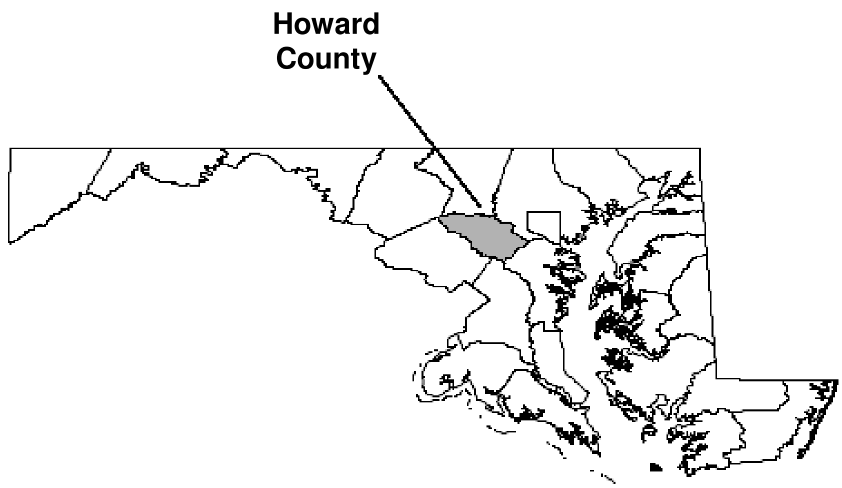
FLOOD INSURANCE STUDY

HOWARD COUNTY, MARYLAND AND INCORPORATED AREAS

Volume 1 of 3

COMMUNITY NAME	COMMUNITY NUMBER
HOWARD COUNTY (UNINCORPORATED AREAS)	240044



EFFECTIVE DATE: November 6, 2013

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
24027CV001A

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

Initial Countywide FIS Effective Date: November 6, 2013

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FLOOD INSURANCE STUDY
HOWARD 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 Howard County, Maryland, and 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 Howard County 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.

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.

The Digital Flood Insurance Rate Map (DFIRM) and FIS report for this countywide study have been produced in digital format. Flood hazard information was converted to meet the Federal Emergency Management Agency (FEMA) DFIRM database specifications and Geographic Information System (GIS) format requirements. The flood hazard information was created and is provided in a digital format so that it can be incorporated into a local GIS and be accessed more easily by the community.

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.

For all flooding sources included in the previous FIS, excluding the Patuxent River and Patapsco River, new 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-05-CRL-01. The MMP study was completed in December 2008.

Hydrologic and hydraulic analyses for Autumn Hill Branch, Cat Rock Run, East Tributary Rockburn Branch, Guilford Run, New Cut Branch, North Tributary West Branch Dorsey Run, Right Fork North Tributary West Branch Dorsey Run, Rockburn Branch, Sucker Branch, Sucker Branch Tributary 1, Sucker Branch Tributary 2, Tiber Hudson Branch, Tiber Hudson Tributary, West Branch Dorsey Run and a portion of Dorsey Run were performed by the USACE under contract with the Howard County Bureau of Environmental Services (BES). The BES study was completed in June 2009 and was provided by Howard County to FEMA for inclusion in this FIS.

The Patuxent River was studied by Greenhorne & O'Mara for FEMA, under Contract No. H-3595. The original study was completed in 1976.

The Maryland Department of Natural Resources (MDNR) and the Baltimore Regional Planning Council jointly conducted a study of the Patapsco River (Reference 1). The results of this study were published in the 1986 Howard County FIS.

Planimetric base map information is provided in digital format for all Flood Insurance Rate Map (FIRM) panels. Road centerlines were provided by the Maryland State Highway Administration (MSHA). Stream centerlines were derived as part of the hydraulic modeling process described in Section 3.2.

Base map is imagery from the National Agriculture Imagery Program (NAIP). NAIP acquires digital ortho imagery during the agricultural growing seasons in the continental U.S. at a scale of 1:40,000 for the purpose of producing natural color digital orthophotos at a 1 meter pixel resolution.

For the Patuxent and Patapsco Rivers, where new hydrologic and hydraulic analysis were not performed, this map reflects more detailed and up-to-date stream channel configurations and floodplain delineations than those shown on the previous FIRM. This is based on the use of the above mentioned digital orthophotographs and topographic data. As a result, the flood profiles for these two rivers may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for these rivers may differ from what is shown on previous maps.

The projection used in the production of this map was Universal Transverse Mercator (UTM), Zone 18. The horizontal datum was North American Vertical Datum of 1983 (NAD83), GRS1980 spheroid. Differences in the datum, spheroid, projection or UTM 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 information shown on the FIRM.

1.3 Coordination

During the course of the original study, the Soil Conservation Service (SCS), the USACE, the U. S. Geological Survey (USGS), and the Howard County Department of Public Works and Office of Emergency Management were notified about the nature and extent of the project. At the same time, pertinent data and information were solicited from these sources. Howard County provided detailed topographic and planimetric maps that were used in the compilation of the study, and the aforementioned 2009 DPW study.

In addition, the County provided vertical control data and recent land-use and zoning maps. Information on local flood problems and history, as well as a report on flooding on Tiber-Hudson Branch, were also provided by the County. The information received from the other sources referenced above included preliminary hydrologic calculations and studies, as well as historic discharge data. The SCS and the USACE were contacted several times during the original study in order to minimize and reconcile all possible conflicts with previous studies.

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

The initial CCO meeting for this revision was held on April 12, 2005, at the MDE offices and attended by representatives of MDE, FEMA, and the USACE (study contractor for this study).

For this countywide FIS, a final CCO meeting was held on February 22, 2010, and was attended by representatives of Howard County, MDE, FEMA, and the USACE (study contractor for this study). 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 Howard County, Maryland. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction.

For this revision, new detailed studies were performed on the streams studied by detailed methods in the previous FIS, with the exception of the Patuxent and the Patapsco Rivers, along with newly studied reaches (refer to Section 1.2). The floodplains for the Patuxent and the Patapsco Rivers were redelineated based on updated topography.

The USACE's detailed methodology included comparing existing condition hydrology calculations to the results used in the effective FIS (refer to Section 3.1). New georeferenced hydraulic models were created for each stream studied in detail, and the resulting GIS layers (floodplains, cross-sections, floodways) were used in the development of the updated floodplain mapping (refer to Sections 3.2 and 4.1).

The flooding sources studied using detailed methods are listed in the following table:

TABLE 1 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Autumn Hill Branch	Stream CB-14
Beaver Run Branch	Stream CB-15
Benson Branch	Stream CB-16
Bonnie Branch	Stream CB-17
Cat Rock Run	Stream CB-18
Clark's Creek	Stream DR-1
Clyde's Branch	Stream DR-2
Deep Run	Stream DR-3
Dorsey Run	Stream DR-4
East Tributary Rockburn Branch	Stream DR-5
Guilford Branch	Stream HB-1
Guilford Run	Stream HB-2
Hammond Branch	Stream HB-3
Lake Elkhorn Branch	Stream HB-4
Little Patuxent River	Stream HB-5
Middle Patuxent River	Stream HB-6
New Cut Branch	Stream HB-7
North Tributary West Branch Dorsey Run	Stream HB-8
Patapsco River	Stream HB-9
Patuxent River	Stream HB-10
Plumtree Branch	Stream HB-11
Red Hill Branch	Stream HB-12
Right Fork North Tributary West Branch Dorsey Run	Stream LPR-1
Rockburn Branch	Stream LPR-2
Sanner Road Tributary	Stream LPR-3
South Branch Patapsco River	Stream LPR-4

TABLE 1 – FLOODING SOURCES STUDIED BY DETAILED METHODS – (Continued)

Stream CB-1	Stream LPR-5
Stream CB-2	Stream LPR-6
Stream CB-3	Sucker Branch
Stream CB-4	Sucker Branch Tributary 1
Stream CB-5	Sucker Branch Tributary 2
Stream CB-6	Tiber Hudson Branch
Stream CB-7	Tiber Hudson Tributary
Stream CB-8	Tributary to Beaver Run Branch
Stream CB-9	Tributary to Bonnie Branch
Stream CB-10	Vista Road Tributary
Stream CB-11	West Branch Dorsey Run
Stream CB-12	Wilde Lake Branch
Stream CB-13	

Flooding sources in parts of the community with low development potential or minimal flood hazard were studied by approximate methods.

The USACE's methodology for approximate study streams included developing the 1-percent-annual-chance discharge for the stream (refer to Section 3.1), creating new georeferenced hydraulic models, and developing a resulting GIS layer for the 1-percent annual chance inundation area for updated floodplain mapping.

The flooding sources studied using approximate methods are listed in the following table:

TABLE 2 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Beaver Run Branch Tributary 4	Deep Run Tributary A
Cattail Creek	Deep Run Tributary D-2
Cattail Creek Tributary 1	Deep Run Tributary D-3
Cattail Creek Tributary A	Deep Run Tributary D-4
Cattail Creek Tributary A-1	Deep Run Tributary D-5
Cattail Creek Tributary A-2	Deep Run Tributary D-7
Cattail Creek Tributary A-3	Deep Run Tributary D-8
Cattail Creek Tributary A-4	Deep Run Tributary D-9
Cattail Creek Tributary A-5	Deep Run Tributary D-14
Cattail Creek Tributary A-6	Deep Run Tributary E
Cattail Creek Tributary A-7	Deep Run Tributary F-1
Cattail Creek Tributary A-8	Deep Run Tributary F-2
Cattail Creek Tributary A-9	Deep Run Tributary G

TABLE 2 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – (Continued)

Cattail Creek Tributary A-10	Deep Run Tributary H
Cattail Creek Tributary A-11	Deep Run Tributary I
Cattail Creek Tributary A-12	Deep Run Tributary J
Cattail Creek Tributary A-13	Deep Run Tributary K
Cattail Creek Tributary B	Deep Run Tributary L
Cattail Creek Tributary C	Deep Run Tributary M
Cattail Creek Tributary D	Deep Run Tributary O
Cattail Creek Tributary E	Deep Run Tributary P
Cattail Creek Tributary E-1	Deep Run Tributary Q
Cattail Creek Tributary E-2	Deep Run Tributary Q-1
Cattail Creek Tributary E-3	Deep Run Tributary R
Cattail Creek Tributary E-4	Deep Run Tributary S
Cattail Creek Tributary E-5	Deep Run Tributary T
Cattail Creek Tributary E-6	Deep Run Tributary U
Cattail Creek Tributary E-7	Deep Run Tributary V
Cattail Creek Tributary E-8	Deep Run Tributary W
Cattail Creek Tributary E-9	Guilford Branch Tributary 1
Cattail Creek Tributary F	Lake Elkhorn Branch Tributary 1
Cattail Creek Tributary G	Lake Elkhorn Branch Tributary 2
Cattail Creek Tributary H	Lake Elkhorn Branch Tributary 3
Cattail Creek Tributary H-1	Lake Elkhorn Branch Tributary 5
Cattail Creek Tributary H-2	Lake Elkhorn Branch Tributary 11
Cattail Creek Tributary I	Lake Elkhorn Branch Tributary 14
Cattail Creek Tributary J	Little Patuxent River Tributary 2
Cattail Creek Tributary K	Little Patuxent River Tributary 3
Cattail Creek Tributary K-1	Little Patuxent River Tributary 5
Cattail Creek Tributary K-2	Little Patuxent River Tributary 6
Cattail Creek Tributary L	Little Patuxent River Tributary 7
Cattail Creek Tributary L-1	Little Patuxent River Tributary 8
Cattail Creek Tributary L-2	Little Patuxent River Tributary 9
Cattail Creek Tributary L-3	Little Patuxent River Tributary 10
Cattail Creek Tributary L-4	Little Patuxent River Tributary 11
Cattail Creek Tributary M	Little Patuxent River Tributary 15
Cattail Creek Tributary N	Little Patuxent River Tributary 18
Cattail Creek Tributary O	Little Patuxent River Tributary 19
Cattail Creek Tributary O-1	Little Patuxent River Tributary 20
Cattail Creek Tributary O-2	Little Patuxent River Tributary 22
Cattail Creek Tributary O-3	Little Patuxent River Tributary 23
Cattail Creek Tributary O-4	Little Patuxent River Tributary 27
Cattail Creek Tributary O-5	Little Patuxent River Tributary 28
Cattail Creek Tributary O-6	Little Patuxent River Tributary 29
Cattail Creek Tributary O-7	Little Patuxent River Tributary 30
Cattail Creek Tributary O-8	Little Patuxent River Tributary 31
Cattail Creek Tributary O-9	Little Plumtree Branch

TABLE 2 – FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – (Continued)

Cattail Creek Tributary P	Patuxent River
Cattail Creek Tributary P-1	Patuxent River Tributary 2
Cattail Creek Tributary P-2	Plumtree Branch Tributary 1
Cattail Creek Tributary P-3	Plumtree Branch Tributary 2
Cattail Creek Tributary P-4	Red Hill Branch Tributary 1
Cattail Creek Tributary Q	Red Hill Branch Tributary 4
Cattail Creek Tributary R	Stream LPR-6 Tributary 1
Cattail Creek Tributary S	Stream LPR-6 Tributary 2
Clarks Creek Tributary 1	Stream LPR-6 Tributary 3
Clarks Creek Tributary 2	Stream LPR-6 Tributary 4
Clarks Creek Tributary 6	Wilde Lake Branch Tributary 1
Clarks Creek Tributary 7	Wilde Lake Branch Tributary 2
Clarks Creek Tributary 8	Wilde Lake Branch Tributary 4
Clarks Creek Tributary 10	Wilde Lake Branch Tributary 5

For this FIS, the vertical datum was converted from the National Geodetic Vertical Datum of 1929 (NGVD) to the North American Vertical Datum of 1988 (NAVD). In addition, the Transverse Mercator, State Plane coordinates, previously referenced to the North American Datum of 1927, are now referenced to the North American Datum of 1983.

No Letters of Map Revision (LOMRs) were recorded for this countywide study.

2.2 Community Description

Howard County is located in the piedmont of the Appalachian Mountains in the central portion of Maryland, between the City of Baltimore and the City of Washington, D.C. It is bordered by Carroll County to the north, Baltimore County to the northeast/east, Anne Arundel County to the southeast, Prince Georges County and the City of Laurel to the south, Montgomery County to the southwest, and Frederick County to the northwest.

According to the U. S. Bureau of the Census, the population of Howard County was 247,842 in 2000, and the estimated population for 2006 was 272,452 (Reference 2). The Howard County Economic Development Authority projects the 2010 population to be 287,720 (Reference 3).

A moderate range of temperature within the county results from seasonal weather changes along the eastern seaboard. The temperature varies from an average low of 22 degrees Fahrenheit (°F) in the winter to an average high of 87°F in the summer. Weather conditions are fairly uniform throughout the county. The average annual rainfall is approximately 45 inches (Reference 4).

The topography of Howard County varies in elevation from 100 to 800 feet NAVD. 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.

Howard County is drained by five major rivers, including the Patuxent River, the Little Patuxent River, the Middle Patuxent River, the Patapsco River, and the South Branch Patapsco River.

The Patuxent River flows southeast along the western and southern borders of the county and continues through central and southern Maryland before discharging into the Chesapeake Bay. It drains the southern portion of Howard County. The Middle Patuxent River flows southeast through central Howard County and discharges into the Little Patuxent River. The Little Patuxent River drains portions of central and southern Howard County, discharging into the Patuxent River in Anne Arundel County.

South Branch Patapsco River has a drainage area of approximately 86 square miles. It flows east along the northern border of the county to its confluence with the Patapsco River. The Patapsco River flows southeast along the northeastern border of the county and discharges into the Chesapeake Bay. It drains an area of approximately 365 square miles, including portions of Carroll, Howard, Baltimore, and Anne Arundel Counties, and Baltimore City.

2.3 Principal Flood Problems

Flooding on the Patuxent, Little Patuxent, Middle Patuxent, Patapsco, and South Branch Patapsco Rivers is most likely to occur in the summer and early fall months during hurricanes or tropical storms. Large flows on the remaining streams within the county, which have relatively small drainage areas, can also occur during intense thunderstorms and frontal storms, as well as the tropical storms and hurricanes.

Development within the floodplains of the Patapsco River near Ellicott City and the Little Patuxent River near Columbia is particularly susceptible to flood damage due to a large amount of urbanization.

Large magnitude floods have occurred in Howard County on several occasions. The most damaging and largest recorded discharges on the major streams within the county occurred on June 22, 1972, during Hurricane Agnes. The magnitude of the discharges ranged from two to four times greater than the previously recorded maximum.

Damage estimates throughout the county (in 1972 dollars) following Hurricane Agnes ranged as high as $8,000,000. The majority of this damage occurred along the Patapsco River in the Ellicott City and Elkridge areas, where $250,000 in damage occurred to private property, $275,000 to county property, and $6,442,000 to commercial and industrial property. Damage along the Little Patuxent River totaled approximately $470,000, including $125,000 to private property, $305,000 to county property, and $40,000 to commercial property. Damage along the Patuxent and Middle Patuxent Rivers was approximately $100,000, primarily to private property. In addition, $215,000 in damage occurred to roads and bridges throughout the county. The Hurricane Agnes flood continues to be the flood of record in Howard County.

2.4 Flood Protection Measures

Several reservoirs have been constructed to provide flood control capabilities along the Patuxent and Patapsco Rivers. The T. Howard Duckett (Rocky Gorge) and Triadelphia Reservoirs are maintained by the Washington Suburban Sanitary Commission on the Patuxent River northwest of the City of Laurel.

Liberty Reservoir, which is maintained by the City of Baltimore, provides flood control on the North Branch Patapsco River in Carroll and Baltimore Counties. In turn, this controls the discharge of the Patapsco River for those areas below Woodstock in Howard County.

The Centennial Dam contributes to flood control along the Little Patuxent River in the southeastern portion of Howard County. Several facilities for the control of local runoff from developing areas have been constructed within the county. These include Wilde Lake and Lake Kittamaquandi, both of which control runoff in the Columbia area.

3.0 ENGINEERING METHODS

For the flooding sources studied by detailed methods (Table 1), 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.

Discharges for the Patapsco River were determined in a joint venture by the MDNR and the Baltimore Regional Planning Council (Reference 1). Rainfall information was determined using a Thiessen polygon procedure with data from rainfall gages located in Carroll, Baltimore, and Anne Arundel Counties. Technical Paper No. 40 was used to calibrate the 10-, 2-, and 1-percent-annual-chance flood storms (Reference 5). Further calibration was done by modeling Hurricane Agnes and comparing hydrographs to hydrographs obtained from stream gage records.

Discharges for the Patuxent River were obtained from the FIS reports for Prince Georges County and the City of Laurel (References 6 and 7). Flood-flow frequency data were based on a statistical analysis of stage-discharge records covering a 26-year period at gaging stations operated by the USGS (Reference 8). This analysis followed the standard log-Pearson Type III method as outlined by the Water Resources Council (Reference 9). Consideration was given to the effects of the T. Howard Duckett (Rocky Gorge) and Triadelphia Reservoirs, which are located upstream of the study area. The effects of these reservoirs were found to be insignificant on large floods, particularly a flood as great as the 1-percent-annual-chance flood.

For all other streams studied by detailed and approximate methods, 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. MDE contracted Dr. Glenn Moglen of the Department of Civil and Environmental Engineering at the University of Maryland to perform these hydrologic calculations. Methods and results of the updated hydrologic analyses are presented below (Reference 10).

The current regional regression equations being used by the 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 11).

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. Howard County is located entirely in the Piedmont 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 were used as significant parameters in this region.

Rural Equations: 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 3 – 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*:* 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 4 –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

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).

Drainage area peak-discharge relationships for the streams studied by detailed methods are listed in Table 5, "Summary of Discharges."

TABLE 5 – 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
AUTUMN HILL BRANCH						
At confluence with New Cut Branch	0.63	534	1,080	1,400	1,400	2,460
At Bali Road	0.20	242	505	664	720	1,190
BEAVER RUN BRANCH						
Confluence with Little Patuxent River	2.09	1,240	2,410	3,100	3,130	5,280
Approximately 600 feet upstream of confluence with Beaver Run Tributary	1.36	1,000	1,920	2,450	2,450	4,080
Approximately 750 feet upstream of Quarterstaff Road	0.96	829	1,570	2,000	2,000	3,300
BENSON BRANCH						
Confluence with Middle Patuxent River	3.03	1,050	2,340	3,190	3,190	6,190
Approximately 2000 feet upstream of Buckskin Lake Drive	0.36	258	597	819	824	1,620
BONNIE BRANCH						
Approximately 150 feet upstream of College Avenue	1.2	780	1,590	2,070	2,070	3,660
Approximately 800 feet downstream of confluence of Tributary to Bonnie Branch	0.92	670	1,350	1,760	1,760	3,070

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
BONNIE BRANCH (CONTINUED)						
Approximately 1,000 feet upstream of Twin Stream Drive	0.37	403	816	1,060	1,060	1,850
CAT ROCK RUN						
At confluence with Tiber-Hudson Branch	0.56	441	930	1,230	1,280	2,240
At Tiber Falls Drive	0.32	351	711	925	917	1,610
CLARK'S CREEK						
At confluence with Little Patuxent River	3.62	1,070	2,200	2,900	3,670	5,290
Approximately 300 feet downstream of Centennial Lane	3.07	964	1,990	2,640	3,250	4,830
Approximately 1,000 feet upstream of Centennial Lane	2.38	810	1,690	2,240	2,740	4,110
CLYDE'S BRANCH						
At confluence of Stream CB-6	5.93	1,590	3,540	4,820	4,660	9,400
At confluence of Stream CB-12	2.04	809	1,820	2,480	2,690	4,830
At confluence of Stream CB-16	1.28	621	1,390	1,880	1,880	3,630
DEEP RUN						
At confluence with Patapsco River	18.1	2,685	4,882	6,578	7,889	11,225
At Park Circle Drive	8.4	1,837	3,297	4,444	5,333	7,553
At Old Montgomery Road	1.1	745	1,510	1,970	2,040	3,470

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
DORSEY RUN						
Approximately 3000 feet downstream of Dorsey Run Road	8.29	2,016	3,559	4,797	5,260	8,036
Approximately 1,300 feet upstream of Washington Boulevard	2.97	1,268	2,388	3,151	3,432	5,387
At Snowden River Parkway	0.11	147	321	430	468	800
EAST TRIBUTARY ROCKBURN BRANCH						
Upstream of confluence with Rockburn Branch	0.37	263	554	787	933	1510
GUILFORD BRANCH						
At confluence with Little Patuxent River	3.13	1,746	3,414	4,953	5,590	9,044
At Washington Boulevard	2.22	1,002	1,879	2,706	3,066	4,860
At Interstate 95	0.51	382	770	1,123	1,427	2,139
GUILFORD RUN						
Upstream of confluence with Guilford Branch	0.31	225	375	562	597	983
At Route 32	0.27	204	342	513	543	901
Downstream of Vollmerhausen Road	0.10	132	175	217	217	690
HAMMOND BRANCH						
Approximately 1,000 feet downstream of Washington Boulevard	7.03	1,642	3,347	4,499	5,316	8,243
At State Route 29	2.99	1,050	2,180	2,890	3,450	5,300
At confluence of Stream HB-12	0.73	364	780	1,050	1,540	1,980

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
LAKE ELKHORN BRANCH						
At confluence with Little Patuxent River	3.72	1,950	3,670	4,650	4,650	7,700
At confluence of Lake Elkhorn Branch Tributary 14	2.65	1,550	2,940	3,740	3,740	6,210
Approximately 500 feet downstream of Old Montgomery Road	1.48	1,030	1,990	2,540	2,540	4,280
LITTLE PATUXENT RIVER						
At County Boundary	109.2	11,063	22,903	30,340	31,675	56,061
At confluence of Middle Patuxent River	97.5	10,547	22,028	29,295	30,084	54,481
Approximately 500 upstream of confluence of Stream LPR-1	28.07	5,570	11,200	14,600	14,800	26,100
At State Route 108	21.5	4,380	9,030	11,900	12,300	21,800
At U.S. Route 40	7.13	2,060	4,360	5,810	6,220	10,800
MIDDLE PATUXENT RIVER						
At confluence with Little Patuxent River	57.65	6,411	14,162	19,361	20,543	37,964
At Clarksville Pike	36.92	4,920	9,560	12,300	14,700	21,200
At State Route 32	11.36	2,350	4,710	6,150	7,110	10,900
NEW CUT BRANCH						
Downstream of confluence with Autumn Hill Branch to confluence with Tiber-Hudson Branch	1.52	748	1,620	2,180	2,440	4,100
At Private Drive (Station 4924)	0.86	350	745	997	1,730	1,880
At New Cut Road	0.28	174	380	514	787	995

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
NORTH TRIBUTARY WEST BRANCH DORSEY RUN						
At confluence with West Branch Dorsey Run	1.44	1,191	2,227	3,247	3,247	5,836
At Mission Road	1.05	1,115	2,067	3,026	3,026	5,405
At U.S. Route 95	0.75	17	100	225	225	1,300
PATAPSCO RIVER						
Just downstream of Hanover Street	315.47	16,000	31,800	43,900	*	*
Approximately 100 feet downstream of State Route 144	293.09	15,000	30,200	42,200	*	*
Approximately 1,600 feet downstream of the confluence of South Branch Patapsco River	255.76	14,300	29,500	41,600	*	*
PATUXENT RIVER						
At the Laurel Gage	*	4,000	13,500	22,000	*	40,000
PLUMTREE BRANCH						
At confluence with Red Hill Branch	3.07	1,570	3,060	3,940	3,790	6,740
At confluence of Little Plumtree Creek	1.93	1,190	2,310	2,970	2,870	5,030
Approximately 700 feet upstream of Michael's Way	0.35	288	636	858	909	1,630
RED HILL BRANCH						
At confluence with Little Patuxtent River	5.89	2,300	4,510	5,820	5,830	10,000
At State Route 100	0.22	301	593	747	763	1,300

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

* Data not computed/available

TABLE 5 – 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
RIGHT FORK NORTH TRIBUTARY WEST BRANCH DORSEY RUN						
(entire reach)	0.12	186	355	547	499	1040
ROCKBURN BRANCH						
Mouth at Patapsco River (River Road)	3.69	1,248	2,630	3,580	3,924	6,697
At Landing Road	1.57	869	1,800	2,370	2,430	4,280
ROCKBURN BRANCH (CONTINUED)						
At Kerger Road	0.23	307	607	781	748	1,330
SANNER ROAD TRIBUTARY						
Approximately 200 feet upstream of confluence with Middle Patuxent River	2.42	1,000	2,170	2,910	2,910	5,480
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	22,400	16,000
Approximately 6,000 feet upstream of Watersville Road	5.49	1,730	3,690	4,920	5,290	9,180
STREAM CB-1						
Approximately 300 feet upstream of confluence with Clyde's Branch	2.24	792	1,830	2,520	2,750	5,050
At confluence of Stream CB-1	1.51	715	1,510	2,020	2,210	3,760
At confluence of Stream CB-4	0.79	528	1,140	1,530	1,530	2,910

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
STREAM CB-2						
At confluence with Stream CB-1	0.09	103	234	322	372	643
STREAM CB-3						
Approximately 200 feet upstream of confluence with Stream CB-1	0.1	147	314	417	434	761
STREAM CB-4						
Approximately 300 feet downstream of State Route 32	0.42	316	690	934	973	1,800
STREAM CB-5						
At confluence with Stream CB-7	0.65	330	710	954	1,210	1,810
STREAM CB-6						
At confluence with Clyde's Branch	1.65	756	1,660	2,240	2,240	4,280
At confluence with Stream CB-5	0.58	503	1,020	1,330	1,330	2,330
At confluence of Stream CB-9	0.35	373	754	979	979	1,710
STREAM CB-7						
Approximately 400 feet upstream of confluence with Stream CB-5	0.18	178	404	550	550	1,060
STREAM CB-8						
At confluence with Stream CB-5	0.11	87	195	266	405	527

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
STREAM CB-9						
Approximately 300 feet upstream of confluence with Stream CB-6	0.22	290	579	749	749	1,290
STREAM CB-10						
At confluence with Clyde's Branch	0.9	472	1,070	1,470	1,470	2,890
STREAM CB-11						
At confluence with Clyde's Branch	0.28	291	611	807	807	1,460
STREAM CB-12						
Approximately 300 feet upstream of confluence with Clyde's Branch	0.13	145	329	448	448	868
STREAM CB-13						
At confluence with Stream CB-12	0.08	118	259	348	348	652
STREAM CB-14						
At confluence with Clyde's Branch	0.35	304	660	883	946	1,650
STREAM CB-15						
Approximately 500 feet upstream of confluence with Stream CB-14	0.1	132	293	394	442	746

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
STREAM CB-16						
Approximately 400 feet upstream of confluence with Clyde's Branch	0.67	446	973	1,310	1,310	2,460
STREAM CB-17						
At confluence with Stream CB-16	0.16	210	438	576	576	1,030
STREAM CB-18						
At confluence with Stream CB-16	0.1	140	304	406	406	754
STREAM DR-1						
At confluence with Deep Run	18.1	2,685	4,882	6,578	7,889	11,225
Approximately 200 feet upstream of confluence of Stream DR-2	3.96	1,045	1,880	2,600	3,174	4,491
Approximately 200 feet upstream of confluence of Stream DR-3	0.95	437	823	1,147	1,338	2,046
STREAM DR-2						
At confluence with Stream DR-1	1.02	431	697	1,020	1,100	1,720
STREAM DR-3						
Approximately 300 feet upstream of Washington Boulevard	1.9	653	1,186	1,666	2,181	2,920
Approximately 250 feet upstream of confluence of Stream DR-4	0.95	453	776	1,130	1,400	1,980

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
STREAM DR-4						
At confluence with Stream DR-3	0.95	495	860	1,260	1,510	2,200
STREAM DR-5						
At County Boundary	0.66	283	475	691	909	1,200
STREAM HB-1						
Approx 250 feet upstream of confluence with Hammond Branch	0.28	424	739	1,140	1,140	2,060
STREAM HB-2						
Approximately 700 feet upstream of confluence with Hammond Branch	0.17	292	554	858	960	1,620
STREAM HB-3						
Approximately 250 feet upstream of confluence with Hammond Branch	0.08	104	170	263	268	465
STREAM HB-4						
At Interstate 95	0.09	37	86	121	247	380
STREAM HB-5						
Approximately 400 feet upstream of confluence with Hammond Branch	0.09	25	52	72	142	231

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
STREAM HB-6						
Approximately 300 feet upstream of confluence with Hammond Branch	0.25	67	156	214	431	621
STREAM HB-7						
At confluence with Hammond Branch	0.15	128	250	334	387	586
STREAM HB-8						
At confluence with Hammond Branch	0.23	280	577	755	771	1,340
STREAM HB-9						
Approximately 400 feet upstream of confluence with Hammond Branch	0.32	277	608	819	957	1,550
STREAM HB-10						
Approximately 200 feet upstream of confluence with Hammond Branch	0.23	343	768	1,050	1,050	2,070
STREAM HB-11						
Approximately 500 feet upstream of confluence with Hammond Branch	0.21	224	485	648	648	1,200
STREAM HB-12						
Approximately 700 feet upstream of confluence with Hammond Branch	0.32	204	447	605	779	1,170

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
STREAM LPR-1						
At confluence with Little Patuxent River	1.04	885	1,660	2,090	2,140	3,410
STREAM LPR-2						
At confluence with Little Patuxent River	1.0	796	1,550	1,980	1,980	3,350
STREAM LPR-3						
At confluence with Little Patuxent River	1.0	916	1,690	2,130	2,130	3,430
STREAM LPR-4						
At confluence with Little Patuxent River	0.36	446	871	1,120	1,120	1,890
STREAM LPR-5						
At Old Annapolis Road	0.44	405	818	1,060	1,110	1,860
STREAM LPR-6						
Approximately 200 feet upstream of confluence with Little Patuxent River	2.48	1,020	2,220	2,970	3,070	5,590
SUCKER BRANCH						
At confluence with Patapsco River (mouth)	2.62	1,360	2,690	3,490	3,750	6,030
At Baltimore National Pike (Route 40)	1.37	866	1,750	2,270	2,480	3,990
At North Ridge Road	0.88	591	1,240	1,640	1,870	2,970

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
SUCKER BRANCH TRIBUTARY 1						
Upstream of confluence with Sucker Branch	0.31	347	701	911	923	1,580
SUCKER BRANCH TRIBUTARY 2						
Upstream of confluence with Sucker Branch	0.16	240	478	617	596	1060
TIBER HUDSON BRANCH						
At confluence with Patapsco River	3.80	1,050	2,020	2,550	2,754	4,180
Upstream of Maryland Route 29	1.0	488	968	1,240	1,339	2,060
Upstream of confluence with Tiber Hudson Tributary	0.50	301	608	780	842	1,310
TIBER HUDSON TRIBUTARY						
Entire reach	0.16	266	512	651	616	1,080
TRIBUTARY TO BEAVER RUN BRANCH						
Approximately 500 feet upstream of confluence with Beaver Run Branch	0.37	367	767	1,010	1,060	1,820
TRIBUTARY TO BONNIE BRANCH						
Approximately 500 feet upstream of confluence with Bonnie Branch	0.45	481	960	1,240	1,240	2,150
Approximately 100 feet upstream of Ellicott Woods Lane	0.25	352	703	908	908	1,560

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

TABLE 5 – 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
WEST BRANCH DORSEY RUN						
At confluence with Dorsey Run	2.08	912	1,628	2,308	2,716	4,010
At Mission Road	0.15	146	296	441	809	853
Downstream of U.S. Route 95	0.06	28	64	91	450	187
WILDE LAKE BRANCH						
Approximately 800 feet upstream of confluence with Little Patuxent River	1.95	1,320	2,480	3,140	3,140	5,160

[1]Please note that the Summary of Discharges table may not include all flow change locations found in the model

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the 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.

Cross sections for the Patapsco River were supplied by the Maryland Water Resources Administration. Cross sections for the Patuxent River were compiled from field surveys. For the Patuxent River, additional information and supplemental cross sections were determined from detailed USGS topographic maps (Reference 12).

Water-surface elevations of floods of the selected recurrence intervals for the Patapsco River and Patuxent River were computed using the USACE HEC-2 step-backwater computer program (Reference 13).

For all other streams included in this report, a triangulated irregular network (TIN), which is a 3-D model of a ground surface, was created from Light Detection and Ranging (LiDAR) data obtained from the MDNR. Cross sections for the backwater analyses were obtained from this TIN. For detailed study streams, below-water portions of the cross sections were either obtained from the effective hydraulic models, which were originally obtained by field survey or from sounding maps, or estimated from the thalweg on the profile sheet in the effective FIS if the effective hydraulic model was not found. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2).

MDE provided a database of information related to bridges and culverts that was used to define structural geometry. The data received from MDE was compared to the effective hydraulic models and if a difference existed, the bridge data were replaced with the more recent information. Additional bridge information was received from MSHA. The source of bridge/culvert data is noted in the HEC-RAS model.

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USACE's HEC-RAS (version 3.1.3) step-backwater computer program (Reference 14).

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 observations of the stream and floodplain areas. These values were used in the updated hydraulic analyses when applicable, and may have been adjusted based on field inspection and/or photographs of more current stream and floodplain conditions. The range of values for Manning's "n" used in this study is as follows.

