WESTCHESTER COUNTY STREAMS, BYRAM RIVER BASIN FLOOD RISK MANAGEMENT FEASIBILITY STUDY

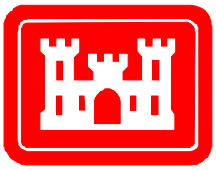
FAIRFIELD COUNTY, CONNECTICUT AND WESTCHESTER COUNTY, NEW YORK

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL IMPACT STATEMENT

June 2018

Westchester County Streams,
Byram River Basin
Flood Risk Management
Fairfield County, Connecticut and
Westchester County, New York

Draft Integrated Feasibility Report &
Environmental Impact Statement



New York District
U.S. Army Corps of Engineers
In Partnership with the
Town of Greenwich, CT

Cover Image: Eastbound Route 1 Bridge over the Byram River with high flow after spring 2007 storms. Photographed by the Town of Greenwich.

PERTINENT DATA

DESCRIPTION

The U.S. Army Corps of Engineers (USACE) Flood Risk Management Tentatively Selected Plan (TSP) for the Westchester County Streams, Byram River Basin feasibility study is presented in this report. The TSP is removing the two Route 1 bridges that straddle the Byram River in Port Chester, NY and replacing them at a higher elevation to allow more water to pass underneath. These historic bridges restrict the flow of the Byram River and induce flooding upstream. Removing the bridges will allow the Byram River to flow freely without backing up into the residential neighborhood upstream. The bridges to be removed carry the local traffic of Route 1 as well as Interstate 95 traffic during emergencies, so they must be replaced after demolition. The new bridges will be built within the same footprint at a higher elevation and without any piers that enter the floodway in order to reduce restrictions to river flow. More details of the project will be determined as part of the optimization process to follow the release of this Draft Integrated Feasibility Report and Environmental Impact Statement.

LOCATION

The Town of Greenwich is located in Fairfield County, CT, and the Village of Port Chester is located in Westchester County, NY, along the Byram River.

FEATURES

This project is the removal of the two Route 1 bridges and the construction of two new bridges. The new bridges will not have a central supporting pier and will have a roadway elevation three feet higher than the current Route 1 bridges. The Byram River will be able to flow unobstructed beneath the new bridges constructed by this project.

REAL ESTATE REQUIREMENTS

The project will require temporary and permanent easements, as well as fee simple purchase for environmental mitigation. The estimated cost for real estate is approximately $1,433,000 (Table ES 1).

Table ES 1: Real Estate Costs for Byram River Project.

	NEW YORK	CONNECTICUT	TOTAL
Permanent Easements (Acres)	±1.8967	±0.0127	±1.9094
Temporary Easements (Acres)	±0.8713	±0.3932	±1.2645
Total Acres	***±2.7680***	***±0.4059***	***±3.1739***

ECONOMICS (FY18 price levels)

The project first cost is $24,302,000 with average annual net benefits of $122,000 and a benefit cost ratio of 1.13 (Table ES 2). The construction of the new bridges is considered a relocation and a non-Federal sponsor responsibility.

Table ES 2: Costs of the Byram River Project

CATEGORY	COSTS
Project First Costs	$24,302,000
Total Investment Costs	$24,945,000
Annualized Investment Costs	$924,000
Annual Operations and Maintenance Costs	$25,000
Total Average Annual Costs	$949,000
Expected Average Annual Without-Project Damages	$2,143,000
Annualized Benefits[1]	$1,071,000
Total Average Annual Net Benefits	$122,000
Benefit Cost Ratio	1.1

[1] The term 'annualized benefits' refers to the sum of the discounted benefits divided over the 50-year period of analysis.

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE), New York District (District) has partnered with the Town of Greenwich, Connecticut to undertake the Westchester County Streams, Byram River Basin, Connecticut and New York (Byram River Basin) flood risk management feasibility study (Figure ES 1). This Draft Integrated Feasibility Report and Environmental Impact Statement (FR/EIS) presents the results of the study team's evaluation of various alternatives to manage the risk of damages caused by frequent fluvial flooding. Benefits, cost, and impacts caused by implementation of the Tentatively Selected Plan (TSP) are described in this draft report. This report fulfills the requirements of the National Environmental Policy Act of 1969 (NEPA) and was written in accordance with the President's Council on Environmental Quality Rules and Regulations for Implementing NEPA (40 CFR §§ 1500-1508), USACE's Procedures for Implementing NEPA (Engineer Regulation 200-2-2), and other applicable Federal and state environmental laws.

There are two bridges the carry Route 1 over the Byram River (the Route 1 bridges) that constrict water flow and induce flooding upstream. Storm events deposit large amounts of precipitation in the Byram River Basin, all of which must pass beneath the Route 1 bridges. These bridges were built in the 19th and early 20th centuries and are currently owned and operated by the New York State Department of Transportation. The Route 1 bridges have a low profile and a central pier that constrict water flow beneath them. The bridges serve as a bottleneck in the river, causing the water surface elevation to increase upstream of the bridges and flood the Pemberwick neighborhood of Greenwich, CT. This neighborhood has been subjected to repeated, severe flooding from high precipitation events, with the largest events being the storms of October 1955, June 1972, September 1975, and April 2007. A large number of structures are affected by flooding; there are approximately 500 structures in the 0.2-percent floodplain of the Byram River. The majority of the damages occur to residential structures. Residents will continue to experience significant damages to their homes from fluvial flooding of the Byram River if no project is undertaken.

The project's purpose is to manage the risk of flooding from the Byram River. USACE considered a range of nonstructural and structural measures that have potential to manage flood damages in Greenwich, CT, the basin's most frequently flooded and densely populated locality. Through an iterative planning process, five main flood risk management alternative plans were identified, evaluated, and compared. These plans were made up of measures that include levees, floodwalls, bridge removals and replacements, wet and dry floodproofing, structure elevations, buyouts of properties, and localized ringwalls.

The TSP for flood risk management at the Byram River includes removing the Route 1 bridges and replacing them with new bridges. The new bridges would not have a central pier and would have a roadway profile with a higher elevation to allow more water to pass underneath them. The plan would provide $1,071,000 in annualized benefits (FY18 Public Law). The estimated benefit cost ratio of the plan is 1.1. The details of the bridge removals and replacements may be adjusted as part of the optimization process to follow the public and agency reviews of this draft report.

The TSP would not have significant adverse cumulative impacts to the natural environment. The Route 1 bridges are historic structures built in the 19th and early 20th centuries and are excellent examples of design of double-arched stone bridges; the plan is to demolish these bridges, which

constitutes an adverse impact to historic properties. This adverse effect will be mitigated by extensively documenting the architecture of the old bridges via architecture survey and photographs, reusing stone in the construction of the new bridges, and other activities based upon coordination and consultation with the New York and Connecticut State Historic Preservation Offices and other consulting parties.

There will be temporary adverse effects to the flow of commuter traffic during the construction phase of the project. To keep traffic flowing, only one bridge will be shut down at a time, reducing the two lane traffic each way to only one lane going each direction. The construction plan is for one bridge to be removed and replaced in each of two successive summertime construction seasons. There will be no adverse cumulative impacts to traffic flow once the construction is completed.

The non-Federal project partners for the implementation of this flood risk management project will need to be determined; while the Town of Greenwich, CT is the non-Federal sponsor for the study, the Route 1 bridges are located in Port Chester, NY. The estimated project first cost is $24,302,000. In accordance with the cost share provisions of Section 103 of the Water Resourced Development Act of 1986, as amended (33 U.S.C. § 2213), the demolition of the Route 1 bridges is considered a project feature and is cost shared 65% Federal and 35% non-Federal interest. The replacement of the bridges is considered a relocation and a Real Estate requirement, which is 100% the responsibility of the non-Federal sponsor. The study's non-Federal sponsor, Town of Greenwich, has indicated its support for the TSP.

The details of the plan will undergo refinement during plan optimization, following the receipt of agency and public feedback on this draft report. The plan will be optimized by reasonably maximizing net national economic development benefits. The study team assumes that basic design of the new Route 1 bridges will not change during feasibility-level design. Potential changes to the TSP based on optimization will be detailed in the Final Integrated Feasibility Report and Environmental Impact Statement. The ultimate design of the project will be determined during Preconstruction, Engineering, and Design based on state-specific information.

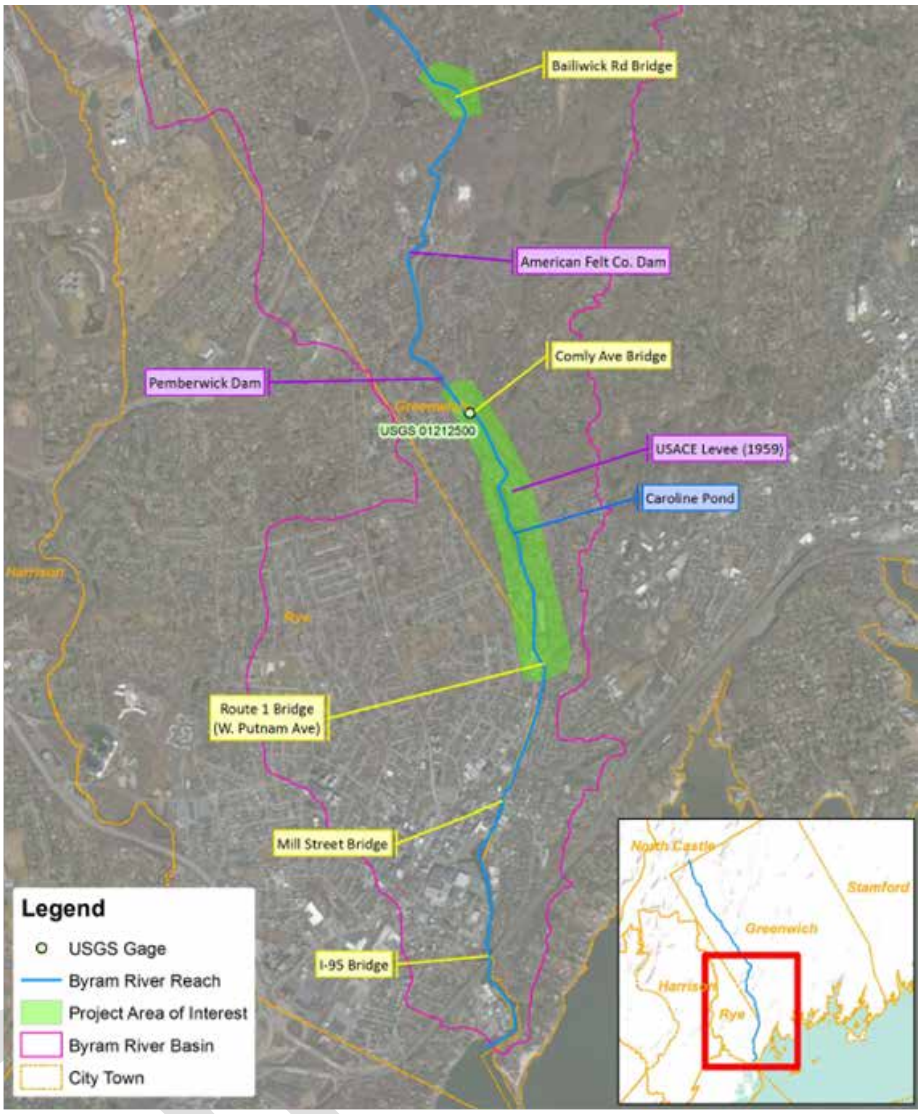


Figure ES 1: Study Area and Focus/Interest Areas

Byram River Basin Flood Risk Management Study
Connecticut and New York

**Sections of text marked with an asterisk are applicable to the satisfaction of National Environmental Policy Act (NEPA) requirements.*

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GLOSSARY OF TERMS, ACRONYMS, AND ABBREVIATIONS

ACE	Annual Chance Exceedance
APE	Area of Potential Effect
CERCLIS	Comprehensive Environmental Response, Compensation, Liability Information System
CEQ	Council On Environmental Quality
CFR	Code Of Federal Regulations
CT DEEP	Connecticut Department of Energy and Environmental Protection
CTSHPO	Connecticut State Historic Preservation Office
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
District	U.S. Army Corps of Engineers, New York District
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FCSA	Feasibility Cost Sharing Agreement
FEMA	Federal Emergency Management Agency
FHA	Federal Highways Administration
FR/EIS	Feasibility Report and Environmental Impact Statement (integrated)
FWCA	Fish and Wildlife Coordination Act
GIS	Geographic Information System
HEC-FDA	Hydrologic Engineering Center – Flood Damage Analysis
HEC-HMS	Hydrologic Engineering Center – Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center – River Analysis System
SHPO	State Historic Preservation Office
HTRW	Hazardous, Toxic, And Radioactive Wastes
LWRP	Local Waterfront Revitalization Plan
MSFCMA	Magnuson-Stevenson Fisheries Conservation and Management Act
NAAQS	National Ambient Air Quality Standards
NAVD88	North American Vertical Datum of 1988
NED	National Economic Development
NEPA	National Environmental Policy Act
NHP	Natural Heritage Program
NLCD	National Land Cover Dataset
NOAA - NMFS	National Ocean and Atmospheric Administration - National Marine Fishery Service
NYSDEC	New York State Department of Environmental Conservation
NYSHPO	New York State Historic Preservation Office
PED	Preconstruction Engineering And Design
RCRIS	Resource Conservation and Recovery Information System
PPA	Project Partnership Agreement
S&A	Supervision And Administration
SLR	Sea Level Rise
TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish And Wildlife Service

WCCoG	Western Connecticut Council of Governments
WRDA	Water Resources Development Act

1. Introduction

1.1 Study Purpose and Scope

The U.S. Army Corps of Engineers (USACE), New York District (District) prepared this Draft Integrated Feasibility Report and Environmental Impact Statement (FR/EIS) for the Westchester County Streams, Byram River Basin, Connecticut and New York, Flood Risk Management Study (Byram River study). It takes into account input from the non-Federal study partner, local governments, natural resource agencies, and the public. This report presents a proposed plan to manage flood risk in the Byram River Basin (Figure 1), and focuses on the Town of Greenwich, Connecticut and the Village of Port Chester, New York. Sections of the report that are required to fulfill the requirements of National Environmental Policy Act (NEPA) of 1970 are marked with an asterisk (*) in the headings.

The Federal objective of water and related land resources project planning is to contribute to national economic development (NED) consistent with managing and reducing risk to the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements (Principles and Guidelines, 1983). Water and related land resources projects are formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. The purpose of this study is to determine if there is a technically feasible, economically justified, and environmentally acceptable recommendation for Federal participation in flood risk management for the Byram River Basin.

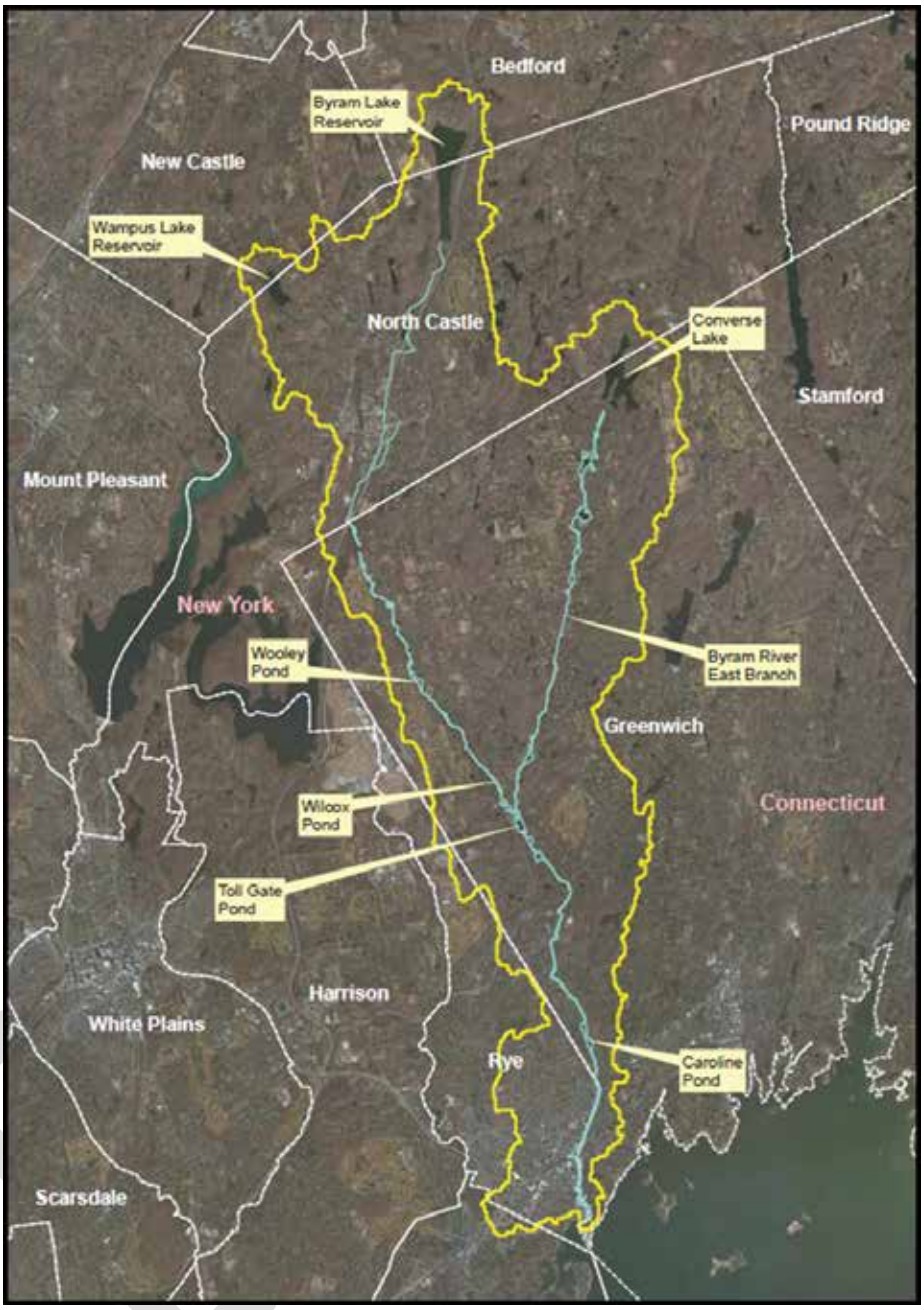

Figure 1: Byram River Flood Risk Management Study Area, the Byram River Basin

1.2 Need for Action*

The Town of Greenwich and the Village of Port Chester have been subjected to repeated, severe flooding caused by overflow of the Byram River due to precipitation of high intensity, large amounts, or prolonged duration. Due to flooding in the area, USACE has been involved in studying the area since the 1940s. USACE constructed levees under the Continuing Authorities Program in the Pemberwick area of the river and recommended additional flood risk management plans in other areas. More information on USACE's involvement in the study area

is detailed in Section 1.6. The Draft Integrated FR/EIS is intended to constitute a final response to the study authority.

1.3 Study Authorization

The Byram River Basin study was authorized by a resolution of the House Committee on Transportation and Infrastructure, Docket 2779, dated May 2nd, 2007 which reads as follows:

> *Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, That the Secretary of the Army review the report of the Chief of Engineers on the Streams in Westchester County, New York, and the Mamaroneck and Sheldrake Rivers Basin and Byram River Basin, New York and Connecticut published as House Document 98-112, and other pertinent reports on the Hutchinson, Mamaroneck and Sheldrake Rivers to determine whether modifications to the recommendations contained therein are advisable at the present time in the interest of water resources development, including flood damage reduction, storm damage reduction, environmental restoration, navigation, watershed management, water supply, and other allied purposes*

The referenced resolution covers the Westchester County Streams study area, which includes the basins of the Byram River, Mamaroneck and Sheldrake Rivers, Hutchinson River, Blind Brook, Bronx River, and the Saw Mill River. The Westchester County Streams Section 905(b) Reconnaissance Report, which recommended feasibility studies for all six river basins and for coastal flooding from Long Island Sound, was approved in 2009. A Feasibility Cost Sharing Agreement (FCSA) for the Byram River Basin, NY & CT, was signed with the Town of Greenwich in 2012 for just under $3 million to conduct a flood risk management study.

1.4 The Planning Process

In compliance with the USACE planning process, this draft integrated report is being released for concurrent public and agency technical review of the Tentatively Selected Plan (TSP). For the TSP, the study team has evaluated an array of alternatives to arrive at a general description of the TSP (removal and replacement of the Route 1 bridges), with more details to be determined in a process called optimization. Optimization of the TSP occurs after comments from the public and agency reviews are received and the draft report package is appropriately modified. Through optimization, the TSP becomes the Recommended Plan. Following final rounds of agency reviews, the study team will prepare and release a Final Integrated FR/EIS to present the Recommended Plan.

1.5 National Environmental Policy Act Requirements

This Draft Integrated FR/EIS was prepared pursuant to the NEPA, the Council on Environmental Quality's (CEQ) Guidance Regarding NEPA Regulations, and the USACE's Procedures for Implementing NEPA (Engineering Regulation [ER]-200-2-2).

NEPA requires the USACE to integrate environmental values into their decision making processes by considering the environmental impacts of their proposed actions and reasonable alternatives to those actions. Federal regulations to implement NEPA are found in Title 40 Code of Federal Regulations (CFR) Parts 1500-1508. The intent of NEPA is to ensure that

information is made available to public officials and citizens about major actions taken by Federal agencies, and to identify and consider public concerns and issues. "Any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork" (40 CFR §1506.4). This report integrates discussions that normally would appear in a Final Environmental Impact Statement into the feasibility report. The purpose of an EIS is to aid a Federal agency's compliance with NEPA.

The EIS must discuss:

- the purpose and need for the proposed action;
- the proposed action and alternatives;
- the probable environmental impacts of the proposed action and alternatives; and
- the agencies and persons consulted during preparation of the EIS.

This integrated report is consistent with NEPA regulatory requirements. The report reflects an integrated planning process which avoids, minimizes, and mitigates adverse project effects associated with coastal storm risk management actions.

1.6 Prior Studies, Reports and Existing Water Projects

The majority of flood damages within the Byram River Basin are within Greenwich, CT. Greenwich is within the jurisdiction of the USACE-New England District for regulatory purposes, but New York District has jurisdiction over flood risk management for Byram River Basin, because district civil works boundaries are defined on a watershed basis and the Byram River Basin is within the civil works jurisdiction of the New York District. Prior to the current study, the USACE has studied the Byram River Basin multiple times throughout the twentieth century, reflecting a pattern of recurring flood damages. Prior USACE reports are described below, along with major storm events to provide situational context:

- 1938: Storm of 21-24 July, 19-22 September
- *Preliminary Examination Report for Flood Control, Byram River and Tributaries, Connecticut* (1942). The report considered channel improvement and rectification of Byram River above U.S. Route 1 to address flood damages in the Pemberwick area and a small portion of Port Chester, NY (approximately 6,000 ft of channel improvements). The alternatives were determined not economically justified.
- 1955: Extra-Tropical Storm of 14-18 October
- *Reconnaissance Report: Byram River, Connecticut,* 1957. This report made a favorable recommendation for a Section 205 – Continuing Authorities Project within the most distressed portion of the Byram River Study area, solely within the Pemberwick neighborhood.
- *Byram River and Tributaries, Design Memorandum,* 1958. A Design Memorandum was developed for the Section 205 project within Pemberwick, which included channel work, levees, and rip-rap along 2,400 ft of the river. The project was constructed in 1959.
- *Survey of Streams in Westchester County, NY, and Fairfield County, CT,* 1968. This survey considered flood damages and potential solutions within all six river basins of the

Westchester County Streams area. It did not find justification for a new project along the Byram River.

- 1971: Tropical Storm Doria, 26-29 August
- 1972: Tropical Storm Agnes, 16-22 June
- *Reconnaissance Report for Byram River, Port Chester, NY & Greenwich, CT,* 1973 The Reconnaissance Report recommended a new Section 205 study along the Byram River, downstream of the constructed project.
- 1975: Hurricane Eloise, 19-27 September
- *Detailed Project Report for Byram River, Port Chester, NY & Greenwich, CT,* 1976. The report found that a project would be economically justified, but the Federal cost was in excess of $1 million, the then-upper limit for Section 205 projects. A recommendation was made to study the Byram River under the General Investigations program.
- *Streams in Westchester County, NY and Fairfield County, CT: Feasibility Report for Flood Control, Mamaroneck and Sheldrake Rivers Basin (Village and Town of Mamaroneck, NY) and Byram River Basin (Greenwich, CT and Port Chester, NY),* 1977. This Feasibility Report identified an economically justified project along 3,000 ft of the Byram River consisting of channel work, levees, and floodwalls, adjacent to and downstream of the existing project at Pemberwick. The project was not authorized due to lack of non-Federal support.
- 2007: 30 March Storm
- 2007: 15-16 April Storm
- *Section 905(B) Reconnaissance Study for Westchester County Streams, Westchester County, NY and Fairfield County, CT,* 2009. In response to extensive flood damages from the 15-16 April 2007 storms, a new Reconnaissance Study was conducted for the Westchester County Streams area. Byram River Basin was recommended for further feasibility level study. The FCSA for the Byram River Basin study was signed with the Town of Greenwich 29 August 2012. Most of the flood damages, and potential solutions, are within Greenwich. The New York State Department of Environmental Conservation (NYSDEC) is a key member of the Project Delivery Team.
- 2010: March Storm
- 2011: Hurricane Irene, 27-29 August
- 2012: Hurricane Sandy, 28-30 October
- Although damages from Hurricane Sandy were noted in the Port Chester section of the Byram River study area, the current feasibility study is scoped to address impacts from fluvial flooding only. A separate feasibility study would be needed to address coastal mechanisms for flooding.

In addition to the existing flood risk management project constructed at Pemberwick in 1959, there is also an existing navigation project (Port Chester Harbor, NY) that was adopted in 1910 and modified in 1930 in the tidal portion of Byram River, in Port Chester, NY. It extends 1.7

miles from the Long Island Sound to the Mill Street Bridge in Port Chester, and the depth ranges from three to 12 feet deep, mean lower low water. The channel was last dredged in 1990 and no work is currently scheduled (USACE 2018). A flood risk management project in our project area would not interfere with the operations of the navigation channel in Port Chester, as there is approximately half a mile between the southern limit of the flood damages area and the northern end of the navigation channel.

1.7 Study Area

The study area is the Byram River Basin. The headwaters of the Byram River are in North Castle, NY and the river flows southward into the Town of Greenwich in Fairfield County, CT, over a length of 13.5 miles, and empties into Long Island Sound. The lower portion of the river is tidal for a length of 1.3 miles. The last 1.6 miles of the Byram River acts as the state boundary between Connecticut and New York. The drainage area at the river mouth is 30 square miles. The riparian zone of the lower three miles of the Byram River is populated with suburban housing and commercial buildings. In the upper reach, generally upstream of the bridge at Bailiwick Road the area is less densely developed. The Byram River study area for this study includes areas west and east of the river, extending between just north of Bailiwick Road to South of West Putnam Avenue. The town of Greenwich, Connecticut (including the neighborhoods of Pemberwick, Glenville, and Round Hill) and the communities of Armonk and Port Chester in New York are either wholly or partly in the basin. The study area lies within the following Congressional Districts: Connecticut – District 4 (Rep. Jim Himes) and New York – District 17 (Rep. Nita Lowey).

The project area is the area that may be directly and indirectly impacted by construction or operations of a proposed project. The Byram River study's project area is the area alongside the fluvial portion of the river; the Byram River is not tidally influenced within the project area. The study team focused its plan formulation and technical analysis within the project area, with two areas of particular interest (Figure 2):

1. The neighborhood near the Bailiwick Bridge in the Town of Greenwich, CT. Small bridges on the Byram River narrow the channel and trap debris, which cause flood damages to residential structures and render Riversville Road, a major thoroughfare, impassable to vehicular traffic, including emergency services.
2. The southern section of the Pemberwick neighborhood in the Town of Greenwich, downstream of the existing Federal levee in the northern section of the neighborhood. Flood damages extend along the floodplain from the southern end of the existing project down to the Route 1 bridges, a distance of approximately 3,000 feet. The majority of the flood damages are in this portion. Additionally, there are approximately 30 structures within Port Chester, NY, that are within the hydraulic reach of the Pemberwick neighborhood.

