# FLOOD INSURANCE STUDY

# ANNE ARUNDEL COUNTY, MARYLAND
## AND INCORPORATED AREAS

**Anne Arundel County**

| Community | CID |
|---|---|
| Annapolis, City of | 240009 |
| Anne Arundel County, (Unincorporated Areas) | 240008 |
| Highland Beach, Town of | 240161 |

REVISED:
February 18, 2015

## Federal Emergency Management Agency

**FLOOD INSURANCE STUDY NUMBER**

**24003CV000B**

NOTICE TO
FLOOD INSURANCE STUDY USERS


Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) report may not contain all data available within the Community Map Repository. Please contact the Community Map Repository for any additional data.


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


Initial County FIS Effective Date: October 16, 2012


Revised Countywide FIS Effective Dates:  February 18, 2015

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FLOOD INSURANCE STUDY
ANNE ARUNDEL COUNTY, MARYLAND AND INCORPORATED AREAS


1.0     UNDERLINE INTRODUCTION

    1.1     Purpose of Study

            This Flood Insurance Study (FIS) revises and updates the FIS report and Flood
            Insurance Rate Maps (FIRMs) in the geographic area of Anne Arundel County,
            Maryland including the City of Annapolis, the Town of Highland Beach, and the
            unincorporated areas of Anne Arundel County (hereinafter referred to collectively
            as Anne Arundel County), and aids in the administration of the National Flood
            Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study
            has developed flood risk data for various areas of the community that will be used
            to establish actuarial flood insurance rates. This information will also be used by
            Anne Arundel County to update existing floodplain regulations as part of the
            Regular Phase of the National Flood Insurance Program (NFIP), and by local and
            regional planners to further promote sound land use and floodplain development.
            Minimum floodplain management requirements for participation in the NFIP are
            set forth in the Code of Federal Regulations at 44 CFR, 60.3.

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

    1.2     Authority and Acknowledgements

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

            This Flood Insurance Study is a revision and compilation of three existing FIS
            studies in Anne Arundel County, Maryland: the City of Annapolis FIS, the Town
            of Highland Beach FIS, and the Anne Arundel County (unincorporated) FIS. The
            Flood Insurance Studies for the City of Annapolis, the Town of Highland Beach,
            and the unincorporated areas of Anne Arundel County, were prepared by the
            Flood Management Division of the Maryland Water Resources Administration of
            the State of Maryland, for the Federal Insurance Administration under Contract
            No. H—4621, and are dated May 4, 1981, April 15, 1982, and July 18, 1985,
            respectively.

            The hydrologic and hydraulic analyses for the October 16, 2012 countywide study
            were performed by the U.S. Army Corps of Engineers (USACE) for Maryland

Department of Environment (MDE) as part of the Federal Emergency Management Agency's (FEMA) Map Modernization Program (MMP) under Contract No. ICA-05-CRL-01. The MMP study was completed in March 2009.

The coastal flood hazard analyses for the February 18, 2015 countywide revision were completed for FEMA by the USACE and its project partners under Project HSFE03-06-X-0023 and Project HSFE03-09-X-1108, and by Risk Assessment, Mapping, and Planning Partners (RAMPP) under contract No. HSFEHQ-09-D-0369, Task Order HSFE03-10-J-0023. The creation of the final FIRM database and coastal floodplain mapping for this revision were performed by RAMPP under contract No. HSFEHQ-09-D-0369, Task Order HSFE03-10-J-0023. This study was completed in March 2013.

For the October 16, 2012 countywide study, base map information is from the National Agricultural 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. This data was obtained through the Maryland Department of Planning and was published on December 8, 2005.

Base map information for the February 18, 2015 countywide revision was provided by the Anne Arundel County GIS Department. The digital ortho imagery was compiled by Axis Geospatial at a scale of 1:100 with a 6 inch ground pixel resolution, and published by the Maryland Department of Information Technology in 2011.

The data is in the Universal Transverse Mercator Zone 18N Coordinate System and horizontally referenced to the North American Datum of 1983 (NAD83) and vertically to the North American Vertical Datum of 1988 (NAVD88).

1.3     Coordination

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

The initial CCO meetings for the three community-based studies were held on different days. The unincorporated areas of Anne Arundel County held their meeting on February 27, 1978 and was attended by representatives of FEMA, Anne Arundel County, and the State of Maryland Water Resources Administration (the study contractor). Further coordination occurred with the USACE, the U.S. Geological Survey (USGS), Anne Arundel County officials, the Soil Conservation Service (SCS), and the Virginia Institute of Marine Science (VIMS). On March 22, 1982, the results of the study were reviewed at a final CCO meeting held with representatives of FEMA, the county, and the study

contractor.

The initial CCO meeting for the community-based study for the City of Annapolis was held on March 13, 1978. The meeting was attended by representatives of the FEMA, formerly known as the Flood Insurance Administration (FIA), the City of Annapolis, and the Flood Management Division of the Maryland Water Resources Administration (the study contractor). The VIMS provided pertinent data throughout the course of the study. On December 3, 1980, a final CCO meeting was held to review the results of the study, attended by representatives of the FIA, the City of Annapolis, and the study contractor.

The community-based FIS for the Town of Highland Beach (FEMA, 1982) does not reference a CCO meeting; therefore, no coordination information is available.

The initial CCO meeting for the October 16, 2012 countywide study was held in July 2006, at the Maryland Department of Environment offices and attended by representatives of MDE, FEMA, and USACE (study contractor for this study).

For the October 16, 2012 countywide study, the results were reviewed at the final CCO meeting held on November 10, 2009 and attended by representatives of FEMA, the community, and the study contractor. All problems raised at that meeting have been addressed.

For the February 18, 2015 countywide revision, an initial CCO meeting was held on February 14, 2011 at the Anne Arundel County Office of Emergency Management in Glen Burnie, MD, and attended by representatives of FEMA, Anne Arundel County, local communities, MDE, and RAMPP. On March 25, 2013, the Flood Risk Review meeting was held at the Anne Arundel County Offices in Annapolis, Maryland, and attended by representatives of FEMA, Anne Arundel County, local communities, MDE, and RAMPP.

The results of the study were reviewed at the final CCO meeting held on August 6, 2013, and attended by representatives of FEMA, Anne Arundel County, local communities, MDE, and RAMPP. All problems raised at that meeting have been addressed in this study.

## 2.0    AREA STUDIED

### 2.1    Scope of Study

This FIS covers the geographic area of Anne Arundel County, Maryland, including all unincorporated areas of the county, the City of Annapolis, and the Town of Highland Beach.

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

TABLE 1 - FLOODING SOURCES STUDIED BY DETAILED METHODS

| | |
|---|---|
| Cabin Branch | Midway Branch |
| Franklin Branch | Patapsco River |
| Hall Creek | Patuxent River |
| Little Patuxent River | Sawmill Creek |
| Marley Creek | Severn Run |

The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction through Anne Arundel County.

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 FIS mapping (refer to Section 3.2).

Numerous streams were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and Anne Arundel County.

USACE's methodology for approximate method streams includes 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 FIS mapping.

This countywide FIS revision includes 79 miles of new coastal analyses for the Chesapeake Bay. The scope of the study included establishing the frequency-peak elevation relationships for coastal flooding sources and preparing flood hazard mapping in Anne Arundel County.


2.2     Community Description

Anne Arundel County is located in the east-central portion of Maryland. It is bordered by the Patapsco River and the City of Baltimore to the north, the Chesapeake Bay to the east, Calvert County to the south, and the Patuxent River to the west. According to the U. S. Census Bureau, the population of Anne

Arundel County was 537,656 in 2010 (US Census, 2010). The estimated population of the county in 2012 was 550,175 (US Census, 2010). Anne Arundel County is a rapidly growing area and is an extension of the Baltimore Metropolitan Region.

The City of Annapolis is located on the south bank of the Severn River and is bordered to the south and west by Anne Arundel County. Annapolis, the capital of the State of Maryland, had a population of 38,394 in 2010 (US Census, 2010). The city is highly urbanized, with residential and light industry along the shorelines. Development is characterized by marinas and piers along the waterfront.

The Town of Highland Beach occupies a small geographical area along the Chesapeake Bay in Anne Arundel County. The town had a population of 96 in 2010 (US Census, 2010). The land use is primarily residential with a moderate development density.

Seven major drainage basins in the county provide drainage directly into the Chesapeake Bay. Nearly two-thirds of the county is drained through the Patapsco River on the north and the Magothy River, the Severn River, the Rhode River, the South River, the West River, and Herring Bay to the east. The Patuxent River on the west drains the remainder of the county. Many large streams are tributaries to the rivers of the county. Located in the north and draining into the Patapsco River are Stony Run, Furnace Creek, and Marley Creek. The Magothy, Severn, South, Rhode, and West Rivers are tidal estuaries fed by many large streams such as Severn Run, Deep Creek, the North River, Ridge Branch, Bell Branch, Beards Creek, and Muddy Creek. The major tributaries of the Patuxent River are the Little Patuxent River, Lyons Creek, Stocketts Run, Kings Branch, and Rock Branch.

All of the major streams in the county are normally sluggish, and many have large accumulations of silt. In many areas along Marley Creek, there is no defined channel as the creek flows through swamps. Streams in the northern and eastern parts of the county are tidal where they flow into the larger estuaries (United States Department of Agriculture (USDA), 1973).

The areas of tidal marsh support coarse grasses and rushes. Some areas are growing up in shrubs and small trees that tolerate saltwater or brackish water (USDA, 1973).

The topography ranges from level to very steep. Nearly level and gently sloping soils are located in large areas north of the Severn River and the Magothy River on the Deale-Shadyside flats and in the southwestern portion of the county adjoining the Patuxent River. The steepest slopes are found in a north-south section that runs through the central part of the county, where many small streams

have cut deep V-shaped valleys into the soft unconsolidated materials of the coastal plain. Broad alluvial terraces border many of the large streams and rivers that flow into the Chesapeake Bay. Elevations in the county range from 0 feet along the shore of the Chesapeake Bay to more than 300 feet in the northwestern part of the county (USDA, 1973).

Anne Arundel County has a continental climate and well defined seasons. However, the Chesapeake Bay exerts a considerable modifying control on the climate, especially in that part of the county immediately adjacent to the bay.

The warmest part of the year occurs in July, when the maximum afternoon temperatures average approximately 89 degrees Fahrenheit (°F). Temperatures of 90°F or higher occur on an average of 31 days per year. The coldest period of the year occurs in January and February when early morning minimum temperatures average approximately 24°F. Minimum temperatures of 32°F or lower occur an average of 103 days per year. The average growing period is 194 days.

Thunderstorms occur on an average of 31 days per year, with almost 70 percent occurring from May through August. Tornadoes are rare and have caused little damage in the past. Tropical storms and hurricanes affect the county an average of once a year, usually in the period from August through October. Most of these have caused minor damage.

Prevailing winds are mostly from the west to northwest, except during the summer when they are more from the south. The average annual velocity of the wind is 10 miles per hour, however, winds may reach 50 to 60 miles per hour and even higher in severe thunderstorms, hurricanes, and general winter storms (USDA, 1973).

2.3     Principal Flood Problems

Storm damage in Anne Arundel County has resulted from severe thunderstorms and from tropical storms and hurricanes that follow a northern route along the Atlantic coastline. Hurricane Hazel struck the county on October 16, 1954. As reported by The Evening Capital, extensive damage occurred to property and oyster beds (The Evening Capital, 1954).

Tropical Storm Connie struck the county on August 13, 1955. Winds were reported as high as 58 miles per hour. Basements were flooded and trees were blown down.  There was extensive crop damage which included $10 million (1955 United States Dollars (USD)) in damage to the tobacco crop (The Evening Capital, 1955).  Winds were reported up to 60 miles per hour in the county when Tropical Storm Diane hit on August 18, 1955. Tides were estimated at 2 to 3 feet above normal on the Middle River and the Back River at their respective confluences with the Chesapeake Bay (The Evening Capita, 1955).

Tropical Storm Agnes occurred on June 26, 1972. At the Baltimore Washington Airport, 2.19 inches and 8.84 inches of rain were recorded June 21 and June 22, respectively (The Evening Capital, 1972).  The entire state of Maryland was declared a disaster area and over $1 million (1972 USD) in damage was reported (The Evening Capital, 1972).  In Anne Arundel County, structures were flooded along Old Annapolis Road, in North Humphrey, and in a trailer court on Belle Grove Road. It is estimated that Tropical Storm Agnes exceeded a 100-year flood.

On September 6, 1996, storm surge from the remnants of Hurricane Fran caused an estimated $1.4 million (1996 USD) in damage in Anne Arundel County.  The damage included 83 homes, 7 commercial buildings, and 100 bulkheads and piers (National Oceanic and Atmospheric Administration (NOAA), 1996).

Tropical storms which caused damages to the area in recent years include Hurricane Floyd in 1999, Hurricane Isabel in 2003, Hurricane Katrina in 2005, Hurricane Irene in 2011, and Hurricane Sandy in 2012 (FEMA, 2013).

2.4     Flood Protection Measures

The State of Maryland Department of Natural Resources has established rules and regulations governing construction on non-tidal waters and flood plains. It restricts development in, obstructions to, and encroachment on the 100-year flood plain.

At present, no flood control structures exist in Anne Arundel County.  The Rocky Gorge Reservoir and the Triadelphia Reservoir, which are located upstream on the Patuxent River, are primarily water-supply reservoirs. They provide regulation of the discharges of lower frequency floods on the Patuxent River. The regulation effect on large floods was found to be minimal.

3.0     ENGINEERING METHODS

For the flooding sources studied by detailed methods in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term, average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood

that equals or exceeds the 1-percent annual chance flood in any 50-year period is approximately 40 percent (4 in 10); 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 each flooding source studied in detail affecting Anne Arundel County.

Information on the methods used to determine peak discharge-frequency relationships for the streams studied by detailed methods is shown below.

The effective Flood Insurance Studies for Anne Arundel County, Maryland included hydrologic analyses for the areas studied in detail. The objectives of the hydrologic portions of the FIS update are to calculate revised 10-, 2-, 1-and 0.2-percent annual chance flows, along with an ultimate 1-percent annual chance flow, based on regression equations produced by Dr. Glen Moglen at the University of Maryland.  The ultimate 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 current FIS update has an additional objective, to establish 10-, 2-, 1-, and 0.2-percent annual chance flows for streams identified within the effective FIS and Flood Insurance Rate Map approximate flood zones and previously unstudied areas. Methods and results of the updated hydrologic analyses are presented below.

The Maryland Department of Environment contracted Dr. Glenn Moglen of the Department of Civil and Environmental Engineering at the University of Maryland to perform the hydrologic calculations for this Flood Insurance Study.

The current regional regression equations being used by the Maryland State Highway Administration were developed by Jonathan Dillow, a hydrologist for the U.S. Geological Survey (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 (USGS, 1996).

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.  Anne Arundel County is located entirely in the Western Coastal Plain Region.

The region regression equations for the Western Coastal Plain Region (Table 2) are based on 22 stations in the Western Coastal Plain; five stations were deleted as outliers since they were highly urban stations partly in the Piedmont Region, had very low peaks, or the data did not fit a Pearson Type distribution real well. The drainage area (DA) ranges from 0.10 to 349.50 square miles, the 1985 impervious area (IA) ranges from 0.0 to 36.8 percent, and percent D soils ($S_D$) ranges from 2.4 to 26.4 percent. The standard errors range from 35.4 percent (0.149 log units) for $Q_2$ to 65.7 percent (0.260 log units) for $Q_{100}$. The standard for $Q_{500}$ is 89.8 percent (0.334 log units) because there is one station that is an outlier at the 500-yr recurrence interval but reasonable for other recurrence intervals.

TABLE 2 - WESTERN COASTAL PLAIN FIXED REGION REGRESSION EQUATIONS

| Western Coastal Plain Fixed Region Regression Equation | Standard error (percent) | Equivalent years of record |
|---|---|---|
| $Q_{1.25} = 18.62 \, DA^{0.611} \, (IA+1)^{0.419} \, (S_D+1)^{0.165}$ | 38.9 | 3.2 |
| $Q_{1.50} = 21.97 \, DA^{0.612} \, (IA+1)^{0.399} \, (S_D+1)^{0.226}$ | 36.3 | 3.2 |
| $Q_{1.75} = 24.42 \, DA^{0.612} \, (IA+1)^{0.391} \, (S_D+1)^{0.246}$ | 35.6 | 3.4 |
| $Q_2 = 26.32 \, DA^{0.612} \, (IA+1)^{0.386} \, (S_D+1)^{0.256}$ | 35.4 | 3.7 |
| $Q_5 = 42.64 \, DA^{0.607} \, (IA+1)^{0.347} \, (S_D+1)^{0.340}$ | 36.3 | 6.8 |
| $Q_{10} = 58.04 \, DA^{0.603} \, (IA+1)^{0.323} \, (S_D+1)^{0.382}$ | 40.6 | 8.4 |
| $Q_{25} = 86.25 \, DA^{0.582} \, (IA+1)^{0.295} \, (S_D+1)^{0.421}$ | 48.9 | 9.3 |
| $Q_{50} = 111.50 \, DA^{0.584} \, (IA+1)^{0.270} \, (S_D+1)^{0.457}$ | 54.7 | 9.9 |
| $Q_{100} = 143.56 \, DA^{0.586} \, (IA+1)^{0.260} \, (S_D+1)^{0.469}$ | 65.7 | 9.0 |
| $Q_{200} = 185.15 \, DA^{0.580} \, (IA+1)^{0.243} \, (S_D+1)^{0.488}$ | 75.5 | 8.7 |
| $Q_{500} = 256.02 \, DA^{0.573} \, (IA+1)^{0.222} \, (S_D+1)^{0.510}$ | 89.8 | 8.3 |

All calculations using the fixed region regression equations were preformed 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 Maryland State Highway Administration began to update and enhance GISHydro into GISHydro2000.

It should also be emphasized that these regression equations, although not developed by the USGS, provide 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 Maryland State Highway Administration or from the following URL:
 http://www.gishydro.umd.edu/HydroPanel/panel_report_103106.pdf  (University of Maryland, 2006).

Results of Dr. Moglen's hydrologic analysis are listed below in Table 3.

### TABLE 3 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) | | | | |
|---|---|---|---|---|---|---|
| | | 10 % annual chance | 2 % annual chance | 1 % annual chance | *1 % ult annual chance | 0.2 % annual chance |
| **CABIN BRANCH** | | | | | | |
| Approximately 350' upstream of Andover Rd. | 0.71 | 304 | 464 | 683 | 715 | 1,130 |
| Approximately 500' downstream of Baltimore & Annapolis RR | 1.09 | 414 | 631 | 922 | 931 | 1,510 |
| Approximately 180' downstream of Old Annapolis Rd. | 1.45 | 537 | 832 | 1,210 | 1,210 | 2,000 |
| Approximately 300' downstream of Furnace Branch Rd. | 1.79 | 631 | 989 | 1,440 | 1,440 | 2,370 |
| Approximately 1450' downstream of Furnace Branch Rd. | 2.06 | 708 | 1,110 | 1,610 | 1,610 | 2,670 |

*1-Percent Annual Chance Ultimate Exceedance Probability Discharge

TABLE 3 - SUMMARY OF DISCHARGES-continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) | | | | |
|---|---|---|---|---|---|---|
| | | 10 % annual chance | 2 % annual chance | 1 % annual chance | *1 % ult annual chance | 0.2 % annual chance |
| CABIN BRANCH - continued | | | | | | |
| Approximately 1250' upstream of Cedar Ave | 2.46 | 801 | 1,270 | 1,830 | 1,830 | 3,040 |
| Approximately 40' upstream of Cedar Ave | 2.83 | 886 | 1,410 | 2,030 | 2,030 | 3,370 |
| Approximately 350' downstream of Interstate 695' | 3.64 | 1,020 | 1,640 | 2,340 | 2,370 | 3,870 |
| At mouth | 4.22 | 1,090 | 1,770 | 2,520 | 2,620 | 4,170 |
| | | | | | | |
| FRANKLIN BRANCH | | | | | | |
| At mouth | 1.81 | 576 | 1,135 | 1,509 | - | 3,195 |
| | | | | | | |
| HALL CREEK | - | - | - | - | - | - |
| | | | | | | |
| LITTLE PATUXENT | | | | | | |
| Downstream of B & O RR (Chessie System RR) and the county boundary | 109.0 | 11,063 | 22,814 | 30,342 | 31,678 | 56,066 |
| Downstream of small unnamed tributary | 111.3 | 11,146 | 23,015 | 30,461 | 31,873 | 56,112 |
| At Baltimore - Washington Pkwy | 124.4 | 11,868 | 23,907 | 31,611 | 33,405 | 57,379 |
| Downstream of small unnamed tributary | 125.9 | 11,897 | 24,021 | 31,674 | 33,477 | 57,408 |
| Downstream of Laurel - Ft Meade Rd | 127.7 | 11,995 | 24,101 | 31,774 | 33,565 | 57,473 |
| Downstream of Patuxent Rd | 142.8 | 12,204 | 24,312 | 32,015 | 34,134 | 57,858 |
| Downstream of Conway Rd | 154.5 | 12,518 | 24,884 | 32,633 | 34,617 | 58,438 |
| Downstream of small unnamed tributary | 156.6 | 12,644 | 24,986 | 32,855 | 34,829 | 58,716 |
| Upstream of confluence with Patuxent River | 160.3 | 12,803 | 25,252 | 33,133 | 35,089 | 59,113 |

- Data Not Available
*1-Percent Annual Chance Ultimate Exceedance Probability Discharge

TABLE 3 - SUMMARY OF DISCHARGES-continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) | | | | |
|---|---|---|---|---|---|---|
| | | 10 % annual chance | 2 % annual chance | 1 % annual chance | *1 % ult annual chance | 0.2 % annual chance |
| **MARLEY CREEK** | | | | | | |
| 200' upstream of Elvaton Rd | 2.19 | 641 | 966 | 1,390 | 1,390 | 2,250 |
| 100' upstream of Elvaton Rd | 2.59 | 711 | 1,070 | 1,540 | 1,540 | 2,480 |
| 500' upstream of Elvaton Rd | 2.78 | 745 | 1,120 | 1,610 | 1,610 | 2,590 |
| 640' upstream of Hospital Dr | 3.26 | 820 | 1,240 | 1,770 | 1,770 | 2,840 |
| 130' upstream of Rt 100 | 4.12 | 921 | 1,400 | 1,990 | 1,950 | 3,190 |
| 500' upstream of Ritchie Hwy (State Rt 2) | 4.28 | 940 | 1,430 | 2,030 | 2,030 | 3,260 |
| 185' downstream of Ritchie Hwy (State Rt 2) | 5.16 | 1,050 | 1,600 | 2,250 | 2,250 | 3,610 |
| 670' downstream of Ritchie Hwy (State Rt 2) | 6.82 | 1,280 | 1,950 | 2,750 | 2,750 | 4,390 |
| 600' upstream of Arundel Expressway (State Rt 10) | 8.00 | 1,470 | 2,260 | 3,180 | 3,150 | 5,090 |
| **MIDWAY BRANCH** | | | | | | |
| At mouth | 8.25 | 1,167 | 3,235 | 4,637 | - | 10,436 |
| **PATAPSCO RIVER** | | | | | | |
| 200' upstream of State Rt 173 | 345 | 15,400 | 30,600 | 42,200 | 42,200 | 72,000 |
| **PATUXENT RIVER** | | | | | | |
| Downstream of Rt 216 | Unknown*** | 8,277 | 15,174 | 26,258 | - | 41,717 |
| 1,100' downstream of Laurel – Ft Meade Rd | Unknown*** | 8,324 | 15,174** | 26267 | - | 41,717** |
| 5,800' downstream of Baltimore – Washington Pkwy | Unknown*** | 8,893 | 15,174** | 26361 | - | 41,717** |

