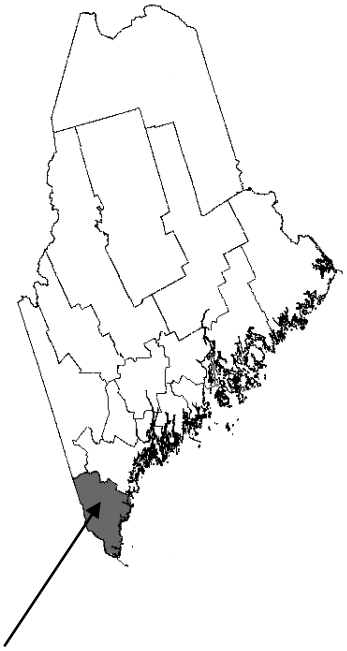
FLOOD INSURANCE STUDY

YORK COUNTY, MAINE

Volume 1 of 3

COMMUNITY NAME	COMMUNITY NUMBER
ACTON, TOWN OF	230190
ALFRED, TOWN OF	230191
ARUNDEL, TOWN OF	230192
BERWICK, TOWN OF	230144
BIDDEFORD, CITY OF	230145
BUXTON, TOWN OF	230146
CORNISH, TOWN OF	230147
DAYTON, TOWN OF	230148
ELIOT, TOWN OF	230149
HOLLIS, TOWN OF	230150
KENNEBUNK, TOWN OF	230151
KENNEBUNKPORT, TOWN OF	230170
KITTERY, TOWN OF	230171
LEBANON, TOWN OF	230193
LIMERICK, TOWN OF	230194
LIMINGTON, TOWN OF	230152
LYMAN, TOWN OF	230195
NEWFIELD, TOWN OF	230196
NORTH BERWICK, TOWN OF	230197
OGUNQUIT, TOWN OF	230632
OLD ORCHARD BEACH, TOWN OF	230153
PARSONSFIELD, TOWN OF	230154
SACO, CITY OF	230155
SANFORD, TOWN OF	230156
SHAPLEIGH, TOWN OF	230198
SOUTH BERWICK, TOWN OF	230157
WATERBORO, TOWN OF	230199
WELLS, TOWN OF	230158
YORK, TOWN OF	230159



PRELIMINARY

November 5, 2013

Federal Emergency Management Agency

FLOOD INSURANCE STUDY NUMBER
23031CV001A

NOTICE TO
FLOOD INSURANCE STUDY USERS

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

The Federal Emergency Management Agency (FEMA) may revise and republish part or all of this Preliminary FIS report at any time. In addition, FEMA may revise part of this FIS report by the Letter of Map Revision (LOMR) process, which does not involve republication or redistribution of the FIS report. Therefore, users should consult community officials and check the Community Map Repository to obtain the most current FIS components. Flood Insurance Rate Map panels for this community contain the most current information that was previously shown separately on the corresponding Flood Boundary and Floodway Map panels (e.g., floodways and cross sections). In addition, former flood hazard zone designations have been changed as follows.

Old Zone(s)	New Zone
A1 through A30	AE
V1 through V30	VE
B	X (shaded)
C	X

Initial Countywide FIS Effective Date:

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FLOOD INSURANCE STUDY
YORK COUNTY, MAINE (ALL JURISDICTIONS)

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study (FIS) revises and updates information on the existence and severity of flood hazards in the geographic area of York County, including the cities of Biddeford and Saco and the towns of Acton, Alfred, Arundel, Berwick, Buxton, Cornish, Dayton, Eliot, Hollis, Kennebunk, Kennebunkport, Kittery, Lebanon, Limerick, Limington, Lyman, Newfield, North Berwick, Ogunquit, Old Orchard Beach, Parsonsfield, Sanford, Shapleigh, South Berwick, Waterboro, Wells, and York (referred to collectively herein as York County), and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood-risk data for various areas of the community that will be used to establish actuarial flood insurance rates and to assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program (NFIP) are set forth in the Code of Federal Regulations (CFR) 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 report are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

This FIS was prepared to incorporate all the communities within York County in a countywide format. Information on the authority and acknowledgements for each jurisdiction included in this countywide FIS, as compiled from their previously printed FIS reports, is shown below:

Acton, Town of:	The hydrologic and hydraulic analyses for the December 5, 1984 study were performed by the Soil Conservation Service (SCS, currently U.S. Department of Agriculture Natural Resources Conservation Service [USDA NRCS]) during the course of the Flood Hazard Analyses for the Little Ossipee River and Balch Pond in the towns of Acton, Newfield, and Shapleigh. This work was completed in September 1977.
Alfred, Town of:	The hydrologic and hydraulic analyses for the July 16, 1990 study were prepared by the U.S. Geological Survey (USGS) for the Federal Emergency Management Agency (FEMA) under Inter-Agency Agreement No. EMW-85-E-

Alfred, Town of - continued:	1823, Project Order No. 20. This work was completed in January 1989. For the May 18, 1998, revision the hydrologic and hydraulic analyses for the Mousam River and Tributary to Middle Branch Mousam River were prepared by Green International Affiliates, Inc. for FEMA under Contract No. EMW-93-C-4144. This work was completed in April 1995.
Arundel, Town of:	The hydrologic and hydraulic analyses for the June 4, 1996 study were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in June 1979. The wave runup analysis was completed in November 1981.
Berwick, Town of:	The hydrologic and hydraulic analyses for the August 5, 1991 study were prepared by Hamilton Engineering Associates, Inc. for FEMA during the preparation of the FISs for the cities of Somersworth and Rochester, New Hampshire.
Biddeford, City of:	The hydrologic and hydraulic analyses for the November 15, 1983 study were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in October 1978. The wave runup analysis for this study was completed in May 1982.
Buxton, Town of:	The hydrologic and hydraulic analyses for the January 5, 1982 study were prepared by USGS for FEMA under Inter-Agency Agreement No. IAA-H-14-78, Project Order No. 10. This work was completed in December 1979.
Cornish, Town of:	The hydrologic and hydraulic analyses for the September 1979 study were prepared by Edward C. Jordan Company for the Federal Insurance Administration (FIA) under Contract No. H-4578. This work was completed in June 1978 and covered all significant flooding sources in the Town of Cornish.
Dayton, Town of:	The hydrologic and hydraulic analyses for the December 1, 1980 study were prepared by USGS for FIA under Inter-Agency Agreement No. IAA-H-14-78, Project Order No. 10. This work was completed in July 1979.

Eliot, Town of:	The hydrologic and hydraulic analyses for the June 5, 1989 study were prepared by USGS for FEMA under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 20. This work was completed in December 1987.
Hollis, Town of:	The hydrologic and hydraulic analyses for the January 19, 1982 study were prepared by USGS for FEMA under Inter-Agency Agreement No. IAA-H-14-78, Project Order No. 10. This work was completed in December 1979.
Kennebunk, Town of:	The hydrologic and hydraulic analyses for the July 19, 1982 study were prepared by Stone & Webster Engineering Corporation for FEMA, under Contract No. H-4092. This work was completed in June 1979. The wave runup analysis was completed in November 1981.
Kennebunkport, Town of:	The hydrologic and hydraulic analyses for the July 4, 1988 study were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in October 1978. The wave runup analysis was completed in December 1981. The Lake of the Woods area, north of Walkers Point, was revised to incorporate updated topographic maps. This work was completed in November 1987 by Dewberry & Davis.
Kittery, Town of:	The hydrologic and hydraulic analyses for the January 5, 1984 study were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in May 1982.
Lebanon, Town of:	The hydrologic and hydraulic analyses for the April 1981 study for Salmon Falls River in the City of Rochester, Strafford County, New Hampshire, were performed by Hamilton Engineering Associates, Inc. for FEMA under Contract No. EMW-C-0334. The hydrologic and hydraulic analyses for Salmon Falls River in the Town of Milton, Strafford County, New Hampshire, were prepared by Costello, Loamsney & DeNapoli, Inc., for FEMA, under Contract No. EMW-84-R-160. This work was completed in November 1985.

Lebanon, Town of - continued:	The hydrologic and hydraulic analyses for the July 3, 2002 study for Salmon Falls River were taken from the work performed for the City of Rochester and the Town of Milton as described above. The hydrologic analyses for Little River, Bog Brook, and Great Brook were prepared by USGS for FEMA under Inter-Agency Agreement No. EMW-98-IA-0175, Project Order No. 1. This work was completed in February 2000.
Limerick, Town of:	The hydrologic and hydraulic analyses for the August 1, 1984 study for the Little Ossipee River were performed by the USDA NRCS during the course of the Flood Hazard Analyses for the Little Ossipee River in the towns of Limerick and Waterboro. This work was completed in September 1977.
Limington, Town of:	The hydrologic and hydraulic analyses for the October 1, 1981 study were prepared by the Water Resources Division of USGS for FEMA under Inter-Agency Agreement No. IAA-H-14-78, Project Order No. 10. This work was completed in December 1979.
Lyman, Town of:	The hydrologic and hydraulic analyses for the May 15, 1991 study were prepared by USGS for FEMA under Inter-Agency Agreement No. EMW-85-E-1823, Project Order No. 20. This work was completed in March 1989.
Newfield, Town of:	The hydrologic and hydraulic analyses for the December 5, 1984 study were performed by the USDA NRCS during the course of the Flood Hazard Analyses for the Little Ossipee River and Balch Pond in the towns of Newfield, Acton, and Shapleigh. This work was completed in September 1977.
North Berwick, Town of:	The hydrologic and hydraulic analyses for the August 1, 1984 study were performed by USDA NRCS during the course of the Flood Hazard Analyses for the Great Works River in the towns of North Berwick and Sanford. This work was completed in September 1977.

Ogunquit, Town of:	The hydrologic and hydraulic analyses for the January 5, 1983 study were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in May 1979. The wave runup analysis was completed in January 1982.
Old Orchard Beach, Town of:	The hydrologic and hydraulic analyses in the January 5, 1984 study were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in October 1978. The wave runup analysis was completed in May 1982.
Parsonsfield, Town of:	The hydrologic and hydraulic analyses for the June, 1979 study were performed by Edward C. Jordan Company, Inc., for FEMA under Contract No. H-4578. This work was completed in March 1978 and covered all significant flooding sources affecting the Town of Parsonsfield.
Saco, City of:	For the original July 5, 1983, FIS report and January 5, 1984 Flood Insurance Rate Map (FIRM) (hereinafter referred to as the 1984 FIS), the hydrologic and hydraulic analyses were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in May 1982. For the March 16, 1998 study, the coastal high hazard area analyses and delineations were prepared by ENSR Consulting & Engineering for FEMA under Contract No. 93-C-420 1. That work was completed in April 1994. Modifications to the ENSR Consulting & Engineering analyses and delineations were made by Dewberry & Davis to bring the study into compliance with the NFIP regulations and the standards set forth in the "Guidelines and Specifications for Wave Elevation Determination and V-Zone Mapping" (Reference 1). The hydrologic and hydraulic analyses for Sawyer Brook were taken from a floodplain management study prepared by USDA NRCS (Reference 2). For the January 5, 2006 revision, the redelineation of the coastal and detailed riverine 1-percent-annual-chance floodplain was

Saco, City of – continued:	performed through a Coordinating Technical Partners (CTP) agreement between the Southern Maine Regional Planning Commission and FEMA. Redelineation of Saco River, Goosefare Brook, Sawyer Brook, and the Atlantic Ocean coastline was performed by Woodward & Curran. For the 2006 revision, the coastal and riverine 1- and 2-percent-annual-chance floodplain elevations from the March 16, 1998, study have been used to delineate the floodplain boundaries between transects and between cross sections using topographic maps, with a contour interval of 2 feet (Reference 3).
Sanford, Town of:	The hydrologic and hydraulic analyses for the December 3, 1991 study represent a revision of the original analyses, which were performed by the USDA NRCS during the course of the Flood Hazard Analyses for the Great Works River in the towns of Sanford and North Berwick. This work was completed in September 1977. The hydrologic and hydraulic analyses were performed by USGS for FEMA under Inter-Agency Agreement No. EMW-87-E-2548, Project Order No. 1A. This work was completed in January 1990. In the July 20, 1998 revision, the hydraulic analyses for the Mousam River (Lower Reach) were taken from a revision to the FIS for the Town of Alfred and were prepared by Green International Affiliates, Inc. for FEMA (Reference 4). This work was completed in April 1995.
Shapleigh, Town of:	The hydrologic and hydraulic analyses for the February 5, 1985 study were performed by the USDA NRCS during the course of the Flood Hazard Analyses for the Little Ossipee River in the towns of Acton, Newfield, and Shapleigh. This work was completed in September 1977.
South Berwick, Town of:	The hydrologic and hydraulic analyses for the December 5, 1984 study were performed by the USDA NRCS during the course of the Flood Hazard Analyses for the Great Works River in the Town of South Berwick. This work was completed in September 1977.

Waterboro, Town of:	The hydrologic and hydraulic analyses for the August 1, 1984 study for the Little Ossipee River from the downstream corporate limits to the Waterboro-Limington-Limerick town boundary were performed by USGS during the course of the FIS for the Town of Limington. This work was completed in December 1979. The hydrologic and hydraulic analyses for the Little Ossipee River from the Waterboro-Limington-Limerick town boundary to the upstream corporate limits and for Little Ossipee Lake were performed by the USDA NRCS during the course of the Flood Hazard Analyses for the Little Ossipee River in Waterboro and Limerick. This work was completed in September 1977.
Wells, Town of:	The hydrologic and hydraulic analyses for the January 5, 1983 FIS report and July 5, 1983 FIRM (herein after referred to as the 1983 FIS) were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. This work was completed in September 1978. The wave height and runup analysis for that study was completed in February 1982. For the January 16, 2003 revision, the hydrologic and hydraulic analyses for the Atlantic Ocean were prepared by ENSR for FEMA under Contract No. EMW-95-C-4783. This work was completed in September 1998.
York, Town of:	The hydrologic and hydraulic analyses for the September 15, 1983 FIS and December 15, 1983 FIRM (herein after referred to as the 1983 FIS) were prepared by Stone & Webster Engineering Corporation for FEMA under Contract No. H-4092. The stillwater flooding portion for that study was completed in October 1978. The wave runup and wave height analyses were completed in May 1982. The hydrologic and hydraulic analyses for the June 17, 2002 revision for the Atlantic Ocean were prepared by ENSR for FEMA under Contract No. EMW-95-C-4783. This work was completed September 2, 1998.

For this countywide FIS, base map information shown of the FIRM panels was obtained from the MeGIS. High resolution orthophoto imagery was produced from 3-inch, 6-inch, and 2-foot pixel cells. Photography was captured during spring 2012 and produced at a scale of 1:600 on August 2012. The projection used in the preparation for the orthophoto imagery was Universal Transverse Mercator (UTM) Zone 19. The horizontal datum is North American Datum (NAD) of 1983, GRS80 spheroid (Reference 5).

The coastal wave height analysis for this FIS was prepared by the Strategic Alliance for Risk Reduction (STARR) for FEMA under Contract No. HSFEHQ-09-D-0370, Task Order 8 and completed April 2013. This analysis is divided into three groups according to the type of study performed by the STARR team. The three groups are referred to in this report as "New Transects," "Updated Map Mod Transects," and "Submitted Transects." Below is a description of each group.

New Transects

Contains the 60 transects in the City of Saco and the towns of Wells and York in addition to one transect in the Town of Kennebunk. A completely new RiskMap engineering analysis was performed for these transects. This analysis includes transect numbers 18-54, 64-78, and 129-136.

Updated Map Mod Transects

Contains 34 transects in the towns of Kittery, Ogunquit, and Old Orchard Beach. This study updated the former analysis (performed as part of FEMA's previous Map Modernization Program) by updating input wave conditions from a newer wave model (Reference 6). This analysis includes transect numbers 1-17, 55-63, and 137-144.

Submitted Transects

Contains the 50 transects in the City of Biddeford and the towns of Kennebunk and Kennebunkport. Sebago Technics completed the coastal engineering analysis for this group in 2010. The STARR team utilized the 2010 study results for mapping. The title of the three studies are "Delineation of the VE-Zone in the City of Biddeford, Maine, 2010," "Delineation of the VE-Zone in the Town of Biddeford, Maine, 2010 Kennebunkport, Maine, 2010," and "Delineation of the VE-Zone in the Town of Kennebunk, Maine, 2010" (References 7, 8, and 9). This analysis includes transect numbers 79-128.

This new analysis resulted in revisions to the Special Flood Hazards Areas (SFHAs) within the cities of Biddeford and Saco and the towns of Kennebunk, Kennebunkport, Kittery, Oguinquit, Old Orchard Beach, Wells, and York.

1.3 Coordination

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

The dates of the initial, intermediate and final CCO meetings held for the incorporated communities within York County are shown in Table 1, "Initial, Intermediate, and Final CCO Meetings."

TABLE 1 - INITIAL, INTERMEDIATE, AND FINAL CCO MEETINGS

Community Name	Initial CCO Date	Intermediate CCO Date	Final CCO Date
Town of Acton	*	*	June 26, 1984
Town of Alfred	August 9, 1994	*	September 4, 1996
Town of Arundel	*	*	*
Town of Berwick	August 4, 1989	*	September 19, 1990
City of Biddeford	August 10, 1976	November 1, 1978	January 19, 1983
Town of Buxton	December 1, 1977	*	August 20, 1980
Town of Cornish	June 1, 1977	*	March 20, 1979
Town of Dayton	December 15, 1977	September 7, 1978	June 23, 1980
Town of Eliot	February 1, 1985	December 1, 1987	June 22, 1988
Town of Hollis	December 1, 1977	September 7, 1979	August 12, 1981
Town of Kennebunk	August 4, 1976	November 1, 1978	February 8, 1982
Town of Kennebunkport	August 4, 1976	*	May 25, 1982
Town of Kittery	August 3, 1976	November 1, 1978	January 27, 1983
Town of Lebanon	*	*	February 3, 2002
Town of Limerick	*	*	March 22, 1984
Town of Limington	December 15, 1977	*	October 9, 1980
Town of Lyman	February 1, 1985	March 1, 1989	November 29, 1989
Town of Newfield	*	*	June 26, 1984
Town of North Berwick	*	*	March 22, 1984
Town of Ogunquit	August 3, 1976	November 1, 1978	August 16, 1982
Town of Old Orchard Beach	August 10, 1976	November 1, 1978	January 18, 1983
Town of Parsonsfield	June 1, 1977	*	June 1, 1978
City of Saco	*	*	February 16, 2005
Town of Sanford	August 9, 1994	*	*
Town of Shapleigh	*	*	September 18, 1984
Town of South Berwick	*	*	June 26, 1984
Town of Waterboro	*	*	March 22, 1984
Town of Wells	September 9, 1994	July 21, 1999	October 5, 2000
Town of York	September 9, 1994	February 15, 1996	October 5, 2000

*Data not available

For this countywide FIS, the initial CCO meeting was held on November 29, 2004 and was attended by FEMA, the Maine Floodplain Management Program, Watershed Concepts, CDM Smith, USGS Maine Water Science Center, and community officials. For the 2013 coastal study, letters were sent to inform the communities of the scope of the FIS, and to solicit pertinent local information. Work map discussion meetings were held with the communities on January 22, 2013, to discuss the initial results of the new coastal flood hazard analysis. The results of this countywide study were reviewed at the final CCO meetings held on _____, and attended by representatives of the communities, the_____. All problems raised at that meeting were addressed in this study.

2.0 AREA STUDIED

2.1 Scope of Study

This FIS report covers the geographic area of York County, Maine, including the incorporated communities listed in Section 1.1. The areas studied by detailed methods were selected with priority given to all known flood hazards and areas of projected development or proposed construction.

In 2007, several flooding sources were studied by detailed methods in the Town of Berwick by the USGS Maine (ME) office in Augusta and have been included in this countywide FIS.

In 2008, the Mousam River was studied by detailed methods in the Town of Kennebunk by USGS and has been included in this countywide FIS.

All or portions of the flooding sources listed in Table 2, "Flooding Sources Studied by Detailed Methods," were studied by detailed methods in the pre-countywide FISs and in the 2007 USGS study in the Town of Berwick and the 2008 USGS study in the Town of Kennebunk (References 10 and 11). Limits of detailed study are indicated on the Flood Profiles (Exhibit 1) and on the FIRM.

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS

Flooding Source Name	Description of Study Reaches
Atlantic Ocean	For the entire coastline within the York County coastal communities of Kennebunk, Kennebunkport, Kittery, Ogunquit, Old Orchard Beach, Saco, Wells, and York, including all estuaries
	Shallow flooding areas near Fortunes Rocks Beach, Lords Pond, Etherington Pond, Lilly Pond, at two points on Horseshoe Cove, near Bracketts Point, at Timber Island, on Curtis Cove, and on the east side of Timber Point in the City of Biddeford; at Sampson's Cove and in Lake of the Woods area in Kennebunkport; at Goodwins Road, Crescent Beach, and at the end of Greenoughs Road in the Town of Kittery; at the southern corporate limits in the Town of Old Orchard Beach and the City of Saco; and at Cow Point Beach, Long Branch, Cape Neddick Harbor, and along a portion of Long Beach in the Town of York
	Tidal flooding affecting the Saco River and Goosefare Brook in Saco; affecting the Saco River, the Little River, Moors Brook, and Thatcher Brook in Biddeford
Balch Pond	The entire pond within the towns of Acton and Newfield

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS – continued

Flooding Source Name	Description of Study Reaches
Batson River	From the dam just downstream of State Route 9 to approximately 3,200 feet upstream of Stone Road in the Town of Kennebunkport.
Bauneg Beg Pond	For the entire shoreline within the communities of North Berwick and Sanford
Blacksmith Brook	From approximately 5,800 feet upstream of the confluence with the Webhannet River to approximately 1,050 feet upstream of U.S. Route 1
Bonny Eagle Dam Pond	Within the Town of Buxton
Branch Brook	For the entire length within the Town of Kennebunk
Bridges Swamp	From Long Beach Avenue to approximately 1,725 feet upstream of Ridge Road
Bunganut Pond	For the entire shoreline within the Town of Lyman
Cape Neddick River	From Shore Road to the confluence of Tributary 1 to Cape Neddick River
Chickering Creek	From a point 750 feet upstream of Dana Avenue to approximately 1,240 feet upstream of Dana Avenue
Cider Hill Creek	From its confluence with the York River to a point approximately 10,000 feet upstream
Coffin Brook*	From its confluence with Worster Brook to approximately 1,550 feet upstream of Route 9
Coffin Brook Tributary 1*	From its confluence with Coffin Brook to approximately 3,250 feet upstream of Woods Road
Cooks Brook	From Dennett Dam to approximately 1 mile upstream of State Route 5
Day Brook	From its confluence with the Mousam River to approximately 4,600 feet upstream of Cat Mousam Road
Depot Brook	From approximately 850 feet downstream of the concrete dam to a point approximately 3,900 feet upstream of the concrete dam

*Studied by USGS-ME

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS – continued

Flooding Source Name	Description of Study Reaches
Dolly Gordon Brook	From its confluence with York River to approximately 100 feet upstream of U.S. Route 1
Driscoll Brook*	From approximately 1,600 feet downstream of Granite Dam to approximately 140 feet upstream of Blackberry Hill Road
Estes Lake	For the entire lake within the Town of Alfred and from Estes Lake Dam to the Town of Sanford corporate limits
Ferguson Brook*	From its confluence with the Worster Brook to approximately 850 feet upstream of Bromo Road
Fuller Brook	From a point 2,300 feet upstream of Haley Road to approximately 5,250 feet upstream of Haley Road
Goodall Brook	From its confluence with the Great Works River to approximately 100 feet upstream of Berwick Road
Goosefare Brook	From a point 10,350 feet upstream of its confluence with the Atlantic Ocean upstream to approximately 2,250 feet upstream of Ross Road
Great Works River	From just upstream of its confluence with Salmon Falls River to approximately 100 feet upstream of Twombley Road
Green Brook	From its confluence with the Ogunquit River to approximately 600 feet upstream of its confluence with Tributary to Green Brook
Hill Creek	From a point 4,450 feet upstream of its confluence with Spruce Creek to approximately 7,950 feet upstream of its confluence with Spruce Creek
Josias River	From its confluence with the Basin to approximately 1,250 feet upstream of U.S. Route 1
Keay Brook*	From its confluence with the Salmon Falls River to approximately 8,300 feet upstream of Ridlon Road
Kennebunk River	From approximately 500 feet upstream of its confluence with the Atlantic Ocean to approximately 2,750 feet upstream of U.S. Route 1 in Arundel
Kennebunk Pond	For the entire shoreline

*Studied by USGS-ME

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS – continued

Flooding Source Name	Description of Study Reaches
Kennebunk River	From approximately 500 feet upstream of its confluence with the Atlantic Ocean to approximately 2,750 feet upstream of U.S. Route 1 in Arundel
Little Ossipee Lake	For the entire shoreline within the Town of Waterboro, including the outlet stream to its confluence with the Little Ossipee River
Little Ossipee River	From its confluence with Saco River to the confluence with Balch Pond Dam
Little River (Town of Berwick)*	From its confluence with Salmon Falls River to the upstream corporate limit (approximately 18,300 feet upstream of Diamond Hill Road)
Little River (Town of Cornish)	From its confluence with the Ossipee River to State Routes 5 and 117
Little River (Town of Kennebunk)	From approximately 1,000 feet upstream of its confluence with the Atlantic Ocean to its confluence with Branch Brook
Little River	From approximately 650 feet upstream of its confluence with the Atlantic Ocean to approximately 2,380 feet upstream of Oak Ridge Road in the City of Biddeford
Littlefield River	From Estes Lake Dam to approximately 1.8 miles upstream of U.S. Route 202 and State Route 4 in the Town of Alfred
Merriland River (Lower Reach)	From its confluence with the Little River to approximately 2,900 feet upstream of U.S. Route 1
Merriland River (Upper Reach)	From the dam just downstream of Hobbs Farm Road to a point approximately 2.1 miles upstream
Middle Branch Mousam River	From approximately 3,000 feet upstream of confluence with Estes Lake to State Route 4/State Route 202
Mill Brook	For the entire length within the community of Old Orchard Beach from Ross Road to approximately 1.2 miles upstream
Moors Brook	From Meetinghouse Road in Biddeford to a point approximately 1.55 miles upstream

*Studied by USGS-ME

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS – continued

Flooding Source Name	Description of Study Reaches
Mousam River (Lower Reach)	From the Kennebunk-Sanford corporate limits to Estes Lake Dam
Mousam River (Town of Kennebunk)*	From approximately 1,000 feet upstream of confluence with the Atlantic Ocean to approximately 500 feet upstream of Mill Street
Mousam River (Town of Sanford)	From its confluence with Estes Lake to the upstream corporate limits approximately 1,000 feet upstream of State Route 109 in the Town of Sanford
Mulloy Brook*	From its confluence with Worster Brook to a point approximately 1.3 miles upstream
Ogunquit River	From Beach Street to its confluence with Green Brook
Ogunquit River Tributary	From its confluence with the Ogunquit River to a point approximately 2,950 feet upstream
Ossipee River	From its confluence with the Saco River to approximately 2.06 miles upstream of the confluence of South River
Piscataqua River	For the entire length within the Town of Eliot
Ponding Area 1	Within the Town of Alfred
Ponding Area 2	Within the towns of Alfred and Lyman
Ponding Area 3	Within the Town of Alfred
Roberts-Wadley Pond	For the entire shoreline within the Town of Lyman.
Saco River	From West Branch Dam to the confluence of the Ossipee River
Saco River-Left Channel	From its confluence with the Saco River to the Town of Buxton upstream corporate limits
Salmon Falls River*	From a point approximately 3,050 feet downstream of New Dam Road to the Town of Lebanon corporate limits, approximately 2.1 miles upstream of Hopper Road.