TABLE 6 – MANNING'S "n" VALUES

FLOODING SOURCE	LEFT OVERBANK	CHANNEL	RIGHT OVERBANK
Autumn Hill Branch	0.050-0.100	0.035-0.043	0.050-0.100
Beaver Run Branch	0.040-0.110	0.024-0.070	0.040-0.110
Benson Branch	0.060-0.120	0.050-0.080	0.050-0.120
Bonnie Branch	0.030-0.090	0.015-0.070	0.025-0.085
Cat Rock Run	0.013-0.100	0.032-0.040	0.013-0.100
Clark's Creek	0.045-0.100	0.050-0.060	0.045-0.080
Clyde's Branch	0.040-0.100	0.040-0.045	0.040-0.100

TABLE 6 – MANNING'S "n" VALUES (CONTINUED)

Deep Run	0.050-0.200	0.040-0.080	0.050-0.200
Dorsey Run	0.030-0.100	0.035-0.100	0.030-0.100
East Tributary Rockburn Branch	0.035-0.100	0.035	0.050-0.100
Guilford Branch	0.050-0.100	0.040-0.100	0.030-0.100
Guilford Run	0.015-0.100	0.040	0.045-0.100
Hammond Branch	0.045-0.150	0.040-0.100	0.040-0.150
Lake Elkhorn Branch	0.050-0.100	0.050-0.100	0.010-0.100
Little Patuxent River	0.035-0.140	0.030-0.055	0.035-0.140
Middle Patuxent River	0.050-0.110	0.040-0.065	0.050-0.120
New Cut Branch	0.040-0.100	0.030-0.100	0.013-0.100
North Tributary West Branch Dorsey Run	0.013-0.100	0.028-0.040	0.030-0.100
Patapsco River	*	*	*
Patuxent River	*	*	*
Plumtree Branch	0.040-0.100	0.040-0.100	0.040-0.100
Red Hill Branch	0.040-0.080	0.040-0.070	0.040-0.080
Right Fork North Tributary West Branch Dorsey Run	0.100	0.035	0.060-0.100
Rockburn Branch	0.040-0.100	0.030-0.038	0.045-0.100
Sanner Road Tributary	0.013-0.100	0.013-0.050	0.013-0.100
South Branch Patapsco River	0.040-0.100	0.030-0.050	0.010-0.100
Stream CB-1	0.040-0.100	0.030-0.050	0.010-0.100
Stream CB-2	0.040-0.100	0.038-0.050	0.040-0.100
Stream CB-3	0.030-0.100	0.040	0.030-0.080
Stream CB-4	0.010-0.100	0.038-0.100	0.040-0.100
Stream CB-5	0.030-0.100	0.040-0.100	0.030-0.100
Stream CB-6	0.040-0.100	0.050-0.080	0.040-0.100
Stream CB-7	0.040-0.100	0.050-0.100	0.040-0.100
Stream CB-8	0.040-0.080	0.040-0.080	0.040-0.080
Stream CB-9	0.030-0.070	0.040-0.070	0.030-0.070
Stream CB-10	0.040-0.100	0.050	0.040-0.100
Stream CB-11	0.040-0.100	0.050	0.010-0.100
Stream CB-12	0.040-0.100	0.050	0.040-0.100
Stream CB-13	0.040-0.100	0.050	0.040-0.100
Stream CB-14	0.040-0.100	0.050	0.040-0.100
Stream CB-15	0.100	0.050	0.040-0.100
Stream CB-16	0.020-0.100	0.040-0.100	0.040-0.100
Stream CB-17	0.040-0.100	0.050	0.010-0.100
Stream CB-18	0.040-0.100	0.050	0.040-0.100
Stream DR-1	0.040-0.100	0.045	0.040-0.100
Stream DR-2	0.035-0.100	0.030-0.045	0.035-0.090
Stream DR-3	0.040-0.090	0.040-0.045	0.040-0.100

* - Data Not Available

TABLE 6 – MANNING'S "n" VALUES (CONTINUED)

Stream DR-4	0.035-0.085	0.030-0.045	0.035-0.090
Stream DR-5	0.050-0.070	0.035-0.050	0.050-0.070
Stream HB-1	0.050-0.070	0.050	0.050-0.080
Stream HB-2	0.057-0.100	0.057-0.060	0.057-0.100
Stream HB-3	0.052-0.135	0.052-0.126	0.065-0.135
Stream HB-4	0.050-0.140	0.050-0.060	0.050-0.140
Stream HB-5	0.100	0.060-0.080	0.100-0.150
Stream HB-6	0.048-0.200	0.048-0.060	0.048-0.200
Stream HB-7	0.040-0.100	0.040-0.100	0.040-0.100
Stream HB-8	0.040-0.090	0.040-0.050	0.040-0.070
Stream HB-9	0.060-0.200	0.060-0.160	0.060-0.100
Stream HB-10	0.050-0.080	0.040-0.060	0.050-0.110
Stream HB-11	0.100-0.120	0.045-0.056	0.050-0.090
Stream HB-12	0.100-0.150	0.045-0.055	0.105-0.150
Stream LPR-1	0.070-0.080	0.045-0.050	0.070-0.080
Stream LPR-2	0.050-0.085	0.050-0.085	0.050-0.085
Stream LPR-3	0.013-0.12	0.035-0.05	0.013-0.1
Stream LPR-4	0.050-0.070	0.050	0.060
Stream LPR-5	0.055-0.080	0.055-0.067	0.055-0.080
Stream LPR-6	0.055-0.110	0.055-0.070	0.055-0.110
Sucker Branch	0.013-0.100	0.030-0.045	0.013-0.100
Sucker Branch Tributary 1	0.013-0.100	0.030-0.040	0.013-0.100
Sucker Branch Tributary 2	0.060	0.035	0.100
Tiber Hudson Branch	0.013-0.100	0.012-0.040	0.013-0.100
Tiber Hudson Tributary	0.013-0.100	0.038-0.050	0.013-0.080
Tributary to Beaver Run Branch	0.065-0.200	0.065-0.110	0.065-0.200
Tributary to Bonnie Branch	0.040-0.085	0.035-0.045	0.025-0.085
Vista Road Tributary	0.050-0.100	0.050-0.060	0.050-0.100
West Branch Dorsey Run	0.030-0.100	0.030-0.040	0.013-0.100
Wilde Lake Branch	0.035-0.085	0.035-0.085	0.055-0.085

The profile baselines depicted on the FIRM represent the hydraulic modeling baselines that match the flood profiles on this FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the Special Flood Hazard Area.

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.

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 NGVD 29. With the completion of NAVD 88, many FIS reports and FIRMs are now prepared using NAVD 88 as the referenced vertical datum.

As noted above, the elevations shown in the FIS report and on the FIRM for Howard 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 -0.72. 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 +0.72= NGVD 29

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

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

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.

Floodplain boundaries for the Patuxent River and the Patapsco River were delineated based on the effective hydraulic models produced by the studies referenced in Section 1.2. The effective flood elevations from these models were converted to NAVD 88, and floodplain boundaries were redelineated using the TIN based on LIDAR data provided by MDNR (Reference 15).

For all other streams included in this report, the floodplain boundaries have been delineated using the flood elevations determined at each cross section, using the hydraulic methods referenced in Section 3.2. Between cross sections the boundaries were interpolated using the TIN based on LIDAR data provided by MDNR (Reference 15).

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. Howard 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. No base flood elevations or depths are shown within this zone.

Zone X (Future)

Zone X is the flood insurance rate zone that corresponds to areas of future conditions 1-percent annual chance flood. No base flood elevations or depths are shown within this zone.

Shaded Zone X

Shaded Zone X is the flood insurance rate zone that corresponds to areas within the 0.2-percent annual chance floodplain; areas of 1-percent annual chance flooding where average depths are less than 1 foot; areas of 1-percent annual chance flooding where the contributing drainage area is less than 1 square mile; and areas protected by levees from the 1- percent annual chance flood. No base flood elevations or 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 Howard 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 Howard 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 7, “Community Map History.”

7.0 OTHER STUDIES

This is a multi-volume FIS. Each volume may be revised separately, in which case it supersedes the previously printed volume. Users should refer to the Table of Contents in Volume 1 for the current effective date of each volume; volumes bearing these dates contain the most up-to-date flood hazard data.

COMMUNITY NAME	INITIAL NFIP MAP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Howard County (Unincorporated Areas)	March 15, 1977	None	March 15, 1977	December 4, 1986 April 2, 1997

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD AND INCORPORATED AREAS

COMMUNITY MAP HISTORY

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 following studies in adjacent communities:

Montgomery County, MD and Incorporated Areas:

Effective September 29, 2006

Frederick County, MD, and Incorporated Areas:

Effective September 18, 2007

Baltimore County, MD (Unincorporated Areas):

Effective September 26, 2008

Anne Arundel County, MD, and Incorporated Areas:

Countywide study currently in progress

Carroll County, MD, and Incorporated Areas:

Countywide study currently in progress

Prince George's County, MD, and Incorporated Areas:

Countywide study currently in progress

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.

9.0 BIBLIOGRAPHY AND REFERENCES

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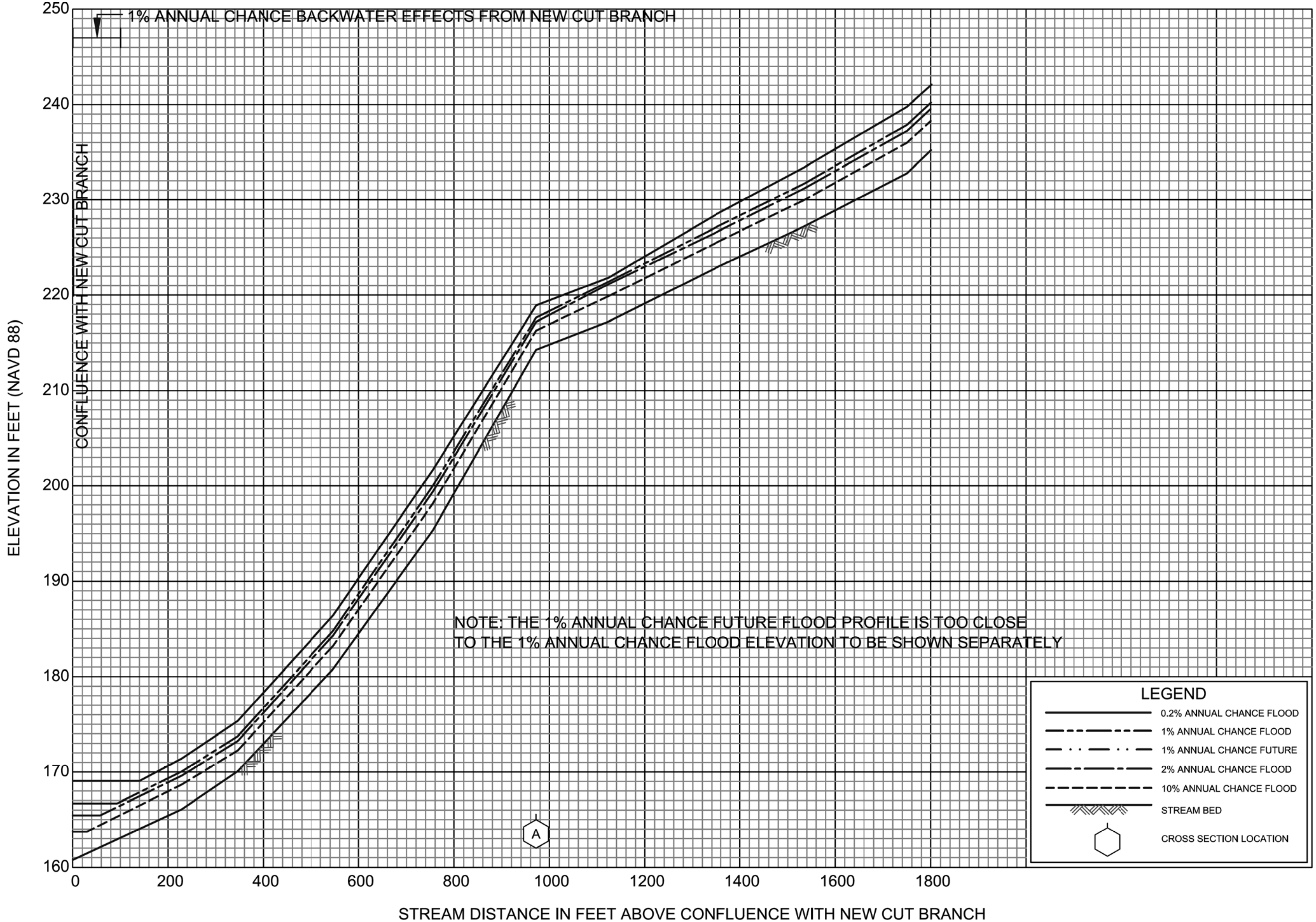


FLOOD PROFILES

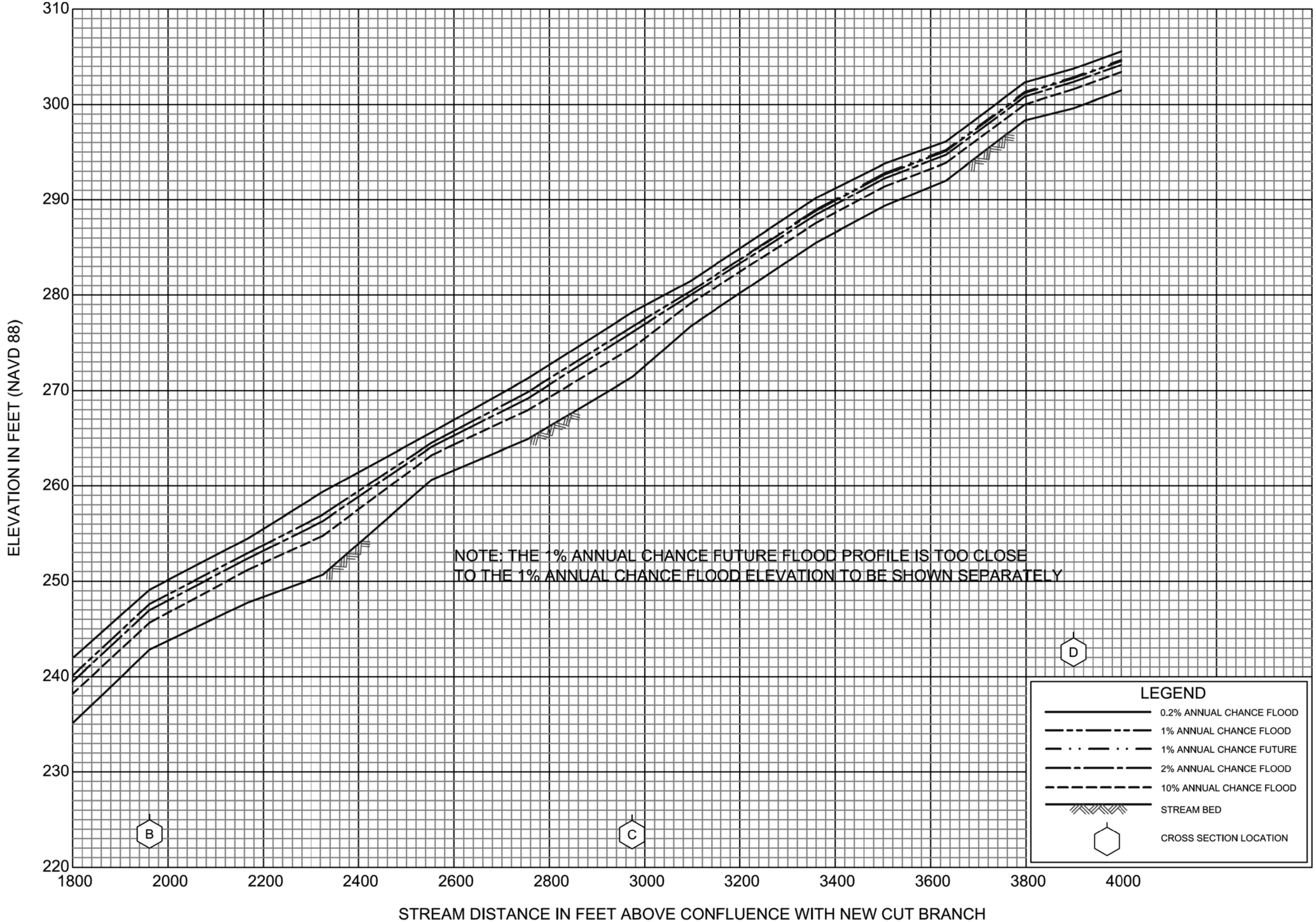
AUTUMN HILL BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

01P



FLOOD PROFILES

AUTUMN HILL BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

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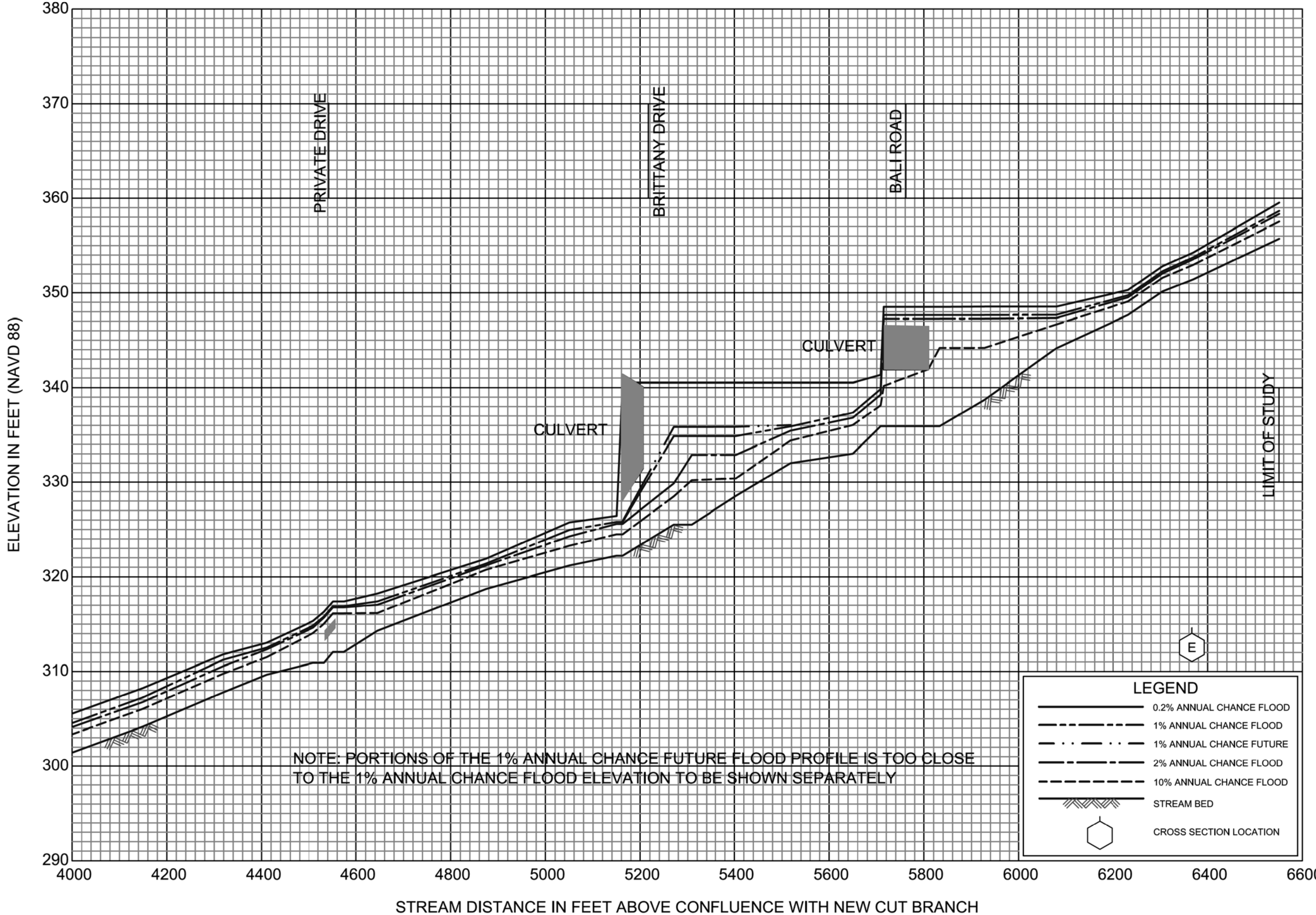


FLOOD PROFILES

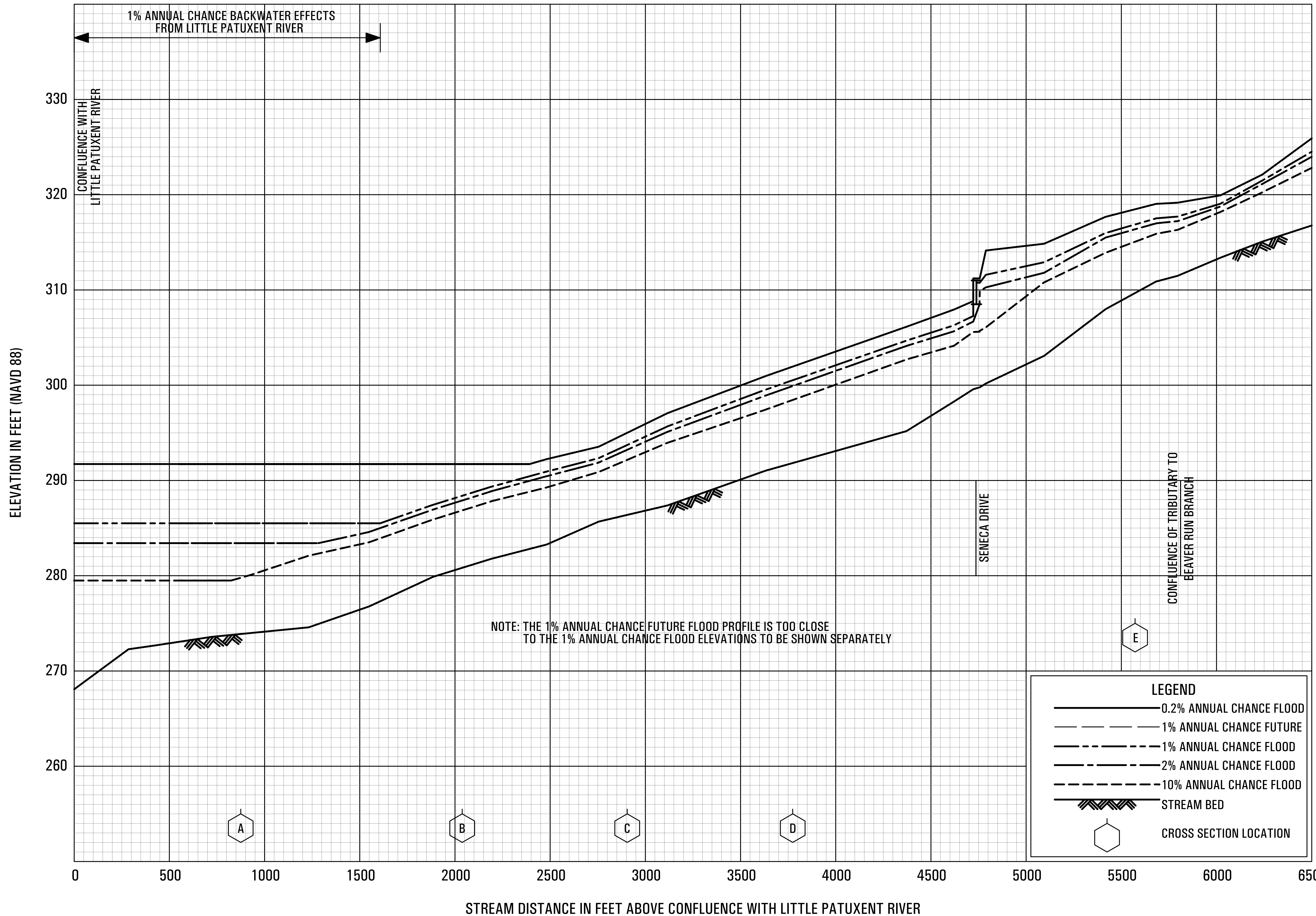
AUTUMN HILL BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

03P



FLOOD PROFILES

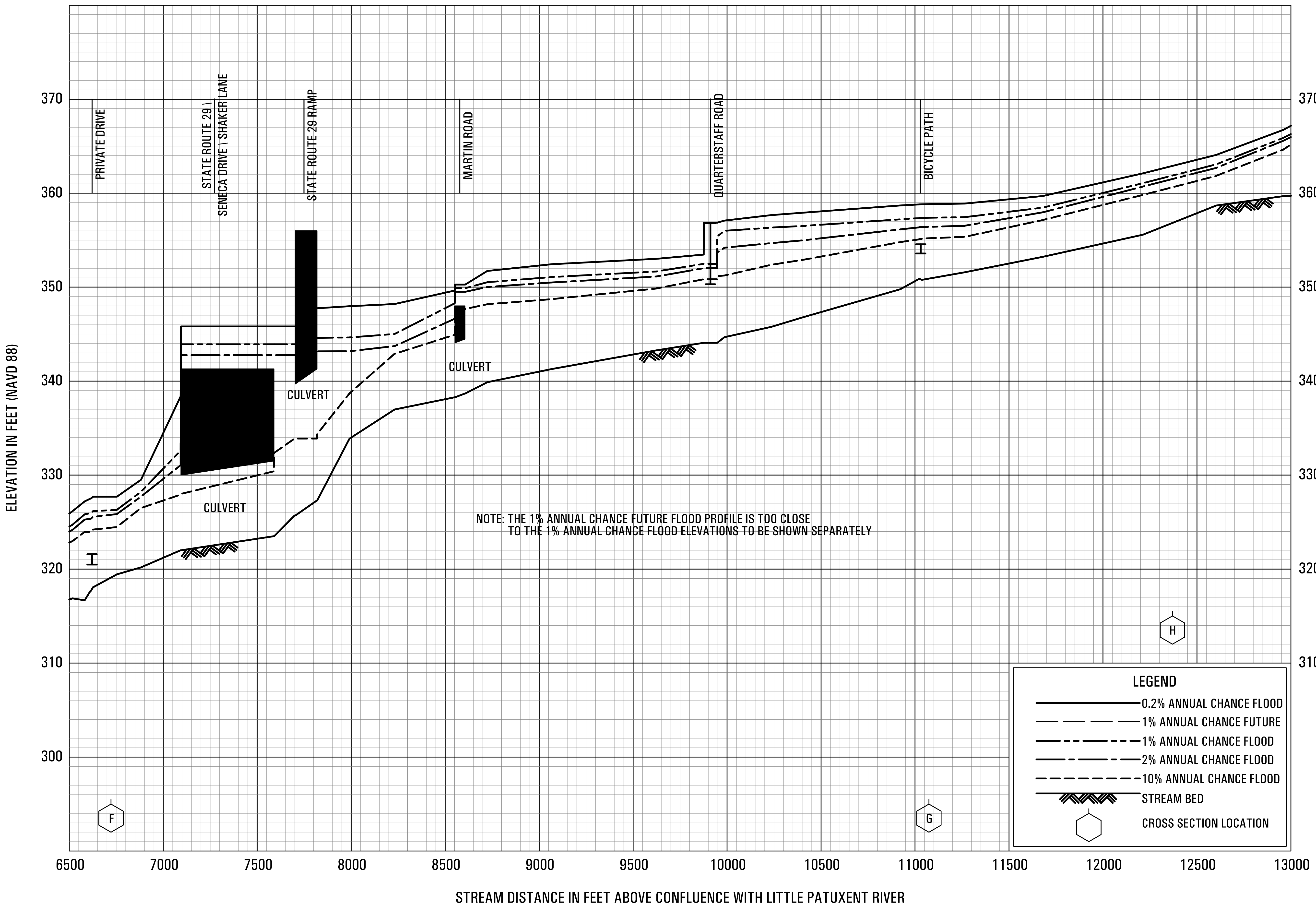
BEAVER RUN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

04P



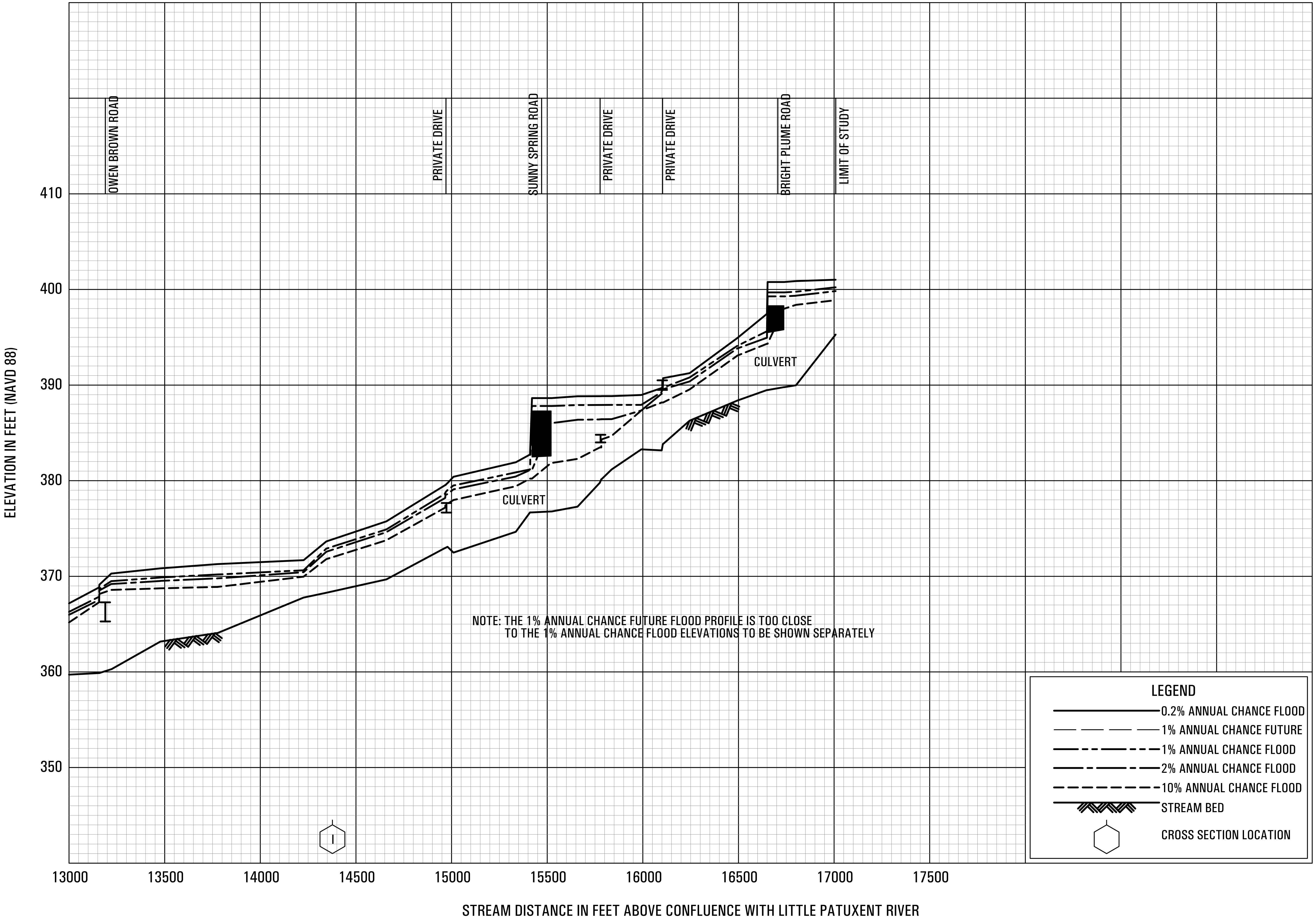
FLOOD PROFILES

BEAVER RUN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



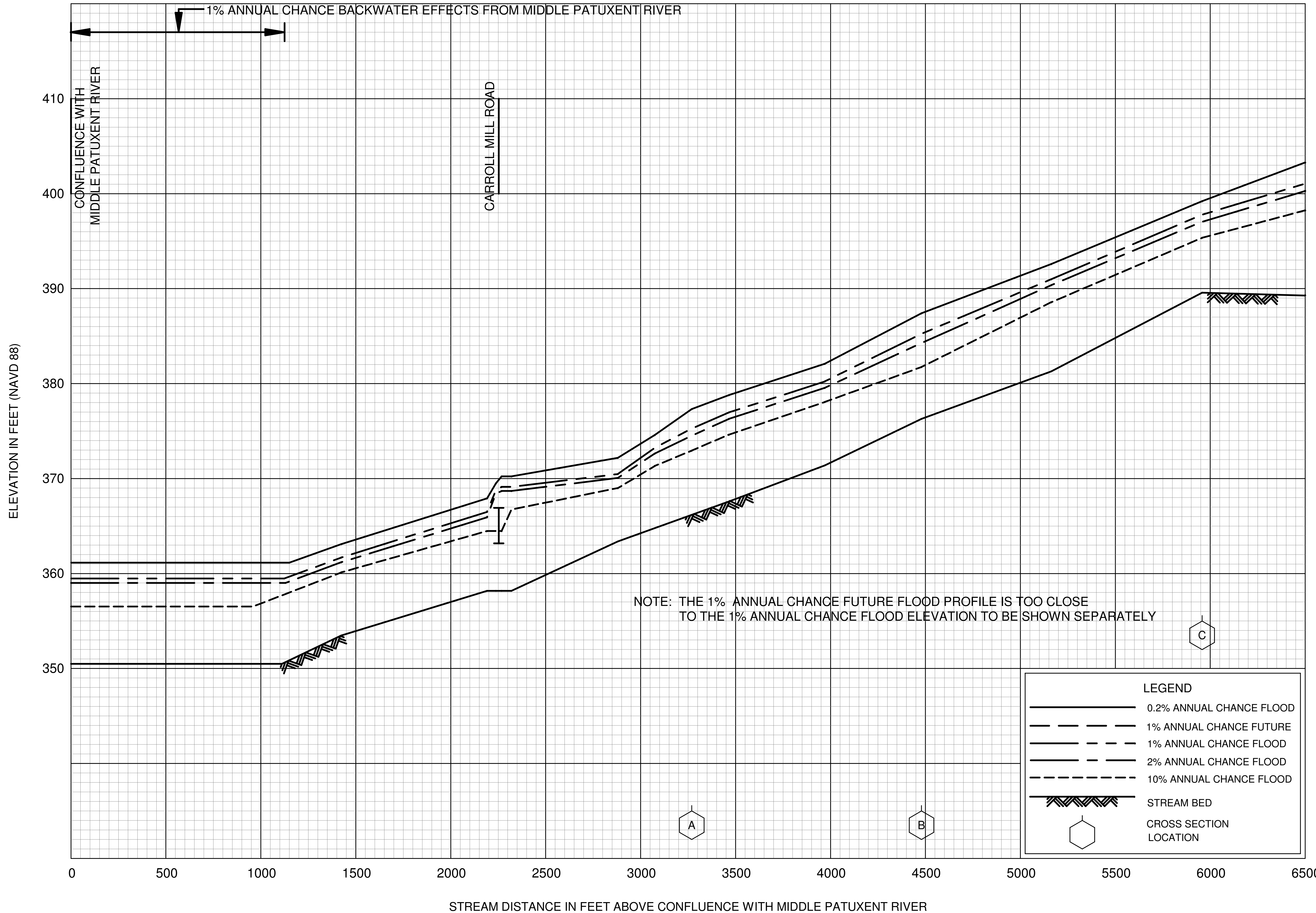
FLOOD PROFILES

BEAVER RUN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

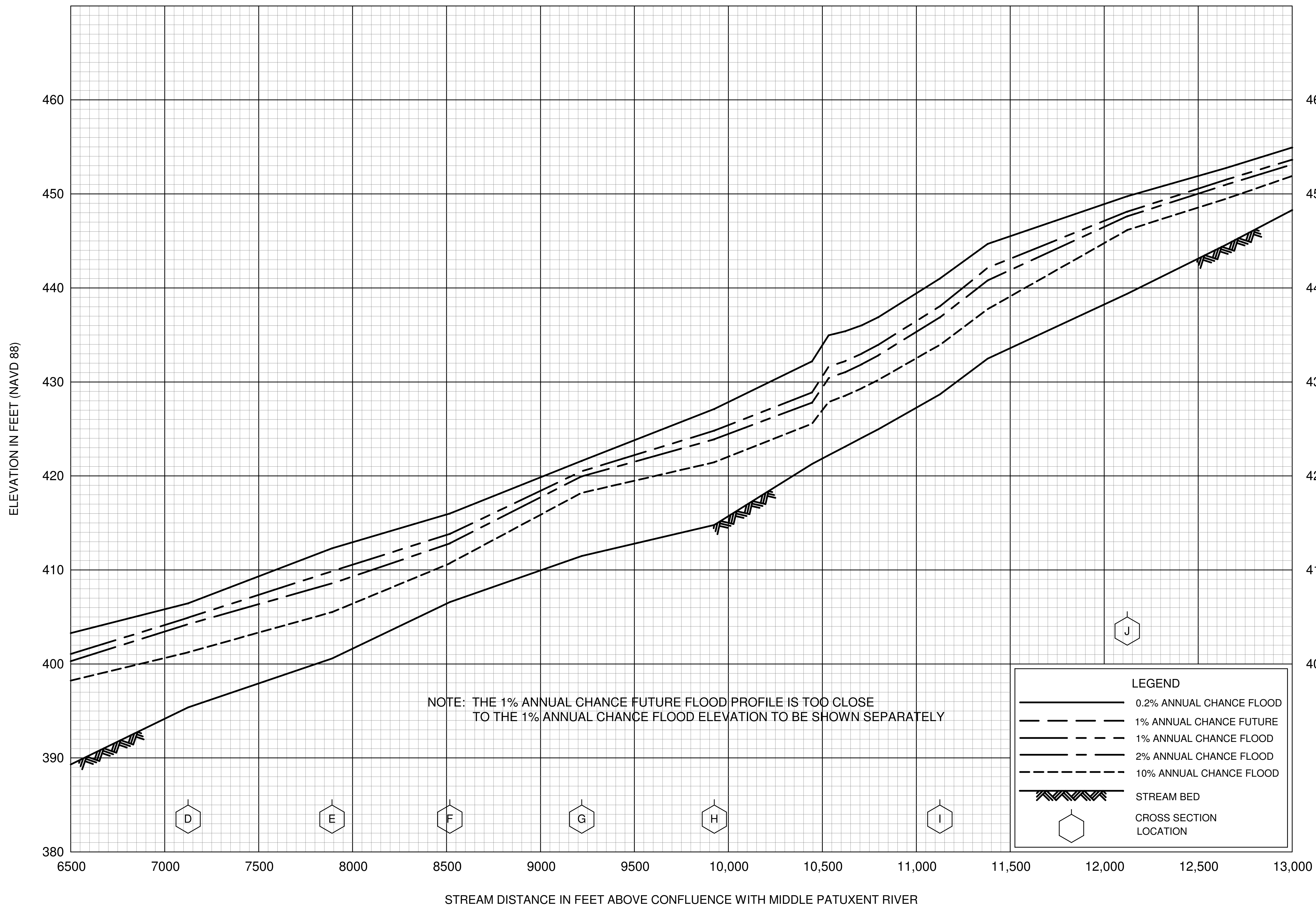
BENSON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

