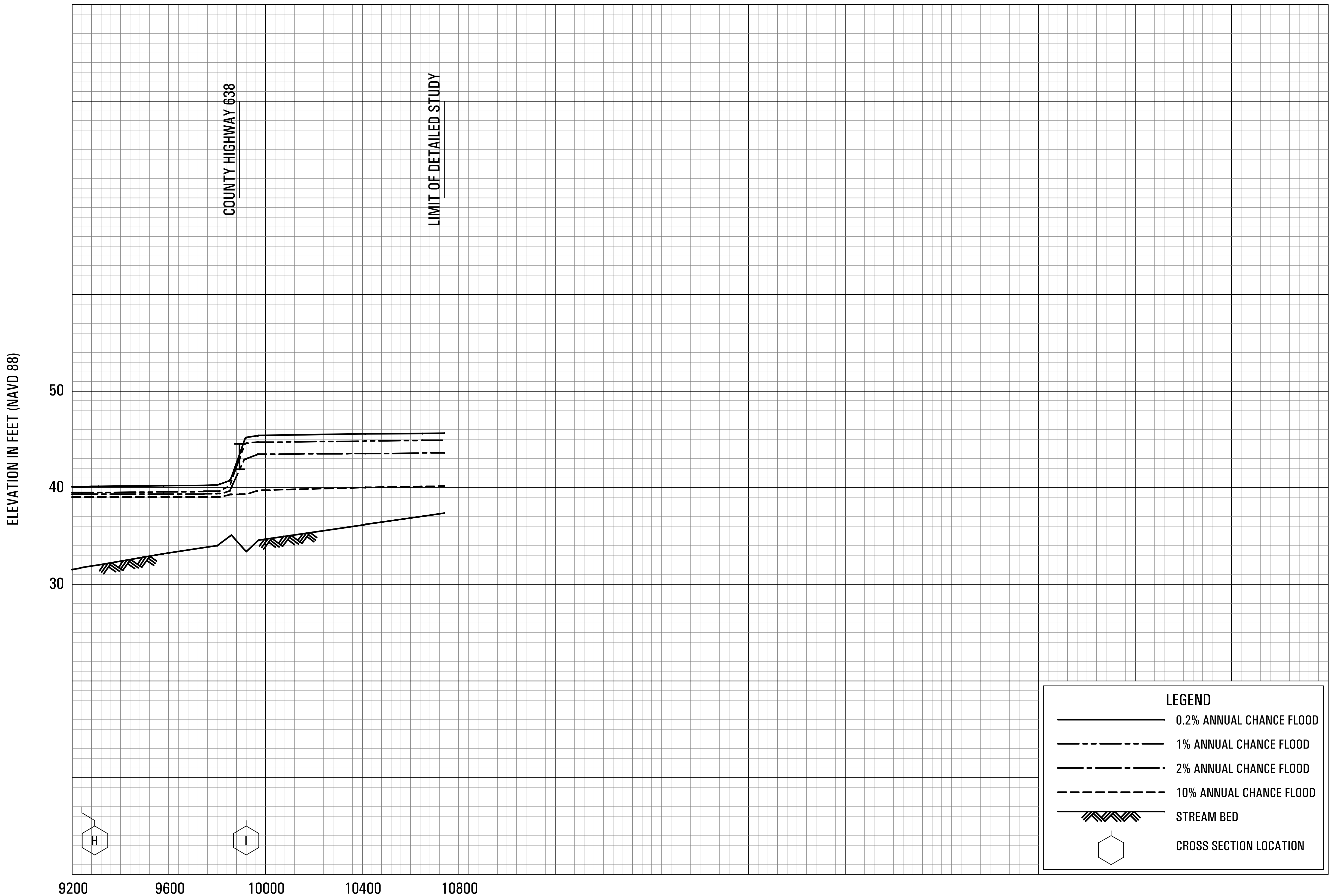
FLOOD PROFILES

MILL CREEK/INDIAN FIELD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



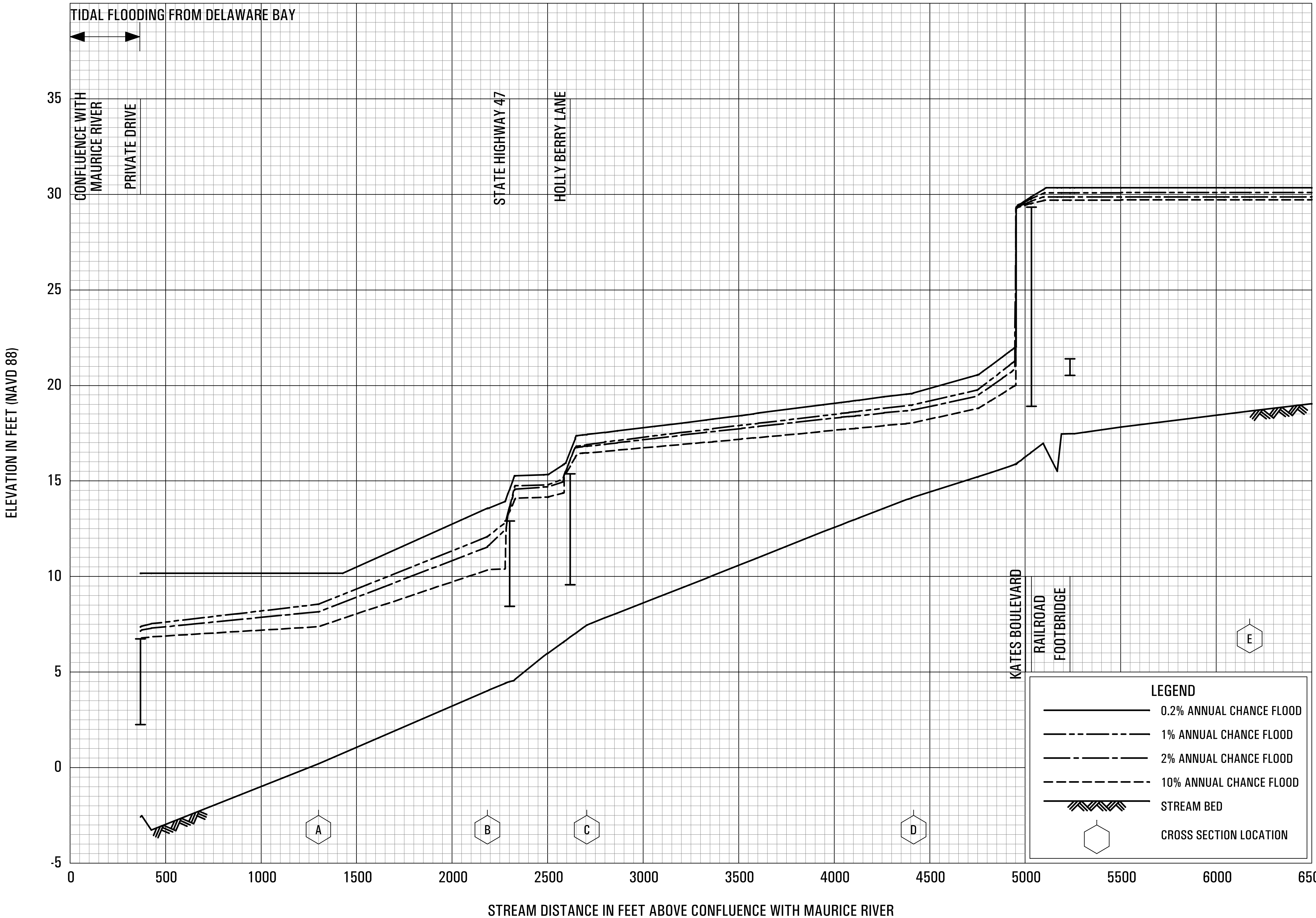
FLOOD PROFILES

