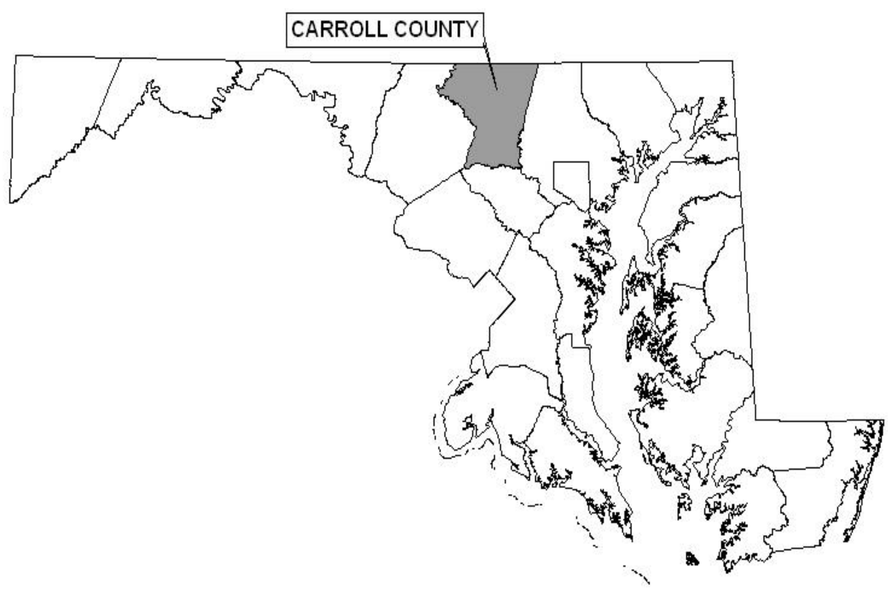
FLOOD INSURANCE STUDY

CARROLL COUNTY, MARYLAND AND INCORPORATED AREAS

Volume 1 of 3

COMMUNITY NAME	COMMUNITY NUMBER
CARROLL COUNTY (UNINCORPORATED AREAS)	240015
HAMPSTEAD, TOWN OF	240090
MANCHESTER, TOWN OF	240107
MOUNT AIRY, TOWN OF	240200
NEW WINDSOR, TOWN OF	240149
SYKESVILLE, TOWN OF	240016
TANEYTOWN, CITY OF	240117
UNION BRIDGE, TOWN OF	240017
WESTMINSTER, CITY OF	240018



EFFECTIVE DATE:
OCTOBER 2, 2015

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
24013CV001A

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.

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult with community officials and check the Community Map Repository to obtain the most current FIS report components.

Flood Insurance Rate Map panels for this community contain new flood zone designations. The flood hazard zones have been changed as follows:

Old Zones	New Zones
A1 through A30	AE
B	X
C	X

Effective Countywide FIS Date: October 2, 2015

TABLE OF CONTENTS-Volume 1 – October 2, 2015

<u>TABLE OF CONTENTS-Volume 1</u> – continued

<u>Page</u>

<u>TABLES</u>

<u>EXHIBITS</u>

<u>TABLE OF CONTENTS-Volume 2</u>– October 2, 2015

TABLE OF CONTENTS-Volume 2– continued

TABLE OF CONTENTS-Volume 3– October 2, 2015

Exhibit 1 – Flood Profiles (continued)

TABLE OF CONTENTS-Volume 3 – continued

Exhibit 1 – Flood Profiles (continued)

FLOOD INSURANCE STUDY
CARROLL COUNTY, MARYLAND AND INCORPORATED AREAS

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of Carroll County, Maryland, including the Cities of Taneytown and Westminster, the Towns of Hampstead, Manchester, Mount Airy, New Windsor, Sykesville, and Union Bridge, and the unincorporated areas of Carroll County (hereinafter referred to collectively as Carroll County).

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 the above referenced communities to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used 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 the Code of Federal Regulations at 44 CFR, 60.3.

Please note that the Town of Mount Airy is geographically located in both Carroll and Frederick Counties. The Town of Mount Airy is included in its entirety in this FIS report.

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) shall 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 the unincorporated areas of, and incorporated communities within, Carroll County in a countywide format FIS. The information on the authority and acknowledgments for previous FISs issued for each jurisdiction in Carroll County is as follows:

Carroll County (Unincorporated Areas):	In the February 1978 FIS, the hydrologic and hydraulic analysis were prepared by Dalton-

Dalton-Little-Newport, for the Federal Emergency Management Agency (FEMA), under Contract H-3810. That work was completed in October 1976 (Reference 1).

Sykesville, Town of:	In the September 1977 FIS, the hydrologic and hydraulic analysis were prepared by Dalton-Dalton-Little-Newport, for FEMA, under Contract H-3810. That work was completed in June 1976 (Reference 2).
Union Bridge, Town of:	In the February 1977 FIS, the hydrologic and hydraulic analyses were prepared by Dalton-Dalton-Little-Newport, for FEMA, under Contract H-3810. That work was completed in April 1976. (Reference 3).
Westminster, City of:	In the December 1977 FIS, the hydrologic and hydraulic analysis were prepared by Dalton-Dalton-Little-Newport, for FEMA, under Contract H-3810. That work was completed in August 1976 (Reference 4).

There are no previous FISs for the Towns of Hampstead, Manchester, Mount Airy, and New Windsor, and the City of Taneytown; therefore the previous authority and acknowledgement information for these communities is not included in this FIS.

For this Countywide FIS, updated hydraulic analyses were performed by the U.S. Army Corps of Engineers (USACE) for the Maryland Department of the Environment (MDE) as part of FEMA's Map Modernization Program (MMP) under Contract No. ICA-08-CRL-01. The MMP study was completed in January 2010.

Planimetric base map information is provided in digital format for all Flood Insurance Rate Map (FIRM) panels. Road centerlines were provided by the Carroll County Department of Planning. Stream centerlines were derived as part of the hydraulic modeling process described in Section 3.2. These base map features are in alignment with digital orthophotography provided by the U.S. Department of Agriculture (USDA), National Agriculture Imagery Program, dated 2007.

The projection used in the preparation of this map was Lambert Conformal Conic State Plane Maryland Zone 1900. The horizontal datum was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or State Plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

1.3 Coordination

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

Carroll County (Unincorporated Areas), February 1978 FIS

In February 1975 and on October 1, 1975, representatives of the Flood Insurance Administration (FIA) and the study contractor, Dalton-Dalton-Little-Newport, met with officials of Carroll County to discuss the scope and methods of study. A search for existing flood-related information and basic data was made of all known sources. Contact was made during the study with the United States Geological Survey (USGS), the Baltimore City Department of Water Supply, the Soil Conservation Service (SCS), the Maryland State Highway Administration (SHA), and the USACE.

A final CCO meeting was held on November 17, 1976, to present the results of the study to the community. Attending the meeting were the FIA, the study contractor, and community officials (Reference 1).

Sykesville, Town of, September 1977 FIS

In February 1975 and on October 1, 1975, representatives of the FIA and the study contractor, Dalton-Dalton-Little-Newport, met with officials from the Town of Sykesville to discuss the scope and methods of study. A search for existing flood-related information and basic data was made of all known sources. Contact was made during the study with the USGS, SHA, and the Carroll County Planning Commission.

A final CCO meeting was held on June 21, 1976, to present the results of the study to the community. Attending the meeting were the FIA, the study contractor, and community officials (Reference 2).

Union Bridge, Town of, February 1977 FIS

A search for existing flood-related information and basic data was made of all known sources. Contact was made during the study with the USDA, SCS, and USGS.

A final CCO meeting was held on April 28, 1976, to present the results of the study to the community. Attending the meeting were the FIA, the study contractor, and community officials (Reference 3).

Westminster, December 1977 FIS

In February 1975 and on October 1, 1975, representatives of the FIA and the study contractor, Dalton-Dalton-Little-Newport, met with officials from the City of Westminster to discuss the scope and methods of study. A search for existing flood-related information and basic data was made of all known sources. Contact was made during the study with the USGS, SHA, the Carroll County Sanitary Commission, and the Carroll County Planning Commission.

A final CCO meeting was held on August 10, 1976, to present the results of the study to the community. Attending the meeting were the FIA, the study contractor, and community officials (Reference 4).

TABLE 1 – INITIAL AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Final CCO Date
Carroll County (Unincorporated Areas)	February 1975 October 1, 1975	November 17, 1976
Sykesville, Town of	February 1975 October 1, 1975	June 21, 1976
Union Bridge, Town of	*	April 28, 1976
Westminster, City of	February 1975 October 1, 1975	August 10, 1976

*Date not available

For this Countywide revision, the initial CCO meeting was held on September 12, 2008 at the MDE offices and attended by representatives of MDE, FEMA, and the USACE (study contractor for this study). Coordination with Carroll County produced data pertaining to floodplain regulations, base map information, digital elevation data, and other pertinent information.

For this revision, a final CCO meeting was held on July 7, 2010, and was attended by representatives of FEMA, the Maryland State NFIP Office, Carroll County, the Cities of Taneytown and Westminster, the Towns of Hampstead, Manchester, Mount Airy, New Windsor, Sykesville, and Union Bridge, and the study contractor. At this meeting the findings of the study and the potential impact of the study results on the community were discussed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Carroll County, Maryland, including all unincorporated and incorporated areas within the county. For this revision, updated hydraulic analyses were completed for all flooding sources included in this report, with the exception of the Liberty Reservoir. Effective backwater elevations were used to map the new floodplain for Liberty Reservoir. This updated analysis was completed by the USACE.

The USACE was contracted to perform detailed studies on the same streams studied with detailed methods in the previous FIS Reports. The selection of streams for detailed study in the previous reports was made with priority given to all known flood hazard areas and areas of projected development and proposed construction through July 1980. Table 2, "Flooding Sources Studied by Detailed Methods," lists the rivers or streams studied in whole or in part by detailed methods.

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Bear Branch	Tributary No 18
Beaver Run	Tributary No 19
Buckhorn Run	Tributary No 21
Copps Branch	Tributary No 22
Copps Branch Tributary	Tributary No 23
Cranberry Branch	Tributary No 24
Double Pipe Creek	Tributary No 25
East Branch Patapsco River	Tributary No 32
Georges Run	Tributary No 33
Little Morgan Run	Tributary No 35
Little Morgan Run II	Tributary No 36
Little Pipe Creek	Tributary No 38
Meadow Branch	Tributary No 39
Meadow Branch Tributary 1	Tributary No 58
Middle Run I	Tributary No 59
Middle Run II	Tributary No 60
Murphy Run	Tributary No 61
North Branch Patapsco River	Tributary No 65
Piney Branch	Tributary No 66
Piney Branch II	Tributary No 67
Piney Creek	Tributary No 69
Piney Run	Tributary No 70
Roaring Run	Tributary No 90
Roop Branch	Tributary No 91
Sams Creek	Tributary No 103
South Branch Patapsco River	Tributary No 104
Tributary No 7	Tributary No 105
Tributary No 9	Tributary No 107
Tributary No 10	Tributary No 108
Tributary No 11	Tributary No 154
Tributary No 14	Tributary No 155
Tributary No 15	Tuckers Branch
Tributary No 16	West Branch Patapsco River

The USACE was contracted to perform approximate studies on the same streams studied using approximate methods in the previous FIS. Approximate analyses were used to study those areas having a low development potential or minimal flooding hazards. Table 3, "Flooding

Sources Studied by Approximate Methods," lists the streams studied by approximate methods.

TABLE 3 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Alloway Creek	Meadow Branch Tributary A
Alloway Creek Tributary 1	Meadow Branch Tributary No.2
Alloway Creek Tributary A1	Middle Run
Aspen Run	Middle Run Tributary
Bear Branch Tributary 1	Monocacy River
Bear Branch Tributary 2	Morgan Run
Bear Branch Tributary 3	Morgan Run Tributary 1
Big Pipe Creek	Morgan Run Tributary 2
Big Pipe Creek Tributary A	Morgan Run Tributary 3
Big Pipe Creek Tributary B	Muddy Creek
Big Pipe Creek Tributary C	Piney Branch II
Big Pipe Creek Tributary D	Piney Branch II Tributary 1
Cabbage Spring Branch	Piney Branch II Tributary 2
Deep Run	Piney Creek Tributary A
Deep Run Tributary	Piney Creek Tributary B
Dickenson Run	Piney Creek Tributary C
Dickenson Run Tributary 1	Priestland Branch
Dickenson Run Tributary 2	Silver Run
East Branch Patapsco River Tributary A	South Branch Gunpowder Falls
Gillis Falls	South Branch Gunpowder Falls Tributary
Gillis Falls Tributary 1	South Branch Patapsco River Tributary A
Gunpowder Falls Tributary 2	South Fork
Grave Run	Talbot Branch
Gunpowder Falls	Tuckers Branch
Gunpowder Falls Tributary	Turkeyfoot Run
Indian Run	Turkeyfoot Run Tributary 1
Joe Branch	Turkeyfoot Run Tributary 2
Liberty Reservoir	West Branch Patapsco River Tributary A
Little Pipe Creek Tributary A	West Branch Patapsco River Tributary B
Little Pipe Creek Tributary B	Wolf Pit Branch
Little Pipe Creek Tributary C	

The following tabulation presents the Letter of Map Revision (LOMR) incorporated into this countywide study:

Letter Type	**Case Number**	**Date Issued**	**Project Identifier**
LOMR	05-03-A533P	01/25/2007	Freedom Hills Farms

2.2 Community Description

Carroll County is located in the north-central portion of Maryland. It is bordered by Howard County, MD to the south, Baltimore County, MD to the east, Adams and York County, PA, to the north, and Frederick County, MD to the west.

According to the U. S. Bureau of the Census, the population of Carroll County was 150,897 in 2000, and the population for the 2010 Census was 167,134, an increase of 10.8% (Reference 5).

Climatic conditions in Carroll County are relatively uniform over the county, the only factor causing a slight difference being elevation. The county enjoys a moderate climate with warm summers and moderately cold winters. The growing season varies from 175 to 180 days. The average annual temperature is 54°F with the average low temperature of 24°F occurring in February and the average high temperature of 87°F occurring in July. Precipitation in Carroll County is rather evenly distributed throughout the year with, an annual average of 45.34 inches per year. Average annual snowfall is 27.8 inches. June, July, and August are the wettest months of the year and February is the driest. The probability for thunderstorms and heavy rains is greatest in August.

The topography of Carroll County varies in elevation from 200 to 1100 feet North American Datum of 1988 (NAVD 88). The terrain generally has a good vegetative cover of hardwoods and conifers, integrated with abundant farms and pasture lands typical of the piedmont areas on the eastern coast of the United States.

The land is drained by streams flowing through comparatively narrow valleys with relatively steep gradients. The county is divided into two distinct drainage systems with Parr's Ridge forming the "backbone" of the county, extending generally from the southwest corner at Mount Airy in a northeasterly direction to the northeast corner. Land to the east and south of the ridge system drains into the Patapsco River. Land to the north and west drains into the Monocacy River. The extreme northeast corner of the county drains into the Gunpowder River (Reference 1).

2.3 Principal Flood Problems

A devastating flood in 1868 washed away much of the Town of Sykesville, which was then located on the south side of the South Branch Patapsco River. A four story stone hotel and the train station were among the structures that were destroyed. Residents rebuilt on the north side of the Patapasco in Carroll County, the present day location of Sykesville.

In 1972 Tropical Storm Agnes brought unprecedented flood damage to the entire county and produced flood stages equal to or greater than the previous worst floods of record. Although the magnitude of flooding varied throughout the county, the gage records accumulated by the USGS indicate that the flood exceeded the elevation of the previous worst flood in 1955 by over 10 feet on the North Branch Patapsco River at Cedarhurst, Maryland, exceeded the 1956 flood elevation at Henryton on the South Branch Patapsco River by over 9 feet, and exceeded the 1949 flood elevation on Big Pipe Creek at Bruceville by nearly 8 feet. The Agnes flood was only one foot below the 1933 f1ood on the Monocacy River at Bridgeport, which is recorded to have been the second worst flood ever recorded in the region based on a flood mark from 1889. Even so, the flood which occurred in 1975 in Carroll County from the effects of Hurricane Eloise, exceeded the Agnes flood elevation at the gage on Cranberry Branch near Westminster by 1.6 feet and at the gage on Big Pipe Creek at Bruceville by 1.1 feet.

Although damage was widespread throughout the county, the rivers causing most damage were the West, North, and South Branches of the Patapsco River, Big Pipe Creek and Little Pipe Creek. The flood in 1972 caused unprecedented disruption to the transportation network in the county. Roads were closed at approximately eighty locations due to the rampaging waters and 28 bridges were destroyed or severely damaged. Damage to the county road system, which was hardest hit, required the replacement of twenty eight bridges. The flood in 1975 damaged and necessitated the replacement of three additional county bridges that had survived the 1972 flood. Total damage to the county road system from Eloise exceeded one million dollars. The Maryland State Highway Administration also suffered road damage during Agnes. The bridge over the South Branch Patapsco River at Sykesville was destroyed while the Maryland Route 91 crossing at the West Branch Patapsco River near Finksburg and the Maryland Route 77 crossing of Double Pipe Creek at Detour were damaged (Reference 1).

The Carroll County Department of Planning provided information related to additional flooding events that have occurred since the previous FIS Report was published. Significant flood losses occurred in the Detour area due to snowmelt following a heavy snowfall in January of 1996. Numerous flood insurance claims were filed in both the town of Detour and nearby Forest & Stream club. In June of 2006, a building on Twin Arch Road just upstream of a railroad tunnel was flooded after several days of locally heavy rain. In August of 2009, a heavy thunderstorm caused flooding near the 100-year frequency in the areas of Lineboro and River Valley Ranch in the northeastern part of the County.

2.4 Flood Protection Measures

Carroll County has instituted a policy of storm water management and sediment control in cooperation with the Soil Conservation District through the application of Chapters 191 and 121 of the Carroll County, Maryland Code of Public Local Laws and Ordinances. Under these chapters the storm water management structures must be included in large land development projects as a condition of approval. If storm water management is determined to be necessary, the Code requires that Environmental Site design measure be used to: replicate predevelopment groundwater recharge provide water quality treatment or 1-inch of runoff and extend the runoff for the 1-year storm for 24 hours. In addition, if downstream flooding is a concern, enough storage must be provided to match the predevelopment 10-year peak flow or the capacity of downstream hydraulic structures if greater than the 10-year storm. There are many storm water management structures of varying sizes constructed throughout county.

Implementation of this policy has measurably reduced the peak discharge rate from l0-year frequency storms in developed drainage basins but has only minimal effects on the l00-year frequency flood peak discharge unless in an area where additional measure has been provided due to insufficient hydraulic structure capacity. The SCS has significantly reduced the flood hazard on Piney Run by construction of a flood control dam approximately one half mile west of the Springfield State Hospital. This project was completed in 1974 and was filled to design elevation in the spring of 1975. During the flood in September 1975, the flood waters rose to the elevation of the emergency spillway thereby affording downstream properties maximum reduction in peak flows.

Evaluation of the effect of the dam at the point where Piney Run crosses Arrington Road indicates that the discharge from a 100-year frequency flood with the dam is reduced to the same discharge as a 25-year frequency flood without the dam.

Of the twenty-nine bridges destroyed by the 1972 flood, many have been replaced and the replacement bridges have generally been designed to pass at least a 50-year frequency magnitude flood. This will significantly reduce backwater effects since most of the bridges destroyed were quite old and hydraulically inferior to the replacement structures (Reference 1).

3.0 <u>ENGINEERING METHODS</u>

For the flooding sources studied by detailed methods (Table 2), standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. 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 exceedance) 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 community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge - frequency relationships for floods of selected recurrence intervals for each stream studied in detail in the county.

MDE contracted Dr. Glenn Moglen of the Department of Civil and Environmental Engineering at the University of Maryland to perform hydrologic calculations. The 10-, 2-, 1-, and 0.2-percent-annual-chance flows were calculated along with a future 1-percent-annual-chance flow. The future 1-percent-annual-chance flow is based on floods that can be anticipated when the watershed land-use changes to a future “ultimate development” condition. The design model provides a realistic representation of the existing watershed conditions; the impact of the “ultimate condition” can be simulated by adjusting the input parameters to reflect future land cover and flow path modifications. The “ultimate development” condition is based upon zoning maps or the Comprehensive Plan. Methods and results of the updated hydrologic analyses are presented below (Reference 6). These methods and calculations were used for all streams other than Copps Branch Tributary, Meadow Branch Tributary No 1, and portions of Copps Branch and Sam’s Creek.

The current regional regression equations being used by the Maryland State Highway Administration (MSHA) were developed by Jonathan Dillow, a hydrologist for the USGS. Dillow defined regression equations for five hydrologic fixed regions: Appalachian Plateaus and Allegheny Ridges, Blue Ridge and Great Valley, Piedmont, Western Coastal Plain and Eastern Coastal Plain (Reference 7).

Dr. Moglen developed a new set of regression equations, called the fixed region regression equations, for the State of Maryland. The fixed region method used in his study is based on the predefined regions of Dillow since these regions are based on physiographic regions. Carroll County is located within the Piedmont and Blue Ridge Region.

The fixed region equations are based on 34 rural stations and 16 urban stations in the Piedmont region. Two sets of regression equations were developed for the rural and urban stations with urban stations having a 10 percent or greater impervious area and rural stations less than 10 percent. Across the two data sets, 9 stations were deleted as outliers: 01582510, 01583000, 01583495, 01583600, 01589000, 01589240, 01592000, 01650050, and 01650085. Therefore, 50 of the 59 stations in the Piedmont Region were used in developing the following two sets of equations. For rural equations, the drainage area (*DA*) ranges from 0.28 to 258.07 square miles and forest cover (*FOR*) ranges from 4.4 to 75.3 percent. For the urban equations, drainage area (*DA*) ranges from 0.39 to 102.05 square miles and impervious area (*IA*) ranges from 10.9 to 42.8 percent. Basin relief and channel slope are highly correlated with drainage area. Therefore, neither basin relief nor channel slope was used as significant parameters in this region.

Rural Equations (Table 4): Standard errors range from 24.3 percent (0.104 log units for Q_{10} to 39.7 percent (0.166 log units) for Q_{500}.

TABLE 4 – PIEDMONT RURAL EQUATIONS

Piedmont (Rural) Fixed Region Regression Equations	Standard Error (Percent)	Equivalent Years of Record
$Q_{1.25} = 202.9\ DA^{0.682}\ (FOR+1)^{-0.222}$	39.0	3.3
$Q_{1.50} = 262.0\ DA^{0.683}\ (FOR+1)^{-0.217}$	33.8	3.8
$Q_{1.75} = 308.9\ DA^{0.679}\ (FOR+1)^{-0.219}$	32.1	4.3
$Q_2 = 349.0\ DA^{0.674}\ (FOR+1)^{-0.224}$	31.3	4.8
$Q_5 = 673.8\ DA^{0.659}\ (FOR+1)^{-0.228}$	25.6	14
$Q_{10} = 992.6\ DA^{0.649}\ (FOR+1)^{-0.230}$	24.3	23
$Q_{25} = 1556\ DA^{0.635}\ (FOR+1)^{-0.231}$	25.3	33
$Q_{50} = 2146\ DA^{0.624}\ (FOR+1)^{-0.235}$	27.5	37
$Q_{100} = 2897\ DA^{0.613}\ (FOR+1)^{-0.238}$	30.6	37
$Q_{200} = 3847\ DA^{0.603}\ (FOR+1)^{-0.239}$	34.2	35
$Q_{500} = 5519\ DA^{0.589}\ (FOR+1)^{-0.242}$	39.7	35

Urban Equations (Table 5): For the urban equations (10 percent or greater impervious area), the standard errors range from 26.0 percent (0.111 log units) for Q_{25} to 41.7 percent (0.174 log units) for $Q_{1.25}$.