07P



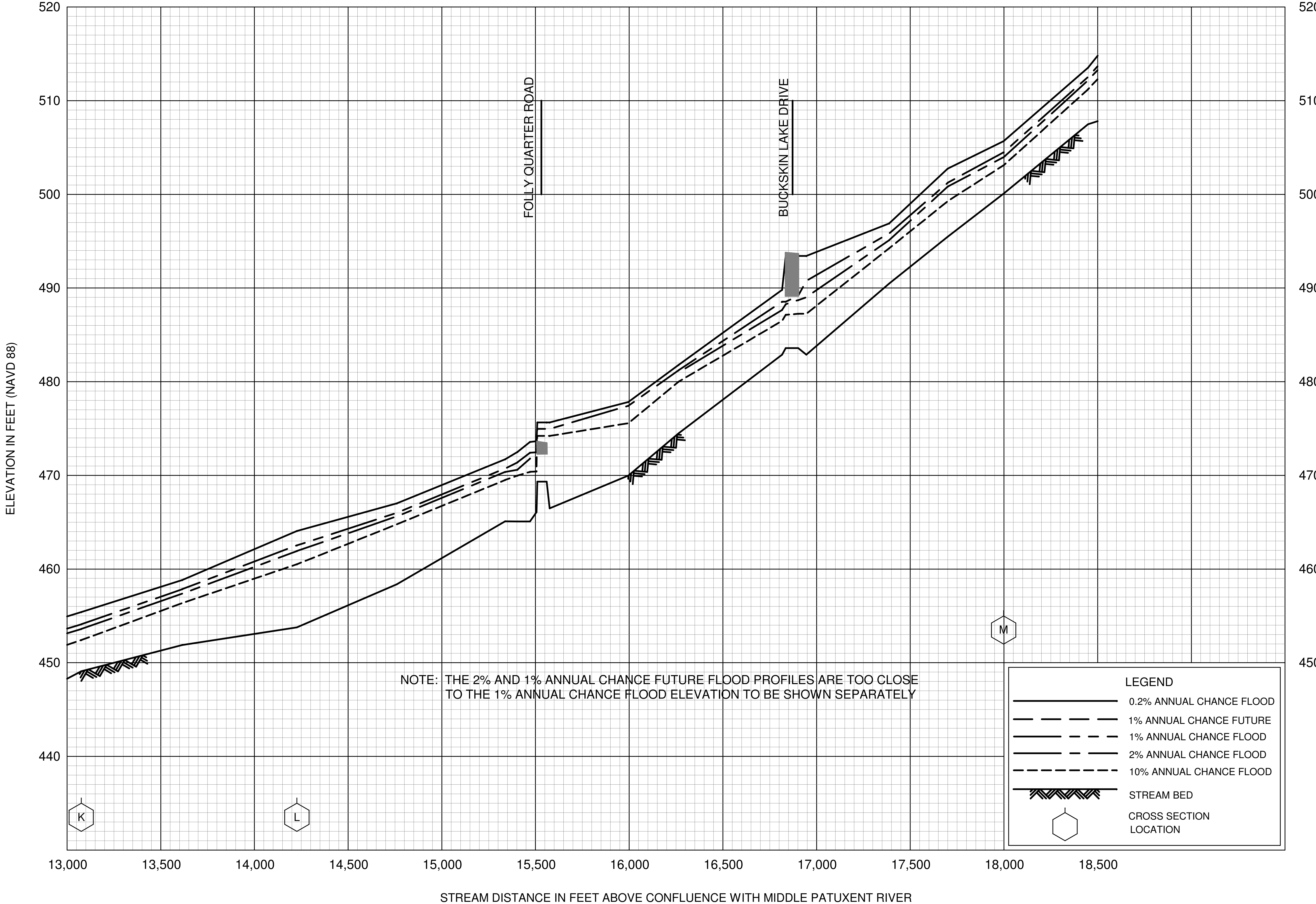
FLOOD PROFILES

BENSON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



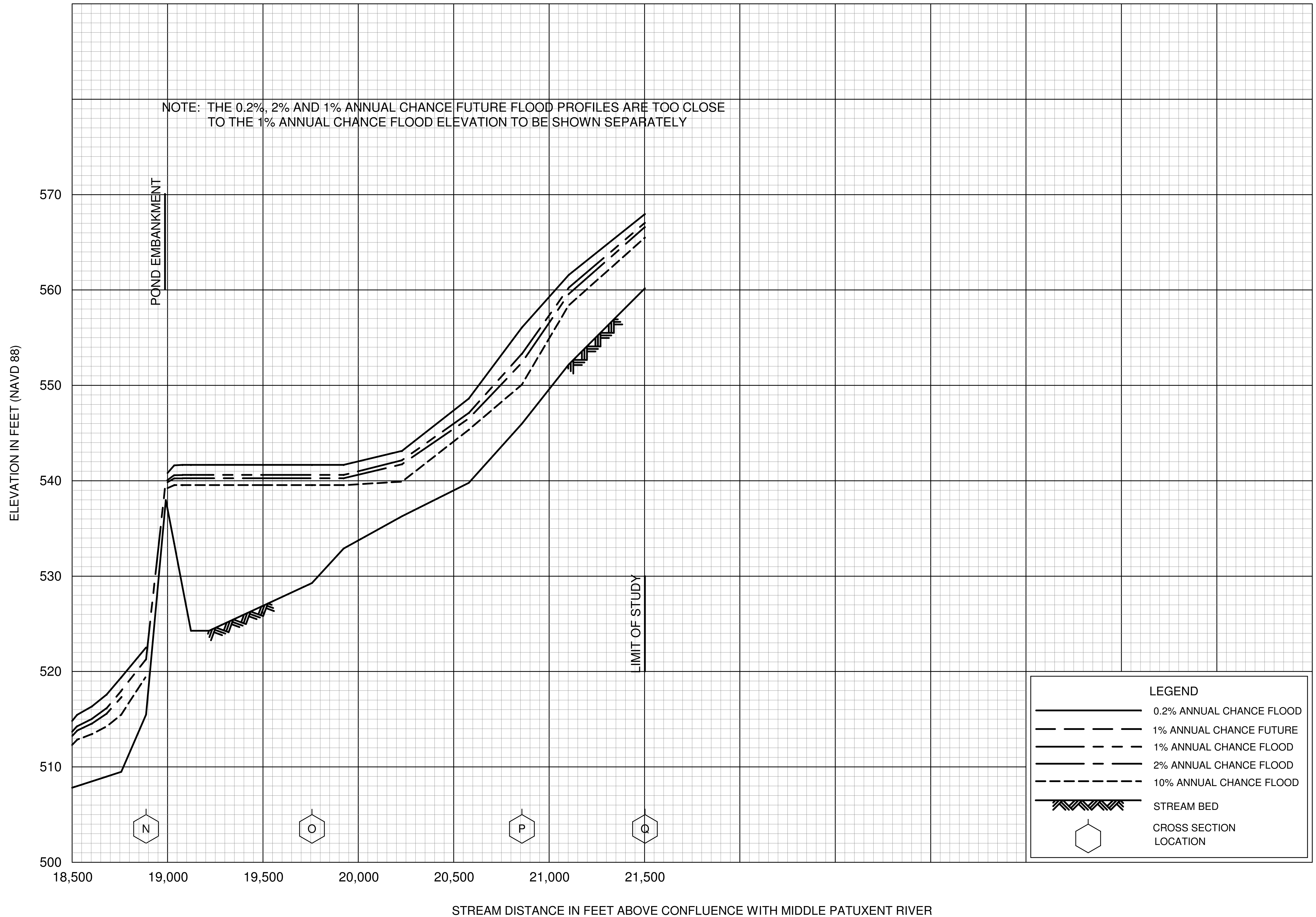
FLOOD PROFILES

BENSON BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

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HOWARD COUNTY, MD

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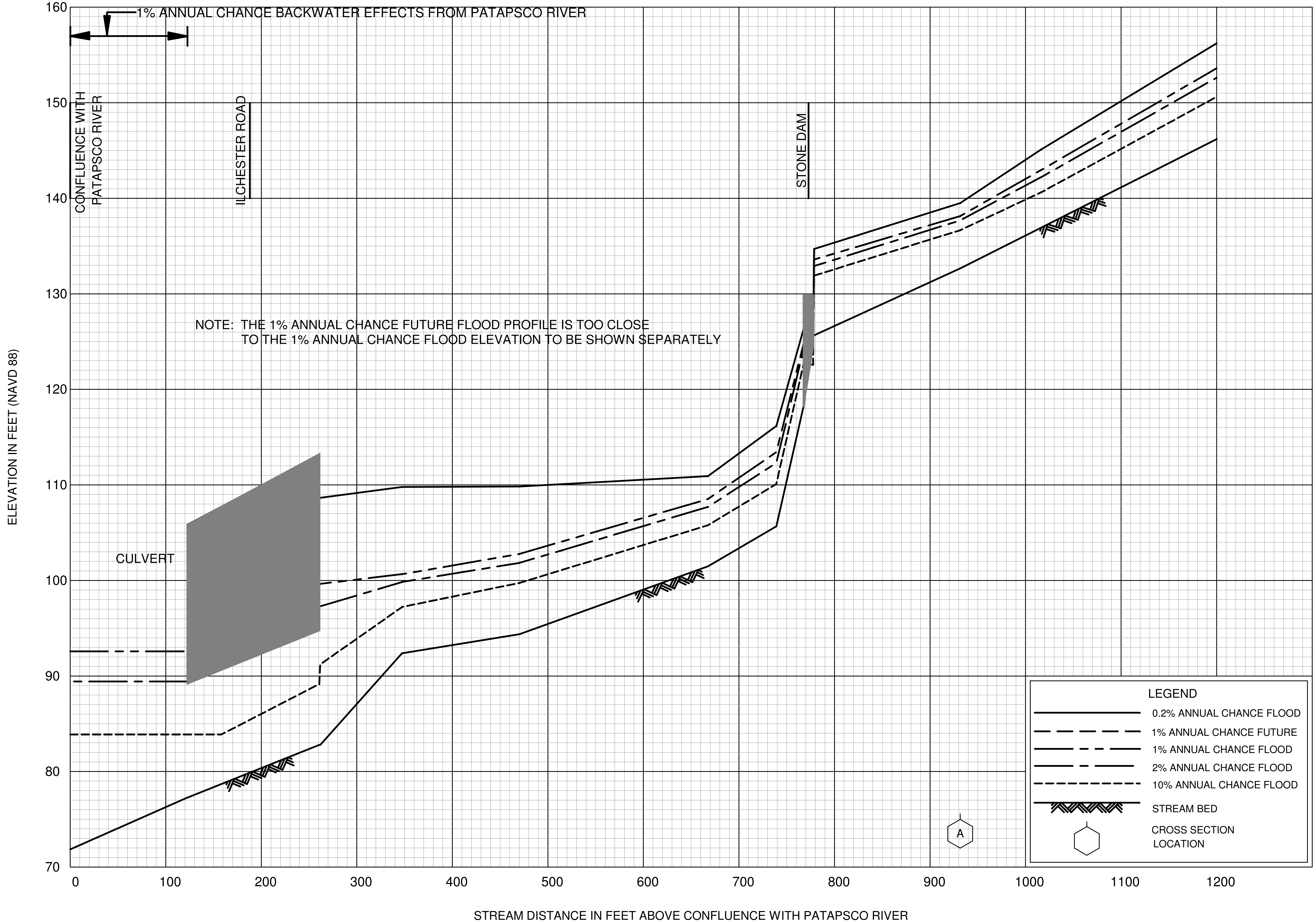

FLOOD PROFILES

BONNIE BRANCH

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HOWARD COUNTY, MD

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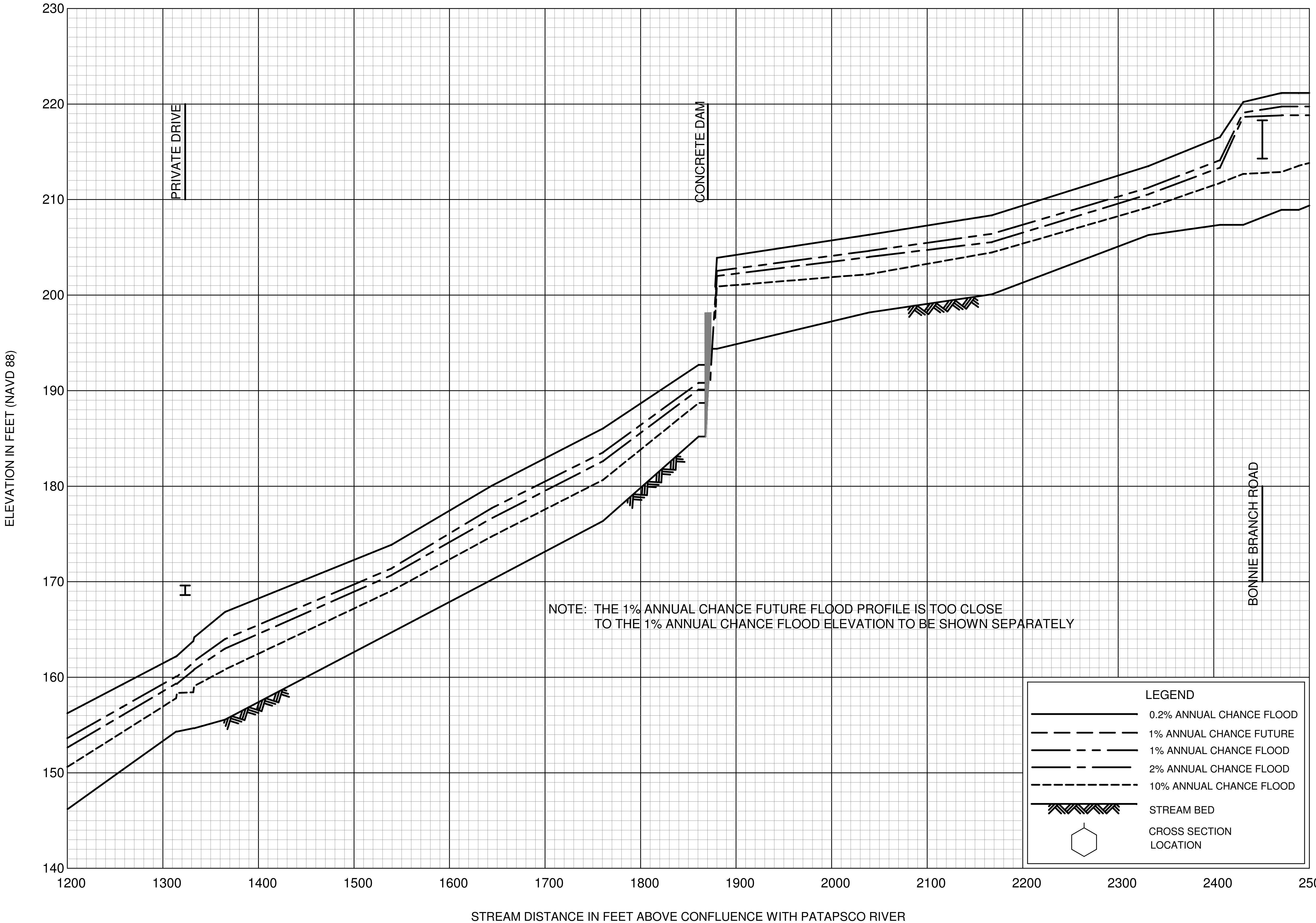

FLOOD PROFILES

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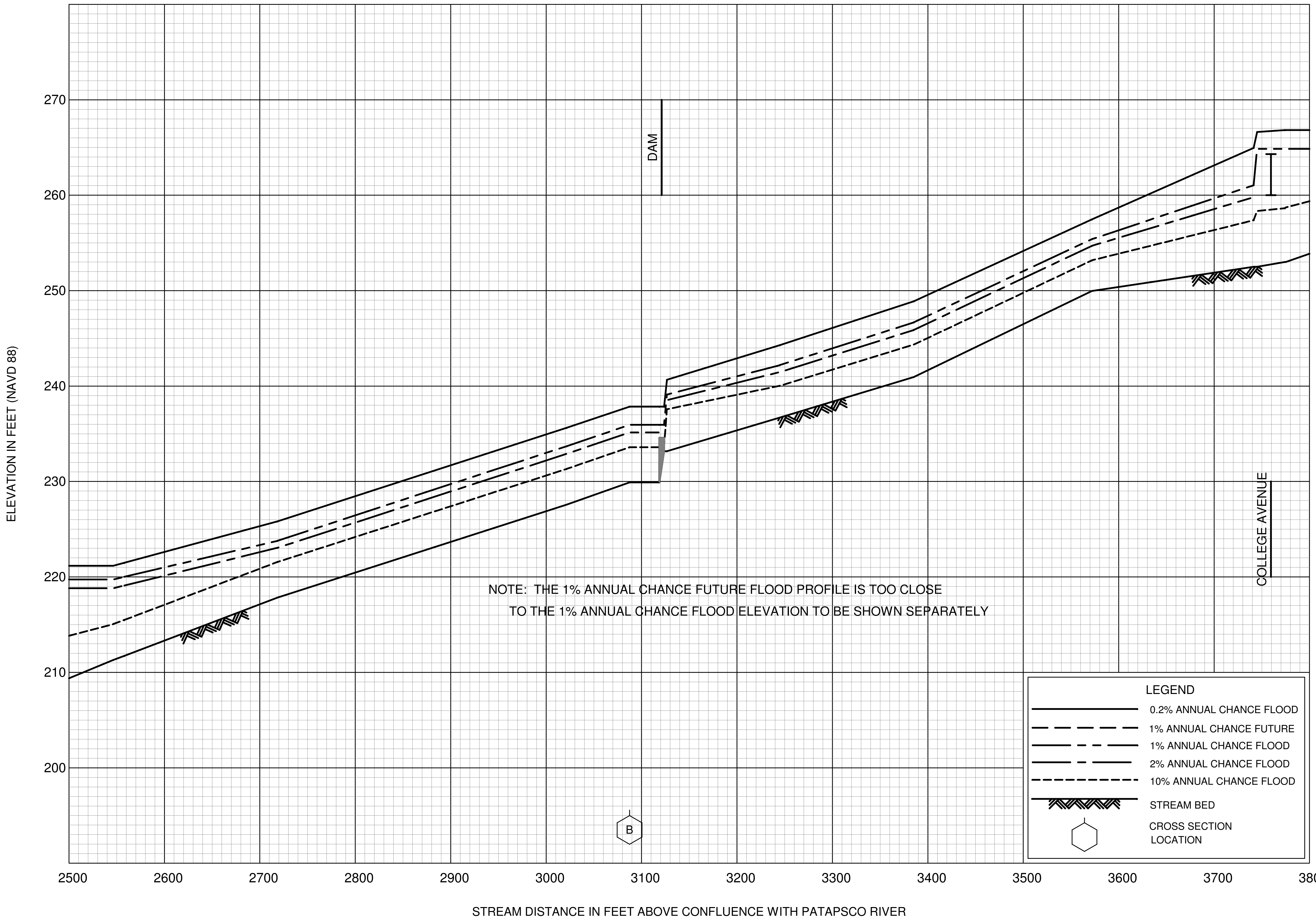

FLOOD PROFILES

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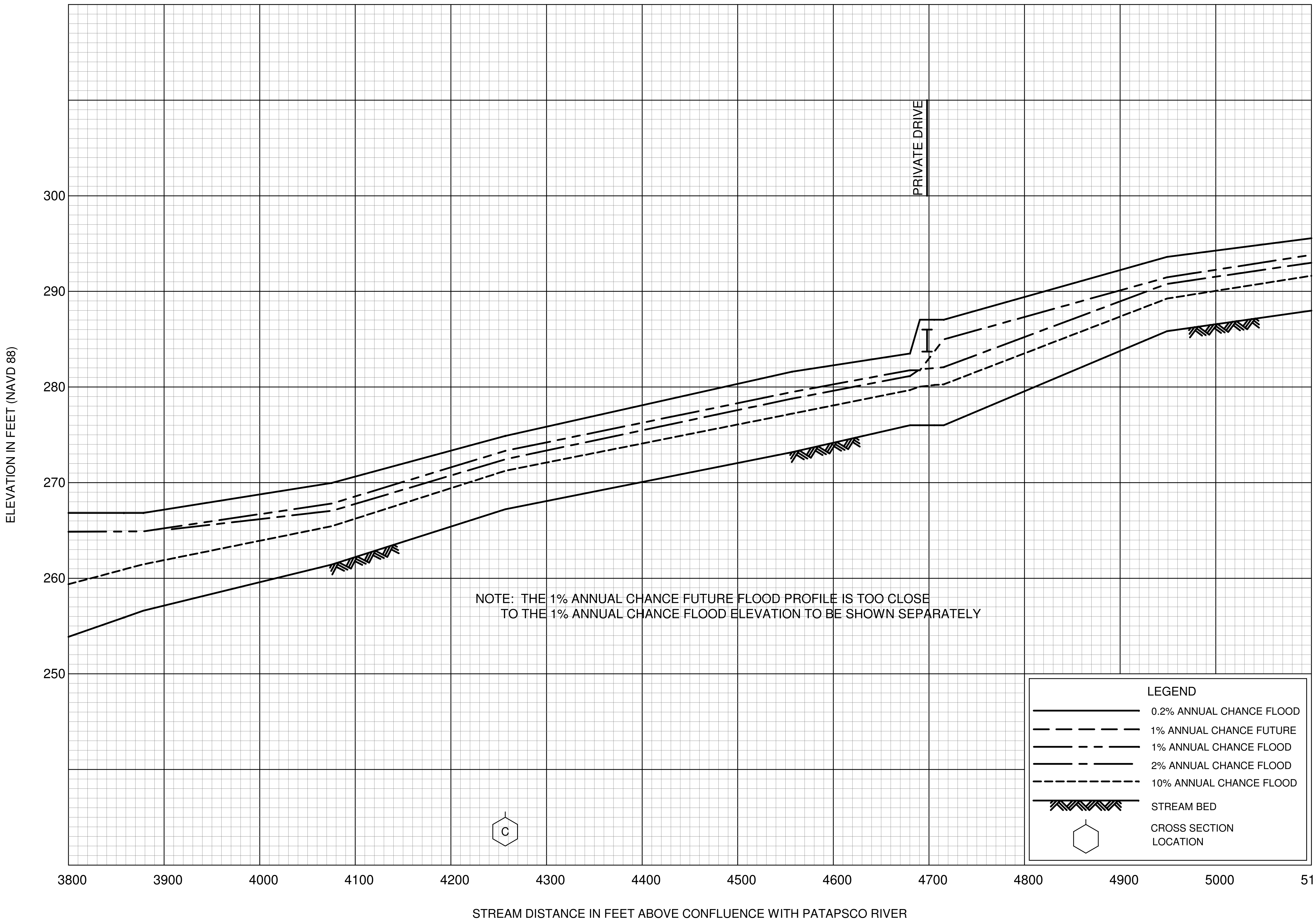

FLOOD PROFILES

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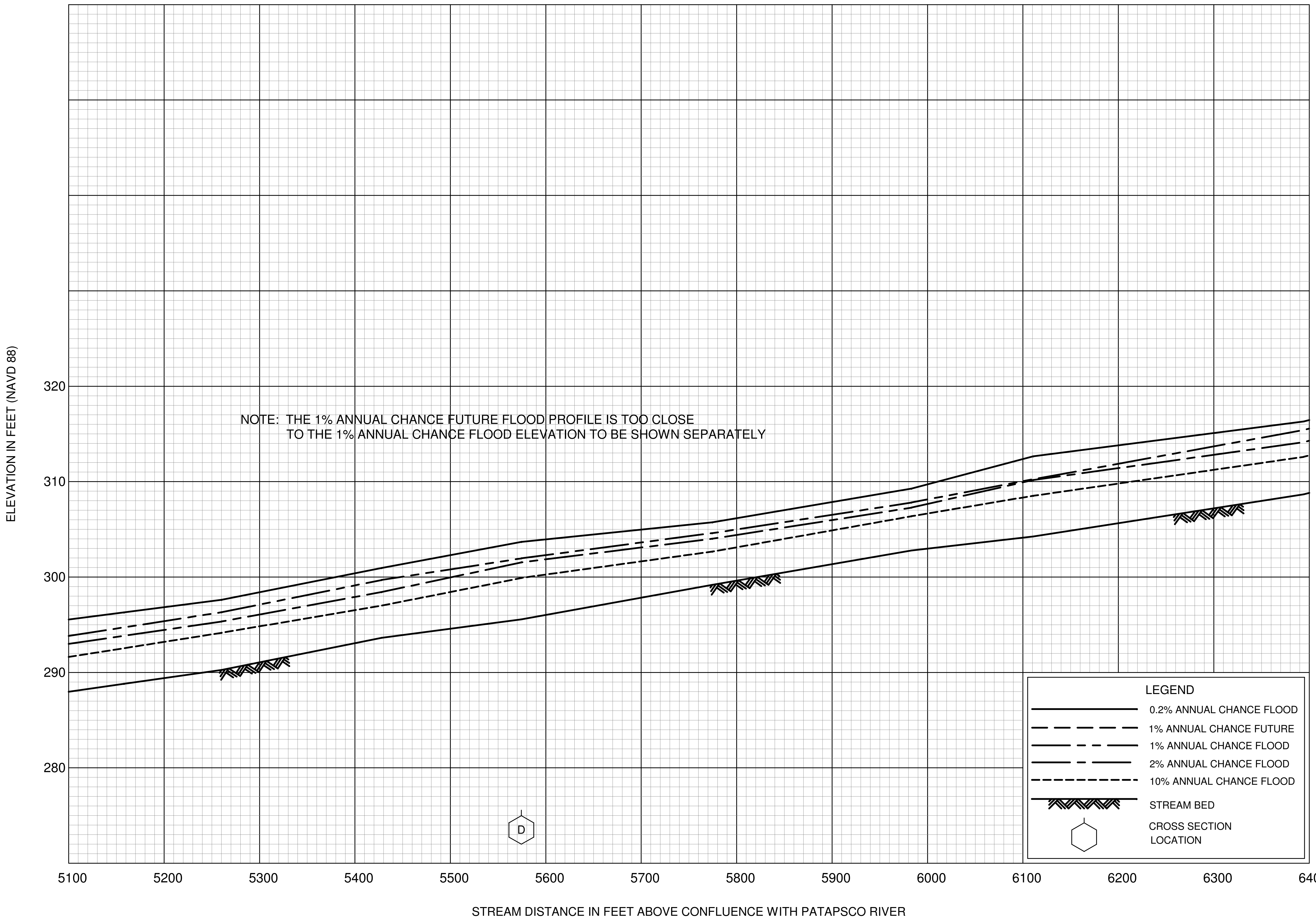

FLOOD PROFILES

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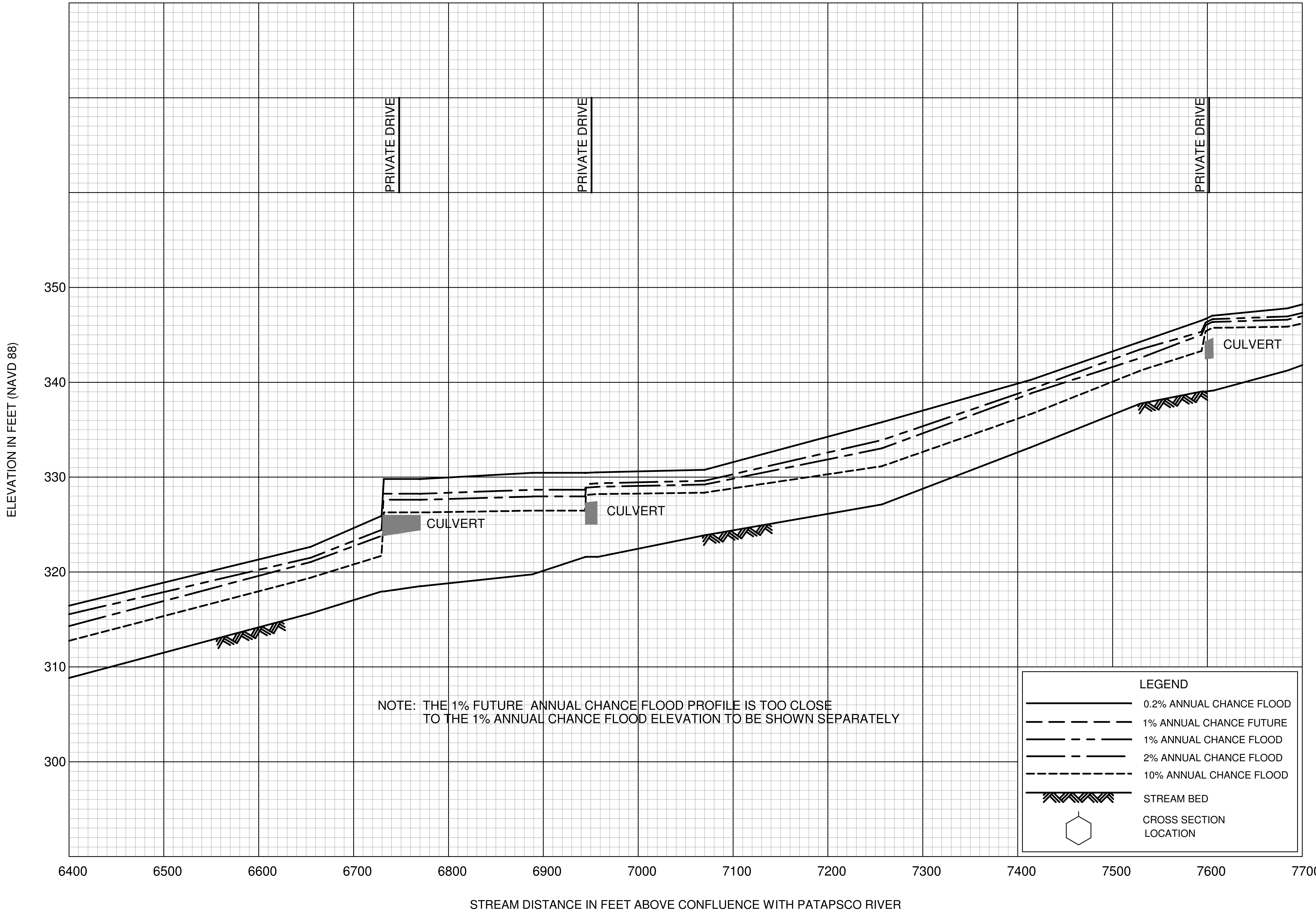

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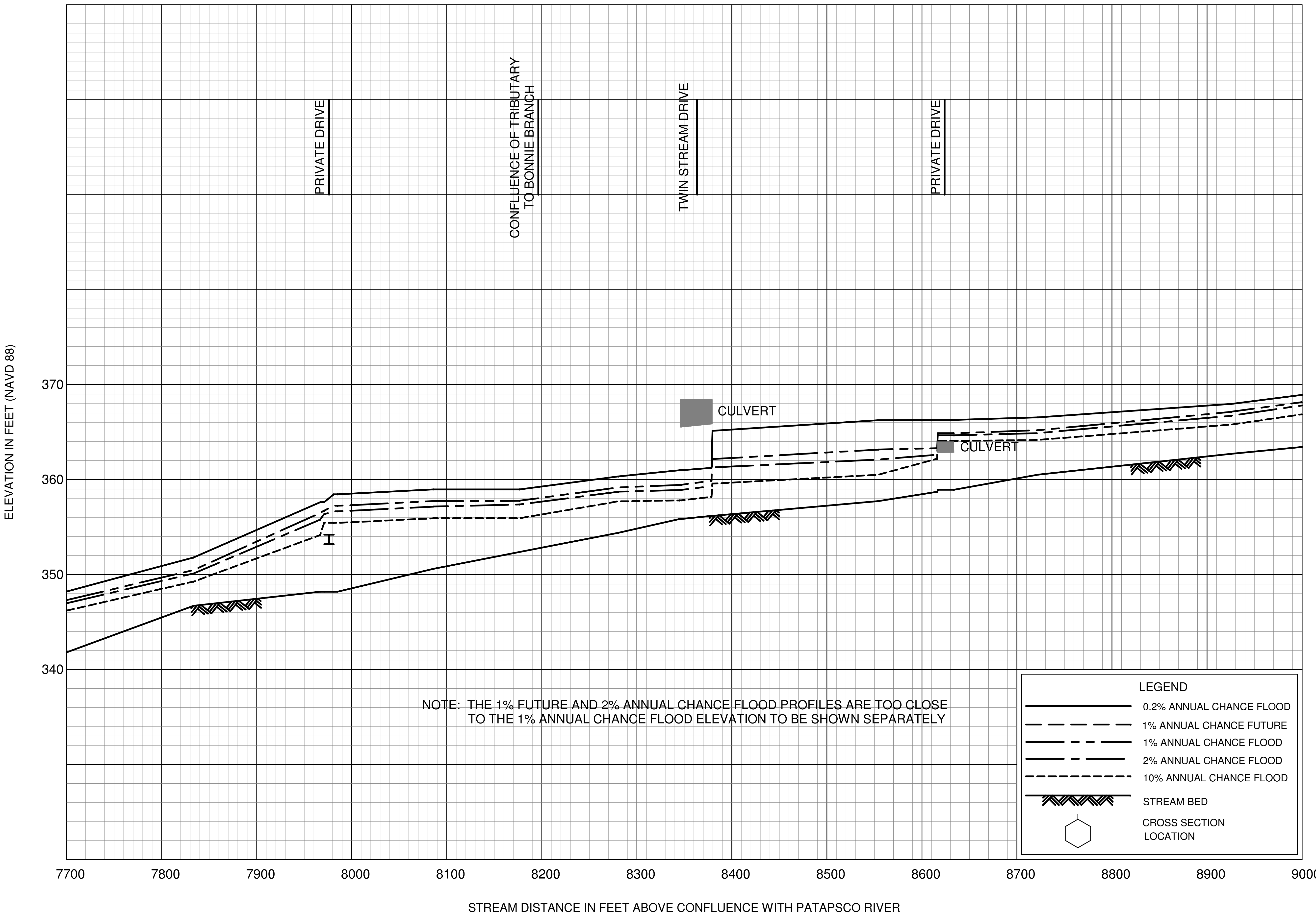