- Data Not Available

*1-Percent Annual Chance Ultimate Exceedance Probability Discharge

**Not provided in either the 18 July 1985 Anne Arundel County FIS Report or the Laurel, MD Flood Study

TABLE 3 - SUMMARY OF DISCHARGES-continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) | | | | |
|---|---|---|---|---|---|---|
| | | 10 % annual chance | 2 % annual chance | 1 % annual chance | *1 % ult annual chance | 0.2 % annual chance |
| PATUXENT RIVER-continued | | | | | | |
| Upstream of the confluence with the Little Patuxent River | Unknown*** | 8,893** | 17,000 | 26,361** | - | 45,000 |
| Upstream of the confluence with Stocketts Run | Unknown*** | 19,000 | 35,000 | 45,000 | - | 70,000 |
| Upstream of the confluence of Western Branch | 400.1 | 24,500 | 43,000 | 52,500 | - | 77,000 |
| SAWMILL CREEK | | | | | | |
| Limit of Detailed Study | 0.80 | 257 | 419 | 603 | 630 | 1,020 |
| At Section AI | 0.92 | 282 | 459 | 659 | 693 | 1,120 |
| At Section AG | 1.08 | 307 | 503 | 718 | 759 | 1,210 |
| Approximately 320' downstream of Section AE | 1.80 | 438 | 709 | 1,010 | 1,080 | 1,680 |
| Approximately 200' downstream of Section AC | 2.22 | 503 | 812 | 1,150 | 1,260 | 1,910 |
| Approximately 455' downstream of Section AA | 2.73 | 556 | 906 | 1,270 | 1,450 | 2,110 |
| Approximately 405' downstream of Interstate 97 | 2.90 | 577 | 939 | 1,320 | 1,500 | 2,190 |
| Approximately 310' downstream of Section U | 4.34 | 761 | 1,230 | 1,710 | 1,910 | 2,820 |

- Data Not Available
*1-Percent Annual Chance Ultimate Exceedance Probability Discharge
**Original values were lower than the value at the next upstream location and were increased to match that upstream value – per FEMA's request
***Not provided in either the 18 July 1985 Anne Arundel County FIS Report or the Laurel, MD Flood Study

TABLE 3 - SUMMARY OF DISCHARGES-continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) | | | | |
|---|---|---|---|---|---|---|
| | | 10 % annual chance | 2 % annual chance | 1 % annual chance | *1 % ult annual chance | 0.2 % annual chance |
| SAWMILL CREEK - continued | | | | | | |
| At Section Q | 4.90 | 829 | 1,340 | 1,860 | 2,060 | 3,050 |
| At Section K | 6.60 | 1,060 | 1,680 | 2,330 | 2,510 | 3,780 |
| At Section E | 8.10 | 1,260 | 1,980 | 2,750 | 2,900 | 4,440 |
| At Section A | 8.77 | 1,340 | 2,100 | 2,910 | 3,040 | 4,690 |
| | | | | | | |
| SEVERN RUN | | | | | | |
| Downstream end of Detailed Study | 4.05 | 889 | 1,390 | 1,970 | 2,000 | 3,210 |
| Downstream of confluence with Picture Frame Branch | 6.81 | 1,350 | 2,180 | 3,050 | 3,240 | 5,000 |
| Downstream of confluence with unnamed tributary | 7.5 | 1,430 | 2,330 | 3,250 | 3,450 | 5,340 |
| Downstream of confluence with Beaver Creek | 10.23 | 1,690 | 2,730 | 3,780 | 3,950 | 6,170 |
| Downstream of confluence with unnamed tributary | 12.41 | 1,860 | 3,020 | 4,170 | 4,330 | 6,800 |
| Downstream of confluence with unnamed tributary | 15.13 | 2,020 | 3,300 | 4,520 | 4,670 | 7,350 |
| Downstream of confluence with unnamed tributary | 16.17 | 2,070 | 3,370 | 4,610 | 4,790 | 7,490 |
| Downstream of confluence with unnamed tributary | 17.02 | 2,120 | 3,460 | 4,730 | 4,930 | 7,680 |
| Downstream of confluence with unnamed tributary | 18.49 | 2,230 | 3,650 | 4,970 | 5,190 | 8,080 |
| Downstream of confluence with Jabez Branch | 24.14 | 2,500 | 4,130 | 5,570 | 5,880 | 9,050 |

*1-Percent Annual Chance Ultimate Exceedance Probability Discharge


The hydrologic analyses for three of the streams studied in detail did not use the methodology developed by Dr. Moglen and the University of Maryland. Franklin Branch and Midway Branch were studied using HEC-HMS to develop flows. For

the Patuxent River, flows from the original FIS were used as Dr. Moglen's methodology was not sufficient for the needs of the larger stream.

**This Countywide Revision**

No new detailed hydrologic analyses were carried out for this countywide study.

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 for the selected recurrence intervals.  Users should be aware that flood elevations shown on the Flood Insurance Rate Map (FIRM) represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data table in the FIS report. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS report in conjunction with the data shown on the FIRM.

A Digital Elevation Model (DEM), which is a 3-D model of a ground surface, was created from Light Detection and Ranging (LIDAR) provided by the Maryland Department of Natural Resources.  Cross sections for the standard-step backwater analyses were obtained from this DEM.  The 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 thalwag 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). For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the FIRM (Exhibit 2).

The hydraulic analyses for this countywide FIS were based on unobstructed flow. The flood elevations shown on the Flood Profiles (Exhibit 1) are thus considered valid only if the hydraulic structures remain unobstructed, operate properly, and do not fail.

All bridges and culverts in the original hydraulic models were surveyed to obtain structural geometry and measurements.  In an effort to identify any bridges that had been modified since the original FIS had been conducted, USACE contacted the MDE and Anne Arundel County to acquire the most recent data on all bridges and culverts.  The bridge inventory data from the MDE and Anne Arundel County was compared to the effective hydraulic models and if a difference existed, the bridge data were replaced with the more recent information.

Water-surface elevations for floods of the selected recurrence intervals were computed through use of the USACE Hydrologic Engineering Centers River Analysis System (HEC-RAS version 4.0) step-backwater computer program.

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 over bank 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 available. Roughness values for the main channels and over banks of smaller streams ranged from 0.03 to 0.06 and 0.048 to 0.125 respectively.

**This Countywide Revision**

No new detailed hydraulic analyses were carried out for this countywide study.

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 well (e.g., mounted in bedrock)

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

Stability C: Monuments which may be affected by surface round monuments (e.g., concrete mounted 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    Coastal Analyses

The stillwater surge elevation is the elevation of the water due solely to the effects of the astronomical tides, storm surge, and wave setup on the water surface but does not include wave heights. The inclusion of wave heights, which is the distance from the trough to the crest of the wave, increases the water-surface elevations. The height of a wave is dependent upon wind speed and its duration, depth of water, and length of fetch. The wave crest elevation is the sum of the stillwater elevation and the portion of the wave height above the stillwater elevation.

**This countywide FIS revision**

Coastal analysis for this revision, considering storm characteristics and the shoreline and bathymetric characteristics of the flooding sources studied, were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline. Users of the FIRM should be aware that coastal flood elevations are provided in Table 4, "Summary of Coastal Stillwater Elevations" table in this report. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

An analysis was performed to establish the frequency peak elevation relationships for coastal flooding in Anne Arundel County. The FEMA, Region III office, initiated a study in 2008 to update the coastal storm surge elevations within the states of Virginia, Maryland, and Delaware, and the District of Columbia including the Atlantic Ocean, Chesapeake Bay, the Delaware Bay, and their tributaries. The study replaces outdated coastal analyses as well as previously published storm surge stillwater elevations for all FIS Reports in the study area,

including Anne Arundel County, MD, and serves as the basis for updated FIRMs. Study efforts were initiated in 2008 and concluded in 2012.

The Chesapeake Bay is the primary coastal flooding source in Anne Arundel County. Coastal flooding along the Severn River affects the northwestern section of the City of Annapolis. The Chesapeake Bay affects the Town of Highland Beach.  Along the Chesapeake Bay, Anne Arundel County is susceptible to bluff retreat in a few locations, including at the county's southern shore, between Severn River and South River, and the shore north and south of the Magothy River mouth. The bluffs along the Chesapeake Bay coastline vary from eight feet to thirty-nine feet in elevation, NAVD88. The majority of the northern coastline is high-density urbanized. The southern coastline is vegetated with medium-density residential. Sillery Bay and Magothy Narrows are inland bays in Anne Arundel County, but are only susceptible to low wave heights.

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

The end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics. ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating Waves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge. The resulting model system is typically referred to as SWAN+ADCIRC (Bunya et al, 2010). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields from three major flood events for the Region III domain: Hurricane Isabel, Hurricane Ernesto, and extra tropical storm Ida. Model skill was assessed by quantitative comparison of model output to wind, wave, water level and high water mark observations.

The tidal surge in the Chesapeake Bay affects 79 miles of Anne Arundel County coastline, and that entire length was modeled for overland wave propagation.  The fetch length across the Chesapeake Bay varies from approximately 1 to 12 miles.

The storm-surge elevations for the 10-, 2-, 1-, and 0.2- percent annual chance floods were determined for the Chesapeake Bay and Patuxent River and are

shown in Table 4, "Summary of Coastal Stillwater Elevations." The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects.

TABLE 4 – SUMMARY OF COASTAL STILLWATER ELEVATIONS

| FLOODING SOURCE AND LOCATION | ELEVATION (feet NAVD88) | | | |
|---|---|---|---|---|
| | 10-Percent Annual Chance | 2-Percent Annual Chance | 1-Percent Annual Chance | 0.2-Percent Annual Chance |
| CHESAPEAKE BAY | | | | |
| Patapsco River | 4.0-4.1 | 4.6 | 4.9 | 6.3-6.4 |
| Cabins Branch | 4.1 | 4.7 | 5.1 | 7.1 |
| Sawmill Creek | 4.0 | 4.7 | 5.1 | 7.1 |
| Marley Creek | 4.1 | 4.7 | 5.1 | 7.0 |
| Severn Run | 3.6-3.7 | 4.2-4.3 | 4.4-4.5 | 5.7-5.9 |
| Back Creek | 3.6 | 4.3 | 4.5 | 5.8-5.9 |
| Spa Creek | 3.7 | 4.3 | 4.5 | 5.9-6.0 |
| College Creek | 3.7 | 4.3 | 4.6 | 6.1 |
| Weems Creek | 3.7 | 4.3-4.4 | 4.6 | 6.3 |
| | | | | |
| PATUXENT RIVER | | | | |
| Chesapeake Bay (Solomon's Island) | 2.6 | 4.0 | 4.7 | 6.2 |
| Western Branch | 3.5 | 6.2 | 7.4 | 9.4 |

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

The coastal analysis for this revision involved transect layout, field reconnaissance, erosion analysis, and overland wave modeling including wave setup, wave height analysis and wave runup.

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

Each transect was taken perpendicular to the shoreline and extended inland to a point where coastal flooding ceased.  Along each transect, wave heights and elevations were computed considering the combined effects of changes in ground elevation, vegetation, and physical features.  The stillwater elevations for a 1-percent annual chance event were used as the starting elevations for these computations. Wave heights were calculated to the nearest 0.1 foot, and wave elevations were determined at whole-foot increments along the transects. The location of the 3-foot breaking wave for determining the terminus of the Zone VE (area with velocity wave action) was computed at each transect.  In Anne Arundel County there were no primary frontal dune systems.

Dune erosion and bluff retreat were taken into account along the Chesapeake Bay coastline.  A review of the geology and shoreline type in Anne Arundel County was made to determine the applicability of standard erosion methods, and FEMA's standard erosion methodology for coastal areas having primary frontal dunes, referred to as the "540 rule," was used (FEMA, 2007(b)).  This methodology first evaluates the dune's cross-sectional profile to determine whether the dune has a reservoir of material that is greater or less than 540 square feet.  If the reservoir is greater than 540 square feet, the "retreat" erosion method is employed and approximately 540 square feet of the dune is eroded using a standardized eroded profile, as specified in FEMA guidelines. If the reservoir is less than 540 square feet, the "removal" erosion method is employed where the dune is removed for subsequent analysis, again using a standard eroded profile. "Retreat" erosion method is also employed along erodible bluffs with steep face slopes. Based on observation of historic coastal bluff erosion, eroded profiles generally retreat between 10-40 feet landward and an equivalent volume is deposited seaward of the bluff toe. Historic coastal bluff erosion data (from VIMS) and local wave environment were both considered in determining the erodibility of bluffs. Wave environment was evaluated using fetch length. If the fetch length was greater than 5 miles, and the VIMS shoreline data shows observed erosion, the bluff is considered erodible and bluff erosion is applied; if the fetch length is less than 5 miles, the area is considered sheltered and no bluff erosion is applied.   The storm surge study provided the return period stillwater elevations required for erosion analyses.  Each cross-shore transect was analyzed for erosion, when applicable.

Wave height calculations used in this flood study are based on the methodologies described in the FEMA guidance for coastal mapping (FEMA, 2007(a)).  Wave

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

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

Computed controlling wave heights at the shoreline range from 1.0 feet to 6.7 feet along the northwestern shore of the county (Patapsco River) where the coastal surge is higher, and from 1.3 feet to 11.1 feet along the Chesapeake Bay shore where the coastal surge is lower. The corresponding wave elevation along the Patapsco River shoreline varies from 5.5 feet to 7.5 feet NAVD88 and along the Chesapeake Bay varies from 5.5 feet to 7.0 feet NAVD88. However, the coastal BFEs include storm surge, wave height, and runup, where it is applicable.

Figure 1, "Transect Location Map," illustrates the location of each transect. Along each transect, wave envelopes were computed considering the combined effects of changes in ground elevation, vegetation and physical features. Between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and engineering judgment to determine the aerial extent of flooding. The results of the calculations are accurate until local topography, vegetation, or cultural development within the community undergoes major changes. In Table

5, "Transect Data," the flood hazard zone and base flood elevations for each transect flooding source is provided, along with the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations for the respective flooding source.

Baltimore City
Baltimore County
Patapsco River
Howard County

Chesapeake Bay

Marley Creek

Magothy River

Anne Arundel County

Severn River

City of Annapolis

Weems Creek

Prince George's County

South River

Mill Creek

Spa Creek

Town of Highland Beach

Queen Anne's County

Chesapeake Bay

Calvert County

Talbot County

295  175  32  97  177  2  178  3  50  214  301  4  2  260

Approximate Scale
0 1 2 4 6 8 Miles

TRANSECT LOCATION MAP

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MARYLAND AND INCORPORATED AREAS

Figure 1

# TABLE 5 – TRANSECT DATA

| Flood Source | Transect | Coordinates | Starting Wave Conditions for the 1% Annual Chance | | Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations* (ft NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Significant Wave Height $H_c$ (ft) | Peak Wave Period $T_p$ (sec) | 10% Annual Chance | 2% Annual Chance | 1% Annual Chance | 0.2% Annual Chance |
| Chesapeake Bay | 1 | N 39.199676 W 76.529817 | 3.9 | 4.8 | 4.1 | 4.7 | 5.0 | 6.8 |
| Chesapeake Bay | 2 | N 39.178679 W 76.525646 | 3.5 | 5.1 | 4.1 | 4.7 | 5.0 | 6.7 |
| Chesapeake Bay | 3 | N 39.174696 W 76.519222 | 3.6 | 5.2 | 4.1 | 4.6 | 5.0 | 6.6 |
| Chesapeake Bay | 4 | N 39.170916 W 76.509932 | 3.5 | 5.4 | 4.0 | 4.6 | 5.0 | 6.5 |
| Chesapeake Bay | 5 | N 39.166845 W 76.505126 | 3.4 | 5.1 | 4.0 | 4.6 | 4.9 | 6.5 |
| Chesapeake Bay | 6 | N 39.155049 W 76.499282 | 1.3 | 4.9 | 4.0<br>4 - 4.1 | 4.6 | 4.9 | 6.4 |
| Chesapeake Bay | 7 | N 39.155669 W 76.490961 | 1.7 | 4.4 | 4.0 | 4.6 | 4.9 | 6.4 |
| Chesapeake Bay | 8 | N 39.159805 W 76.486932 | 1.7 | 4.4 | 4.0 | 4.6 | 4.9 | 6.4 |
| Chesapeake Bay | 9 | N 39.156133 W 76.472399 | 3.6 | 4.9 | 4.0 | 4.6 | 4.9 | 6.2 |
| Chesapeake Bay | 10 | N 39.150197 W 76.464058 | 4.1 | 5.1 | 4.0 | 4.6 | 4.8 | 6.1<br>6.1 - 6.2 |
| Chesapeake Bay | 11 | N 39.142410 W 76.449886 | 4.3 | 5.2 | 4.0<br>3.8 – 4.0 | 4.6<br>4.4 - 4.7 | 4.8<br>4.7 - 4.8 | 6.0<br>5.9 – 6.0 |
| Chesapeake Bay | 12 | N 39.138882 W 76.442267 | 4.3 | 5.2 | 4.0<br>3.8 – 4.0 | 4.6 | 4.8<br>4.8 - 4.9 | 6.0<br>5.9 – 6.0 |
| Chesapeake Bay | 13 | N 39.131690 W 76.435634 | 3.5 | 5.2 | 4.0 | 4.6 | 4.8 | 6.0 |
| Chesapeake Bay | 14 | N 39.128421 W 76.432205 | 4.8 | 4.9 | 4.0<br>3.9 – 4.0 | 4.5<br>4.5 - 4.6 | 4.8<br>4.8 - 4.9 | 6.0 |
| Chesapeake Bay | 15 | N 39.123823 W 76.433049 | 5.0 | 4.8 | 4.0 | 4.5 | 4.8 | 6.0<br>6.0 - 6.1 |
| Chesapeake Bay | 16 | N 39.116595 W 76.432736 | 4.9 | 4.7 | 4.0<br>3.9 – 4.0 | 4.5<br>4.5 - 4.8 | 4.8<br>4.8 - 5 | 5.9 |
| Chesapeake Bay | 17 | N 39.108859 W 76.432577 | 4.8 | 4.7 | 4.0 | 4.5 | 4.7 | 5.9 |
| Chesapeake Bay | 18 | N 39.094558 W 76.426653 | 4.3 | 4.4 | 3.9 | 4.5 | 4.7 | 5.8<br>5.8 - 6.1 |
| Chesapeake Bay | 19 | N 39.079767 W 76.421826 | 4.3 | 4.3 | 3.9 | 4.4 | 4.6 | 5.8 |
| Chesapeake Bay | 20 | N 39.071993 W 76.424429 | 4.0 | 4.2 | 3.9 | 4.4 | 4.6 | 5.8 |
| Chesapeake Bay | 21 | N 39.063008 W 76.429711 | 3.6 | 4.0 | 3.9 | 4.4 | 4.6 | 5.7<br>5.7 - 5.9 |
| Chesapeake Bay | 22 | N 39.076237 W 76.443930 | 2.4 | 2.9 | 3.9 | 4.4 | 4.7 | 6.0 |
| Chesapeake Bay | 23 | N 39.093621 W 76.441804 | 1.2 | 2.4 | 4.0 | 4.5 | 4.7<br>4.7 - 4.8 | 6.2<br>6.2 - 6.3 |

* For transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and range.

# TABLE 5 – TRANSECT DATA - continued

| Flood Source | Transect | Coordinates | Starting Wave Conditions for the 1% Annual Chance | | Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations* (ft NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Significant Wave Height $H_s$ (ft) | Peak Wave Period $T_p$ (sec) | 10% Annual Chance | 2% Annual Chance | 1% Annual Chance | 0.2% Annual Chance |
| Chesapeake Bay | 24 | N 39.095945 W 76.450446 | 1.8 | 2.7 | 3.9 3.9 – 4.0 | 4.5 | 4.7 | 6.3 |
| Chesapeake Bay | 25 | N 39.093019 W 76.457749 | 2.1 | 2.8 | 3.9 | 4.5 4.4 - 4.5 | 4.7 | 6.2 |
| Chesapeake Bay | 26 | N 39.089497 W 76.461407 | 2.3 | 3.0 | 3.9 | 4.5 | 4.7 | 6.2 |
| Chesapeake Bay | 27 | N 39.082340 W 76.468676 | 2.6 | 3.2 | 3.9 | 4.5 | 4.7 | 6.2 6.2 - 6.3 |
| Chesapeake Bay | 28 | N 39.082803 W 76.485173 | 2.2 | 3.1 | 3.9 | 4.5 | 4.7 | 6.3 |
| Chesapeake Bay | 29 | N 39.081057 W 76.491086 | 2.5 | 3.2 | 3.9 | 4.5 | 4.7 | 6.2 |
| Chesapeake Bay | 30 | N 39.079534 W 76.500766 | 2.3 | 3.2 | 3.8 | 4.5 | 4.8 | 6.2 |
| Chesapeake Bay | 31 | N 39.085652 W 76.518605 | 1.7 | 2.6 | 3.9 | 4.5 | 4.8 | 6.4 |
| Chesapeake Bay | 32 | N 39.077825 W 76.517552 | 1.9 | 2.9 | 3.9 | 4.5 | 4.8 4.7 - 4.8 | 6.3 |
| Chesapeake Bay | 33 | N 39.071365 W 76.516438 | 1.7 | 2.9 | 3.9 | 4.5 | 4.8 | 6.3 |
| Chesapeake Bay | 34 | N 39.071384 W 76.505133 | 1.8 | 3.0 | 3.9 | 4.5 | 4.8 | 6.2 |
| Chesapeake Bay | 35 | N 39.067151 W 76.497922 | 2.1 | 3.1 | 3.8 | 4.5 | 4.7 | 6.1 6.1 - 6.2 |
| Chesapeake Bay | 36 | N 39.064464 W 76.490848 | 1.4 | 3.1 | 3.9 | 4.5 | 4.7 | 6.1 |
| Chesapeake Bay | 37 | N 39.064780 W 76.480408 | 2.4 | 3.1 | 3.8 3.8 - 3.9 | 4.4 | 4.7 | 6.0 6.0 - 6.1 |
| Chesapeake Bay | 38 | N 39.061642 W 76.473423 | 2.5 | 3.1 | 3.8 | 4.4 | 4.7 | 6.0 |
| Chesapeake Bay | 39 | N 39.060376 W 76.460143 | 2.9 | 3.5 | 3.9 3.8 - 3.9 | 4.4 | 4.7 | 5.9 5.8 - 5.9 |
| Chesapeake Bay | 40 | N 39.055873 W 76.453157 | 2.5 | 3.7 | 3.9 | 4.4 | 4.7 | 5.8 |
| Chesapeake Bay | 41 | N 39.053073 W 76.441139 | 2.6 | 3.9 | 3.8 | 4.4 | 4.7 | 5.8 |
| Chesapeake Bay | 42 | N 39.045861 W 76.428007 | 3.1 | 3.7 | 3.8 3.7 - 3.8 | 4.4 | 4.6 | 5.6 |
| Chesapeake Bay | 43 | N 39.042874 W 76.421246 | 3.2 | 3.9 | 3.8 | 4.4 | 4.6 | 5.6 |
| Chesapeake Bay | 44 | N 39.034009 W 76.406750 | 3.5 | 4.2 | 3.8 | 4.3 | 4.5 | 5.6 |
| Chesapeake Bay | 45 | N 39.019316 W 76.398340 | 4.0 | 4.7 | 3.8 | 4.3 | 4.5 | 5.5 5.5 - 6.2 |
| Chesapeake Bay | 46 | N 39.004243 W 76.408720 | 4.2 | 5.0 | 3.7 3.7 - 3.8 | 4.3 | 4.5 | 5.6 5.6 - 6.2 |
| Chesapeake Bay | 47 | N 38.995936 W 76.441621 | 4.2 | 4.7 | 3.7 | 4.3 | 4.5 | 6.0 |

* For transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and range.