*Studied by USGS-ME

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS – continued

Flooding Source Name	Description of Study Reaches
Sawyer Brook	From Sawyer Street to approximately 50 feet upstream of Therrien Avenue
Shaker Pond	The entire pond
Smith Brook	From State Route 9 to a point approximately 1,225 feet upstream
South Branch of West Brook	From its confluence with West Brook to a point approximately 2,225 feet upstream
Spinney Creek	From approximately 5,300 feet upstream of its confluence with the Piscataqua River to approximately 350 feet upstream of Dennett Road in the Town of Eliot.
Spruce Creek	From just downstream of Wilson Road (State Route 101) to a point approximately 2,100 feet upstream
Stevens Brook	From approximately 2 miles upstream of its confluence with Ogunquit River to approximately 2,000 feet upstream of U.S. Route 1 in the Town of Wells.
Swan Pond	For the entire shoreline within the Town of Lyman
Thatcher Brook	From its confluence with the Saco River to a point approximately 2,350 feet upstream of South Street
Tributary 1 to Cape Neddick River	From its confluence with Cape Neddick River to approximately 1,450 feet upstream of Mountain Road
Tributary 1 to Green Brook	From its confluence with Green Brook to approximately 1,400 feet upstream of Hiltons Lane
Tributary to Middle Branch Mousam River	From approximately 200 feet downstream of Middle Branch Drive to approximately 2,800 feet upstream of Middle Branch Drive
Unnamed Tributary to Stony Brook	From a point approximately 850 feet upstream of Burnham Lane to approximately 3,650 feet upstream of Burnham Lane
Webhannet River	From approximately 3,800 feet downstream of U.S. Route 4 (Blue Star Memorial Highway) to approximately 2,950 feet upstream of U.S. Route 4 (Blue Star Memorial Highway)

TABLE 2 – FLOODING SOURCES STUDIED BY DETAILED METHODS – continued

Flooding Source Name	Description of Study Reaches
West Brook	From approximately 11,000 feet upstream of its confluence with Great Works River to approximately 3,200 feet upstream of confluence with the South Branch of West Brook
Worster Brook*	From its confluence with the Salmon Falls River to approximately 5,900 feet upstream of Brown Road
Worster Brook Tributary 3*	From its confluence with Worster Brook to approximately 150 feet upstream of Thompson Hill Road
York River	From its confluence with the Atlantic Ocean to a point approximately 1.5 miles upstream of Scotland Bridge Road

*Studied by the USGS-ME

In 2007, several flooding sources were studied by detailed methods in the Town of Berwick by the USGS-ME office in Augusta and have been included in this countywide FIS. These flooding sources include: Coffin Brook from the confluence with Worster Brook to a point 1.63 mile upstream; Unnamed Tributary to Coffin Brook (scoped by FEMA as Coffin Brook Tributary 1) from the confluence with Coffin Brook to Cemetery Road; Driscoll Brook from the downstream corporate limits to Blackberry Hill Road; Ferguson Brook from the confluence with Worster Brook to Sullivan Road; Keay Brook from the confluence with Salmon Falls River to the upstream corporate limit; Little River from the confluence with Salmon Falls River to the upstream corporate limit; Mulloy Brook from the confluence with Worster Brook to a point 1.1 mile upstream; Worster Brook from the confluence with Salmon Falls River to a point 5.8 miles upstream; and Unnamed Tributary to Worster Brook (scoped by FEMA as Worster Brook Tributary 3) from the confluence with Worster Brook to Cemetery/Thompson Hill Rd. The Salmon Falls River was redelineated from Sullivan Street to the abandoned bridge on Walnut Grove Road. Limits of detailed study are indicated on the Flood Profiles and on the FIRM. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

In 2008, the Mousam River in the Town of Kennebunk was studied by detailed methods by the USGS-ME office in Augusta and has been included in this countywide FIS. Mousam River was studied from a point 2,000 feet downstream from the bridge/dam combination at U.S. Route 1 to 500 feet upstream from Mill Street. Limits of detailed study are indicated on the Flood Profiles and on the FIRM. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

For this countywide study, revised coastal analyses were performed for open water flooding sources in the cities of Biddeford and Saco and the towns of Kennebunk, Kennebunkport, Kittery, Oguinquit, Old Orchard Beach, Wells, and York.

Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon, by FEMA and the individual communities within York County. For this countywide revision, Baston River (upstream portion), Beaver Dam Brook, Paddy Creek, Round Swamps Brook, Smith Brook (upstream portion), Turbats Creek, and Tyler Brook in the Town of Kennebunkport were studied using approximate methods by Ransom Consulting Engineers and Scientists. This study was completed June 28, 2012 (Reference 12). All or portions of the flooding sources listed in Table 3, "Flooding Sources Studied by Approximate Methods," were studied by approximate methods in the pre-countywide FISs.

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS

Flooding Source Name	Community(ies)
Adams Brook	Berwick
Alewife Pond	Kennebunk
Arundel Swamp Brook	Arundel
Bartlett Pond	Lyman
Batson River (upstream portion)*	Kennebunkport
Beach Island	Biddeford
Beaver Dam Brook	Berwick, North Berwick
Beaver Pond Brook*	Kennebunkport
Bell Marsh	York
Bennett Brook	South Berwick
Benson Brook	Parsonsfield
Big Ledge Brook	Saco
Black Brook	Limington
Blacksmith Brook	Wells
Bluff Island (shoreline)	Saco
Bog Brook	Lebanon
Bonny Eagle Pond Outlet Brook	Buxton
Boulter Pond	York
Boyd Brook	South Berwick
Boyd Pond	Limington
Boymon Brook	Saco
Braceys Swamp	York
Branch Brook	Newfield, Wells Kennebunk
Bridges Swamp (portions)	York
Brimstone Pond	Arundel
Brown Brook	Cornish
Buff Brook	Waterboro

*Studied in 2012 by Ransom Consulting Engineers and Scientists within the Town of Kennebunkport

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – continued

Flooding Source Name	Community(ies)
Bumpkin Island	Kennebunkport
Bush Brook	Biddeford
Cape Island	Kennebunkport
Cape Neddick River (portions)	York
Carding Mill Brook	Hollis
Carlisle Brook	Lyman
Carll Branch	Waterboro
Cascade Brook	Old Orchard Beach, Saco
Chases Pond	York
Chellis Brook	Parsonsfield
Chickering Creek	Kittery
Chicks Brook	South Berwick, York
Cider Hill Creek (portions)	York
Cider Mill Pond	North Berwick
Clay Hill Brook	York
Coffin Brook	Berwick
Cooks Brook	Lyman
Cooks Brook, below Dennett Dam	Hollis
Crockett Brook	Hollis, Kittery
Curtis Pond	Sanford
Cutts Pond	Kittery
Cutts Ridge Brook	Eliot, Kittery, York
Davis Pond	Arundel
Deep Brook	Saco
Deer Pond	Hollis
Deering Brook	Buxton
Deering Pond	Sanford
Dennett Brook	Saco
Derring Pond	Kittery
Doles Pond	Limington
Dolly Gordon Brook (portions)	York
Driscoll Brook	Berwick
Duck Brook	Arundel
Duck Island (shorelines)	Kittery
Eagle Island (shoreline)	Saco
East Goose Rock	Kennebunkport
East Sister Island (shorelines)	Kittery
Emerson Brook	Parsonsfield
Estes Brook	North Berwick
Etherington Pond	Biddeford

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – continued

Flooding Source Name	Community(ies)
Fenderson Brook	Parsonsfield
Ferguson Brook	Berwick
Fishing Island (shorelines)	Kittery
Fogg Brook	Buxton
Folly Island	Kennebunkport
Folly Pond	York
Foss Pond	Limington
Foxwell Brook	Saco
Frost Brook	North Berwick, South Berwick
Fuller Brook	Kittery
Garden Brook	York
Goff Mill Brook	Arundel
Goodall Brook (portions)	Sanford
Gooseberry Island	Biddeford, Kittery
Goosefare Brook	Saco
Grant Brook	North Berwick, Saco, Lebanon
Great Collins Brook	Parsonsfield
Great Creek	Eliot
Great East Lake	Acton
Great Pond	Biddeford
Great Spring Brook	Dayton
Great Works River (portions)	Sanford
Green Brook	Wells
Green Island	Kennebunkport
Haines Meadow Brook	Buxton
Hamlin Brook	Limington
Hamlinton Brook	Waterboro
Hansen Pond	Acton
Harmon Brook	Saco
Harvey Mill Stream	Waterboro
Hay Brook	Alfred, Sanford
Heath, the	Eliot, Lyman, Wells
Henderson Brook	Waterboro
Hill Creek	Kittery
Hilton Brook	Berwick
Hom Island (shorelines)	Kittery
Home Pond	Limington
Hoopers Brook	South Berwick
Hussey Brook	North Berwick
Hutchins Creek	Kittery

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – continued

Flooding Source Name	Community(ies)
Indian Pond	York
Innis Brook	Saco
Isinglass Pond	Waterboro
Jagger Pond	Sanford
Johnson Brook	Kittery, York
Josias River	York
Junkins Brook	Hollis
Keay Brook	Berwick
Kennebunk Pond, East Outlet	Lyman
Kennebunk Pond, West Outlet	Lyman
Kennebunk River	Arundel, Kennebunk
Killick Brook	Hollis
Killick Pond	Hollis
Killick Pond Brook	Limington
L Pond	Sanford
Lake Carolyn	York
Legion Pond	Kittery
Libby Brook	York, Kittery
Lily Pond	Biddeford, Hollis
Little Brook	Eliot
Little Long Pond	Sanford
Little River	Berwick, Biddeford, Buxton, Cornish, Lebanon, North Berwick, York
Locke Brook	Hollis
Long Pond	Saco
Lords Brook	Lyman
Lords Pond	Biddeford
Love Brook	Berwick
Lovers Brook	South Berwick
Merriland River	Wells
Middle Branch	Waterboro
Middle Branch Mousam River	Alfred
Middle Branch Pond	Alfred, Waterboro
Middle Pond	York
Mill Brook (portions)	Old Orchard Beach
Mill Creek	Saco
Milliken Pond	Old Orchard Beach
Moody Pond	Waterboro
Moulton Brook	York
Mousam River (portions)	Kennebunk, Shapleigh

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – continued

Flooding Source Name	Community(ies)
Mud Pond	Sanford
Muddy Brook	Hollis, York
Mulloy Brook	Berwick
Negro Island	Biddeford
Neoutaquet River	North Berwick
Nonesuch Brook	Saco
Northwest Pond	Waterboro
Ogunquit River	South Berwick, Wells
Ogunquit River (portions above Green Brook)	Ogunquit
Old Fishing Pond	Sanford
Paddy Creek*	Kennebunkport
Parker Pond	Lyman
Pease Brook	Cornish
Pendexter Brook	Parsonsfield
Perkins Brook	North Berwick
Perkins Marsh Brook	Sanford
Picture Pond	Sanford
Portsmouth Naval Shipyard	Kittery
Pot Hook Brook	Dayton
Pugsley Brook	Cornish
Ram Island (shoreline)	Saco
Rogers Brook	York
Round Pond	Lyman, Sanford
Round Swamp Brook*	Kennebunkport
Runnels Brook	Dayton
Rush Swamp	York
Salmon Falls River	Acton, Berwick, South Berwick
Sand Pond	Sanford
Sandy Brook	Saco
Scituate Pond	York
Shoreys Brook	Eliot
Short Pond	Saco
Skelton Power Station at Union Falls	Dayton
Smelt Brook	York
Smith Brook	Hollis
Smith Brook (upstream portion)*	Kennebunkport

*Studied in 2012 by Ransom Consulting Engineers and Scientists within the Town of Kennebunkport

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – continued

Flooding Source Name	Community(ies)
South Branch Libby Brook	York
South Branch of West Brook	Wells
South River	Parsonsfield
Southside Brook	York
Springy Brook	Lyman
Spruce Creek	Eliot, Kittery
Stackpole Creek	Saco
Stage Island	Biddeford, Kennebunkport
Stevens Brook	Wells
Stony Brook	Hollis
Stratton Island (shoreline)	Saco
Stroudwater River	Buxton
Stuart Brook	Saco
Sturgeon Creek	Eliot
Sucker Brook	Kennebunk
Sunken Branch Brook	Lyman
Swan Pond Brook	Biddeford, Lyman
Swan Pond Creek	Dayton
Thatcher Brook	Biddeford
Togue Brook	Berwick
Tongue Brook	North Berwick
Torwater Pond	Lyman
Trafton Brook	Alfred
Tributary to Middle Branch Mousam River	Alfred
Trott Island	Kennebunkport
Turbats Creek*	Kennebunkport
Tyler Brook*	Kennebunkport
Unnamed Areas	York
Unnamed Low-Lying Areas	Kittery, Old Orchard Beach
Unnamed Ponds	Lyman, Waterboro, Wells
Unnamed Streams	Lyman, Wells
Unnamed Swamps	Waterboro, Eliot, Kennebunkport
Unnamed Tributaries	Countywide
Wales Pond	Hollis
Ward Brook	Kennebunk
Wards Pond	Limington

*Studied in 2012 by Ransom Consulting Engineers and Scientists within the Town of Kennebunkport

TABLE 3 - FLOODING SOURCES STUDIED BY APPROXIMATE METHODS – continued

Flooding Source Name	Community(ies)
Webhannet River	Wells
Wedgewood Brook	Parsonsfield
Welchs Pond	York
West Branch Libby Brook	York
West Brook	Biddeford, Wells
West Goose Rock	Kennebunkport
Whaleback Brook	Limington
Whippoorwill Swamp	York
White Island (shorelines)	Kittery
Whites Marsh Brook	South Berwick
Wilcox Pond	Biddeford
Wilson Creek	Kittery
Wood Island	Biddeford, Kittery
Worster Brook	Berwick
York Pond	Eliot
York River	Eliot, York

This FIS also incorporates the determinations of letters issued by FEMA resulting in map changes (Letter of Map Revision [LOMR], Letter of Map Revision - based on Fill [LOMR-F], and Letter of Map Amendment [LOMA]), as shown in Table 4, "Letters of Map Change."

TABLE 4 – LETTERS OF MAP CHANGE

Community	Case Number	Flooding Source	Letter Date
Alfred, Town of	01-01-037P	Middle Branch Mousam River	09/19/2001
Alfred, Town of	06-01-B101X	Ponding Areas 1.2 and 3	06/01/2006
Biddeford, City of	199102354FIA	Saco River and Thatcher Brook	03/10/1987
Biddeford, City of	13-01-0424P	Unnamed Tributary to West Brook	09/17/2013
Hollis, Town of	10-01-0538P	Unnamed Tributary to Stony Brook	11/17/2010
Kittery, Town of	07-01-0122P	Hill Creek	07/19/2007

TABLE 4 – LETTERS OF MAP CHANGE - continued

Community	Case Number	Flooding Source	Letter Date
Kittery, Town of	10-01-2103P	Chickering Creek	09/07/2011
Kittery, Town of	12-01-1257P	Fuller Brook	11/23/2012
Lyman, Town of	06-01-B101X	Ponding Areas 1.2 and 3	06/01/2006
Old Orchard Beach, Town of	01-01-009P	Local Wetland Area	10/14/2001
Saco, Town of	07-01-0775P	Saco River	06/18/2007
Saco, Town of	07-01-1253P	Deep Brook	01/14/2008

Detail-studied streams that were not re-studied as part of this revision may include a profile baseline on the FIRM. The profile baselines for these streams were based on the best available data at the time of their study and are depicted as they were on the previous FIRMs. In some cases, the transferred profile baseline may deviate significantly from the channel or may be outside of the floodplain.

Revised coastal analyses were performed for the open water flooding sources in the cities of Biddeford and Saco and the towns of Kennebunk, Kennebunkport, Kittery, Oguinquit, Old Orchard Beach, Wells, and York.

All new or revised modeling and updated topographic data, including existing 2006 light detection and ranging (LiDAR) bare earth data that were processed to create 2 feet contours and breakline data, were used to delineate the coastal floodplain and regulatory floodway boundaries along the shoreline for the cities of Biddeford and Saco and the towns of Kennebunk, Kennebunkport, Kittery, Oguinquit, Old Orchard Beach, Wells, and York (Reference 13).

2.2 Community Description

York County is located at the southernmost tip of Maine. In York County, there are 27 towns and 2 cities. The towns of Cornish, Limerick, Limington, Newfield, and Parsonsfield are in the northern part of the county. The towns of Arundel, Buxton, Dayton, Hollis, Kennebunk, Kennebunkport, Old Orchard Beach, and Wells, and the cities of Biddeford and Saco are located in the eastern part of the county. The towns of Acton and Shapleigh are in the western portion of the county. The towns of Alfred, Lyman, Sanford, and Waterboro are in the central portion of the county. The southern portion of the county is made up of the towns of Berwick, Eliot, Kittery, Lebanon, North Berwick, Ogunquit, South Berwick, and York.

York County is bordered on the north and northeast by Oxford and Cumberland Counties in Maine. It is bordered on the west and south by New Hampshire counties Carroll,

Strafford, and Rockingham. The east and southeast sides of York County are formed by the Atlantic Ocean.

According to census records, the population of York County was 197,131 in 2010, 186,742 in 2000, and 164,587 in 1990 (Reference 14). The total area in York County consists of 1,271 square miles, including 280 square miles of water area.

The topography of York County can be described as gently rolling, moderately hilly terrain, with sand dunes and tidal marshes along the coast. There is a range of soil associations in York County. Most of York County consists of soils belonging to the Hermon-Lyman-Peru association. These are upland soils formed in glacial tills and have sandy or loamy textures. Soils in this association vary from excessively drained to moderately drained. Many ridges and hilltops are shallow to bedrock. Located adjacent to rivers and brooks are soils of the Colton-Adams-Histosol association. The Adams and Colton are generally deep, well-drained and coarse-textured soils that formed in glacial outwash on plains and terraces. Histosols are very poorly drained soils, formed in organic material and found in low-lying areas along the streams.

Located within the county are Maine's Appalachian Mountains, as well as some of the beaches and anchorages on the Atlantic Coast. The western foothills of Maine provide abundant natural resources, including lakes, ponds, rivers, and mountains. The Little Ossipee, Mousam, Saco, and Piscataqua Rivers are among the main rivers that pass through the county. An extensive marsh-swamp, referred to as the "Heath," is located several miles inland and north of the Saco River. Much of the county is heavily forested, with portions cleared for development and agricultural use. Of the urban uses, residential makes up the largest portion. The cities of Biddeford and Saco comprise one of the largest industrial, commercial, and service trade centers in southwestern Maine.

2.3 Principal Flood Problems

The low-lying coastal areas of York County, including the towns of Arundel, Kennebunk, Kennebunkport, Kittery, Ogunquit, Old Orchard Beach, Wells, and York and the cities of Biddeford and Saco, are subject to the periodic flooding and wave attack that accompany coastal storms such as northeasters and hurricanes. The majority of these storms cause damage to low coastal highways, boats, beaches, and seawalls. Occasionally, a major storm accompanied by strong onshore winds and high tides results in surge and wave activity that causes extensive property damage and erosion. Some of the more significant storms that occurred in York County include those of November 1945, 1963, and 1968; February 1972; January and February 1978; and October 1991. These storms damaged harbors, marinas, and residential and commercial developments in the flood-prone coastal areas. Continuing erosion associated with severe storms also acts to reduce the beach and dune width to below protective and recreational use requirements (Reference 15). Present and future demands associated with the seasonal tourist industry will further intensify the pressure for development of flood-prone coastal lands. However, the adoption of local or state development regulations concerning floodplain management will help alleviate storm-related losses.

The flood problems for the communities within York County have been compiled and are described below:

The towns of Acton, Eliot, Newfield, South Berwick, and Shapleigh are experiencing an increase in urbanization, and developmental pressures are expected to continue increasing in these towns. Urbanization within the watershed increases the flood hazard by increasing the rate and amount of runoff. Encroachment into the floodplain by land filling and other developments constricts the flow and reduces the storage of floodwaters. This in turn increases flood depths and the area flooded upstream.

Flooding occurs almost annually along the Great Works River, affecting the towns of North Berwick, South Berwick, and Sanford. Most of the floods are caused by rapid thawing of snow and ice in late winter and early spring, and the flooding is often accelerated by rainfall and ice jams. Less often, flooding occurs later in the year as a result of hurricanes. Minor flooding occurs almost annually. The flood of March 1936 is generally considered to be the largest in recent years in the Town of South Berwick. This flood also involved the Salmon Falls River. It was generated from approximately 6 inches of rain over a 10-day period and further complicated by high antecedent moisture conditions, snow cover, and ice laden streams. The recurrence interval of this flood was estimated at approximately 1-percent-annual-chance. There are no available records of any significant flood damage in the study area (Reference 16). Notable floods also occurred in this region in 2006 and 2007.

