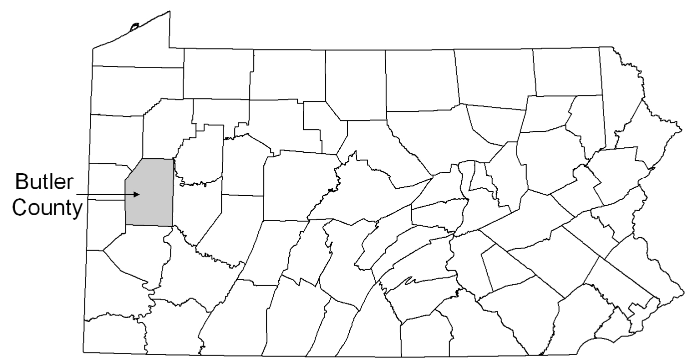
FLOOD INSURANCE STUDY

This Preliminary FIS report only includes revised Floodway Data Tables and revised Flood Profiles. The unrevised components will appear in the final FIS report.

BUTLER COUNTY, PENNSYLVANIA

AND INCORPORATED AREAS



COMMUNITY NAME	COMMUNITY NUMBER
ADAMS, TOWNSHIP OF	421415
ALLEGHENY, TOWNSHIP OF	422341
BRADY, TOWNSHIP OF	422241
BRUIN, BOROUGH OF	420211
BUFFALO, TOWNSHIP OF	421416
BUTLER, CITY OF	420212
BUTLER, TOWNSHIP OF	421138
CALLERY, BOROUGH OF	420213
CENTER, TOWNSHIP OF	421417
CHERRY, TOWNSHIP OF	422342
CHERRY VALLEY, BOROUGH OF*	422682
CHICORA, BOROUGH OF	420214
CLAY, TOWNSHIP OF	422343
CLEARFIELD, TOWNSHIP OF	422344
CLINTON, TOWNSHIP OF	422345
CONCORD, TOWNSHIP OF	422346
CONNOQUENESSING, BOROUGH OF	421413
CONNOQUENESSING, TOWNSHIP OF	421418
CRANBERRY, TOWNSHIP OF	421217
DONEGAL, TOWNSHIP OF	422347
EAST BUTLER, BOROUGH OF	420215
EAU CLAIRE, BOROUGH OF*	422348
EVANS CITY, BOROUGH OF	420216
FAIRVIEW, BOROUGH OF*	422685
FAIRVIEW, TOWNSHIP OF	422603
FORWARD, TOWNSHIP OF	421419
FRANKLIN, TOWNSHIP OF	422350
HARMONY, BOROUGH OF	420217
HARRISVILLE, BOROUGH OF	422351
JACKSON, TOWNSHIP OF	421420
JEFFERSON, TOWNSHIP OF	421421
KARNS CITY, BOROUGH OF	420218
LANCASTER, TOWNSHIP OF	421422

COMMUNITY NAME	COMMUNITY NUMBER
MARION, TOWNSHIP OF	420219
MARS, BOROUGH OF	420220
MERCER, TOWNSHIP OF	422352
MIDDLESEX, TOWNSHIP OF	421229
MUDDY CREEK, TOWNSHIP OF	422353
OAKLAND, TOWNSHIP OF	422354
PARKER, TOWNSHIP OF	421219
PENN, TOWNSHIP OF	421241
PETROLIA, BOROUGH OF	420221
PORTERSVILLE, BOROUGH OF*	422355
PROSPECT, BOROUGH OF	422356
SAXONBURG, BOROUGH OF*	422357
SEVEN FIELDS, BOROUGH OF	422683
SLIPPERY ROCK, BOROUGH OF*	421414
SLIPPERY ROCK, TOWNSHIP OF	420222
SUMMIT, TOWNSHIP OF	422358
VALENCIA, BOROUGH OF	420223
VENANGO, TOWNSHIP OF	422359
WASHINGTON, TOWNSHIP OF	420224
WEST LIBERTY, BOROUGH OF	420225
WEST SUNBURY, BOROUGH OF*	422684
WINFIELD, TOWNSHIP OF	421225
WORTH, TOWNSHIP OF	421425
ZELIENOPLE, BOROUGH OF	420226

*NO SPECIAL FLOOD HAZARD AREAS IDENTIFIED

EFFECTIVE DATE:

Federal Emergency Management Agency

Flood Insurance Study Number
42019CV000A

REVISED PRELIMINARY
JUNE 26, 2013

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.

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

Selected Flood Insurance Rate Maps (FIRM) panels for this community contain information that was previously shown separately on the corresponding Flood Boundary and Floodway Map (FBFM) panels (e.g., floodways and cross sections). In addition, former flood hazard zone designations have been changed as follows:

Old Zone(s)	New Zones
A1 through A30	AE
B	X
C	X

Initial Countywide FIS Effective Date:

This Preliminary FIS report only includes revised Floodway Data Tables and revised Flood Profiles. The unrevised components will appear in the final FIS report.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

FIGURES

TABLES

EXHIBITS

FLOOD INSURANCE STUDY
BUTLER COUNTY, PENNSYLVANIA
(ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) report investigates the existence and severity of flood hazards in the geographic area of flood hazards in the geographic area of Butler County, including the City of Butler; the Boroughs of Bruin, Callery, Cherry Valley, Chicora, Connoquenessing, East Butler, Eau Claire, Evans City, Fairview, Harmony, Harrisville, Karns City, Mars, Petrolia, Portersville, Prospect, Saxonburg, Seven Fields, Slippery Rock, Valencia, West Liberty, West Sunbury, and Zelienople; and the Townships of Adams, Allegheny, Brady, Buffalo, Butler, Center, Cherry, Clay, Clearfield, Clinton, Concord, Connoquenessing, Cranberry, Donegal, Fairview, Forward, Franklin, Jackson, Jefferson, Lancaster, Marion, Mercer, Middlesex, Muddy Creek, Oakland, Parker, Penn, Slippery Rock, Summit, Venango, Washington, Winfield, and Worth (referred to collectively herein as Butler County).

This FIS 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 county that will establish actuarial flood insurance rates and to assist the county in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

Please note that on the effective date of this study, the Boroughs of Cherry Valley, Eau Claire, Fairview, Portersville, Saxonburg, Slippery Rock, and West Sunbury have no mapped Special Flood Hazard Areas (SFHA). This does not preclude future determinations of SFHA that could be necessitated by changed conditions affecting the community (i.e. annexation of new lands) or the availability of new scientific or technical data about flood hazards.

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.

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

1.2 Authority and Acknowledgments

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

This FIS was prepared to include all jurisdictions within Butler County into a countywide format FIS.

Information on the authority and acknowledgements for each of the previously printed FISs for communities within Butler County was compiled, and is shown below.

Adams, Township of:	The hydrologic and hydraulic analyses for the April 17, 1989 study were prepared by the Pittsburgh District of the U.S. Army Corps of Engineers (USACE) for the FEMA, under Inter-Agency Agreement No. EMW-86-E-2266, Project No. 2 (Reference 1). This work was completed in August 1987.
Buffalo, Township of:	For the original July 18, 1983, FIS report and January 18, 1984, Flood Insurance Rate Map (FIRM) (hereinafter referred to as the 1984 FIS), the hydrologic and hydraulic analyses were prepared by the USACE, Pittsburgh District, for FEMA, under the Inter-Agency Agreement No. IAA-H-9-79, Project Order No. 40 and Amendment No. 1. That work was completed in July 1982. For the July 5, 2001 revision, the hydrologic and hydraulic analyses for Buffalo Creek were prepared as part of a restudy of the Allegheny River by the USACE for FEMA, under Inter-Agency Agreement No. EMW-94-E-4311 (Reference 2). This work was completed in October 1997.
Butler, City of:	The hydrologic and hydraulic analyses in the February 1, 1984 study represent a revision of the original analyses preformed by Michael Baker, Jr., Inc., for FEMA, under Contract No. H-3812 (Reference 3). The hydrologic analysis for Connoquenessing Creek was performed by the USACE. This work was completed in February 1977. The updated version was prepared by Gannett Fleming Water Resources Engineering, Inc., for FEMA. The updated version was completed in June 1983.
Butler, Township of:	The hydrologic and hydraulic analyses in the January 1978 study were done by Michael Baker, Jr., Inc., for FEMA, under Contract No. H-3812 (Reference 4). This work, which was completed in February 1977, covered all significant flooding sources in the Township of Butler with the exception of Connoquenessing Creek for which the USACE provided the hydrologic data.
Callery, Borough of:	The hydrologic and hydraulic analyses for the April 17, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No.

EMW-86-E-2226, Project Order No. 2 (Reference 5). This work was completed in August 1987.

Center, Township of: The hydrologic and hydraulic analyses for the June 19, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 6). This work was completed in August 1987.

Cranberry, Township of: The hydrologic and hydraulic analyses for the October 1, 1981 study were preformed by the Pittsburgh District of the USACE, for FEMA, under Inter-Agency Agreement Nos. IAA-H-10-77 and IAA-H-10-77 Amendment #3, Project Order No. 16, respectively (Reference 7). This work was completed in April 1979.

East Butler, Borough of: The hydrologic and hydraulic analyses for the March 18, 1991 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 8). This work was completed in January 1988.

Evans City, Borough of: The hydrologic and hydraulic analyses for the May 4, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 9). This work was completed in August 1987.

Forward, Township of: The hydrologic and hydraulic analyses for the June 19, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 10). This work was completed in February 1988.

Harmony, Borough of: The hydrologic and hydraulic analyses for the May 4, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 11). This work was completed in August 1987.

Jackson, Township of: The hydrologic and hydraulic analyses for the September 15, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 12). This work was completed in August 1987.

Mars, Borough of: The hydrologic and hydraulic analyses for the May 4, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 13). This work was completed in August 1987.

Middlesex, Township of:	The hydrologic and hydraulic analyses for the June 1, 1983 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. IAA-H-9-79, Project Order No. 40 and Amendment No. 1 (Reference 14). This work was completed in June 1982.
Penn, Township of:	The hydrologic and hydraulic analyses for the August 15, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 15). This work was completed in August 1987.
Petrolia, Borough of:	The hydrologic and hydraulic analyses for the December 5, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 16). This work was completed in January 1988.
Valencia, Borough of:	The hydrologic and hydraulic analyses for the May 4, 1989 study were prepared by the USACE, Pittsburgh District, for FEMA, under Inter-Agency Agreement No. EMW-86-E-2226, Project Order No. 2 (Reference 17). This work was completed in August 1987.
Zelienople, Borough of:	The hydrologic and hydraulic analyses for the June 17, 1989 study were prepared by the Pittsburgh District of the USACE for FEMA, under Inter-Agency Agreement EMW-E-1153, Project Order No. 1, Amendment No. 20 (Reference 18). This work was completed in February 1985.

There are no previous FIS reports or FIRMs published for the Boroughs of Cherry Valley, Eau Claire, Fairview, Portersville, Seven Fields, Slippery Rock, and West Sunbury. There are no previous FIS reports were prepared for the Boroughs of Bruin, Chicora, Connoquenessing, Harrisville, Karns City, Prospect, Saxonburg, and West Liberty; and the Townships of Allegheny, Brady, Cherry, Clay, Clearfield, Clinton, Concord, Connoquenessing, Donegal, Fairview, Franklin, Jefferson, Lancaster, Marion, Mercer, Muddy Creek, Oakland, Parker, Slippery Rock, Summit, Venango, Washington, Winfield, and Worth; therefore the previous authority and acknowledgment information for these communities are not included in this FIS. These communities may not appear in the Community Map History table (Section 6).

For this countywide FIS, the DFIRM database and mapping were prepared for FEMA by GG3, a joint venture between Gannett Fleming, Inc., Camp Hill, Pennsylvania, and Greenhorne & O'Mara, Inc., Laurel, Maryland under Joint Venture Contract No. EMP-2006-CO-2606, Task Order No. 6. The new countywide FIS includes new detailed hydraulic analysis for the Allegheny River; and new hydraulic and hydrologic analyses along Breakneck Creek, Brush Creek and Coal Run Above Brush Creek. Redelineation and digitizing of effective flood hazard information and new approximate analyses was also performed. This work was completed in 2012.

The orthophotography base mapping was provided by the PAMAP Program, Bureau of Topographic and Geologic Survey, PA Department of Conservation and Natural Resources. The digital countywide FIRM was produced in Pennsylvania State Plane South Zone coordinate system (FIPS Zone 3702) with a Lambert Conformal Conic projection, units in feet, and referenced to the North American Datum of 1983, GRS80 spheroid. Differences in datum and spheroid used in the production of the FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on this FIRM.

1.3 Coordination

An initial Consultation Coordination Officer's (CCO) meeting is held typically with representatives of FEMA, the community, and the study contractor to explain the nature and purpose of a FIS, and to identify the streams to be studied by detailed methods. A final CCO meeting is held typically with the same representatives to review the results of the study. The initial and final meeting dates for the previous FIS reports for Butler County and its communities are listed in Table 1, "Initial and Final CCO Meetings."

Table 1 – Initial and Final CCO Meetings

COMMUNITY NAME	INITIAL MEETING	FINAL MEETING
Adams, Township of	May 21, 1985	May 4, 1988
Buffalo, Township of	December 5, 1978 September 1993	March 4, 1983 April 21, 1999
Butler, City of	September 4, 1975	April 26, 1977
Butler, Township of	September 4, 1975	May 19, 1977
Callery, Borough of	May 21, 1985	May 3, 1988
Center, Township of	May 21, 1985	July 7, 1988
Cranberry, Township of	September 9, 1976	May 11, 1981
East Butler, Borough of	May 21, 1985	April 24, 1990
Evans City, Borough of	May 21, 1985	May 4, 1988
Forward, Township of	May 21, 1985	July 6, 1988
Harmony, Borough of	May 21, 1985	May 4, 1988
Jackson Township of	May 21, 1985	July 6, 1988
Mars, Borough of	May 21, 1985	May 4, 1988
Middlesex, Township of	December 4, 1978	January 11, 1983
Penn, Township of	May 21, 1985	May 3, 1988
Petrolia, Borough of	May 21, 1985	December 16, 1988
Valencia, Borough of	May 21, 1985	May 3, 1988
Zelienople, Borough of	July 27, 1983	August 7, 1985

For this countywide revision, the final CCO meeting was held on May 5, 2010, and attended by representatives of FEMA, the study contractor, and the local communities. All problems raised at that meeting has been addressed.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the geographic area of Butler County, Pennsylvania, including all jurisdictions listed in Section 1.1. Table 2, "Areas Studied by Detailed Methods," lists the streams that were studied by detailed methods. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction.

Table 2 – Areas Studied by Detailed Methods

Stream	Limits of Detailed Study
Allegheny River	From Clarion/Venango County boundary to approximately 1,000 feet downstream to Armstrong County boundary.
Bonnie Brook	Approximately 0.3 mile downstream of East Butler Road to approximately 0.6 mile upstream of East Butler Road.
Breakneck Creek	Confluence with Connoquenessing Creek to approximately 120 feet upstream of Three Degree Road.
Brush Creek	Approximately 0.7 mile downstream of Powell Road to approximately 0.8 mile upstream of Commonwealth Drive.
Buffalo Creek	Confluence with Allegheny River to approximately 815 feet upstream of the railroad.
Butcher Run	Confluence with Connoquenessing Creek to approximately 0.4 mile upstream of William Flynn Highway.
Coal Run Above Brush Creek	Confluence with Brush Creek to approximately 0.3 mile upstream of Canterbury Trail.
Coal Run Above Connoquenessing Creek	Confluence with Connoquenessing Creek to approximately 700 feet upstream of Zeigler Avenue.
Connoquenessing Creek	Approximately 0.7 mile downstream of New Castle Street to approximately 0.9 mile upstream of Franklin Glass Access Road, and from just upstream of Armco Plant Road to approximately 150 feet upstream of Pine Tract Road.
Glade Run	Approximately 1.0 mile downstream of Sheldon Road to just upstream of the Glade Lake Dam.

Table 2 – Areas Studied by Detailed Methods (Continued)

Stream	Limits of Detailed Study
Little Bull Creek	Approximately 0.8 mile downstream of Hranica Road to approximately 0.3 mile downstream of Hranica Road.
Little Connoquenessing Creek	Confluence with Connoquenessing Creek to approximately 0.4 mile upstream of Little Creek Road.
Scholars Run	Confluence with Connoquenessing Creek to approximately 0.7 mile upstream of Fanker Road.
Shanks Hollow Run	Confluence with Sullivan Run to approximately 400 feet upstream of Wicks Street.
Shearer Run	Confluence with Connoquenessing Creek to approximately 0.4 mile upstream of Shearer Road.
South Branch Bear Creek	Approximately 1,000 feet downstream of the railroad to approximately 500 feet upstream of Nesbit Street.
Sullivan Run	Confluence with Connoquenessing Creek to approximately 0.3 mile upstream of North 6th Avenue.

Approximate analyses were used to study those areas having a low development potential or minimal flooding hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the communities.

Streams that have names in the countywide FIS other than those used in the previously printed FIS reports for the communities in which they are located are shown in Table 3, "Streams Name Changes."

Table 3 – Stream Name Changes

Community	Old Stream Name	New Stream Name
Township of Cranberry	Coal Run	Coal Run Above Brush Creek
Township of Butler	Coal Run	Coal Run Above Connoquenessing Creek
City of Butler	Coal Run	Coal Run above Connoquenessing Creek
Township of Clinton	Lardimtown Run	Lardintown Run

No Letters of Map Revision (LOMRs) were incorporated as part of this study.

2.2 Community Description

Butler County is located in southwestern Pennsylvania. It is bordered by Mercer and Venango Counties to the north, Clarion County to the northeast, Armstrong County to the east, Westmoreland County to the southeast, Allegheny County to the south, and Lawrence and Beaver Counties to the west. The county was first settled in approximately 1800 (Reference 19). The 2010 population of the county was 183,862 (Reference 20).

The county's land area is approximately 795 square miles (Reference 19). The climate for this area is temperate, with the usual seasonal variation in temperature. The area is geographically located in a region of variable air mass activity, being subjected to polar and tropical, continental, and maritime air mass invasions. The weather is usually moderate, but is subject to frequent and rapid changes as a result of air mass movements. The average monthly mean temperature ranges from 18 degrees Fahrenheit (°F) in January to 82°F in July. The highest recorded temperature was 102°F in 1988 and the lowest recorded temperature was -20°F in 1994. Yearly precipitation averages approximately 42 inches, with the maximum monthly averages occurring in July with 4.24 inches of rain, respectively, and minimum monthly averages occurring in February with 2.58 inches, respectively (Reference 21).

Butler County lies in the unglaciated Appalachian Plateau. The topography consists mostly of rolling hills with elevations ranging from 1,000 feet to over 1,260 feet. The stratigraphy of the county is characteristic of the Pennsylvanian Age. Formations throughout most of the county consist of cyclic sequences of sandstone, shale, limestone, and coal in the Allegheny Group. Conemaugh Formations dominate the higher elevations and consist of cyclic sequences of red and gray shales and siltstones with thin limestones and coals (Reference 22). The soils in the county can be grouped as soils having a slow infiltration rate, soils with a layer of impeding downward water movement, and soils with moderately fine to fine texture.