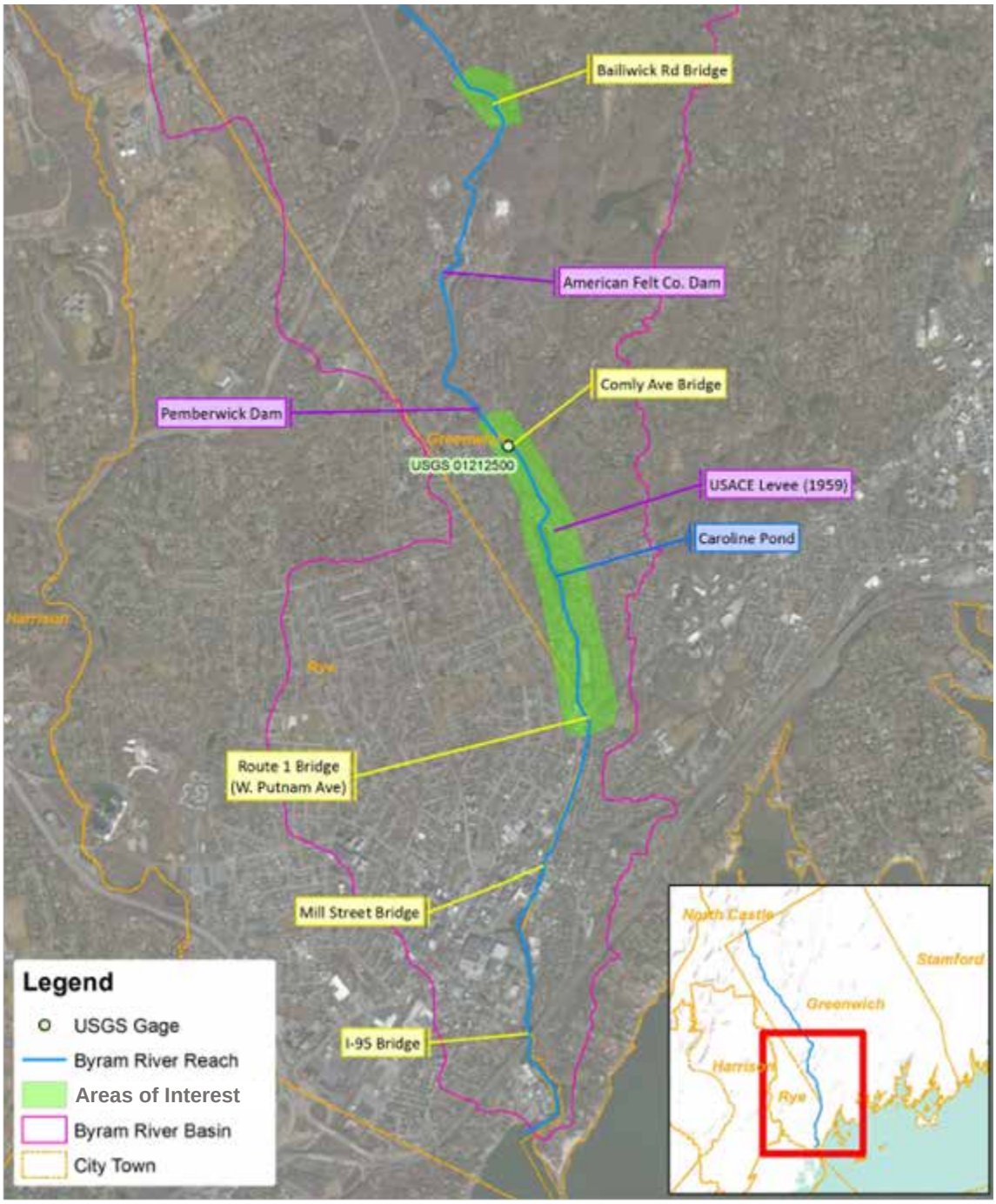

Figure 2: Byram River Focused Damage Areas Under Study

The critical infrastructure within the Byram River project area includes five bridges, two dams, one levee, one school, two fiberoptic cables, and one oil/gas pipeline (Figure 3).

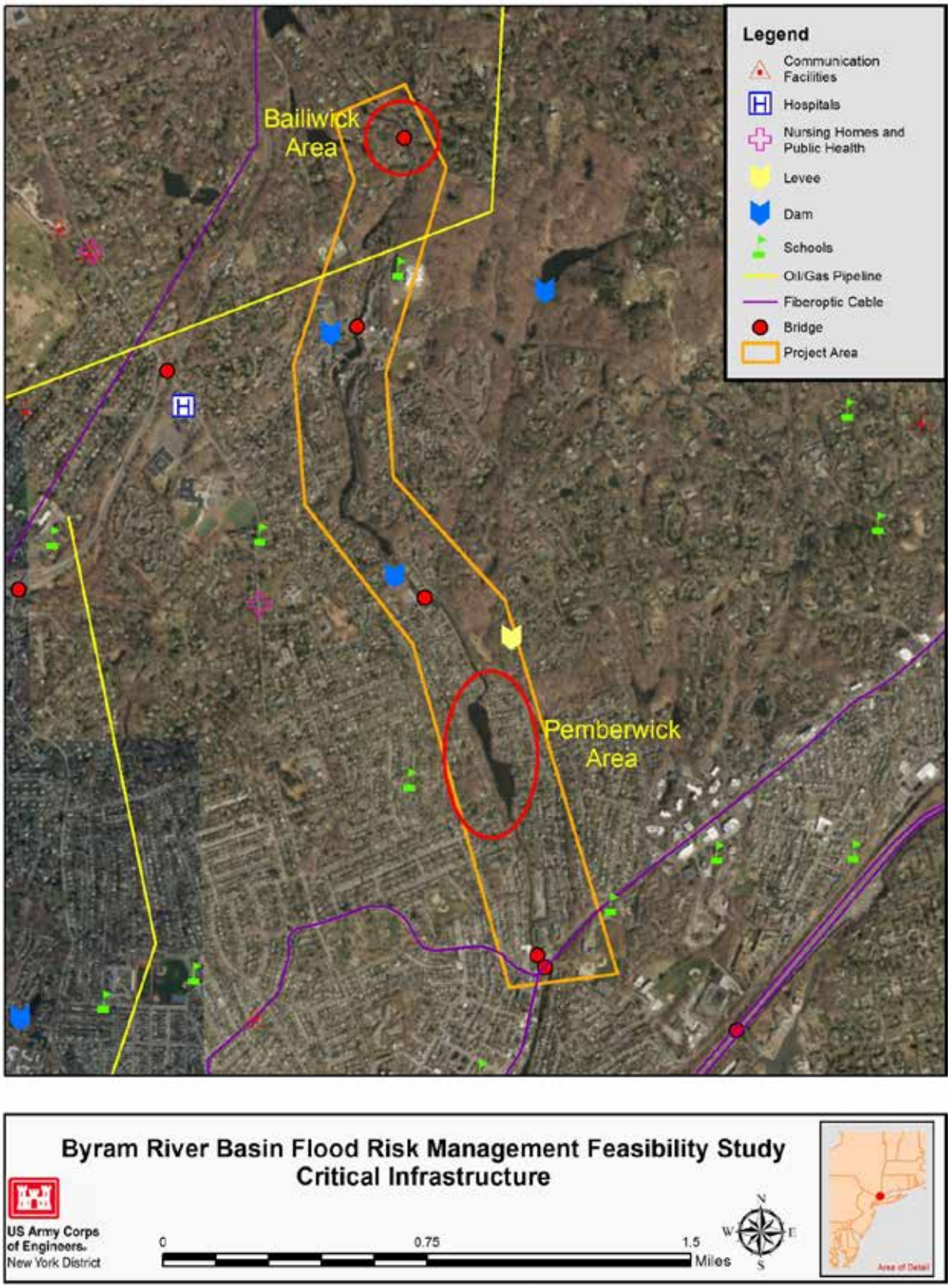

Figure 3: Critical Infrastructure within the Project Area

The project footprint, or project alignment, is the area in which measures will likely be built and consists of the alignment of the structural features associated with the proposed plan as well as any temporary construction easements or working areas.

1.8 Non-Federal Partner

The non-Federal cost sharing partner for the Byram River Feasibility Study is the Town of Greenwich, CT. In 2012, the USACE and the Town of Greenwich executed a FCSA for the current study. Although the study area spans Connecticut and New York, most of the fluvial damages are within the Town of Greenwich. New York State (through the New York State Department of Environmental Conservation) participates as an active study team member to facilitate coordination for interstate activities.

1.9 Areas of Controversy

Members of the public have had opportunities to comment to the development of study alternates via public information meetings and a formal NEPA scoping period. In addition, the District has coordinated with the Town of Greenwich, as the potential non-Federal sponsor for implementation, as well as the Village of Port Chester, the New York Department of Transportation, and the New York Department of Environmental Conservation as study stakeholders.

Based on public and agency coordination conducted to date, no specific areas of controversy related to the study have been identified. This section may be updated pending comments received during the 45 day public and agency review period of the Draft Integrated FR/EIS.

2. Existing Conditions/Affected Environment*

The following description of the environment to be affected within existing conditions is in accordance with the requirements of National Environmental Policy Act (NEPA) and serves as the baseline for Section 5: Environmental Impacts and Section 6: Cumulative Impacts of this draft integrated report. This section briefly describes the environmental setting.

An Environmental Resource Inventory report was prepared for this study and is excerpted within this report and in Appendix A1. The full Environmental Resource Inventory report can be provided upon request. For the purposes of consistent orientation during discussions related to riverbanks, the banks will be referred to as left or right based on a downstream viewpoint.

2.1 Topography, Geology and Soils

2.1.1 Geology and Topography

The topography of the project area has a general slope downward from north to south. In the northernmost section of the project area, the elevation changes gradually from +130 North American Vertical Datum 1988 (NAVD88) just north of Bailiwick Road, southward to an elevation of +80 feet NAVD88 at the top of the Pemberwick Dam. The elevation drops to +40 feet NAVD88 at the base of the dam. From here, the elevation change from the dam base to the head of Caroline Pond is approximately 25 feet, while the last 2.5 miles has an elevation change of approximately five feet, a very shallow grade line. The banks of the Byram River vary throughout the project corridor from vertical walls to soil/sloped as gentle as 3:1, horizontal to vertical.

According to the Connecticut Department of Energy and Environmental Protection (CT DEEP) Bedrock Geology Geographic Information System (GIS) layer, and the NY State Museum Bedrock Geology GIS layer, the geology of the project area is generally consistent, with only three different types of bedrock consisting of Harrison gneiss, schist and granulite member, and Hartland Formation (CDM Smith, 2018).

2.1.2 Soils

Soils found within the project area are described in Table 1.

Hydric Soils

Hydric Soils are those that are saturated through natural or artificial means sufficiently enough to support the growth and regeneration of hydrophytic vegetation (NRCS 2007). The Agawam, Canton and Charlton, Charlton-Chatfield, Hollis-Chatfield, Ninigret, Paxton, Pootattuck, Tisbury, Udorthents and Woodbridge soils are included on the list of hydric soils developed by the Natural Resources Conservation Service (NRCS)(NRCS, 2018a). The Pootatuck soils are listed as a soil that meets Connecticut inland wetland soil criteria (NRCS, 2018b).

Prime Farmland Soils

Prime Farmland Soils is defined by the US Department of Agriculture (USDA) as land that has the best combination of characteristics for producing food. It can have any land use including cultivated land, pastureland, or forest, among others. However Prime Farmland Soils usually do not occur in urban or water areas. The USDA states that, “The soil qualities, growing season, and

moisture supply are those needed for the soil to economically produce sustained high yields of crops when proper management, including water management and acceptable farming methods are applied"(NRCS, 2018c).

Four soil series within the project area are defined as Prime Farmland soil. These include the Agawam Fine Sandy Loam, Canton and Charlton soils, the Pootatuck Fine Sandy Loam and the Ninigret and Tisbury series.

Table 1: Soils Found within Project Area

SOIL NAME	SLOPE	DESCRIPTION	PRIME FARMLAND SOIL	HYDRIC SOIL (NRCS-DESIGNATED)
Agawam Fine Sandy Loam	0-3%	Very deep, well drained; granite and/or schist and/or gneiss parent material.	Yes	Yes
Agawan-Urban land complex	0-8%	Very deep, well drained; granite and/or schist and/or gneiss parent material.	No	No
Canton and Charlton soils	3-25%	Very deep, well drained; granite and/or schist and/or gneiss parent material.	Yes	Yes
Charlton-Chatfield	3-45%	Very deep, well drained; granite and/or schist and/or gneiss parent material.	No	Yes
Charlton-Urban Complex	3-8%	Very deep, well drained; granite and/or schist and/or gneiss parent material.	No	No
Hollis-Chatfield	15-45%	Well drained to somewhat excessively well drained; granite, gneiss and schist parent material.	No	Yes
Ninigret and Tisbury	0-5%	Very deep, moderately well drained; granite and/or schist and/or gneiss parent material.	Yes	Yes
Paxton	3-8%	Very deep, well drained; granite and/or schist and/or gneiss parent material.	No	Yes
Pootatuck fine sandy loam	Nearly level	Very deep, moderately well drained; coarse-loamy alluvium parent material.	Yes	Yes
Rock outcrop-Hollis complex	3-45%	Shallow to moderately deep, somewhat excessively drained; granite and/or schist and/or gneiss parent material.	No	No
Udorthents	Nearly level	Very deep, well-drained soil. Drift as parent material.	No	Yes
Urban land-Charlton-Chatfield Complex	3%-45%	Very deep, well-drained; granite and/or schist and/or gneiss parent material.	No	No
Woodbridge	8-15%	Very deep, moderately well drained; granite and/or schist and/or gneiss parent material.	No	Yes

2.2 Water Resources

2.2.1 Surface Water

The Byram River originates in Connecticut near the northern boundary with New York and flows for approximately 13.5 miles before discharging into the Long Island Sound. The last approximately 1.6 miles of the river serves as the boundary between New York and Connecticut. The total watershed area is 30 square miles.

Within the project area, the Byram River has experienced modifications in the form of dams for historical milling operations and recreation, channel alteration for flood risk management purposes, and replacement of natural riverbanks with stone and concrete retaining walls.

Throughout the project area, the river width varies greatly, ranging from 35 feet to 80 feet and changes from natural river bank to retaining walls in several sections. A one-half mile segment of the Byram River immediately downstream of the Pemberwick Dam was modified into a trapezoidal channel stabilized with riprap along the banks and channel bottom by the USACE in 1956 for flood risk management. The substrate of the river is predominantly comprised of mud and muck, although large gravel bars have formed around the Route 1 bridges. The average depth of the river within the project area is 1.5 feet. The average width of the riparian zone along the river within the project area is 10 feet.

2.2.2 Water Quality and Habitat

From its headwaters until around the Route 1 bridges, the Byram River is freshwater. The water quality classification by the CT DEEP in this segment is Class B. This classification means its designated uses are: habitat for fish and other aquatic life and wildlife, recreation, and industrial and agricultural water supply. The impaired segment precludes swimming and other water contact related activities (C.G.S. 22a-426-4, 2018)(see Appendix A1).

From the Route 1 bridges to its confluence with the Long Island Sound, the Byram River is designated as Class SB. The designated uses for Class SB waters are habitat for marine fish and aquatic and wildlife, commercial shellfish harvesting, recreation, industrial water supply and navigation.

New York State DEC classifies the Byram River as Class C and SC. The best usage of Class C waters is fishing. Waters with this classification are suitable for fish, shellfish and wildlife propagation and survival. The water quality is suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes. The best usage of Class SC waters is fishing. Such waters are suitable for fish, shellfish and wildlife propagation and survival. The water quality is suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes (NYSDEC, 2018))(see Appendix A1).

According to the 2016 State of Connecticut Integrated Water Quality Report, the Byram River watershed has one segment with a Total Maximum Daily Load (TMDL) on the impaired water list due to elevated levels of bacteria (fecal coliform). The segment is located between Pemberwick Dam and Caroline Pond. This impaired segment precludes swimming and other water contact related activities (CDM Smith, 2018).

2.2.3 Wetlands

The Federal definition of wetlands (33 C.F.R. §328.3(b); EO 11990) identifies wetlands as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." As defined above, wetlands generally include swamps, marshes, bogs, and similar areas. Federal wetland delineation methods require the identification of three parameters to confirm the presence of wetlands; hydric soils, hydrophytic vegetation, and wetland hydrology. All three parameters must be present for an area to qualify as a wetland under this method.

Based on a review the U.S. Fish and Wildlife National Wetland Inventory mapping system, there is a small freshwater forested/scrub shrub wetland approximately three acres in size within the project area just downstream of Caroline Pond (see Appendix A1).

Connecticut Regulated Wetlands

The State of Connecticut criteria for identifying freshwater wetlands is primarily based on soil type with wetlands being defined as "land, including submerged land which consists of any of the soil types designated as poorly drained, very poorly drained, alluvial, and floodplain by the National Cooperative Soils Survey, as amended from time to time, of the NRCS of USDA." (CT DEEP, 2018a) The state of Connecticut has delegated permitting authority of inland wetlands to municipalities, which are also responsible for preparing "Inland Wetlands and Watercourse" maps that identify and indicate the general location and boundaries of inland wetlands and the general location of watercourses.

A review of the "Inland Wetland and Watercourse Map, Greenwich, Connecticut" (Wetland and Watercourses Map), indicated sixteen wetlands within the project area. Field investigations conducted in 2014 confirmed the presence of two of the sixteen wetlands and identified two additional wetland resource areas that were not identified on the Wetland and Watercourses Map. The wetlands were primarily located within the central portion of the project area and were all under 0.10 acres in size. A full description of these wetlands and their locations within the project area are included in Appendix A1.

Tidal wetlands are regulated by the CT DEEP and are defined as "those areas which border or lie beneath tidal waters" which can include banks and lands subject to tidal action and support specific plant species listed in the implementing law, the Tidal Wetlands Act (CT DEEP, 2018b). Based on environmental mapping databases, there are no tidal wetlands within or near the project area.

New York Regulated Wetlands

The New York state criteria for identifying freshwater wetlands is predominantly based on vegetation. The State regulates wetlands that are 12.5 acres or greater in size. Smaller wetlands may be eligible for protection if they are considered of unusual local importance. The law also requires a 100 ft buffer around any regulated wetlands. Based on a review of New York's environmental mapping system, there are no New York State regulated wetlands or buffer areas within or near the project area (NYSDEC, 2018b).

Generally, New York defines tidal wetlands as those areas which border on or lie beneath tidal waters and all banks subject to tides. Based on a review of New York's environmental mapping

database, there are no regulated tidal wetlands within or near the project area (NYSDEC, 2018c) (see Appendix A1).

2.3 Vegetation

2.3.1 Upland

The majority of the project area is densely developed with residential and commercial properties, therefore the vegetation in the project area is predominantly maintained lawn and landscaping. There are areas with hardwood forest in certain sections throughout the project area. However, the majority of these forested areas are thin fragments on the river banks directly adjacent to the river and Caroline Pond. The forest communities are comprised of red oak (*Quercus rubra*), tree of heaven (*Ailanthus altissima*), several maple species (*Acer* sp.), ash species (*Fraxinus* sp.), black locust (*Robinia pseudoacacia*), American elm (*Ulmus Americana*), American beech (*Fagus grandifolia*), sycamore (*Platanus* sp.), and catalpa (*Catalpa* sp.). The ground cover and shrub layer throughout the project area consists predominantly of Japanese knotweed (*Polygonum cuspidatum*), poison ivy (*Toxicodendron radicans*), skunk cabbage (*Symplocarpus foetidus*), silky dogwood (*Cornus amomum*), purple loosestrife (*Lythrum salicaria*), and Virginia creeper (*Parthenocissus quinquefolia*) (CDM Smith, 2018).

2.3.2 Wetlands

Vegetation observed in wetland areas include red maple (*Acer rubrum*), American beech, skunk cabbage, purple loosestrife, reed canary grass (*Phalaris arundinace*), soft rush (*Juncus effuses*), umbrella sedge (*Cyperus strigosus*), and willow (*Salix sp*.) (CDM Smith, 2018).

2.4 Fishery Resources

Information obtained from the CT DEEP indicates that there is a healthy population of American eel (*Anguilla rostrata*), in the section of the river near Pemberwick Dam, as well as bluegill (*Lepomis macrochirus*), brook trout (*Salvelinus fontinalis*), blacknose dace (*Rhinichthys atratulus*), pumpkinseed (*Lepomis gibbosus*), redbreast sunfish (*Lepomis auritus*), and white sucker (*Catostomus commersoni*) located throughout the project area. There is also an established eel run through the Byram River and the Town of Greenwich operates an eel pass and trap at Pemberwick Dam (CDM Smith, 2018).

The majority of these species are warm water fishes commonly found in small and medium sized rivers and pools with constant flow, adjacent to the coast. Additionally, species like the American eel prefer to spend daylight hours hiding in undercut banks and deep pools, while white sucker spend time in large pools and pool and riffle habitats. These types of habitats are found within the project area in both the Pemberwick dam pool and also the naturalized river channel in close proximity to Den Lane.

2.4.1 Essential Fish Habitat

Essential Fish Habitat (EFH) is defined under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." The MSFCMA requires federal agencies to conduct an assessment to determine whether the proposed action “may adversely affect” designated EFH

and to consult with the National Marine Fishery Service on activities that may adversely affect Essential Fish Habitat. As part of the consultation, the Federal Agency must perform an EFH assessment and coordinate the assessment with the National Oceanic and Atmospheric Administration – National Marine Fishery Service (NOAA-NMFS). The objective of an EFH assessment is to determine or relevant commercial, federally managed fisheries species within the proposed action area.

The NOAA-NMFS EFH Mapping System and NOAA-NMFS 10x10 Square Coordinates were consulted to determine the potential presence of EFH habitat within the Byram River. Unfortunately, neither resource is at a level of detail that shows the extent of possible EFH within the river. However, the Long Island Sound is designated as EFH habitat for over 36 species near the confluence of the Byram River with the Long Island Sound. Given that the tidal range extends into the lower portion of the project area, there is a potential for EFH habitat for some species to occur in the Byram River. Refer to Appendix A5 for further discussion of EFH designated species that may occur within the project area.

2.5 Aquatic Macroinvertebrates

The CT DEEP conducts benthic macroinvertebrate sampling within the project area as part of their statewide water quality monitoring effort. The CT DEEP conducted sampling approximately 0.32 miles north of Caroline Pond near Comly Avenue in 2009. Macroinvertebrates collected at this location during included freshwater crustacean (*Amphipoda*), (*Gammaridae*), crane fly (*Tipulidae*), mayfly (*Baetidae*) (*Heptageniidae*), caddisfly (*Brachycentridae*), (*Hydroptilidae*) (*Hydropsychidae*) (*Philopotamidae*) (Lepidostomatidea) ((long horned caddisfly- (*Leptoceridae*), non-biting midge (*Chironomidae*), dance fly (*Empididae*), snail (*Hydrobiidae*), riffle beetles (*Elmidae*), freshwater roundworm (*Nematoda*), black fly (*Simuliidae*); bivalve mollusk (*Pisidiidae*), and flatworm (*Turbellaria*).

Species observed during field studies include freshwater mussel (*Unionoida* sp.), crayfish, and water striders (*Gerridae* sp.) (CDM Smith, 2018).

2.6 Reptiles and Amphibians

During field reconnaissance, snapping turtles (*Chelydra s. serpentia*) were observed swimming and basking in Caroline Pond. Snapping turtles in this type of pond habitat and are expected to be seen in areas in close proximity to humans. No amphibians were observed (CDM Smith, 2018).

2.7 Birds

Species found within the project area are those that are typically found in residential neighborhoods and are adapted to living in close proximity to humans such as house sparrow (*Passer domesticus*), gray catbird (*Dumetella carolinensis*), grackle (*Quiscalus quiscula*), rock dove (*Columba livia*), gull, and blue jay (*Cyanocitta cristata*). The riparian habitat along the Byram River provides habitat supportive of species such as mallard (*Anas platyrhynchos*), great blue heron (*Ardea Herodias*), killdeer (*Charadrius vociferous*), and osprey (*Pandion haliaetus*) which use the riparian habitat for roosting, nesting and feeding during the summer months, before migrating south for the winter. The river and Caroline pond also provide habitat for

migrating water fowl, such as mallard and geese, to feed and rest during their migrations (CDM Smith, 2018).

A full list of species observed during field studies is located in Appendix A1.

2.8 Mammals

Given the urbanization found in the project area, mammalian species that would most likely be found would be those adapted to humans. Grey squirrel (*Sciurus carolinensis*) were observed during field visits, as were deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), and opossum (*Didelhis virginiana*) (CDM Smith, 2018).

2.9 Threatened and Endangered Species

2.9.1 Federal Threatened and Endangered Species

United States Fish and Wildlife (USFWS) Trust Species

The District consulted the U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Conservation database in November 2017, the northern long-eared bat (*Myotis septentrionalis*) and the rufa red knot (*Calidris canutus rufa*), both listed as threatened, were identified as potentially occurring within the project area (USFWS, 2017).

However, based on an official list of endangered and threatened species list the District obtained in April 2018, only the northern long-eared bat was identified as potentially occurring within the project area. The list is included in Appendix A9.

The northern long-eared bat hibernates in caves and abandoned mines with hibernation generally beginning in October/November and emergence typically occurring in April. Northern long-eared bats roost singly or in colonies underneath bark, in cavities or in crevices of both live and dead trees. Tree species commonly used as roost sites include American elm, slippery elm, shagbark hickory, silver maple, and green ash. This species has also been observed in manmade structures such as buildings, barns, sheds, cabins, under eaves of buildings, and bat houses. Preferred foraging areas are in forested habitats (USFWS, 2015).

In addition, the USFWS is currently evaluating the little brown bat (*Myotis lucifugus*), and the tricolored bat (*Perimyotis subflavus*) to determine if listing under the Endangered Species Act (ESA) is warranted. Both species are known to occur in Connecticut.

NOAA-NMFS Trust Species

A list of endangered species under the jurisdiction of the NOAA-NMFS Greater Atlantic Regional Fisheries Office is included in Appendix A1. The District consulted the NOAA-NMFS (ESA) Section 7 Mapper and Estimated Range Maps of each listed species located at the Greater Atlantic Regional Fisheries Office website to determine the potential occurrence of listed species within the project area. Although the ESA Section 7 Mapper did not indicate the potential presence of any trust species within the project area, it did indicate the potential occurrence of Atlantic sturgeon (*Acipenser oxyrinchus*), shortnose sturgeon (*Acipenser brevirostrum*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidcochelys kempii*), and Green sea turtle (*Chelonia mydas*) in the lower portion of the Byram River (see Appendix A9) (NOAA-NMFS, 2018a).

Based on a review of the Estimated Range Maps, the project area is within "Accessible Waterways" for both Atlantic sturgeon and shortnose sturgeon (NOAA-NMFS, May 2018b; NOAA-NMFS, May 2018c). A review of the Atlantic Sturgeon Critical Habitat maps did not indicate that the project area is considered critical habitat (NOAA-NMFS, May 2018d). The Estimated Range Maps for the shortnose and Atlantic sturgeon are located in Appendix A9.

Brief descriptions of the species' habitat preferences are provided below:

Atlantic Sturgeon

Atlantic sturgeon are an anadromous species that spawn in freshwater in the spring and early summer and migrate into estuarine and marine waters where they spend most of their lives. They spawn in moderately flowing water (46-76 cm/s) in deep parts of large rivers. Sturgeon eggs are highly adhesive and are deposited on bottom substrate, usually on hard surfaces (e.g., cobble). Once larvae begin migrating downstream they use benthic structure (especially gravel matrices) as refuges. Juveniles usually reside in estuarine waters for months to years.

Subadults and adults live in coastal waters and estuaries when not spawning, generally in shallow (10-50 m depth) nearshore areas dominated by gravel and sand substrates. Long distance migrations away from spawning rivers are common. Preferred food sources are worms, mollusks and crustaceans (NOAA-NMFS, 2018e).

Shortnose Sturgeon

Shortnose sturgeon is an anadromous species that inhabit rivers and estuaries. They spawn in the coastal rivers along the east coast of North America from the St. John River in Canada to the St. Johns River in Florida. They prefer the nearshore marine, estuarine, and riverine habitat of large river systems and do not appear to make long distance offshore migrations. Shortnose sturgeon, Preferred food sources include crustaceans, mollusks, and insects (NOAA-NMFS, 2018f).