TABLE 5 –PIEDMONT URBAN EQUATIONS

Piedmont (Urban) Fixed Region Regression Equations	Standard Error (Percent)	Equivalent Years of Record
$Q_{1.25} = 17.85\ DA^{0.652}\ (IA+1)^{0.635}$	41.7	3.3
$Q_{1.50} = 24.66\ DA^{0.648}\ (IA+1)^{0.631}$	36.9	3.8
$Q_{1.75} = 30.82\ DA^{0.643}\ (IA+1)^{0.611}$	35.6	4.1
$Q_{2} = 37.01\ DA^{0.635}\ (IA+1)^{0.588}$	35.1	4.5
$Q_{5} = 94.76\ DA^{0.624}\ (IA+1)^{0.499}$	28.5	13
$Q_{10} = 169.2\ DA^{0.622}\ (IA+1)^{0.435}$	26.2	24
$Q_{25} = 341.0\ DA^{0.619}\ (IA+1)^{0.349}$	26.0	38
$Q_{50} = 562.4\ DA^{0.619}\ (IA+1)^{0.284}$	27.7	44
$Q_{100} = 898.3\ DA^{0.619}\ (IA+1)^{0.222}$	30.7	45
$Q_{200} = 1413\ DA^{0.621}\ (IA+1)^{0.160}$	34.8	44
$Q_{500} = 2529\ DA^{0.623}\ (IA+1)^{0.079}$	41.2	40

The fixed Blue Ridge Region equations (Table 6) are based on 20 stations in Maryland with drainage area (DA) ranging from 0.11 to 820 square miles and percent limestone (LIME) ranging from 0.0 to 100 percent. Basin relief, land slope, forest cover, and soils characteristics were all investigated as explanatory variables but were not statistically significant across all recurrence intervals in the regression equations. The standard errors range from 51.6 percent (0.211 log units) for Q_{25} to 74.6 percent (0.289 log units) for $Q_{1.25}$.

TABLE 6 –BLUE RIDGE EQUATIONS

Blue Ridge Fixed Region Regression Equations	Standard Error (Percent)	Equivalent Years of Record
$Q_{1.25} = 57.39\ DA^{0.784}\ (LIME+1)^{-0.190}$	74.6	46
$Q_{1.50} = 81.45\ DA^{0.764}\ (LIME+1)^{-0.193}$	67.1	47
$Q_{1.75} = 96.33\ DA^{0.755}\ (LIME+1)^{-0.194}$	65.2	48
$Q_{2} = 107.20\ DA^{0.750}\ (LIME+1)^{-0.194}$	64.0	49
$Q_{5} = 221.28\ DA^{0.710}\ (LIME+1)^{-0.202}$	55.4	50
$Q_{10} = 336.84\ DA^{0.687}\ (LIME+1)^{-0.207}$	52.5	51
$Q_{25} = 545.62\ DA^{0.660}\ (LIME+1)^{-0.214}$	51.6	52
$Q_{50} = 759.45\ DA^{0.641}\ (LIME+1)^{-0.219}$	52.5	53
$Q_{100} = 1034.7\ DA^{0.624}\ (LIME+1)^{-0.224}$	54.4	54
$Q_{200} = 1387.6\ DA^{0.608}\ (LIME+1)^{-0.229}$	57.4	55
$Q_{500} = 2008.6\ DA^{0.587}\ (LIME+1)^{-0.235}$	62.3	56

All calculations using the fixed region regression equations were performed with GISHydro2000. GISHydro is a computer program used to assemble and evaluate hydrologic models for watershed analysis. Originally developed in the mid-1980s, the program combines a database of terrain, land use, and soils data with specialized GIS tools for assembling data and extracting model parameters. The primary purpose of the GISHydro program is to assist engineers in performing watershed analyses in the State of Maryland. In the Fall of 1997, a new collaborative project between the Department of Civil and Environmental Engineering at the University of Maryland and the MSHA began to update and enhance GISHydro into GISHydro2000.

It should also be emphasized that these regression equations, although not developed by the USGS, provide a better standard error performance than the current USGS regression equations for Maryland and also apply not just to rural but to both rural and urban watershed conditions. These equations were endorsed for use in Maryland by the Maryland Hydrology Panel as documented in their report which can be obtained from the MSHA or from the following URL:

http://www.gishydro.umd.edu/HydroPanel/panel_report_103106.pdf
(University of Maryland 2006).

The 10-, 2-, 1-, and 0.2-percent-annual-chance flows for portions of Copps Branch and all of Copps Branch Tributary were taken from Letter of Map Revision (LOMR) Case Number 09-03-0356P. The peak flows for the LOMR were computed using the NRCS TR-20 hydrologic model. Peak flows for Copps Branch downstream of the area revised by LOMR were calculated by Dr. Glenn Moglen as described above.

The 10-, 2-, 1-, and 0.2-percent-annual-chance flows for Meadow Branch Tributary 1 were taken from LOMR Case Number 08-03-0973P. The peak flows were computed using the USACE's HEC-HMS hydrologic modeling software, version 3.1.0.

The 10-, 2-, 1-, and 0.2-percent-annual-chance flows for Sam's Creek downstream of Lehigh Road were carried forwarded from the previous FIS (Reference 1). The flows are based on the results of an analysis of USGS gages within Carroll County projected within the Sam's Creek watershed. Peak flows for Sam's Creek upstream of Lehigh Road were calculated by Dr. Glenn Moglen as described above.

Drainage area peak-discharge relationships for the streams studied by detailed methods are listed in Table 7, "Summary of Discharges."

TABLE 7 – SUMMARY OF DISCHARGES

		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
BEAR BRANCH						
Downstream of Hughes Shop Road	4.6	1,237	2,548	3,355	3,372	6,096
Downstream of Dotsie Dr	1.8	777	1,730	2,340	2,340	4,500
BEAVER RUN						
Downstream of Gamber Road	14.36	2,740	6,110	8,320	8,760	16,300
Downstream of Confluence with Middle Run	9.55	1,960	4,500	6,200	6,710	12,500
Downstream of Confluence with Tributary 32	2.66	1,070	2,310	3,100	3,500	5,820
BUCKHORN RUN						
Approximately 1000 Feet upstream of Confluence with Piney Run	1.24	555	1,170	1,570	1,640	2,940
COPPS BRANCH						
At Confluence with Little Pipe Creek	2.33	1,140	2,340	3,080	3,290	5,500
Downstream of WMC Drive	0.29	133	272	352	352	812
COPPS BRANCH TRIBUTARY						
At Confluence with Copps Branch	0.26	201	520	681	681	1,043
CRANBERRY BRANCH						
Upstream of Old Manchester Road	3.51	1,100	2,260	2,990	3,040	5,450
Approximately 8,000 Feet upstream of Monks Way	0.74	410	890	1,190	1,190	2,260

TABLE 7 – SUMMARY OF DISCHARGES (Continued)

		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
DOUBLE PIPE CREEK						
At Confluence with Monocacy River	193.18	14,134	25,971	32,691	32,879	53,490
EAST BRANCH PATAPSCO RIVER						
At Confluence with North Branch Patapsco River	20.92	3,440	6,790	8,800	8,910	15,400
GEORGES RUN						
At the Confluence of Tributary 7	0.92	569	1,220	1,630	1,630	3,020
LITTLE MORGAN RUN						
At Warfieldsburg Road	1.93	740	1,550	2,060	2,090	3,810
LITTLE MORGAN RUN II						
Upstream of Bartholow Road	7.08	1,680	3,810	5,230	5,530	10,400
Upstream of Old Washington Road	2.16	714	1490	1970	1970	3640
LITTLE PIPE CREEK						
At Confluence of Big Pipe Creek	83.63	8,967	17,017	21,756	22,091	36,709
At Locust Street	41.16	5,784	11,202	14,497	14,861	24,886
At Stone Chapel Road	5.56	1,720	3,690	4,930	5,320	9,240
MEADOW BRANCH						
Approximately 10,000 Feet Downstream of Taneytown Pike	4.79	1,330	3,010	4,130	4,370	8,170
Downstream of Confluence with Meadow Branch Tributary 2	1.07	510	1,170	1,610	1,720	3,200

TABLE 7 – SUMMARY OF DISCHARGES (Continued)						
		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
MEADOW BRANCH TRIBUTARY 1						
At Confluence with Meadow Branch	0.41	209	486	627	685	1,111
MIDDLE RUN I						
At Bollinger Road	3.29	1,010	2,330	3,200	3,280	6,420
Approximately 10,000 Feet upstream of Bollinger Road	1.07	617	1,330	1,780	1,810	3,310
MIDDLE RUN II						
At Louisville Road	6.04	1,640	3,340	4,390	4,390	7,910
Downstream of Confluence with Tributary 38	1.72	694	1,460	1,940	1,940	3,600
MURPHY RUN						
At Upper Beckleysville Road	2.8	992	2,220	3,020	3,280	5,390
At Eagle Ridge Court	0.42	303	684	931	970	1,810
NORTH BRANCH PATAPSCO RIVER						
Approximately 300 Feet Upstream of Emory Road	56.01	5,880	13,400	18,500	19,100	37,500
At Wesley Road	41.41	4,970	11,300	15,500	16,000	31,200
PINEY BRANCH						
At Confluence with South Branch Patapsco River	0.35	426	822	1,050	1,050	1,750
PINEY BRANCH II						
Confluence with Tributary 158	2.83	*	*	2,772	*	*
Upstream of confluence with Tributary 157	2.94	*	*	2,845	*	*
*Data not available						

TABLE 7 – SUMMARY OF DISCHARGES (Continued)						
		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
PINEY BRANCH II (Continued)						
Confluence with Tributary 157	2.96	*	*	2,855	*	*
Upstream of confluence with Tuckers Branch	3.04	*	*	2,899	*	*
Confluence with Tuckers Branch	5.89	*	*	5,350	*	*
Confluence with Tributary 156	6.19	*	*	5,512	*	*
PINEY CREEK						
At Confluence of Tributary 154	28.38	3,697	7,189	9,272	9,272	15,952
At Teeter Road	17.69	2,814	5,578	7,239	7,239	12,674
PINEY RUN						
Approximately 150 Feet Upstream of Arrington Road	17.04	3,190	7,000	9,470	9,640	18,300
ROARING RUN						
At Confluence with North Branch Patapsco River	2.41	890	2,020	2,750	2,790	5,360
Approximately 150 Feet Upstream of Sandymount Road	0.64	360	770	1,030	1,040	1,970
ROOP BRANCH						
At Confluence with Little Pipe Creek	3.34	1,057	2,209	2,914	2,929	5,375
SAMS CREEK						
At Confluence with Little Pipe Creek	21.77	2,927	5,468	6,699	6,699	10,800
At Lehigh Road	18.31	2,381	4,448	5,450	5,450	8,786
*Data not available						

TABLE 7 – SUMMARY OF DISCHARGES (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cubic feet per second)				
		10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
SOUTH BRANCH PATAPSCO RIVER						
Approximately 900 feet upstream of Marriottsville Road	64.65	6,830	13,100	16,800	20,900	28,400
Approximately 2,000 feet upstream of Gaither Road	42.11	5,250	10,200	13,100	16,000	22,400
Approximately 6,000 feet upstream of Watersville Road	5.49	1,730	3,690	4,920	5,290	9,180
TRIBUTARY NO 7						
At Confluence with Georges Run	0.47	386	821	1,090	1,090	2,000
TRIBUTARY NO 9						
At Confluence with Murphy Run	0.56	393	862	1,160	1,300	2,190
TRIBUTARY NO 10						
At County Boundary	0.99	485	1,030	1,380	1,690	2,600
TRIBUTARY NO 11						
At Confluence with Tributary 10	0.54	357	774	1,040	1,240	2,000
TRIBUTARY NO 14						
At Sullivan Road	0.15	240	550	760	760	1,510
TRIBUTARY NO 15						
At Confluence with West Branch Patapsco River	0.86	663	1,330	1,720	1,940	3,000
TRIBUTARY NO 16						
At Confluence with West Branch Patapsco River	0.95	728	1,440	1,860	1,980	3,210

TABLE 7 – SUMMARY OF DISCHARGES (Continued)

		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
TRIBUTARY NO 18						
At Confluence with Cranberry Branch	0.62	422	923	1,240	1,240	2,340
TRIBUTARY NO 19						
At Confluence with Cranberry Branch	0.37	285	639	868	944	1,670
TRIBUTARY NO 21						
At Confluence with West Branch Patapsco River	0.14	277	630	868	868	1,730
TRIBUTARY NO 22						
At Confluence with West Branch Patapsco River	0.93	732	1,440	1,860	1,860	3,180
TRIBUTARY NO 23						
At Confluence with West Branch Patapsco River	1.09	652	1,380	1,840	1,840	3,370
TRIBUTARY NO 24						
Approximately 1200 Feet Upstream of Carrolton Road	0.96	445	948	1,270	1,510	2,390
TRIBUTARY NO 25						
At Confluence with West Branch Patapsco River	0.8	461	989	1,330	1,330	2,520
TRIBUTARY NO 32						
At Poole Road	0.54	437	917	1,210	1,270	2,190
TRIBUTARY NO 33						
At Confluence with Beaver Run	0.82	466	999	1,340	1,420	2,540

TABLE 7 – SUMMARY OF DISCHARGES (Continued)						
		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
TRIBUTARY NO 35						
At Confluence with Beaver Run	0.68	471	1,010	1,350	1,350	2,500
TRIBUTARY NO 36						
At Confluence with Beaver Run	0.3	301	634	838	892	1,520
TRIBUTARY NO 38						
At Confluence with Middle Run II	1.05	522	1,110	1,490	1,530	2,800
TRIBUTARY NO 39						
At Confluence with Middle Run II	2.19	808	1,840	2,530	2,530	5,010
TRIBUTARY NO 58						
At Washington Road	0.23	220	488	659	714	1,250
TRIBUTARY NO 59						
Approximately 1100 Feet Upstream of Snowdens Run Road	2.34	1,140	2,340	3,070	3,360	5,510
TRIBUTARY NO 60						
At Confluence with Liberty Reservoir	0.52	556	1,060	1,350	1,350	2,250
TRIBUTARY NO 61						
At Sykesville Road	0.68	539	887	1,117	1,117	1,495
TRIBUTARY NO 65						
Approximately 400 Feet Upstream of Confluence with Piney Run	0.33	227	496	671	840	1,300

TABLE 7 – SUMMARY OF DISCHARGES (Continued)

		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
TRIBUTARY NO 66						
At Confluence with Piney Run	0.44	299	685	938	938	1,840
TRIBUTARY NO 67						
Approximately 900 Feet Upstream of Confluence with South Branch Patapsco River	0.42	323	713	962	1,010	1,830
TRIBUTARY NO 69						
At Confluence with South Branch Patapsco River	0.5	447	916	1,200	1,280	2,120
TRIBUTARY NO 70						
At Confluence with South Branch Patapsco River	1.0	477	1,010	1,360	1,910	2,560
TRIBUTARY NO 90						
At Confluence with South Branch Patapsco River	1.21	753	1,550	2,040	2,140	3,650
TRIBUTARY NO 91						
Approximately 1000 Feet Upstream of Confluence with South Branch Patapsco River	1.27	921	1,790	2,290	2,360	3,880
TRIBUTARY NO 103						
At Confluence with Little Pipe Creek	1.23	895	1,740	2,240	2,330	3,800

TABLE 7 – SUMMARY OF DISCHARGES (Continued)						
		PEAK DISCHARGES (cubic feet per second)				
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	Future 1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
TRIBUTARY NO 104						
At Confluence with Little Pipe Creek	0.59	441	940	1,250	1,420	2,300
TRIBUTARY NO 105						
At Confluence with Little Pipe Creek	1.81	752	1,580	2,100	2,230	3,900
TRIBUTARY NO 107						
At Confluence with Copps Branch	0.17	223	462	605	690	1,080
TRIBUTARY NO 108						
At Confluence with Little Pipe Creek	1.55	802	1,700	2,270	2,330	4,240
TRIBUTARY NO 154						
At Confluence with Piney Creek	2.27	592	1,280	1,730	1,730	3,250
TRIBUTARY NO 155						
Approximately 1000 Feet Upstream of Confluence with Tributary No 154	0.76	279	637	872	872	1,710
TUCKERS BRANCH						
Above confluence with Piney Branch II	2.78	*	*	2,451	*	*
WEST BRANCH PATAPSCO RIVER						
At Carrollton Road	17.57	3,420	7,360	9,900	10,200	18,800
Approximately 800 Feet Upstream of Cranberry Road	9.53	2,620	5,440	7,190	7,500	13,100
At Sullivan Road	2.76	910	2,090	2,870	3,230	5,750
*Data not available						

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding were carried out to provide estimates of the elevations of floods for 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 in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

A Digital Elevation Model (DEM), which is a 3-D model of the ground surface, was provided by the Carroll County Department of Planning. Cross sections for the hydraulic analyses were obtained from this DEM. For detailed study streams, below-water portions of the cross sections were either obtained from the previous FEMA hydraulic models, which in most cases were originally obtained by field survey, or estimated from the thalweg on the profile sheet in the effective FIS. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

The previous FEMA hydraulic models contained surveyed structural geometry and measurements for bridges and culverts. In an effort to identify any bridges/culverts that had been modified or added since the previous studies had been conducted, MDE provided the USACE with a database of bridge/culvert measurements and photographs. This database was supplemented by additional field investigation conducted by the USACE. Information from the database/field investigation was compared to the data from the previous hydraulic models. If no difference existed, the surveyed elevations and measurements from the previous model were used. If a difference existed or the bridge/culvert was not included in the previous model, the measurement information from the database/field investigation was used, and structural elevations were based off the DEM.

Additional channel, bridge/culvert, and other hydraulic model input data was obtained from effective LOMRs and from development related plans and studies provided by the Carroll County Department of Planning.

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USACE's HEC-RAS (Version 4.0) step-backwater computer program (Reference 8).

Starting water-surface elevations were calculated using the slope-area method for most detailed study streams. Where the detailed study began at an existing structure with known backwater effects, the headwater elevation for each frequency flood was acquired from the effective FIS and used as the starting water surface elevation in the hydraulic analysis.

Channel and overbank roughness factors (Manning's "n" values) used in the original hydraulic computations were chosen by engineering judgment and were based on field inspection, aerial photography, or stream photographs. The range of values used for Manning's "n" used in this study is shown in Table 8, "Manning's "n" Values."

TABLE 8 – MANNING'S "n" VALUES

STREAM	CHANNEL "n"	OVERBANK "n"
Bear Branch	0.04	0.04 - 0.1
Beaver Run	0.035	0.04 – 0.1
Buckhorn Run	0.04	0.08 – 0.1
Copps Branch	0.035-0.1	0.04 – 0.1
Copps Branch Tributary	0.05	0.1
Cranberry Branch	0.04-0.045	0.05-0.1
Double Pipe Creek	0.035	0.05 – 0.1
East Branch Patapsco River	0.045	0.065 – 0.1
Georges Run	0.038	0.06 – 0.08
Little Morgan Run	0.045	0.09 – 0.12
Little Morgan Run II	0.035 – 0.04	0.07 – 0.1
Little Pipe Creek	0.03 – 0.035	0.013 – 0.1
Meadow Branch	0.035 – 0.4	0.04 – 0.1
Meadow Branch Tributary No 1	0.05	0.04 – 0.1
Middle Run I	0.035	0.035 – 0.1
Middle Run II	0.04	0.06 – 0.13
Murphy Run	0.04	0.045 – 0.12
North Branch Patapsco River	0.04	0.05 – 0.1
Piney Branch	0.045	0.06 – 0.1
Piney Branch II	0.05	0.013 – 0.1
Piney Creek	0.04	0.06 – 0.11
Piney Run	0.025 – 0.05	0.06 – 0.1
Roaring Run	0.045 – 0.055	0.05 – 0.1

TABLE 8 – MANNING'S "n" VALUES (Continued)

STREAM	CHANNEL "n"	OVERBANK "n"
Roop Branch	0.028 – 0.07	0.045 – 0.1
Sams Creek	0.028 – 0.04	0.036 – 0.1
South Branch Patapsco River	0.03 – 0.1	0.013 – 0.1
Tributary No 7	0.035	0.05 – 0.1
Tributary No 9	0.045	0.06 – 0.1
Tributary No 10	0.035	0.05 – 0.1
Tributary No 11	0.035	0.06 – 0.1
Tributary No 14	0.045	0.05 – 0.1
Tributary No 15	0.035	0.05 – 0.1
Tributary No 16	0.035	0.06 – 0.1
Tributary No 18	0.035	0.05 – 0.1
Tributary No 19	0.045	0.06 – 0.1
Tributary No 21	0.045	0.1
Tributary No 22	0.04	0.065 – 0.1
Tributary No 23	0.045	0.1
Tributary No 24	0.045	0.06 – 0.1
Tributary No 25	0.045	0.06 – 0.1
Tributary No 32	0.045	0.07 – 0.1
Tributary No 33	0.035	0.05 – 0.1
Tributary No 35	0.035	0.06 – 0.1
Tributary No 36	0.045	0.05 – 0.1
Tributary No 38	0.05	0.07 – 0.1
Tributary No 39	0.03	0.06 – 0.8
Tributary No 58	0.035	0.05 – 0.1
Tributary No 59	0.045	0.06 – 0.1
Tributary No 60	0.05	0.06 – 0.1
Tributary No 61	0.05	0.06 – 0.1

TABLE 8 – MANNING'S "n" VALUES (Continued)

STREAM	CHANNEL "n"	OVERBANK "n"
Tributary No 65	0.04	0.06 – 0.1
Tributary No 66	0.045	0.07 – 0.1
Tributary No 67	0.035	0.06 – 0.1
Tributary No 69	0.04	0.045 – 0.1
Tributary No 70	0.04	0.045 – 0.1
Tributary No 90	0.035 – 0.045	0.045 – 0.1
Tributary No 91	0.032	0.03 - 0.07
Tributary No 103	0.04	0.045 – 0.1
Tributary No 104	0.045	0.05 – 0.1
Tributary No 105	0.04 – 0.1	0.05 – 0.1
Tributary No 107	0.03	0.035 – 0.5
Tributary No 108	0.03 – 0.04	0.045 – 0.1
Tributary No 154	0.045	0.05 – 0.12
Tributary No 155	0.04	0.08 – 0.12
Tuckers Branch	0.05	0.05 – 0.1
West Branch Patapsco River	0.04	0.05 – 0.1

The hydraulic analyses in this study are based on the effects of unobstructed flow. The efficiency of hydraulic structures can be seriously reduced by debris blockage, ice jams, and siltation. The flood elevations as shown on the profiles are thus considered valid only if hydraulic structures in general remain unobstructed and in proper operating condition.

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

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

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

- Stability B: Monuments which generally hold their position/elevation (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 bench marks, the FIRM may also show vertical control monument established by a local jurisdiction; these monuments will be shown on the FIRM with the appropriate designations. Local monuments will only be placed on the FIRM if the community has requested that they be included, and if the monuments meet the aforementioned NSRS inclusion criteria.

To obtain current elevation, description and/or location information for bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site, 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 purposes of establishing local vertical control. Although these monuments are not shown on the digital 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 Vertical Datum

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

The elevations shown in the FIS report and on the FIRM for Carroll County are referenced to NAVD 88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD 29 by applying a standard conversion factor to the NAVD 88 values. The conversion factor to NGVD 29 is +0.67. The BFE's shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 feet will appear as 102 on the FIRM, and a BFE of 102.6 feet will appear on the FIRM as 103.

Therefore, users that wish to convert the elevations in this FIS to NGVD 29 should apply the stated conversion factor to elevations shown on the

Flood Profiles in this FIS Report, which are shown at a minimum to the nearest 0.1 foot.