MILL CREEK/INDIAN FIELD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

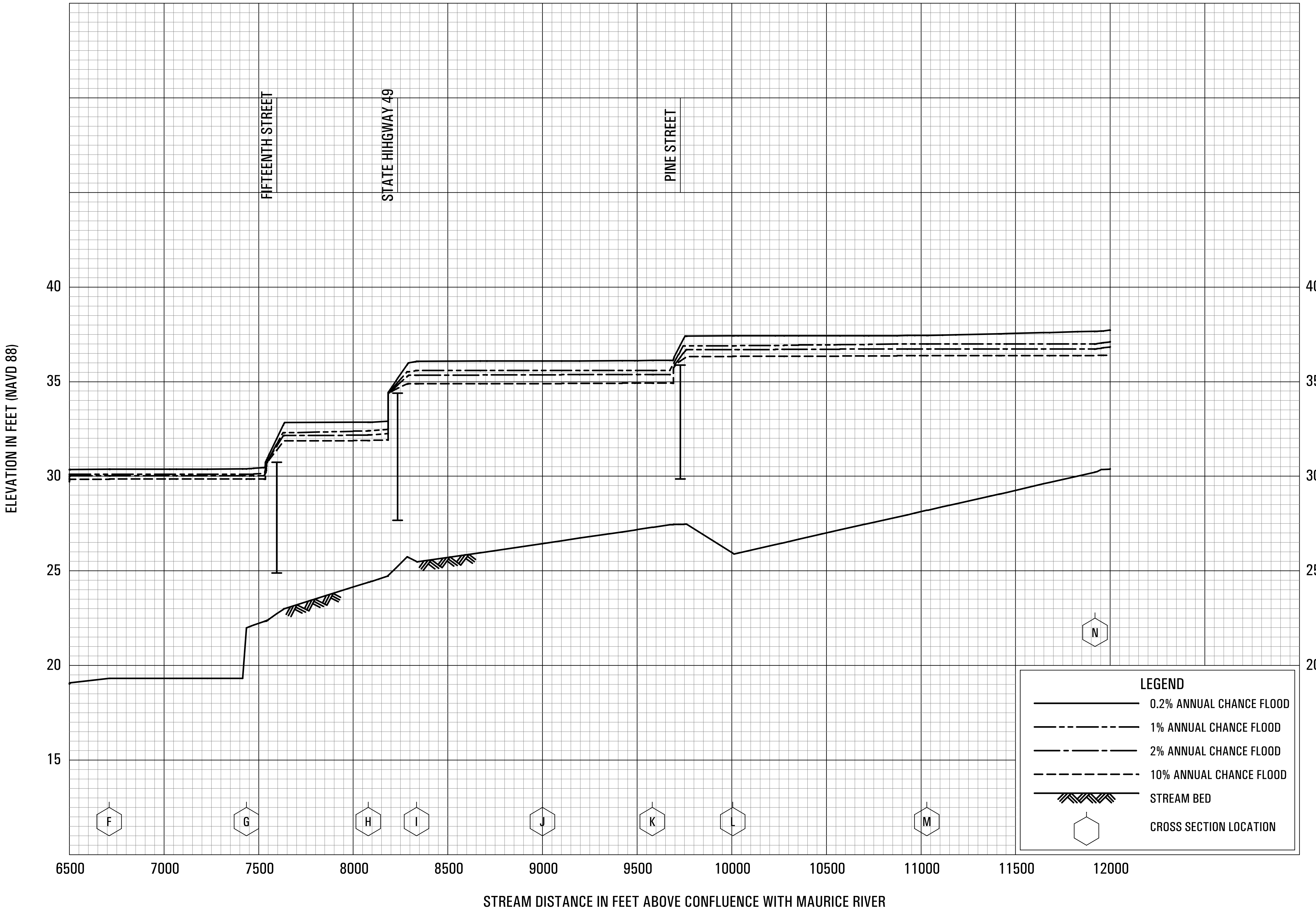
PETTICOAT STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