The four sea turtle species would likely to be present as juveniles, subadults and adults within Long Island Sound and its associated bays and nearshore areas from May to November; using this area for foraging. Nesting for these species ranges from Mexico, Gulf of Mexico and the southeastern U.S. (NOAA-NMFS, 2018g).

2.9.2 State Threatened and Endangered Species

Based on coordination with the CT DEEP and the NY DEC, no state threatened or endangered species are known to occur within the project area. Refer to Appendix A11 for pertinent correspondence.

2.10 Socioeconomics

The populations of Greenwich and Port Chester have been increasing over the last two decades. The population of Greenwich increased 2.0% from 2010 to 2016 to 62,418. Its median household income increased 35.5% from the year 2000 to 2010 to $134,223. Although employment in Greenwich declined from 2000 to 2010, it increased by 4.4% from 2010 to 2016.

The population of Port Chester increased 1.6% from 2010 to 2016 to 29,417, the same percentage increase as New York state overall. Port Chester's median household income increased by 24.6% from 2000 to 2010 to $56,524 per household. Employment in Port Chester increased by 16.3% from 2000 to 2010 and then declined slightly from 2010 to 2016. The

resulting percentage increase from 2000 to 2016 is 15.9%. This was a greater percent increase for employment than the 8.8% increase for Westchester County or the 11.04% increase for the State of New York for the same time period.

2.10.1 Environmental Justice

The Environmental Protection Agency defines Environmental Justice as the "fair treatment and meaningful involvement of all people regardless of race, color, national origin or income with respect to the development implementation and enforcement of environmental laws, regulations and policies. Fair treatment means no group of peoples should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies" (USEPA, 2018).

Executive Order 12898, "Federal Actions to address Environmental Justice in Minority and Low Income Populations" mandates that each federal agency identify and address potential disproportionately high and adverse effects of its activities, programs, and policies on minority populations and low income populations. Specifically, the adverse effects pertain to human health, and the environment must be identified and addressed. According to EO 12898, minority populations exist where the percentage of minorities exceeds 50% or where the minority population percentage in the affected area is meaningfully greater than in the general population. EO 12898 does not provide criteria to determine if an affected area consists of a low-income population.

A cursory analysis was conducted to determine the potential applicability of Environmental Justice issues. The analysis took into account a comparison of the percentage of low income and minority populations occurring in each municipality within the Counties in which they are located. Those municipalities where the combined minority populations and/or the low income populations are higher than the County would be subject to Environmental Justice considerations.

The combined minority population of Westchester County, NY is 42.8%. The percentage of individuals living below the poverty line is 9.8% and the percentage of families living below the poverty line is 6.9%.

Port Chester has a combined minority population of 69.7% which is higher than Westchester County overall. In addition, the percentage of individuals and families living below the poverty level is greater than Westchester County overall at 12.9% and 10.4% respectively.

Fairfield County, CT has a combined minority population of 34.2%. The percentage of individuals living below the poverty level is 8.8% and the percentage of families living below the poverty level is 6.4%.

Greenwich has a combined minority population of 22.8% which is lower than Fairfield County. In addition, the percentage of individuals living below the poverty level is 6.3% and families is 4.8%.

2.11 Cultural Resources

As an agency of the federal government, the USACE has certain responsibilities concerning the protection and preservation of historic properties. Section 106 of the National Historic

Preservation Act of 1966, as amended, and its implementing regulations, the Advisory Council on Historic Preservation's "Procedures for the Protection of Historic and Cultural Properties" (36 CFR 800), direct federal agencies to take into account the effect of an undertaking on historic properties included or eligible for listing on the National Register of Historic Places. In accordance with these guiding regulations, the District carried out a cultural resources investigation of the project area to identify historic properties, including archaeological sites, and initiated coordination with the New York and Connecticut State Historic Preservation Offices, Federally-recognized Tribes, and local interested parties.

Executive Order 13175, "Consultation and Coordination with Indian Tribal Governments", requires all federal agencies to consult with Indian Tribes and respect tribal sovereignty as they develop policy on issues that impact Indian communities. This includes conducting government-to-government consultation on agency undertakings.

The NEPA mandate to assess proposed Federal actions' environmental impacts includes the evaluation of impacts to historic and cultural resources. Under NEPA, a significant impact is based on context and intensity or severity of the impact. Context refers to the geographic, biophysical and social context of society as a whole, a region and/or local affected interests. Severity refers to the magnitude, duration and timing of the effect and can be beneficial or adverse, and direct, indirect or cumulative (40 C.F.R. §1508.8).

2.11.1 Cultural Resources within the Project Area

Several surveys were completed within the New York and Connecticut portions of the project area that identified a number of historic properties or sites, buildings and structures that are listed on, eligible for listing on, or have the potential to be eligible for the National Register of Historic Places.

New York

Archaeological Sites

Based on a review of the New York State Historic Preservation Office (NYSHPO) files, no sites have been documented within the New York State portion of the project area. The area was investigated in 1977 as part of the Corps original study and in 2000 and 2010 as part of a Phase IB and II archaeological survey for the Port Chester Redevelopment Project (Zukerman and Rothschild 1977, John Milner and Associates 2000, Roberg-Lopez 2010).

Historic Buildings and Structures

The two Route 1 bridges are eligible for the National Register (Panamerican Consultants 2014a; New York State Office of Parks and Recreation 2015). A number of other buildings and structures were also identified within the New York portion of the project area. These include:

- The 1940s-era industrial building at 13 Riverdale Avenue;
- Two 1950s-era buildings at 604 North Main Street;
- The filing station on the east side of the Byram River at 780 Putnam Avenue;
- The William James Memorial Gateway park and 1920s pumphouse; and
- Retaining walls and related structures that line the river (Panamerican Consultants 2013a).

Connecticut

Archaeological Sites

Only one archaeological site is identified within the project area. It is identified as a potential Archaic campsite along the Byram River. The site was investigated in the 1920s and the current record in the Connecticut Office of State Archaeology/Connecticut Archaeology Center indicates it has since been destroyed. Historic period archaeological sites have been identified in the northern portion of the project area and include ruins and archaeological deposits associated with the Byram River Beagle Club (Panamerican Consultants 2014b).

Historic Buildings and Structures

There are five properties listed on the National Register within the Connecticut portion of the project area. These include the Glenville Historic District, the New Mill and Depot (formerly portions of the American Felt Company), the Glenville School, the Thomas Lyon House, and the Byram School. The New Mill and Depot and the Glenville School are listed as individual properties as well as contributing elements of the Glenville Historic District. The Glenville Historic District includes several structures associated with the mill that are not included in the individual nomination for the mill. These structures include the dam and adjacent system of retaining walls (Panamerican Consultants 2014b).

Two bridges, the Bailiwick Road Bridge and the Glenville Street Bridge, are eligible for the National Register (Panamerican Consultants 2014b).

Within the Connecticut portion of the project area there are a number of structures and buildings that may be eligible for the National Register. These include:

- Stone fences at the northern edge of the project area associated with 212 Riversville Road;
- The dam associated with the mill complex on the east side of Riversville Road;
- The cut-stone dam and factory building associated with the former Russell, Burdsall and Ward Bolt and Nut Company;
- The gas station on the east side of the Byram River in the center of the traffic circle near the south edge of the project area at 780 Putnam Avenue (due to the state boundary, the building is located in New York and the gas pumps are on a separate parcel within the Town of Greenwich in Connecticut);
- Cut- and rough-stone culverts and drain outlets that intersect the Byram River within the project area, as well as a rough-stone-lined drainage ditch extending from a concrete drain pipe beneath Riversville Road near Bailiwick Road, a cut-stone line drain at the Byram River near the south end of the Glenville Historic District, and a cut-stone culvert for the Pemberwick Brook beneath Pemberwick Road just southeast of its intersection with Comly Avenue; and
- Retaining walls and related structures stabilizing the banks of the Byram River and include large mortared cut-stone and poured-concrete structures adjacent to bridges and within the Mill and Depot complex as well as small un-mortared rough stone wall associated with individual residences (Panamerican Consultants 2014b).

2.11.2 Cultural Resources in the Area of Potential Effect (APE)

The Area of Potential Effect (APE) for the identification of historic properties and the undertaking's effects on historic properties for this Draft Integrated FR/EIS is the Byram River at the location of the Route 1 bridges, including both streambanks in Greenwich and Port Chester just upstream and downstream of both bridges (Figure 4).

2.11.2.1 Known National Register Properties in the Area of Potential Effect

The Route 1 bridges were built in 1880s and 1920s/1930s. Both Route 1 bridges were determined to be eligible for the New York State and National Registers in 2015 under National Register of Historic Places criteria A and C for their association with historical events and their architectural characteristics, respectively. The bridges are associated with the federal highway road building movement and possibly the Works Progress Administration. Architecturally, they are examples of craftsmanship and design of double arched stone bridges (New York Office of Parks, Recreation and Historic Preservation 2015).

The Thomas Lyon House, located on West Putnam Avenue immediately adjacent to the Route 1 bridges in Greenwich, was listed on the Connecticut State and National Register of Historic Places in 1977. The house is the oldest Colonial house in Greenwich. It was built c. 1695 and moved to its current site in 1927. The Town of Greenwich assumed responsibility of the house in 2007. The house is a classic saltbox and retains much of its original building material.

The Byram School is located just outside but adjacent to the APE along West Putnam Avenue.

2.11.2.2 Archaeological Resources

A Phase IA cultural resources investigation of the project area was completed in 2014 to provide historic context, identify historic properties and make recommendations for additional studies (Panamerican 2014a and Panamerican 2014b). No sites were identified within the APE for New York or Connecticut.

Figure 4: Area of Potential Effect (APE)

2.11.3 Architectural Resources

There are a number of resources within the APE that are potentially eligible for the National Register. These include:

- 1950s-era buildings on the west side of the river between the two bridges;
- 1920s-early 1930s-era filling station on the Port Chester parcel on the east side of the Byram River; and
- The William James Memorial Gateway Park located on the west side of the river south of the West Putnam Avenue bridge, including the 1920s-era sewer pumphouse and historic wrought iron fence.

2.11.4 Coordination and Consultation

The Phase IA survey was coordinated with the New York State Office of Parks, Recreation and Historic Preservation (New York State Historic Preservation Office [NYSHPO]) and the Connecticut Department of Economic and Community Development (Connecticut State Historic Preservation Office [CTSHPO]), which concurred with the resource determinations. The proposed project and results of the survey were coordinated with the Mashantucket Pequot (CT) and the Delaware Nation, the Delaware Tribe of Indians and the Stockbridge Munsee Community of Indians
(Appendix A.4). Coordination with the Advisory Council on Historic Preservation upon completion of the public review to provide the ACHP with the content of the public comments as well any comments from the NYSHPO, CTSHPO and the Tribes.

2.12 Coastal Zone Management

The Coastal Zone Management Act of 1972 (16 U.S.C. §§1451–1464) was enacted by Congress to balance the demands for growth and development with the competing demands for protection of coastal resources. This act requires that federal activities affecting land or water resources located in the coastal zone be consistent to the maximum extent practicable with the federally approved state coastal zone management plans. This act is regulated in New York by the New York Department of State. In addition, local governments can participate in Coastal Zone Management compliance through the development of Local Waterfront Revitalization Plans (LWRPs). Municipalities within the project area that have prepared LWRPs include the Village of Port Chester. In Connecticut, the Coastal Zone Management Act (CZMA) is regulated by the CT DEEP, and the municipality adopts the State policies.

The southernmost portion of the project area lies within the Coastal Zone Management jurisdictional boundaries of both States and within the Village of Port Chester Local Waterfront Redevelopment Plan boundaries (see Appendix A1).

2.13 Floodplains

The 1-percent and 0.2-percent floodplains extend out from the current floodway into the Pemberwick area (Figure 5). Due to topography, the 0.2-percent floodplain is not much more expansive than the 1-percent floodplain. The area around Caroline Pond has the widest floodplain. The floodplain widens upstream from the Route 1 bridges.

2.14 Land Uses and Zoning

The project area includes primarily two land uses; commercial and residential. The northern section of the project area, from Bailiwick Road to Pemberwick Dam is predominantly residential with undeveloped areas of woods and open space. The middle section from Pemberwick Dam to Caroline Pond, is primarily developed residential with some commercial uses and undeveloped areas comprised of wetlands, woods and open space. Directly adjacent to Caroline Pond, on both the eastern and western sides, the existing land use is predominantly developed residential.

The National Land Cover Dataset (NLCD) was used to calculate the land cover within the project area (Figure 6). About 85.5% of the project area is developed, 12.9% is forested, and 1.7% is open water. Overwhelmingly, the project area is a developed space, with essentially no agricultural, wetlands, or shrub areas.

2.15 Hazardous, Toxic, and Radioactive Waste

The purposed of a Phase I Environmental Site Assessment is to identify any hazardous, toxic, and radioactive waste (HTRW) conditions that indicate any past or current release of potential contaminants to ground water or surface waters within the project area. A Phase I Environmental Site Assessment is required by USACE ER 1165-2-132 *Hazardous, Toxic and Radioactive Wastes (HTRW) Guidance for Civil Works Projects.* The scope of this effort is limited to the areas of proposed construction as defined by the Tentatively Selected Plan (TSP).

Sites identified from environmental data bases will be classified based on the potential to impact project construction.

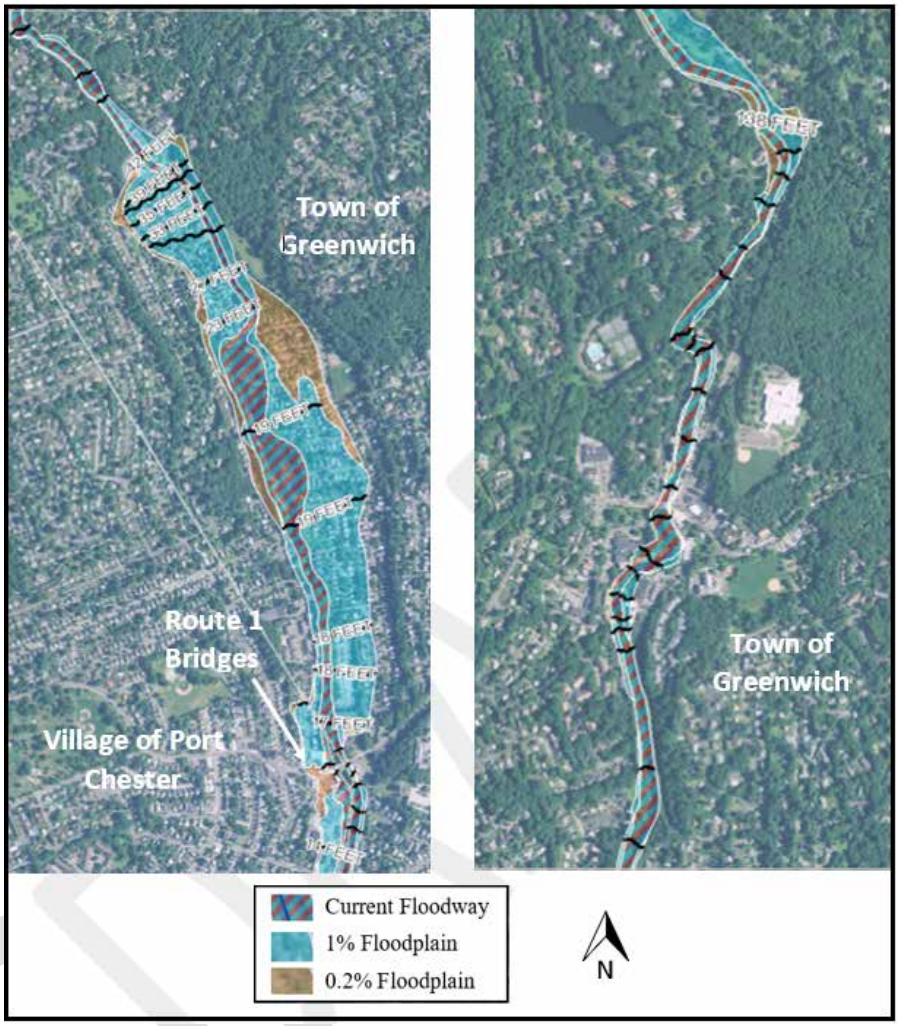

Figure 5: Federal Emergency Management Agency (FEMA) floodplains within the project area (FEMA's National Flood Hazard Layer)

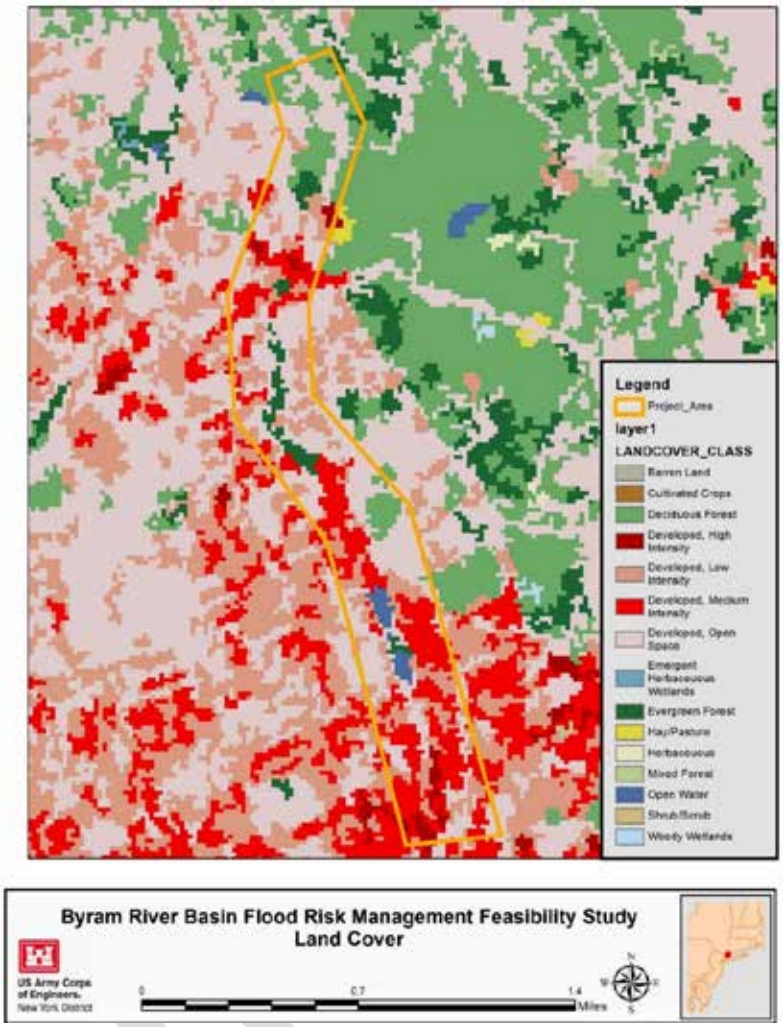

Figure 6: Land cover within the Byram River Basin project area (NLDC)

As part of the Phase I Environmental Site Assessment, the following databases were reviewed:

- NPL – National Priorities List;
- CERCLIS – Comprehensive Environmental Response Compensation and Liability Information System;
- SEM – Superfund Enterprise Management System;
- RCRIS – Resource Conservation and Recovery Information System;
- TRIS – Toxic Release Inventory System;
- CT DEEP State Superfund List;
- NYDEC Spills Incident Data Base; and
- NYDEC Environmental Site Remediation Data Base (Appendix A.7).

As a result of this review, a total of 55 sites were located within the study area, primarily consisting of homeowners heating oil tanks that are still in remediation or have been listed as closed or remediated. All but three sites are well outside the project area. Two of the three sites are located on West Putnam Avenue at the Byram River and are former gas stations that have gone through remedial actions and are closed. The third location, the Pemberwick, which is a multiunit apartment building on West Putnam Avenue and Homestead Lane just east of the Route 1 bridges, is in remediation for a leaking underground storage tank for home heating oil (CDM Smith 2018).

2.16 Aesthetic and Scenic Resources

The aesthetic quality within the project area is influenced by heavy residential and business development. Much of the land along the river is developed with single family residences in the northern portion of the project area and business in the southern portion of the project area.

There are two town-designated scenic resources located within the project area (Town of Greenwich, 2009). The northernmost scenic area is located just north of Caroline Pond. This is an identified resource due to scenic views of Caroline Pond, facing south. The second resource is the section of the project area that borders the State of New York. That section of the Connecticut and New York border is considered a Coastal Scenic Area by the Town of Greenwich due to the views of the tidal channel of the Byram River, and the views continuing south to the Port Chester Harbor and the Long Island Sound. A figure showing the locations of the Town designated scenic resources is located in Appendix A1.

There are no scenic byways, National Wildlife Refuges, National Parks, National Forests, National Natural Landmarks or National Heritage sites within the project area.

2.17 Recreation

Specific areas supportive of active and/or passive recreational activities within the project area include the William James Memorial Gateway Park and Caroline Pond. The William James Memorial Gateway Park is located in Port Chester along the right bank of the Byram River downstream of the bridges. Park features include a restored pump house that serves as a pavilion overlooking the Byram River. Caroline Pond is a 20-acre manmade pond used for boating/kayaking, fishing, and ice skating.

2.18 Air Quality

The Clean Air Act (CAA), as amended, assigns the USEPA the responsibility to establish primary and secondary National Ambient Air Quality Standards (NAAQS) that specify acceptable concentration levels of six criteria pollutants: particulate matter (measured as both particulate matter less than 10 microns in diameter (PM 10) and particulate matter less than 2.5 microns in diameter (PM2.5), sulfur dioxide (SO2), carbon monoxide (CO), oxides of nitrogen (NOx), ozone (O3), and lead. Short-tern NAAQS (1-, 8- and 24-hour periods) have been established for regulated emissions contributing to acute health effects while long term NAAQS (annual averages) have been established for those emissions contributing to chronic health effects.

Federal regulations designated Air Quality Control Regions (AQXRs) in violation of the NAAQS as nonattainment areas. Federal regulations designated AQCRS with levels below the NAAQS as nonattainment and have been redesignated to attainment for a probation period through implementation of maintained plans. According to the severity of the pollution problem ozone and PM10 nonattainment areas can be categorized as marginal, moderate, serious severe or extreme.

Westchester and Fairfield Counties are located in the New York-New Jersey-Long Island Air Quality Control Region. Similar to most urban industrial areas, emissions from automobiles, manufacturing processes, utility plants, and refineries have impacted air quality in the project area. Based on the NAAQS for this region, Westchester and Fairfield Counties are designated as moderate non-attainment areas for ozone and as a maintenance area for carbon monoxide (USEPA, 2018b).

2.19 Noise

Noise is defined as unwanted sound. The day-night noise level (Ldn) is widely used to describe noise levels in any given community (USEPA 1978). The unit of measurement for Ldn is the "A"-weighted decibel (dBA), which closely approximates the frequency responses of human hearing. The primary source of noise in the study area is vehicular traffic on local roadways and local construction projects that may be underway. The typical Ldn in residential areas ranges from 39 to 59 dBA (USEPA 1978). It is assumed that the existing sound levels in the study area are roughly within this range.

2.20 Transportation

The main north/southbound access roads located to the west of and parallel to the Byram River include Riverdale Avenue, Caroline Place, Fletcher Avenue and North Main Street. Pemberwick and Byram Roads are the primary north/southbound access roads the east of the Byram River. Bridge crossings within the project area include Route 1 (two bridges), Comly Avenue, and Bailiwick Road.

Route 1 (also known as Putnam Avenue within the project area) is an interstate that runs east/west through several states across the northeast, including New York and Connecticut. Within the project area, Route 1 has two lanes in each direction with a 35 mph speed limit and is considered a main artery. At the Route 1 bridges, traffic is circulated through a roundabout (Byram Traffic Circle) connecting Putnam Avenue, North Main Street, and West Putnam Avenue. Several businesses reside inside the roundabout. Connecticut Transit's Bus 11 is routed through the roundabout and has a stop located on West Putnam Avenue at the eastside of the roundabout. Currently, Route 1 is the largest road within the project area, connecting New York City to Bridgeport, CT.

Route 1 is approximately a half mile north of and parallel to Interstate 95. Due to its proximity to I-95, Route 1 often serves as an alternate route when travel conditions on I-95 become impacted from accidents or general congestion.

The Byram Traffic Circle East connector serves as the main access from I-95 Exit 2 to westbound Hillside Avenue and Route 1 southbound. Byram road serves as a main access from I-95 Exit 2 to Route 1 northbound and southbound as well as Hillside Avenue. Putnam Avenue

provides eastbound access to Route 1 southbound, Route 1 northbound as well as I-95 Exit via Byram Road.

2.21 Describing Storms and Flood Levels

Floods are often defined according to their likelihood of occurring in any given year at a specific location. The most commonly used definition is the "100-year flood." This refers to a flood level or peak that has a 1 in 100, or 1-percent chance of being equaled or exceeded in any year (i.e., 1-percent "annual exceedance probability"). Therefore, the 100-year flood is also referred to as the "1-percent flood," or as having a "recurrence interval," or "return period" of 100 years.

A common misinterpretation is that a 100-year flood is likely to occur only once in a 100-year period. In fact, a second 100-year flood could occur a year or even a week after the first one. The term only means that that the average interval between floods greater than the 100-year flood over a very long period (say 1,000 years) will be 100 years. However, the actual interval between floods greater than this magnitude will vary considerably.

In addition, the probability of a certain flood occurring will increase for a longer period of time. For example, over the life of an average 30-year mortgage, a home located within the 100-year flood zone has a 26-percent chance of being flooded at least once. Even more significantly, a house in a 10-year flood zone is almost certain to be flooded at least once (96-percent chance) in the same 30-year mortgage cycle. The probability (P) that one or more of a certain-size flood occurring during any period will exceed a given flood threshold can be estimated as

$$P = 1 - \left[1 - \frac{1}{T}\right]^n$$

where *T* is the return period of a given flood (e.g., 100 years, 50 years, 25 years) and *n* is the number of years in the period. The probability of flooding by various return period floods in any given year and over the life of a 30-year mortgage is summarized in Table 2.

Table 2: Examples of Flooding by Various Return Periods

RETURN PERIOD (YEARS)	CHANCE OF FLOODING IN ANY GIVEN YEAR	PERCENT CHANCE OF FLOODING DURING 30-YEAR MORTGAGE
10	10 in 100 (10%)	96%
50	2 in 100 (2%)	46%
100	1 in 100 (1%)	26%
500	0.2 in 100 (0.2%)	6%

Because of the potential confusion, recent USACE guidance documents and policy letters recommend use of the annual exceedance probability terminology instead of the recurrence interval or return period terminology. For example, one would discuss the "1-percent-annual-exceedance-probability flood" or "1-percent-chance-exceedance flood," which may be

shortened to "1-percent flood" as opposed to the "100-year flood." This report uses the short form "1-percent flood."

2.21.1 Water Surface Elevation

The water surface elevations for the existing condition of the Byram River in the project area from the Long Island Sound to upstream of the Merritt Parkway are shown below in Table 3.

Table 3: Existing Conditions Flood Elevations – Selected Area of Interest Cross Sections

LOCATION	PEAK WATER SURFACE ELEVATIONS (FT NAVD88)					
	50% FLOOD	10% FLOOD	4% FLOOD	2% FLOOD	1% FLOOD	0.2% FLOOD
Long Island Sound (50-percent flood stillwater)	6.9	6.9	6.9	6.9	6.9	6.9
Upstream of Amtrak RR Bridge	7.1	7.7	8.3	9.0	9.9	12.8
Downstream of Northbound Route 1 Bridge	7.6	9.2	10.4	11.4	12.4	15.4
Upstream of Southbound Route 1 Bridge	8.1	10.6	14.4	16.1	17.8	20.6
Caroline Pond	11.9	14.5	16.5	18.0	19.5	22.6
Upstream of Comly Ave Bridge	31.3	33.6	34.9	35.9	37.0	42.0
Byram River Reservoir	74.9	76.8	77.8	78.6	79.4	81.4
Downstream of Glenville Road Bridge	113.6	115.6	116.2	116.7	117.2	118.1
Upstream of Glenville Rd Bridge	113.7	115.8	116.6	117.4	120.3	122.4
Downstream of Bailiwick Rd Bridge	127.4	130.9	133.4	135.5	136.1	139.5
Upstream of Bailiwick Rd Bridge	128	133.1	134.7	135.7	136.1	139.6
Toll Gate Pond	143.6	146.0	146.8	147.4	148.0	149.5
Downstream of Merritt Pkwy (SR 15)	144.0	146.4	147.4	148.1	148.8	150.1
Upstream of Merritt Pkwy (SR 15)	145.0	147.2	148.4	149.3	150.2	152.2

3. Plan Formulation

3.1 Problem Statement / Purpose and Need

The problem definition is the detailed description of a problem. It begins with a problem statement, a simple assertion of the basic problem.

