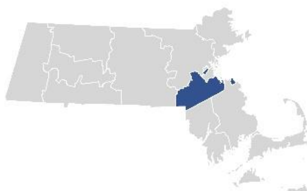
FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 2 OF 7



NORFOLK COUNTY, MASSACHUSETTS

(ALL JURISDICTIONS)

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
AVON, TOWN OF	250231	MILTON, TOWN OF	250245
BELLINGHAM, TOWN OF	250232	NEEDHAM, TOWN OF	255215
BRAINTREE, TOWN OF	250233	NORFOLK, TOWN OF	255217
BROOKLINE, TOWN OF	250234	NORWOOD, TOWN OF	250248
CANTON, TOWN OF	250235	PLAINVILLE, TOWN OF	250249
COHASSET, TOWN OF	250236	QUINCY, CITY OF	255219
DEDHAM, TOWN OF	250237	RANDOLPH, TOWN OF	250251
DOVER, TOWN OF	250238	SHARON, TOWN OF	250252
FOXBOROUGH, TOWN OF	250239	STOUGHTON, TOWN OF	250253
FRANKLIN, TOWN OF	250240	WALPOLE, TOWN OF	250254
HOLBROOK, TOWN OF	255212	WELLESLEY, TOWN OF	250255
MEDFIELD, TOWN OF	250242	WESTWOOD, TOWN OF	255225
MEDWAY, TOWN OF	250243	WEYMOUTH, TOWN OF	250257
MILLIS, TOWN OF	250244	WRENTHAM, TOWN OF	250258