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TABLE 5 – TRANSECT DATA - continued

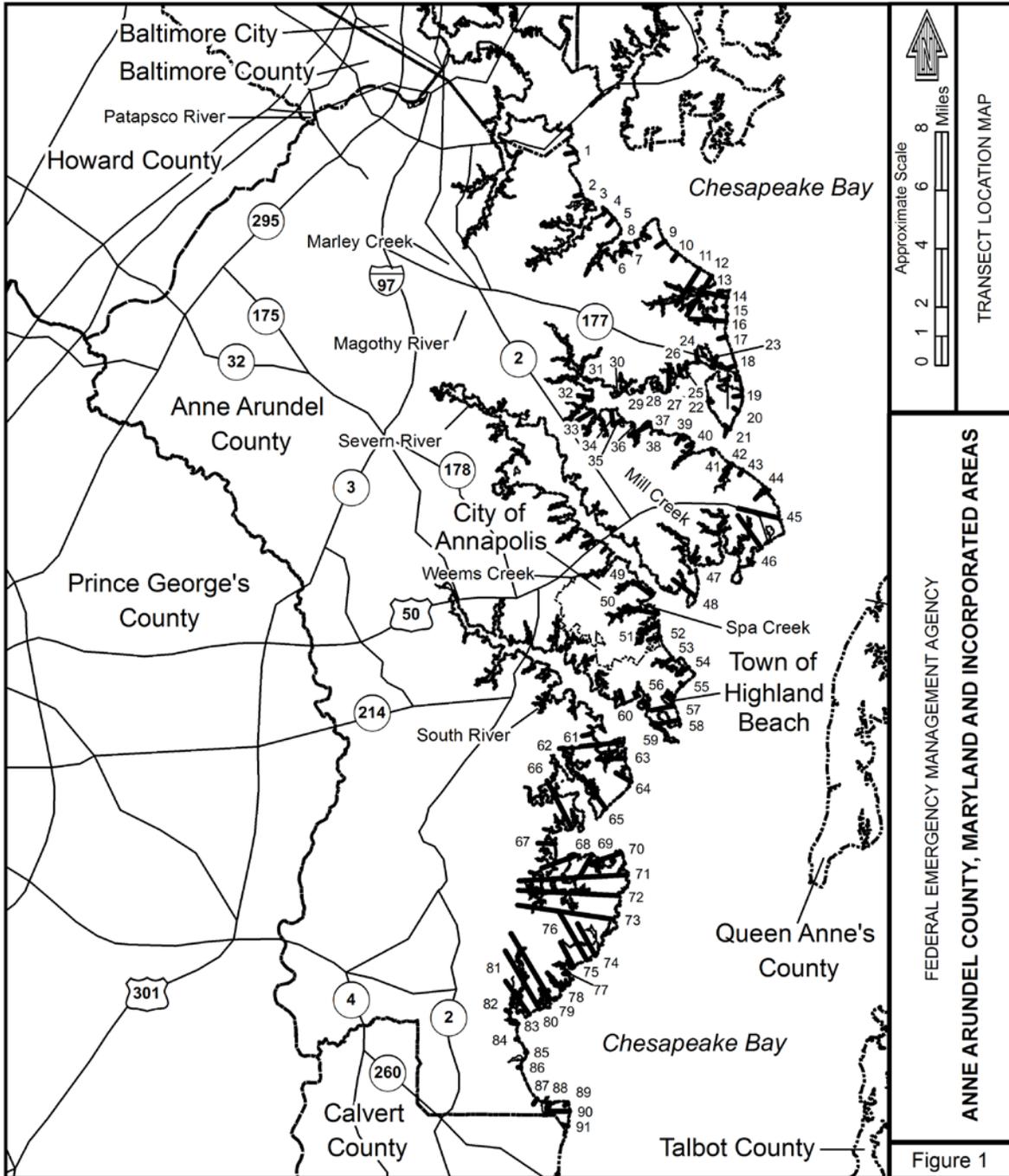| Flood Source | Transect | Coordinates | Starting Wave Conditions for the 1% Annual Chance | | Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations* (ft NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Significant Wave Height $H_s$ (ft) | Peak Wave Period $T_p$ (sec) | 10% Annual Chance | 2% Annual Chance | 1% Annual Chance | 0.2% Annual Chance |
| Chesapeake Bay | 48 | N 38.980003 W 76.450565 | 4.8 | 5.0 | 3.7 | 4.3 / 4.2 - 4.3 | 4.5 | 6.0 / 5.9 – 6.0 |
| Chesapeake Bay | 49 | N 38.979923 W 76.477860 | 4.0 | 4.4 | 3.7 | 4.3 | 4.5 / 4.5 - 4.6 | 5.9 / 5.9 - 6.1 |
| Chesapeake Bay | 50 | N 38.970976 W 76.474211 | 4.4 | 4.8 | 3.6 / 3.6 - 3.7 | 4.2 / 4.2 - 4.3 | 4.5 | 5.8 / 5.8 – 6.0 |
| Chesapeake Bay | 51 | N 38.965298 W 76.473795 | 4.6 | 4.9 | 3.6 / 3.6 - 3.8 | 4.2 / 4.2 - 4.3 | 4.5 | 5.8 / 5.8 - 5.9 |
| Chesapeake Bay | 52 | N 38.959444 W 76.472590 | 4.1 | 5.0 | 3.6 | 4.2 | 4.5 | 5.7 / 5.7 - 5.8 |
| Chesapeake Bay | 53 | N 38.949021 W 76.464572 | 3.6 | 5.0 | 3.6 | 4.2 | 4.4 | 5.5 |
| Chesapeake Bay | 54 | N 38.944549 W 76.454346 | 5.2 | 5.2 | 3.6 / 3.5 - 3.6 | 4.2 | 4.4 | 5.4 / 5.3 - 5.4 |
| Chesapeake Bay | 55 | N 38.935490 W 76.457927 | 5.3 | 5.1 | 3.6 | 4.2 | 4.4 | 5.7 |
| Chesapeake Bay | 56 | N 38.929878 W 76.463264 | 4.8 | 5.3 | 3.6 | 4.2 | 4.4 | 5.7 / 5.6 - 5.7 |
| Chesapeake Bay | 57 | N 38.925231 W 76.463368 | 4.8 | 5.2 | 3.6 | 4.2 | 4.4 / 4.4 - 4.5 | 5.6 / 5.6 - 6.1 |
| Chesapeake Bay | 58 | N 38.918283 W 76.459944 | 5.3 | 5.3 | 3.5 | 4.1 / 4.1 - 4.2 | 4.4 | 5.4 / 5.4 - 5.9 |
| Chesapeake Bay | 59 | N 38.914639 W 76.474867 | 4.7 | 5.0 | 3.6 | 4.2 | 4.4 | 5.9 |
| Chesapeake Bay | 60 | N 38.926260 W 76.495097 | 3.7 | 4.9 | 3.6 | 4.2 | 4.5 | 6.2 / 6.2 - 6.3 |
| Chesapeake Bay | 61 | N 38.911049 W 76.515083 | 2.0 | 3.3 | 3.6 | 4.2 | 4.5 | 6.2 |
| Chesapeake Bay | 62 | N 38.906912 W 76.495173 | 4.5 | 5.0 | 3.6 | 4.2 / 4.2 - 4.3 | 4.4 / 4.4 - 4.7 | 6.0 / 6.0 - 6.8 |
| Chesapeake Bay | 63 | N 38.898980 W 76.493769 | 5.4 | 5.2 | 3.5 | 4.2 | 4.4 / 4.4 - 4.5 | 5.9 / 5.9 - 6.1 |
| Chesapeake Bay | 64 | N 38.887354 W 76.489852 | 4.8 | 5.5 | 3.5 | 4.1 / 4.1 - 4.2 | 4.4 | 5.7 / 5.7 - 5.8 |
| Chesapeake Bay | 65 | N 38.873889 W 76.505563 | 4.8 | 5.3 | 3.5 / 3.2 - 3.5 | 4.1 / 3.8 - 4.1 | 4.4 / 4 - 4.4 | 5.9 |
| Chesapeake Bay | 66 | N 38.863999 W 76.527092 | 3.1 | 3.9 | 3.5 / 3.5 - 3.6 | 4.1 / 4.1 - 4.2 | 4.4 / 4.4 - 4.5 | 5.8 / 5.8 - 6.3 |
| Chesapeake Bay | 67 | N 38.856052 W 76.537328 | 2.6 | 3.8 | 3.5 | 4.1 | 4.4 | 5.8 |
| Chesapeake Bay | 68 | N 38.850869 W 76.522705 | 2.8 | 5.0 | 3.5 / 3.5 - 3.6 | 4.1 / 4.1 - 4.3 | 4.3 / 4.3 - 4.5 | 5.7 / 5.7 - 5.8 |
| Chesapeake Bay | 69 | N 38.850918 W 76.514144 | 3.4 | 4.4 | 3.5 | 4.1 | 4.3 | 5.6 |
| Chesapeake Bay | 70 | N 38.851866 W 76.495493 | 4.0 | 5.7 | 3.5 | 4.1 | 4.3 | 5.4 / 5.4 - 5.5 |
| Chesapeake Bay | 71 | N 38.841223 W 76.491817 | 3.9 | 5.9 | 3.4 / 3.4 - 3.6 | 4.1 / 4 - 4.3 | 4.3 / 4.3 - 4.5 | 5.4 / 5.4 - 5.9 |

* For transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and range.

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TABLE 5 – TRANSECT DATA - continued

| Flood Source | Transect | Coordinates | Starting Wave Conditions for the 1% Annual Chance | | Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations* (ft NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Significant Wave Height $H_c$ (ft) | Peak Wave Period $T_p$ (sec) | 10% Annual Chance | 2% Annual Chance | 1% Annual Chance | 0.2% Annual Chance |
| Chesapeake Bay | 72 | N 38.830820 W 76.496775 | 4.2 | 5.5 | 3.5 3.4 - 3.6 | 4.1 3.9 - 4.2 | 4.3 4.1 - 4.4 | 5.7 5.4 - 5.7 |
| Chesapeake Bay | 73 | N 38.819014 W 76.499963 | 3.5 | 5.9 | 3.5 3.4 - 3.6 | 4.1 3.9 - 4.2 | 4.3 4.1 - 4.4 | 5.6 5.3 - 5.7 |
| Chesapeake Bay | 74 | N 38.800803 W 76.511127 | 7.0 | 5.5 | 3.4 3.4 - 3.5 | 4.0 4.0 - 4.2 | 4.3 4.3 - 4.4 | 5.6 5.6 - 5.9 |
| Chesapeake Bay | 75 | N 38.798581 W 76.516566 | 5.4 | 5.7 | 3.5 | 4.1 4.1 - 4.2 | 4.3 4.3 - 4.4 | 5.8 5.8 - 5.9 |
| Chesapeake Bay | 76 | N 38.795027 W 76.524790 | 3.8 | 5.5 | 3.5 | 4.1 4.1 - 4.2 | 4.4 4.4 - 4.5 | 5.9 5.8 - 6.3 |
| Chesapeake Bay | 77 | N 38.791458 W 76.527689 | 3.2 | 5.6 | 3.5 | 4.1 | 4.3 | 5.9 |
| Chesapeake Bay | 78 | N 38.783804 W 76.531974 | 6.5 | 5.6 | 3.5 | 4.1 4.1 - 4.2 | 4.3 4.3 - 4.5 | 5.8 5.8 - 6.3 |
| Chesapeake Bay | 79 | N 38.778782 W 76.539425 | 4.4 | 5.5 | 3.5 | 4.1 4.1 - 4.2 | 4.4 4.4 - 4.5 | 6.0 6.0 - 6.4 |
| Chesapeake Bay | 80 | N 38.774070 W 76.546121 | 3.1 | 5.5 | 3.5 3.5 - 3.6 | 4.1 4.1 - 4.2 | 4.4 4.4 - 4.6 | 6.0 6.0 - 6.4 |
| Chesapeake Bay | 81 | N 38.771313 W 76.552535 | 3.8 | 5.2 | 3.5 3.5 - 3.6 | 4.1 4.1 - 4.3 | 4.4 4.4 - 4.6 | 5.9 5.9 - 6.6 |
| Chesapeake Bay | 82 | N 38.772125 W 76.564516 | 2.2 | 4.6 | 3.6 0 - 0 | 4.2 0 - 0 | 4.5 0 - 0 | 6.3 |
| Chesapeake Bay | 83 | N 38.766527 W 76.559706 | 3.9 | 4.8 | 3.6 | 4.1 | 4.4 | 6.0 |
| Chesapeake Bay | 84 | N 38.759092 W 76.559464 | 4.3 | 5.2 | 3.5 | 4.1 | 4.4 | 5.9 |
| Chesapeake Bay | 85 | N 38.752378 W 76.553904 | 4.3 | 5.7 | 3.5 | 4.0 | 4.3 | 5.7 |
| Chesapeake Bay | 86 | N 38.744973 W 76.557439 | 4.5 | 5.7 | 3.5 | 4.1 | 4.3 | 5.7 |
| Chesapeake Bay | 87 | N 38.729279 W 76.546979 | 3.6 | 5.9 | 3.5 | 4.0 | 4.2 | 5.4 5.3 - 5.4 |

\* For transects with a constant Stillwater elevation, only one number is provided to represent both the starting value and range.

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

includes wave heights less than three feet. A depiction of how the Zones VE and AE are mapped is shown in Figure 2.

Post-storm field visits and laboratory tests have confirmed that wave heights as small as 1.5 feet can cause significant damage to structures when constructed without consideration to the coastal hazards. Additional flood hazards associated with coastal waves include floating debris, high velocity flow, erosion, and scour which can cause damage to Zone AE-type construction in these coastal areas. To help community officials and property owners recognize this increased potential for damage due to wave action in the AE zone, FEMA issued guidance in December 2008 on identifying and mapping the 1.5-foot wave height line, referred to as the Limit of Moderate Wave Action (LiMWA). While FEMA does not impose floodplain management requirements based on the LiMWA, the LiMWA is provided to help communicate the higher risk that exists in that area. Consequently, it is important to be aware of the area between this inland limit and the Zone VE boundary as it still poses a high risk, though not as high of a risk as Zone VE, see Figure 2 "Transect Schematic".
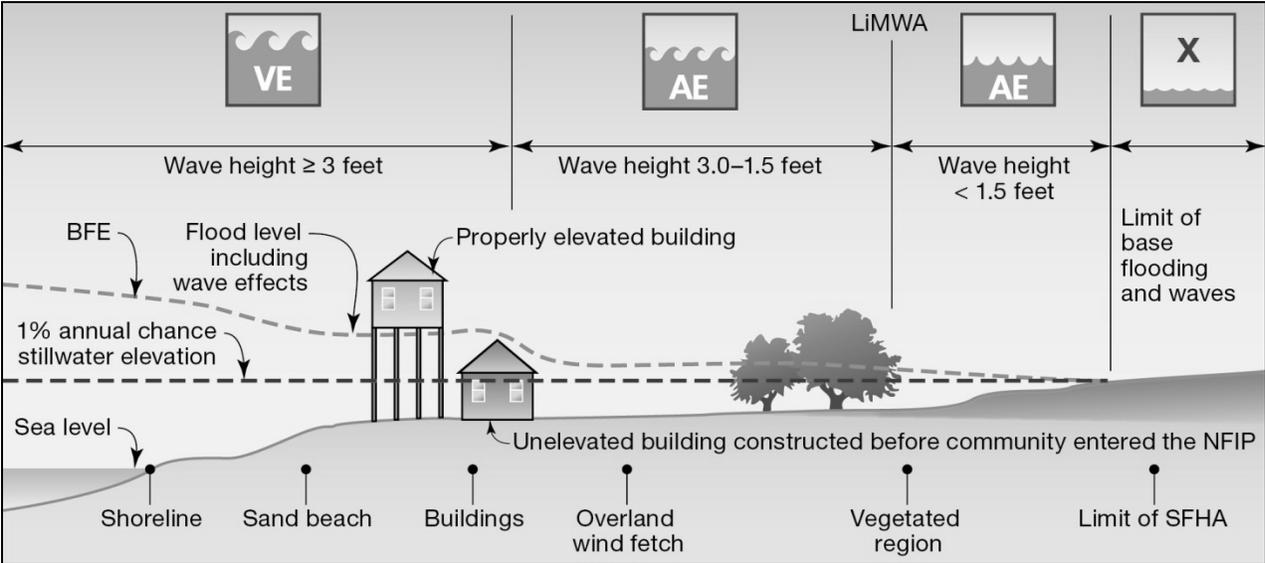


**Figure 2 - Transect Schematic**

3.4     Vertical Datum

All FIS reports and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FIS reports and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD29). With the finalization of the NAVD88, many FIS reports and FIRMs are being prepared using NAVD88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD88. Structure and ground elevations in the community must, therefore, be referenced to NAVD88. It is important to note that adjacent communities may be referenced to NGVD29. This may result in differences in BFEs across the corporate limits between the communities. The vertical datum conversion factor from NGVD29 to NAVD88 for Anne Arundel County is –0.81 feet.

For more information on NAVD88, see FEMA publication entitled, <u>Converting the National Flood Insurance Program to the North American Vertical Datum of 1988</u>, FEMA Publication FIA-20/June 1992, or contact the National Geodetic Survey online ( http://www.ngs.noaa.gov ) or at the following address:

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

## 4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program (NFIP) encourages state and local governments to adopt sound floodplain management programs. To assist in this endeavor, each FIS provides 1-percent annual chance floodplain data, which may include a combination of the following: 10-, 2-, 1-, and 0.2-percent annual chance flood elevations; delineations of the 1- and 0.2-percent annual chance floodplains; and 1-percent annual chance floodway. This information is presented on the FIRM and in many components of the FIS, including Flood Profiles, Floodway Data Tables, and Summary of Stillwater Elevations Table. Users should reference the data presented in the FIS as well as additional information that may be available at the local community map repository before making flood elevation and/or floodplain boundary determinations. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

### 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. For each stream studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections the boundaries were interpolated using the DEM discussed in Section 3.2.

For this revision, the coastal boundaries were mapped using LiDAR data obtained from Maryland Department of Natural Resources (MDNR), flown by Airborne 1 Corporation, processed by Computational Consulting Services LLC , and post-processed by Spatial Systems Associates in 2004 (MDNR, 2004).

The 1- and 0.2-percent annual chance floodplain boundaries are shown on the Flood Insurance Rate Maps (Exhibit 2). On this map, the 1-percent annual chance floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AO, and VE), and the 0.2-percent annual chance floodplain boundary corresponds to the boundary of areas of moderate flood hazards.  In cases where the 1- and 0.2-percent annual chance floodplain boundaries are close together, only the 1-percent annual chance 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 of floodplains, such as structures and fill, reduces the flood carrying capacity, increases the 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 National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management.  Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe.  The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights.  Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The following streams had floodway analyses conducted as part of the previous FIS and have been updated: Cabin Branch, Little Patuxent River, Marley Creek, Patapsco River, Patuxent River, Sawmill Creek, and Severn Run.  The following streams did not have floodways in the effective FIS, so no floodways were computed for the map modernization update: Hall Creek, Midway Branch and Franklin Branch.  The floodways presented in the effective FIS were computed on the basis of equal conveyance reduction from each side of the floodplain.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage, and heightens potential flood hazards by further increasing velocities.  A listing of stream velocities at selected

cross sections is provided in Table 6, "Floodway Data." In order to reduce the risk of property damage in areas where the stream velocities are high, the community may wish to restrict development in areas outside the floodway.

As shown on the updated Flood Insurance Rate Maps (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the boundaries of the floodway and the 1-percent annual chance flood are either close together or collinear, only the floodway boundary has been shown.

