FLOOD INSURANCE STUDY

VOLUME 1 OF 3

MIDDLESEX COUNTY, NEW JERSEY
(ALL JURISDICTIONS)

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

COMMUNITY NAME	COMMUNITY NUMBER	COMMUNITY NAME	COMMUNITY NUMBER
CARTERET, BOROUGH OF	340257	NORTH BRUNSWICK, TOWNSHIP OF	340271
CRANBURY, TOWNSHIP OF	340258	OLD BRIDGE, TOWNSHIP OF	340265
DUNELLEN, BOROUGH OF	340259	PERTH AMBOY, CITY OF	340272
EAST BRUNSWICK, TOWNSHIP OF	340260	PISCATAWAY, TOWNSHIP OF	340274
EDISON, TOWNSHIP OF	340261	PLAINSBORO, TOWNSHIP OF	340275
HELMETTA, BOROUGH OF	340262	SAYREVILLE, BOROUGH OF	340276
HIGHLAND PARK, BOROUGH OF	340263	SOUTH AMBOY, CITY OF	340277
JAMESBURG, BOROUGH OF	340264	SOUTH BRUNSWICK, TOWNSHIP OF	340278
METUCHEN, BOROUGH OF	340266	SOUTH PLAINFIELD, BOROUGH OF	340279
MIDDLESEX, BOROUGH OF	345305	SOUTH RIVER, BOROUGH OF	340280
MILLTOWN, BOROUGH OF	340268	SPOTSWOOD, BOROUGH OF	340282
MONROE, TOWNSHIP OF	340269	WOODBRIDGE, TOWNSHIP OF	345331
NEW BRUNSWICK, CITY OF	340270		

EFFECTIVE:

PRELIMINARY JANUARY 31, 2014

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
34023CV001B

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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

Initial Countywide FIS Effective Date: July 6, 2010

Revised Countywide FIS Date: TBD - to incorporate new detailed coastal flood hazard analyses, to add Base Flood Elevations, floodway, and Special Flood Hazard Areas; to change zone designations and Special Flood Hazard Areas; and to reflect updated topographic information.

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 – Volume 1

TABLE OF CONTENTS – Volume 1 - continued

Page

FIGURES

TABLES

TABLE OF CONTENTS – Volume 1 - continued

EXHIBITS

TABLE OF CONTENTS – Volume 1 – continued

TABLE OF CONTENTS – Volume 2 – July 6, 2010

EXHIBITS - continued

TABLE OF CONTENTS – Volume 2 - continued

EXHIBITS - continued

TABLE OF CONTENTS – Volume 3 – July 6, 2010

EXHIBITS - continued

<u>TABLE OF CONTENTS</u> – Volume 3 - continued

<u>EXHIBITS</u> - continued

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

1.0 INTRODUCTION

1.1 Purpose of Study

This countywide Flood Insurance Study (FIS) investigates the existence and severity of flood hazards in, or revises and updates previous FISs/Flood Insurance Rate Maps (FIRMs) for the geographic area of Middlesex County, including the Boroughs of Carteret, Dunellen, Helmetta, Highland Park, Jamesburg, Metuchen, Middlesex, Milltown, Sayreville, South Plainfield, South River, and Spotswood; the Cities of New Brunswick, Perth Amboy, and South Amboy; and the Townships of Cranbury, East Brunswick, Edison, Monroe, North Brunswick, Old Bridge, Piscataway, Plainsboro, South Brunswick, and Woodbridge; referred to collectively as Middlesex County.

This FIS aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This FIS has developed flood risk data for various areas of the county that will be used to establish actuarial flood insurance rates. This information will also be used by Middlesex County to update existing floodplain regulations as part of the Regular Phase of the National Flood Insurance Program (NFIP), and will also be used by local and regional planners to further promote sound land use and floodplain development. Minimum floodplain management requirements for participation in the NFIP are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

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

1.2 Authority and Acknowledgments

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

The original July 6, 2010 countywide FIS was prepared to include all jurisdictions within Middlesex County into a countywide format FIS. Information on the authority and acknowledgments for each jurisdiction with a previously printed FIS report included in this countywide FIS is shown below.

This FIS was prepared to include all jurisdictions within Middlesex County in a countywide format. Information on the authority and acknowledgments for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below.

Carteret, Borough of:	the hydrologic and hydraulic analyses from the original FIS report, dated November 1976 were prepared by the U.S. Army Corps of Engineers (USACE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-16-75, Project Order No. 16. In the revision for the FIS dated April 15, 1992, the hydrologic analyses for Arthur Kill and the Rahway River were prepared by Camp, Dresser, and McKee, Inc., while preparing the FIS for the contiguous City of New York, New York. That work was completed in December 1981.
Cranbury, Township of:	the hydrologic and hydraulic analyses from the original FIS report, dated September 1979 were prepared by the New Jersey Department of Environmental Protection (NJDEP) for FEMA, under Contract No. H-3959. For the FIS dated November 17, 1981, the hydrologic and hydraulic analyses for that study were conducted by Justin and Courtney, Inc., under subcontract to the NJDEP.
Dunellen, Borough of:	the hydrologic and hydraulic analyses from the FIS report dated February 4, 1988, were prepared by the Natural Resources Conservation Service (NRCS) of Somerset, New Jersey, for FEMA, under Contract No. IAA-H-23-74, Project Order No. 10. The updated hydrologic and hydraulic analyses for Green Brook were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management. This work was completed in July 1986.
East Brunswick, Township of:	the hydrologic and hydraulic analyses from the original FIS report, dated July 6, 1981, and January 6, 1982, Flood Insurance Rate Map (FIRM) (hereinafter referred to as the 1982 FIS), were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management, for FEMA, under Contract No. H-3855. Mapping was supplied by the Township of East Brunswick and by the updated State of New Jersey Flood Hazard Report Nos. 2, 7, and 8.

That work was completed in October 1977. The hydrologic and hydraulic analyses for the 1982 FIS were performed by Anderson-Nichols and Company, Inc., under subcontract to the NJDEP. Survey and topographic data were supplied by GEOD Aerial Mapping, Inc., under subcontract with Anderson-Nichols and Company, Inc. Tidal flood data were determined by Tetra Tech, Inc. For the May 3, 1990, FIS report, the hydraulic analyses for Cedar Brook No. 3 were prepared by Lynch, Carmody, Guiliano & Karol, P.A.

For the September 18, 1986, FIS report, the updated tidal analysis for Raritan Bay was performed by Camp, Dresser and McKee for FEMA during the preparation of the FIS for the City of New York. That work was completed in December 1981.

Edison, Township of: the hydrologic and hydraulic analyses represents a revision from the original FIS report, dated December 1982 by the USACE for FEMA. For the FIS report, dated December 19, 1984, the hydrologic and hydraulic analyses for the Raritan River were performed by the NJDEP.

The original tidal analysis for the Raritan River was performed by the NJDEP. The updated version was prepared by RBA Group for FEMA, under Contract No. EMW-C-0674.

Helmetta, Borough of: the hydrologic and hydraulic analyses from the April 16, 1984, FIS report, were prepared by the NJDEP for FEMA, under Contract No. H-3959. That work was completed in October 1981. The hydrologic and hydraulic analyses for that study were conducted by Justin & Courtney, Inc., under subcontract to the NJDEP.

Highland Park, Borough of: the hydrologic and hydraulic analyses, for the FIS dated December 1976, were performed by the USACE, New York District, for the Federal Insurance Administration (FIA), under Inter-Agency Agreement No. IAA-H-2-73, Project Order No. 4. This work, which was completed in June 1973, covered all flooding sources affecting the Borough of Highland Park.

Jamesburg, Borough of: the hydrologic and hydraulic analyses from the November 1983 FIS report, were prepared by the NJDEP for FEMA, under Contract No. H-3959. The study was performed by Justin & Courtney, Inc., under subcontract to the NJDEP. That work was completed in October 1981.

Metuchen, Borough of: the hydrologic and hydraulic analyses from the June 1979 FIS report, were prepared by the New Jersey Division of Water Resources for the FIA, under Contract No. H-3855. That work was completed in October 1977. The study was performed by McPhee, Smith, Rosenstein Engineers, under subcontract to the New Jersey Division of Water Resources.

Middlesex, Borough of: the hydrologic and hydraulic analyses from the March 18, 1986, FIS report, represent a revision of the original analyses by the USACE. The updated version was prepared by The RBA Group for FEMA, under Contract No. EMW-C-1195. That work was completed in October 1984.

Milltown, Borough of: the hydrologic and hydraulic analyses from the August 4, 1980, FIS report, were performed by the NJDEP, Division of Water Resources, Bureau of Floodplain Management for the FIA under Contract No. H-3855. That work was completed in August 1977. The study was prepared by Anderson-Nichols and Company, Inc., for the NJDEP, Division of Water Resources, Bureau of Floodplain Management. GEOD Aerial Mapping, Inc., supplied the survey and topographic data to Anderson-Nichols.

Monroe, Township of: the hydrologic and hydraulic analyses from the original October 1981 FIS report, were performed by Justin & Courtney, Inc., under subcontract to the NJDEP. That work was completed in October 1981. The second revision was prepared by Dewberry & Davis under agreement with FEMA. Flood boundaries on Clear Brook and the Possum Hollow Road Drainage Channel were revised based on updated topographic maps submitted by the community. That work was completed in July 1986. In the third revision, from the November 6, 1991, FIS report, analyses were performed by Carr Engineering Associates, P.A., to reflect the effects of a channelization project on Clear Brook and an unnamed tributary to Clear Brook. This work was completed in June 1990. That work was prepared by the NJDEP for FEMA, under Contract No. H-3959.

New Brunswick, City of: the hydrologic and hydraulic analyses from the June 1979 FIS report, were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management for the FIA, under Contract No. H-3855. This work was completed in October 1977. Survey and topographic data were supplied by GEOD Aerial Mapping, Inc., under subcontract with Anderson-Nichols and Company, Inc., under subcontract to the NJDEP, Division of Water Resources, Bureau of Floodplain Management. Tidal flood data were determined by Tetra Tech, Inc., which has conducted an extensive tidal study of the eastern seaboard of the United States. Approval to use this data for insurance applications was obtained from the FIA.

North Brunswick, Township of: the hydrologic and hydraulic analyses from the November 1979 FIS report, were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management for the FIA, under Contract No. H-3855. This work was completed in December 1977. The report was prepared by Anderson Nichols and Company, Inc., Boston, Massachusetts, for the NJDEP, Division of Water Resources, Bureau of Floodplain Management. Survey, topographic data, and topographic mapping were supplied by GEOD Aerial Mapping, Inc., Oak Ridge, New Jersey, under subcontract to Anderson Nichols and Company. The mapping for Lawrence Brook, however, was an update of mapping in Flood Hazard Report No. 7.

Old Bridge, Township of: the hydrologic and hydraulic analyses from the original August 1982 FIS report, were prepared by URS Company, Inc., for FEMA, under Contract No. H-6808. The original study was completed in August 1982. The hydrologic and hydraulic analyses in that study for the South

River and Matchaponix Brook were obtained from the FISs for the Townships of Monroe and East Brunswick, and the Borough of Spotswood. The addition of the wave height analysis was prepared by Dewberry and Davis for FEMA, under Contract No. EMW-C-0543; this was completed in July 1983. The updated study, from the October 16, 1987, FIS report were prepared by Dewberry and Davis. The Township of Old Bridge Department of Engineering and Planning and the NJDEP provided technical data. This work was completed in September 1986.

Perth Amboy, City of: the hydrologic and hydraulic analyses of the revision of the original study from the November 1, 1983, FIS report, prepared by Tetra Tech, Inc., for FEMA, under Contract No. H-3830. The updated version was prepared by Tetra Tech, Inc., under agreement with FEMA. This work was completed in August 1981.

Piscataway, Township of: the hydrologic and hydraulic analyses from the July 18, 1983, FIS report, were prepared by the USACE, New York District, for FEMA, under Inter-Agency Agreement No. IAA-H-7-76, Project Order No. 11. The hydrologic and hydraulic analyses for Bonygutt Brook, Bound Brook, Ambrose Brook, and Doty's Brook were conducted by T & M Associates under subcontract to the USACE. This work was completed in January 1982.

Plainsboro, Township of: the hydrologic and hydraulic analyses from the December 19, 1984, FIS report, were prepared by the NJDEP for FEMA, under Contract No. H-3959. The hydrologic and hydraulic analyses for that study were conducted by Justin & Courtney, Inc., under subcontract to the NJDEP. This work was completed in November 1981.

Sayreville, Borough of: the hydrologic and hydraulic analyses from the original June 1977 FIS report, were performed by the NJDEP for FEMA, under Contract No. H-3855. The original work was completed in June 1977. The updated stillwater analysis was performed by Camp, Dresser and McKee for FEMA during the preparation of the FIS for the City of New York. The New York study was completed in December 1981. The addition of the wave height analysis was performed by Dewberry & Davis and completed in July 1985.

South Amboy, City of:	the hydrologic and hydraulic analyses of the revision from the August 1981 FIS report, were performed by Tetra Tech, Inc., for FEMA. The Tetra Tech work was completed in August 1981. The updated analysis for the Raritan River was prepared by Camp, Dresser and McKee for FEMA during the preparation of the FIS for the City of New York. The New York study was completed in December 1981. The updated version was prepared by Dewberry & Davis, under agreement with FEMA. That work was completed in June 1985.
South Brunswick, Township of:	the hydrologic and hydraulic analyses from the December 18, 1985, FIS report, were prepared by the NJDEP for FEMA, under Contract No. H-3959. The hydrologic and hydraulic analyses were performed by O'Brien & Gere Engineers, Inc., under subcontract to the NJDEP. This work was completed in March 1984.
South Plainfield, Borough of:	the hydrologic and hydraulic analyses from the February 1980 FIS report, were performed by the NJDEP, for the FIA, under Contract No. H-3855. This work was completed in June 1977.
South River, Borough of:	the original hydrologic and hydraulic analyses from the May 1977 FIS report, were performed by the NJDEP for FEMA, under Contract No. H-3855. The original work was completed in May 1977. The updated tidal analysis for the South River was performed by Camp, Dresser and McKee for FEMA during the preparation of the FIS for the City of New York. The New York study was completed in December 1981.
Spotswood, Borough of:	the original hydrologic and hydraulic analyses from the August 1977 FIS report, were prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management, for FEMA, under Contract No. H-3855. The work for the original study was completed in August 1977. The hydrologic and hydraulic analyses for Cedar Brook in this revision were prepared by Lynch,

Carmody, Guiliano, & Karol, P.A., under agreement with FEMA. The work for this revision was completed in December 1988.

Woodbridge, Township of: the original hydrologic and hydraulic analyses from the January 1979 FIS report, were revised by Anderson Nichols, Inc., for FEMA. The updated version was prepared by the NJDEP, Division of Water Resources, Bureau of Floodplain Management, under agreement with FEMA, Contract No. H-3959. This study was completed in January 1979. The hydrologic and hydraulic analyses in the updated study were computed by Richard Browne Associates under subcontract to the NJDEP, Division of Water Resources, Bureau of Floodplain Management. The wave height analysis for this study was prepared by Dewberry and Davis for FEMA, under Contract No. H-EMW-C-0543. That work was completed in July 1981.

For the July 6, 2010 countywide study, revised hydrologic and hydraulic analyses for Boundary Branch Mill Brook No. 1, Coppermine Brook, Mill Brook No. 1, South Branch Rahway River, and West Branch Mill Brook No. 1, were prepared for FEMA by Leonard Jackson Associates. Also, floodplains for all detailed study, unrevised streams have been redelineated using updated topographic data provided to FEMA by Middlesex County. Revised hydraulic analyses for the Raritan River were prepared by Dewberry under Contract No. EMW-2000-CO-0003. This work was completed in November 2002. Additionally, flood hazards previously assessed using approximate methods were re-analyzed throughout the county and results were then mapped using the Middlesex County topographic data. This work was completed in July 2008. Finally, the hydrology and hydraulic analyses for Matawan Creek were taken from the Monmouth County (All Jurisdictions) FIS dated September 25, 2009 (FEMA, 2009).

For the [date] countywide revision, the coastal wave height analysis along Arthur Kill, Raritan Bay and Raritan River were prepared by Risk Assessment Mapping and Planning Partners (RAMPP) for FEMA under contract No.HSFEHQ-09-D-0369, task order HSFE02-09-J-0001. This work was completed in 2012.

Base map information shown on this FIRM was provided in digital format by the State of New Jersey Office of Information Technology. This information was derived from digital orthophotos produced at a scale of 1:2,400 with 1-foot pixel resolution from photography dated April 2012.

The projection used for the production of this FIRM is New Jersey State Plane, FIPSZONE 2900. The horizontal datum was NAD 83, GRS80 spheroid. Differences in datum, spheroid, projection, or State Plane zones used in the production of FIRMs for adjacent counties may result in slight positional differences in map features at the county boundaries. These differences do not affect the accuracy of information shown on the FIRM.

1.3 Coordination

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

The dates of the initial and final CCO meetings held for jurisdictions within Middlesex County are shown in Table 1, "Initial and Final CCO Meetings."

TABLE 1 - INITIAL AND FINAL CCO MEETINGS

Community	Initial CCO Date	Final CCO Date
Borough of Carteret	*	April 29, 1976
Township of Cranbury	March 15, 1976	July 9, 1981
Borough of Dunellen	*	June 6, 1975
Township of East Brunswick	May 12, 1975	January 21, 1981
Township of Edison	June 10, 1981	February 23, 1984
Borough of Helmetta	March 15, 1976	November 7, 1983
Borough of Highland Park		
Borough of Jamesburg	March 15, 1976	June 28, 1983
Borough of Metuchen	May 5, 1975	September 25, 1978
Borough of Middlesex	April 6, 1983	April 9, 1985
Borough of Milltown	*	April 4, 1979
Township of Monroe	March 15, 1976	March 16, 1984
City of New Brunswick	May 12, 1975	June 26, 1978
Township of North Brunswick	May 12, 1975	May 8, 1979
Township of Old Bridge	June 1980	August 6, 1984
City of Perth Amboy	September 1975	June 10, 1983
Township of Piscataway	June 23, 1975	August 10, 1982
Township of Plainsboro	March 15, 1976	May 25, 1983
Borough of Sayreville	*	July 18, 1979
City of South Amboy	September 1975	June 23, 1982
Township of South Brunswick	March 1976	December 5, 1984
Borough of South Plainfield	May 5, 1975	August 21, 1978
Borough of South River	*	August 28, 1978
Borough of Spotswood	May 12, 1975	November 21, 1978
Township of Woodbridge	November 10, 1976	December 16, 1981

*Data not available

For the July 6, 2010 countywide FIS, initial CCO meetings were held December 6 and 8, 2005. These meetings were attended by representatives of the Cities of New Brunswick, Perth Amboy, and South Amboy; the Boroughs of Carteret, Helmetta, Highland Park, Jamesburg, Metuchen, Middlesex, Milltown, Sayreville, South Plainfield, South River, and Spotswood; the Townships of Cranbury, East Brunswick, Edison, Monroe, Old Bridge, Piscataway, Plainsboro, and Woodbridge; the New Jersey Department of Environmental Protection (NJDEP), FEMA, and Michael Baker, Jr., Inc.

Final CCO meetings for the July 6, 2010 countywide study were held February 5 and 6, 2009. These meetings were attended by representatives of the Cities of New Brunswick, Perth Amboy, and South Amboy; the Boroughs of Carteret, Jamesburg, Metuchen, Middlesex, Milltown, and Spotswood; and the Townships of East Brunswick, Edison, Old Bridge, Piscataway, Plainsboro, South Brunswick, and Woodbridge; the NJDEP, FEMA, Dewberry, and Leonard Jackson Associates.

For the [TBD] countywide revision, an initial CCO meeting was held on August 24, 2011, and attended by representatives of NJDEP, RAMPP, FEMA, and local officials.. The Flood Risk Review (FRR) meeting was held on August 21, 2013.

The results of the study were reviewed at the final CCO meeting held on ________________________________, and attended by representatives of ____. All concerns raised at that meeting have been addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS covers the incorporated areas of the geographic area of Middlesex County, New Jersey.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods from the July 6, 2010 County-Wide Study," were studied by detailed methods. For the July 6, 2010 County-wide study, limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM (Exhibit 2). The areas studied were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

TABLE 2 - FLOODING SOURCES STUDIED BY DETAILED METHODS FROM THE JULY 6, 2010 COUNTY-WIDE STUDY

Ambrose Brook
Arthur Kill
Barclay Brook
Barclay’s Brook
Beaverdam Brook
Bee Brook
Bentleys Brook
Bog Brook
Bonhamtown Gut
Bonygutt Brook
Bound Brook
Boundary Branch Mill Brook No. 1
Carters Brook
Cedar Brook No. 1
Cedar Brook No. 2
Cedar Brook No. 3
Cheesequake Creek
Clear Brook
Coppermine Brook
Cow Yard Brook
Cranbury Brook
Crossway Creek
Deep Run
Devils Brook
Dismal Brook
Diversion Channel
Doty’s Brook
Great Ditch
Green Brook
Heards Brook
Heathcote Brook
Heathcote Brook Branch
Ireland Brook
Iresick Brook
Lawrence Brook
Mae Brook
Manalapan Brook
Matawan Creek
Matchponix Brook
Mellins Creek
Mile Run
Mill Brook No. 1
Mill Brook No. 2
Millstone River
Oakeys Brook
Parkway Branch
Pumpkin Patch Brook
Rahway River
Raritan Bay
Raritan River
Robinsons Branch
Robinsons Branch Tributary
Sawmill Book No. 1
Sawmill Brook No. 2
Shallow Brook
Six Mile Run
Six Mile Run Branch
South Branch Rahway River
South River
Spa Spring Creek
Stream 14-14-2-2
Stream 14-14-2-3
Sucker Brook
Switzgable Brook
Ten Mile Run
Tennents Brook
Tributary A to Lawrence Brook
Tributary No. 1 to Sucker Brook
Tributary No. 1 to Ten Mile Run
Tributary No. 2 to Ten Mile Run
Tributary to Carters Brook
Tributary to Cedar Brook No. 3
Tributary to Cranbury Brook
Tributary to Hathecote Brook
Tributary to Lawrence Brook
Tributary to Manalapan Brook
Tributary to Mile Run
Tributary to Millstone River
Tributary to Oakeys Brook
Tributary to Sawmill Brook No. 2
Tributary to Six Mile Run Branch
West Branch Mill Brook No. 1
Wigwam Brook
Woodbridge River

Riverine flooding sources throughout the county have been studied by detailed methods at different times and, prior to the July 6, 2010 countywide FIS, often on a community-by-community basis. Table 3, "Model Dates for Riverine Flooding Sources" below represents the hydraulic modeling dates for the detailed study flooding sources in the county.

TABLE 3 – MODEL DATES FOR RIVERINE FLOODING SOURCES

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Ambrose Brook	Borough of Middlesex	October 1984
Ambrose Brook	Township of Piscataway	January 1982
Barclay Brook	Township of Old Bridge	August 1982
Barclay's Brook	Borough of Jamesburg	October 1981
Barclay's Brook	Township of Monroe	October 1981
Beaverdam Brook	Township of East Brunswick	October 1977
Bee Brook	Township of Plainsboro	November 1981
Bentley's Brook	Township of Monroe	October 1981
Bog Brook	Borough of Milltown, Township of East Brunswick	October 1977
Bonhamtown Brook	Borough of Metuchen	October 1977
Bonhamtown Brook	Township of Edison	December 1982
Bonygutt Brook	Borough of Dunellen	July 1986
Bonygutt Brook	Borough of Middlesex	October 1984
Bonygutt Brook	Township of Piscataway	January 1982
Bound Brook	Borough of Middlesex	October 1984
Bound Brook	Borough of South Plainfield	June 1977
Bound Brook	Township of Edison	December 1982
Bound Brook	Township of Piscataway	January 1982
Boundary Branch of Mill Brook	Borough of Highland Park	August 2008
Carters Brook	Township of South Brunswick	March 1984
Cedar Brook No. 1	Township of Cranbury	September 1979
Cedar Brook No. 1	Township of Monroe	October 1981
Cedar Brook No. 1	Township of Plainsboro	November 1981
Cedar Brook No. 2	Borough of South Plainfield	June 1977
Cedar Brook No. 3	Borough of Spotswood	December 1988
Cedar Brook No. 3	Township of East Brunswick	May 1990

TABLE 3 – MODEL DATES FOR RIVERINE FLOODING SOURCES- continued

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Cheesequake Creek	Borough of Sayreville	June 1977
Clear Brook	Township of Monroe	June 1990
Coppermine Brook	Township of Edison	August 2008
Cow Yard Brook	Township of South Brunswick	March 1984
Cranbury Brook	Township of Cranbury	September 1979
Cranbury Brook	Township of Monroe	October 1981
Cranbury Brook	Township of Plainsboro	November 1981
Crossway Creek	Borough of Sayreville	June 1977
Deep Run	Township of Old Bridge	August 1982
Devils Brook	Township of Plainsboro	November 1981
Devils Brook	Township of South Brunswick	March 1984
Dismal Brook	Borough of Metuchen	October 1977
Dismal Brook	Township of Edison	December 1982
Diversion Channel	Township of North Brunswick	December 1977
Doty's Brook	Township of Piscataway	January 1982
Great Ditch	Township of South Brunswick	March 1984
Green Brook	Borough of Middlesex	October 1984
Green Brook	Borough of Dunellen	July 1986
Heards Brook	Township of Woodbridge	January 1979
Heathcote Brook	Township of South Brunswick	March 1984
Heathcote Brook Branch	Township of South Brunswick	March 1984
Ireland Brook	Township of East Brunswick	October 1977
Ireland Brook	Township of South Brunswick	March 1984
Iresick Brook	Township of Old Bridge	August 1982
Lawrence Brook	Borough of Milltown, City of New Brunswick, Township of East Brunswick	October 1977
Lawrence Brook	Township of North Brunswick	December 1977
Lawrence Brook	Township of South Brunswick	March 1984
Mae Brook	Township of North Brunswick	December 1977
Manalapan Brook	Borough of Helmetta, Borough of Jamesburg, Township of Monroe	October 1981
Manalapan Brook	Borough of Spotswood	August 1977
Matchaponix Brook	Borough of Spotswood	August 1977
Matchaponix Brook	Township of Old Bridge, Township of Monroe	October 1981
Mellins Creek	Borough of Sayreville	June 1977
Mile Run	City of New Brunswick	October 1977
Mile Run	Township of North Brunswick,	December 1977

TABLE 3 – MODEL DATES FOR RIVERINE FLOODING SOURCES- continued

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Mill Brook No.1	Borough of Highland Park	August 2008
Mill Brook No.2	Township of Edison	December 1982
Millstone River	Township of Cranbury	September 1979
Millstone River	Township of Monroe	October 1981
Millstone River	Township of Plainsboro	November 1981
Millstone River	Township of South Brunswick	March 1984
Oakeys Brook	Township of South Brunswick, Township of North Brunswick	March 1984
Parkway Branch	Township of Woodbridge	January 1979
Pumpkin Patch Brook	Township of Woodbridge	January 1979
Rahway River	Township of Woodbridge	January 1979
Raritan River	Borough of Sayreville, Township of Piscataway, City of New Brunswick, Borough of Middlesex, Township of East Brunswick, Township of Edison	August 2008
Robinsons Branch	Township of Edison	December 1982
Robinsons Branch Tributary	Township of Edison	December 1982
Sawmill Brook No. 1	Township of East Brunswick, Borough of Milltown	October 1977
Sawmill Brook No. 2	Borough of Helmetta, Township of Monroe	October 1981
Shallow Brook	Township of Cranbury	September 1979
Shallow Brook	Township of Monroe	October 1981
Shallow Brook	Township of Plainsboro	November 1981
Shallow Brook	Township of South Brunswick	March 1984
Six Mile Run Branch	Township of South Brunswick	March 1984
Six Mile Run	Township of North Brunswick	December 1977
South Branch Rahway River	Township of Woodbridge	August 2008
South River	Borough of Sayreville	June 1977
South River	Borough of South River	May 1977
South River	Borough of Spotswood	August 1977
South River	Township of East Brunswick	October 1977
South River	Township of Old Bridge	August 1982
Spa Spring Creek	City of Perth Amboy	August 1981
Spa Spring Creek	Township of Woodbridge	January 1979
Stream 14-14-2-2	Borough of South Plainfield	June 1977
Stream 14-14-2-3	Borough of South Plainfield	June 1978
Sucker Brook	Borough of Milltown	August 1977

TABLE 3 – MODEL DATES FOR RIVERINE FLOODING SOURCES- continued

STREAM NAME	COMMUNITY	MOST RECENT MODEL DATE
Sucker Brook	Township of North Brunswick,	December 1977
Switzgable Brook	Township of South Brunswick	March 1984
Ten Mile Run	Township of South Brunswick	March 1984
Tennents Brook	Borough of Sayreville	June 1977
Tennents Brook	Township of Old Bridge	August 1982
Tributary A to Lawrence Brook	Township of South Brunswick	March 1984
Tributary No. 1 to Sucker Brook	Township of North Brunswick	December 1977
Tributary No. 1 to Ten Mile Run	Township of South Brunswick	March 1984
Tributary No. 2 to Ten Mile Run	Township of South Brunswick	March 1984
Tributary to Carters Brook	Township of South Brunswick	March 1984
Tributary to Cedar Brook No. 3	Borough of Spotswood	August 1977
Tributary to Cranbury Brook	Township of Monroe	October 1981
Tributary to Heathcote Brook	Township of South Brunswick	March 1984
Tributary to Lawrence Brook	Township of South Brunswick	March 1984
Tributary to Manalapan Brook	Township of Monroe	October 1981
Tributary to Mile Run	New Brunswick	October 1977
Tributary to Millstone River	Township of Cranbury	September 1979
Tributary to Oakeys Brook	Township of South Brunswick	March 1984
Tributary to Sawmill Brook No. 2	Borough of Helmetta	October 1981
Tributary to Six Mile Run Branch	Township of South Brunswick	March 1984
West Branch Mill Brook No. 1	Borough of Highland Park	August 2008
Wigwam Brook	Township of Monroe, Borough of Jamesburg	October 1981
Woodbridge River	City of Perth Amboy	August 1981
Woodbridge River	Township of Woodbridge	January 1979

All or portions of numerous flooding sources in the county were studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. For the July 6, 2010 countywide FIS, all areas of approximate flood hazard analyses were updated using the topography provided by Middlesex County and the flood frequency estimation techniques developed by the U.S. Geological Survey (USGS).