The Allegheny River, which has a total drainage area of 11,778 square miles at its confluence, joins the Monongahela River to form the Ohio River at Pittsburgh, Pennsylvania. The headwaters of the Allegheny River are in the western slope of the Appalachian Mountain Range in Potter County in northwestern Pennsylvania. It flows in a northwestern direction from its source until it reaches Portville, New York, near the New York-Pennsylvania border. It then flows west to Salamanca, New York, and southward into Pennsylvania to its confluence at Pittsburgh. The Allegheny River flows for a total distance of 322 miles.

Bonnie Brook, with a total drainage area of 20.4 square miles at its mouth, joins Connoquenessing Creek on the left bank at creek mile 47.7 at the City of Butler. It flows in a southwestern direction from its source near North Oakland. Local relief above the stream varies from a low of 1,010 feet to an average hilltop elevation of 1,200 feet within the community. The valley floor varies in width from 300 to 500 feet.

Breakneck Creek has its source near the community of Bakerstown, which is located in the Township of Richland in northern Allegheny County. It flows in a generally northwest direction throughout its length, emptying into Connoquenessing Creek near Harmony Junction in the Township of Jackson. The Breakneck Creek basin is roughly rectangular in shape and encompasses a total drainage area of 42.6 square miles. Basin topography varies from an elevation of 1,310 feet at the extreme headwaters to a low of 920 feet at the mouth.

Brush Creek rises in the Township of Pine, Allegheny County, and flows through the Townships of Marshall and Cranberry in a generally northwestern direction through the Township of Sewickley and on into Connoquenessing Creek, a tributary to the Beaver River. The Brush Creek drainage basin above the downstream corporate limits is roughly rectangular in shape, about seven miles long and four miles wide, encompassing a drainage area of 26.3 miles. Basin topography varies from an elevation of 1,260 feet, at the headwaters, to about 960 feet at the downstream limits. The floodplain averages 500 feet in width and contains various commercial and residential structures and three major highways. The valleys carrying the tributaries are quite narrow with steep hillside slopes.

Buffalo Creek, with a total drainage area of 171 square miles at its confluence, has its source approximately 3 miles west of the Borough of Chicora near the Butler-Armstrong County line. This stream flows in a southern direction to its confluence where it joins the Allegheny River. The average bed slope of Buffalo Creek is 10 feet per mile.

Butcher Run is located in the Township of Butler in central Butler County. The lower portion of Butcher Run is presently industrial and commercial.

Coal Run, a tributary to Brush Creek, with a drainage area of 3.28 square miles, is entirely within the Township of Cranberry. It flows generally in a western direction to Brush Creek. The basin topography varies from an elevation of 1,200 feet at the headwaters to approximately 996 feet at the mouth. Coal Run has a moderately wide flood plain and an average slope of about 34 feet per mile.

Connoquenessing Creek, with a total drainage area of 838 square miles at its mouth, has its source near the community of Hooker in central Butler County. The stream flows in a southern direction from its source until it reaches the community of Renfrew in southwestern Butler County. It then turns and flows in a generally western direction to its confluence with the Beaver River at Ellwood City, a total distance of 58 miles. Above the stream's valley, the local relief rises from a low of 880 to 950 feet to an average hilltop elevation in the watershed of 1,200 to 1,300 feet.

Glade Run is a tributary to Connoquenessing Creek. The Glade Run watershed is largely rural or agricultural with some residential development near the upstream corporate limits of the Township of Middlesex. The stream flows northwest from its source in the Township of Clinton, which is approximately three miles southwest of Glade Mills. The Glade Run basin is roughly rectangular in shape with a length of approximately 4.5 miles and an average width of approximately 2.5 miles. The drainage area at the downstream corporate limits of the Township of Middlesex is 11.48 square miles. Relief in the basin varies from an elevation of 1,000 feet to 1,350 feet at the headwaters of Glade Run. The width of the valley floor within the study area averages 400 to 500 feet. The average bed slope of Glade Run is approximately 37 feet per mile.

Little Bull Creek, which has its source in the Township of Buffalo, flows southeast through the township. Downstream of the township, the creek flows southwest to its confluence with Bull Creek. The Little Bull Creek basin is roughly rectangular in shape with a length of 2.1 miles and an average width of approximately 1.9 miles. The drainage area at the downstream corporate limits is 3.88 square miles. Relief in the basin varies from an elevation of 1,040 feet to 1,280 feet at the headwaters. The width of the valley floor within the study area averages approximately 500 feet and the average bedslope is approximately 25 feet per mile. Watershed development is largely rural with some strip mining.

Little Connoquenessing Creek, with a total drainage area of 64.5 square miles at its mouth, has its headwaters in the Township of Center, north of the City of Butler. The stream flows in a generally southern direction through the Townships of Center, Butler, and Connoquenessing. It then turns and flows in a western direction through the Township of Lancaster before finally turning and meandering in a southern direction to its confluence with the Connoquenessing Creek in the Township of Jackson. The basin is roughly triangular in shape, and the topography varies from an elevation of 1,320 feet at the headwaters to a low of 890 feet at the mouth.

The Scholars Run basin is very narrow and roughly rectangular in shape. It encompasses a total drainage area of 7.1 square miles. Scholars Run, which has its headwaters in the northwestern portion of the Township of Lancaster, flows in a southern direction throughout its length. The average slope of Scholars Run through the community is approximately 31 feet per mile.

Shearer Run is located in the Township of Butler in central Butler County. The lower portion of Butcher Run is presently industrial and commercial.

South Branch Bear Creek, with a total drainage area of 14.7 square miles at its mouth, joins Bear Creek on the right bank at creek mile 4.3 at the Borough of Bruin. It flows in a northern direction from its source upstream of the Borough of Karns City, and its average bed slope in the Borough of Petrolia is 23 feet per mile. Local relief above the stream varies from a low of 1,140 feet to an average hilltop elevation of 1,300 feet within the study limits. The valley floor varies in width from 300 to 500 feet.

Sullivan Run and its tributary, Shanks Hollow Run, drain the western portion of the City of Butler. Sullivan Run flows south to its confluence with Connoquenessing Creek.

Floodplain development along Connoquenessing Creek is limited to industrial and commercial structures. The floodplains of Coal Run and the lower portion of Sullivan Run also consist of commercial and industrial development. The upper portions of Sullivan Run and Shanks Hollow Run contain some residential floodplain development.

2.3 Principal Flood Problems

The main flooding problem for all waterways is the potential for flash flooding as a result of intense, localized thunderstorms. The main flooding season is usually the spring and summer months from April to September; however, flooding can occur at any time.

Due to their basin size and shape, and steep slopes, Bonnie Brook and South Branch Bear Creek are more susceptible to flash flooding from high-intensity, short-duration thunderstorms than the typical rain-snowmelt winter storms. Low-lying areas of the City of Butler are subject to periodic flooding caused by the overflow of Sullivan Run, Shanks Hollow Run, and Coal Run. Flooding on Buffalo Creek is caused primarily by backwater from the Allegheny River.

On Breakneck Creek, the highest known flood in the studied area occurred in June 1974. The main flood problem on Breakneck Creek, Little Connoquenessing Creek, and Scholars Run is the potential for flash flooding. It is often the result of intense, localized thunderstorms. The main flood season is usually the spring and summer months from April to September, however, flooding can occur anytime.

The highest known flood for Brush Creek and Coal Run occurred in June 1974. At that time, the discharge for Brush Creek at the downstream corporate limits of the Township of Cranberry and Coal Run at the mouth, were estimated to be 4,200 cubic square feet (cfs) and 1,450 cfs, respectively.

Flooding on Buffalo Creek is caused primarily by backwater from the Allegheny River.

Low-lying areas of the City of Butler are subject to periodic flooding caused by the overflow of Coal Run, Hanks Hollow Run, and Sullivan Run.

The largest flood of record along Connoquenessing Creek occurred on September 18, 2004 (Reference 23). The second largest flood of record occurred as a result of heavy rains in June 1924. Analyses by the USACE of the U.S. Geological Survey (USGS) gage (No. 0310600) near Zelienople, Pennsylvania, indicated that the flood had a recurrence interval of approximately 0.33-percent-annual-chance reoccurrence interval (Reference 24). The third largest flood of record occurred in October 1954 as a result of Hurricane Hazel. Analyses of the USACE streamflow gage below Lyndora Bridge determined a recurrence interval of approximately the 1.67-percent-annual-chance flood.

Table 4, “Major Flooding Along Connoquenessing Creek”, shows major flooding of record on Connoquenessing Creek as measured at the USGS gaging station (No. 0310600) located at the Hazen Road Bridge in Hazen. The gage zero elevation is 851.84 feet.

Table 4 – Major Flooding Along Connoquenessing Creek

Date of Crest	Stage (feet)	Discharge (cfs)
September 18, 2004	*	24,500
June 29, 1924	16.66	23,000[1]/21,500[2]
October 16, 1954	15.51	18,000
March 10, 1964	14.77	16,000
January 27, 1952	14.54	15,200
April 20, 1940	13.90	13,900
July 1, 1974	13.93	13,900
April 5, 1957	13.86	13,500
June 24, 1972	13.32	11,800
December 31, 1990	*	11,600
January 6, 2005	*	11,600
January 19, 1996	*	9,480

[1] Data from the Township of Jackson
[2] Data from the Borough of Zelienople
* No Data Available

Major floods occurred on Glade Run in October 1954, June 1974, and May 1980. The 1974 flood may be the highest known flood, but the high-water data are not available.

The highest known flood on Little Bull Creek occurred on June 30, 1974. According to several known high-water marks obtained from this flood, the estimated recurrence interval was approximately the 2-percent-annual-chance flood.

In July 1973 and June 1974, flooding on Sullivan Run caused water damage to homes and businesses and forced the closing of certain bridges. No damage estimates are available for these recent floods. High-water marks provided by the Pittsburgh District of the USACE are shown in Table 5, "High Water Marks in Butler County".

Table 5 – High Water Marks in Butler County

Bridge	Elevation	Relation to Bridge
July 1973		
New Castle Street	992.18 feet	3.25 feet above Deck
Mercer Street	1,002.05 feet	0.12 feet above Deck
North 6th Avenue	1,003.99 feet	1.94 feet below Deck
June 1974		
Route 68	988.58 feet	0.95 feet below Deck
West Brandy Street	991.33 feet	0.90 feet above Deck
Mercer Street	1,000.55 feet	1.38 feet below Deck
North 6th Avenue	1,002.89 feet	3.04 feet below Deck

2.4 Flood Protection Measures

There are no existing, authorized, or proposed flood control or related measures within the Boroughs of Callery, East Butler, Evans City, Harmony, Mars, Petrolia, Valencia, or Zelienople; or the Townships of Adams, Buffalo, Forward, Jackson, or Middlesex, that would reduce flood levels within these boroughs or townships.

In July 1964, the USACE completed a channel alignment and improvement on Connoquenessing Creek (Reference 25). The Connoquenessing Creek horseshoe curve near the confluence of Sullivan Run was bypassed with a new channel between the Bessemer and Lake Erie Railroad and the Chessie System Railroad. The channel alignment begins just above the Sawmill Run confluence with Connoquenessing Creek and ends upstream within the City of Butler.

Sullivan Run presently flows in the old Connoquenessing Creek channel from the old confluence to the new improved channel. The old Connoquenessing Creek channel upstream of the former confluence is now filled in. The relocation and channelization of Connoquenessing Creek, which extends from the southern boundary of the City of Butler to a point approximately 540 feet upstream of the Monroe Street bridge, has almost eliminated any flood problem from the Connoquenessing Creek in the City of Butler.

A detention dam has been built in the Township of Cranberry by a private developer at the headwaters of Coal Run to protect some homes in new developments downstream from the dam, from being flooded.

Lake Oneida Dam and Lake is located in the Township of Oakland. The dam, constructed in 1918 by the Butler Water Company, is an earthen embankment dam approximately 38 feet high with an uncontrolled spillway. The dam controls a drainage area of 17 square miles, which is approximately 85 percent of the Connoquenessing Creek drainage area. The primary use of the impoundment is public water supply; however, it does provide some flood control.

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-annual-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 (100-year) 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 peak discharge-frequency relationships for each flooding source studied by detailed methods affecting the communities with Butler County.

Pre-countywide Analysis

There are no gage or flow records for Bonnie Brook, Little Connoquenessing Creek, Scholars Run and South Branch Bear Creek. The flow for the 1-percent-annual-chance flood was developed using multiple regression formulas based on factors determined from a USACE study of small streams in Pennsylvania (Reference 26). The factors used were drainage area, stream length, stream slope, and basin shape.

Flood flows on Buffalo Creek and Connoquenessing Creek were developed using the standard log-Pearson Type III analysis of stage discharge records following the methods outlined in Bulletin 17B (Reference 27). Records used in the analysis were obtained at the USGS recording gage located approximately 3 miles upstream of Freeport, Pennsylvania. This gage has been in operation since October 1940. Flood flow frequencies at this gaging station were increased to reflect the additional drainage area of Buffalo Creek at its confluence. The stage-discharge records used in the analysis of Connoquenessing Creek were obtained at the USGS recording gage (No. 0310600) located at Hazen in Beaver County, Pennsylvania. This gage has been in operation since October 1919. From October 1919 to June 1941, it was a non-recording gage. Flood flow frequencies developed at the gaging station were modified to reflect any major changes in the drainage area of Connoquenessing Creek.

Since no gages existed on Butcher Run, Coal Run Above Connoquenessing Creek, Shanks Hollow Run, Shearer Run, and Sullivan Run, the Natural Resource Conservation Service (NRCS, formerly the SCS) Method of Urban Hydrology for Small Watersheds was used to determine peak flows (Reference 28). This method considered the effects of varying development and channel conditions throughout a watershed. Butcher Run, Coal Run, Shanks Hollow Run, Shearer Run, and Sullivan Run have urbanization varying from extensive to very little. The effects of urbanization make an individual analysis of each section of these watersheds compulsory, for which the NRCS method is applicable.

There are no gage or flow records for Glade Run and Little Bull Creek. Flows for the 10-, 2-, 1-, and 0.5-percent-annual-chance floods were developed using multiple regression formulas based on factors determined from a USACE study of flood frequencies of small streams in Pennsylvania (Reference 26). The factors used were drainage area, stream slope, and basin shape.

<u>Countywide Analysis</u>

For this countywide FIS, new hydrologic analyses were performed by GG3 along Allegheny River in the Township of Allegheny; Breakneck Creek in the Boroughs of Callery, and Evans City, and the Townships of Adams, Forward and Jackson; and Brush Creek and Coal Run Above Brush Creek) in the Township of Cranberry. For the Allegheny River, peak flood discharges were computed using gage data. For Breakneck Creek, Brush Creek and Coal Run; peak flood discharges were computed using USGS Regression Equations (Reference 29).

The Allegheny River was restudied through water year 1995 for the peak discharge frequency relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance flood events. The flood frequency program used was developed by the USACE based on a log-Pearson Type III analysis of the peak event partial series flow records. The program follows the methods outlined by the USGS Bulletin 17B (Reference 27).

Natural flows were calculated to update the partial series record of peak events used in developing the natural flow frequencies. These natural flows were calculated using the Reservoir Reduction Program (modified to analyze the Allegheny River only). Average reduction curves were then developed from the difference between the natural flow and actual flow. The natural flood-flow frequencies developed were modified by means of the average reduction curves to reflect the reduction caused by existing upstream flood control reservoirs.

The stage-discharge records used in the analysis of the Allegheny River were obtained at Lock and Dam No. 7 at Kittanning with five years of record. A staff gage located on the upper lock wall at Lock and Dam No. 7 has been maintained by the USACE since January 1931. In 1939, the USGS installed a recording gage on the upstream lock wall. Prior to 1931, a non-recording gage was maintained downstream of Lock and Dam No. 7. To supplement the gage records at Parker and Lock and Dam No. 9, newspaper files and historical records were searched. In addition to interviewing local residents along the stream, high-water data were obtained by actual field observation.

The data for the hydrologic analyses of the Allegheny River was based on records of river stages and discharges from gage stations located on the Allegheny River. These USGS gages include: Gage Station Nos. 030344500 and 03036500.

Methodology used to calculate peak discharges for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for Breakneck Creek, Brush Creek and Coal Run (above Brush Creek) is found in the 2008 USGS publication; *"Regression Equations for Estimating Flood Flows at Selected Recurrence Intervals for Ungaged Streams in Pennsylvania"* (Reference 29). The arithmetic equation for discharge is:

$$\hat{Q}_T = 10^A (DA)^b (El)^c (1+0.01C)^d (1+0.01U)^e (1+0.1Sto)^f$$

Where $\hat{Q}_T$ is the T-year predicted flood flow, in cubic feet per second (cfs); A is the intercept (estimated by Generalized Least Squares (GLS)); DA is the drainage area, in square miles; El is mean elevation, in feet; C is basin underlain by carbonate bedrock, in percent; U is urban area in the basin, in percent; Sto is storage in the basin, in percent; and b, c, d, e, and f are basin characteristic coefficients of regression estimated by GLS.

The publication divides the state of Pennsylvania into four flood-flow regions and hydrologic unit code boundaries. Butler County is divided by Regions 3 and 4. The basin characteristic coefficients of regression for mean elevation, underlain by carbonate bedrock, and storage area only applicable for Region 3, which Breakneck Creek, Brush Creek and Coal Run Above Brush Creek fall within.

Drainage areas for Breakneck Creek, Brush Creek and Coal Run Above Brush Creek were all found to be urbanized beyond the acceptable limit of the state regression equations. Regression equations used to estimate urban peak discharges for ungaged sites were used from the 1984 USGS publication; *"Flood Characteristic of Urban Watersheds in the United Stations"* (Reference 30). These equations were utilized in conjunction with the aforementioned rural equations to account for increased runoff due to urbanization.

The three-parameter estimating equations for urban discharge are:

$$UQ(10) = 9.51\ Area^{0.21}\ (13\text{-}BDF)^{-0.36}\ RQ(10)^{0.79}$$

$$UQ(50) = 8.04\ Area^{0.15}\ (13\text{-}BDF)^{-0.32}\ RQ(50)^{0.81}$$

$$UQ(100) = 7.70\ Area^{0.15}\ (13\text{-}BDF)^{-0.32}\ RQ(100)^{0.82}$$

$$UQ(500) = 7.47\ Area^{0.16}\ (13\text{-}BDF)^{-0.30}\ RQ(500)^{0.82}$$

Where *UQ(n)* is the discharge in cfs for the n-year recurrence interval; *Area*, contributing drainage area, in square miles; *BDF* is a basin development factor; and *RQ(n)* is the discharge in cfs for the n-year recurrence interval of the rural discharge calculated above.
BDF was computed by first dividing each basin into thirds. Then within each third, the drainage system is evaluated and each assigned a value according to four aspects:

- Channel Improvements
- Channel linings
- Storm drains, or storm sewers
- Curb-and-gutter streets

Peak discharge-drainage area relationships for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods for each stream studied by detailed methods are presented in Table 6, "Summary of Discharges."