Problem statement: *The Town of Greenwich and the Village of Port Chester have been subjected to repeated, severe flooding caused by overflow of the Byram River due to precipitation of high intensity, large amounts, or prolonged duration.*

The flooding caused by overflow of the Byram River causes damages to structures. Flood damages are particularly severe in the southern section of the Pemberwick neighborhood, just downstream of the existing Federal levee built in the 1950s. These flood damages extend along the floodplain from the southern end of the existing Federal levee to the Route 1 bridges, a distance of approximately 3,000 feet. A group of about 30 structures downstream within the town of Port Chester, New York are also affected by flooding from the Byram River.

Flooding from the Byram River also causes disruption to Riverdale Avenue, Riversville Road, and Bailiwick Road. The neighborhood near the Bailiwick Bridge is a major thoroughfare and is rendered impassable to vehicular traffic, including emergency services, due to flooding.

A brief summary of rain events that have impacted the area is provided below.

Flood of 1955

The October 1955 flood is considered a 4-percent flood event and was caused by a combination of a cold front with moderate to heavy rains and an extra-tropical storm with heavy rainfall. The flooding caused county officials to declare a state of emergency (Connecticut History 2018). The Byram River was two feet over the flood state in the Pemberwick section of Greenwich. Roads were, 95% of Greenwich was without electrical power, and over 30 families were evacuated from their homes. Three homes were carried away by the flood waters (Figure 7 and Figure 8). It is estimated that this flood caused a flow discharge of 4,520 cubic feet per second on the Byram River at Route 1 (USACE 1977). Damages from this event amounted to $1,066,000 (1976 price level). The town hired an engineer to conduct a flood control survey to ascertain how to prevent a flood like this from reoccurring.

Storm of 1971

The storm of 26-29 August 1971 caused 5.7 inches of rain to fall at the White Plains Airport, which is adjacent to the Byram River Basin.

Flood of 1972

The flood of 1972 was caused by Tropical Storm Agnes. This flood caused substantial damages in the Byram River Basin totaling $483,000 (1976 price level). The basin-wide total rainfall for Byram River was 5.5 inches.

Storm of 1975

The storm of 19-27 September 1975 was caused by Hurricane Eloise and is the largest recorded flood event to affect the Byram River Basin; based off USACE hydraulic modeling, this event

was a 2-percent event. The Byram River basin-wide rainfall was 9.1 inches. The flood discharge was estimated to be 4,400 cubic feet per second (USACE 1977).

2007 Nor'easter

The 2007 Nor'easter flooding also heavily impacted the Greenwich area. The damages were so great the FEMA had a disaster recovery center open in Greenwich for three months after the event (FEMA 2007). The 2007 Nor'easter is considered a 4-percent flood event.

Figure 7: Byram River, Pemberwick, during the October 16, 1955 flood (Greenwich Historical Society)

Figure 8: A house destroyed by the Byram River Flood of 1955 (Greenwich Historical Society)

3.1.1 Future Without-Project Conditions/ No Action *

The future without-project condition (FWOP) serves as the base condition and is used for comparison during all of the alternative analyses. The period of analysis used in the comparison of potential costs and benefits of alternative plans is 2023 through 2072. Relevant resources of the area and the No Action alternative are succinctly described as required by NEPA. The No Action alternative and the plan formulation "future without-project" setting are equivalent.

In the absence of Federal action, flooding problems in the Byram River Basin associated with rainfall events, as well as the associated maintenance and reconstruction of flood risk management facilities, are expected to continue. These problems may be exacerbated by increased damage potential in the floodplain of the Byram River Basin based upon increases in the values of structures and contents, as well as by climate change, leading to an expected increase in intensity and frequency of storm events. It is expected, based on future land use projections in the study area, there will be no to limited new development within the Basin in the 50-year period of analysis.

However, in the long term, properties in flood prone areas, are likely to sustain continued damage during future storm events. Without proactively addressing flood risks, damages will continue to accrue. The estimate of future without project damages is based primarily on structure and content damages to commercial and residential buildings and is estimated through

the USACE Hydrologic Engineering Center – Flood Damage Analysis (HEC-FDA) software. Content damages include damages to material items housed within the buildings. Although there are damages from transportation induced delays, they have not been captured in the HEC-FDA model for Byram River. The total Future Without-Project equivalent annual damages is $2.1 million dollars (FY18 P.L.; 2.75% Federal Discount Rate).

3.2 Opportunities

Opportunities to solve problems in the study area have been identified by the study team. There are opportunities in the Byram River study area to:

1. Reduce flood damages to residents, property, and infrastructure
2. Reduce damages related to isolation from flooded roads

3.3 Planning Objectives

Plans are formulated to achieve planning objectives. Planning objectives and constraints are inexorably linked to problems and opportunities. A planning objective states the intended purposes of the planning process. It is a statement of what solutions should try to achieve. Objectives provide a clear statement of the study purpose.

In support of the goal, the planning objectives are to:

1. *Manage the risk of damages from flooding caused by fluvial events from the Byram River through 2072.*
   Measurement: estimated annual damages, as calculated by the HEC-FDA model
2. *Support community resiliency through 2072.*
   Measurement: qualitative analysis of how a project would aid the community in recovery from floods by reducing flood damages

3.4 Planning Constraints

Constraints are restrictions that limit the extent of the planning process. They can be divided into universal constraints and study-specific constraints. Universal planning constraints are the legal and policy constraints to be included in every planning study. Study-specific planning constraints are statements of things unique to a specific planning study that alternative plans should avoid. Constraints are designed to avoid undesirable changes between without- and with-plan conditions.

Our study specific constraints are physical. The topography of the study area is characterized by a quick rise in elevation out of the 0.2-percent floodplain. Based on the quick rise in elevation and the high level of development within the floodplain, there are physical space constraints that will affect the screening of measures (*i.e.* not enough room for storage and detention basins in the immediate study area).

3.5 Key Uncertainties

Limitations to the quantity and quality of information result in uncertainties. The study team dealt with four major uncertainties:

Sea Level Rise (SLR). The Byram River is tidal from the mouth to about the Route 1 bridges, which is at the southern end of the Pemberwick damages area. The project is not a tidal/coastal flood risk management project, however, over the next 50 years SLR could be as high as two feet, which would increase the tidal influence on the river to potentially include the project area (SLR scenarios for this area are in the process of update and analysis). Our study is scoped to address fluvial flood events, not coastal events, which constitute a separate flood mechanism. Even so, a rise in water surface elevation through SLR may exacerbate flood damages from rainfall events over the 50 year period of analysis. How SLR projections affect the water surface elevations with the proposed project in place is detailed in section 4.4.2 and Appendix B2-Hydraulics.

Development. It is assumed that the people will continue to live along the Byram River, based on real estate market appeal of the Town of Greenwich and the relatively affordable prices of the homes along the Byram River.

Public Acceptability. The study team has been engaging the public early and often in the planning process to minimize uncertainty.

Data. The study team is relying on existing data and literature surveys for HTRW, Cultural Resources, and Geotechnical information based on the data collected for the 1977 Feasibility Report and the extensive record keeping by the Town of Greenwich since then. There is a possibility that the presence of unforeseen HTRW or Cultural Resources, or discrepancies in the Geotechnical data may require project design modifications.

3.6 Federal Action

Per the 1983 Principles and Guidelines, the Federal objective of water and related land resources project planning is to "contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements." Water and related land resources project plans are formulated to alleviate problems and take advantage of opportunities in ways that contribute to this objective. Contributions to NED are increases in the net value of the national output of goods and services. In addition to the national economic development and environmental quality accounts, evaluation of the beneficial and adverse effects of the alternatives will provide a basis to determine which plans should be considered further, dropped, or reformulated; these accounts include regional economic development (RED) and other social effects (OSE).

3.7 Planning Goal

A study goal based on problems and opportunities was developed to help create and evaluate alternative plans. It is the overarching intent of the project.

Goal: *Reduce the risk of damages from fluvial flooding of the Byram River.*

3.8 Management Measures

Plans to manage the risk of flood damage are composed of measures. A measure can be nonstructural (actions to reduce flood damages without significantly altering the nature or extent of flooding) or structural (a physical modification designed to reduce the frequency of damaging

levels of flood inundation). They can be used individually or combined with other management measures to form alternative plans. Measures were developed to address problems and to make the most of opportunities. They were derived from a variety of sources including prior studies, the public scoping process, and the study team's experience.

The following nonstructural and structural measures were considered to provide flood risk management and maximize project benefits. All measures were screened for their capability to meet objectives and avoid constraints, as well as for engineering and economic feasibility. Measures that warranted consideration were assembled into alternative plans. Below are the nonstructural and structural measures that were considered.

3.8.1 Structural Features

1. Levees and floodwalls

Floodwalls and levees are intended to provide reduce the risk of flooding to homes, commercial buildings, municipal buildings, roadways, and bridges by preventing floodwaters from reaching these structures. While levees and floodwalls can provide a cost-effective means to prevent flooding of low-lying areas, interior drainage facilities are required to handle run-off trapped behind them to prevent interior residual flooding.

2. Channel modifications

Channel modifications may be used to help communities by reducing the risk of riverine flooding and stream blockages. Channel modifications can include dredging, deepening and widening, re-channelization, dam modifications, and elevating or widening bridges. Channel modifications can be an effective means to reduce flooding, however, environmental impacts may be significant. Channel modifications are typically only effective for more frequent flooding or the lower frequency floods.

3. Bridge modification

Bridge modifications can include modifying or removing a bridge to improve the conveyance of water flow and to accommodate channel modifications.

4. Diversions

An underground culvert may be used to divert river overflow from upstream of a developed area. Flood flows contained within the culvert would bypass the developed area and re-enter the river downstream. Under normal conditions, base flow would continue to flow within the river channel. An intake structure would allow flood flows to be diverted into the culvert. This type of alternative can also minimize environmental impacts to the stream by avoiding alterations within the river channel.

5. Detention basins

Detention basins may be used to reduce the peak flood flows by temporarily storing (detaining) floodwater, then releasing it at a substantially reduced flow to reduce peak flood flows. This reduces peak water surface elevations and helps to minimize flood damages downstream.

The structural measures described here may require rain runoff storage and interior drainage facilities, such as pump stations, ponding areas, or pipe diversions.

6. Pumps

Some of the structural management measures would need to be implemented in conjunction with pump systems. Flood risk management utilizing pumps involves removing and relocating flow from within a river channel and diverting it to a location downstream of the flood prone area.

3.8.2 Nonstructural Actions

1. Flood proofing of frequently flooded structures

Flood proofing is a body of techniques for preventing damages due to floods, and requires adjustments both to structures and to building contents. It involves keeping water out of structures, as well as reducing the effects of water entry. Wet flood proofing entails that all construction materials and finishing materials be water resistant, and all utilities must be elevated above the design flood elevation. Dry flood proofing consists of waterproofing structures.

2. Ringwalls/structural peripheral wall

This technique is applicable on a small-scale basis. As nonstructural measures, berms and floodwalls are intended to reduce the frequency of flooding but not eliminate floodplain management and flood insurance requirements.

3. Elevation (raising) of frequently flooded structures

This technique lifts an existing structure. Elevation can be performed using fill material, on extended foundation walls, on piers, post, piles, and columns.

4. Buyouts (acquisition) of frequently flooded structures

This technique includes permanent evacuation of existing areas subject to erosion and/or inundation and involves the acquisition of this land and its structures, either by purchase or by exercising the powers of eminent domain. Following this action, all development in these areas is either demolished or relocated.

5. Flood warning system

Flood warning systems may be utilized to warn property owners of impending floods, and therefore allow time to evacuate and relocate property subject to flood damage.

6. Rebuilding

If the estimated cost of any other nonstructural alternative exceeds the estimated cost to demolish a structure and rebuild an equivalent structure, rebuilding the structure above the design flood elevation may be an economically viable nonstructural alternative.

3.9 Screening of Management Measures

Management measures were retained for further consideration based on their ability to meet the following screening criteria:

1. Does the measure meet objectives?
2. Does the measure avoid constraints?
3. Is the measure feasible to design and construct?
4. Is the measure economically feasible?

This section describes the screening of the flood risk management measures to develop the alternatives for the Byram River Study and explains why diversions, storage, and pumps were screened out. The measures have been grouped under structural and nonstructural flood risk management measures.

3.9.1 Structural Flood Risk Management Measures

Structural flood risk management measures involve physical modifications to the river and/or its surrounding area to control the flow of the river and to reduce the frequency of flooding. Structural alternatives evaluated include levees and floodwalls, channel modifications, bridge modifications, diversions, storage, and pumps.

1. Levees and Floodwalls

As part of the Pemberwick Flood Control Project (USACE, 1958), a levee was constructed from Halock Drive to Rex Street along the east bank of the Byram. USACE made recommendations in 1977 to extend the existing levee on the east bank and floodwalls along both banks of the river, between Route 1 and Rex Street (USACE, 1977). At the time, these recommendations were found to meet objectives, avoid constraints, and be technically and economically feasible; however, the plan was not constructed. Further description of the 1977 recommended plan can be found in section 3.11.3. The current study is revisiting the levees and floodwalls proposed in 1977, updating the designs to accommodate existing conditions.

2. Channel Modifications

Channel modifications include manmade alterations to the channel's characteristics such as deepening and/or widening to improve flow conveyance. Channel modifications considered as part of the Byram River Study include:

- Dredging of the river that would include the removal of accumulated silt and debris from the channel bottom
- Channel widening between the Route 1 bridges and the Comly Avenue Bridge

As part of the 1977 Feasibility Report, dredging was proposed from a point approximately 700 feet downstream of the Route 1 bridges to a point near the outlet of Caroline Pond. A "dredging only" scenario with the same bottom profile as recommended in the 1977 Feasibility Report was considered and evaluated using the models Hydrologic Engineering Center – River Analysis System (HEC-RAS) and Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS). The modeled water surface for the "dredging only" scenario showed a reduction of 2.2 feet at the upstream face of southbound Route 1 bridge and 1.4 feet at the outlet of Caroline Pond. Table 4 shows the modeled water surface at key cross sections within the project area for the 1-percent flood.

Table 4: One-Percent Peak Flood Water Elevations – Channel Modifications

LOCATION	1-PERCENT FLOOD ELEVATION [FT]	
	EXISTING	DREDGING ONLY
Long Island Sound (2-year Stillwater)	6.9	6.9
Upstream of Amtrak RR Bridge	9.9	9.9
Downstream of Northbound Route 1 Bridge	12.4	12.3
Upstream of Southbound Route 1 Bridge	17.8	15.6
Caroline Pond	19.5	18.1
Upstream of Comly Ave Bridge	37.0	37.0

Despite these reductions in water surface elevations, it was determined from the HEC-RAS output profiles that channel widening alone would not be an effective solution to flooding in the study area. Table 4 shows that for the existing conditions the modeled water surface for the 1-percent flood at the upstream face of the southbound Route 1 bridge is 17.8 feet. In general the ground surface elevation in this area is around 11 feet. Because the modeled water surface elevation is significantly higher than the ground surface elevation in the area it would not be possible to reduce the extent of the 1-percent floodplain solely by widening the channel.

3. Bridge Modifications

Bridge modifications for flood management include the modification or removal of a bridge to improve the conveyance of flow and/or to accommodate channel modifications. Bridge modifications considered as part of this project included:

- Removal and replacement of the Route 1 bridges (Northbound and Southbound)
- Adjustments to the private bridge near Pecksland Road and/or Bailiwick Road bridges

The Route 1 bridges are located in the downstream region of the river, while the private and Bailiwick Road bridges cross the river at the upstream end of the project area (Figure 9).

To evaluate the potential for flood risk management associated with modifications to the Route 1 bridges, adjustments were made to the existing HEC-RAS and HEC-HMS models to represent the removal of the Route 1 bridges including the loss of storage behind the bridges. Removing the bridges from the models would maximize the possible conveyance for the region and would represent the maximum reduction in water surface elevation possible with bridge improvements. No changes were made to the river bed profile or the channel widths.

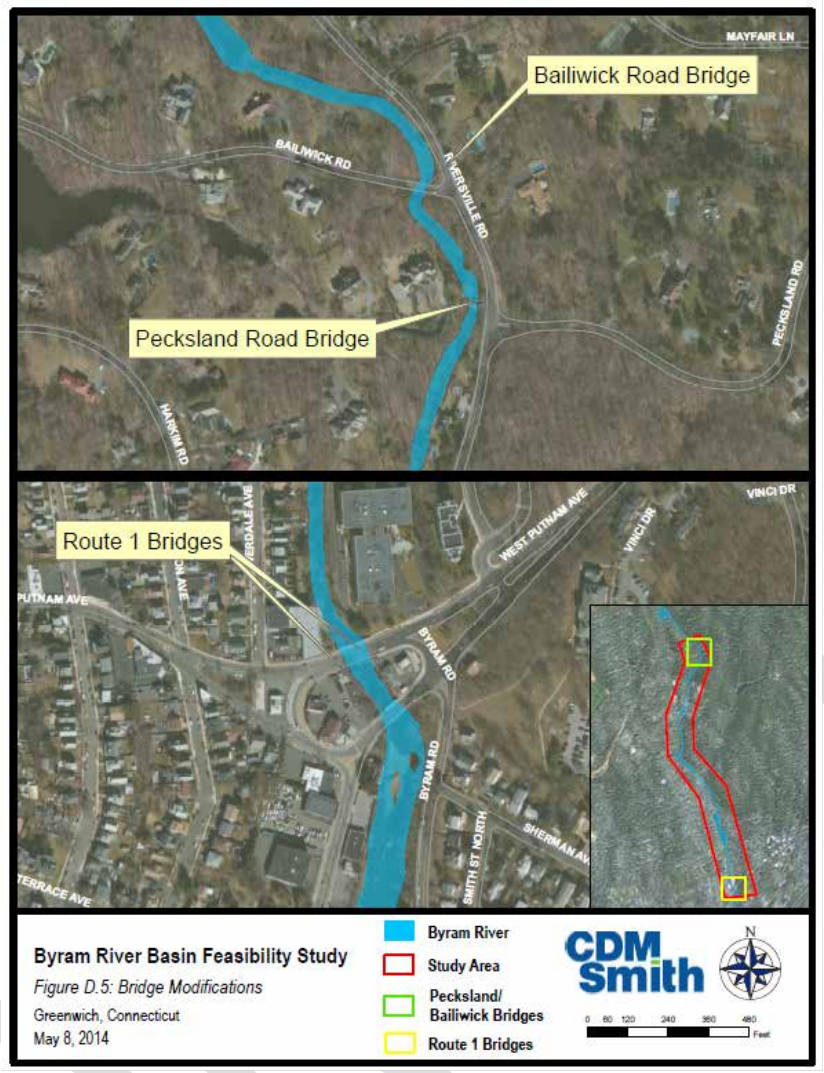

Figure 9: Locations of bridges considered for modifications

The removal of the Route 1 bridges results in a modeled water surface at the upstream face of the southbound bridge that is over 4.5 feet lower than existing conditions for the 1-percent flood.

To evaluate the potential for flood risk management associated with modifications to the private bridge near Pecksland Road and/or Bailiwick Road bridge, different modification scenarios were modeled. Under current conditions, the Pecksland Road private bridge completely controls upstream flooding for events larger than the 4-percent event. Raising the Pecksland Road private bridge by two feet increases the capacity of the structure to the 1-percent flood and decreases flooding by as much as two feet upstream. Modifications to the Bailiwick Road bridge would only have an impact on events smaller than the 2-percent event.

4. Diversions

Diversions involve rerouting floodwater either to a location downstream or to another waterway with adequate capacity. Diversions considered as part of the Byram Study include:

- Diversion of flow from the wetlands just downstream of I-684 and north of the Bedford Road culvert (Basin 01) to Rye Lake in the neighboring Bronx River watershed
- Diversion of flow from Comly Avenue to south of Route 1

Diverting the Byram River at the wetlands just south of I-684 removes 8.5 square miles of drainage area from the watershed. While this represents a significant portion (28%) of the overall watershed area, the removal does not significantly reduce the downstream discharge. This is because the diverted portion is primarily a less developed area, producing relatively less runoff than the other large sub-basins and the area currently discharges to a flat wetland area which stores storm runoff and significantly attenuates any contribution to the peak discharge downstream.

Diverting flows from Comly Avenue to Route 1 was evaluated to reduce flood conditions during a 1-percent storm event to approximately an existing 0.2-percent storm event. It was determined that to achieve this reduction a large box culvert of 12-foot high by 45-foot wide would be required to convey flow from Comly Avenue to Route 1 around the Pemberwick area. Due to the intensity of existing development within this region of the project area and estimated construction costs, this large culvert size was determined to be infeasible.

5. Detention Basins

Flood management through storage refers to providing an excavated area for runoff to be held prior to entering the project area. It was determined that a storage volume in excess of 1,500 acre-feet would be required to reduce flood impacts from a 1-percent storm event to impacts experienced during a 10-percent storm event. Two locations, one near the Merritt Parkway and another along Pemberwick Road, were considered for construction of a 150 acre storage pond 10 feet deep (Figure 10). As neither location was sufficient to accommodate the volume needed to reduce flood impacts to that of a 10-percent storm, an additional, more realistic storage scenario was evaluated near the Merritt Parkway.

The Merritt Parkway Storage area would require raising the existing dam at the Toll Gate Pond outlet. As an additional measure, major excavation could be done on the west bank all the way to the Merritt Parkway where a retaining wall would be necessary to support the road embankment. This would add an additional 19 acres of storage area, increasing the available storage of the project by nearly 70%.

The reduction in downstream peak discharge is at the cost of increased inundation upstream of the dam during extreme events. Due to limited areas applicable for storage, costs associated with acquiring and/or relocating properties, maintenance costs, and environmental impacts from tree clearing and land disturbances, storage was found to be an unsuitable solution for the level of flood Risk Management provided by these measures.

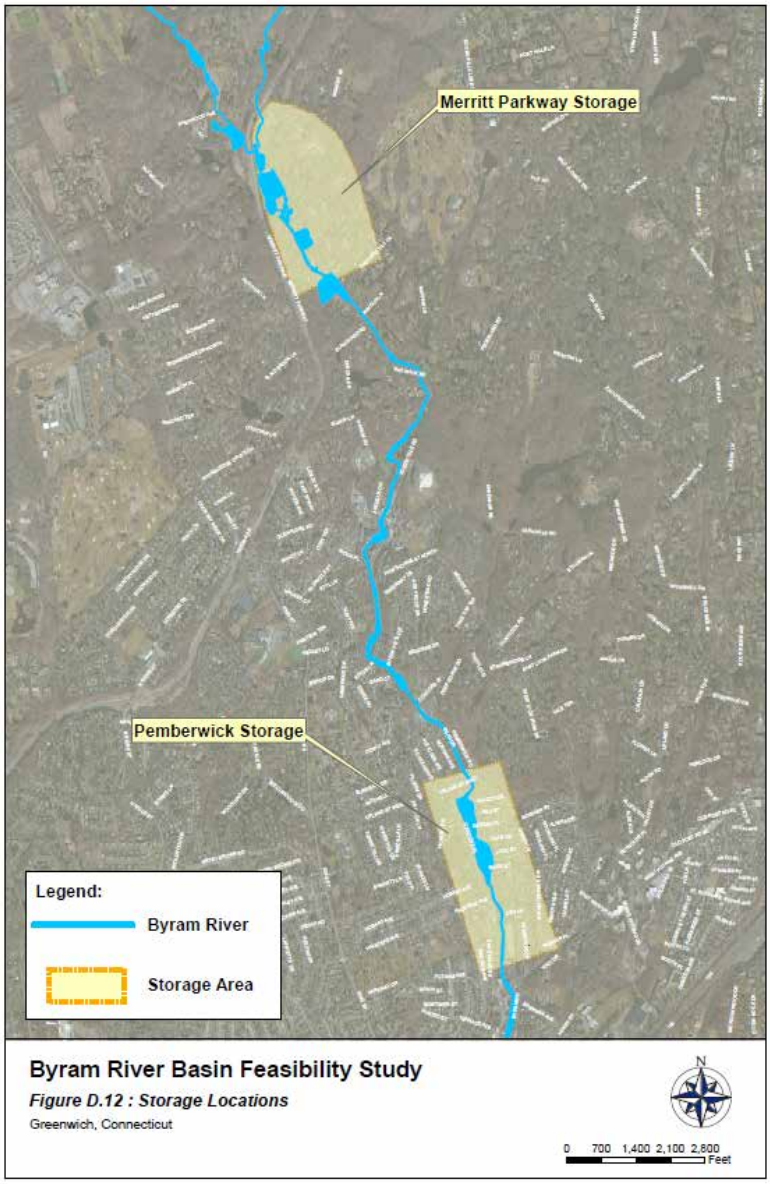

Figure 10: Locations considered for storage along the Byram River

6. Pumps

Some of the management measures listed previously, if utilized, would need to be implemented in conjunction with pump systems. It was determined that pumping was not a feasible solution due to the size of the pumping facility needed and the associated cost.

To reduce flow from a 1-percent storm event to a 10-percent storm event within the Pemberwick area, the pumping capacity requirement is approximately 3,450 cubic feet per second. To develop a conceptual level cost for a facility of this scale, similar facilities constructed (or planned for construction) were investigated. It was estimated that a facility with the desired capacity would cost in excess of $350 million to construct (not including land acquisition, permitting, design, and maintenance). Additionally, due to the space constraints in the area,

obtaining the land to pond water and construct the pumps would be difficult and costly; therefore pumps were determined to be infeasible.

Structural Measures Screening Summary: Of the structural measures considered, diversions and storage were screened out because of physical space constraints. There is not enough room for effective diversion or storage within the Byram River basin to address flooding in the Pemberwick or the Bailiwick Bridge areas; diversions and storage were also screened out at an early stage in the 1977 study for the same reasons, but were revisited for the current study due to requests received from dialogue with the public. Pumps were also considered because they were requested by the public. They were removed from consideration because the preliminary estimate of the construction cost was $350 million, which did not include the operation and maintenance that would be required. The structural measures that remained for consideration include levees and floodwalls, channel modifications, and bridge modifications.

3.9.2 Nonstructural Flood Risk Management Measures

Evaluation of nonstructural measures was performed for the 10-percent, 1-percent, and 0.2-percent storm events. Nonstructural flood proofing measures included in the evaluation were dry and wet flood proofing, ringwalls, elevation, and acquisition. Participation in non-structural solutions would be voluntary for the identified properties.

Structures impacted by the 10-percent storm event include flood proofing recommendations to protect against the 1-percent storm event. Of the 493 structures evaluated, 47 were recommended for nonstructural flood proofing for the 10-percent storm event, 202 for the 1-percent storm event, and 322 for the 0.2-percent storm event.

Nonstructural Measures Screening Summary

The screening of flood risk management measures included an assessment of the potential engineering, economic, environmental, public, financial, and institutional feasibility of implementing each measure. All of the nonstructural measures were retained for formulation of alternatives. The structural measures that remained for consideration include levees, floodwalls, channel modifications, and bridge modifications.

Those measures that are not entirely screened out are carried forward for more detailed analysis as alternative plan components. Based on the physical layout of the study area, the flood hydrology, and the profiles of structures at risk, the initial array of alternative plans were developed for consideration for application to flooding problems in the study area.

3.10 Evaluation of the Initial Array of Alternatives

Alternative plans are made up of management measures. The purpose of the evaluation step is to carefully examine each alternative plan and determine if it is worthy of additional consideration. Criteria used to evaluate a plan to determine if it qualifies for further consideration include all significant resources, outputs, and plan effects. Significant plan effects must include contributions to planning objectives and constraints. They also include the Federal Objective, environmental compliance requirements, the 1983 Principles and Guidelines Criteria four evaluation criteria, and other impacts important to the study team and stakeholders.