Portions of the floodway for the Patapsco River and the Patuxent River extend beyond the county boundary.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 6 for certain downstream cross sections of the Patuxent River are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

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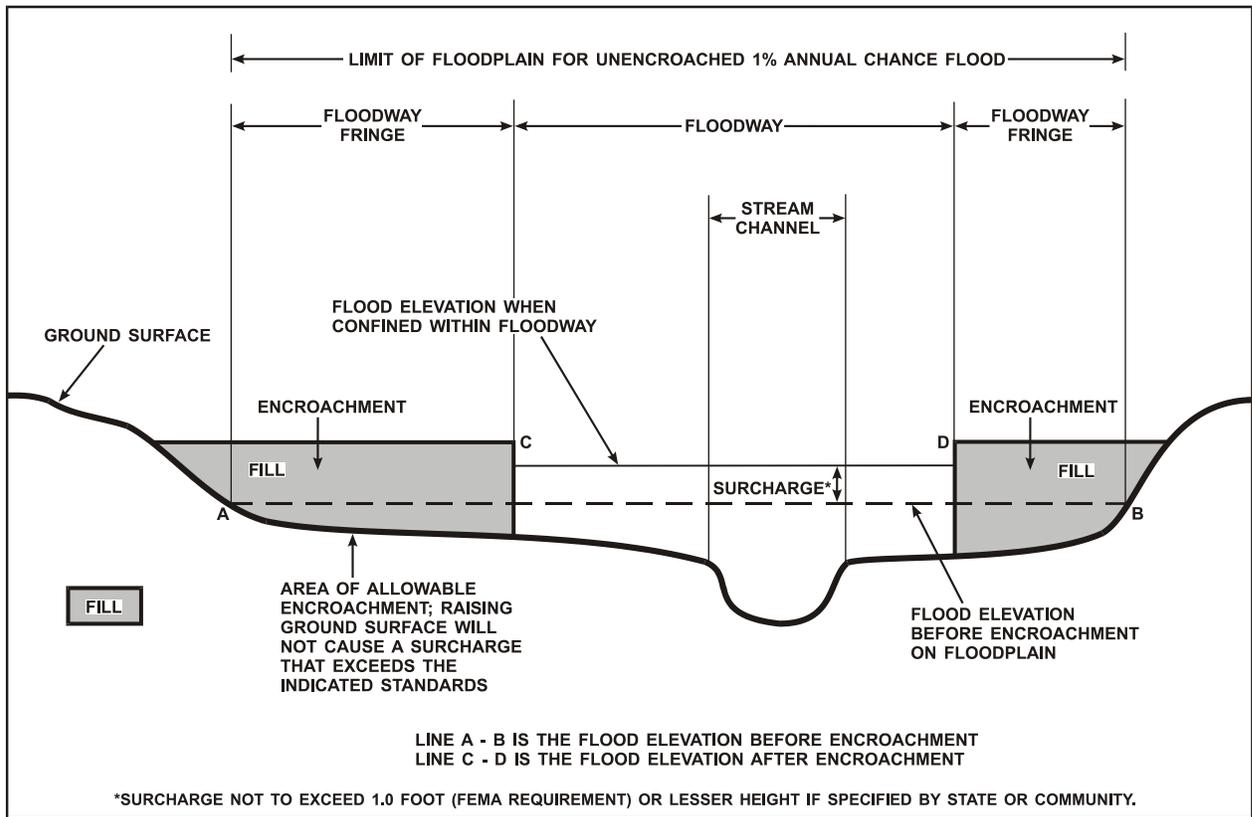
**Figure 3 – Floodway Schematic**

The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Cabin Branch | | | | | | | | |
| A | 56 | 120 | 1,282 | 2.3 | 12.3 | 12.3 | 12.3 | 0.0 |
| B | 1,388 | 269 | 2,188 | 1.1 | 12.5 | 12.5 | 12.5 | 0.0 |
| C | 3,400 | 51 | 293 | 8.0 | 17.5 | 17.5 | 17.7 | 0.2 |
| D | 3,999 | 55 | 424 | 5.5 | 19.6 | 19.6 | 19.7 | 0.1 |
| E | 4,319 | 57 | 225 | 10.4 | 23.0 | 23.0 | 23.0 | 0.1 |
| F | 4,783 | 35 | 259 | 9.0 | 26.9 | 26.9 | 27.2 | 0.3 |
| G | 6,581 | 150 | 342 | 5.9 | 40.8 | 40.8 | 40.8 | 0.1 |
| H | 7,536 | 61 | 404 | 5.0 | 46.6 | 46.6 | 47.2 | 0.5 |
| I | 7,735 | 75 | 348 | 5.8 | 47.4 | 47.4 | 47.8 | 0.4 |
| J | 8,329 | 51 | 182 | 11.2 | 51.0 | 51.0 | 51.0 | 0.0 |
| K | 8,594 | 50 | 511 | 4.0 | 53.5 | 53.5 | 53.5 | 0.0 |
| L | 9,323 | 34 | 163 | 12.5 | 56.6 | 56.6 | 56.7 | 0.1 |
| M | 9,947 | 75 | 394 | 5.2 | 60.7 | 60.7 | 61.4 | 0.7 |
| N | 10,539 | 100 | 510 | 4.2 | 66.0 | 66.0 | 66.0 | 0.0 |
| O | 11,308 | 104 | 330 | 5.6 | 67.4 | 67.4 | 67.5 | 0.1 |
| P | 11,887 | 105 | 386 | 4.2 | 68.9 | 68.9 | 69.7 | 0.8 |
| Q | 12,482 | 52 | 149 | 9.7 | 72.0 | 72.0 | 72.4 | 0.4 |
| R | 13,153 | 50 | 252 | 5.7 | 75.5 | 75.5 | 76.4 | 0.9 |
| S | 13,533 | 60 | 388 | 3.7 | 81.3 | 81.3 | 82.1 | 0.9 |
| T | 14,072 | 48 | 304 | 4.0 | 82.0 | 82.0 | 82.9 | 0.9 |
| U | 14,353 | 152 | 487 | 2.5 | 83.1 | 83.1 | 83.8 | 0.8 |
| V | 14,882 | 130 | 363 | 3.3 | 83.9 | 83.9 | 84.7 | 0.8 |
| W | 15,488 | 42 | 126 | 9.6 | 86.7 | 86.7 | 86.7 | 0.0 |
| X | 16,095 | 131 | 369 | 3.3 | 90.7 | 90.7 | 90.9 | 0.2 |
| Y | 16,698 | 145 | 234 | 5.2 | 93.3 | 93.3 | 93.5 | 0.2 |
| Z | 17,180 | 133 | 914 | 1.0 | 99.5 | 99.5 | 100.4 | 0.9 |

[1]Stream distance in feet above the Chessie Railroad

| | FEDERAL EMERGENCY MANAGEMENT AGENCY | FLOODWAY DATA |
|---|---|---|
| **TABLE 7** | **ANNE ARUNDEL COUNTY, MD** | |
| | **AND INCORPORATED AREAS** | **CABIN BRANCH** |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Cabin Branch (continued) | | | | | | | | |
| AA | 17,970[1] | 82 | 453 | 2.0 | 99.6 | 99.6 | 100.5 | 0.9 |
| AB | 18,676[1] | 44 | 178 | 5.2 | 100.3 | 100.3 | 101.3 | 0.9 |
| AC | 19,604[1] | 44 | 145 | 6.4 | 104.0 | 104.0 | 104.7 | 0.8 |
| AD | 20,253[1] | 61 | 126 | 5.4 | 107.7 | 107.7 | 108.0 | 0.2 |
| AE | 20,534[1] | 190 | 1,090 | 0.6 | 116.1 | 116.1 | 116.1 | 0.0 |
| AF | 20,961[1] | 150 | 542 | 1.3 | 116.1 | 116.1 | 116.1 | 0.0 |
| AG | 21,433[1] | 145 | 777 | 0.9 | 118.4 | 118.4 | 118.4 | 0.0 |
| Little Patuxent River | | | | | | | | |
| A | 3,675[2] | 1,681 | 19,827 | 1.7 | 45.5 | 45.5 | 46.2 | 0.6 |
| B | 7,129[2] | 2,322 | 21,524 | 1.5 | 46.5 | 46.5 | 47.2 | 0.8 |
| C | 12,514[2] | 480 | 5,166 | 6.4 | 51.8 | 51.8 | 52.8 | 1.0 |
| D | 17,617[2] | 1,073 | 7,138 | 4.6 | 57.3 | 57.3 | 57.7 | 0.4 |
| E | 17,695[2] | 1,073 | 12,684 | 2.6 | 61.1 | 61.1 | 61.8 | 0.7 |
| F | 18,078[2] | 1,390 | 21,708 | 1.5 | 61.1 | 61.1 | 61.9 | 0.8 |
| G | 25,732[2] | 375 | 4,895 | 6.7 | 65.1 | 65.1 | 66.0 | 0.9 |
| H | 30,555[2] | 1,640 | 20,065 | 1.6 | 70.9 | 70.9 | 71.5 | 0.7 |
| I | 35,430[2] | 1,236 | 9,249 | 3.5 | 73.4 | 73.4 | 74.1 | 4.3 |
| J | 39,729[2] | 497 | 3,700 | 8.8 | 79.9 | 79.9 | 80.0 | 5.3 |
| K | 40,074[2] | 752 | 11,195 | 2.9 | 85.8 | 85.8 | 86.0 | 8.3 |
| L | 40,589[2] | 1,340 | 22,123 | 1.5 | 87.7 | 87.7 | 88.6 | 9.9 |
| M | 41,893[2] | 2,185 | 26,589 | 1.2 | 87.7 | 87.7 | 88.7 | 10.0 |
| N | 56,521[2] | 2,446 | 13,264 | 2.4 | 98.1 | 98.1 | 98.5 | 4.3 |

[1]Stream distance in feet above the Chessie Railroad

[2]Stream distance in feet above above the confluence with the Patuxent River

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **CABIN BRANCH - LITTLE PATUXENT RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Little Patuxent River (continued) | | | | | | | | |
| O | 58,046[1] | 1,807 | 9,322 | 3.4 | 99.9 | 99.9 | 100.0 | 0.2 |
| P | 58,353[1] | 1,549 | 10,828 | 3.0 | 102.4 | 102.4 | 102.4 | 0.0 |
| Q | 61,920[1] | 1,137 | 9,359 | 3.4 | 105.0 | 105.0 | 105.3 | 0.3 |
| R | 63,387[1] | 471 | 4,421 | 7.2 | 106.3 | 106.3 | 107.0 | 0.7 |
| S | 64,519[1] | 1,080 | 8,784 | 3.6 | 108.8 | 108.8 | 109.2 | 0.4 |
| T | 65,936[1] | 1,455 | 4,457 | 7.1 | 109.3 | 109.3 | 110.2 | 0.8 |
| U | 66,112[1] | 1,462 | 14,814 | 2.1 | 113.2 | 113.2 | 113.3 | 0.1 |
| V | 67,489[1] | 1,512 | 16,756 | 1.9 | 113.6 | 113.6 | 114.0 | 0.4 |
| W | 69,618[1] | 765 | 8,289 | 3.8 | 115.2 | 115.2 | 115.8 | 0.6 |
| X | 72,368[1] | 1,190 | 11,654 | 2.7 | 117.5 | 117.5 | 118.5 | 0.9 |
| Y | 73,832[1] | 1,440 | 11,828 | 2.7 | 119.0 | 119.0 | 119.8 | 0.8 |
| Z | 74,863[1] | 403 | 5,435 | 5.8 | 122.5 | 122.5 | 122.6 | 0.1 |
| AA | 75,072[1] | 403 | 6,249 | 5.1 | 124.7 | 124.7 | 124.7 | 0.0 |
| AB | 79,171[1] | 600 | 7,795 | 3.9 | 126.7 | 126.7 | 126.7 | 0.0 |
| AC | 84,953[1] | 701 | 6,773 | 4.5 | 128.2 | 128.2 | 128.8 | 0.6 |
| AD | 87,475[1] | 640 | 6,966 | 4.4 | 130.0 | 130.0 | 130.6 | 0.6 |
| AE | 89,057[1] | 1,475 | 14,468 | 2.1 | 131.5 | 131.5 | 132.5 | 1.0 |
| Marley Creek | | | | | | | | |
| A | 51[2] | 85.0 | 708.5 | 3.2 | 12.0 | 12.0 | 13.0 | 1.0 |
| B | 193[2] | 90.0 | 506.8 | 4.0 | 11.9 | 11.9 | 12.9 | 1.0 |
| C | 1,089[2] | 99.6 | 699.4 | 2.9 | 14.7 | 14.7 | 14.9 | 0.2 |
| D | 2,336[2] | 75.0 | 382.5 | 5.2 | 16.0 | 16.0 | 16.5 | 0.5 |
| E | 3,123[2] | 275.0 | 1,753.5 | 1.0 | 19.7 | 19.7 | 19.7 | 0.0 |

[1]Stream distance in feet above the confluence with the Patuxent River

[2]Stream distance in feet from upstream span of State Route 2 (Ritchie Highway)

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** |
|---|---|---|
| | | **LITTLE PATUXENT RIVER - MARLEY CREEK** |

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Marley Creek (continued) | | | | | | | | |
| F | 3,981[1] | 103.4 | 674.2 | 2.6 | 21.9 | 21.9 | 22.0 | 0.1 |
| G | 4,838[1] | 153.3 | 909.5 | 1.8 | 22.2 | 22.2 | 22.5 | 0.3 |
| H | 5,426[1] | 177.7 | 655.8 | 2.5 | 23.4 | 23.4 | 23.6 | 0.3 |
| I | 7,467[1] | 79.6 | 307.2 | 5.0 | 25.4 | 25.4 | 25.8 | 0.4 |
| J | 7,920[1] | 154.5 | 685.4 | 2.0 | 26.5 | 26.5 | 27.3 | 0.9 |
| Patapsco River | | | | | | | | |
| A | 977[2] | 83/576[3] | 8,345.6 | 5.1 | 12.6 | 12.6 | 13.5 | 0.9 |
| B | 1,937[2] | 78/503[3] | 8,064.7 | 5.2 | 12.9 | 12.9 | 13.8 | 0.9 |
| C | 2,937[2] | 27/409[3] | 6,306.6 | 6.7 | 13.0 | 13.0 | 13.9 | 0.9 |
| D | 3,804[2] | 98/2,157[3] | 30,495.7 | 1.4 | 14.3 | 14.3 | 15.0 | 0.7 |
| E | 4,697[2] | 903/2,050[3] | 31,011.5 | 1.4 | 14.3 | 14.3 | 15.1 | 0.8 |
| F | 5,720[2] | 817/1,900[3] | 24,862.8 | 1.7 | 14.5 | 14.5 | 15.2 | 0.8 |
| G | 6,649[2] | 761/1,550[3] | 22,190.9 | 1.9 | 14.6 | 14.6 | 15.3 | 0.7 |
| H | 7,589[2] | 924/1,650[3] | 23,906.4 | 1.8 | 14.7 | 14.7 | 15.5 | 0.8 |
| I | 8,459[2] | 617/1,161[3] | 15,192.0 | 2.8 | 14.6 | 14.6 | 15.4 | 0.8 |
| J | 9,093[2] | 897/1,380[3] | 20,406.2 | 2.1 | 16.7 | 16.7 | 17.2 | 0.5 |
| K | 9,331[2] | 1012/1,425[3] | 23,077.3 | 1.8 | 17.1 | 17.1 | 17.7 | 0.6 |
| L | 10,296[2] | 1377/1,850[3] | 28,380.1 | 1.5 | 17.3 | 17.3 | 17.8 | 0.6 |
| M | 11,206[2] | 1488/1,850[3] | 26,871.5 | 1.6 | 17.4 | 17.4 | 18.0 | 0.6 |
| N | 12,088[2] | 1,233/1,875[3] | 25,856.9 | 1.6 | 17.5 | 17.5 | 18.1 | 0.6 |
| O | 12,378[2] | 1,013/1,700[3] | 24,407.9 | 1.7 | 17.6 | 17.6 | 18.5 | 0.9 |
| P | 13,454[2] | 542/1,300[3] | 17,641.4 | 2.4 | 17.6 | 17.6 | 18.5 | 0.9 |

[1]Stream distance in feet from upstream span of State Route 2 (Ritchie Highway)

[2]Stream distance in feet above the Anne Arundel County Boundary

[3]Floodway width within Anne Arundel County / Total floodway width

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **MARLEY CREEK - PATAPSCO RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Patapsco River (continued) | | | | | | | | |
| Q | 14,375 | 83/700[2] | 6,601.8 | 6.4 | 17.6 | 17.6 | 18.4 | 0.9 |
| R | 15,307 | 116/800[2] | 6,128.0 | 6.9 | 18.1 | 18.1 | 18.9 | 0.8 |
| S | 16,262 | 143/1,129[2] | 14,518.5 | 2.9 | 20.3 | 20.3 | 21.2 | 0.9 |
| T | 16,494 | 310/1,200[2] | 18,672.3 | 2.3 | 20.6 | 20.6 | 21.6 | 0.9 |
| U | 16,793 | 380/1,137[2] | 18,746.3 | 2.3 | 20.9 | 20.9 | 21.8 | 0.9 |
| V | 16,883 | 403/1,100[2] | 18,417.1 | 2.3 | 21.0 | 21.0 | 21.9 | 0.9 |
| W | 18,706 | 797/1,500[2] | 23,061.9 | 1.8 | 21.4 | 21.4 | 22.3 | 0.9 |
| X | 20,379 | 493/1,550[2] | 27,238.7 | 1.6 | 21.8 | 21.8 | 22.7 | 0.9 |
| Y | 22,632 | 25/1,400[2] | 24,866.4 | 1.7 | 22.1 | 22.1 | 23.0 | 0.9 |
| Z | 25,088 | 884/1,322[2] | 20,280.4 | 2.1 | 22.5 | 22.5 | 23.3 | 0.9 |
| AA | 26,439 | 2,155/2,429[2] | 33,507.5 | 1.3 | 23.0 | 23.0 | 23.9 | 0.9 |
| AB | 26,952 | 1,926/1,346[2] | 22,144.4 | 1.9 | 26.2 | 26.2 | 27.1 | 0.8 |
| Patuxent River | | | | | | | | |
| A | 21,021 | 260/658[2] | 6,289.9 | 8.35 | 7.5 | -2.69[3] | 7.5 | 0.0 |
| B | 26,469 | 306/820[2] | 7,869.4 | 6.7 | 7.5 | 3.23[3] | 7.5 | 0.0 |
| C | 29,000 | 379/540[2] | 6,262.4 | 8.4 | 7.5 | 5.11[3] | 7.5 | 0.0 |
| D | 31,018 | 707 | 5,167.1 | 10.2 | 7.5 | 6.58[3] | 7.5 | 0.0 |

[1]Stream distance in feet above the Anne Arundel County Boundary
[2]Floodway width within Anne Arundel County / Total floodway width
[3]Elevation computed without backwater effects from Lower Patuxent River

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **PATAPSCO RIVER - PATUXENT RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Patuxent River (continued) | | | | | | | | |
| E | 31,141 | 696 | 5,836.5 | 9.0 | 7.5 | 7.51[3] | 7.5 | 0.0 |
| F | 31,627 | 1,100/1,152[2] | 15,880.9 | 3.3 | 13.1 | 13.1 | 13.8 | 0.7 |
| G | 37,179 | 51/3,230[2] | 47,483.2 | 1.1 | 13.7 | 13.7 | 14.6 | 0.9 |
| H | 41,146 | 683/2,080[2] | 28,451.3 | 1.9 | 13.8 | 13.8 | 14.8 | 0.9 |
| I | 41,827 | 784/1,860[2] | 23,954.5 | 2.2 | 13.9 | 13.9 | 14.8 | 0.9 |
| J | 42,466 | 945/1,680[2] | 21,222.5 | 2.5 | 14.0 | 14.0 | 14.9 | 0.9 |
| K | 43,180 | 707/1,470[2] | 19,523.3 | 2.7 | 14.1 | 14.1 | 15.0 | 0.9 |
| L | 45,507 | 515/1,170[2] | 15,426.3 | 3.4 | 14.5 | 14.5 | 15.4 | 0.9 |
| M | 47,415 | 306/1,005[2] | 15,117.7 | 3.5 | 15.5 | 15.5 | 16.4 | 0.9 |
| N | 51,041 | 99/1,075[2] | 16,450.5 | 3.2 | 17.5 | 17.5 | 18.2 | 0.7 |
| O | 53,971 | 1004/1,170[2] | 16,444.4 | 3.2 | 18.5 | 18.5 | 19.3 | 0.8 |
| P | 56,694 | 120/700[2] | 11,981.7 | 4.4 | 20.1 | 20.1 | 21.0 | 0.8 |
| Q | 59,049 | 434/750[2] | 12,173.2 | 4.3 | 21.5 | 21.5 | 22.0 | 0.5 |
| R | 61,589 | 173/735[2] | 15,443.2 | 3.4 | 22.4 | 22.4 | 23.3 | 0.8 |
| S | 63,353 | 156/670[2] | 14,711.8 | 3.6 | 23.1 | 23.1 | 23.8 | 0.7 |
| T | 64,793 | 57/660[2] | 12,904.0 | 4.1 | 23.4 | 23.4 | 24.2 | 0.8 |

[1]Stream distance in feet above the Anne Arundel County Boundary
[2]Floodway width within Anne Arundel County / Total floodway width
[3]Elevation computed without backwater effects from Lower Patuxent River

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **PATUXENT RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Patuxent River (continued) | | | | | | | | |
| U | 68,581 | 1,213 | 24,333.1 | 1.9 | 24.3 | 24.3 | 25.2 | 1.0 |
| V | 69,849 | 1,297 | 25,496.2 | 1.8 | 24.4 | 24.4 | 25.3 | 1.0 |
| W | 69,955 | 1,272 | 24,359.5 | 1.9 | 24.4 | 24.4 | 25.3 | 1.0 |
| X | 73,878 | 341/1,589[2] | 28,085.0 | 1.6 | 24.7 | 24.7 | 25.6 | 1.0 |
| Y | 76,389 | 739/925[2] | 14,838.4 | 3.0 | 24.8 | 24.8 | 25.8 | 1.0 |
| Z | 76,568 | 731/900[2] | 16,125.2 | 2.8 | 27.0 | 27.0 | 27.7 | 0.7 |
| AA | 78,361 | 1,008/1,040[2] | 18,454.6 | 2.4 | 27.5 | 27.5 | 28.3 | 0.8 |
| AB | 79,086 | 788/1,093[2] | 18,710.0 | 2.4 | 27.6 | 27.6 | 28.4 | 0.8 |
| AC | 79,406 | 784/1,070[2] | 18,427.4 | 2.4 | 27.6 | 27.6 | 28.4 | 0.8 |
| AD | 81,075 | 594/1,370[2] | 19,571.4 | 2.3 | 27.9 | 27.9 | 28.6 | 0.8 |
| AE | 85,795 | 810 | 11,552.9 | 3.9 | 28.6 | 28.6 | 29.4 | 0.8 |
| AF | 89,845 | 201/1,705[2] | 27,373.4 | 1.6 | 29.6 | 29.6 | 30.5 | 0.9 |
| AG | 93,761 | 1,328 | 18,904.3 | 2.4 | 30.1 | 30.1 | 31.1 | 1.0 |
| AH | 97,274 | 669/900[2] | 12,129.0 | 3.7 | 31.1 | 31.1 | 32.0 | 0.9 |
| AI | 98,904 | 873 | 9,730.6 | 4.6 | 32.2 | 32.2 | 33.1 | 0.9 |
| AJ | 99,238 | 779 | 9,411.0 | 4.8 | 32.5 | 32.5 | 33.3 | 0.9 |
| AK | 99,470 | 772 | 9,628.7 | 4.7 | 32.7 | 32.7 | 33.5 | 0.8 |
| AL | 100,624 | 364/570[2] | 7,538.2 | 6.0 | 33.7 | 33.7 | 34.4 | 0.7 |

[1]Stream distance in feet above the Anne Arundel County Boundary
[2]Floodway width within Anne Arundel County / Total floodway width

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **PATUXENT RIVER** |
|---|---|---|

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| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Patuxent River (continued) | | | | | | | | |
| AM | 100,959 | 397/560[2] | 7,070.7 | 6.4 | 34.1 | 34.1 | 34.8 | 0.7 |
| AN | 101,008 | 391/565[2] | 7,219.5 | 6.2 | 34.4 | 34.4 | 35.1 | 0.7 |
| AO | 101,727 | 442/550[2] | 8,645.4 | 5.2 | 36.0 | 36.0 | 36.6 | 0.6 |
| AP | 102,356 | 424 | 8,903.1 | 5.1 | 36.3 | 36.3 | 37.2 | 0.9 |
| AQ | 102,791 | 450 | 10,204.9 | 4.4 | 38.3 | 38.3 | 38.9 | 0.6 |
| AR | 106,062 | 564/950[2] | 18,387.0 | 2.5 | 38.8 | 38.8 | 39.7 | 1.0 |
| AS | 107,429 | 334/1,240[2] | 19,496.4 | 2.3 | 39.1 | 39.1 | 40.0 | 1.0 |
| AT | 111,857 | 288/1,956[2] | 31,591.7 | 1.4 | 39.7 | 39.7 | 40.6 | 0.9 |
| AU | 113,858 | 315/2,045[2] | 31,694.6 | 1.4 | 39.8 | 39.8 | 40.8 | 0.9 |
| AV | 115,119 | 149/2,960[2] | 46,142.0 | 1.0 | 39.9 | 39.9 | 40.8 | 0.9 |
| AW | 117,159 | 361/1,930[2] | 29,188.9 | 1.5 | 40.0 | 40.0 | 40.9 | 0.9 |
| AX | 118,598 | 777/1,912[2] | 22,510.5 | 2.0 | 40.0 | 40.0 | 41.0 | 1.0 |
| AY | 118,899 | 1,131/1,870[2] | 26,120.8 | 1.7 | 42.2 | 42.2 | 42.3 | 0.1 |
| AZ | 119,643 | 1,271/1,520[2] | 19,196.9 | 2.3 | 42.3 | 42.3 | 42.4 | 0.2 |
| BA | 123,616 | 342/1,580[2] | 16,935.6 | 2.7 | 43.1 | 43.1 | 43.6 | 0.4 |
| BB | 128,937 | 530/1,170[2] | 10,411.1 | 4.9 | 45.5 | 45.5 | 46.5 | 1.0 |
| BC | 129,758 | 429/1,280[2] | 8,413.5 | 5.6 | 45.8 | 45.8 | 46.8 | 1.0 |
| BD | 131,156 | 195/1,310[2] | 9,721.1 | 2.7 | 47.2 | 47.2 | 48.1 | 0.9 |