The [date] FIS revision includes a new coastal analysis and mapping for 25 miles of shoreline.

2.2 Community Description

Middlesex County is located in the central part of New Jersey. There are 25 communities in Middlesex County. The Boroughs of Dunellen and Middlesex, and the Township of Piscataway are located in the northwest portion of the county. The Boroughs of Highland Park, Metuchen, and South Plainfield, and the Township of Edison are located in the northern portion of the county. The Borough of Carteret, the City of Perth Amboy, and the Township of Woodbridge are located in the northeast portion of the county. The City of New Brunswick and the Townships of North Brunswick and South Brunswick are located in the western portion of the county. The Boroughs of Milltown, Sayreville, South River, and Spotswood, and the Township of East Brunswick are located in the central portion of the county. The City of South Amboy and the Township of Old Bridge are located in the eastern part of the county. The Township of Plainsboro is located in the southwest portion of the county. The Boroughs of Helmetta and Jamesburg and the Township of Cranbury are located in the southern portion of the county. The Township of Monroe is located in the southeast portion of the county.

Middlesex County is bordered to the north by Union County, New Jersey; to the northwest by Somerset County, New Jersey; to the northeast by Richmond County, New York; to the south by Monmouth County, New Jersey; and to the southwest by Mercer County, New Jersey.

According to the 2012 U.S. Census Bureau, the population of Middlesex County was 823,041, and the land area was 308.91 square miles (U.S. Census Bureau, 2012).

The topography of the county consists of marshes and wetlands along coastal and floodplains in the east. Geological formations and early glacial ages have left Lawrence Brook and other streams, with a natural divide between deposits consisting of varying characteristics. Portions of the county consist of clay soils underlain by rock formations while other areas consist of Quaternary glacial deposits of sand and gravel underlain by Cretaceous bedrock.

The climate of Middlesex County is mostly continental due to the predominance of winds from the interior. Average seasonal temperatures range from 39 degrees Fahrenheit (˚F) in January to 87°F in July, with extremes of -17˚F below zero to

106˚F. Average annual precipitation is 45 inches, while relative humidity averages about 70 percent (U.S. Department of Commerce and National Oceanic and Atmospheric Administration; 1967-2012).

2.3 Principal Flood Problems

Past history of flooding in Middlesex County indicates that flooding of varied origin may be experienced in any season of the year since New Jersey lies within the major storm tracks of North America. In Middlesex County, the low-lying areas along streams are subject to periodic flooding. Flooding during the winter months is less frequent, but spring flooding compounded by snowmelt and ice has occurred. The more extensive floods have occurred in late summer and fall, usually associated with tropical disturbances moving northward along the Atlantic Coast.

Two major floods that have occurred were Hurricane Doria in August 1971 and the flooding in Middlesex County of 1975 as a result of a continuing period of heavy rains. The 1975 flooding was produced from the combination of a tropical storm system arriving immediately following a storm which had already rain-soaked the area. Although varied flooding was experienced throughout Middlesex County, the maximum discharge on record at the Lawrence Brook gage occurred during this 1975 flood. This record discharge at Farrington Dam is similar to the discharge calculated for the 1-percent annual chance (100-year) flood (4,920 cubic feet per second (cfs)).

In the Townships of Plainsboro and Cranbury, on July 21, 1975, the gaging station (No. 01400730) at Plainsboro on the Millstone River registered a flood flow of 3,970 (cfs). Flood flows from the storm in Plainsboro caused damage to roads and several highway bridges.

In the Township of Cranbury, on July 21, 1975, Cranbury Brook flooded the central area of the Village of Cranbury. Damage was primarily flooded basements, though there was some shallow flooding of first-floor areas.

All of the major streams in the Township of Monroe are subject to periodic flooding. The principal area of flooding is in the floodplain of Matchaponix Brook. Flood flows were recorded on Manalapan Brook in 1968 and 1975 at Spotswood, which is just north of Monroe. The flows reflected flooding from both Manalapan Brook and Matchaponix Brook, which join upstream of the gaging station.

In the Borough of Jamesburg, flooding occurs from overflow of Manalapan Brook, Barclay's Brook, and Lake Manalapan. Floods were recorded on Manalapan Brook in 1968 and 1975 at the gaging station at Spotswood, which is approximately 5.5 miles downstream from Jamesburg.

In the Borough of Helmetta, Manalapan Brook has been subject to periodic flooding. Floods were recorded in 1958, 1975, 1989, and 2007 at the gaging station (No. 01405400) located approximately 2 miles downstream from Helmetta at Spotswood. There are no other records of flood problems in the Borough of Helmetta.

In the Township of South Brunswick, numerous low-lying areas are subject to flooding caused by the overflow of the streams in the area. In recent years, flooding has occurred along the Millstone River at the confluence of Heathcote Brook, along Heathcote Brook and its tributaries, along Ten Mile Run and Six Mile Run, and along Lawrence Brook, Oakeys Brook, and Cow Yard Brook. On Lawrence Brook, floods were recorded in 1927, 1928, 1938, 1944, 1959, 1967, 1968, 1971, 1975, and 1989. Most damage was to highways and associated works.

In the Township of North Brunswick, recorded gage history of flooding in the area began in 1927 at the gage on Lawrence Brook. Since then, a number of major and minor floods have been experienced, as indicated by peak stages and discharges recorded at the gage at Farrington Dam (USGS gage no. 01405000). The maximum recorded discharge for the gage is 4,920 cfs, which occurred in July 1975. North Brunswick has experienced flooding at various locations throughout the township such as along U.S. Route 1 and in some commercial developments. During the 1975 flood, Milltown Road was inundated and the police reported that roads were full of stalled and abandoned vehicles. Some of the flooding has been attributed to local drainage problems and is not considered as part of this study.

In the City of New Brunswick, the recorded gage history of flooding in the area began in 1903 for the Raritan River and in 1927 for Lawrence Brook. Since then, a number of major and minor floods have been experienced as indicated by peak stages and discharges recorded at the gage on the Raritan River at Calco Dam (USGS Gage No. 01403060) and the gage on Lawrence Brook at Farrington Dam (USGS Gage No. 01405000). The maximum recorded discharges for the gages are 82,900 cfs at Calco Dam, which occurred in September 1999, and 4,920 cfs at Farrington Dam, which occurred in July 1975. The City of New Brunswick has experienced flooding along the Raritan River and Lawrence Brook, with the more serious flooding being in the vicinity of Burnet Street near Lawrence Brook and Landing Road near the Raritan River. At times, the severity of this flooding has made it necessary to evacuate residents by boat.

In the City of South Amboy, many major floods have occurred since recent past. On November 25, 1950, a fierce northeaster struck the city with gale-force winds and more than 3 inches of precipitation. During the passage of that storm, a maximum tidal height of 9.5 feet was recorded at Perth Amboy.

South Amboy, as well as most of New Jersey, was deluged on November 6-7, 1953, by heavy rains as a northeaster moved up the Atlantic coast. Striking the area with gale-force winds, the storm produced a tidal elevation of 8.9 feet at Perth Amboy. On September 12, 1960, the study area and most of New Jersey was hit by Hurricane Donna. Pounding the entire coastline with heavy rains accompanied by winds of nearly 70 miles per hour (mph), this storm caused the greatest flood of record in South Amboy. The concurrence of the hurricane tidal surge with the mean high tide resulted in a record maximum tide of 10.0 feet at South Amboy.

In South Amboy, on March 6-8, 1962, a storm, generating winds of 45 mph, with gusts up to 70 mph, remained in the New Jersey region for 60 hours. This unusually long duration coincided with five successive high spring tides. Severe flooding conditions along the entire coastline of New Jersey resulted from the high storm waters, strong waves, and gale-force winds. The city was hit by a disastrous flood on August 27, 1971. On that date, a warm front passed through the city. Severe thunderstorms associated with the front deluged the city with over 6 inches of rain. The flooding situation intensified as Tropical Storm Doria swept through the area later that evening and during the morning hours of the next day. The total rainfall from the thunderstorms and Tropical Storm Doria was almost 9 inches at Perth Amboy. A similar situation occurred on September 11-14, 1971, as heavy rains associated with violent thunderstorms preceded Tropical Storm Heidi. These two storms resulted in 140 million dollars in property damage throughout the State of New Jersey.

The Township of Old Bridge is subject to tidal flooding along Cheesequake Creek, and both tidal and fluvial floods on Tennents Brook, Iresick Brook, Deep Run, and the South River. The township also experiences fluvial flooding along Barclay Brook and Matchaponix Brook. Despite the numerous streams and low-lying areas found within the township, flood damage has been relatively minor. This is largely due to the fact that development in the natural floodplain areas of the streams in the community has been minimal. In general, the flood damages that occurred in the past have been due to inadequate storm drainage.

The Borough of Milltown has reported flooding at two locations on Lawrence Brook, the Riva Avenue Bridge and the Raritan River Railroad crossing downstream, of Main Street. Flooding in the area of Main Street and Washington Avenue has been attributed to the structure at the railroad crossing. The flooding of 1975 forced the closing of Main Street and three bridges to traffic. Sandbagging by the police was necessary to keep floodwaters out of the headquarters in Main Street. The post office, power substation municipal garage also had been affected.

The Borough of Highland Park experiences periodic flooding from the Raritan River, Mill Brook No. 1, West Branch Mill Brook No. 1, Boundary Branch Mill Brook No. 1, and Cedar Creek.

The Township of East Brunswick has experienced flooding along the Raritan and South Rivers, with the more serious flooding along Lawrence Brook. Stream flooding or local flooding has been reported along each of the major streams in the township. Serious flooding has occurred at almost all crossings of Irelands Brook. Flooding has been reported along Beaverdam Brook and on the upstream portion of Sawmill Brook. For public safety during the 1975 flood, it was necessary to close six roads, including State Route 18, Tices Lane, Rues Lane, and Cranbury Road.

The Borough of Sayreville has experienced flooding along the Raritan and South Rivers, with the more serious flooding contained in the vicinity of the Bordentown-Amboy Turnpike near Robert Street. At times, the severity of this flooding has made it necessary to evacuate residents by boat.

The Borough of South River has experienced flooding along the South River, with the more serious flooding being in the area of the main business section near Veteran Memorial Bridge. Also, tidal flooding has been experienced along Causeway and Freeman Streets.

The Borough of Spotswood has experienced flooding along the South River, Manalapan Brook, Matchaponix Brook, Cedar Brook, and Tributary to Cedar Brook. Localized flooding has been reported in several sections of the borough, particularly to the northeast of the railroad tracks; the most severe problem is located in the area between Crescent Avenue and New Brunswick Avenue.

The City of Perth Amboy and the Borough of Carteret are subject to flooding conditions resulting from tropical storms, extratropical cyclones, and to a lesser extent, severe thunderstorm activity. Most of the of the serious flood problems are attributed to tropical storms, especially hurricanes, which produce high tidal surges and associated wave action on Raritan River (in Carteret), Raritan Bay, and Arthur Kill.

In the Township of Woodbridge the flooding along the Raritan River is principally tidal from the Raritan Bay. Both the Rahway and Woodbridge Rivers are inundated by the 1-percent annual chance tidal flood from Arthur Kill. The 1-percent annual chance tidal flood also inundates the lower portions of Heards Brook and most of Spa Spring. Both the South Branch Rahway River and Pumpkin Patch Brook are periodically subject to riverine flooding.

There are essentially no major flooding problems within the Borough of Metuchen.

Little specific flood information is available for the streams in the Township of Edison, but it is known that floods occurred as early as 1903 in the general area and again in 1916, 1928, and 1968.

The Borough of South Plainfield has experienced recurrent flooding problems along the major portion of streams. Recorded flooding history for Bound Brook dates back to 1833; since that time, six major floods have occurred in the Bound Brook drainage basin (October 9, 1903; July 26, 1916; July 23, 1938; May 29, 1968; August 28, 1971; and August 2, 1973).

In the Borough of Dunellen, as storms approach and cross the Watchung Mountains from the south or east, rainfall becomes intensified on the southeastern side of the mountains resulting in damaging erosion and sediment deposition.

In the Borough of Middlesex, recorded history of flooding in the Greek Brook basin goes back as far as 1893. Flooding on Green Brook has been described as "flashy" or producing severe flood conditions due to the high intensity of rainfall for a short duration. Flood damage in the basin is more common and severe than elsewhere in the Raritan River basin because of encroachments that have and are taking place in the floodplains. At some locations, conditions are so bad that buildings have been constructed over the top of the stream, and the floodplains have been virtually eliminated. This situation has been further aggravated by construction of numerous hydraulically inadequate bridges along Green Brook. Flooding in the Bound Brook Basin is very closely interrelated with flooding in the Green Brook Basin.

The Township of Piscataway has had isolated cases of serious flooding in the past. Areas adjacent to the Raritan River have become inundated during severe storms. Flooding along Ambrose Brook, characteristically floods roads and underpasses, most notably the Reading Railroad underpass and the Interstate Route 287 underpass on Possumtown Road. Bonygutt Brook causes some local roadway flooding, particularly in the area of Rock Avenue. The most serious flooding problem occurs on Bound Brook, just downstream of New Market Lake.

On September 22, 1992, Tropical Storm Danielle produced rain fall across much of New Jersey. The southwest portion of the state experienced over 3 inches of rain. The storm washed out miles of beaches along the coastline.

Hurricane Floyd originally made landfall in Cape Fear, North Carolina, as a Category 2 hurricane on September 16, 1999. The storm crossed over North Carolina and southeastern Virginia, before briefly entered the western Atlantic Ocean. The storm reached New Jersey on September 17, 1999. Record breaking flooding was recorded throughout the State of New Jersey. The Raritan River basin experienced record floods of up to 4.5 ft. higher than any previous record flood crest. The areas of Bound Brook and Manville were especially hit hard. A Federal Emergency Declaration was issued on September 17, 1999. Overall damage estimates for Hurricane Floyd, in the State of New Jersey are estimated around $250 million dollars.

Hurricane Irene came ashore in Little Egg Inlet in Southern New Jersey; on August 28, 2011. In anticipation of the storm, Governor Chris Christy declared a state of emergency on August 25th, with President Obama reaffirming the declaration on August 27th. Mandatory evacuations were ordered throughout the State of New Jersey. Wind Speeds were recorded at 75 mph and rain totals reached over 10 inches in many parts of the state. Over 3,500 customers lost power, in Middlesex County, during the storm. Overall damage estimates, for Middlesex County, came to over 100 million dollars. (Associated Press, 2011)

Hurricane Sandy came ashore as an immense tropical storm in Brigantine, New Jersey, on October 29, 2012. Sandy dropped heavy rain on the area; almost a foot in some areas. Wind gust were recorded at 90 mph. A full moon made the high tides 20 percent higher than normal and amplified the storm surge. The New Jersey shore suffered the most damage. Some barrier island communities suffered severe “wash over” including the creation of two temporary inlets. Seaside communities were damaged and destroyed up and down the coastline. NOAA’s gage #8531680 at Sandy Hook, NJ; the high water mark (which is considered as a stillwater elevation without waves) was 9.21 ft. NAVD88 at 6:00 PM on October 29, 2012. The Middlesex County Utilities Authority noted that the three pumping stations went off line during the storm; South Amboy, Edison and Sayreville. Some 235, 000 Middlesex County households had lost power during the storm. Initial reports suggest that 87,000 homes and businesses were damaged or destroyed by the storm. Governor Chris Christy declared a state of emergency on October 31. Hurricane Sandy is estimated to cost the State of New Jersey over $36 billion (Associated Press, 2012).

2.4 Flood Protection Measures

FEMA specifies that all levees must have a minimum of 3-foot freeboard against 1-percent annual chance flooding to be considered a safe flood protection structure.

The National Weather Service provides municipalities with an early warning of expected flooding, particularly in the case of intense hurricanes.

There are no major flood control structures or measures existing, authorized, or proposed in the Boroughs of Highland Park, Metuchen, and South River; in the Cities of Perth Amboy and South Amboy; and in the Townships of Old Bridge and Piscataway.

The Township of Piscataway provides for the cleaning of stream channel and drainage facilities of debris and siltation as required.

While there are a number of dams located within the South River Basin, they were not designed with capacities for flood control.

There are dams located on Devils Brook and Shallow Brook; however, they do not affect the flood flows.

There are no flood protection works in the Townships of Cranbury, Monroe, Plainsboro, and South Brunswick, and the Boroughs of Jamesburg and Spotswood. New construction is subject to the requirements of a township ordinance restricting construction in floodplain areas in accordance with FEMA initial land-use regulation requirements.

The New Jersey Department of Environmental Protection (NJDEP) has adopted rules, regulations, and minimum standards concerning development and use of land, which apply to development in the Boroughs of Helmetta, Milltown, Sayreville, South River and Spotswood, and the City of New Brunswick, and to the Townships of East Brunswick, Monroe, North Brunswick, and South Brunswick.

An arrangement is in effect with the Township of Cranbury that, when the floodgates are opened at Brainerd Lake in Cranbury, Plainsboro is notified. This provides approximately two hours warning for Plainsboro Pond to be watched for rising water levels.

The Borough of South Plainfield has lowered the water-surface elevation at Spring Lake in an attempt to increase retention.

Since the storm of August 2-3, 1973, emergency funds have been used to clear and snag Green Brook and to remove some of the vegetation that had impeded flow in the past. Fill was removed from the floodplain of Green Brook to the encroachment limit as outlined in Flood Hazard Report No. 3 (State of New Jersey, DEP, 1972).

In an effort to tackle flood problems on a regional basis, the Green Brook Flood Control project was initiated. The New Jersey Department of Environmental Protection has partnered with the New York District of the Corps of Engineers to build in Central New Jersey the Green Brook Flood Control Project. NJDEP has partnered with Somerset and Middlesex Counties. The project is supported by the 13 impacted communities and the Green Brook Flood Control Commission.

The Bound Brook portion of the protection is at the lower end of the Green Brook basin and has been the focus of the design and the construction. The structural elements of the Bound Brook Flood Works will be certifiable by FEMA and will provide a 150 year level of protection. The construction of the Bound Brook Flood Works was started in 1999. The Bound Brook Flood Works will cost about 110 million dollars.

The Bound Brook Flood Works consists of an array of the following Structural and Non-Structural Flood Control options: Earthen Levees, Concrete Flood Walls, Closable Flood Barriers, Removal of a five span railroad bridge and embankment, Multiple Bridge Raisings, Large Pumping Stations, Upgrading of multiple elements of major elements of the Bound Brook Storm Water collection system, Buy-outs and Flood Proofing of an Apartment Complex. This is an environmental friendly project with a mitigation of wetlands impacts being addressed at the Finderne Farms site in near-by Bridgewater. (NJDEP 2014)

In the Township of Edison, the only flood protection structures within the study area are located along Bonhamtown Brook in the form of diversion tunnels on Bernard Street and Dorothy Avenue. The diversion tunnels convey flows directly to Mill Brook. The township has also attempted to increase culvert openings on several streams to reduce flooding upstream. There are some non-structural measures of flood protection being used to aid in the prevention of future flood damage. These are in the form of land-use regulations adopted by Edison to control building in the floodplains.

The Boroughs of Sayreville and Milltown have no formal structural measures designed specifically for flood protection, but flows on the Raritan River are regulated by Spruce Run and Round Valley reservoirs.

In the Township of East Brunswick, flows in the lower portion of Lawrence Brook are regulated within the township by the Farrington Reservoir. The reservoir has a storage capacity of 655 million gallons. The township has no other formal structural measures designed specifically for flood protection; flows on the Raritan River are regulated by the Spruce Run and Round Valley Reservoirs. The levee located within the township does not meet the FEMA freeboard requirement.

While there are a number of dams within the Lawrence Brook Basin, they were not designed with capacities for flood control.

Several minor channel improvements have been made along Pumpkin Patch Brook. These were primarily to prevent erosion and do not affect the flood elevations significantly.

In the Township of Woodbridge, the levee constructed on the north side of the South Branch Rahway River between Wood Avenue and the Garden State Parkway protects that area of the industrial park from storms up to a 1-percent annual chance recurrence interval. This levee does not meet FEMA specifications; flood boundaries have been delineated outside the levee. The replacement of the New Dover Road bridge and the channel improvements from the Rahway River upstream to the county park have significantly reduced flooding. Heards Brook and its tributary have been improved from its mouth upstream to Metuchen Avenue. These improvements include a system of trapezoidal and rectangular concrete channels, a well-defined earthen channel, and a massive culvert project under the railroad crossing. Wedgwood Brook has also been improved from its mouth upstream to the railroad embankment.

In the Borough of Carteret, flood protection measures include filling in land in low areas to provide higher elevations before construction, and installing check valves on storm and sanitary lines to prevent back-up in areas of low development.

In the Township of North Brunswick, the Farrington Dam regulates flows in the lower portions of Lawrence Brook. This reduces the flows in that area of the township between Milltown and New Brunswick. The township contains no other formal structural measures designed for flood protection. This township uses the U.S. Department of Housing and Urban Development Flood Boundary and Floodway Map in a manner consistent with sound floodplain zoning.

The City of New Brunswick has no formal structural measures designed specifically for flood protection. But flows on the Raritan River are regulated by the

Spruce Run and Round Valley Reservoirs. Flows in the lower portion of Lawrence Brook are regulated by the Farrington Reservoir (capacity 655 million gallons).

Lake Manalapan Dam is located on the southern corporate limits of Jamesburg with the Township of Monroe. It provides a minimal amount of flood protection to the Borough of Jamesburg, as it affects flows on Manalapan Brook.

Middlesex County has no levee type structure that would require analysis of levee failure and removal under Section D.2.10.3.4.1 of the Draft Atlantic Ocean and Gulf of Mexico Coastal Guidelines update.

In alignment with standard practice used in other FEMA studies, all coastal armoring structures and beach stabilization structures have been included in the analysis without adjusting the analysis to remove the structure or reduce the effects of the structure.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the county, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this FIS. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the county at the time of completion of this FIS. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for the flooding sources studied in detail affecting the county.

Each community within Middlesex County has a previously printed FIS report. The hydrologic analyses described in those reports prior to the June 6, 2010 countywide FIS have been compiled and are summarized below.

Discharges for Bee Brook, Cow Yard Brook, Six Mile Run Branch, Switzgable Brook, Tributary to Carters Brook, Tributary to Cedar Brook, Tributary to

Heathcote Brook, Tributary to Lawrence Brook, Tributary to Manalapan Brook, Tributary to Millstone River, Tributary No.1 to Sucker Brook, Tributary to Six Mile Run, Tributary to No. 1 to Ten Mile Run, Tributary to No.2 to Ten Mile Run were determined using the Rational Method, which obtains flows using the watershed, a coefficient of runoff based on surface conditions within the watershed, and the intensity of rainfall based on concentration time. Varying values of the runoff coefficient were used for different flood frequencies as suggested in the Modified Rational Method of Estimating Flood Flows (National Resources Committee, 1938).

Discharges for Barclay Brook, Barclay's Brook, Beaverdam Brook, Bentley's Brook, Bog Brook, Carters Brook, Cedar Brook No. 1, Cedar Brook No. 2, Cheesequake Creek, Clear Brook, Cranbury Brook, Crossway Creek, Deep Run, Devils Brook, Doty's, Great Ditch, Heards Brook, Heathcote Brook, Heathcote Brook Branch, Ireland Brook, Iresick Brook, Mae Brook, Mellins Creek, Mile Run, Oakeys Brook, Parkway Branch, Pumpkin Patch Brook, Sawmill Brook, Shallow Brook, Six Mile Run, South Branch Rahway River, Stream 14-14-2-2, Stream 14-14-2-3, Sucker Brook, Ten Mile Run, Tennents Brook, Tributary to Cranbury Brook, Tributary to Mile Run and Tributary to Oakeys Brook were based on the method for estimating flood-peak magnitudes shown in Special Report 38 (U.S. Department of the Interior, 1974). This method is based on a multiple regression analysis used to develop mathematical relationships between hydrologic characteristics and flood discharges at the various recurrence intervals (50-, 10-, 2-, 1-annual chance flood) obtained from gaging station data. Flood information from 103 sites was used in making the analysis. Hydrologic parameters included drainage area, main channel slope, surface storage area, and an index of manmade impervious cover based on basin population and development conditions. The 0.2-percent annual chance flood was extrapolated from the lower frequency floods.