Table 6 – Summary of Discharges

		PEAK DISCHARGES (CFS)			
FLOODING SOURCE AND LOCATION	**DRAINAGE AREA (SQUARE MILES)**	**10-PERCENT-ANNUAL-CHANCE**	**2-PERCENT-ANNUAL-CHANCE**	**1-PERCENT-ANNUAL-CHANCE**	**0.2-PERCENT-ANNUAL-CHANCE**
BONNIE BROOK					
At the downstream corporate limits of the Borough of East Butler	19.0	*	*	3,060	*
Upstream of unnamed tributary	17.8	*	*	2,940	*
BREAKNECK CREEK					
At the confluence with Connoquenessing Creek	41.7	4,425	6,740	8,010	11,110
Above the confluence with Liken Run	35.8	4,055	6,165	7,330	10,145
Approximately 0.25 miles upstream of the confluence with Liken Run	34.4	3,930	5,980	7,105	9,840
Above unnamed tributary	33.1	3,810	5,800	6,890	9,545
Approximately 0.5 miles above railroad crossing	31.7	3,565	5,445	6,470	8,975
Above the confluence of unnamed tributary	29.7	3,380	5,175	6,145	8,530
Above Wolfe Run	23.7	2,925	4,470	5,305	7,350
Above unnamed tributary	21.5	2,705	4,140	4,915	6,805
Above Spring Run	20.6	*	*	2,700	*
Above Kaufman Run	12.3	*	*	2,470	*
At downstream corporate limits of the Borough of Mars	10.5	*	*	1,950	*
Above Warrendale Run	6.9	*	*	1,610	*
Above unnamed tributary	5.4	*	*	1,300	*

* Data Not Available

Table 6 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CFS) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
BREAKNECK CREEK (Cont..)					
At downstream corporate limits of the Borough of Valencia	4.1	*	*	900	*
BRUSH CREEK					
Downstream corporate Limits of Township of Cranberry	27.1	3,425	5,225	6,215	8,610
Just upstream of the confluence with Brush Creek Tributary 3	22.5	2,865	4,395	5,225	7,260
Approximately 1.3 miles downstream of the confluence with Brush Creek Tributary 4	20.0	2,695	4,125	4,905	6,800
Just upstream of the confluence with Brush Creek Tributary 4	17.1	2,490	3,810	4,530	6,275
Upstream of Coal Run	13.1	1,950	3,000	3,565	4,955
Approximately 865 feet upstream of Freedom Road	10.5	1,570	2,425	2,880	4,005
Approximately 360 feet downstream of Butler/Allegheny County Boundary	8.4	1,275	1,990	2,360	3,290
BUFFALO CREEK					
At the confluence with the Allegheny River	171.0	7,900	12,600	14,800	21,500
BUTCHER RUN					
At the confluence with Connoquenessing Creek	4.0	1,200	1,775	2,030	2,690
COAL RUN ABOVE BRUSH CREEK					
Upstream of mouth	3.6	740	1,155	1,370	1,910
At Perry Highway	2.8	590	920	1,095	1,525

* Data Not Available

Table 6 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CFS) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
COAL RUN ABOVE BRUSH CREEK (Cont..)					
Upstream of I-79	2.0	455	720	855	1,195
Approximately 0.25 miles downstream of Fox Run Road	1.2	300	475	570	795
Approximately 275 feet downstream of Old Farm Road	1.0	215	345	405	570
Approximately 400 feet upstream of Old Farm Road	0.4	140	225	265	375
Approximately 900 feet downstream of Northfield Road	0.2	75	120	140	200
COAL RUN ABOVE CONNOQUENESSING CREEK					
At the confluence with Connoquenessing Creek	6.4	1,580	2,300	2,630	3,430
CONNOQUENESSING CREEK					
At downstream corporate limits of the Township of Jackson	324.7	13,370	19,150	21,860	28,817
Above the confluence of Scholars Run	309.3	12,917	18,526	21,155	27,910
Above the confluence of Breakneck Creek	199.7	*	*	14,400	*
At downstream corporate limits of the Township of Forward	196.5	*	*	14,400	*
Above the confluence with Glade Run	148.4	*	*	11,700	*
At downstream corporate of the Township of Penn	136.5	*	*	11,700	*
Above Thorn Creek	93.8	*	*	8,700	*

* Data Not Available

Table 6 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CFS) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
CONNOQUENESSING CREEK (Cont..)					
At the corporate limits of the City of Butler	81.20	3,480	4,830	5,540	*
Above Bonnie Brook	46.30	2,170	3,040	3,480	4,900
At the downstream corporate limits of the Township of Center	44.10	*	*	3,500	*
Above the confluence of Stony Creek	20.80	*	*	1,400	*
GLADE RUN					
At a point approximately 2,270 feet downstream of private road	11.48	1,320	2,210	2,710	4,240
At a point approximately 550 feet upstream of the confluence of Tributary 3	8.38	1,130	1,890	2,300	3,500
At a point approximately 1,850 feet upstream of the confluence of Tributary 4	4.03	670	1,080	1,290	1,880
LITTLE BULL CREEK					
At the downstream corporate limits of the Township of Buffalo	3.88	960	1,630	2,000	3,030
LITTLE CONNOQUENESSING CREEK					
At the confluence with Connoquenessing Creek	64.50	*	*	7,800	*
SCHOLARS RUN					
At the confluence with Connoquenessing Creek	7.10	*	*	1,800	*
SHANKS HOLLOW RUN					
At the confluence with Sullivan Run	2.50	890	1,270	1,420	1,850

* Data Not Available

Table 6 – Summary of Discharges (Continued)

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CFS) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
SHEARER RUN					
At approximately 0.1 mile from confluence with Connoquenessing Creek	1.2	430	670	790	1,100
SOUTH BRANCH BEAR CREEK					
At downstream corporate limits of the Borough of Petrolia	9.9	*	*	2,120	*
At confluence with unnamed tributary	8.9	*	*	1,830	*
SULLIVAN RUN					
At the confluence with Connoquenessing Creek	6.3	2,100	3,000	3,350	4,300
Above Shore Street	5.3	1,700	2,450	2,800	3,600
Above Shanks Hollow	2.5	800	1,140	1,290	1,650

* Data Not Available

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables 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 in conjunction with the data shown on the FIRM.

Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. 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 is computed (Section 4.2), selected cross section locations are also shown on the FIRM (Exhibit 2). Unless specified otherwise, the hydraulic analyses for these studies were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations shown on the Flood Profiles and FIRM (Exhibits 1 and 2) are referenced to the North American Vertical Datum of 1988 (NAVD88).

Cross sections for the flooding sources studied by detailed methods were obtained from field surveys. All bridges were field surveyed to obtain elevation data and structural geometry.

Pre-countywide Analyses

Cross section data for Bonnie Brook, Butcher Run, Coal Run above Connoquenessing Creek, Little Connoquenessing Creek, Scholars Run, Shanks Hollow Run, Shearer Run, and Sullivan Run were obtained by field measurement.

Cross section data for Buffalo Creek were obtained from topographic maps compiled from aerial photographs flown in November 1983 (Reference 30).

Within the City of Butler, cross section data for Connoquenessing Creek were obtained from plans of the USACE channelization and alignment project and from field surveys (Reference 31). All other municipalities used cross sections field surveyed for all portions of the Connoquenessing Creek outside the USACE alignment and improvement projects. All Connoquenessing Creek bridge openings were measured by field survey. Cross sections for the portions of Connoquenessing Creek outside the channel improvements were obtained by field measurement.

Cross section data for Glade Run were taken from field surveys and topographic maps compiled from aerial photographs (Reference 31). Further field checks were made if any information was questionable or if a reach required specific roughness inspection and evaluation.

Cross section data for Little Bull Creek were obtained from topographic maps (Reference 32).

Cross section data for South Branch Bear Creek were obtained by field measurement.

Starting water-surface elevations for Bonnie Brook were based at normal depth.

Starting water-surface elevations for Little Connoquenessing Creek, and Scholars Run were based on critical depth.

For Buffalo Creek, starting water-surface elevations were developed using a stage-discharge rating curve, assuming normal flow on the Allegheny River. The resulting profiles on Buffalo Creek were much lower than the Allegheny River levels at the confluence, so the Allegheny River backwater elevations were adopted for the final flood elevations on Buffalo Creek throughout the Township of Buffalo. Flood profiles for were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for Butcher Run, Coal Run above Connoquenessing Creek, Shearer Run, South Branch Bear Creek and Sullivan Run were obtained by the standard slope-area method, with energy grade slopes taken from high and low water profiles, as outlined in the HEC-2 user’s manual (Reference 33).

Starting water-surface elevations for Connoquenesing Creek were developed from a backwater analysis downstream into the Township of Butler.

Starting water-surface elevations for Glade Run were obtained by extrapolation of profile computations initiated far enough downstream to assure convergence at the downstream corporate limits of the Township of Middlesex.

Starting water-surface elevations for Little Bull Creek were obtained by extrapolation of profile computations initiated far enough downstream to assure convergence at the downstream corporate limits of the Township of Buffalo.

Starting water-surface elevations for Shanks Hollow Run were determined by backwatering Sullivan Run.

Water-surface elevations of floods of the selected recurrence interval for Bonnie Brook, Butcher Run, Buffalo Creek, Coal Run above Connoquenessing Creek, Connoquenessing Creek, Glade Run, Little Bull Creek, Little Connoquenessing Creek, Scholars Run, Sullivan Run, Shanks Hollow Run, Shearer Run, and South Branch Bear Creek were computed using the USACE HEC-2 stepbackwater computer program (Reference 33). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence interval. All frequency profiles were derived on the assumptions that stable channels are maintained and that vegetation does not markedly modify the roughness characteristics. Similarly, no allowance was made for any effects from ice jams or debris.

Countywide Analyses

GG3 completed new detailed hydraulic analysis for Allegheny River, Breakneck Creek, Brush Creek, and Coal Run Above Brush Creek.

The water surface elevations were computed by GG3 partners, Greenhorne & O'Mara, Inc. and Gannet Fleming, Inc., using the USACE Hydrologic Engineering Centers River Analysis System (HEC-RAS) computer program (Reference 34). The HEC-RAS model is based on cross section geometry generated using manual and semi-automated methods derived from GIS techniques and data.

The new detailed analysis along Allegheny River is approximately 2,000 feet long from the approximately the Clarion/Venango County border, to the border of the Township of Allegheny and the Armstrong County boundary. The analysis along Breakneck Creek extended from its confluence with the Connoquenessing Creek in the Township of Jackson up to a point approximately 850 feet upstream of Myoma Road in Adams Township. The analysis along Brush Creek extends from the downstream limits at the Beaver County/Butler County boundary to the upstream limits at the Allegheny County/Butler County boundary. The Coal Run above Brush Creek analysis extends from its confluence with Brush Creek to a point immediately downstream of Northfield Road in the Township of Cranberry.

Cross section elevations were extracted from a Digital Terrain Model (DTM) and field surveyed channel geometry along Connoquenessing Creek. The DTM was generated by combining overbank elevation data from PAMAP LiDAR (Reference 35) with data from traditional field survey of the stream channel and its immediate overbank areas. All bridges, culverts, dams, and other hydraulic obstructions were field surveyed to provide data on elevation, orientation, and structural geometry. All field survey data for structures and stream channels was provided by GG3 partner Gannett Fleming, Inc., Camp Hill, Pennsylvania.

The HEC-RAS computer program allows the use of an “ineffective flow” boundaries within a modeled cross section to distinguish areas of ponding or backwater from areas of active flow that contribute to the conveyance of flooding along the floodplain. As part of the modeling process, preliminary water-surface elevations calculated using HEC-RAS were delineated on the DTM using GIS software. This process helped identify natural areas of ineffective flow, which were defined as ineffective flow areas in subsequent runs of the HEC-RAS model.

The HEC-RAS models for all streams were not calibrated to historic events because high-water elevation information was not available.

A streamline was derived using PAMAP orthoimagery. This serves as a base line to define distances along the stream channel as indicated on the Flood Profile and the Floodway Data Tables. Selected cross sections used in the hydraulic analysis are located on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2) relative to distances along this base line.

Manning’s values used for the analysis were estimated based on a field reconnaissance conducted by Gannett Fleming, Inc. and supplemented by aerial photography and 2006 National Land Use Dataset (Reference 35) in extended overbank areas of cross sections. Overbank manning’s “n” values range from ponding areas with “n” equaling 0.040 to dense brush and forested areas with “n” equaling 0.12. Typical channel manning’s “n” values range from 0.035 to 0.065.

As part of this countywide FIS, the 1-percent-annual-chance flood elevations for flooding sources studied with approximate methods were determined using USGS Regression Equations (Reference 29) and the USACE HEC-RAS computer program (Reference 33). The peak flood discharges from the regression equations were input into a HEC-RAS model that included cross sections extracted from PAMAP LiDAR. Because this cross section information was not supplemented with field survey data and the models did not include bridge and culvert information, the resulting floodplain boundaries are considered approximate. Approximately 541 stream miles in the County were analyzed using this approach.

Channel and overbank roughness factors (Manning’s “n”) used in the hydraulic computations were estimated by engineering judgment and based on field observation at each cross section and adjusted with known high-water marks and stream gage rating curves where possible (Reference 36, 37, and 38). Table 7, “Manning’s “n” Values”, shows the channel and overbank “n” values for the streams studied by detailed methods.

Table 7 – Manning's "n" Values

Stream	Channel "n"	Overbank "n"
Allegheny River	0.026 – 0.350	0.050 – 0.100
Bonnie Branch	0.045	0.080
Breakneck Creek	0.035 – 0.050	0.050 – 0.120
Brush Creek	0.050 – 0.055	0.065 – 0.120
Buffalo Creek	0.030	0.070
Butcher Run	0.020 – 0.040	0.07 – 0.100
Coal Run Above Brush Creek	0.060 – 0.065	0.040 – 0.120
Coal Run Above Connoquenessing Creek	0.060 – 0.065	0.040 – 0.120
Connoquenessing Creek		
(channelized section)	0.019 – 0.036	0.070 – 0.090
(above channelized section)	0.030 – 0.045	0.070 – 0.100
Glade Run	0.045	0.100
Little Bull Creek	0.040	0.080
Little Connoquenessing Creek	0.040	0.080
Scholars Run	0.045	0.080
Shanks Hollow Run	0.020 – 0.033	0.080
Shearer Run	0.040 – 0.060	0.100
South Branch Bear Creek	0.045 – 0.050	0.080
Sullivan Run	0.030 – 0.035	0.080 – 0.100

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

Benchmarks catalogued by the NGS and entered into the NSRS vary widely in vertical stability classification. NSRS vertical stability classifications are as follows:

- Stability A: Monuments of the most reliable nature, expected to hold position/elevation (e.g. mounted in bedrock)
- Stability B: Monuments which generally hold their position/elevation (e.g. concrete bridge abutment)
- Stability C: Monuments which may be affected by surface ground movements (e.g. concrete monument below frost line)
- Stability D: Mark of questionable or unknown vertical stability (e.g. concrete monument above frost line, or steel witness post)

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

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

It is important to note that temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

3.3 Vertical Datum

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

Flood elevations shown in this FIS report and on the FIRM are referenced to the NAVD88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Some of the data used in this revision were taken from the prior effective FIS reports and FIRMs and adjusted to NAVD88. The datum conversion factor from NGVD29 to NAVD88 in Butler County is **-0.47 feet**. The data points used to determine the conversion are listed in Table 8, "Vertical Datum Conversion".

Table 8 – Vertical Datum Conversion

USGS 7.5-minute Quadrangle Name	Corner	Latitude (Decimal Degrees)	Longitude (Decimal Degrees)	Conversion from NGVD29 to NAVD88 (feet)
Grove City	SE	80.000	41.125	-0.404 feet
Barkeyville	SE	79.875	41.125	-0.469 feet
Eau Claire	SE	79.750	41.125	-0.518 feet
Harlansburg	SE	80.125	41.000	-0.427 feet
Slippery Rock	SE	80.000	41.000	-0.410 feet
West Sunbury	SE	79.875	41.000	-0.436 feet
Hilliards	SE	79.750	41.000	-0.548 feet
Portersville	SE	80.125	40.875	-0.446 feet
Prospect	SE	80.000	40.875	-0.443 feet
Mount Chestnut	SE	79.875	40.875	-0.476 feet
East Butler	SE	79.750	40.875	-0.518 feet
Zelienople	SE	80.125	40.750	-0.472 feet
Evans City	SE	80.000	40.750	-0.469 feet
Butler	SE	79.875	40.750	-0.479 feet
Saxonburg	SE	79.750	40.750	-0.505 feet
			AVERAGE	**-0.468 feet**

For additional information regarding conversion between the NGVD29 and NAVD88, visit the National Geodetic Survey (NGS) website at www.ngs.noaa.gov, or contact the National Geodetic Survey at the following address:

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

Temporary vertical monuments are often established during the preparation of a flood hazard analysis for the purpose of establishing local vertical control. Although these monuments are not shown on the FIRM, they may be found in the Technical Support Data Notebook associated with the FIS report and FIRM for this community. Interested individuals may contact FEMA to access these data.

To obtain current elevation, description, and/or location information for benchmarks shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

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

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent-annual-chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent-annual-chance flood is employed to indicate additional areas of flood risk in the community. For each stream studied by detailed methods, the 1- and 0.2-percent-annual-chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. The boundaries were interpolated between cross sections using digital terrain models developed from PAMAP LiDAR data collected in 2006.

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

For the streams studied by approximate methods, only the 1-percent-annual-chance floodplain boundary is shown on the FIRM (Exhibit 2). The boundary of the 1-percent-annual-chance floodplain was delineated using digital terrain models developed from PAMAP LiDAR data collected in 2006.

4.2 Floodways

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

The floodways presented in this study were computed for certain stream segments on the basis of equal-conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (see Table 9, "Floodway Data"). In cases where the floodway and 1-percent-annual-chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

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

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 9 for certain downstream cross sections of Breakneck Creek, Buffalo Creek, and Sullivan Run 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.

Encroachment into areas subject to inundation by floodwaters having hazardous velocities aggravates the risk of flood damage and heightens potential flood hazards by further increasing velocities. A listing of stream velocities at selected cross sections is provided in Table 9, "Floodway Data". 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.

No floodways were computed for Bonnie Brook, Buffalo Creek, Little Connoquenessing Creek, Scholars Run, and South Branch Bear Creek.