REVISED: REVISED PRELIMINARY 04/07/2023

FLOOD INSURANCE STUDY NUMBER
25021CV002E
Version Number 2.6.3.6

FEMA

TABLE OF CONTENTS
Volume 1

Figures

<u>Tables</u>

Volume 2

<u>Figures</u>

<u>Tables</u>

Volume 3

Figures

Tables

Volume 4

Tables

Volume 5

Exhibits

Volume 6

<u>Exhibits</u>

Volume 7
<u>Exhibits</u>

Published Separately

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Abbott Run (upper)	County boundary	Point of one square mile of drainage area	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	Flow-change locations were selected based on 50% change in drainage area. Sub-basin delineation used hydro-conditioned lidar topography (FEMA 2011; USGS 2011, 2014, 2015). Cross sections were placed at entrances and exits of structures, at flow-change locations, and at significant changes in stream morphology. Overbank geometries were taken from lidar topography; channel geometries were calculated from regional bankfull equations (Bent 2006). Roughness was estimated from drainage area. Starting water-surface elevations were from normal depth using slope of lower end of reach. Ineffective flow was applied where applicable. These special considerations apply to all Zone A flooding sources in this table dated 12/1/2021 unless otherwise specified.
Abbott Run Tributary A	County boundary	Point of one square mile of drainage area	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Arnolds Brook	Confluence with Peters River	Approximately 480 feet above Lizotte Drive	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	7/1/1980	AE w/Floodway	Structure geometry was obtained from bridge plans, except for those structures which were unavailable or out of date, which were surveyed. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from topographic maps. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Beaver Brook (Avon)	Brockton Reservoir	Avon corporate limits	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	3/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Cross sections and structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from drainage area and channel geometry.
Beaver Brook (Bellingham)	Confluence with Charles River	Beaver Pond	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	7/1/1980	AE w/Floodway	Structure geometry was obtained from bridge plans, except for those structures which were unavailable or out of date, which were surveyed. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from topographic maps. Starting water-surface elevations were from the slope-area method.
Beaver Brook (Bellingham upper)	Beaver Pond	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	Flow-change locations were selected based on 50% change in drainage area. Sub-basin delineation used hydro-conditioned lidar topography (FEMA 2011; USGS 2011, 2014, 2015). Cross sections were placed at entrances and exits of structures, at flow-change locations, and at significant changes in stream morphology. Overbank geometries were taken from lidar topography; channel geometries were calculated from regional bankfull equations (Bent 2006). Roughness was estimated from drainage area. Starting water-surface elevations were from normal depth using slope of lower end of reach. Ineffective flow was applied where applicable. These special considerations apply to all Zone A flooding sources in this table dated 4/30/2018 unless otherwise specified.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Beaver Brook (Bellingham) Tributary A	Confluence with Beaver Brook (Bellingham)	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Beaver Brook (Holbrook)	Holbrook corporate limits	Approximately 1,000 feet above Weymouth Street	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.
Beaver Brook (Sharon lower)	Confluence with Massapoag Brook	Just below Upland Road	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Beaver Brook (Sharon)	Just below Upland Road	Approximately 3,400 feet above Upland Road	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	6/1/1977	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne 1976). Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Beaver Brook (Sharon upper)	Approximately 3,400 feet above Upland Road	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Beaver Brook (Sharon) Zone A tributaries	Confluences with Beaver Brook (Sharon)	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Beaver Meadow Brook	Bolivar Pond	Pleasant Street	HEC-1 (USACE 1973)	HEC-2 (USACE 1974)	2/1/1986	AE w/Floodway	As needed, cross sections may have been interpolated between surveyed cross sections using topographic maps (Sewell 1984b). Starting water-surface elevations were from downstream studies.
Beaver Meadow Brook (upper)	Pleasant Street	Just north of Pine Street	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Beaver Meadow Brook Tributary A	Confluence with Beaver Meadow Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Beth Road flooding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (249.3 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Billings Brook	Just below Old Post Road	Approximately 200 feet above Dirt Road	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	6/1/1977	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne 1976). Starting water-surface elevations were from the slope-area method.
Billings Brook Branch	Dirt Road	Just above Wolomolopoag Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	6/1/1977	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne 1976). Starting water-surface elevations were from the slope-area method.
Blue Hill River	Approximately 1,700 feet above West Street	Approximately 600 feet below Interstate 93	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Blue Hill River	Approximately 600 feet below Interstate 93	Approximately 500 feet above Interstate 93	Regression equations (Wandle 1983)	HEC-RAS 4.1.0 (Brunner 2010)	3/31/2018	A	Drainage area was determined from StreamStats on a 10-meter DEM and used in the regression equations to calculate 10-, 4-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. The 1-percent-plus event discharge was developed using the standard error associated with the regression equation for the 1-percent-annual-chance event (52%).
Blue Hill River Tributary A and Zone A tributaries	Confluence with Blue Hill River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Blue Hills Reservoir	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (257.0 feet NAVD88).
Bodwell Street ponding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (202.2 feet NAVD88).
Bogastow Brook	Confluence with Charles River	County boundary	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	1/1/1983	AE w/Floodway	Structures were field-checked. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from field measurement and photogrammetric maps. Starting water-surface elevations were from the slope-area method.
Bogastow Brook Zone A tributaries	Confluences with Bogastow Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Bogle Brook 2	Mouth at Morses Pond	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Bolivar Pond	Entire shoreline	Entire shoreline	HEC-1 (USACE 1973)	HEC-1 (USACE 1973)	12/1/1976	AE w/Floodway	HEC-1 analysis for entire river system above Forge Pond Dam provided elevation-frequency relationships for pond.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Boulder Brook	Mouth at Morses Pond	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Boulder Brook Tributary A	Confluence with Boulder Brook	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Bouncing Brook and Zone A tributaries	Confluence with Farm River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Bound Brook and Zone A tributaries	County boundary	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 4.1.0 (Brunner 2010)	5/31/2017	A	See special considerations for Beaver Brook (Bellingham upper).
Brook A (Stetson Brook)	Confluence with Glovers Brook	Approximately 285 feet above Allen Street	Rational method	HEC-2 (USACE 1974)	11/1/1985	AE w/Floodway	Structures were field-checked. Cross sections were field-surveyed. Starting water-surface elevations were from Glovers Brook profiles.
Brook B	Confluence with Upper Reservoir	Approximately 1,100 feet above Vesey Road	Log-Pearson type III flood frequency analysis, drainage-area ratio (Johnstone and Cross 1949)	HEC-2 (USACE 1974)	11/1/1985	AE w/Floodway	Streamgage used in statistical analysis was USGS streamgage 01104900 (Mill Brook at Westwood). Discharges were adjusted using drainage-area ratio equation with exponent of 0.75. Structures were field-checked. Cross sections were field-surveyed. Starting water-surface elevations were from an analysis of Upper Reservoir consisting of evaluation of reservoir capacity, discharge data between Upper Reservoir and Great Pond, and local rainfall and runoff data.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Brook No. 1	Wrentham/ Plainville corporate limits	Confluence with Rabbit Hill Pond	Regression equations (Wandle 1977)	E431 (Shearman 1976)	1/1/1979	AE w/Floodway	Cross sections and structures were obtained from field surveys. Starting water-surface elevations were from dam computations.
Bubbling Brook	Willett Pond Dam	Walpole/ Westwood corporate limits	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	1/1/2001	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Underwater portions of cross sections and structures were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from Willett Pond.
Buckmaster Brook	Confluence with Germany Brook	Approximately 250 feet above Arcadia Road	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/2/1973	AE	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps, aerial photographs, and field observations. Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures were obtained from field surveys.
Bungay Brook	Confluence with Peters River	Approximately 1,310 feet above Wrentham Road	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	7/1/1980	AE w/Floodway	Structure geometry was obtained from bridge plans, except for those structures which were unavailable or out of date, which were surveyed. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from topographic maps. Starting water-surface elevations were from Peters River profiles.
Bungay Brook (upper)	Approximately 1,310 feet above Wrentham Road	County boundary	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Bungay Brook Tributary A	Confluence with Bungay Brook	County boundary	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Burnt Swamp Brook	County boundary	Approximately 1,700 feet north of West Street	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	2/1/1980	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs (Quinn 1979b). Starting water-surface elevations were from the slope-area method. Some hydraulic structures with minimal effect on the water surface were omitted from the hydraulic model. Profiles were verified by recent high-water marks.
Callahan Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (174.3 feet NAVD88).
Canoe River (Foxborough)	Beaumont Road	Maple Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	3/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Contributing flows from adjacent communities were incorporated. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Cross sections and structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Canoe River (Sharon)	Approximately 10,000 above East Street	Approximately 13,000 feet above East Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	6/1/1977	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne 1976). Starting water-surface elevations were from the slope-area method.
Canton River	Confluence with Neponset River	Approximately 110 feet above Washington Street	Log-Pearson type III flood frequency analysis	HEC-RAS 4.1.0 (Brunner 2010)	3/31/2018	AE w/Floodway	Bulletin 17B flood-frequency analysis (IACWD 1982) was performed on USGS streamgage 01105500 with data from water years 1953 to 2016. The 1-percent-plus event discharge was developed using the 84-percent confidence limit. Hydraulic analysis took into account the flood mitigation dam, levee, and diversion channel along Canton River, but the levee was not accredited to provide protection from the base flood.
Caroline Brook	Confluence with Fuller Brook	Just below Forest Street	unknown	unknown	7/11/2008	AE	Studied in LOMR 08-01-0508X
Caroline Brook (upper)	Just below Forest Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Centre Street pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (183.6 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Charles River	County boundary	Newton Lower Falls Dam	Log-Pearson type III flood frequency analysis	HEC-RAS 5.0 (USACE 2016a)	6/1/2017	AE w/Floodway	Bulletin 17B flood-frequency analysis (IACWD 1982), modified with the expected moments algorithm (Cohn 1997, Cohn 2001, Griffis 2004), was performed on USGS streamgage 01104500 with data from water years 1932 to 2015. Estimated at-site discharges were not weighted by regression estimates because peak flows are affected by upstream diversion to Mother Brook. Peak flows upstream or downstream of the gage were computed using a drainage-area-ratio method (Johnstone and Cross 1949). The Stony Brook watershed (23.7 square miles) was included in the contributing drainage area because annual peak flows on Stony Brook occurred within a few days of those on Charles River every year from 2000 to 2015. Roughness factors were estimated using field notes, photographs, and orthoimagery. Overbank portions of cross sections were taken from lidar topography (USGS 2014). Structures and underwater portions of cross sections were from field surveys. Starting water-surface elevations were the known water surface at New Charles River Dam.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Charles River (Lower Reach)	Newton Lower Falls Dam	County boundary	multiple (see Special Considerations)	HEC-2 (USACE 1974)	7/1/1980	AE	Discharges in Needham were taken from studies in Wellesley, Dover, Westwood, Dedham, and Newton if they compared favorably with estimates from Bulletin 17B methods (IACWD 1982) incorporating updated streamflow records and were consistent throughout adjacent communities. Discharges in Wellesley were taken from studies in Newton and Needham. Discharges in Dedham and Dover were from log-Pearson type III analysis (IACWD 1982, WRC 1967, Johnson and Tasker 1974) on USGS streamgage 01103500 (Charles River at Charles River Village). In Dedham, streamgage discharges were transposed to other locations using a drainage-area ratio (SCS 1972a). One third of the flow in Charles River is diverted to Mother Brook. Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from topographic maps. Starting water-surface elevations were from various methods from community to community, including hydraulic analysis of controls, profiles from adjacent communities, and other studies. Profiles were verified by high-water marks from the floods of August 1955 and March 1968.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Charles River (Upper Reach)	County boundary	County boundary	multiple (see Special Considerations)	HEC-2 (USACE 1974)	7/1/1980	AE	Discharges in Franklin were taken from studies in Medway or computed by scaling the discharges from the Medway/ Bellingham/ Franklin boundary based on the ratio of drainage areas. Discharges in Medfield were taken from studies in Needham and a USACE hydrologic analysis. Discharges in Bellingham, Dover, Medway, Millis, and Norfolk were from log-Pearson type III analysis (IACWD 1982, WRC 1967, Johnson and Tasker 1974) on USGS streamgage 01103500 (Charles River at Charles River Village). In Bellingham, streamgage discharges were transposed to other locations using a drainage-area ratio with an exponent of 0.7 (USACE 1976a). In Medway, Millis, and Norfolk, streamgage discharges were extrapolated (SCS 1972a, USACE 1976a). Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from topographic maps. Starting water-surface elevations were from various methods from community to community, including hydraulic analysis of controls, profiles from adjacent communities, and other studies. Profiles were verified by high-water marks from the floods of August 1955 and March 1968.
Charles River Zone A tributaries	Confluences with Charles River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Chicken Brook	Confluence with Charles River	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	6/1/2017	AE w/Floodway	Peak flows were computed from regional regression equations. Roughness factors were estimated using field notes, photographs, and orthoimagery. Overbank portions of cross sections were taken from lidar topography (FEMA 2011). Structures and underwater portions of cross sections were from field surveys. Starting water-surface elevations were from normal depth.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Coastal Tributary E	Bower Road Extension	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Cobb's Brook	Confluence with Neponset River	Approximately 50 feet above North Street	unknown	WSP-2 (SCS 1976)	12/1/1975	AE w/Floodway	Cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from normal depth.
Cochato River	Confluence with Monatiquot River	North Shore Road Dam	HEC-1 (USACE 1973)	HEC-RAS 2.2 (USACE 1998)	7/1/1998	AE w/Floodway	Hydrologic analysis was revised to resolve discrepancies between Holbrook and Randolph FISs. Cross sections and structures were obtained from field surveys. Starting water-surface elevations were from Monatiquot River profiles.
Coon Hollow Brook	Confluence with Blue Hill River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Cranberry Brook and Zone A tributaries	Confluence with Cochato River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Cress Brook	Confluence with Mill River	Lake Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from photogrammetric maps (USGS 1970b) or field measurement. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Cress Brook Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (158.8 feet NAVD88).
Crocker Brook	Approximately 1,700 feet above Crocker Pond	Approximately 1,100 feet above East Street	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	2/1/1980	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs (Quinn 1979b). Starting water-surface elevations were from the slope-area method. Some hydraulic structures with minimal effect on the water surface were omitted from the hydraulic model. Profiles were verified by recent high-water marks.
Cunningham Brook	Confluence with Furnace Brook	Approximately 400 feet above Robertson Street	unknown	HEC-2 (USACE 1974)	7/1/1983	AE w/Floodway	Hydrologic analysis was performed by USACE for local flood protection studies (USACE 1976b). Structure data were taken from the USACE project (USACE 1976b). Cross sections were taken from topographic maps (Avis 1979). Hydraulic model was calibrated to USACE (1976b), taking recent modifications into account. Starting water-surface elevations were from Furnace Brook profiles.