Peak discharges for Robinsons Branch and Robinsons Branch Tributary were based on stream flow records at the USGS gage (No. 01396000) at Milton Lake. Values for the 10-, 2-, 1-, and 0.2-percent annual chance flood calculated from a log-Pearson Type III statistical distribution of the annual peak flows from 1940 through 1977, using a weighted gage skew coefficient (Water Resources Council, 1976 & 1967). The flows calculated at the gage were transposed to other specific sites along Robinson Branch and Robinsons Branch Tributary using the drainage area-discharge formula shown above. A transfer coefficient of 0.85 was used since the resulting discharges agreed well with those used in the FIS for Scotch Plains (U.S. Department of Housing and Urban Development, 1977).

Peak discharge-frequency relationships for Matawan Creek were based on a statistical analysis of the stream flow at the discontinued Lake Lefferts stream gage located in the Borough of Matawan (period of record: 1932-1955). Flood-frequency analysis procedures from the Water Resource Council Bulletin 17 (Water Resource Council, 1976) were used. A log-Pearson Type III distribution of annual peak flows at this stream gage was used to determine values of 10-, 2-, 1-, and 0.2-percent annual chance peak discharges (Water Resource Council, 1967). Flows calculated at this gage were transposed to different drainage areas using a drainage area-discharge relationship.

Peak discharges for Mill Brook No. 2 and Bonhamtown Brook were computed using Special Report 38 at the downstream limits of detailed study and the Rational Method at the upstream corporate limits (NJDEP, 1976). Discharges along specific portions of the streams are influenced by the diversion tunnels on Bonhamtown Brook that divert flow from it to Mill Brook above the natural confluence of the streams. The natural and diverted flows for the selected recurrence intervals were determined by hydraulic analyses of the streams and tunnel system.

In the Township of Brunswick, the upper portion of Lawrence Brook (below Monmouth Junction Road and Ridge Road), there is no watershed ridge line between Switzgable Brook and Lawrence Brook. It was necessary to reduce the discharges in the lower portion of Lawrence Brook and increase the discharges for Switzgable Brook and Heathcote Brook.

In the Township of North Brunswick, the upper portion of Oakeys Brook, a diversion channel under the railroad made it necessary to reduce discharges in the main stream. This splitting of the total discharge values was performed through an analysis of both the main stream and the diversion channel to ensure hydraulic continuity at the downstream and upstream ends of the diversion.

For the Rahway River, peak discharges were calculated using the USACE HEC-1 flood hydrograph computer package (USACE, 1973). The HEC-1 model was developed by the USACE Hydrologic Engineering Center (HEC) for the New York District of the USACE in 1976 (USACE, 1976). The model separated the Rahway River into 13 sections of similar hydrologic and hydraulic characteristics, developed flood hydrographs for each section, and routed and combined these hydrographs down the river. The entire model was calibrated to reproduce measured hydrographs at both the USGS gaging stations located at Springfield and Rahway, New Jersey.

For Tributary to Sawmill Brook No. 2, hydrologic analyses were developed using a method for estimating flood-peak magnitudes (U.S. Department of the Interior, 1974). The method is based on a multiple regression analysis used to develop mathematical relationships between flood discharges at the various recurrence intervals (50-, 10-, 2-, and 1-percent annual chance flood) obtained from gaging station data and hydrologic characteristics. Flood information from 103 sites was used in making the analysis. Hydrologic parameters included stream drainage area, main channel slope, surface storage area, and an index of manmade impervious cover based on basin population and development conditions. The 0.2-annual chance flood discharge value was extrapolated from the lower frequency floods.

In the Township of Piscataway, peak discharge-frequency relationships were developed for Ambrose Brook and Bound Brook using methods outlined in Special Report 38 (NJDEP, 1974). Special Report 38 is based on a regression analysis of 103 gages in New Jersey and is used to estimate peak flood magnitudes having selected recurrence intervals for drainage areas larger than 1.0 square mile with various degrees of suburban development. The parameters of basin size, channel slope, surface storage and population density are used in this method.

In the Borough of Middlesex, peak discharges for floods of selected recurrence intervals for the lower portion of Green Brook and Bound Brook were obtained from the Supplemental Flood Hazard Study X (NJDEP, Unpublished).

Peak discharges for floods of the selected recurrence intervals on the upper portion of Green Brook were developed using the following drainage area-discharge relationship:

$$Q_1/Q_2 = (A_1/A_2)^T$$

Where Q_1 is the resulting peak discharge at the site, Q_2 is the peak discharge at the site immediately downstream, A_1 and A_2 are the drainage areas at the two sites, and T is the transfer coefficient. The transfer coefficients used at the various sites on Green Brook are listed below:

Location	T
Just upstream of the confluence of Ambrose Brook	0.73
Just upstream of the confluence of Bound Brook	0.24
Just upstream of the confluence of Bonygutt Brook	0.28

The same transfer relationship was used to develop discharges for Ambrose Brook from its confluence with Green Brook. The transfer coefficients range from 0.86 to 0.95.

In the Borough of Dunellen, the same parameters used in modeling the Bound Brook watershed formed the basis for the development of peak discharges for Bonygutt Brook. Due to the small size of the Bonygutt Brook subwatershed, it was necessary to adjust (lower) discharges as small contributing drainage areas produced the peak at points further upstream. Also, the railroad culvert was routed as a discharge-reducing structure and the appropriate adjustments were made on peak discharges downstream from that point.

In the Township of Piscataway and in the Borough of Middlesex, peak discharge-frequency relationships were developed for Bonygutt Brook using methods outlined in Special Report 38 (U.S. Department of the Interior, 1974).

In the Borough of Highland Park, water-surface elevations of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program.

In the Township of Edison, discharges for Bound Brook and Dismal Brook were calculated using Special Report 38 (U.S. Department of the Interior, 1974). The resulting discharge-frequency curves were adjusted to coincide with the discharge information in Flood Hazard Report No. 15 (NJDEP, 1973). The flows were transposed to specific sites along Bound Brook and Dismal Brook using the drainage area-discharge formula shown above. A transfer coefficient of 0.71 was used since the resulting discharges agreed well with those used in the FISs for South Plainfield and Metuchen (FEMA, 1979 & 1977).

In the Borough of Metuchen, peak discharge-frequency relationships were developed for Dismal Brook using methods outlined in Special Report 38 (NJDEP, 1974).

In the Borough of South Plainfield, discharges for Bound Brook to its confluence with Cedar Brook No. 2 were calculated using Special Report 38, prepared by the USGS in cooperation with the NJDEP (U.S. Department of the Interior, 1974). The resulting frequency-discharge curves were adjusted to coincide with the discharge information from Flood Hazard Report No. 15, published by the NJDEP (1973). Discharges for the remainder of Bound Brook within the borough were determined by the USACE for the Piscataway FIS (U.S. Department of Housing and Urban Development, unpublished).

In the Borough of Dunellen, discharges for Green Brook were then computer based on rainfall-frequency relationships as adjusted in accordance with the discharge-frequency data obtained from USGS gage No. 4035 on Green Brook at Plainfield, New Jersey (U.S. Department of Commerce, 1963). Frequency analysis of historic events indicates that Tropical Storm Doria has a recurrence interval of approximately 100 years on Green Brook. Portions of the watershed, however, experienced flood peaks that approached the 0.2-percent annual chance frequency level. The storm of August 2-3, 1973, has a recurrence interval greater than 500 years on Green Brook in the Borough of Dunellen. This storm has a recurrence interval of approximately 150 years on Bonygutt Brook. These findings appear to be consistent with the rainfall patterns and stream flow conditions prior to these flood events. In considering floods of such magnitude, the washing out of bridges, scouring of stream banks, and temporary restrictions due to debris carried by the flood are unpredictable. This makes greater precision in determining peak-frequency relationships beyond the scope of this study.

In the Township of Plainsboro, flood flows for the Millstone River were based on stream gage records. Flows calculated for the gage located at Kingston (No. 01460500 – 29 years of record for Township of Plainsboro FIS, dated December 1984) were transposed to specific locations on the Millstone River according to the following drainage area-discharge formula:

$$Q_T/Q_G = (A_1/A_2)^T$$

Where Q_T is the discharge at a specific location, A_1 is the drainage area at that point, Q_G is the discharge at the gage, A_2 is the drainage area at the gage, and T is the transfer exponent. A value for T of 0.75 was used for the Millstone River. Values of the 10-, 2-, 1-, 0.2-annual chance flood peak discharges were calculated at the gage using a log-Pearson Type III analysis of annual peak flow data and the natural gage skew (Water Resources Council, 1967). For the portion of the Millstone River studied in the Township of Cranbury, a value of 0.75 was considered to be representative for T.

In the Township of Monroe, there are several gaging stations on the Millstone River. Discharge data for the three gaging stations were obtained and evaluated. Only data for the gaging station (No. 01402000) at Blackwell's Mills were adopted for this study, since the station has a long period of record with reliable data. For the Monroe FIS dated April, 1985, 55 years of record were used in the log-Pearson Type III analysis of computed peak discharge values (Water Resource Council, 1967). Discharges for the Millstone River were obtained based on the ratio from Flood Hazard Report No. 12 and the discharge for the gaging station (NJDEP, 1973).

In the Township of South Brunswick, discharges for Lawrence Brook and the Millstone River were based on stream gage records. Values for the discharges were calculated at the gage using a log-Pearson Type III analysis of annual peak flow data and the natural gage skew (Water Resource Council, 1967). Flows calculated at the gaging station (No. 01405000, 68 years of record) at Farrington Dam on Lawrence Brook were transposed to specific locations on Lawrence Brook according to the following drainage area-discharge formula:

$$Q_T/Q_G = (A_1/A_2)^T$$

A value of 0.5 was used for the transfer exponent T. The transposed discharges from the equation were then weighted with discharges obtained using the regional equation from Special Report 38 (U.S. Department of the Interior, 1974).

Peak discharges for Spa Spring Creek were determined using an average of the Rational Method and the Special Report 38 relationships. The two methods were used because the drainage area for the stream varies from 0.6 and 1.4 square miles and is close to the acceptable drainage area limits of both methods (the upper limit for the Rational Method and the lower limit for the Special Report 38 method). Runoff coefficients for the Rational Method were estimated by field observations based on published values for different land uses (Ven Te Chow, 1959).

Peak discharges for Wigwam Brook were determined using the Rational Method in the Township of Monroe and the Special Report 38 method in the Borough of Jamesburg.

Peak discharges for the Woodbridge River in the Township of Woodbridge were determined using Flood Runoff index curves developed by the New Jersey Department of Conservation and Economic Development, now the Department of Environmental Protection (New Jersey Department of Conservation and Economic Development, 1951).

In the Boroughs of Helmetta, Jamesburg, and Spotswood, and the Township of Monroe, the gaging stations located on the South River at Old Bridge (No. 01405500) and on Manalapan Brook at Spotswood (No. 01405400) were the principal sources of data for defining discharge-frequency relationships for Manalapan Brook and Matchaponix Brook. The gages have been in operation since 1939 and 1957, respectively. Values of peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data (Water Resources Council, 1967). Discharges for Manalapan Brook and Matchaponix Brook were determined based on the ratio from Flood Hazard Reports No. 17 and No. 8 and the discharge for the two gaging stations (NJDEP, 1974 & 1973). In the Borough of Spotswood, Matchaponix Brook was studied with a log-Pearson Type III analysis of annual peak flow data and natural gage skew (Water Resources Council, 1976). Flows calculated for the gages located in Spotswood and at Old Bridge were transposed to specific locations according to the following drainage area-discharge formula:

$$Q_T/Q_G = (A_1/A_2)^T$$

A value of 0.5 was used for T for Matchaponix Brook.

Flows for Lawrence Brook, Raritan River, and South River were based on stream gage records. Values for the 10-, 2-, 1-, and 0.2-annual chance flood peak discharges were calculated at the gages using a log-Pearson Type III analysis of annual peak flow data and the natural gage skew (Water Resources Council, 1976). Flows calculated for gages located on the Raritan River at Calco Dam, on the South River at Old Bridge, and on Lawrence Brook at Farrington Dam were transposed to specific locations according to the following standard area-discharge formula:

$$Q_1/Q_2 = (A_1/A_2)^T$$

For the Raritan River, a value of 0.8 was used for T, which corresponds to a previous study for this portion of the river. For the South River and Lawrence Brook, a value of 0.5 was considered to be more representative.

Information on the methods used to determine peak discharge-frequency relationships for the streams restudied as part of the July 6, 2010 countywide FIS are shown below.

Peak discharge-frequency relationships were developed for Mill Brook No. 1, Boundary Branch Mill Brook No.1 and West Branch Mill Brook No. 1, using methods outlined in Special Report 38 (U.S. Department of the Interior, 1974). Special Report 38 is based on a regression analysis of 103 gages in New Jersey and is used to estimate peak flood magnitudes having selected recurrence intervals for drainage areas larger than 0.63 square mile with various degrees of suburban development. The parameters of basin size, channel slope, surface storage and population density are used in this method.

Peak discharges on the South Branch Rahway River from the effective Township of Woodbridge FIS were utilized from the beginning of the hydraulic model to the confluence with Coppermine Brook. Upstream of the confluence with Coppermine Brook, methods and procedures outlined in New Jersey Special Report 38 (U.S. Department of the Interior, 1974) were utilized to determine peak discharges. Peak discharges on Coppermine Brook were calculated utilizing Special Report 38.

No new detailed hydrologic analyses were carried out for the [date] countywide FIS revision study.

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

TABLE 4 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
AMBROSE BROOK					
At confluence with Green Brook	14.2	1,760	2,735	3,265	4,575
At Middlesex – Piscataway corporate limits	12.8	1,600	2,480	2,990	4,180
At Hoes Lane	9.68	1,325	2,070	2,500	3,485
Upstream of Doty's Brook	7.12	1,040	1,635	1,977	2,650
At Lake Nelson Dam	5.03	735	1,170	1,425	1,915
At So. Washington Avenue	4.52	670	1,071	1,300	1,410
BARCLAY BROOK					
At confluence with Matchaponix Brook	6.0	700	1,140	1,390	2,110
Upstream of confluence with first tributary just above Englishtown Road	3.7	430	710	870	1,335
Upstream of confluence with third tributary upstream of Englishtown Road	2.1	380	630	780	1,210
At its confluence with Manalapan Brook	1.95	390	655	820	1,300
Upstream of Forge Street	1.80	360	610	760	1,220
Upstream of confluence of an unnamed tributary	1.26	245	420	530	860
BEAVERDAM BROOK[1]					
Downstream of confluence with Lawrence Brook	2.1	375	575	700	1,000
Downstream of limit of detailed study	0.6	195	315	420	610

[1]Discharge values reduced downstream of restrictive New Jersey Turnpike culvert

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BEE BROOK					
At confluence with Devils Brook	0.99	215	310	380	510
BENTLEY'S BROOK					
At confluence with Millstone River	4.40	580	970	1,215	1,940
BOG BROOK					
At confluence with Lawrence Brook	1.4	90	155	190	290
At Kuhlthau Avenue	0.7	65	115	140	205
At upstream Milltown – East Brunswick corporate limits	0.4	45	80	95	145
Downstream of limit of detailed study	0.3	45	80	95	145
BONHAMTOWN BROOK					
At confluence with Mill Brook	1.0	50	155	220	500
At Edison – Metuchen corporate limits	0.9	450	610	690	940
BONYGUTT BROOK					
At confluence with Green Brook	2.6	515	810	975	1,425
At Middlesex – Dunellen corporate limits	2.2	475	700	900	1,400
At Dunellen – Piscataway corporate limits	2.1	165	305	395	685
BOUND BROOK					
At Middlesex – Piscataway corporate limits	24.2	1,530	2,800	3,550	6,000
At confluence with Green Brook	21.0	1,640	3,100	4,050	7,600
Just upstream of Stream 14-14-2-2	18.6	1,640	3,100	4,050	7,600
Just upstream of Stream 14-14-2-3	16.6	1,640	3,100	4,050	7,600
Upstream of New Market Lake Dam	16.2	1,640	3,100	4,050	7,600
Just upstream of Cedar Brook No. 2	9.8	980	2,000	2,600	5,000

TABLE 4 - SUMMARY OF DISCHARGES- continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
BOUND BROOK-CONTINUED					
Just upstream of the second crossing of railroad	8.4	930	1,800	2,400	4,500
Approximately 800 feet downstream of Woodbrook Road	5.4	730	1,350	1,800	3,300
At Railroad	3.1	495	915	1,220	2,235
BOUNDARY BRANCH MILL BROOK NO. 1					
At confluence with Mill Brook No. 1	0.75	244	396	483	718
CARTERS BROOK					
At confluence with Heathcote Brook	2.12	500	830	1,035	1,615
At Raymond Road	1.2	320	540	675	1,070
At Mid Point	0.82	215	390	500	760
At Old Road	0.56	160	280	350	520
CEDAR BROOK NO. 1					
At confluence with Cranbury Brook	5.0	570	960	1,200	1,930
Upstream of confluence of Tributary No. 2	3.7	475	800	1,000	1,610
Upstream of confluence of Tributary No. 3	2.2	335	570	715	1,165
At Cranbury-Monroe corporate limits	1.20	210	350	465	730
At Applegarth Road	0.92	185	310	410	610
CEDAR BROOK NO. 2					
At confluence with Bound Brook	6.47	1,152	1,861	2,120	3,300
CEDAR BROOK NO. 3					
At confluence with Manalapan Brook	3.22	120	200	250	370
Downstream of confluence with Tributary to Cedar Brook No. 3	3.17	115	195	245	360
Upstream of confluence with Tributary of Cedar Brook No. 3	3.05	105	190	235	350
At Spotswood-East Brunswick corporate limits	1.02	30	60	80	110

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
CHEESEQUAKE- MELLINS CREEK					
At downstream Old Bridge – Sayreville corporate limits	7.4	165	280	345	500
Downstream of the confluence of Crossway Creek	5.7	155	265	320	470
Upstream of confluence of Crossway Creek	3.8	75	135	165	250
Downstream of Garden State Parkway	3.6	65	120	150	230
Downstream of confluence of Mellins Creek	3.4	60	115	140	220
At mouth of Mellins Creek	0.9	45	95	130	160
At upstream Old Bridge – Sayreville corporate limits	0.7	40	80	110	135
CLEAR BROOK					
At confluence with Cranbury Brook	1.20	220	385	485	785
At Union Valley-Half Acre Road	0.64	*	*	141.9	*
COPPERMINE BROOK					
Upstream of confluence with South Branch Rahway River	2.2	370	600	730	1,100
COW YARD BROOK					
At confluence with Oakeys Brook	0.68	210	315	370	500
At Black Horse Lane	0.59	195	300	360	490
At Deans Road	0.48	190	280	330	440
CRANBURY BROOK					
At confluence with the Millstone River	21.3	710	1,180	1,450	2,295
At Cranbury-Plainsboro corporate limits	18.2	670	1,120	1,380	2,190
Upstream of confluence of Cedar Brook No. 1	13.1	595	1,000	1,230	1,960
Upstream of Main Street	10.7	530	890	1,100	1,755
Upstream of railroad	9.26	435	735	910	1,455
Upstream of confluence of Clear Brook	7.16	315	540	670	1,085

*Data not available

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
CRANBURY BROOK-CONTINUED					
Upstream of confluence of Tributary to Cranbury Brook	4.02	245	420	525	850
At Longstreet Road	1.71	150	300	390	580
CROSSWAY CREEK					
At confluence with Cheesequake Creek	1.9	425	685	840	1,130
Downstream of Garden State Parkway	1.0	340	545	670	950
Upstream of Garden State Parkway	0.4	200	320	400	500
Approximately 880 feet upstream of Frank Avenue culvert	0.1	20	55	90	130
DEEP RUN					
At Old Bridge-Sayreville corporate limits	16.1	955	1,545	1,875	2,845
Upstream of confluence with tributary from Burnt Fly Bog	9.4	1,260	2,030	2,485	3,800
DEVILS BROOK					
At confluence with the Millstone River	16.4	745	1,245	1,535	2,445
Upstream of confluence of Bee Brook	14.7	695	1,165	1,435	2,285
Upstream of confluence of Shallow Brook	6.9	420	710	880	1,425
At the Plainsboro-South Brunswick corporate limits	4.4	290	505	630	1,020
At Culver Road	3.43	255	440	550	895
At Hay Press Road	1.70	240	415	525	855
DISMAL BROOK					
At its confluence with Bound Brook	1.7	325	600	800	1,460
At the Edison-Metuchen corporate limits	1.2	310	500	605	1,030
DOTY'S BROOK					
At confluence with Ambrose Brook	2.04	452	730	893	1,215
At Corporate Place South	0.94	254	395	516	665

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
GREAT DITCH					
Upstream of confluence with Lawrence Brook	8.65	170	300	380	580
GREEN BROOK					
At confluence with Raritan River	65.0	7,500	11,000	12,500	16,750
Just upstream of confluence of Ambrose Brook	51.2	6,300	9,240	10,500	14,070
Just upstream of confluence of Bound Brook	24.3	5,270	7,730	8,800	11,765
Just upstream of confluence of Bonygutt Brook	21.5	5,095	7,470	8,500	11,370
Approximately 780 feet from Warrenville Road	21.51	3,720	6,200	8,500	14,400
Downstream of North Washington Avenue	20.44	3,650	6,100	7,900	14,400
HEARDS BROOK					
At mouth	2.4	640	1,010	1,230	1,810
At Elmwood Avenue	1.4	470	750	910	1,350
At State Route 9	0.9	310	510	630	950
HEATHCOTE BROOK					
At Delaware & Raritan Canal viaduct	9.52	1,611	2,666	3,286	5,065
Upstream of confluence of Carters Brook	5.98	1,141	1,931	2,391	3,705
Upstream of confluence of Heathcote Brook Branch	3.15	751	1,316	1,636	2,550
Upstream of confluence of Switzgable Brook	1.39	270	455	595	915
At a point just east of the intersection of U.S. Route 1 and New Road	0.75	250	375	450	610
HEATHCOTE BROOK BRANCH					
At confluence with Heathcote Brook	1.40	355	595	745	1,280

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
IRELAND BROOK					
At confluence with Lawrence Brook	6.3	450	750	920	1,300
At Fresh Ponds Road	5.4	440	720	890	1,290
Upstream of Fresh Ponds Road	4.5	425	700	870	1,250
At the South Brunswick-East Brunswick corporate Limits	3.4	400	680	830	1,200
Downstream of limit of detailed study	1.4	355	585	730	1,050
IRESICK BROOK					
At mouth	3.4	290	485	595	910
Upstream of confluence with first tributary above Duhernal Lake	2.5	220	370	455	700
LAWRENCE BROOK					
At confluence with Raritan River	44.0	2,405	4,385	5,590	9,360
At New Brunswick-North Brunswick corporate limit	42.5	2,385	4,350	5,545	9,280
Downstream of confluence with Sawmill Brook No. 1	40.7	2,310	4,220	5,375	9,000
Upstream of confluence with Sawmill Brook No. 1	36.9	2,200	4,020	5,120	8,570
Downstream of confluence with Bog Brook	35.6	2,160	3,945	5,025	8,410
Upstream of confluence with Bog Brook	34.2	2,120	3,870	4,925	8,250
Downstream of confluence with Sucker Brook	34.0	2,110	3,855	4,910	8,220
Upstream of confluence with Sucker Brook	32.6	2,065	3,775	4,805	8,050
At Farrington Dam	32.3	2,060	3,760	4,790	8,020
Downstream of confluence with Beaverdam Brook	30.8	2,010	3,670	4,675	7,830
Upstream of confluence with Beaverdam Brook	28.7	1,940	3,545	4,515	7,555
Downstream of confluence with Mae Brook	28.0	1,915	3,495	4,455	7,455
Upstream of confluence with Mae Brook	26.1	1,850	3,375	4,300	7,205

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs)			
		10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
LAWRENCE BROOK-CONTINUED					
Downstream of confluence with Ireland Brook	26.0	1,845	3,370	4,295	7,190
Upstream of confluence with Ireland Brook	19.8	1,610	2,940	3,750	6,275
At the North Brunswick-South Brunswick corporate limit	19.2	1,590	2,900	3,695	6,185
Upstream of confluence of Oakeys Brook	17.50	1,144	1,934	2,414	3,825
Upstream of U.S. Route 130	15.57	1,104	1,864	2,334	3,705
Upstream of Deans-Rhode Hall Road	14.40	1,044	1,764	2,214	3,495
Upstream of confluence of Great Ditch	4.95	514	844	1,064	1,685
Upstream of Major Road	3.59	414	654	824	1,265
Upstream of railroad tracks	2.48	290	340	350	450
MAE BROOK					
At confluence with Lawrence Brook	1.96	375	625	775	1,250
Downstream of Route 130	1.36	270	455	570	840
Approximately 70 feet downstream from Adams Station Lane	0.25	120	225	295	370
MANALAPAN BROOK					
Upstream of confluence of Matchaponix Brook	43.98	1,165	1,905	2,310	3,515
Downstream of confluence of Cedar Brook No. 3	43.87	1,160	1,900	2,305	3,510
Upstream of confluence of Cedar Brook No. 3	40.56	1,120	1,825	2,215	3,375
At Spotswood-Monroe corporate limits	40.5	1,120	1,830	2,210	3,370
Upstream of Daniel Road	39.0	1,100	1,790	2,170	3,310
At Spotswood-Helmetta-Monroe corporate limits	38.79	1,090	1,785	2,165	3,296
Upstream of confluence of Tributary No. 4	38.2	1,080	1,770	2,150	3,270
Upstream of confluence of Sawmill Brook No. 2	33.2	1,010	1,650	2,010	3,050
Upstream of confluence of Tributary to Manalapan Brook	32.1	990	1,630	1,970	3,000

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
MANALAPAN BROOK-CONTINUED					
At the Monroe-Jamesburg corporate limits	30.5	990	1,630	1,970	3,000
Upstream of confluence of Wigwam Brook	28.4	930	1,530	1,850	2,820
Upstream of railroad	27.1	915	1,495	1,810	2,760
Upstream of School House Road	26.1	895	1,465	1,775	2,710
Upstream of Hoffman Street Road	24.7	870	1,430	1,730	2,630
Upstream of confluence of Tributary No. 16	23.7	850	1,400	1,690	2,580
At county boundary	17.3	730	1,195	1,450	2,205
MATAWAN CREEK					
At USGS Gaging Station at Lake Lefferts Dam	6.11	1,080	2,030	2,590	4,410
At New Brunswick Road	4.18	830	1,555	1,990	3,380
MATCHAPONIX BROOK					
At confluence with South River	44.0	1,950	3,090	3,640	5,170
Upstream of Old Texas Road	42.2	1,910	3,020	3,560	5,060
Upstream of confluence of Barclay Brook	35.8	1,760	2,790	3,280	4,660
Upstream of confluence of Tributary No. 2	32.7	1,680	2,660	3,140	4,460
Upstream of confluence of Tributary No. 3	30.3	1,620	2,560	3,020	4,260
Upstream of Old Bridge-Englishtown Road	29.8	1,600	2,540	2,990	4,250
Upstream of Union Hill Road	29.0	1,580	2,510	2,950	4,190
At county boundary	28.4	1,570	2,480	2,930	4,150
MILE RUN					
At Raritan River	5.72	1,210	1,850	2,215	3,000
At Hamilton Avenue	4.18	880	1,370	1,645	2,250
Downstream Tributary to Mile Run	3.00	645	1,015	1,225	1,660
At Livingston Avenue	1.02	325	520	630	880
At Georges Road	0.27	240	455	560	685