FLOOD PROFILES

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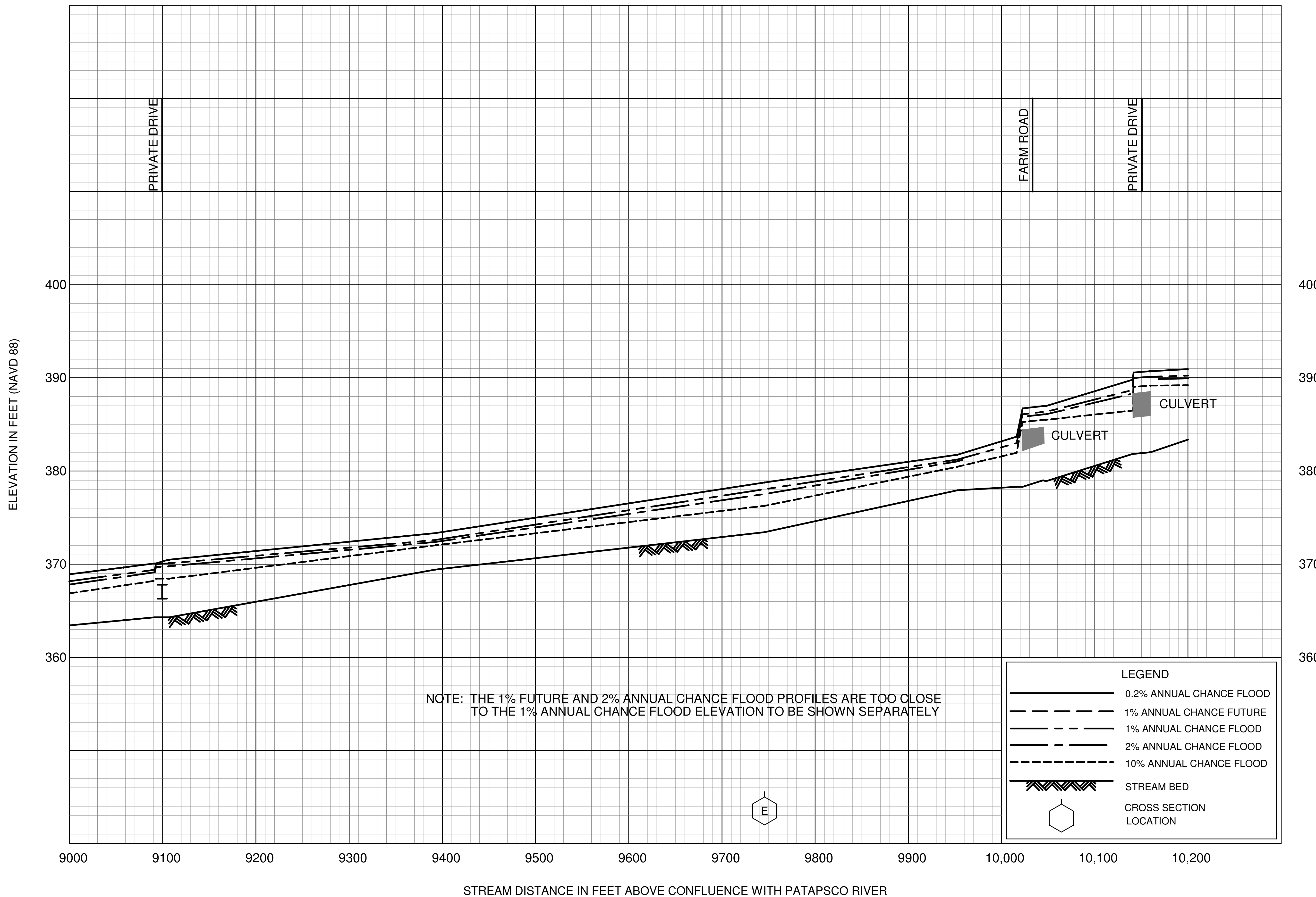

FLOOD PROFILES

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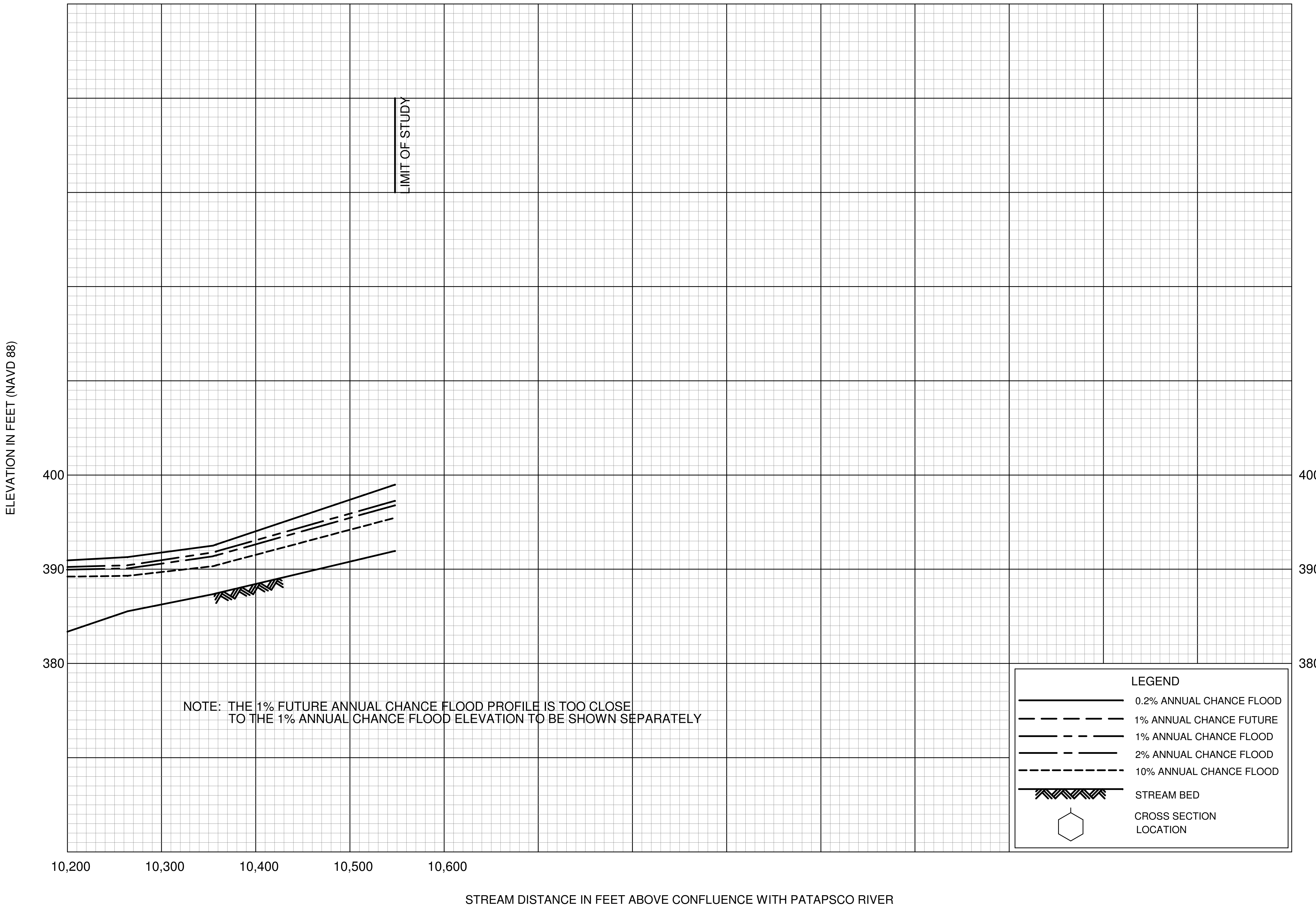

FLOOD PROFILES

BONNIE BRANCH

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HOWARD COUNTY, MD

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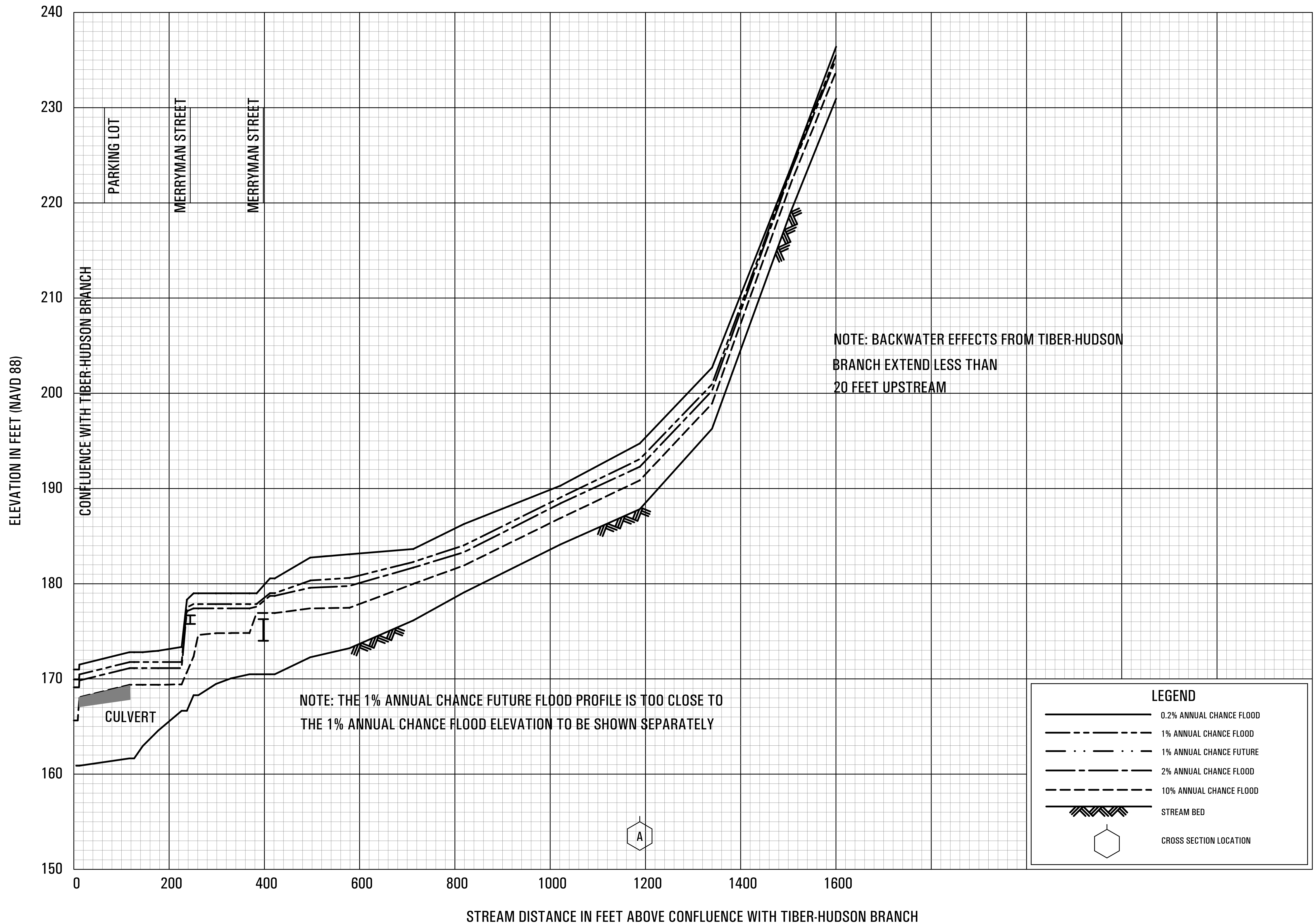


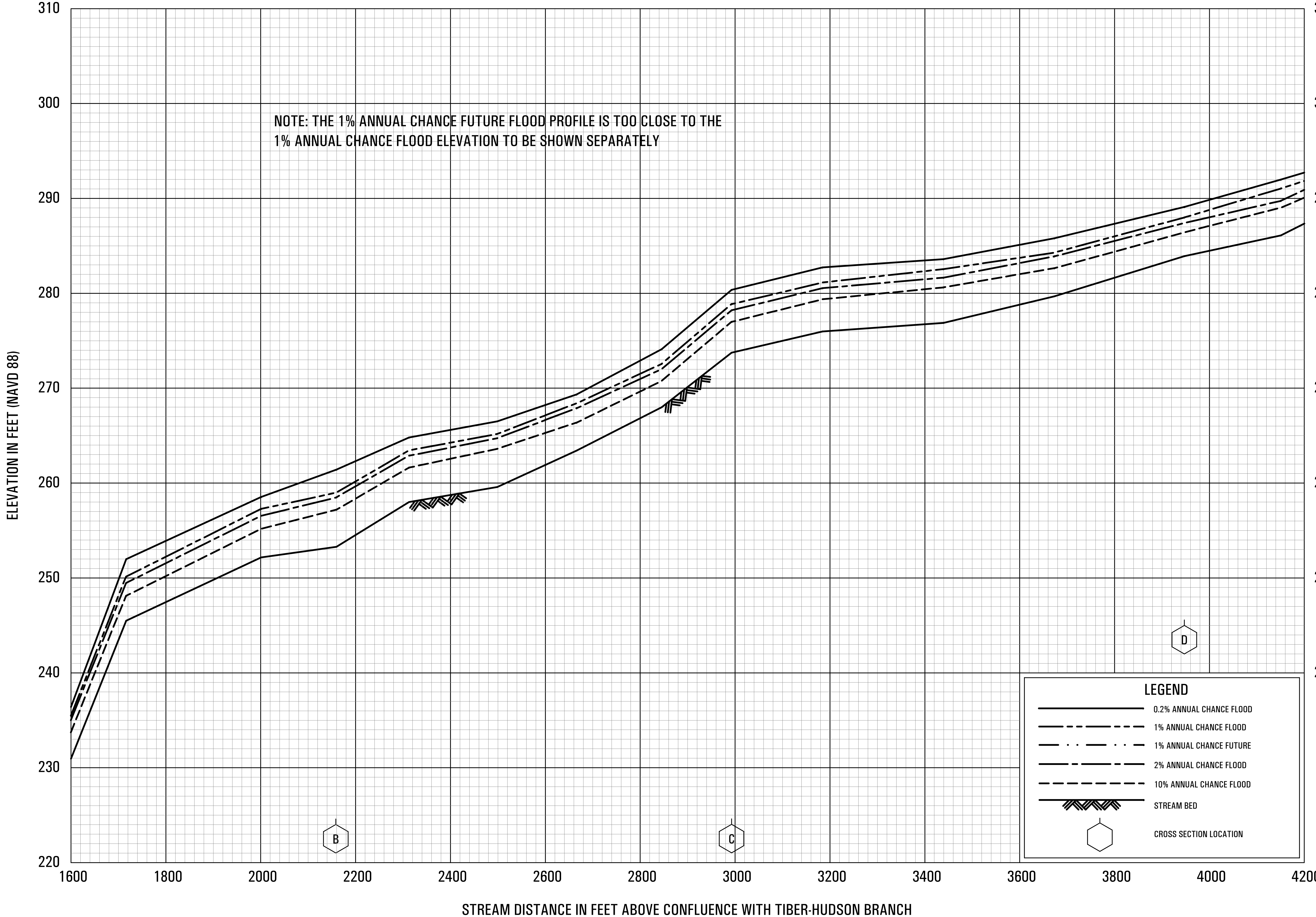
FLOOD PROFILES

CAT ROCK RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

CAT ROCK RUN

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HOWARD COUNTY, MD

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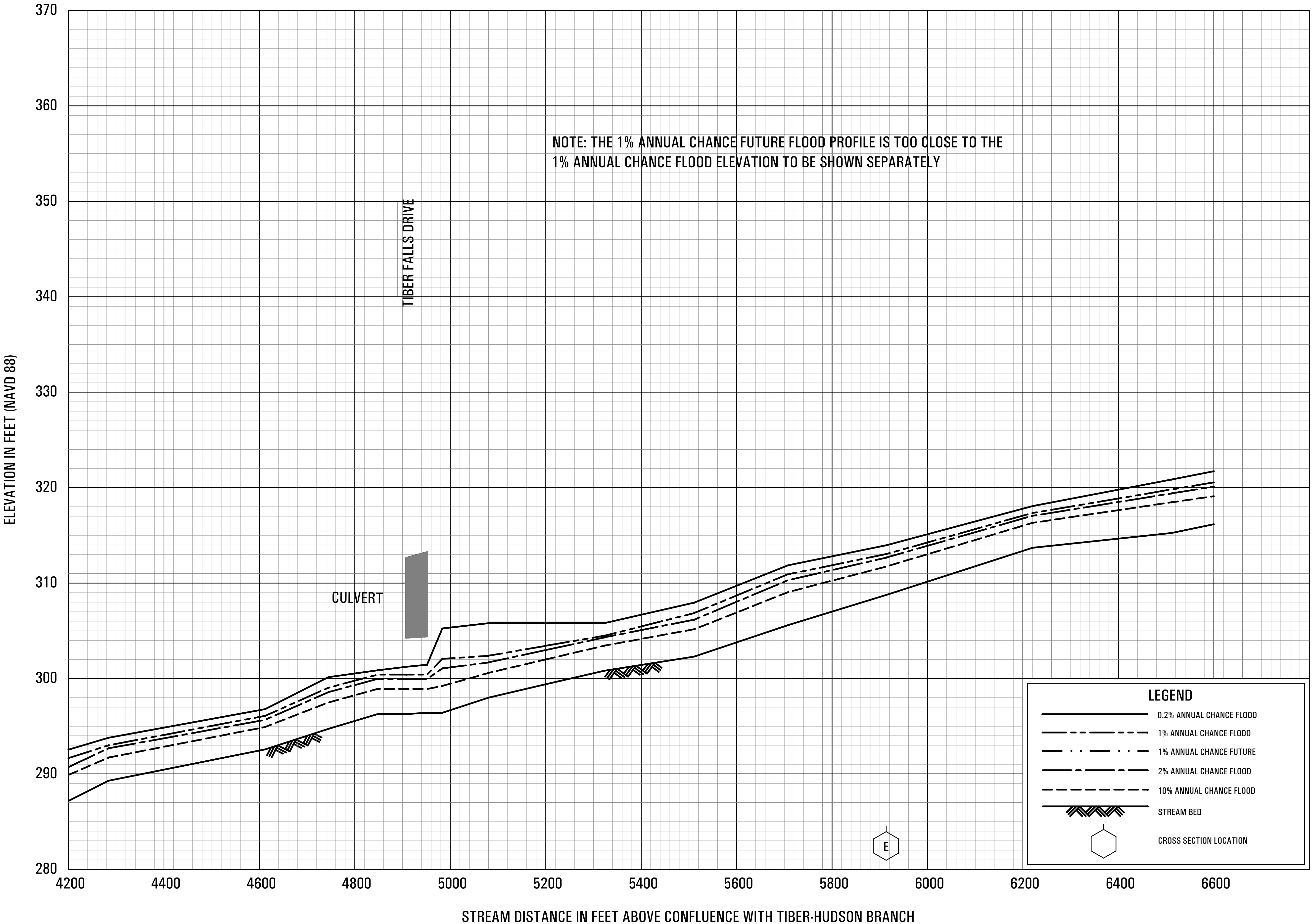