Danielson Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (145.7 feet NAVD88).
Diamond Brook	Confluence with Neponset River	Washington Street	Regression equations (Wandle 1977)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	Flows from equations were modified to account for floodwater storage in Allens Pond using reservoir routing (SCS 1972a). Cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from normal depth.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Diamond Brook (upper)	Washington Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Dix Brook and Zone A tributaries	Confluence with Mine Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Dorchester Brook	Atkinson Avenue	Stoughton/ Easton corporate limits	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	10/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Discharges were compared against streamgage records from Neponset River in Canton using drainage-area ratios. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Starting water-surface elevations were from the slope-area method.
Duck Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (202.3 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Edwards Road pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (285.0 feet NAVD88).
Ellias Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (32.0 feet NAVD88).
Farm River	Confluence with Monatiquot River	Approximately 1,700 feet above West Street	Log-Pearson type III flood frequency analysis (Wandle 1977)	HEC-2 (USACE 1974)	1/1/1984	AE w/Floodway	Streamgage used in analysis was USGS streamgage 01105500 (East Branch Neponset River in Canton) with a regional skew of 0.5 and adjustments for partial duration and sample size. Discharges were compared to outflow records at Armstrong Cork Company Dam on Monatiquot River and found to agree, so they were transposed to this location. At locations along Farm River, discharges were calculated from Armstrong Dam discharges using drainage-area ratio equation with exponent of 0.7. Cross sections and structures were obtained from field surveys, except cross sections available from the NRCS study (SCS undated).
Forge Pond	Entire shoreline	Entire shoreline	HEC-1 (USACE 1973)	HEC-1 (USACE 1973)	1/1/1973	AE	HEC-1 analysis for entire river system above Forge Pond Dam provided elevation-frequency relationships for pond.
Franklin Street pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (197.4 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Fuller Brook (lower)	Confluence with Waban Brook	Approximately 200 feet below Wellesley High School fields	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Fuller Brook	Approximately 200 feet below Wellesley High School fields	Approximately 1,800 feet above Smith Street	HEC-1 (USACE 1973)	HEC-2 (USACE 1974)	11/1/1972	AE	Input to HEC-1 model included soil maps (SCS 1982), topographic maps (USGS 1970d), and 24-hour rainfall. Rainfall was calculated for 10-, 2-, and 1-percent-annual-chance storms and extrapolated for 0.2-percent-annual-chance storm. Methodology used within HEC-1 conformed to TR-55 (SCS 1974a) and WRC (1976).
Fuller Brook (upper)	Approximately 1,800 feet above Smith Street	Pine Swamp	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Fuller Brook Zone A tributaries	Confluences with Fuller Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Furnace Brook	Tidal limit	Approximately 850 above Hayden Street	unknown	HEC-2 (USACE 1974)	10/1/1976	AE w/Floodway	Hydrologic analysis was performed by USACE for local flood protection studies (USACE 1976b). Cross sections were field-surveyed. Overbank extensions of field-surveyed cross sections and additional sections needed for hydraulic continuity were taken from topographic maps (Avis 1979). Hydraulic model was calibrated to USACE (1976b), taking recent modifications into account. Starting water-surface elevations were from normal depth.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Germany Brook	Confluence with Hawes Brook	Westwood/ Norwood corporate limits	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	7/1/1977	AE w/Floodway	Log-Pearson type III flood frequency analysis (WRC 1976) was performed on USGS streamgage 01105550 (Plantingfield Brook in Norwood) with a regional skew coefficient. Gage statistics were used to calibrate parameters for regression equations for 10-, 2-, and 1-percent-annual-chance flows, which were used to calculate flows on Germany Brook due to watershed similarities. 0.2-percent-annual-chance flows were extrapolated. Structures were obtained from field surveys. Underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne undated). Starting water-surface elevations were from Hawes Brook profiles. The hydraulic model was checked for agreement with information from local residents on the floods of March 1968 and August 1955.
Glovers Brook	Confluence with Cochato River	Approximately 1,000 feet above Warren Street	Log-Pearson type III flood frequency analysis	HEC-2 (USACE 1974)	11/1/1985	AE w/Floodway	Streamgage used in statistical analysis was USGS streamgage 01104900 (Mill Brook at Westwood). Discharges were adjusted based on analysis of rainfall data, culvert capacity, and available storage from Bear Swamp. Structures were field-checked. Cross sections were field-surveyed. Starting water-surface elevations were from Cochato River profiles.
Granite Plaza rail flooding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (13.7 and 22.2 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Hales Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (270.1 feet NAVD88).
Harlow Pond Lateral	Confluence with Charles River	Approximately 2,000 feet above Phillips Pond	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	11/1/1982	AE	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from photogrammetric maps (USGS 1970b) or field measurement. Starting water-surface elevations were from the slope-area method.
Hawes Brook	Confluence with Neponset River	Willet Pond Dam	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	7/1/1977	AE w/Floodway	Log-Pearson type III flood frequency analysis (WRC 1976) was performed on USGS streamgage 01105550 (Plantingfield Brook in Norwood) with a regional skew coefficient. Gage statistics were used to calibrate parameters for regression equations for 10-, 2-, and 1-percent-annual-chance flows, which were used to calculate flows on Germany Brook due to watershed similarities. 0.2-percent-annual-chance flows were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne undated). Starting water-surface elevations were from Neponset River profiles. The hydraulic model was checked for agreement with information from local residents on the floods of March 1968 and August 1955.
Hawthorne Brook	Confluence with Turnpike Lake	Cowell Street	Regression equations (Wandle 1977)	E431 (Shearman 1976)	1/1/1979	AE w/Floodway	Cross sections and structures were obtained from field surveys. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Herring Brook	Confluence with Weymouth Back River	Approximately 300 feet above Iron Hill Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	9/1/1987	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1971). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Contributing flows from adjacent communities were incorporated. Discharges were compared against streamgage records from Old Swamp River near Whitmans Pond. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from normal elevations as determined from field inspection.
Herring Brook (upper)	Approximately 300 feet above Iron Hill Street	Approximately 80 feet below Libbey Industrial Parkway	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Herring Brook Tributary A	Culvert above intersection of Hawthorne Street and High Street	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Hopedale Street ponding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (47.7 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Hopping Brook	Confluence with Charles River	Approximately 1,400 feet above Milford Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	11/1/1978	AE w/Floodway	Discharges from regression equations were compared to discharges developed from unit hydrograph theory. Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs. Starting water-surface elevations were from the slope-area method.
Hopping Brook (upper)	Approximately 1,400 feet above Milford Street	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Hopping Brook Tributary A	Confluence with Hopping Brook	Milford Street	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Houghtons Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (157.7 feet NAVD88).
Jackson Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (209.6 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
James Brook	Confluence with Cohasset Cove	Sohier Street	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	8/1/1983	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and from topographic maps (Avis 1978). Hydraulic model was calibrated to historic flood information obtained from local residents and to floodplain maps (RKPC 1976), taking recent modifications into account. Starting water-surface elevations were from normal depth.
James Brook (upper)	Sohier Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 4.1.0 (Brunner 2010)	5/31/2017	A	See special considerations for Beaver Brook (Bellingham upper).
Kingsbury Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (137.0 feet NAVD88).
Lake Archer and outlet	Mouth at Lake Pearl	Lake Archer	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Lake Holbrook	Holbrook/ Randolph corporate limits	Spring Street	unknown	Stage-storage-discharge relationships	5/1/1985	AE	Relationships were based on lake outlet structures.
Lake Waban	Entire shoreline	Entire shoreline	Reservoir routing (Fair et al. 1966)	Dam analysis	11/1/1977	AE	Discharge-frequency relationships for Waban Brook were developed from TR-55 (SCS 1974a) and regression equations (Johnson and Tasker 1974). Flows were routed through Morses Pond, Paintshop Pond, and Lake Waban using reservoir routing. Water-surface elevations were from dam analysis.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Liberty Street ponding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (212.3 feet NAVD88).
Lily Pond Stream	Confluence with Lily Pond	Approximately 2,798 feet above confluence with Lily Pond	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	8/1/1983	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and from topographic maps (Avis 1978). Hydraulic model was calibrated to historic flood information obtained from local residents and to floodplain maps (RKPC 1976), taking recent modifications into account. Starting water-surface elevations were from Lily Pond elevations.
Lowder Brook and Zone A tributaries	Culvert above Gonzalez Field	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mann Pond Lateral	Confluence with Stop River	Boardman Street	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from topographic maps (USGS 1970b) or from engineering studies or construction plans where available. Starting water-surface elevations were from a combination of routed discharge frequency and elevation-discharge relationship at the downstream end.
Martha Jones pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (169.9 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Martin Brook	Confluence with Cochato River	Approximately 1,000 feet above Oak Street	Log-Pearson type III flood frequency analysis, drainage-area ratio (Johnstone and Cross 1949)	HEC-2 (USACE 1974)	11/1/1985	AE w/Floodway	Streamgage used in statistical analysis was USGS streamgage 01104900 (Mill Brook at Westwood). Discharges were adjusted using drainage-area ratio equation with exponent of 0.75. Structures were obtained from field surveys. Cross sections were field-surveyed. Starting water-surface elevations were from Cochato River profiles.
Mary Lee Brook	Confluence with Cochato River	South Main Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	11/1/1985	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) was extrapolated. Results from rural regression equations were transformed to urban peakflows using three-parameter estimations (Sauer et al. 1983) with a basin development factor of 4. Final results were compared to log-Pearson type III analysis on Old Swamp River in South Weymouth and Town Brook in Quincy, watersheds sufficiently similar in size and character. Structures were field-checked. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from aerial photographs. Starting water-surface elevations were from Cochato River profiles.
Mary Lee Brook (upper)	South Main Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mary Lee Brook Zone A tributaries	Confluences with Mary Lee Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Massapoag Brook (Canton)	Outlet at Forge Pond	Canton/ Sharon corporate limits	HEC-1 (USACE 1973)	HEC-2 (USACE 1974)	2/1/1986	AE w/Floodway	As needed, cross sections may have been interpolated between surveyed cross sections using topographic maps (Sewell 1984b). Starting water-surface elevations were from downstream studies.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Massapoag Brook (Sharon lower)	Canton/ Sharon corporate limits	Approximately 100 feet below Wooden Foot Bridge	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Massapoag Brook (Sharon)	Approximately 100 feet below Wooden Foot Bridge	Confluence with Massapoag Lake	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	6/1/1977	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne 1976).
Massapoag Lake	Entire shoreline	Entire shoreline	Regression equations (Johnson and Tasker 1974)	Dam analysis	2/1/1986	AE	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Water-surface elevation is controlled by flume house at outlet structure, with 3.5 to 4.0 feet of planking. Spillway was determined to be unable to handle 2-, 1-, and 0.2-percent-annual-chance floods and was modeled under the assumption that it would be fully opened. Elevations were computed using a stage-discharge curve based on outlet at flume house and flow overtopping Beach Street.
McAuliffe Road ponds	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (117.5 and 121.9 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Meadow Brook	Confluence with Neponset River	Pleasant Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	7/1/1977	AE w/Floodway	Log-Pearson type III flood frequency analysis (WRC 1976) was performed on USGS streamgage 01105550 (Plantingfield Brook in Norwood) with a regional skew coefficient. Gage statistics were used to calibrate parameters for regression equations for 10-, 2-, and 1-percent-annual-chance flows, which were used to calculate flows on Germany Brook due to watershed similarities. 0.2-percent-annual-chance flows were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne undated). Starting water-surface elevations were from Neponset River profiles. The hydraulic model was checked for agreement with information from local residents on the floods of March 1968 and August 1955.
Mill Brook	Mouth at Willett Pond	Dover/ Westwood corporate limits	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	12/1/1999	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures were obtained from field surveys. Starting water-surface elevations were from Millett Pond elevations.
Mill River (Norfolk)	Confluence with Charles River	Norfolk/ Wrentham corporate limits	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from topographic maps (USGS 1970b) or from engineering studies or construction plans where available. Starting water-surface elevations were from a combination of routed discharge frequency and elevation-discharge relationship at the downstream end.
Mill River (Norfolk upper)	Norfolk/ Wrentham corporate limits	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Mill River (Norfolk) Zone A tributaries	Confluences with Mill River (Norfolk)	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mill River (Weymouth lower)	Confluence with Herring Brook	Approximately 750 above Mill Street	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mill River (Weymouth)	Approximately 750 feet above Mill Street	Hollis Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	9/1/1987	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1971). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Contributing flows from adjacent communities were incorporated. Discharges were compared against streamgage records from Old Swamp River near Whitmans Pond. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from normal elevations as determined from field inspection.
Mill River (Weymouth upper)	Hollis Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mill River (Weymouth) Zone A tributaries	Confluences with Mill River (Weymouth)	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Mill River Tributary A	Confluence with Mill River	Driveway approximately 550 feet above Main Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	9/1/1987	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1971). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Contributing flows from adjacent communities were incorporated. Discharges were compared against streamgage records from Old Swamp River near Whitmans Pond. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from normal elevations as determined from field inspection.
Mill River Tributary B	Confluence with Mill River Tributary A	Railroad	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	9/1/1987	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1971). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Contributing flows from adjacent communities were incorporated. Discharges were compared against streamgage records from Old Swamp River near Whitmans Pond. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from normal elevations as determined from field inspection.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Miller Brook	Confluence with Mill River	Franklin/ Norfolk corporate limits	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Overbank portions of cross sections were obtained from topographic maps (USGS 1970b) or from engineering studies or construction plans where available. Starting water-surface elevations were from a combination of routed discharge frequency and elevation-discharge relationship at the downstream end.