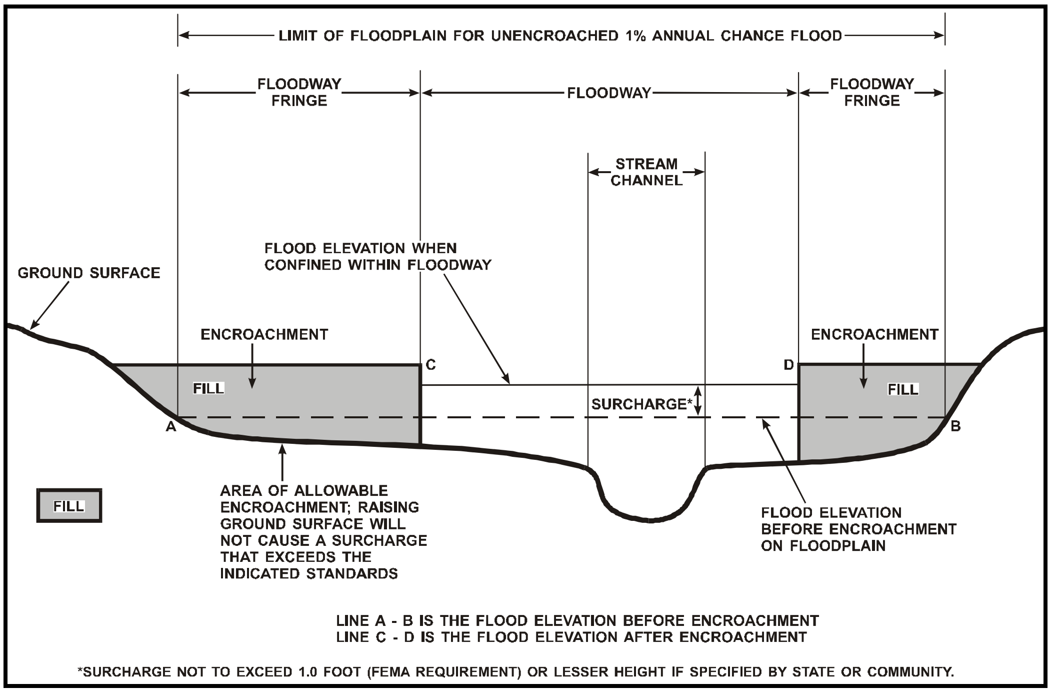


Figure 1 – Floodway Schematic

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
ALLEGHENY RIVER								
A	467,902[1]	316/544[3]	15,655	9.7	883.1	883.1	883.4	0.3
BREAKNECK CREEK								
A	268[2]	330	2,010	4.0	913.1	910.2[4]	910.2[4]	0.0
B	1,124[2]	358	2,723	2.9	913.1	912.9[4]	913.0[4]	0.1
C	1,965[2]	457	3,659	2.2	913.5	913.5	913.9	0.4
D	3,883[2]	199	1,937	4.1	915.6	915.6	916.1	0.5
E	5,951[2]	237	2,103	3.8	917.7	917.7	918.6	0.9
F	7,433[2]	191	2,169	3.7	919.1	919.1	919.9	0.8
G	11,512[2]	394	3,378	2.4	924.7	924.7	925.6	0.9
H	15,573[2]	330	1,654	4.3	931.4	931.4	932.3	0.9
I	16,957[2]	406	1,687	4.2	934.9	934.9	935.5	0.6
J	18,993[2]	190	1,962	3.6	942.5	942.5	943.1	0.6
K	20,101[2]	121	1,465	4.7	947.3	947.3	948.0	0.7
L	21,217[2]	113	1,609	4.3	950.8	950.8	951.3	0.5
M	22,631[2]	249	3,355	2.1	951.4	951.4	952.3	0.9

[1] Feet above confluence with Ohio River

[2] Feet above confluence with Connoquenessing Creek

[3] Width/Width within county

[4] Elevations computed without consideration of backwater effects from Connoquenessing Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA (ALL JURISDICTIONS)

FLOODWAY DATA

ALLEGHENY RIVER AND BREAKNECK CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
BREAKNECK CREEK (cont.)								
N	23,855	217	3,151	2.2	953.7	953.7	954.5	0.8
O	26,638	307	3,511	1.8	957.1	957.1	958.0	0.9
P	28,039	196	2,123	3.1	957.3	957.3	958.2	0.8
Q	32,172	440	3,925	1.6	960.5	960.5	961.4	0.9
R	33,518	398	3,376	1.8	961.8	961.8	962.7	0.9
S	34,943	625	4,553	1.2	962.3	962.3	963.2	0.9
T	38,565	390	2,490	2.1	967.8	967.8	968.5	0.7
U	41,061	246	1,870	2.6	971.0	971.0	971.7	0.7
V	42,962	367	2,074	2.4	972.7	972.7	973.6	0.9
W – AM*								

[1] Feet above confluence with Connoquenessing Creek

* Floodway Data Not Available

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA
(ALL JURISDICTIONS)

FLOODWAY DATA

BREAKNECK CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
BRUSH CREEK								
A	43[1]	168	1,542	4.0	975.6	975.6	976.3	0.7
B	6,003[1]	176	1,724	3.0	986.1	986.1	986.9	0.8
C	9,043[1]	566	3,556	1.5	987.4	987.4	988.4	1.0
D	20,561[1]	182	1,281	3.5	1,008.9	1,008.9	1,009.7	0.8
E	28,619[1]	448	1,328	1.8	1,022.7	1,022.7	1,023.0	0.3

[1] Feet above Beaver County boundary

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA
(ALL JURISDICTIONS)

FLOODWAY DATA

BRUSH CREEK

FLOODING SOURCE		FLOODWAY			1-PERCENT-ANNUAL-CHANCE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY (FEET NAVD88)	WITHOUT FLOODWAY (FEET NAVD88)	WITH FLOODWAY (FEET NAVD88)	INCREASE (FEET)
COAL RUN ABOVE BRUSH CREEK								
A	1,530[1]	314	1,094	1.3	1,012.5	1,012.5	1,012.7	0.2
B	2,786[1]	143	423	3.2	1,014.7	1,014.7	1,015.0	0.3
C	7,134[1]	62	235	4.7	1,029.6	1,029.6	1,030.5	0.9
D	8,461[1]	77	329	2.6	1,036.3	1,036.3	1,036.4	0.1
E	11,529[1]	44	102	4.0	1,056.8	1,056.8	1,057.2	0.4
F	14,485[1]	13	30	4.6	1,085.2	1,085.2	1,085.8	0.6

[1] Feet above confluence with Brush Creek

TABLE 9

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA
(ALL JURISDICTIONS)

FLOODWAY DATA

COAL RUN ABOVE BRUSH RUN

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

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

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 0.2-percent-annual-chance floodplain, areas within the 0.2-percent-annual-chance floodplain, areas of 1-percent-annual-chance flooding where average depths are less than 1 foot, areas of 1-percent-annual-chance flooding where the contributing drainage area is less than 1 square mile (sq. mi.), and areas protected from the base flood by levees. No BFEs or 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 rate zones as described in Section 5.0 and, in the 1-percent-annual-chance floodplains that were studied by detailed methods, shows selected whole-foot BFEs or average depths. Insurance agents use 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 Luzerne County. Previously, separate Flood Hazard Boundary Maps (FHBMs) and/or FIRMs were prepared for each incorporated community with identified flood hazard areas and the unincorporated areas of the County. Historical map dates relating to pre-countywide maps prepared for each community are presented in Table 10, “Community Map History.”

COMMUNITY NAME	INITIAL NFIP MAP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Adams, Township of	September 13, 1974	May 7, 1976	April 17, 1989	
Allegheny, Township of	March 28, 1975	None	May 1, 1985	
Brady, Township of	October 25, 1974	September 3, 1975	June 19, 1985	
Bruin, Borough of	July 30, 1976	None	May 1, 1985	
Buffalo, Township of	September 20, 1974	August 27, 1976	January 18, 1984	July 5, 2001
Butler, City of	May 24, 1974	April 9, 1976	April 17, 1978	February 1, 1984
Butler, Township of	October 18, 1974	None	July 3, 1978	
Callery, Borough of	August 9, 1974	April 9, 1976	April 17, 1989	
Center, Township of	September 13, 1974	April 30, 1976	June 19, 1989	
Cherry, Township of	January 10, 1975	January 16, 1981	May 1, 1985	
Chicora, Borough of	June 14, 1974	April 9, 1976	August 10, 1979	
Clay, Township of	January 17, 1975	None	May 1, 1985	
Clearfield, Township of	January 10, 1975	None	April 17, 1985	
Clinton, Township of	January 10, 1975	None	December 11, 1981	
Concord, Township of	January 17, 1975	None	May 1, 1985	
Connoquenessing, Borough of	November 15, 1974	None	September 1, 1986	

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL NFIP MAP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Connoquenessing, Township of	November 15, 1974	None	September 1, 1986	
Cranberry, Township of	September 20, 1974	April 30, 1976	April 1, 1982	
Donegal, Township of	January 17, 1975	None	February 15, 1985	
East Butler, Borough of	July 26, 1974	July 16, 1976	March 18, 1991	
Evans City, Borough of	June 28, 1974	July 30, 1976	May 4, 1989	
Fairview, Township of	January 24, 1975	None	September 1, 1986	
Forward, Township of	September 13, 1974	April 16, 1976	June 19, 1989	
Franklin, Township of	January 24, 1975	None	February 15, 1985	
Harmony, Borough of	June 14, 1974	May 14, 1976	May 4, 1989	
Harrisville, Borough of	January 24, 1975	February 20, 1976	June 30, 1976	
Jackson, Township of	November 15, 1974	None	September 15, 1989	
Jefferson, Township of	November 1, 1974	June 25, 1976	February 15, 1985	
Karns City, Borough of	November 8, 1974	None	February 15, 1985	
Lancaster, Township of	September 6, 1974	May 7, 1976	May 1, 1986	
Marion, Township of	June 2, 1974	July 2, 1976	June 8, 1984	
Mars, Borough of	May 31, 1974	June 4, 1976	May 4, 1989	
Mercer, Township of	January 10, 1975	None	June 8, 1984	

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL NFIP MAP DATE	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	INITIAL FIRM DATE	FIRM REVISIONS DATE
Middlesex, Township of	July 26, 1974	July 2, 1976	December 1, 1983	
Muddy Creek, Township of	January 10, 1975	None	April 17, 1985	
Oakland, Township of	January 10, 1975	None	April 17, 1985	
Parker, Township of	September 20, 1974	July 16, 1976	September 1, 1986	
Penn, Township of	November 22, 1974	July 2, 1976	August 15, 1989	
Petrolia, Borough of	November 22, 1974	None	December 5, 1989	
Prospect, Borough of	January 17, 1975	None	February 15, 1985	
Saxonburg, Borough of	December 27, 1974	None	April 17, 1985	
Slippery Rock, Township of	October 8, 1976	None	September 1, 1986	
Summit, Township of	January 24, 1975	None	February 15, 1985	
Valencia, Borough of	November 22, 1974	None	May 4, 1989	
Venango, Township of	January 24, 1975	None	May 1, 1985	
Washington, Township of	September 13, 1974	May 21, 1976 July 18, 1980	February 15, 1985	
West Liberty, Borough of	November 1, 1974	None	September 1, 1986	
Winfield, Township of	July 26, 1974	August 27, 1976	May 1, 1986	
Worth, Township of	November 15, 1974	April 18, 1980	September 1, 1986	
Zelienople, Borough of	June 14, 1974	July 2, 1976	June 17, 1986	

TABLE 10

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA
(ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

7.0 OTHER STUDIES

This FIS report either supersedes or is compatible with all previous studies published on streams studied in this report and should be considered authoritative for the 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 Federal Insurance and Mitigation Division, FEMA Region III, One Independence Mall, Sixth Floor, 615 Chestnut Street, Philadelphia, PA 19106-4404.

9.0 BIBLIOGRAPHY AND REFERENCES

1. Federal Emergency Management Agency, Flood Insurance Study, Township of Adams, Butler County, Pennsylvania, Washington, D.C., April, 17, 1989.

2. Federal Emergency Management Agency, Flood Insurance Study, Township of Buffalo, Butler County, Pennsylvania, Washington, D.C., July 5, 2001.

3. Federal Emergency Management Agency, Flood Insurance Study, City of Butler, Butler County, Pennsylvania, Washington, D.C., February 1, 1984.

4. Federal Emergency Management Agency, Flood Insurance Study, Township of Butler, Butler County, Pennsylvania, Washington, D.C., January 1978.

5. Federal Emergency Management Agency, Flood Insurance Study, Borough of Callery, Butler County, Pennsylvania, Washington, D.C., April, 17, 1989.

6. Federal Emergency Management Agency, Flood Insurance Study, Township of Center, Butler County, Pennsylvania, Washington, D.C., June 19, 1989.

7. Federal Emergency Management Agency, Flood Insurance Study, Township of Cranberry, Butler County, Pennsylvania, Washington, D.C., October 1, 1981.

8. Federal Emergency Management Agency, Flood Insurance Study, Borough of East Butler, Butler County, Pennsylvania, Washington, D.C., March 18, 1991.

9. Federal Emergency Management Agency, Flood Insurance Study, Borough of Evans City, Butler County, Pennsylvania, Washington, D.C., May 4, 1989.

10. Federal Emergency Management Agency, Flood Insurance Study, Township of Forward, Butler County, Pennsylvania, Washington, D.C., June 19, 1989.

11. Federal Emergency Management Agency, Flood Insurance Study, Borough of Harmony, Butler County, Pennsylvania, Washington, D.C., May 4, 1989.

12. Federal Emergency Management Agency, Flood Insurance Study, Township of Jackson, Butler County, Pennsylvania, Washington, D.C., September 15, 1989.

13. Federal Emergency Management Agency, Flood Insurance Study, Borough of Mars, Butler County, Pennsylvania, Washington, D.C., May 4, 1989.

14. Federal Emergency Management Agency, Flood Insurance Study, Township of Middlesex, Butler County, Pennsylvania, Washington, D.C., June 1, 1983.

15. Federal Emergency Management Agency, Flood Insurance Study, Township of Penn, Butler County, Pennsylvania, Washington, D.C., August 15, 1989.

16. Federal Emergency Management Agency, Flood Insurance Study, Borough of Petrolia, Butler County, Pennsylvania, Washington, D.C., December 5, 1989.

17. Federal Emergency Management Agency, Flood Insurance Study, Borough of Valencia, Butler County, Pennsylvania, Washington, D.C., May 4, 1989.

18. Federal Emergency Management Agency, Flood Insurance Study, Borough of Zelienople, Butler County, Pennsylvania, Washington, D.C., June 17, 1986.

19. Wikipedia, Butler County, Pennsylvania. Retrieved on August 4, 2006 from http://en.wikipedia.org/wiki/Butler_County,_Pennsylvania.

20. U.S. Census Bureau, 2010 U.S. Census: Butler County, Pennsylvania. Retrieved on August 1, 2012 from http://2010.census.gov/

21. The Weather Channel, Monthly Averages for Butler County, Pennsylvania. Retrieved on August 1, 2012 from http://www.weather.com.

22. Commonwealth of Pennsylvania, Department of Internal Affairs, Topographic and Geologic Survey, Geologic Map of Pennsylvania, Harrisburg, Pennsylvania, 1960.

23. USGS Surface Water for USA: Peak Streamflow for the Nation, USGS Gaging Station No. 03106000 Connoquenessing Creek near Zelienople, PA in Beaver County, Pennsylvania, Retrieved on August 4, 2006 from http://nwis.waterdata.usgs.gov/nwis/peak?site_no=03106000&agency_cd=USGS&format=html.

24. U.S. Department of the Interior, Geological Survey, Water-Supply Paper 1675, Magnitude and Frequency of Floods in the United States, Part 3-A. Ohio River Basin Except Cumberland and Tennessee River Basins, Washington, D.C., U.S. Government Printing Office, 1965.

25. U.S. Army Corps of Engineers, Pittsburgh District, Butler Flood Protection Project, Connoquenessing Creek, Unit One and Unit Two, Pittsburgh, Pennsylvania, 1966.

26. U.S. Army Corps of Engineers, Pittsburgh District, "Untitled Regression Data," Pittsburgh, Pennsylvania, 1975.

27. U. S. Department of the Interior, Geological Survey, Office of Water Data Collection, Interagency Advisory Committee on Water Data, "Guidelines for Determining Flood

Flow Frequency," Bulletin 17B, Reston, Virginia, revised September 1981, revised March 1982.

28. U.S. Department of Agriculture, Soil Conservation Service, Technical Release No. 55, Urban Hydrology for Small Watersheds, Washington, D.C., January 1975.

29. U.S. Department of the Interior, Geological Survey, Scientific Investigations Report 2008-5102, Regression Equations for Estimating Flood Flows at Selected Recurrence Intervals for Ungaged Streams in Pennsylvania, by Mark A. Roland and Marla H. Stuckey, Reston, Virginia, 2008.

30. U.S. Department of the Interior, Geological Survey, Water Supply Paper 2207, Flood Characteristics of urban watersheds in the United States, by V.B. Sauer, V.A. Stricker Jr., and K.V. Wilson, Reston, Virginia, 1983.

31. Michael Baker, Jr., Inc., of Beaver, Pennsylvania, Topographic Maps compiled from aerial photographs, Scale 1:2,400, Contour Interval 4 Feet: Freeport, Pennsylvania, July 1984.

32. Kucera Associates of Menpor, Ohio, Topographic Maps compiled from aerial photographs, Scale 1:2,400, Contour Interval 4 Feet: Buffalo, Pennsylvania, 1981; Middlesex, Pennsylvania, April 21, 1980.

33. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973, revised April 1984, revised May 1991.

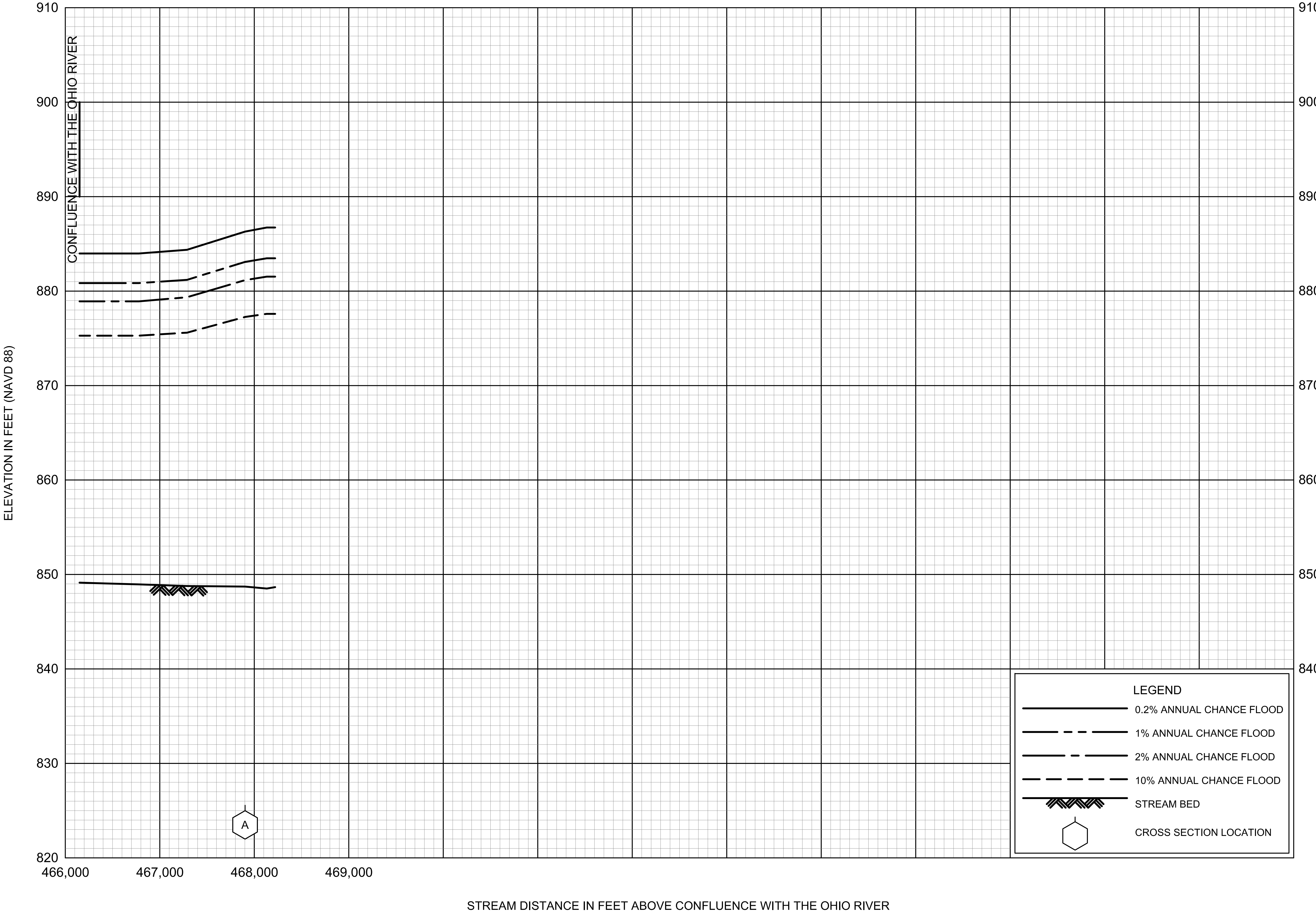
34. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-RAS River Analysis System Version 4.0.0, Davis, California, March 2008.

35. Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey, PAMAP Program, PAMAP Program LiDAR Processing/Contour Enhancement Lines of Pennsylvania, Middletown, Pennsylvania, April, 2006.

36. Ven Te Chow, ed., Handbook of Applied Hydrology, New York, McGraw-Hill Book Company, 1964.

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

38. U.S. Department of the Interior, Geological Survey, Water-Supply Paper 1849, Roughness Characteristics of Natural Channels, Washington, D.C., 1967.



FLOOD PROFILES

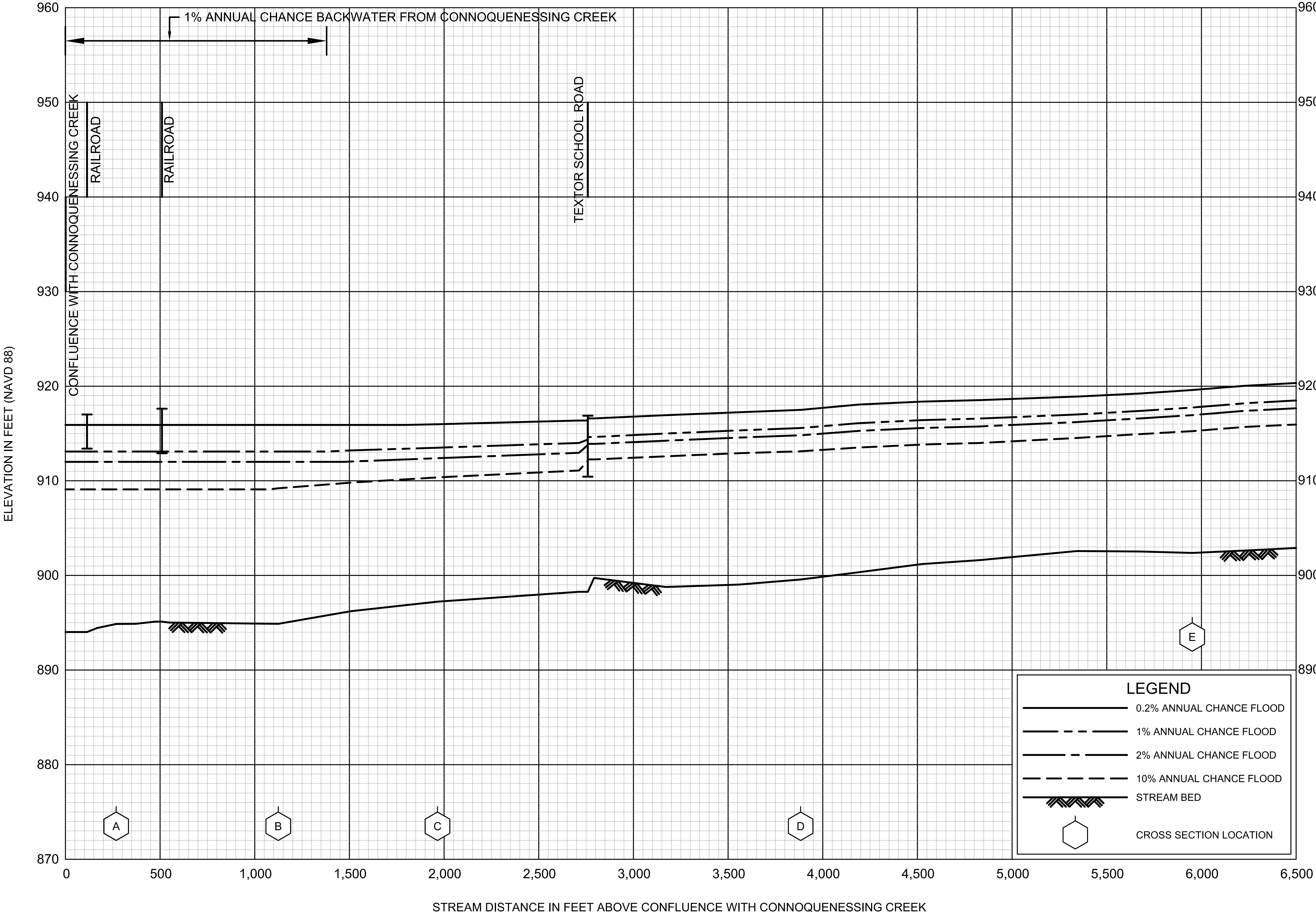
ALLEGHENY RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)

01P



FLOOD PROFILES

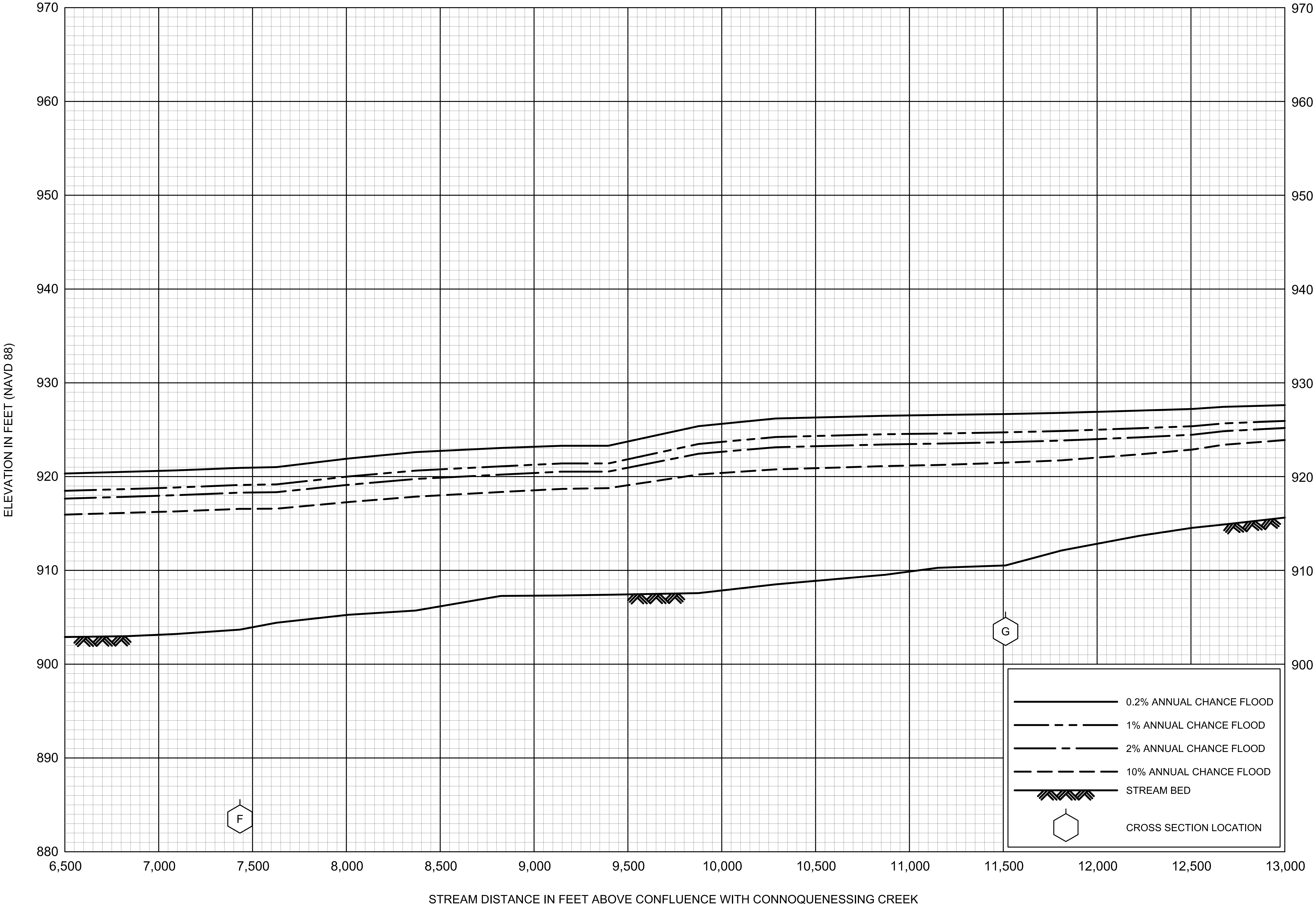
BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)

03P



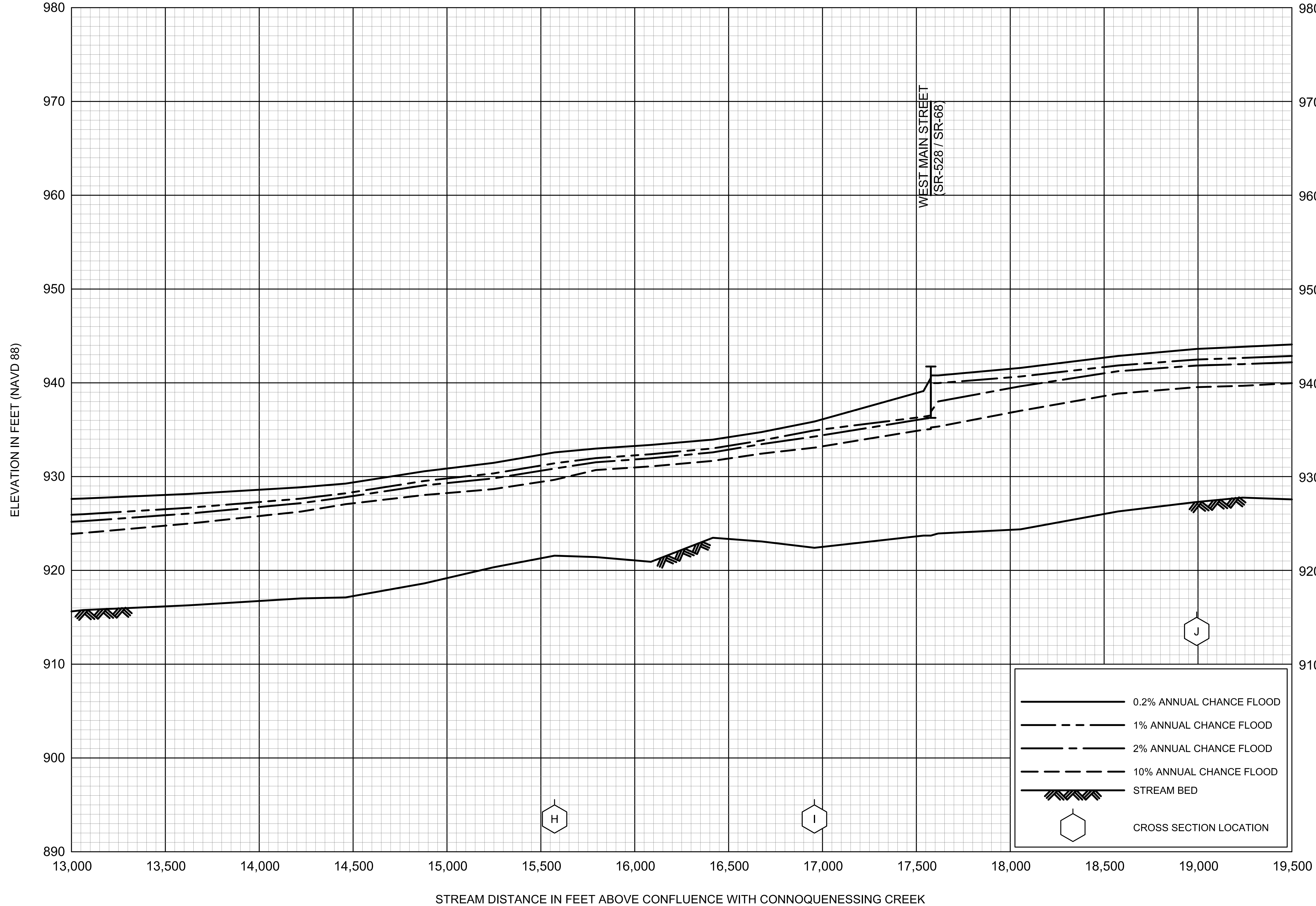
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



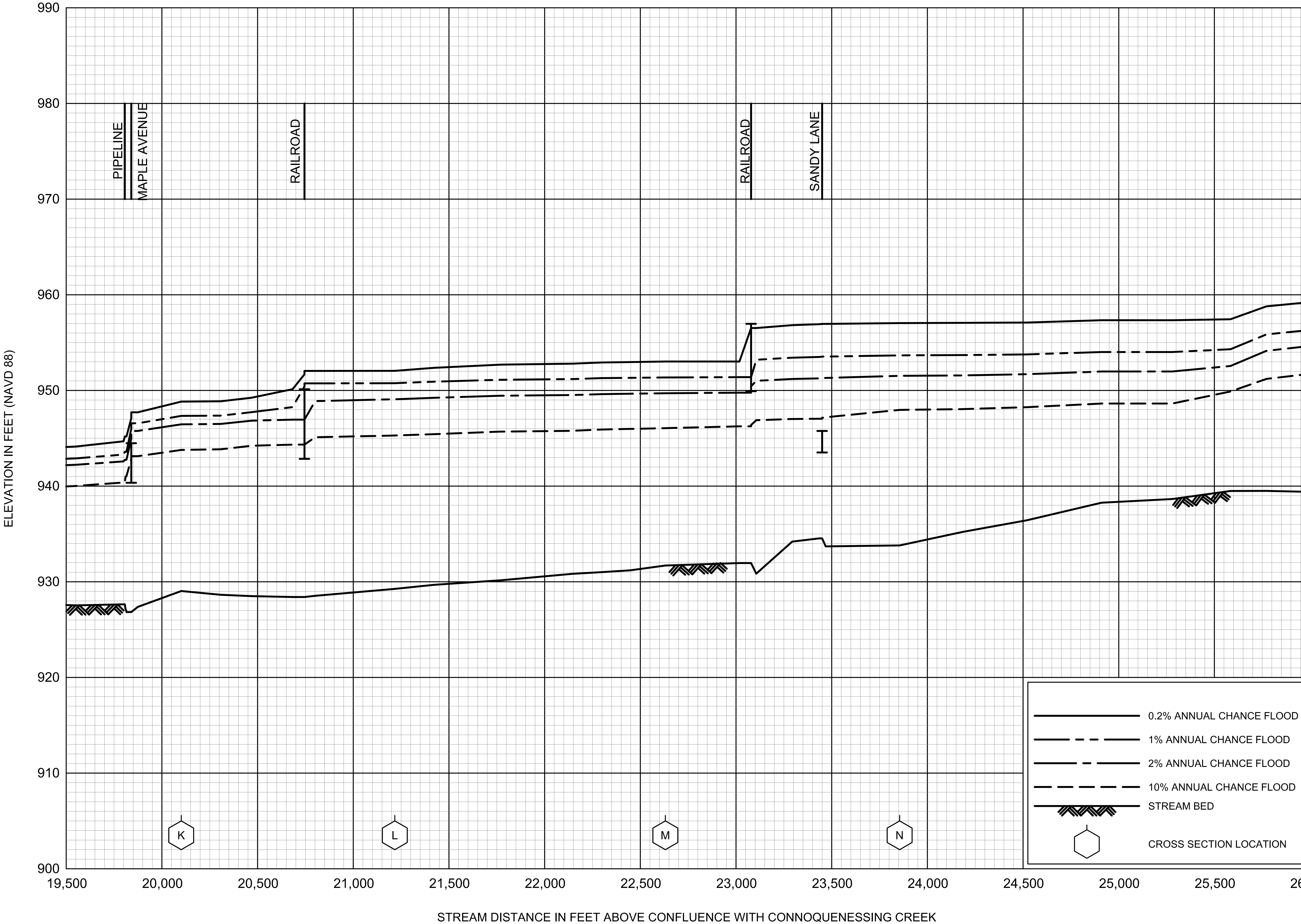
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

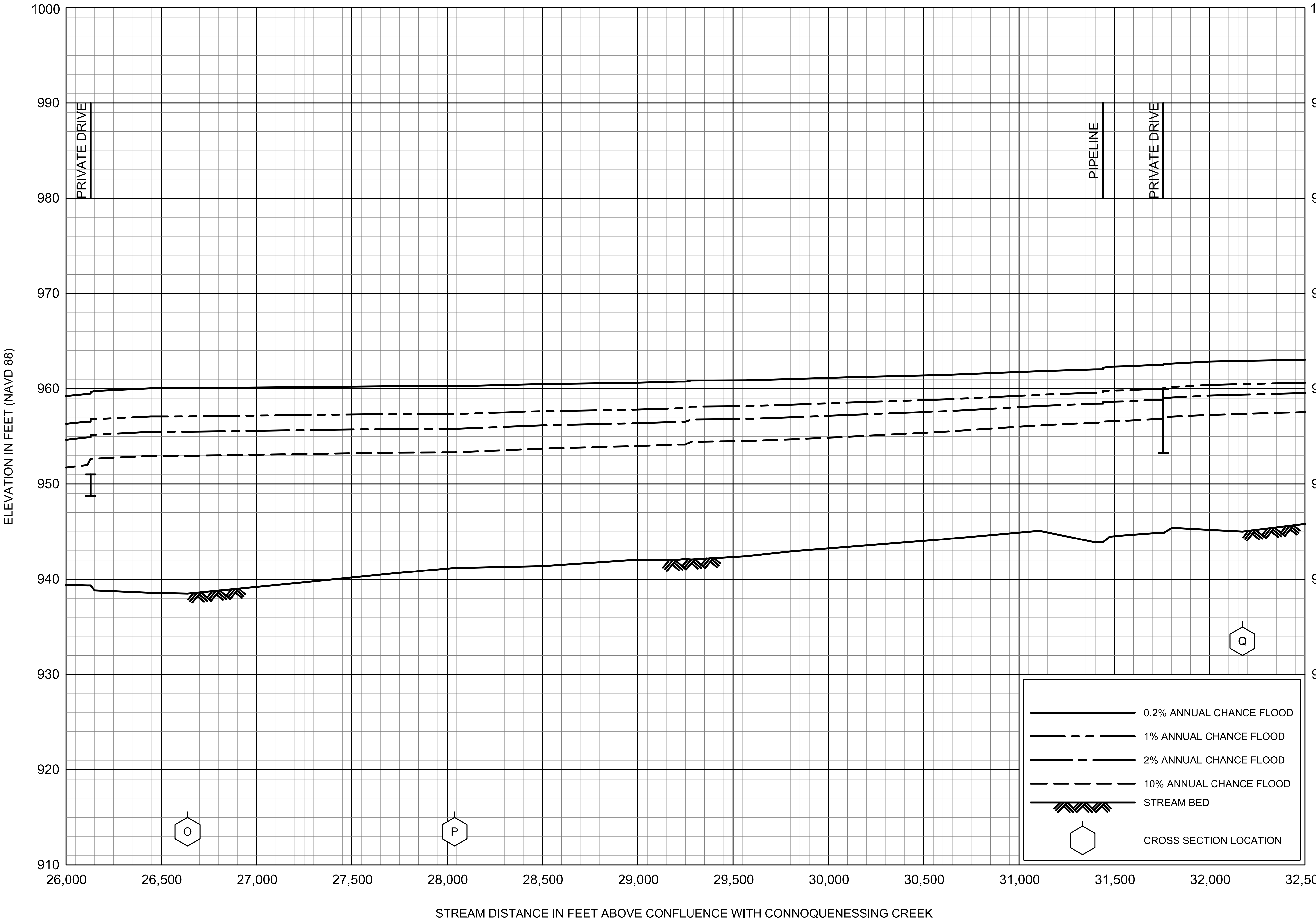
BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)