Based on results from the preliminary analysis of potential flood risk management measures, five alternatives were formulated:

- Alternative 1: No Action, as required by USACE regulations
- Alternative 2: Non-structural alternatives, as required by USACE regulations
  - Nonstructural treatments in the 10-percent floodplain
  - Nonstructural treatments in the 1-percent floodplain
- Alternative 3: An update of the structural plan identified in the 1977 Feasibility Report that includes levees and floodwalls
- Alternative 4: A structural alternative involving channel widening, bridge modifications, and levees and floodwalls that are smaller than those evaluated in Alternative 3

3.10.1 Alternative 1 – No Action Alternative

This plan fails to meet the objectives or needs for the majority of the project area. It will, however, provide the base against which project benefits are measured. The future without-project equivalent average annual damages is $2,143,000. Additionally, this plan would be implemented if project costs exceed project benefits, indicating that flood risk management measures are not in the Federal interest. The economic analysis of this alternative is presented in Table 5.

Table 5: Alternative 1 Preliminary Costs and Benefits

ALTERNATIVE		ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
1	No Action	$0	$0	$0	$0	-

3.10.2 Alternative 2 – Nonstructural

Non-structural measures are required to be evaluated during feasibility studies. The nonstructural flood damage reduction analysis involved looking at treatments of individual structures for two storm events (10-percent and 1-percent).

Under this alternative, a total of 493 structures were evaluated for nonstructural flood protection within the project area (Table 6). Table 7 shows the results of the preliminary economic analysis of the two nonstructural alternatives. Figure 11 and Figure 12 show the structures recommended for nonstructural treatments in the 1-percent floodplain.

Table 6: Summary of Nonstructural Alternative

FLOOD TREATMENT	NUMBER OF STRUCTURES REQUIRING TREATMENT FOR EACH FLOODPLAIN	
	10-PERCENT	1-PERCENT
Dry Flood Proofing	5	45
Wet Flood Proofing	1	93
Ringwall	10	12
Elevation	30	51
Buyout	1	1
Total	47	202

Table 7: Alternative 2 Preliminary Costs and Benefits

ALTERNATIVE	ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
Nonstructural treatments in the 10-percent floodplain	$851,000	$19,170,000	$799,000	$52,000	1.07
Nonstructural treatments in the 1-percent floodplain	$1,050,000	$33,169,000	$1,382,000	-$332,000	0.77

The preliminary economic analysis of nonstructural treatments in the 1-percent floodplain shows that the costs outweigh the benefits and that the BCR is below one; therefore, the alternative is not economically justified. The preliminary economic analysis of nonstructural treatments in the 10-percent floodplain shows that the benefits outweigh the costs and that the BCR is above one; therefore, the alternative will be retained for further detailed economic analysis in the final array of alternatives.

Implementing nonstructural measures in the 10-percent floodplain meets the overall project objective of reducing storm damage in the Town of Greenwich. However, as the measures only protect buildings and structures from flooding, considerable residual damage would remain after a storm (i.e. to the infrastructure and vehicles), and significant emergency personnel activity would be required. The non-structural features will not obstruct water views, nor will waterfront access need to be modified.

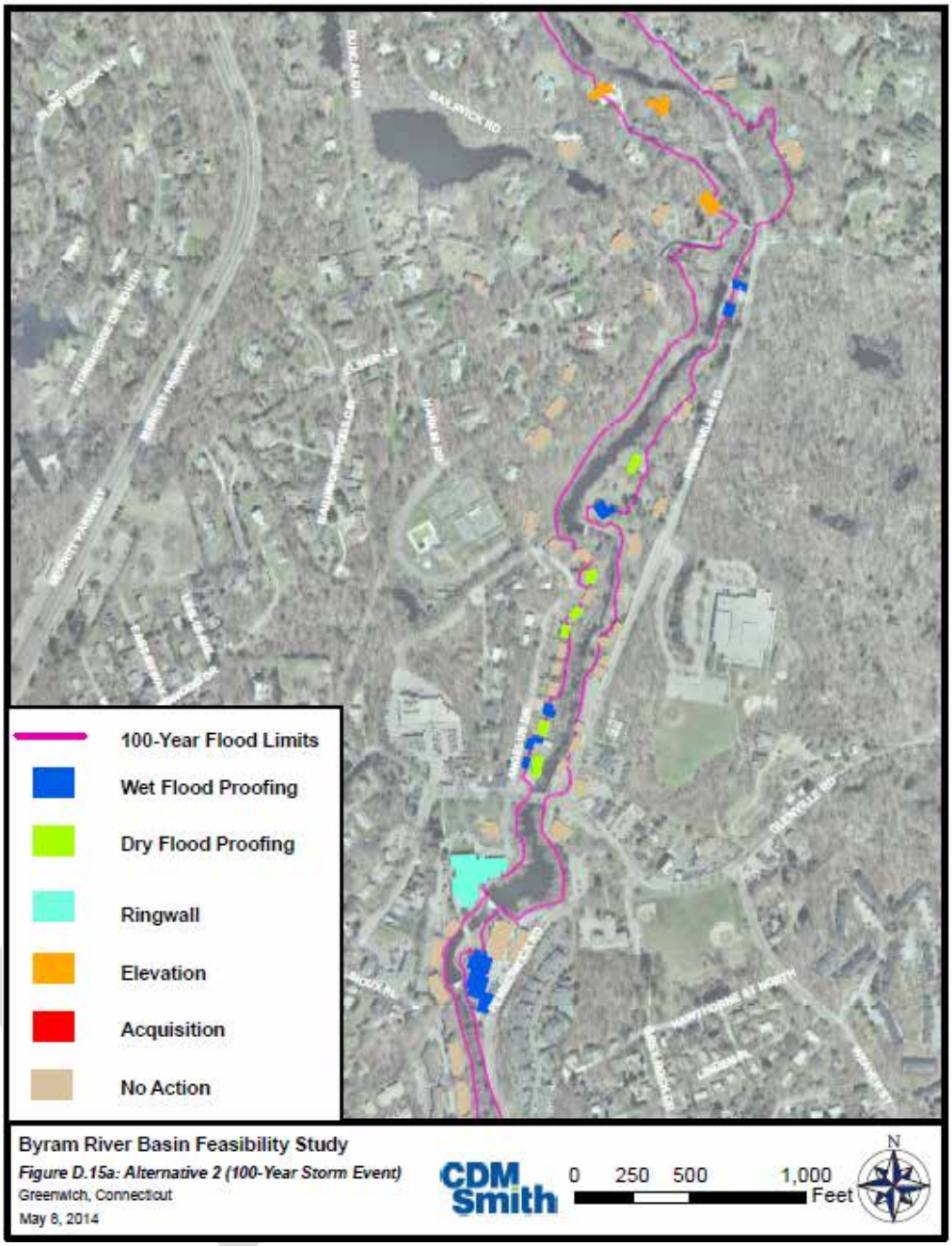

Figure 11: Nonstructural Treatments in the 1-percent Floodplain in the Bailiwick Area

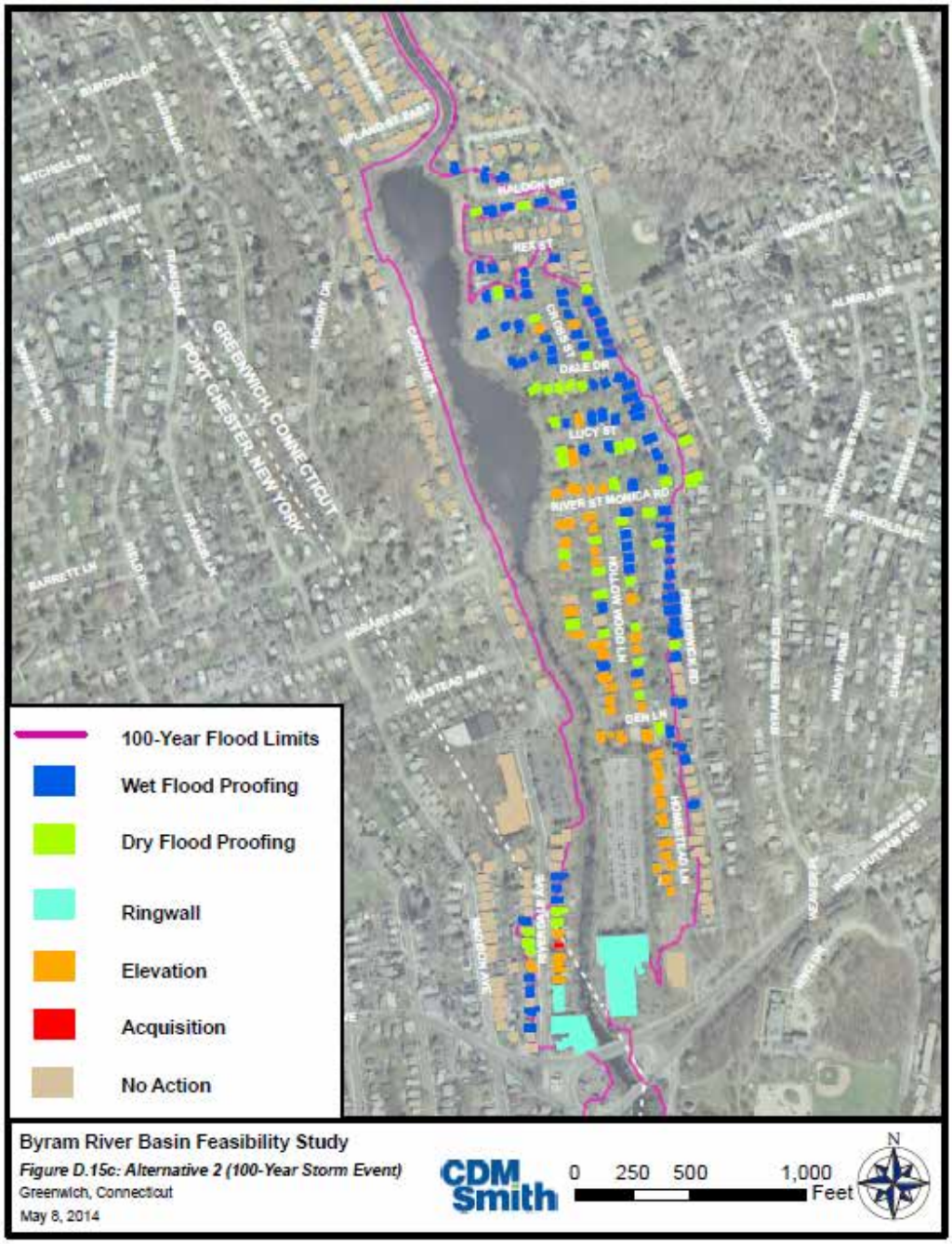

Figure 12: Initial Array Nonstructural Treatments in the 1-percent Floodplain in the Pemberwick Area

3.10.3 Alternative 3 – Structural (1977 updated) – Levees, floodwalls, and channel work

Alternative 3 includes the structural alternative formulated using Federal recommendations from the 1977 Feasibility Report. The 1977 Reconnaissance Report recommended levees, floodwalls, and channel work for our current study area; the plan also included ponding areas, pumping stations, storm drainage interceptors, and other associated interior drainage facilities (Figure 13). The 1977 recommended plan was not implemented due to lack of non-Federal support.

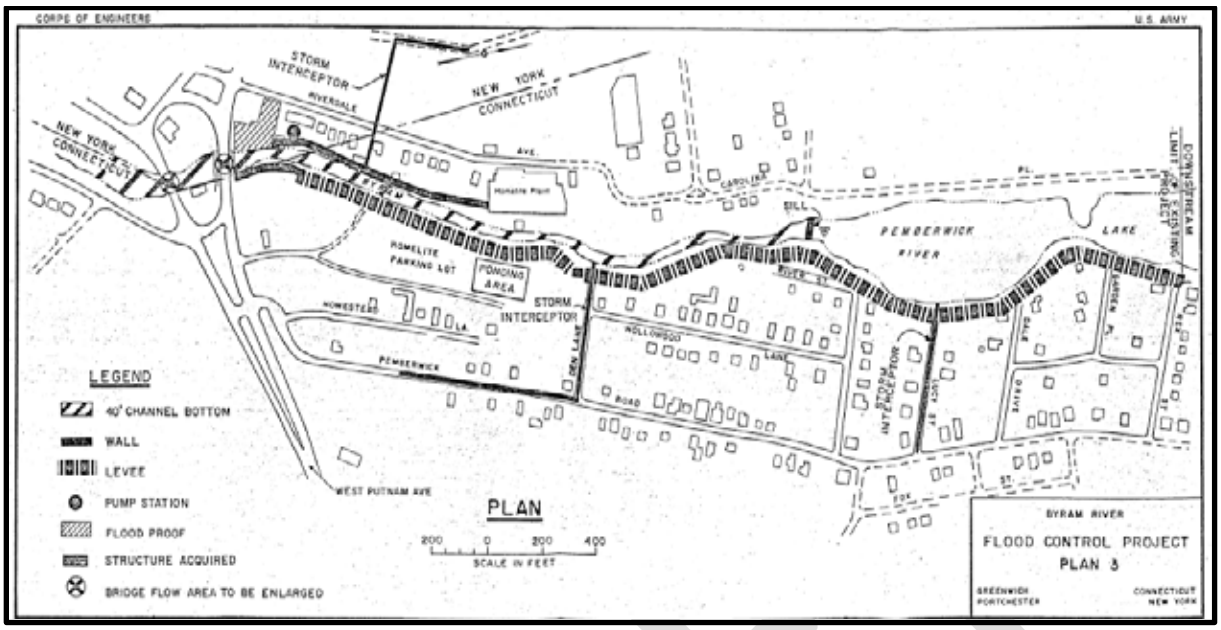

Figure 13: Plan Recommended in 1977 Reconnaissance Report

For Recommendations from the 1977 Feasibility Report have been updated to accommodate existing conditions. Recommendations in the current study include dredging, channel modifications, and construction of floodwalls and levees to reduce flooding risk (Figure 14). The proposed floodwalls have a top elevation of 19 to 20 feet NAVD88. The existing levee near Rex Street would need to be raised by an average of two feet. Some parts of the 1977 Feasibility Study alignment were changed from levee to floodwalls because of residential or commercial development since 1977. All modifications made to the channel profile were consistent with recommendations presented in the 1977 Feasibility Report. Dredging would begin approximately 700 feet downstream of the northbound Route 1 bridge and extends north for approximately 3,200 feet, matching the existing channel bottom at approximately River Street. In addition to the channel modifications, a concrete sill was also added at the mouth of Caroline Pond. Alternative 3 also includes non-structural treatments in the Bailiwick Bridge damage area on structures for which the treatments would be economically justified.

The preliminary economic analysis of Alternative 3 in Table 8 shows that the costs outweigh the benefits and that the BCR is below one; therefore, the alternative is not economically justified.

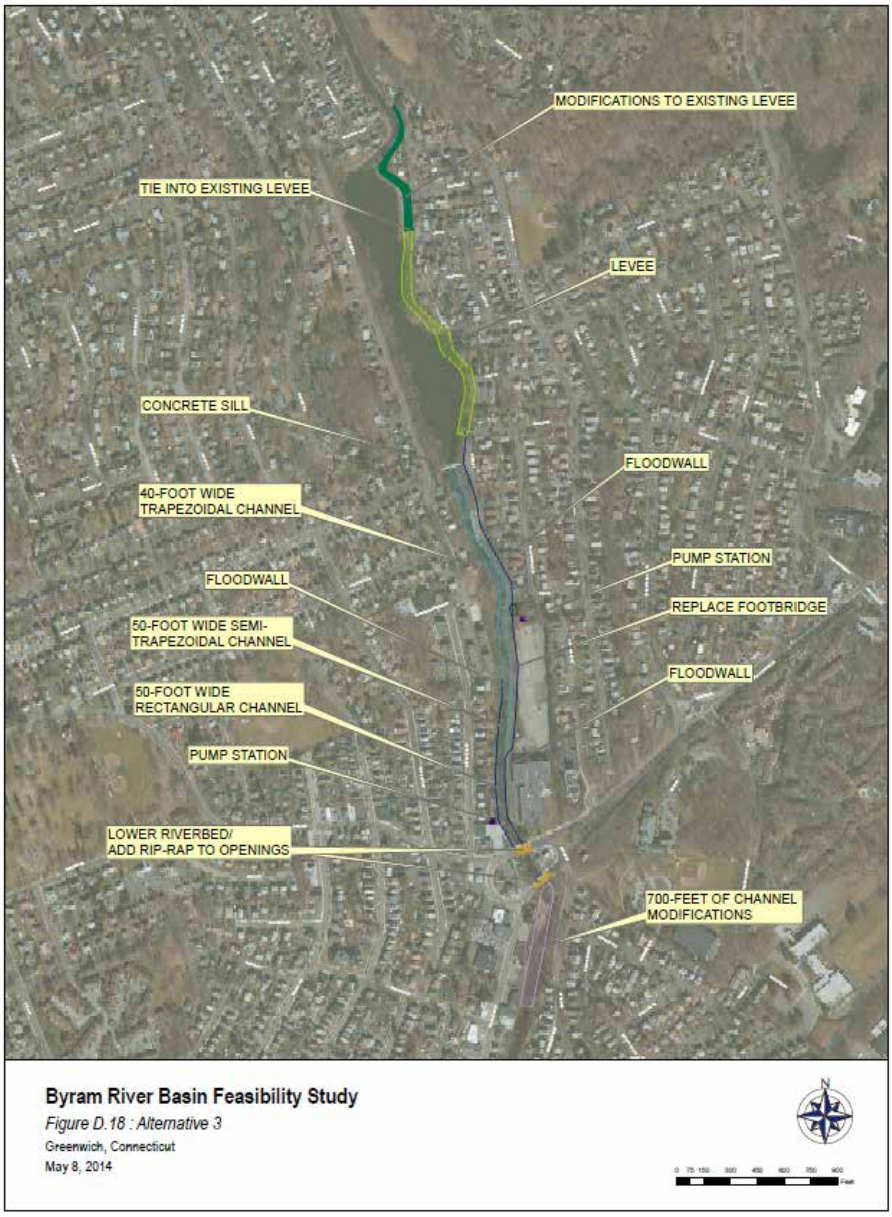

Figure 14: Alternative 3 Plan

Table 8: Alternative 3 Preliminary Costs and Benefits (FY16)

ALTERNATIVE 3	ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
Update of 1977 Plan – Levees & Floodwall	$2,467,000	$98,896,000	$4,328,000	-$1,861,000	0.57

3.10.4 Alternative 4 – Smaller levees and floodwalls with bridge removals and replacement and channel widening

Alternative 4 incorporates many of the features used in Alternative 3 including dredging, channel modifications, and construction of floodwalls and levees, and also includes the replacement of both Route 1 bridges that are owned and operated by the New York State Department of Transportation (Figure 15). This plan is designed to reduce flooding risk in the 1-percent floodplain. The crown elevations needed for the floodwalls and levees in Alternative 4 are lower than those needed in Alternative 3 because the removal and replacement of both Route 1 bridges increases the conveyance of water under the bridges and downstream. Allowing more water to move under the bridges would prevent the water from backing up at the bridges and decrease the water surface elevation upstream of the bridges.

The levee and floodwalls' top elevation in Alternative 4 could be reduced by up to 3.5 feet from the levees and floodwalls proposed in Alternative 3. Under Alternative 4 the existing levee would be need to be modified to insure the proper level of flood risk management. The proposed sill at the mouth of Caroline Pond discussed in Alternative 3 will also be included in Alternative 4 along with the removal and replacement of a small footbridge upstream of the Route 1 bridges.

The preliminary economic analysis of Alternative 4 in Table 9 shows that the costs outweigh the benefits and that the BCR is below one; therefore, the alternative is not economically justified.

Table 9: Alternative 4 Preliminary Costs and Benefits

ALTERNATIVE 4	ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
Levee & Floodwall, Route 1 Bridges	$2,601,000	$101,646,000	$4,236,000	-$1,635,000	0.58

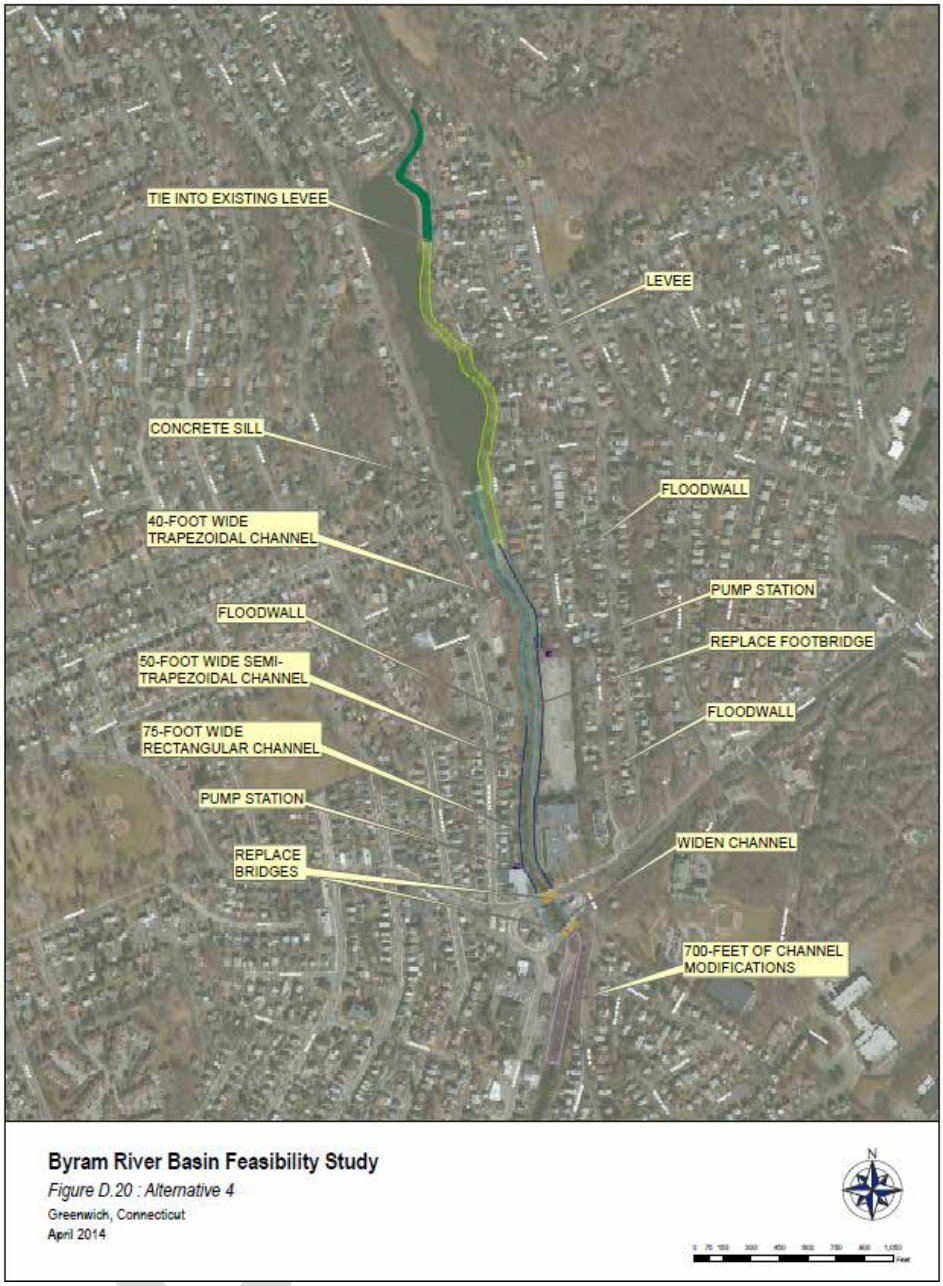

Figure 15: Alternative 4 Plan

3.10.5 Summary of the Initial Array Evaluation

The preliminary economic analysis of Alternatives 3 and 4 showed that the plans have more costs than benefits, or a benefit cost ratio of less than one. This preliminary analysis does not include additional costs such as real estate and cultural resources; these additional costs would only lower the benefit cost ratio. Therefore, the study team determined that Alternatives 3 and 4 were not economically viable options to address flooding risk in the Byram River Basin study area and removed the alternatives from further analysis.

A brief summary of the magnitude of impacts the alternatives that are being carried forward are likely to have on environmental and socioeconomic resources is presented below. Table 10

defines the criteria used to identify magnitude of the potential impacts. Table 11 and Table 12 summarize the impacts of the alternatives on the various environmental and socioeconomic resources.

Table 10: Defining Criteria for Scale of Impacts

IMPACT SCALE	CRITERIA
No Effect	The resource area would not be affected and there would be no impact.
Negligible	Changes would either be non-detectable or, if detected, would have effects that would be slight and local. Impacts would be well below regulatory standards, as applicable.
Minor	Changes to the resource would be measurable, but the changes would be small and localized. Impacts would be within or below regulatory standards, as applicable. Mitigation measures would reduce any potential adverse effects.
Moderate	Changes to the resource would be measurable and could have either localized or regional scale impacts. Impacts would be within or below regulatory standards, but historical conditions would be altered on a short-term basis. Mitigation measures would be necessary, and the measures would reduce any potential adverse effects.
Major	Changes to the resource would be readily measurable and would have substantial consequences on regional levels. Impacts would exceed regulatory standards. Mitigation measures to offset the adverse effects would be required to reduce impacts, though long-term changes to the resource would be expected.

Table 11: Scale of Initial Array's Impacts to Environmental Resources

	1 – No Action	2 – Nonstructural 1% and 10%
WATER RESOURCES	No Effect	No Effect
VEGETATION	No Effect	Negligible
FISH AND WILDLIFE	No Effect	No Effect
CULTURAL RESOURCES	No Effect	Minor
AIR QUALITY	No Effect	Negligible
TOPOGRAPHY	No Effect	No Effect
HTRW	Minor	No Effect

Table 12: Scale of Impacts to Socioeconomic Resources

	1 – No Action	2 – Nonstructural 1% and 10%
RECREATION	No Effect	No Effect
AESTHETICS	No Effect	Negligible
SOCIOECONOMIC/ ENV. JUSTICE	Moderate	Negligible
TRANSPORTATION	Minor	Minor
NOISE	No Effect	Moderate

The No Action Alternative has no effect on the majority of environmental and socioeconomic resources; there are negative impacts to socioeconomics/environmental justice, transportation, and HTRW because the roads subject to flooding along the Byram River will continue to experience flooding. The nonstructural alternatives do not interfere with the existing floodplains and therefore would not impact water resources or fish and wildlife. There would be only negligible and minor effects on vegetation and cultural resources as the project footprint would be localized to individual, already developed properties. The nonstructural impacts to socioeconomic resources would be minimal except for noise; however, the noise impacts would only be experienced during the construction duration.

3.11 Evaluation of the Final Array of Alternatives

The final array of alternatives consists of the alternative plans that made it through the evaluation of the initial array and are analyzed at a more refined level. Three main changes occurred between the initial and final array of alternatives:

1. Alternative 3 and Alternative 4 were removed from further consideration because the evaluation of the initial array showed that they are not cost effective options.
2. The analysis of Alternative 2 was expanded by analyzing the costs and benefits associated with the 2-percent and 4-percent floods in addition to the 10-percent and 1-percent events analyzed in the initial array.
3. The removal and replacement of the Route 1 bridges included in Alternative 4 was broken out to be analyzed on its own as a separate alternative; this became Alternative 5. Removal and replacement of the Route 1 bridges was also analyzed in conjunction with nonstructural measures in the resulting 10-percent, 4-percent, 2-percent, and 1-percent floodplains as Alternatives 5a, 5b, 5c, and 5d.

With the three changes mentioned above, the final array of alternatives consists of ten alternative plans:

- Alternative 1: No Action, as required by USACE regulations
- Alternative 2a: Nonstructural treatments in the 10-percent floodplain
- Alternative 2b: Nonstructural treatments in the 4-percent floodplain
- Alternative 2c: Nonstructural treatments in the 2-percent floodplain
- Alternative 2d: Nonstructural treatments in the 1-percent floodplain
- Alternative 5: Route 1 bridge removals and replacements
- Alternative 5a: Route 1 bridge removals and replacements and nonstructural treatments in resulting 10-percent floodplain
- Alternative 5b: Route 1 bridge removals and replacements and nonstructural treatments in resulting 4-percent floodplain
- Alternative 5c: Route 1 bridge removals and replacements and nonstructural treatments in resulting 2-percent floodplain
- Alternative 5d: Route 1 bridge removals and replacements and nonstructural treatments in resulting 1-percent floodplain

3.11.1 Alternative 1 – No Action Alternative

The no action alternative was kept for comparison purposes. The plan still provides no economic benefits to the study area (Table 13).