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
MILL BROOK NO. 1					
At confluence with Raritan River	2.5	654	1,025	1,236	1,799
Upstream of confluence with West Branch Mill Brook No. 1	1.47	414	658	798	1,174
Upstream of confluence with Boundary Branch Mill Brook No. 1	0.63	189	309	378	566
MILL BROOK NO. 2					
At the railroad bridge	3.1	670	1,060	1,290	1,910
Upstream of the confluence of Bonhamtown Brook	1.5	615	940	1,120	1,640
MILLSTONE RIVER					
At county boundary	170.0	7,330	11,355	13,545	19,420
At South Brunswick-Plainsboro corporate limits	157.8	6,925	10,725	12,800	18,350
Above confluence of Stony Brook	99.0	4,885	7,570	9,030	12,950
Above confluence of Little Bear Brook	81.8	4,230	6,555	7,820	11,215
Above confluence of Big Bear Brook	65.8	3,600	5,575	6,650	9,535
Above confluence of Cranberry Brook	42.7	2,600	4,025	4,800	6,885
At Plainsboro-Cranbury corporate limits	39.3	2,445	3,785	4,515	6,475
Upstream of confluence of Rocky Brook	20.9	1,525	2,360	2,815	4,035
At Cranbury-Monroe corporate limits	16.55	1,280	1,985	2,365	3,395
Upstream of confluence of Bentley’s Brook	9.75	860	1,335	1,590	2,280
At county boundary	7.47	705	1,095	1,305	1,870
OAKEYS BROOK					
At confluence with Lawrence Brook	5.2	725	1,200	1,490	2,100
Upstream of Diversion Channel	3.4	510	850	1,060	1,500
At U.S. Route 1	1.5	265	455	570	860
At Mid Point	0.86	190	335	425	640
At Kroy Road	0.55	145	260	325	640
At Henderson Road	0.35	115	205	265	420

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
PARKWAY BRANCH					
At the mouth	1.3	340	560	690	1,050
PUMPKIN PATCH BROOK					
At county boundary	1.8	440	710	870	1,300
At Inwood Avenue	0.9	264	430	530	800
RAHWAY RIVER					
Downstream of confluence of South Branch Rahway River	77.4	4,874	8,175	9,932	14,984
RARITAN RIVER					
At the Sayreville-South Amboy corporate limits	1,093.0	43,600	54,170	62,090	80,950
At Washington Canal	1,072.0	42,820	53,210	60,990	79,160
At downstream East Brunswick-Edison - Sayreville corporate limits (confluence of the South River)	939.7	38,540	47,890	54,890	71,240
Downstream of Lawrence Brook	932.5	38,300	47,590	54,560	70,800
Upstream of Lawrence Brook	888.5	36,850	45,780	52,480	68,120
Upstream of Mile Run	880.0	36,600	45,100	52,100	67,600
Downstream of Mile Run	878.9	36,530	45,390	52,030	67,530
Upstream of Queens Bridge	785.0	33,000	41,000	47,000	61,000
ROBINSONS BRANCH					
Downstream of confluence of Robinsons Branch Tributary	4.0	560	930	1,130	1,730
At Inman Avenue	2.8	330	550	660	1,020
At Tingley Road	1.5	190	320	390	600
ROBINSONS BRANCH TRIBUTARY					
At Inman Avenue	0.7	95	165	200	310
At the 84-inch diameter culvert	0.3	50	85	100	155
SAWMILL BROOK NO. 1[1]					
At confluence with Lawrence Brook	3.9	370	550	650	895
Downstream of Cranberry Road	0.4	185	345	445	555

[1]DISCHARGE VALUES REDUCED DOWNSTREAM OF RESTRICTIVE NEW JERSEY TURNPIKE CULVERT

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SAWMILL BROOK NO. 2					
At confluence with Manalapan Brook	4.85	255	430	550	815
Upstream of confluence of Tributary to Sawmill Brook	1.09	65	95	130	190
At upstream Helmetta corporate limits	0.74	55	85	105	150
SHALLOW BROOK					
At confluence with Devils Brook	6.0	390	665	830	1,340
At Plainsboro-South Brunswick corporate limits	4.9	340	585	735	1,185
At Mid Point	2.10	310	535	670	1,090
At U.S. Route 130	1.63	275	470	595	970
At the South Brunswick-Monroe corporate limits	0.75	220	365	450	730
At New Jersey Turnpike	0.43	125	185	220	300
SIXMILE RUN					
At County Boundary	3.0	320	540	665	980
Downstream of Hidden Lake Drive	2.0	250	420	520	745
Downstream of Cozzens Lane	1.8	220	375	465	670
At limit of detailed study	0.6	110	205	260	315
SIX MILE RUN BRANCH					
At State Route 27	0.92	330	480	575	760
Upstream of the confluence of Tributary to Six Mile Run Branch	0.37	165	245	290	390
At Stillwell Road	0.27	140	205	245	330
At a point approximately 1,200 feet upstream of Stillwell Road	0.16	100	155	180	245
SOUTH BRANCH RAHWAY RIVER					
At the County Boundary	10.2	1,450	2,250	2,700	3,970
At Gills Lane	5.8	920	1,450	1,760	2,600
At upstream confluence with Parkway Branch	4.2	690	1,100	1,330	1,980
Upstream of confluence with Coppermine Brook	2.3	240	400	490	730

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SOUTH RIVER					
At confluence with Raritan River	132.3	3,905	6,010	7,050	9,650
Upstream of Washington Canal	130.0	3,875	5,965	6,995	9,580
Downstream of confluence of Tennents Brook	125.0	3,785	5,830	6,835	9,360
Upstream of confluence of Tennents Brook	114.0	3,615	5,575	6,540	8,955
Upstream of confluence of Deep Run	97.0	3,345	5,145	6,035	8,265
Downstream of Duhernal Dam	94.6	3,310	5,090	5,975	8,175
At confluence of Matchaponix Brook	88.0	3,185	4,900	5,750	7,870
SPA SPRING CREEK					
At confluence with Woodbridge River	1.1	520	720	820	1,100
At Convery Boulevard	0.6	330	460	520	680
STREAM 14-14-2-2					
At confluence with Bound Brook	1.28	251	414	510	850
STREAM 14-14-2-3					
At confluence with Bound Brook	1.84	420	670	810	1,200
SUCKER BROOK					
At confluence with Lawrence Brook	1.40	360	580	720	1,100
At powerline crossing	1.27	340	560	680	1,050
Downstream of confluence with Tributary to Sucker Brook	1.12	320	520	645	950
Upstream of confluence with Tributary No. 1 to Sucker Brook	0.59	285	435	520	660
At limit of detailed study	0.37	270	390	475	605

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
SWITZGABLE BROOK					
At confluence with Heathcote Brook	0.34	311	566	696	1,030
TEN MILE RUN					
At State Route 27	1.54	350	585	715	1,105
Upstream of confluence of Tributary No. 2 to Ten Mile Run	0.65	225	415	520	790
At Hastings Road	0.13	60	100	130	195
TENNENTS BROOK					
At Sayreville-Old Bridge corporate limits	9.6	475	775	940	1,410
At upstream limits of Tennents Pond	6.1	385	635	775	1,165
TRIBUTARY A TO LAWRENCE BROOK					
At New Road	0.58	210	240	250	320
TRIBUTARY NO. 1 TO SUCKER BROOK					
At confluence with Sucker Brook	0.52	170	310	400	510
At limit of detailed study	0.46	150	280	360	460
TRIBUTARY NO. 1 TO TEN MILE RUN					
At confluence with Ten Mile Run	0.65	200	290	350	470
At Mid Point	0.46	160	240	290	400
At Allstone Road	0.34	155	230	275	380
TRIBUTARY NO. 2 TO TEN MILE RUN					
At confluence with Ten Mile Run	0.26	135	200	240	325
At Leahy Road	0.17	110	165	195	265
At a point approximately 167 feet upstream of Rumson Road	0.07	50	75	85	110

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
TRIBUTARY TO CARTERS BROOK					
At confluence with Carters Brook	0.53	130	195	235	320
At State Route 27	0.44	125	190	225	305
TRIBUTARY TO CEDAR BROOK NO. 3					
At confluence of Cedar Brook No. 3	0.23	120	210	280	350
At midpoint	0.10	70	130	165	205
At upstream Spotswood-East Brunswick corporate limits	0.07	50	95	125	155
TRIBUTARY TO CRANBURY BROOK					
At confluence with Cranbury Brook	2.08	275	475	595	965
At Union Valley-Gravel Hill Road	0.87	250	385	445	580
TRIBUTARY TO HEATHCOTE BROOK					
At confluence with Heathcote Brook	0.63	175	270	325	450
At State Route 27	0.48	160	245	290	395
TRIBUTARY TO LAWRENCE BROOK					
At confluence of Lawrence Brook	0.53	215	325	380	510
Upstream of an Unnamed tributray	0.14	60	90	105	140
TRIBUTARY TO MANALAPAN BROOK					
At confluence with Manalapan Brook	0.32	85	130	160	225
TRIBUTARY TO MILE RUN					
At confluence of Mile Run	1.98	440	700	850	1,160
At Route 91 – Jersey Avenue	1.48	370	595	725	1,010
At Somerset Street	0.43	260	475	610	760

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
TRIBUTARY TO MILLSTONE RIVER					
At confluence with Millstone River	0.5	95	145	170	230
At a point 3,447 feet upstream of mouth	0.3	75	115	135	180
TRIBUTARY TO OAKEYS BROOK					
At confluence with Oakeys Brook	1.12	240	405	520	810
At Black Horse Lane	0.99	230	400	520	800
At U.S. Route 1	0.80	225	400	510	780
At Henderson Road	0.66	205	360	470	720
At a point approximately 6,000 feet upstream of Confluence with Oakeys Brook	0.34	115	205	255	390
TRIBUTARY TO SAWMILL BROOK NO. 2					
At confluence with Sawmill Brook No. 2	3.62	295	440	540	840
TRIBUTARY TO SIX MILE RUN BRANCH					
At confluence with Six Mile Run Branch	0.32	160	240	280	375
At Sand Hills Road	0.22	125	185	215	285
At limit of detailed study	0.10	75	110	130	175
WEST BRANCH MILL BROOK NO. 1					
At confluence with Mill Brook No. 1	0.95	292	470	572	848
WIGWAM BROOK					
At confluence with Manalapan Brook	1.36	350	540	675	1,075
At the Monroe-Jamesburg corporate limits	0.72	190	340	425	610
At a point approximately 3,700 feet upstream of Monroe-Jamesburg corporate limits	0.30	105	190	240	385

TABLE 4 - SUMMARY OF DISCHARGES - continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
WOODBRIDGE RIVER					
At confluence with Arthur Kill	9.9	2,120	2,590	2,740	2,850
Upstream of confluence of Spa Spring Creek	8.0	1,780	2,180	2,310	2,400
Upstream of confluence of Heards Brook	4.6	1,370	1,670	1,770	1,840
Upstream of confluence of Wedgewood Brook	2.7	990	1,210	1,280	1,330
At Omar Avenue	0.6	380	470	500	520

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the source studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Users should be aware that flood elevations shown on the FIRM represent rounded whole-foot elevations and may not exactly reflect the elevations shown on the Flood Profiles or in the Floodway Data tables in the FIS report. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Cross sections were determined from topographic maps and field surveys. All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. All topographic mapping used to determine cross sections is referenced in Section 4.1.

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

Each incorporated community within Middlesex County has a previously printed FIS report. The hydraulic analyses described in those reports prior to the July 6, 2010 countywide FIS have been compiled and are summarized below.

The rivers in the Township of North Brunswick are part of the Raritan River Basin system. To ensure consistency, a continuous backwater analysis starting at the mouth of the Raritan River was performed. The Township of North Brunswick is contained within the scope of this analysis which encompasses seven communities in the immediate area. Riverine flood elevations for the 10- through 0.2-percent annual chance flood events were calculated using a tide elevation of 4.6 feet North American Vertical Datum (NAVD 88) as a starting condition at the mouth of the Raritan River. The calculated Raritan River flood elevations at the junction with

Lawrence Brook were used as starting water-surface elevations for the backwater analysis of Lawrence Brook. Similarly, the backwater analyses of Tributary No. 1 to Sucker Brook, Oakeys Brook, Six Mile Run, Mile Run, and Diversion Channel were conducted in the same manner. Starting water-surface elevations for Mae Brook were performed using the slope/area method.

Along the detailed study reach of the streams, an analysis of hydraulic characteristics was conducted to establish flood elevations for the selected recurrence intervals. Cross sections for the backwater analysis were taken at appropriate locations to compute the significance of natural and manmade obstructions upon flood flows. The valley portion of these was obtained photogrammetrically, while the below water portion was determined by actual field surveys conducted by GEOD Aerial Mapping, Inc. (GEOD Aerial, 1976). Where possible, bridge and dam plans were utilized, and where plans were not available, all significant hydraulic features of structures were measured in the field.

Using this cross-sectional data in the USACE HEC-2 backwater computer program enabled the computation of water-surface elevations for floods of the selected recurrence intervals (USACE, 1973). Where possible, computed water-surface elevations were compared with recorded gage data and were also in agreement to a tolerance of 0.5 foot (U.S. Department of the Interior, 1976).

In the Township of North Brunswick, the approximate 1-percent annual chance flooding for the Hidden Lake area was developed by interpolation of depths from curves contained in Water Resources Circular No. 14 which depict depths of flooding as a function of the mean annual flood for coastal and non-coastal plains in the State of New Jersey (New Jersey, Department of Conservation and Economic Development and the Division of Water Policy and Supply, 1964). These depths were translated to the mapping with the final delineation being tempered with regard to past flood history and on-site examinations.

In the Township of Cranbury, overbank cross sections for the streams studied in detail were obtained from aerial photographs (Quinn and Associates, 1976). The below-water sections were obtained by field measurement.

In the Township of Edison, cross sections were located above and below bridges, at control locations along the stream lengths, and at significant changes in ground relief, land use, and land cover. Stream channel sections were field surveyed and combined with available topographic data on the overbanks. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

The HEC-2 computer program and hand calculations were used to determine the hydraulic operation of the diversion tunnels on Bonhamtown Brook along Bernards Street and Dorothy Avenue. The HEC-2 model for the Raritan River is based on Flood Hazard Report No. 2 for the Raritan River (New Jersey Department of Environmental Protection, 1982).

In the Township of Edison, cross-section data were obtained from topographic maps compiled from aerial photographs (Quinn & Associates, 1976); below-water sections were obtained by field measurement. Cross sections were located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures in the urbanized areas.

In the Township of East Brunswick, cross sections for the backwater analyses were taken at appropriate locations to compute the significance of natural and manmade obstructions on flood flows. The valley portion of the cross sections was obtained photogrammetrically, while the below-water portion was determined by field surveys (GEOD Aerial, 1976). Where possible, bridge and dam plans were utilized; where plans were not available, all significant hydraulic features of structures were field measured. On undeveloped reaches, or on long reaches between structures, cross sections were located at regular intervals and at changes in valley configuration. At structures, to determine their ability to pass flood flows, cross sections were taken at close intervals upstream and downstream of structures and used in conjunction with their significant hydraulic structures.

In the Township of Plainsboro, overbank cross-section data were obtained from topographic maps compiled from aerial photographs (A.D.R., 1973; Quinn and Associates, 1976).

In the Township of Piscataway, cross sections for the backwater analyses of the Raritan River, Ambrose Brook, Doty's Brook, and Bonygutt Brook were field surveyed and located at close intervals above and below bridges and culverts in order to compute the significant backwater effects of these structures. Cross sections for the backwater analyses of Bound Brook were provided by the NJDEP, Division of Water Resources, as used in their Raritan River Flood Hazard Report No. 15 (Anderson-Nichols and Company, 1973). The information was field checked to ensure accuracy and updated where necessary.

In the Borough of Metuchen, channel cross sections and partial overbank cross sections were obtained through field surveys. The overbanks were extended using topographic maps as prepared by Geod Corporation from an aerial survey (Geod Corporation, 1976). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

In the Borough of Metuchen, starting conditions for Dismal Brook and Bonhamtown Brook studied in detail were determined by slope-energy methods.

In the Borough of South Plainfield, cross-section information from Flood Hazard Report No. 15 (New Jersey Department of Environmental Protection, 1974) was used for Bound Brook and for the lower portion of Cedar Brook No. 2 to Kenyon Avenue.

For the remaining streams, channel cross sections and partial overbank cross sections were obtained through field surveys. The overbanks were extended using the NJDEP topographic maps, dated April 26, 1971 (New Jersey Department of Environmental Protection, 1971).

In the Borough of South River, cross sections for the backwater analysis of the South River were taken at appropriate locations to compute the significant effects of natural and manmade obstructions on flood flows. The valley portion of these cross sections was obtained photogrammetrically (A. O. Quinn Associates, 1968; GEOD Aerial, 1976). The below-water portion was determined by field surveys (GEOD Aerial, 1976). Where possible, bridge and dam plans were utilized; where plans were not available, all significant hydraulic features of structures were measured in the field.

In either undeveloped segments or long segments between structures, cross sections were located at regular intervals and at changes in valley configuration. To determine the ability of structures to pass flood flows, cross sections were taken at close intervals upstream and downstream and used in conjunction with the significant hydraulic features of the structures.

In the Borough of Middlesex, cross sections for the backwater analyses of the Raritan River were developed by the USACE from Flood Hazard Report No. 2 for the river (New Jersey Department of Environmental Protection, 1972). Bridge opening geometry and underwater cross sections were obtained from the Works Progress Administration (Works Progress Administration, 1937). For Green Brook and Bound Brook, cross sections were developed using the Supplemental Flood Hazard Report X (New Jersey Department of Environmental Protection, unpublished). For Ambrose Brook and Bonygutt Brook, cross sections and bridge opening geometry were field surveyed to obtain elevation data.

In the Borough of Helmetta, overbank cross-section data for the streams studied by detailed methods were obtained from topographic maps compiled from aerial photographs (Quinn and Associates of Horsham, 1976).

In the Borough of Milltown, cross sections for the backwater analysis were taken at appropriate locations to compute the significance of natural and manmade obstructions upon flood flows. The valley portion of these was obtained photogrammetrically, while the below-water portion was determined by field surveys (GEOD Aerial, 1976).

In the Borough of Milltown, in undeveloped reaches, or on long reaches between structures, cross sections were located at regular intervals and at changes in valley configuration. At structures, to determine their ability to pass flood flows, cross sections were taken at close intervals up and downstream and used in conjunction with the significant hydraulic features of the structure.

In the Borough of Milltown, at some locations along study streams, hydraulic conditions may create a situation of supercritical flow. Because of the inherent instability of such a condition, an assumption of critical flow has been adopted for the backwater analyses of this study.

In the City of Perth Amboy, cross-section data and structural geometry were obtained from the channel improvements study developed by Killam Associates (Killam Associates, 1974). Cross-section data and structural geometry for Spa Spring Creek were determined using field survey.

In the Township of Woodbridge, cross-section data and bridge and culvert geometry for the Rahway River and the South Branch Rahway River were field surveyed by the USACE for their studies in the basin (USACE, 1973). The cross-section data and structure geometry for the Woodbridge River were obtained from the channel improvements study developed by Killam Associates (Killam Associates, 1974). Cross-section data from the mouth of Heards Brook upstream to Gorham Avenue was also obtained from channel improvement plans (Killam Associates, 1976). Cross-section and structure data for Heards Brook upstream from Gorham Avenue upstream, and for Parkway Branch, Pumpkin Patch Brook, and Spa Spring were field surveyed by Richard Browne Associates for this study.

In the Borough of Spotswood, field surveys were conducted by Lynch, Carmody, Guiliano, & Karol, P.A.

In the Township of Old Bridge, channel cross sections and partial overbank cross sections for the streams studied by detailed methods were obtained through field surveys. The overbanks were extended using topographic maps compiled from aerial photographs (Topographic Data Consultants, 1980; New Jersey Department of Environmental Protection, Middlesex County, no date; County of Middlesex, no date). For Matawan Creek, water-surface elevations of floods of the selected recurrence intervals were computed through use of the USACE HEC-2 step-backwater computer program.

In the Township of Cranbury, water-surface elevations for the streams studied by detailed methods were computed through use of the USACE HEC-2 step-backwater computer program (USACE, 1973). Starting water-surface elevations for Cranbury Brook and Tributary to Millstone River in the Township of Cranbury were taken from the computed elevations of the Millstone River at these streams' confluences. Starting water-surface elevations for Cedar Brook were taken from the computed elevations on Cranbury Brook at the confluence of Cedar Brook.

In the Township of Edison, starting water-surface elevations for Mill Brook were obtained from the previous FIS for Edison (FEMA, 1982). Starting water-surface elevations for Dismal Brook, Robinsons Branch Tributary, and Bonhamtown Brook in the Township of Edison, were based on coincidental flood heights on the receiving main streams.

The Robinsons Branch model was calibrated to measured high-water marks from the August 1971 storm.

Starting water-surface elevations for Bentley's Brook in the Township of Monroe were determined assuming coincident peaks at its confluence with the Millstone

River. Starting water-surface elevations for Barclay's Brook and Wigwam Brook were determined assuming coincident peaks at their respective confluence with Manalapan Brook. Starting water-surface elevations for Tributary to Cranbury Brook and Clear Brook were determined assuming coincident peaks at their respective confluence with Cranbury Brook. Starting water-surface elevations for Tributary to Manalapan Brook were determined using critical depth calculations.

For the streams studied by approximate methods, the extent of the 1-percent annual chance flood was determined using depth-discharge-frequency relations for coastal and non-coastal floodplain sites in New Jersey.

In the Township of East Brunswick, where possible, computed water-surface elevations were compared with recorded gage data and were also in agreement to a tolerance of 0.5 foot (U.S. Department of the Interior, 1976).

The May 3, 1990, FIS for the Township of East Brunswick was based on a revised HEC-2 analysis for Cedar Brook No. 3. All hydraulic input data used in the revised model are consistent with the 1982 FIS.

The streams in the study area are part of the Raritan River basin and, to ensure consistency, a continuous backwater analysis starting at the mouth of the Raritan River was performed. The Township of East Brunswick is contained within the scope of this analysis, which encompasses seven communities in the immediate area. Riverine elevations for the 10-, 2-, 1-, and 0.2-percent annual chance floods were calculated using a tidal elevation of 5.7 feet as a starting condition at the mouth of the Raritan River. The calculated Raritan River elevations at the junctions were used as the starting water-surface elevations for the backwater analyses of the South River and Lawrence Brook. Similarly, the backwater analyses of Cedar Brook No. 3, Irelands Brook, and Beaverdam Brook were conducted in the same manner, with the exception of Big Brook.

In the Township of East Brunswick, due to the large differences in drainage area between Lawrence Brook and Bog Brook, a probability analysis was performed which showed that these streams would not peak concurrently. For Bog Brook, in the vicinity of its confluence, a series of backwater calculations was conducted using conditions that would be less severe than those resulting from assuming concurrent peaks. For each frequency flood, two starting combinations were examined. One is based on the respective tributary flow in combination with a moderate main stem water-surface elevation, and a second is based on a moderate tributary flow in combination with the respective main stem water-surface elevation. For example, a 1-percent annual chance discharge for Bog Brook was used in combination with a 10-percent annual chance flood elevation on Lawrence Brook as a starting water surface and vice versa. These combinations produced an envelope of curves for each frequency flood. Within this envelope area, the higher water surfaces are considered reasonable for flooding conditions of the given frequency and are presented on the profiles.

Since the Washington Canal carries the majority of the South River flow through the swamp area encompassing it, the backwater analysis of the South River was routed through the Washington Canal upstream to its confluence with the South River. Thus, the model bypasses the downstream segment of the South River.

Starting water-surface elevations for the Millstone River were obtained from the FIS for the Township of South Brunswick (FEMA, 1985). Starting water-surface elevations for Devils Brook, Shallow Brook, Bee Brook, Cranbury Brook, and Cedar Brook No. 1 in the Township of Plainsboro were calculated by coincident peak flow assumptions from their respective main stems.

In the Township of Plainsboro, for the streams studied by approximate methods, the extent of the 1-percent annual chance flood was determined using depth-discharge-frequency relationships for coastal and non-coastal plain sites in New Jersey (New Jersey Department of Environmental Protection, 1974).

In the Township of South Brunswick, starting water-surface elevations for Lawrence Brook and the Millstone River were obtained from the FISs for the Townships of East Brunswick and Franklin, respectively (FEMA, 1981, 1979). Starting water-surface elevations for Six Mile Run Branch and Ten Mile Run were determined by normal depth calculations. Starting water-surface elevations for the Tributary to Carters Brook, Carters Brook, Heathcote Brook Branch, Tributary to Six Mile Run Branch, Six Mile Run Branch, Cow Yard Brook, Tributary to Oakeys Brook, Great Ditch, Tributary to Lawrence Brook, Switzgable Brook, Heathcote Brook, Tributary Nos. 1 and 2 to Ten Mile Run, and Tributary to Heathcote Brook studied by detailed methods were determined assuming coincident peak flows.

Starting water-surface elevations on the Millstone River were taken from the FIS for the Borough of Manville (U.S. Department of Housing and Urban Development, 1978).

In the Township of Piscataway, starting water-surface elevations for Bound Brook and Bonygutt Brook were determined by analysis of rating curves developed by McPhee, Smith and Rosenstein, engineers who performed a basin-wide study of the area. Starting water-surface elevations for the 10- and 1-percent annual chance floods for Ambrose and Doty's Brooks were obtained from a study by T & M Associates (T & M Associates, 1981). The 2- and 0.2-percent annual chance starting water-surface elevations for Ambrose and Doty's Brooks were determined by extrapolating the 10- and 1-percent annual chance water-surface elevations.

In the Borough of South Plainfield, for Stream 14-14-2-2, starting water-surface elevations were determined by using the New Brunswick Avenue bridge as the control structure. Stream 14-14-2-3 and Cedar Brook in the Borough of South Plainfield are all tributaries to Bound Brook; thus, the starting water-surface elevations were taken from the Bound Brook profile.

In the Borough of Dunellen, water-surface elevations obtained from the FISs for the Borough of Middlesex and the Township of Green Brook were used where

Bonygutt Brook forms the corporate limits between these communities and the Borough of Dunellen (U.S. Department of Housing and Urban Development, 1976; FEMA, 1988). For areas of Bonygutt Brook that were not studied in the Middlesex and Green Brook studies, backwater computations using standard NRCS computer programs were used to determine water-surface profiles (U.S. Department of Agriculture, 1972). Bernoulli's Theorem was applied to the total energy head at each cross section, and Manning's formula was used to determine friction losses between cross sections. At road and railroad crossing structures, water-surface computations were made for open channel flow, pressure flow, and weir flow, or a combination of those.

Starting water-surface elevations for Green Brook were obtained from the FIS for the Township of Green Brook (FEMA, 1988).

In the Borough of Middlesex, water-surface elevations of floods of the selected recurrence intervals for the Raritan River were computed using the USGS E-431 step-backwater computer program (U.S. Department of the Interior, 1974).

In the Borough of Middlesex, starting water-surface elevations for Green Brook were determined assuming coincident peaks at its confluence with the Raritan River. Starting water-surface elevations for Bound Brook were determined assuming coincident peaks at its confluence with Green Brook. Starting water-surface elevations for Ambrose Brook and Bonygutt Brook were determined using normal depth calculations.