In the Town of Sanford, the flood of March 1983 produced maximum flows of 4,020 cubic feet per second (cfs) at the USGS gage on the Mousam River near West Kennebunk and had a recurrence interval of approximately 85 years (Reference 17). No records of flood damages to the town are available.

Minor flooding occurs almost annually in the towns of Acton, Limerick, Limington, Newfield, Shapleigh, and Waterboro due to snowmelt and ice jams on the Little Ossipee River. Areas flooded include wooded and open lowlands, roads, and bridges. The flood of record occurred in March 1936 and had a peak discharge of 8,530 cfs at the Little Ossipee Flowage Dam in Limerick and Waterboro. This flood was generated from approximately 4 inches of rain over a 2- day period and further complicated by high antecedent moisture conditions, snow cover, and ice laden streams. The recurrence interval of the flood was estimated to be slightly in excess of 1-percent-annual-chance. There are no available records of any flood damage in the study area (Reference 16).

A USGS gaging station is located on the Little Ossipee River near South Limington and had a period of record of 42 years. The highest recorded discharge (5,760 cfs) at the gage occurred in March 1977. The USGS gaging station was discontinued in September 1982 (Reference 17).

Numerous low-lying areas along the Little Ossipee River are subject to frequent flooding. Flooding of these areas can cause damage to dwellings, existing woodlands, roads, and bridges. A 1-percent-annual-chance flood in Waterboro would inundate approximately 1,300 acres; the 0.2-percent-annual-chance flood would inundate approximately 1,500 acres In Limerick, a 1-percent-annual-chance flood would inundate approximately 900 acres; the 0.2-percent-annual-chance flood would inundate approximately 1,100 acres (Reference 18).

In the towns of Waterboro and Limerick, an estimated 60 building lots are located within the 1-percent-annual-chance floodplain adjacent to the Little Ossipee Flowage.

Approximately 15 of these lots have been recently developed with either seasonal or year-round homes. Due to this development pressure on floodplain lands, significant flood damage potential exists if development is allowed to continue uncontrolled (Reference 18).

Small areas of localized flooding occur along the southern portion of the Town of Limington. The Little Ossipee River flows approximately 10 miles through a relatively uninhabited section of the town. The river drops a total of 58 feet in Limington, at a fairly constant rate, except for two sets of falls. There has been very little development in Limington on the floodplains of the river.

Low-lying areas of Cornish and Parsonsfield are subject to periodic flooding caused by the overflow of the Ossipee River. Cornish also is subject to periodic flooding from the Little River. The most severe flooding occurs in the early spring as a result of snowmelt and heavy rain in conjunction with ice jams. Additional floods, generally lower in magnitude, also occur in late summer as a result of hurricanes and tropical storms. The two major floods occurring in Cornish and Parsonsfield from the Ossipee River were in 1936 and 1953, and the frequencies and peak discharges of these floods were recorded at the two USGS gages at Cornish. The peak discharge of the 1936 flood was 17,200 cfs, and its recurrence interval of approximately 0.3-percent-annual-chance. The 1953 flood had a peak discharge of 13,800 cfs, and a recurrence interval of 1-percent-annual-chance (Reference 16). In the Town of Parsonsfield, the 1936 flood caused flooding of the woolen mill located in Kezar Falls Village and the area near South River. Damages were slight due to the relatively steep banks and sparse development in the floodplain.

Major floods on the Saco River have occurred in the spring, and are usually the result of heavy rainfall combined with snowmelt. Although there has been flooding during other months, 10 of the 14 greatest floods have occurred during March, April, or May. Heavy rainfall associated with hurricanes moving up the coast of Maine has caused flooding in the fall. This flooding occurs on the riverine and estuarine reaches of the Saco River and affects the towns of Buxton, Dayton, Hollis, Limington, Cornish, and the cities of Biddeford and Saco.

The greatest recorded flood in the lower Saco River basin occurred at West Buxton in March 1936, with a peak flow of 58,200 cfs (Reference 16). In the vicinity of the cities of Biddeford and Saco, damage from the 1936 flood was centered in the more intensely developed residential, commercial, and industrial areas (Reference 19). The March 1953 flood, the most severe recorded for the New Hampshire portion of the Saco River, caused a peak flow of 50,000 cfs at West Buxton. The 1953 flood caused about $1.8 million in flood damage (Reference 20). The March 1936 and March 1953 floods have recurrence intervals of 0.25- and 0.625-percent-annual-chance, respectively. Small areas of localized flooding have been noted along the small brooks studied by approximate methods. Road overflow is not uncommon on these brooks, especially when the culverts at road crossings are clogged with ice.

In the Town of Cornish, the peak discharge of the March 1936 flood was 45,000 cfs, and its recurrence interval is 0.5-percent-annual-chance. The March 1953 flood had a peak discharge of 42,400 cfs and a recurrence interval of 0.58-percent-annual-chance. The frequencies and peak discharges of these floods were recorded at the two USGS gages at Cornish (Reference 16).

Flooding along the Piscataqua River in the Town of Eliot is primarily caused by coastal storm surges that occur during hurricanes and northeasters. The coastal flood of record occurred in February 1978. Flood elevations from the storm were estimated to have a recurrence interval of approximately 1-percent-annual-chance (Reference 20). Only minor flooding along the Piscataqua River is caused by runoff from the upstream rivers that combine to create the Piscataqua River. The most notable riverine flood upstream from Eliot was the March 1936 flood along the Salmon Falls River in South Berwick.

In the Town of Berwick, the March 1936 flood on the Salmon Falls River had an approximate recurrence interval of 2-percent-annual-chance. This flood washed out the Eddy Bridge, the Worster Bridge at New Dam, and Rochester Road.

The most severe floods in the Town of Lebanon occur in early spring as a result of snowmelt and heavy rains. In the past, ice jams have helped to cause high-water conditions, but they have not caused a major flood problem in Lebanon. The dams on the Salmon Falls River are recreational.

Riverine flooding has not generally been a serious problem in the towns of Kennebunk, Kennebunkport, Ogunquit, Wells, and York. In the Town of Ogunquit, some riverine flooding has occurred on the non-tidal portions of the Josias and Ogunquit Rivers. Most of the floodplains are underdeveloped, and damage is limited during flooding. However, ice jamming occurs on the Josias River upstream of the U.S. Route 1 Bridge. In the Town of Wells, the only riverine flooding occurs infrequently on a small portion of U.S. Route 1 near the Merriland River (Reference 21).

Severe flooding in the Town of Alfred is limited to the Littlefield River, including the shorelines of Estes Lake and Shaker Pond. Flooding generally occurs in the spring from rapid runoff caused by heavy rains combined with snowmelt. Less frequently, flooding occurs later in the year as a result of hurricanes. Significant flooding has occurred in this location in 1977, 1983, and 1984. These floods had recurrence intervals of 2-, 1-, and 3-percent-annual-chance, respectively.

Severe flooding in Lyman is limited to the shorelines of Bunganut, Swan, Kennebunk and Roberts-Wadley Ponds. Flooding generally occurs in the spring months from rapid runoff, which is caused by heavy rains combined with snowmelt. Less frequently, flooding occurs later in the year as the result of hurricanes.

Riverine flooding generally occurs in the winter and early spring as a result of heavy rainfall on snow-covered ground. Notable riverine floods occurred in this region in 1936, 2006, and 2007 (References 22 and 23).

Coastal flooding occurs frequently in York County. Low pressure systems moving up the east coast with strong northeasterly wind gusts in the Gulf of Maine can cause rapidly growing seas and storm surges throughout the area. Low pressure systems coincide with astronomical high tides frequently and high winds often cause tide levels to rise above flood level, submerging docks, moving rocks onto roads, flooding, and causing beach erosion (Reference 24).

Minor flooding was reported when Hurricane Sandy merged with a strong upper level trough approaching from the west just off the mid-Atlantic coast on October 29, 2012 (Reference 24).

2.4 Flood Protection Measures

The coastal communities of York County have adopted the minimum shoreland zoning ordinance as required by the State of Maine (Reference 25). This ordinance serves to protect the shorelines by restricting construction to reduce flood damage.

In 1971, the State of Maine enacted the "Mandatory Zoning and Subdivision Control Law" (Chapter 424, Section 4811 thru 4814 of the Maine Statutes), which requires all municipal units of government to adopt zoning and subdivision control ordinances for shoreland areas. Shoreland areas are defined as land within 250 feet of the normal high water mark of any pond, river, or salt water body. If a municipality fails to adopt zoning and subdivision controls for any reason, the Maine Department of Environmental Protection and the Maine Land Use Regulation Commission shall adopt suitable ordinances for that municipality. The law was revised by the Maine Legislature in 1973 to give the municipalities until June 30, 1974 to adopt the ordinances. At that time, a moratorium was declared in those communities that had failed to develop ordinances on all shoreland areas as defined above. This law prohibits filling or earth-moving without permit within 250 feet of the shoreland.

Flood protection measures for York County have been compiled and are summarized below:

Beach erosion control studies have been conducted for the Kennebunk, Kennebunkport, and Old Orchard Beach beaches to determine the need and justification for restoring eroded beaches in order to provide additional shore protection and bathing beach area (Reference 15). Beach erosion control studies have also been conducted for Camp Ellis Beach in the City of Saco (Reference 26).

The State of Maine provides concrete seawalls and stone revetments to protect coastal highways. Other protective structures were generally constructed and are maintained either by the coastal community or by private property owners to satisfy their individual requirements and financial capabilities. Limited financial resources sometimes result in less than adequate protection. These structures include such backshore protection as timber and steel sheetpiles, bulkheads, stone revetments, concrete seawalls, and pre-cast concrete units (Reference 15). The coastal communities in York County affected by this are the towns of Kennebunk, Kennebunkport, Ogunquit, Old Orchard Beach, Wells, and York and the cities of Biddeford and Saco.

Flood discharges in the Saco River basin are greatly affected by the natural valley storage afforded by the large floodplain extending from near the Maine-New Hampshire border to Hiram, Maine. It has been estimated that nearly 200,000 acre-feet of water (8,712 million cubic feet) was stored in this area during both the 1936 and 1953 floods (References 27 and 28).

Cataract Dam, Springs Dam, and Bradbury Dam, all located on the Saco River near Factory Island, help reduce flood flows on the river within the cities of Biddeford and Saco. Federal agencies, in cooperation with state and local interests, have constructed massive stone jetties at the entrance to the Saco River for flood protection and navigational purposes (Reference 15). In 1967, a study recommended that local interests regulate development in flood hazard areas of the Saco River basin and adopt suitable

building codes providing for the flood-proofing of existing structures in such areas (Reference 19).

In Buxton, Dayton, and Hollis, the Saco River is a wide, smoothly flowing river, which is affected by backwater from the three power dams owned by the Central Maine Power Company. Skelton Station is a large hydro-power dam located at Union Falls in Dayton. This composite dam is about 1,965 feet long and was completed in 1949. The station runs at full capacity during high water. Any excess water is passed through two grated, concrete spillway sections that have a capacity of approximately 132,000 cfs. The reservoir, which extends about 3 miles upstream from this dam, has a normal pool elevation of 126.3 feet.

The Clarks Mill Dam in Dayton is town-operated to maintain a reservoir for fire protection. The stop logs in the sluice are seldom changed. It is a low head dam, and the spillway is adequate to pass the peak flows of this study. The dam near Dennett Road is abandoned and in very poor shape. It is a low head rock crib dam, and the gate section has been completely washed out. Downstream of this dam, the stream drops rapidly to join the Saco River.

At Bar Mills, there is another hydro-power dam on the Saco River just north of U.S. Highway 202. The dam, which is about 1,245 feet long, was completed in 1888. The power station runs at full capacity during high water. Excess water during high flows is passed over a 62.6 foot long spillway section. The dam creates a reservoir that extends about 4.5 miles upstream, almost to West Buxton. The normal full pond elevation is 146.5 feet.

Proceeding upstream, the next dam on the Saco River is the West Buxton Power Station, built in 1906. It is a concrete gravity dam about 585 feet long and 30 feet high. The dam has two overflow sections, with a total crest length of 333 feet, a gated section with a 20-foot wide vertical lift gate, and two 40-foot wide stanchion sections. The power station could pass a 0.2-percent-annual-chance discharge with no retention of floodwaters. At its normal elevation of 177.1 feet, the pond extends about 1.5 miles upstream, almost to the Bonny Eagle Dam.

The hydro-power station at Bonny Eagle was built in 1910. It is a concrete gravity dam approximately 1,120 feet long with a 350-foot spillway section. This station has a maximum operating head of 38 feet.

Flood elevations downstream from the confluence of the Saco and Little Ossipee Rivers are affected by the dam at the Bonny Eagle Power Station, located about 1.5 miles downstream. The Little Ossipee River and its network of small streams are controlled by the operation of dams located upstream of the Town of Limington at the outlets of Little Ossipee Lake and Balch and Ledgemere Ponds, which have a combined storage capacity of 581 million cubic feet.

None of these dams significantly alters streamflow or controls flooding.

The Saco River Corridor Commission has zoned all the shoreland of the Saco River in Dayton, Hollis, and Limington, all the shoreland of the Little Ossipee River in Limington, and all of the shoreland along the Ossipee River from the New Hampshire border to its confluence with the Saco River. This protected area is known as the "Saco

River Corridor" and includes the land areas within 500 feet of the normal high water mark of the Saco River. In areas where the floodplain exceeds 500 feet in width, the corridor is extended to include the floodplain area up to a maximum of 1,000 feet wide. In Dayton, Hollis, and Limington, the Saco River corridor is zoned either Resource Protection or Limited Residential, which severely restricts encroachment and development in the floodplain (Reference 29). In 1967, the United States Army Corps of Engineers (USACE) made a study of the need for flood control structures in the Saco River basin-use regulations in the floodplain could best control and protect development (Reference 30). The Saco River Environmental Advisory Committee has mapped the Saco River floodplain based on the 1936 flood data. The maps have been provided to all Saco River Corridor communities for their use in planning and zoning in the floodplain. Results of updated pre-countywide studies were used to revise the delineation of the corridor.

Buxton's Town Land Use Plan (1976) provides flood protection by limiting development within 300 horizontal feet of the normal high-water mark of Bonny Eagle and Duck Ponds, The Bog (Groveville), the Little and Stroudwater Rivers, and McKenney Brook (Reference 29).

In the Town of Acton, a 10-foot high earthfill dam with a steel and concrete spillway is located at the outlet of Balch Pond. If adequately maintained, the dam provides safe passage of flood flows.

Estes Lake on the Mousam River has a capacity of 210 million cubic feet of storage. This affords flood protection for towns downstream from the Town of Alfred but not for the Town of Alfred itself because the lake is located close to the downstream corporate limits. Shaker Pond has a natural outlet with no dam.

The greatest flood protection measures afforded the Town of Cornish along the Ossipee and Saco Rivers are the relatively steep banks, which tend to contain the flood flows. In the headwaters of the Ossipee River, Ossipee Lake acts as a natural flood-retarding basin, reducing the peak discharge in the Town of Cornish. The bog areas upstream of Hiram Falls Dam on the Saco River also act as a flood storage basin and reduce the peak discharge in Cornish. Non-structural flood protection measures are also being utilized to aid in the prevention of future flood damage. These are land-use regulations adopted from the Saco River Corridor Commission, established in 1973. These land-use regulations control buildings within areas that have a high risk of flooding.

Flood protection measures in the Town of Eliot along the Piscataqua River are limited to those afforded by local zoning ordinances and those privately constructed by local residents.

The dam on Cooks Brook at Clarks Mills is operated by the Town of Hollis to maintain a reservoir for fire prevention. The stop logs in the sluice are changed infrequently. It is a low head dam, and the spillway is adequate to pass the peak flows utilized in this study. The dam near Dennett Road is abandoned and in poor condition. It is a low head, rock crib dam, with the gate section completely washed out. None of these dams significantly alter high stream flow or control flooding in the Town of Hollis.

In the Town of Limerick, the Little Ossipee Flowage Dam outlet on the Little Ossipee River has 4-foot high flashboards used for temporary flood protection.

Several dams are located on streams within the Town of Kennebunk, but these do not provide significant flood protection. Stone breakwater jetties have been constructed at the mouth of the Kennebunk River by the federal government in cooperation with local interests.

Three dams are located along the Great Works River in the Town of North Berwick. These dams have not been designed for flood control in the community, but they do serve to reduce peak flows downstream.

A 10-foot high earthfill dam with a steel and concrete spillway is located at the outlet of Balch Pond in the Town of Newfield. If adequately maintained, the dam provides safe passage of flood flows.

The USDA NRCS in Orono, Maine, maintains a flood control dike on Ogunquit Beach in the Town of Ogunquit. A stabilization project calls for the re-establishment of the primary dune height of 22 feet. The project affects a 6,300-foot length of beach and has a 5:1 fore-and-back slope with a 25-foot top width (Reference 31). Several dams are located on streams within Ogunquit, but these do not provide significant flood protection.

The steep banks of the Ossipee River, which contain the riverflows, provide the greatest flood protection to the Town of Parsonsfield. In the headwaters of the Ossipee River, Ossipee Lake reduces the peak flow discharges in the Town of Parsonsfield. There are no structural flood protection measures scheduled for construction in the future.

A masonry dam approximately 25 feet high is located at the outlet of Leigh's Mill Pond in South Berwick. Brattle Dam No. 1, a masonry structure approximately 10 feet high, crosses the Great Works River at Brattle Street. Brattle Dam No. 2, a stone and timber dam approximately 15 feet high, is located some 300 feet downstream. A masonry dam approximately 9 feet high is located at the outlet of Shapleigh Pond in the Town of Shapleigh. If adequately maintained, the dams provide safe passage of flood flows.

The flow of the Mousam River is regulated by Square Pond and Mousam and Estes Lakes, with a combined capacity of approximately 700 million cubic feet, and by power plants upstream. Seven dams on the Mousam River in the Town of Sanford provide negligible flood protection

In the Town of Waterboro, the Little Ossipee Flowage Outlet Dam on the Little Ossipee River has 4-foot high flashboards used for temporary flood protection. The Little Ossipee Lake Dam on Little Ossipee Lake provides safe passage of flood flows at its present discharge capacity.

Concrete seawall barriers exist along much of the coastline in the Town of Wells, and a jetty extends out from the entrance to Wells Harbor. Seawalls delineated on the FIRM for the January 16, 2003 Wells FIS revision have been identified as flood protection structures that reduce wave effects during the base flood.

In 1945, the USACE constructed a seawall at York Harbor in the Town of York. The seawall has been washed out and consequently improvements made (Reference 32). Seawalls delineated on the FIRM for the July 15, 2002 York FIS revision have been identified as flood protection structures that reduce wave effects during the base flood. There are no flood protection structures on the streams in York.

There are no known existing or planned flood protection structures within the towns of Arundel, Berwick, or Lebanon. There are dams on the Salmon Falls River in Berwick, but they are for recreational purposes only.

3.0 ENGINEERING METHODS

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

3.1 Riverine Hydrologic Analyses

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

For each community within York County that has a previously printed FIS report, the hydrologic analyses described in those reports have been compiled and are summarized below.

Pre-countywide Analyses

During major floods, the entire length of the Little River (Town of Kennebunk) in Kennebunk and Wells acts as an estuary. Water-surface elevations during floods are not a function of discharge alone but a complex function of discharge, flood volume, tide levels, and wind effects. Rather than attempt to treat these factors separately, the Atlantic Ocean tidal flood elevations were used as the flood elevations for this estuary. Since the peak discharges of the Little River (Town of Kennebunk) would not be used in flooding analysis, no hydrology has been established for the Little River in these towns.

Flood flows for the various frequencies of the Great Works River and Goodall Brook were computed from an analysis of stream hydraulics, soil cover, land use, and rainfall data using the USDA NRCS TR-20 computer program (Reference 33). A 24-hour duration storm and normal antecedent moisture conditions were used. All flood flows were reservoir routed through Bauneg Beg Pond. The discharges obtained from the TR-20 program are somewhat higher than those estimated from a USGS regression equation; however, they fall within the standard errors of estimate for the equation (Reference 34).

For the Little Ossipee River, flood flows for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods were computed using the USDA NRCS TR-20 computer program (Reference 33). A 24-hour duration storm and normal antecedent moisture conditions were used. The USGS gage (No. 01066500) located on the Little Ossipee River near South Limington has a period of record of 36 years. The computed discharges correlated favorably with a log-Pearson Type III analysis of the gage data (Reference 34).

For the Littlefield River and Mousam River (Lower Reach) for the Town of Alfred, the primary source of peak-flow data used to determine flood discharges for the flooding sources studied by detailed methods was USGS gaging station No. 01069500 on the Mousam River near West Kennebunk. The West Kennebunk gage is located approximately 0.5 mile downstream of Estes Lake Dam and has a drainage area of approximately 99 square miles. Records of flood peaks were available at this gage from 1940 to 1984. The 1-percent-annual-chance discharge at the gage was based on a log-Pearson Type III analysis of annual peak flow data (Reference 35).

Peak discharges upstream from the USGS gage were established by adjusting the discharge computed at the gage from differences in drainage area between the upstream site and the gage using the following formula:

$$Q = Q_g(A/A_g)^b$$

where Q is the desired 1-percent-annual-chance flood discharge at the upstream site, Q_g is the 1-percent-annual-chance flood discharge at the USGS gage, and A and A_g, are drainage areas at the respective sites. The value of the exponent b is 0.8.

Since the gage is located downstream of all regulation affecting Sanford, the peak flow data already take into account the effects of any regulation by upstream lakes and reservoirs. The flood discharges computed at the gage were modified on the basis of drainage area relationships to compute the adopted discharges in Sanford (Reference 34). The discharges for the Mousam River (Lower Reach) were derived from discharges calculated for Estes Lake. According to USGS Water-Supply Paper 1580-B, a useable storage capacity of less than 4.5 million cubic feet per square mile, in general, affects peak discharges by less than 10 percent (Reference 36). The useable storage capacity of Estes Lake is less than this limit; therefore, it was not considered in the computation of upstream flood discharges. The 1-percent-annual-chance flood flow for Tributary to Middle Branch Mousam River was determined using the USGS regional regression equation for the region (Reference 34).

Two USGS gages on the Ossipee River were used to establish the peak discharge-frequency relationships. The gage located at Effingham Falls, New Hampshire, has 34 years of record, and the gage located at Cornish, Maine, has 60 years of record (References 37 and 38). Values of the 10-, 2-, 1-, 0.2-percent-annual-chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data in accordance with the U.S. Water Resources Council Bulletin 17 (Reference 39). Peak flows for other locations on the Ossipee River were computed by use of the drainage area proration method mentioned above, $Q = Q_g(A/A_g)^b$ (Reference 40). The value of b applied to the Ossipee River was 0.8. This value was based on the analysis of peak discharges at the two gages listed above.

In the pre-countywide July 4, 1988 FIS for the Town of Kennebunkport, the 1-percent-annual-chance flood elevation at the Lake of the Woods area was also determined by the

proportion method, with a transposition coefficient of 0.75. Reservoir routing was performed to find the water-surface elevation of that flood in this area.

The stage-frequency relationship for the Piscataqua River in the Town of Eliot was established through information obtained in a review of flood history of the area and the pre-countywide FISs for the towns of South Berwick and Kittery, Maine, and the cities of Portsmouth and Dover, New Hampshire (References 16, 41, 42, 43, 44, and 45). In the pre-countywide FISs for the downstream communities of Kittery and Portsmouth, New Hampshire, the 1-percent-annual-chance flood elevations for the Piscataqua River were determined to be 8.0 and 8.2 respectively (References 43 and 44). These elevations agree with high-water data obtained by USGS staff during the February 1978 flood, which was considered a 1-percent-annual-chance event. In the FIS for the City of Dover, New Hampshire, a 1-percent-annual-chance elevation of 8.4 feet was determined for the Cocheco River near its confluence of the Piscataqua River (Reference 45). Based on these results, a 1-percent-annual-chance flood elevation for the entire length of the Piscataqua River in Eliot was determined to be 8.3 feet.