Miller Brook (upper)	Franklin/ Norfolk corporate limits	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mine Brook (Franklin)	Confluence with Charles River	Approximately 200 feet above Washington Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	2/1/1980	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs (Quinn 1979a). Starting water-surface elevations were from the slope-area method.
Mine Brook (Franklin) Zone A tributaries	Confluences with Mine Brook (Franklin)	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mine Brook (Walpole)	Confluence with Neponset River	Medfield/ Walpole corporate limits	unknown	WSP-2 (SCS 1976)	12/1/1975	AE w/Floodway	Cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from normal depth.
Mine Brook (Walpole upper)	Medfield/ Walpole corporate limits	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Mine Brook (Walpole) Zone A tributaries	Confluences with Mine Brook (Walpole)	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Miscoe Brook and Zone A tributaries	Approximately 200 feet above Washington Street	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Mishkan Tefia swamp	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (93.3 feet NAVD88).
Monatiquot River	Quincy Avenue	Confluence of Farm River and Cochato River	Log-Pearson type III flood frequency analysis (Wandle 1977)	HEC-2 (USACE 1974)	1/1/1984	AE w/Floodway	Streamgage used in analysis was USGS streamgage 01105500 (East Branch Neponset River in Canton) with a regional skew of 0.5 and adjustments for partial duration and sample size. Discharges were compared to outflow records at Armstrong Cork Company Dam on Monatiquot River and found to agree, so they were transposed to this location. At other locations along Monatiquot River, discharges were calculated from Armstrong Dam discharges using drainage-area ratio equation with exponent of 0.7. Cross sections and structures were obtained from field surveys, except cross sections available from the NRCS study (SCS undated). The 1984 study used much of the geometry and the starting water-surface elevations from the previous study.
Monatiquot River Zone A tributaries	Confluences with Monatiquot River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Morses Pond	Entire shoreline	Entire shoreline	Reservoir routing (Fair et al. 1966)	Dam analysis	11/1/1977	AE	Discharge-frequency relationships for Waban Brook were developed from TR-55 (SCS 1974a) and regression equations (Johnson and Tasker 1974). Flows were routed through Morses Pond, Paintshop Pond, and Lake Waban using reservoir routing. Water-surface elevations were from dam analysis.
Mother Brook	County boundary	Divergence from Charles River	Log-Pearson type III flood frequency analysis (IACWD 1982)	HEC-2 (USACE 1974)	6/1/1977	AE	By law, one third of the discharge on Charles River is diverted to Mother Brook. Charles River discharges were computed from log-Pearson type III analysis and transposed to Mother Brook location using drainage-area ratios. Most cross sections were field-surveyed, but some may have been interpolated as necessary with the aid of survey data and topographic mapping (MDC 1959). Starting water-surface elevations were from basic hydraulic calculations using Manning's equation.
Muddy River	County boundary	Above Leverett Pond	unknown	unknown	5/1/1972	AE	
Muddy River (upper)	Above Leverett Pond	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Myrtle Street Lateral	Confluence with Charles River	Approximately 3,000 feet above Myrtle Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from photogrammetric maps (USGS 1970b) or field measurement. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Neponset River	Adams Street	Foxborough/ Walpole corporate limits	Log-Pearson type III flood frequency analysis	HEC-RAS 5.0 (USACE 2016a)	6/1/2017	AE w/Floodway	Bulletin 17B flood-frequency analyses (IACWD 1982), modified with the expected moments algorithm (Cohn 1997, Cohn 2001, Griffis 2004), were performed on USGS streamgages 01105000, 01105554, and 011055566 with data from water years 1938 to 2015, 2005 to 2015, and 1997 to 2015, respectively. Estimated at-site discharges for streamgages 01105000 and 01105554 were weighted with regression estimates. Those for streamgage 011055566 were not weighted because peak flows are affected by the upstream confluence with Mother Brook. Most peak flows upstream or downstream of the gages were computed using a drainage-area-ratio method (Johnstone and Cross 1949). However, upstream of the confluence with Mine Brook, peak flows were determined from regression equations (Zarriello 2017) instead. Roughness factors were estimated using field notes, photographs, and orthoimagery. Overbank portions of cross sections were taken from lidar topography (FEMA 2011, USGS 2011, USGS 2014). Structures and underwater portions of cross sections were from field surveys. Starting water-surface elevations were from normal depth.
Neponset River (upper)	Walpole/ Foxborough corporate limits	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Neponset River Zone A tributaries	Confluences with Neponset River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Noanet Brook and Zone A tributaries	Confluence with Charles River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Norroway Brook (lower)	Confluence with Farm River	Upper Reservoir	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Norroway Brook	Confluence with Upper Reservoir	Approximately 285 feet above Warren Street	Log-Pearson type III flood frequency analysis	HEC-2 (USACE 1974)	7/1/1977	AE w/Floodway	Streamgage used in statistical analysis was USGS streamgage 01104900 (Mill Brook at Westwood). Discharges were adjusted based on analysis of rainfall data, culvert capacity, and available storage from Bear Swamp. Structures were field-checked. Cross sections were field-surveyed. Starting water-surface elevations were from an analysis of Upper Reservoir consisting of evaluation of reservoir capacity, discharge data between Upper Reservoir and Great Pond, and local rainfall and runoff data.
Norroway Brook (upper)	Approximately 285 feet above Warren Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Norroway Brook Zone A tributaries	Confluences with Norroway Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
North Brook and Zone A tributaries	Confluence with Charles River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
North Holbrook swamp	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (190.6 feet NAVD88).
Old Swamp River	Approximately 80 feet below Libbey Industrial Parkway	Approximately 2,750 feet above Ralph Talbot Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	5/1/1990	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1971). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Contributing flows from adjacent communities were incorporated. Discharges were compared against streamgage records from Old Swamp River near Whitmans Pond. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from normal elevations as determined from field inspection.
Old Swamp River (upper)	Approximately 2,750 feet above Ralph Talbot Street	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Old Swamp River Tributary A	Confluence with Old Swamp River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Pecunit Brook	Confluence with Neponset River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Pequid Brook (Lower Reach)	Confluence with Forge Pond	Reservoir Pond	HEC-1 (USACE 1973)	HEC-2 (USACE 1974)	2/1/1986	AE	As needed, cross sections may have been interpolated between surveyed cross sections using topographic maps (Sewell 1984b). Starting water-surface elevations were from downstream studies.
Pequid Brook (Upper Reach)	Confluence with Reservoir Pond	Unnamed bridge	HEC-1 (USACE 1973)	HEC-2 (USACE 1974)	2/1/1986	AE	As needed, cross sections may have been interpolated between surveyed cross sections using topographic maps (Sewell 1984b). Starting water-surface elevations were from downstream studies.
Pequid Brook (Upper Reach upper)	Unnamed bridge	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Peters River	County boundary	Silver Lake	Drainage-area ratio	HEC-2 (USACE 1974)	7/1/1980	AE w/Floodway	Discharge at Woonsocket boundary was taken from Woonsocket FIS. Upstream, drainage-area ratio equation was used with exponent of 0.7. Structure geometry was obtained from bridge plans, except for those structures which were unavailable or out of date, which were surveyed. Underwater portions of cross sections were obtained from field surveys. Overbank portions were obtained from topographic maps. Starting water-surface elevations were from adjacent studies.
Peters River Tributary A	Confluence with Peters River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Peters River Tributary B	Confluence with Peters River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Peters River Tributary B1	Confluence with Peters River Tributary B	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Peters River Tributary C	Confluence with Peters River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Pickerel Brook	Confluence with Traphole Brook	Approximately 1,800 feet above Wolcott Avenue	unknown	WSP-2 (SCS 1976)	12/1/1975	AE w/Floodway	Cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from normal depth.
Pine Tree Brook	Confluence with Neponset River	Approximately 2,000 feet above Interstate 95	Discharge-frequency-drainage area relationships	HEC-2 (USACE 1974)	10/1/1976	AE	Relationships were developed from information received from Amherst office of NRCS using TR-55 (SCS 1974a). Cross sections were taken from the NRCS study (SCS 1966). Starting water-surface elevations were from Neponset River profiles.
Pine Tree Brook (upper)	Approximately 2,000 feet above Interstate 95	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Pinewood Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (122.6 feet NAVD88).
Plantingfield Brook	Interstate 95	Norwood/ Westwood corporate limits	Log-Pearson type III flood frequency analysis (WRC 1976)	HEC-2 (USACE 1974)	7/1/1977	AE w/Floodway	Streamgage used in analysis was USGS streamgage 01105550 (Plantingfield Brook in Norwood) with a regional skew coefficient. Gage statistics were used to calibrate parameters for regression equation (Johnson and Tasker 1974) for 10-, 2-, and 1-percent-annual-chance flows, which was used to calculate flows elsewhere in the reach. 0.2-percent-annual-chance flows were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne undated). Starting water-surface elevations were from the slope-area method. The hydraulic model was checked for agreement with information from local residents on the floods of March 1968 and August 1955.
Plantingfield Brook (upper)	Norwood/ Westwood corporate limits	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Pleasantdale Road flooding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (94.2 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Plymouth River	County boundary	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Plymouth River Tributary F	Confluence with Plymouth River	County boundary	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Ponkapoag Brook	Confluence with Neponset River	Turnpike Street	Regression equations (Sauer et al. 1983)		2/1/1986	AE w/Floodway	Discharge-frequency relationships were calculated as if basin were rural, then transformed to urban flows based on basin development characterstics. As needed, cross sections may have been interpolated between surveyed cross sections using topographic maps (Sewell 1984b). Starting water-surface elevations were from Neponset River profiles.
Ponkapoag Brook (upper)	Turnpike Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Powisett Brook and Zone A tributaries	Confluence with Charles River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Prison Farm Lateral	Confluence with Stop River	Spring Street	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from topographic maps (USGS 1970b) or from engineering studies or construction plans where available. Starting water-surface elevations were from a combination of routed discharge frequency and elevation-discharge relationship at the downstream end.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Purgatory Brook (lower)	Confluence with Plantingfield Brook	Just below U.S. Route 1	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Purgatory Brook	Just below U.S. Route 1	Approximate 6,500 feet above Gay Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	12/1/1999	AE w/Floodway	Log-Pearson type III flood frequency analysis (WRC 1976) was performed on USGS streamgage 01105550 (Plantingfield Brook in Norwood) with a regional skew coefficient. Gage statistics were used to calibrate parameters for regression equations for 10-, 2-, and 1-percent-annual-chance flows, which were used to calculate flows on Germany Brook due to watershed similarities. 0.2-percent-annual-chance flows were extrapolated. Structures were obtained from field surveys. Underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne undated). Starting water-surface elevations were from the slope-area method. The hydraulic model was checked for agreement with information from local residents on the floods of March 1968 and August 1955.
Quick Stream (upper)	County boundary	Point of one square mile of drainage area	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Rabbit Hill Brook	Wrentham/ Plainville corporate limits	Crocker Pond	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	2/1/1980	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs (Quinn 1979b). Starting water-surface elevations were from the slope-area method. Some hydraulic structures with minimal effect on the water surface were omitted from the hydraulic model. Profiles were verified by recent high-water marks.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Rainbow Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (202.7 feet NAVD88).
Rattlesnake Run	Confluence with Straits Pond	Approximately 528 feet above confluence with Straits Pond	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	8/1/1983	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and from topographic maps (Avis 1978). Hydraulic model was calibrated to historic flood information obtained from local residents and to floodplain maps (RKPC 1976), taking recent modifications into account. Starting water-surface elevations were from normal depth.
Rattlesnake Run (upper)	Approximately 528 feet above confluence with Straits Pond	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Redwing Brook	Just north of Pine Street	Approximately 1,000 feet above Pine Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	10/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Discharges were compared against streamgage records from Neponset River in Canton using drainage-area ratios. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Redwing Brook (upper)	Approximately 1,000 feet above Pine Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Redwing Brook Tributary A	Confluence with Redwing Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Reservoir Pond	Entire shoreline	Entire shoreline	HEC-1 (USACE 1973)	HEC-1 (USACE 1973)	12/1/1976	AE	HEC-1 analysis for entire river system above Forge Pond Dam provided elevation-frequency relationships for pond.
Richardsons Brook	Confluence with Little Harbor	Approximately 1,160 feet above confluence with Little Harbor	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	8/1/1983	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and from topographic maps (Avis 1978). Hydraulic model was calibrated to historic flood information obtained from local residents and to floodplain maps (RKPC 1976), taking recent modifications into account. Starting water-surface elevations were from normal depth.
Richardsons Brook (upper)	Approximately 1,160 feet above confluence with Little Harbor	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 4.1.0 (Brunner 2010)	5/31/2017	A	See special considerations for Beaver Brook (Bellingham upper).
Richardsons Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (147.0 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Robinson Brook	County boundary	Central Street	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	3/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Cross sections and structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from the slope-area method.
Rock Meadow Brook	Country Club Road	Approximately 1,600 feet above Hartford Street	TR-20 (SCS 1965)	unknown	11/2/1973	AE	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps, aerial photographs, and field observations. Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures were obtained from field surveys.
Rocky Brook	Confluence with Trout Brook	Just above abandoned railroad	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	6/1/1985	AE w/Floodway	Discharges from regression equations were used after evaluation of basin storage and urbanization based on maps (SCS 1982) and field reconnaissance determined that basin is sufficiently rural. 0.2-percent-annual-chance discharge (not available from equations) was extrapolated. Discharges were compared to discharges developed from unit hydrograph theory. Structures and underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Sewell 1984a). Starting water-surface elevations were from the slope-area method. Roughness value of 0.024 was used for concrete culverts.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Rosemary Brook	Confluence with Charles River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Ruckaduck Lake	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (197.4 feet NAVD88).
Rumford River	County boundary	Vandys Pond	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	3/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Cross sections and structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from the slope-area method.
Sabrina Lake	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (136.5 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Sawmill Brook 3 Tributary B1	County boundary	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
School Meadow Brook	Confluence with Neponset River	Approximately 350 feet above U.S. Route 1	unknown	WSP-2 (SCS 1976)	12/1/1975	AE w/Floodway	Cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from normal depth.
School Meadow Brook (upper)	Approximately 350 feet above U.S. Route 1	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