22P



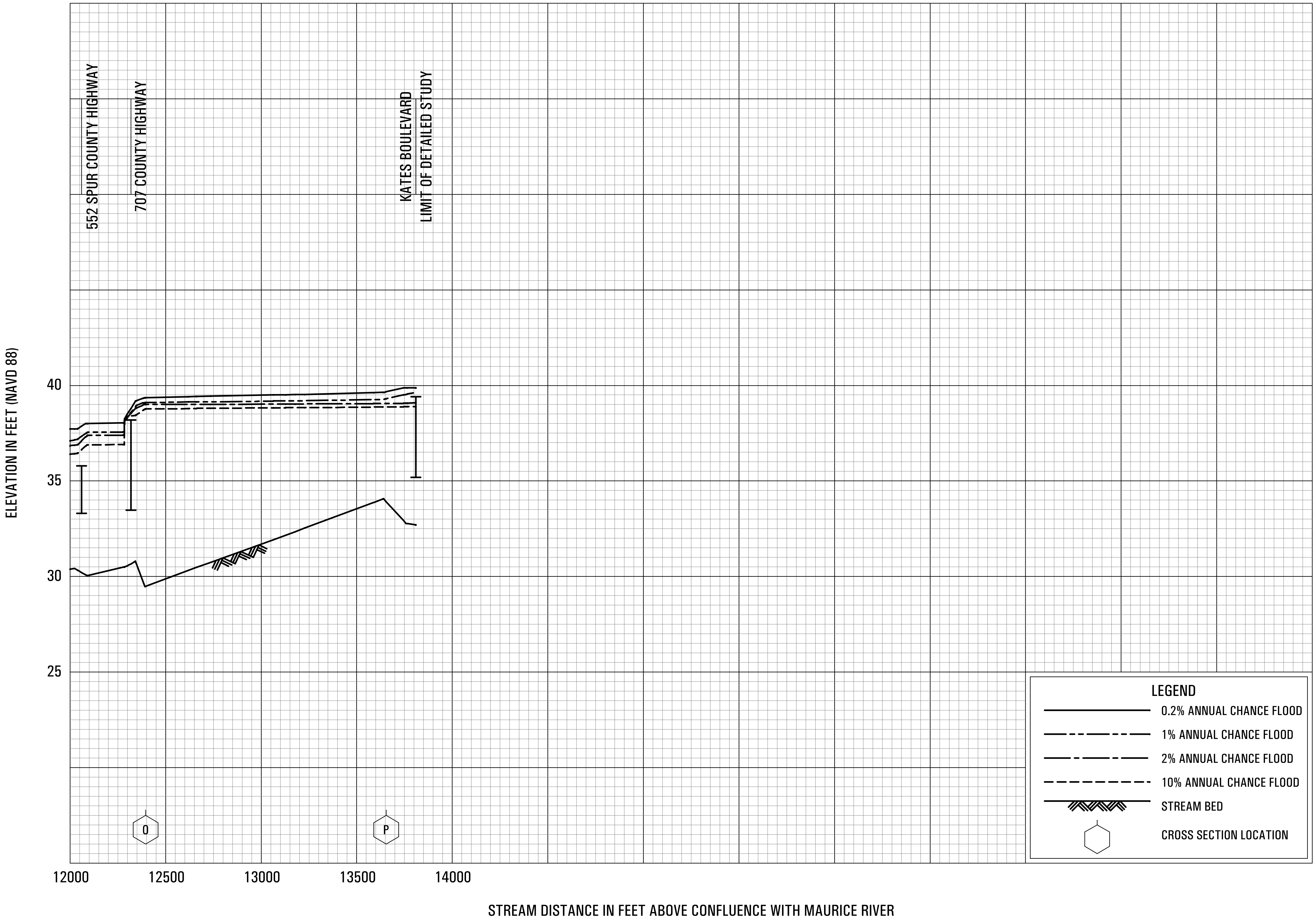
FLOOD PROFILES

PETTICOAT STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



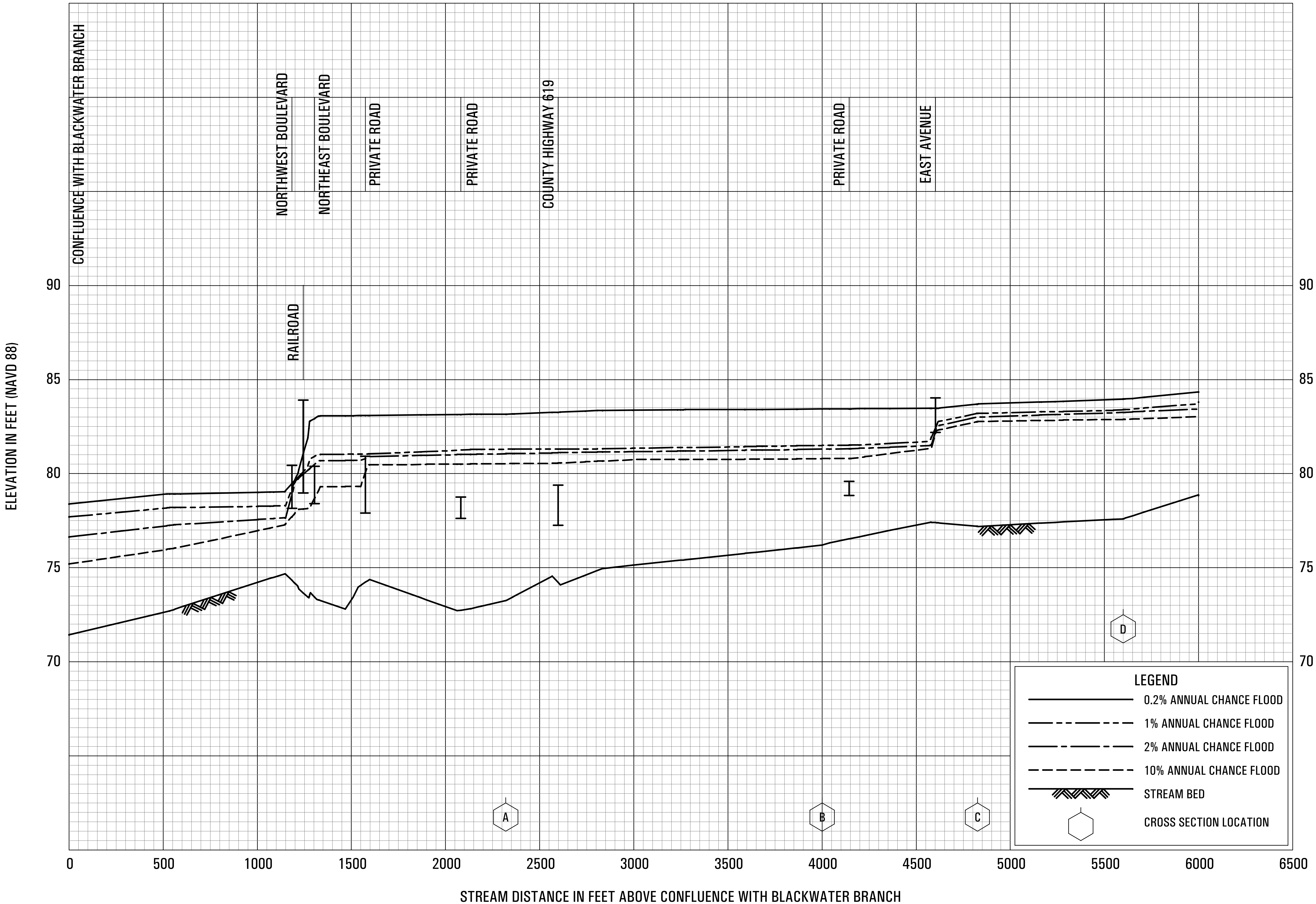
FLOOD PROFILES

PETTICOAT STREAM

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