In the Borough of Helmetta, starting water-surface elevations for Sawmill Brook No. 2 and Tributary to Sawmill Brook No. 2 were taken at their respective confluence assuming coincident peak flows.

In the Borough of Milltown, the rivers in the study area are part of the Raritan River Basin system, so, to ensure consistency, a continuous backwater analysis starting at the mouth of the Raritan River was performed. The Borough of Milltown is within the scope of this analysis, which encompasses seven communities in the immediate area. Riverine flood elevations for the selected recurrence intervals were calculated using a tide elevation of 4.6 feet NAVD as a starting condition at the mouth of the Raritan River. The calculated Raritan River flood elevations at the confluence with Lawrence Brook were used as the starting water surface for the backwater analysis of Lawrence Brook. The backwater analyses of Bog Brook and Sucker Brook were conducted in the same manner. In the Borough of Milltown, starting elevations for Sawmill Brook were performed using the slope/area method.

In the Borough of Jamesburg, starting water-surface elevations for Manalapan Brook were obtained from the FIS for the Township of Monroe and were coordinated with Flood Hazard Report No. 8 (FEMA, 1987; New Jersey Department of Environmental Protection, 1972).

In the City of New Brunswick, the rivers in the study area are part of the Raritan River Basin system and to ensure consistency, a continuous backwater analysis starting at the mouth of the Raritan River was performed. The City of New Brunswick is contained within the scope of this analysis, which encompasses seven communities in the immediate area. Riverine flood elevations for the 10- through 0.2-percent annual chance flood events were calculated using a tidal elevation of 4.6 feet as a starting condition at the mouth of the Raritan. The calculated Raritan River flood elevations at the junction with Lawrence Brook were used as starting water-surface elevations for the backwater analysis of Lawrence Brook. Similarly, the backwater analysis of the Tributary to Mile Run was conducted in the same manner.

In the Township of Woodbridge, starting water-surface elevations on the Rahway and Woodbridge Rivers were taken from the 10-percent annual chance tide level on Arthur Kill. Normal depth, taken from slope/area calculations, was used for the starting water-surface elevations for Parkway Branch, Spa Spring Creek, and Heards Brook.

The HEC-2 model used for the Rahway River was originally coded in 1974 as part of a Special Flood Hazard Information Report prepared for the New York District of the USACE (USACE, 1975). This model was adjusted in 1976 as part of the comprehensive hydrologic-hydraulic analyses prepared by the USACE Hydrologic Engineering Center (USACE, 1976). Although the coding of the model is deficient in certain areas when compared to current criteria, the hydraulic parameters were adjusted so that the final model duplicated historical field-surveyed flood marks along the entire river.

In order to develop a valid floodway with this model for flood insurance purposes (Section 4.2), certain parameters had to be adjusted so that the model geometry agreed with the mapping used for delineation. Since these adjustments generally did not alter the calibrated water-surface elevations by more than one or two tenths of a foot, it was decided by FEMA that the adjusted model would be used for this study after it was updated to reflect current conditions in the watershed (e.g., bridges that were replaced or washed out since the original model was developed).

New HEC-2 models were developed for Parkway Branch, Pumpkin Patch Brook, the Woodbridge River, Spa Spring, and Heards Brook.

In the Township of Woodbridge, normal depth from slope/area calculations was used as the starting water-surface elevation for Pumpkin Patch Brook (FEMA, September 20, 2006).

Within the City of Rahway, starting water-surface elevations for South Branch Rahway River were obtained from a known water-surface elevation from Arthur Kill (FEMA, September 2006).

In the Borough of Sayreville, starting water-surface elevations for Robinson River, Tennents Brook, and Crossway Creek studied in detail, except for the South River, were calculated using the Raritan Bay tidal elevation of 5.7 feet. Starting water-surface elevations for the South River were taken at its confluence with the Raritan River.

Since the Washington Canal carries the majority of the South River flow through the swamp area encompassing it, the backwater analysis of the South River was routed through the Washington Canal upstream to its confluence with the South River. Thus, the model bypasses the downstream segment of the South River.

In the Borough of Spotswood, the calculated Raritan River flood elevations at the confluence of the South River were used as the starting water-surface elevation for the backwater analysis of the South River. Similarly, concurrent peaks were assumed for the starting conditions for the backwater analysis of the Tributary to Cedar Brook.

In the Township of Old Bridge, for Iresick Brook, the starting water-surface elevations were determined using critical depth over the control structure at Riverdale Road. For Barclay Brook and Deep Run, starting water-surface elevations were determined using the slope/area method.

For the July 6, 2010 countywide FIS, water surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-RAS standard step-backwater computer software (USACE, 2004).

Starting water-surface elevations for the Mill Brook No.1 was obtained from the effective NOAA Tide & Currents data for New Brunswick, NJ, Tide Gage on Raritan River, Station ID 8531463.

Starting water-surface elevations for Boundary Branch Mill Brook No.1, Coppermine Brook, and West Branch Mill Brook No.1 were obtained utilizing the slope/area method.

Starting water-surface elevations for South Branch Rahway River were obtained from the effective Township of Woodbridge FIS.

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

The hydraulic analyses for this FIS 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.

No new hydraulic analyses were carried out for the [date] countywide FIS revision.

Roughness factors (Manning's "n") used in the hydraulic computations were chosen by engineering judgment and were based on field observations of the streams and floodplain areas. Roughness factors for all streams studied by detailed methods are shown in Table 5, "Manning's "n" Values."

TABLE 5 - MANNING'S "n" VALUES

Stream	Channel “n”	Overbank “n”
Ambrose Brook	0.013-0.030	0.030-2.00
Barclay Brook	0.020-0.045	0.040-0.150
Barclay's Brook	0.020-0.042	0.090-0.110
Beaverdam Brook	0.030-0.045	0.055-0.110
Bee Brook	0.045	0.100-0.120
Bentley's Brook	0.035	0.070
Bog Brook	0.030-0.045	0.055-0.110
Bonhamtown Brook	0.035	0.050-0.080
Bonygutt Brook	0.024-0.030	0.070-0.080
Bound Brook	0.015-0.045	0.050-0.165
Boundary Branch Mill Brook No. 1	0.012-0.040	0.013-0.100
Carters Brook	0.040-0.060	0.120-0.160
Cedar Brook No. 1	0.020-0.055	0.080-0.140
Cedar Brook No. 2	0.015-0.040	0.050-0.100
Cedar Brook No. 3	0.030-0.045	0.055-0.110
Cheesequake Creek	0.030	0.040-0.065
Clear Brook	0.013-0.040	0.080-0.110
Coppermine Brook	0.026-0.040	0.050-0.090
Cow Yard Brook	0.040	0.120
Cranbury Brook	0.013-0.055	0.08-0.140
Crossway Creek	0.025-0.048	0.035-0.150
Deep Run	0.020-0.045	0.030-0.130
Devils Brook	0.035-0.045	0.090-0.120
Dismal Brook	0.035-0.150	0.015-0.100
Diversion Channel	0.035-0.040	*
Doty's Brook	0.025-0.030	0.035-0.100
Great Ditch	0.040	0.100
Green Brook	0.018-0.050	0.080-0.300
Heards Brook	0.015-0.040	0.030-0.080
Heathcote Brook	0.030-0.055	0.090-0.120
Heathcote Brook Branch	0.040	0.120
Ireland Brook	0.030-0.045	0.055-0.110
Iresick Brook	0.020-0.033	0.040-0.120
Lawrence Brook	0.030-0.055	0.060-0.110
Mae Brook	0.035-0.040	0.060-0.100
Manalapan Brook	0.020-0.040	0.080-0.110
Matawan Creek	0.018-0.040	0.060-0.100

*Data not available

TABLE 5 - MANNING'S "n" VALUES- continued

Stream	Channel “n”	Overbank “n”
Matchaponix Brook	0.040-0.060	0.100-0.200
Mellins Creek	0.030	0.040-0.065
Mile Run	0.035-0.040	0.070-0.100
Mill Brook No. 1	0.012-0.040	0.013-0.100
Mill Brook No. 2	0.035	0.050-0.080
Millstone River	0.030-0.055	0.050-0.110
Oakeys Brook	0.035-0.045	0.070-0.100
Parkway Branch	0.030-0.045	0.080
Pumpkin Patch Brook	0.025-0.040	0.080
Rahway River	0.027-0.035	0.035-0.080
Raritan River	0.030-0.045	0.060-0.100
Robinsons Branch	0.020-0.100	0.080-0.150
Robinsons Branch Tributary	0.035	0.080-0.100
Sawmill Brook No. 1	0.030-0.050	0.055-0.120
Sawmill Brook No. 2	0.020-0.050	0.090-0.120
Shallow Brook	0.020-0.050	0.090-0.120
Sixmile Run	0.035-0.040	0.060-0.100
Six Mile Run Branch	0.045-0.075	0.090-0.140
South Branch Rahway River	0.012-0.045	0.013-0.100
South River	0.030-0.045	0.060-0.100
Spa Spring Creek	0.030	0.040-0.080
Stream 14-14-2-2	0.015-0.040	0.050-0.100
Stream 14-14-2-3	0.015-0.040	0.050-0.100
Sucker Brook	0.035-0.045	0.055-0.100
Switzgable Brook	0.040-0.050	0.090
Ten Mile Run	0.055-0.060	0.130-0.180
Tennents Brook	0.030	0.060
Tributary No. 1 to Sucker Brook	0.035-0.040	0.055-0.100
Tributary No. 1 to Ten Mile Run	0.060-0.065	0.180-0.200
Tributary No. 2 to Ten Mile Run	0.055-0.060	0.160-0.180
Tributary to Carters Brook	0.060	0.140-0.160
Tributary to Cedar Brook No. 3	0.040-0.090	0.040-0.090
Tributary to Cranbury Brook	0.035-0.040	0.100-0.120
Tributary to Heathcote Brook	0.030-0.050	0.120
Tributary to Lawrence Brook	0.040	0.120
Tributary to Manalapan Brook	0.030-0.045	0.100-0.120
Tributary to Mile Run	0.040-0.045	0.070-0.100
Tributary to Mill Brook	0.080-0.150	0.015-0.035
Tributary to Millstone River	0.040-0.050	0.09-0.120
Tributary to Oakeys Brook	0.035	0.070
Tributary to Sawmill Brook No. 2	0.020-0.070	0.110-0.120

TABLE 5 - MANNING'S "n" VALUES- continued

Stream	Channel "n"	Overbank "n"
Tributary to Six Mile Run Branch	0.040-0.060	0.070-0.110
West Branch Mill Brook No. 1	0.012-0.040	0.013-0.100
West Branch Rahway River	0.012-0.040	0.013-0.100
Wigwam Brook	0.015-0.035	0.090-0.120
Woodbridge River	0.025-0.030	0.060-0.100

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

All elevations are referenced to the North American Vertical Datum of 1988 (NAVD 88).

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

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

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

In addition to NSRS bench marks, the FIRM may also show vertical control 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 bench marks shown on the FIRM for this jurisdiction, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their Web site at www.ngs.noaa.gov.

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

3.3 Coastal Analysis

The FEMA, Region II office, initiated a study in 2009 to update the coastal storm surge elevations within the states of New York and New Jersey including the Atlantic Ocean, the Barnegat Bay, the Raritan Bay, the Jamaica Bay, the Long Island Sound and their tributaries. The study replaces outdated coastal analyses as well as previously published storm surge stillwater elevations for all FIS Reports in the study area, including Middlesex County, NJ, and serves as the basis for updated FIRMs. The coastal study for the New Jersey Atlantic Ocean coast and New York City coast was conducted for FEMA by RAMPP under contract HSFEHQ-09-D-0369 task order HSFE02-09-J-0001.

The end-to-end storm surge modeling system includes the Advanced Circulation Model for Oceanic, Coastal and Estuarine Waters (ADCIRC) for simulation of 2-dimensional hydrodynamics. ADCIRC was dynamically coupled to the unstructured numerical wave model Simulating Waves Nearshore (unSWAN) to calculate the contribution of waves to total storm surge (FEMA, 2010). The resulting model system is typically referred to as SWAN+ADCIRC (FEMA, 2010). A seamless modeling grid was developed to support the storm surge modeling efforts. The modeling system validation consisted of a comprehensive tidal calibration followed by a validation using carefully reconstructed wind and pressure fields for six major flood events for the Region II domain: the 1938 hurricane, the Great Atlantic Hurricane of 1944, Hurricane Donna, Hurricane Gloria, and two extra-tropical storms, from 1984 and 1992. Model skill was assessed by quantitative comparison of model output to wind, wave, water level and high water mark observations. The model was then used to simulate 30 historical extra-tropical storms and 157 synthetic hurricanes to create a synthetic water elevation record from which the 10-, 2-, 1-, and 0.2- percent annual chance of exceedence elevations were determined. Two of the more recent storm events, Hurricane Irene and Hurricane Sandy were not used in this study for validation. Both Hurricane Irene and Hurricane Sandy occurred during the study or after this storm surge was completed. Hurricane Irene was a major rainfall event and did not produce major coastal tidal flooding. The climatology of Hurricane Sandy, at this time, is not well studied.

Wave setup results in an increased water level at the shoreline due to the breaking of waves and transfer of momentum to the water column during hurricanes and severe storms. For the New York and New Jersey surge study, wave setup was determined directly from the coupled wave and storm surge model. The total stillwater elevation (SWEL) with wave setup was then used for the erosion and wave modeling.

The stillwater elevations for the 10-, 2-, 1-, and 0.2- percent annual chance floods determined for the primary sources of flooding in Middlesex County: the Arthur Kill, Raritan River, Raritan Bay are shown in Table 6, "Transect Data." The analyses reported herein reflect the stillwater elevations due to tidal and wind setup effects. If the elevation on the FIRM is higher than the elevation shown in this table, a wave height, wave runup, and/or wave setup component likely exists, in which case, the higher elevation should be used for construction and/or floodplain management purposes.

Coastal flooding along the Arthur Kill, Raritan River and Raritan Bay are in the northeastern part of the county. Along the Arthur Kill, the shoreline is comprised of a mix of lower-lying areas towards the north and south end and medium density residential areas.

The fetch length across the Arthur Kill varies from approximately 0.2 to 1 miles. The fetch length across the Raritan Bay varies from approximately 2 to 4 miles, across Raritan River varies from approximately 0.5 to 1 miles.

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

Transects represent the locations where the overland wave height analysis was modeled and are placed with consideration given to topography, land use, shoreline features and orientation, and the available fetch distance. Each transect was placed to capture the dominant wave direction, typically perpendicular to the shoreline and extended inland to a point where coastal flooding ceased. Along each transect, wave heights were computed considering the combined effects of changes in ground elevation, obstructions, and wind contributions. Transects were placed along the shoreline along all sources of primary flooding in Monmouth County, as illustrated on the FIRMs and in the "Transect Location Map" provided in Figure 1. Transects also represent locations visited during field reconnaissance to assist in parameterizing obstructions and observing shore protection features.

Erosion was modeled at transects where a dune was identified; this included sections of the Raritan Bay and most of the Atlantic Ocean shoreline. A review of the geology and shoreline type in Monmouth County supported using FEMA's standard erosion methodology for primary frontal dunes, referred to as the "540 rule," (FEMA, 2007). Beach profiles collected before and after Hurricane Sandy were also used to qualitatively assess the beach response during an extreme event and found to be in good agreement with standard erosion methodology.

Erosion was also modeled at steep bluffs vulnerable to a fetch greater than 5 miles found along the Raritan Bay and the Atlantic Ocean. The field reconnaissance data along with imagery collected after Hurricane Sandy was used to identify the resilience of shore protection in preventing bluff erosion during storm events. For transects where bluff erosion was applicable, a retreat-style erosion method was applied allowing between 150 and 540 ft^2 of material to be eroded targeting a horizontal retreat distance between 10 and 30 ft, depending on the height of the bluff.

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

Simulations of inland wave propagation were conducted using FEMA's Wave Height Analysis for Flood Insurance Studies (WHAFIS) model Version 4.0 (FEMA, August 2007). WHAFIS is a one-dimensional model that was applied to each transect in the study area. The model uses the total stillwater and starting wave information extracted from the coupled wave and storm surge model. In Table 6, "Transect Data," the 10-, 2-, 1-, and 0.2-percent annual chance stillwater elevations for each transect are provided along with the starting wave height and period. Simulations of wave transformations were then conducted with WHAFIS taking into account the storm-induced erosion and overland features of each transect. The model outputs the combined flood elevation from the total SWEL and wave height along each cross-shore transect allowing for the establishment of base flood elevations (BFEs) and flood zones from the shoreline to points inland within the study area. Wave heights were calculated to the nearest 0.1 foot, and BFEs were determined at whole-foot increments along the transects.

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

The results of the overland wave height and runup calculations are accurate until local topography, vegetation, or cultural development within the community undergoes major changes. Consequently between transects, elevations were interpolated using topographic maps, land-use and land-cover data, and engineering judgment to determine the extent of coastal flood zones.

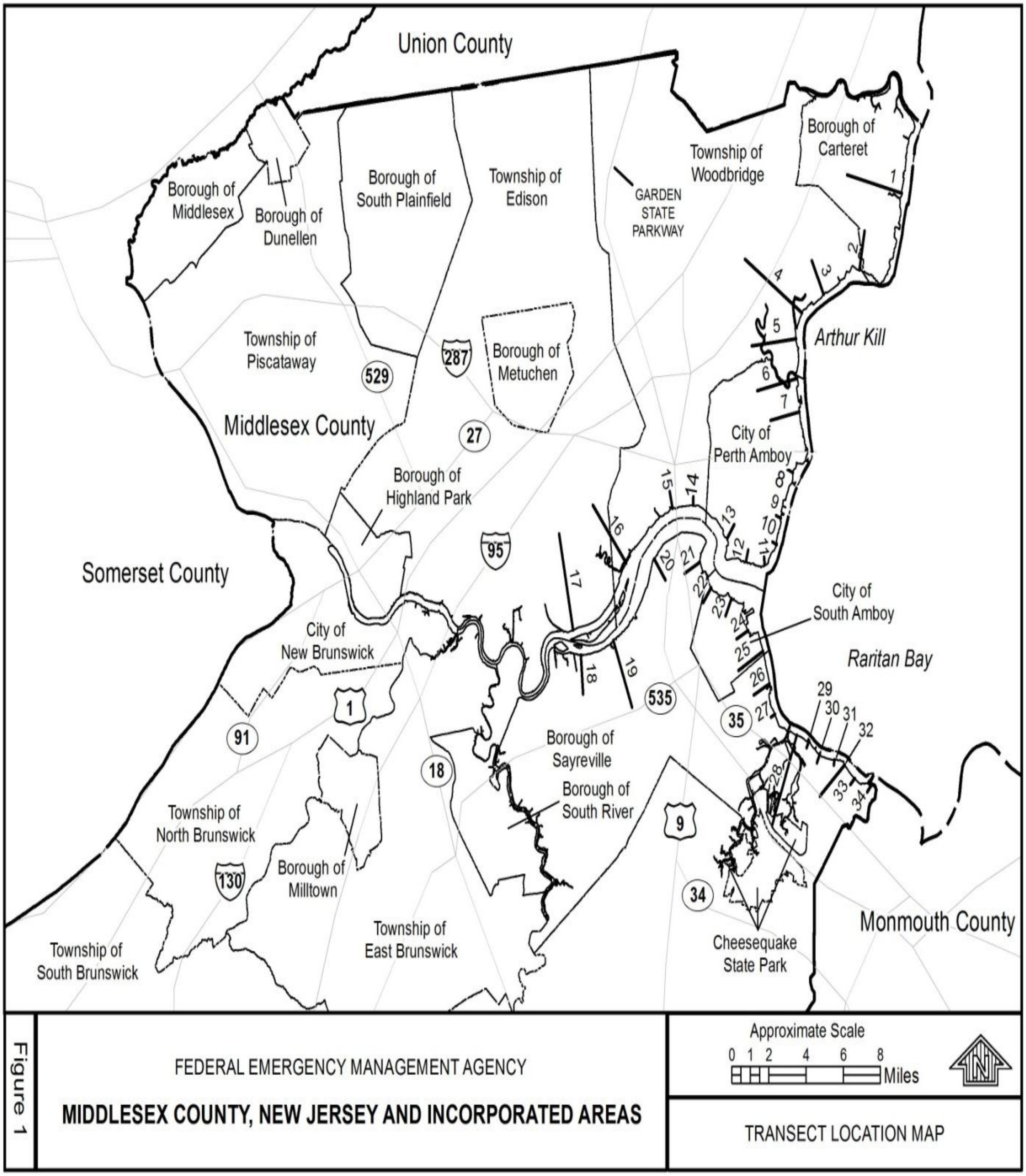

Figure 1 – Transect Location Map

TABLE 6 - TRANSECT DATA								
		Starting Wave Conditions for the 1% Annual Chance			Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations*(ft NAVD88)			
Flood Source	**Transect**	**Coordinates**	**Significant Wave Height**	**Peak Wave Period**	**10% Annual Chance**	**2% Annual Chance**	**1% Annual Chance**	**0.2% Annual Chance**
ARTHUR KILL	1	N 40.578386 W 74.211732	1.28	2.01	7.7	10.7 9.8 - 10.7	12.0 11.5 - 12	15.2 14.9 - 15.4
ARTHUR KILL	2	N 40.562111 W 74.229110	2.42	2.86	7.9 7.8 - 7.9	11	12.4 12.4 - 12.8	15.8 15.6 - 16.2
ARTHUR KILL	3	N 40.556925 W 74.243539	2.89	3.22	8 7.7 - 8	11.1 10.7 - 11.1	12.5 12.3 - 12.6	15.9 15.9 - 16
ARTHUR KILL	4	N 40.553034 W 74.252359	2.98	3.34	8.0	10.7 10.3 - 10.9	12.6 12 - 12.6	16.1 15.5 - 16.4
ARTHUR KILL	5	N 40.547470 W 74.254854	3.05	3.56	8.1 7.5 - 8.1	11.2 10.7 - 11.2	12.6 12.3 - 12.6	16.1 15.7 - 16.1
ARTHUR KILL	6	N 40.539079 W 74.254376	3.15	4.01	8 7.5 - 8.1	11.2 10.5 - 11.3	12.7 12.1 - 12.9	16.1 15.7 - 16.3
ARTHUR KILL	7	N 40.531933 W 74.253592	3.29	4.11	8.1	11.3 11 - 11.3	12.7 12.6 - 12.9	16.1 16.1 - 16.3
ARTHUR KILL	8	N 40.518978 W 74.256276	3.16	3.76	8.2	11.2	12.7 12.7 - 12.8	16.2
ARTHUR KILL	9	N 40.509188 W 74.261122	3.64	5.01	8.2	11.4	12.9	16.4
ARTHUR KILL	10	N 40.503640 W 74.262799	4.12	4.83	8.2	11.5	13.0	16.5
ARTHUR KILL	11	N 40.499307 W 74.267768	4.90	4.81	8.7 8.7 - 9.1	11.5	13.0	16.7
RARITAN RIVER	12	N 40.499982 W 74.275375	4.32	5.00	8.3	11.6	12.8	16.7 16.6 - 16.7
RARITAN RIVER	13	N 40.504922 W 74.283003	3.35	5.19	8.3	11.5 11.3 - 11.5	13.0 12.5 - 13	16.6 16.4 - 16.6
RARITAN RIVER	14	N 40.512068 W 74.296842	2.26	3.59	8.3	11.4	12.9 12.8 - 12.9	16.6 16.4 - 16.6
RARITAN RIVER	15	N 40.511453 W 74.305149	2.09	2.35	8.4	11.7 11.7 - 11.9	13.1 12.7 - 13.1	16.6 16.5 - 16.6
RARITAN RIVER	16	N 40.499787 W 74.323952	2.24	2.38	8.5 8.3 - 8.6	11.8 11.5 - 11.9	13.2 13.1 - 13.4	16.8 16.6 - 17.1
RARITAN RIVER	17	N 40.485545 W 74.345582	1.76	2.39	8.7 8.5 - 8.7	12 11.8 - 12.2	13.5 13.3 - 13.7	17.1 16.1 - 17.4
RARITAN RIVER	18	N 40.480218 W 74.342380	1.80	2.56	8.7 8.5 - 8.7	12 11.5 - 12	13.5 13.2 - 13.5	17.1 16.7 - 17.1
RARITAN RIVER	19	N 40.483292 W 74.329273	1.86	2.55	8.6 7.7 - 8.6	11.9 11.3 - 11.9	13.3 12.8 - 13.4	16.8 16.5 - 17.1

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

		Starting Wave Conditions for the 1% Annual Chance		Starting Stillwater Elevations (ft NAVD88) Range of Stillwater Elevations*(ft NAVD88)			
Flood Source	Transect	Coordinates	Significant Wave Height	Peak Wave Period	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance

Flood Source	Transect	Coordinates	Significant Wave Height	Peak Wave Period	10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
RARITAN RIVER	20	N 40.500681 W 74.312594	2.26	2.39	8.4	11.6 11.4 - 11.6	13.1 12.8 - 13.1	16.6 16.3 - 16.6
RARITAN RIVER	21	N 40.499906 W 74.294069	3.34	4.95	8.4 7.7 - 8.4	11.7 11.7 - 11.9	13.2 12.9 - 13.4	16.8 16.8 - 17.1
RARITAN RIVER	22	N 40.494469 W 74.289439	3.36	4.73	8.4	11.5 11.2 - 11.5	13.1 12.9 - 13.1	16.7 16.6 - 16.7
RARITAN RIVER	23	N 40.492128 W 74.281133	4.17	4.93	8.4	11.6 11.4 - 11.6	13.1 12.8 - 13.1	16.7 16.7 - 16.8
RARITAN BAY	24	N 40.485374 W 74.274480	5.33	5.71	8.4 7.7 - 8.4	11.6	13.1 12.9 - 13.3	16.6 16.6 - 17
RARITAN BAY	25	N 40.480878 W 74.268473	5.27	5.65	8.3 6.6 - 8.3	11.6 11.2 - 11.6	13.0	16.6 16.6 - 16.9
RARITAN BAY	26	N 40.474004 W 74.265880	6.63	6.19	8.4 7.2 - 8.5	11.6 11.4 - 11.7	13.1 12.8 - 13.2	16.6 16.6 - 17
RARITAN BAY	27	N 40.467440 W 74.263687	6.61	6.51	8.4	11.6	13.1	16.5 16.5 - 16.6
RARITAN BAY	28	N 40.462952 W 74.254804	6.66	6.58	8.4 7.1 - 8.6	11.5 11 - 11.5	12.9 12.4 - 12.9	16.3 15.7 - 16.4
RARITAN BAY	29	N 40.461811 W 74.249909	6.72	6.61	8.3	11.5	12.7 12.6 - 12.7	16.3 16.3 - 16.4
RARITAN BAY	30	N 40.458956 W 74.245469	6.41	6.95	8.3	11.5	12.9	16.3 16.3 - 16.4
RARITAN BAY	31	N 40.457734 W 74.239664	6.53	6.87	8.3	11.4	12.8	16.2 16.1 - 16.2
RARITAN BAY	32	N 40.456571 W 74.235392	6.83	7.15	8.3 8.2 - 8.3	11.4 11.2 - 11.8	12.8 12.8 - 13.4	16.3 16.3 - 17.4
RARITAN BAY	33	N 40.453733 W 74.231370	6.71	7.13	8.3	11.4	12.8	16.2 16.2 - 16.4
RARITAN BAY	34	N 40.453064 W 74.223762	6.58	6.26	8.5 8.2 - 8.6	11.2 11.1 - 11.3	12.6 12.5 - 12.8	16.1 16.1 - 16.3

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

Areas of coastline subject to significant wave attack are referred to as coastal high hazard zones. The USACE has established the 3-foot breaking wave as the criterion for identifying the limit of coastal high hazard zones. The 3-foot wave has been determined to be the minimum size wave capable of causing major damage to conventional wood frame or brick veneer structures. The one exception to the 3-foot wave criteria is where a primary frontal dune exists. The limit of the coastal high hazard area then becomes the landward toe of the primary frontal dune or where a 3-foot or greater breaking wave exists, whichever is most landward. The coastal high hazard zone is depicted on the FIRMs as Zone VE, where the delineated flood hazard includes wave heights equal to or greater than three feet. Zone AE is depicted on the FIRMs where the delineated flood hazard includes wave heights less than three feet. A depiction of how the Zones VE and AE are mapped is shown in Figure 2, "Transect Schematic.".