School Meadow Brook Zone A tributaries	Confluences with School Meadow Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Sevenmile River	County boundary	Headwaters at unnamed pond	Regression equations (Zarriello et al. 2012)	HEC-RAS 4.1.0 (Brunner 2010)	7/1/2014	AE w/Floodway	Regression equations were used to calculated discharges at locations with parameters within acceptable ranges. For other locations, a drainage-area ratio method was used to estimate discharges. Most underwater cross-section data and structure elevations were from field surveys in March and April, 2012. Underwater cross-section data for selected cross sections were obtained from WSP 2 input files from previously effective study. Overbank cross-section data were from lidar topography (FEMA 2011). Starting water-surface elevations were from normal depth, with the slope set at 0.0009. The hydraulic model was calibrated to high-water marks from the March and April 2010 flood at Read Street (Zarriello and Bent 2011).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Shea Drive swamp	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (153.1 feet NAVD88).
Sheldon Street ponding	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (47.6 feet NAVD88).
Shepards Brook	Confluence with Charles River	Approximately 1,400 feet south of Partridge Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	2/1/1980	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs (Quinn 1979a). Starting water-surface elevations were from the slope-area method.
Shepards Brook (upper)	Approximately 1,400 feet south of Partridge Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Shepards Brook Tributary A	Confluence with Shepards Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Smelt Brook 2 and Zone A tributaries	Confluence with Monatiquot River	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
South Brook	Confluence with Purgatory Brook	East Street	HEC-1 (USACE 1973)	HEC-RAS 2.2 (USACE 1998)	1/1/2001	AE	Unit hydrograph method was used to develop hydrographs for each sub-basin. NRCS lag formula was used to calculate lag time. Hydrographs were routed through model using Modified Puls method. Rainfall depths were from USWB (1961). Peakflows were verified using Nationwide Urban Equations (Jennings et al. 1993). Structures were obtained from field surveys. Starting water-surface elevations were from Purgatory Brook profiles.
St. Moritz Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (91.0 feet NAVD88).
Stall Brook (lower)	Confluence with Charles River	Alder Street	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Stall Brook	Alder Street	County boundary	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	7/1/1980	AE	Refer to FIS report for Worcester County, Massachusetts (All Jurisdictions)
Steep Hill Brook (lower)	Bolivar Pond	Stoughton/ Canton corporate limits	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Steep Hill Brook	Stoughton/ Canton corporate limits	Just above Brittons Pond	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	10/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Discharges were compared against streamgage records from Neponset River in Canton using drainage-area ratios. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Starting water-surface elevations were from the slope-area method.
Steep Hill Brook (upper)	Just above Brittons Pond	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Steep Hill Brook Tributary A and Zone A tributaries	Confluence with Steep Hill Brook	Points of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Steep Hill Brook Tributary B	Confluence with Steep Hill Brook	Diversion from Massapoag Brook	Regression equations (Wandle 1983)	HEC-RAS 4.1.0 (Brunner 2010)	3/31/2018	A	Drainage area was determined from StreamStats on a 10-meter DEM and used in the regression equations to calculate 10-, 4-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. The 1-percent-plus event discharge was developed using the standard error associated with the regression equation for the 1-percent-annual-chance event (52%).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Stevens Terrace pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (202.0 feet NAVD88).
Stony Brook	Confluence with Stop River	Norfolk/ Wrentham corporate limits	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from topographic maps (USGS 1970b) or from engineering studies or construction plans where available. Starting water-surface elevations were from a combination of routed discharge frequency and elevation-discharge relationship at the downstream end.
Stony Brook 2 Tributary A	Confluence with Stony Brook 2	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Stop River	Walpole/ Norfolk corporate limits	Norfolk/ Wrentham corporate limits	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	11/1/1982	AE w/Floodway	Structures were obtained from field surveys. Underwater portions of cross sections were obtained from field surveys. Overbank portions of cross sections were obtained from topographic maps (USGS 1970b) or from engineering studies or construction plans where available. Starting water-surface elevations were from a combination of routed discharge frequency and elevation-discharge relationship at the downstream end.
Stop River (upper)	Norfolk/ Wrentham corporate limits	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Stop River Tributary A	Confluence with Stop River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Sucker Brook	Confluence with Massapoag Lake	Approximately 2,100 feet above confluence with Massapoag Lake	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	6/1/1977	AE w/Floodway	0.2-percent-annual-chance discharges (not available from equations) were extrapolated. Structures and underwater portions of cross sections were field-surveyed. Overbank portions of cross sections and interpolated cross sections were taken from topographic maps (Teledyne 1976). Starting water-surface elevations were from the slope-area method.
Sylvys Brook	County boundary	Point of one square mile of drainage area	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Sylvys Brook Tributary A	Confluence with Sylvys Brook	County boundary	Regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	12/1/2021	A	See special considerations for Abbott Run (upper).
Ten Mile River	County boundary	High Street	Regression-weighted log-Pearson type III flood frequency analysis (Cohn et al. 2012)	HEC-RAS 4.1.0 (Brunner 2010)	7/1/2014	AE w/Floodway	Log-Pearson type III discharges from USGS streamgage 01109403 (Ten Mile River at Pawtucket Avenue at East Providence) were from Zarriello et al. (2012). Flows were transferred upstream and downstream using a weighted hybrid method (Guimaraes and Bohman 1992). Underwater cross-section data and structure elevations were from field surveys in March and April, 2012. Overbank cross-section data were from lidar topography (FEMA 2011). Starting water-surface elevations were from normal depth, using a slope of 0.0005. The hydraulic model was calibrated to high-water marks from the April 2010 flood (Zarriello and Bent 2011).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Timberline Drive pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (184.4 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Town Brook	State Route 3A	Chickatawbut Road	HEC-HMS (USACE 2016b)	HEC-RAS 5.0 (USACE 2016a)	6/1/2017	AE w/Floodway	Peak flows were determined using a HEC-HMS rainfall-runoff model (SCS Curve Number and Unit Hydrograph method [USDA 1986], with kinematic wave routing), including reservoir routing at Old Quincy Reservoir. The outflow rating at the gated structure on Old Quincy Reservoir was developed from two discharge-elevation values published in the design document for the system (USACE 1985). The outflow rating for the spillway was created using HEC-RAS modeling. These ratings were used for storm routing in HEC-HMS using the modified Puls method. One-day storm duration (NOAA 2015) was used for the rainfall input data. Flood-frequency analysis on the USGS Town Brook streamgage 01105585 (using only the 17 years of data since the current Town Brook drainage system was built) was used to calibrate the model at the gage location. The streamgage analysis was a log-Pearson type III flood-frequency analysis (IACWD 1982) modified by the expected moments algorithm (Cohn 1997, Cohn 2001). Peak flows from the 12 modeled subbasins were applied to the HEC-RAS hydraulic model, which was used to optimize flow at junctions where the two Town Brook diversions leave and rejoin the system. One diversion flows under Burgin Parkway; the other flows through Deep Rock Tunnel. Diversion ratings at these junctions needed for the rainfall-runoff model were computed in HEC-RAS. Roughness factors were estimated using field notes, photographs, and orthoimagery. Overbank portions of cross sections were taken from lidar topography (USGS 2014). Structures and underwater portions of cross sections were from field surveys. Starting water-surface elevations were the known water surface of 5 feet for all profiles. "Lids" were used at cross sections in the hydraulic model to constrain water inside long culverted reaches.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Traphole Brook (lower)	Confluence with Neponset River	Summer Street	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Traphole Brook	Summer Street	Approximately 75 feet above U.S. Route 1	TR-20 (SCS 1965)	HEC-2 (USACE 1974)	7/1/1977	AE w/Floodway	Peakflows were taken from NRCS study on Diamond and Traphole Brooks (SCS 1972b, 1975). Cross sections were obtained from field surveys. Overbank portions of cross sections were derived from topographic maps (Avis 1980b). Starting water-surface elevations were from the slope-area method.
Traphole Brook (upper)	Approximately 75 feet above U.S. Route 1	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Traphole Brook Tributary A	Confluence with Traphole Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary C2	Confluence with Cochato River	Approximately 400 feet above Kleen Way	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	7/15/1988	AE	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Tributary C2B	Confluence with Tributary C2	Approximately 250 feet above Woodlawn Road	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.
Tributary C2B (upper)	Approximately 250 feet above Woodlawn Road	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary C2B Tributary A	Confluence with Tributary C2B	Approximately 500 feet above Kleen Way	unknown	unknown	5/1/1985	AE	
Tributary C2B Tributary A (upper)	Approximately 500 feet above Kleen Way	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Tributary R1	Confluence with Trout Brook	State Route 37	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	7/15/1988	AE	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.
Tributary R1 (upper)	State Route 37	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary R2	Confluence with Trout Brook	Approximately 520 feet above Reeds Lane	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Tributary R2 (upper)	Approximately 520 feet above Reeds Lane	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary R3	Confluence with Trout Brook	Approximately 100 feet above State Route 37	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.
Tributary R4	Confluence with Trout Brook	Approximately 150 feet above State Route 37	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Tributary R4 (upper)	Approximately 150 feet above State Route 37	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary to Great Black Swamp	Great Black Swamp	Approximately 2,000 feet west of Saint Joseph's Cemetery on Oakland Street	Regression equations (Wandle 1983)	HEC-2 (USACE 1974)	11/1/1978	AE w/Floodway	Discharges from regression equations were compared to discharges developed from unit hydrograph theory. Structures were obtained from field surveys. Cross sections were obtained from field surveys and aerial photographs. Starting water-surface elevations were from the slope-area method.
Tributary to Great Black Swamp (upper)	2,000 feet west of Saint Joseph's Cemetery on Oakland Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary to Great Black Swamp Tributary A1	Confluence with Tributary to Great Black Swamp Tributary A	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary to Steep Hill Brook	Confluence with Steep Hill Brook	Town Pond	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	10/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Discharges were compared against streamgage records from Neponset River in Canton using drainage-area ratios. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Starting water-surface elevations were from the slope-area method.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Tributary to Steep Hill Brook (upper)	Town Pond	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Tributary to Steep Hill Brook Tributary A	Confluence with Tributary to Steep Hill Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Trout Brook (Avon)	County boundary	Ladge Drive	Regression equations (Johnson and Tasker 1974)	HEC-2 (USACE 1974)	3/1/1978	AE w/Floodway	Drainage areas and slopes were taken from topographic maps (USGS 1964a). Annual regional precipitation value of 3.67 feet per year was taken from USWB (1961). These variables were used to calculate 10-, 2-, and 1-percent-annual-chance floods. 0.2-percent-annual-chance floods were extrapolated. Areas of swamp, bog, open water, and urban development were computed and assigned weighting values to account for storage and rapid urban run-off. These values were used to adjust final discharges. Cross sections and structures were obtained from field surveys. No more than 0.25 mile is between each cross section. Starting water-surface elevations were from drainage area and channel geometry.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Trout Brook (Dover)	Confluence with Charles River	Approximately 1,500 feet above Access Road	Regression equations (Wandle 1983), TR-55 (SCS 1974a)	HEC-2 (USACE 1974)	6/1/1985	AE w/Floodway	Discharges from regression equations were used for upper portion only, where evaluation of basin storage and urbanization based on maps (SCS 1982) and field reconnaissance determined that basin is sufficiently rural. 0.2-percent-annual-chance discharge (not available from equations) was extrapolated. Discharges from TR-55 were used for lower portion. Discharges were compared to discharges developed from unit hydrograph theory. For the whole reach, structures and underwater portions of cross sections were obtained from field surveys. For the lower portion, cross sections were obtained from field surveys and topographic maps (Maguire 1977). For the upper portion, cross sections were obtained from topographic maps (Sewell 1984a). Profiles were verified by high-water marks from the floods of August 1955 and March 1968. Starting water-surface elevations were from the slope-area method. Roughness value of 0.024 was used for concrete culverts.
Trout Brook (Dover upper)	Approximately 1,500 feet above Access Road	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Trout Brook (Dover) Tributary A	Confluence with Trout Brook (Dover)	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Trout Brook (Holbrook)	South Shore Road	Spring Street	TR-20 (SCS 1965)	WSP-2 (SCS 1976)	5/1/1985	AE w/Floodway	For input to TR-20 model, basin boundaries were delineated on USGS topographic maps. Times of concentration were calculation from watershed characteristics. Soil characteristics were derived from soil maps (Norfolk 1926) and a Holbrook Planning Study (Holbrook 1966). Rainfall characteristics were from USWB (1961). 24-hour rainfall was used. For smaller drainages, tabular flood routing was used (SCS 1972a). Structures, complete cross sections, and high-water marks were obtained from field surveys. Sewer plans, highway drawings, engineering studies, and construction plans were used to supplement surveys. Distances were taken from topographic maps (Avis 1980a). Starting water-surface elevations were from normal depth.
Trout Brook (Holbrook upper)	Spring Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Trout Brook (Milton)	Confluence with Pine Tree Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Trout Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (252.2 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Turkey Hill Run	County boundary	County boundary	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	8/1/1983	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and from topographic maps (Avis 1978). Hydraulic model was calibrated to historic flood information obtained from local residents and to floodplain maps (RKPC 1976), taking recent modifications into account. Starting water-surface elevations were from mean high tide.
Turkey Hill Run (upper)	County boundary	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Turtle Brook	Mirimichi Street Dam	Confluence with Hawthorne Brook	Regression equations (Wandle 1977)	E431 (Shearman 1976)	1/1/1979	AE w/Floodway	Cross sections and structures were obtained from field surveys. Hydraulic computations assumed that flashboards would be removed from both dams on Turnpike Lake and that flow in the diversion canal would be negligible. Starting water-surface elevations were from Lake Mirimichi elevations.
Uncas Brook	Mouth at Lake Pearl	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Uncas Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (303.1 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Unnamed Tributary to Mary Lee Brook	Confluence with Mary Lee Brook	Just above Union Street	Log-Pearson type III flood frequency analysis, drainage-area ratio (Johnstone and Cross 1949)	HEC-2 (USACE 1974)	11/1/1985	AE w/Floodway	Streamgage used in statistical analysis was USGS streamgage 01104900 (Mill Brook at Westwood). Discharges were adjusted using drainage-area ratio equation with exponent of 0.75. Structures were field-checked. Cross sections were field-surveyed. Starting water-surface elevations were from Mary Lee Brook profiles.
Unnamed Tributary to Robinson Brook	Confluence with Robinson Brook	Approximately 1,720 feet above Robinson Brook	unknown	unknown	3/1/1978	AE	
Unquity Brook	Confluence with Neponset River	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Vine Brook	Confluence with Charles River	Just above Industrial Drive	TR-55 (SCS 1974a)	HEC-2 (USACE 1974)	1/1/1978	AE	Cross sections were field-surveyed. As necessary, interpolated cross sections were prepared from survey data with the aid of topographic maps (USGS 1970b). Starting water-surface elevations were from normal depth.
Vine Brook (upper)	Just above Industrial Drive	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).
Waban Brook	Confluence with Charles River	Morses Pond Dam	Discharge-frequency relationships	HEC-2 (USACE 1974)	11/1/1977	AE	Relationships were developed from TR-55 (SCS 1974a) and regression equations (Johnson and Tasker 1974). Flows were routed through Morses Pond, Paintshop Pond, and Lake Waban using standard routing (Fair et al. 1966). Cross sections were field-surveyed. As necessary, interpolated cross sections were prepared from survey data with the aid of town mapping (Wellesley 1973). Starting water-surface elevations were from dam analysis.