NAVD 88 +0.67= NGVD 29

For additional information regarding conversion between NGVD 29 and NAVD 88, visit the NGS website at www.ngs.noaa.gov, or contact the NGS at the following address:

NGS Information Services
NOAA, N/NGS 12
National Geodetic Survey, SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

Internet Address: http://www.ngs.noaa.gov

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 the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at 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 report 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-percent and 0.2-percent-annual-chance floodplains; and a 1-percent-annual-chance floodway. This information is presented on the FIRM and in many components of the FIS report, including Flood Profiles, and Floodway Data tables. Users should reference the data presented in the FIS report 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 (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance (500-year) flood is employed to indicate additional areas of flood risk in the community.

The Liberty Reservoir spillway elevation of 420 feet (NGVD29), depicted on USGS quad map Finksburg, was confirmed as the known spillway elevation by the City of Baltimore Department of Public Works who maintains the dam. The datum shift from NGVD29 to NAVD88 for the reservoir area was determined to be an average of -0.21ft. Therefore the approximate floodplain boundary for Liberty Reservoir was redelineated using effective backwater elevations.

For all other flooding sources included in this report, the 1 and 0.2-percent-annual-chance floodplain boundaries shown on the FIRM were delineated utilizing a Triangulated Irregular Network (TIN). The ground elevation TIN was created from LIDAR data provided by the Carroll County Department of Planning. The 1- and 0.2-percent-annual-chance floodplain elevations calculated at cross sections (as described in Section 3.2) were converted to a water surface TIN. The water surface TIN was then intersected with the ground elevation TIN. The 1 and 0.2-percent-annual-chance floodplain are boundaries depicted at locations where the two TIN surfaces intersect.

The 1- and 0.2-percent-annual-chance floodplain boundaries are shown on the FIRM (Exhibit 2). In cases where the 1- and 0.2-percent-annual-chance floodplain boundaries are close together, only the 1-percent-annual-chance boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to the limitations of the map scale.

For the streams studied by approximate methods only the 1-percent-annual-chance floodplain boundary is shown.

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.

Floodways were not computed for any streams included in this report. Carroll County's regulatory requirements for floodplain development are more restrictive than the minimum federal standards; therefore the identification of floodways for detailed study streams is not necessary.

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 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 X (Future Base Flood)

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

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications. The current FIRM presents flooding information for the entire geographic area of Carroll County.

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

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

The current FIRM presents flooding information for the entire geographic area of Carroll County. Previously, separate Flood Hazard Boundary Maps and/or FIRMS were prepared for each incorporated community with identified flood hazard areas and the unincorporated areas of the county. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 9, "Community Map History."

7.0 OTHER STUDIES

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

This study was completed in coordination with the effective or in-progress studies in the adjacent communities of Frederick County, MD (and Incorporated Areas), Montgomery County, MD (and Incorporated Areas), Howard County, MD (and Incorporated Areas), Baltimore County, MD (and Incorporated Areas), York County, PA (All Jurisdictions), and Adams County, PA (All Jurisdictions).

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting Federal Insurance and Mitigation Division, Federal Emergency Management Agency, One Independence Mall, Sixth Floor, 615 Chestnut St., Philadelphia 19106-4404.

COMMUNITY NAME	INITIAL NFIP MAP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Carroll County (Unincorporated Areas)	April 4, 1975	None	August 1, 1978	August 7, 1981
Hampstead, Town of	January 21, 1977	None	January 7, 1983	
New Windsor, Town of	November 22, 1974	None	February 16, 1979	
Sykesville, Town of	November 9, 1973	January 16, 1976	September 30, 1977	October 10, 1980
Union Bridge, Town of	November 16, 1973	None	August 1, 1977	
Westminster, City of	June 25, 1973	June 28, 1974	December 1, 1977	October 10, 1980

TABLE 9	FEDERAL EMERGENCY MANAGEMENT AGENCY CARROLL COUNTY, MD AND INCORPORATED AREAS	COMMUNITY MAP HISTORY

9.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, Carroll County, Maryland (Unincorporated Areas), Washington, D.C., February 7, 1978.

2. Federal Emergency Management Agency, Flood Insurance Study, Town of Sykesville, Carroll County, Maryland, Washington, D.C., September 30, 1977.

3. Federal Emergency Management Agency, Flood Insurance Study, Town of Union Bridge, Carroll County, Maryland, Washington, D.C., February 1, 1977.

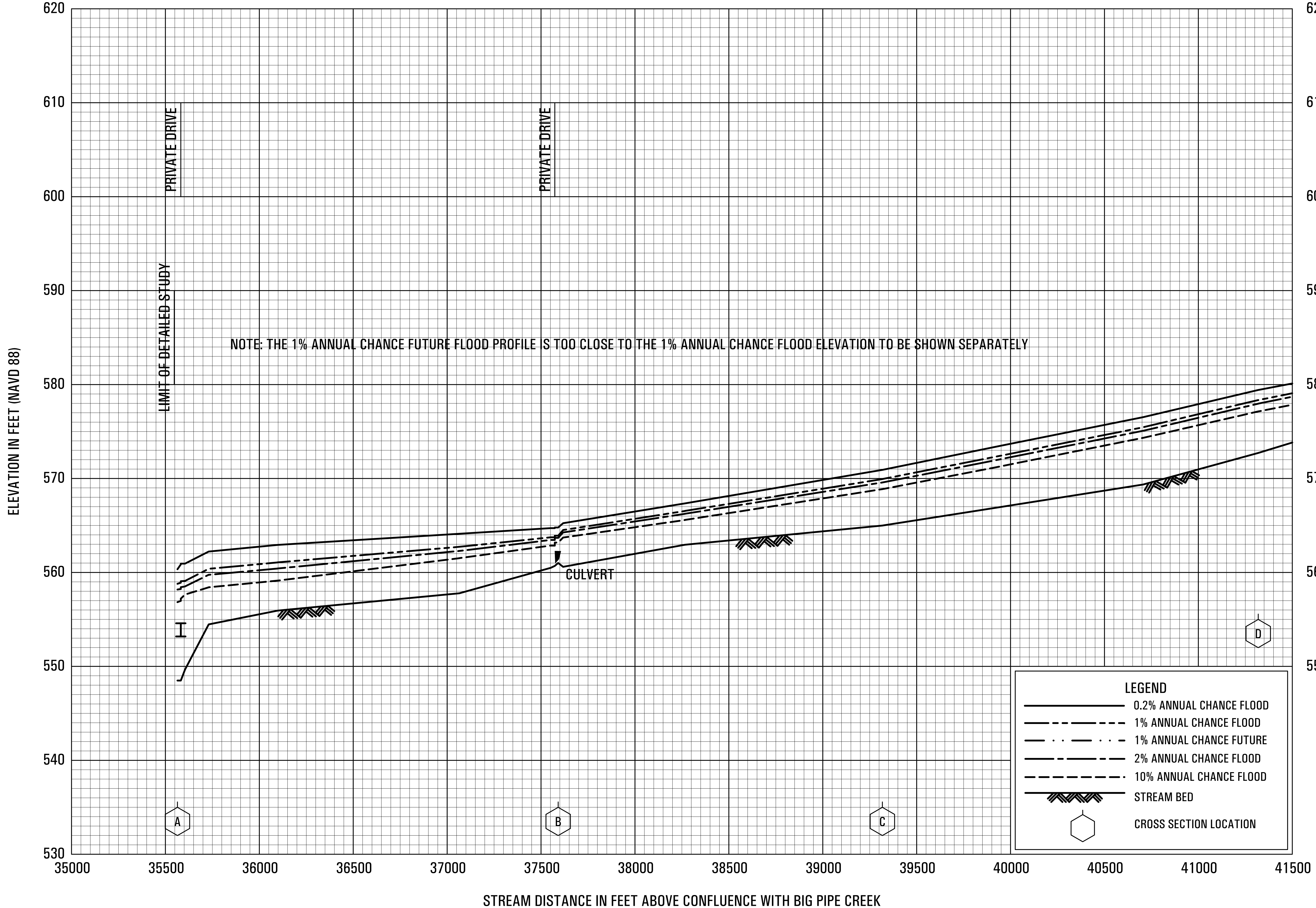
4. Federal Emergency Management Agency, Flood Insurance Study, City of Westminster, Carroll County, Maryland, Washington, D.C., December 1, 1977.

5. U.S. Department of Commerce, U.S. Census Bureau, Carroll County Quickfacts, http://quickfacts.census.gov/qfd/states/24/24013.html

6. University of Maryland, Department of Civil and Environmental Engineering, Procedure Used to Calculate Peak Flow Hydrology in Maryland, Glen E. Moglen, November 27, 2006.

7. Dillow, J.J.A., 1996. Technique for estimating magnitude and frequency of peak flows in Maryland: U.S. Geological Survey Water-Resources Investigations Report, 95-4154, 55p.

8. U.S. Army Corps of Engineers, Hydraulic Engineering Center, HEC-RAS River Analysis System, Version 4.0, Davis, California, March 2008.



FLOOD PROFILES

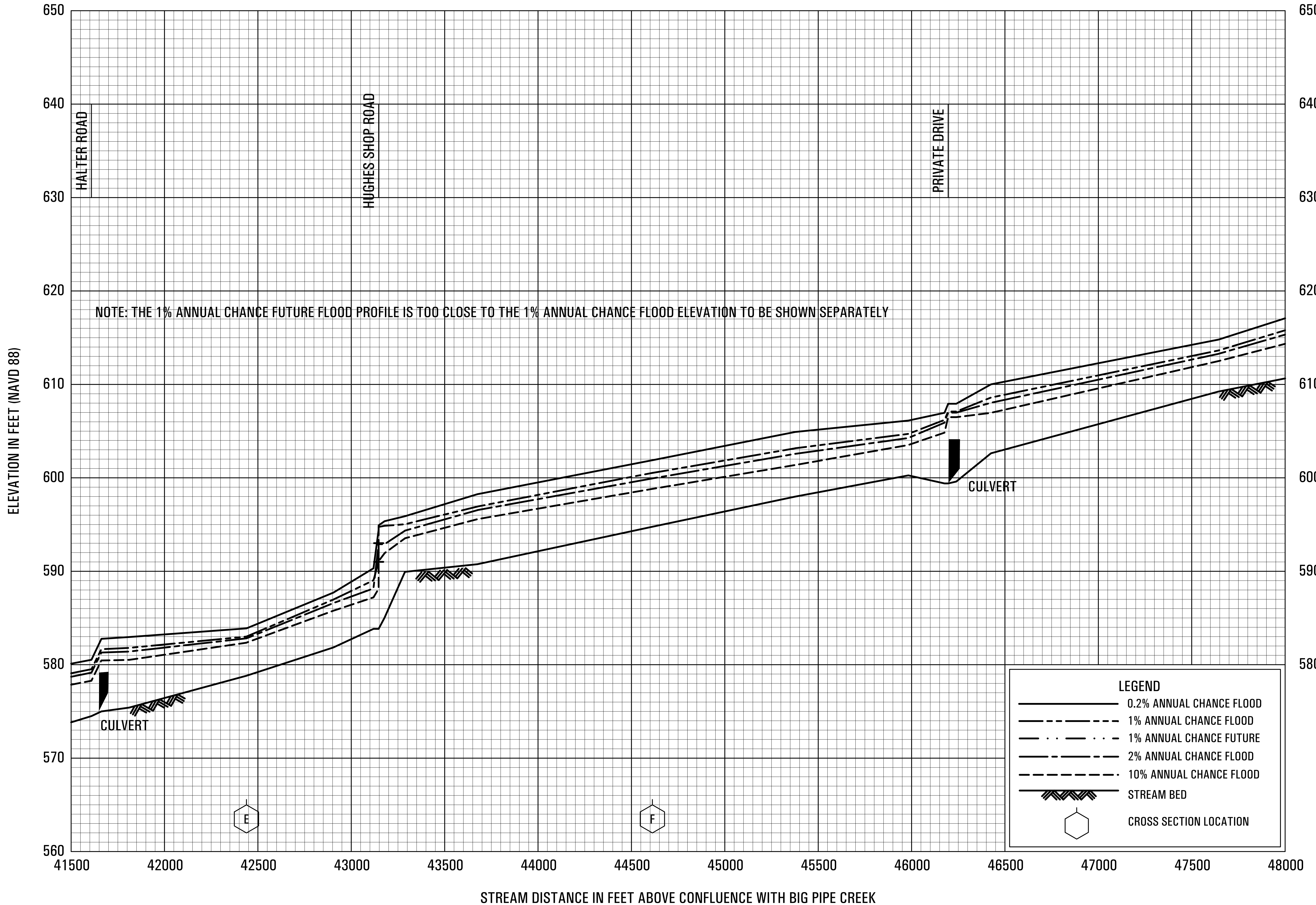
BEAR BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

01P



FLOOD PROFILES

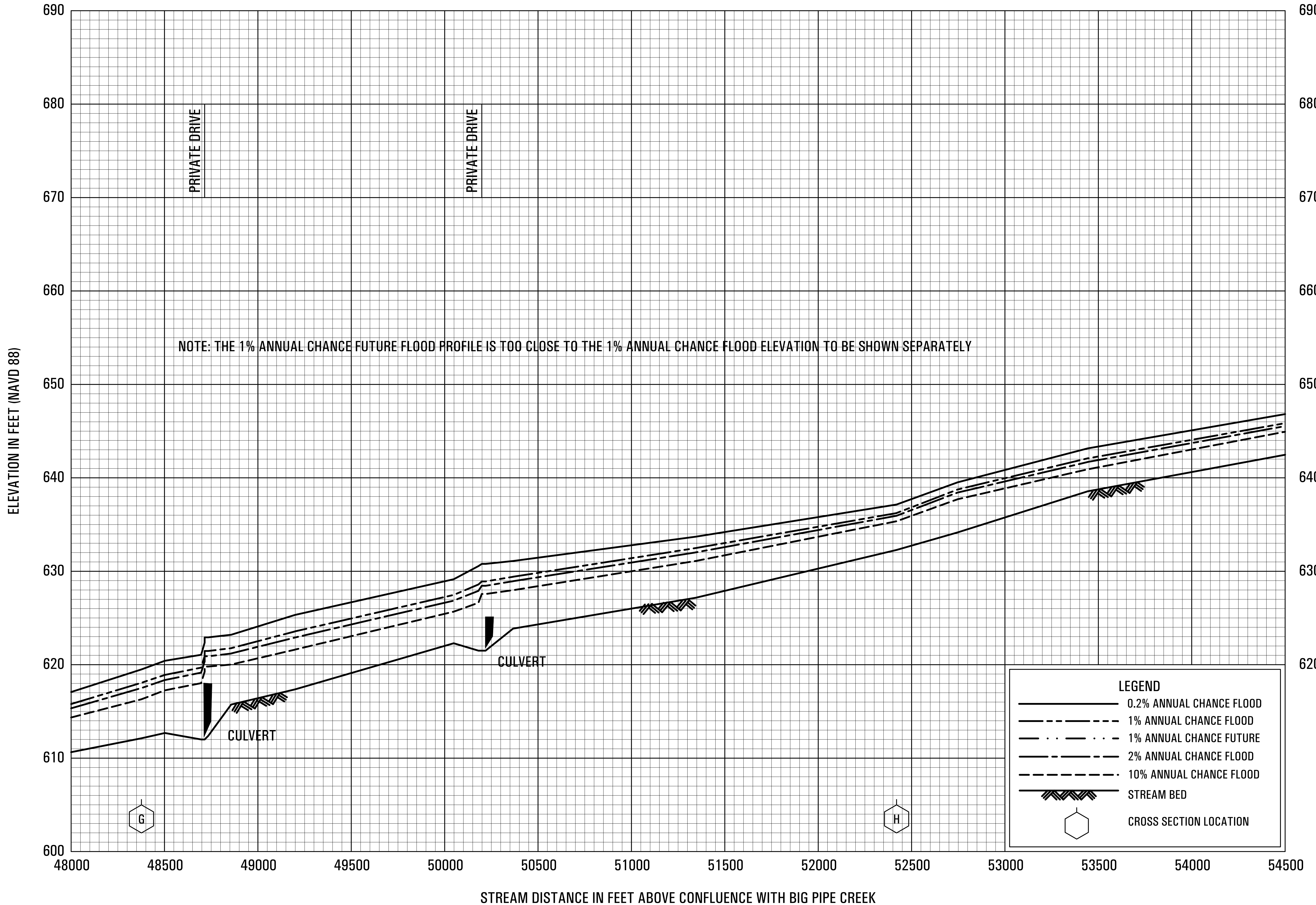
BEAR BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

02P



FLOOD PROFILES

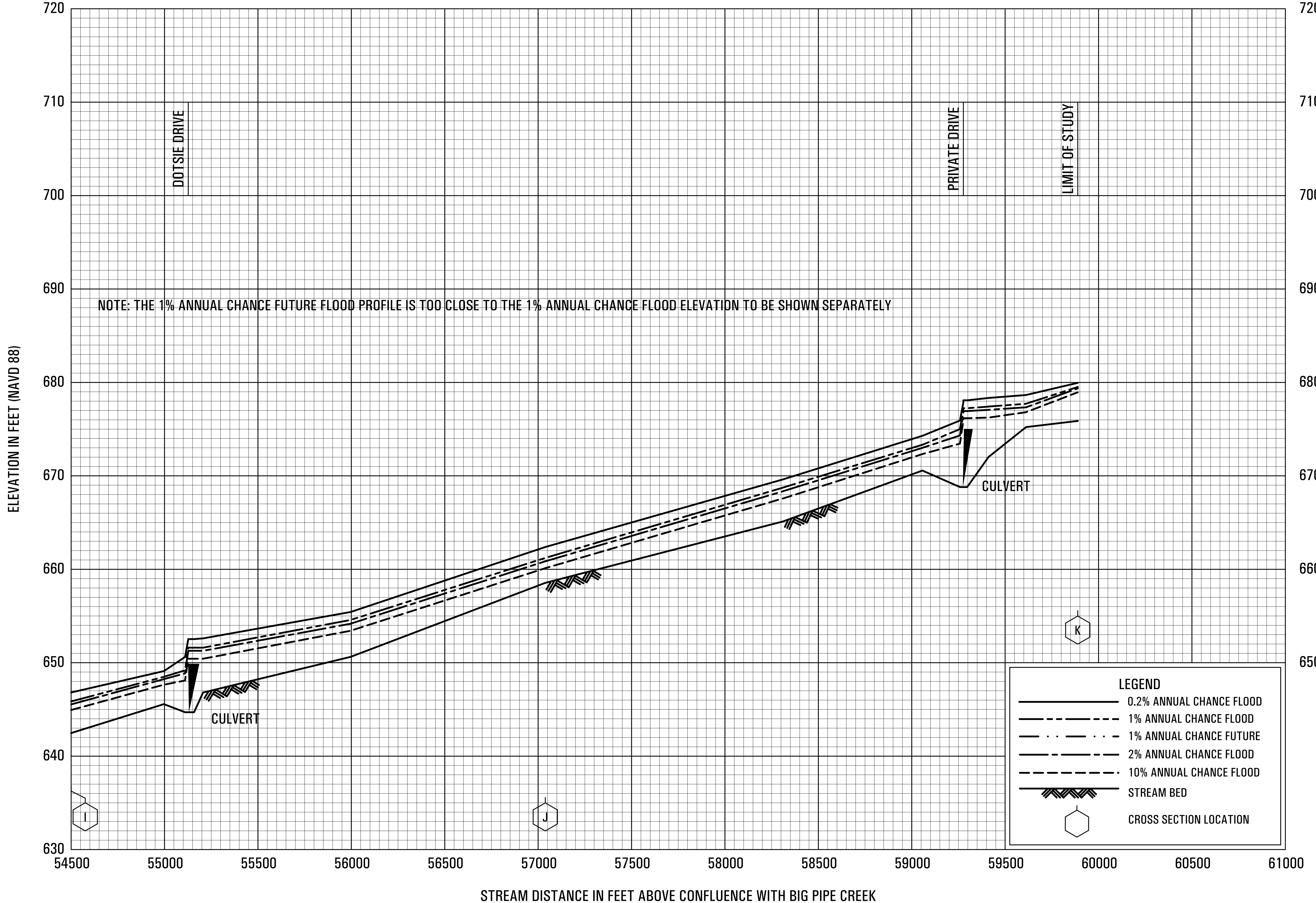
BEAR BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

03P



FLOOD PROFILES

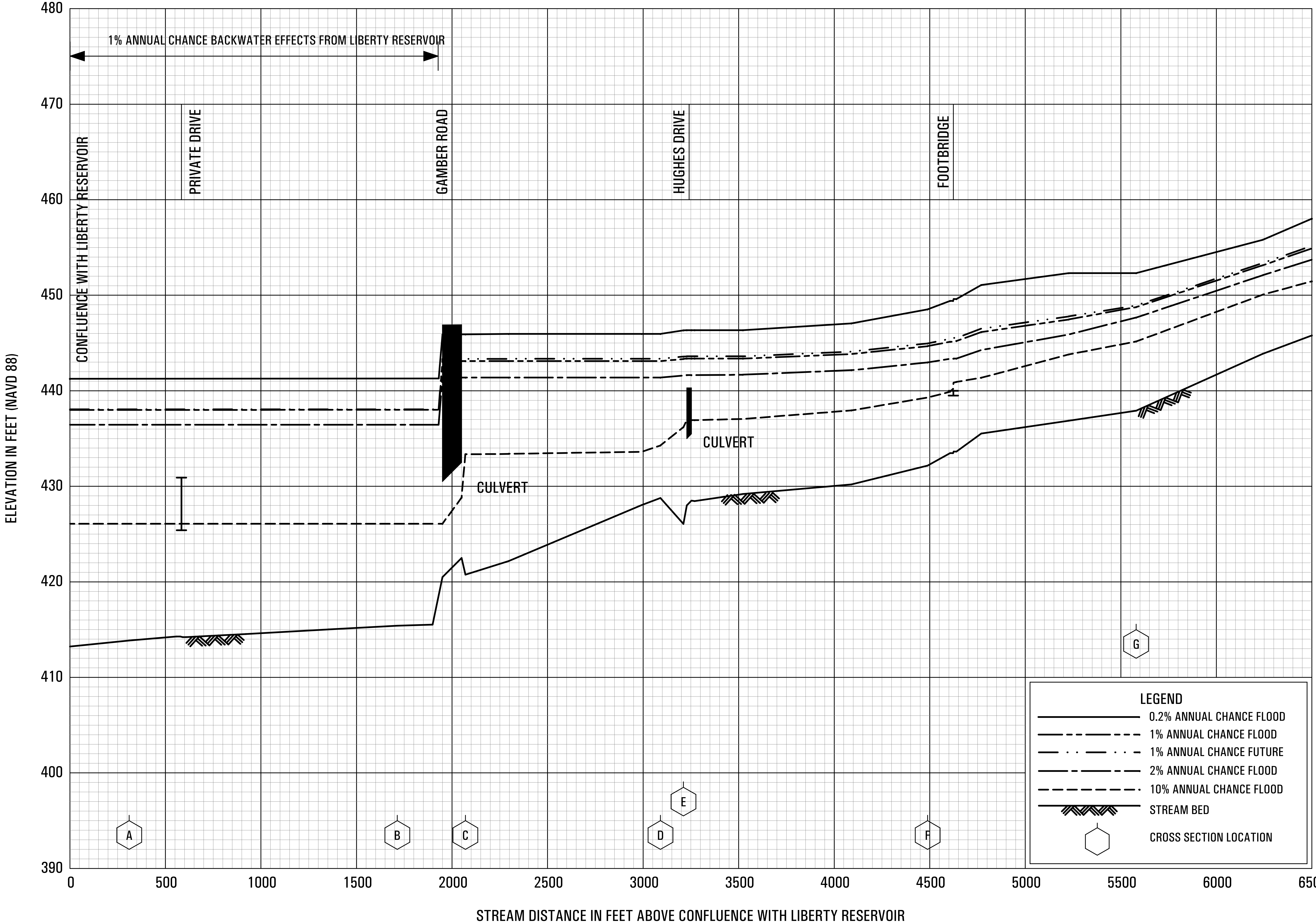
BEAR BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