06P



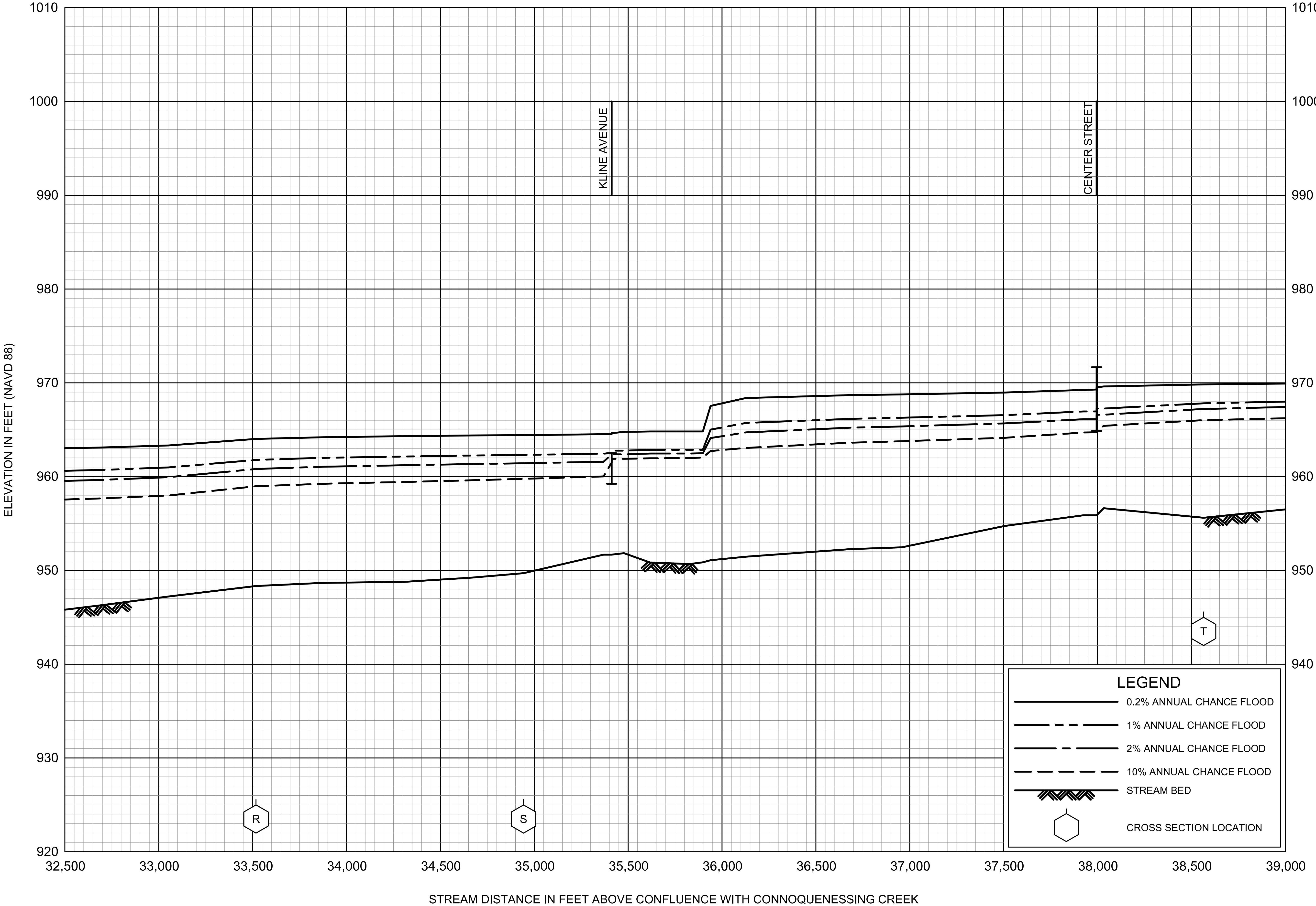
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

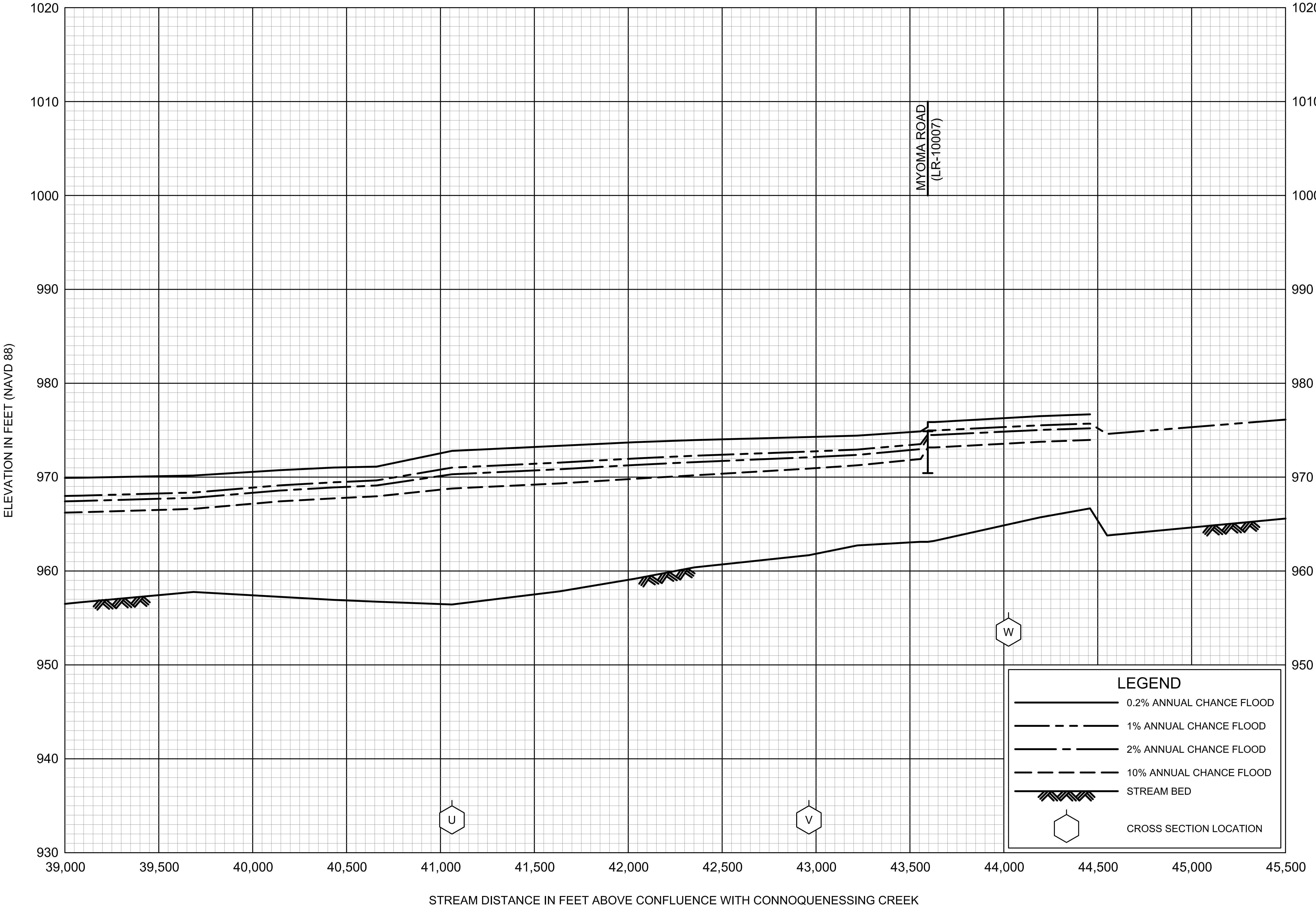
BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)

08P



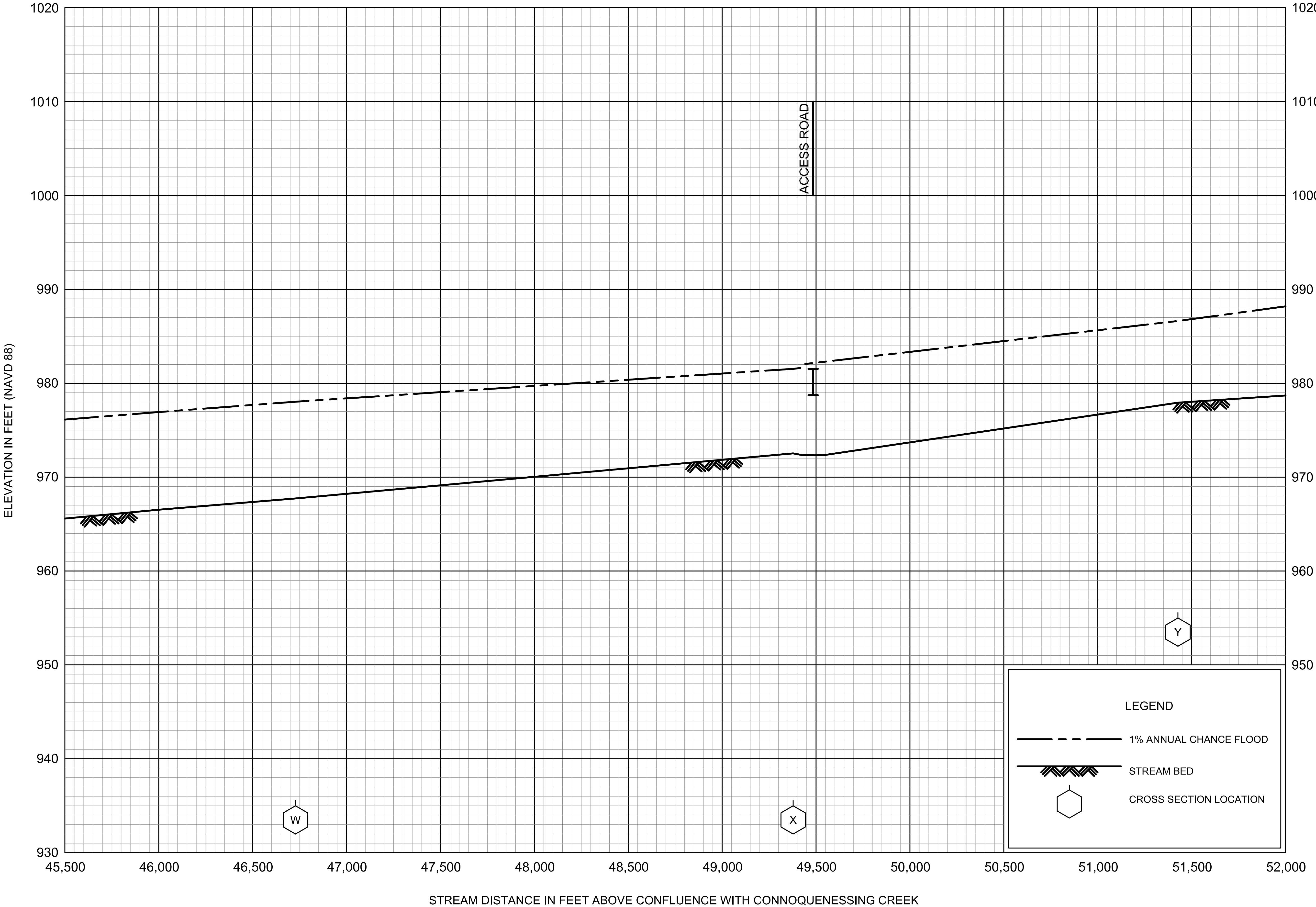
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

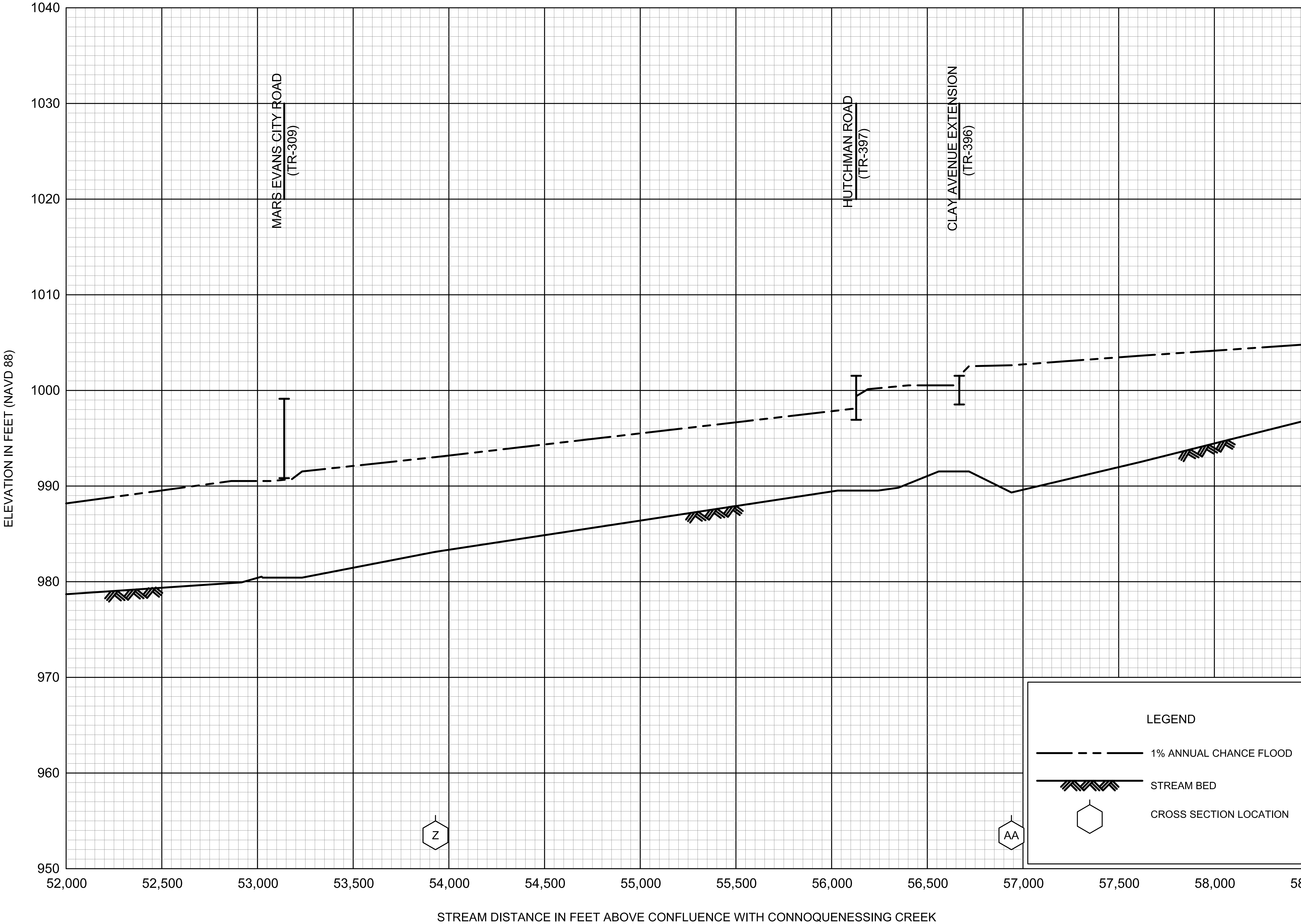
BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)

10P



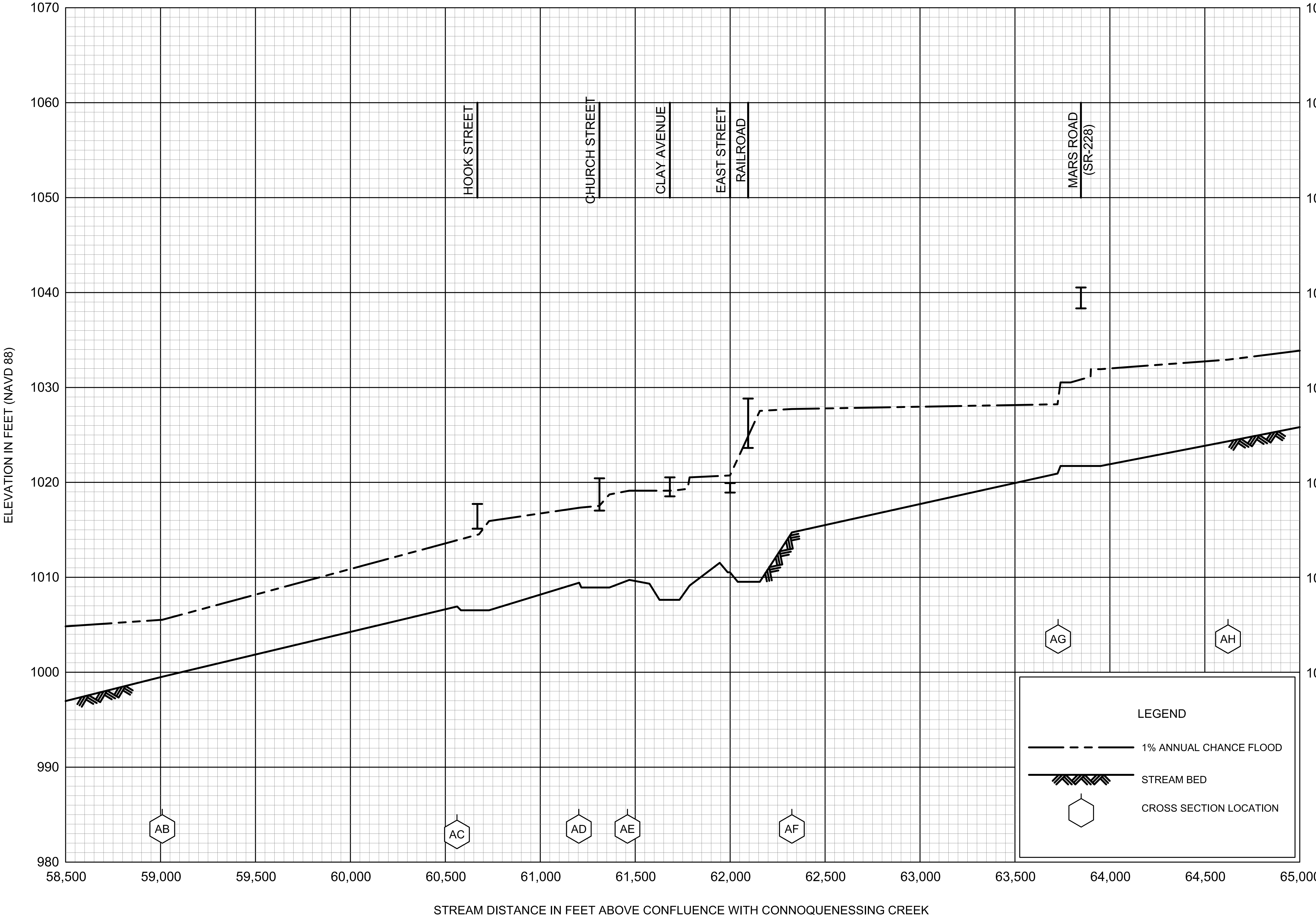
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