[1]Stream distance in feet above the Anne Arundel County Boundary
[2]Floodway width within Anne Arundel County / Total floodway width

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **PATUXENT RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Patuxent River (continued) | | | | | | | | |
| BE | 133,564 | 1,575 | 11,614.2 | 2.3 | 48.4 | 48.4 | 49.3 | 0.9 |
| BF | 135,994 | 233/260[2] | 2,095.2 | 12.6 | 51.7 | 51.7 | 52.6 | 0.9 |
| BG | 136,140 | 517/780[2] | 9,463.4 | 2.8 | 57.5 | 57.5 | 57.5 | 0.0 |
| BH | 140,356 | 1,830/2,000[2] | 13,725.7 | 1.9 | 58.5 | 58.5 | 59.5 | 1.0 |
| BI | 140,725 | 1,583/1,900[2] | 13,619.5 | 1.9 | 58.7 | 58.7 | 59.6 | 0.9 |
| BJ | 141,653 | 322/485[2] | 3,726.3 | 7.1 | 59.9 | 59.9 | 60.5 | 0.7 |
| BK | 146,790 | 206/341[2] | 4,091.8 | 6.4 | 66.5 | 66.5 | 67.3 | 0.8 |
| BL | 147,073 | 268/341[2] | 4,516.0 | 5.8 | 67.7 | 67.7 | 68.1 | 0.4 |
| BM | 149,786 | 237/1,870[2] | 11,450.2 | 2.3 | 69.1 | 69.1 | 70.1 | 1.0 |
| BN | 156,363 | 1,142/1,882[2] | 10,030.7 | 2.6 | 77.1 | 77.1 | 78.0 | 0.9 |
| BO | 159,495 | 419/1,130[2] | 5,852.5 | 4.5 | 81.3 | 81.3 | 82.1 | 0.8 |
| BP | 163,211 | 603/1,560[2] | 9,550.5 | 2.8 | 86.2 | 86.2 | 87.2 | 0.9 |
| BQ | 163,295 | 861/1,575[2] | 8,689.6 | 3.0 | 86.3 | 86.3 | 87.3 | 1.0 |
| BR | 163,384 | 939/1,690[2] | 8,217.6 | 3.2 | 87.0 | 87.0 | 87.6 | 0.6 |
| BS | 163,946 | 1,030/1,543[2] | 6,546.8 | 4.0 | 87.9 | 87.9 | 88.4 | 0.6 |
| BT | 166385 | 692/1,960[2] | 10999.4 | 2.4 | 90.1 | 90.1 | 91.1 | 1.0 |
| BU | 168860 | 1,116/2,060[2] | 9660.8 | 2.7 | 94.0 | 94.0 | 94.2 | 0.2 |
| BV | 171491 | 205/1,778[2] | 9932 | 2.7 | 96.7 | 96.7 | 97.4 | 0.7 |

[1]Stream distance in feet above the Anne Arundel County Boundary
[2]Floodway width within Anne Arundel County / Total floodway width

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **PATUXENT RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Patuxent River (continued) | | | | | | | | |
| BW | 173461.9 | 1,068/1,960[2] | 9819 | 2.7 | 98.5 | 98.5 | 99.0 | 0.6 |
| BX | 175001 | 1,780 | 10045 | 2.6 | 100.0 | 100.0 | 100.7 | 0.7 |
| BY | 178,886.2 | 669/1,930[2] | 10,963.9 | 2.4 | 105.0 | 105.0 | 105.9 | 0.8 |
| BZ | 183,401.8 | 377/412[2] | 2,891.9 | 9.1 | 112.9 | 112.9 | 113.0 | 0.2 |
| CA | 183,459.5 | 372 | 4,001.7 | 6.6 | 116.7 | 116.7 | 117.2 | 0.6 |
| CB | 183,635.8 | 265/372[2] | 4,263.7 | 6.2 | 117.3 | 117.3 | 117.7 | 0.4 |
| CC | 186,101 | 1,101/1,680[2] | 20,014.7 | 1.3 | 118.5 | 118.5 | 119.3 | 0.7 |
| CD | 186,829.2 | 981/1,765[2] | 16,473.0 | 1.6 | 118.7 | 118.7 | 119.5 | 0.8 |
| CE | 186,902 | 1,015/1,780[2] | 16,868.3 | 1.6 | 118.9 | 118.9 | 119.7 | 0.7 |
| CF | 191,681.5 | 1,124/2,570[2] | 18,847.5 | 1.4 | 120.4 | 120.4 | 121.3 | 0.9 |
| CG | 196,356.8 | 184/2,250[2] | 10,622.1 | 2.5 | 125.3 | 125.3 | 126.0 | 0.7 |
| CH | 201,119 | 427/530[2] | 3,356.5 | 7.8 | 134.5 | 134.5 | 135.3 | 0.8 |
| CI | 201,411.6 | 592/840[2] | 8,838.7 | 3.0 | 139.7 | 139.7 | 139.7 | 0.0 |
| CJ | 203,946.7 | 695/1,060[2] | 8,385.4 | 3.1 | 140.3 | 140.3 | 141.3 | 0.9 |

[1]Stream distance in feet above the Anne Arundel County Boundary

[2]Floodway width within Anne Arundel County / Total floodway width

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **PATUXENT RIVER** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Sawmill Creek | | | | | | | | |
| A | 0 | 46 | 506.8 | 5.7 | 10.7 | 10.7 | 10.9 | 0.3 |
| B | 383 | 279 | 1,475.8 | 1.9 | 10.9 | 10.9 | 11.6 | 0.8 |
| C | 828 | 48 | 370.9 | 7.4 | 11.1 | 11.1 | 11.8 | 0.6 |
| D | 1,617 | 184 | 1,124.8 | 2.4 | 12.7 | 12.7 | 13.7 | 1.0 |
| E | 2,957 | 56.4 | 383.4 | 7.2 | 15.4 | 15.4 | 16.3 | 0.9 |
| F | 3,509 | 270.5 | 1,060.6 | 2.2 | 17.4 | 17.4 | 18.2 | 0.8 |
| G | 3,874 | 59.8 | 330.2 | 7.1 | 18.2 | 18.2 | 19.1 | 0.8 |
| H | 3,999 | 94.0 | 608.9 | 3.8 | 22.4 | 22.4 | 22.4 | 0.0 |
| I | 5,035 | 300.4 | 1,530.4 | 1.5 | 23.1 | 23.1 | 23.3 | 0.2 |
| J | 5,616 | 302.3 | 759.3 | 3.1 | 23.5 | 23.5 | 23.9 | 0.4 |
| K | 6,292 | 178.5 | 701.8 | 3.3 | 24.9 | 24.9 | 25.7 | 0.8 |
| L | 6,644 | 111.0 | 746.4 | 2.5 | 25.2 | 25.2 | 26.2 | 1.0 |
| M | 7,118 | 82.0 | 547.0 | 3.4 | 25.5 | 25.5 | 26.4 | 0.9 |
| N | 7,893 | 51.1 | 283.1 | 6.6 | 28.0 | 28.0 | 28.4 | 0.4 |
| O | 7,992 | 125.0 | 481.6 | 3.9 | 31.7 | 31.7 | 32.2 | 0.5 |
| P | 8,393 | 172.3 | 546.2 | 3.4 | 32.7 | 32.7 | 33.1 | 0.4 |
| Q | 8,477 | 172.1 | 850.1 | 2.2 | 35.1 | 35.1 | 36.1 | 1.0 |
| R | 8,856 | 34.7 | 240.9 | 7.1 | 35.4 | 35.4 | 36.4 | 1.0 |
| S | 8,938 | 110.0 | 615.3 | 2.8 | 37.4 | 37.4 | 38.2 | 0.8 |
| T | 10,219 | 97.7 | 559.1 | 3.1 | 37.9 | 37.9 | 38.8 | 0.8 |
| U | 11,399 | 76.2 | 338.9 | 3.9 | 40.6 | 40.6 | 41.6 | 1.0 |
| V | 13,083 | 48.4 | 206.3 | 6.4 | 46.3 | 46.3 | 47.2 | 0.8 |

[1]Stream distance in feet from upstream side of Governor Richie Highway (State Route 2)

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **SAWMILL CREEK** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Sawmill Creek (continued) | | | | | | | | |
| W | 13,256[1] | 35.2 | 291.5 | 4.5 | 51.3 | 51.3 | 51.5 | 0.2 |
| X | 13,550[1] | 57.5 | 627.4 | 2.1 | 55.6 | 55.6 | 55.8 | 0.2 |
| Y | 14,354[1] | 81.0 | 819.3 | 1.6 | 57.2 | 57.2 | 57.3 | 0.2 |
| Z | 15,210[1] | 171.9 | 1,232.4 | 1.0 | 57.2 | 57.2 | 57.4 | 0.2 |
| AA | 16,065[1] | 80.5 | 349.2 | 3.3 | 57.3 | 57.3 | 57.6 | 0.2 |
| AB | 17,529[1] | 70.7 | 344.7 | 3.3 | 62.0 | 62.0 | 62.2 | 0.1 |
| AC | 18,292[1] | 59.3 | 261.4 | 3.9 | 63.8 | 63.8 | 64.2 | 0.4 |
| AD | 19,098[1] | 42.8 | 166.1 | 6.1 | 67.4 | 67.4 | 67.6 | 0.2 |
| AE | 20,159[1] | 265.0 | 255.3 | 2.8 | 71.5 | 71.5 | 71.5 | 0.0 |
| AF | 20,396[1] | 55.0 | 106.7 | 6.7 | 73.6 | 73.6 | 73.7 | 0.1 |
| AG | 20,463[1] | 60.0 | 375.8 | 1.9 | 78.2 | 78.2 | 79.0 | 0.8 |
| AH | 21,628[1] | 40.0 | 105.8 | 6.2 | 81.0 | 81.0 | 81.2 | 0.3 |
| AI | 21,674[1] | 115.0 | 351.1 | 1.9 | 83.6 | 83.6 | 83.7 | 0.2 |
| AJ | 22,772[1] | 80.0 | 242.6 | 2.5 | 84.4 | 84.4 | 84.5 | 0.1 |
| AK | 23,405[1] | 50.0 | 712.0 | 0.9 | 104.8 | 104.8 | 105.4 | 0.6 |
| Severn Run | | | | | | | | |
| A | -285[2] | 278.7 | 2,218.0 | 2.5 | 8.9 | 8.9 | 9.8 | 0.8 |
| B | 0[2] | 135.0 | 625.4 | 10.3 | 11.2 | 11.2 | 11.6 | 0.4 |

[1]Stream distance in feet from upstream side of Governor Richie Highway (State Route 2)
[2]Stream distance in feet above downstream face of Veteran's Highway

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **SAWMILL CREEK - SEVERN RUN** |
|---|---|---|

44

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Severn Run (continued) | | | | | | | | |
| C | 818 | 453.4 | 6,637.7 | 0.8 | 19.0 | 19.0 | 19.0 | 0.0 |
| D | 1,681 | 447.7 | 5,690.9 | 0.9 | 19.0 | 19.0 | 19.1 | 0.0 |
| E | 2,354 | 413.1 | 4,602.2 | 1.1 | 19.0 | 19.0 | 19.1 | 0.1 |
| F | 3,499 | 285.6 | 2,841.2 | 1.8 | 19.1 | 19.1 | 19.2 | 0.1 |
| G | 5,109 | 378.4 | 3,368.6 | 1.5 | 19.4 | 19.4 | 19.7 | 0.3 |
| H | 6,443 | 245.1 | 2,040.4 | 2.4 | 19.8 | 19.8 | 20.1 | 0.3 |
| I | 7,583 | 294.4 | 2,067.1 | 2.3 | 20.5 | 20.5 | 20.7 | 0.2 |
| J | 9,023 | 190.4 | 1,410.4 | 3.3 | 21.5 | 21.5 | 21.7 | 0.2 |
| K | 11,299 | 146.0 | 1,110.3 | 4.2 | 25.3 | 25.3 | 25.7 | 0.4 |
| L | 12,711 | 135.1 | 1,124.0 | 4.0 | 27.6 | 27.6 | 27.9 | 0.3 |
| M | 13,833 | 269.8 | 1,938.9 | 2.3 | 28.8 | 28.8 | 29.0 | 0.3 |
| N | 15,497 | 266.2 | 1,655.8 | 2.7 | 30.3 | 30.3 | 30.4 | 0.1 |
| O | 17,992 | 465.6 | 2,868.6 | 1.5 | 34.3 | 34.3 | 34.4 | 0.0 |
| P | 18,781 | 263.8 | 1,826.6 | 2.3 | 34.6 | 34.6 | 34.7 | 0.0 |
| Q | 20,134 | 164.3 | 950.6 | 4.4 | 36.3 | 36.3 | 36.3 | 0.1 |
| R | 21,108 | 197.5 | 1,254.6 | 3.3 | 40.1 | 40.1 | 40.5 | 0.3 |
| S | 22,573 | 311.2 | 1,806.3 | 2.1 | 44.6 | 44.6 | 45.0 | 0.4 |
| T | 23,069 | 116.7 | 542.4 | 7.0 | 45.4 | 45.4 | 45.8 | 0.4 |
| U | 23,813 | 269.5 | 2,631.1 | 1.4 | 50.6 | 50.6 | 50.8 | 0.2 |
| V | 24,462 | 308.8 | 2,163.3 | 1.8 | 50.8 | 50.8 | 51.0 | 0.2 |

[1]Stream distance in feet above downstream face of Veteran's Highway

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **SEVERN RUN** |
|---|---|---|

| FLOODING SOURCE | | FLOODWAY | | | 1-PERCENT-ANNUAL-CHANCE FLOOD WATER-SURFACE ELEVATION (FEET NAVD88) | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| Severn Run (continued) | | | | | | | | |
| W | 25,745 | 206.8 | 1,523.1 | 2.5 | 51.4 | 51.4 | 51.6 | 0.2 |
| X | 26,726 | 264.1 | 1,546.3 | 2.4 | 52.3 | 52.3 | 52.4 | 0.1 |
| Y | 27,445 | 252.8 | 1,388.4 | 2.7 | 53.1 | 53.1 | 53.3 | 0.2 |
| Z | 28,660 | 203.0 | 1,829.5 | 2.1 | 57.0 | 57.0 | 57.0 | 0.0 |
| AA | 29,864 | 132.5 | 986.6 | 3.8 | 57.5 | 57.5 | 57.6 | 0.2 |
| AB | 30,478 | 254.5 | 2,014.9 | 1.9 | 58.3 | 58.3 | 58.5 | 0.1 |
| AC | 31,355 | 180.6 | 903.8 | 4.2 | 58.8 | 58.8 | 59.0 | 0.1 |
| AD | 32,166 | 157.3 | 762.3 | 4.3 | 61.3 | 61.3 | 61.5 | 0.2 |
| AE | 33,726 | 133.5 | 948.6 | 3.4 | 64.6 | 64.6 | 65.0 | 0.4 |
| AF | 34,900 | 168.7 | 940.3 | 3.5 | 66.8 | 66.8 | 67.4 | 0.6 |
| AG | 36,066 | 370.8 | 1,963.8 | 1.6 | 69.4 | 69.4 | 69.9 | 0.5 |
| AH | 37,699 | 291.4 | 1,334.8 | 2.3 | 72.4 | 72.4 | 73.0 | 0.6 |
| AI | 39,161 | 255.3 | 1,370.0 | 2.2 | 76.5 | 76.5 | 77.4 | 0.9 |
| AJ | 39,471 | 269.2 | 1,256.4 | 2.4 | 78.5 | 78.5 | 78.9 | 0.4 |
| AK | 40,717 | 95.0 | 328.2 | 6.0 | 80.8 | 80.8 | 80.9 | 0.1 |
| AL | 40,939 | 72.0 | 277.6 | 7.1 | 82.5 | 82.5 | 83.3 | 0.8 |
| AM | 41,637 | 66.5 | 428.3 | 4.6 | 86.4 | 86.4 | 86.6 | 0.3 |
| AN | 42,331 | 48.4 | 235.3 | 8.4 | 87.1 | 87.1 | 88.0 | 0.9 |
| AO | 42,823 | 96.5 | 633.8 | 3.1 | 90.7 | 90.7 | 91.0 | 0.4 |
| AP | 45,144 | 244.3 | 413.8 | 6.6 | 98.1 | 98.1 | 99.0 | 0.9 |

[1]Stream distance in feet above downstream face of Veteran's Highway

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **FLOODWAY DATA** **SEVERN RUN** |
|---|---|---|

## 5.0    INSURANCE APPLICATION

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

Zone A:

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

Zone AE:

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

Zone AO:

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

Zone VE:

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

Zone X:

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

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, floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

The current FIRM presents flooding information for the entire geographic area of Anne Arundel 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 FIS report either supersedes or is compatible with all previous studies on streams studied in this report and should be considered authoritative for purposes of the NFIP.

8.0     LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Flood Insurance and Mitigation Division, Federal Emergency Management Agency, One Independence Mall, 6th floor, 615 Chestnut Street, Philadelphia, PA 19106.

| COMMUNITY NAME | INITIAL IDENTIFICATION | FLOOD HAZARD BOUNDARY MAP REVISIONS DATE | FIRM EFFECTIVE DATE | FIRM REVISIONS DATE |
|---|---|---|---|---|
| Annapolis, City of | June 28, 1974 | December 19, 1975 | November 4, 1981 | |
| Anne Arundel County (Unincorporated Areas) | November 15, 1974 | August 4, 1978 November 9, 1979 | May 2, 1983 | July 18, 1985 September 27, 1985 |
| Highland Beach, Town of | November 4, 1981 | None | November 4, 1981 | October 15, 1982 |

| TABLE 7 | FEDERAL EMERGENCY MANAGEMENT AGENCY **ANNE ARUNDEL COUNTY, MD** AND INCORPORATED AREAS | **COMMUNITY MAP HISTORY** |
|---|---|---|

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FLOOD PROFILES
CABIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

01P

FLOOD PROFILES

CABIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

02P

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET IN FEET ABOVE THE CHESSIE SYSTEM

PRIVATE ROAD

RAMP FOR INTERSTATE 695

STATE ROUTE 2

HARBOR TUNNEL THRUWAY

CEDAR AVE/HARRIS HEIGHTS AVE

CULVERT

CULVERT

CULVERT

CULVERT

LEGEND
0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION

FLOOD PROFILES

CABIN BRANCH

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET IN FEET ABOVE THE CHESSIE SYSTEM

CEDAR AVENUE

GLEN BURNIE BYPASS (STATE ROUTE 3)

FURNACE BRANCH ROAD

OLD ANNAPOLIS ROAD

CULVERT

CULVERT

LEGEND

0.2% ANNUAL CHANCE FLOOD

1% ANNUAL CHANCE FLOOD

2% ANNUAL CHANCE FLOOD

10% ANNUAL CHANCE FLOOD

STREAM BED

CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

03P

FLOOD PROFILES

CABIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

04P

FLOOD PROFILES

FRANKLIN BRANCH

180 — 1% ANNUAL CHANCE BACKWATER EFFECTS FROM MIDWAY BRANCH

LEONARD WOOD AVE

REDWOOD AVENUE

LLEWELLYN AVENUE

CONFLUENCE WITH MIDWAY BRANCH

CULVERT

CULVERT

CULVERT

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH MIDWAY BRANCH

LEGEND

0.2% ANNUAL CHANCE FLOOD

1% ANNUAL CHANCE FLOOD

2% ANNUAL CHANCE FLOOD

10% ANNUAL CHANCE FLOOD

STREAM BED

CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

05P

FLOOD PROFILES

FRANKLIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

06P

FLOOD PROFILES

FRANKLIN BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

07P

FLOOD PROFILES

HALL CREEK

ANNE ARUNDEL COUNTY BOUNDARY

ANNE ARUNDEL COUNTY BOUNDARY

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE ANNE ARUNDEL COUNTY BOUNDARY

LEGEND

— 0.2% ANNUAL CHANCE FLOOD

—·— 1% ANNUAL CHANCE FLOOD

—·— 2% ANNUAL CHANCE FLOOD

——— 10% ANNUAL CHANCE FLOOD

STREAM BED

CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

08P

CONFLUENCE WITH PATUXENT RIVER

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH PATUXENT RIVER

**LEGEND**

— 0.2% ANNUAL CHANCE FLOOD

—·— 1% ANNUAL CHANCE FLOOD

—··— 2% ANNUAL CHANCE FLOOD

— — 10% ANNUAL CHANCE FLOOD

STREAM BED

CROSS SECTION LOCATION

FLOOD PROFILES

LITTLE PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

09P

FLOOD PROFILES

LITTLE PATUXENT RIVER

CONWAY ROAD

CONFLUENCE WITH TOWSERS BRANCH

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH PATUXENT RIVER

LEGEND

——————— 0.2% ANNUAL CHANCE FLOOD

—··—··— 1% ANNUAL CHANCE FLOOD

—·—·—·— 2% ANNUAL CHANCE FLOOD

——————— 10% ANNUAL CHANCE FLOOD

〰〰〰 STREAM BED

⬡ CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

10P

FLOOD PROFILES

LITTLE PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

11P

FLOOD PROFILES

LITTLE PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

12P

FLOOD PROFILES

LITTLE PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

13P

FLOOD PROFILES

LITTLE PATUXENT RIVER

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH PATUXENT RIVER

LAUREL FORT MEADE ROAD (RTE. 198)

RIVER ROAD

BALTIMORE WASHINGTON PARKWAY (HWY 295)

CONFLUENCE WITH DORSEY RUN

BALTIMORE WASHINGTON PARKWAY (HWY 295)