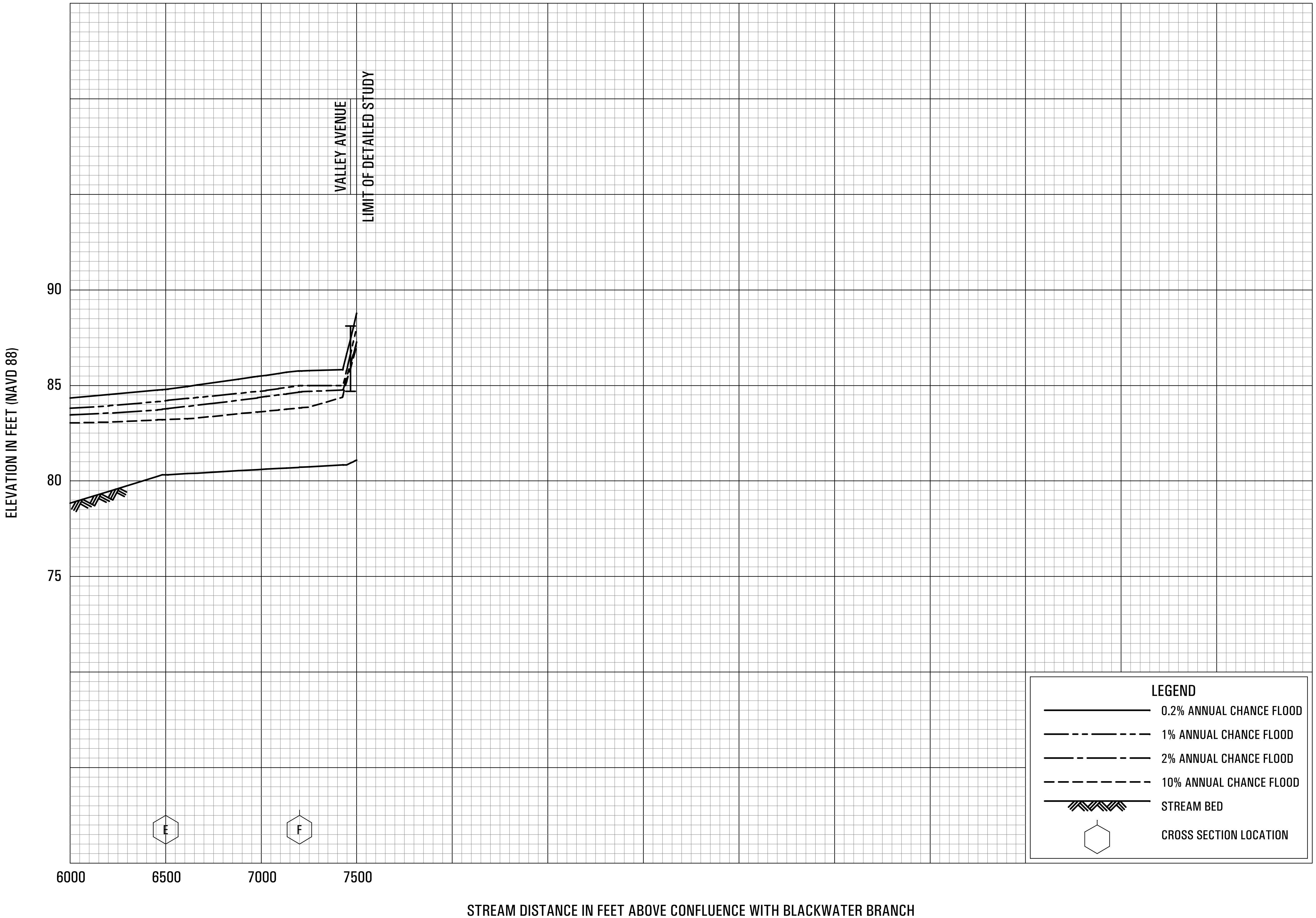
FLOOD PROFILES

PINEY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



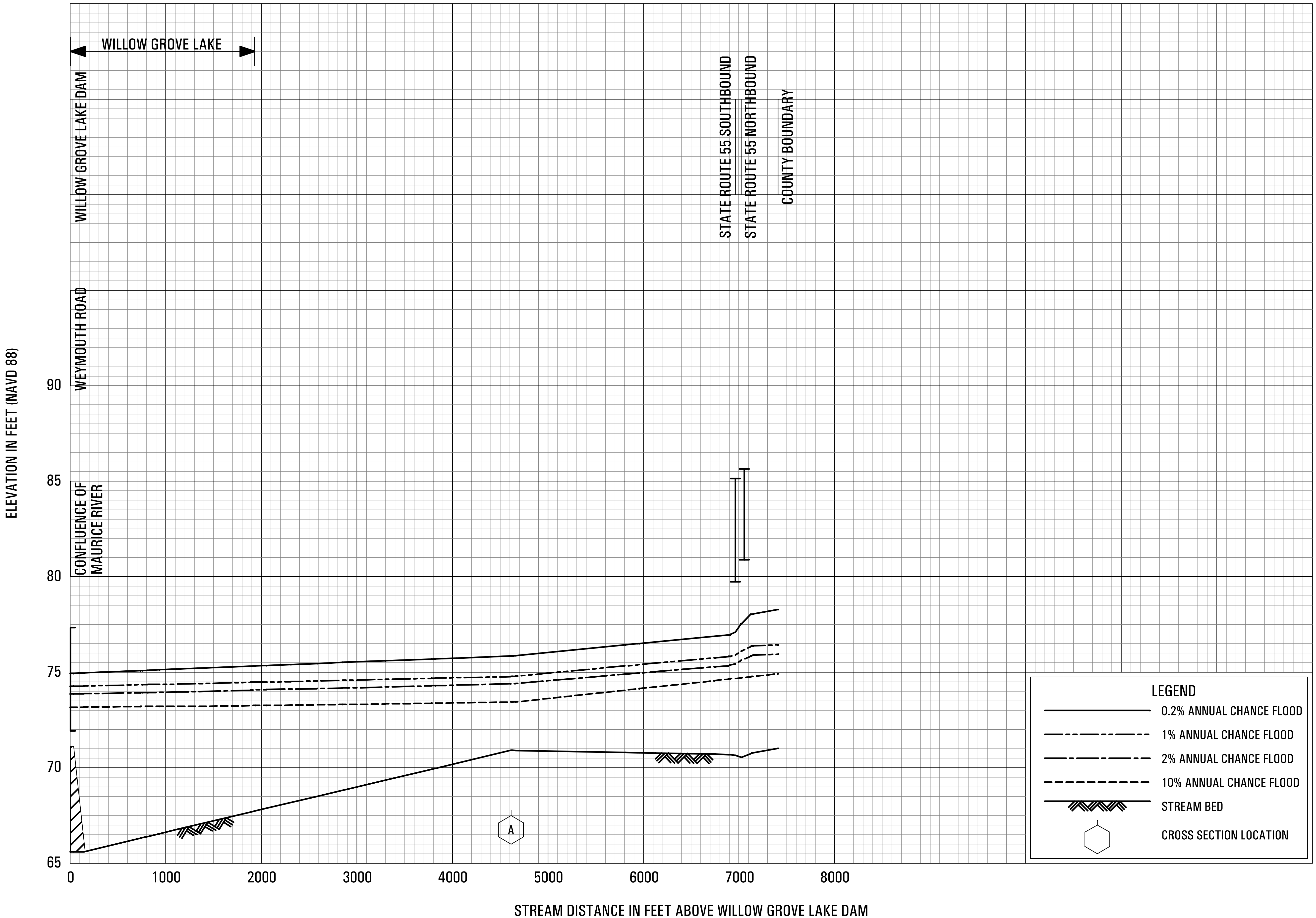
FLOOD PROFILES

PINEY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