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

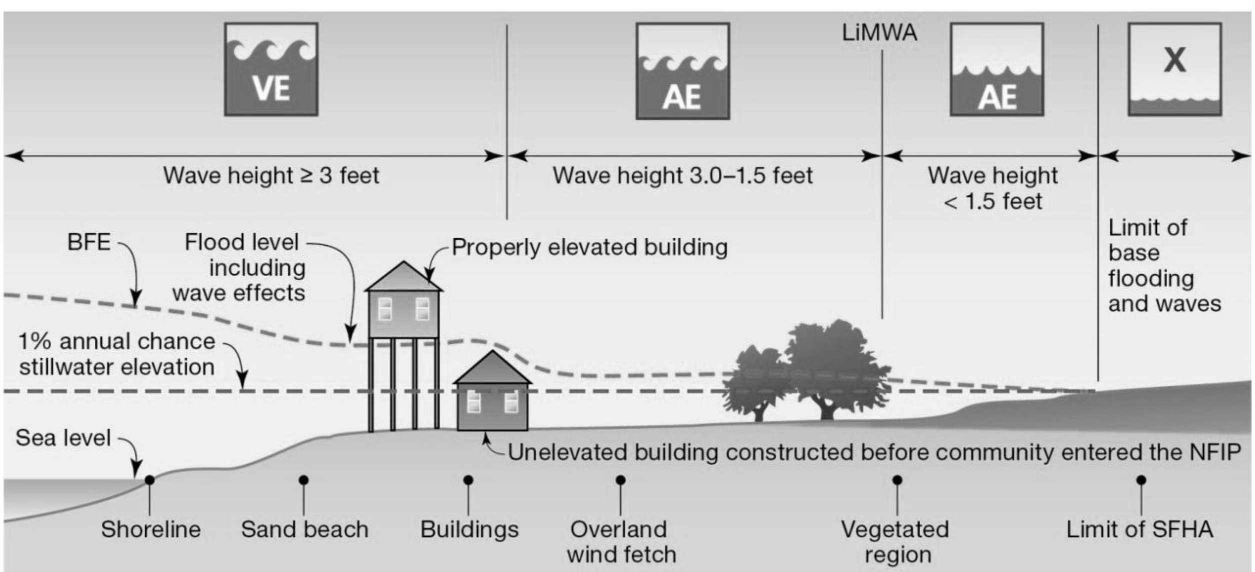

Figure 2 – Transect Schematic

3.4 Vertical Datum

All FISs and FIRMs are referenced to a specific vertical datum. The vertical datum provides a starting point against which flood, ground, and structure elevations can be referenced and compared. Until recently, the standard vertical datum in use for newly created or revised FISs and FIRMs was the National Geodetic Vertical Datum of 1929 (NGVD 29). With the finalization of the North American Vertical Datum of 1988 (NAVD 88), many FIS reports and FIRMs are being prepared using NAVD 88 as the referenced vertical datum.

All flood elevations shown in this FIS report and on the FIRM are referenced to NAVD 88. Structure and ground elevations in the community must, therefore, be referenced to NAVD 88. It is important to note that adjacent communities may be referenced to NGVD 29. This may result in apparent differences in base flood elevations across the corporate limits between the communities.

Prior versions of the FIS report and FIRM were referenced to NGVD 29. When a datum conversion is effected for an FIS report and FIRM, the Flood Profiles and base flood elevations (BFEs) reflect the new datum values. To compare structure and ground elevations to 1-percent annual chance flood elevations shown in the FIS and on the FIRM, the subject structure and ground elevations must be referenced to the new datum values.

As noted above, the elevations shown in this FIS report and on the FIRMs for Middlesex County are referenced to NAVD 88. Ground, structure, and flood elevations may be compared and/or referenced to NGVD 29 by applying a standard conversion factor. The conversion factor to NGVD 29 is +1.1 feet. The conversion between datums may be expressed as an equation:

$$\text{NAVD 88} + 1.1 \text{ feet} = \text{NGVD 29}$$

The BFEs shown on the FIRM represent whole-foot rounded values. For example, a BFE of 102.4 will appear as 102 on the FIRM and 102.6 will appear as 103. Therefore, users that wish to convert the elevations in this FIS to NGVD 29 should apply the stated conversion factor(s) to elevations shown on the Flood Profiles and supporting data tables in the FIS report, which are shown at a minimum to the nearest 0.1 foot.

For more information on NAVD 88, see Converting the National Flood Insurance Program to the North American Vertical Datum of 1988, FEMA Publication FIA-20/June 1992, or contact the Vertical Network Branch, National Geodetic Survey, Coast and Geodetic Survey, National Oceanic and Atmospheric Administration, Rockville, Maryland 20910 (Internet address http://www.ngs.noaa.gov).

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

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

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance flood is employed to indicate additional areas of flood risk in the county. For the streams studied in detail, the 1- and 0.2-percent annual chance floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using bare earth digital elevation data provided by Middlesex County. The topographic data was composed of bare earth mass points and 3-D breaklines. The point elevation data is comprised mostly of LiDAR with some spot heights generated from aerial photography flown within the same year in support of digital orthophotography acquisition. The 3-D breaklines were produced from 1"=1,000' high-precision color aerial photography collected in 2002 using photogrammeteric methods. Water surface elevation triangular irregular networks (TINs) were created from the model cross sections and intersected with the bare earth ground TIN to produce the floodplain corridor. The resulting floodplains were smoothed and incorporated in the DFIRM.

Topographic elevation data for Middlesex County were derived from a continuous Light Detection and Ranging (LiDAR) dataset collected from early December 2006 to February 2007 and reviewed by the U.S. Geological Survey (USGS, 2010).

Final seamless Digital Elevation Model (DEM) products were developed at a 1-meter horizontal resolution. RAMPP used the Universal Transverse Mercator (UTM) Zone 18, in meters as the horizontal coordinate system. The vertical datum used for was North American Vertical Datum of 1988 (NAVD88) in meters. For the coastal analysis, the data was converted to the State Plane New Jersey FIPS 2900 (feet) horizontal coordinate system, and the vertical units were converted from meters to feet.

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 FIRMs (Exhibit 2). These boundaries were also delineated using the topographic data provided by Middlesex County.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the NFIP, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 1-percent annual chance floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent floodplain areas, that must be kept free of encroachment so that the 1-percent annual chance flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. However, the State of New Jersey has established criteria limiting the increase in flood heights to 0.2 foot. Thus, floodways having no more than a 0.2-foot surcharge have been delineated for this countywide FIS. The floodways in this FIS are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this FIS were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain.

Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections (Table 7). The computed floodways are shown on the FIRM (Exhibit 2). In cases where the floodway and 1-percent annual chance floodplain boundaries are either close together or collinear, only the floodway boundary is shown.

Portions of the floodways for Green Brook, Matawan Creek, Mile Run, Millstone River, Rahway River, and Raritan River, extend beyond the county boundary.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 7, “Floodway Data”, for certain downstream cross sections of Ambrose Brook, Barclay Brook, Bonygutt Brook, Boundary Branch Mill Brook No. 1, Cheesequake Creek, Crossway Creek, Deep Run, Dismal Brook, Doty’s Brook, Heards Brook, Lawrence Brook, Mellins Creek, Mill Brook No. 1, Parkway Branch, Rahway River, Raritan River, Sawmill Brook No. 1, Shallow Brook, South River, Spa Spring Creek, Stream 14-14-2-3, Sucker Brook, Tennents Brook, Tributary to Manalapan Brook, and Woodbridge River, are lower than the regulatory flood elevations in that area, which must take into account the 1-percent annual chance flooding due to backwater from other sources.

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

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

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Cedar Brook No. 3								
A	84,305[1]	123		0.5	15.9	15.9	16.1	0.2
B	84,655[1]	56	165	1.5	15.9	15.9	16.1	0.2
C	85,415[1]	24	38	6.6	17.5	17.5	17.5	0.0
D	86,080[1]	106	634	0.4	28.9	28.9	28.9	0.0
E	87,940[1]	72 466	174	1.3	29.0	29.0	29.0	0.0
F	90,120[1]	290	115	1.2	32.1	32.1	32.2	0.1
G	92,100[1]	156	177	0.5	33.9	33.9	34.0	0.1
H	92,900[1]	639	466	0.2	34.1	34.1	34.2	0.1
I	93,700[1]	603	521	0.2	34.1	34.1	34.2	0.1
Cheesequake Creek								
A	4,565[2]	210		0.1[4]	*	4.6[4]	4.8[4]	0.2[4]
Clear Brook								
A	1,260[3]	90 2,535	166	2.9	98.2	98.2	98.4	0.2
B	1,910[3]	203	290	1.7	100.3	100.3	100.3	0.0
C	2,056[3]	230	660	0.7	104.5	104.5	104.6	0.1
D	2,826[3]	106	325	1.5	104.7	104.7	104.9	0.2
E	3,210[3]	148	440	1.1	106.8	106.8	106.8	0.0
F	3,398[3]	344	1,803	0.3	109.5	109.5	109.7	0.2
G	3,828[3]	311	1,503	0.3	109.5	109.5	109.7	0.2
H	4,498[3]	176	800	0.6	110.2	110.2	110.4	0.2
I	4,918[3]	155	557	0.9	110.2	110.2	110.4	0.2
J	5,348[3]	109	240	1.6	110.4	110.4	110.6	0.2
K	5,504[3]	179	1,098	0.4	117.6	117.6	117.6	0.0
L	5,955[3]	237	830	0.5	117.6	117.6	117.6	0.0

[1] Feet above mouth of Raritan River
[2] Feet above origin of study
[3] Feet above confluence of Cranbury Brook

[4] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

CEDAR BROOK NO. 3 – CHEESEQUAKE CREEK – CLEAR BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Crossway Creek								
A	3,600	930	2,890	0.3[2]	*	4.6[2]	4.8[2]	0.2[2]
B	5,470	250	440	1.9[2]	*	4.6[2]	4.8[2]	0.2[2]
C	7,585	250	460	1.8[2]	*	11.2[2]	11.3[2]	0.1[2]
D	7,731	70	474	1.8[2]	*	12.9[2]	12.9[2]	0.0[2]
E	8,435	40	96	8.8	13.0	13.0	13.1	0.1
F	8,990	30	157	4.3	15.5	15.5	15.7	0.2
G	11,030	20	77	5.2	29.5	29.5	29.5	0.0
H	11,450	20	43	9.3	34.5	34.5	34.5	0.0
I	12,160	35	118	2.5	37.6	37.6	37.6	0.0
J	12,430	30	35	8.4	42.8	42.8	42.8	0.0
K	12,705	20	110	2.7	54.0	54.0	54.0	0.0
L	13,420	30	20	4.5	58.1	58.1	58.1	0.0

[1] Feet above Origin of Study (Origin of Study is located approximately 1,120 feet downstream of State Route 35)

[2] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

CROSSWAY CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Deep Run								
A	1,800	504	1,303	1.4[2]	*	4.8[2]	5.0[2]	0.2[2]
B	4,180	769	1,577	1.2[2]	*	8.2[2]	8.4[2]	0.2[2]
C	6,530	376	622	2.8[2]	*	10.3[2]	10.5[2]	0.2[2]
D	8,035	246	1,212	1.5	13.9	13.9	14.0	0.1
E	10,230	333	1,053	1.8	15.2	15.2	15.3	0.1
F	11,760	705	2,053	0.9	16.4	16.4	16.5	0.1
G	14,665	515	1,440	1.3	18.4	18.4	18.6	0.2
H	16,390	462	1,019	1.8	20.0	20.0	20.2	0.2
I	18,500	649	1,496	1.3	23.4	23.4	23.6	0.2
J	20,525	370	1,023	1.8	27.2	27.2	27.4	0.2
K	23,290	197	839	2.2	31.9	31.9	32.0	0.1
L	26,395	296	1,080	1.7	35.5	35.5	35.7	0.2
M	29,150	285	847	2.2	38.5	38.5	38.7	0.2
N	30,445	193	918	2.0	41.2	41.2	41.4	0.2
O	31,955	61	301	8.3	42.4	42.4	42.4	0.0
P	33,875	101	636	3.9	47.0	47.0	47.1	0.1
Q	35,970	229	1,390	1.8	50.8	50.8	51.0	0.2
R	38,220	225	1,210	2.1	54.4	54.4	54.5	0.1

[1] Feet above Bordentown Avenue (County Highway 615)

[2] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

DEEP RUN

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Heards Brook								
A	500	94	520	2.4[2]	*	5.2[2]	5.2[2]	0.0[2]
B	1,500	105	486	2.5[2]	*	5.4[2]	5.4[2]	0.0[2]
C	2,100	34	179	6.9[2]	*	5.4[2]	5.4[2]	0.0[2]
D	3,100	51	118	9.1	9.5	9.5	9.5	0.0
E	3,370	53	119	9.0	12.5	12.5	12.5	0.0
F	3,960	51	135	7.9	13.9	13.9	14.1	0.2
G	4,215	51	131	8.2	14.4	14.4	14.5	0.1
H	4,400	43	113	9.5	16.6	16.6	16.6	0.0
I	4,760	100	499	2.1	24.0	24.0	24.0	0.0
J	5,018	49	374	2.9	24.0	24.0	24.0	0.0
K	5,365	51	266	4.0	24.1	24.1	24.3	0.2
L	5,748	26	83	7.4	24.7	24.7	24.7	0.0
M	6,130	28	90	6.9	30.6	30.6	30.6	0.0
N	6,430	28	68	9.1	31.6	31.6	31.6	0.0
O	6,950	20	78	8.0	36.8	36.8	37.0	0.2
P	7,150	18	69	9.0	39.1	39.1	39.1	0.0

[1] Feet above confluence with Woodbridge River

[2] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

HEARDS BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Iresick Brook								
A	450	122	996	0.6	15.5	15.5	15.7	0.2
B	1,555	97	192	2.4	15.5	15.5	15.7	0.2
C	2,335	27	69	6.6	16.1	16.1	16.3	0.2
D	3,105	23	76	6.0	17.8	17.8	17.9	0.1
E	4,165	94	244	1.9	23.0	23.0	23.1	0.1
F	4,910	24	100	4.6	23.5	23.5	23.6	0.1
G	5,305	24	104	4.4	24.0	24.0	24.2	0.2
H	6,050	37	158	2.9	26.4	26.4	26.4	0.0
I	6,465	31	143	3.2	26.5	26.5	26.5	0.0
J	7,280	22	120	3.8	30.3	30.3	30.4	0.1
K	7,995	16	82	5.5	31.2	31.2	31.4	0.2
L	9,140	91	175	2.6	35.1	35.1	35.3	0.2
M	10,165	125	278	1.6	39.0	39.0	39.1	0.1
N	10,920	58	156	2.9	41.2	41.2	41.4	0.2
O	11,855	92	232	2.0	45.1	45.1	45.3	0.2

[1] Feet above confluence with Duhernal Lake

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

IRESICK BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lawrence Brook								
A	53,210	550	4,163	1.3[2]	*	9.3[2]	9.5[2]	0.2[2]
B	55,005	380	3,339	1.7[2]	*	9.5[2]	9.7[2]	0.2[2]
C	55,740	220	1,408	4.0[2]	*	9.5[2]	9.7[2]	0.2[2]
D	55,975	238	1,974	2.8[2]	*	10.0[2]	10.1[2]	0.1[2]
E	56,675	325	2,931	1.9[2]	*	10.3[2]	10.5[2]	0.2[2]
F	57,660	107	1,264	4.4[2]	*	10.5[2]	10.7[2]	0.2[2]
G	58,350	342	2,477	2.3[2]	*	11.0[2]	11.1[2]	0.1[2]
H	58,785	204	1,734	3.2[2]	*	11.1[2]	11.2[2]	0.1[2]
I	58,865	170	914	6.1[2]	*	11.1[2]	11.2[2]	0.1[2]
J	58,935	175	1,836	3.0[2]	*	11.6[2]	11.8[2]	0.2[2]
K	59,030	225	3,446	1.6	20.3	20.3	20.3	0.0
L	59,110	236	2,955	1.9	20.3	20.3	20.3	0.0
M	59,250	247	4,118	1.4	20.4	20.4	20.4	0.0
N	59,550	221	3,268	1.7	20.4	20.4	20.4	0.0
O	59,650	224	4,061	1.4	23.9	23.9	23.9	0.0
P	61,330	227	4,061	1.4	24.0	24.0	24.0	0.0
Q	63,235	258	3,741	1.5	24.0	24.0	24.0	0.0
R	65,710	428	4,674	1.2	24.1	24.1	24.1	0.0
S	67,380	419	3,041	1.8	24.2	24.2	24.2	0.0
T	67,515	455	3,467	1.6	25.6	25.6	25.6	0.0
U	69,090	355	3,634	1.5	25.7	25.7	25.7	0.0
V	70,465	414	3,542	1.5	25.8	25.8	25.8	0.0
W	71,690	505	5,020	1.0	25.9	25.9	25.9	0.0
X	72,355	340	4,720	1.1	25.9	25.9	25.9	0.0
Y	72,460	670	4,835	1.1	26.1	26.1	26.1	0.0
Z	73,580	485	3,800	1.3	26.2	26.2	26.2	0.0

[1] Feet above mouth of Raritan River

[2] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

LAWRENCE BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lawrence Brook (continued)								
AA	74,720	220	1,520	3.4	26.4	26.4	26.4	0.0
AB	74,980	220	1,030	5.0	26.4	26.4	26.4	0.0
AC	75,050	230	1,130	4.5	27.1	27.1	27.1	0.0
AD	75,155	255	2,115	2.4	27.4	27.4	27.5	0.1
AE	75,300	310	1,900	2.7	28.4	28.4	28.4	0.0
AF	76,090	325	2,165	2.3	28.7	28.7	28.7	0.0
AG	77,355	340	1,165	4.2	29.1	29.1	29.1	0.0
AH	78,590	250	1,595	3.1	31.2	31.2	31.3	0.1
AI	78,880	340	1,140	4.3	31.2	31.2	31.4	0.2
AJ	78,960	290	1,020	4.8	33.9	33.9	34.0	0.1
AK	79,980	405	3,232	1.5	34.8	34.8	34.9	0.1
AL	80,675	375	3,305	1.5	35.0	35.0	35.1	0.1
AM	81,160	444	3,487	1.4	35.1	35.1	35.2	0.1
AN	81,230	524	11,000	0.4	51.8	51.8	51.8	0.0
AO	85,555	864	10,000	0.5	51.8	51.8	51.8	0.0
AP	87,270	610	8,419	0.6	51.8	51.8	51.8	0.0
AQ	87,630	472	5,996	0.8	51.8	51.8	51.8	0.0
AR	87,750	480	4,154	1.2	51.8	51.8	51.8	0.0
AS	87,860	497	6,365	0.8	52.3	52.3	52.3	0.0
AT	89,600	467	6,564	0.7	52.3	52.3	52.3	0.0
AU	92,740	451	5,795	0.8	52.4	52.4	52.4	0.0
AV	94,840	405	3,167	1.4	52.4	52.4	52.4	0.0
AW	94,950	400	3,574	1.3	53.5	53.5	53.5	0.0
AX	96,020	350	3,609	1.2	53.6	53.6	53.6	0.0
AY	98,080	385	2,900	1.5	53.7	53.7	53.7	0.0
AZ	98,945	257	1,895	2.0	53.8	53.8	53.8	0.0

[1] Feet above mouth of Raritan River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

LAWRENCE BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lawrence Brook (continued)								
BA	99,990	243	1,730	1.4	54.0	54.0	54.0	0.0
BB	100,240	158	972	2.5	54.0	54.0	54.0	0.0
BC	100,479	116	732	3.3	56.0	56.0	56.0	0.0
BD	101,249	215	1,039	2.3	56.5	56.5	56.5	0.0
BE	102,349	137	698	3.5	56.9	56.9	56.9	0.0
BF	102,562	260	556	4.3	57.7	57.7	57.7	0.0
BG	102,673	429	3,352	0.7	63.4	63.4	63.4	0.0
BH	104,538	355	2,775	0.9	63.5	63.5	63.5	0.0
BI	106,053	123	610	3.8	63.5	63.5	63.5	0.0
BJ	106,306	140	490	4.8	64.0	64.0	64.0	0.0
BK	107,456	270	1,321	1.7	65.2	65.2	65.3	0.1
BL	107,720	240	1,044	2.1	65.9	65.9	65.9	0.0
BM	109,045	250	1,121	2.0	66.8	66.8	66.8	0.0
BN	110,110	230	1,015	2.2	67.7	67.7	67.7	0.0
BO	111,510	390	913	1.2	68.8	68.8	69.0	0.2
BP	111,730	230	1,125	0.9	70.5	70.5	70.6	0.1
BQ	112,153	460	1,361	0.6	70.8	70.8	70.9	0.1
BR	113,305	106	118	7.0	71.3	71.3	71.3	0.0
BS	114,465	300	628	1.3	74.1	74.1	74.1	0.0
BT	115,815	247	343	2.4	75.6	75.6	75.6	0.0
BU	116,370	121	267	3.1	76.7	76.7	76.7	0.0
BV	117,050	170	686	0.5	77.9	77.9	77.9	0.0
BW	117,631	90	509	0.7	79.7	79.7	79.7	0.0
BX	118,841	231	1,359	0.3	79.7	79.7	79.8	0.1
BY	120,421	163	1,342	0.3	79.7	79.7	79.8	0.1
BZ	121,981	59	211	1.7	79.8	79.8	79.9	0.1

[1] Feet above mouth of Raritan River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

LAWRENCE BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Lawrence Brook (continued)								
CA	122,451	16	73	0.8	79.8	79.8	80.0	0.2
CB	122,829	29	33	1.8	80.5	80.5	80.7	0.2
CC	123,712	660	1,873	0.1	81.2	81.2	81.4	0.2
CD	124,612	738	1,872	0.1	81.2	81.2	81.4	0.2
CE	125,512	1,013	2,846	0.1	81.2	81.2	81.4	0.2
Mae Brook								
A	97,730	123	618	1.3	53.6	53.6	53.8	0.2
B	99,140	80	144	5.4	58.4	58.4	58.4	0.0
C	101,090	45	115	5.0	71.8	71.8	71.8	0.0
D	101,350	44	94	6.1	72.9	72.9	73.0	0.1
E	101,440	71	208	2.7	74.6	74.6	74.6	0.0
F	102,180	88	158	3.6	77.8	77.8	77.8	0.0
G	103,620	95	230	1.7	85.5	85.5	85.7	0.2
H	104,540	45	83	4.2	89.8	89.8	89.8	0.0
I	105,830	120	162	2.2	100.4	100.4	100.4	0.0
J	105,930	100	204	1.7	100.9	100.9	100.9	0.0
K	106,600	89	171	2.0	102.2	102.2	102.4	0.2
L	107,670	436	434	0.7	105.5	105.5	105.7	0.2

[1] Feet above mouth of Raritan River

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

LAWRENCE BROOK – MAE BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Pumpkin Patch Brook								
A	5,020[1]	51	113	6.2	60.1	60.1	60.1	0.0
B	5,740[1]	47	169	4.1	63.0	63.0	63.1	0.1
C	6,720[1]	41	177	3.9	65.1	65.1	65.3	0.2
D	7,185[1]	42	173	4.1	66.0	66.0	66.2	0.2
E	7,810[1]	25	135	5.2	68.0	68.0	68.2	0.2
F	7,960[1]	44	159	4.4	68.4	68.4	68.6	0.2
G	8,370[1]	185	455	1.5	69.3	69.3	69.4	0.1
H	8,980[1]	100	252	2.8	71.1	71.1	71.2	0.1
I	9,525[1]	37	101	6.9	72.5	72.5	72.7	0.2
J	10,660[1]	39	122	5.7	80.8	80.8	80.8	0.0
K	10,890[1]	40	100	7.0	84.0	84.0	84.0	0.0
Rahway River								
A	4,268[2]	646/441[3]	4,541	2.1[4]	*	2.7[4]	2.7[4]	0.0[4]
B	7,680[2]	774/359[3]	4,735	2.0[4]	*	3.1[4]	3.1[4]	0.0[4]
C	9,632[2]	521/205[3]	4,108	2.3[4]	*	3.5[4]	3.5[4]	0.0[4]
D	12,622[2]	411/181[3]	2,567	3.6[4]	*	4.0[4]	4.0[4]	0.0[4]
E	15,524[2]	724/424[3]	3,743	2.5[4]	*	4.8[4]	4.9[4]	0.1[4]
F	17,386[2]	300/148[3]	3,317	2.8[4]	*	5.1[4]	5.1[4]	0.0[4]

[1] Feet above confluence with Robinsons Branch
[2] Feet above confluence with Arthur Kill
[3] Width/width within county boundary

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

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

PUMPKIN PATCH BROOK – RAHWAY RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Raritan River								
A	14,873	1,930	35,861	1.7[3]	*	4.0[3]	4.0[3]	0.0[3]
B	29,133	1,950	19,395	3.2[3]	*	5.8[3]	6.0[3]	0.2[3]
C	36,633	4,253	23,067	5.0[3]	*	7.4[3]	7.6[3]	0.2[3]
D	48,423	560	10,008	5.5[3]	*	10.6[3]	10.8[3]	0.2[3]
E	53,093	788	14,653	3. 7[3]	*	11.9[3]	12.1[3]	0.2[3]
F	54,133	682	11,418	4.9[3]	*	12.0[3]	12.2[3]	0.2[3]
G	57,793	1,065	15,585	3.4[3]	*	12.8[3]	13.0[3]	0.2[3]
H	59,533	930	16,007	3.9[3]	*	13.2[3]	13.3[3]	0.1[3]
I	64,753	900	11,667	4.5	14.3	14.3	14.5	0.2
J	67,782	795	13,067	4.0	15.6	15.6	15.8	0.2
K	78,155	806[2]	9,074	5.7	18.0	18.0	18.2	0.2
L	83,650	501[2]	7,378	6.4	21.1	21.1	21.3	0.2
M	89,055	719[2]	8,894	5.3	24.3	24.3	24.5	0.2
N	94,956	766[2]	9,595	4.9	29.3	29.3	29.5	0.2
O	97,341	927[2]	12,271	3.8	30.2	30.2	30.4	0.2

[1] Feet above confluence with Raritan Bay
[2] Width extends beyond county boundary
[3] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.
* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