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Wading River	County boundary	Headwaters at Lake Mirimichi	Regression-weighted log-Pearson type III flood frequency analysis (Cohn et al. 2012)	HEC-RAS 4.1.0 (Brunner 2010)	7/1/2014	AE w/Floodway	Log-Pearson type III discharges from USGS streamgages 01109000 (Wading River near Norton) and 01108500 (Wading River at West Manfield) were from Zariello et al. (2012). Flows were transferred upstream and downstream using a weighted hybrid method (Guimaraes and Bohman 1992). In a small reach about halfway between the streamgages, flows were calculated using drainage-area ratios to assure a smooth transition. Underwater cross-section data and structure elevations were from field surveys in March and April, 2012. Overbank cross-section data were from lidar topography (FEMA 2011). Starting water-surface elevations were from normal depth, using a slope of 0.0005. The hydraulic model was calibrated to high-water marks and streamgage data from the March and April 2010 flood (Zarriello and Bent 2011).
Walker Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (146.5 feet NAVD88).
Walnut Hill Stream	Confluence with The Gulf	Manmade pond above Beechwood Street	Regression equations (Wandle 1977)	HEC-2 (USACE 1974)	8/1/1983	AE w/Floodway	Structures were obtained from field surveys. Cross sections were obtained from field surveys and from topographic maps (Avis 1978). Hydraulic model was calibrated to historic flood information obtained from local residents and to floodplain maps (RKPC 1976), taking recent modifications into account. Starting water-surface elevations were from normal depth.
Walnut Hill Stream (upper)	Manmade pond above Beechwood Street	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 4.1.0 (Brunner 2010)	5/31/2017	A	See special considerations for Beaver Brook (Bellingham upper).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Weld Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (187.2 feet NAVD88).
Wellesley Water Lands	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (115.7 feet NAVD88).
West Mill Brook	Confluence with Charles River	Medfield Junction	unknown	unknown	1/1/1978	AE	Flooding on West Mill Brook is caused by backwater from Charles River, so no profiles were developed for this reach.
Whiting Pond Bypass	County boundary	Divergence from Ten Mile River	none	HEC-RAS 4.1.0 (Brunner 2010)	7/1/2014	AE w/Floodway	Flows for this diversion of Ten Mile River were calculated using split-flow optimization in HEC-RAS. Underwater cross-section data and structure elevations were from field surveys in March and April, 2012. Overbank cross-section data were from lidar topography (FEMA 2011). Starting water-surface elevations were from Ten Mile River profiles.
Whortleberry Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (92.3 feet NAVD88).