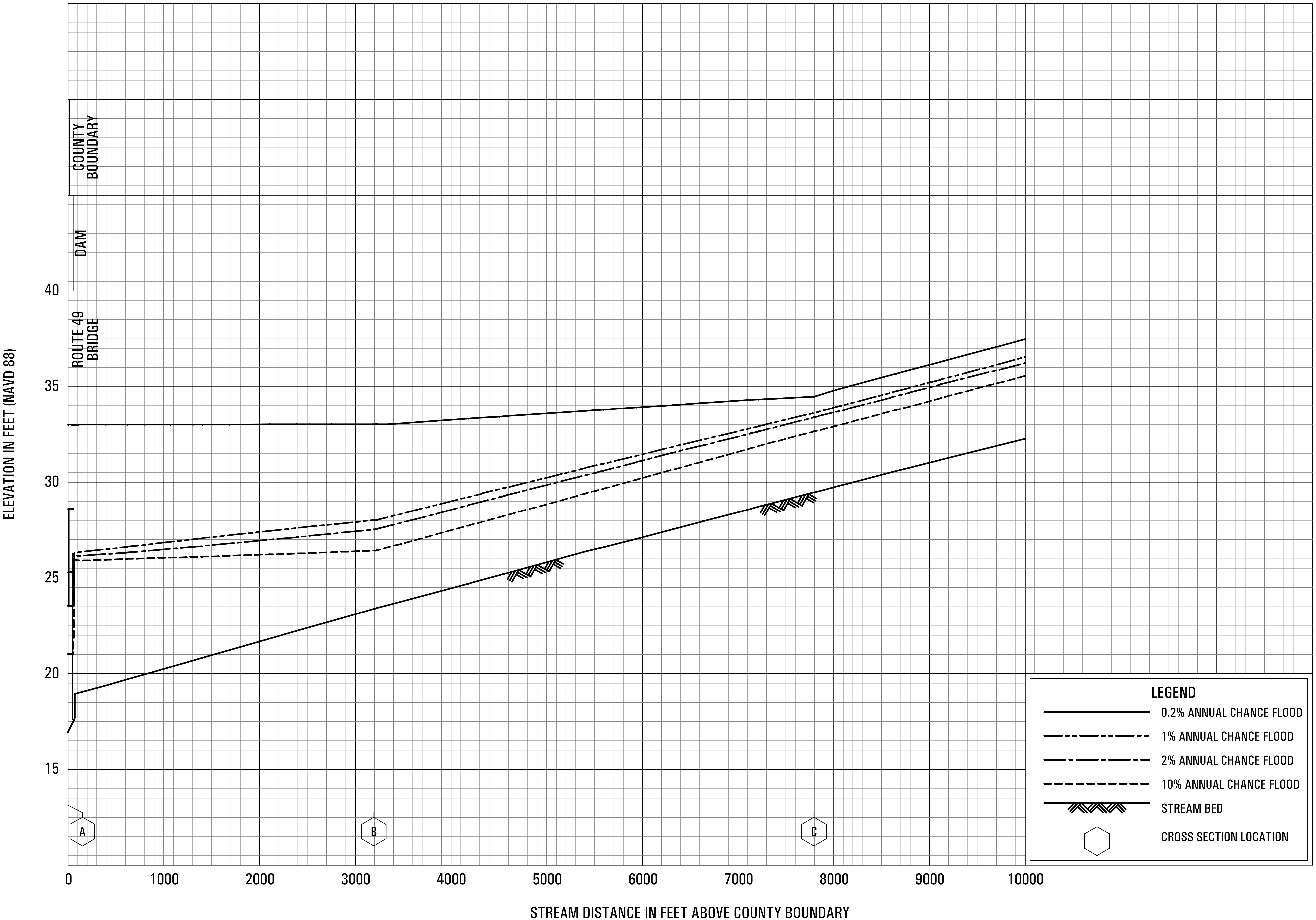
FLOOD PROFILES

SCOTLAND RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



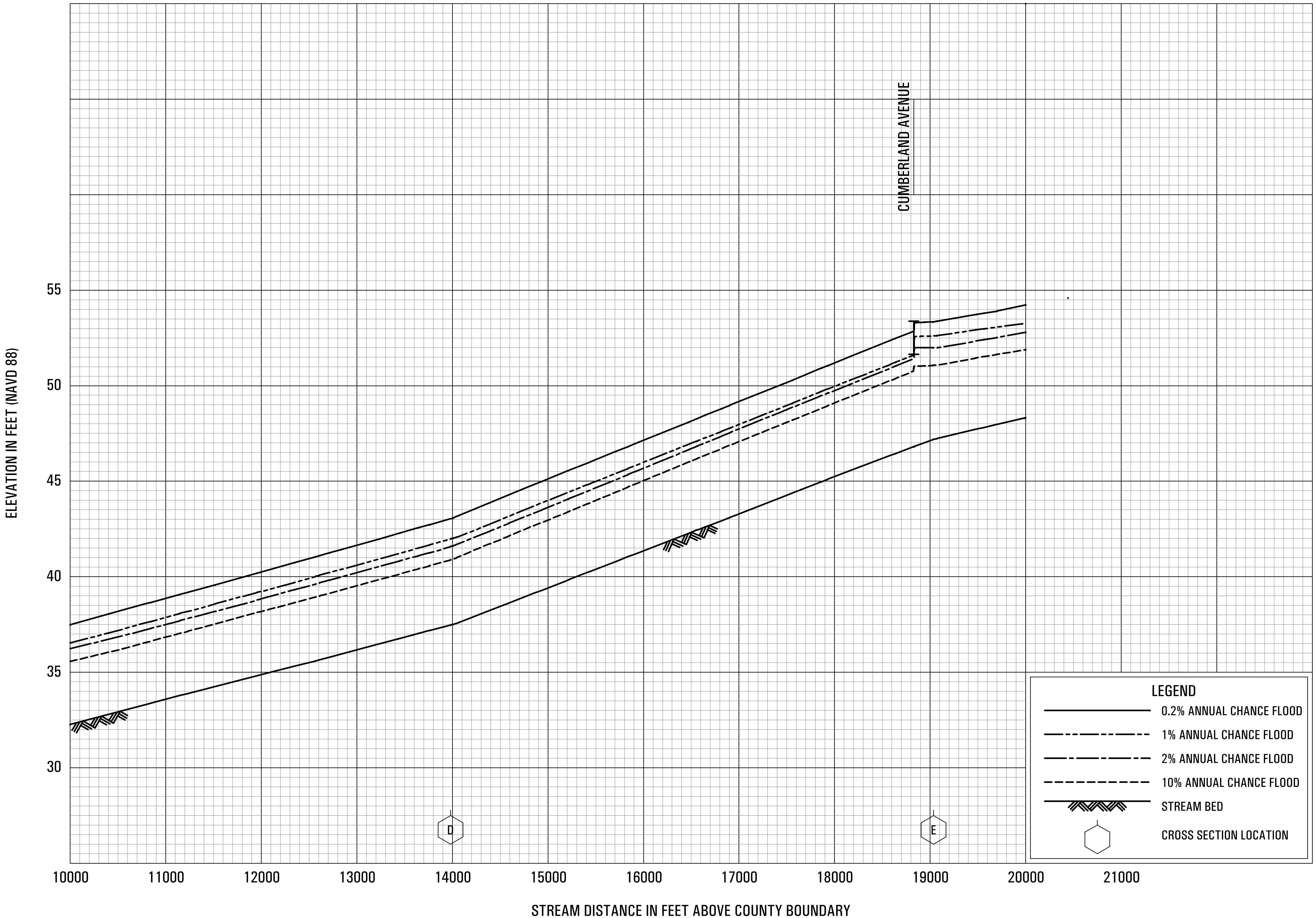
FLOOD PROFILES

TUCKAHOE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