The computation of flow past the hydro-power plant at West Buxton was the principal source of data for defining discharge frequency relationships for the Saco River. Records of annual, maximum daily discharges were furnished to USGS by the Central Maine Power Company. Discharges were computed from records of flow over dam, through waste gates, and through wheels of the power plant. The data cover a period of 66 years (1908 to 1916 and 1920 to 1977). Discharge figures for this station have not been published by USGS since 1940; prior to 1940, these data were published as "Station 01067000, Saco River at West Buxton, Maine."

Values for the 10-, 2-, 1-, and 0.2-percent-annual-chance peak discharges were obtained from a log-Pearson Type III distribution of these annual, maximum daily flow data (Reference 46). The results from this analysis increased by 1.7 percent to simulate instantaneous discharge because the flow data for West Buxton are values of maximum daily discharge. The 1.7-percent factor was determined to be the average amount by which instantaneous peak flows exceeded concomitant daily flows at West Buxton and was based on a comparison of 59 events. The instantaneous peak discharges were computed from flow through wheels and gates and flow over spillways. Because of the difference in drainage area from West Buxton (1,571 square miles) to the Hollis-Dayton corporate limits (1,594 square miles), further increases in the peak flow were required to estimate flow at the downstream end of the study area. The area at the Hollis-Limington corporate limits is 1,550 square miles, so a slight decrease in flow was made for the upstream end of the reach. Flood discharges for the right and left channel around Bonny Eagle Island were computed using split flow techniques. The largest part of the flow goes through the left channel where the spillway section of the dam is located.

The hydrologic analyses for Salmon Falls River were taken from the pre-countywide FISs for the cities of Somersworth and Rochester, New Hampshire (References 47 and 48). Flood discharge-frequencies for the Salmon Falls River were computed using log-Pearson Type III statistical analyses (Reference 46) of peak discharges at gage No. 01072500 located on the Salmon Falls River near South Lebanon, Maine. The gage was in operation from 1930 to 1969.

For the March 16, 1998 FIS for the City of Saco, Sawyer Brook discharges were computed using the NRCS TR-20 computer program (Reference 49). This program used historical rainfall data for all computed frequencies. Modeled storms had 24-hour duration and a Type III rainfall distribution.

The Batson, Josias, Kennebunk, Ogunquit, Ogunquit Tributary, and Little Rivers; the Bog, Goosefare, Great, and Smith Brooks; Spruce and Spinney Creeks; and miscellaneous streams and rivers throughout the County of York are ungaged. The 10-, 2-, 1-, and 0.2-percent-annual-chance flood peak discharges were computed based on the Maine flood magnitude and frequency formulas developed by USGS and were found to be applicable to these flood sources (References 34 and 50). The USGS formulas predict discharges based on the parameters of watershed drainage area, main channel slope, and percentage of area of lakes and ponds.

The values of the peak flows for Cooks and Day Brooks at 10-, 2-, 1-, and 0.2-percent-annual-chance intervals were obtained using equations developed by R. A. Morrill and outlined in USGS Open-File Report 75-292 (Reference 34).

The 1-percent-annual-chance flood discharge at the outlets of Bunganut Pond, Swan Pond, Kennebunk Pond, and Roberts-Wadley Pond were determined by applying a USGS regression equation (Reference 34).

Countywide Analyses

The 10-, 2-, 1-, and 0.2-percent-annual-chance flood flows for Coffin Brook, Coffin Brook Tributary 1, Driscoll Brook, Ferguson Brook, Keay Brook, Little River (Town of Berwick), Mulloy Brook, Worster Brook, and Worster Brook Tributary 3 were computed with regression equations (Reference 51). The regression equations use drainage area and percent wetlands as explanatory variables. All drainage areas were determined using a Watershed Information System (WISE) (Reference 52) and a geographic information system (GIS). Basin wetlands were computed with U.S. Fish and Wildlife Service National Wetland Inventory maps at a scale of 1:24,000 with GIS.

For the Mousam River in Kennebunk, flood frequency curves, including the 10-, 2-, 1-, and 0.2-percent-annual-chance flood flows for the Mousam River at Whichers Mills Road in Kennebunk were updated after the 2007 flood in southern Maine (Reference 53). Although continuous data were collected at this historical gage on the Mousam River near Kennebunk (USGS Station number 01069500) from 1939 through 1984, a number of historical peak flows occurred at this station outside of the period of record (1996, 2006, and 2007). Peak flows for selected recurrence intervals were estimated by use of the Expected Moments Algorithm (Reference 54) in order to make better use of the historical peak flow data outside of the period of record. Although station number 01069500 is not in the study area of this detailed flood insurance study, drainage area adjustments were made to the published peak discharges at West Kennebunk in order to estimate peak discharges at three locations on the Mousam River: Twine Mill Dam, the confluence with Day Brook, and U.S. Route 1.

Peak discharges for the same three locations were estimated through drainage area adjustments by use of the following equation:

$$Q_{ungaged} = Q_{gaged}(DA_{ungaged}/DA_{gaged})b;$$

where Q is the flow in cubic feet per second, DA is the drainage area in square miles, and b is a coefficient that depends on the recurrence interval (Reference 55). Although values of b are published for many recurrence intervals in Hodgkins' report, b was computed specifically for each location and each recurrence interval along the Mousam River in Kennebunk using the formula listed above, and solving for b. Initial values for gaged and ungaged discharge were determined through regression equations that depend on drainage area and percent wetland in the basin (Reference 55). Regression equations used without the adjustments listed above are inappropriate along the Mousam River because of the regulation in this watershed.

Drainage areas were calculated using WISE (Reference 52). Basin wetlands were computed with U.S. Fish and Wildlife Service National Wetland Inventory maps at a scale of 1:24,000 with GIS.

Peak discharge-drainage area relationships for York County are shown in Table 5, Summary of Discharges. This table includes the revised flooding sources in the Town of Berwick and the Mousam River (Town of Kennebunk).

TABLE 5 – SUMMARY OF DISCHARGES

		PEAK DISCHARGES (CUBIC FEET PER SECOND)			
FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
BATSON RIVER					
At dam near U.S. Route 1	5.76	408	693	849	1,310
BLACKSMITH BROOK					
At U.S. Route 1	2.25	179	312	385	607
BRIDGES SWAMP					
At mouth	1.09	110	198	249	403
BUNGANUT POND					
At outlet	2.91	*	*	165	*
CAPE NEDDICK RIVER					
At confluence with Cape Neddick Harbor	9.53	479	785	950	1,420

*Data not computed

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
CHICKERING CREEK					
At Dana Avenue	.015	73	108	123	155
CIDER HILL CREEK					
Above confluence with York River	4.99	285	477	582	886
COFFIN BROOK[1]					
At confluence with Worster Brook	0.91	173	291	350	505
About ¾ mile downstream from School Street, upstream from confluence with Unnamed Stream (Coffin Brook Tributary 1)	0.50	106	182	219	320
About 2,030 feet downstream from School Street	0.37	80.4	138	168	245
COFFIN BROOK TRIBUTARY 1[1]					
At confluence with Coffin Brook	0.39	89.30	154	186	273
About 350 feet upstream from Mayberry Lane	0.31	73	127	154	226
COOKS BROOK					
At Dyer Road	10.30	494	803	968	1,440
At Clarks Mill (State Route 35)	9.82	469	772	934	1,410
At State Route 5	8.76	469	772	934	1,410
Dayton-Hollis-Lyman corporate limits	7.11	382	632	766	1,160

[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
DAY BROOK					
At confluence with the Mousam River	2.68	194	335	412	644
DEPOT BROOK					
At U.S. Route 1	1.41	124	219	273	436
DOLLY GORDON BROOK					
Above confluence with York River	3.42	196	329	400	613
Above Maine Turnpike	1.25	88	147	179	274
DRISCOLL BROOK[1]					
At downstream corporate limits	1.72	146	231	273	377
At Blackmore Road, about 3,150 feet upstream from downstream corporate limits	1.24	95.90	152	179	247
Upstream from confluence with Unnamed Stream, about 4,100 feet downstream from Blackberry Hill Road	0.47	40.80	65.80	78.20	109
At Blackberry Hill Road	0.29	17.00	26.90	31.80	43.9
ESTES LAKE					
At USGS gage No. 01069500	99.00	*	*	4,000	*

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
ESTES LAKE					
At outlet of Estes Lake	98.00	*	*	4,000	*
Above confluence with Mousam River (Littlefield River Branch)	50.50	*	*	2,300	*
FERGUSON BROOK[1]					
At confluence with Worster Brook	0.65	91.40	152	182	259
About 2,260 feet downstream from School Street	0.44	60.80	101	121	174
About 1,420 feet upstream from School Street	0.21	38.70	66.5	80.50	118
FULLER BROOK					
Above Haley Road	.031	*	*	166	*
GOODALL BROOK					
At Berwick Road	0.90	110	190	220	250
GOOSEFARE BROOK					
At confluence of Branch Brook	6.45	410	689	840	1,284
At the Boston and Maine Railroad bridge	3.98	279	468	571	873
Upstream of Ross Road	2.82	211	355	433	662

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
GREAT WORKS RIVER					
At Vine Road	86.30	4,210	6,950	8,010	11,000
At Emery's Bridge Road	82.10	4,000	6,620	7,640	10,500
At Old South Berwick Road	46.10	1,780	3,110	3,640	5,180
At State Route 9	36.90	1,070	2,000	2,360	3,930
At Oak Woods Road	22.10	550	1,160	1,370	2,160
At the outlet of Bauneg Beg Pond	18.20	540	1,060	1,240	1,710
At Sand Pond Road	11.40	930	1,660	1,940	2,640
At Twombley Road	3.50	440	740	860	970
GREEN BROOK					
At confluence with Ogunquit River	5.02	397	660	801	1,211
HILL CREEK					
At Haley Road	.047	*	*	400	*
JOSIAS RIVER					
At confluence with the Basin	7.31	546	930	1,140	1,760
Upstream of Shore Road	6.65	506	862	1,057	1,632
KEAY BROOK[1]					
At confluence with Salmon Falls River	11.60	4,470	692	796	1,050

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
KEAY BROOK[1] – continued					
Upstream from confluence with Murdock Lake tributary, about 500 feet downstream from Ridlon Road	9.20	421	626	723	960
Upstream from confluence with Unnamed Tributary, about 3,100 feet upstream from Ridlon Road	8.40	403	601	695	925
KENNEBUNK POND					
At outlet (west)	1.14	*	*	69	*
KENNEBUNK RIVER					
At mouth	52.88	2,317	3,644	4,335	6,262
LITTLE OSSIPEE RIVER					
At the mouth	187.00	4,630	7,890	9,640	14,800
At USGS gage No. 01066500	168.00	4,250	7,240	8,850	13,600
At the Limington-Limerick-Waterboro town boundary	157.00	4,030	6,860	8,380	12,900
At Little Ossipee Flowage Outlet Dam	155.20	2,900	6,400	7,800	12,000
At State Route 5	112.40	4,000	7,400	9,000	13,400
At a point approximately 2,500 feet below the upstream corporate limits	66.50	1,700	3,300	4,000	6,000

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
LITTLE OSSIPEE RIVER - continued					
At State Route 11	21.70	370	690	830	1,250
At Balch Pond Road	14.00	250	470	550	760
LITTLE RIVER (TOWN OF BERWICK)					
At confluence with Salmon Falls River[1]	54.40	1771	2517	2862	3685
About 2,500 feet downstream from Long Swamp Road[1]	51.70	1644	2334	2653	3413
At a point approximately 2.4 miles upstream of its mouth	6.31	423	715	874	1,342
At mouth	6.31	423	715	874	1,342
LITTLE RIVER (TOWN OF CORNISH)					
Upstream from confluence with Unnamed Stream, about 1.2 miles downstream from Diamond Hill Road[1]	49.20	1,545	2,193	2,492	3,206
Confluence with Ossipee River	7.60	620	1,060	1,310	2,070
LITTLEFIELD RIVER					
At USGS gage No. 01069500	99.00	*	*	4,000	*
At outlet of Estes Lake	98.00	*	*	4,000	*

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
LITTLEFIELD RIVER - continued					
Above confluence with the Mousam River (Littlefield River Branch)	50.50	*	*	2,330	*
Above confluence with Hay Brook	43.50	*	*	2,070	*
Above confluence with Middle Branch	22.40	*	*	1,220	*
At outlet of Shaker Pond	19.40	*	*	1,080	*
MERRILAND RIVER (LOWER REACH)					
At Lords Road	16.81	935	1,529	1,846	2,757
MERRILAND RIVER (UPPER REACH)					
At Hobbs Road	10.77	602	993	1,202	1,807
MIDDLE BRANCH MOUSAM RIVER					
At State Route2/U.S. Route 202	16.2	*	*	1,547	*
MILL BROOK					
At Ross Road	2.68	169	288	354	547
Moors Brook					
At Meetinghouse Road	2.83	264	466	579	921

*Data not computed

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
MOUSAM RIVER (TOWN OF KENNEBUNK)[1]					
At U.S. Route 1/Kesslan Dam	111.6	3,560	6,660	8,560	15,040
At confluence with Day Brook	107.7	3,390	6,340	8,160	14,320
Twine Mill Dam	106.7	3,320	6,220	7,990	14,030
MOUSAM RIVER (TOWN OF SANFORD)					
At inlet to Estes Lake	47.50	1,380	2,020	2,340	3,160
At small mill dam approximately 420 feet downstream of Washington Street	41.50	1,240	1,820	2,100	2,840
At Mill Pond Dam	37.30	1,140	1,670	1,930	2,610
Upstream of confluence of unnamed tributary approximately 1,170 feet downstream of Stanley Road	32.00	1,000	1,470	1,710	2,310
MOUSAM RIVER (LOWER REACH)					
At downstream corporate limits	102.00	*	*	4,000	*
MULLOY BROOK[1]					
At confluence with Worster Brook	0.47	87	148	178	258
About 1,900 feet upstream from School Street	0.28	71	124	152	224

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
OGUNQUIT RIVER					
At breached dam	14.60	933	1,551	1,882	2,845
Downstream of Maine Turnpike	13.16	859	1,427	1,732	2,618
Upstream of Maine Turnpike	12.94	847	1,408	1,709	2,583
Upstream of North Village Road	11.94	794	1,321	1,602	2,422
At mouth	13.16	933	1,551	1,882	2,845
East of Maine Turnpike	12.94	859	1,427	1,732	2,618
West of Maine Turnpike	11.94	847	1,408	1,709	2,583
OGUNQUIT RIVER TRIBUTARY					
At confluence with Ogunquit River	1.01	110	182	221	334
OSSIPEE RIVER					
Cornish Gage (No. 01065500)	453	7,840	11,760	13,690	18,890
At corporate limits	450	7,715	11,575	13,470	18,590
Upstream of Mill Brook	388	6,920	10,380	12,080	16,670
Upstream of South River	354	6,435	9,655	11,240	15,510
ROBERTS-WADLEY POND					
At outlet	9.00	*	*	233	*
SACO RIVER					
At Springs Dam	1,680	25,800	38,600	45,000	62,600

*Data not computed

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
SACO RIVER - continued					
At West Buxton dam	1,572	25,400	37,900	44,000	61,000
Saco boundary	1,623	25,800	38,600	45,000	62,600
Cornish Gage (No. 01066000)	1,298	23,065	33,790	38,950	52,560
Buxton-Dayton-Hollis corporate limits (mouth of Cooks Brook)	1,594	25,600	38,200	44,200	61,500
Skelton hydro-power station	1,622	25,800	38,600	45,000	62,600
At Bar Mills Dam	1,594	25,600	38,200	44,200	61,500
At Bonny Eagle Dam	1,560	25,300	37,700	43,800	60,600
At the Hollis-Limington-Standish town boundary	1,550	25,200	37,500	43,600	60,200
At the Baldwin-Standish-Limington town boundary	1,330	23,600	34,600	39,800	53,800
At the Baldwin-Cornish-Limington town boundary	1,296	23,100	33,800	39,000	52,600
SACO RIVER-RIGHT CHANNEL					
At the Buxton-Town of Standish boundary	1,560	25,300	37,700	43,800	60,600
SALMON FALLS RIVER					
At New Dam Road	235	4,600	7,460	9,000	13,800
At Walnut Grove Road	149	3,360	5,450	6,570	10,080
At Spaulding Avenue	130	3,050	4,940	5,960	9,150
SAWYER BROOK					
At Sawyer Street	0.17	190	305	355	460

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
SAWYER BROOK - continued					
At Therrien Avenue	0.09	65	110	125	165
SMITH BROOK					
At State Route 9	1.54	112	195	241	381
SOUTH BRANCH OF WEST BROOK					
At confluence with West Brook	2.77	207	347	422	645
SPINNEY CREEK					
At confluence with the Piscataqua River	1.03	99	178	222	359
SPRUCE CREEK					
At the confluence with the Piscataqua River	2.56	167	285	349	542
STEVENS BROOK					
At U.S. Route 1	2.01	187	336	418	668
SWAN POND					
At outlet	0.97	*	*	99	*
THATCHER BROOK					
At Main Street	6.54	353	584	708	1,069
TRIBUTARY 1 TO CAPE NEDDICK RIVER					
Above private road	2.01	138	226	274	409

*Data not computed

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
TRIBUTARY 1 TO GREEN BROOK					
At confluence with Green Brook	1.22	136	210	255	385
TRIBUTARY TO MIDDLE BRANCH MOUSAM RIVER	0.50	35	60	75	115
UNNAMED TRIBUTARY TO STONY BROOK					
At Burnham Lane	.04	*	*	221	*
WORSTER BROOK TRIBUTARY 3[1]					
At confluence with Worster Brook	0.86	95	155	185	261
About 1,620 feet upstream from confluence with Worster Brook	0.46	74	124	150	216
About 2,700 feet upstream from confluence with Worster Brook	0.16	30	53	65	95
WEBHANNET RIVER					
Approximately 0.5 mile upstream of U.S. Route 1	5.25	393	673	826	1,282
WEST BROOK					
At Bragdon Road bridge	6.61	415	696	847	1,294
At Bragdon Road culvert	3.84	268	451	549	838

*Data not computed
[1]Updated calculations for this countywide study

TABLE 5 – SUMMARY OF DISCHARGES – continued

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQUARE MILES)	PEAK DISCHARGES (CUBIC FEET PER SECOND) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
WORSTER BROOK[1]					
At confluence with Salmon Falls River	7.59	411	669	777	1040
Upstream from confluence with Ferguson Brook	6.12	375	572	666	899
Upstream from confluence with Coffin Brook	4.71	246	972	432	580
Upstream from confluence with Mulloy Brook	4.24	206	311	362	484
Upstream from confluence with Unnamed Stream, about 1.6 miles downstream from Brown Road	2.49	128	196	228	308
At Brown Road	0.60	88.2	147	176	252
About 2,700 feet upstream from Brown Road	0.36	56.20	94.60	114	164
About 3,700 feet upstream from Brown Road	0.23	35.30	59.70	71.90	104

[1]Updated calculations for this countywide study

Approximate analyses in the Town of Kennebunkport were studied by Ransom Consulting Engineers and Scientists in 2012 and are described below.

In the Town of Kennebunkport, Baston River (upstream portion), Beaver Dam Brook, Paddy Creek, Round Swamps Brook, Smith Brook (upstream portion), Turbats Creek, and Tyler Brook were studied by approximate methods. Discharges were calculated using the USDA NRCS TR20 method using Runoff Curve numbers and Times of Concentrations for subwatersheds, using 1-percent-annual-chance rainfall distribution for a 24-hour storm. Non-steady flow simulations were used to account for storage and timing differences of peak passage within the watershed. The Cornell University "Extreme Precipitation in New York and New England" website (Reference 56) was accessed in 2012 to obtain the 1-percent-annual-chance, 24-hour rainfall.

3.2 Riverine Hydraulic Analyses

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

Cross section data for the below-water sections were obtained from field surveys. Cross sections were located at close intervals above and below bridges, culverts, and dams in order to compute the significant backwater effects of these structures. In addition, cross sections were taken between hydraulic controls whenever warranted by topographic changes.

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.

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

For each community within York County, the hydraulic analyses described in these reports have been compiled and are summarized below.

<u>Pre-countywide Analyses</u>

All cross sections, bridges, and culverts were surveyed to obtain elevation data, structural data, and structural geometry. Cross sections were selected immediately below changes in stream configuration. Roughness coefficients (Manning's "n") were determined by field inspection at each cross section using a step-by-step procedure. Where feasible, transposed cross sections were used to reduce the number of surveyed cross sections. Transposed cross sections are surveyed sections that can be transferred either upstream or downstream to represent a location that is similar in valley shape.

For the Little Ossipee River in the Town of Acton, topographic data were obtained from 10 surveyed valley and bridge cross sections and from USGS topographic maps (References 57 and 58). Water-surface elevations of floods were computed using the USDA NRCS Water Surface Profiles (WSP) WSP-2 computer program (Reference 59). Starting water-surface elevations for the Little Ossipee River were obtained from the FIS for the Town of Newfield (described below).

Cross section data for the Littlefield River in Alfred were obtained from USGS topographic maps (References 58 and 60). Below-water portions of the cross sections were taken from maps of Maine lakes (Reference 61). Water-surface elevations of floods of the selected recurrence intervals for the Littlefield River were computed using the USGS step-backwater computer program (Reference 62). The starting water-surface elevation at the Estes Lake outlet was determined by applying flow over broad-crested

weir equations (Reference 63). For the Littlefield River, which was modeled without a floodway, the results of the water-surface computations are tabulated for the selected cross sections.

In Alfred, cross section data for the Mousam River and Tributary to Middle Branch Mousam River were obtained through field surveys. Water-surface elevations of floods of the selected recurrence intervals for the Mousam River and Tributary to Middle Branch Mousam River were computed using the USACE HEC-2 computer program (Reference 64). The starting water-surface elevations for the Mousam River were assumed to be at critical depth downstream of Old Falls Dam in Kennebunk. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

In Arundel, cross sections for the Kennebeck River were obtained from field surveys and photogrammetric mapping. Water-surface profiles of floods of the selected recurrence intervals on the stream studied by detailed methods were computed using the USACE HEC-2 step-backwater model (Reference 65). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the Kennebunk River were taken from mean spring high tide.

Cross sections for the backwater analyses of the Salmon Falls River in Berwick were obtained from aerial photographs flown in May 1980 at a scale of 1:9,600 (Reference 66). The below-water sections were obtained by field measurement. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 67). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations were calculated using the slope/area method.

In Biddeford, cross section data for the Little River, Saco River, Moors Brook, and Thatcher Brook were obtained from topographic maps compiled from aerial photographs (Reference 68). Below-water sections were obtained from field surveys. Water-surface elevations of floods of the selected recurrence intervals were determined using the USACE HEC-2 step-backwater computer program (Reference 69). Starting water-surface elevations for the Saco River were based on the computed pool elevations behind Springs Dam and Bradbury Dam. Starting water-surface elevations for the Little River, Moors Brook, and Thatcher Brook were determined based on the mean spring high tide. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals.

For the Saco River and Saco River-Right Channel in Buxton, cross sections for the backwater analyses were obtained from topographic maps developed from aerial photographs taken on November 13, 1978 (References 70 and 71). The below-water sections were obtained by field measurements. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the USGS E-341 step-backwater computer program (Reference 72). The downstream starting water-surface elevations were taken from the FISs for the Town of Dayton and the City of Saco (below). These elevations were verified by computations of discharge at the Bradbury and Springs Dams in the cities of Biddeford and Saco, respectively. The starting water-surf ace elevations upstream of Skelton Station were determined by a log-Pearson Type III analysis of annual, maximum forebay elevations. The water-surface elevations, for the years 1949 to 1978, were furnished by Central Maine Power Company. The starting elevations upstream of West Buxton and Bar Mills Dams were determined from the

spillway discharge curves provided by the Central Maine Power Company. Adjustments were made for maximum flow through the hydro-stations at designated flood times. For the streams studied by approximate methods, the 1-percent-annual-chance flood elevations were estimated using a method developed by USGS hydrologists at the Augusta, Maine, office. A regional stage-frequency relationship indicated an estimated 10-foot rise over the mapped stream elevation as the inundation limit of the 1-percent-annual-chance flood (Reference 73).

Cross section data for the Saco River, Ossipee River, and Little River (Town of Cornish) in Cornish were obtained from photogrammetric maps; the below-water sections were obtained by field survey (Reference 74). Several small wooden bridges were not studied and are not shown because they are assumed to be washed out during flooding. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the USACE HEC-2 step-backwater computer program (Reference 69). Starting water-surface elevations for the Saco, Ossipee, and Little Rivers were calculated using the slope/area method.