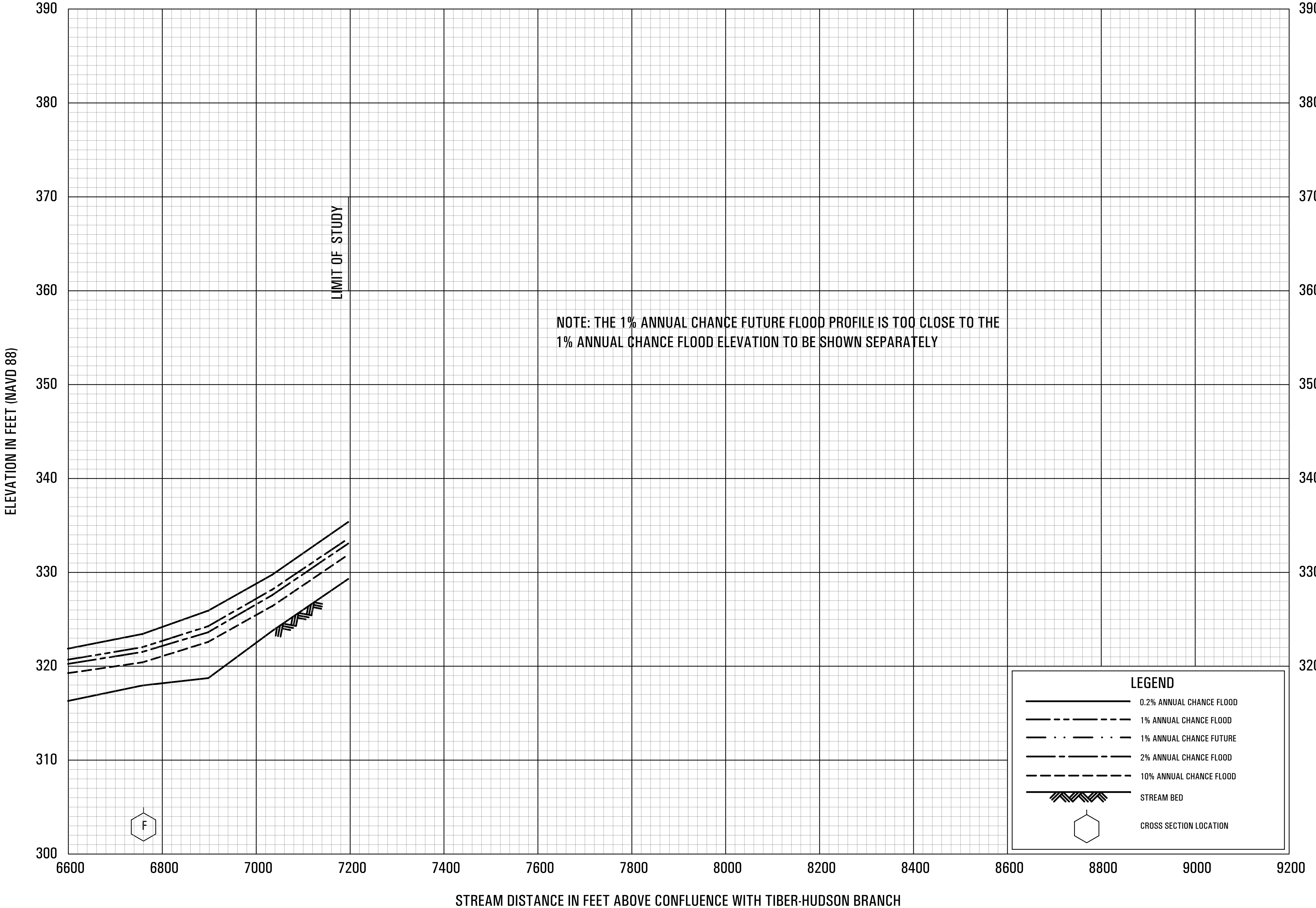
FLOOD PROFILES

CAT ROCK RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



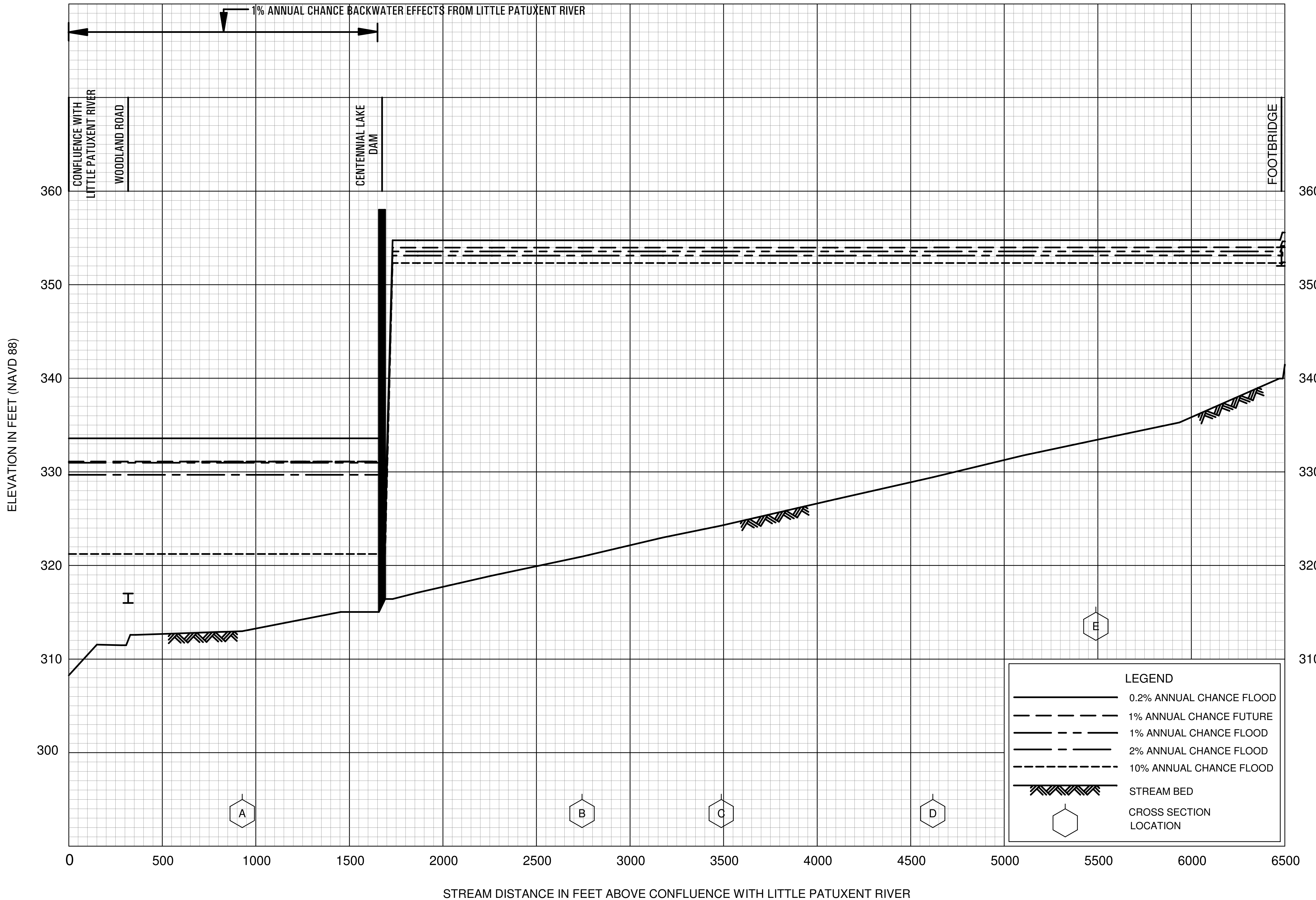
FLOOD PROFILES

CAT ROCK RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



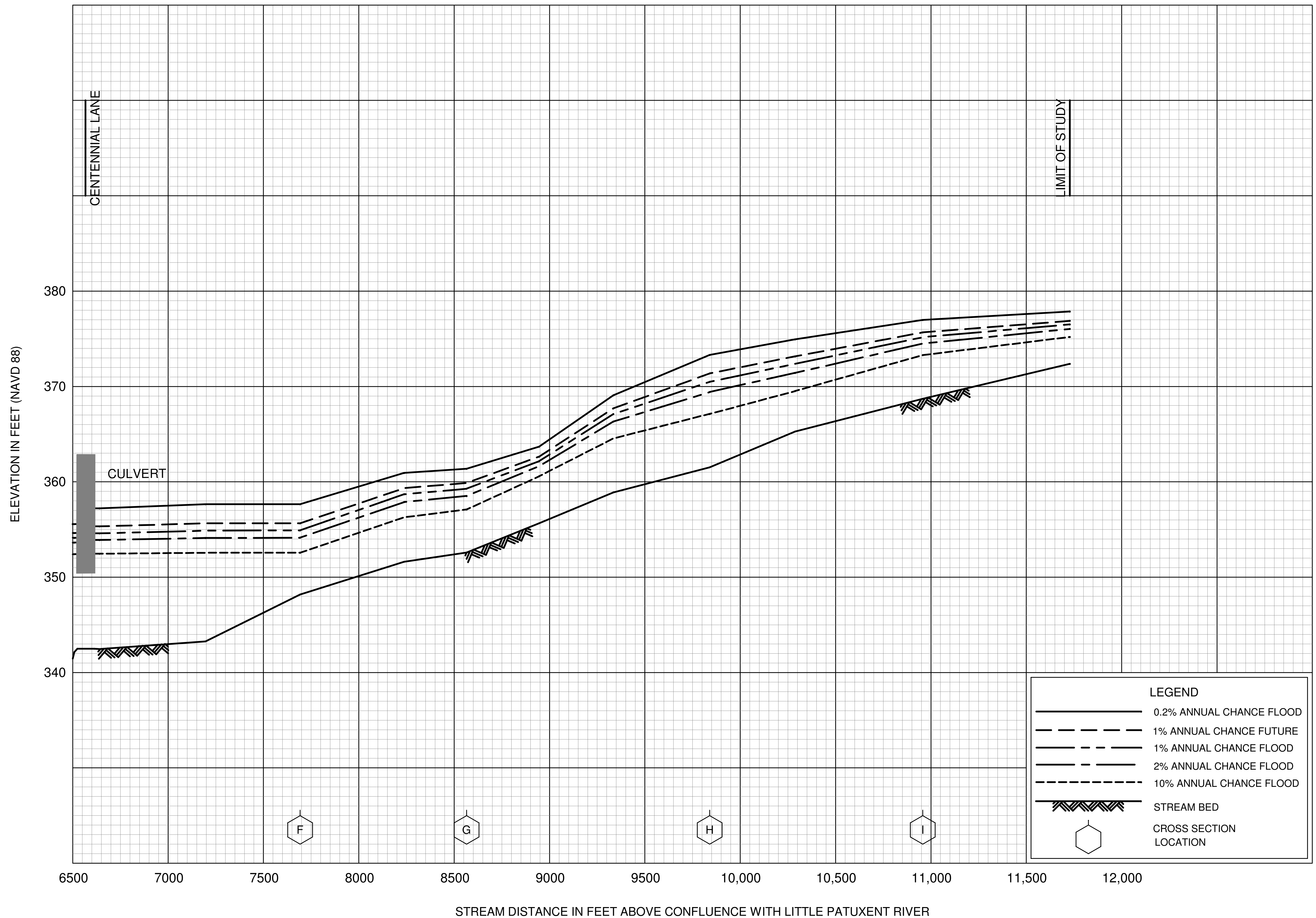
FLOOD PROFILES

CLARK'S CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



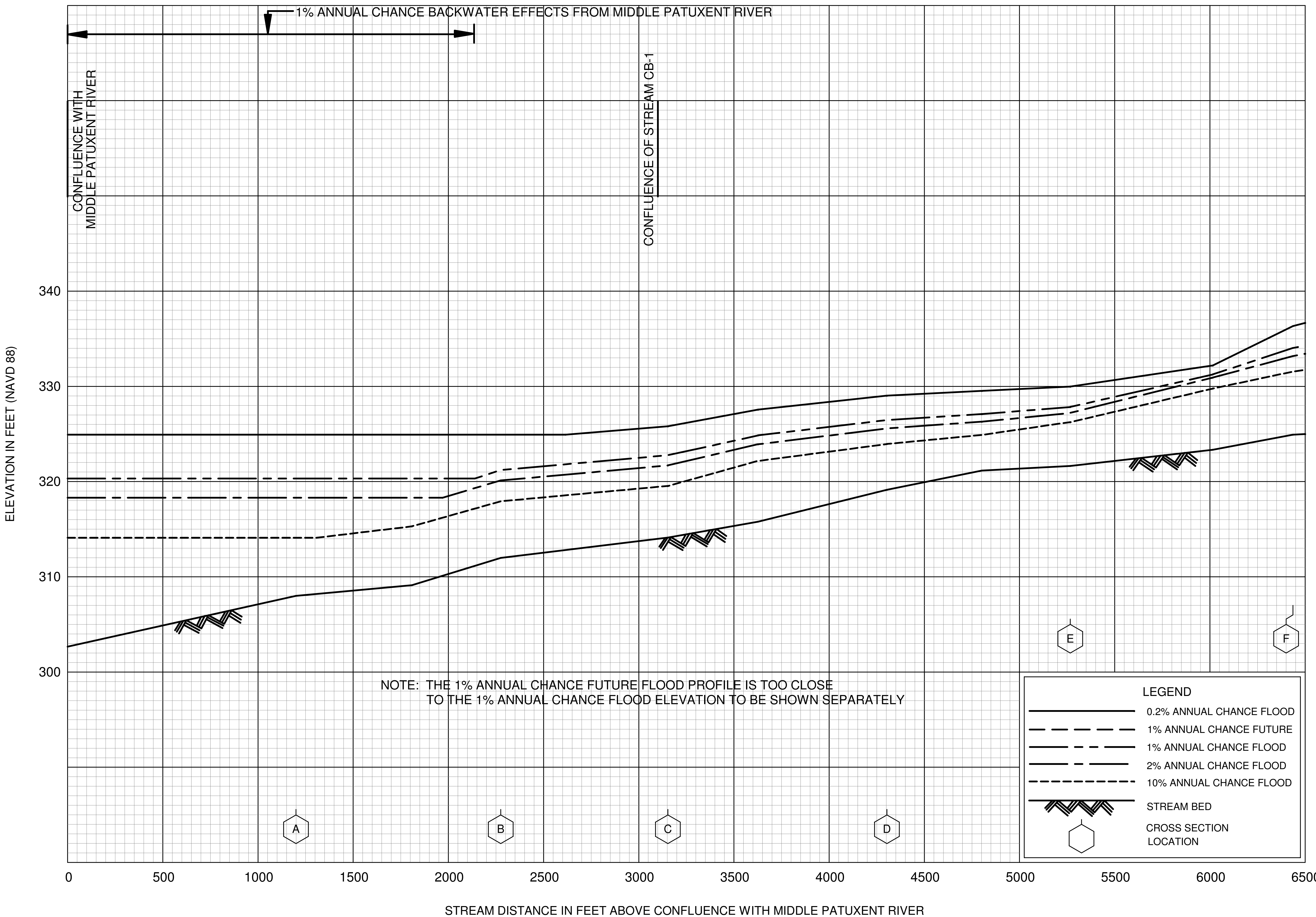
FLOOD PROFILES

CLARK'S CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



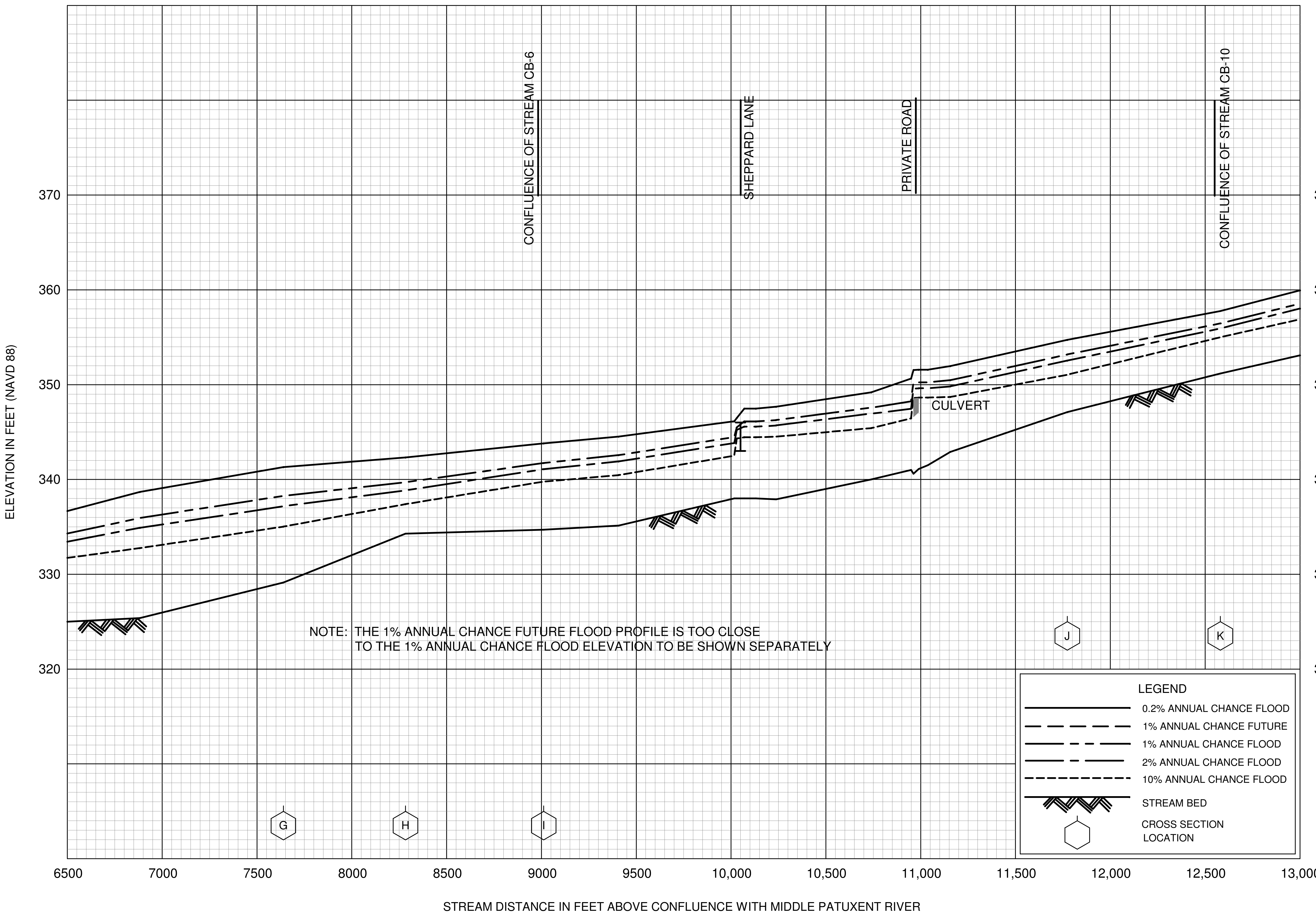
FLOOD PROFILES

CLYDES BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



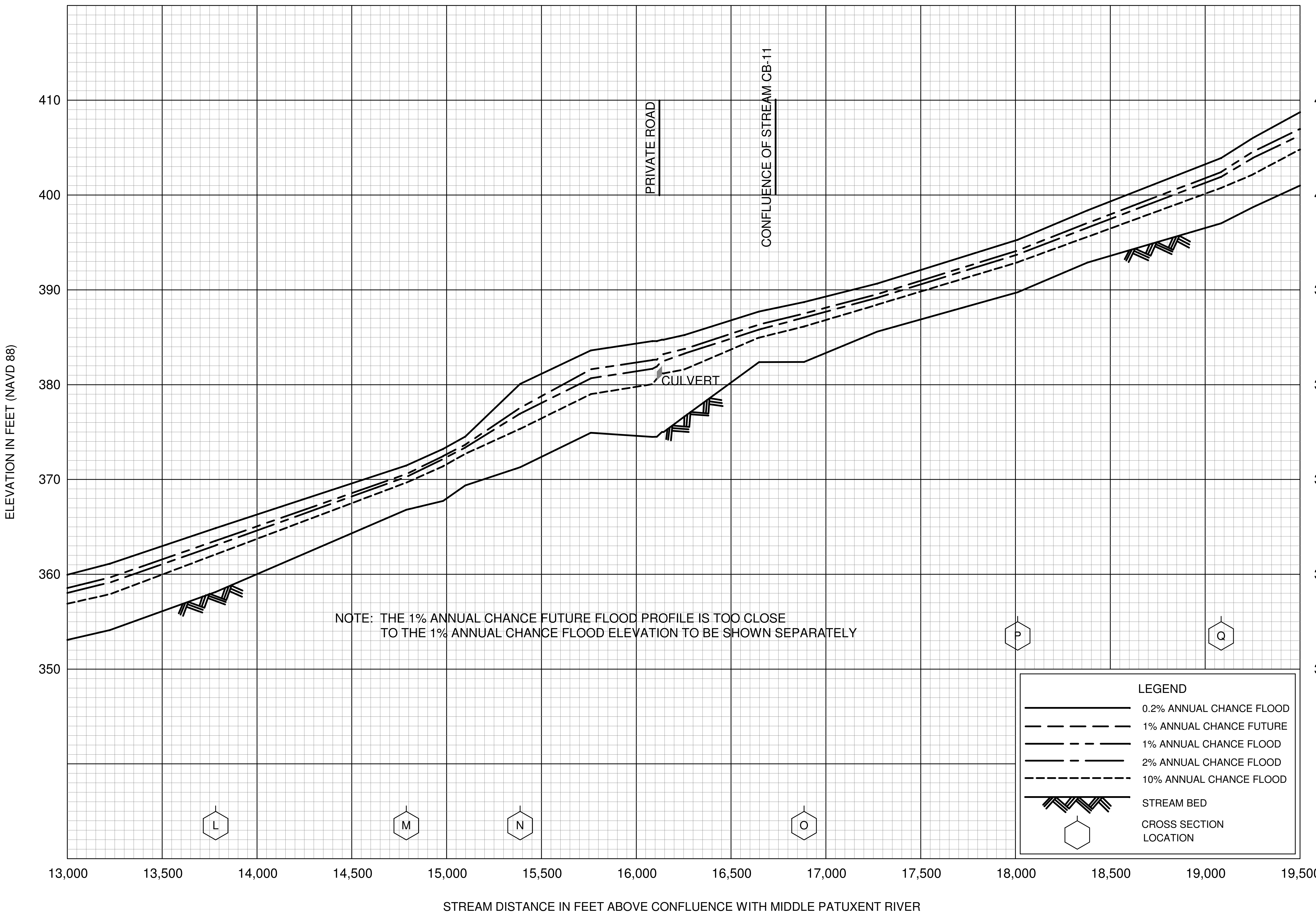
FLOOD PROFILES

CLYDES BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

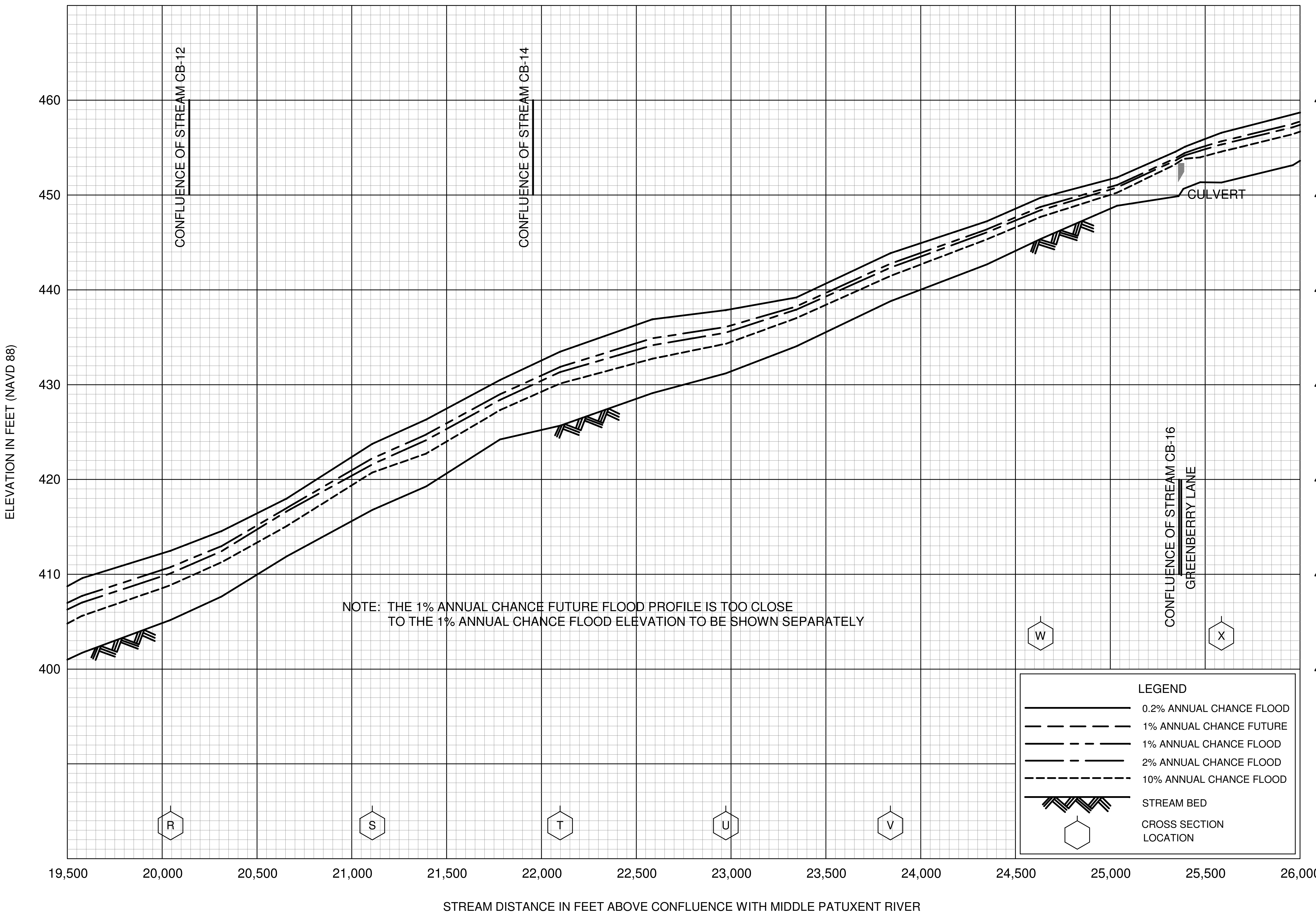
CLYDES BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

28P



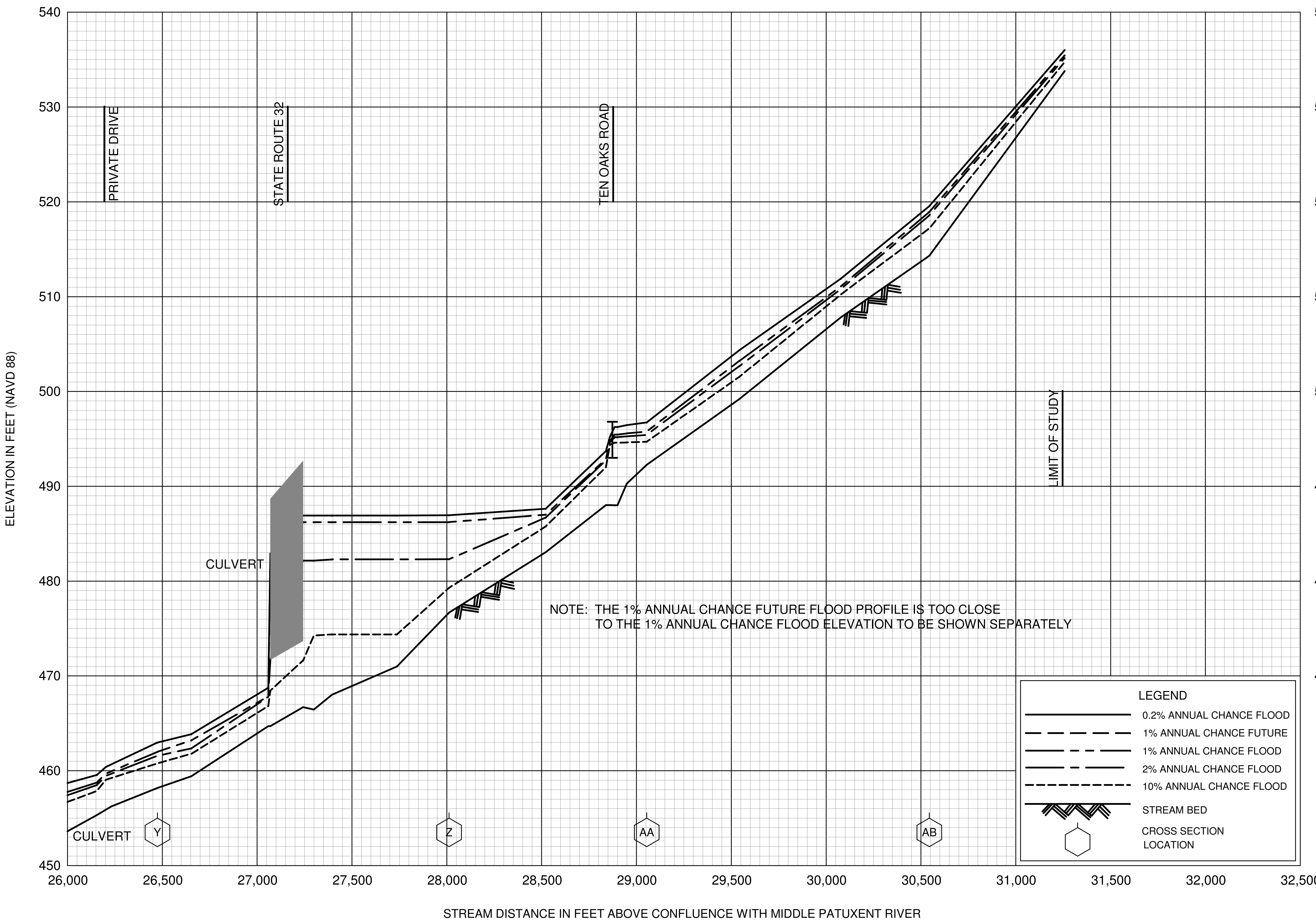
FLOOD PROFILES

CLYDES BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



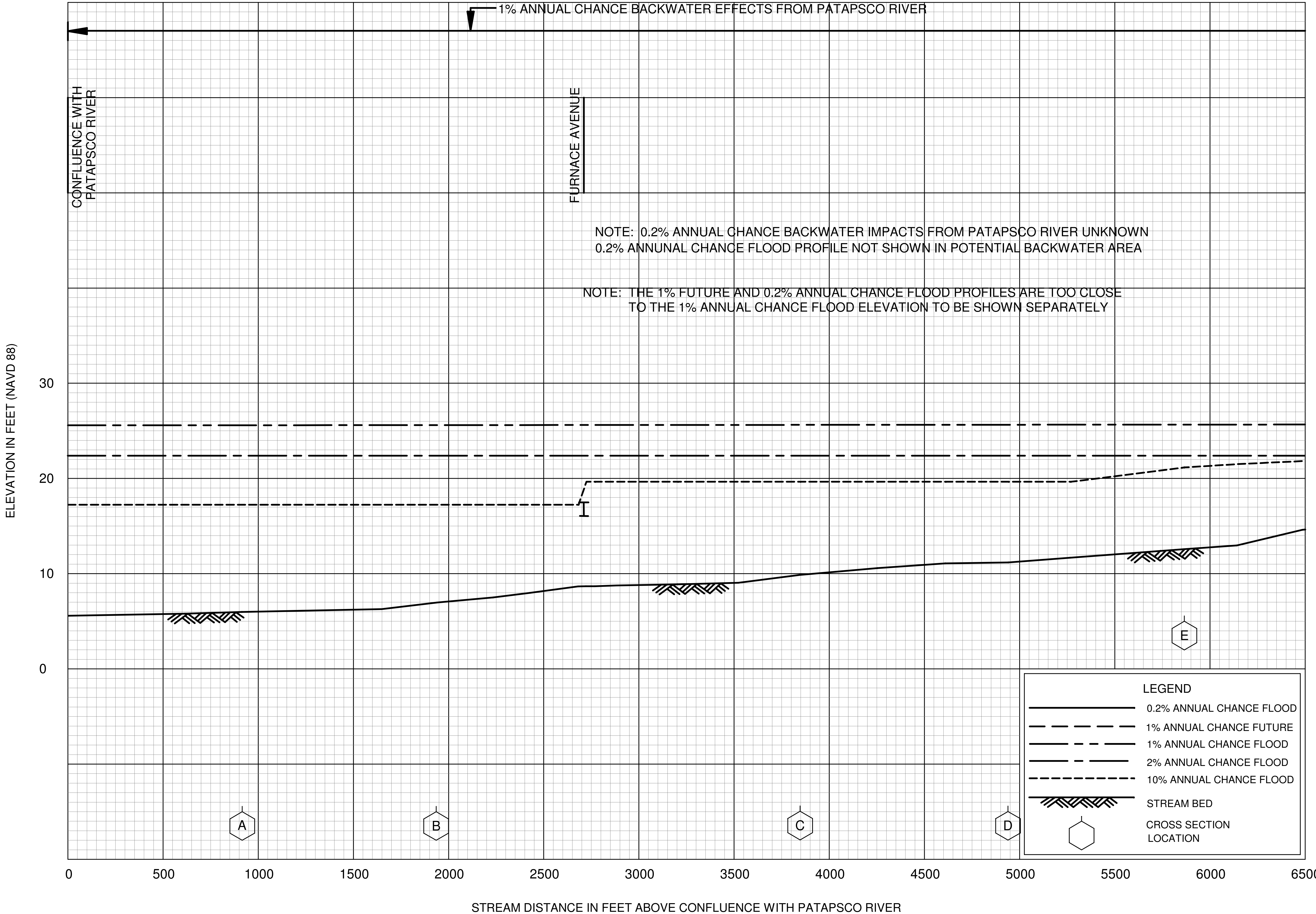
FLOOD PROFILES

CLYDES BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



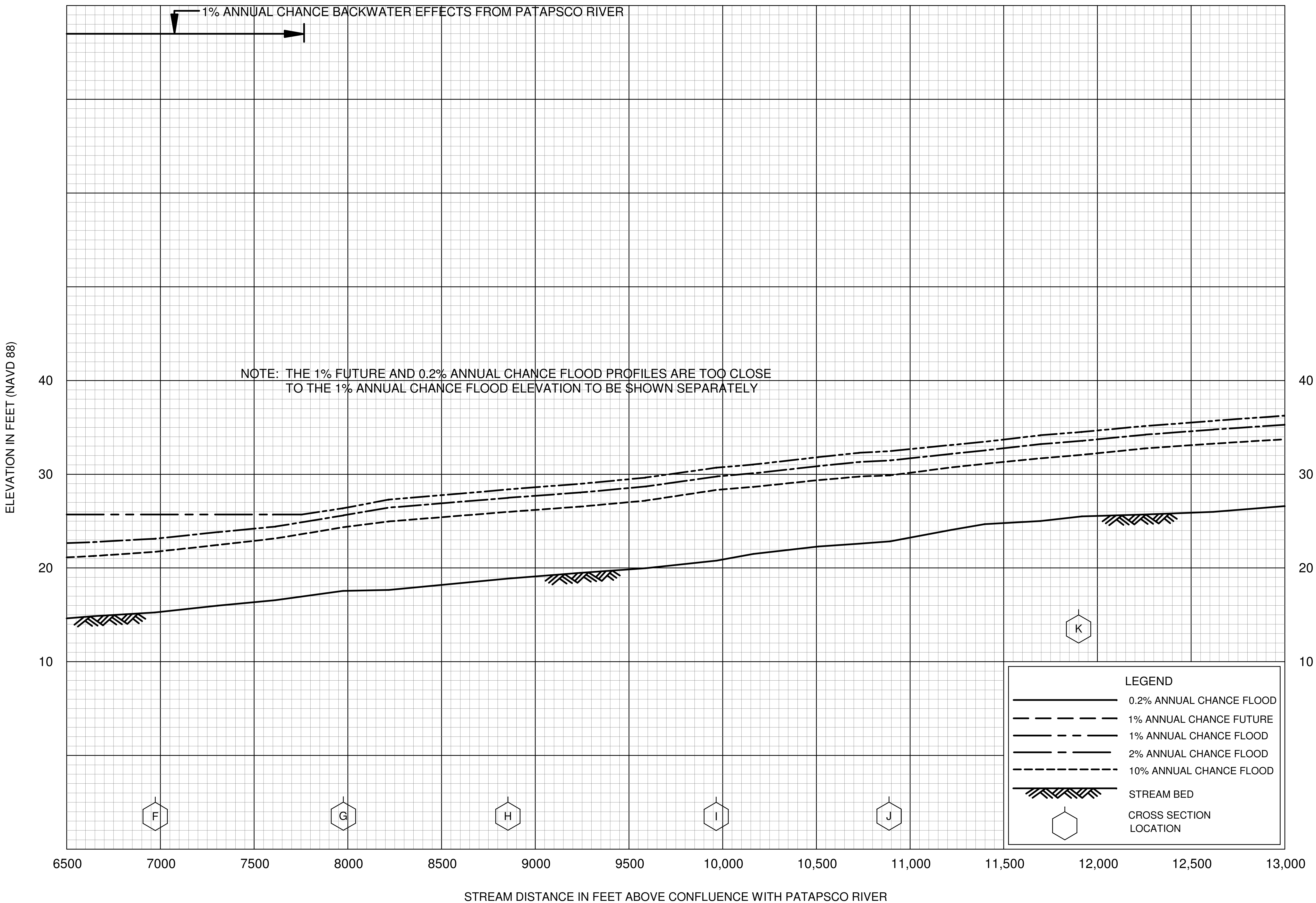
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



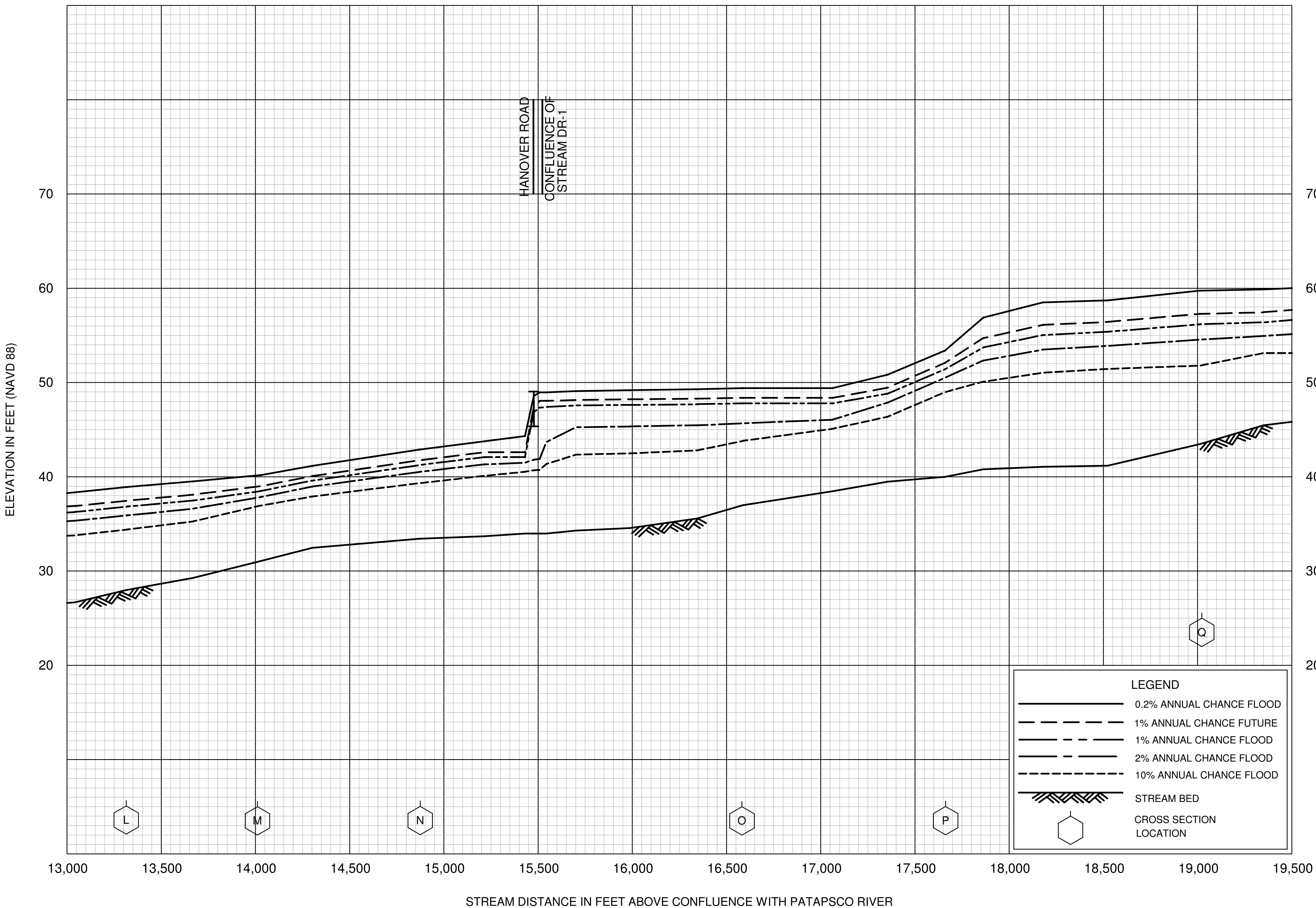
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



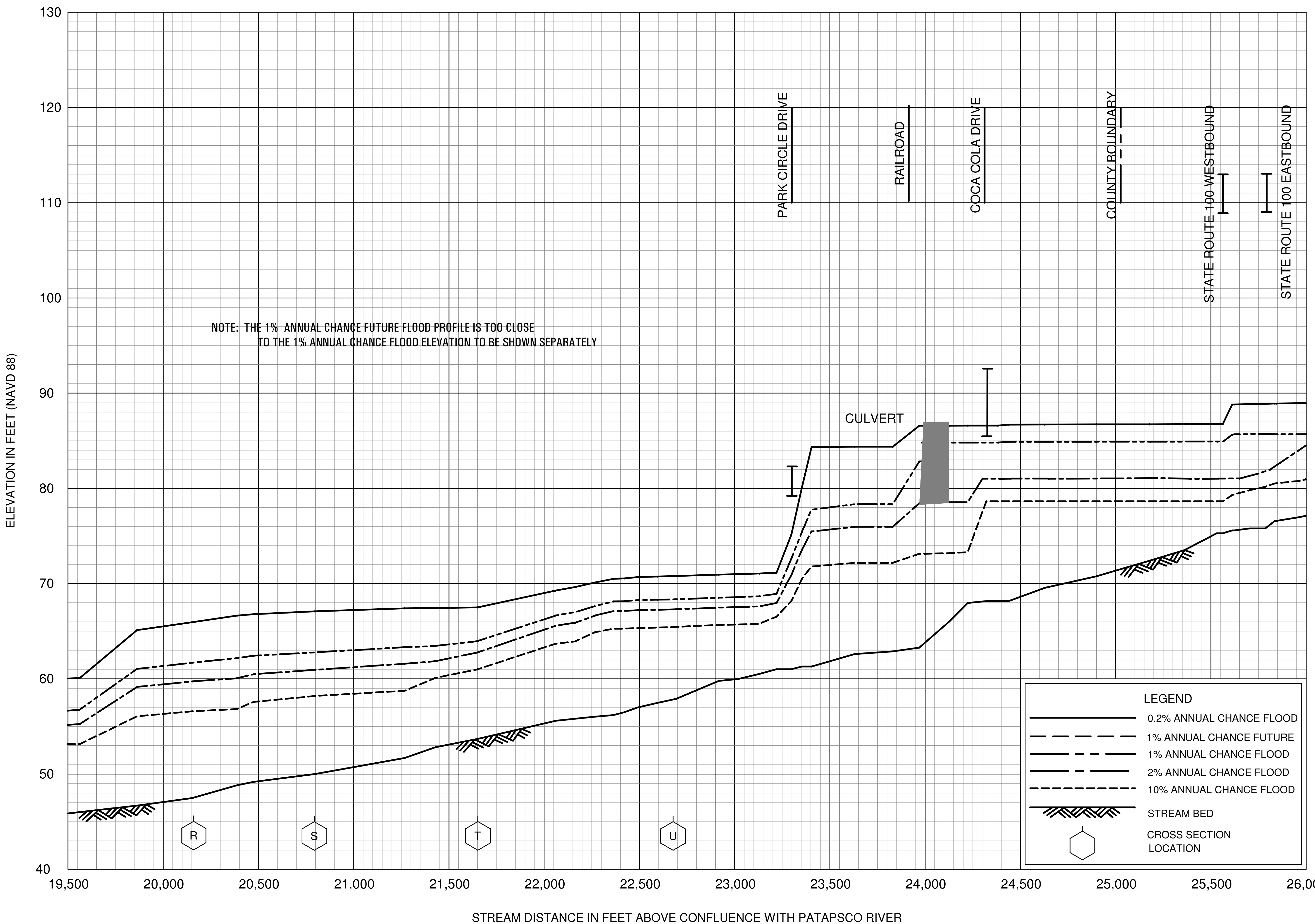
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



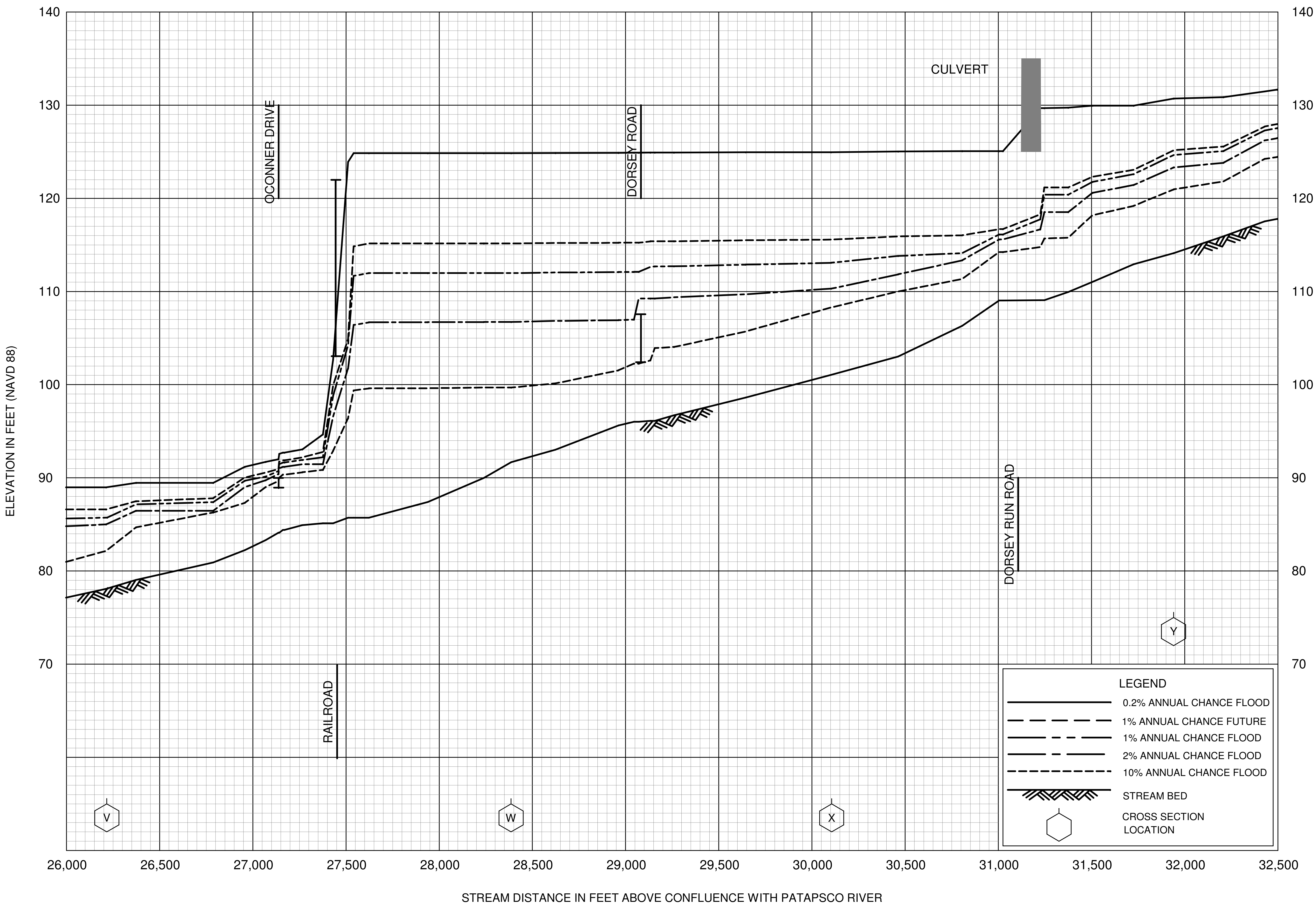
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



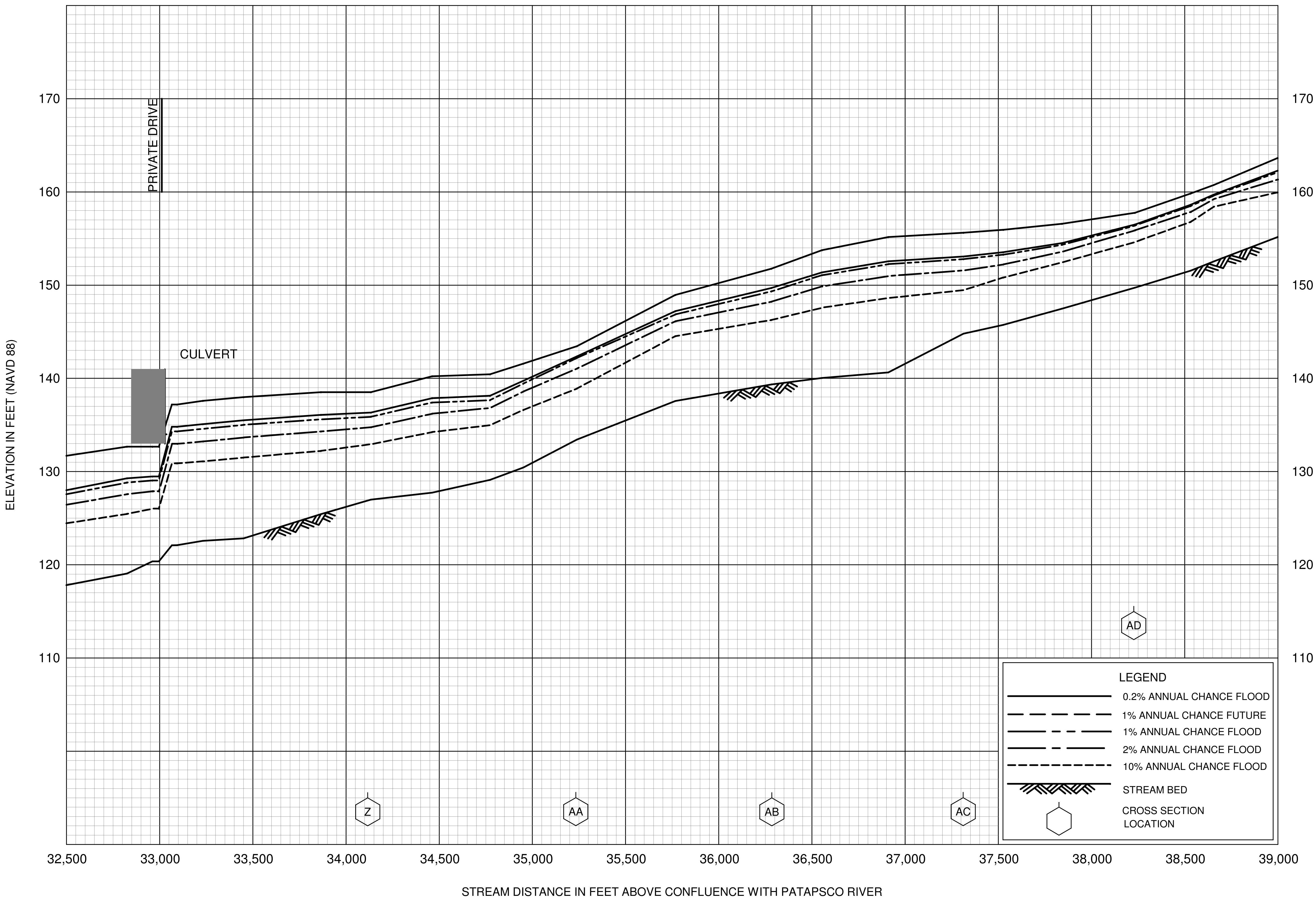
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