Table 13: Alternative 1 Costs and Benefits

ALTERNATIVE	ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
1 No Action	$0	$0	$0	$0	-

3.11.2 Alternative 2 – Nonstructural

The economic analysis of Alternative 2 was refined from its original analysis in the initial array of alternatives. The structure inventory was updated and refined to more accurately represent the study area. These updates include applying land surveyed first floor and ground elevations to a majority of the structures, determining structure depreciated replacement values with Marshall & Swift valuation services, and eliminating errors that resulted in double counting structure damages obtained from flood events. The net effect of these updates decreased the without-project damages that can be prevented and therefore the benefits and associated BCRs calculated with the analysis of the final array have decreased. Additionally, in order to investigate the possibility of capturing more benefits, the 4-percent and 2-percent flood events were added to the analysis (Table 14).

Table 14: Alternative 2a, 2b, 2c, and 2d Refined Costs and Benefits

ALTERNATIVE	ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
2a Nonstructural in 10-percent floodplain	$434,000	$18,444,000	$701,000	-$268,000	0.62
2b Nonstructural in 4-percent floodplain	$559,000	$29,745,000	$1,131,000	-$572,000	0.49
2c Nonstructural in 2-percent floodplain	$1,337,000	$36,962,000	$1,405,000	-$68,000	0.95
2d Nonstructural in 1-percent floodplain	$1,358,000	$42,605,000	$1,620,000	-$262,000	0.84

The refined economic analysis indicates that Alternatives 2a, 2b, 2c, and 2d each have costs that outweigh their benefits and have a BCR below one. Nonstructural measures in the 10-percent floodplain, which was previously found to be economically justified during the evaluation of the initial array of alternatives, was found to be economically unjustified during this analysis due to the structure inventory updates.

3.11.3 Alternative 5 – Bridge Removals and Replacements and Nonstructural Treatments

Alternative 5 consists of five different sub-alternatives by combining the removal of the Route 1 bridges with nonstructural measures. The removal of the Route 1 bridges modifies the floodplains behind the bridge; the resulting floodplains from removing the bridges was determined and the structures were reevaluated within the new floodplain limits for nonstructural flood proofing. The resulting alternatives were the removal of the Route 1 bridges with minor channel improvements in conjunction with nonstructural treatments in the resulting 10-percent, 4-percent, 2-percent, and 1-percent floodplains. The bridges to be removed carry the local traffic of Route 1 as well as I-95 traffic during emergencies, so the bridges must be replaced after they are demolished. The new bridges will be built within the same footprint at a higher elevation and without any piers that enter the floodway in order to reduce restrictions to river flow.

Besides reducing the risk of flooding damages, there is an additional benefit for the alternatives that include replacing the Route 1 bridges as a measure. The benefit is the extension of the serviceable life of the bridges and the subsequent postponement of the bridge replacements by 25 years. Since the costs of the new bridges are included in the first costs of the project, a credit is needed on the benefit side, which is accomplished by the advanced bridge replacement benefit calculation. Replacing the Route 1 bridges early adds an additional $303,000 in annualized benefits to the economic analysis of Alternative 5. Please see the Economics Appendix for more details about the advanced bridge replacement benefit.

The number of structures that would receive the various types of nonstructural treatments for each floodplain in conjunction with removal of the Route 1 bridges is found in Table 15. The economic analysis of Alternatives 5, 5a, 5b, 5c, and 5d are shown in Table 16.

Table 15: Summary of Nonstructural Flood Mitigation Recommendations with Route 1 Bridge Removal and Replacement

ALTERNATIVE		FLOOD PROTECTION				
		DRY FLOOD PROOFING	WET FLOOD PROOFING	RINGWALL	ELEVATION	TOTAL
5a	Nonstructural in resulting 10-percent floodplain	9	8	9	15	41
5b	Nonstructural in resulting 4-percent floodplain	35	29	11	22	97
5c	Nonstructural in resulting 2-percent floodplain	47	60	12	22	141
5d	Nonstructural in resulting 1-percent floodplain	59	90	12	22	183

Table 16: Alternative 5, 5a, 5b, 5c, and 5d Costs and Benefits

ALTERNATIVE		ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
5	Replacement of Route 1 Bridges	$1,071,000	$24,302,000	$949,000	$122,000	1.13
5a	Route 1 Bridges w/ nonstructural in resulting 10% floodplain	$1,305,000	$42,877,000	$1,715,000	-$410,000	0.76
5b	Route 1 Bridges w/ nonstructural in resulting 4% floodplain	$1,325,000	$46,749,000	$1,862,000	-$537,000	0.71
5c	Route 1 Bridges w/ nonstructural in resulting 2% floodplain	$1,339,000	$52,502,000	$2,081,000	-$741,000	0.64
5d	Route 1 Bridges w/ nonstructural in resulting 1% floodplain	$1,355,000	$58,319,000	$2,302,000	-$947,000	0.59

The economic analysis indicates that the removal and replacement of the Route 1 bridges in conjunction with nonstructural measures does not have benefits that outweigh their costs in any

of the resulting floodplains. Since the benefit cost ratio is below one, Alternatives 5a, 5b, 5c, and 5d are not economically justified as flood risk management plans. Alternative 5, removal and replacement of the Route 1 bridges without any nonstructural measures is economically justified with benefits that outweigh its costs. Alternative 5 has average annual net benefits of about $122,000 and a BCR of 1.13.

3.12 Identification of the Tentatively Selected Plan

3.12.1 The Federal Objective

Per the 1983 Principles and Guidelines, the Federal objective of water and related land resources project planning is to "contribute to national economic development consistent with protecting the Nations' environment, pursuant to national economic development consistent with protecting the Nations' environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements."

3.12.2 1983 Principles and Guidelines Criteria

The 1983 Principles and Guidelines require that plans are formulated in consideration of four criteria: **completeness**, **effectiveness**, **efficiency**, and **acceptability**.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to realization of the contributions to the objective.

The alternatives in the final array were evaluated with consideration of necessary investments and other actions. The plans were looked at for environmental, traffic, and cultural resource impacts, as well as the costs associated with mitigating those impacts and acquiring the required real estate for implementation.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

All of the actionable alternatives in the final array alleviate the problem of flooding from the Byram River and achieve the study opportunities to reduce flood damages to residents, property, and infrastructure, and reduce damages related to isolation from flooded roads. Therefore, Alternatives 2 and Alternatives 5 are effective.

Efficiency is the extent to which an alternative plan is the most cost effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

Efficiency was measured through a comparison of BCRs, reduced damages, and benefits from the project, as described in Section 3.12. This comparison revealed that only Alternative 5 is efficient.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

The study team formulated the alternatives in accordance with applicable laws and regulations. One important facet of acceptability is implementability, which is the feasibility of a plan in the technical, environmental, economic, social, and similar senses. The actionable alternative plans meeting the acceptability criteria.

It is necessary to know the preliminary benefits and costs of the alternatives in order to assess their effectiveness and efficiency. Accordingly, the annualized costs and benefits for Alternatives 1, 2a through 2b, and 5 through 5d are presented in Table 17.

Table 17: Summary Economics of Alternatives 2 and Alternatives 5

ALTERNATIVE	ANNUAL BENEFITS	TOTAL FIRST COST	TOTAL ANNUAL COST	NET BENEFITS	BCR
2a	$434,000	$18,444,000	$701,000	-$268,000	0.62
2b	$559,000	$29,745,000	$1,131,000	-$572,000	0.49
2c	$1,337,000	$36,962,000	$1,405,000	-$68,000	0.95
2d	$1,358,000	$42,605,000	$1,620,000	-$262,000	0.84
5*	$1,071,000	$24,302,000	$949,000	$122,000	1.13
5a*	$1,305,000	$42,877,000	$1,715,000	-$410,000	0.76
5b*	$1,325,000	$46,749,000	$1,862,000	-$537,000	0.71
5c*	$1,339,000	$52,502,000	$2,081,000	-$741,000	0.64
5d*	$1,355,000	$58,319,000	$2,302,000	-$947,000	0.59

*All bridge replacement alternatives include annualized advanced bridge replacement benefits of $303,000

Consideration of the BCRs shows that the only alternative that is cost effective is Alternative 5, removal and replacement of the Route 1 bridges (Table 18).

Table 18: Summary of Consideration of Principles and Guidelines Criteria

ALTERNATIVE	COMPLETENESS	EFFECTIVENESS	EFFICIENCY	ACCEPTABILITY
1 - No Action	N	N	N	N
2a, 2b, 2c, 2d	Y	Y	N	Y
5, 5a, 5b, 5c, 5d	Y	Y	Y	Y

The study team carefully analyzed and compared all of the alternatives for completeness, their effectiveness at alleviating flooding problems, their benefits and costs, and their legality. While the nonstructural alternatives were complete, effective, and acceptable, the bridge removal of Alternative 5 is more efficient because it has more net benefits.

3.12.3 Summary of the Final Array Evaluation

After considering the Federal Objective, the Principles and Guidelines criteria, and environmental effects of the final array of alternatives, the study team identified Alternative 5 as the national economic development plan and tentatively selected plan.

This section also provides a brief summary of the magnitude of impacts the final array of alternatives are likely to have on environmental and socioeconomic resources. The criteria were previously defined in Table 10 located in Section 3.10.5. Table 19 and Table 20 summarize the impacts of the alternatives on the various environmental and socioeconomic resources.

Table 19: Scale of Final Array's Impacts to Environmental Resources

ALTERNATIVE	1– No Action	2a 2b 2c 2d	5, 5a, 5b, 5c, 5d
WATER RESOURCES	No Effect	No Effect	Minor
VEGETATION	No Effect	Negligible	Minor
FISH AND WILDLIFE	No Effect	No Effect	Minor
CULTURAL RESOURCES	No Effect	Moderate	Major
AIR QUALITY	No Effect	Negligible	Negligible
TOPOGRAPHY	No Effect	No Effect	Negligible
HTRW	Minor	Minor	No Effect

Table 20: Scale of Final Array's Impacts to Socioeconomic Resources

ALTERNATIVE	1– No Action	2a 2b 2c 2d	5, 5a, 5b, 5c, 5d
RECREATION	No Effect	No Effect	Minor
AESTHETICS	No Effect	Negligible	Moderate
SOCIOECONOMIC/ ENV. JUSTICE	Moderate	Negligible	Negligible
TRANSPORTATION	Minor	Minor	Major
NOISE	No Effect	Moderate	Moderate

3.12.4 Trade-Off Analysis

The implementation of the Tentatively Selected Plan has short term and long term tradeoffs. In the short term, the removal of the old Route 1 bridges and construction of the new Route 1 bridges will create impacts associated with construction including noise, air pollution, as well as traffic and recreation impacts; the majority of these impacts will occur in Port Chester, NY

where the bridges are located (for more information, see Section 6). However, in the long term, the Tentatively Selected Plan will decrease the risk of flooding in the Town of Greenwich and traffic will not be negatively impacted.

While the removal of the Route 1 bridges will result in a decreased risk of flooding, the bridges that will be subsequently constructed in their place will not be historic bridges. Efforts are being made to make the replacement bridges similar in appearance to the current structures, however, the replacement bridges will be different and there will no longer be historic value.

4. Tentatively Selected Plan

The Tentatively Selected Plan (TSP) for flood risk management at Byram River is Alternative 5, removing the Route 1 bridges that straddle the Byram River in Port Chester, NY and replacing them at a higher elevation to allow more water to pass underneath. In the existing condition, the wide piers supporting the bridges and the low road profile constrict the flow of water; this causes water to build up behind the bridge, increases the water surface elevation, and causes properties to flood. Since the Route 1 bridges carry the local traffic of Route 1 as well as Interstate 95 traffic during emergencies, the bridges must be replaced after they are demolished. The Route 1 bridges would be replaced with two bridges in the same location that have roadway profiles about three feet higher than the existing profile and do not have center piers (Figure 16). The plan also includes minor channel improvements to remove accumulated sediment. The TSP would decrease the extent of the floodplain and reduce the water surface elevation behind the bridges during storm events, resulting in decreased risk of damages to structures. The exact details of the bridge removals and replacements may be adjusted as part of the optimization process to follow the public and agency reviews of this Draft Report.

The Route 1 bridges are owned and operated by the New York State Department of Transportation. The non-Federal cost sharing partner(s) for implementation is being coordinated and has not been identified as of the release of this Draft Report.

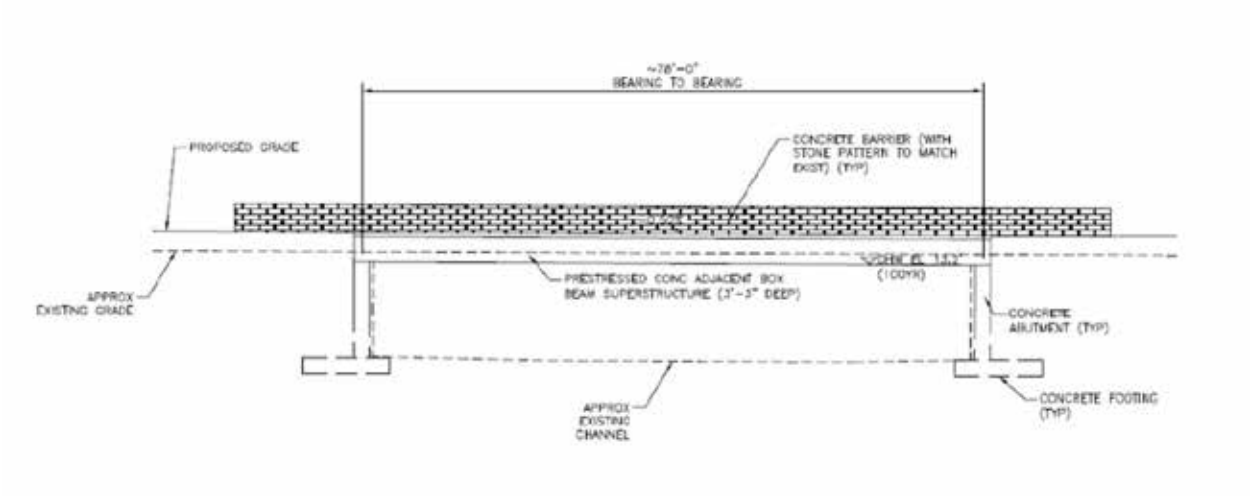

Figure 16: Concept design of Replacement of the Route 1 Bridges

4.1 Benefits of the Plan

Removing the Route 1 bridges and replacing them with bridges with higher bridge decks and no abutments will lower the water surface elevation behind the bridges during rain events. For example, the water surface elevation would decrease by two to four feet during for the 1-percent flood event. Minor channel improvements around the bridge abutments are also proposed to improve the hydraulic efficiency of the river channel. The TSP would decrease the extent of the 1-percent floodplain (Figure 17) and reduce the water surface elevation behind the bridges during storm events, resulting in decreased risk of damages to structures; for more information, please see Appendix B2 - Hydraulics.

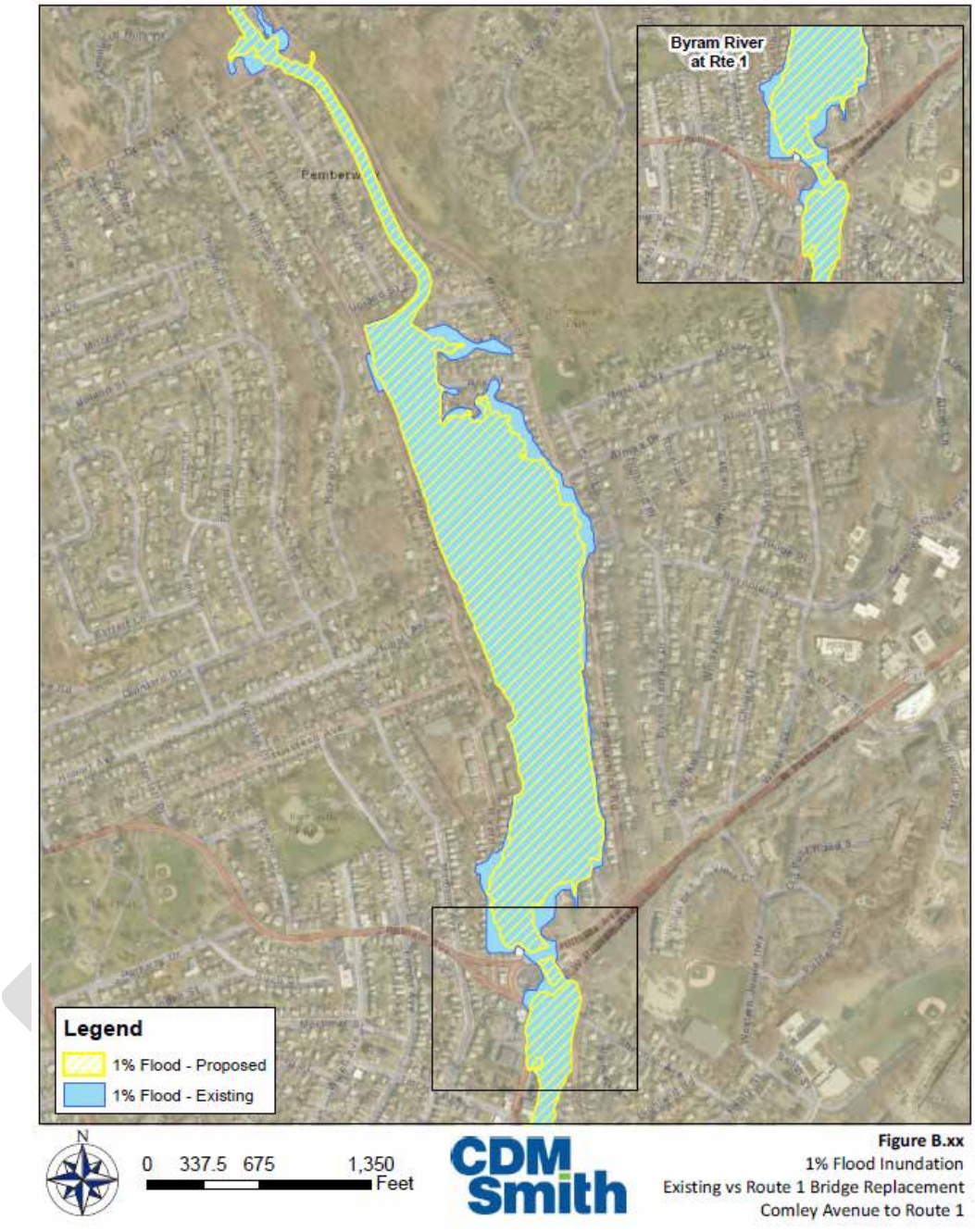

Figure 17: Existing 1-percent Floodplain and Resulting 1-percent floodplain with TSP

The figure shows how the 1-percent floodplain would change between the with- and without-project conditions. The difference between the floodplains does not appear significant because of the steep topography of the area; however, the removal of the Route 1 bridges would lower the water surface elevation within the floodplain. This decrease in water surface elevation would result in the removal of 45 structures with first floor flooding from the 1-percent floodplain, or about which is 66% of the structures that experience first floor flooding in the without-project condition.

The future without-project equivalent annual damages are about $2,143,000 and the Tentatively Selected Plan would decrease the equivalent annual damages by about $770,000. Coupled with $303,000 in annualized benefits received from extending the life of the bridges, the average annual economic risk in the area would decrease by about 50%.

Additionally, Riverdale Avenue along the west side of the Byram River upstream of the Route 1 bridges would experience a decrease in flooding. Water depths at the low spots on the road are expected to decrease by over 3.5 feet during a 1-percent flood event. This will help vehicular traffic, including emergency services, reach the area during flood events.

4.2 Cost Estimate

A summary of the costs of the Byram TSP is presented in Table 21 and Table 22.

Table 21: Summary of TSP Costs

CATEGORY	COSTS
Project First Costs	$24,302,000
Interest During Construction	$643,000
Total Investment Costs	$24,945,000
Annualized Investment Costs	$924,000
Annual Operations and Maintenance Costs	$25,000
Total Average Annual Costs	$949,000
Expected Average Annual Without-Project Damages	$2,143,000
Expected Average Annual With-Project Damages	$1,375,000
Annualized Benefits	$1,071,000
Total Average Annual Net Benefits	$122,000
Benefit Cost Ratio	1.13

Table 22: Total First Costs for Byram (FY18 P.L.)

ACCOUNT/FEATURE	AMOUNT
01 – Lands and Damages	$1,433,000
02 – Relocations	$9,829,000
06 – Fish and Wildlife Facilities	$39,000
08 – Roads, Railroads, & Bridges	$5,533,000
18 – Cultural Resource Preservation	$1,732,000
30 – Planning, Engineering, & Design	$4,000,000
31 – Construction Management	$1,736,000
Total	$24,302,000

4.3 Operations, Maintenance, Repair, Replacement, & Rehabilitation Considerations

Although new Route 1 bridges will be self-sustaining, some periodic maintenance will be required. The annual operation and maintenance costs include annual inspections and maintenance of the project. Total annual Operations and Maintenance costs are estimated to be lower than $25,000, which is the annual operation and maintenance cost for the existing bridges.

4.4 Risk and Uncertainty Analysis

4.4.1 Residual Risk

Flood risk to people and structures at any location in a floodplain is the function of flood hazard at the location, and their exposure and vulnerability to the flood hazard. Residual risk is the flood risk that remains after the selected plan is in place. It is the exposure to loss remaining after other known risks have been countered, factored in, or eliminated. No flood risk management project will ever eliminate all flood risk to life and property.

The risk of damages from fluvial flooding from the Byram River will reduce the future without-project equivalent average annual damages of $2,143,000 by about $770,000. Coupled with $303,000 in benefits received from extending the life of the bridges, the average annual economic risk in the project area would decrease by about 50%. The majority of these benefits would occur in the Pemberwick area.

Post-disaster assistance and aid for owners of these properties may come from other Federal agencies, such as FEMA and the U.S. Department of Housing and Urban Development (USHUD), or from programs run by the State of Connecticut.

The risk of coastal storm damage would not be reduced by the Tentatively Selected Plan because this is a fluvial study. Areas that experience tidal flooding would not benefit from the project.

4.4.2 Climate Change and Sea Level Rise

The proposed Route 1 bridges will substantially decrease water level stages within the vicinity of Route 1. Regardless of potential future climate changes, there will still be a net improvement in implementation of the proposed design.

A review of temperature, precipitation, and stream flow data indicate climate change will likely have none or minimal impacts on inland hydrology, or streamflow from precipitation, for this project. The results suggest that the balance between increasing temperatures and increasing precipitation simultaneously may contribute to the lack of streamflow sensitivity to changes in climate.

The southern portion of the project footprint is at the extreme northern reach of the tidal influence.Changes in sea levels due to climate variability may cause the project to be tidally influenced in the future. A rise in water surface elevation through changes in sea levels may exacerbate flood damages from both rainfall and coastal surge events. Table 23 shows a brief summary of how sea level change may affect the water surface elevation of the 1-percent flood at different sea level rise scenarios. Please see Appendix B2- Hydraulics for more detail.

Table 23: Sea Level Change Analysis of With-Project Water Surface Elevations

LOCATION	1-PERCENT FLOOD STAGE (FT), ROUTE 1 BRIDGE REMOVAL			
	NO SLR	LOW SCENARIO	INTER. SCENARIO	HIGH SCENARIO
Upstream of North bridge	14.37	15.75	15.75	16.8
Immediately upstream of North Bridge	14.04	15.53	15.53	16.62
In between bridges	12.69	14.28	14.28	15.31
Immediately downstream of South Bridge	12.35	12.49	12.75	14.26
Downstream of South bridge	12.35	12.5	12.77	14.31

4.4.3 Study/ PED/ Implementation

There are a few risks that may affect the study, PED, and implementation schedule for the project. The study team used existing data to make assumptions about the geotechnical characteristics and the presence of cultural resources and HTRW; there is a risk that additional information on these items may require redesign of the project or a delay in implementation.

Another risk is that the Route 1 bridges that are proposed to be removed in the TSP are not owned by our non-Federal sponsor, the Town of Greenwich; the bridges are owned and operated by the New York State Department of Transportation. If the NYSDOT does not support the project, implementation may be delayed or canceled. There could be delays in implementation with multiple non-Federal sponsors or sub-cost sharing agreements.

4.4.4 Economics

Because uncertainty has been defined for key input parameters in the economic analysis, uncertainty in the expected benefits may be calculated. Table 24 presents the distribution of expected average annual benefits for Alternative 5, the Tentatively Selected Plan, along with the distribution of net benefits and benefit to cost ratios. There is a 75% chance that the BCR for the TSP will exceed 0.8, a 50% chance that it will exceed 1.1, and a 25% chance that it will exceed 1.4. More details can be found in the Economic Appendix.

Table 24: Economic Summary of Tentatively Selected Plan with Uncertainty (FY18 P.L.)

	PROBABILITY DISTRIBUTION QUARTILES (Percent chance that the value will be exceeded)		
	75%	50%	25%
Expected Annualized Benefits	$771,000	$994,000	$1,284,000
Net Benefits	-$178,000	$45,000	$335,000
BCR	0.8	1.1	1.4

4.5 Economic, Environmental, and Other Social Effects

USACE guidance requires that study alternatives be evaluated under the following accounts: the national economic development (NED), regional economic development (RED), other social effects (OSE), and environmental quality (EQ). NED effects have been addressed above and in the Economics Appendix. In reducing damages from future flood events, the proposed project would contribute to NED. As detailed in Chapter 5, there would be minimal environmental impacts due to implementation of the plan with the exception of the adverse effects to the historic bridges and the requirement to have a traffic implementation plan during the removal and construction of the bridges to mitigate impacts to traffic.

RED effects are the impact of project spending, either directly or indirectly, on the local economy. Implementation of the project could induce RED benefits in the area as residents and business owners may be able to allocate resources and spending on other goods and services rather than on repairing and replacing structures or goods damaged by flooding.

OSE include the effects that are not covered in the NED, RED, and EQ. Community resilience is the measure of the sustained ability of a community to utilize available resources to respond to, withstand, and recover from adverse situations. The proposed project would contribute to community resilience, as damages in the study area may not occur as frequently or as severely. Flooding along Riverdale Avenue will decrease and allow for people to evacuate and for emergency services to reach affected areas. The community would be able to recover more quickly after storms; businesses would be able to reopen after a flood event and people would be able to return to work.

4.6 Executive Order (EO) 11988

Executive Order 11988 requires that Federal agencies avoid, to the extent possible, adverse impacts associated with the occupancy and modification of flood plains and to avoid support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in ER 1165-2-26, requires an eight-step process that agencies should carry

out as part of their decision-making on projects that have potential impacts to, or are within the floodplain. The eight steps and project-specific responses to them are summarized in Table 25.

Table 25: EO 11988 Steps

EO 11988 STEP	PROJECT-SPECIFIC RESPONSE
Determine if a proposed action is in the base floodplain (that area which has a one percent or greater chance of flooding in any given year).	The proposed action is within the base floodplain. However, the project is designed to reduce damages to existing infrastructure.
If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain.	Practicable measures and alternatives were formulated and evaluated against USACE guidance, including nonstructural measures such as buy-outs (land acquisition and demolition of structures).
If the action must be in the flood plain, advise the general public in the affected area and obtain their views and comments.	The Draft Integrated Feasibility Report and Environmental Impact Statement was released to public review in June 2018 and coordination with agency officials and the public have occurred throughout the study.
Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.	The anticipated impacts associated with the Selected Plan are summarized in Chapters 5 and 6 of this report. The project would not alter or impact the natural or beneficial flood plain values.
If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.	The project will not encourage development in the floodplain because all properties available for development have been developed. The project provides benefits solely for existing development.
As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.	The project would not induce development in the flood plain. Section 3 of this report summarizes the alternative identification, screening and selection process. The "no action" alternative was included in the plan formulation phase.
If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings.	The Draft Integrated Feasibility Report and Environmental Impact Statement was released to public review in June 2018.
Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.	The Recommended Plan is the most responsive to all of the study objectives and the most consistent with the executive order.

5. Environmental Effects *

This chapter discusses the potential positive and adverse environmental consequences of the TSP. The effects of the TSP are directly compared act against the baseline Future Without Project /No Action alternative conditions as described in Chapter 3.

In accordance with the USACE Planning policy, the TSP has not yet undergone optimization. Typically to account for potential modifications to the TSP during optimization, impacts to environmental resources are presented as ranges which are further refined for better accuracy and precision as the plan is further developed. However, given that the TSP for this study has a relatively small and distinct footprint that is unlikely to substantially change, a maximum impact is assumed for the purposes of this report.