LEGEND

0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

14P

FLOOD PROFILES

LITTLE PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

15P

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH PATUXENT RIVER

LEGEND

──────── 0.2% ANNUAL CHANCE FLOOD

─··──··── 1% ANNUAL CHANCE FLOOD

─·──·──·─ 2% ANNUAL CHANCE FLOOD

──────── 10% ANNUAL CHANCE FLOOD

STREAM BED

CROSS SECTION LOCATION

BROCK BRIDGE ROAD

COUNTY BOUNDARY

AB

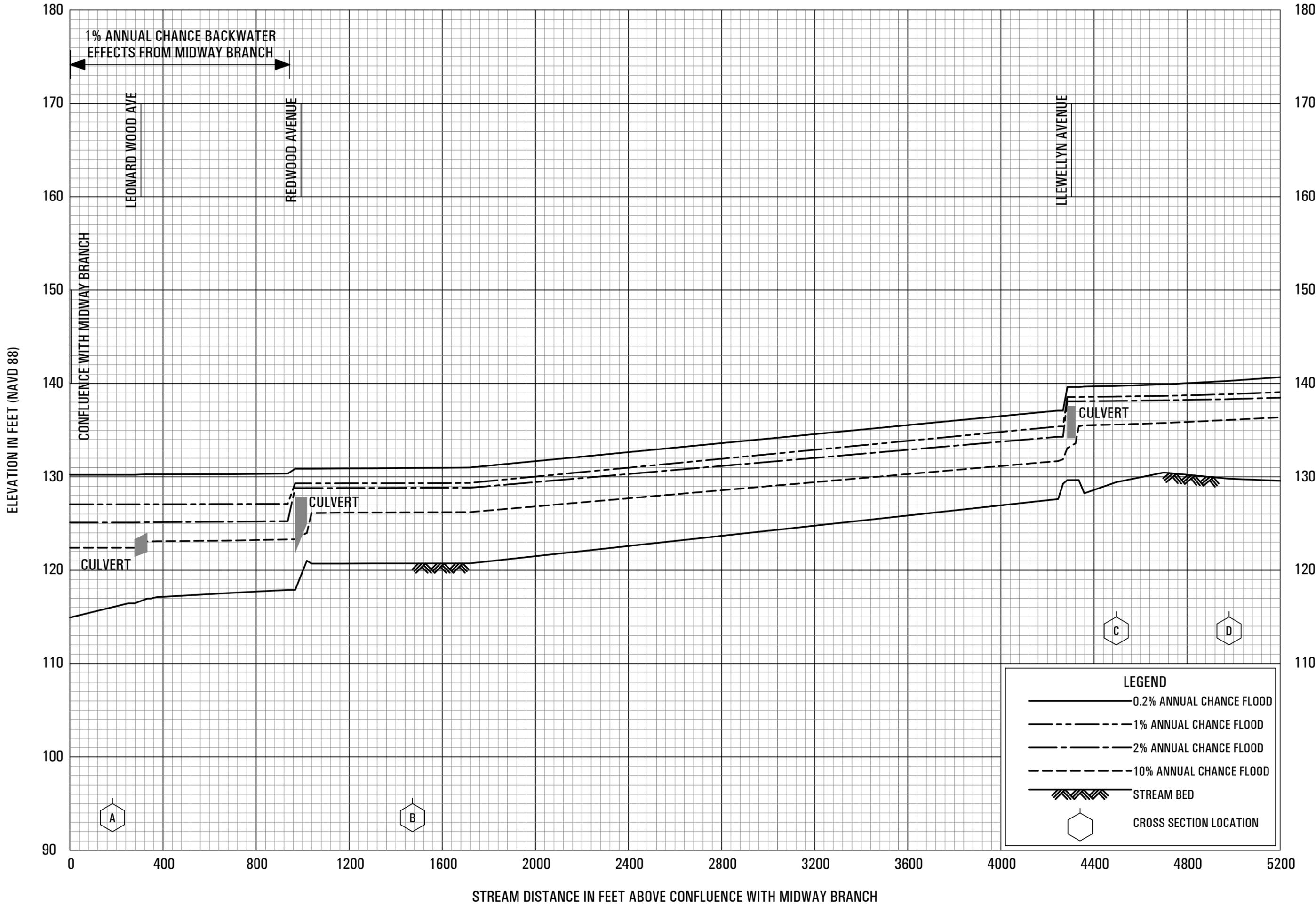AC

AD

AE

FLOOD PROFILES

MARLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

16P

FLOOD PROFILES

MARLEY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
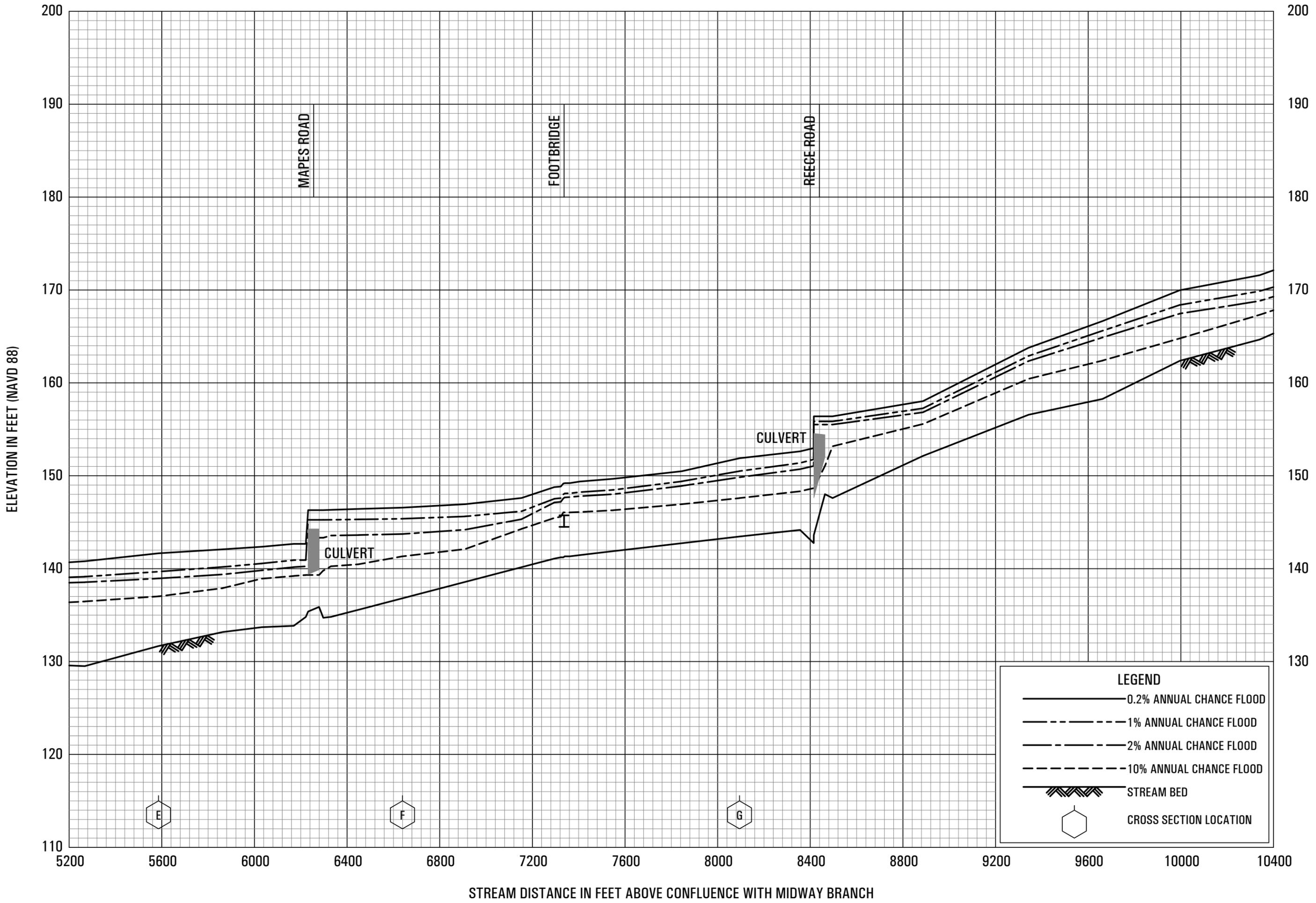
ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

17P

FLOOD PROFILES

MIDWAY BRANCH

FLOOD PROFILES

MIDWAY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

19P

LEGEND

──────── 0.2% ANNUAL CHANCE FLOOD

─·─·─·─ 1% ANNUAL CHANCE FLOOD

─··─··─ 2% ANNUAL CHANCE FLOOD

─ ─ ─ ─ 10% ANNUAL CHANCE FLOOD

▨▨▨▨ STREAM BED

⬡ CROSS SECTION LOCATION

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE CONFLUENCE WITH LITTLE PATUXENT RIVER

WILDLIFE LOOP

CULVERT

FLOOD PROFILES

MIDWAY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

20P

FLOOD PROFILES
MIDWAY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY
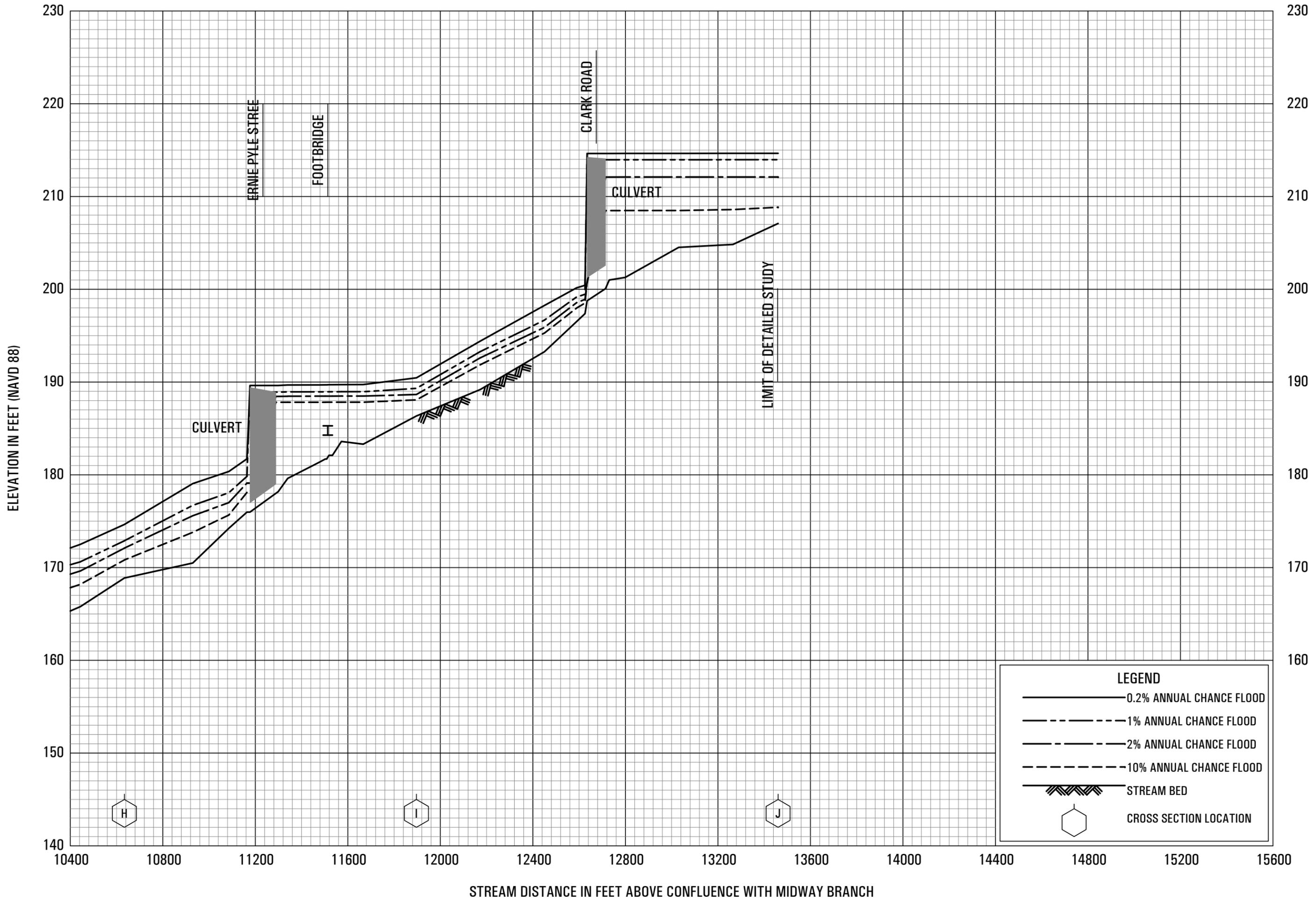ANNE ARUNDEL COUNTY, MD
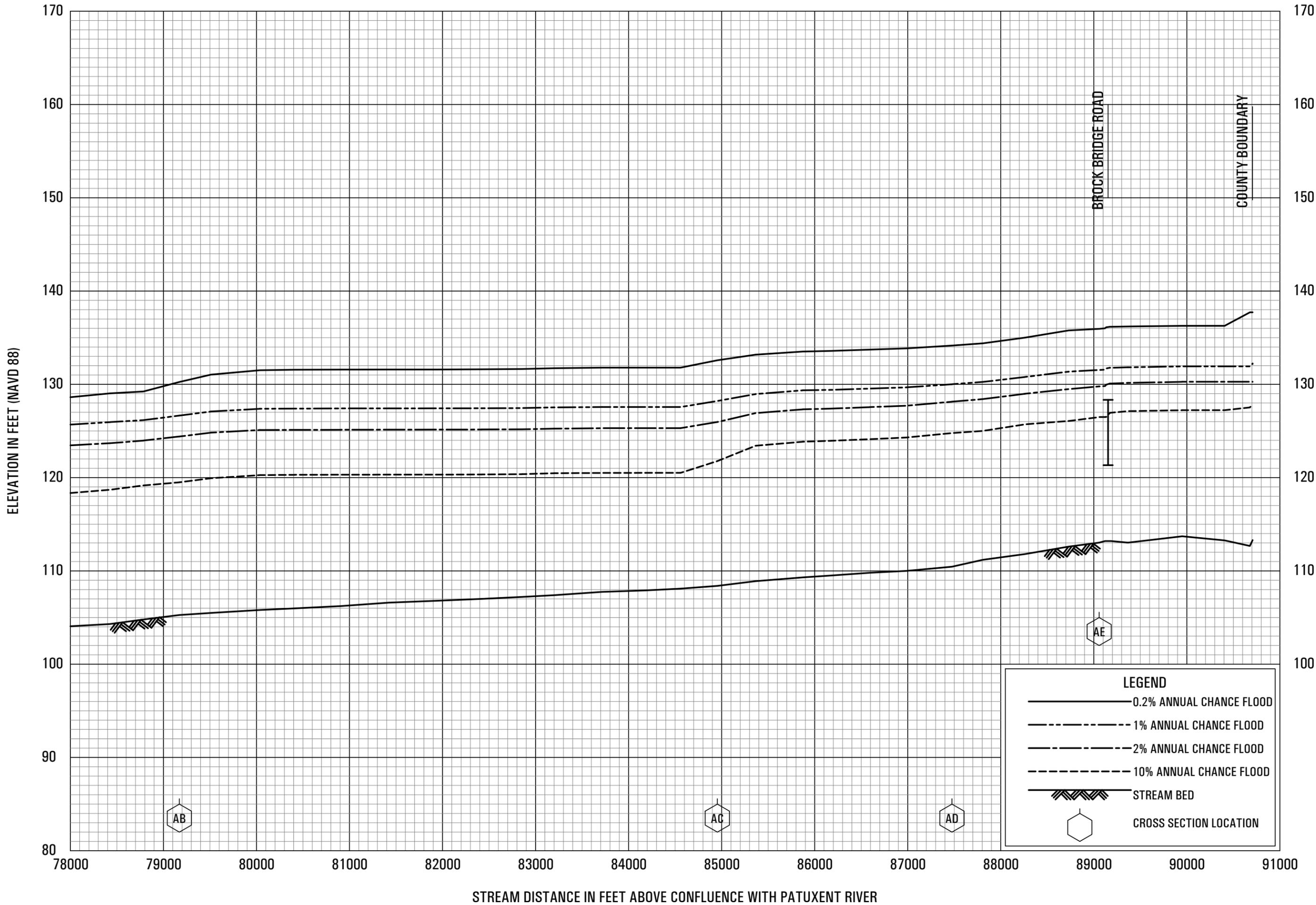AND INCORPORATED AREAS

21P

FLOOD PROFILES

MIDWAY BRANCH

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

22P

FLOOD PROFILES

PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

23P

FLOOD PROFILES

PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

24P

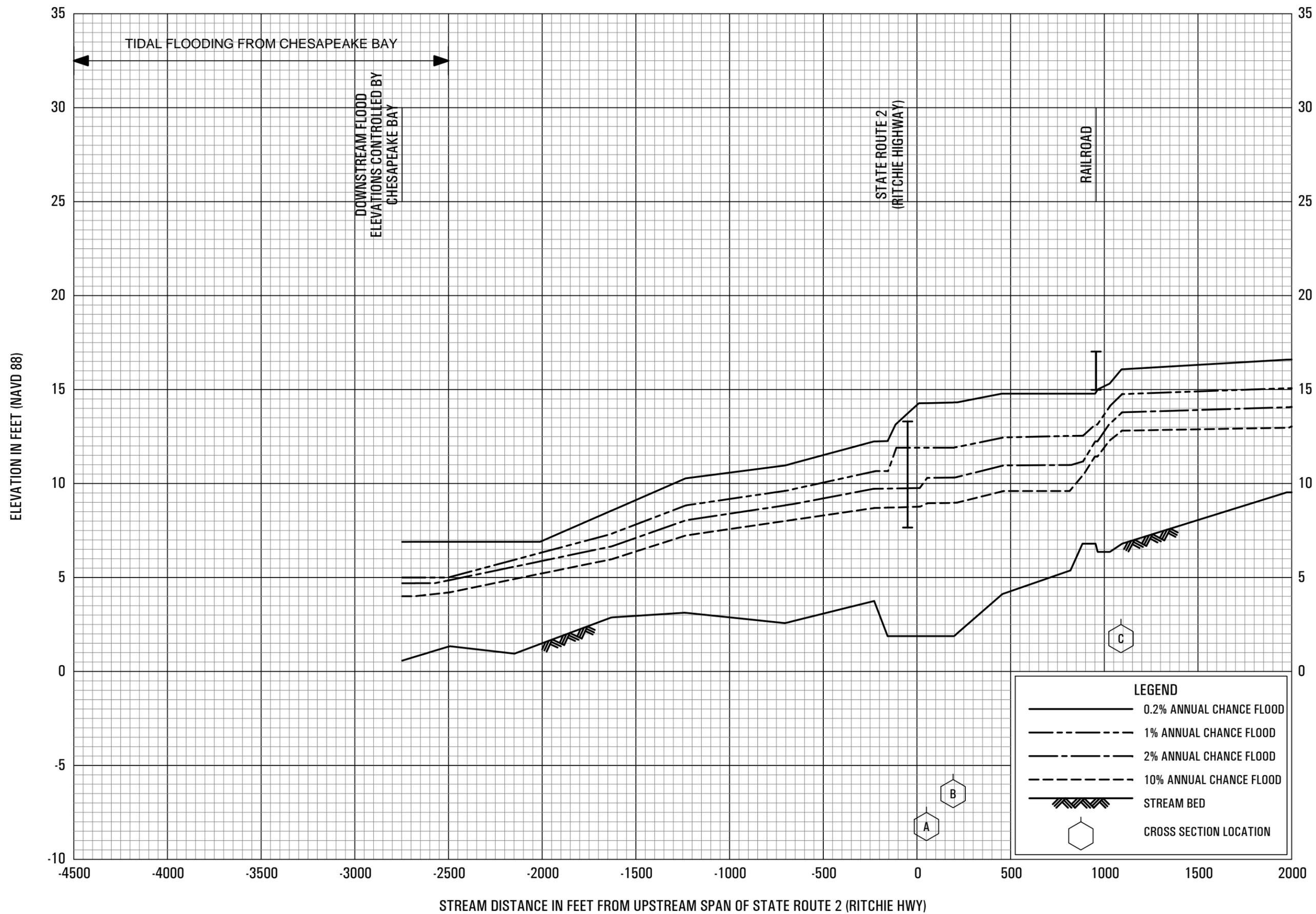FLOOD PROFILES
PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

25P

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE ANNE ARUNDEL COUNTY BOUNDARY