04P

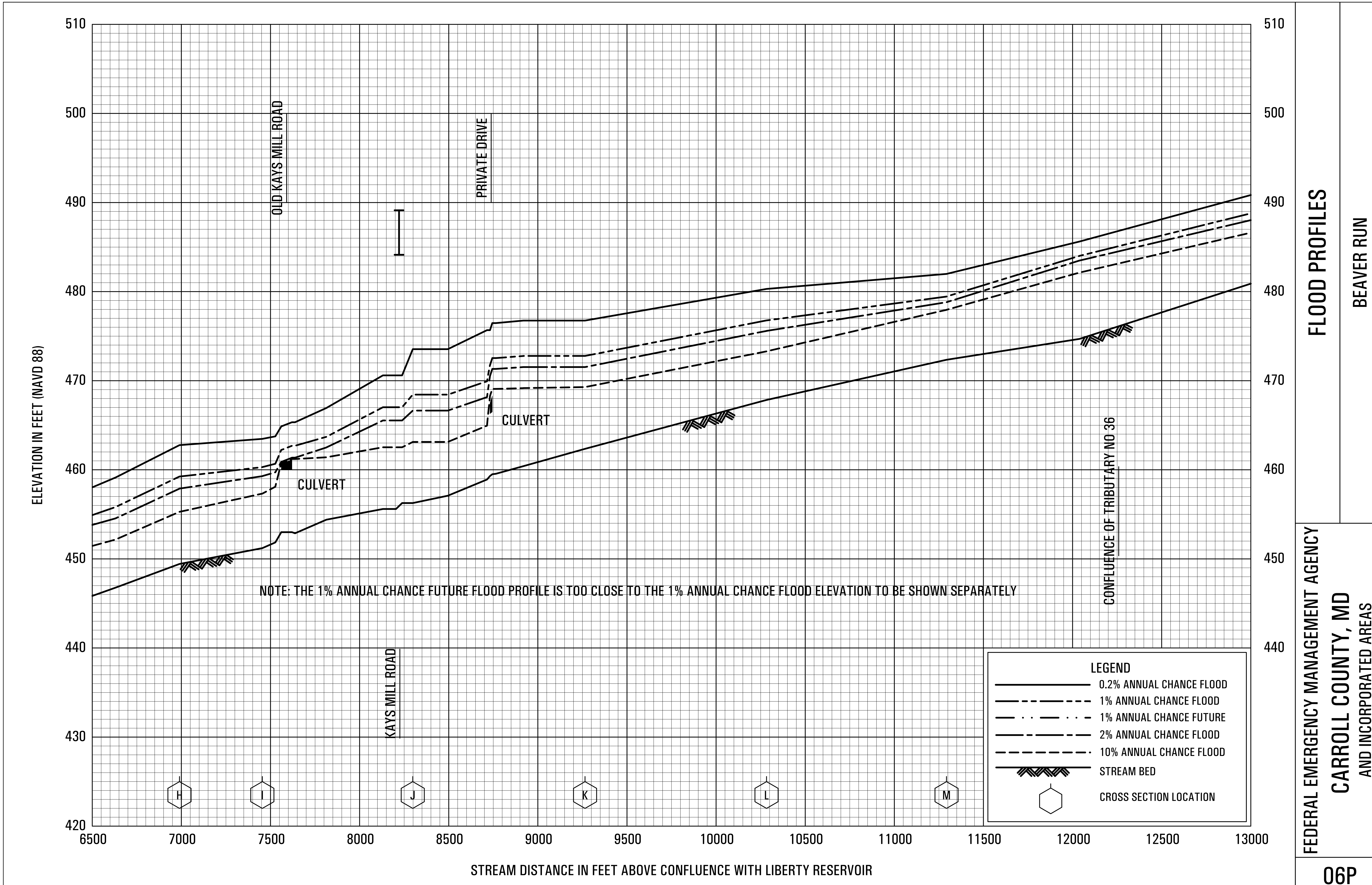


FLOOD PROFILES

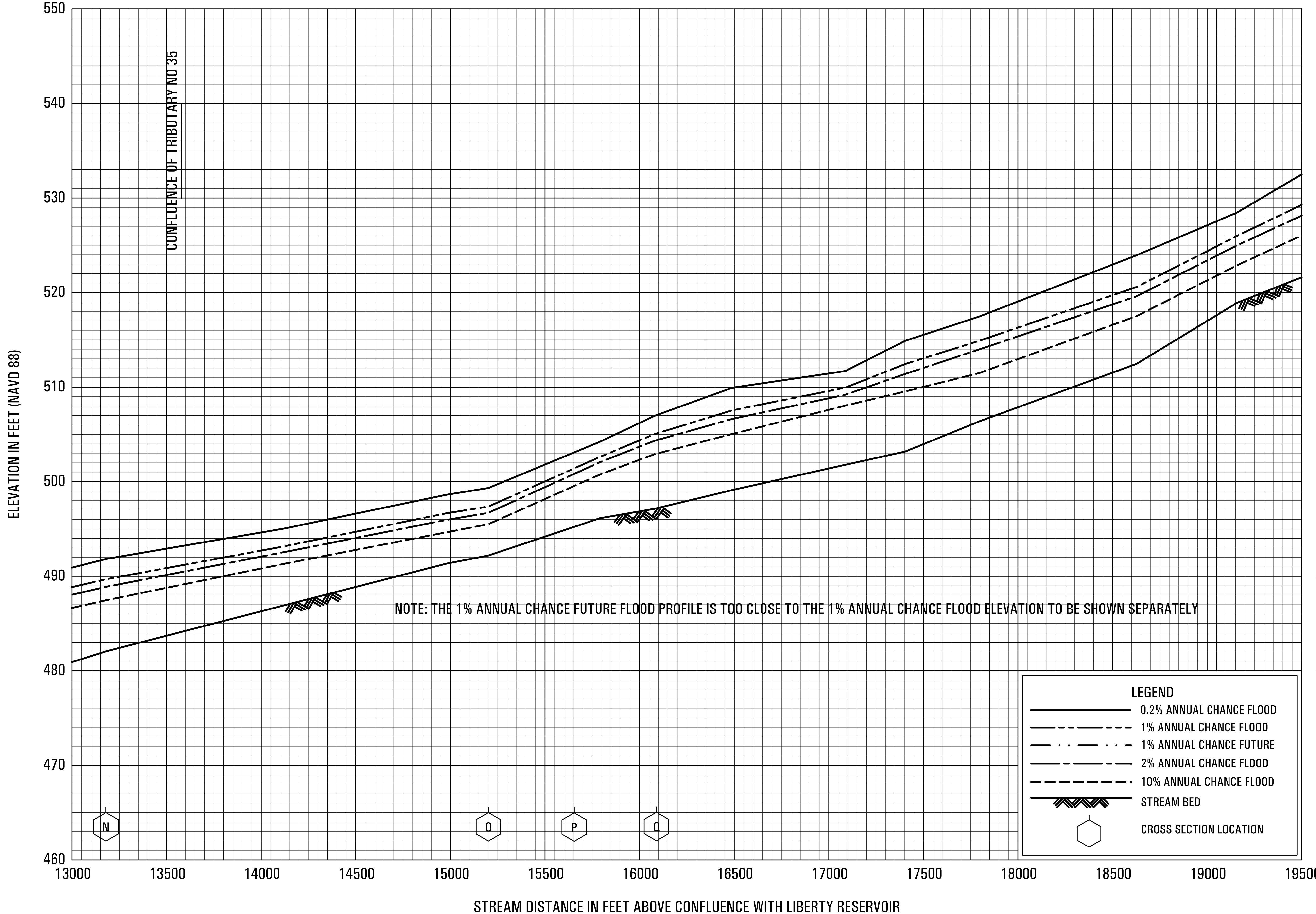
BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD
AND INCORPORATED AREAS



ELEVATION IN FEET (NAVD 88)
510
500
490
480
470
460
450
440
430
420
6500
7000
7500
8000
8500
9000
9500
10000
10500
11000
11500
12000
12500
13000
OLD KAYS MILL ROAD
PRIVATE DRIVE
KAYS MILL ROAD
CULVERT
CULVERT
CONFLUENCE OF TRIBUTARY NO 36
NOTE: THE 1% ANNUAL CHANCE FUTURE FLOOD PROFILE IS TOO CLOSE TO THE 1% ANNUAL CHANCE FLOOD ELEVATION TO BE SHOWN SEPARATELY
H
I
J
K
L
M
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FUTURE
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION
STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH LIBERTY RESERVOIR
FLOOD PROFILES
BEAVER RUN
FEDERAL EMERGENCY MANAGEMENT AGENCY
CARROLL COUNTY, MD
AND INCORPORATED AREAS
06P



FLOOD PROFILES

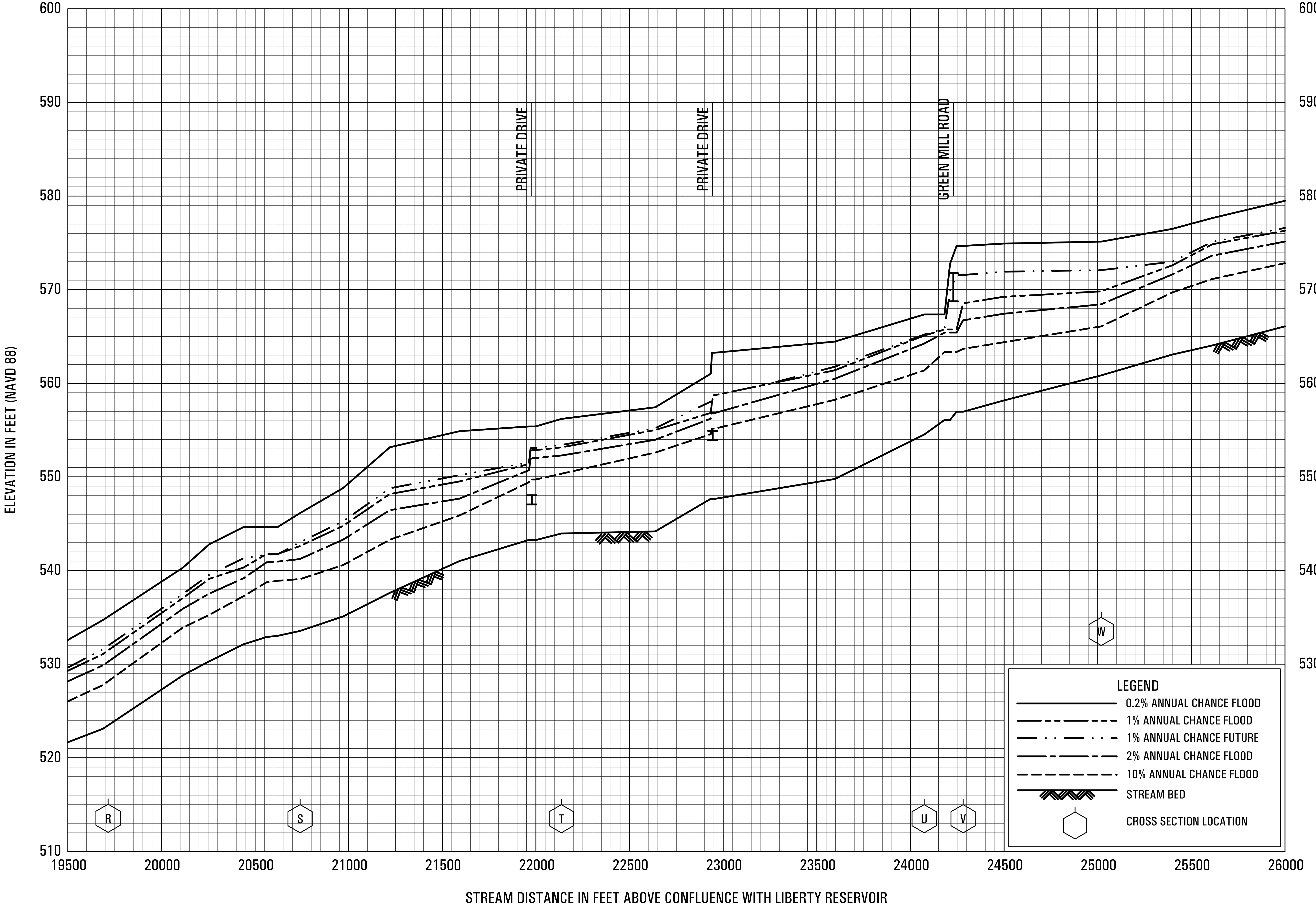
BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

07P



FLOOD PROFILES

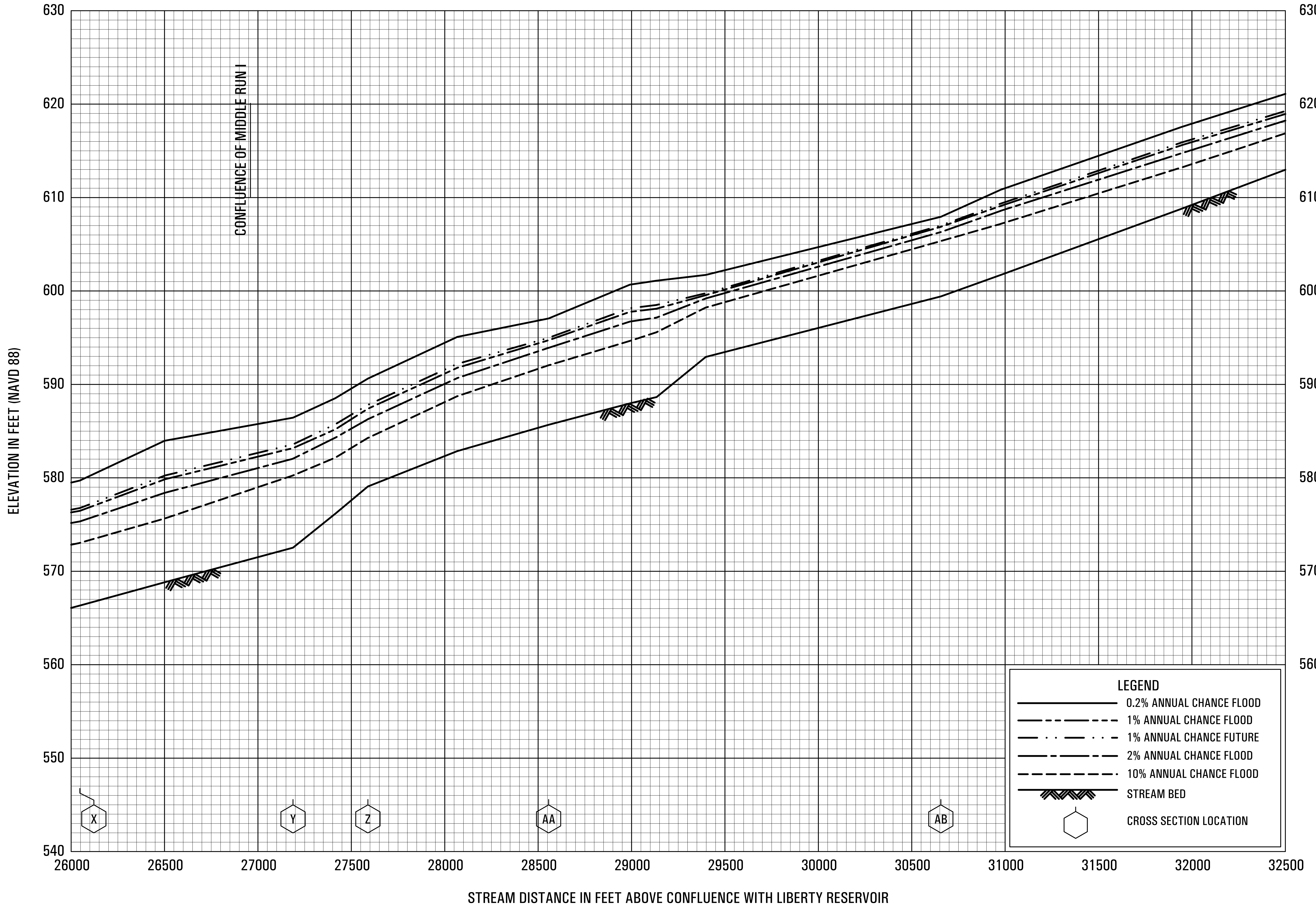
BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

08P



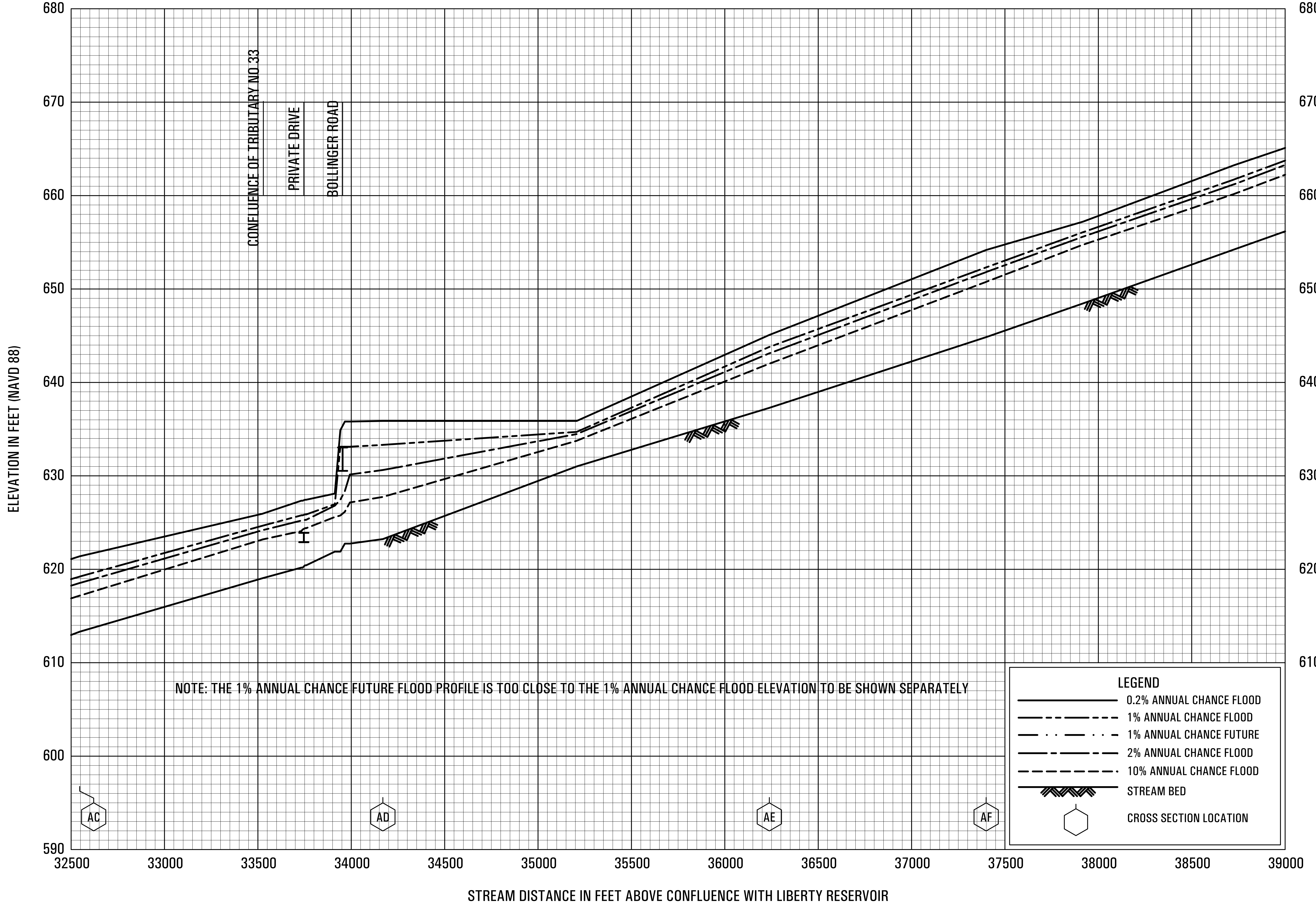
FLOOD PROFILES

BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

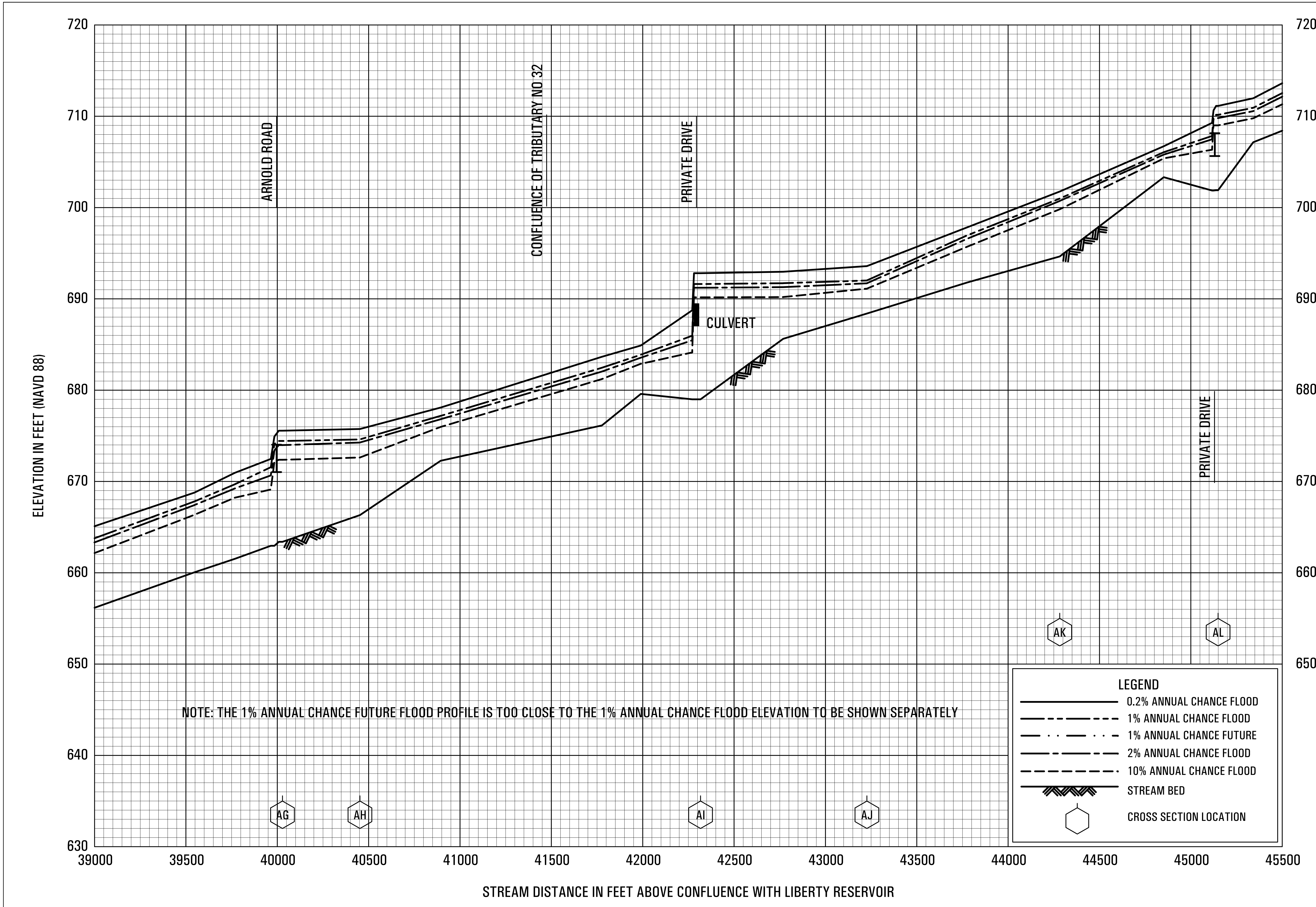
BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