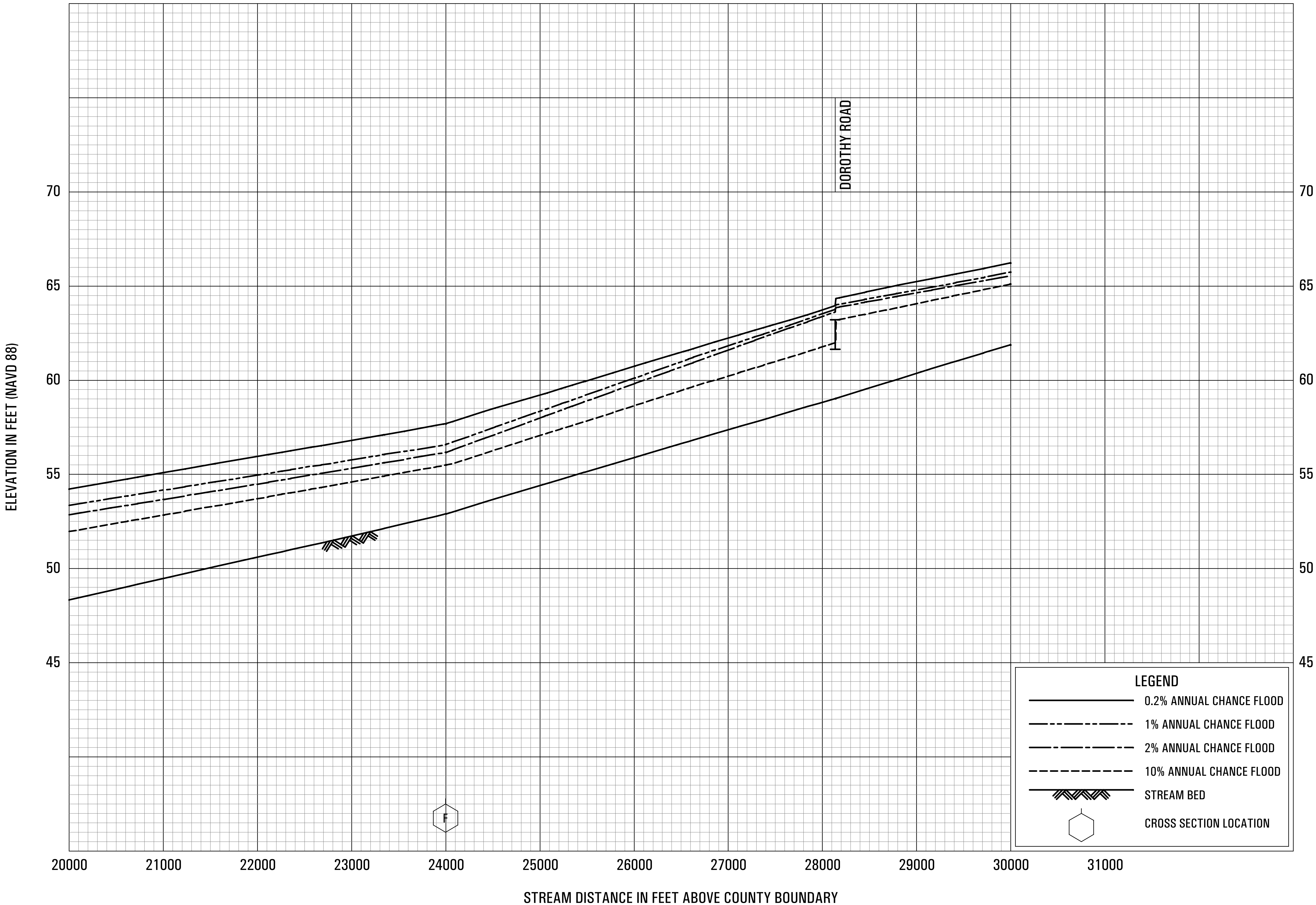
FLOOD PROFILES

TUCKAHOE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

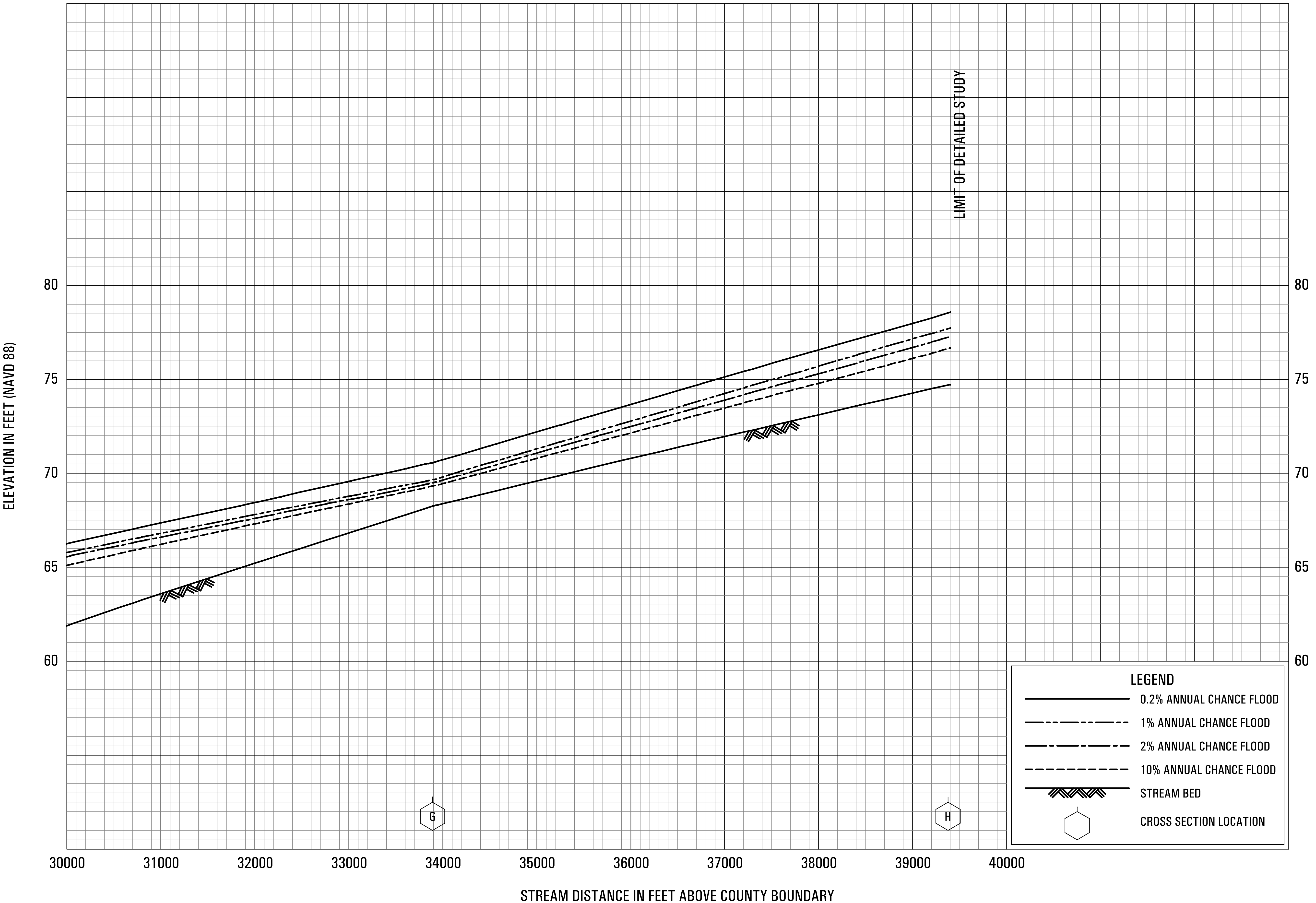
TUCKAHOE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