Cross section data for the backwater analyses of the Saco River and Cooks Brook in Dayton and Hollis were obtained from aerial photographs taken for this study on November 13, 1978 (References 75 and 76). The below-water data were obtained by field measurement. Water-surface elevations of floods of the selected recurrence intervals were computed through use of the USGS E431 step-backwater computer program (Reference 72). The starting water-surface elevations on the Saco River were taken from the FISs of the cities of Biddeford and Saco (both are described within this section). These elevations were verified by computations of discharge at the Bradbury and Springs Dams in Biddeford and Saco, respectively. The starting water-surface elevations upstream of Skelton Station Dam were determined by a log-Pearson Type III analysis of annual maximum forebay elevations. Skelton Station Pond is completely flooded by backwater from the Saco River.

In the Dayton and Hollis area, the starting water-surface elevations on Cooks Brook were determined by computations of discharge over Dennett Dam and Clarks Mill Dam. To determine stage-discharge relations for each of these dams, the study contractor made direct readings of pond elevations, surveyed the dams, and recorded their physical dimensions. Reference points were set in the forebays of the dams so the head on the dams could be computed for observed and measured flows. Current-meter measurements were made at both dams, and a relationship between stages and discharges was determined. These ratings were extended on the basis of the standard flow-over-dam formulas (Reference 63):

$$Q = C\ L\ (H)3/2$$

where Q is the discharge being studied (in cfs), C is the coefficient of discharge, L is the length of the dam perpendicular to the direction of flow (in feet), and H is the head on the dam (in feet).

The measurements of flow to obtain values of "C" did not differentiate the flow for leakage or flow through deep gates. The dams were observed during two seasons of high flow, and no gate changes were made. Therefore, the assumption was made that the gates are opened only during times of major repair. This assumption was verified by local residents. The coefficient of discharge was determined using the tables and graphs of the USGS Techniques of Water Resources Investigations, which lists "C” values for various

dam types (Reference 63). The actual "C" value used in the formula given above to compute the flood elevation was based on both of these "C" determinations. This procedure was used for the abandoned dam near Dennett Road, as well as the Clarks Mill Dam. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals. For the streams studied by approximate methods in Dayton and Hollis, the 1-percent-annual-chance flood elevations were estimated using a regional stage-frequency relationship that indicates an estimated 10-foot rise over the mapped stream elevation as the inundation limit of the 1-percent-annual-chance flood (Reference 73).

Also in Hollis, the Flood Hazard Boundary Map (FHBM) was used to delineate additional small, localized areas of flooding, including swamps and ponds (Reference 77).

In Eliot, cross sectional data for Spinney Creek were obtained from topographic maps compiled from aerial photographs (Reference 68). Below-water sections were obtained from field surveys. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 67). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water-surface elevations for Spinney Creek were determined using the mean spring high tide. Portions of the profiles for Spinney Creek were not prepared where those portions were affected by backwater from the Piscataqua River.

Water-surface profiles for the Branch Brook, Batson River, Day Brook, Kennebunk River, Little River, Little River (Town of Kennebunk), and Smith Brook in Kennebunk and Kennebunkport were developed using the USACE HEC-2 step-backwater model (Reference 65). Cross sectional data for both computer models were obtained from photogrammetric mapping while below-water cross sections were obtained by field survey. In areas where the streams meander, the channel distances were determined from the centerline of flow in the floodplain, not the stream centerline.

In Kennebunk, starting water-surface elevations for the Kennebunk River were taken from mean spring high tide. The slope/area method was used for Day Brook. It was determined that flooding on Branch Brook would be totally controlled by the Atlantic Ocean for the entire length of the detailed study within Kennebunk. The Little River is an estuary where water-surface elevations are not a function of discharge alone. For this reason, the HEC-2 step-backwater computer program was not used to analyze the flooding on the Little River.

In Kennebunkport, starting water-surface elevations for the Batson River were taken at critical depth. Starting water-surface elevations for the Kennebunk River, Little River, and Smith Brook were determined from the mean spring high tide. It was determined that flooding on the Kennebunk River would be totally controlled by the Atlantic Ocean for the entire length of the detailed study within Kennebunkport.

Cross sectional data for Spinney and Spruce Creeks in Kittery were obtained from topographic maps compiled from aerial photographs (Reference 68). Below-water sections were obtained from field surveys. Water-surface elevations of floods of the selected recurrence intervals were determined using the USACE HEC-2 step-backwater computer program (Reference 69). Starting water-surface elevations for Spruce Creek and Spinney Creek were determined using the mean spring high tide.

For the Salmon Falls River in Lebanon, the computer model Quick-2, a simple step-backwater modeling program (Reference 78) was used to analyze Bog Brook, Great Brook, and Little River. The model requires cross section data, Manning's "n" value, slope, and flow data as input. The input values were determined from field reconnaissance. All of the structures and representative cross sections were modeled for each flooding source. The flood line was produced using engineering judgment. Cross sections for the backwater analyses of the Salmon Falls River were obtained from aerial photographs flown in May 1980 at a scale of 1.0 inch equals 800 feet. The below-water sections were obtained by field measurement. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step- backwater computer program (Reference 79). Starting water-surface elevations for the Salmon Falls River were taken from known elevations in the FIS for the City of Rochester, New Hampshire (Reference 48).

Cross section data for the Little Ossipee River in Limerick were obtained from 21 surveyed valley and bridge cross sections and from USGS topographic maps (Reference 57). Water-surface elevations of floods of the selected recurrence intervals were computed using the USDA NRCS WSP-2 computer program (Reference 59).

In Limington, cross section data for the backwater analyses of the Saco and Little Ossipee Rivers were obtained from aerial photographs (Reference 80). The below-water sections were obtained by field measurements. For the streams studied by approximate methods, the 1-percent-annual-chance flood elevations were estimated by a method developed by USGS hydrologists at the Augusta, Maine, office (Reference 73). The regional stage-frequency relationship indicates that the inundation limit of the 1-percent-annual-chance flood is an estimated 10 feet higher than the stream elevation as mapped on USGS topographic maps (References 57 and 58). The Town of Lebanon used this data for their starting water-surface elevation data for the Little Ossipee River.

For the Bunganut, Kennebunk, Roberts-Wadley, and Swan Ponds in Lyman, cross sections were extended into overbank areas using topographic maps (Reference 60). The 1-percent-annual-chance flood elevation for Bunganut Pond was determined by rating the outlet overflow weir and culvert pipe. The outlet weir was rated by applying the USGS step-backwater computer program (Reference 81). Traditional flow-over-weir equations were not applicable in this case. Flow through the culvert was determined by applying appropriate formulas published by USGS (Reference 82). The 1-percent-annual-chance flood elevation for Swan Pond was determined by rating the culvert at the outlet of the pond. Flow through the culvert was calculated by applying standard USGS practices (Reference 82). Flow over the roadway at the culvert was computed using the USGS step-backwater computer program (Reference 81). The 1-percent-annual-chance flood elevation for Kennebunk Pond was determined by rating both the east and west outlets of the pond. The constricted opening at the west outlet was rated by using the USGS step-backwater computer program (Reference 81). The culvert at the east outlet was rated using standard USGS practices (Reference 82).

The 1-percent-annual-chance flood elevation for Roberts-Wadley Pond in Lyman was calculated using the USGS step-backwater computer program (Reference 81). The dam at the outlet of the pond is irregular and has two small breached sections. Traditional weir equations were not appropriate. The step-backwater program was used to compute critical flow over the dam and then to adjust for the effects of velocity head to compute the pond's 1-percent-annual-chance flood elevation. Starting elevations used in step-

backwater applications were based on slope-conveyance computations. Resultant flood elevations for the ponds were confirmed by comparisons with knowledge of historical flood elevations obtained from local residents.

Topographic data for Balch Pond and the Little Ossipee River in Newfield were obtained from 10 surveyed valley and bridge cross sections and from USGS topographic maps (References 57 and 58). Water-surface elevations of floods of the selected recurrence intervals were computed using the USDA NRCS WSP-2 computer program (Reference 59). Starting water-surface elevations for the Little Ossipee River were obtained from the FIS for the Town of Limerick (described above).

Topographic data for Bauneg Pond and the Little Ossipee River in North Berwick were obtained from 47 surveyed valley and bridge cross sections and from USGS topographic maps (References 60 and 83). Water-surface elevations of floods of the selected recurrence intervals were computed using the USDA NRCS WSP-2 computer program (Reference 59). Starting water-surface elevations for the Great Works River were obtained from the FIS for the Town of South Berwick (described below).

Water-surface profiles for the Josias River, Ogunquit River, and Ogunquit River Tributary in Ogunquit were developed using the USACE HEC-2 step-backwater computer model was applied (Reference 65). Cross sectional data for both computer models were obtained from photogrammetric mapping while below-water cross sections were obtained by field survey. Critical depth was used for starting water-surface elevations on the Josias and Ogunquit Rivers. The slope/area method was used to obtain the starting water-surface elevation for the Ogunquit River Tributary. Hydraulic analyses of the shoreline characteristics of the flooding source studied in detail were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along the shoreline.

Cross sectional data for the Goosefare and Mill Brooks in Old Orchard Beach were obtained from photogrammetric mapping while the below-water sections were obtained by field survey (Reference 68). Water-surface elevations were developed using two computer models. The riverine portions of the streams studied by detailed methods utilized the USACE HEC-2 step-backwater computer program (Reference 65). Water-surface elevations for the portion of Mill Brook downstream of Ross Road to the Boston & Maine railroad were determined using rainfall data (Reference 84). For the streams studied by detailed riverine methods, the starting water-surface elevations were taken at the mean spring tide level of 5.4 feet.

The above-water cross section data for the Ossipee River in Parsonsfield were obtained from photogrammetric maps (Reference 74); the below-water sections were obtained by field survey. Water-surface profiles were developed for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods using a HEC-2 step-backwater computer program (Reference 85). The computer program was started using the slope-area method at the confluence of the Ossipee and Saco Rivers and was continued upstream. A trial-and-error procedure was employed to calibrate the program using the flood of record (1936) on the Ossipee River (Reference 16). Streams studied by approximate methods were checked by information gathered from the detailed study areas, information from the town, and the Flood Hazard Boundary Map (Reference 86). No normal depth calculations were made for these areas.

Cross section data for the Goosefare Brook, Saco River, and Sawyer Brook in Saco were obtained from topographic maps compiled from aerial photographs (Reference 68).

Below-water sections were obtained from field surveys. For the 1984 Town of Saco FIS, water-surface elevations of floods of the selected recurrence intervals for the Saco River and Goosefare Brook were computed using the USACE HEC-2 step-backwater computer program (Reference 64). Starting water-surface elevations for the Saco River were based on computed pool elevations behind the Springs Dam and the Bradbury Dam. Starting water-surface elevations for Goosefare Brook were determined based on the mean spring high tide.

For the March 16, 1998 Town of Saco FIS, water-surface elevations for Sawyer Brook were computed using the NRCS WSP2 standard step-backwater computer program (Reference 87). Starting water-surface elevations for Sawyer Brook were computed using critical depth. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

The hydraulic analysis for Goodall Brook and the Great Works River in the September 4, 1984 Town of Sanford FIS was taken from a USDA NRCS flood hazard analysis for the Great Works River (Reference 88). Topographic data were obtained from 47 surveyed valley and bridge cross sections and from USGS topographic maps (References 60 and 83). Water-surface elevations of floods of the selected recurrence intervals were computed using the USDA NRCS WSP-2 computer program (Reference 59).

For the December 3, 1991 Town of Sanford FIS revision, cross section data for the backwater analyses for Bauneg Beg Pond, Estes Lake, and Middle Branch were obtained from field surveys conducted during the 1989 field season by the study contractor, and water-surface elevations were computed using the USGS WSPRO step-backwater computer program (References 81 and 89). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The hydraulic analysis for Estes Lake and the starting water-surface elevations for the Mousam River at Estes Lake were taken from the FIS for the Town of Alfred (above). Starting water-surface elevations for the Great Works River and Goodall Brook were taken from the USDA NRCS Flood Hazard Analyses for South Berwick (Reference 90). Starting water-surface elevations upstream of each of the seven dams on the Mousam River were determined from stage-discharge relationships based on the surveyed physical characteristics of the dams and appropriate flow over weir equations documented by USGS (Reference 82).

For the July 20, 1998, Town of Sanford FIS revision, water-surface elevations for the 1-percent-annual-chance floods were computed for the Mousam River (Lower Reach) using the USACE HEC-2 computer program (Reference 91). The starting water-surface was assumed to be at critical depth downstream of Old Falls Dam at Kennebunk, and the computer model includes this dam as it controls the water-surface at the Sanford-Kennebunk corporate limits.

Topographic data for the Little Ossipee River in Shapleigh were obtained from 17 surveyed valley and bridge cross sections and from USGS topographic maps (References 57 and 58). Field surveys were obtained during the summer of 1975. Only those features in the floodplain at the time the surveys were made were considered in the computations. Water-surface elevations of floods of the selected recurrence intervals were computed using the USDA NRCS WSP-2 computer program (Reference 66). Starting water-surface elevations for the Little Ossipee River were obtained from the FIS for the Town of Newfield (described above).

For the Great Works River in South Berwick, topographic data were obtained from 32 surveyed valley and bridge cross sections and from USGS topographic maps (References 60 and 83). Field surveys were obtained in 1975. Only those features in the floodplain at the time the surveys were made were considered in the computations. Water-surface elevations of floods of the selected recurrence intervals were computed using the USDA NRCS WSP-2 computer program (Reference 59). Starting water-surface elevations for the Great Works River were calculated by the slope/area method.

Valley and bridge cross sections for Little Ossipee Lake and Little Ossipee River in Waterboro were obtained from USGS 15-minute series topographic maps (Reference 57). Water-surface elevations of floods of the selected recurrence intervals for the Little Ossipee River from the downstream corporate limits to the Waterboro-Limington-Limerick town boundary were computed using the USGS step-backwater computer program (Reference 92). Water-surface elevations for the Little Ossipee River from the Waterboro-Limington-Limerick town boundary to the upstream corporate limits were computed using the USDA NRCS WSP-2 computer program (Reference 59). Starting water-surface elevations for the Little Ossipee River were obtained from the FIS for Limington (described above).

Water-surface elevations for Blacksmith Brook, Depot Brook, Green Brook, Little River (Town of Kennebunk), Merriland River (Lower and Upper Reach), Ogunquit River, South Branch of West Brook, Stevens Brook, Tributary 1 to Green Brook, Webhannet River, and West Brook in Wells were computed using USACE HEC-2 step-backwater model (Reference 65). Cross sectional data for both computer models were obtained from photogrammetric mapping, while below-water cross sections were obtained by field survey.

Also in Wells, the Little River (Town of Kennebunk) is an estuary where water-surface elevations are not a function of discharge alone. For this reason, the HEC-2 step-backwater computer program was not used in analyzing the flooding on the Little River (Town of Kennebunk) (Reference 65). Starting water-surface elevations for the Ogunquit, Webhannet, and Meniland Rivers and Blacksmith Brook were taken at critical depth. Starting water-surface elevations for Depot Brook, Green Brook, Stevens Brook, West Brook, and South Branch of West Brook were obtained using the slope/area method. For Tributary 1 to Green Brook, the starting water-surface elevations were taken from the flood profile of Green Brook at their confluence. It was determined that flooding from Branch Brook and Little River is controlled by the Atlantic Ocean for their detailed study lengths within Wells. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

In York, cross sections for the Cape Neddick River, Cider Hill Creek, Dolly Gordon Brook, Tributary 1 to Cape Neddick River and the York River were obtained from photogrammetric mapping while below-water sections were obtained by field survey (Reference 68). Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (Reference 65). For the streams studied by detailed riverine methods, with the exception of Bridges Swamp, the starting water-surface elevations were taken at the mean spring tide level of 5.4 feet. For Bridges Swamp, the starting water-surface elevations were computed using the slope/area method.

Countywide Analyses

Analyses of the hydraulic characteristics of flooding from Coffin Brook, Coffin Brook Tributary 1, Driscoll Brook, Ferguson Brook, Keay Brook, Little River (Town of Berwick), Mousam River (Town of Kennebunk), Mulloy Brook, Worster Brook, and Worster Brook Tributary 3 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. 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 for the flooding source studied by detailed methods were obtained from field surveys and supplemented by LiDAR (Reference 13). All bridges, dams, and culverts were field surveyed to obtain elevation data and structural geometry. In cases where dams and (or) their gates were inaccessible for the Mousam River (Town of Kennebunk), plans were obtained from Kennebunk Power and Light in order to include these structures in the hydraulic model. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles.

Water-surface elevations of floods of the selected recurrence intervals for Coffin Brook, Coffin Brook Tributary 1, Driscoll Brook, Ferguson Brook, Keay Brook, Little River (Town of Berwick), Mulloy Brook, Worster Brook, and Worster Brook Tributary 3 were computed using the USACE HEC-RAS 3.1.3 step-backwater computer program (Reference 93). The starting water surface elevations for the 10-, 2-, 1- and 0.2-percent-annual-chance flow profiles at the mouth were calculated by the HEC-RAS normal depth computation routine and a downstream water surface slopes estimated from channel survey data.

Water-surface elevations of floods of the selected recurrence intervals for Mousam River (Town of Kennebunk) were computed using the USACE HEC-RAS 4.0 step-backwater computer program (Reference 94). The starting water surface elevations for the 10-, 2-, 1-, and 0.2-percent-annual-chance flow profiles at the mouth were calculated by the HEC-RAS normal depth computation routine, and a downstream water surface slope was estimated from channel survey data. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. The starting water surface elevations for the 10-, 2-, 1-, and 0.2-percent-annual-chance flow profiles downstream of U.S. Route 1 were estimated from channel survey data.

The 1-, and 0.2-percent-annual-chance flood boundaries were drafted with WISE using existing digital topographical maps with 10-foot contour intervals downloaded from the Maine OGIS website (Reference 95) and available LiDAR Data (Reference 13). Topographic maps were verified and adjusted based on digital orthophoto quads also downloaded from this site. The 10-, 2-, 1-, and 0.2-percent-annual-chance flood profiles were drafted with WISE (Reference 52).

Based on the results of the new coastal analysis, the backwater elevations are revised where necessary. The flooding sources of Batson River, Blacksmith Brook, Bridges Swamp, Cape Neddick River, Cider Hill Creek, Depot Brook, Dolly Gordon Brook, Goosefare Brook, Josias River, Kennebunk River, Little River, Merriland River (Lower Reach), Mill Brook, Moors Brook, Mousam River (Town of Kennebunk), Ogunquit

River, Saco River, Salmon Falls River (floodway data tables [FDT] only), Smith Brook, Spinney Creek, Spruce Creek, Stevens Brook, Webhannet River, and the York river (FIRM only) were revised for backwater elevations.

Roughness factors (Manning's "n") used in the hydraulic computations for this updated countywide study were determined from field observations guided by U.S. Geological Water Supply Publications (References 96 and 97).

Table 6, "Manning's "n" Values," shows the channel and overbank "n" values for the streams studied by detailed methods in both the pre-countywide and countywide studies. Values calculated for this countywide study have been noted in the table:

TABLE 6 – MANNING'S "n" VALUES

Flooding Source	Channel "n"	Overbanks
Batson River	0.020-0.050	0.050-0.090
Blacksmith Brook	0.050	0.090
Bridges Swamp	0.050	0.090
Bunganut Pond (at outlet)	0.030-0.045	0.055-0.110
Cape Neddick River	0.013-0.050	0.090
Cider Hill Creek	0.020-0.050	0.050-0.020
Coffin Brook[1]	0.045-0.05	0.09-0.11
Coffin Brook Tributary 1[1]	0.05-0.06	0.1-0.11
Cooks Brook	0.030-0.055	0.040-0.110
Day Brook	0.013-0.050	0.050-0.090
Depot Brook	0.013-0.050	0.050-0.090
Dolly Gordon Brook	0.013-0.050	0.050-0.090
Driscoll Brook[1]	0.04-0.05	0.045-0.1
Ferguson Brook[1]	0.045-0.06	0.05-0.12
Goosefare Brook	0.013-0.050	0.050-0.090
Great Works River	0.030-0.060	0.035-0.110
Green Brook	0.030-0.050	0.030-0.090
Kennebunk Pond (at west outlet)	0.030-0.045	0.055-0.110
Kennebunk River	0.020-0.050	0.090
Keay Brook[1]	0.045-0.06	0.085-0.11
Little Ossipee River	0.015-0.057	0.060-0.100
Little Ossipee River (Limington)	0.020-0.060	0.045-0.125
Little River	0.020-0.050	0.050-0.090
Little River (Cornish)	0.035-0.05	0.08-0.10
Little River(Berwick)[1]	0.045-0.075	0.05-0.15
Littlefield River	0.030-0.045	0.055-0.110
Merriland River	0.013-0.050	0.050-0.090
Mill Brook	0.013-0.050	0.050-0.090
Moors Brook	0.020-0.050	0.050-0.090
Mousam River (Alfred)	0.030-0.070	0.070-0.080
Mousam River (Kennebunk)[1]	0.038-0.045	0.09-0.11
Mousam River (Lower Reach)	0.03-0.07	0.07-0.08
Mulloy Brook[1]	0.045-0.06	0.09

[1]Updated calculations for this countywide study

TABLE 6 – MANNING'S "n" VALUES - continued

Flooding Source	Channel "n"	Overbanks
Ogunquit River	0.030-0.050	0.090
Ossipee River	0.03-0.045	0.07-0.09
Roberts-Wadley Pond (at outlet)	0.030-0.045	0.055-0.110
Saco River	0.030-0.055	0.040-0.110
Saco River (Cornish)	0.035-0.045	0.08-0.09
Saco River (Limington)	0.035-0.055	0.045-0.110
Saco River (Saco and Biddeford)	0.050	0.090
Saco River-Right Channel	0.030-0.055	0.040-0.110
Salmon Falls River (Berwick)	0.030-0.045	0.050-0.150
Salmon Falls River (Rochester, NH)	0.03-0.04	0.06-0.15
Salmon Falls River (Milton, NH)	0.03-0.07	0.04-0.12
Sawyer Brook	0.055-0.065	0.080-0.095
Smith Brook	0.013-0.050	0.050-0.090
South Branch of West Brook	0.050	0.090
Spinney Creek	0.013-0.050	0.050-0.090
Spruce Creek	0.013-0.050	0.050-0.090
Stevens Brook	0.013-0.050	0.050-0.090
Swan Pond (at outlet)	0.030-0.045	0.055-0.110
Thatcher Brook	0.013-0.050	0.050-0.090
Tributary 1 to Cape Neddick River	0.013-0.050	0.090
Tributary 1 to Green Brook	0.013-0.050	0.050-0.090
Tributary to Middle Branch Mousam River	0.045	0.100
Webhannet River	0.050	0.090
West Brook	0.013-0.050	0.050-0.090
Worster Brook[1]	0.03-0.47	0.075-0.12
Worster Brook Tributary 3[1]	0.045-0.055	0.05-0.11

[1]Updated calculations for this countywide study

In the Town of Kennebunkport, Baston River (upstream portion), Beaver Dam Brook, Paddy Creek, Round Swamps Brook, Smith Brook (upstream portion), Turbats Creek, and Tyler Brook were studied by approximate methods by Ransom Consulting Engineers and Scientists in 2012. For Tyler Brook, HydroCAD (Reference 98) was used to determine the extent of the 1-percent-annual-chance flood. HEC-RAS (Reference 99) was used to determine the extent of the 1-percent-annual-chance flood for all other areas. Major bridges and culverts impacting storage were considered in this approach.

3.3 Coastal Hydrologic Analyses

In New England, the flooding of low-lying areas is caused primarily by storm surges generated by extratropical coastal storms called northeasters. Hurricanes also occasionally produce significant storm surges in New England, but they do not occur nearly as frequently as northeasters.

A northeaster is typically a large counterclockwise wind circulation around a low pressure. The storm is often as much as 1,000 miles wide, and the storm speed is approximately 25 mph as it travels up the eastern coast of the United States. Sustained

wind speeds of 10 to 40 mph are common, with short-term wind speeds of up to 70 mph. Such information is available on synoptic weather charts published by the National Weather Service.