LEGEND

——————— 0.2% ANNUAL CHANCE FLOOD

— - — - — 1% ANNUAL CHANCE FLOOD

— · — · — 2% ANNUAL CHANCE FLOOD

— — — — 10% ANNUAL CHANCE FLOOD

〰〰〰 STREAM BED

CROSS SECTION LOCATION

FLOOD PROFILES

PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

26P

FLOOD PROFILES

PATAPSCO RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

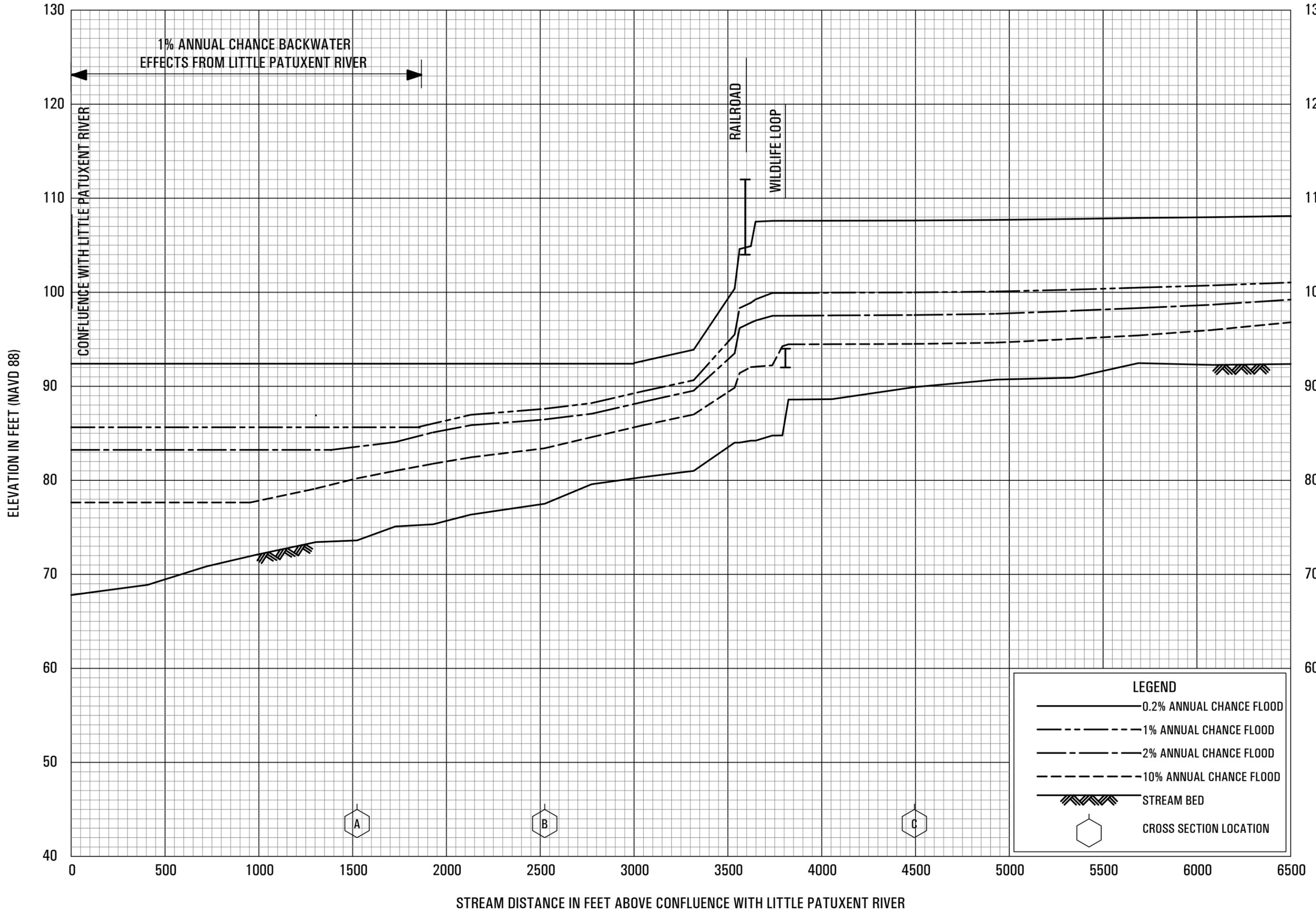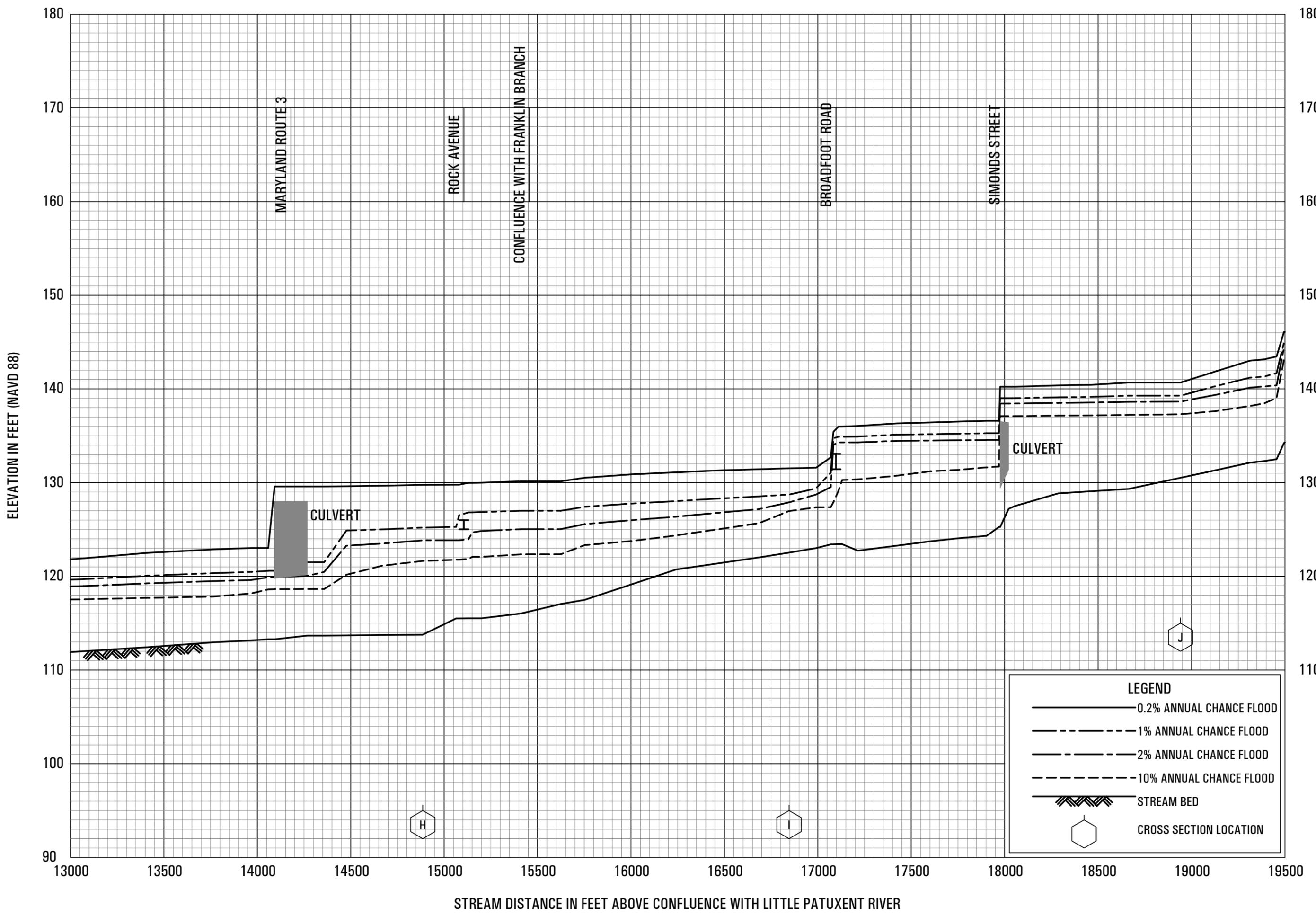ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

27P

DOWNSTREAM FLOOD ELEVATIONS CONTROLLED BY CHESAPEAKE BAY

PENNSYLVANIA AVENUE
(STATE ROUTE 4)

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE COUNTY BOUNDARY

LEGEND

| | |
|---|---|
| ———————— | 0.2% ANNUAL CHANCE FLOOD |
| —·—·—·—·— | 1% ANNUAL CHANCE FLOOD |
| —··—··—··— | 2% ANNUAL CHANCE FLOOD |
| — — — — — | 10% ANNUAL CHANCE FLOOD |
| ⋀⋀⋀⋀⋀⋀ | STREAM BED |
| ⬡ | CROSS SECTION LOCATION |

FLOOD PROFILES

PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

28P

FLOOD PROFILES
PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
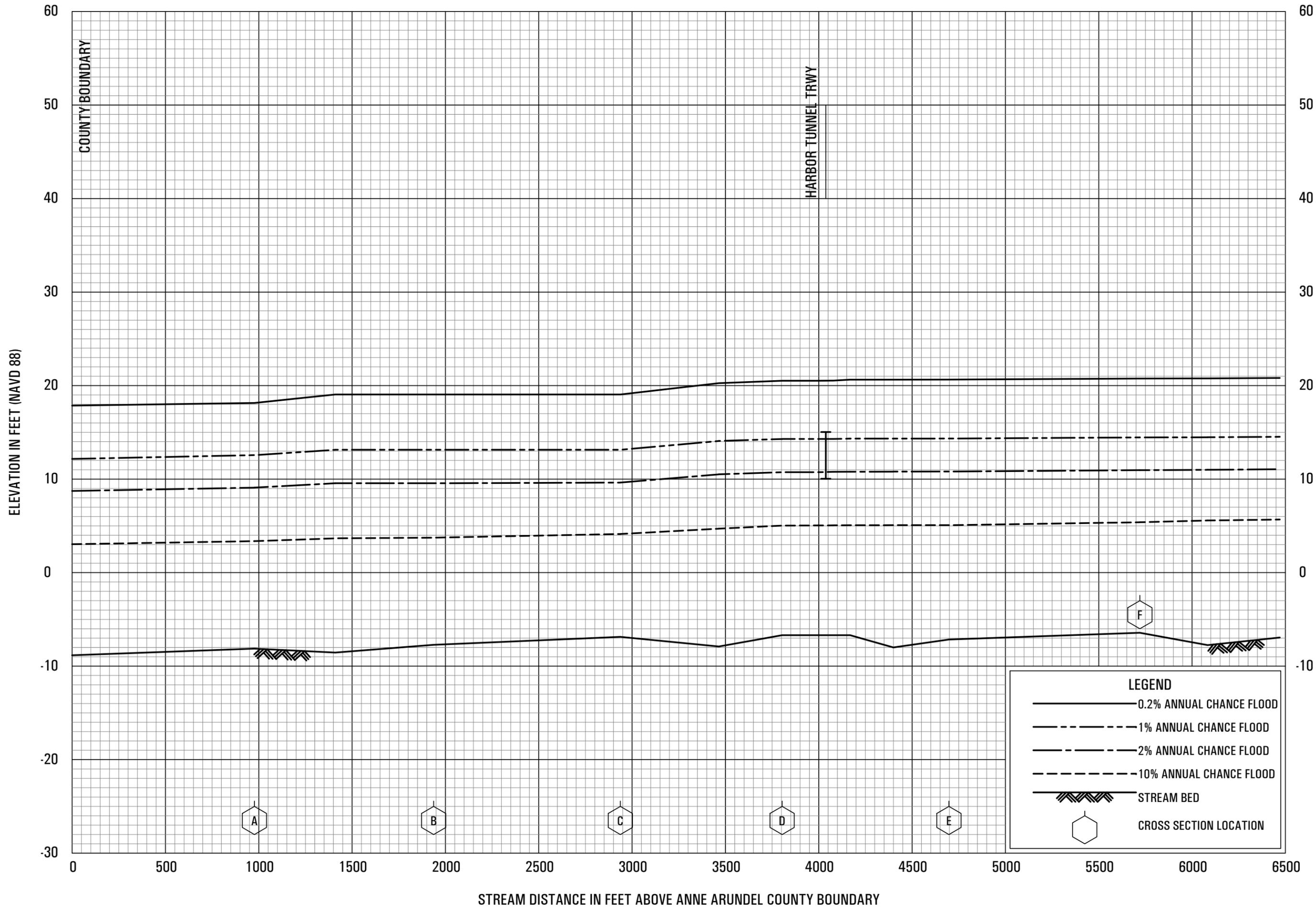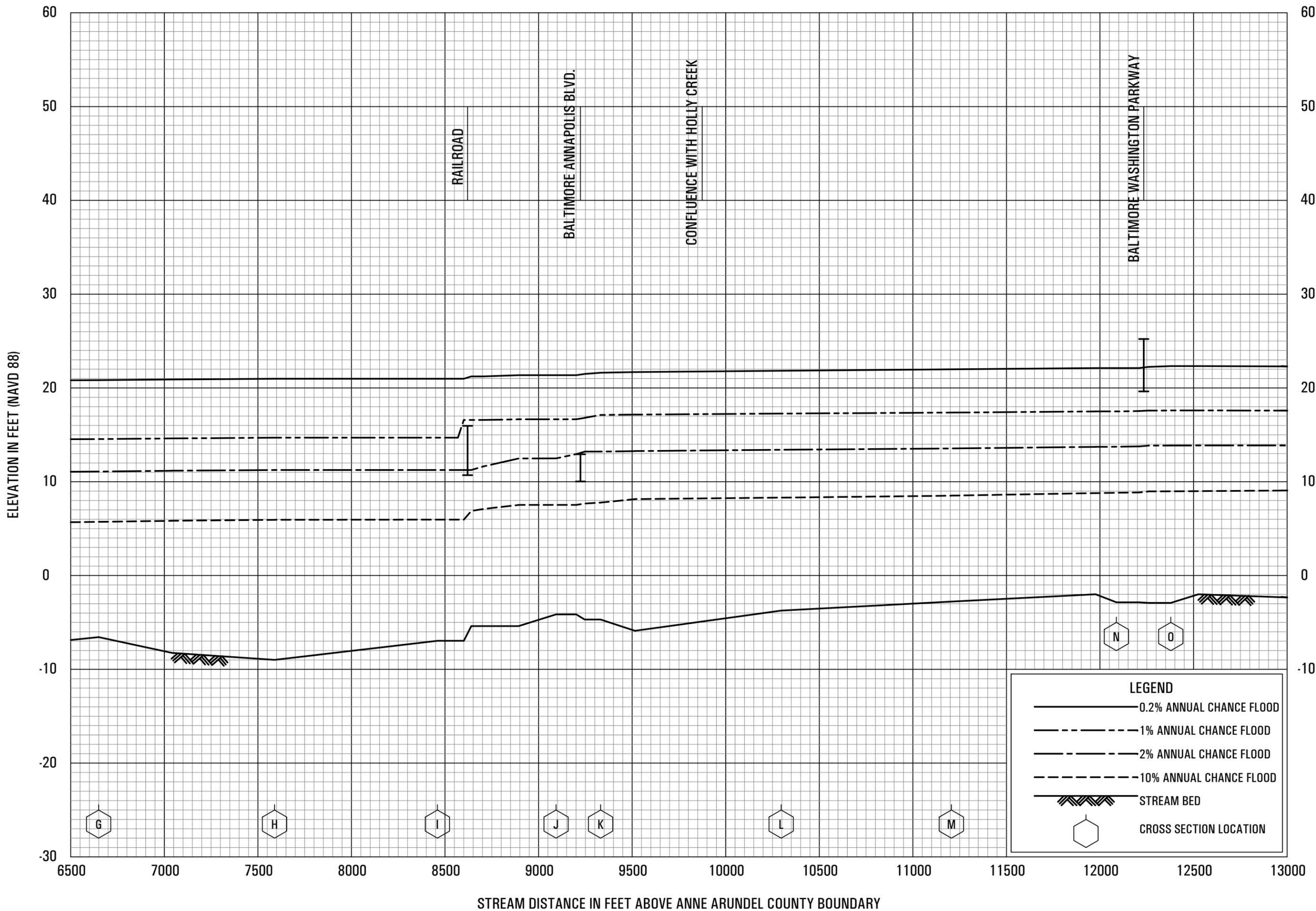ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

29P

FLOOD PROFILES

PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

30P

FLOOD PROFILES

PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

31P

FLOOD PROFILES

PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

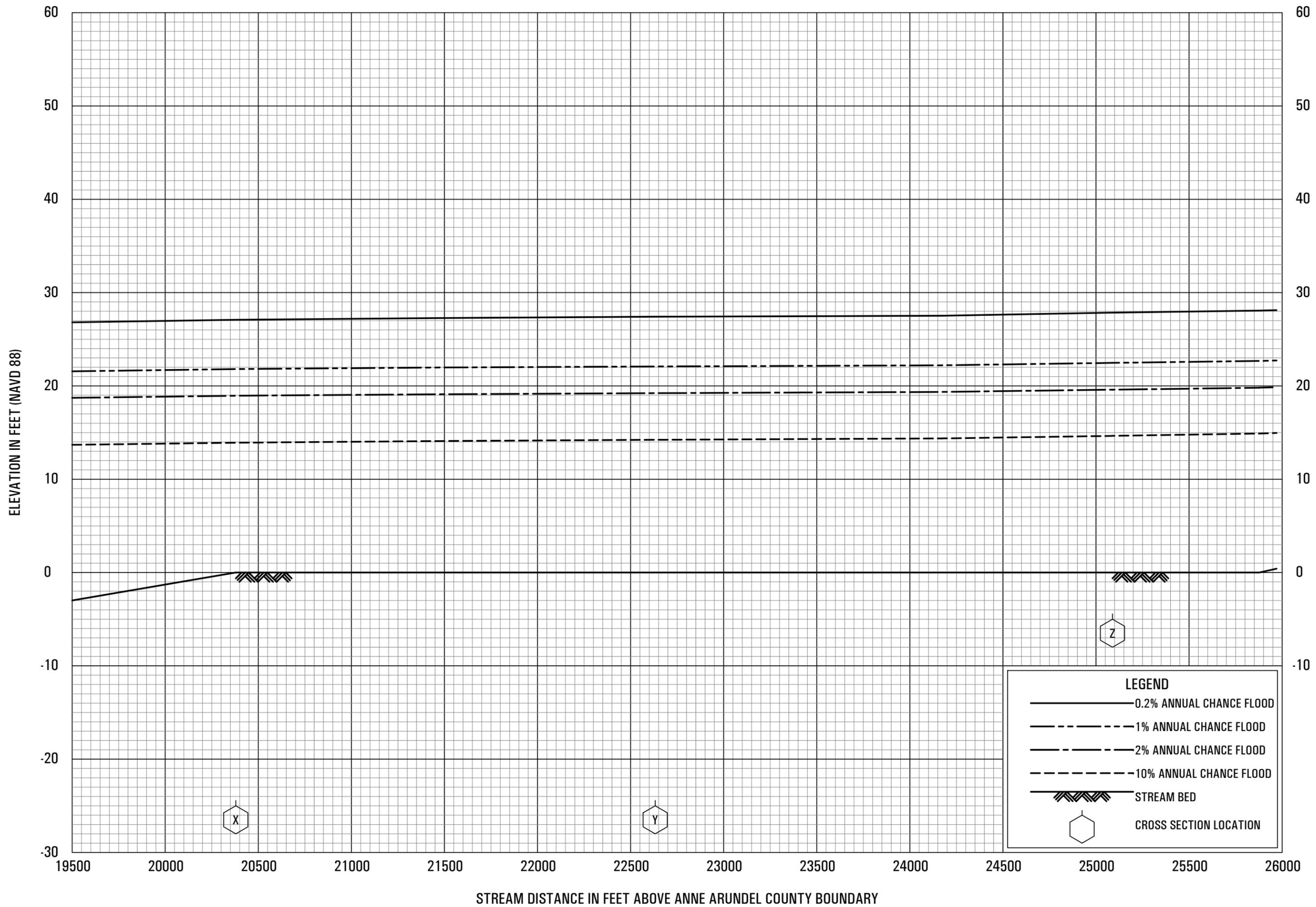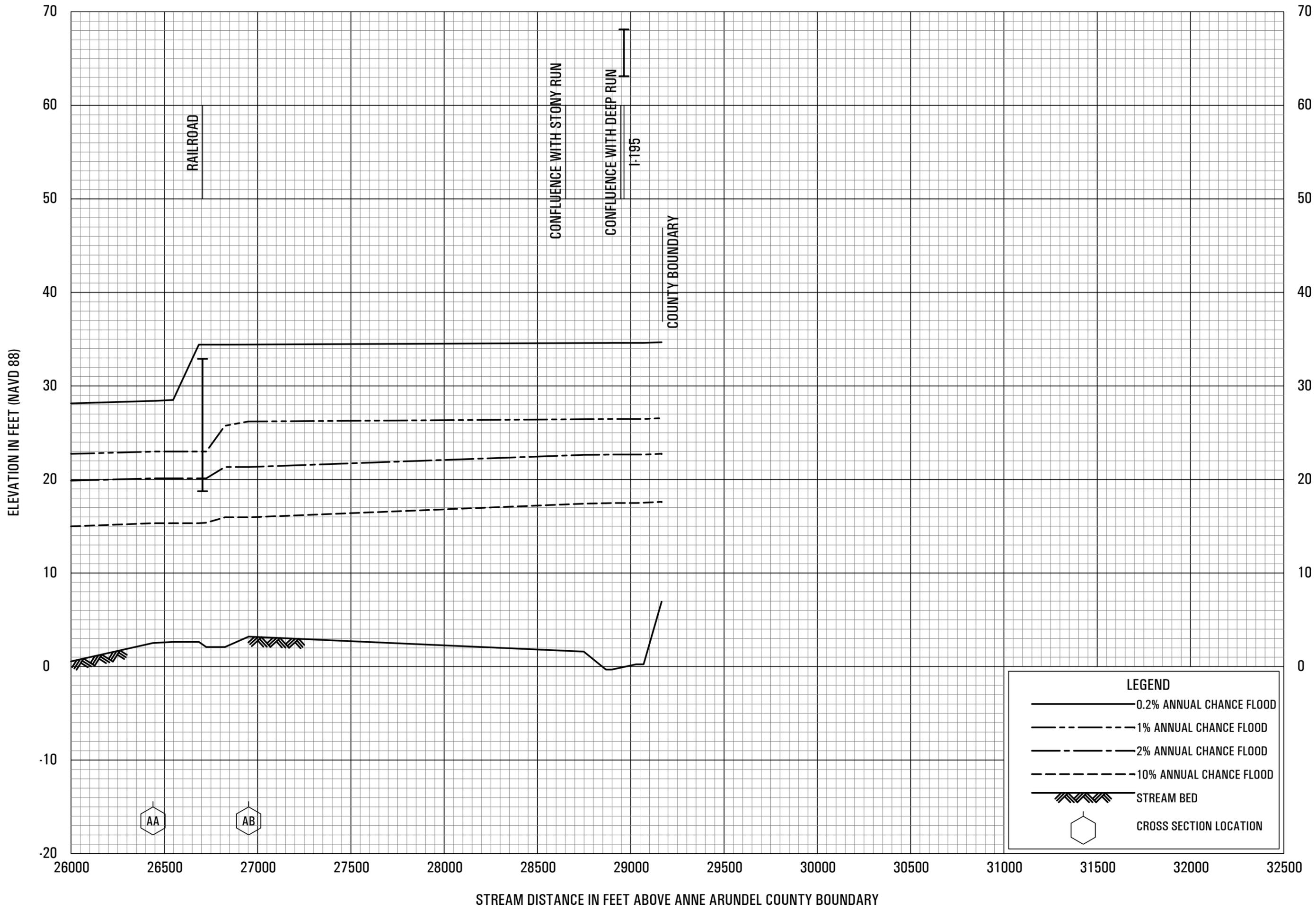ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

32P

FLOOD PROFILES

PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

33P

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE COUNTY BOUNDARY

LEMON'S BRIDGE (RAILROAD)

KNOLLS (DUVALL) STREET

CONFLUENCE WITH THOMAS BRANCH

LEGEND

0.2% ANNUAL CHANCE FLOOD

1% ANNUAL CHANCE FLOOD

2% ANNUAL CHANCE FLOOD
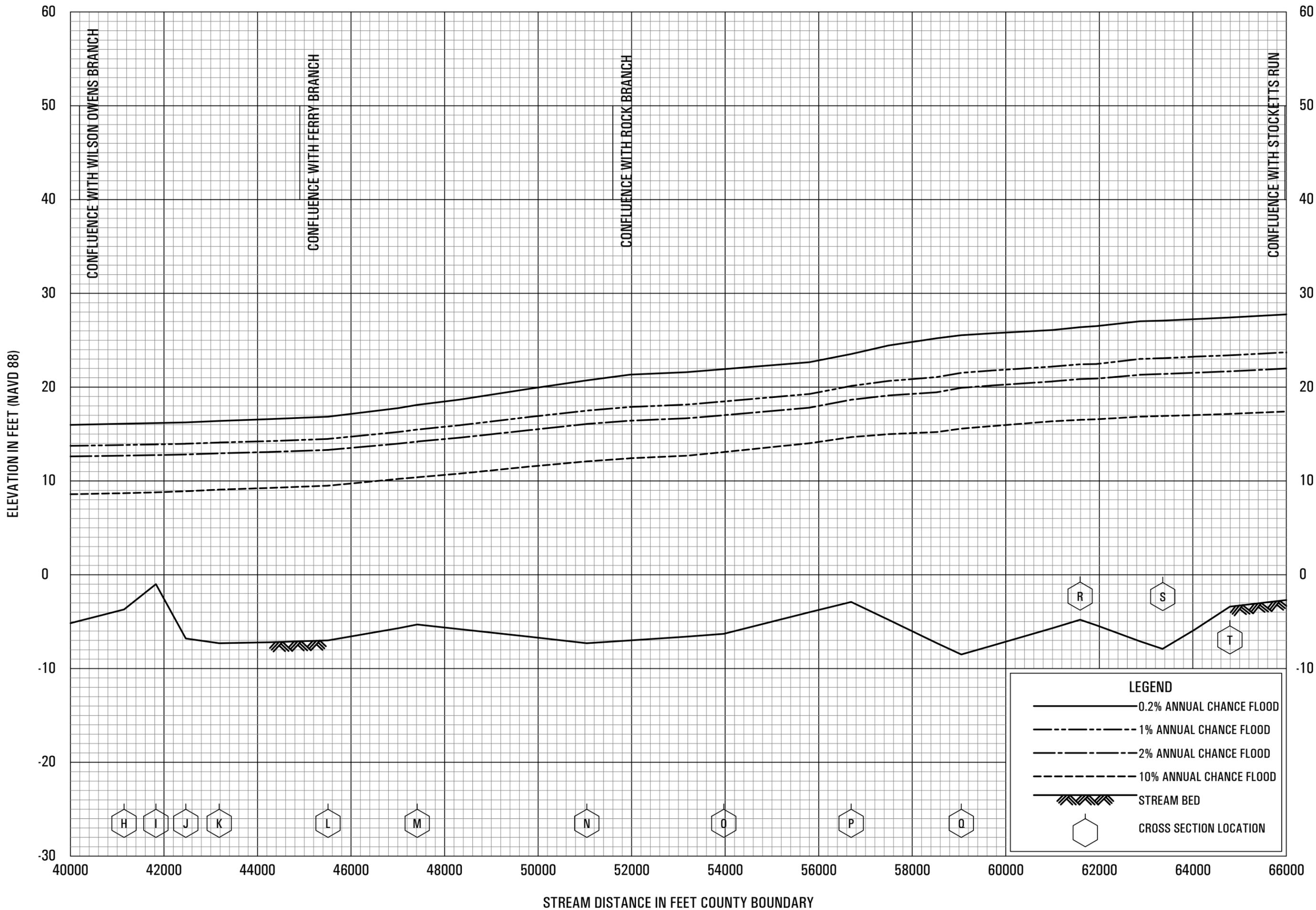
10% ANNUAL CHANCE FLOOD