10P



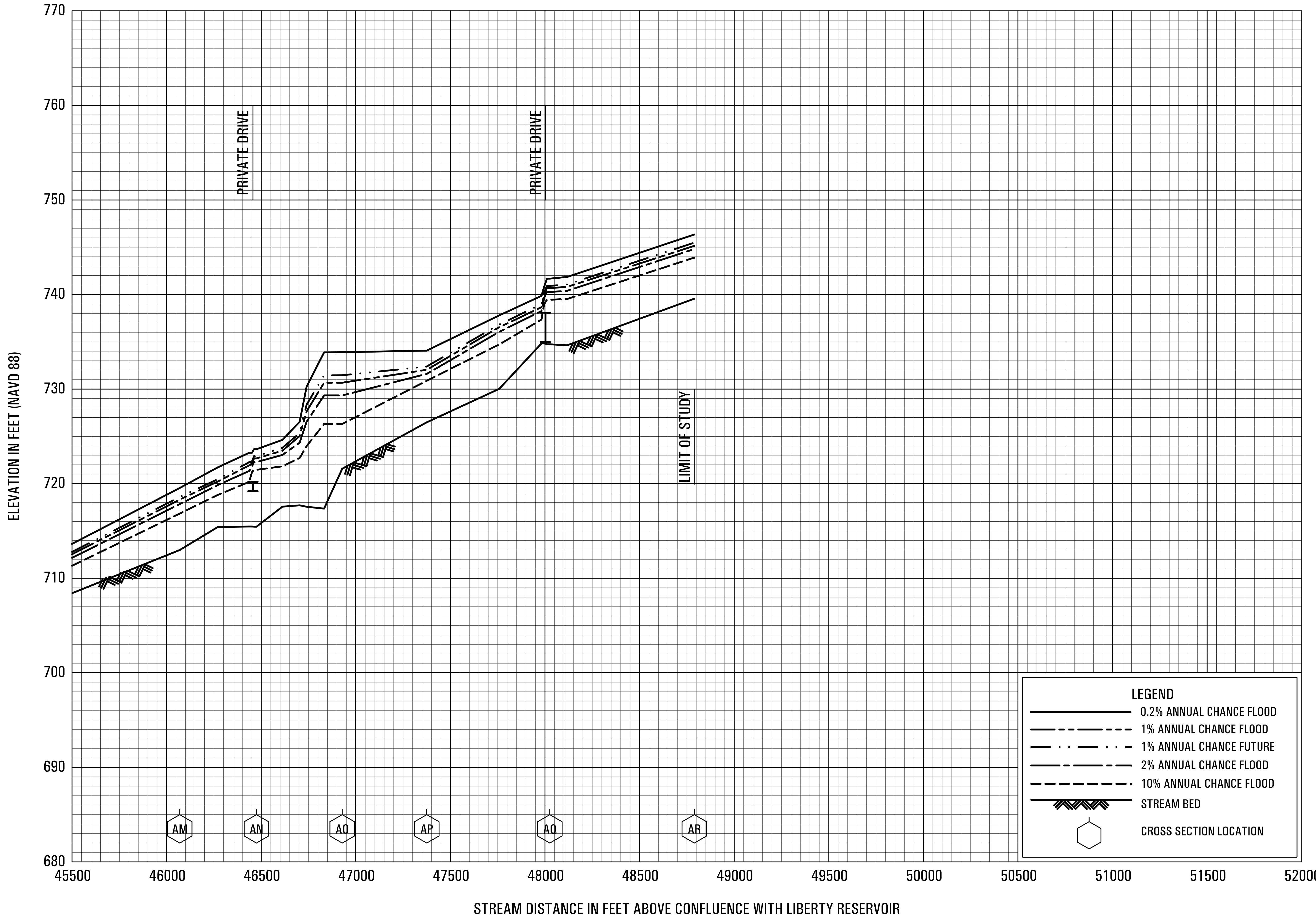
FLOOD PROFILES

BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



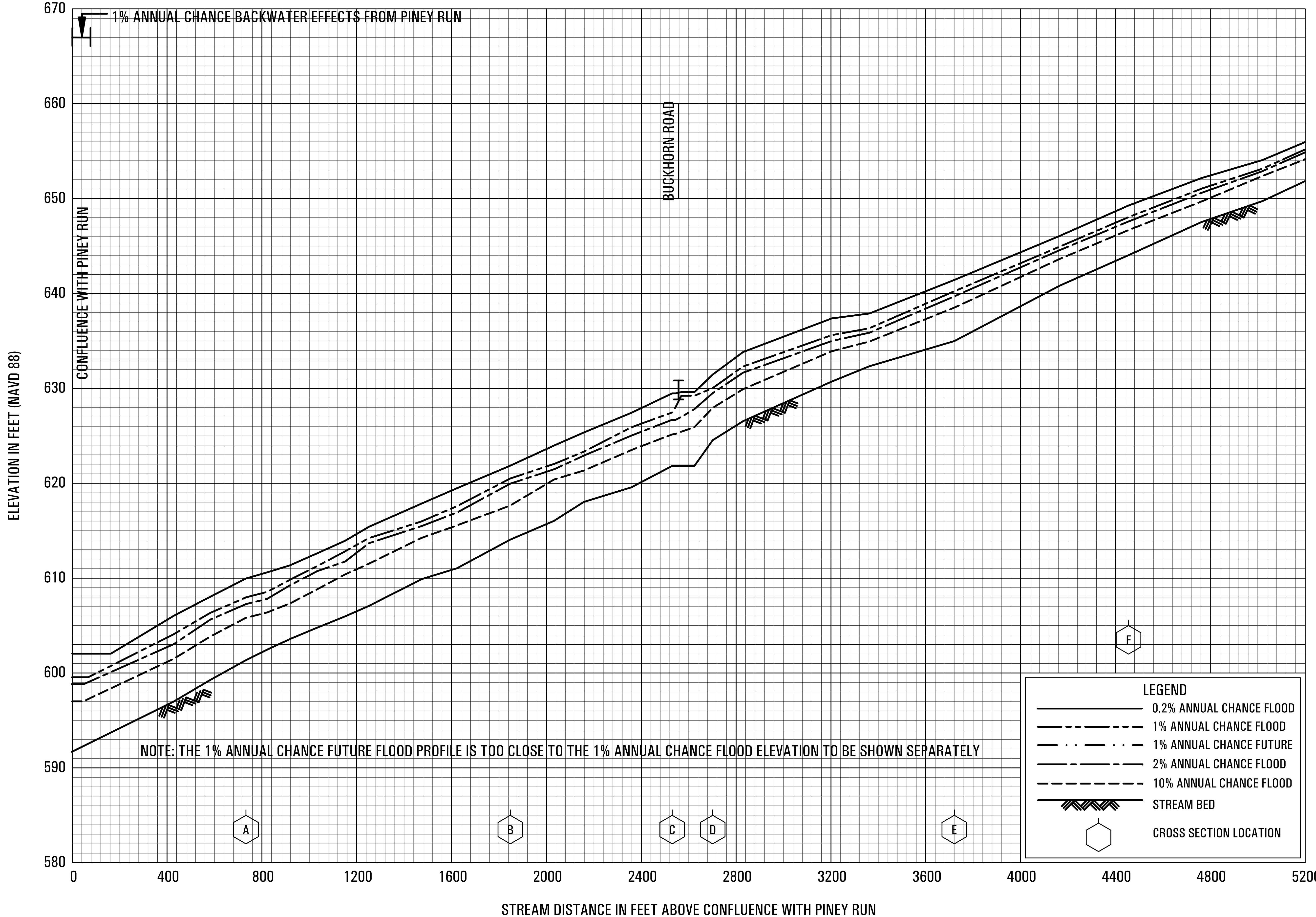
FLOOD PROFILES

BEAVER RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

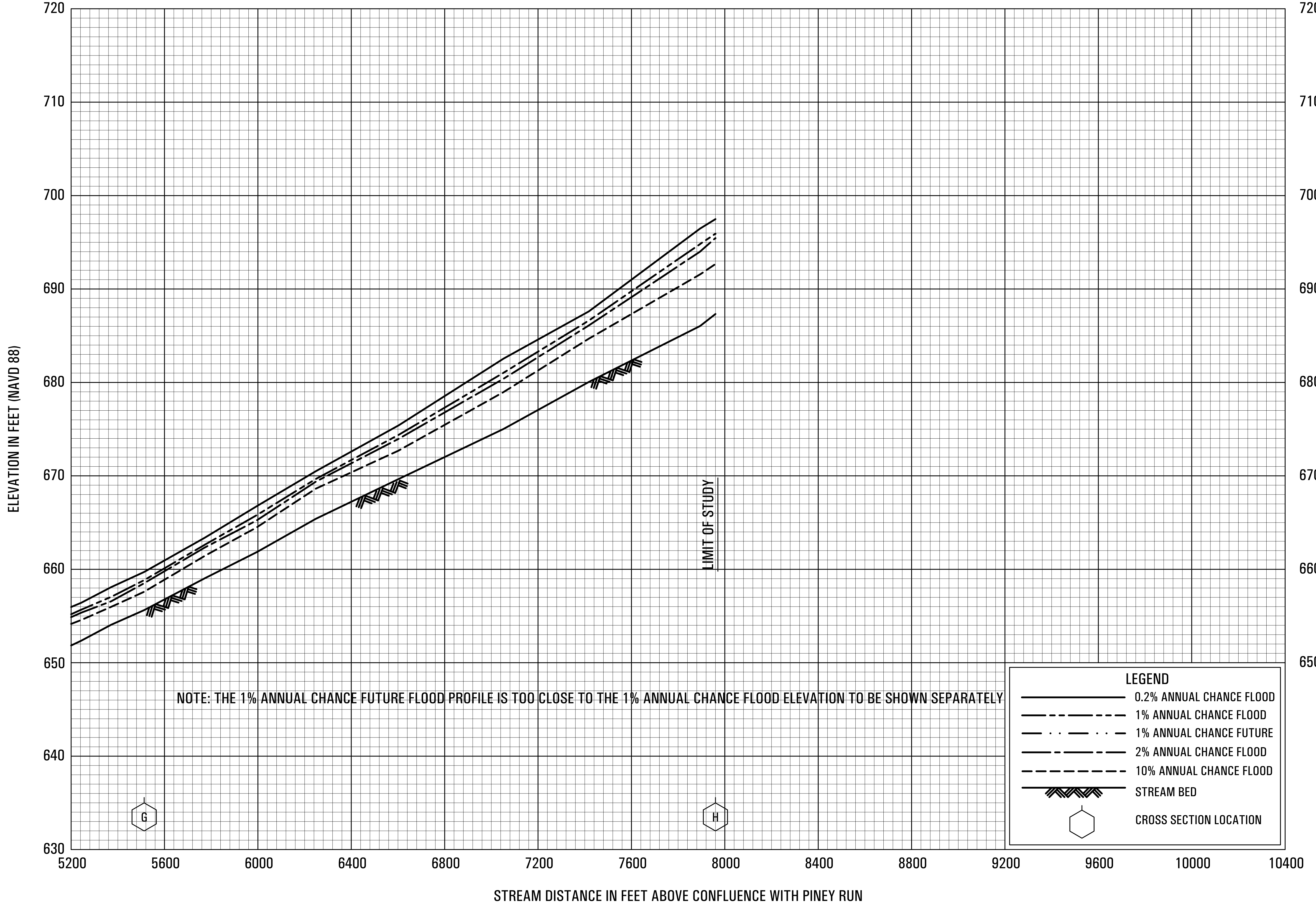
BUCKHORN RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

13P



FLOOD PROFILES

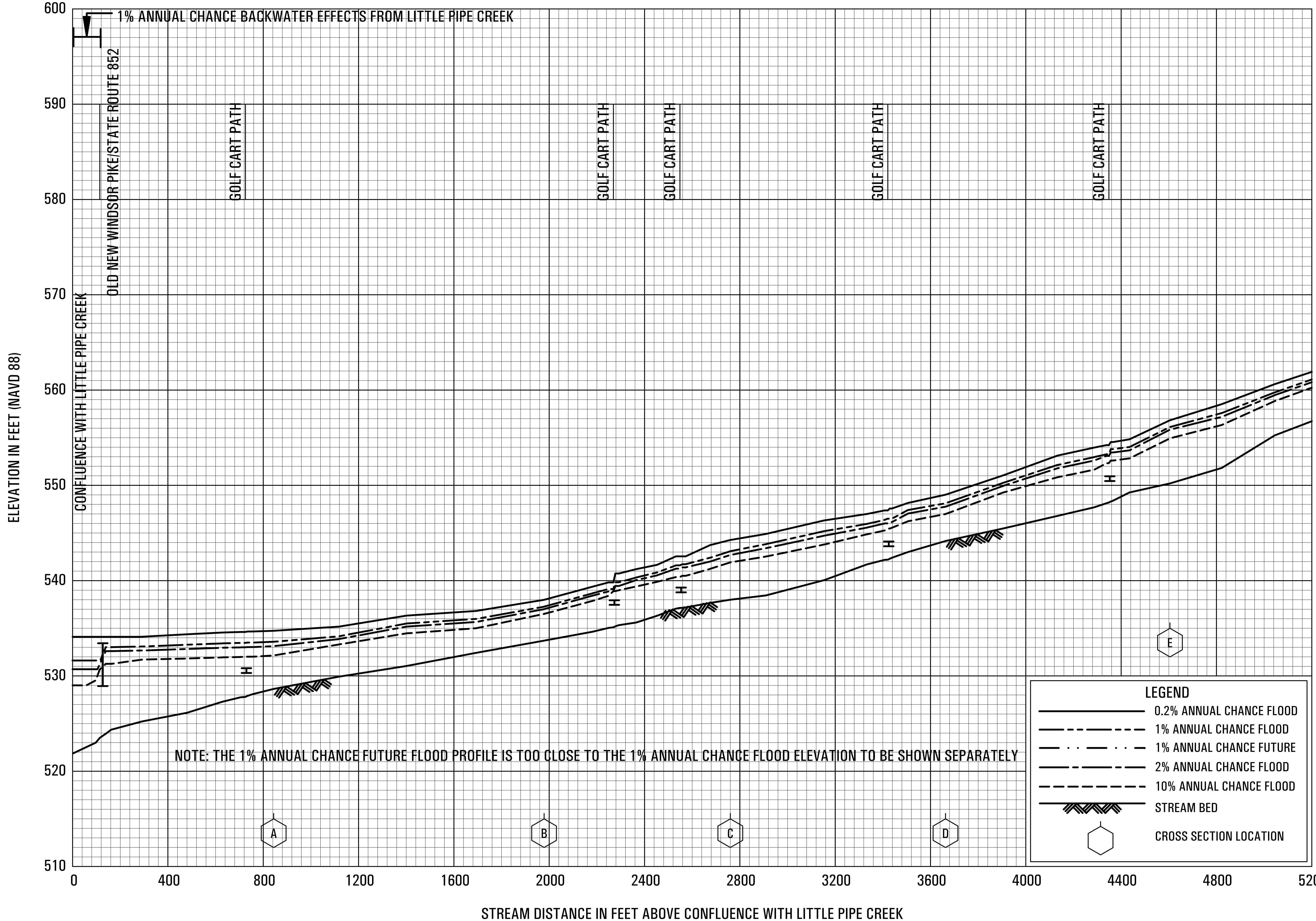
BUCKHORN RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

14P



FLOOD PROFILES

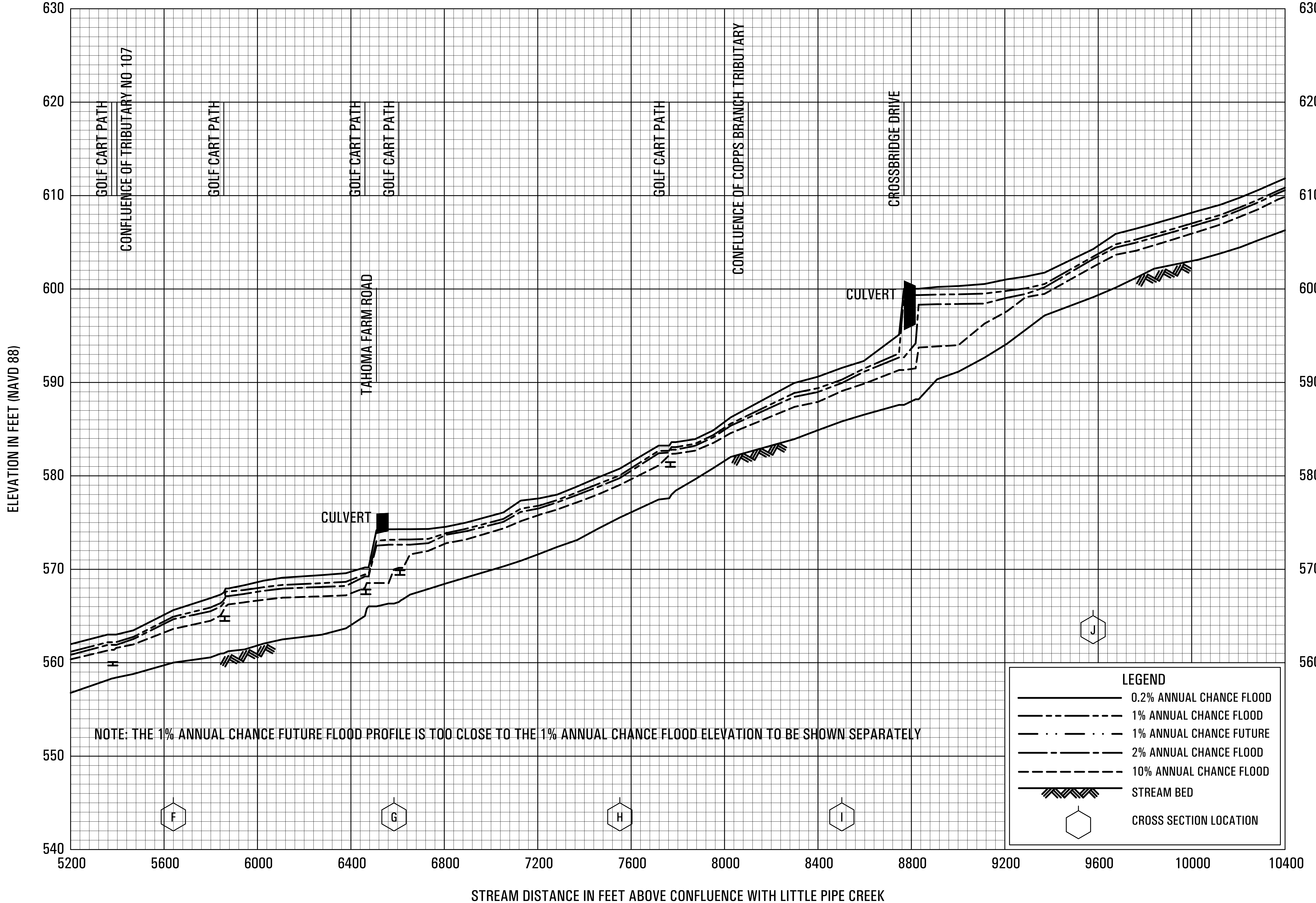
COPPS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

15P



FLOOD PROFILES

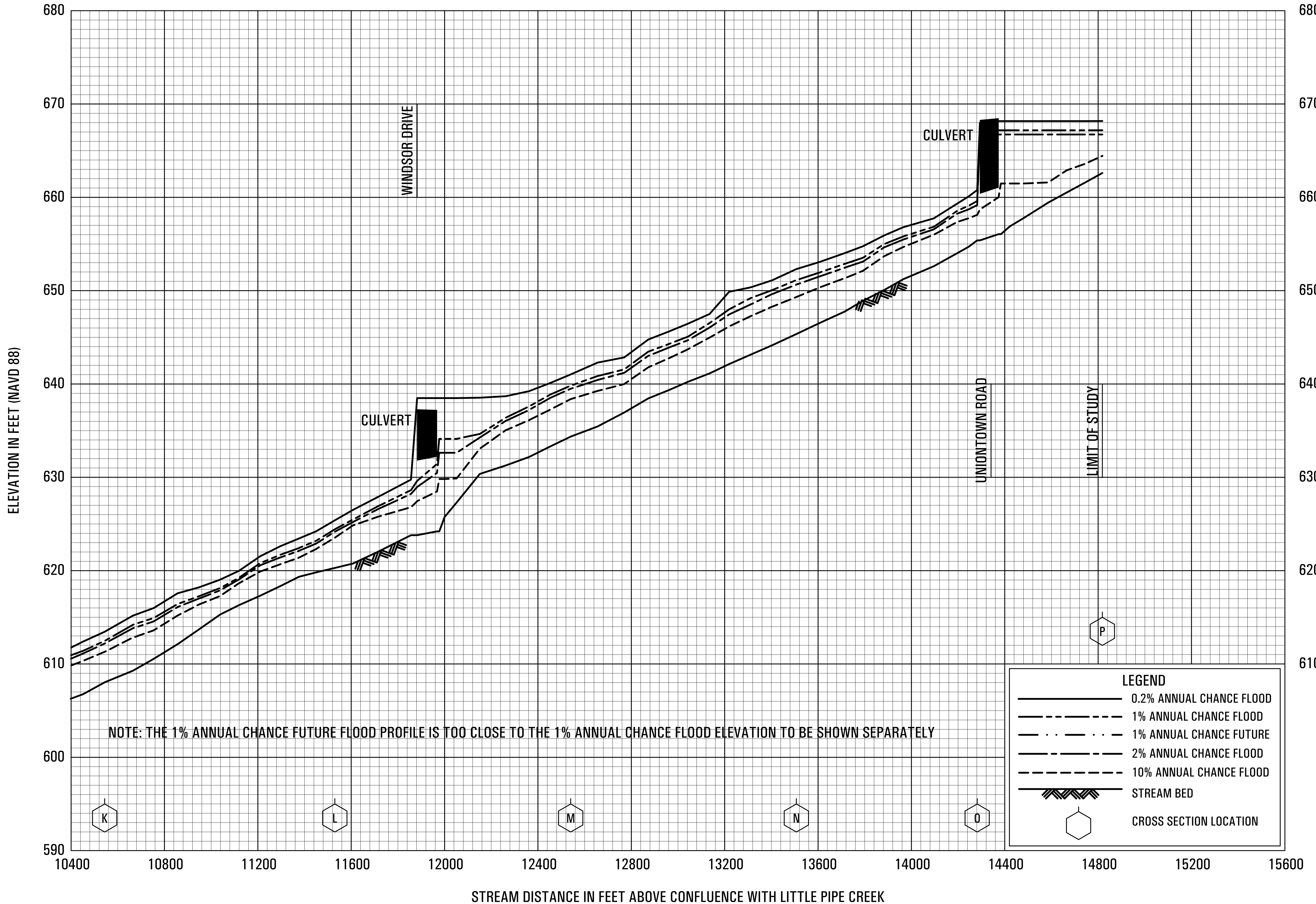
COPPS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