Table 12: Summary of Hydrologic and Hydraulic Analyses

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Woods Pond	Entire shoreline	Entire shoreline	none	none	4/30/2018	A	Analysis of lidar DEM (FEMA 2011; USGS 2011, 2014, 2015), guided by shape of existing waterbody feature (e.g., effective FIRM, National Wetland Inventory, or National Hydrography Dataset), if extant, was used to determine a stillwater elevation corresponding to the expected 1-percent-annual-chance floodplain (193.5 feet NAVD88).
York Brook	Confluence with Upper Pequid Brook	Point of one square mile of drainage area	2017 state regression equations (Zarriello 2017)	HEC-RAS 5.0 (USACE 2016a)	4/30/2018	A	See special considerations for Beaver Brook (Bellingham upper).

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Abbott Run (upper)	*	*
Abbott Run Tributary A	*	*
Arnolds Brook	0.030-0.055	0.050-0.100
Beaver Brook (Avon)	0.030-0.060	0.050-0.100
Beaver Brook (Bellingham) (approximate)	0.057	0.103-0.105
Beaver Brook (Bellingham) (detailed)	0.030-0.055	0.050-0.100
Beaver Brook (Bellingham) Tributary A	0.057	0.106
Beaver Brook (Holbrook)	0.040-0.045	0.030-0.11
Beaver Brook (Sharon)	0.02-0.05	0.04-0.075
Beaver Brook (Sharon) (approximate) (lower)	0.056	0.102-0.103
Beaver Brook (Sharon) (approximate) (upper)	0.057	0.104-0.105
Beaver Brook (Sharon) Zone A tributaries	0.057	0.105-0.106
Beaver Meadow Brook (approximate)	0.056-0.057	0.102-0.104
Beaver Meadow Brook (detailed)	0.015-0.040	0.045-0.080
Beaver Meadow Brook Tributary A	0.057	0.105-0.106
Billings Brook	0.02-0.05	0.04-0.075
Billings Brook Branch	0.02-0.05	0.04-0.075
Blue Hill River (lower)	0.055-0.057	0.100-0.105
Blue Hill River (upper)	0.06	0.15
Blue Hill River Tributary A and Zone A tributaries	0.057	0.105-0.106
Bogastow Brook	0.035-0.043	0.060-0.100
Bogastow Brook Zone A tributaries	0.057	0.103-0.106
Bogle Brook 2	0.055-0.056	0.100-0.101
Boulder Brook	0.057	0.104-0.106
Boulder Brook Tributary A	0.057	0.105-0.106
Bouncing Brook and Zone A tributaries	0.057	0.105-0.106
Bound Brook and Zone A tributaries	0.053-0.057	0.095-0.106
Brook A (Stetson Brook)	0.05	0.060-0.100
Brook B	0.05	0.1
Brook No. 1	0.015-0.045	0.040-0.080
Bubbling Brook	0.013-0.05	0.035-0.110

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Bungay Brook	0.030-0.55	0.050-0.100
Bungay Brook (upper)	*	*
Bungay Brook Tributary A	*	*
Burnt Swamp Brook	0.040-0.050	0.070-0.100
Canoe River (Foxborough)	0.030-0.060	0.050-0.100
Canoe River (Sharon)	0.02-0.05	0.04-0.075
Canton River	0.03-0.055	0.035-0.15
Caroline Brook (approximate)	0.057	0.105-0.106
Caroline Brook (detailed)	*	*
Charles River	0.034-0.065	0.040-0.080
Charles River (Lower Reach)	0.014-0.055	0.020-0.120
Charles River (Upper Reach)	0.014-0.055	0.020-0.120
Charles River Zone A tributaries	0.057	0.104-0.106
Chicken Brook	0.02-0.06	0.05-0.11
Coastal Tributary E	0.057	0.105-0.106
Cobb's Brook	0.035-0.045	0.045-0.090
Cochato River (Braintree)	0.015-0.090	0.016-0.120
Coon Hollow Brook	0.057	0.104-0.105
Cranberry Brook and Zone A tributaries	0.057	0.104-0.106
Cress Brook	0.04	0.08
Crocker Brook	0.04	0.08
Cunningham Brook	0.04	0.06
Diamond Brook (approximate)	0.057	0.104-0.105
Diamond Brook (detailed)	0.040-0.060	0.050-0.080
Dix Brook and Zone A tributaries	0.056-0.057	0.103-0.106
Dorchester Brook	0.013-0.06	0.029-0.08
Farm River	0.015-0.090	0.016-0.120
Fuller Brook (approximate) (lower)	0.055-0.056	0.099-0.102
Fuller Brook (approximate) (upper)	0.056-0.057	0.102-0.104
Fuller Brook (detailed)	*	*
Fuller Brook Zone A tributaries	0.057	0.105
Furnace Brook	0.015-0.060	0.070-0.110

Table 13: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Germany Brook	0.02-0.05	0.04-0.10
Glovers Brook	0.05	0.060-0.100
Harlow Pond Lateral	0.03	0.08
Hawes Brook	0.02-0.05	0.04-0.10
Hawthorne Brook	0.025-0.035	0.045-0.070
Herring Brook (approximate)	0.051-0.055	0.090-0.099
Herring Brook (detailed)	0.030-0.060	0.050-0.100
Herring Brook Tributary A	0.057	0.105-0.106
Hopping Brook (approximate)	0.052-0.057	0.092-0.106
Hopping Brook (detailed)	0.018-0.060	0.020-0.160
Hopping Brook Tributary A	0.056	0.103
James Brook (approximate)	0.057	0.105
James Brook (detailed)	0.015-0.040	0.060-0.120
Lake Archer and outlet	0.057	0.105
Lake Holbrook	0.035-0.040	0.020-0.110
Lake Waban	0.015-0.050	0.040-0.080
Lily Pond Stream	0.013-0.040	0.090-0.100
Lowder Brook and Zone A tributaries	0.056-0.057	0.101-0.106
Mann Pond Lateral	0.010-0.065	0.050-0.100
Martin Brook	0.05	0.08
Mary Lee Brook (approximate)	0.057	0.105-0.106
Mary Lee Brook (detailed)	0.033-0.064	0.064-0.085
Mary Lee Brook Zone A tributaries	0.057	0.105-0.106
Massapoag Brook (Canton)	0.015-0.040	0.045-0.080
Massapoag Brook (Sharon) (approximate)	0.053-0.055	0.094-0.099
Massapoag Brook (Sharon) (detailed)	0.02-0.05	0.04-0.075
Meadow Brook	0.02-0.05	0.04-0.10
Mill Brook	0.013-0.045	0.035-0.110
Mill River (Norfolk) (approximate)	0.053-0.057	0.094-0.104
Mill River (Norfolk) (detailed)	0.025-0.060	0.050-0.100
Mill River (Norfolk) Zone A tributaries	0.057	0.104-0.106
Mill River (Weymouth) (approximate) (lower)	0.054-0.055	0.097-0.098

Table 13: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Mill River (Weymouth) (approximate) (upper)	0.056-0.057	0.101-0.106
Mill River (Weymouth) (detailed)	0.030-0.060	0.050-0.100
Mill River (Weymouth) Zone A tributaries	0.057	0.105-0.106
Mill River Tributary A	0.030-0.060	0.050-0.100
Mill River Tributary B	0.030-0.060	0.050-0.100
Miller Brook (approximate)	0.057	0.104-0.105
Miller Brook (detailed)	0.015-0.070	0.050-0.200
Mine Brook (Franklin)	0.040-0.070	0.060-0.090
Mine Brook (Franklin) Zone A tributaries	0.057	0.103-0.106
Mine Brook (Walpole) (approximate)	0.055-0.057	0.099-0.104
Mine Brook (Walpole) (detailed)	0.030-0.100	0.010-0.110
Mine Brook (Walpole) Zone A tributaries	0.057	0.104-0.106
Miscoe Brook and Zone A tributaries	0.056-0.057	0.103-0.106
Monatiquot River	0.015-0.090	0.016-0.120
Monatiquot River Zone A tributaries	0.057	0.105-0.106
Morses Pond	0.015-0.050	0.040-0.080
Mother Brook	0.025-0.035	0.065-0.09
Muddy River (approximate)	0.057	0.104-0.106
Muddy River (detailed)	*	*
Myrtle Street Lateral	0.025-0.050	0.07
Neponset River (approximate)	0.056-0.057	0.102-0.106
Neponset River (detailed)	0.020-0.065	0.04-0.11
Neponset River Zone A tributaries	0.056-0.057	0.103-0.106
Noanet Brook and Zone A tributaries	0.056-0.057	0.103-0.106
Norroway Brook (approximate) (lower)	0.055-0.056	0.099-0.102
Norroway Brook (approximate) (upper)	0.057	0.104-0.105
Norroway Brook (detailed)	0.05	0.060-0.100
Norroway Brook Zone A tributaries	0.057	0.105-0.106
North Brook and Zone A tributaries	0.055-0.057	0.100-0.106
Old Swamp River (approximate)	0.056-0.057	0.102-0.105
Old Swamp River (detailed)	0.030-0.060	0.050-0.100
Old Swamp River Tributary A	0.057	0.105-0.106

Table 13: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Paintshop Pond	0.015-0.050	0.040-0.080
Pecunit Brook	0.057	0.104-0.106
Pequid Brook (Lower Reach)	0.015-0.040	0.045-0.080
Pequid Brook (Upper Reach) (approximate)	0.055-0.057	0.099-0.104
Pequid Brook (Upper Reach) (detailed)	0.015-0.040	0.045-0.080
Peters River	0.030-0.055	0.050-0.100
Peters River Tributary A	*	*
Peters River Tributary B	*	*
Peters River Tributary B1	*	*
Peters River Tributary C	*	*
Pickerel Brook	0.025-0.070	0.030-0.095
Pine Tree Brook (approximate)	0.055-0.057	0.099-0.104
Pine Tree Brook (detailed)	0.04-0.05	0.08
Plantingfield Brook (approximate)	0.057	0.105
Plantingfield Brook (detailed)	0.02-0.05	0.04-0.10
Plymouth River	0.057	0.104-0.106
Plymouth River Tributary F	0.057	0.105-0.106
Ponkapoag Brook (approximate)	0.056-0.057	0.103-0.106
Ponkapoag Brook (detailed)	0.015-0.040	0.045-0.080
Powisett Brook and Zone A tributaries	0.057	0.104-0.106
Prison Farm Lateral	0.04	0.09
Purgatory Brook (approximate)	0.056	0.101-0.102
Purgatory Brook (detailed)	0.013-0.05	0.035-0.110
Quick Stream (upper)	*	*
Rabbit Hill Brook	0.04	0.08
Rattlesnake Run (approximate)	0.057	0.105-0.106
Rattlesnake Run (detailed)	0.020-0.040	0.080-0.090
Redwing Brook (approximate)	0.057	0.105-0.106
Redwing Brook (detailed)	0.013-0.06	0.016-0.08
Redwing Brook Tributary A	0.057	0.106
Richardsons Brook (approximate)	0.057	0.105-0.106
Richardsons Brook (detailed)	0.020-0.040	0.07

Table 13: Roughness Coefficients

Flooding Source	Channel “n”	Overbank “n”
Robinson Brook	0.030-0.060	0.050-0.100
Rocky Brook	0.03	0.064
Rosemary Brook	0.055-0.057	0.101-0.104
Rumford River	0.030-0.060	0.050-0.100
Sawmill Brook 3 Tributary B1	0.057	0.106
School Meadow Brook (approximate)	0.057	0.104-0.105
School Meadow Brook (detailed)	0.05	0.060-0.090
School Meadow Brook Zone A tributaries	0.057	0.105-0.106
Sevenmile River	0.03-0.04	0.04-0.1
Shepards Brook (approximate)	0.056-0.057	0.102-0.106
Shepards Brook (detailed)	0.050-0.060	0.070-0.080
Shepards Brook Tributary A	0.057	0.104-0.105
Smelt Brook 2 and Zone A tributaries	0.056-0.057	0.102-0.106
South Brook	0.050-0.093	0.050-0.090
Stall Brook (approximate)	0.057	0.103-0.106
Stall Brook (detailed)	*	*
Steep Hill Brook (approximate) (lower)	0.055	0.098-0.099
Steep Hill Brook (approximate) (upper)	0.057	0.105-0.106
Steep Hill Brook (detailed)	0.013-0.06	0.016-0.08
Steep Hill Brook Tributary A and Zone A tributaries	0.057	0.104-0.106
Steep Hill Brook Tributary B	0.055-0.08	0.12
Stony Brook	0.040-0.065	0.090-0.100
Stony Brook 2 Tributary A	0.057	0.105-0.106
Stop River (approximate)	0.057	0.105-0.106
Stop River (detailed)	0.010-0.065	0.040-0.100
Stop River Tributary A	0.057	0.105-0.106
Sucker Brook	0.02-0.05	0.04-0.075
Sylvys Brook	*	*
Sylvys Brook Tributary A	*	*
Ten Mile River	0.025-0.055	0.03-0.085
Town Brook	0.012-0.050	0.015-0.080