Revised coastal analyses were performed for the open water flooding sources along the Atlantic coastline of York County, including the towns of Kennebunk, Kennebunkport, Kittery, Old Orchard Beach, Wells, and York; the Town of Ogunquit; and the cities of Biddeford and Saco. A description of these revised analyses is presented in the countywide coastal analyses section below.

This analysis is divided into three groups according to the type of study performed by the STARR team. The three groups are referred to in this report as "New Transects," "Updated Map Mod Transects," and "Submitted Transects." Below is a description of each group.

New Transects

Contains the 60 transects in the City of Saco and the towns of Wells and York in addition to one transect in the Town of Kennebunk. A completely new RiskMap engineering analysis was performed for these transects. This analysis includes transect numbers 18-54, 64-78, and 129-136.

Updated Map Mod Transects

Contains 34 transects in the towns of Kittery, Ogunquit, and Old Orchard Beach. This study updated the former analysis (performed as part of FEMA's previous Map Modernization Program) by updating input wave conditions from a newer wave model (Reference 6). This analysis includes transect numbers 1-17, 55-63, and 137-144.

Submitted Transects

Contains the 50 transects in the City of Biddeford and the towns of Kennebunk and Kennebunkport. Sebago Technics completed the coastal engineering analysis for this group in 2010. The STARR team utilized the 2010 study results for mapping. The title of the three studies are "Delineation of the VE-Zone in the City of Biddeford, Maine, 2010," "Delineation of the VE-Zone in the Town of Biddeford, Maine, 2010 Kennebunkport, Maine, 2010," and "Delineation of the VE-Zone in the Town of Kennebunk, Maine, 2010" (References 7, 8, and 9). This analysis includes transect numbers 79-128.

Coastal stillwater elevations presented in the pre-countywide FISs that have not been superseded by the revised coastal analyses have been compiled and are presented in Table 7, "Summary of Pre-countywide Stillwater Elevations."

Pre-countywide Analyses

The pre-countywide stillwater elevations for the 10-, 2-, 1-, and 0.2-percent-annual-chance floods that are not superseded by the coastal study have been determined and are shown in Table 7, "Summary of Pre-countywide Stillwater Elevations." See Section 3.2 Riverine Hydraulic Analyses for information on how these pre-countywide Stillwater elevations were obtained.

TABLE 7 - SUMMARY OF PRE-COUNTYWIDE STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (FEET NAVD 88[1]) 10-PERCENT-ANNUAL-CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE
Balch Pond	558.4	559.0	559.2	559.8
Bauneg Beg Pond				
Entire shoreline within North Berwick	208.8	209.2	209.6	209.8
Entire shoreline within Sanford	207.3	209.2	209.6	209.8
Bonny Eagle Dam Pond	*	*	268.4	*
Bunganut Pond				
Entire shoreline within Lyman	*	*	277.1	*
Kennebunk Pond				
Entire shoreline within Lyman	*	*	273.8	*
Lake of the Woods				
Entire area	10.7	11.1	11.3	11.5
Little Ossipee Lake	311.3	311.7	312.3	314
Ponding Area 1	*	*	280.9	*
Ponding Area 2				
Town of Lyman	*	*	289.4	*
South of Roux Road	*	*	289.4	*
North of Roux Road	*	*	290.4	*
Ponding Area 3	*	*	289.4	*
Roberts-Wadley Pond				
Entire shoreline within Lyman	*	*	275.7	*
Swan Pond				
Entire shoreline within Lyman	*	*	281.6	*

*Data not available
[1]North American Vertical Datum of 1988

Countywide Analyses

Revised coastal analyses were performed for the open water flooding sources along the Atlantic coastline of York County, including the cities of Biddeford and Saco and the towns of Kennebunk, Kennebunkport, Kittery, Ogunquit, Old Orchard Beach, Wells, and York. All revised coastal analyses of coastal flood hazards were performed in accordance with Appendix D "Guidance for Coastal Flooding Analyses and Mapping," (Reference 100) of the Guidelines and Specifications as well as the "Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update" (Reference 101).

The stillwater elevation (SWEL) is the elevation of the water due to effects of astronomic tides and storm surge on the water surface. Several previous studies were reviewed, and it was determined that the 10-percent, 2-percent, 1-percent, and 0.2-percent stillwater elevations for updated Map Mod transects should be taken from the "Flood Mapping Activities for York County, Maine" (Reference 102).

This report did not update the SWEL values for the new transects; therefore, the 10-percent, 2-percent, 1-percent, and 0.2-percent for the new transects were obtained from the adjacent communities to maintain consistency. The SWEL values were obtained as following:

The SWEL values for York were obtained from the Town of Kittery.

The SWEL values for Wells were obtained from the towns of Kennebunk and Ogunquit.

The SWEL values for Saco were obtained from the City of Biddeford and the Town of Old Orchard Beach.

The 10-, 2-, 1- and 0.2-percent-annual-chance annual-chance stillwater elevations for the revised coastal flooding sources are presented in Table 8, "Summary of Coastal Stillwater Elevations."

TABLE 8 – SUMMARY OF COASTAL STILLWATER ELEVATIONS

FLOODING SOURCE AND LOCATION	ELEVATION (FEET NAVD 88[1])			
	10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
ATLANTIC OCEAN				
Entire open coastline in the City of Biddeford	7.9	8.5	8.9	9.5
Entire shoreline within the Town of Kennebunk	7.9	8.5	8.9	9.5
Entire shoreline within the Town of Kennebunkport	7.9	8.5	8.9	9.5

[1]North American Vertical Datum of 1988

TABLE 8 – SUMMARY OF COASTAL STILLWATER ELEVATIONS - continued

FLOODING SOURCE AND LOCATION	ELEVATION (FEET NAVD88[1]) 10-PERCENT	2-PERCENT	1-PERCENT	0.2-PERCENT
ATLANTIC OCEAN - continued				
Entire shoreline within the Town of Kittery	8.2	8.8	9.2	9.8
Entire shoreline within the Town of Ogunquit	7.9	8.5	8.9	9.5
Entire shoreline within the Town of Old Orchard Beach	7.9	8.5	8.9	9.5
Entire shoreline within the City of Saco	7.9	8.5	8.9	9.5
Entire shoreline within the Town of York	8.2	8.8	9.2	9.8
Entire shoreline within the Town of Wells	7.9	8.5	8.9	9.5

[1]North American Vertical Datum of 1988

3.4 Coastal Hydraulic Analyses

The energy-based significant wave height (Hmo) and peak wave period (Tp) are used as inputs to wave setup and wave runup calculations and were calculated using the Steady-State Spectral Wave Model (STWAVE). STWAVE is a phased-averaged spectral wave model that simulates depth-induced wave refraction and shoaling, depth-and steepness-induced wave breaking, diffraction, wind-wave growth, and wave-wave interaction and white capping that redistribute and dissipate energy in a growing wave field. The model accepts a spectral form of the wave as an input condition and provides Hmo and Tp results over the gridded model domain.

STARR team developed STWAVE models for the entire coastline of York County, and the results were obtained from the model for the coastal flooding analysis in the City of Saco and the towns of Kittery, Ogunquit, Old Orchard Beach, Wells, and York.

An extremal analysis of historic wind gage records was performed to determine the thresholds for peak wind speeds using three Peaks Over Threshold (POT) statistical methods derived from Goda (Reference 103). The threshold with the highest overall R-squared correlation to the Fisher-Tippett Type I (Gumbel), Fisher-Tippett Type II (Frechet), or Weibull distribution was chosen to represent the wind speed at 10 meters elevation. The wind speeds for 10-percent, 2-percent, 1-percent, and 0.2-percent-annual-chance events calculated from the extremal analysis for the Wind Buoy 440007 using the POT method were arithmetically averaged, and the resulting wind speed value was used for York County wave height and wave setup calculations at each coastal transect location. Wind speed data sets used in the extremal analyses were obtained from the National Oceanographic and Atmospheric Administration (NOAA) National Climatic

Data Center. The wind data set consists of 1-hour interval data for the period December 1978 to January 2012 (Reference 104).

Offshore (deepwater) wave heights, wave setup, and wave runup for each transect were calculated using Mathcad sheets developed by STARR to apply methodologies from the USACE's Coastal Engineering Manual (Reference 105) and FEMA Guidelines and Specifications (Reference 101). Methodologies for each type of calculation are discussed in more detail below. Results from the Mathcad calculations performed for each transect were compiled in a summary spreadsheet.

Overland wave heights were calculated for restricted and unrestricted fetch settings using the Wave Height Analysis for Flood Insurance Studies (WHAFIS), Version 4.0 (Reference 106), within the Coastal Hazard Analysis for Mapping Program (CHAMP) (Reference 107), following the methodology described in the FEMA Guidelines and Specifications for each coastal transect.

The general working procedure for the new transects and submitted transects included eight steps: 1) laying out transects; 2) determining off-shore significant wave heights and corresponding wave periods from STWAVE outputs; 3) performing the off-shore engineering analysis; 4) preparing WHAFIS input data and populating the CHAMP database; 5) performing erosion analysis for erodible transects without a coastal structure; 6) performing WHAFIS modeling runs on eroded transects and transects with both intact and failed structures, as applicable; 7) performing wave runup analysis on intact and failed structures; and 8) identifying primary frontal dunes.

The general working procedure for the updated map mod transects included five steps: 1) determining off-shore significant wave heights and corresponding wave periods from STWAVE output; 2) updating the existing offshore engineering analysis with the updated wave conditions; 3) updating the existing Map Mod CHAMP databases with the updated wave conditions and the updated wave setup; 4) performing WHAFIS modeling runs on eroded transects and transects with both intact and failed structures, as applicable; and 5) updating the existing runup analysis with the updated wave condition and wave setup or performing a new runup analysis if the existing map mod method is not applicable for the intact and the failed transects.

Coastal engineering analysis was performed for each new, submitted, and Map Mod coastal transect using wave condition extracted from the STWAVE model and SWEL data to generate wave setup and wave runup values for open coast transects and transects with vertical structures or revetments and to generate input used in developing CHAMP and WHAFIS input data. Mathcad sheets were developed and applied by STARR for the calculations to help ensure consistency and accuracy. The input data and results of the analysis were compiled for each transect in a summary spreadsheet. The Mathcad sheets and summary spreadsheet are included in the digital data files compiled for the coastal submittal. This STWAVE model was developed for the entire coastline of York County, and the results were obtained from the model for the coastal flooding analysis in the City of Saco and the towns of Kittery, Ogunquit, Old Orchard Beach, Wells, and York.

CHAMP is a Microsoft (MS) Windows-interfaced Visual Basic language program that allows the user to enter data, perform coastal engineering analyses, view and tabulate results, and chart summary information for each representative transect along a coastline

within a user-friendly graphical interface. With CHAMP, the user can import digital elevation data; perform storm-induced erosion treatments, wave height, and wave runup analyses; plot summary graphics of the results; and create summary tables and reports in a single environment. CHAMP version 2.0 (Reference 107) was used to perform erosion analysis, run WHAFIS, and apply RUNUP 2.0 to transects without coastal structures. Application of CHAMP followed the instructions in the FEMA Guidelines and Specifications (Reference 101) and the Coastal Hazard Analysis Modeling Program user's guide found in the software documentation (Reference 108).

Wave setup can be a significant contributor to the total water level at the shoreline and was included in the determination of coastal base flood elevations. Wave setup is defined as the increase in total stillwater elevation against a barrier caused by the attenuation of waves in shallow water. Wave setup is based upon wave breaking characteristics and profile slope. Wave setup values were calculated for each coastal transect using the Direct Integration Method (DIM), as described in the FEMA Guidelines and Specifications, Equation D.2.6-1. For those coastal transects where a structure was located, documentation was gathered on the structure, and the wave setup against the coastal structure was also calculated.

The fundamental analysis of overland wave effects for an FIS is provided by FEMA's Wave Height Analysis For Flood Insurance Studies computer program, WHAFIS 4.0, a computer program that uses representative transects to compute wave crest elevations in a given study area. Topographic, vegetative, and cultural features are identified along each specified transect landward of the shoreline. WHAFIS uses this and other input information to calculate wave heights, wave crest elevations, flood insurance risk zone designations, and flood zone boundaries along the transects.

The original basis for the WHAFIS model was the 1977 National Academy of Sciences (NAS) report "Methodology for Calculating Wave Action Effects Associated with Storm Surges" (Reference 109). The NAS methodology accounted for varying fetch lengths, barriers to wave transmission, and the regeneration of waves over flooded land areas. Since the incorporation of the NAS methodology into the initial version of WHAFIS, periodic upgrades have been made to WHAFIS to incorporate improved or additional wave considerations.

WHAFIS 4.0 was applied using CHAMP to calculate overland wave height propagation and establish base flood elevations. For profiles with vertical structures or revetments, a failed structure analysis was performed, and a new profile of the failed structure was generated and analyzed.

Wave runup is the uprush of water caused by the interaction of waves with the area of shoreline where the stillwater hits the land or other barrier intercepting the stillwater level. The wave runup elevation is the vertical height above the stillwater level ultimately attained by the extremity of the uprushing water. Wave runup at a shore barrier can provide flood hazards above and beyond those from stillwater inundation. Guidance in the FEMA Guidelines and Specifications (Reference 101) suggests using the 2-percent wave runup value, the value exceeded by 2 percent of the runup events. The 2-percent wave runup value is particularly important for steep slopes and vertical structures.

Wave runup was calculated for each coastal transect using methods described in the FEMA Guidelines and Specifications (Reference 101). Runup estimates were developed for vertical walls using the guidance in Figure D.2.8-3 of the FEMA Guidelines and Specifications (Reference 101), taken from the Shore Protection Manual (Reference 110). Technical Advisory Committee for Water Retaining Structures (TAW) method was applied for sloped structures with a slope steeper than 1:8. For slopes milder than 1:8, the FEMA Wave Runup Model RUNUP 2.0 was used. Both the SPM and RUNUP 2.0 provide mean wave runup. The mean wave runup was multiplied by 2.2 to obtain the 2-percent runup height. Wave runup elevation was added to the stillwater elevation and does not include wave setup.

The Limit of Moderate Wave Action (LiMWA) is determined and defined as the location of the 1.5-foot wave. Typical constructions in areas of wave heights less than 3-feet high have experienced damage, suggesting that construction requirements within some areas of the AE zone should be more like those requirements for the VE zone. Testing and investigations have confirmed that a wave height greater than 1.5 feet can cause structure failure. The LiMWA was determined for all areas subject to significant wave attack in accordance with "Procedure Memorandum No. 50 – Policy and Procedures for Identifying and Mapping Areas Subject to Wave Heights Greater than 1.5 feet as an Informational Layer on Flood Insurance Rate Maps (FIRMs)" (Reference 111). The effects of wave hazards in the Zone AE areas (or shoreline in areas where VE Zones are not identified) and the limit of the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot breaking waves are projected during a 1-percent-annual-chance flooding event.

The effects of wave hazards in the Zone AE areas (or shoreline in areas where VE Zones are not identified) and the limit of the LiMWA boundary are similar to, but less severe than, those in Zone VE where 3-foot breaking waves are projected during a 1-percent-annual-chance flooding event.

Primary frontal dune (PFD) evaluations were performed for all communities in York County and mapped where sufficient data were available to support the delineation. PDFs were identified in the communities of Biddeford, Kennebunk, Kennebunkport, Ogunquit, Old Orchard Beach, Saco, and Wells. Provided below is a summary of the analyses performed. All revised coastal analyses were performed in accordance with the FEMA Guidelines and Specifications (Reference 101).

In accordance with 44 CFR Section 59.1 of the National Flood Insurance Program (NFIP), the effect of the PFD on coastal high hazard area (V Zone) mapping was evaluated for the communities in York County. Identification of the PFD was based upon a FEMA-approved numerical approach for analyzing the dune's dimensional characteristics. Using this methodology, the landward toe of the PFD is delineated based on knowledge of local geological processes and remote sensing/GIS technologies utilizing LiDAR data. The PFD defined the landward limit of the V Zone along portions of the shoreline only within the communities of Biddeford, Kennebunk, Kennebunkport, Ogunquit, Old Orchard Beach, Saco, and Wells.

Figure 1, "Transect Schematic," represents s sample transect that illustrates the relationship between stillwater elevation, the wave crest elevation, the ground elevation profile, and the location of the V/A zone boundary.

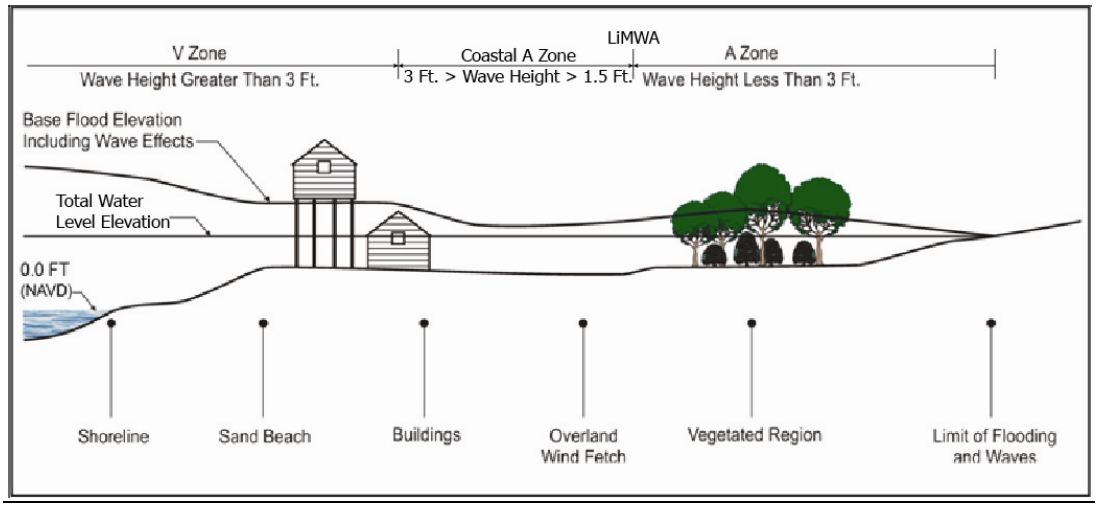

Figure1. Transect Schematic

Transects (profiles) were located for coastal hydrologic and hydraulic analyses perpendicular to the average shoreline along areas subject to coastal flooding; transects extend off-shore to areas representative of deep water conditions and extend inland to a point where wave action ceases, in accordance with the "User's Manual for Wave Height Analysis" (Reference 112). Transects were placed with consideration of topographic and structural changes of the land surface, as well as the cultural characteristics of the land, so that they would closely represent local conditions. Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

Coastal transect topography data were obtained from LiDAR data collected in November 2006 by Sanborn Mapping Company, Inc., accurate to 2-foot contours (Reference 13). Additionally, portions of 33 coastal transects were field surveyed in May and June of 2007, and 55 coastal transects in December 2011 to supplement the contour data for the study area. In addition, a coastal field inspection was conducted from November to December 2011 for the shoreline of the City of Saco and the towns of York and Wells. Georeferenced global positioning system (GPS) points and tracks, as well as photographs, were collected and attributed with various descriptive information such as upland type; coastal formations, including dunes and bluffs; coastal vegetation; coastal structures; and shore type. As appropriate, coastal protection structure details and 0.0 foot NAVD 88 elevation were included and noted in the transect field surveys. Bathymetric data were obtained from the NOAA National Ocean Service (NOS) Hydrographic Data Base (NOSHDB) and Hydrographic Survey Meta Data Base (HSMDB) (NOAA May 27, 2010) (Reference 113). The sounding datum of mean low low water (MLLW) was converted to vertical datum NAVD 88.

Transects were spaced close together in areas of complex topography and dense development. In areas having more uniform characteristics, transects were spaced at larger intervals. It was also necessary to locate transects in areas where unique flooding existed and in areas where computed wave heights varied significantly between adjacent transects.

Table 9, “Transect Descriptions,” provides a description of the transect locations, the 1-percent-annual-chance stillwater elevations, and the maximum 1-percent-annual-chance wave crest elevations for the countywide coastal study. Figures 2A through 2D, "Transect Location Map," illustrates the location of the transects for the entire county.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS

		ELEVATION (FEET NAVD 88[2])	
TRANSECT	LOCATION	1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
1	The transect crosses a mixed substrate beach (sand and cobble), rocky shoreline, and soil bluffs with multiple coastal structures. The transect terminates in residential area at Route 1 on Badgers Island in Kittery.	9.2	11.5
2	The transect crosses a gabion revetment at the shoreline, extends over an open playing field, then terminates at U.S. Navy buildings at Goodrich Avenue in Kittery.	9.2	17.7
3	The transect crosses a rocky shoreline with interspersed structures before terminating in a residential area at Bowen Road in Kittery.	9.2	16.7
4	The transect extends up Spruce Creek, intersecting a marshy shoreline before terminating at Whippoorwill Lane in Kittery.	9.2	13.2
5	The transect crosses a bedrock shore with some interspersed seawall before intersecting residential area. The transect terminates at Lawrence Lane in Kittery.	9.2	27.0

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
6	The transect crosses a rocky shore and seawall before intersecting residential, commercial, and public/infrastructure. The transect crosses Route 103 in Kittery and terminates at the first row of houses.	9.2	25.3
7	The transect crosses a rocky shoreline with some revetment below residential and open upland development. The transect crosses Route 103 in Kittery and terminates at the first row of houses.	9.2	26.1
8	The transect crosses a bedrock outcrop and terminates in a forested area with no development west of Pocahontas Road in Kittery.	9.2	25.0
9	The transect crosses a cobble beach and extends up a rocky bluff. Residential development is present upland. The transect terminates in forested area west of Pocahontas Road in Kittery.	9.2	24.0
10	The transect crosses a cobble beach with a significant beach berm, extends across a backwater pond, then terminates in forested area by Pocahontas Road in Kittery.	9.2	19.6

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
11	The transect crosses a rocky shoreline and rocky bluffs in Appledore Island on the Isles of Sholes. Upland development is open with isolated residential development with open/grass and shrub cover.	9.2	24.6
12	The transect crosses a cobble beach and rocky bluffs, extends into residential and open development before terminating at Pocahontas Road in Kittery.	9.2	22.0
13	The transect crosses a rocky shoreline and a small section of cobble beach then extends across small backwater before terminating in forested area.	9.2	20.6
14	The transect crosses a rocky shoreline, extends into a residential area at Goodwin Road, then terminates at forested upland to the west.	9.2	20.8
15	The transect crosses a cobble beach at Crescent Beach, extends over Chauncy Creek estuary, then terminates at an area of sparse residential development at Cutts Island Road in Kittery.	9.2	20.5
16	The transect crosses a rocky shoreline with sparse residential and open development upland. The transect terminates in a wooded upland area by Old Cart Path Road in Kittery.	9.2	20.5

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
17	The transect crosses a rocky shoreline and extends up Brave Boat Harbor then terminates at a residential area east of Route 103 in Kittery.	9.2	19.0
18	The transect crosses a rocky cobble and bedrock shoreline North of Brave Boat Cove in York.	9.2	21.4
19	The transect crosses a rocky berm and into a marshy backwater area by Raynes Neck in York.	9.2	21.1
20	The transect crosses a rocky cobble and bedrock shore then extends toward Surf Point Road in York.	9.2	23.0
21	The transect crosses a mixed cobble gravel beach into residential area by Kings Road in York.	9.2	22.3
22	The transect crosses a large berm and extends into a marshy backwater area, extends northwest, then terminates before Brave Boat Harbor Road and Route 103 in York.	9.2	22.0
23	The transect crosses a bedrock shore with a small masonry seawall, extends over residential area, crosses Seal Harbor Point Lane, and terminates in forested area.	9.2	22.3
24	The transect crosses a mixed cobble gravel beach over the intersection of Argo Point Lane and Seal Point Lane in York.	9.2	21.6