16P



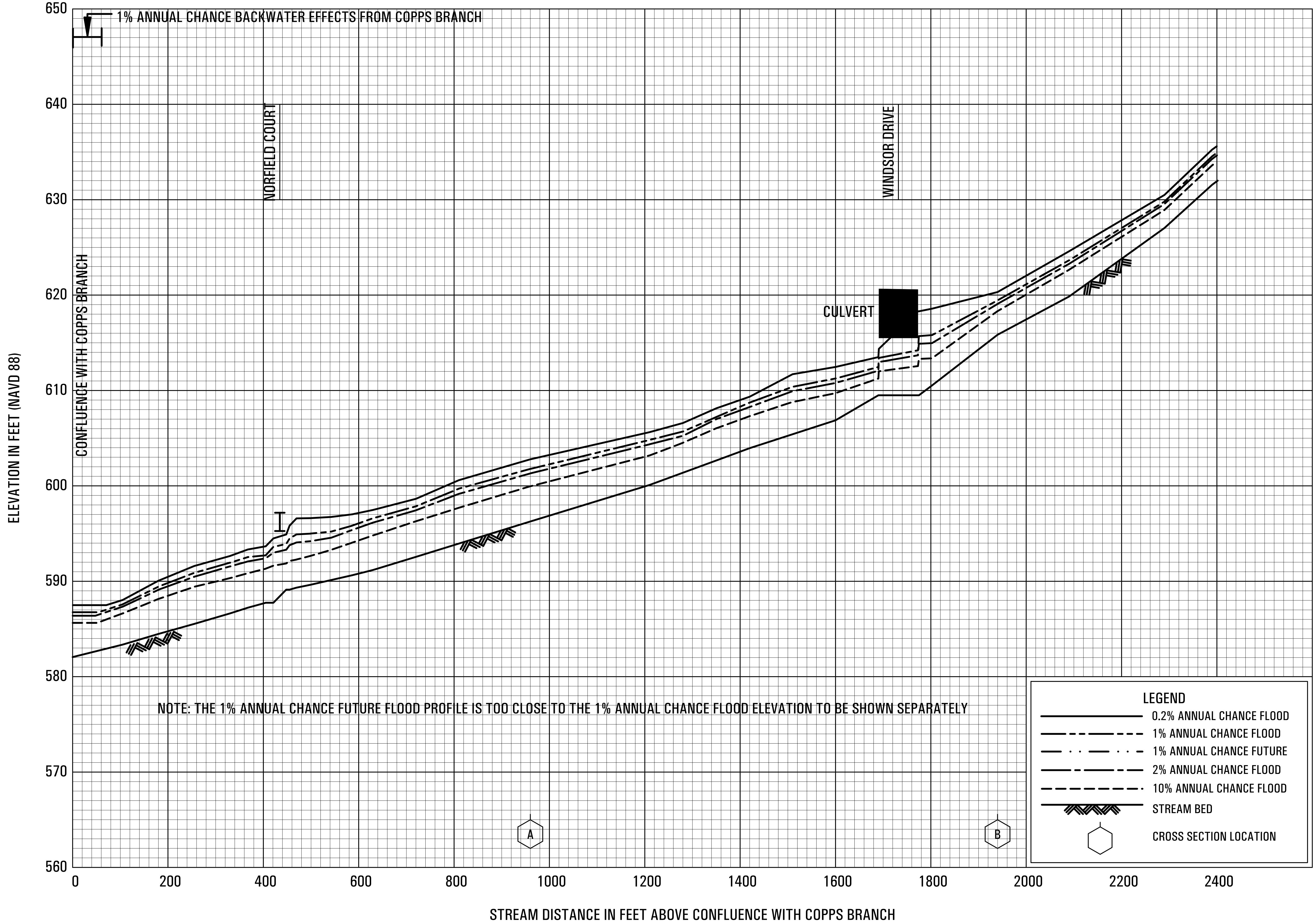
FLOOD PROFILES

COPPS BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

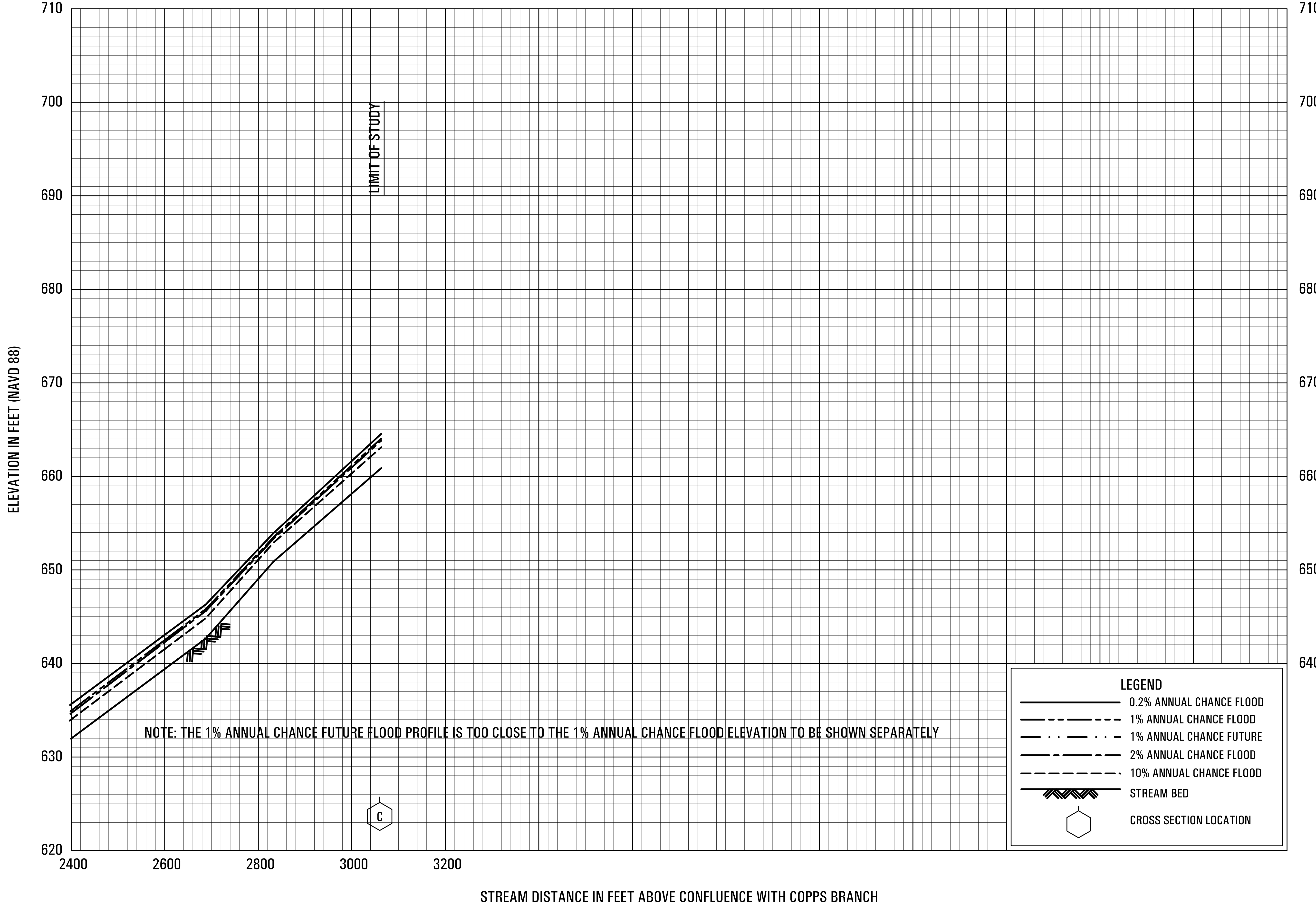
COPPS BRANCH TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