STREAM BED

CROSS SECTION LOCATION

FLOOD PROFILES
PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

34P

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE COUNTY BOUNDARY

MD ROUTE 198

COUNTY BOUNDARY

LEGEND
———————— 0.2% ANNUAL CHANCE FLOOD
—··—··—··— 1% ANNUAL CHANCE FLOOD
—·—·—·—·— 2% ANNUAL CHANCE FLOOD
———————— 10% ANNUAL CHANCE FLOOD
〰〰〰 STREAM BED
⬡ CROSS SECTION LOCATION

CG
CH
CI
CJ

FLOOD PROFILES

PATUXENT RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

35P

FLOOD PROFILES

SAWMILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

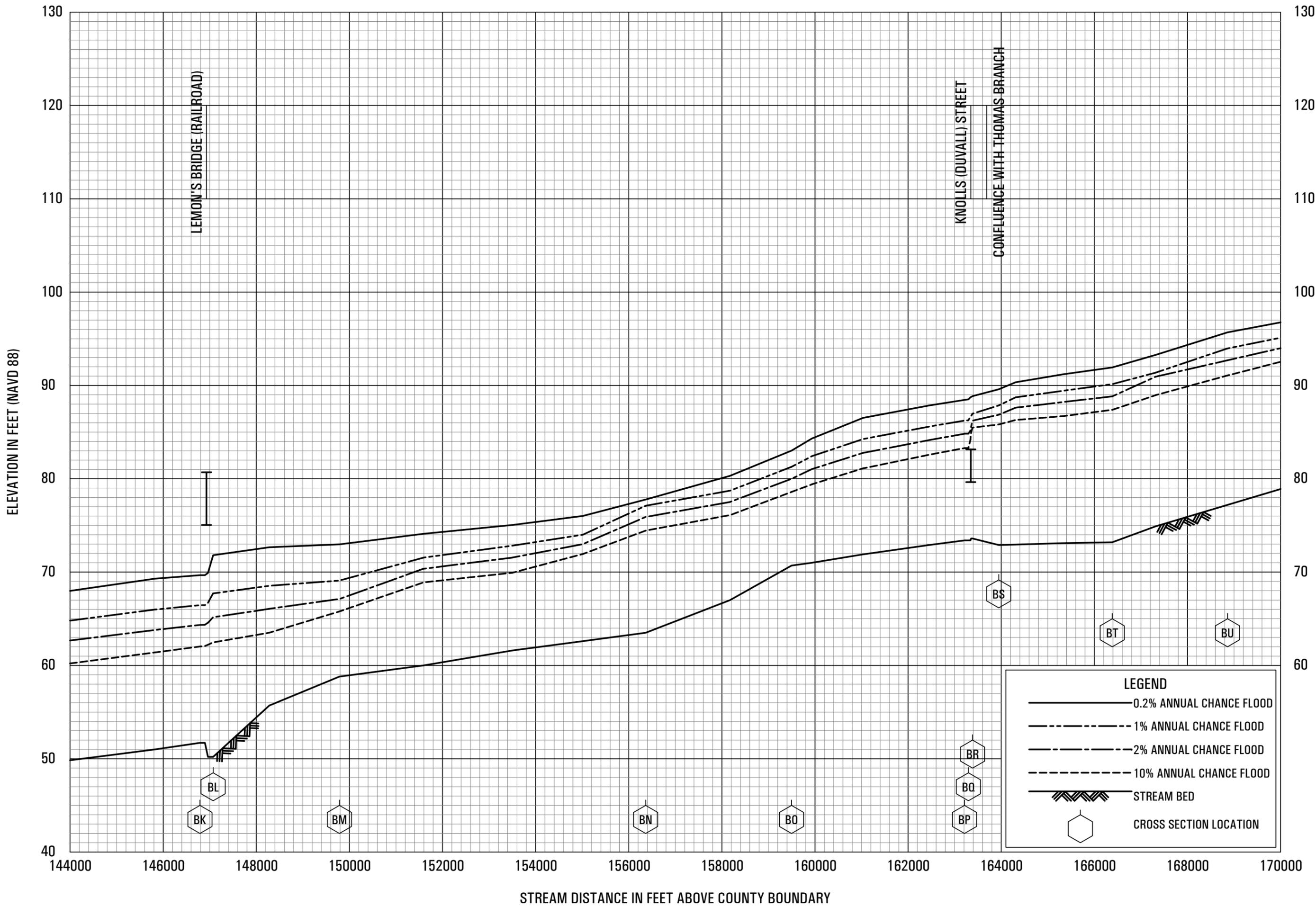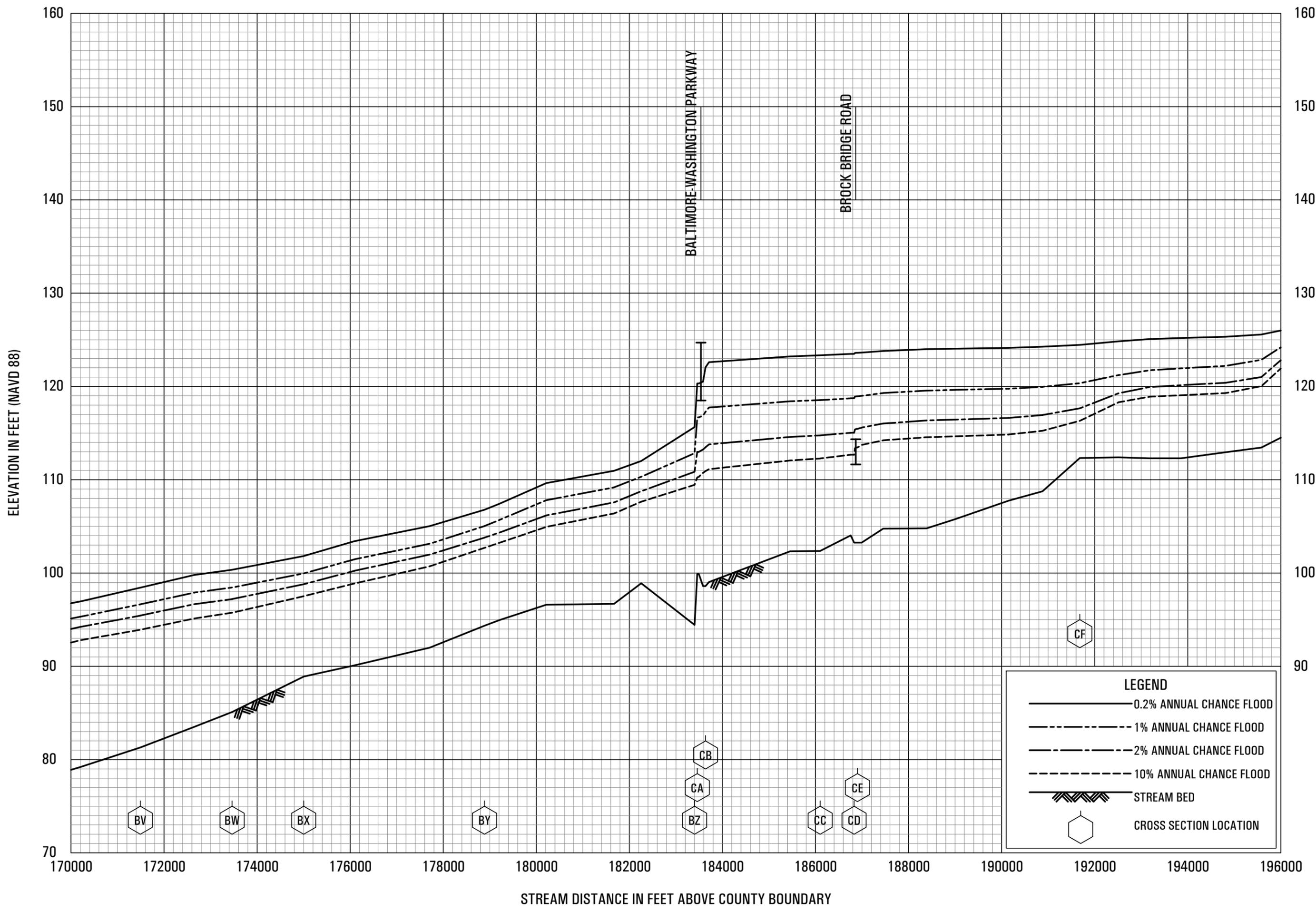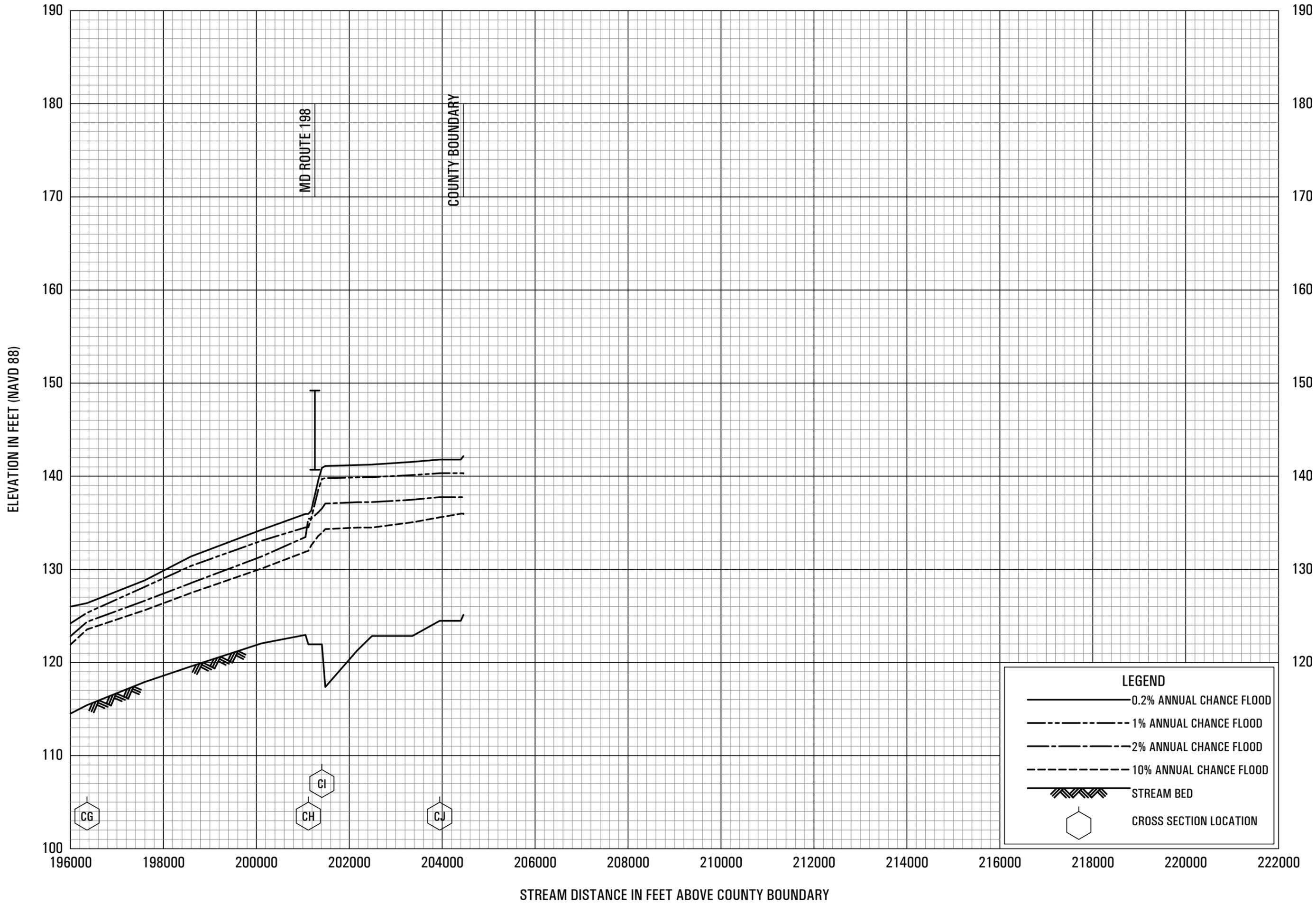ANNE ARUNDEL COUNTY, MD
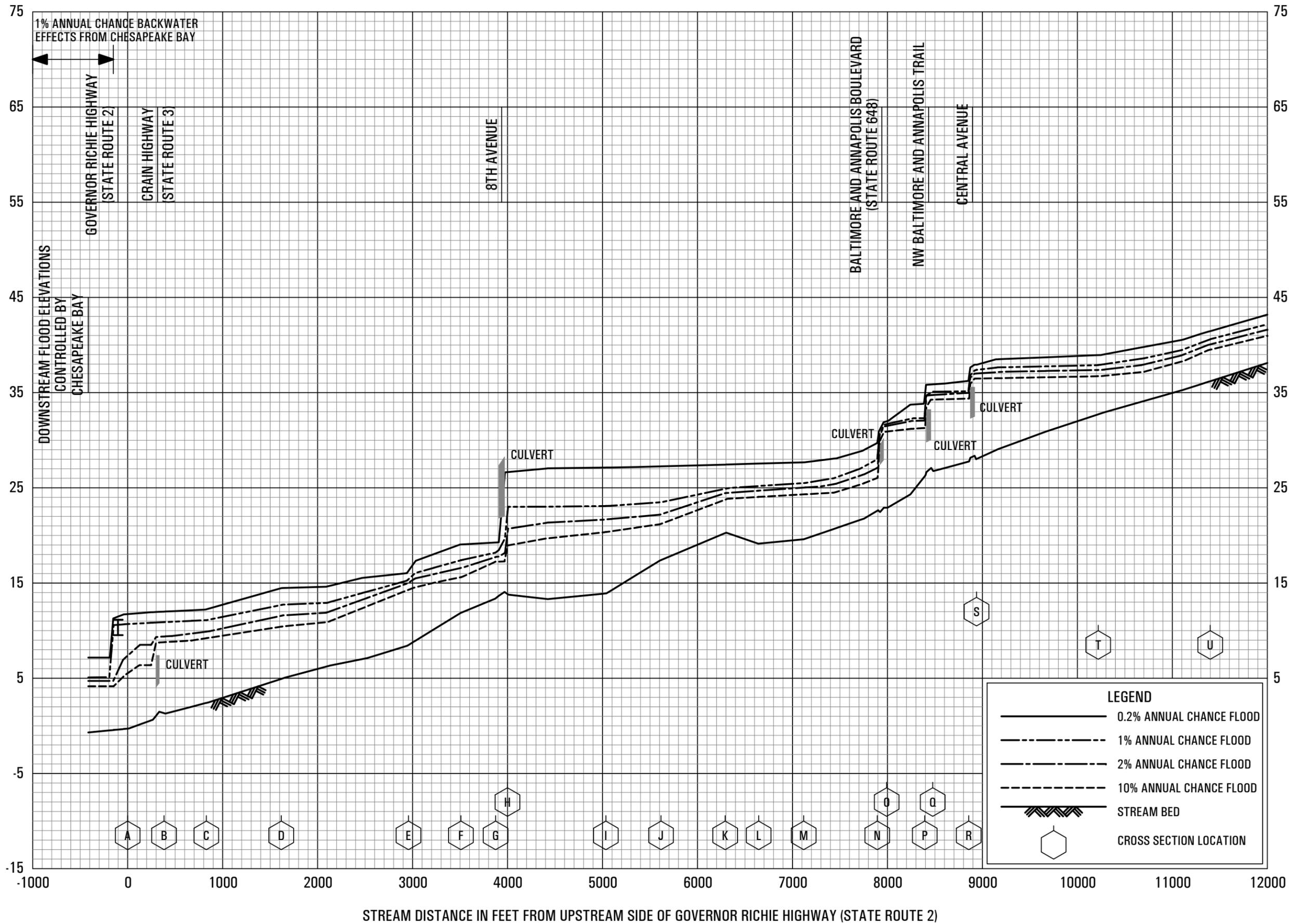AND INCORPORATED AREAS

36P

FLOOD PROFILES
SAWMILL CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

37P

FLOOD PROFILES

SEVERN RUN

LIMIT OF RIVERINE ANALYSIS

VETERAN'S HIGHWAY

I-97

CULVERT

CONFLUENCE WITH JABEZ BRANCH

DICUS MILL ROAD

CONFLUENCE WITH UNNAMED TRIBUTARY

CONFLUENCE WITH UNNAMED TRIBUTARY

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE DOWNSTREAM FACE OF VETERAN'S HIGHWAY

**LEGEND**

| | |
|---|---|
| ———————— | 0.2% ANNUAL CHANCE FLOOD |
| —·—··—·—··— | 1% ANNUAL CHANCE FLOOD |
| —·—·—·—·— | 2% ANNUAL CHANCE FLOOD |
| — — — — — | 10% ANNUAL CHANCE FLOOD |
| ▨▨▨▨▨ | STREAM BED |
| ⬡ | CROSS SECTION LOCATION |

FEDERAL EMERGENCY MANAGEMENT AGENCY

ANNE ARUNDEL COUNTY, MD

AND INCORPORATED AREAS

38P

FLOOD PROFILES
SEVERN RUN

ELEVATION IN FEET (NAVD 88)

CONFLUENCE OF SEVERN RIVER

NEW CUT ROAD

STREAM DISTANCE IN FEET ABOVE DOWNSTREAM FACE OF VETERAN'S HIGHWAY

LEGEND

0.2% ANNUAL CHANCE FLOOD
1% ANNUAL CHANCE FLOOD
2% ANNUAL CHANCE FLOOD
10% ANNUAL CHANCE FLOOD
STREAM BED
CROSS SECTION LOCATION

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

39P

CONFLUENCE WITH UNNAMED TRIBUTARY

CONFLUENCE OF BEAVER CREEK

ELEVATION IN FEET (NAVD 88)

STREAM DISTANCE IN FEET ABOVE DOWNSTREAM FACE OF VETERAN'S HIGHWAY

**LEGEND**

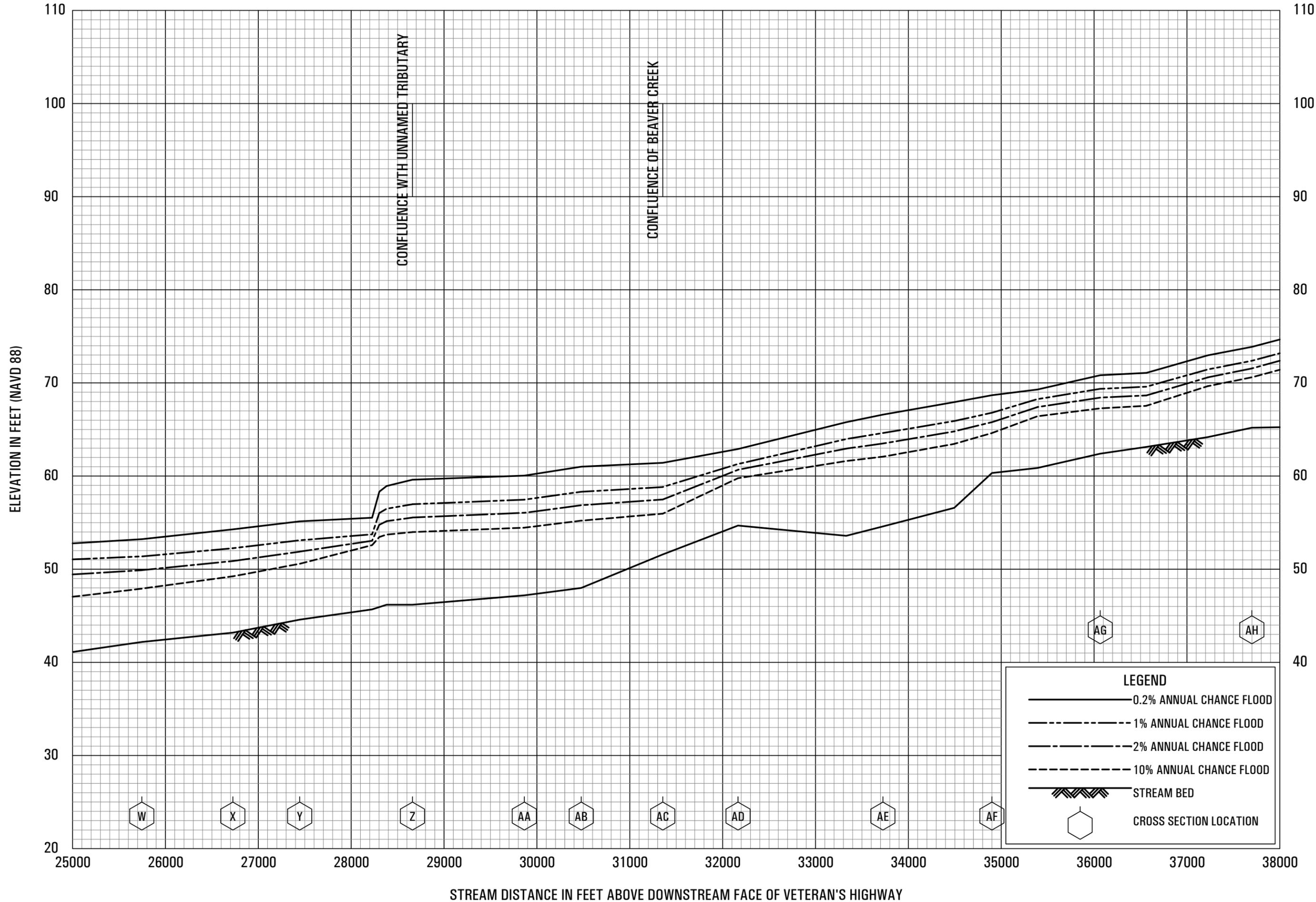| | |
|---|---|
| ——————— | 0.2% ANNUAL CHANCE FLOOD |
| —··—··—·· | 1% ANNUAL CHANCE FLOOD |
| —·—·—·— | 2% ANNUAL CHANCE FLOOD |
| — — — — | 10% ANNUAL CHANCE FLOOD |
| ⋀⋀⋀⋀⋀ | STREAM BED |
| ⬡ | CROSS SECTION LOCATION |

**FLOOD PROFILES**

SEVERN RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

**ANNE ARUNDEL COUNTY, MD**

AND INCORPORATED AREAS

40P

FLOOD PROFILES

SEVERN RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY
ANNE ARUNDEL COUNTY, MD
AND INCORPORATED AREAS

41P