30P



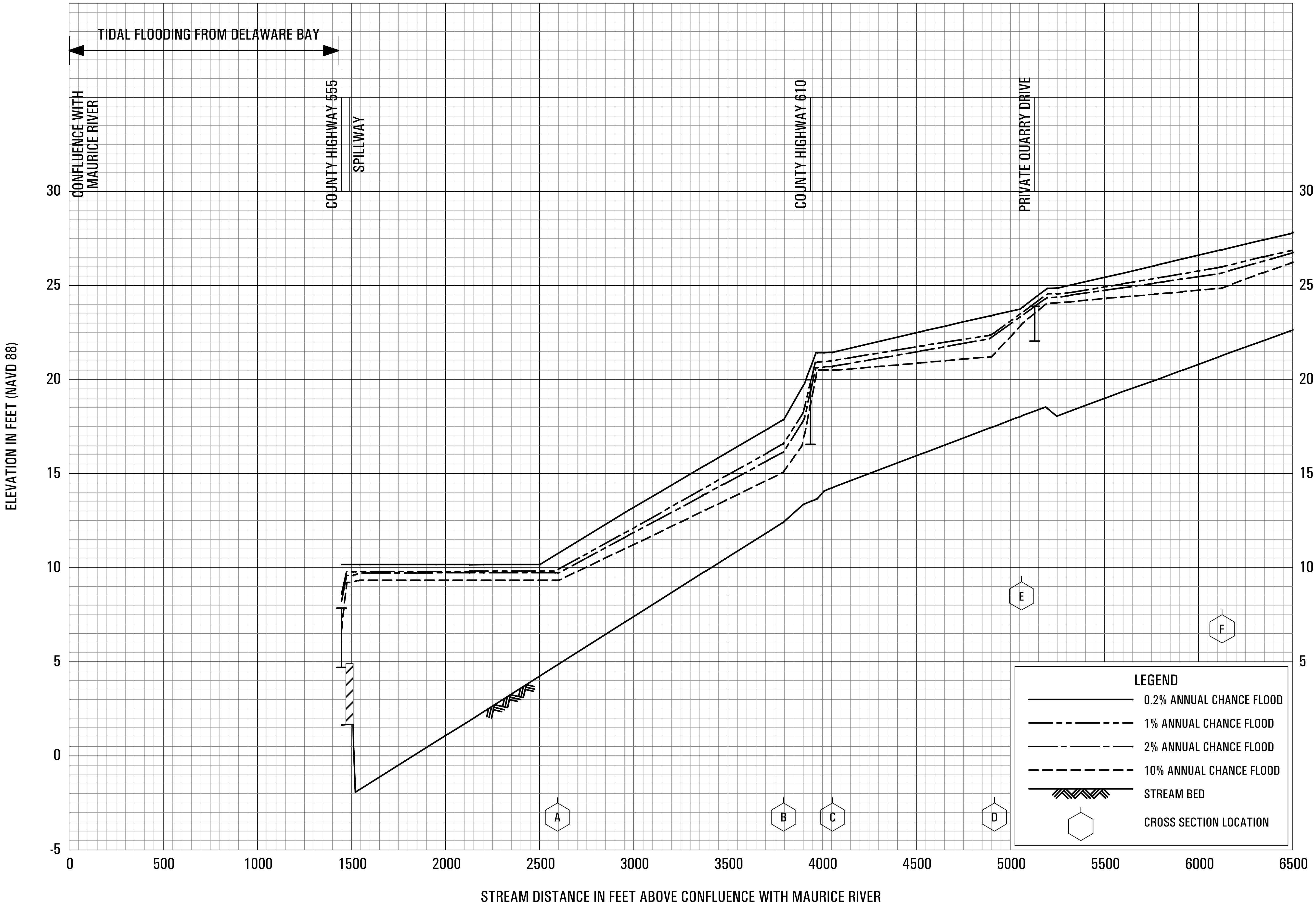
FLOOD PROFILES

TUCKAHOE RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



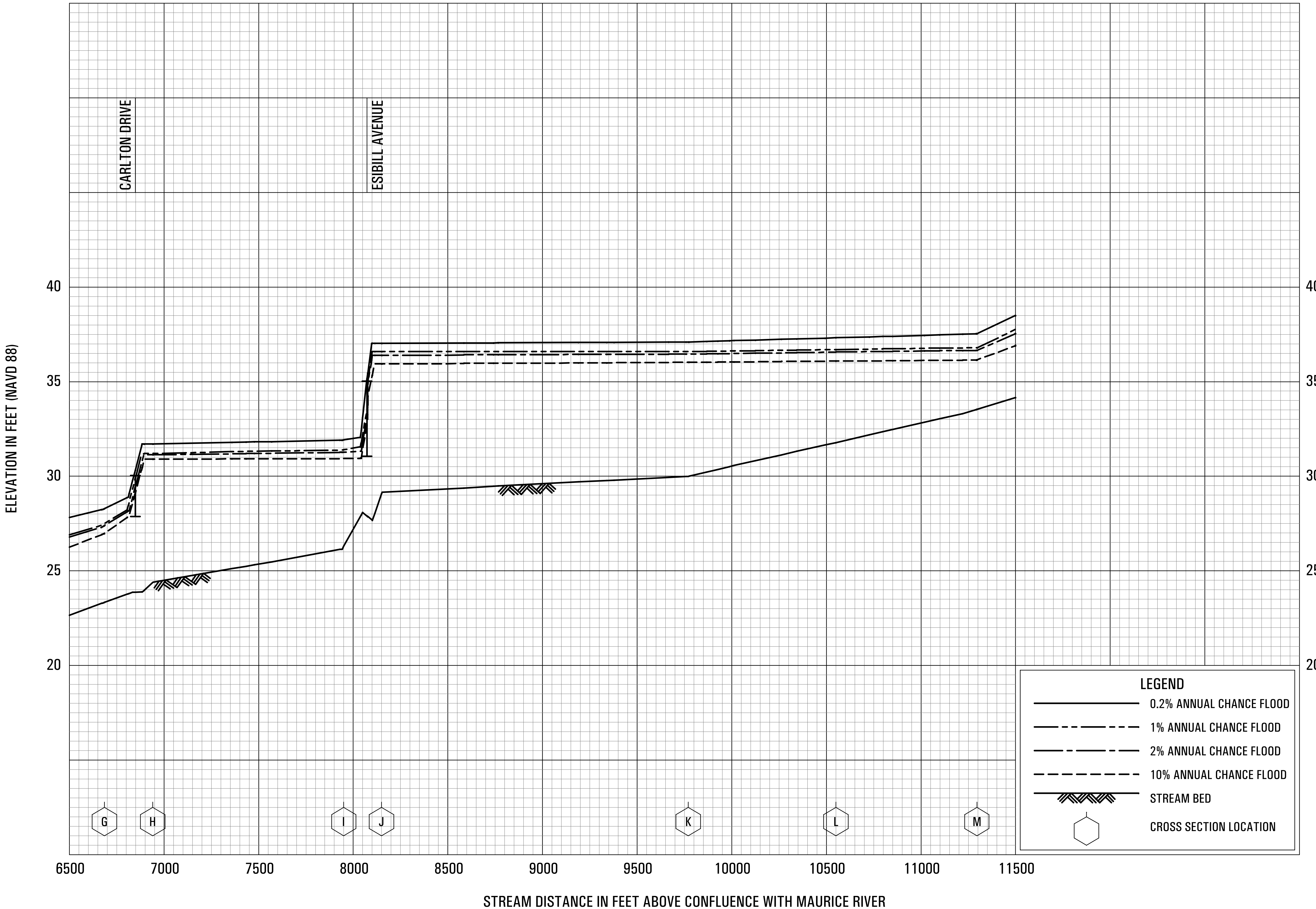
FLOOD PROFILES

WHITE MARSH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