18P



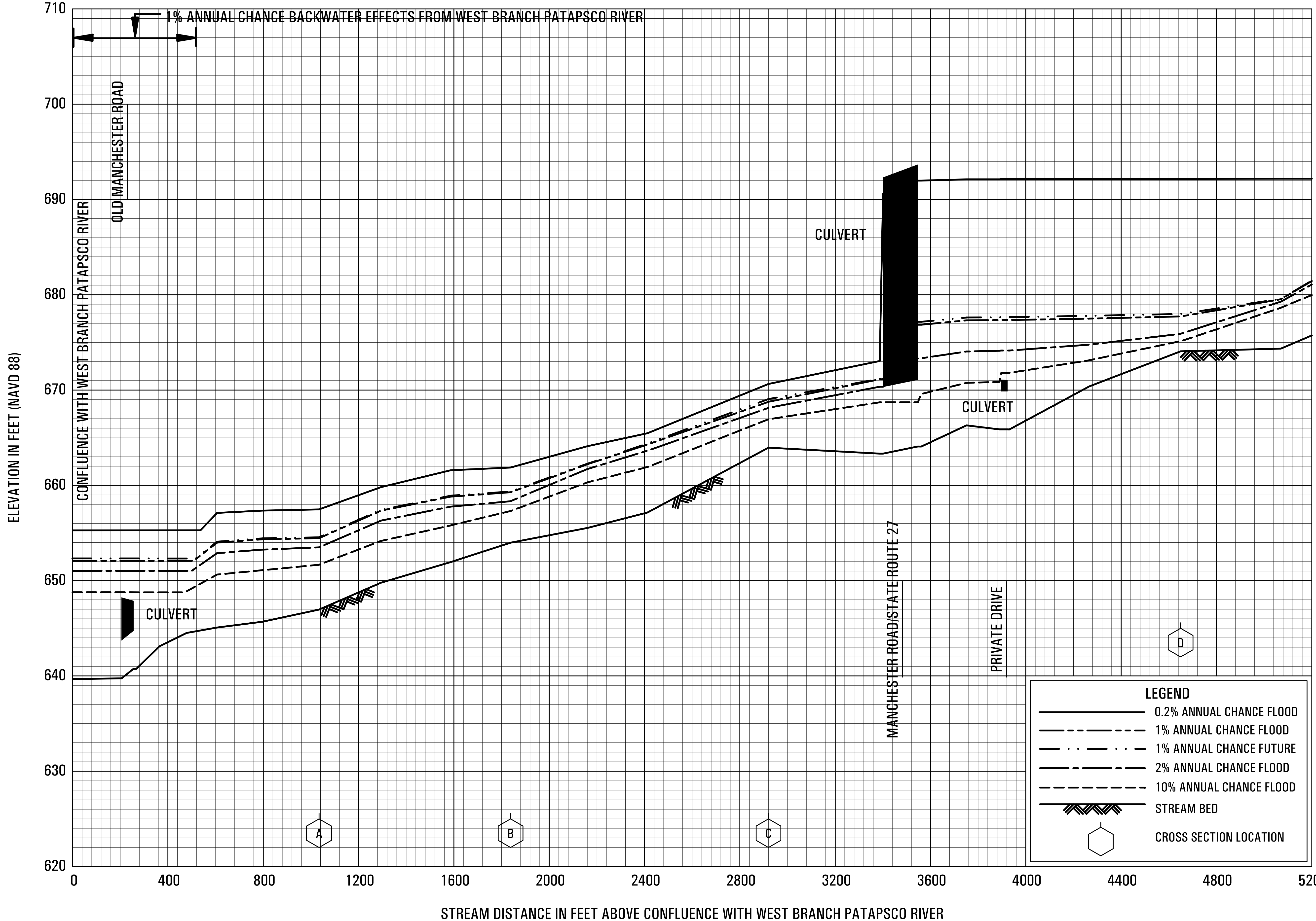
FLOOD PROFILES

COPPS BRANCH TRIBUTARY

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



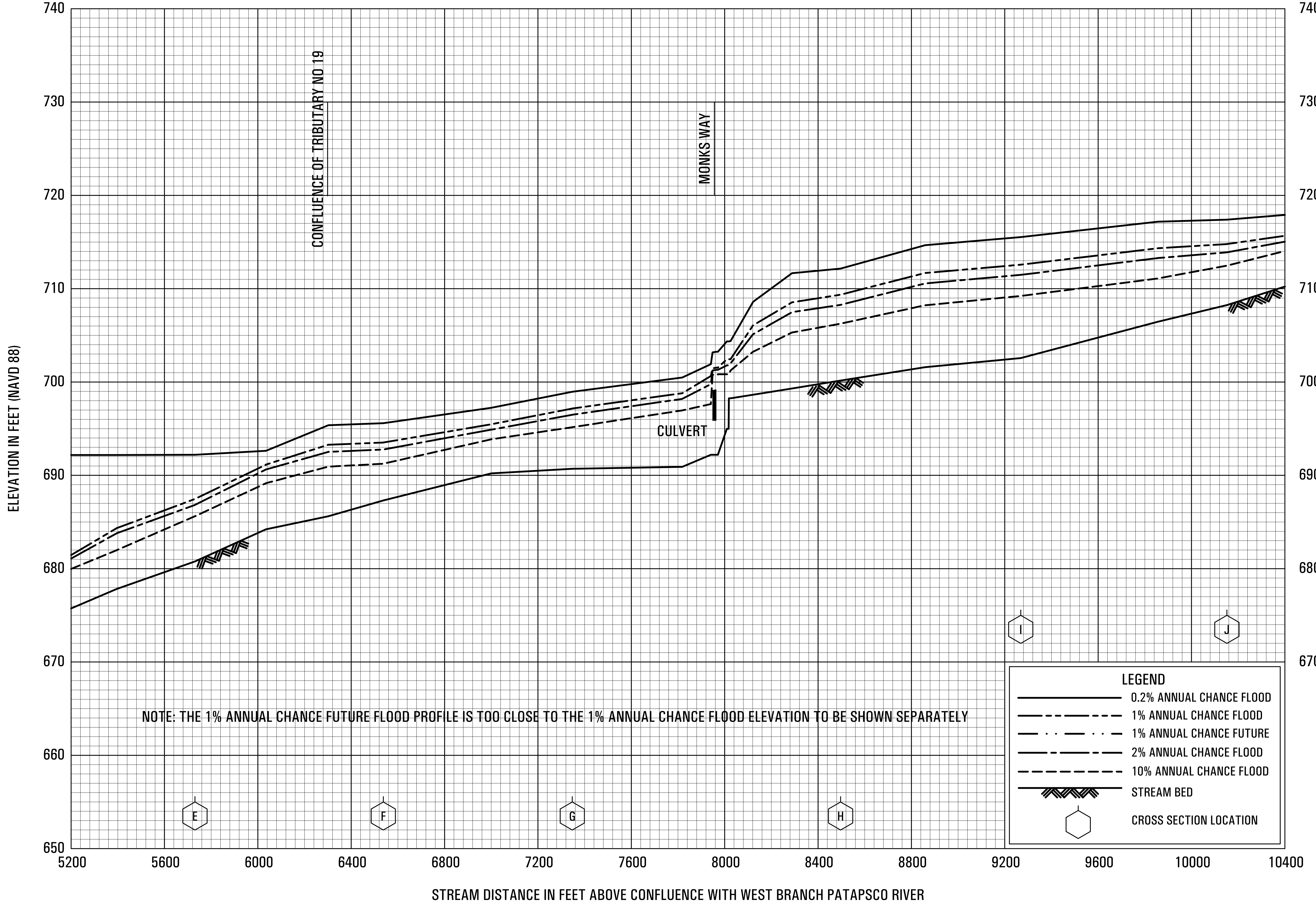
FLOOD PROFILES

CRANBERRY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



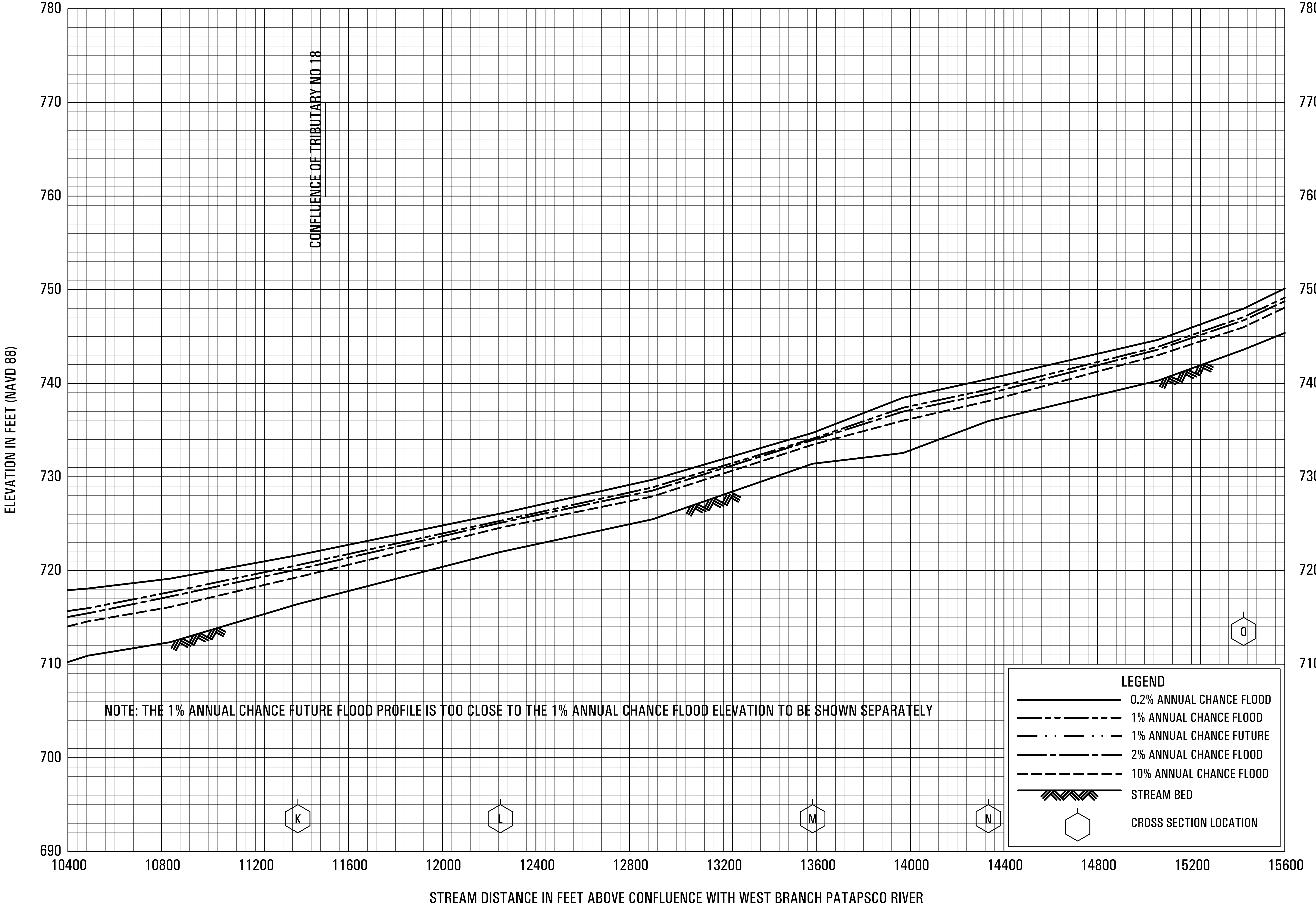
FLOOD PROFILES

CRANBERRY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



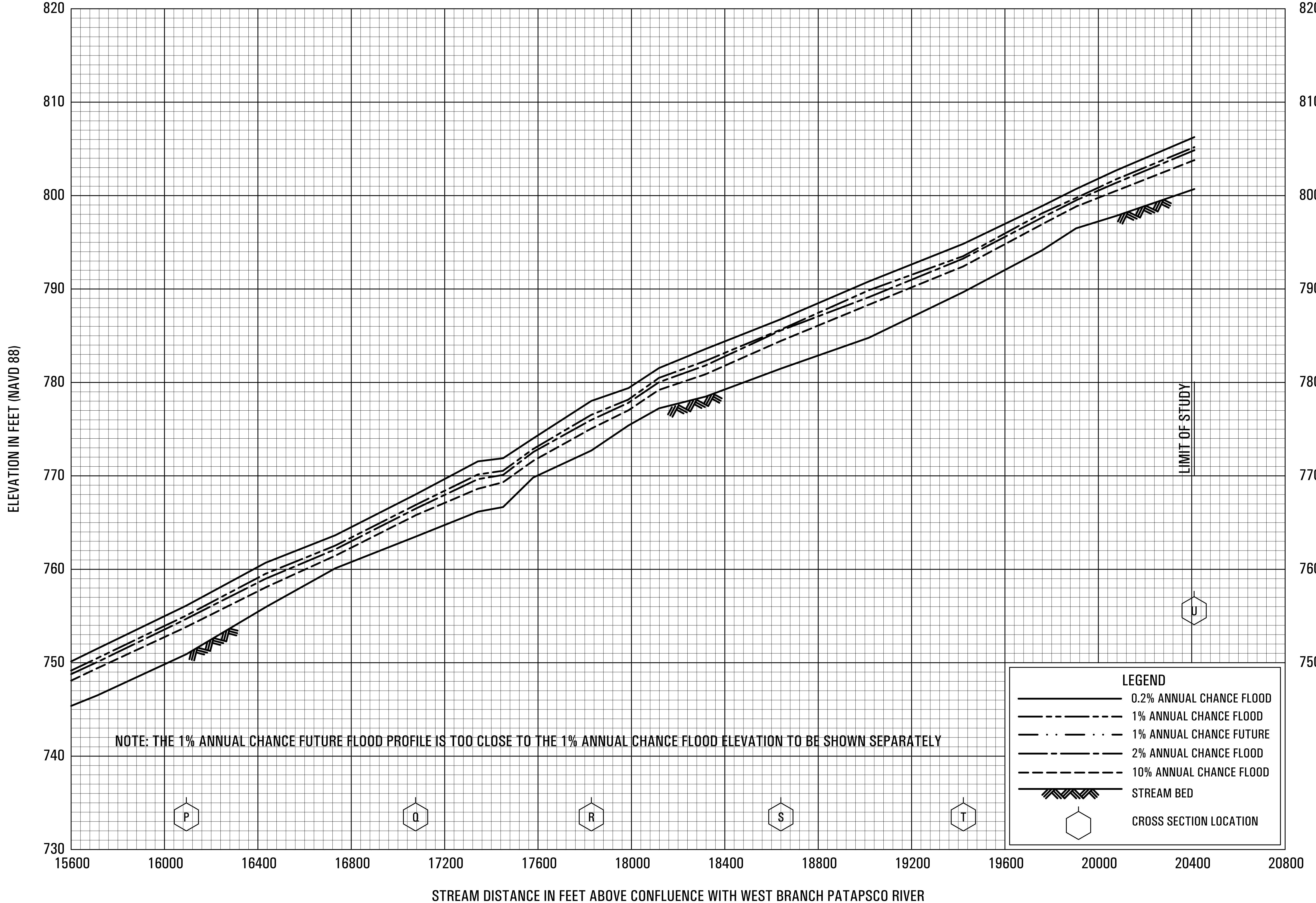
FLOOD PROFILES

CRANBERRY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



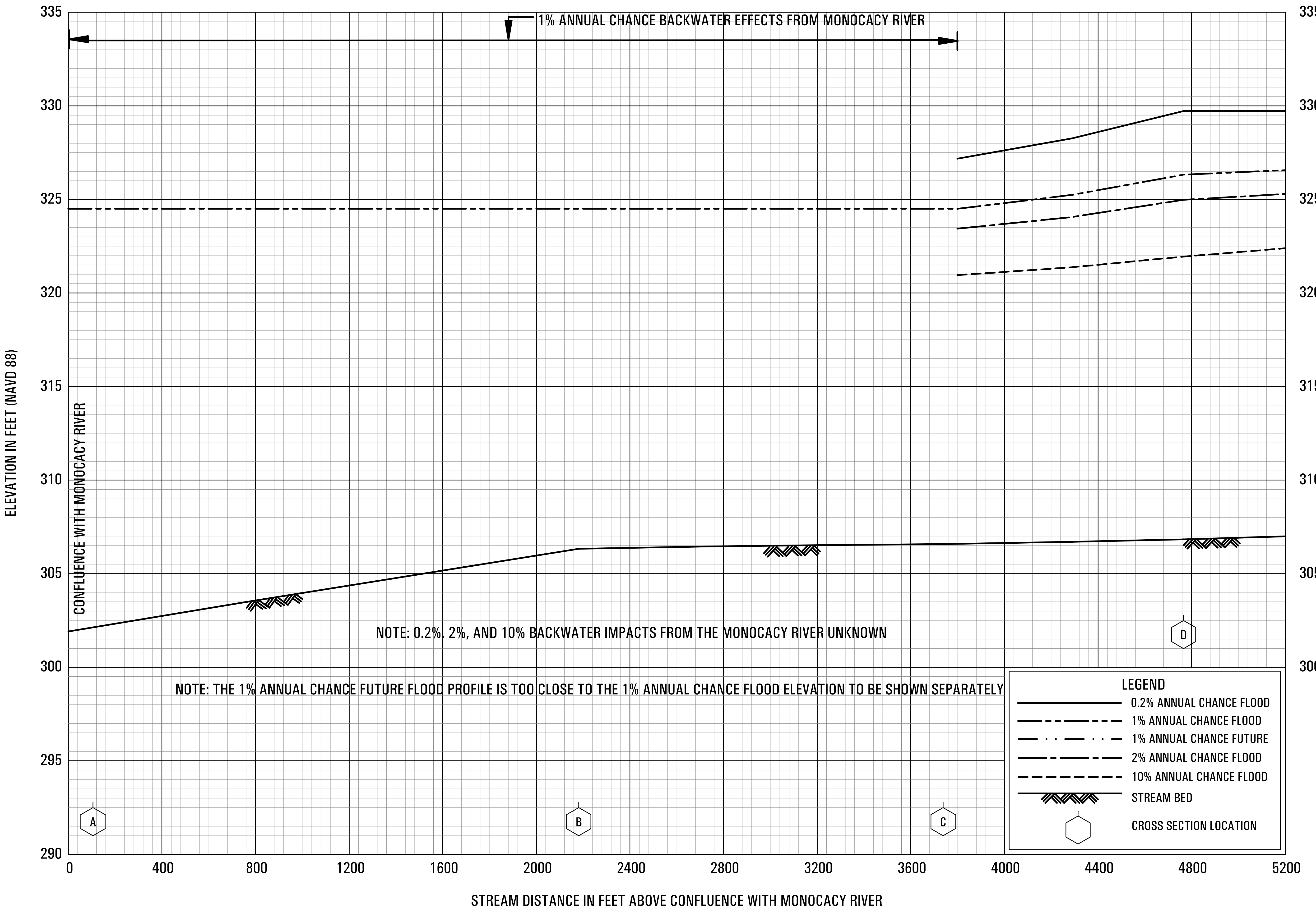
FLOOD PROFILES

CRANBERRY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

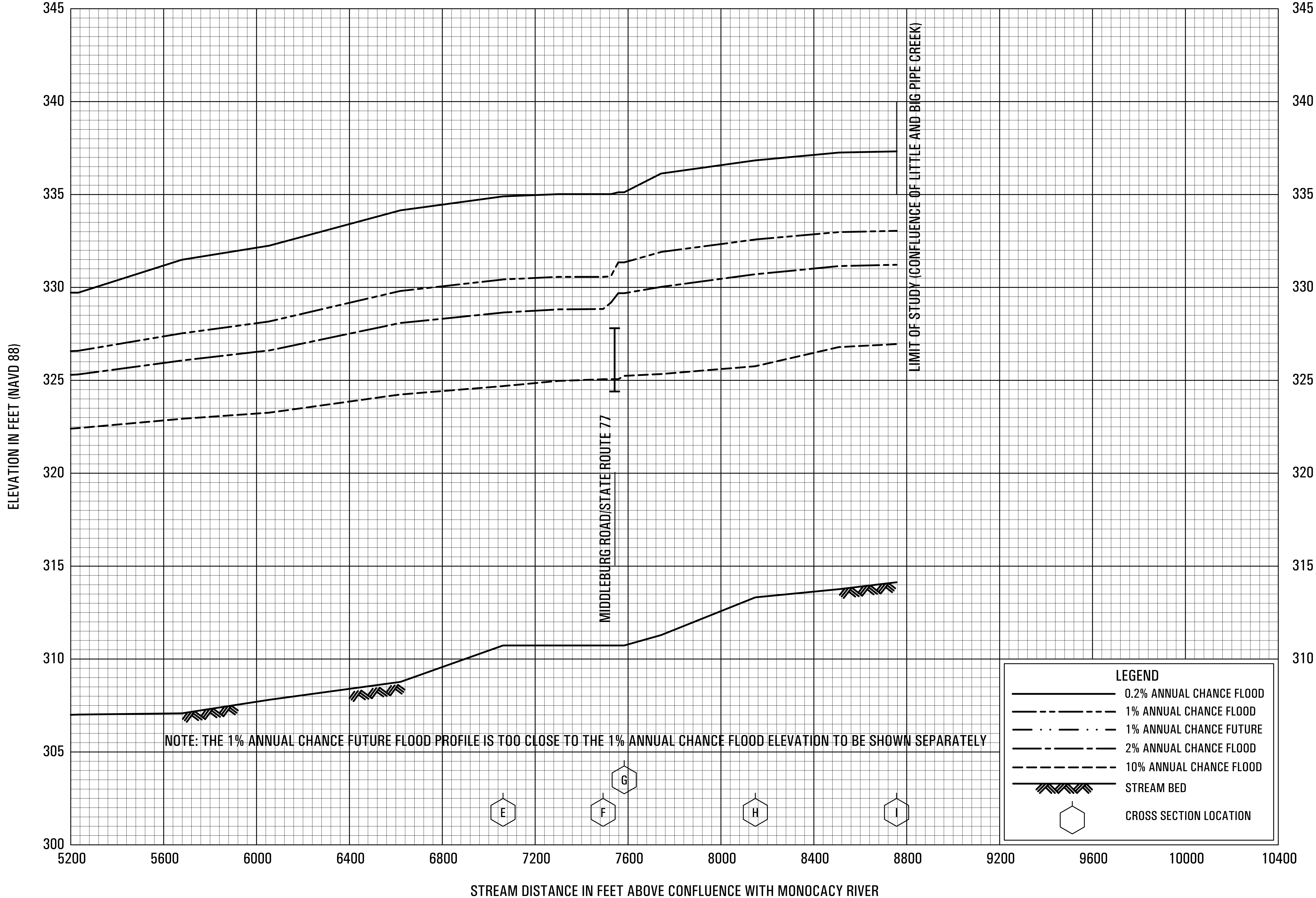
DOUBLE PIPE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