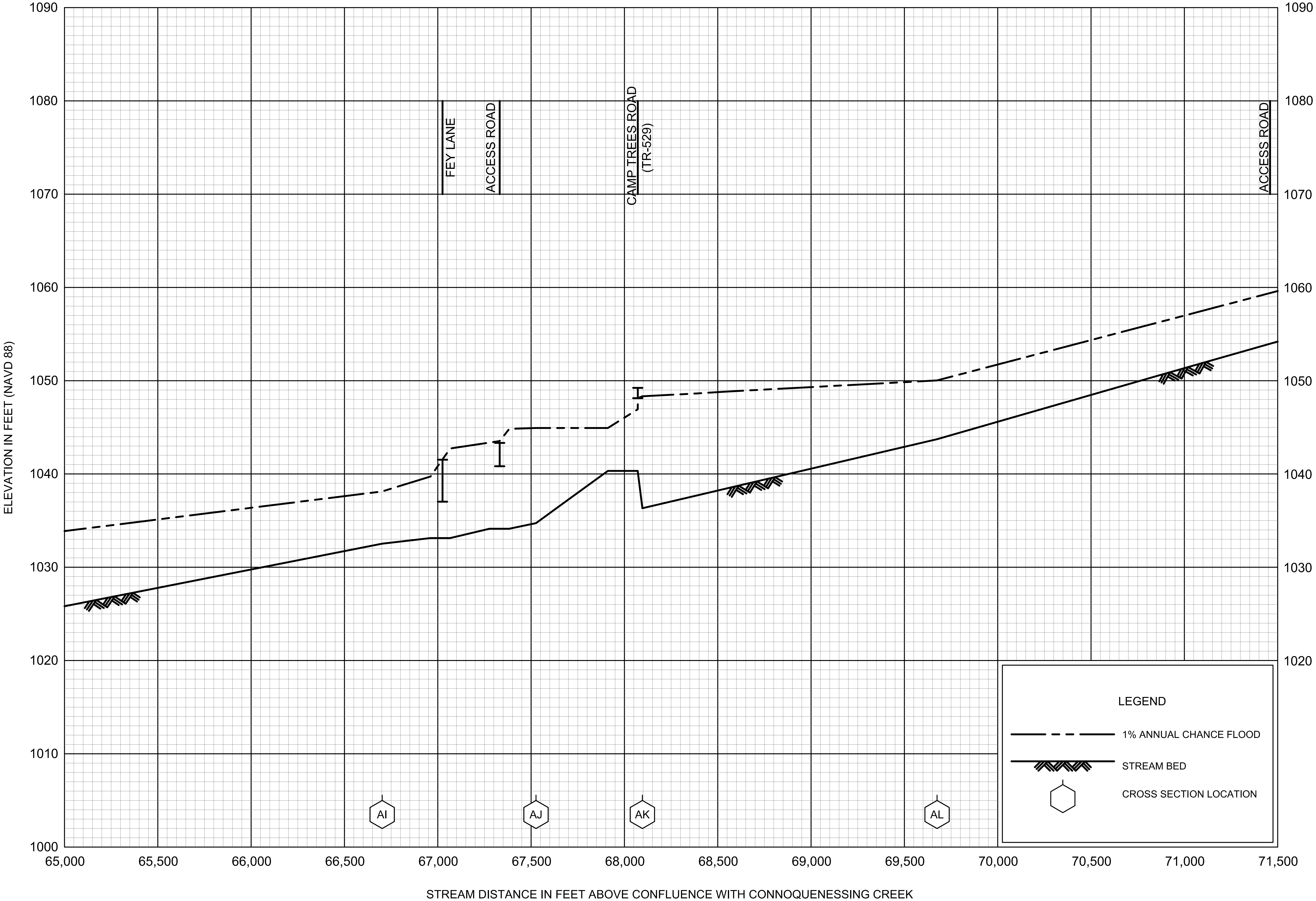
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



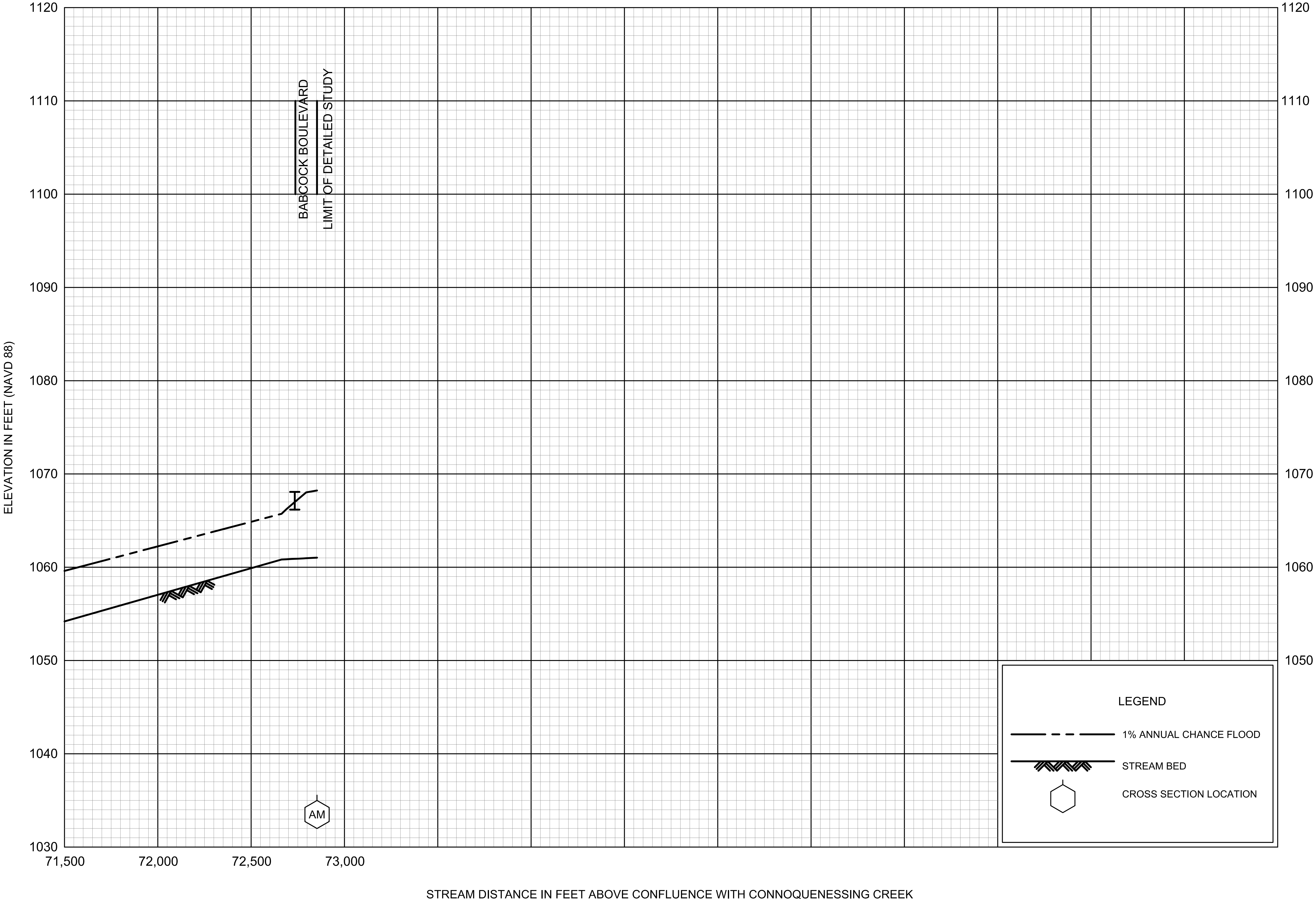
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



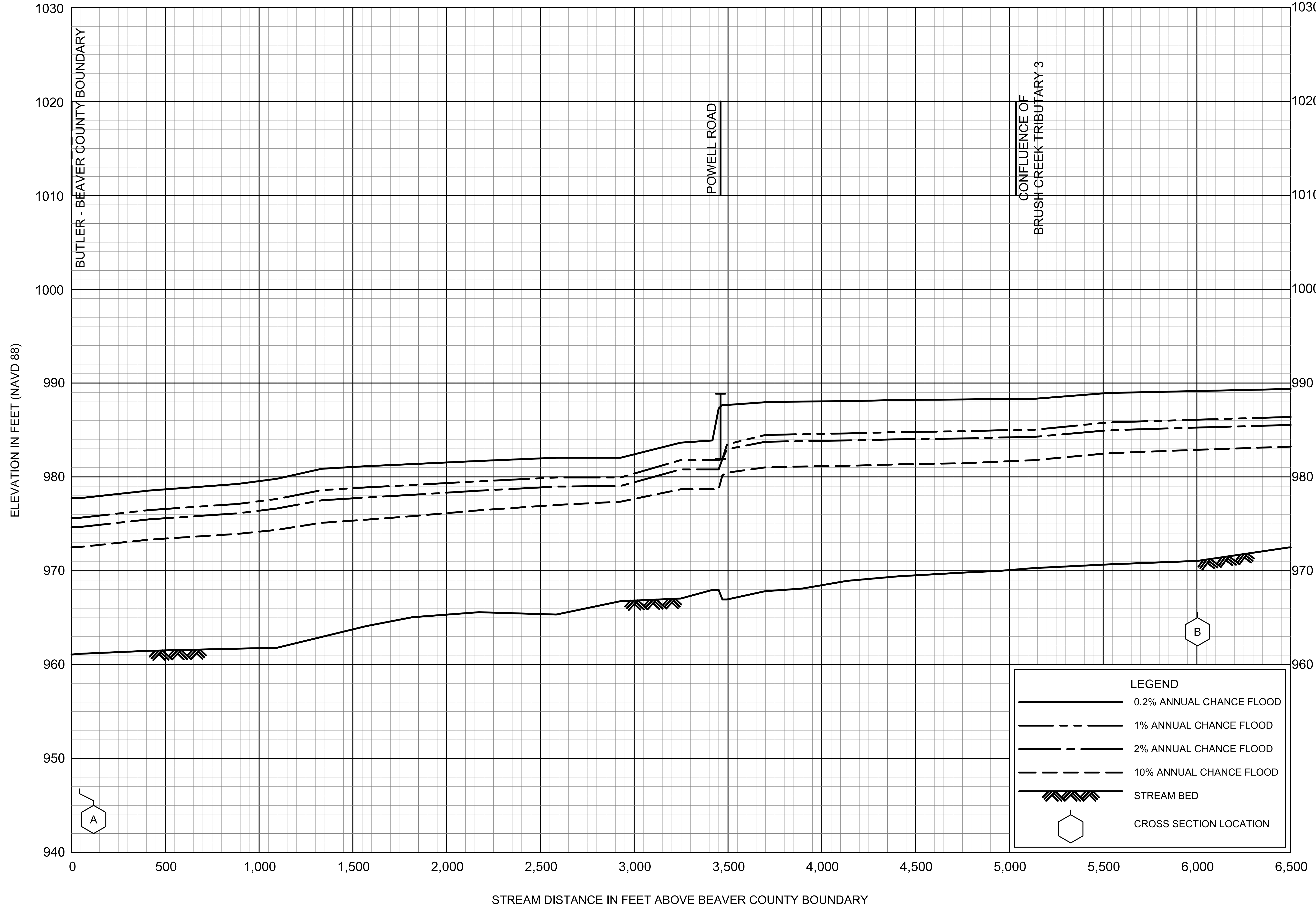
FLOOD PROFILES

BREAKNECK CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



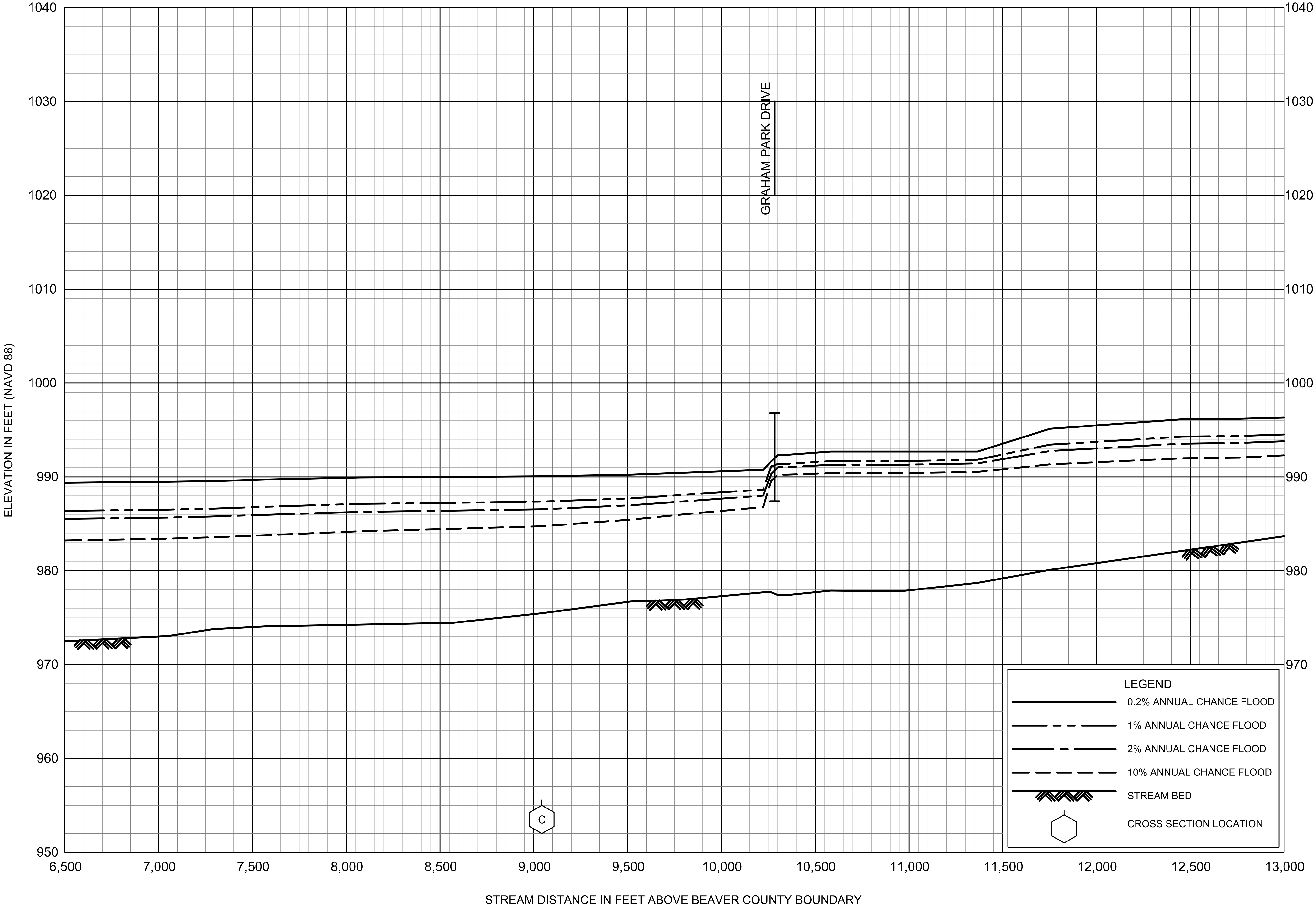
FLOOD PROFILES

BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

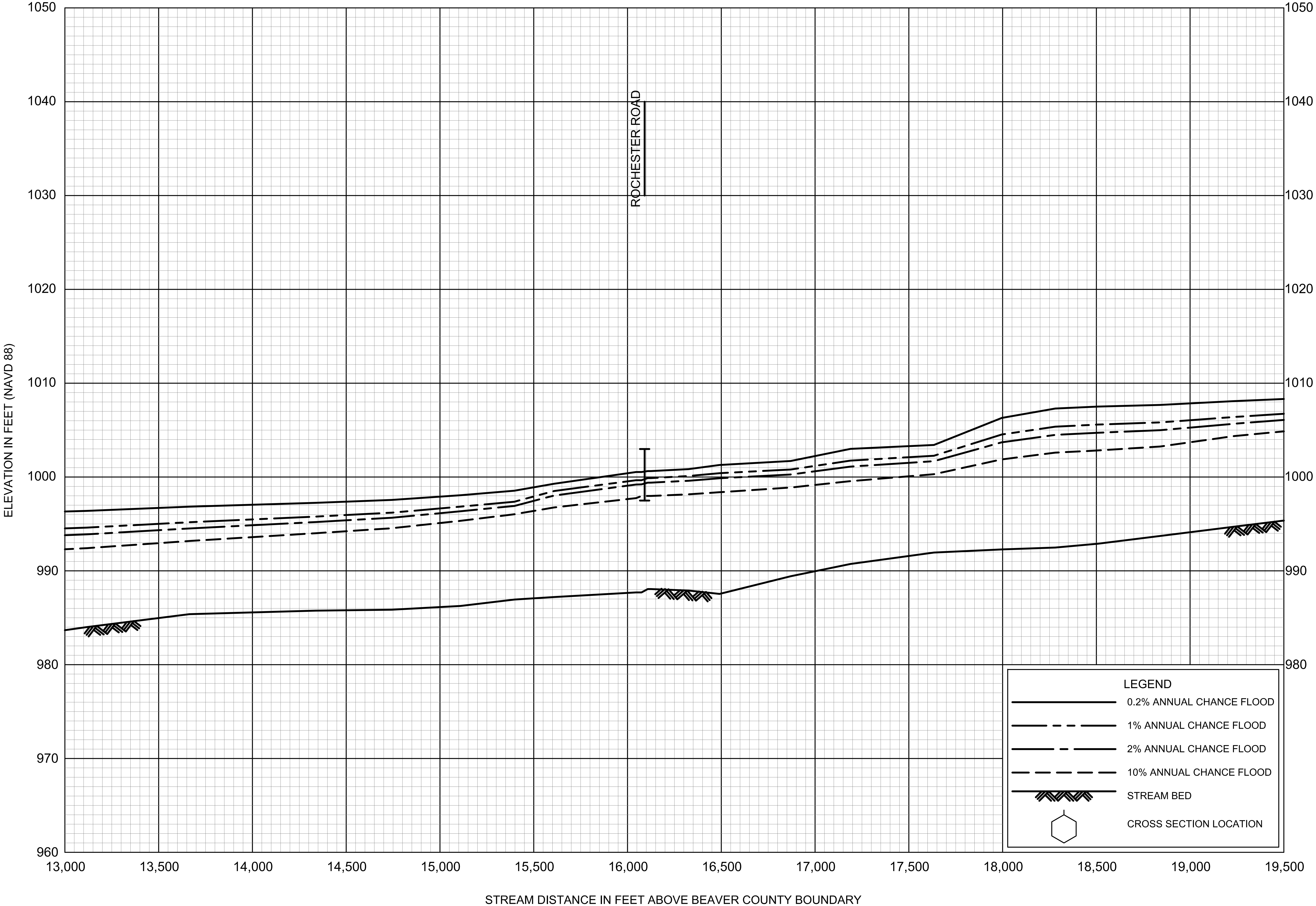
BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)