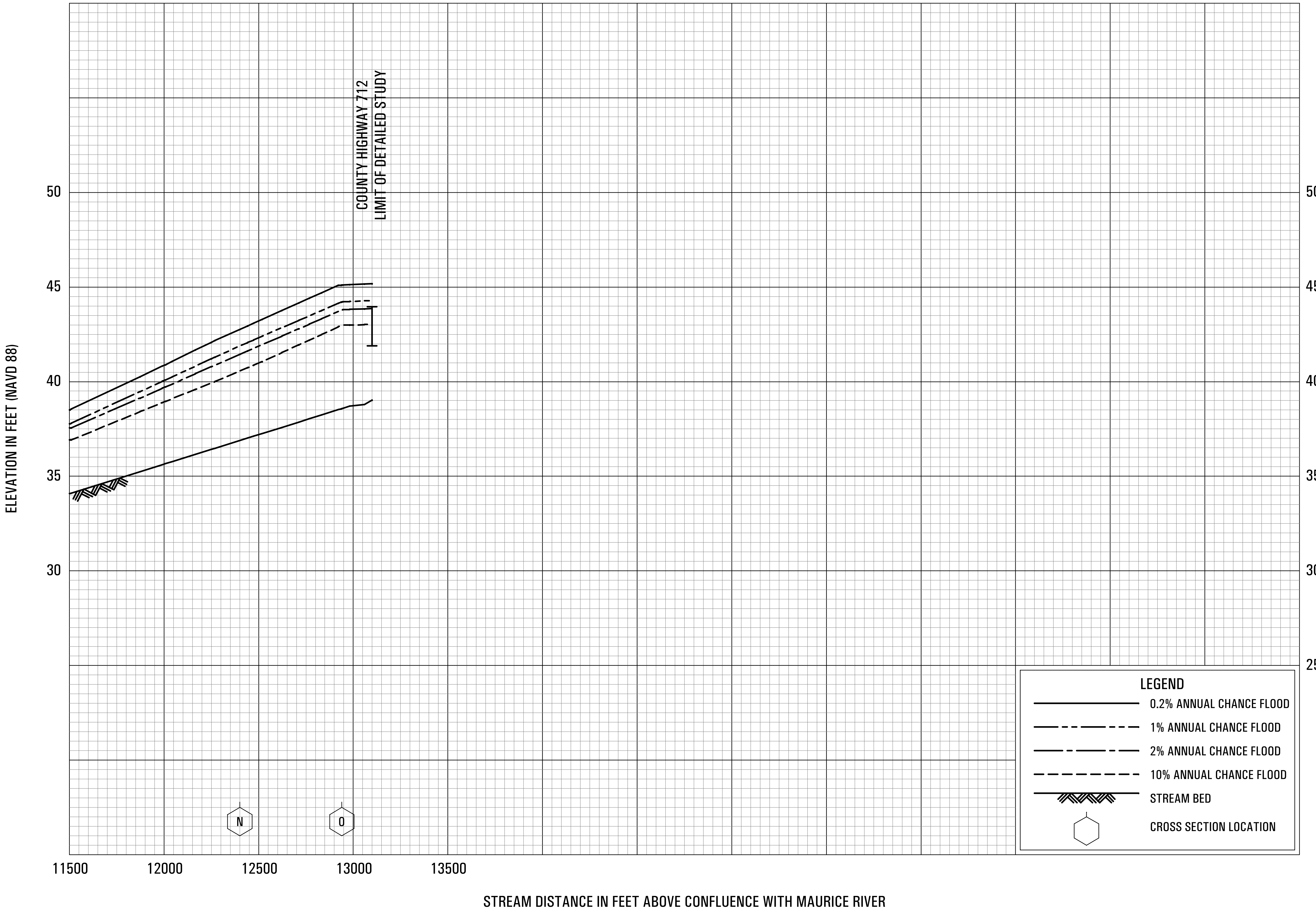
FLOOD PROFILES

WHITE MARSH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

WHITE MARSH RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CUMBERLAND COUNTY, NJ

(ALL JURISDICTIONS)

34P