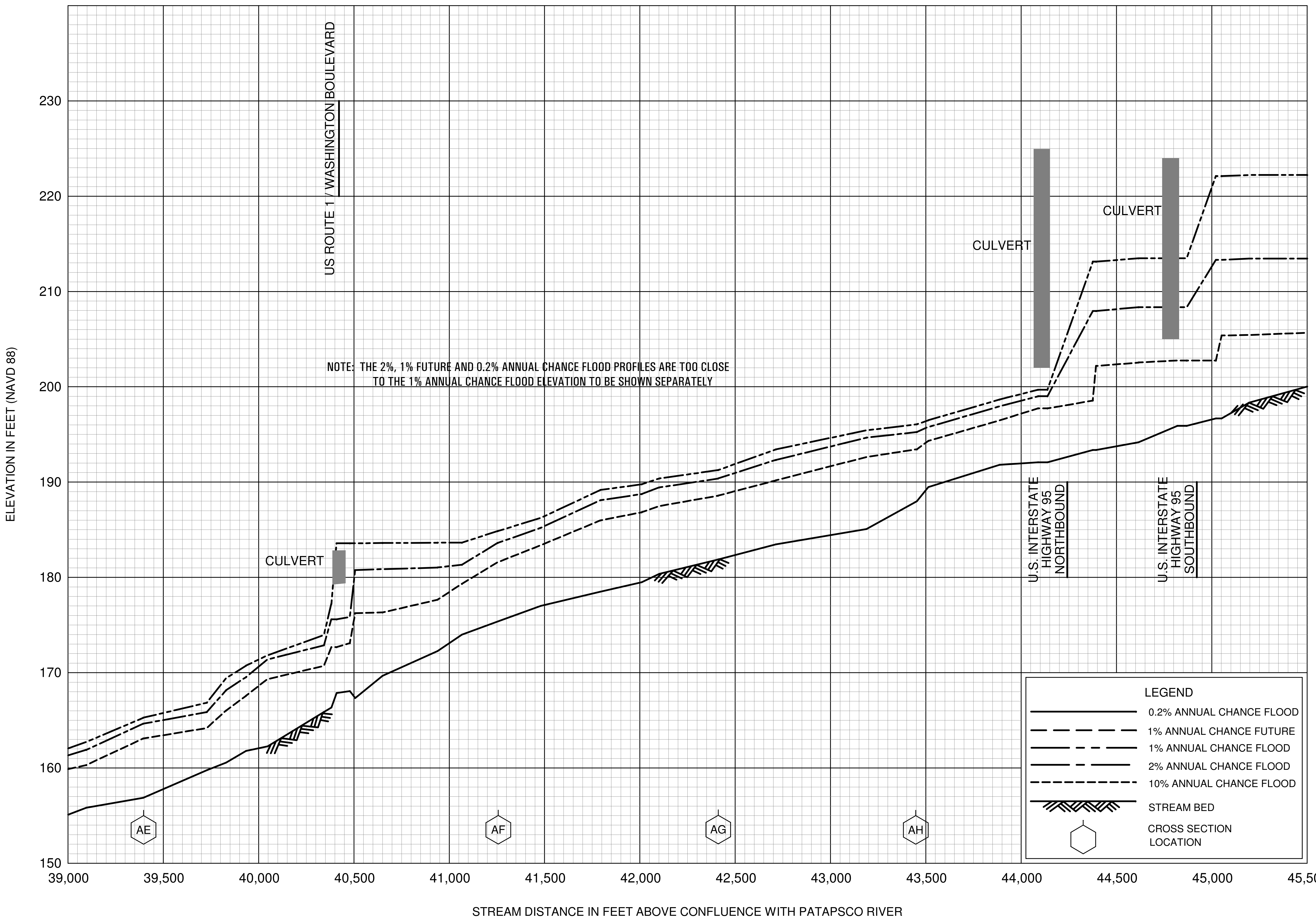
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



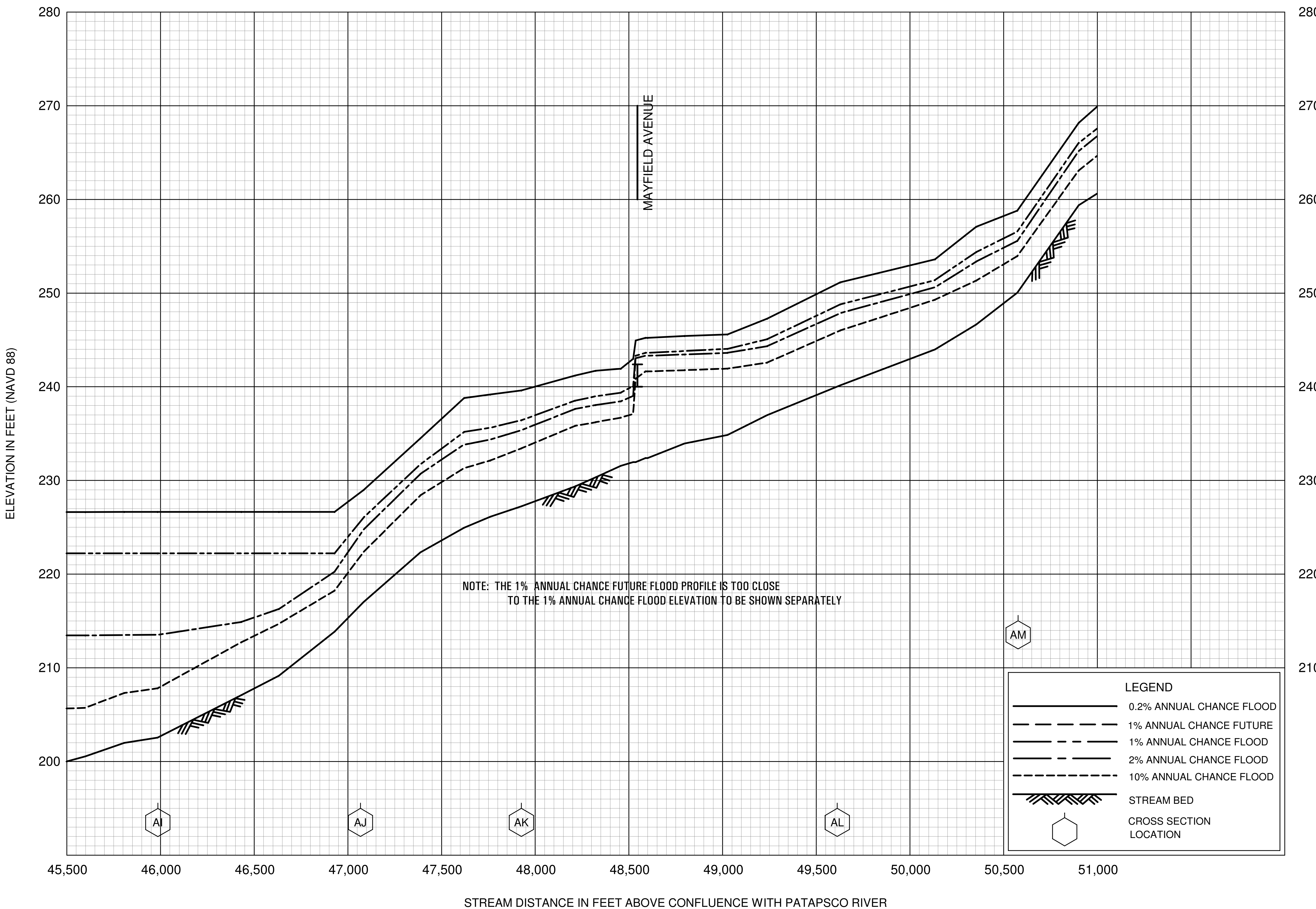
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



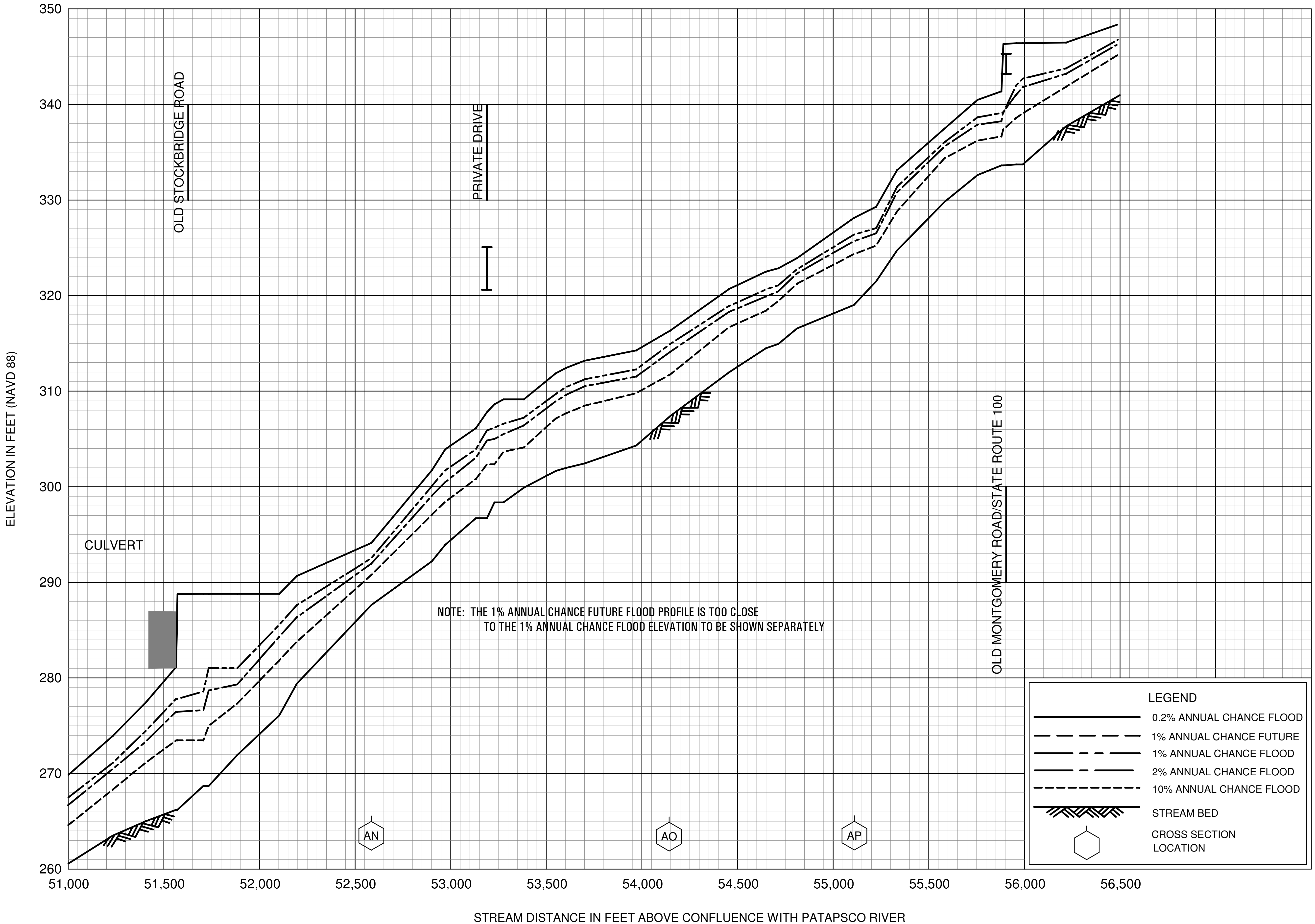
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



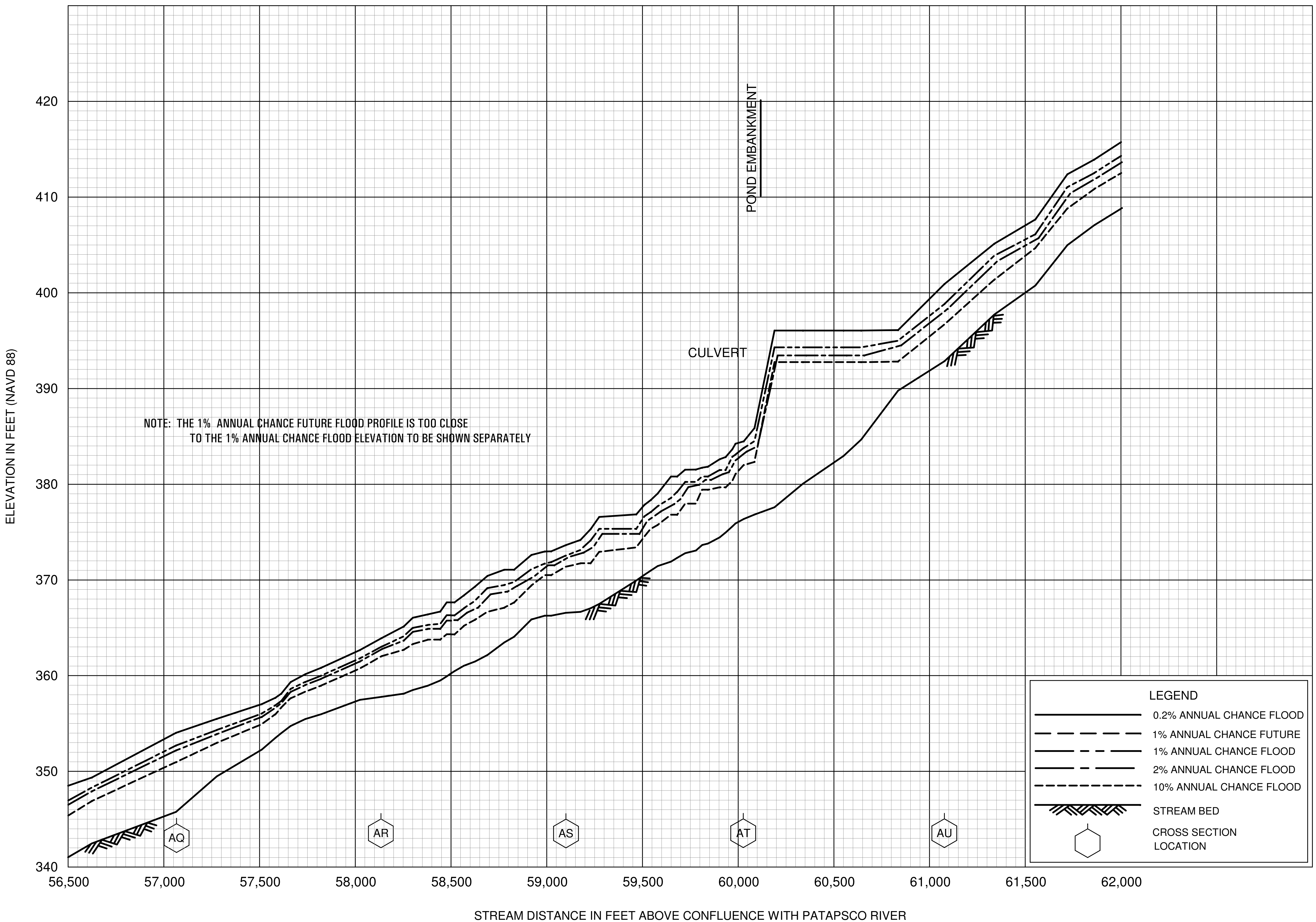
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



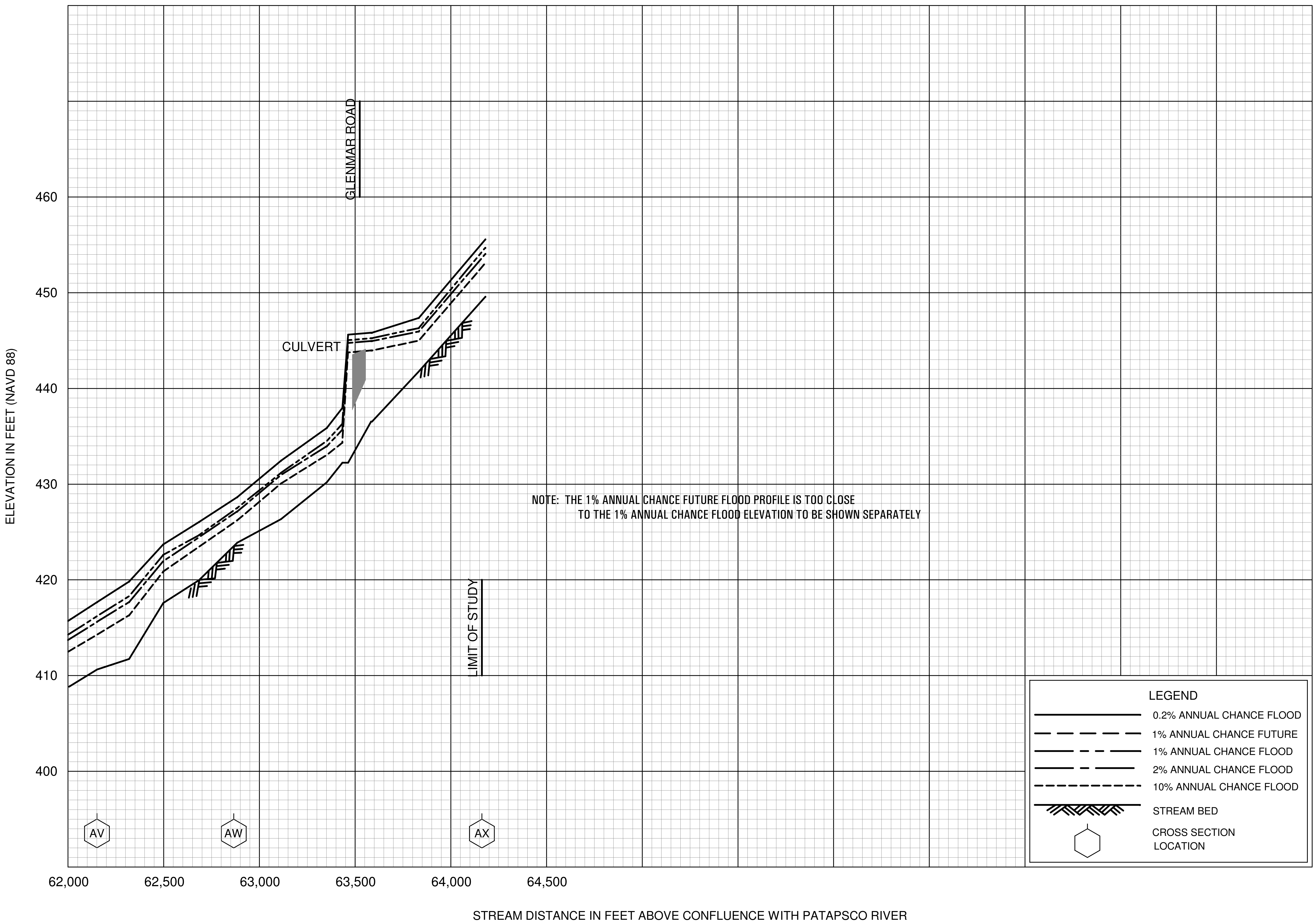
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



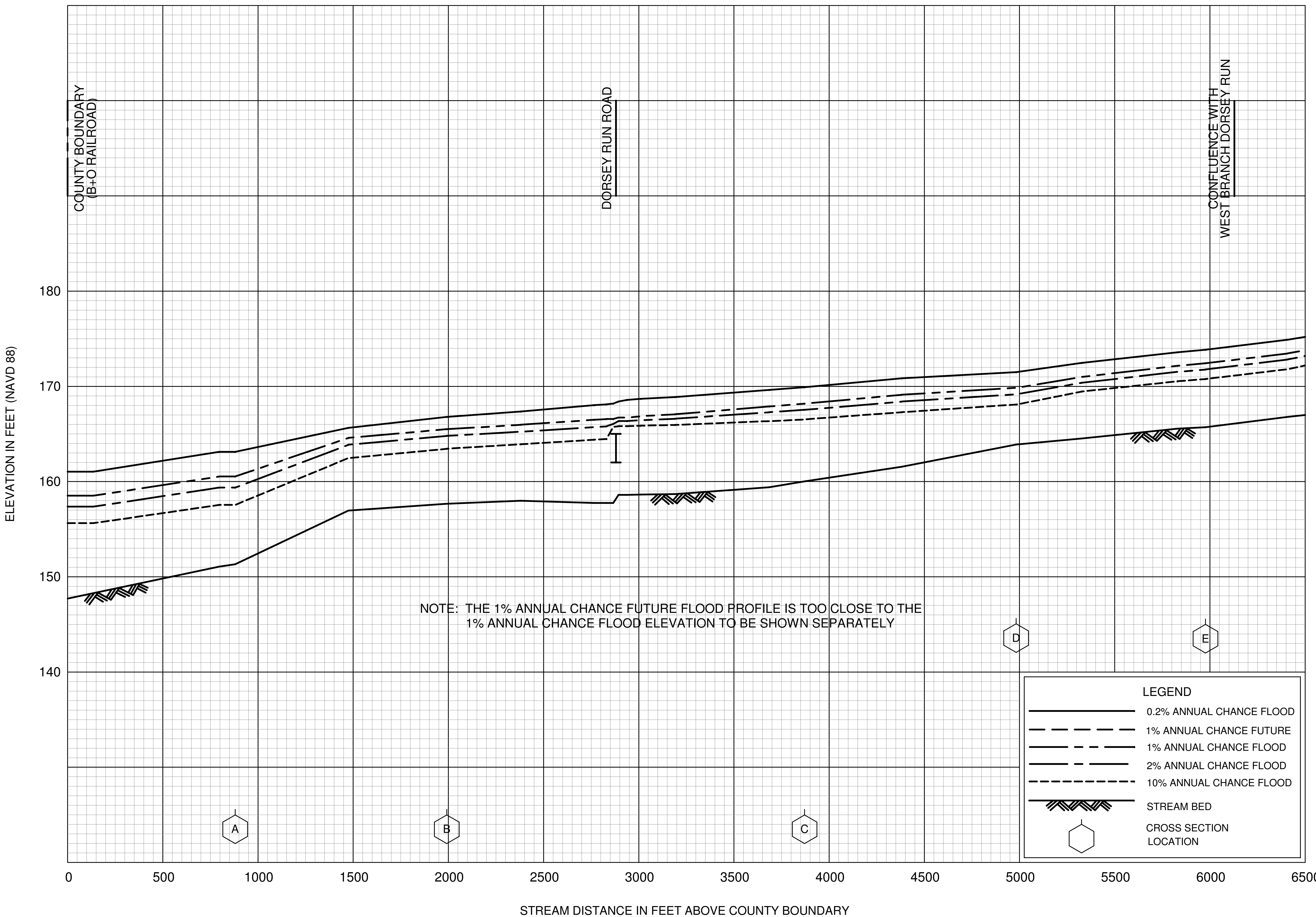
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