24P



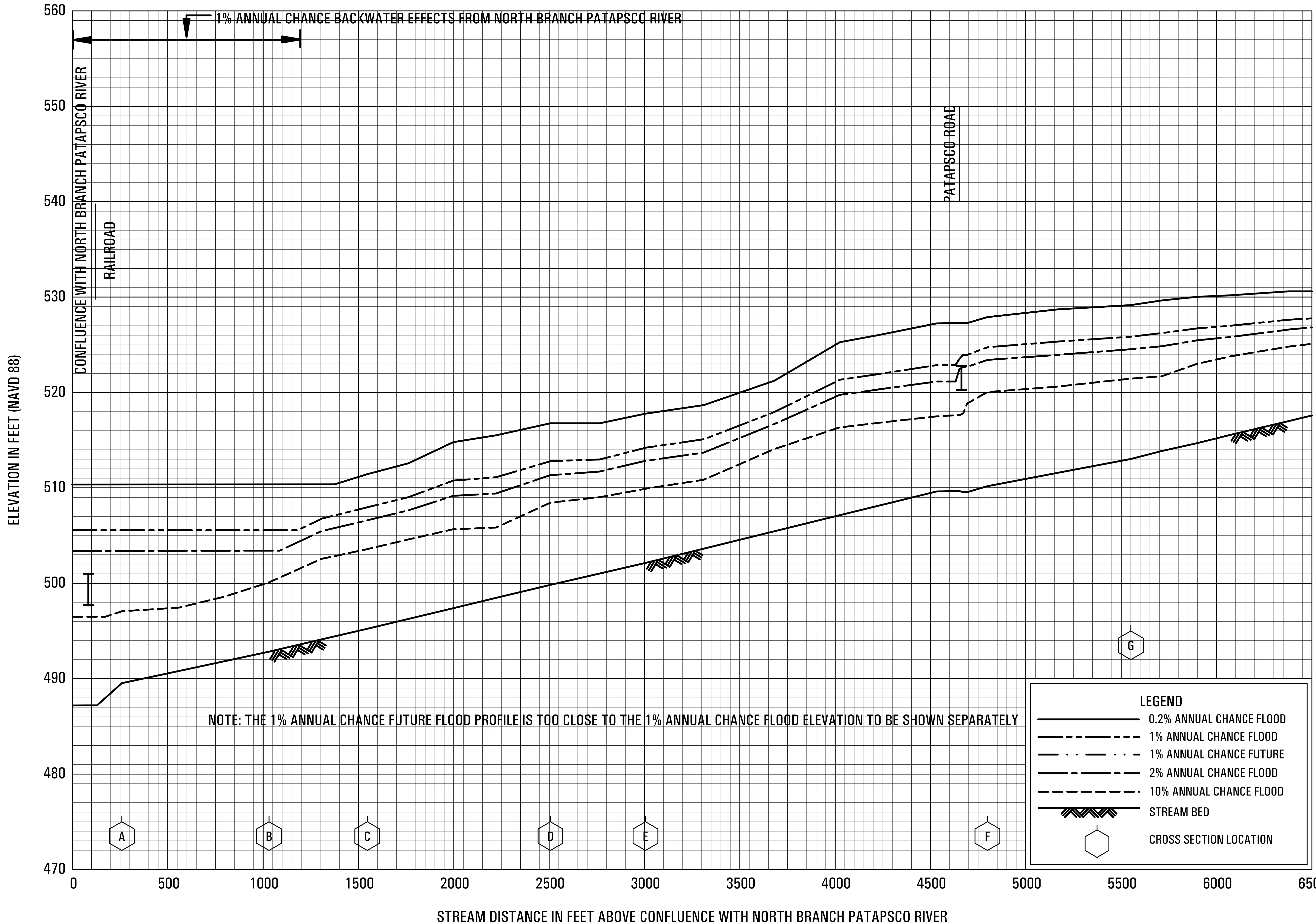
FLOOD PROFILES

DOUBLE PIPE CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



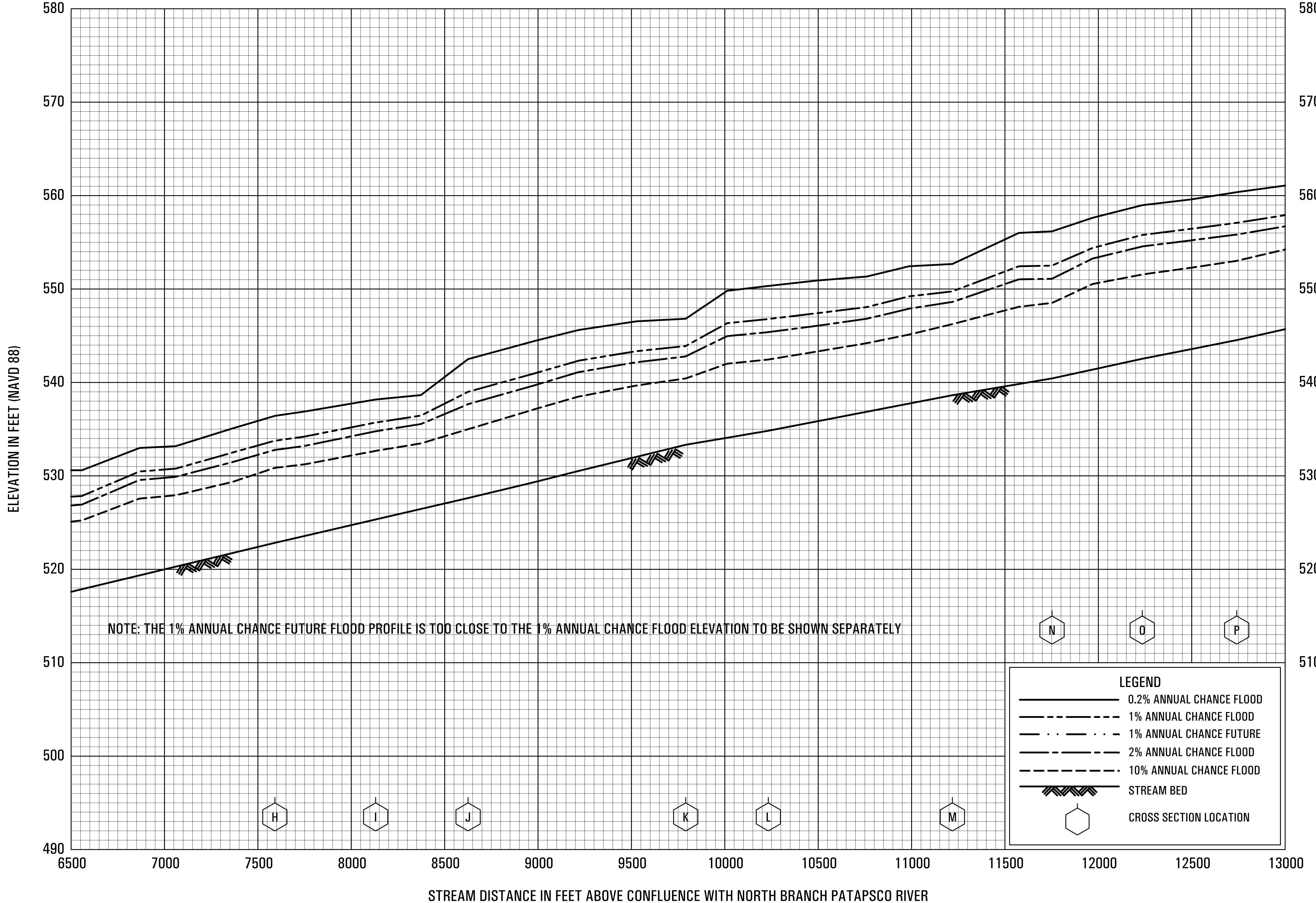
FLOOD PROFILES

EAST BRANCH PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



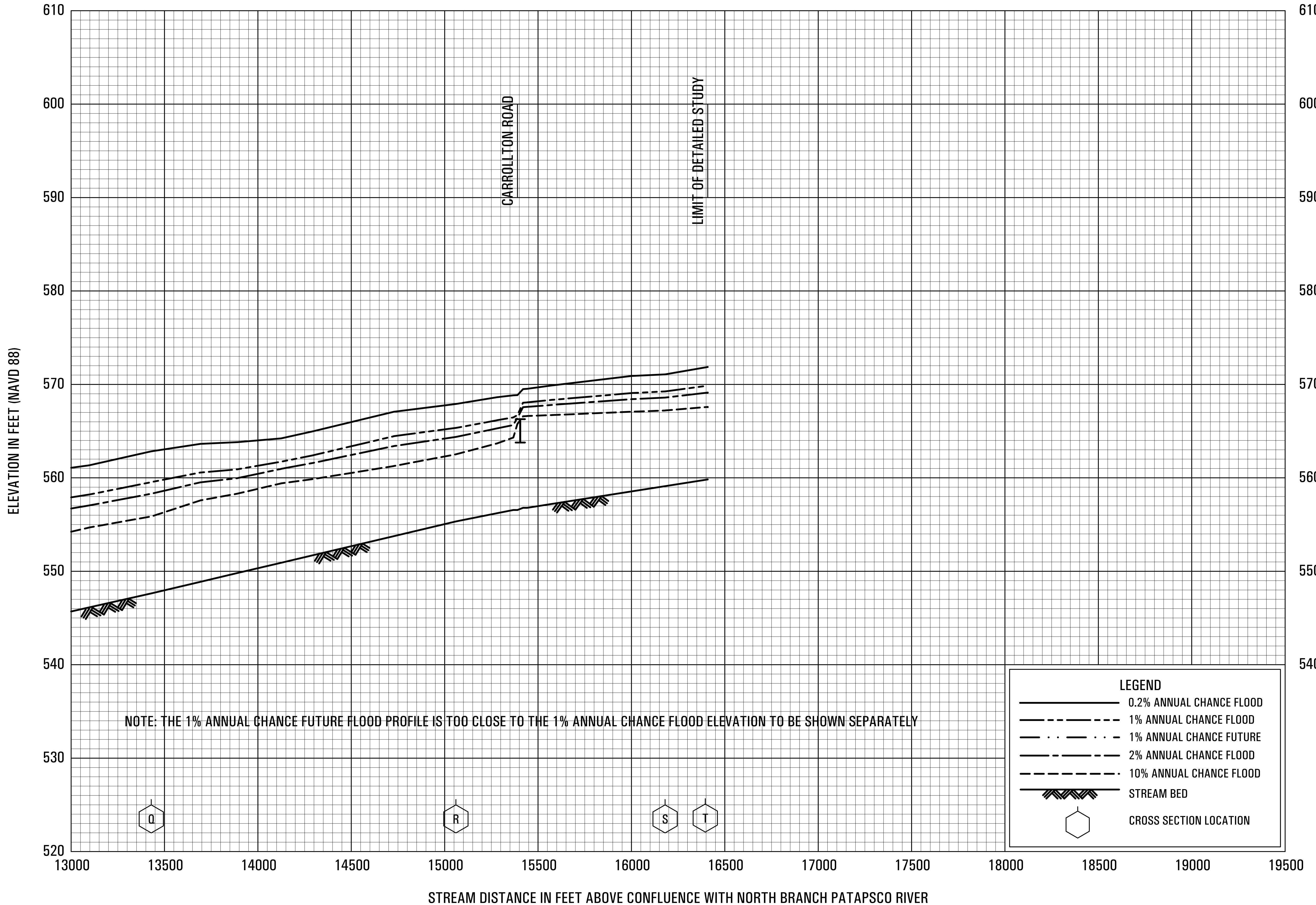
FLOOD PROFILES

EAST BRANCH PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



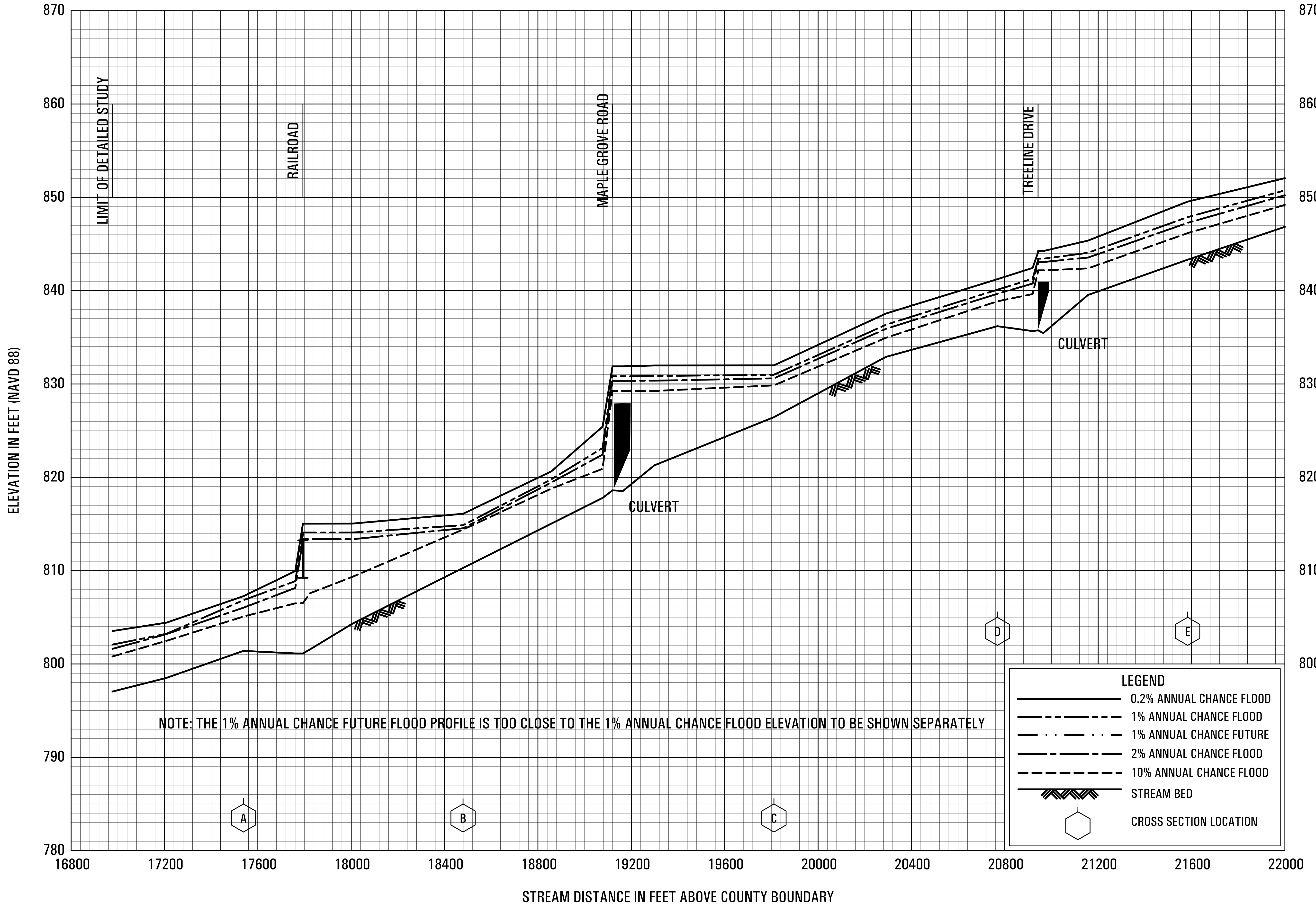
FLOOD PROFILES

EAST BRANCH PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



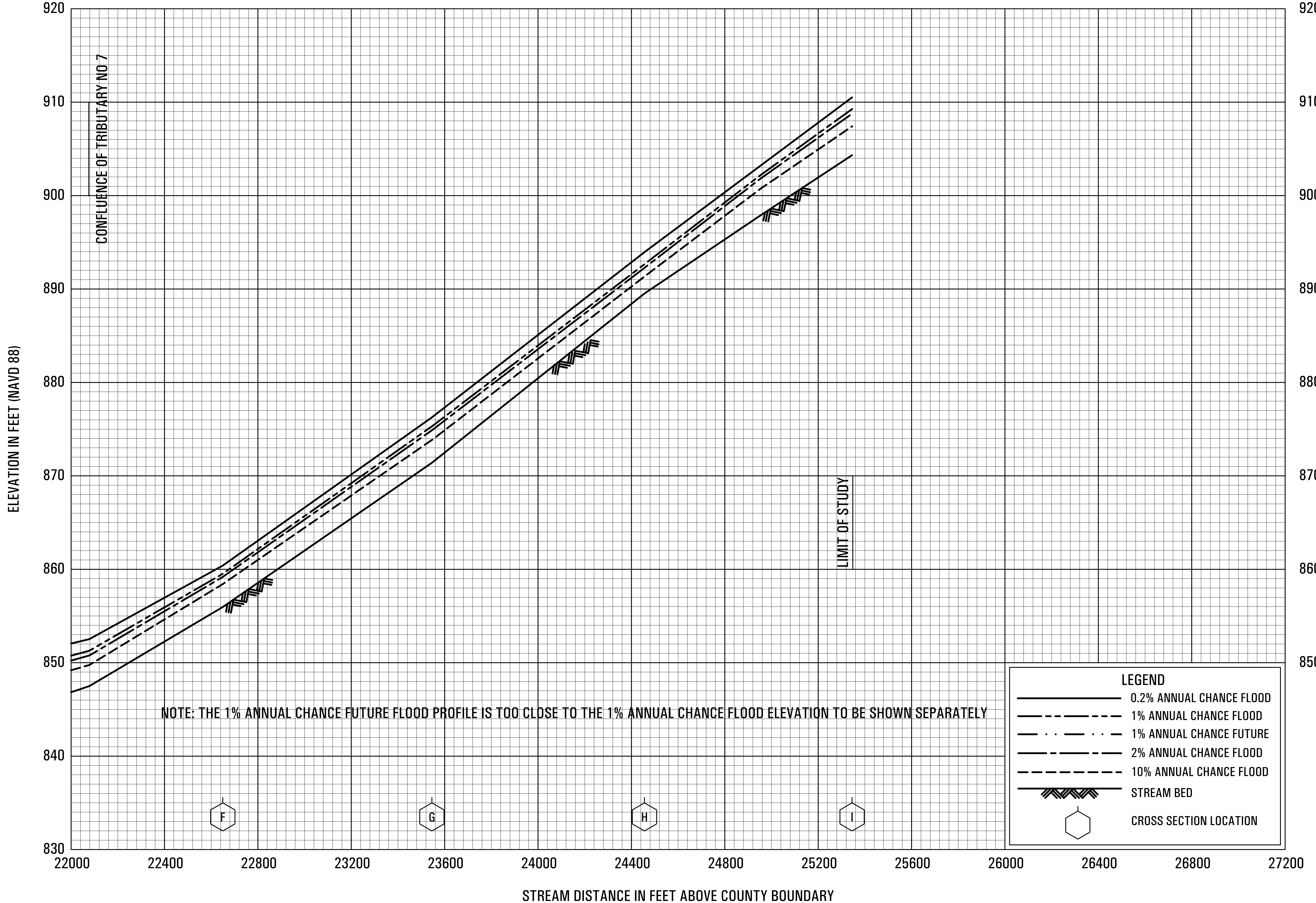
FLOOD PROFILES

GEORGES RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



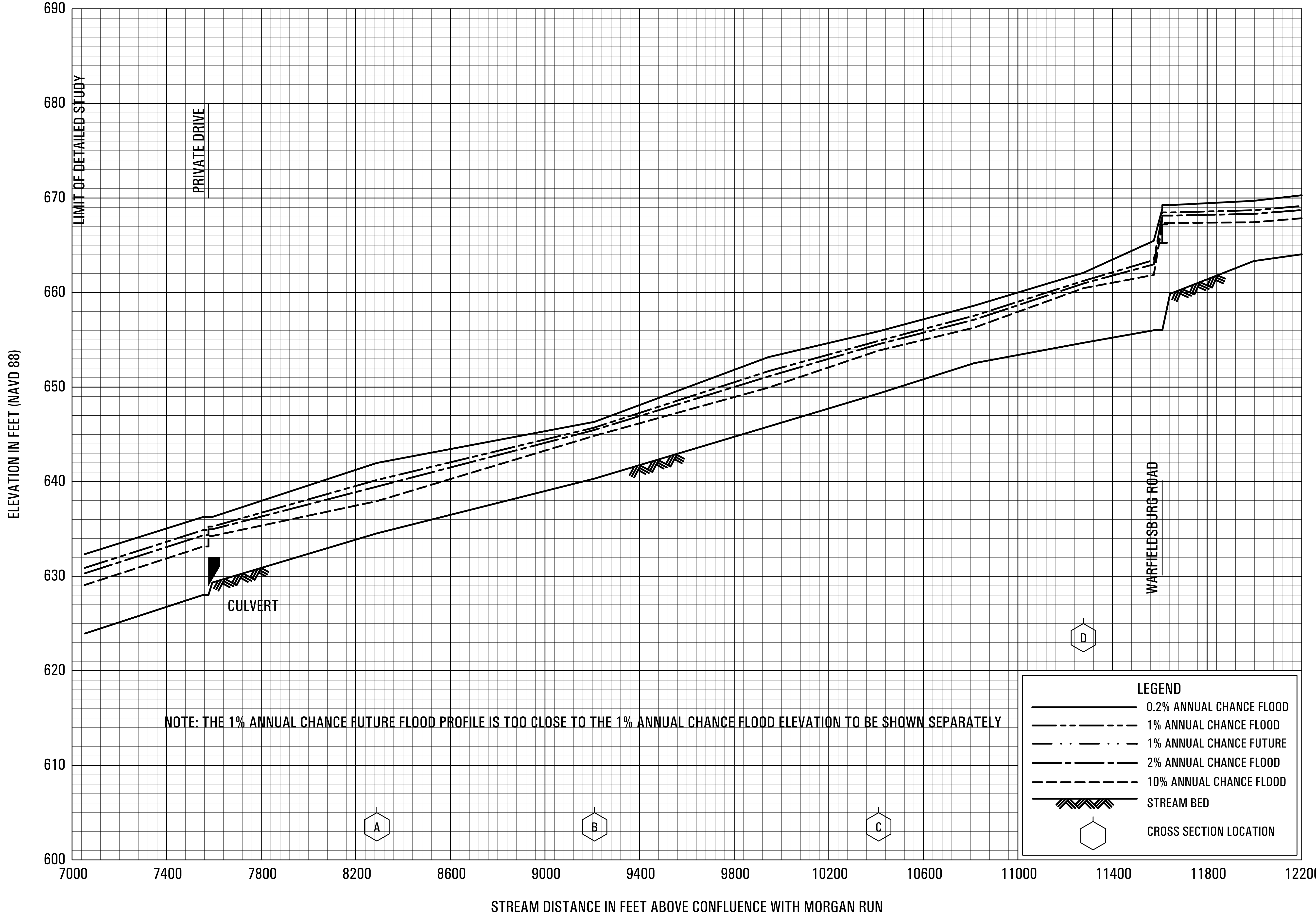
FLOOD PROFILES

GEORGES RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



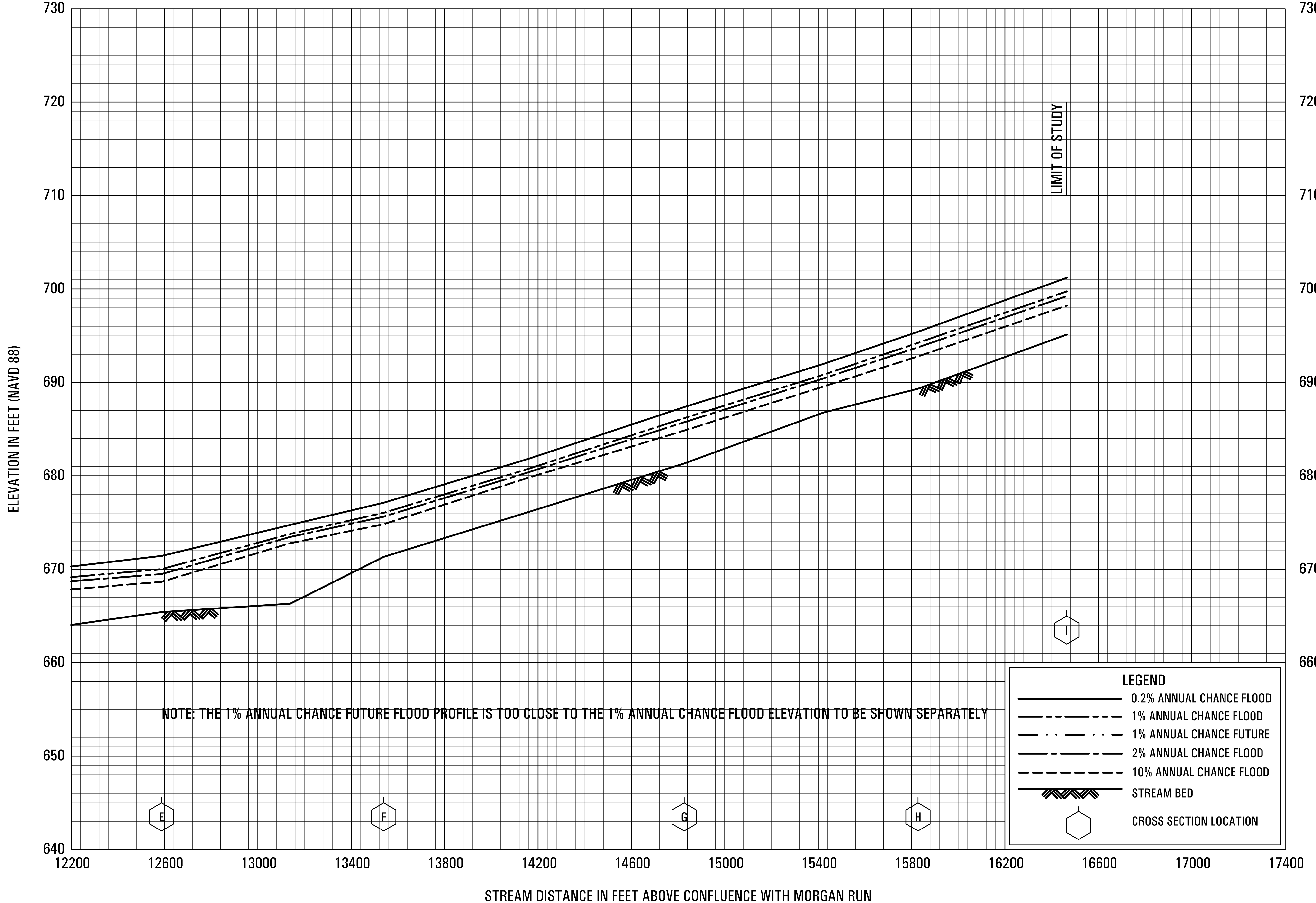
FLOOD PROFILES

LITTLE MORGAN RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

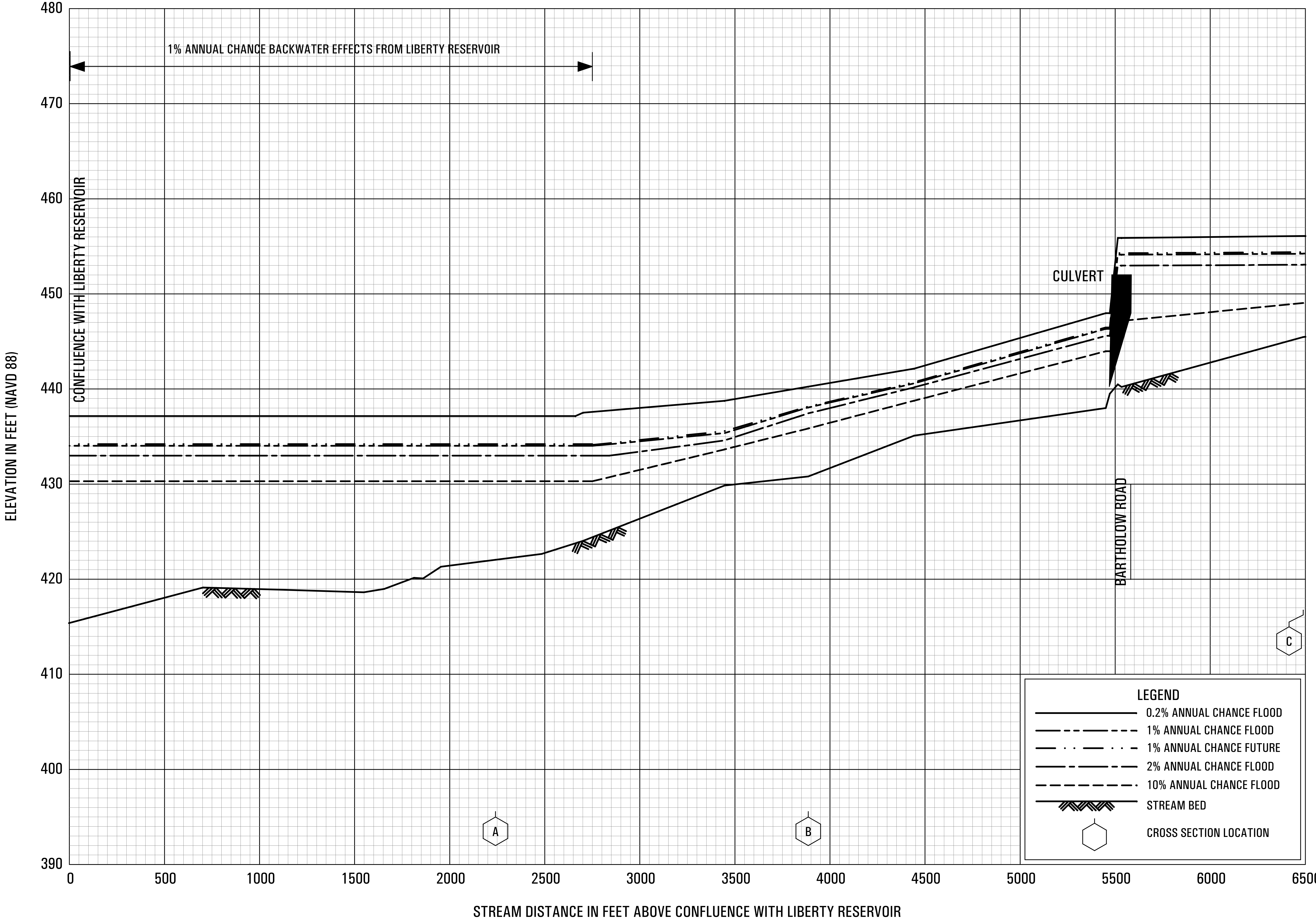
LITTLE MORGAN RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

32P



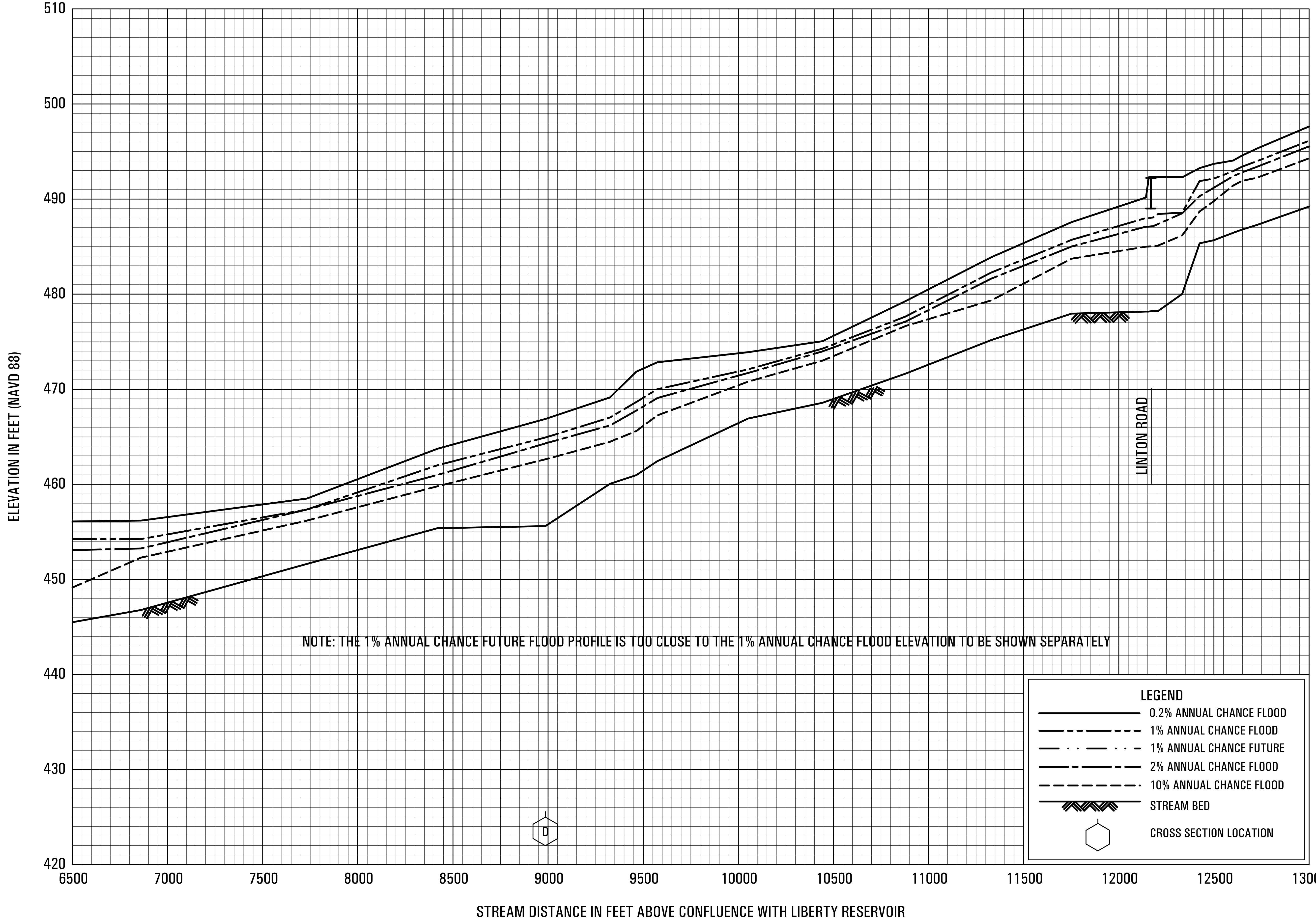
FLOOD PROFILES

LITTLE MORGAN RUN II

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

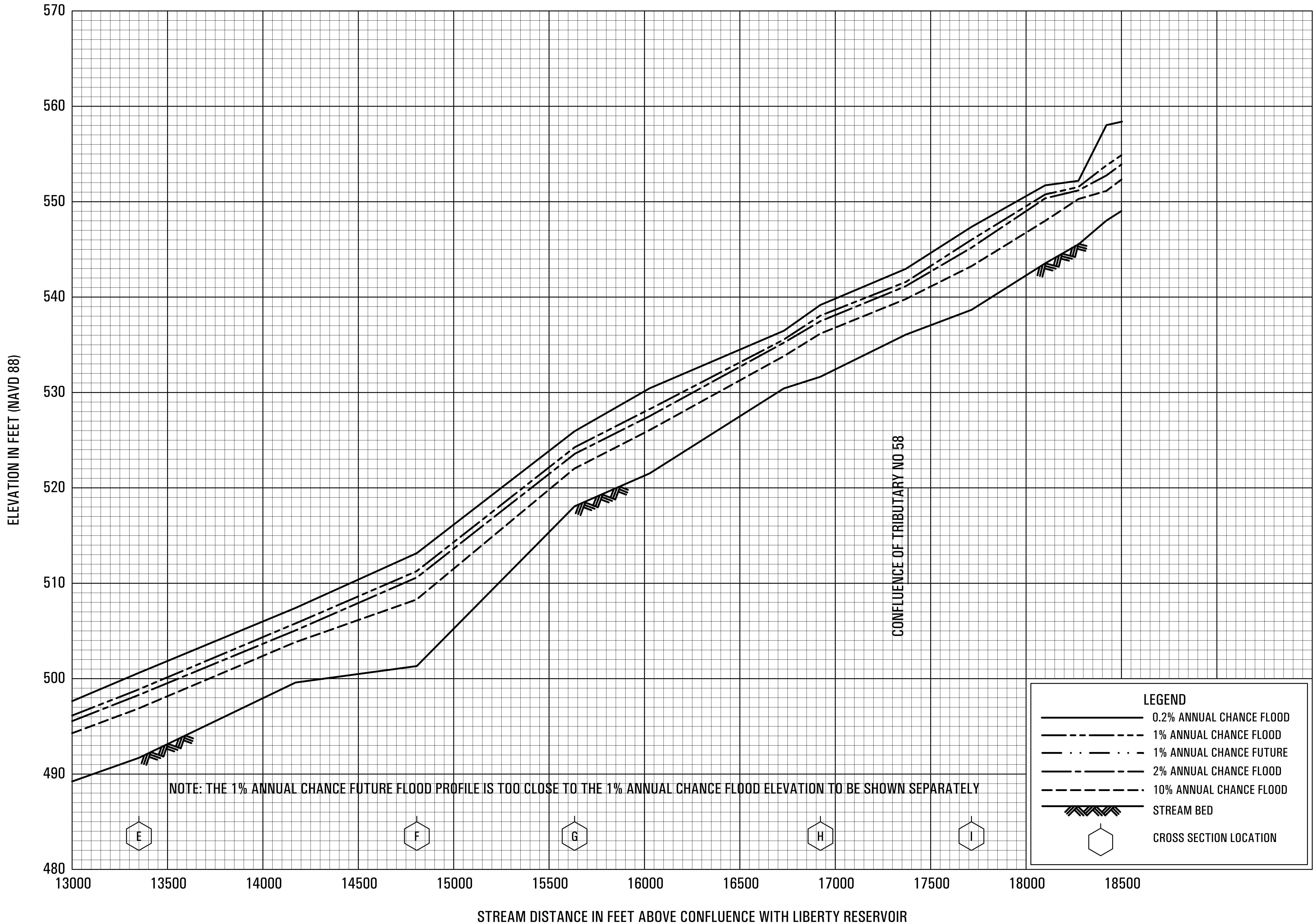
LITTLE MORGAN RUN II

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS

34P



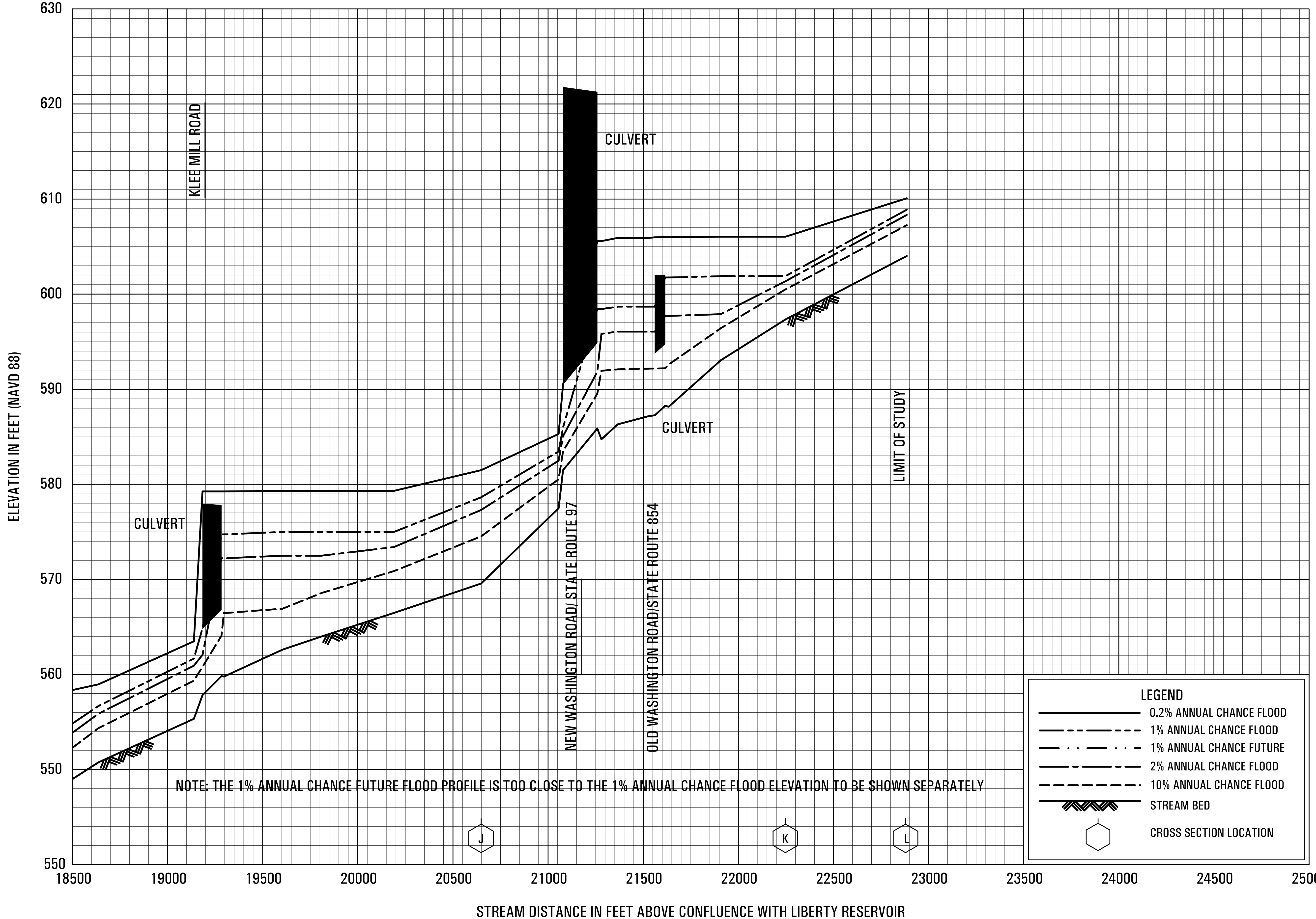
FLOOD PROFILES

LITTLE MORGAN RUN II

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

LITTLE MORGAN RUN II

FEDERAL EMERGENCY MANAGEMENT AGENCY

CARROLL COUNTY, MD

AND INCORPORATED AREAS