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Traphole Brook	0.02-0.080	0.04-0.110
Traphole Brook (approximate) (lower)	0.056	0.101-0.102
Traphole Brook (approximate) (upper)	0.057	0.104-0.105
Traphole Brook Tributary A	0.057	0.106
Tributary C2	*	*
Tributary C2B (approximate)	0.057	0.106
Tributary C2B (detailed)	0.04	0.030-0.090
Tributary C2B Tributary A (approximate)	0.057	0.106
Tributary C2B Tributary A (detailed)	*	*
Tributary R1 (approximate)	0.057	0.105-0.106
Tributary R1 (detailed)	*	*
Tributary R2 (approximate)	0.057	0.105-0.106
Tributary R2 (detailed)	0.04	0.040-0.090
Tributary R3	0.04	0.030-0.110
Tributary R4 (approximate)	0.057	0.106
Tributary R4 (detailed)	0.040-0.005	0.040-0.100
Tributary to Great Black Swamp (approximate)	0.057	0.105-0.106
Tributary to Great Black Swamp (detailed)	0.015-0.055	0.020-0.120
Tributary to Great Black Swamp Tributary A1	0.057	0.105-0.106
Tributary to Steep Hill Brook (approximate)	0.056-0.057	0.103-0.105
Tributary to Steep Hill Brook (detailed)	0.013-0.06	0.016-0.08
Tributary to Steep Hill Brook Tributary A	0.057	0.106
Trout Brook (Avon)	0.030-0.060	0.050-0.100
Trout Brook (Dover) (approximate)	0.057	0.104-0.105
Trout Brook (Dover) (detailed)	0.014-0.040	0.030-0.100
Trout Brook (Dover) Tributary A	0.057	0.105-0.106
Trout Brook (Holbrook)	*	*
Trout Brook (Milton)	0.057	0.104-0.105
Turkey Hill Run (approximate)	0.057	0.105
Turkey Hill Run (detailed)	0.015-0.070	0.090-0.110
Turtle Brook	0.025-0.080	0.035-0.080
Uncas Brook	0.057	0.103-0.106

Table 13: Roughness Coefficients

Flooding Source	Channel "n"	Overbank "n"
Unnamed Tributary to Mary Lee Brook	0.05	0.1
Unquity Brook	0.057	0.104-0.105
Vine Brook (approximate)	0.057	0.105
Vine Brook (detailed)	0.015-0.040	0.040-0.080
Waban Brook	0.015-0.050	0.040-0.080
Wading River	0.02-0.05	0.06-0.12
Walnut Hill Stream (approximate)	0.057	0.105-0.106
Walnut Hill Stream (detailed)	0.015-0.040	0.090-0.120
West Mill Brook	0.015-0.040	0.040-0.080
Weymouth Back River	0.030-0.060	0.050-0.100
Weymouth Fore River (Braintree)	0.015-0.090	0.016-0.120
Weymouth Fore River (Weymouth)	0.030-0.060	0.050-0.100
Whiting Pond Bypass	0.036-0.060	0.09-0.11
York Brook	0.057	0.103-0.106

*Data not available

5.3 Coastal Analyses

For the areas of Norfolk County that are impacted by coastal flooding processes, coastal flood hazard analyses were performed to provide estimates of coastal BFEs. Coastal BFEs reflect the increase in water levels during a flood event due to extreme tides and storm surge as well as overland wave effects.

The following subsections provide summaries of how each coastal process was considered for this FIS Report. Greater detail (including assumptions, analysis, and results) is available in the archived project documentation. Table 14 summarizes the methods and/or models used for the coastal analyses. Refer to Section 2.5.1 for descriptions of the terms used in this section.

Table 14: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Extremal analysis	Peaks Over Threshold (POT)	5/1/2009

Table 14: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Primary frontal dune	Massachusetts Office of Coastal Zone Management (MAOCZM 2002) with field survey	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Stillwater elevation and storm surge	USACE Tidal Flood Profiles (USACE 1988) with extrapolation	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Wave generation	ACES	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Wave height	WHAFIS 3.0 (FEMA 1988)	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Wave runup for sloped structures with slope gentler than 1:8	RUNUP 2.0 (FEMA 2007b)	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Wave runup for sloped structures with slope steeper than 1:8	TAW	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Wave runup for vertical structures	SPM (USACE 1984)	5/1/2009

Table 14: Summary of Coastal Analyses

Flooding Source	Study Limits From	Study Limits To	Hazard Evaluated	Model or Method Used	Date Analysis was Completed
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Wave setup	DIM (FEMA 2007a)	5/1/2009
Massa-chusetts Bay	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Entire coastline in Towns of Braintree, Cohasset, and Weymouth	Extremal analysis	Peaks Over Threshold (POT)	5/1/2009
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Coastal erosion	CHAMP 2.0 (FEMA 2007b)	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Overland wave height	WHAFIS 4.0 (FEMA undated)	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Stillwater elevation and storm surge	Updated tidal flood profiles (STARR 2012)	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Wave height	STWAVE (USACE 2001)	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Wave runup for sloped structures with slope gentler than 1:8	RUNUP 2.0 (FEMA 2007b)	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Wave runup for sloped structures with slope steeper than 1:8	TAW	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Wave runup for vertical structures	SPM (USACE 1984)	8/1/2012
Quincy Bay	Entire coastline in City of Quincy	Entire coastline in City of Quincy	Wave setup	DIM (FEMA 2007a)	8/1/2012

5.3.1 Total Stillwater Elevations

The total stillwater elevations (stillwater including storm surge plus wave setup) for the 1% annual chance flood were determined for areas subject to coastal flooding. The models and methods that were used to determine storm surge and wave setup are listed in Table 14. The stillwater elevation that was used for each transect in coastal analyses is shown in Table 16, "Coastal Transect Parameters."

Figure 8: 1% Annual Chance Total Stillwater Elevations for Coastal Areas

[Not Applicable to this Flood Risk Project]

Astronomical Tide

Astronomical tidal statistics were generated directly from local tidal constituents by sampling the predicted tide at random times throughout the tidal epoch.

Storm Surge Statistics

Storm surge is modeled based on characteristics of actual storms responsible for significant coastal flooding. The characteristics of these storms are typically determined by statistical study of the regional historical record of storms or by statistical study of tidal gages.

When historic records are used to calculate storm surge, characteristics such as the strength, size, track, etc., of storms are identified by site. Storm data was used in conjunction with numerical hydrodynamic models to determine the corresponding storm surge levels. An extreme value analysis was performed on the storm surge modeling results to determine a stillwater elevation for the 1% annual chance event.

Tidal gages can be used instead of historic records of storms when the available tidal gage record for the area represents both the astronomical tide component and the storm surge component. Table 15 provides the gage name, managing agency, gage type, gage identifier, start date, end date, and statistical methodology applied to each gage used to determine the stillwater elevations. For areas between gages, peak stillwater elevations for selected recurrence intervals were estimated by combining interpolation between gages and observed high water marks during major storms. A regionalized statistical approach was applied to the gage data so that stillwater elevations in areas between gages could be identified.

Table 15: Tide Gage Analysis Specifics

Gage Name	Managing Agency of Tide Gage Record	Gage Type	Start Date	End Date	Statistical Methodology
NDBC Station 44013	NOAA	Buoy	1987	2007	POT

Combined Riverine and Tidal Effects

Riverine and surge rates for the lower reaches of the Inundation River were combined by developing curves for rate of occurrence vs. flood level for each flood source.

Wave Setup Analysis

Wave setup was computed during the storm surge modeling through the methods and models listed in Table 14 and included in the frequency analysis for the determination of the total stillwater elevations. The oscillating component of wave setup, *dynamic wave setup*, was calculated for areas subject to wave runup hazards.

5.3.2 Waves

A coastal wave model was used to calculate the nearshore wave fields required for the addition of wave setup effects. Three nested grids were used to obtain sufficient nearshore resolution to represent the radiation stress gradients required as ADCIRC inputs. Radiation stress fields output from the inner grids are used by ADCIRC to estimate the contribution of breaking waves (wave setup effects) to the total stillwater elevation.

5.3.3 Coastal Erosion

A single storm episode can cause extensive erosion in coastal areas. Storm-induced erosion was evaluated to determine the modification to existing topography that is expected to be associated with flooding events. Erosion was evaluated using the methods listed in Table 14. The post-event eroded profile was used for the subsequent transect-based onshore wave hazard analyses.

5.3.4 Wave Hazard Analyses

Overland wave hazards were evaluated to determine the combined effects of ground elevation, vegetation, and physical features on overland wave propagation and wave runup. These analyses were performed at representative transects along all shorelines for which waves were expected to be present during the floods of the selected recurrence intervals. The results of these analyses were used to determine elevations for the 1% annual chance flood.

Transect locations were chosen with consideration given to the physical land characteristics as well as development type and density so that they would closely represent conditions in their locality. Additional consideration was given to changes in the total stillwater elevation. Transects were spaced close together in areas of complex topography and dense development or where total stillwater elevations varied. In areas having more uniform characteristics, transects were spaced at larger intervals. Transects shown in Figure 9, "Transect Location Map," are also depicted on the FIRM. Table 16 provides the location, stillwater elevations, and starting wave conditions for each transect evaluated for overland wave hazards. In this table, "starting" indicates the parameter value at the beginning of the transect.

Wave Height Analysis

Wave height analyses were performed to determine wave heights and corresponding wave crest elevations for the areas inundated by coastal flooding and subject to overland wave propagation hazards. Refer to Figure 6 for a schematic of a coastal transect evaluated for overland wave propagation hazards.

Wave heights and wave crest elevations were modeled using the methods and models listed in Table 14, "Summary of Coastal Analyses".

Wave Runup Analysis

Wave runup analyses were performed to determine the height and extent of runup beyond the limit of stillwater inundation for the 1% annual chance flood. Wave runup elevations were modeled using the methods and models listed in Table 14.