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
25	The transect extends up York Harbor, crosses Route 103, then terminates approximately 1,000 feet from the intersection of Seabury Lane in York.	9.2	18.0
26	The transect crosses a sandy mixed beach at Harbor Beach Road, extends into York Harbor, crossing Harris Island Road and Route 103, then terminates at Dabney Lane in York.	9.2	20.6
27	The transect crosses a steep bedrock outcrop at Stage Neck Road in York Harbor.	9.2	21.8
28	The transect crosses a steep bedrock outcrop, extends into residential area, then terminates at Peradventure Way in York.	9.2	23.6
29	The transect crosses a mixed cobble, gravel, bedrock beach, into residential area, crosses Banks Rock Road, and terminates west of Norwood Farms Road in York.	9.2	23.1
30	The transect crosses a steep bedrock shore with revetment at top, extends into residential area to Roaring Rock Point, then terminates at Sea Trumpet Cul-de-Sac in York.	9.2	22.5

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
31	The transect crosses a mixed substrate beach, intersects Route 1A, then terminates at Brook Lane in York.	9.2	20.9
32	The transect crosses a gabion revetment at the base of Route 1A then terminates at a trailer park west of Route 1A in York.	9.2	21.2
33	The transect crosses a mixed substrate beach and concrete and gabion revetment at the base of Route 1A, extends west into a residential area, then terminates at Cottage Lane in York.	9.2	21.1
34	The transect crosses a mixed substrate beach, intersects Route 1A at intersection of Webber Road, then terminates at campground area off Garrison Avenue in York.	9.2	20.0
35	The transect crosses sandy beach and gabion revetment at the intersection of Route 1A and Morningside Avenue, crosses over low lying backwater area, then terminates at Ridge Road in York.	9.2	21.6
36	The transect crosses a mixed cobble and gravel shoreline and extends up a steep till bluff, crosses residential area at Church Street Extension, then terminates at the intersection of Nicole Road in York.	9.2	21.0

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
37	The transect crosses a steep bedrock outcrop and over Nubble road in York.	9.2	24.3
38	The transect crosses bedrock shoreline and small cottages, extends over Sohier Park Road, and terminates at Nubble Road in York.	9.2	23.7
39	The transect crosses a bedrock outcrop and a gabion/concrete seawall at the base of homes. The transect terminates at Nubble Road in York.	9.2	25.1
40	The transect crosses gabion revetment at Ocean Ave Extension, terminating at Broadway Street in York.	9.2	23.6
41	The transect crosses sandy beach at York Beach, extends over parking lot and commercial area at Ocean Avenue, then terminates at Church Street.	9.2	19.6
42	The transect crosses a steep bedrock shoreline with concrete seawall interspersed, intersects residential area at Freeman Street, then terminates at Shore Road in York.	9.2	22.2
43	The transect crosses a mixed gravel and cobble beach, intersects Freeman Street, then terminates at Route 1A in York.	9.2	22.9

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
44	The transect extends over rocky cobble shoreline, through residential area, then terminates at the intersection of Route 1A and Cape Neddick Road.	9.2	22.5
45	The transect crosses a gravel shoreline on the north end of Cape Neddick Harbor, extends over a backwater marsh area, then terminates in a residential area at Shore Road in York.	9.2	18.6
46	The transect extends over a mixed cobble and bedrock shore to the northeast then terminates at Anbelwold Circuit Road in York.	9.2	23.5
47	The transect extends over a bedrock shore and bluff before terminating at Anbelwood Circuit Road in York.	9.2	23.1
48	The transect crosses mixed substrate beach, extends into a backwater pond area, then terminates at the intersection of Agamenticus Avenue.	9.2	20.8
49	The transect extends over bedrock shoreline and a small concrete seawall then intersects residential area before terminating at Ossipee Road in York.	9.2	24.1

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
50	The transect extends over bedrock shoreline and small concrete seawall at the base of residential area then crosses into backwater pond, terminating at Burnt Marsh Road.	9.2	23.2
51	The transect extends over mixed gravel beach and revetment at the base of Shore Road. The transect crosses over Phillips Pond and backwater marsh then terminates at Phillips Cove Road Cul-de-Sac in York.	9.2	22.4
52	The transect extends over a steep bedrock outcrop at the end of Cragmere Way. The transect ends at Shore Road in York.	9.2	24.0
53	The transect extends over a large bedrock outcrop and over hotel complex at the end of Bald Head Cliff Road in York.	9.2	24.1
54	The transect extends over steep bedrock shoreline at Circuit Road in York.	9.2	23.6
55	The transect crosses high rocky bluffs south of Oarweed Cove then intersects and terminates at residential area east of Shore Road in Ogunquit.	8.9	24.7

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
56	The transect crosses high rocky bluff, intersects residential area, and crosses Perkins Cove before terminating at residential area at Woodbury Lane in Ogunquit.	8.9	23.1
57	The transect crosses mixed substrate beach with revetment and parking lot, extends through Perkins Cove, then terminates at Shore Road in Ogunquit.	8.9	21.9
58	The transect crosses rocky bluffs with interspersed revetment, extends over residential area, then terminates east of Frazier Pasture Road.	8.9	21.4
59	The transect crosses rocky bluff reinforced with revetment, extends over residential area, then terminates at Ontio Way in Ogunquit.	8.9	22.8
60	The transect crosses a mixed shoreline with a large seawall then extends into a dense commercial and residential area before terminating at School Street in Ogunquit.	8.9	21.4
61	The transect crosses sandy beach and parking lot, extends over the Ogunquit River marsh, then terminates at residential and commercial area at Main Street in Ogunquit.	8.9	20.6

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
62	The transect crosses sandy beach with vegetated dunes, extends over the Ogunquit River marsh, then terminates at residential and commercial area at Main Street in Ogunquit.	8.9	19.7
63	The transect crosses sandy beach with vegetated dunes, extends over the Ogunquit River marsh, then terminates in residential area at Bayview Avenue in Ogunquit.	8.9	19.7
64	The transect crosses sandy beach and concrete seawall, extends across residential area at Ocean Ave, crosses backwater estuary, intersects Dike Street, then terminates at the intersection of Spring Street and Bourne Avenue in Wells.	8.9	20.9
65	The transect crosses sandy beach and concrete seawall at the shoreline, extends over residential area at Ocean Avenue, crosses Stevens Brook estuary, then terminates at Blanchard and Williams Street in Wells.	8.9	21.1
66	The transect extends over sandy mixed beach and a concrete seawall at a residential area along Ocean Avenue, crosses backwater estuary, then terminates at Elmere Road in Wells.	8.9	21.2

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
67	The transect extends over gabion revetment at the base of Ocean Avenue then crosses backwater estuary, ending at Eldredge Road in Wells.	8.9	22.3
68	The transect crosses rocky shore and gabion revetment, intersects residential area at Shore Lane and Webhannet Drive, then terminates at Ocean Avenue in Wells.	8.9	22.0
69	The transect crosses seawall and intersects houses at Webhannet Drive, extends over backwater estuary of the Webhannet River, then terminates at Batchelder Road in Wells.	8.9	21.9
70	The transect crosses over concrete seawall, extends over residential area at Gold Ribbon Drive, crosses over backwater estuary of the Webhannet River, then terminates at Curtis Street in Wells.	8.9	22.0
71	The transect crosses sandy beach and concrete seawall, intersects residential area at Webhannet Drive, extends over backwater estuary of the Webhannet River, then terminates in wooded area east of Route 1.	8.9	21.3
72	The transect crosses sandy beach and seawall built into dune, intersects residential area at Atlantic Avenue, crosses backwater estuary at Webhannet River, then terminates by Route 1 in Wells.	8.9	20.7

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
73	The transect crosses sandy beach and seawall built into dune, intersects residential area at Atlantic Ave, crosses backwater estuary at Webhannet River, then terminates by Route 1 in Wells.	8.9	21.7
74	The transect crosses sandy beach and a large dune, extends across a residential area at Atlantic Avenue, crosses Webhannet River and Marina, and terminates at Hardy's Bluff Road.	8.9	19.8
75	The transect extends over a large dune area, crosses Island Beach Road and backwater estuary, terminating at Route 1 in Wells.	8.9	19.5
76	The transect crosses sandy beach and concrete seawall, extends over Island Beach Road and Drakes Island Road, then terminates at Route 1.	8.9	17.6
77	The transect crosses dunes at the northern end of Drake Island in Wells then extends over backwater area before terminating at forested bluff.	8.9	19.9
78	The transect crosses sandy beach and dunes at the mouth of the Little River then extends up to Route 9 in Wells.	8.9	21.0

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
79	The transect crosses a sandy beach and dunes before intersecting Crescent Surf Road approximately 1,700 feet east of the mouth of Little River. The transect extends over the Little River Estuary before terminating in dense forest north of Route 9.	8.9	17.3
80	The transect crosses a bedrock shoreline and seawall before it reaches Crescent Surf Road in Kennebunk.	8.9	19.6
81	The transect crosses sandy beach then a small seawall approximately 2,800 feet west of the mouth of the Mousam River, extends across Parsons Beach Road, crosses estuary, then terminates in wooded upland area.	8.9	17.9
82	The transect crosses sandy beach and dunes at Parsons Beach, approximately 2,000 feet west of the mouth of the Mousam River, extends over estuary, then terminates in wooded upland area.	8.9	17.4
83	The transect crosses over a steep bluff at Great Hill, extends northwest to the western extent of Great Hill Road, then follows the eastern edge of the Mousam River before terminating by Whipporwill Circle in Kennebunk.	8.9	17.6

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
84	The transect crosses over beach at Great Hill Road, intersects residential area at Atlantic Circle, extends over estuary at Mousam River, then terminates in a wooded upland area east of the river in Kennebunk.	8.9	16.2
85	The transect crosses over a revetment at Libbys Point, extends over a residential area at Robie Road, then terminates in a wooded area north of Great Hill Road.	8.9	18.1
86	The transect crosses a mixed substrate beach into residential area, then terminates at Great Hill Road in Kennebunk.	8.9	15.5
87	The transect crosses steep bedrock shoreline at Lord's Point, extends up Lord's Point Road, then terminates in a residential area.	8.9	18.1
88	The transect crosses a sandy stretch of beach north of Lord's Point, crosses Kennebunk Beach, extends northwest through residential area, then terminates at Eagle Rock Lane in Kennebunk.	8.9	18.4
89	The transect crosses a bedrock shoreline with some structures at Kennebunk Beach, extends north along Bruen Place through a residential area, then terminates north of Woodland Avenue.	8.9	18.7

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
90	The transect crosses a mixed substrate beach on Kennebunk Beach, extends through residential area along Boothby Road, crosses estuary, then terminates in a wooded upland area.	8.9	18.2
91	The transect crosses a sandy beach at Goochs Beach, extends through a residential area at Surf Lane, crosses over a backwater estuary, then terminates by Governors Way in Kennebunk.	8.9	18.2
92	The transect crosses a sandy beach at Goochs Beach then extends north between Beach Avenue and the southern extent of Seagrass Lane in Kennebunk.	8.9	17.3
93	The transect crosses over a beach area just east of the mouth of the Kennebunk River along Ocean Avenue, extends over a residential area, then terminates at Grandview Avenue.	8.9	17.6
94	The transect crosses over a bedrock shoreline and seawall in Cape Arundel, extends northeast through Old Fort Point along Arlington Street, then terminates at Haverhill Street in Kennebunkport.	8.9	18.1

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
95	The transect crosses over a mixed substrate and bedrock beach into a residential area then terminates at Atlantic Street in Kennebunkport.	8.9	21.2
96	The transect crosses over a bedrock bluff East of Walkers Point, intersects residential area, then terminates at Ocean Avenue.	8.9	17.9
97	The transect crosses over a mixed substrate beach with bedrock bluffs, extends northwest along Halcyon Drive, then terminates at Shore Road.	8.9	17.0
98	The transect extends up Turbats Creek to the northwest along White Creek Lane in Kennebunkport.	8.9	15.5
99	The transect crosses over a low lying area at Langsford Road, extends up Paddy Creek, then terminates at Wildes District Road in Kennebunkport.	8.9	14.3
100	The transect crosses over a rocky shoreline at Bickford Island, extends north along the southern extent of Pier Road, then terminates east of Cape Porpoise.	8.9	13.4
101	The transect crosses over a rocky shoreline on Trott Island and terminates in a wooded upland area on the island.	8.9	18.1

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
102	The transect crosses over a mixed cobble shoreline on Cape Porpoise, extends through residential area, then terminates before reaching Fishers Lane.	8.9	15.8
103	The transect crosses over a mixed cobble shoreline north of Cape Porpoise, extends west along Marshall Point Road at the intersection with Skipper Joes Point Road, then terminates in a wooded upland area of Kennebunkport.	8.9	18.1
104	The transect crosses south of the mouth of the Batson River near the northern extent of Marshall Point Road, and extends northwest parallel to the Batson River.	8.9	17.0
105	The transect crosses a sandy beach and dune area at Kings Highway and Sunset Lane, extends into a residential area, crosses Smith Brook, and then terminates in wooded area in Kennebunkport.	8.9	15.3
106	The transect crosses a sandy beach and revetment at Goosefare Bay, extends north over a residential area at Kings Highway and Norwood Lane, crosses Smith Brook, then terminates in wooded area in Kennebunkport.	8.9	17.0

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
107	The transect crosses a sandy beach and revetment at Goosefare Bay, extends north over a residential area at Kings Highway, crosses Smith Brook, then terminates in wooded area in Kennebunkport.	8.9	16.9
108	The transect crosses over a sandy beach and dune area in Goosefare Bay, extends north over a residential area at Kings Highway, crosses Smith Brook, then terminates in wooded area in Kennebunkport.	8.9	16.7
109	The transect crosses over a sandy beach and dune area in Goosefare Bay, extends north over a residential area at Kings Highway, then terminates in a wooded upland area off of New Biddeford Road in Kennebunkport.	8.9	16.2
110	The transect crosses a sandy beach and revetment in Goosefare Bay, extends through a residential area at Sand Point Road, crosses over backwater area, then terminates at Ward Avenue in Kennebunkport.	8.9	16.2
111	The transect crosses a mixed substrate beach at Timber Island then terminates in a wooded area on the island.	8.9	17.8

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
112	The transect extends up the east side of Curtis Cove, extending northwest through the pocket beach parallel to Brackett Point Road, crosses over the Little River, then terminates in a residential area by Bryant Lane in Kennebunkport.	8.9	18.2
113	The transect extends over a rocky shore at Granite Point, terminating in a residential area by Granite Juniper Lane in Biddeford.	8.9	18.1
114	The transect crosses a mixed beach and seawall at New Barn Cove, extends over Granite Point Road and Little River estuary, then terminates in wooded upland.	8.9	17.2
115	The transect crosses a mixed substrate beach and extends over Granite Point Road, crosses backwater estuary of the Little River, and terminates in a wooded upland area in Kennebunkport.	8.9	16.4
116	The transect crosses over a steep bedrock outcrop at Horseshoe Cove, extends northwest through Old Kings Highway and Seal Lane, parallels Fortunes Rocks Road, then terminates at Icehouse Road in Biddeford.	8.9	17.8

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
117	The transect crosses over rocky shoreline at Fortunes Rocks, extends northwest along Neptune Lane, then terminates in a wooded upland area at Route 9.	8.9	18.5
118	The transect crosses over revetment at Fortunes Rocks Road, extends over Etherington Pond, then terminates at Burnie Way.	8.9	18.8
119	The transect crosses sandy beach and a seawall and extends northwest along Thorndike Avenue, terminating at Route 9 in Biddeford.	8.9	18.5
120	The transect crosses sandy beach and dunes on Fletcher Neck, extends northwest along Beach Avenue, then terminates in a wooded upland area in Biddeford.	8.9	17.8
121	The transect crosses a sandy beach and revetment at Fletcher Neck, extends over a residential area, then crosses backwater over The Pool.	8.9	18.5
122	The transect crosses a seawall at Ocean Avenue in Biddeford Pool then extends northwest along Fifth Street in Biddeford.	8.9	17.8
123	The transect crosses a rocky and mixed substrate beach, extending into a residential area at 1st Street in Biddeford Pool.	8.9	17.3

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
124	The transect crosses a steep bluff at Biddeford Pool and extends southwest between Staples Street and Bayview Avenue in Biddeford.	8.9	16.2
125	The transect crosses a sandy beach at Wood Island Harbor, extends southwest along Sky Harbor Drive, crosses The Pool, then terminates at Route 9 in Biddeford.	8.9	16.4
126	The transect crosses a steep rocky outcrop on Basket Island before terminating at the top of the bluff on the island.	8.9	17.3
127	The transect crosses sandy beach and dunes, extends into residential area at Hills Beach Road in Biddeford, crosses Back Bay estuary, then terminates in wooded upland area.	8.9	12.7
128	The transect crosses between the north and south jetties at the mouth of the Saco River then extends west up the river. The transect then crosses the shoreline approximately 1,200 feet north of the intersection of Pool Street and Hills Beach Road.	8.9	12.0
129	The transect crosses over a small section of sandy beach then extends over a residential area at Bay Avenue in Ferry Beach Saco.	8.9	18.3

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
130	The transect crosses over a gabion revetment, down Pearl Avenue, and extends toward the backwater estuary behind Ferry Beach.	8.9	19.9
131	The transect crosses over sandy beach area with blown out dune, extends over North Avenue and Main Avenue, and crosses backwater estuary behind Ferry Beach.	8.9	18.7
132	The transect crosses over gabion revetment, extends into residential area, down Beacon Avenue, and ends at Ferry Road in Saco.	8.9	20.9
133	The transect crosses sandy beach and vegetated dunes, extends into residential area at Route 9 in Saco, then terminates in wooded upland area.	8.9	18.9
134	The transect crosses over dunes and into forested residential area, intersects Seaside Avenue, and terminates by Route 9 in Saco.	8.9	18.7
135	The transect crosses over dunes and into residential area, extends over Seaside Avenue and over estuary, then terminates in wooded area in Saco.	8.9	17.0
136	The transect crosses over dunes and residential area at Oceanside Drive, extends over estuary at Goosefare Brook, then terminates in an upland wooded area in Saco.	8.9	19.3

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
137	The transect crosses sandy beach at the mouth of Goosefare Brook, crosses through wooded upland, then terminates by Manor Street in Old Orchard Beach.	8.9	19.1
138	The transect crosses sandy beach and vegetated dunes, extends through residential development at Tioga Avenue in Old Orchard Beach, then terminates in wooded upland area.	8.9	20.0
139	The transect crosses sandy beach and vegetated dunes, extends into dense commercial and residential development, then terminates before reaching 2nd Street in Old Orchard Beach.	8.9	17.8
140	The transect crosses sandy beach and vegetated dunes, then extends up W. Grand Avenue through dense commercial and residential area in Old Orchard Beach.	8.9	19.6
141	The transect crosses sandy beach with vegetated dunes, extends into dense residential area, follows Walnut Street, and terminates in wooded area in Old Orchard Beach.	8.9	18.8

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

TABLE 9 – COUNTYWIDE TRANSECT DESCRIPTIONS - continued

TRANSECT	LOCATION	ELEVATION (FEET NAVD 88[2]) 1-PERCENT-ANNUAL-CHANCE STILLWATER	MAXIMUM 1-PERCENT-ANNUAL-CHANCE WAVE CREST[1]
142	The transect crosses sandy beach with vegetated dunes into dense residential commercial area, crosses backwater area, and terminates by Portland Avenue in Old Orchard Beach.	8.9	19.7
143	The transect crosses sandy beach, small seawall, low intermittent vegetated dunes, crosses commercial stretch, then extends into backwater estuary before terminating in wooded area at Old Orchard Beach.	8.9	19.7
144	The transect crosses sandy beach with low vegetated dunes, extends into a residential area at Route 9, and crosses backwater estuary before terminating adjacent to Mill Brook in the town of Old Orchard Beach.	8.9	19.1

[1]Because of map scale limitations, the maximum wave elevation may not be shown on the FIRM.
[2]North American Vertical Datum of 1988.

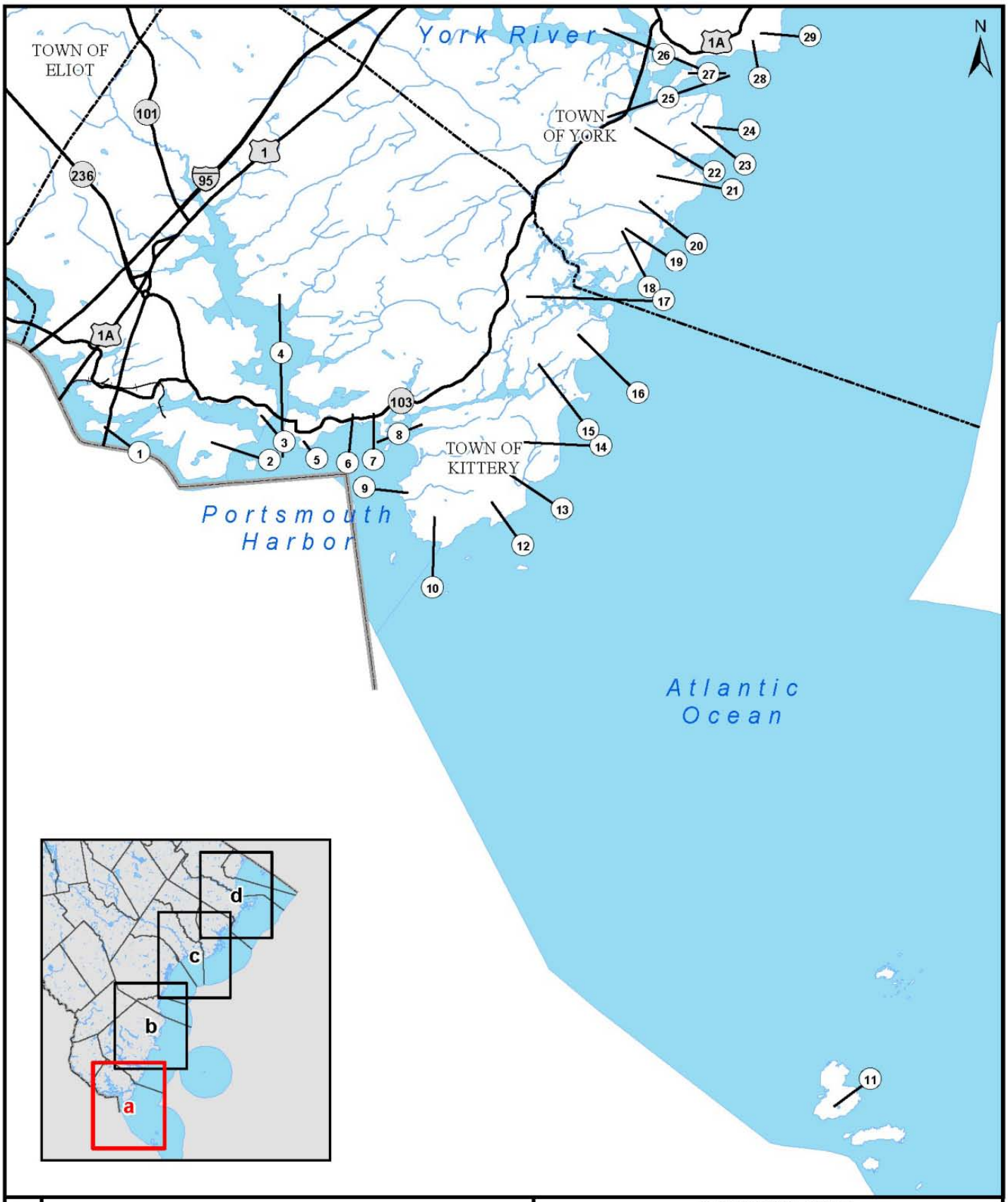

FIGURE 2A

FEDERAL EMERGENCY MANAGEMENT AGENCY

YORK COUNTY, ME

(ALL JURISDICTIONS)