16P



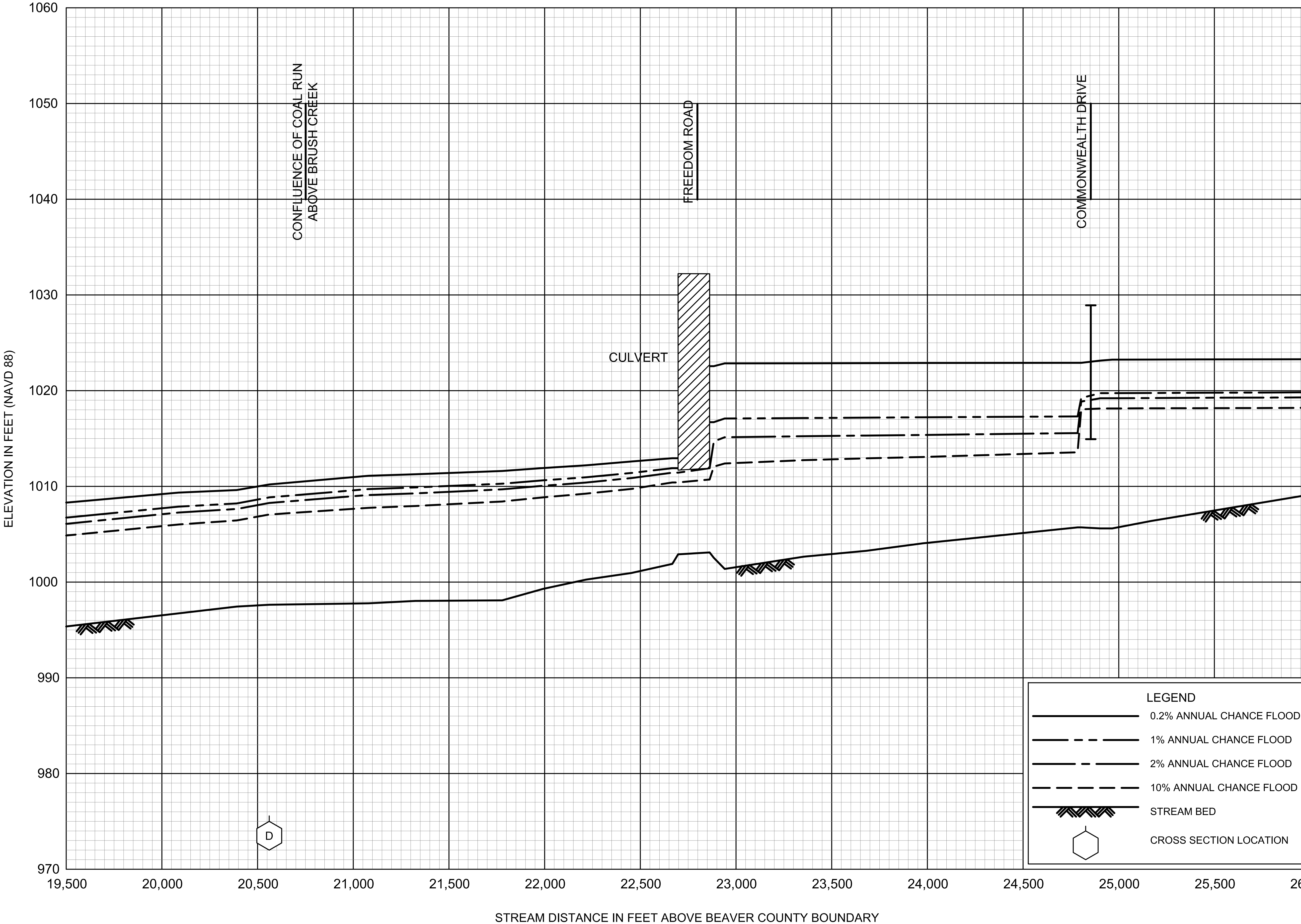
FLOOD PROFILES

BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



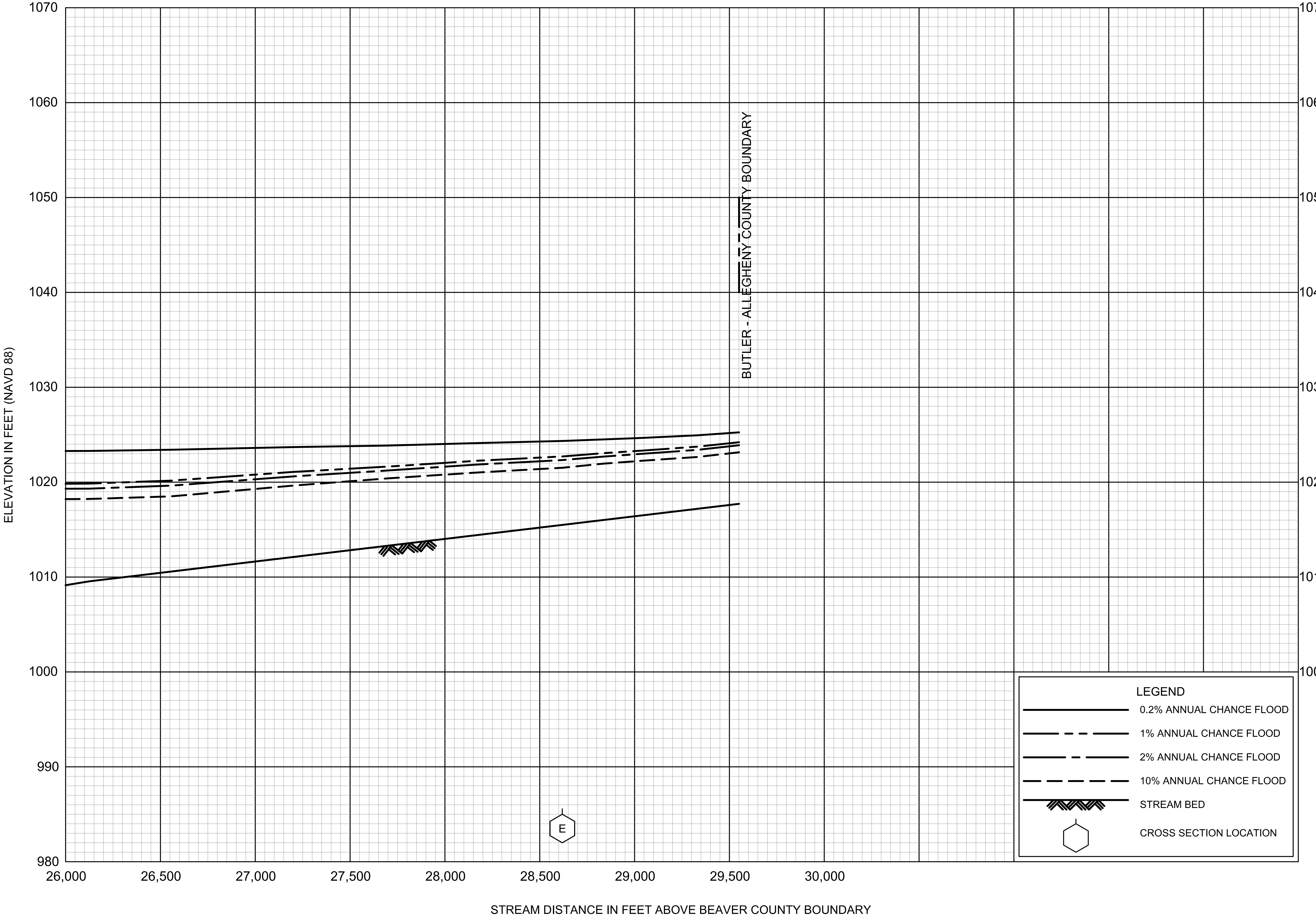
FLOOD PROFILES

BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



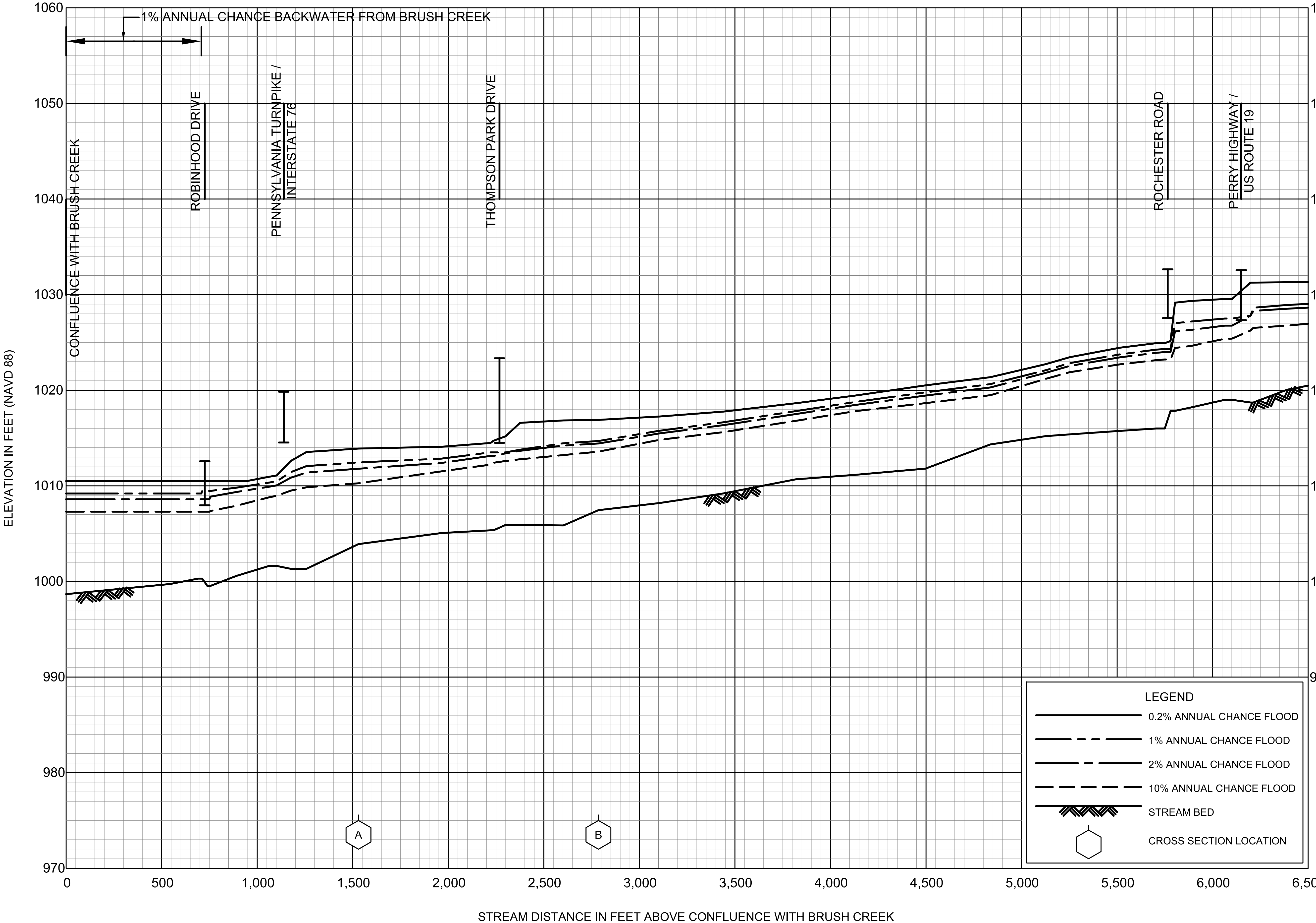
FLOOD PROFILES

BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



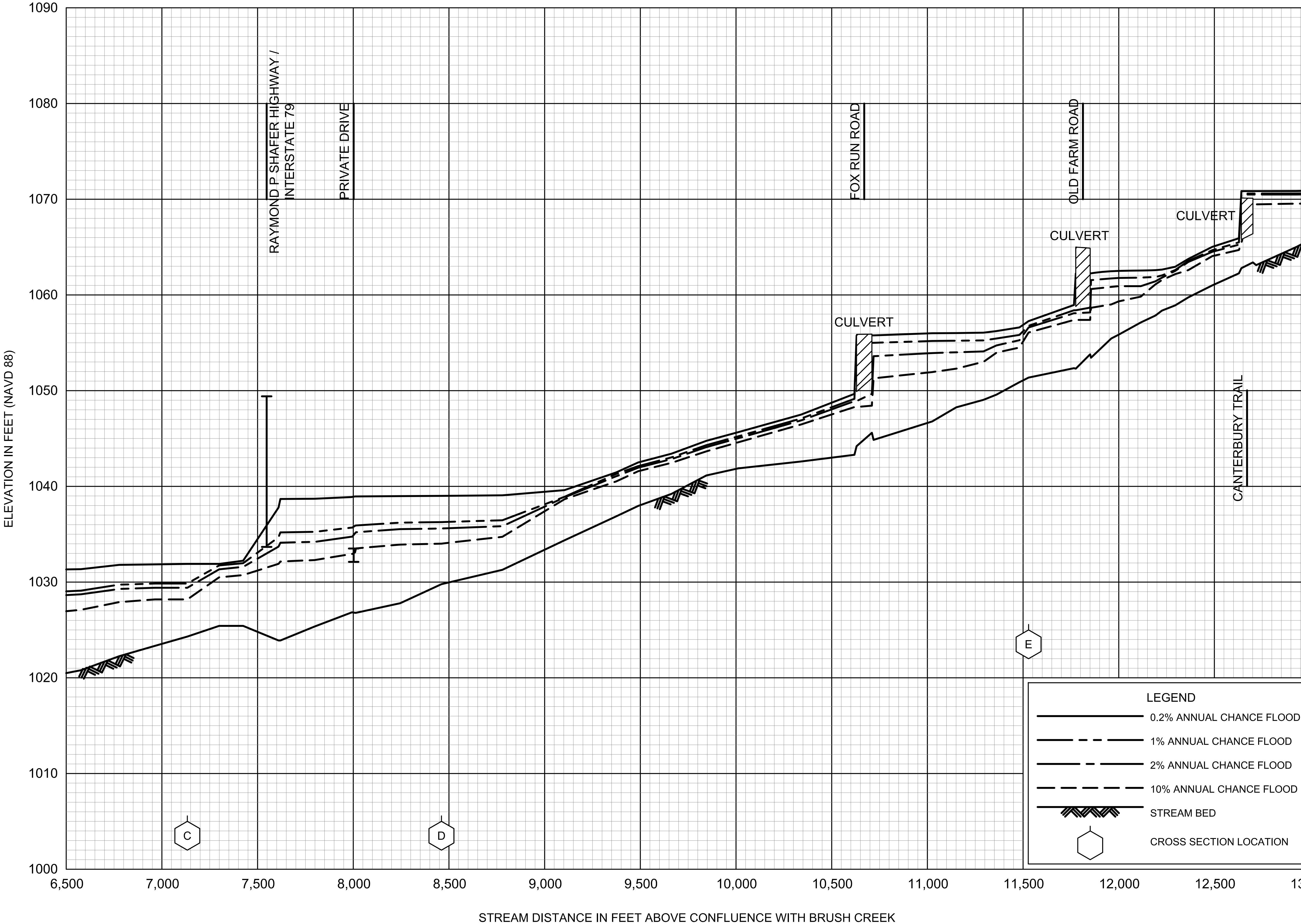
FLOOD PROFILES

COAL RUN ABOVE BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



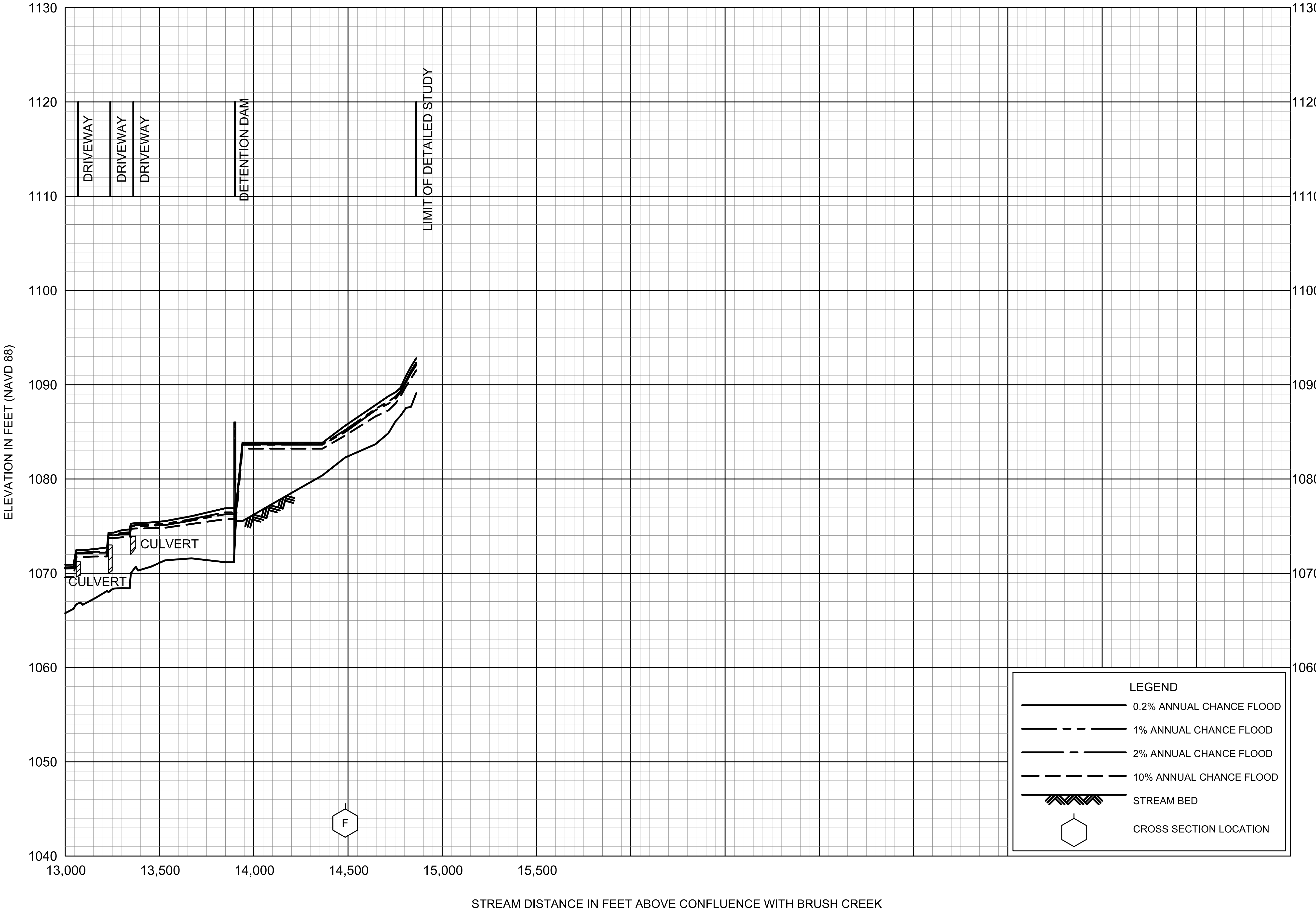
FLOOD PROFILES

COAL RUN ABOVE BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)



FLOOD PROFILES

COAL RUN ABOVE BRUSH CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

BUTLER COUNTY, PA

(ALL JURISDICTIONS)