Up to approximately 300 feet of the Byram River channel may be disturbed related to the implementation of the TSP. Approximately 0.09 acres of open water may be filled in from a combination of concrete and riprap while approximately 0.02 acres of open water will be restored as a result of removing the existing center abutments.

Construction of the TSP is expected to take approximately two years.

In addition to discussing potential beneficial and adverse environmental effects, this chapter outlines potential mitigation measures for adverse impacts and potential adaptive management methods that may be implemented to ensure success of the mitigation. In accordance with the CEQ NEPA regulations, mitigation includes: 1) Avoiding the impact by not taking a certain action or parts of an action; 2) Minimizing the impact by limiting the degree or magnitude of the action and its implementation; 3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment; 4) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and 5) Compensating for the impact by replacing or providing substitute resources or environments.

5.1 Topography, Geology, and Soils

5.1.1 Topography and Geology

No short or long term adverse impacts to geology from implementation of the proposed action is anticipated.

Due to the fact that the bridges are being raised, minor grading will be required to immediate surrounding areas to accommodate the raised roadway profiles. However, the topographical changes are expected to be negligible.

There will also be minor grading within the Byram River channel to restore the portion of the channel where the center abutments are removed to existing grade. The topographical changes are expected to be negligible.

5.1.2 Soils

No significant impacts to soils will occur as a result of implementation of the TSP. Scour protection will be required to prevent erosion. The channel modifications within the Byram River will involve the excavation and fill of the riverbanks and channel in order to remove the existing abutments, center piers, and place the riprap along the toe of the new bridge abutments. The

riprap is meant to prevent scouring and erosion of soil around the abutments during high flow events. Overall, the impact to soils will be negligible.

Hydric Soils

The Udorthents soil type occur within the TSP project footprint along the left bank of the Byram River and meet hydric soil criteria. The However, the soils within the TSP footprint have already been modified by the construction of the original bridges and surrounding development. Therefore, no significant adverse impacts will occur from implementation of the TSP.

Prime Farmland

The proposed action occurs in an urbanized setting that does not include any additional land uses related to agriculture or silviculture. Therefore, adverse impacts to Prime Farmland soils will not occur.

Mitigation

An Erosion and Sediment Control Plan will be developed and submitted to the Town of Greenwich and the Westchester County Conservation District for approval prior to the construction of the proposed project. Best management practices including, but not limited to, silt fence, turbidity curtains, cofferdams and temporary seeding will be implemented to reduce soil erosion within the project footprint. Following completion of modifications and structures, temporary work locations will be restored to pre-construction conditions.

5.2 Water Resources

5.2.1 Surface Water

Overall, adverse impacts to the Byram River will be minor. Approximately 300 feet of the Byram River will be impacted during construction as a result of the implementation of the TSP. Of the 300 feet, approximately 150 feet of the impact will be temporary from the creation of equipment access areas. Construction will include the removal of the existing stone bridge abutments and the center piers, and the installation of new concrete abutments along the riverbank within the same footprint as the old abutments. Approximately 0.09 acres of open water will be filled as a result of the new bridge abutments and the rip rap being used for scour protection.

Positive effects from implementation of the TSP include the restoration of approximately 0.02 acres of open water habitat and natural flow of the river within the project footprint which will alleviate flooding. Minor regrading will be required to bring the river bottom within the former center pier footprint to the same bed elevation as the surrounding channel bottom. In-situ substrate will be used to form the restored bed.

Mitigation

Discussions of water resources mitigation are included in Section 5.2.2 below.

Monitoring and Adaptive Management

Discussions of water resources monitoring and adaptive management are included in Section 5.2.2 below.

5.2.2 Water Quality and Habitat

The TSP will have minor temporary adverse impacts and no adverse long term impacts on water quality. Cofferdams will be installed within the work area so that all bridge deconstruction and construction activities will occur in dry conditions. The cofferdams will be installed in a manner to maintain flow of the river. In addition, a silt curtain would be installed downstream of the work area to further prevent any sediment or turbid water from migrating downstream. Furthermore, to minimize impacts to fish and aquatic resources, in-water work will be restricted from March 1 through June 30. This window will not apply once the cofferdams are installed.

Any impacts on water quality would be temporary and localized since turbidity levels and concentration of materials suspended in the water column would quickly return to ambient conditions.

Minor short term impacts to aquatic habitat within the TSP footprint during the construction are expected as a result of riparian vegetation removal and construction activities within the river channel. Mitigation actions described below will minimize impacts

Long term adverse effects to aquatic habitat resulting from the TSP are expected to be minor. The new bridge abutments are being constructed in the same location as the existing abutments and the scour protection will be limited to the immediate toe of the abutments and will not extend into the entire channel. The substrate around the bridges consists of gravel bars and large rock so the rip rap will not constitute a significant change in substrate. The removal of the center piers of the existing bridges constitutes a positive effect as it will restore approximately 0.02 acres of open water habitat with natural substrate.

Mitigation

During construction, standard erosion and sediment control Best Management Practices (BMPs) to protect water quality during in river work will be implemented to reduce the potential adverse and significant impacts. General post construction site restoration in the form of replanting native grass, shrub and tree species along the riverbank will minimize riparian habitat impacts.

Monitoring and Adaptive Management

As no compensatory mitigation to water resources is proposed, no monitoring or adaptive management will be performed.

5.2.3 Wetlands

Federal

There are no federally regulated wetlands within the TSP footprint. Therefore, there will not be any direct wetland impacts as a result of implementing the TSP. Indirect impacts to the small freshwater forested/scrub shrub wetland north of the TSP footprint is not expected given that the wetlands area located along the river channel and will still be subject to inundation during flood events.

Connecticut Regulated Wetlands

Given that there are no state regulated wetlands within the TSP project footprint, there will not be any direct wetland impacts. Indirect impacts to any wetlands north of the TSP project footprint as a result of increasing the channel capacity are not expected given that the wetlands are located along the river channel and will still be subject to inundation during flood events.

New York Regulated Wetlands

There are no state regulated freshwater or coastal wetlands within the immediate footprint of the TSP. Therefore, there will not be any direct adverse impacts to these resources. There will not be any indirect impacts to coastal wetlands downstream of the TSP project footprint as they will be subject to the same tidal inundation that currently exists.

There are no regulated wetlands within the immediate footprint of the TSP. In addition, the increase in capacity Therefore

Mitigation
As no wetlands will be directly or indirectly impacted by the TSP, no mitigation is proposed.

5.3 Vegetation

5.3.1 Upland

The implementation of the TSP will have minor adverse impacts to upland vegetation. Approximately 0.13 acres of upland and riparian vegetation will be removed as a result of implementation of the TSP. This impact is predominantly considered a temporary impact as the area will be restored to pre-construction site conditions through the replanting of native grass, shrub and tree species once construction is completed.

5.3.2 Wetlands

There are no Federal, Connecticut or New York state regulated wetlands within the footprint of the TSP. Therefore there will be no direct impacts to wetland vegetation resulting from the implementation of the TSP.

Mitigation
The restoration of disturbed work areas with native grass, shrub and tree species will minimize adverse impacts to upland and riparian areas. The proposed action will have no significant impacts on regulated wetlands, and as such no mitigation measures will be required.

Monitoring
The vegetation planted as part of site restoration will be subject to the USACE's standard one year contractor warranty period. During this time, the construction contractor will be required to perform activities such as watering and weeding to ensure survivability of the plant material. The District will inspect the vegetation for successful establishment and the contractor will be required to replace any plant material that has not survived during this one year warranty period. As the replanting is part of general site restoration and not compensatory mitigation, no other post construction monitoring or adaptive management actions is proposed.

5.4 Fishery Resources

Implementation of the TSP is expected to have minor temporary adverse impacts to fishery resources due to noise and turbidity from equipment operating in the stream and along the banks. The turbidity caused by construction activities, mainly the installation and removal of cofferdams, could hinder predation efficiency of sight feeding fish within the project area.

However, any juvenile or adult fish within the TSP project footprint are expected to be mobile enough to leave the area.

In addition, the initial loss of aquatic macroinvertebrate species resulting from channel modifications will eliminate a food source for fish until the area is recolonized by macroinvertebrate species.

Long term adverse impacts to fishery resources are expected to be negligible. A positive effect of the TSP will be the restoration of approximately 0.02 acres of open water and benthic habitat that fish species could utilize for foraging as a result of removing the existing center bridge piers.

Mitigation
The use of erosion and sediment control best management practices, including a cofferdams, will minimize sedimentation and turbidity that can negatively impact fish species and their habitat. In addition, an in-water work restriction from March 1 through June 30 to protect anadromous fish species as recommended by the Connecticut Division of Fish and Wildlife will be observed.

Monitoring and Adaptive Management
As no compensatory mitigation that would benefit fish species is proposed, no monitoring or adaptive management will be performed.

5.4.1 Essential Fish Habitat

The TSP will not have any adverse direct or indirect impacts on EFH. A Feasibility level Essential Fish Habitat Assessment has been prepared and is located in Appendix A.5. The Draft FR/EIS and appendices, including A5 will be submitted to NOAA-Fisheries for review.

Mitigation
Mitigation measures for EFH species are the same as discussed in Section 5.4.

5.5 Aquatic Macroinvertebrates

Implementation of the TSP will have negligible adverse impacts and negligible positive effects on aquatic macroinvertebrates. Construction of the TSP will cause the direct mortality of aquatic invertebrates as a result of the installation of the cofferdams, excavation required to remove the center bridge piers, and the installation of the scour protection. Temporary increases in turbidity and suspended sediments near the construction activities could cause direct mortality or indirect decreased reproductive success in benthic species over the short term.

The scour protection will constitute a change in substrate that will benefit some species and adversely impact others. The removal of the center abutments will restore approximately 0.02 acres of open water and natural substrate that will benefit macro invertebrate species within the Byram River.

Recolonization of aquatic macroinvertebrate species within the TSP project footprint is expected after construction via recruitment of nearby colonies.

Mitigation
The use of erosion and sediment control best management practices, including cofferdams, will minimize sedimentation and turbidity that can negatively impact benthic resources and their habitat. In addition, the in-water work restriction from March 1 through June 30 to protect

fishery resources will provide similar protection to any benthic resources that also spawn during this timeframe.

Monitoring and Adaptive Management
As no compensatory mitigation is proposed, no specific monitoring plan will be developed for benthic resources.

5.6 Reptiles and Amphibians

Implementation of the TSP will have negligible impacts on reptile and amphibian species. Habitat supportive of these species within the TSP footprint is extremely limited given the presence of Route 1, business development along the riverbanks, and steep riverbank slopes. Construction activities to removing (and replacing) the bridges may cause mortality of any less mobile species inhabiting the TSP project footprint. More mobile species will be temporarily displaced from the area and are expected to relocate to other, undisturbed locations of the overall project area.

The new bridge abutments will be located in the same location of the riverbanks as the existing abutments, therefore, loss or modification of existing habitat is negligible. Installation of the scour protection along the new bridge abutments may restrict or preclude movement of herpetofauna between the land and river and could potentially reduce the amount of natural banks within the TSP project footprint. However, the impacts associated with the installation of the rip rap will be negligible given that the steep riverbank slopes and the presence of large stones/rock within the river and along the banks already present a navigation challenge in some portions of the TSP project footprint. Following construction, reptile and amphibian species are expected to resume their normal habits consistent with post-construction habitat availability in and within the vicinity of the TSP project footprint.

Mitigation

The re-establishment of wetland, upland and riparian vegetation as described in Sections 5.8 and 5.9 will provide foraging and cover habitat supportive of reptiles and amphibians.

Monitoring and Adaptive Management

As no compensatory mitigation is proposed, no specific monitoring plan will be developed for reptile and amphibian species.

5.7 Birds

The construction of the TSP and any associated mitigation will create short-term minor adverse impacts to migratory bird species. However, since bird species are highly mobile, they are expected to move away from the TSP project footprint during construction. Furthermore, outside the breeding season these species do not permanently remain in any one location. Therefore, adverse impacts to bird species are expected to be short term and minor, limited to the period of construction. Following construction, bird species are expected to resume their normal habits consistent with post-construction habitat availability in and within the vicinity of the TSP project footprint. Long term adverse impacts to birds will be negligible.

Mitigation

In order to comply with the Migratory Bird Treaty Act, a clearing restriction of shrubs and trees from April 15 through August 31 will be implemented during to avoid adverse impacts to any potential nesting birds that are covered under this act. This clearing restriction will provide protection to non-migratory birds as well. Post construction replanting efforts with native vegetation will benefit birds by restoring or enhancing foraging, shelter and nesting habitat.

Monitoring and Adaptive Management

As no compensatory mitigation is proposed, no specific monitoring plan will be developed for benthic resources.

5.8 Mammals

Construction activities associated with the TSP will result in the temporary disturbance of habitat (e.g. vegetation and tree removal). Construction activities may also cause the temporary and permanent displacement of more mobile species due to increased human activity and habitat alterations. Tree clearing restrictions implemented to protect migratory bird and endangered and threatened bat species will provide some protection for tree-dwelling mammal species. Following construction, mammals are expected to resume their normal habits consistent with post-construction habitat availability in and within the vicinity of the TSP project footprint.

Given the level of development and traffic on Route 1, long-term impacts on local mammal populations will be negligible.

Mitigation

The re-establishment of upland, riparian vegetation as described in sections 5.8.3 Wetlands and 5.9 Uplands and Riparian Corridor will provide foraging and cover habitat supportive of wildlife.

Monitoring and Adaptive Management

As no compensatory mitigation is proposed, no specific monitoring plan will be developed for benthic resources.

5.9 Endangered and Threatened Species

5.9.1 Federal Threatened and Endangered Species

USFWS Trust Species

The implementation of the TSP will not have any short term or long term adverse impacts to northern long-eared bat. Although any tree clearing will be minimal, a tree clearing restriction from 1 April through 30 September will be implemented during construction to minimize any adverse impacts to this species during construction. Alternatively, if clearing must occur within this timeframe, the District will consult with USFWS to determine the appropriate course of action.

The implementation of the tree clearing restriction is a standard protocol in this region that does not require formal consultation with the U.S. Fish and Wildlife (USFWS). The Draft Feasibility Report/Environmental Impact Statement is being used as the primary coordination vehicle with

the USFWS and completion of ESA Section 7 consultation will be presented in the final report. A letter to the USFWS New England Field Office requesting concurrence on a No Effect determination is included in Appendix A.

NOAA-NMFS Trust Species

The overall project area does not contain habitat supportive of any of the NOAA-NMFS Trust Species. Therefore, there will be no direct adverse impacts to these species. The portion of the river that could potentially be utilized by Atlantic and shortnose sturgeon is approximately one mile downstream of the project area. The small scope of the project relative to the size of the river in combination with the implementation of cofferdams during construction will minimize adverse indirect impacts to any potential sturgeon habitat that may exist in the lower portion of the river. None of the sea turtle species are expected to utilize any portion of the river, therefore indirect adverse impacts to sea turtles will not occur.

Similar to coordination with the USFWS, the District will use the Draft FR/EIS to complete ESA Section 7 consultation with NOAA-NMFS. Completion of ESA Section 7 consultation will be presented in the final report. A No Effect determination is included in Appendix A.9.

Mitigation

A tree clearing restriction extending from April 1 through September 30 will be implemented during construction to protect the northern long eared bat. A preference to tree species that provide roosting habitat for northern long eared bat will be given during the development of mitigation plans.

The re-establishment of native vegetation within the TSP project footprint and mitigation sites will restore northern long-eared bat habitat.

As no NOAA-NMFS Trust species occur within the overall project area, no mitigation measures are proposed. Implementation of erosion and sediment control best management practices will minimize any potential indirect impacts to these species.

Monitoring and Adaptive Management

As no compensatory mitigation is proposed, no specific monitoring plan will be developed for the northern long-eared bat.

5.9.2 State Endangered and Threatened Species

Given that no known Connecticut or New York state endangered and/or threatened species occur within the overall project area, implementation of the TSP will have no effect on such species.

5.10 Socioeconomics

The TSP will cause the Pemberwick area to experience less fluvial flooding. The population of Greenwich shows an increasing trend from 2000 to 2016, and would be expected to continue increasing with the TSP in place. Reducing flood damages to the houses in this area will cause less strain on the vulnerable population that lives in this area. Although the entire population that lives and works in the floodplain is vulnerable and at risk of flooding and harm, case studies have shown that certain sub-populations are more susceptible to harm from flooding. These "socially vulnerable groups" are typically children, the elderly, those disabled, low income,

minorities, and female head of households. Some of these have impediments to evacuating and therefore have a higher potential for loss of life. Others have a lack of resources or have special needs that may also inhibit preparing for an impending flood or evacuating. Constructing the TSP will reduce the impacts to this sector of the population.

Environmental Justice

As discussed in Section 2.10, Environmental Justice considerations are applicable to the Village of Port Chester. The Village of Port Chester will receive flood risk management benefits from implementation of the TSP. The District has been coordinating with representatives throughout the study to ensure any concerns within the community have been addressed. Therefore, significant and disproportionate adverse impacts to residents of the Village of Port Chester are not expected.

5.11 Cultural Resources

The demolition of the Route 1 bridges will constitute an adverse effect on historic properties, specifically the bridges themselves. As currently planned, the removal (and replacement) of the bridges should not have an adverse effect on the potentially eligible buildings in the William James Memorial Gateway Park or the Thomas Lyon House. The current work will be within the footprint of the existing bridge construction and the new construction should not have an adverse effect on archaeological sites related to the use of the area before the bridges' construction. Both banks, however, may have information related to the construction of the bridges. The visual effect of the dual stone bridges will also be adversely affected by the removal of the bridges.

Mitigation

A preliminary draft Memoradum of Agreement has been prepared for review and comment by the public and is included in Appendix A.4. Draft requirements of the Memorandum of Agreement include:

- Documentation of the existing bridges that will include development of an historic context for the construction and use of the bridges, review of available design and as-built construction drawings, and current drawings and photographs. This documentation may be completed in accordance with the Historic American Engineer Record (HAER);
- Preparation of reports to meet the Section 106 responsibilities, which will be provided to the relevant regulatory agencies and public venues, as well as less technical reports for distribution to local libraries and the general public;
- Potential use of stone from the current bridges in the new bridge design or use of new stone for the bridges; and
- Continued coordination with the NY and CT Historic Preservation Offices and any consulting parties.

Additional items may be identified as a result of the ongoing coordination with the NY and CT Historic Preservation Offices, consulting parties, Federally-recognized Tribes, and others as part of the public review.

5.12 Coastal Zone Management

The TSP is compliance with all applicable policies. Statements of Compliance to the New York State Coastal Zone Management (CZM) policies, the Village of Port Chester LWRP and the Connecticut CZM policies have been prepared and are located in Appendix A.6.

5.13 Floodplains

With the project in place, the 1% floodplain of the Byram River within the project area will be reduced in extent. The project will cause the floodplain to be narrower than it currently is (Figure 17). This will reduce the number of structures that are damaged during flooding events. The water surface elevations for the existing conditions and the proposed with-project TSP conditions are shown in Table 26.

Table 26: Existing vs. Proposed Stages at Route 1 Bridge

LOCATION	HEC-RAS CROSS SECTION	EXISTING CONDITION STAGE (FT)			PROPOSED CONDITION STAGE (FT)		
		50% FLOOD	2% FLOOD	1% FLOOD	50% FLOOD	2% FLOOD	1% FLOOD
Upstream of North bridge	9633.9	8.2	16.22	17.95	8.06	12.5	14.37
Immediately upstream of North Bridge	9476.7	8.08	16.08	17.87	7.94	12.1	14.04
In between bridges	9405.8	7.9	14.71	16.23	7.8	11.68	12.69
Immediately downstream of South Bridge	9190.9	7.62	11.26	12.19	7.64	11.38	12.35
Downstream of South bridge	9102.9	7.59	11.35	12.35	7.59	11.35	12.35

5.14 Land Use and Zoning

The land within the project area is already heavily developed and the TSP will not contribute to significant adverse effects to land use and zoning. The TSP will serve to protect current land uses when combined with other past, current, and future flood risk management measures implemented in the basin.

5.15 Hazardous, Toxic and Radioactive Waste

There are no known hazardous, toxic and radioactive waste sites within the project area. Three previously recorded sites within the project area have been remediated. Prior to demolition

and/or construction activities, best management practices will include the testing soil to determine if it is suitable for reuse or is special handling required. If any additional contaminants are identified, the non-federal sponsor will be responsible for remediating the site prior to any demolition or construction efforts by the District.

5.16 Aesthetic and Scenic Resources

The removal of the bridges will have a major adverse impact on to the area's aesthetics. The construction of the TSP will also have short-term, minor adverse impacts to aesthetic and scenic resources with the presence of construction equipment and active construction activities throughout the project area.

Mitigation

Mitigation measures that will be implemented to minimize impacts to aesthetics include:

- Replanting disturbed areas with native vegetation.
- Recreating the aesthetics of the original Route 1 bridges through re-use of the stone from the original bridges or use of a stone façade.

5.17 Recreation

Implementation of the TSP will create short term minor impacts to recreation during construction. The William James Gateway Memorial Park abuts the south western side of the southernmost Route 1 Bridge. During construction, temporary closures to the sidewalk near the park may occur to ensure public safety near the work zone. Alternate access to the main park feature, the pump house pavilion, will be provided. In addition, minor grading may be required on the northern end of the park property to match the new grade of the bridge. However, this will not affect the ability to use the pump house pavilion. Access to the river through William James Memorial Park during construction will not be impeded.

No significant long term permanent adverse impacts are expected to occur to the park as a result of implementing the TSP.

Mitigation

Specific mitigation measures that will be evaluated may be implemented to reduce the limited short-term and long-term effects of the TSP on recreation include:

- Situating construction access and staging areas away from the pump house pavilion to the greatest extent practicable. This evaluation will occur during the Preconstruction Engineering Design Phase;
- Erecting temporary fences and other physical barriers to control movement through construction areas and maintain a safe distance for pedestrians; and
- Installing signage that informs residents and others using affected recreational spaces of the proposed action’s purpose and closure duration.
- Providing alternate access routes to the park during closures of sidewalks.
- Replanting any trees removed during construction with native species that enhance the character of the park.

5.18 Air Quality

Implementation of the TSP will have short term, minor impacts on air quality within the project footprint. The project will produce temporary localized emission increases from the diesel powered construction equipment working onsite. The localized emission increases from the diesel-powered equipment will last only during the project's construction period and then end when the project is over, thus any potential impacts will be temporary in nature.

As stated in the Air Quality Section (Section 3.17), Westchester and Fairfield Counties have been designated as: 1) a 'moderate' nonattainment area for the 2008 8-hour ozone standard; 2) in maintenance for the 2006 PM2.5 standard; and 3) in maintenance of the 1971 CO standard. The County is part of a larger Ozone Transport Region. Ozone is controlled through the regulation of its precursor emissions, which include NOx and VOCs. VOCs are emitted at a fractional rate compared to NOx emissions. SO2 is a precursor for PM2.5. Because of these designations and since the project is a Federal Action taken by the USACE, this project triggers a General Conformity Review under 40 CFR §93.154. General Conformity ensures that Federal Actions do not have a negative impact on State Implementation Plans (SIPs). For the pollutants to be emitted as part of the project, the annual de minimis levels are: 100 tons for NOx, 50 tons for VOC, and 100 tons for CO2, PM2.5, and SO2 (each pollutant separately). Projects that do not have any annual emissions exceeding these threshold levels are considered to be in conformity with the SIP.

The Project's General Conformity-related annual emissions are significantly below all of the de minimis levels. Therefore, by rule (40 CFR §93.153 (b)), the Project is considered de minimis and will have only a temporary impact around the construction activities with no long-term impacts and no negative effects on the applicable SIP. Documentation of the emissions calculations is included in Appendix A.6.

Mitigation

Because the impact on air quality will be less than significant, no mitigation measures will be required outside of existing air quality regulations. The CT DEEP and the NYSDEC outline requirements applicable to construction, such as controlling fugitive dust and open burning. All persons responsible for any operation, process, handling, transportation, or storage facility that could result in fugitive dust will take reasonable precautions to prevent such dust from becoming airborne. In addition, construction will be performed in full compliance with current applicable Connecticut and New York air pollution control requirements with compliant practices and/or products. These requirements include the following:

- Control and Open Prohibition of Burning (Connecticut General Statutes (CGS) 22a-174(f); NYSDEC Chapter III, Part 215);
- Control of Particulate Emissions/idling prohibitions (CGS 22a-174-18, NYSDEC Chapter III, Subpart 257-3); and
- the USACE and its contractors will use BMPs during construction and comply with all applicable air pollution control regulations.

5.19 Noise

The implementation of the proposed action will result in an increase in short-term minor adverse impacts related to noise. The specific impact of construction activities on the nearby receptors will vary depending on the type, number, and loudness of equipment in use. Excavators and other heavy equipment, truck removal of excavated material, and the delivery of riprap and concrete to workspaces will be the primary sources of noise. Individual pieces of heavy equipment typically generate noise levels of 80–90 dBA at a distance of 50 feet (15 m). With multiple items of equipment operating concurrently, noise levels can be relatively high during daytime periods at locations within several hundred feet of active construction sites. The zone of relatively high noise levels typically extends to distances of 400–800 feet from the site of major equipment operations. Locations more than 800 feet from construction sites seldom experience substantial levels (greater than 62 dBA) of noise.

Property owners within the footprint and vicinity of the project footprint will experience appreciable amounts of noise from heavy equipment during the two year construction period. In addition, limited truck and worker traffic may be audible at locations along haul roads and roadways approaching the construction area.

There will be no permanent or ongoing sources of noise from the proposed action. Noise will end with the construction phase; therefore, there will be no long-term permanent significant impacts on the noise environment.

Mitigation

Due to the nature of the work and the proximity of structures to the project footprint, the ability to fully mitigate noise is limited. Construction activities will adhere to the applicable noise ordinance established by the Town of Greenwich and the Village of Port Chester to minimize adverse impacts to noise to the greatest extent practicable.

5.20 Transportation

The implementation of the TSP will have significant adverse impacts to traffic within the project area during the approximate two-year construction period. An analysis evaluating five potential traffic management scenarios and their effect on traffic was conducted. Alternatives analyzed include:

- Closure of the North Route 1 bridge;
- Closure of the South Route 1 bridge;
- Partial closure of both bridges;
- Partial closure of the north Route 1 bridge; and
- Partial closure of south Route 1 bridge.

All alternatives will increase travel time through the Byram Traffic Circle. Depending on the alternative, impacts to vehicle delay and queuing will be greatest at several locations:

- Northbound Byram Traffic Circle East approach to Hillside Avenue
- Eastbound Putnam Avenue left turn approach to North Main Street
- Byram Road approach to West Putnam Avenue

Based on the analysis, the District is proposing to implement a partial closure of both bridges during construction. Under this alternative, intersections are expected to be able to accommodate the potential closure of the one lane along each bridge with the exception of the northbound Byram Road approach to West Putnam Avenue. Traffic delays will result from increased difficulty crossing or merging with West Putnam Avenue traffic because of the one lane restriction. It can be expected that bus routes within the project area will be subject to schedule delays.

The new bridges will support the same traffic volume and will have the same flow pattern as the existing bridges. Therefore, there will be no long term adverse impacts to traffic once construction ends.

The traffic analysis will be further refined during optimization and based on comments received from the public and regulating agencies during the 45-day comment period of the Draft Integrated FR/EIS. Refer to Appendix A.10 for the full traffic analysis report.

Mitigation

Mitigation measures to further minimize impacts to traffic during construction that may be evaluated during optimization of the TSP include:

- Additional larger scale detours
- Temporary intersection widening to provide auxiliary lanes
- Temporary intersection traffic signal control

5.21 Climate Change

The construction of this project will have no effect on climate change. Impact climate change may have on the TSP are presented in Section 4.4.

5.22 Comparison of Environmental Consequences of the No Action Plan and the TSP

Water Resources

No Action: Water quality and habitat would remain unchanged. There would be no changes to wetland communities. The river would still be subject to flooding around the Route 1 bridges.

TSP: Water quality and habitat would remain unchanged. There would be no changes to wetland communities. The river would still be subject to flooding around the Route 1 bridges.

Vegetation

No Action: Upland and wetland communities would remain as they are expect for changes associated with natural disturbance events – including future flooding events – and community succession.