APPROXIMATE SCALE

0 5,000 10,000 15,000 20,000 Feet

TRANSECT LOCATION MAP

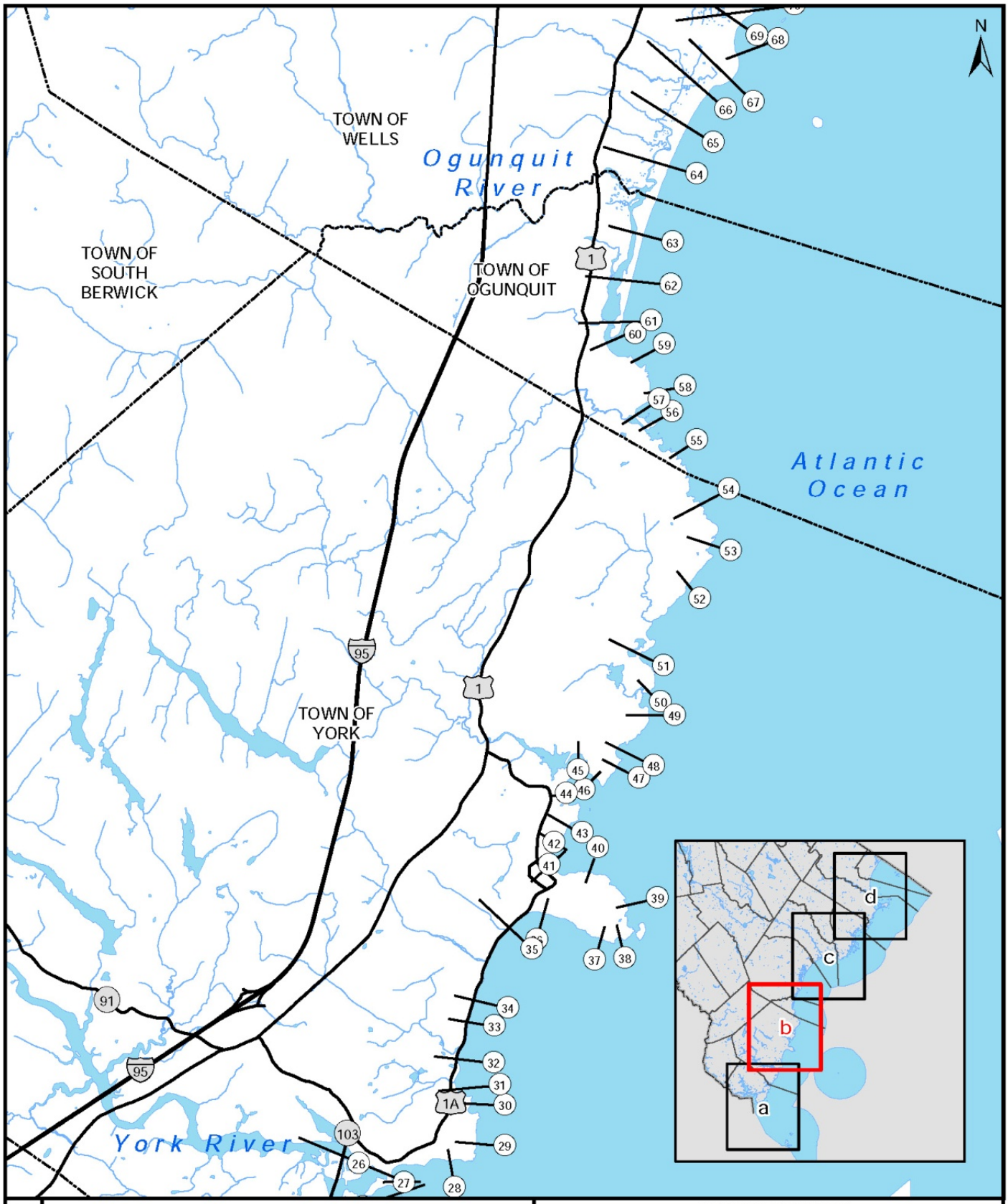

FIGURE 2B

FEDERAL EMERGENCY MANAGEMENT AGENCY

YORK COUNTY, ME

(ALL JURISDICTIONS)

APPROXIMATE SCALE

0 5,000 10,000 15,000 20,000 Feet

TRANSECT LOCATION MAP

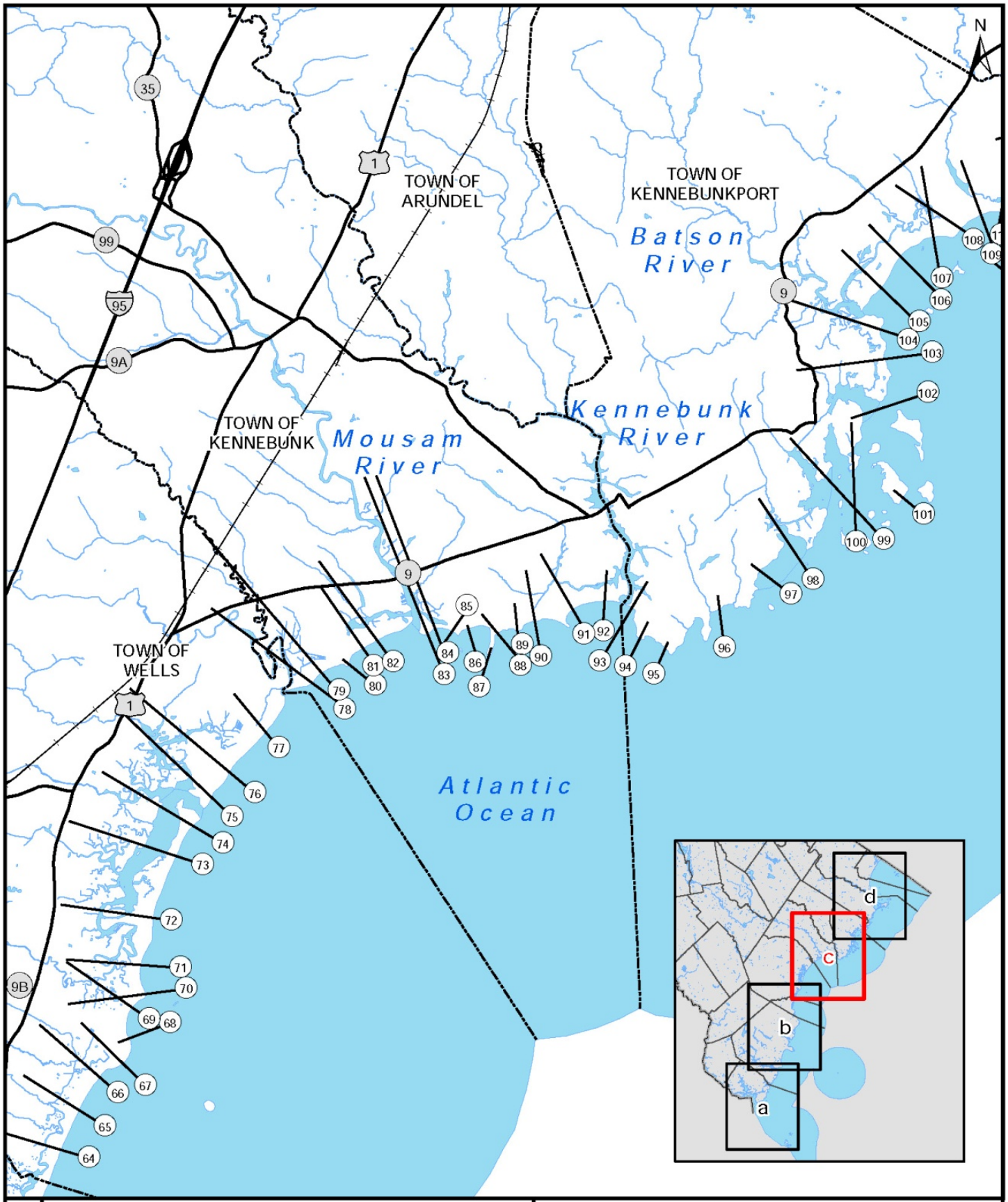

FIGURE 2C

FEDERAL EMERGENCY MANAGEMENT AGENCY

YORK COUNTY, ME

(ALL JURISDICTIONS)

APPROXIMATE SCALE

0 5,000 10,000 15,000 20,000 Feet

TRANSECT LOCATION MAP

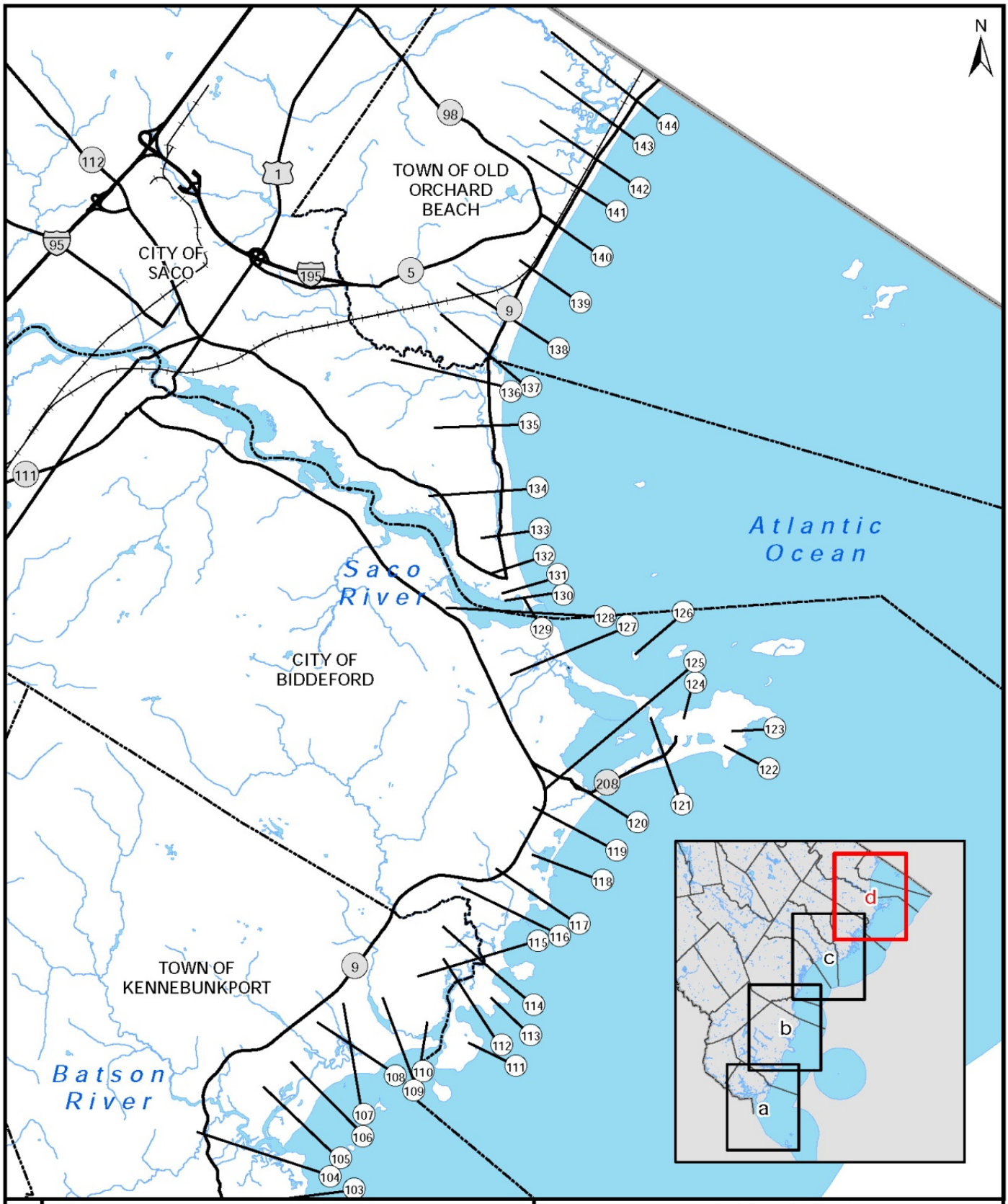

FIGURE 2D

FEDERAL EMERGENCY MANAGEMENT AGENCY

YORK COUNTY, ME

(ALL JURISDICTIONS)

APPROXIMATE SCALE

0 5,000 10,000 15,000 20,000 Feet

TRANSECT LOCATION MAP

The results of the coastal analysis using detailed methods are summarized in Table 10, "Transect Data," which provides the flood hazard zone and base flood elevations for each coastal transect along with the 10-, 2-, 1- and 0.2-percent-annual-chance flood stillwater elevations from the different flooding sources, including effects of wave setup where applicable.

TABLE 10 – COUNTYWIDE TRANSECT DATA

	STILLWATER ELEVATIONS (FEET NAVD 88[3])						
TRANSECT	10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
1	8.2	8.8	9.2	9.8	9.7	VE	14
2	8.2	8.8	9.2	9.8	11.6	VE	15
3	8.2	8.8	9.2	9.8	10.9	VE	21
4	8.2	8.8	9.2	9.8	9.9	VE	12
5	8.2	8.8	9.2	9.8	17.7	AE	18
						VE	20
6	8.2	8.8	9.2	9.8	16.6	AE	17
						VE	19
7	8.2	8.8	9.2	9.8	17.1	AE	17
						VE	24
8	8.2	8.8	9.2	9.8	16.4	AE	17
						VE	19
9	8.2	8.8	9.2	9.8	15.7	AE	16
						VE	18

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
10	8.2	8.8	9.2	9.8	12.8	AE	13-14
						VE	16
11	8.2	8.8	9.2	9.8	16.1	VE	40
12	8.2	8.8	9.2	9.8	14.4	AE	14
						VE	20
13	8.2	8.8	9.2	9.8	13.5	AE	14-15
						VE	16
14	8.2	8.8	9.2	9.8	13.6	AE	14
						VE	19
15	8.2	8.8	9.2	9.8	13.4	AE	14-15
						VE	19
16	8.2	8.8	9.2	9.8	13.4	VE	23
17	8.2	8.8	9.2	9.8	12.4	AE	12-13
						VE	15
18	8.2	8.8	9.2	9.8	14.0	AE	14
						VE	19
19	8.2	8.8	9.2	9.8	13.8	AE	14-15
						VE	18
20	8.2	8.8	9.2	9.8	15.1	AE	15-16
						VE	18

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
21	8.2	8.8	9.2	9.8	14.6	AE	15
						VE	18
22	8.2	8.8	9.2	9.8	14.4	AE	9-10
						VE	18
23	8.2	8.8	9.2	9.8	14.6	VE	17
24	8.2	8.8	9.2	9.8	14.2	VE	17
25	8.2	8.8	9.2	9.8	11.8	VE	14-15
26	8.2	8.8	9.2	9.8	13.5	AE	14-15
						VE	16
27	8.2	8.8	9.2	9.8	14.3	VE	21
28	8.2	8.8	9.2	9.8	15.5	VE	22
29	8.2	8.8	9.2	9.8	15.2	VE	17
30	8.2	8.8	9.2	9.8	14.7	VE	20
31	8.2	8.8	9.2	9.8	13.7	VE	16
32	8.2	8.8	9.2	9.8	13.9	AE	14
						VE	16
33	8.2	8.8	9.2	9.8	13.8	AE	14
						VE	16

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
34	8.2	8.8	9.2	9.8	13.1	AE	13
						VE	15
35	8.2	8.8	9.2	9.8	14.2	AE	14
						VE	17
36	8.2	8.8	9.2	9.8	13.7	VE	16
37	8.2	8.8	9.2	9.8	15.9	VE	18
38	8.2	8.8	9.2	9.8	15.5	VE	18
39	8.2	8.8	9.2	9.8	16.5	VE	22
40	8.2	8.8	9.2	9.8	15.4	VE	18
41	8.2	8.8	9.2	9.8	12.8	AE	13-14
						VE	15
42	8.2	8.8	9.2	9.8	14.5	VE	17
43	8.2	8.8	9.2	9.8	15.0	VE	19
44	8.2	8.8	9.2	9.8	14.7	AE	15
						VE	17
45	8.2	8.8	9.2	9.8	12.2	AE	13
						VE	14
46	8.2	8.8	9.2	9.8	15.4	VE	21

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
47	8.2	8.8	9.2	9.8	15.1	VE	21
48	8.2	8.8	9.2	9.8	13.6	AE	14
						VE	16
49	8.2	8.8	9.2	9.8	15.8	VE	20
50	8.2	8.8	9.2	9.8	15.2	AE	15-16
						VE	18
51	8.2	8.8	9.2	9.8	14.7	AE	15-16
						VE	21
52	8.2	8.8	9.2	9.8	15.7	VE	18
53	8.2	8.8	9.2	9.8	15.8	VE	18
54	8.2	8.8	9.2	9.8	15.4	VE	18
55	7.9	8.5	8.9	9.5	16.2	VE	27
56	7.9	8.5	8.9	9.5	15.1	AE	15
						VE	19
57	7.9	8.5	8.9	9.5	14.3	AE	14-15
						VE	20
58	7.9	8.5	8.9	9.5	14.0	VE	22
59	7.9	8.5	8.9	9.5	14.9	VE	21

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
60	7.9	8.5	8.9	9.5	13.3	VE	20
61	7.9	8.5	8.9	9.5	13.4	AE VE	14-15 16
62	7.9	8.5	8.9	9.5	12.9	AE VE	14-15 15
63	7.9	8.5	8.9	9.5	12.9	AE VE	14-15 15
64	7.9	8.5	8.9	9.5	13.7	AE VE	14-15 16
65	7.9	8.5	8.9	9.5	13.8	AE VE	14-15 16
66	7.9	8.5	8.9	9.5	13.9	AE VE	14-15 18
67	7.9	8.5	8.9	9.5	14.6	AE VE	15-16 17
68	7.9	8.5	8.9	9.5	14.4	VE	19
69	7.9	8.5	8.9	9.5	14.3	AE VE	14-16 16-17

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
70	7.9	8.5	8.9	9.5	14.4	AE	14-16
						VE	18
71	7.9	8.5	8.9	9.5	13.9	AE	14-16
						VE	16-17
72	7.9	8.5	8.9	9.5	13.5	AE	14-16
						VE	16
73	7.9	8.5	8.9	9.5	14.2	AE	14-16
						VE	16-17
74	7.9	8.5	8.9	9.5	12.9	AE	13-14
						VE	15-16
75	7.9	8.5	8.9	9.5	12.8	AE	13-15
						VE	15-16
76	7.9	8.5	8.9	9.5	11.5	AE	12-13
						VE	16
77	7.9	8.5	8.9	9.5	13.0	AE	14-15
						VE	15
78	7.9	8.5	8.9	9.5	14.2	AE	14-16
						VE	16
79	7.9	8.5	8.9	9.5	11.3	AE	12-13
						VE	13

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
80	7.9	8.5	8.9	9.5	12.8	VE	18
81	7.9	8.5	8.9	9.5	11.7	AE	12-13
						VE	16
82	7.9	8.5	8.9	9.5	11.4	AE	11-13
						VE	13
83	7.9	8.5	8.9	9.5	11.5	AE	12-14
						VE	22
84	7.9	8.5	8.9	9.5	10.6	AE	11-12
						VE	18
85	7.9	8.5	8.9	9.5	11.8	AE	12
						VE	18
86	7.9	8.5	8.9	9.5	10.1	VE	12
87	7.9	8.5	8.9	9.5	11.8	VE	13
88	7.9	8.5	8.9	9.5	12.0	AE	12
						VE	14
89	7.9	8.5	8.9	9.5	12.2	AE	12
						VE	18
90	7.9	8.5	8.9	9.5	11.9	AE	9-10
						VE	16

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
91	7.9	8.5	8.9	9.5	11.9	AE	9-10
						VE	14
92	7.9	8.5	8.9	9.5	11.3	AE	9
						VE	17
93	7.9	8.5	8.9	9.5	11.5	AE	12
						VE	16
94	7.9	8.5	8.9	9.5	12.0	AE	12
						VE	18
95	7.9	8.5	8.9	9.5	13.9	VE	21
96	7.9	8.5	8.9	9.5	11.7	VE	22
97	7.9	8.5	8.9	9.5	11.1	VE	22
98	7.9	8.5	8.9	9.5	10.1	AE	10
						VE	13
99	7.9	8.5	8.9	9.5	9.8	AE	10
						VE	12
100	7.9	8.5	8.9	9.5	10.0	AE	10
						VE	16
101	7.9	8.5	8.9	9.5	11.8	VE	15
102	7.9	8.5	8.9	9.5	10.3	VE	16

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
103	7.9	8.5	8.9	9.5	11.8	AE	12
						VE	16
104	7.9	8.5	8.9	9.5	11.1	AE	11-13
						VE	17
105	7.9	8.5	8.9	9.5	10.0	AE	10-11
						VE	13
106	7.9	8.5	8.9	9.5	11.1	AE	11-12
						VE	16
107	7.9	8.5	8.9	9.5	11.0	AE	11-13
						VE	18
108	7.9	8.5	8.9	9.5	10.9	AE	11-13
						VE	16
109	7.9	8.5	8.9	9.5	10.6	AE	11
						VE	15
110	7.9	8.5	8.9	9.5	10.6	AE	11
						VE	16
111	7.9	8.5	8.9	9.5	11.6	AE	12
						VE	17
112	7.9	8.5	8.9	9.5	11.9	AE	12-14

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
113	7.9	8.5	8.9	9.5	11.8	VE	17
114	7.9	8.5	8.9	9.5	11.2	AE VE	11-12 15
115	7.9	8.5	8.9	9.5	10.7	AE VE	11-12 16
116	7.9	8.5	8.9	9.5	11.6	AE VE	11-12 17
117	7.9	8.5	8.9	9.5	12.1	AE VE	11-12 17
118	7.9	8.5	8.9	9.5	12.3	AE VE	13 16
119	7.9	8.5	8.9	9.5	12.1	AE VE	12-13 16
120	7.9	8.5	8.9	9.5	11.6	AE VE	12-13 14
121	7.9	8.5	8.9	9.5	12.1	AE VE	12-13 17
122	7.9	8.5	8.9	9.5	11.6	VE	19
123	7.9	8.5	8.9	9.5	11.3	VE	15

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
124	7.9	8.5	8.9	9.5	10.6	VE	17
125	7.9	8.5	8.9	9.5	10.7	AE	12
						VE	13
126	7.9	8.5	8.9	9.5	11.3	VE	25
127	7.9	8.5	8.9	9.5	10.2	AE	11-12
						VE	12
128	7.9	8.5	8.9	9.5	9.9	VE	14
129	7.9	8.5	8.9	9.5	12.0	AE	13
						VE	14
130	7.9	8.5	8.9	9.5	13.0	AE	13-14
						VE	17
131	7.9	8.5	8.9	9.5	12.2	AE	12-13
						VE	14
132	7.9	8.5	8.9	9.5	13.6	AE	12
						VE	19
133	7.9	8.5	8.9	9.5	12.4	VE	15
134	7.9	8.5	8.9	9.5	12.2	VE	14
135	7.9	8.5	8.9	9.5	12.6	AE	13
						VE	15

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

TABLE 10 – COUNTYWIDE TRANSECT DATA - continued

TRANSECT	STILLWATER ELEVATIONS (FEET NAVD 88[3]) 10-PERCENT-ANNUAL CHANCE	2-PERCENT-ANNUAL-CHANCE	1-PERCENT-ANNUAL-CHANCE	0.2-PERCENT-ANNUAL-CHANCE	TOTAL WATER LEVEL[1] 1-PERCENT-ANNUAL-CHANCE	ZONE	BASE FLOOD ELEVATION (FEET NAVD 88[2,3])
136	7.9	8.5	8.9	9.5	12.6	AE	13-15
						VE	15
137	7.9	8.5	8.9	9.5	12.5	AE	13-14
						VE	15
138	7.9	8.5	8.9	9.5	13.1	AE	13-15
						VE	15
139	7.9	8.5	8.9	9.5	13.0	AE	13
						VE	15
140	7.9	8.5	8.9	9.5	12.8	VE	16
141	7.9	8.5	8.9	9.5	12.3	AE	13-14
						VE	14
142	7.9	8.5	8.9	9.5	12.9	AE	13-15
						VE	15
143	7.9	8.5	8.9	9.5	12.7	AE	13-15
						VE	15
144	7.9	8.5	8.9	9.5	12.5	AE	13-15
						VE	15

[1]Including stillwater elevation and effects of wave setup.
[2]Due to map scale limitations, base flood elevations shown on the FIRM represent average elevations for the zones depicted.
[3]North American Vertical Datum of 1988

3.5 Vertical Datum

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

All flood elevations shown in this countywide FIS report and on the FIRM are referenced to the NAVD 88. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. Ground, structure, and flood elevations may be compared and/or referenced to NGVD 29 by applying a standard conversion factor. **The conversion factor from NGVD 29 to NAVD 88 is -0.7, and from NAVD 88 to NGVD 29 is +0.7.**

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

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

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

The base flood elevations (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 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.

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