RARITAN RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South Branch Rahway River (continued)								
AA	20,048.16[1]	450	1,395	1.4	31.2	31.2	31.4	0.2
AB	20,312.16[1]	425	1,471	1.3	31.5	31.5	31.7	0.2
AC	20,887.68[1]	219	723	2.7	33.2	33.2	33.3	0.1
AD	21,310.08[1]	155	720	1.9	34.9	34.9	35.0	0.1
AE	21,785.28[1]	40	310	4.3	36.7	36.7	36.9	0.2
AF	22,424.16[1]	80	456	2.9	37.6	37.6	37.7	0.1
AG	23,205.60[1]	75	402	3.3	38.3	38.3	38.5	0.2
AH	23,785[1]	116	625	0.8	40.5	40.5	40.6	0.1
AI	24,325[1]	126	767	0.6	40.5	40.5	40.6	0.1
AJ	25,165[1]	560	2,578	0.2	40.5	40.5	40.6	0.1
AK	26,235[1]	820	2,184	0.2	40.5	40.5	40.6	0.1
AL	27,185[1]	350	337	3.6	41.0	41.0	41.1	0.1
AM	27,747[1]	520	1,237	0.4	43.7	43.7	43.9	0.2
South River								
A	38,000[2]	3,760	16,150	0.4[3]	*	7.5[3]	7.7[3]	0.2[3]
B	39,840[2]	3,485	22,210	0.3[3]	*	7.5[3]	7.7[3]	0.2[3]
C	45,270[2]	2,585	11,920	0.6[3]	*	7.6[3]	7.8[3]	0.2[3]
D	45,490[2]	390	6,070	1.2[3]	*	7.6[3]	7.8[3]	0.2[3]
E	45,840[2]	405	7,220	1.0[3]	*	7.6[3]	7.8[3]	0.2[3]
F	48,050[2]	520	7,300	1.0[3]	*	7.7[3]	7.9[3]	0.2[3]
G	48,160[2]	515	6,400	1.1[3]	*	7.7[3].	7.9[3]	0.2[3]
H	49,790[2]	1,155	8,930	0.8[3]	*	7.7[3]	7.9[3]	0.2[3]
I	53,010[2]	370	4,980	1.4[3]	*	7.8[3]	8.0[3]	0.2[3]

[1] Feet above confluence with Rahway River
[2] Feet above mouth of Raritan River
[3] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.
* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

SOUTH BRANCH RAHWAY RIVER – SOUTH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
South River (continued)								
J	55,700	430	6,000	1.1[2]	*	7.8[2]	8.0[2]	0.2[2]
K	60,040	685	6,000	1.1[2]	*	7.9[2]	8.1[2]	0.2[2]
L	61,870	315	4,420	1.4[2]	*	8.0[2]	8.2[2]	0.2[2]
M	64,910	190	2,480	2.4[2]	*	8.1[2]	8.3[2]	0.2[2]
N	65,150	420	4,474	1.4[2]	*	8.9[2]	9.1[2]	0.2[2]
O	66,780	1,576	10,836	0.6[2]	*	9.0[2]	9.2[2]	0.2[2]
P	67,660	740	5,318	1.1[2]	*	9.0[2]	9.2[2]	0.2[2]
Q	68,630	860	6,685	0.9[2]	*	9.0[2]	9.2[2]	0.2[2]
R	69,070	350	3,459	1.8[2]	*	9.0[2]	9.2[2]	0.2[2]
S	69,150	360	2,006	3.0[2]	*	9.0[2]	9.2[2]	0.2[2]
T	69,860	760	3,317	1.8[2]	*	9.3[2]	9.5[2]	0.2[2]
U	70,090	595	5,444	1.1[2]	*	9.6[2]	9.7[2]	0.1[2]
V	70,900	602	5,293	1.1[2]	*	9.6[2]	9.8[2]	0.2[2]
W	71,960	1,114	8,687	0.7[2]	*	9.7[2]	9.8[2]	0.1[2]
X	72,640	1,191	7,161	0.8[2]	*	9.7[2]	9.8[2]	0.1[2]
Y	74,130	850	4,069	1.5[2]	*	9.8[2]	9.9[2]	0.1[2]
Z	74,170	780	7,450	0.8[2]	*	9.9[2]	10.0[2]	0.1[2]
AA	74,300	1,540	11,712	0.5[2]	*	10.9[2]	10.9[2]	0.0[2]
AB	77,530	708	2,643	2.3[2]	*	11.0[2]	11.0[2]	0.0[2]
AC	79,720	463	2,385	2.5[2]	*	12.6[2]	12.6[2]	0.0[2]
AD	81,450	1,994	4,328	1.3	13.9	13.9	14.0	0.1

[1] Feet above mouth of Raritan River

[2] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

SOUTH RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Spa Spring Creek								
A	400[1]	60	242	3.9[3]	*	5.2[3]	5.2[3]	0.0[3]
B	770[1]	30	99	9.6[3]	*	5.4[3]	5.4[3]	0.0[3]
C	1,355[1]	57	446	2.1[3]	*	11.5[3]	11.5[3]	0.0[3]
D	1,580[1]	170	908	0.9[3]	*	11.7[3]	11.7[3]	0.0[3]
E	2,000[1]	170	836	1.0[3]	*	11.7[3]	11.7[3]	0.0[3]
F	2,335[1]	117	397	2.1	12.3	12.3	12.3	0.0
G	2,670[1]	120	261	2.4	13.5	13.5	13.7	0.2
H	3,100[1]	82	293	2.1	13.6	13.6	13.8	0.2
I	3,420[1]	40	209	3.0	13.7	13.7	13.9	0.2
Stream 14-14-2-2								
A	30[2]	78	291	1.8	60.2	60.2	60.4	0.2
B	670[2]	137	603	0.9	60.4	60.4	60.6	0.2
C	1,040[2]	27	153	3.3	60.8	60.8	61.0	0.2
D	1,490[2]	27	141	3.6	61.5	61.5	61.7	0.2
E	1,810[2]	19	117	4.4	61.5	61.5	61.7	0.2
F	3,350[2]	578	1,019	0.5	64.4	64.4	64.4	0.0
G	3,710[2]	111	156	3.3	64.4	64.4	64.5	0.1
H	4,509[2]	203	373	1.4	70.4	70.4	70.6	0.2
I	4,990[2]	163	704	0.7	70.5	70.5	70.7	0.2
J	5,360[2]	196	692	0.7	70.8	70.8	71.0	0.2
K	5,810[2]	167	1,011	0.5	73.6	73.6	73.8	0.2
L	6,410[2]	182	645	0.8	73.6	73.6	73.8	0.2
M	6,830[2]	66	349	1.5	73.6	73.6	73.8	0.2
N	7,130[2]	58	286	1.8	73.7	73.7	73.9	0.2

[1] Feet above confluence with Woodbridge River
[2] Feet above downstream side of New Brunswick Avenue
[3] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.
* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

SPA SPRING CREEK – STREAM 14-14-2-2

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Tennents Brook								
A	58,680[1]	550	3,640	0.3[3]	*	7.8[3]	8.0[3]	0.2[3]
B	60,340[1]	580	3,260	0.3[3]	*	7.8[3]	8.0[3]	0.2[3]
C	62,250[1]	370	1,890	0.6[3]	*	7.8[3]	8.0[3]	0.2[3]
D	62,865[1]	48	300	3.1[3]	*	9.1[3]	9.3[3]	0.2[3]
E	63,660[1]	425	1,856	0.5[3]	*	9.6[3]	9.8[3]	0.2[3]
F	64,250[1]	331	1,545	0.6[3]	*	9.9[3]	10.1[3]	0.2[3]
G	69,190[1]	327	1,006	0.8	13.9	13.9	14.1	0.2
H	70,420[1]	368	1,460	0.5	14.7	14.7	14.9	0.2
I	73,330[1]	166	456	1.7	18.0	18.0	18.2	0.2
J	74,080[1]	229	548	1.4	22.0	22.0	22.2	0.2
K	76,680[1]	98	278	2.8	23.7	23.7	23.9	0.2
L	77,550[1]	26	78	10.0	25.7	25.7	25.7	0.0
M	78,340[1]	118	275	2.8	28.8	28.8	29.0	0.2
N	78,820[1]	194	538	1.4	30.6	30.6	30.8	0.2
O	79,207[1]	114	262	3.0	32.0	32.0	32.1	0.1
Tributary A to Lawrence Brook								
A	300[2]	978	2,526	0.1	81.2	81.2	81.4	0.2
B	900[2]	1,310	3,988	0.1	81.9	81.9	82.1	0.2
C	2,100[2]	1,053	2,967	0.1	81.9	81.9	82.1	0.2
D	3,000[2]	1,201	3,325	0.1	81.9	81.9	82.1	0.2
E	3,900[2]	875	2,267	0.1	81.9	81.9	82.1	0.2
F	4,800[2]	1,016	2,707	0.1	81.9	81.9	82.1	0.2

[1] Feet above mouth of Raritan River

[2] Feet above confluence with Lawrence Brook

[3] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

TENNENTS BROOK – TRIBUTARY A TO LAWRENCE BROOK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Wigwam Brook (continued)								
O	5,239[1]	59	93	3.5	93.6	93.6	93.6	0.0
P	5,664[1]	58	57	5.8	99.4	99.4	99.5	0.1
Q	6,106[1]	410	3,128	0.1	109.0	109.0	109.1	0.1
R	6,436[1]	177	466	0.7	109.0	109.0	109.1	0.1
S	6,816[1]	57	57	5.8	109.1	109.1	109.1	0.0
Woodbridge River								
A	401[2]	176	1,637	1.6[3]	*	5.2[3]	5.2[3]	0.0[3]
B	1,183[2]	176	1,639	1.6[3]	*	5.2[3]	5.2[3]	0.0[3]
C	2,598[2]	155	1,543	1.8[3]	*	5.3[3]	5.3[3]	0.0[3]
D	3,817[2]	183	1,712	1.6[3]	*	5.4[3]	5.6[3]	0.2[3]
E	4,599[2]	160	1,504	1.8[3]	*	5.4[3]	5.6[3]	0.2[3]
F	5,560[2]	155	1,350	2.0[3]	*	5.5[3]	5.7[3]	0.2[3]
G	7,001[2]	312	1,737	1.3[3]	*	5.6[3]	5.8[3]	0.2[3]
H	8,300[2]	183	1,332	1.7[3]	*	5.6[3]	5.8[3]	0.2[3]
I	10,491[2]	196	1,103	2.0[3]	*	5.8[3]	6.0[3]	0.2[3]
J	11,400[2]	184	1,069	2.1[3]	*	6.0[3]	6.1[3]	0.1[3]
K	11,938[2]	80	585	3.8[3]	*	6.0[3]	6.2[3]	0.2[3]
L	12,651[2]	50	535	4.2[3]	*	6.4[3]	6.6[3]	0.2[3]
M	13,960[2]	139	1,165	1.4[3]	*	7.5[3]	7.7[3]	0.2[3]
N	15,650[2]	390	2,097	0.8[3]	*	7.7[3]	7.8[3]	0.1[3]
O	17,498[2]	384	2,088	0.6[3]	*	8.1[3]	8.2[3]	0.1[3]
P	18,997[2]	428	2,064	0.6[3]	*	8.1[3]	8.3[3]	0.2[3]
Q	20,581[2]	301	1,704	0.7[3]	*	8.3[3]	8.4[3]	0.1[3]
R	21,389[2]	157	633	1.8[3]	*	8.4[3]	8.6[3]	0.2[3]

[1] Feet above confluence with Manalapan Brook
[2] Feet above confluence with Arthur Kill
[3] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.
* Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

WIGWAM BROOK – WOODBRIDGE RIVER

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER-SURFACE ELEVATION (FEET NAVD)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
Woodbridge River (continued)								
S	21,685	325	1,794	0.6[2]	*	8.7[2]	8.8[2]	0.1[2]
T	23,301	385	1,957	0.6[2]	*	8.9[2]	9.0[2]	0.1[2]
U	24,299	255	1,315	0.6[2]	*	8.9[2]	9.1[2]	0.2[2]
V	24,753	190	932	0.8[2]	*	9.0[2]	9.2[2]	0.2[2]
W	25,502	420	1,870	0.4[2]	*	9.2[2]	9.4[2]	0.2[2]
X	26,331	486	1,908	0.3[2]	*	9.2[2]	9.4[2]	0.2[2]

[1] Feet above confluence with Arthur Kill

[2] Coastal flooding effects control NFIP regulatory Base Flood Elevations in this area. Riverine floodway data are provided for the purpose of a no-rise analysis in accordance with floodway determinations for development within the SFHA.

[*] Data superseded by updated coastal analyses

TABLE 7

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

FLOODWAY DATA

WOODBRIDGE RIVER

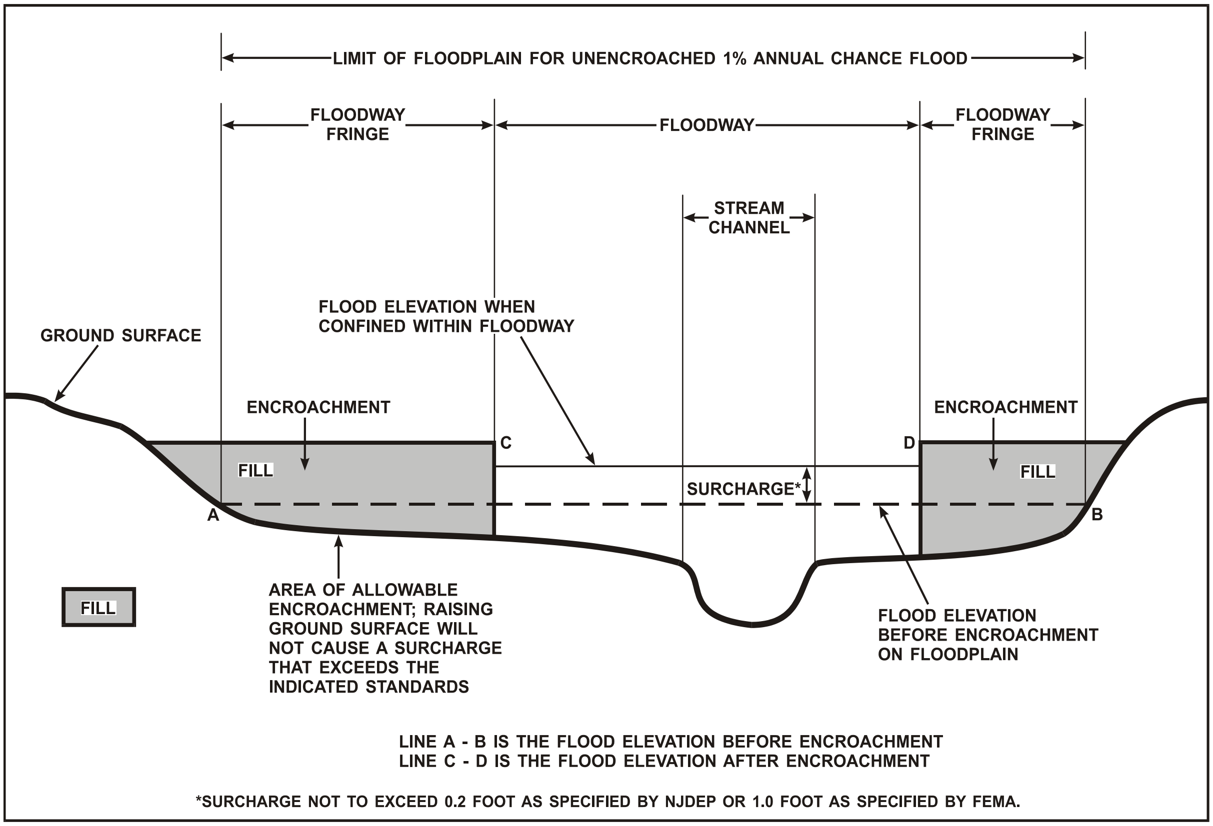

Figure 3 – Floodway Schematic

5.0 INSURANCE APPLICATIONS

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

Zone A

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

Zone AE

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

Zone AH

Zone AH is the flood insurance rate zone that corresponds to the areas of 1-percent annual chance shallow flooding (usually areas of ponding) where average depths are between 1 and 3 feet. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone AO

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

Zone AR

Area of special flood hazard formerly protected from the 1-percent annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1-percent annual chance or greater flood event.

Zone A99

Zone A99 is the flood insurance rate zone that corresponds to areas of the 1-percent annual chance floodplain that will be protected by a Federal flood protection system where construction has reached specified statutory milestones. No base flood elevations or depths are shown within this zone.

Zone V

Zone V is the flood insurance rate zone that corresponds to the 1-percent annual chance coastal floodplains that have additional hazards associated with storm waves. Because approximate hydraulic analyses are performed for such areas, no base flood elevations are shown within this zone.

Zone VE

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

Zone X

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

Zone D

Zone D is the flood insurance rate zone that corresponds to unstudied areas where flood hazards are undetermined, but possible.

6.0 FLOOD INSURANCE RATE MAP

The FIRM is designed for flood insurance and floodplain management applications.

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

For floodplain management applications, the map shows by tints, screens, and symbols, the 1- and 0.2-percent annual chance floodplains. Floodways and the locations of selected cross sections used in the hydraulic analyses and floodway computations are shown where applicable.

This countywide FIRM presents flooding information for the entire geographic area of Middlesex County. Historical data relating to the maps prepared for each community, is presented in Table 8, "Community Map History."

7.0 OTHER STUDIES

Information pertaining to revised and unrevised flood hazards for each jurisdiction within Middlesex County has been compiled into this FIS. Therefore, this FIS supersedes all previously printed FIS reports, FIRMs, and/or FBFMs for all of the incorporated and unincorporated jurisdictions within Middlesex County, and should be considered authoritative for the purposes of the NFIP.

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

8.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this FIS can be obtained by contacting FEMA, Federal Insurance and Mitigation Division, 26 Federal Plaza, Room 1337, New York, New York 10278.

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Carteret, Borough of	January 9, 1974	None	November 15, 1978	April 15,1992
Cranbury, Township of	May 10, 1974	December 27, 1974	May 17, 1982	
Dunellen, Borough of	August 31, 1973	None	April 1, 1977	February 4, 1988
East Brunswick, Township of	January 23,1974	April 15, 1977	January 6, 1982	September 18, 1986 May 3, 1990
Edison, Township of	December 28, 1973	June 4, 1976	August 16, 1982	June 19, 1985
Helmetta, Borough of	June 28, 1974	February 27, 1976	October 16, 1984	
Highland Park, Borough of	April 20, 1973	None	June 1, 1977	
Jamesburg, Borough of	June 28, 1974	February 6, 1976	May 15, 1984	
Metuchen, Borough of	November 5, 1976	None	December 4, 1979	
Middlesex, Borough of	July 10, 1971	None	July 10, 1971	July 1, 1974 January 9, 1976 March 18, 1986
Milltown, Borough of	May 3, 1974	July 2, 1976	February 4, 1981	

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
Monroe, Township of	March 8, 1974	January 7, 1977	April 17, 1985	April 3, 1987 November 6, 1991 September 30, 1995 February 4, 1998
New Brunswick, City of	June 15, 1973	March 19, 1976	December 4, 1979	
North Brunswick, Township of	June 28, 1974	None	May 1, 1980	
Old Bridge, Township of	June 28, 1974	April 30, 1976 October 23, 1981	November 15, 1985	October 16, 1987 August 3, 1992
Perth Amboy, City of	June 21, 1974	June 4, 1976	December 18, 1979	May 1, 1984
Piscataway, Township of	June 28, 1974	June 4, 1976	January 18, 1984	
Plainsboro, Township of	May 31, 1974	July 9, 1976	June 19, 1985	
Sayreville, Borough of	December 28, 1973	April 16, 1976	March 16, 1981	January 16, 1987
South Amboy, City of	February 1, 1974	December 12, 1975	December 4, 1979	June 1, 1983 September 4, 1986
South Brunswick, Township of	January 16, 1974	September 24, 1976	December 18, 1985	

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

COMMUNITY NAME	INITIAL IDENTIFICATION	FLOOD HAZARD BOUNDARY MAP REVISIONS DATE	FIRM EFFECTIVE DATE	FIRM REVISIONS DATE
South Plainfield, Borough of	February 22, 1974	March 5, 1976	August 1, 1980	
South River, Borough of	April 5, 1974	March 5, 1976	June 4, 1980	September 18, 1986
Spotswood, Borough of	July 6, 1973	March 5, 1976	December 18, 1979	August 20, 1982 February 16, 1990
Woodbridge, Township of	June 2, 1972	None	June 2, 1972	July 1, 1974 April 30, 1976 September 1, 1983

TABLE 8

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ (ALL JURISDICTIONS)

COMMUNITY MAP HISTORY

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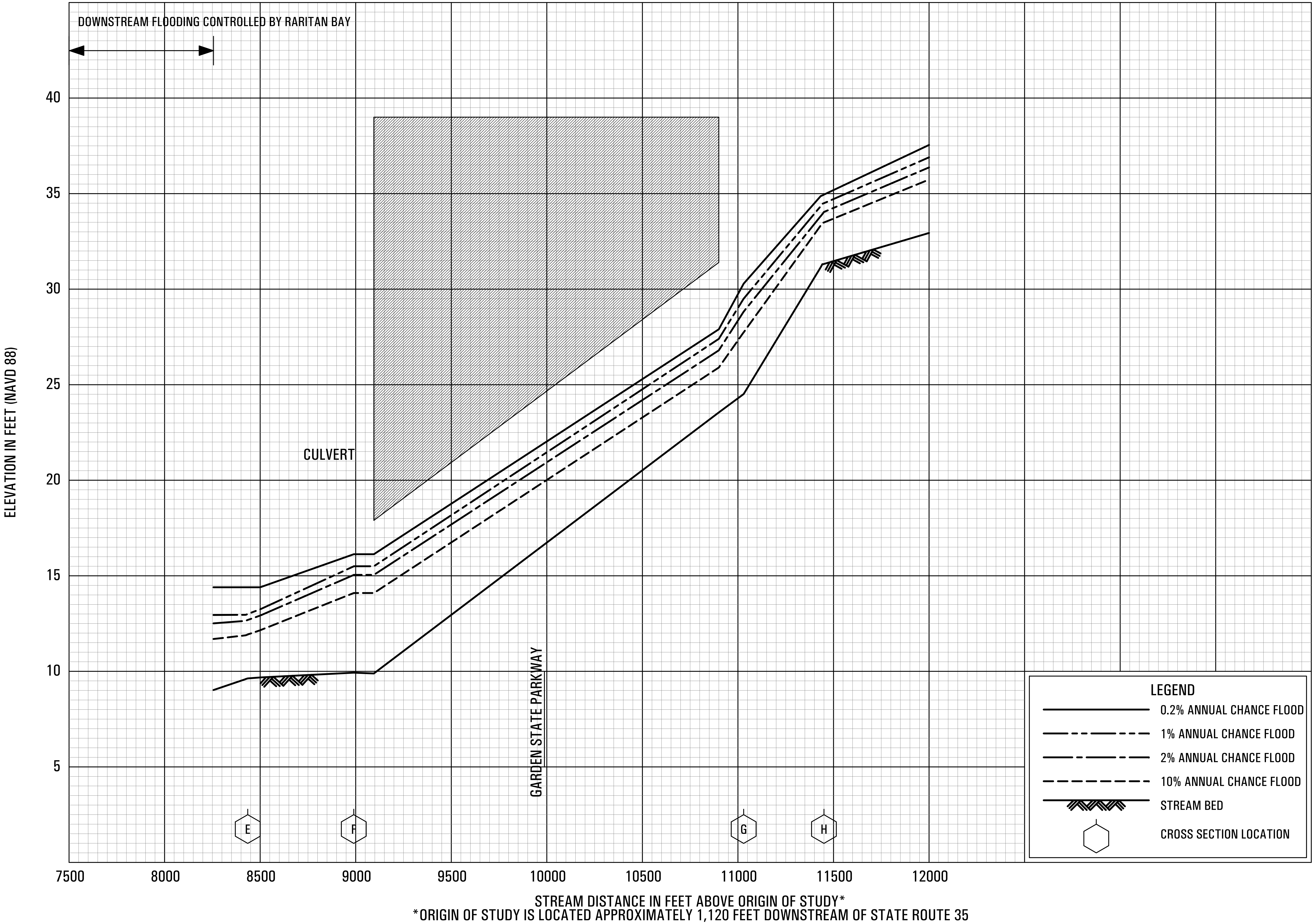