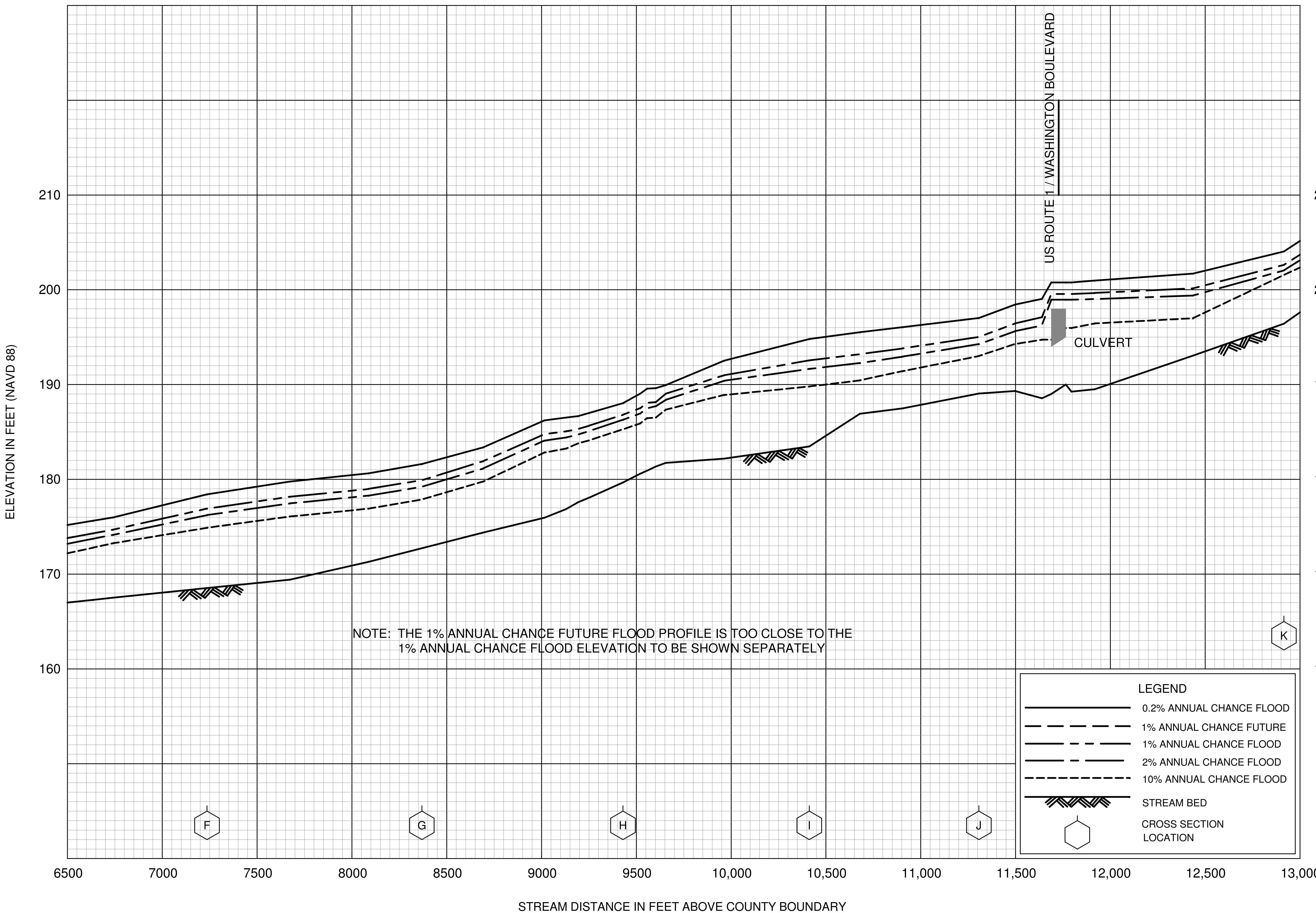
FLOOD PROFILES

DORSEY RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



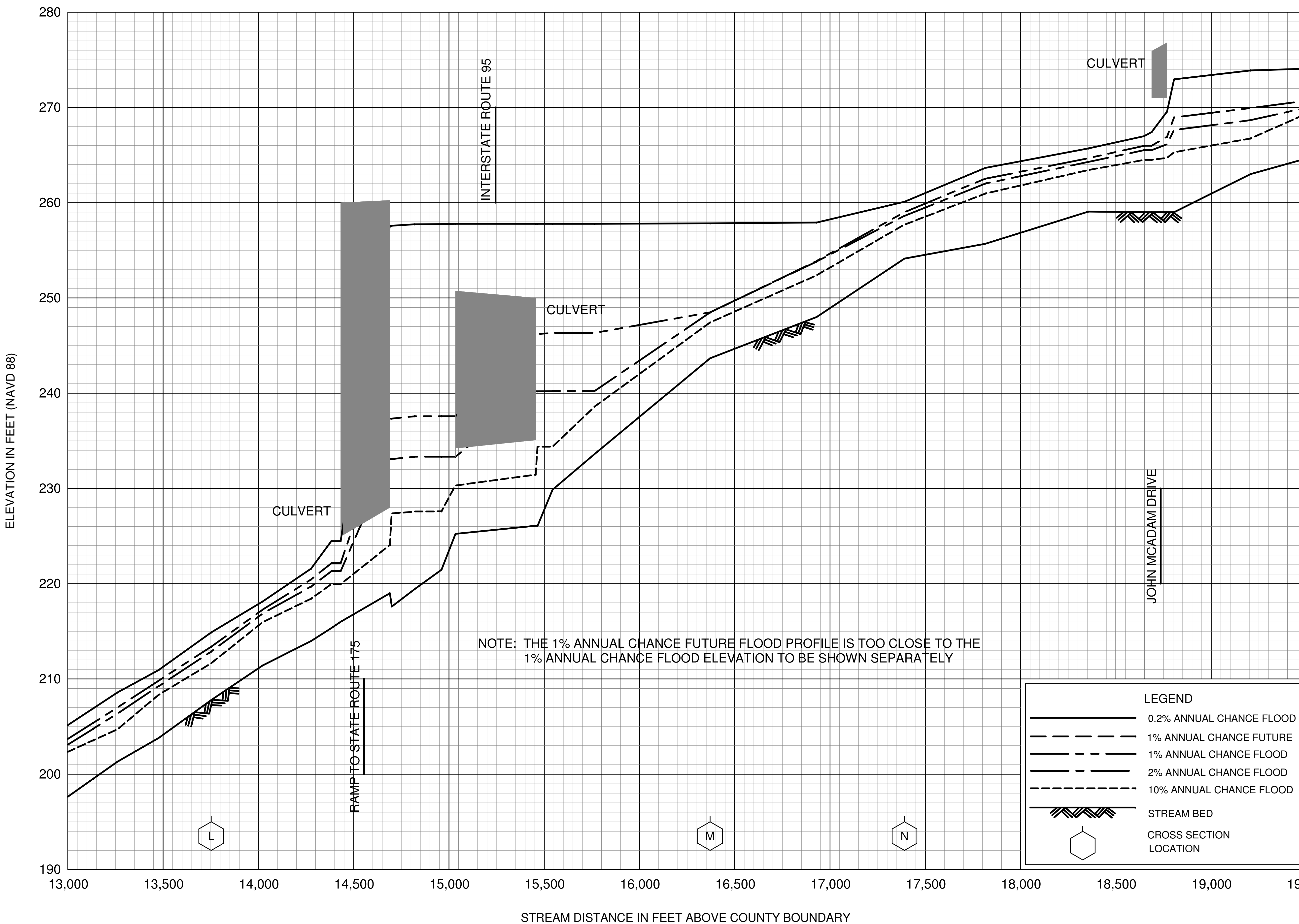
FLOOD PROFILES

DORSEY RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



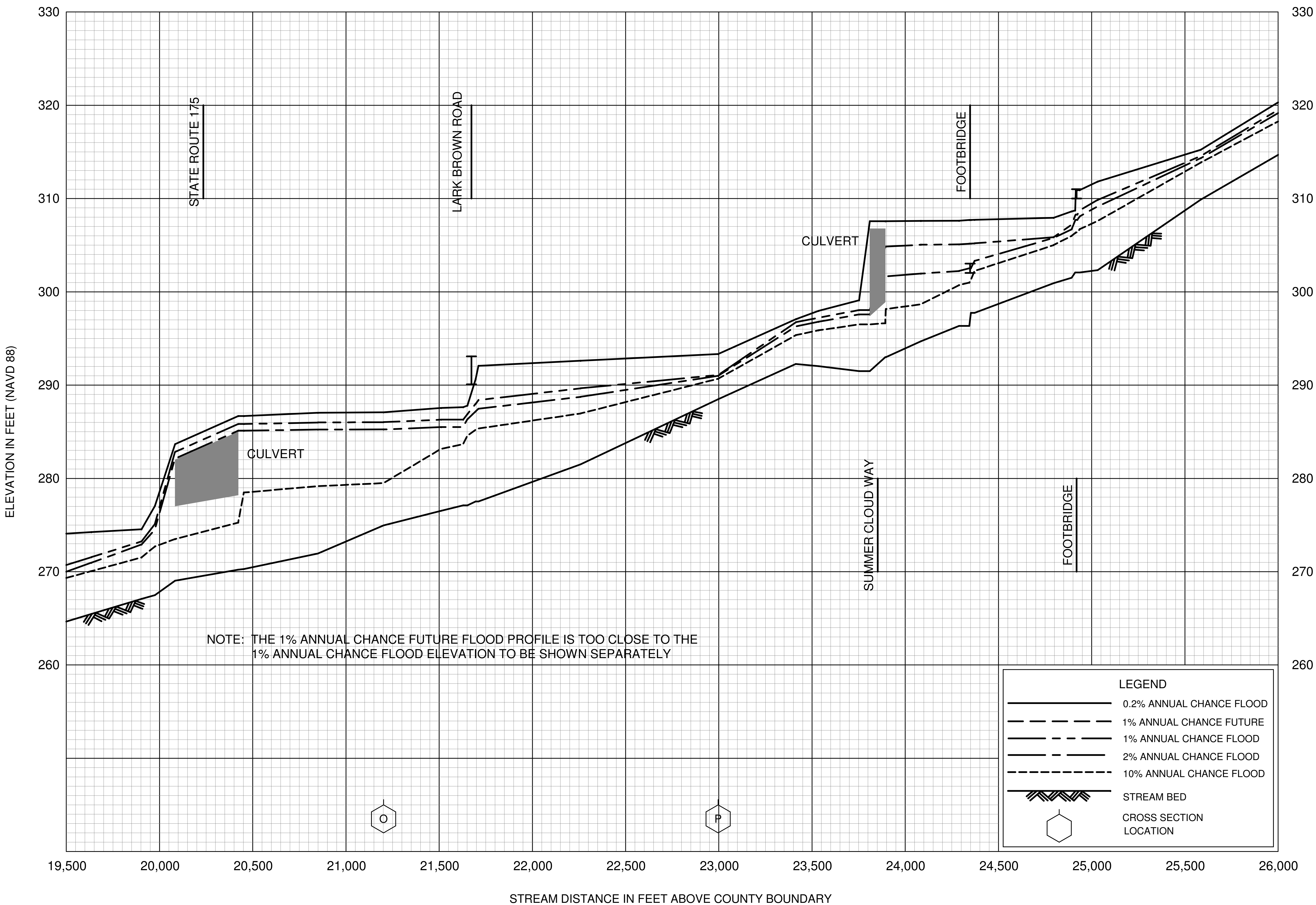
FLOOD PROFILES

DORSEY RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



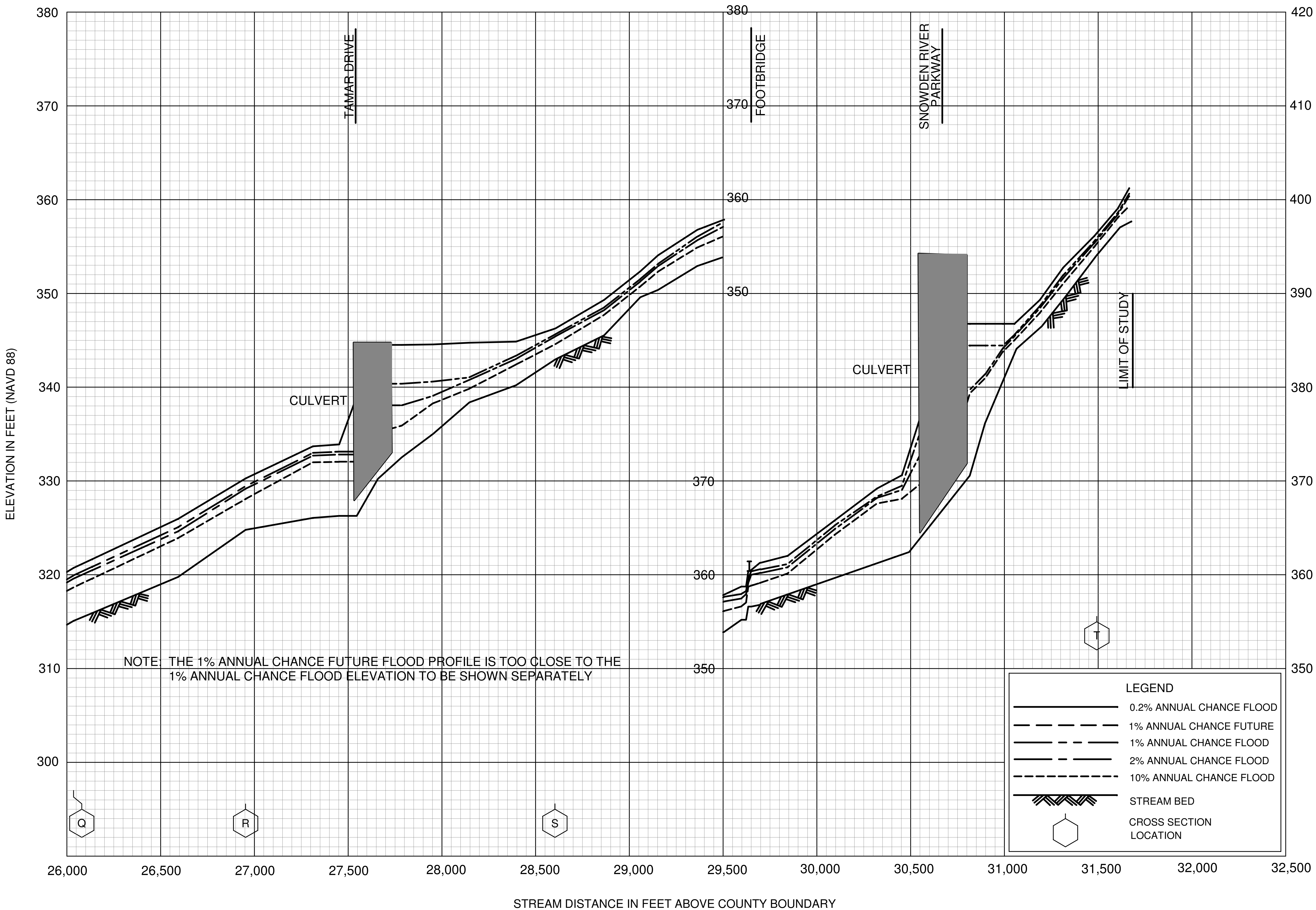
FLOOD PROFILES

DORSEY RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



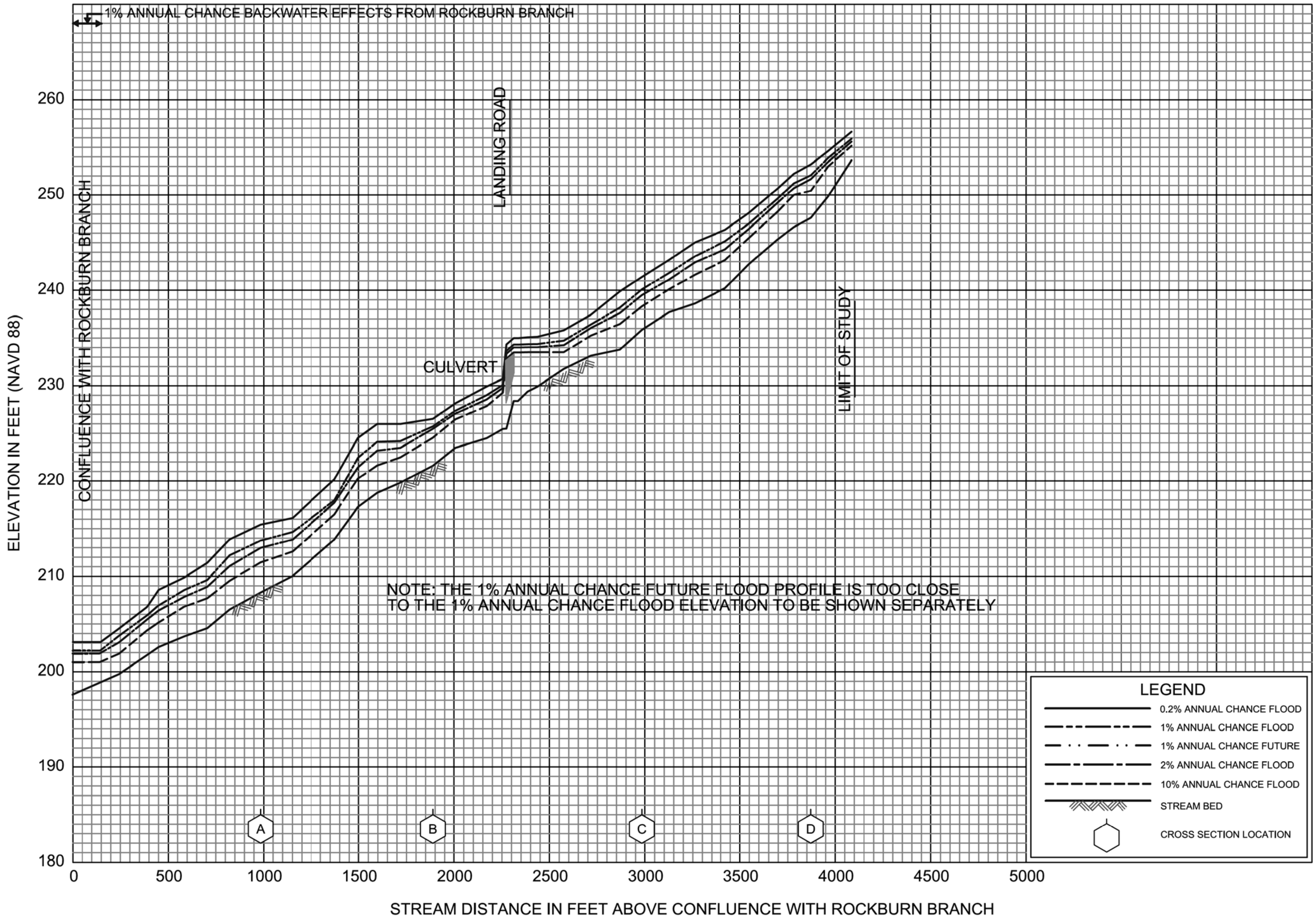
FLOOD PROFILES

DORSEY RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



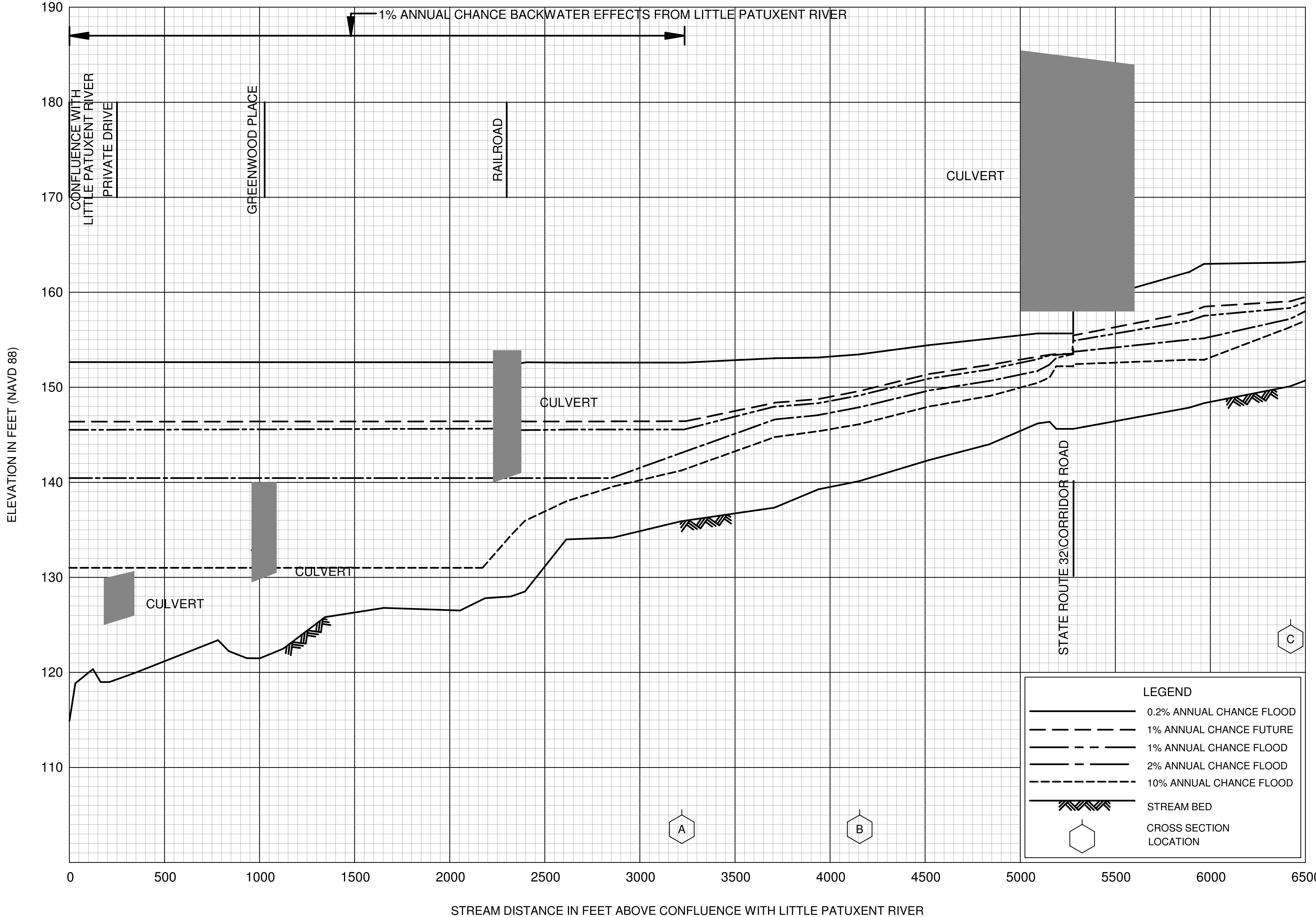
FLOOD PROFILES

EAST TRIBUTARY ROCKBURN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MARYLAND

AND INCORPORATED AREAS



FLOOD PROFILES

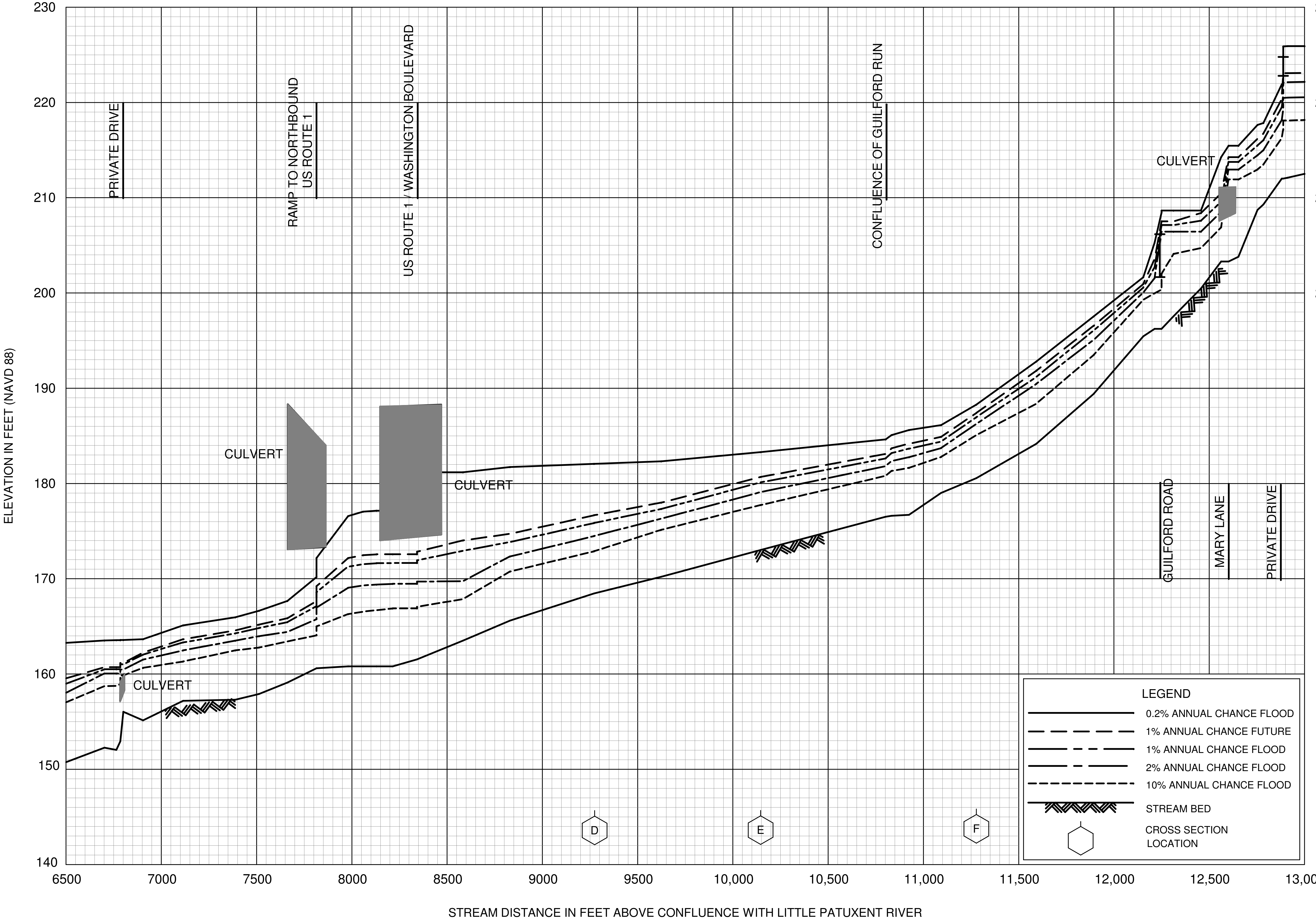
GUILFORD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