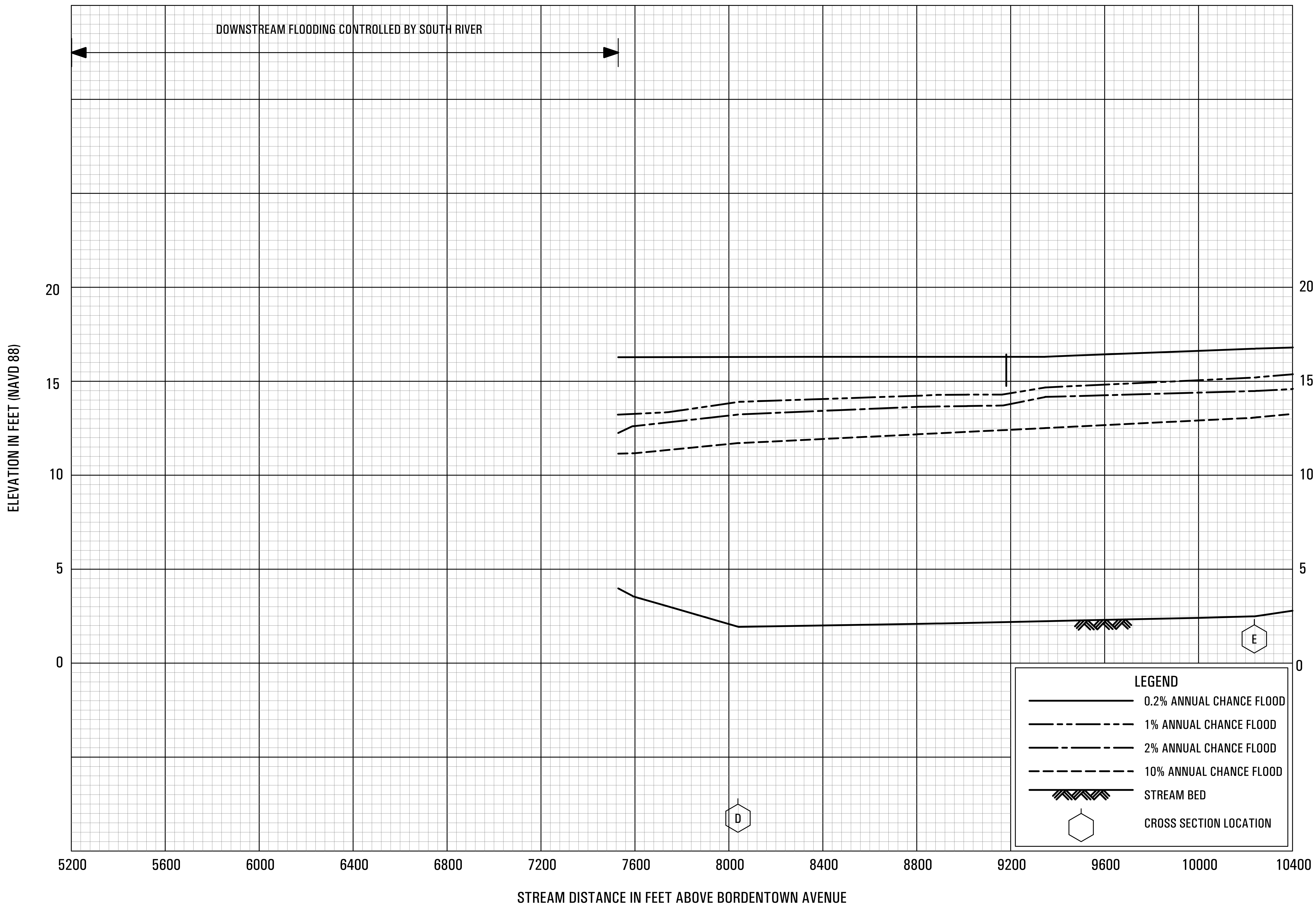
FLOOD PROFILES

CROSSWAY CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



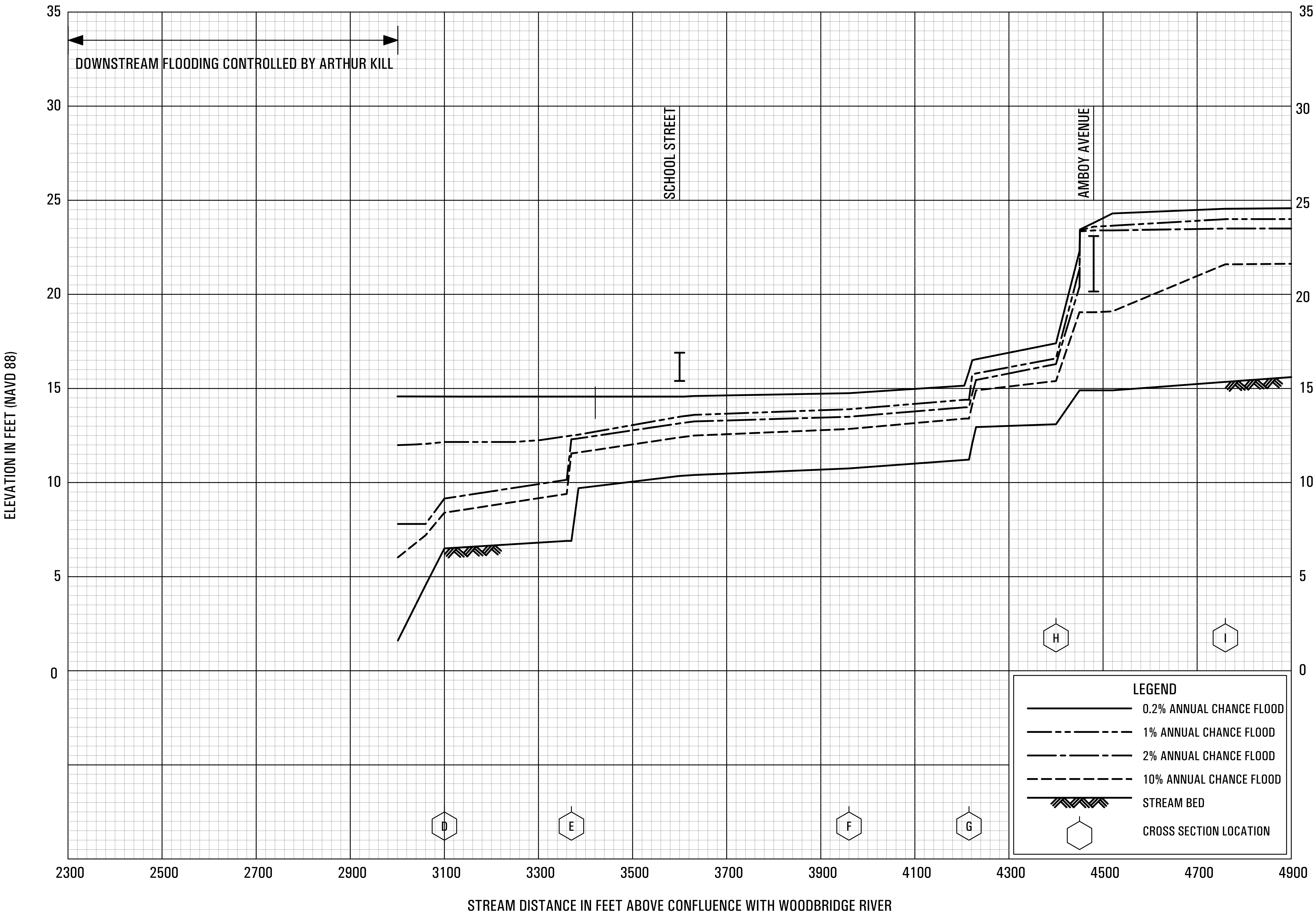
FLOOD PROFILES

DEEP RUN

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



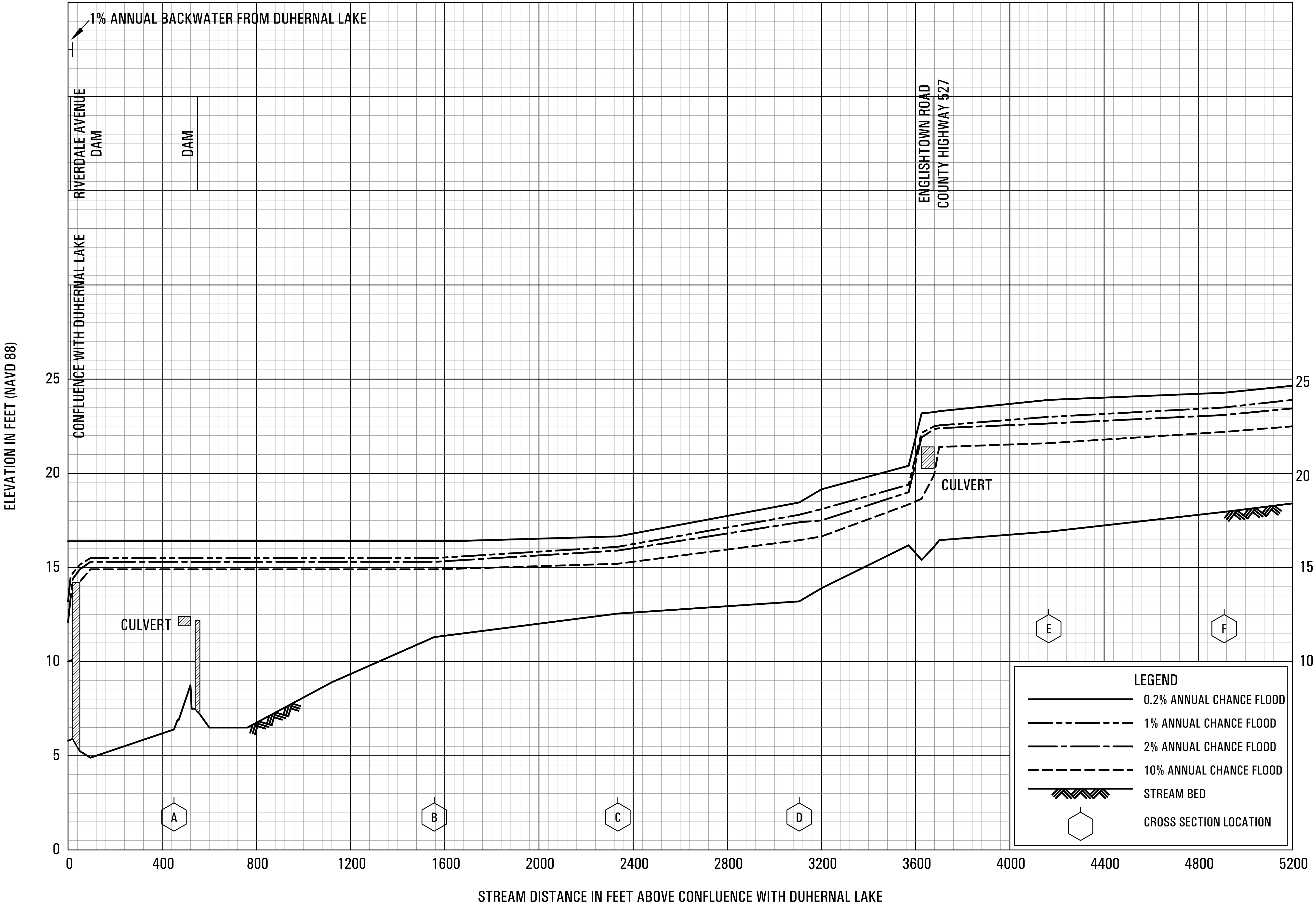
FLOOD PROFILES

HEARDS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



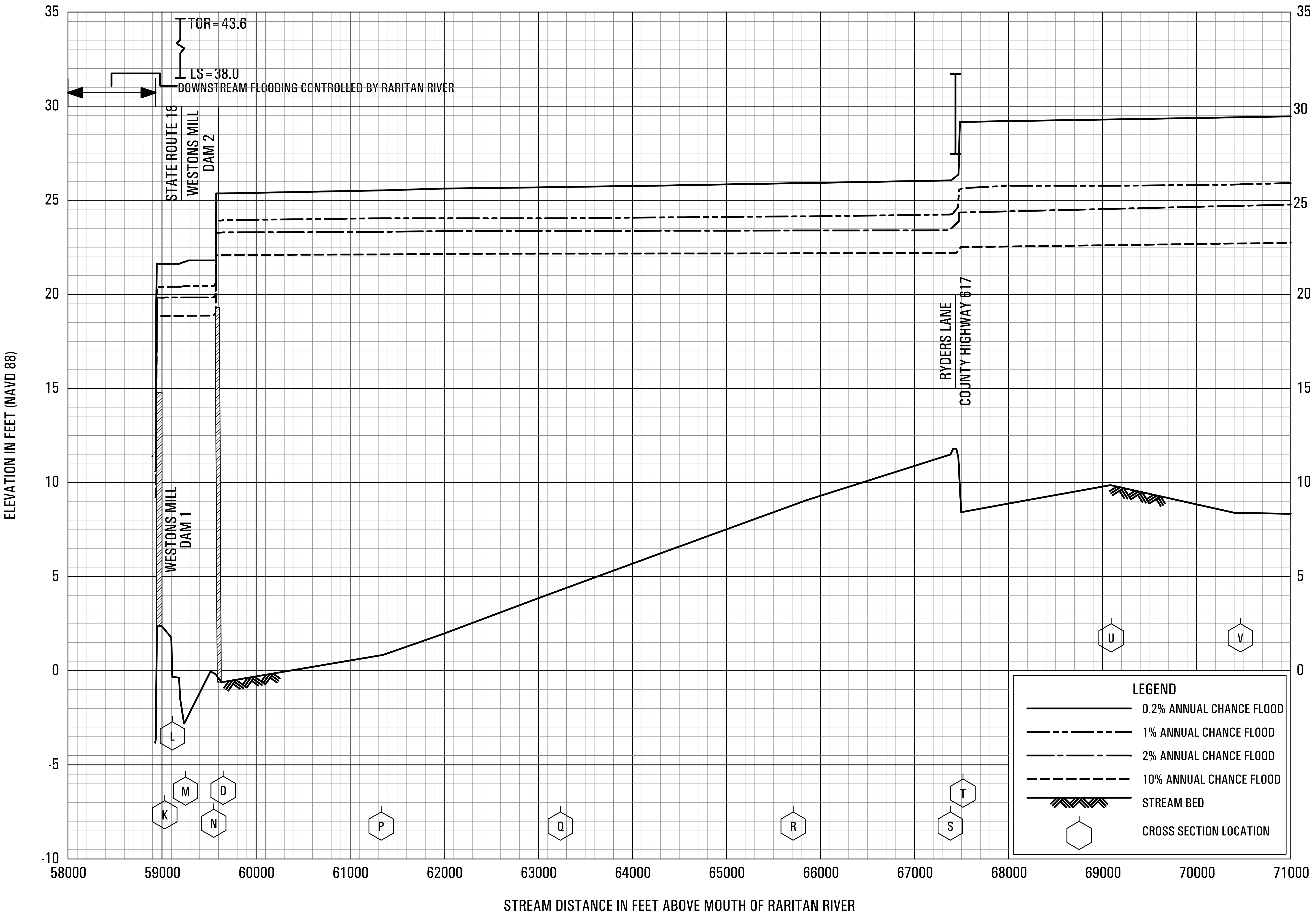
FLOOD PROFILES

IRESICK BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

LAWRENCE BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)

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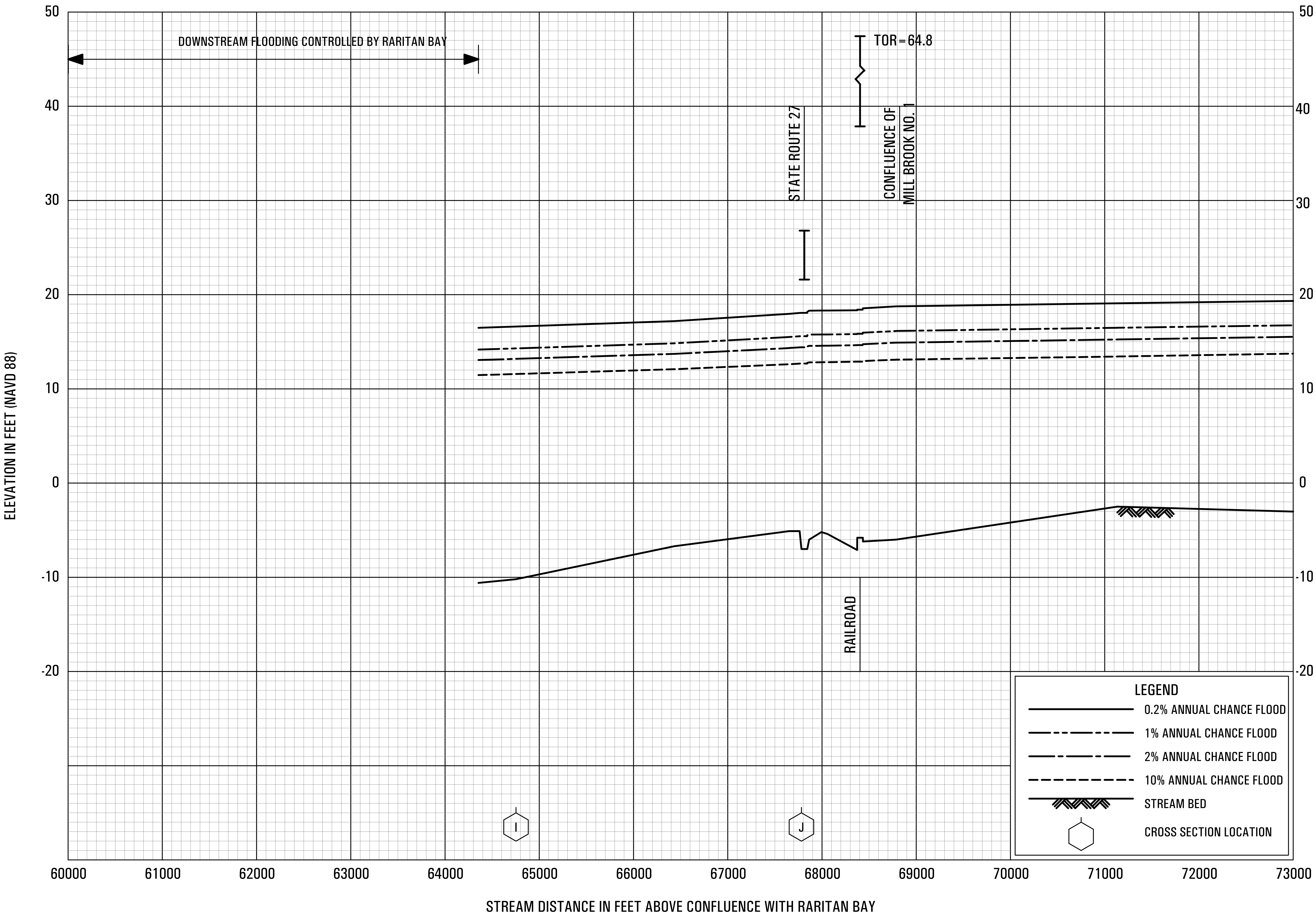


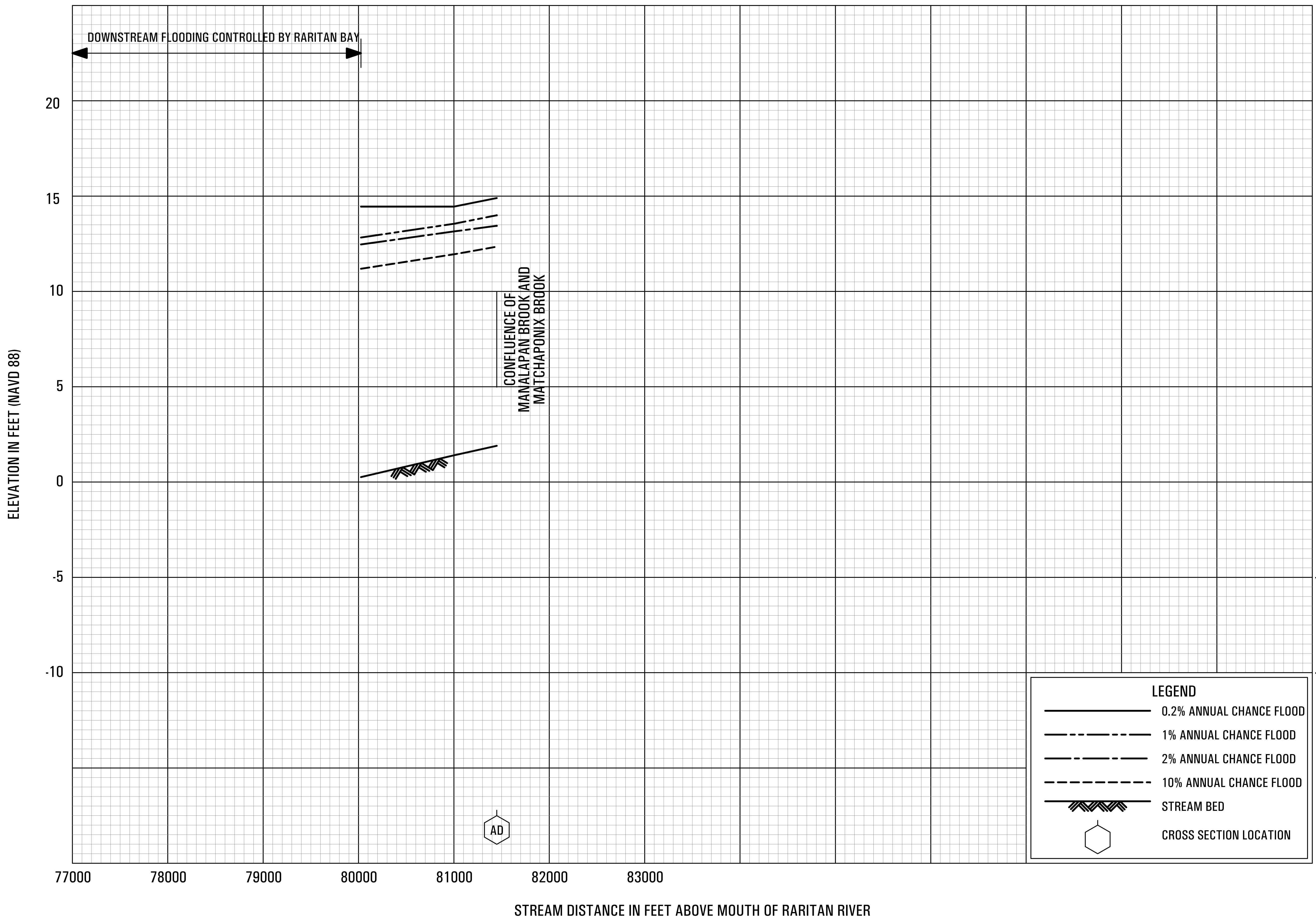
FLOOD PROFILES

RARITAN RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



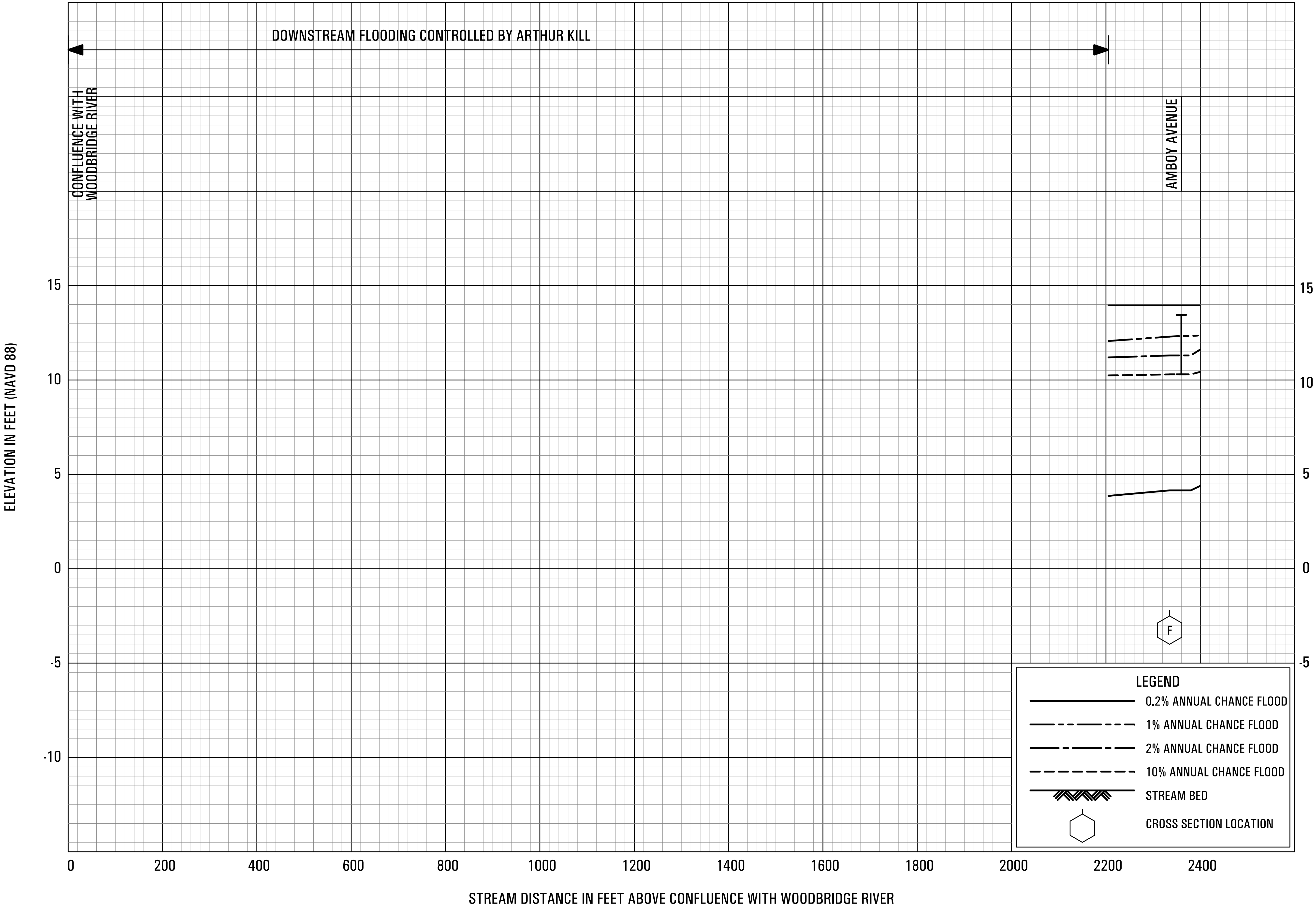
FLOOD PROFILES

SOUTH RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



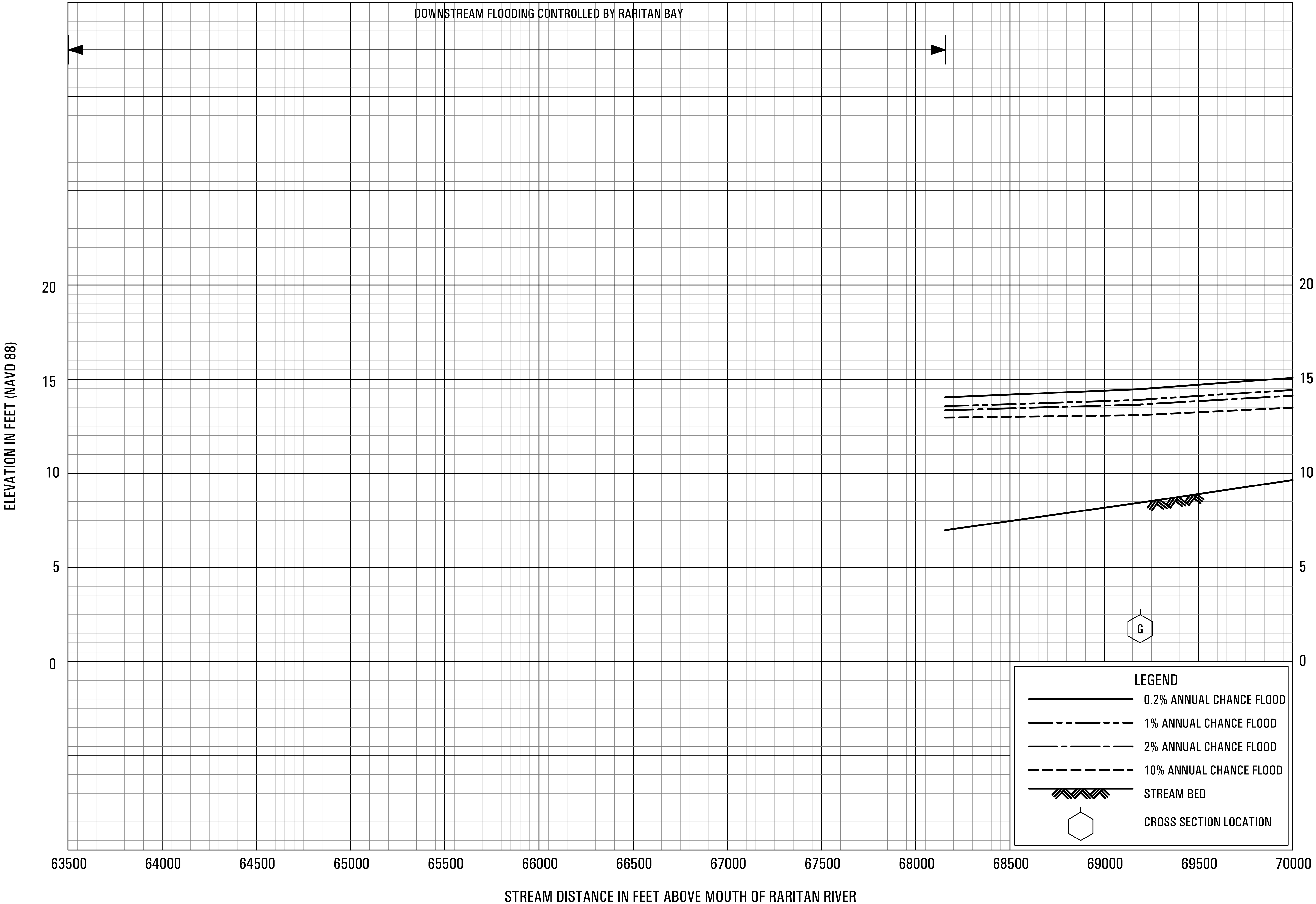
FLOOD PROFILES

SPA SRPING CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)



FLOOD PROFILES

TENNENTS BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY

MIDDLESEX COUNTY, NJ

(ALL JURISDICTIONS)