48P



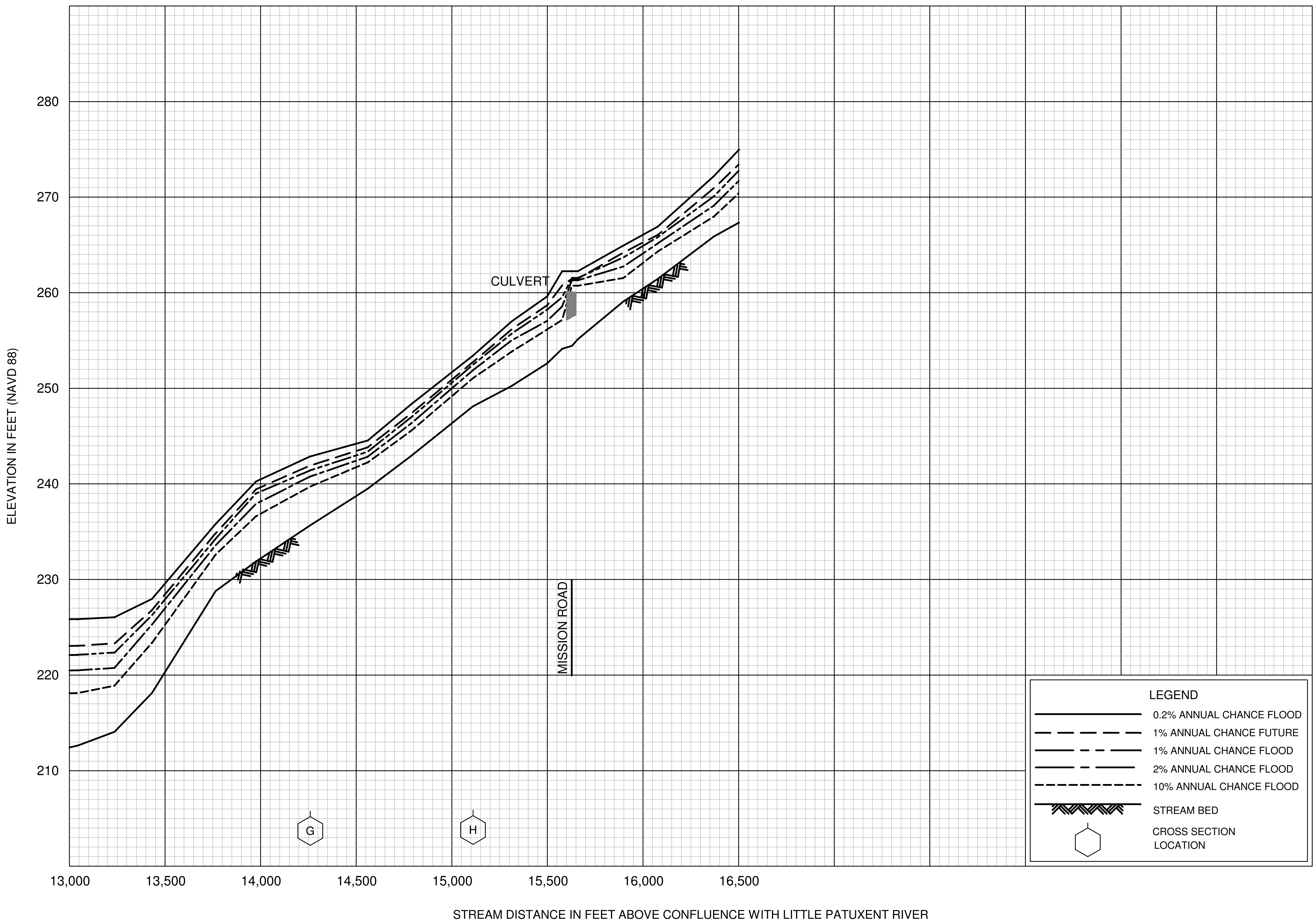
FLOOD PROFILES

GUILFORD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



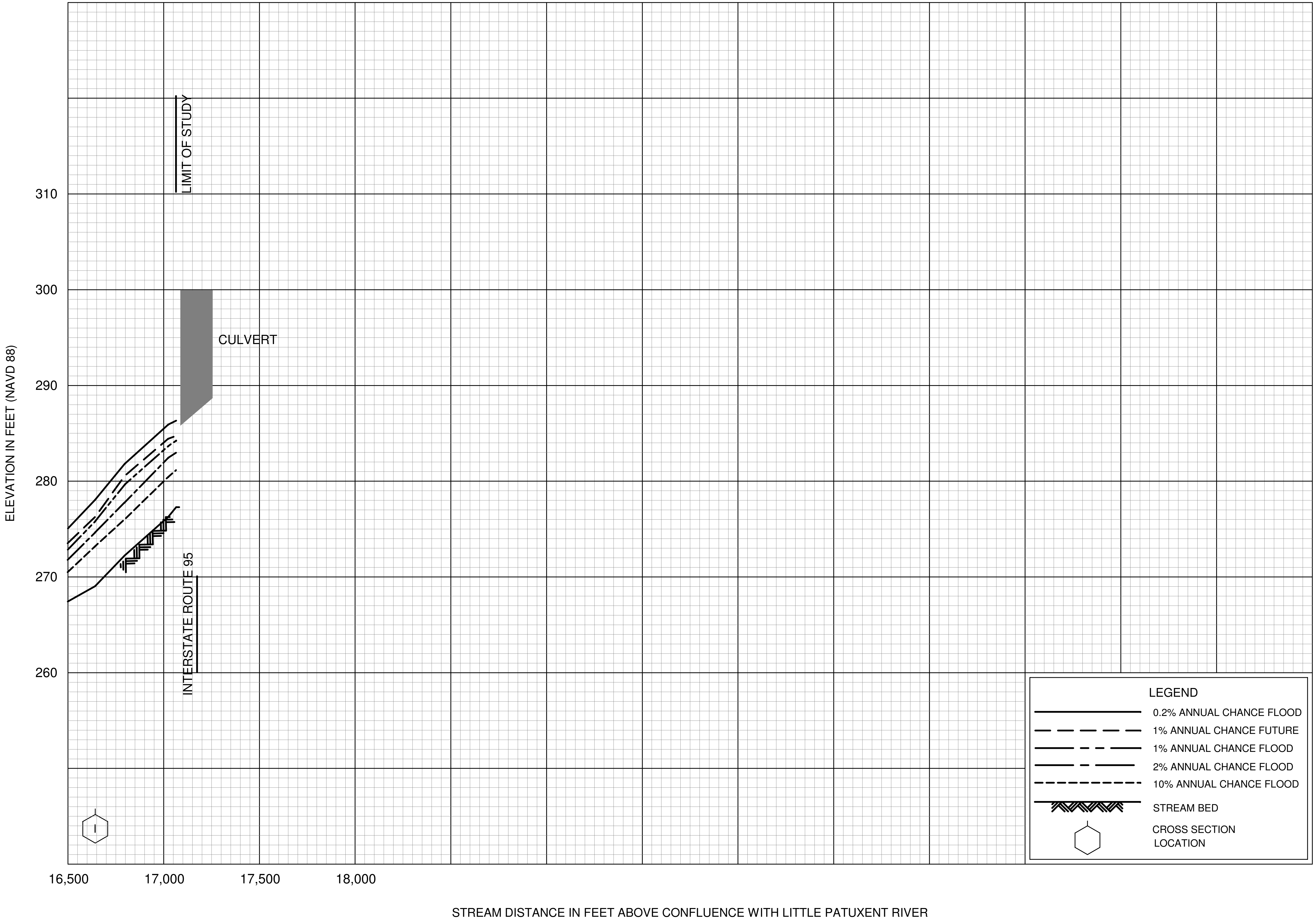
FLOOD PROFILES

GUILFORD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



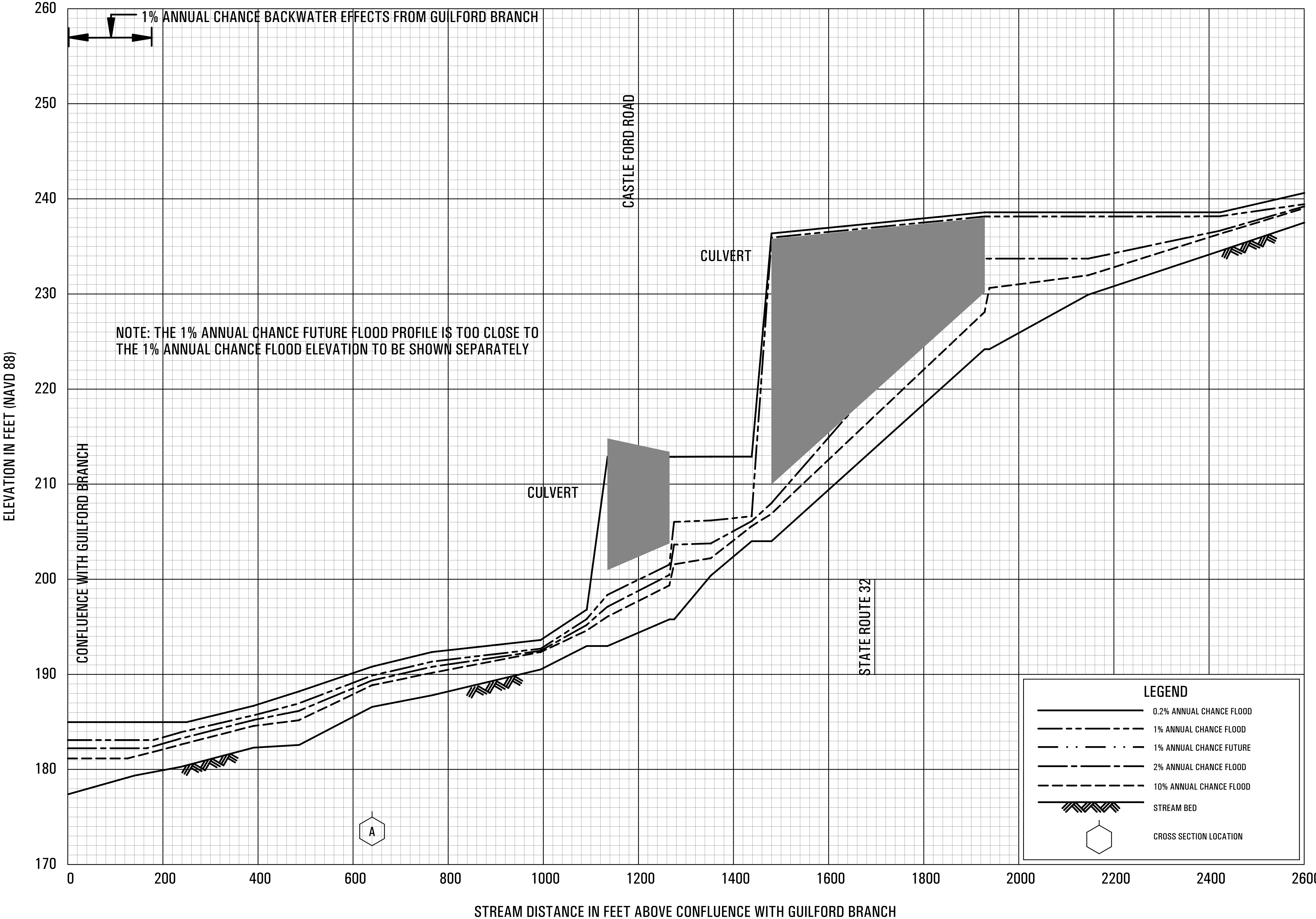
FLOOD PROFILES

GUILFORD BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



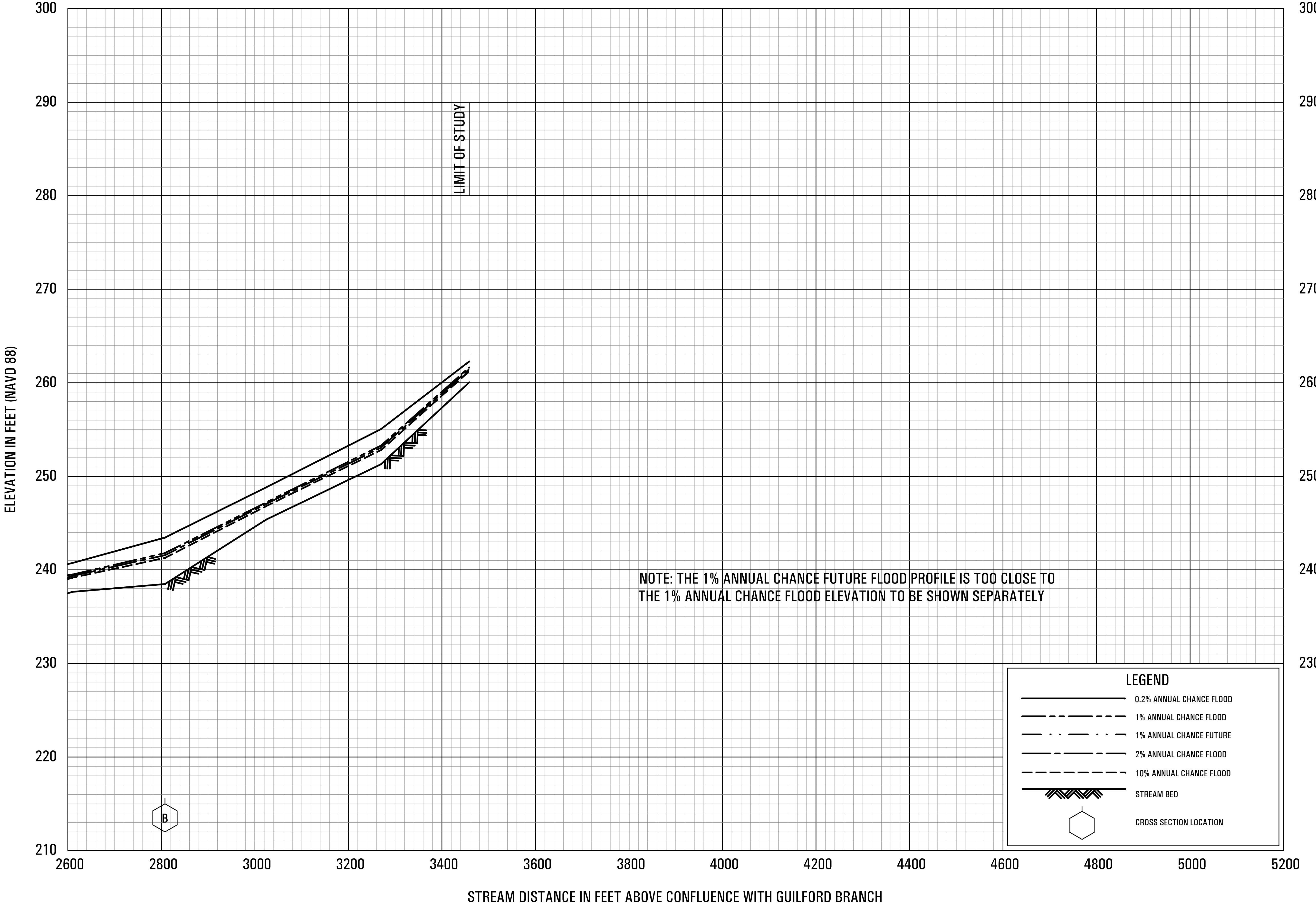
FLOOD PROFILES

GUILFORD RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPOARTED AREAS



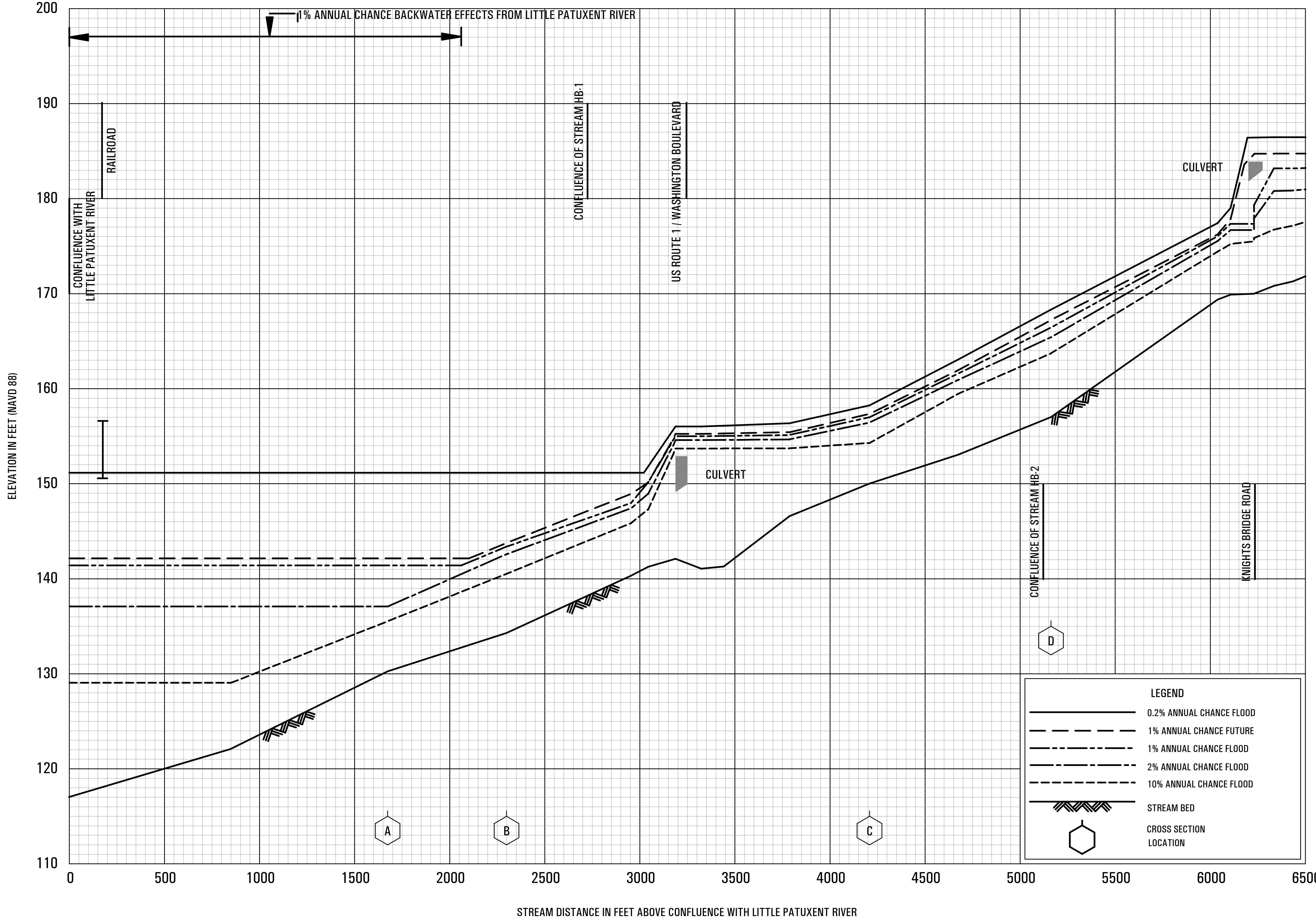
FLOOD PROFILES

GUILFORD RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPOARTED AREAS



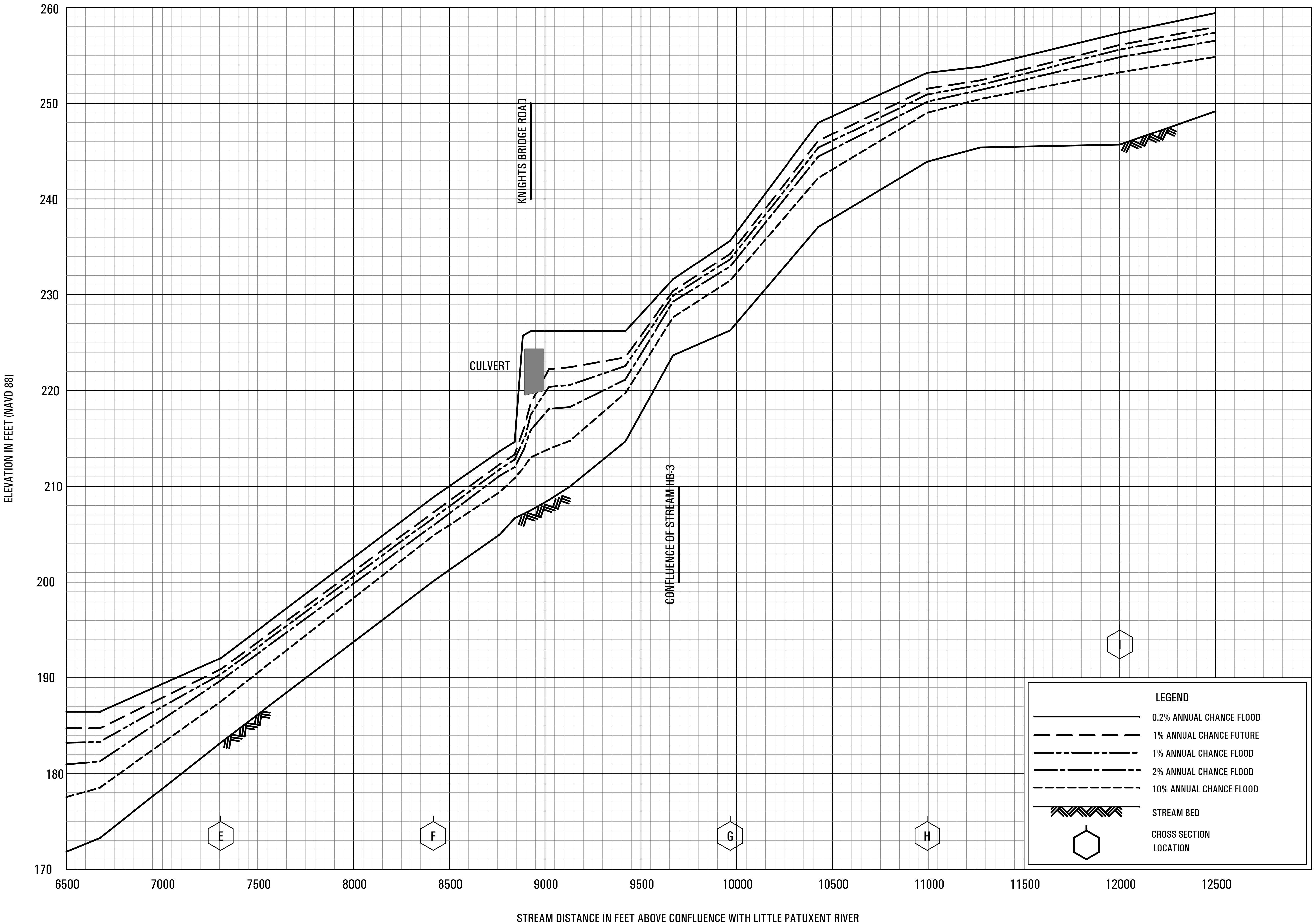
FLOOD PROFILES

HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



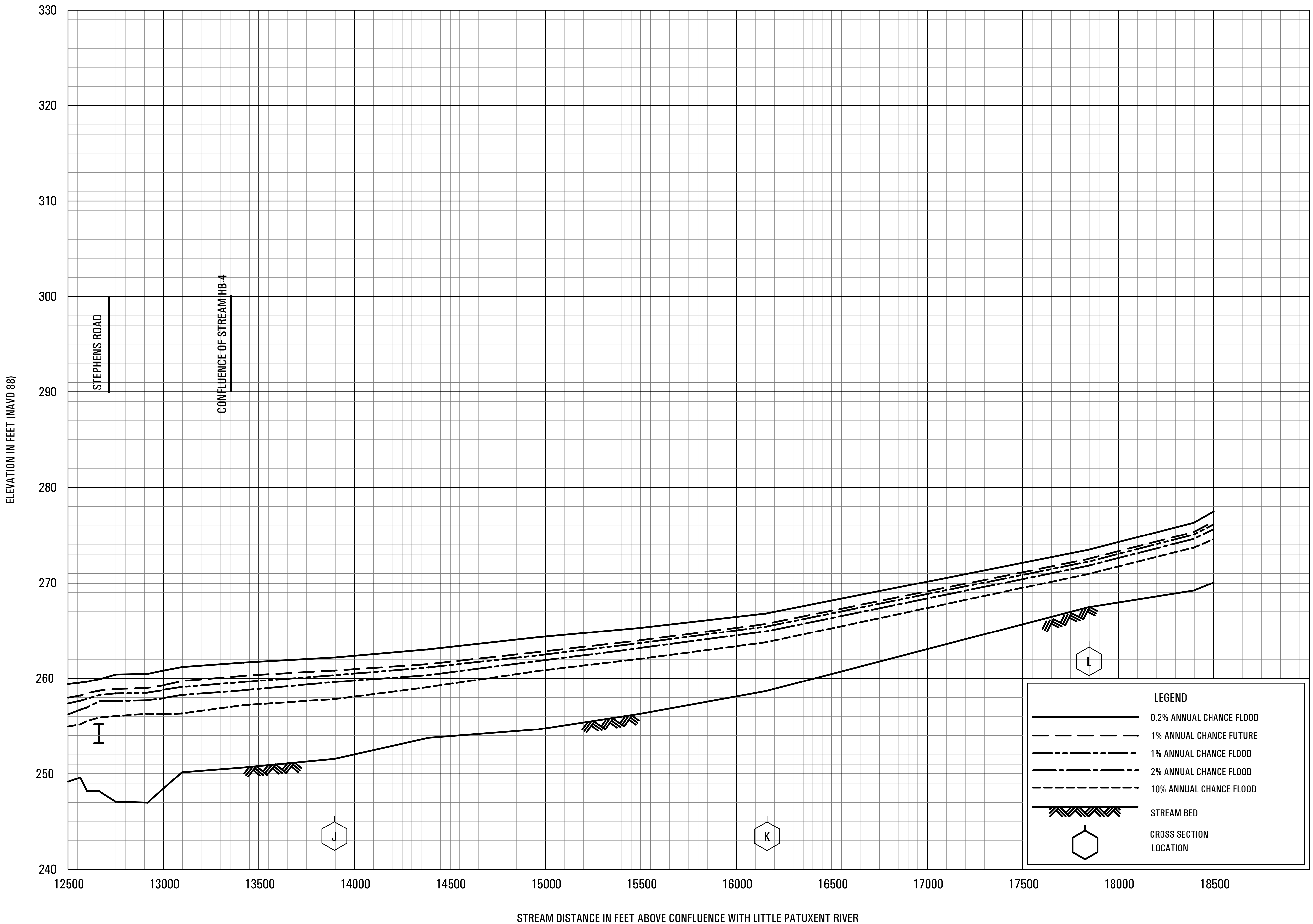
FLOOD PROFILES

HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

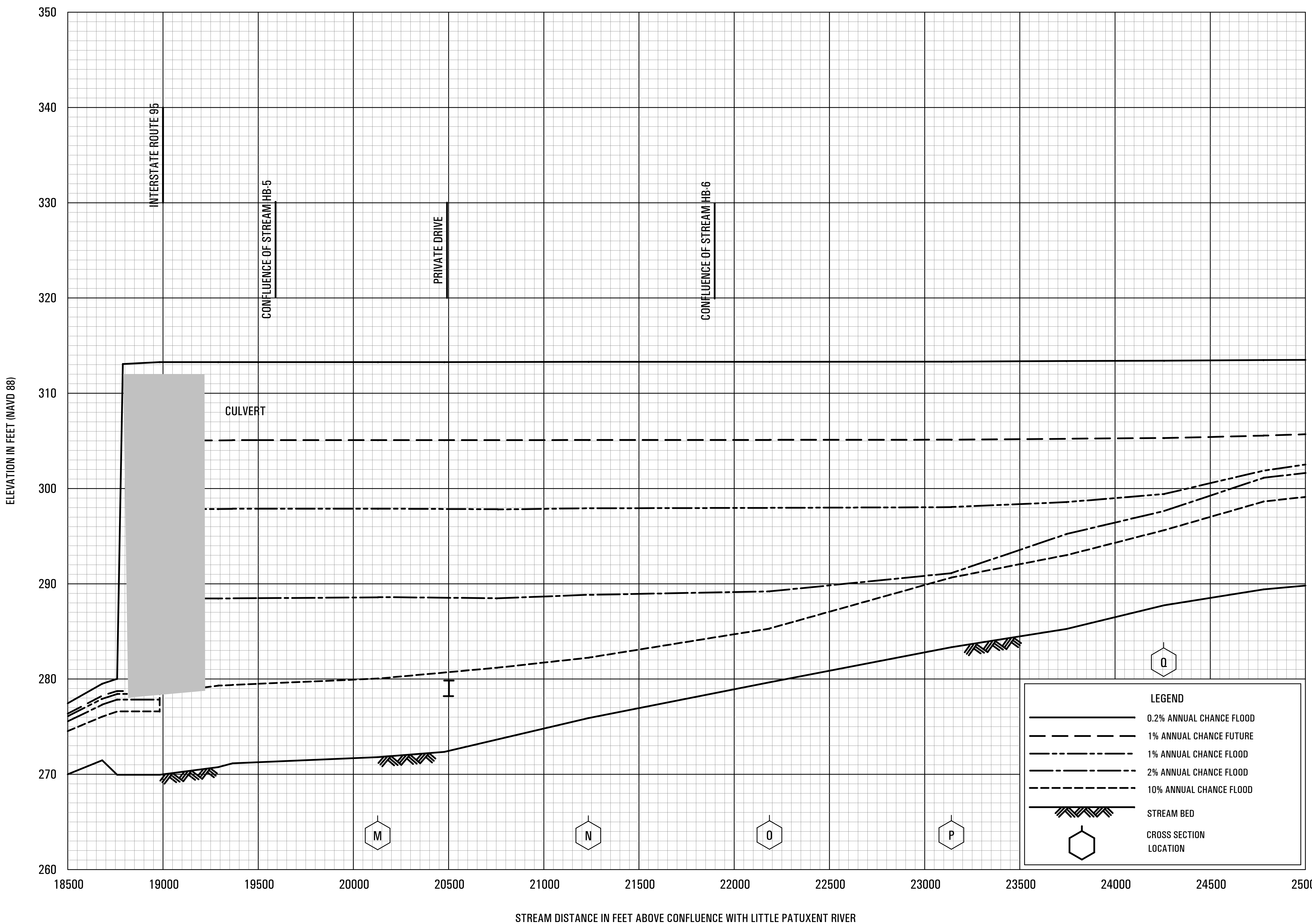
HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

56P



FLOOD PROFILES

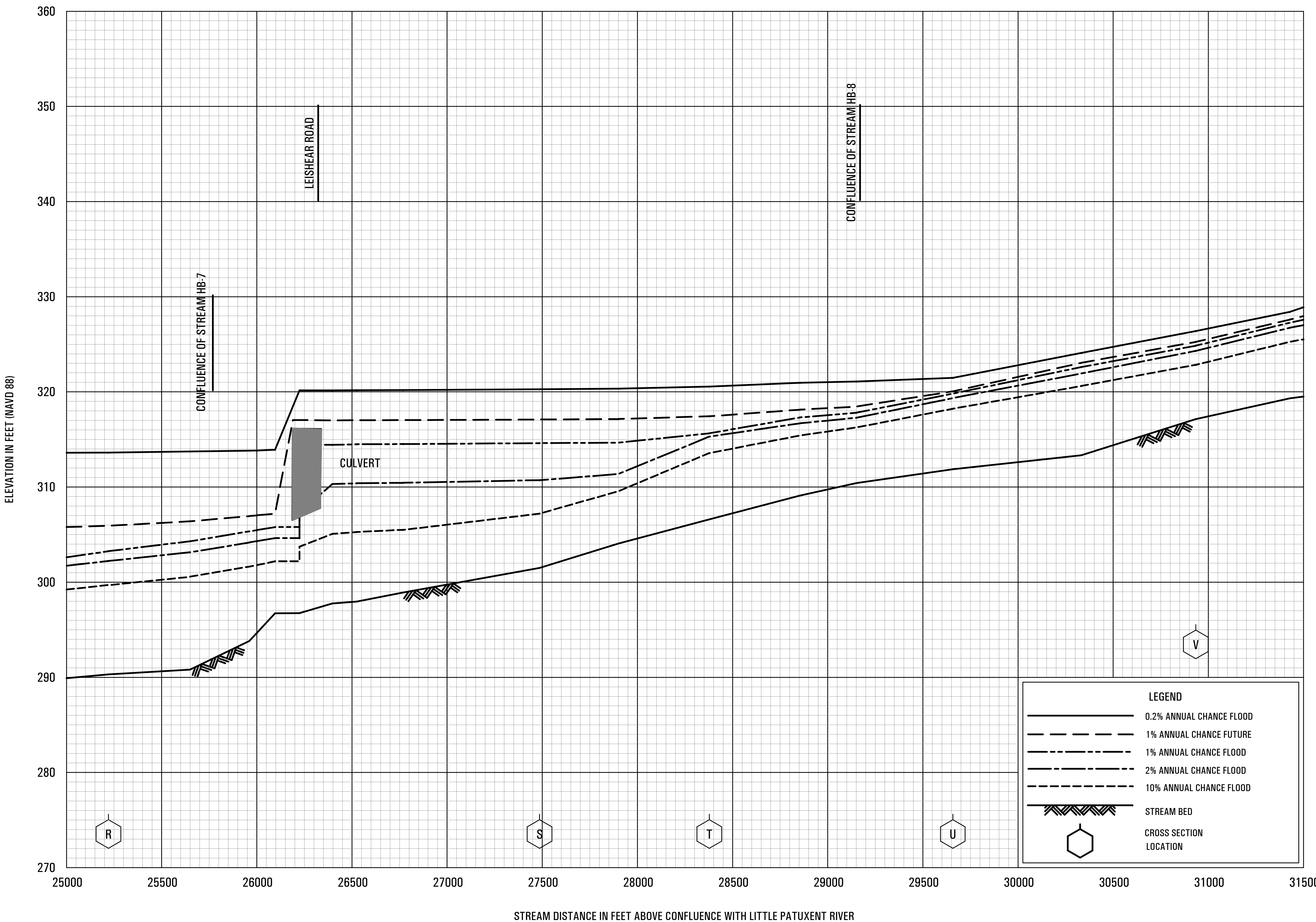
HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

57P



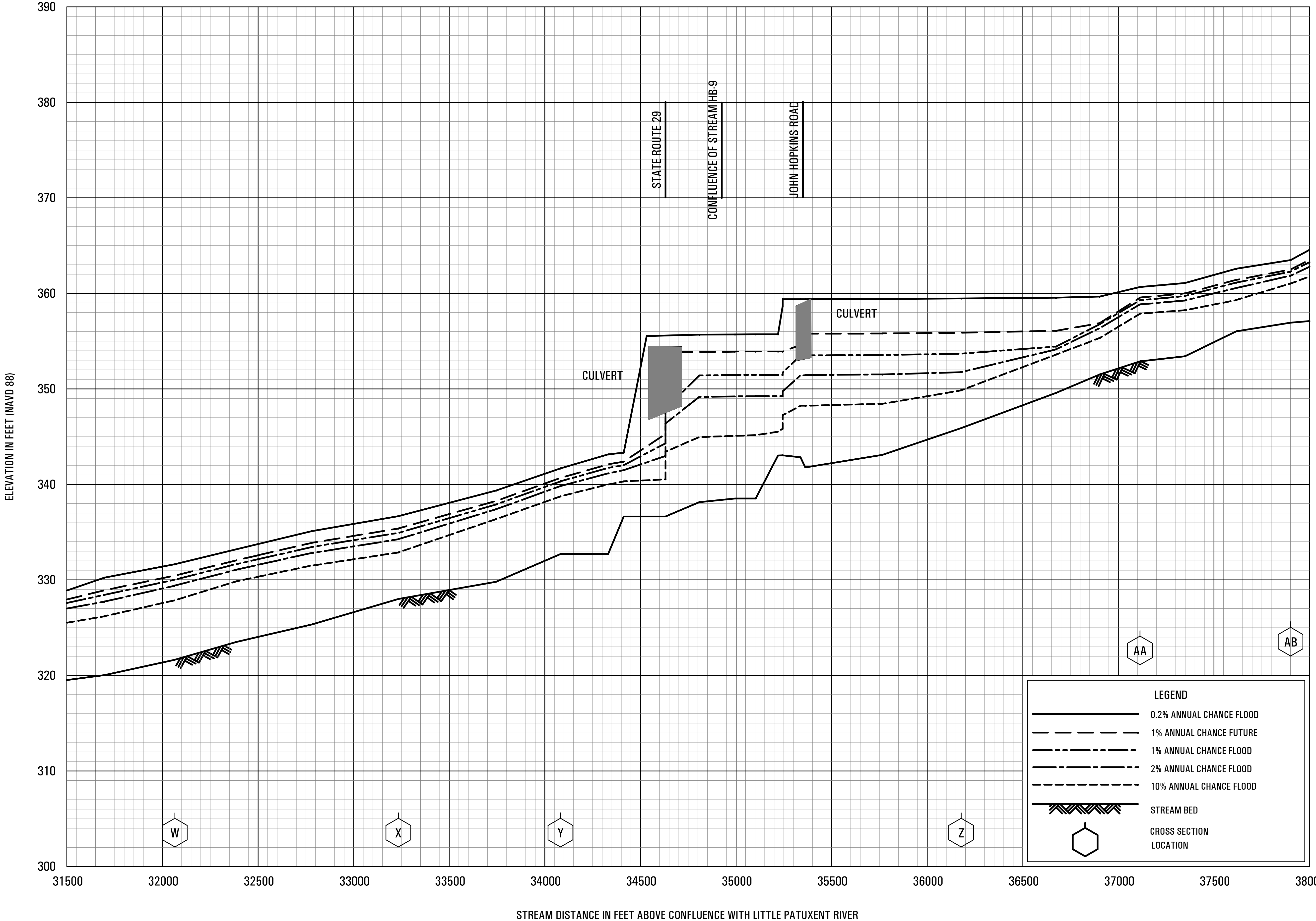
FLOOD PROFILES

HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



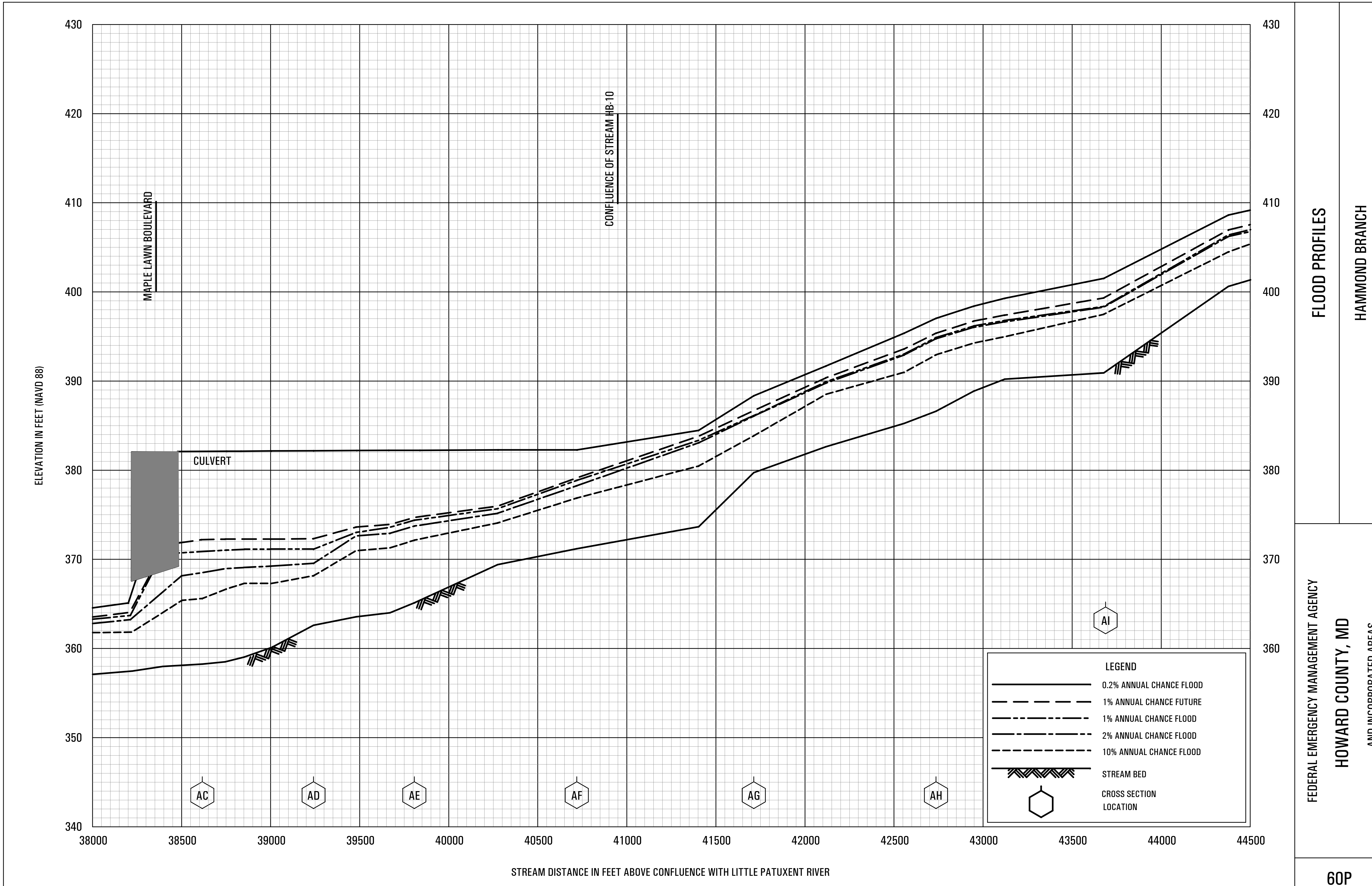
FLOOD PROFILES

HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS


FLOOD PROFILES
HAMMOND BRANCH
FEDERAL EMERGENCY MANAGEMENT AGENCY
HOWARD COUNTY, MD
AND INCORPORATED AREAS
60P
ELEVATION IN FEET (NAVD 88)
STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH LITTLE PATUXENT RIVER
MAPLE LAWN BOULEVARD
CONFLUENCE OF STREAM HB-10
CULVERT
LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FUTURE
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION
AC
AD
AE
AF
AG
AH
AI
340
350
360
370
380
390
400
410
420
430
38000
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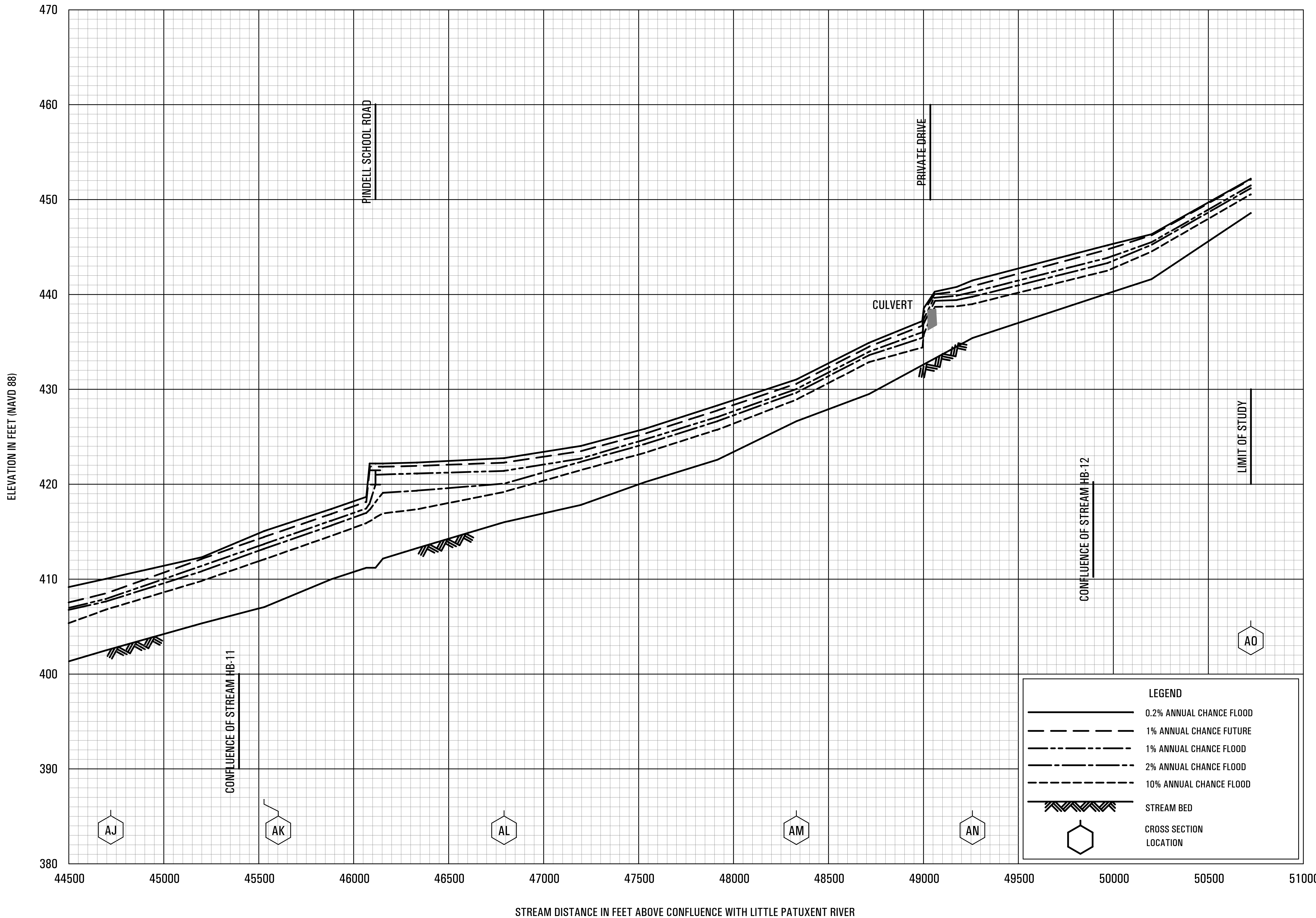


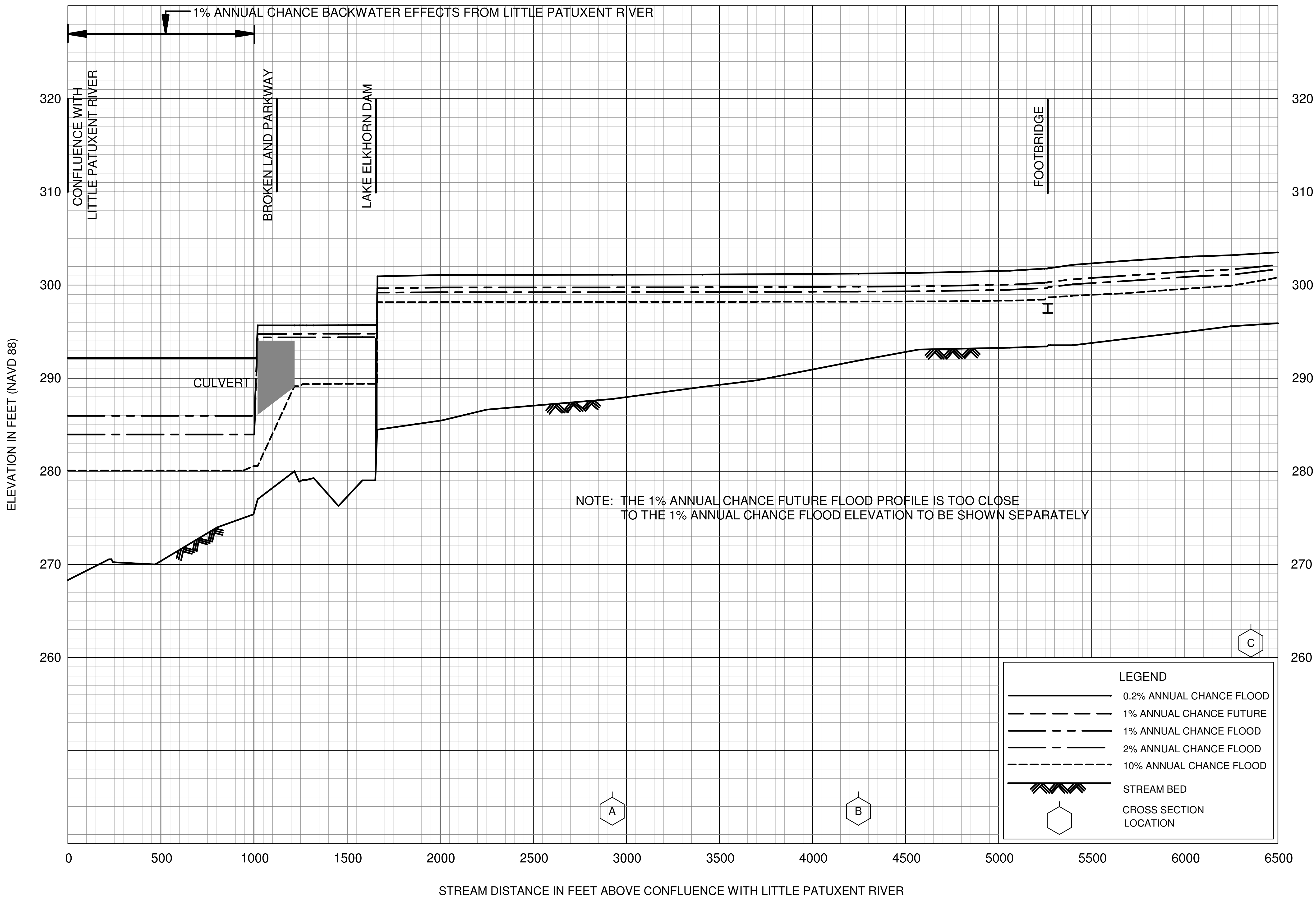
FLOOD PROFILES

HAMMOND BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

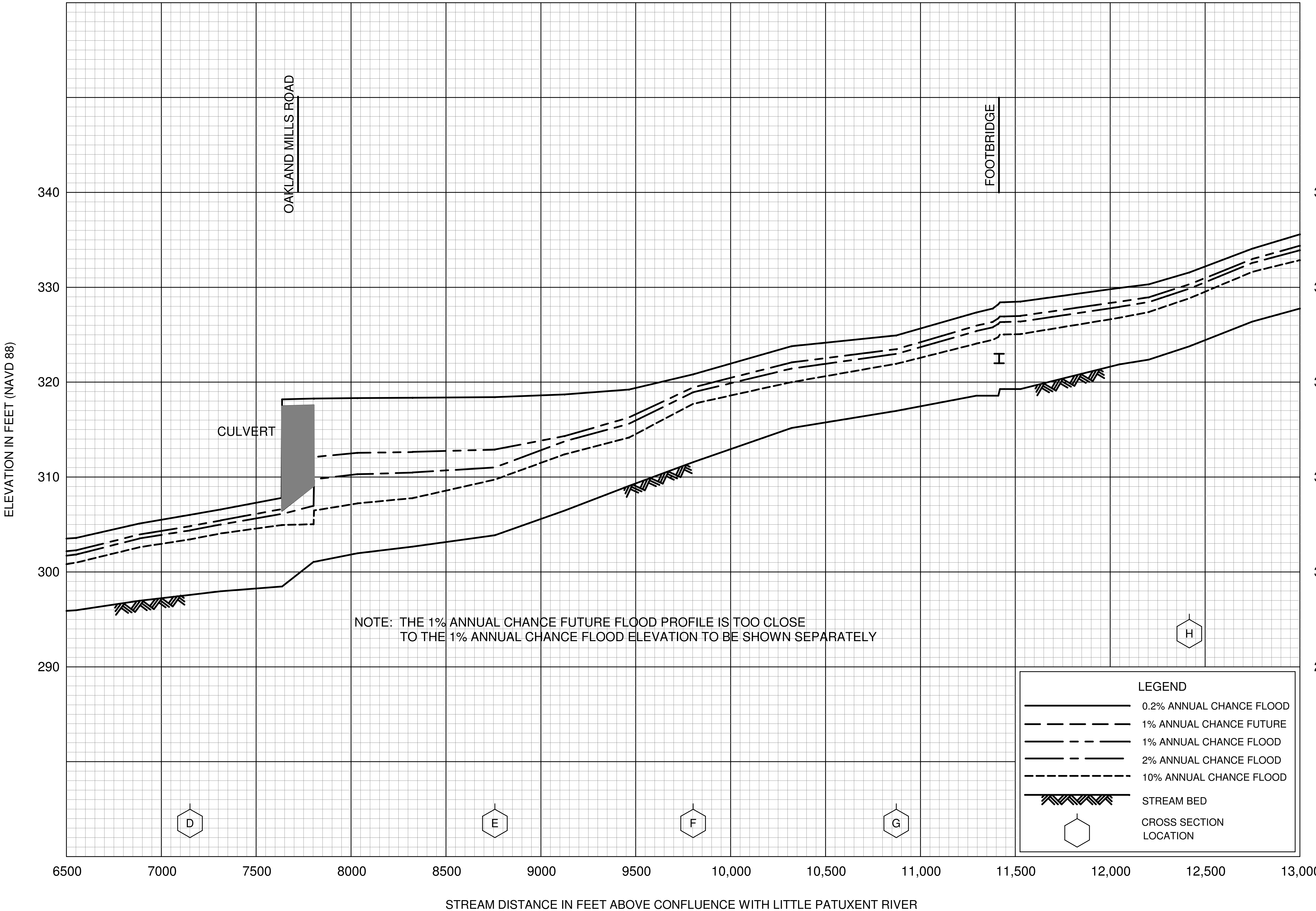
LAKE ELKHORN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS

62P



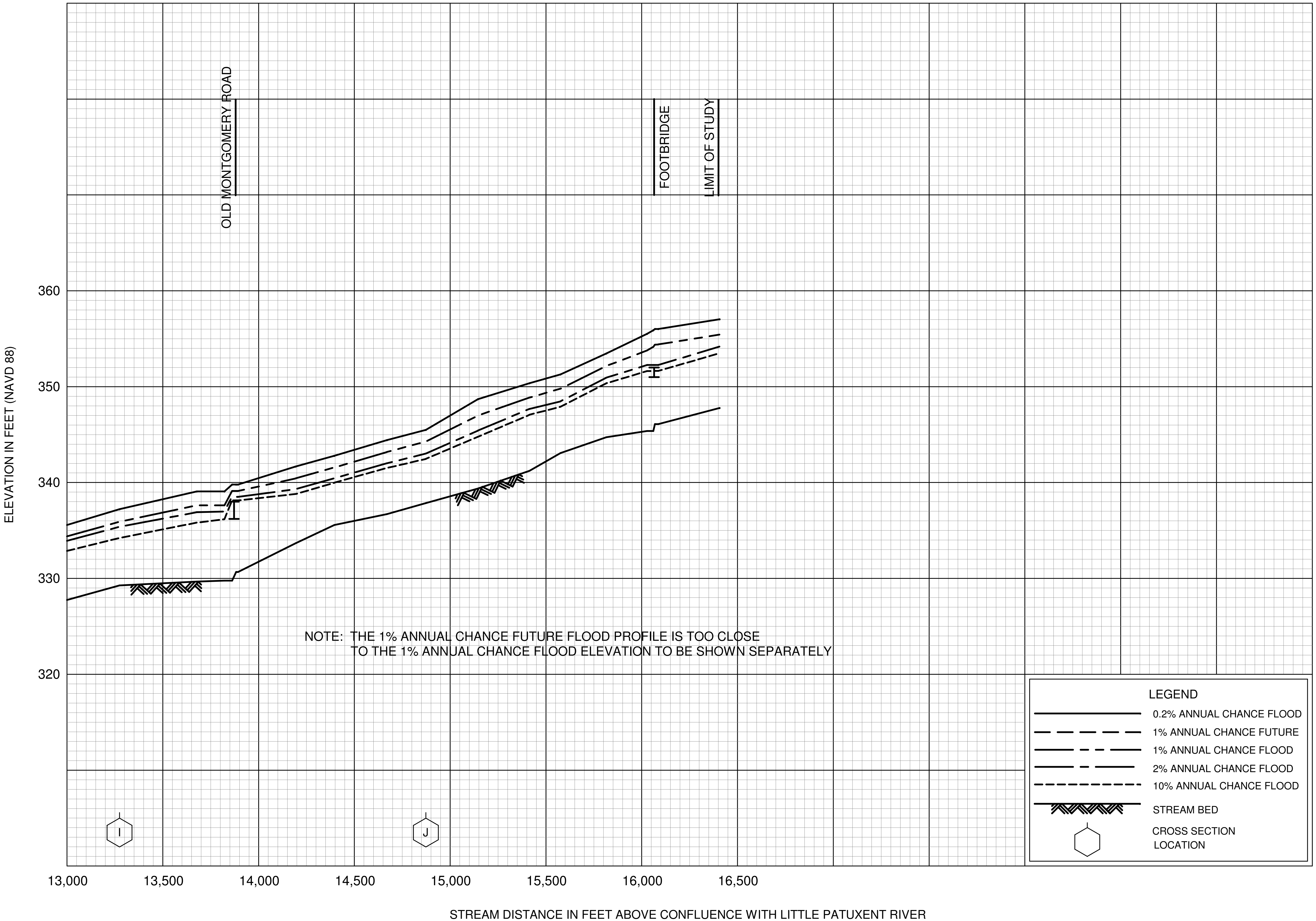
FLOOD PROFILES

LAKE ELKHORN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS



FLOOD PROFILES

LAKE ELKHORN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

HOWARD COUNTY, MD

AND INCORPORATED AREAS