TSP: Approximately 0.13 acres of upland and riparian vegetation will be removed.

Fish and Wildlife

No Action: Fish and wildlife utilization of the project areas will be consistent with current conditions. The same is true for any state and/or federal endangered, threatened or special concern species that may occur within the project area.

TSP: Implementation of the TSP will predominantly have temporary impacts on fish and wildlife resources, with the impacts occurring during construction. The TSP will result in the restoration of 0.02 acres of open water habitat that could be utilized by fish and aquatic macroinvertebrates.

Cultural Resources

No Action: Effects to historic properties would remain unchanged.

TSP: The Rte 1 bridges are eligible for the New York State and National Registers. The demolition of the bridges constitute an adverse effect on historic properties.

Air Quality

No Action: Ambient air quality would remain unchanged when compared to existing condition under the No Action alternative.

TSP: Localized increases in emissions from construction equipment will occur during implementation of the TSP. However, project emissions are below the General Conformity de minimis levels. No long term adverse impacts to air quality will occur with implementation of the TSP.

Socioeconomics

No Action: Flooding damages would continue within the project area.

TSP: Implementation of the TSP will manage fluvial flood risk for up to the 1-percent storm event within the project area. No adverse, disproportionate effect.

Recreation

No Action: Parks and water dependent recreational opportunities within the project would remain the same under the No Action alternative.

TSP: Temporary closures to the sidewalk near the William James Gateway Memorial Park may be required during construction of the TSP. However, alternate access to the park will be provided.

Aesthetics

No Action: Aesthetic and scenic resources would remain unchanged from current conditions.

TSP: Construction activities will have short term minor adverse impacts to the aesthetics within and near the vicinity of the TSP project footprint. The new bridges will retain the same aesthetic as the existing, historic bridges. Therefore, no long term adverse impacts resulting from TSP implementation will occur.

Transportation

No Action: Traffic conditions would remain unchanged when compared to existing conditions.

TSP: Significant adverse impacts to traffic will occur during construction of the TSP.

Noise

No Action: Noise conditions would remain unchanged when compared to existing conditions.

TSP: An increase in noise will occur during construction of the TSP. No long-term significant adverse impacts to noise will occur from implementation of the TSP.

5.23 Summary of Mitigation

A summary of mitigation measures is presented below in Table 27.

Table 27: Summary of Mitigation Measures

Land Use · Disturbed areas will be restored and their use returned to pre-construction land uses.
Soils · Implementation of Erosion and Sediment Control Best Management Practices (BMPs) during construction.
Water Resources · Implementation of Erosion and Sediment Control Best Management Practices (BMPs) during construction, including the installation of a cofferdam within the Byram River to remove (and replace) the Route 1 bridges.
Vegetation · Restoration of disturbed areas with native grass, shrub and tree species.
Aquatic Resources and Wildlife · Tree and shrub clearing restriction from April 1 through August 31 to comply with the Migratory Bird Treaty Act. · Tree clearing restriction from April 1 through September 30 to protect Endangered and Threatened bat species. · In-water work restriction from March 1 through June 30. · Re-establishment of native herbaceous, shrub and tree species in disturbed areas.
Federal and State Endangered, Threatened and Special Concern Species · Implementation of a tree clearing restriction from April 1 through September 30 to protect roosting bat species. · Including tree species used by bats for summer roosting in site plans where feasible.
Cultural Resources · Execution and implementation of a Memorandum of Agreement with NY and CT State Historic Preservation Offices to include documentation of the current bridges, re-use of historic stone in new bridge construction, publication of the technical report, preparation of a general report on the historic context of the bridges and their construction, and archaeological monitoring during demolition for recordation of any identified elements associated with the construction of the bridges.
Recreation · Erecting temporary fences and other physical barriers to control movement through construction areas and maintain a safe distance for pedestrians. · Installing signage that informs residents and others using the effected recreational spaces of the proposed actions purpose and closure duration. · Providing alternate access routes to the park during closures of sidewalks. · Replanting any trees removed within the William James Memorial Gateway Park during construction with native species that enhance the character of the park.
Aesthetics and Scenic Resources · Replanting disturbed areas with native herbaceous, shrub and tree material after construction.
Transportation · Preparation of a Construction Traffic Management Plan. · Routing and scheduling construction vehicles to minimize conflicts with other traffic

· Strategically locating localized staging areas to minimize traffic impacts; and · Establishing detours and alternate routes when it is important to close the work area to perform certain construction tasks or when diverting traffic will substantially reduce traffic volumes.
Air Quality · Because the air emissions are below de minimis levels for NOx, VOC, PM2.5 and SO2, no specific mitigation is required. Construction will be performed in compliance with current Connecticut and New York air pollution control requirements.
Noise · Construction will occur within the timeframes allowed as per local noise ordinances.

6. Cumulative Effects*

The Council of Environmental Quality (CEQ) defines cumulative effects as the impact on the environment, which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency or individual takes the action.

The cumulative impact analysis encompasses the Byram River Basin. As stated in previous sections of the report, the Byram River has experienced numerous modifications. In addition to the cumulative impacts associated with those disturbances, the cumulative impacts analysis evaluates the impacts associated with past, present and foreseeable future actions listed in Table 28 and Table 29 in this section. Identification of these actions were completed through internet research, the NEPA scoping process and coordination with study stakeholders. Connecticut is divided into several regions of which the local governments within a specific region form operating councils. The Town of Greenwich is part of the Western Connecticut Council of Governments (WCCoG). The Council prepared a Natural Hazard Mitigation Plan (NHMP) for the years 2016-2021. The NHMP identifies flood risk management measures each municipality has undertaken, is in the process of implementing or will be implementing. Westchester County, New York prepared a Hazard Mitigation Plan (HMP) in 2015. For the purposes of the cumulative impact analysis, the actions identified in both the WCCoG's NHMP and Westchester County's HMP is herein incorporated by reference (WCCoG, 2016).

Table 28: Existing and Future Federal Projects

PROJECT NAME	DESCRIPTION	LOCATION	STATUS
Navigation Channel	1.7 mile navigation channel	Byram River from Mill Street Bridge to Long Island Sound	Constructed in 1910; modified in 1930
Flood Risk Management Project	Levee and minor channel modification	Pemberwick section of Greenwich.	Constructed in 1959

Table 29: Other Actions Within the Byram River Basin

PROJECT NAME	TYPE	DESCRIPTION	LOCATION	RESPONSIBLE ENTITY	STATUS
Bulkhead Reconstruction Project	Bulkhead repair	Reconstruction of collapsed bulkhead	Along Byram River approximately 0.70 miles south of the Rte 1 Bridges	Village of Port Chester	Permits submitted to NYSDEC in 2017.
777 Putnam Avenue	Apartment Building	120 unit apartment building	Town of Greenwich near the Route 1 bridges	Private Developer	Permits submitted in 2017 but were withdrawn.

6.1 Land Use

The TSP will not contribute to significant adverse cumulative effects to land use. The TSP will serve to protect current land uses when combined with other past, current, and future flood risk management measures implemented in the basin.

6.2 Topography, Geology and Soils

The proposed action will not have any significant adverse cumulative impacts to topography, geology or soils. The TSP and other actions within the Byram River Basin will be required to prevent soil erosion through the preparation and implementation of an erosion and sediment control plan. The TSP will provide a cumulative benefit of regional flood risk management within the Byram River Basin when combined with changes in topography related to other past, current and future flood storm risk management projects.

6.3 Water Resources

The TSP, and current and future actions taken by others will be required to protect water quality in and adjacent to water bodies through the implementation through the acquisition of water quality certifications, wetland permits that include mitigation requirements for water resource impacts, State Pollution Discharge Elimination Systems permits and implementation of erosion and sediment control BMPs. Therefore, the TSP will not contribute to adverse cumulative impacts to water resources.

In general, the flood risk management measures, stormwater management, habitat mitigation and ecosystem restoration actions when combined with each other could result in minor improvements in water quality and aquatic habitat. Flood risk management measures contribute to water quality and aquatic habitat improvements by reducing the amount of manmade debris and pollutants introduced into waterways during flood events. Stormwater management measures reduce the amount of urban runoff that typically has high levels of nutrients and other pollutants that contribute to water quality and habitat degradation, entering waterways.

6.4 Vegetation

The TSP and any current and future actions taken by others will result in negligible short-term and moderate long-term adverse impacts to riparian vegetation within the project area. Short-term impacts include removal of vegetation within construction workspaces. These impacts will have minor cumulative impacts due to the restoration of impacted areas. The loss of mature trees in a watershed with high density development may have moderate cumulative impacts. Replacing trees wherever feasible and in accordance to any local or state requirements will minimize adverse cumulative impacts. As the TSP includes replanting trees as part of site restoration, the proposed project will not significantly contribute to adverse cumulative impacts to vegetation.

6.5 Fish and Wildlife

The TSP is expected to have minor cumulative impacts to fish and wildlife resources. The proposed project will be working predominantly within an existing bridge footprint and will

restore approximately 0.02 acres of open water habitat previously impacted by a structure. Disturbed areas will be restored with native vegetation after construction. In addition, actions taken by others that effect aquatic, wetland and riparian habitat are subject to permit mitigation requirements. Any mitigation actions taken by others in conjunction with any ecosystem restoration projects could improve fish and wildlife habitat throughout the watershed.

The TSP will not have significant adverse cumulative impacts to state and/or Federal endangered, threatened and special concern species that may occur in the project area.

6.6 Socioeconomic and Environmental Justice

In general, the objective of the TSP and other flood risk management measures implemented within the Byram River Watershed is to provide a long term risk reduction to loss of life and property/infrastructure damages resulting from flood events.

The TSP will have no adverse cumulative impacts on the existing demographics, economy, housing and Environmental Justice communities in the geographical region analyzed for cumulative impacts. Increasing flood risk management will reduce damage to property and infrastructure within the project area; thus implementation of the TSP is expected to benefit the local economy and housing in the long term.

All of the actions considered could produce positive cumulative socioeconomic impacts within the watershed by reducing flooding, which is disruptive to socioeconomic conditions.

6.7 Cultural Resources

The TSP will have no adverse cumulative impacts on historic properties.

6.8 Coastal Zone Management

The TSP and other actions within the local and state jurisdictional Coastal Zone Management boundaries are required to demonstrate compliance with State and local CZM policies. Therefore, the majority of impacts will be short-term effects resulting from construction activities. The timing of the implementation of the TSP and any other actions is such that it is not anticipated that construction noted actions will be concurrent.

6.9 Hazardous, Toxic and Radioactive

The TSP will not contribute to the release and/or exposure of HTRW substances. All state and federally permitted actions, including the TSP, must implement measures such as erosion and sediment BMPs and/or an environmental protection plan to manage the risk of improper release, exposure and disposal of HTRW substances.

6.10 Aesthetics and Scenic Resources

The TSP and any other actions within the project area will not have a significant impact on scenic resources. The aesthetics of the new bridge will replicate the existing bridges to minimize potential cumulative impacts.

6.11 Recreation

The TSP will result in a short term closure to the William James Gateway Memorial Park, but these impacts overall will have negligible cumulative impacts.

6.12 Air Quality

The TSP will not have any adverse cumulative impacts on air quality. Air emissions related to land-based construction activities are a short-term and local impact accounted for in Connecticut's and New York's State Implementation Plans (SIPs). There are no operable parts of the completed project that will result in air emissions.

There will be no ongoing sources of greenhouse gas emissions resulting from the TSP once the project is completed.

6.13 Noise

The TSP will introduce short-term increases in the noise environment from construction. These changes will have a negligible cumulative effect. There will be no adverse long term cumulative impacts on the existing environment once construction is completed.

6.14 Transportation

The TSP will not have any long term adverse cumulative impacts on transportation. Positive cumulative impacts resulting from the combination of the TSP and with past, actively occurring or future flood risk management actions will be the reduction in road closures and damage to transportation infrastructure in some locations of the project area due to flooding within the Byram River watershed.

7. Coordination & Compliance with Environmental Requirements*

A NEPA Scoping Meeting was held on November 16, 2017. The NEPA Scoping Meeting initiated a 30-day public comment period that was closed on December 15, 2017. A NEPA Scoping Document was prepared and posted on the District website.

No comments were received from the public. One response citing a "No comment" was received via email from the U.S. Fish and Wildlife Service, New England Field Office regarding federally and endangered species. The email is included in Appendix A.3.

The District sent letters extending an invitation to the Federal Highways Administration to serve as a cooperating agency in developing the draft FR/EIS. The Federal Highways Administration (FHA) declined the invitation, however they will be provided an opportunity to review and comment on the draft FR/EIS. Relevant correspondence between the District and the FHA is located in Appendix A10.

The District has coordinated with the both the USFWS New England and New York Field Offices as it relates to the Fish and Wildlife Coordination Act and Section 7 of the Endangered Species Act. Both field offices have opted not to prepare formal Fish and Wildlife Coordination Act reports. As the managing regional authority for northern long-eared bat, the New England Field Office will review the Draft FR/EIS for compliance with Section 7 of the ESA. To facilitate their review, a letter requesting their concurrence for a determination of "No Effect" to this species has been developed and is included in Appendix A.3. The USFWS New York Field Office will review the draft FR/EIS and will submit any comments they have to the District as an informal compliance with the Fish and Wildlife Coordination Act. Relevant correspondence between the District and two USFWS field offices is included in Appendix A.3.

The District has coordinated with the New York Department of Transportation (NYDOT) as the owner of the bridges through several meetings, including the NEPA Scoping Meeting. They will be given the opportunity to review the draft FR/EIS. Relevant correspondence between the District and NY DOT is included in Appendix G.

The District has also coordinated with the New York Department of Conservation and the Village of Port Chester as study stakeholders. They will be given an opportunity to review the draft FR/EIS.

The District has coordinated the results of the Phase I survey (Appendix A.4) with the NY and CT State Historic Preservation Offices. The District is in the process of coordinating the TSP and its determination of effect with these offices and potential consulting parties such as the Port Chester and Greenwich Historical Societies, as well consultation with the relevant federally-recognized Tribes. This coordination and consultation includes the review of the preliminary draft Memorandum of Agreement regarding the additional activities to be completed as part of project.

The Draft Integrated FR/EIS will be posted on the study webpage located on the District website and will undergo a 45 day public and agency comment period. A notice of availability of the Draft FR/EIS will be published in the Federal Register and will be provided to interested parties in addition to applicable state and federal agencies. A list of Federal, state, local and non-profit organizations that will receive a copy of the notice of availability is included in Appendix A12.

All comments received will be addressed in the Final FR/EIS. The FR/EIS will undergo a 30 day public review prior to the publication of the Record of Decision. Table 30 and Table 31 show compliance and shows the list of report preparers.

Table 30: Summary of Primary Federal Laws and Regulations Applicable to the Proposed Project

LEGISLATIVE TITLE U.S. CODE/OTHER		COMPLIANCE
Clean Air Act	42 U.S.C. §§ 7401 7671g	An air quality analysis was completed for the project. Based upon the completed analysis, the emissions from the project are considered to have an insignificant impact on the regional air quality, and according to 40 CFR 93.153 (f) and (g) the proposed project is presumed to conform to the SIP. A preliminary draft Record of Non-Applicability is located in Appendix A.8
Clean Water Act	33 U.S.C. §§ 1251 et seq.	A 404(b) Evaluation is located in Appendix A.2
Coastal Zone Management Act	16 U.S.C. §§ 1451-1464 N.J.A.C. 7:7 and N.J.A.C. 7:7E	The States of Connecticut and New York are the administering authorities for the CZMA. Statements of Compliance to the New York and Connecticut Rules in addition to the Village of Port Chester Local Waterfront Development Program are located in Appendix A.6.
Endangered Species Act of 1973	16 U.S.C. §§ 1531 et seq.	Based on initial coordination with the U.S. Fish and Wildlife Service, the project may contain habitat supportive of northern long-eared bat. Protection of these species typically involves implementing a tree clearing restriction from 1 April – 30 September. The District will continue coordination with the USFWS throughout the duration of the feasibility study. No endangered species under the jurisdiction of NOAA-Fisheries occur within the project area. A No Effect Determination is located in Appendix A.9
Environmental Justice in Minority and Low Income Populations	Executive Order 12898	The Village of Port Chester meets Environmental Justice criteria. Coordination with the Village of Port Chester has been ongoing throughout the study. Circulation of the Draft FR/EIS will satisfy compliance with this E.O.
Fish and Wildlife Coordination Act	16 U.S.C. §§ 661 et seq.	Both the USFWS New England Field and New York Field Offices have opted to not prepare formal Fish and Wildlife Coordination Act (FWCA) reports. The New England Field Office will review the Draft FR/EIS and comment pursuant to Section 7 of the ESA and the New York Field Office will review the Draft FR/EIS and submit any comments to satisfy compliance with the FWCA. Correspondence documenting coordination to date is included in Appendix A.3.
Magnuson-Stevens Act Fishery Conservation and Management Act	Section 305(b)(2) 1996 Amendments	An Essential Fish Habitat Assessment has been prepared and is included in Appendix A5. The Draft FR/EIS and the EFH Assessment will be used as the coordination vehicle with NOAA-Fisheries.

LEGISLATIVE TITLE U.S. CODE/OTHER		COMPLIANCE
Migratory Bird Conservation Act of 1928, as amended	16 U.S.C. § 715	A tree clearing restriction from 1 April through 30 September will be implemented during construction to comply with this act.
National Environmental Policy Act of 1969	42 U.S.C. §§ 4321-4347	The draft FR/EIS will be undergo a 45 day public/agency comment period. The final FR/EIS will incorporate any comments received and undergo a 30 day public/agency comment period. The Record of Decision will fulfill requirements of this act.
National Historic Preservation Act of 1966	16 U.S.C. §§ 470 et seq.	The District has continued to coordinate with the State Historic Preservation Offices to fulfill the requirements of this act. The draft Programmatic Agreement for the project is located in Appendix A.
Executive Order 11593 Protection and Enhancement of the Cultural Environment	May 13, 1971	Requires Federal agencies to administer to cultural properties under their control to preserve, restore and maintain these properties. This EO does not apply to this project as the bridge and project is not owned by or under the control of the District.
Executive Order 11990, Protection of Wetlands	May 24, 1977	Circulation of this report for public and agency review fulfills the requirements of this order.
Executive Order 13007 Indian Sacred Sites	May 24, 1996	Requires the Federal agency accommodate access to and ceremonial use of Indian Sacred Sites on Federal lands. This EO does not apply as there are no Federal lands as part of this project
Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks	April 21, 1997	Implementation of this project will reduce environmental health risks. Circulation of this report for public and agency review fulfills the requirements of this order.
Executive Order 13112 Invasive Species	February 3, 1999	BMPs to prevent spread, proper disposal of invasive species during construction, replanting with native vegetation monitoring and adaptive management such as invasive species management until mitigation is determined to be successful.
Executive Order 13175, Consultation and Coordination with Indian Tribal Governments	November 6, 2000	Requires all federal agencies to consult with Indian Tribes and respect tribal sovereignty as they develop policy on issues that impact Indian communities. This includes conducting government-to-government consultation on agency undertakings. Consultation with the Mashantucket Pequot, the Delaware Nation, the Delaware Tribe of Indians and the Stockbridge Munsee Community of Indians is ongoing.
Presidential Memorandum: Government-to-Government Relations with Native American Tribal Governments	May 4, 1994	Requires Federal agencies to recognize Tribes as sovereign government and consult with them on projects and undertakings. Consultation with the Mashantucket Pequot, the Delaware Nation, the Delaware Tribe of Indians and the Stockbridge Munsee Community of Indians is ongoing.

Table 31: Compliance Status with Applicable State Laws

LEGISLATIVE TITLE/OR CODE		COMPLIANCE
Connecticut Freshwater Wetlands	401 33 U.S.C. § 1341	The Water Quality Certification will be obtained during the construction phase.
Connecticut Coastal Zone Management Act	C.G.S. §§ 22a-90 to 22a-111	A statement of compliance with the CT CZM is located in Appendix A.6. This statement of compliance also includes the compliance statement to the Long Island Sound Coastal Zone Management policies.
Connecticut Environmental Policy Act	C.G.S. §§ 22a-22a-1h; 22a-1a-22-1a-12	Compliance with this law will be completed during the PED Phase.
Connecticut Erosion & Sediment Control Regulations	C.G.S. §§ 22a-328	An erosion and sediment control plan will be developed during the construction phase and will be submitted to the Town of Greenwich for approval.
New York Water Quality Certification	401 33 U.S.C.	The Water Quality Certification will be obtained during the construction phase.
New York Coastal Zone Management Program	Article 42, Section §911	A statement of compliance with the New York CZM Rules and the Village of Port Chester LWRP is located in Appendix A.6.
New York State Environmental Quality Review (SEQR)	6 NYCRR Part 617	Compliance with this law will be completed during the PED Phase.
New York Erosion and Sediment Control Regulations	Article 15, Article 24 and Article 25	An erosion and sediment control plan will be developed during the construction phase and will be submitted to the Westchester County Soil and Water Conservation District for approval.

Table 32: List of Report Preparers

INDIVIDUAL	DISCIPLINE
Olivia Cackler	Plan Formulation
Karen Baumert	Plan Formulation
Kimberly Rightler	Environmental Resources
Nancy Brighton	Environmental and Cultural Resources
Anna Jansson	Plan Formulation
Carlos Gonzalez	Real Estate
Andre Chauncey	Hydrology and Hydraulics
Mukesh Kumar	Cost Engineering
Robert Muskthel	Cost Engineering
Mitchel Laird	Economics
Maggie Lofstedt	Environmental Resources
Derek Etkin	Hydrology and Hydraulics
Kevin O'Malley	Geotechnical
Timothy Hester	Real Estate
David Giel	Traffic
Eric LeClair	Structural Engineering
Shelby Basel	Plan Formulation

8. Plan Implementation

8.1 Institutional Requirements

The non-Federal Sponsors, the Town of Greenwich and the New York State Department of Environmental Conservation, would need to provide their support of the recommendations presented in this report and agree that they intend to execute a Project Partnership Agreement (PPA) for the recommended plan before the Draft Integrated Feasibility Report and Environmental Assessment can move forward to the Civil Works Review Board Milestone. A coordinated PPA package would be prepared subsequent to the approval of the Feasibility Report, which would reflect the recommendations of the report.

Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent of initial project costs assigned to flood risk management, plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits, and as further defined below:

   (1) Provide, during design, 35 percent of design costs allocated to coastal and storm damage reduction in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

   (2) Provide all lands, easements, rights-of-way, and perform or assure performance of all relocations, including utility relocations, as determined by the Federal government to be necessary for the initial construction, periodic nourishment or operation and maintenance of the project;

   (3) Provide, during construction, any additional amounts necessary to make its total contribution equal to 35 percent of initial project costs assigned to flood damage reduction plus 100 percent of initial project costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;

b. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities, which might reduce the outputs produced by the project, hinder operation and maintenance of the project, or interfere with the project's proper function;

c. Inform affected interests, at least yearly, of the extent of protection afforded by the flood risk management features; participate in and comply with applicable Federal floodplain management and flood insurance programs; comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. §§ 701b-12); and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

d. Operate, maintain, repair, replace, and rehabilitate the completed project, or function portion of the project, at no cost to the Federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal government;

e. For so long as the project remains authorized, ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;

f. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;

g. At least twice annually and after storm events, perform surveillance of the project and provide the results of such surveillance to the Federal government;

h. Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

i. Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the project, except for damages due to the fault or negligence of the United States or its contractors;

j. Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of three years after completion of the accounting for which such books, records, documents, and other evidence are required, to the extent and in such detail as will properly reflect total cost of the project, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and local governments at 32 CFR, Section 33.20;

k. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. §§ 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal government determines to be necessary for the initial construction, periodic nourishment, operation and maintenance of the project;

l. Assume, as between the Federal government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way required for the initial construction, periodic nourishment, or operation and maintenance of the project;

m. Agree, as between the Federal government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and, to the maximum extent practicable, operate, maintain, repair, replace, and rehabilitate the project in a manner that will not cause liability to arise under CERCLA;

n. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, (42 U.S.C. §§ 1962d-5b) and Section 101(e) of the Water Resources Development Act (WRDA) 86, Public Law 99-662, as amended, (33 U.S.C. § 2211(e)) which provide that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element;

o. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. §§ 4601-4655) and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way necessary for construction, operation, and maintenance of the project including those necessary for relocations, the borrowing of material, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. § 2000d), and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. §§ 3141-3148 and 40 U.S.C. §§ 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. §§ 276a et seq.), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. §§ 327 et seq.), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. § 276c)); and

q. Not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal sponsor's obligations for the project unless the Federal agency providing the funds verifies in writing that such funds are authorized to be used to carry out the project.

8.2 Real Estate Requirements

USACE projects require the non-Federal sponsor provide lands, easements, rights-of-way and relocations, and disposal/borrow areas (LERRDs) for a project. Currently, the TSP will require the non-Federal sponsor to acquire temporary and permanent easements for construction. Since the project is currently at a feasibility-level design, the size of the real estate interests required are preliminary estimates only based on available Geographic Information System (GIS) data. The precise size and location of the required real estate interests will be identified during the Preconstruction Engineering and Design (PED) phase when Plans and Specifications and detailed drawings are prepared. As a result, the require acreage are subject to change with project refinements. The non-Federal costs for Real Estate are estimated to be $1,433,000. Details are provided in Appendix E (Real Estate Plan).

8.3 Preconstruction Engineering and Design

In order for PED and construction to be initiated, USACE must sign a PPA with a non-Federal sponsor to cost share PED and construction. This project would require congressional authorization for PED and implementation. PED and construction are typically cost shared 65% Federal and 35% non-Federal. Implementation would then occur, provided that sufficient funds are appropriated to design and construct the project.

8.4 Construction Schedule

The draft schedule for plan implementation was developed for planning and cost estimating purpose (Table 33). The schedule assumes that the project will be authorized and funded for construction by the Congress in a Water Resources Development Act or similar legislation in 2021. All dates are dependent upon this authorization. Dates for design and construction are also dependent upon appropriation of Federal and non-Federal funding. Table 34 is the proposed construction schedule.

Table 33: Draft TSP Implementation Schedule

Submission of the Chief's Report	December 2019
Chief of Engineering Report Approval	January 2020
Project Partnership Agreement (PPA)	
PPA Execution	January 2020
Pre-Construction Engineering & Design (PED)	
Design Start	February 2020
Design End	October 2021
Real Estate Acquisition Start	February 2020
Real Estate Acquisition End	October 2021
Construction	
Construction Start	October 2021
Construction Complete	September 2023

Table 34: Draft Construction Schedule

TASK	DURATION	START	FINISH
Mobilization	**5 days**	**Friday 10/1/21**	**Thurs 10/7/21**
Notice to Proceed	0 days	Friday 10/1/21	Friday 10/1/21
Coordination Meeting	0 days	Friday 10/1/21	Friday 10/1/21
Mobilization to Site	5 days	Friday 10/1/21	Thursday 10/7/21
Roads, Railroads, and Bridges	**506 days**	**Friday 10/8/21**	**Friday 9/15/23**
Site Prep Work/Setup Traffic Controls North Bridge	20 days	Friday 10/8/21	Thursday 11/4/21
Demolition of North Bridge	34 days	Friday 11/5/21	Wednesday 12/22/21
Setup Cofferdams North Bridge	8 days	Thursday 12/23/21	Monday 1/3/22
Abutments and Footings North Bridge	75 days	Tuesday 1/4/22	Monday 4/18/22
Set Deck and Pour Roadway North Bridge	112 days	Tuesday 4/19/22	Wednesday 9/21/22
Finishing and Painting North Bridge	5 days	Thursday 9/22/22	Wednesday 9/28/22
Site Prep Work/Setup Traffic Controls South Bridge	20 days	Thursday 9/29/22	Wednesday 10/26/22
Demolition of South Bridge	34 days	Thursday 10/27/22	Tuesday 12/13/22
Setup Cofferdams South Bridge	8 days	Wednesday 12/14/22	Friday 12/23/22
Abutments and Footings South Bridge	75 days	Monday 12/26/22	Friday 4/7/23
Set Deck and Pour Roadway South Bridge	110 days	Monday 4/9/23	Friday 9/8/23
Finish work and Painting South Bridge	5 days	Monday 9/11/23	Friday 9/15/23
Demobilization	**10 days**	**Monday 9/18/23**	**Friday 9/29/23**
Punchlist	5 days	Monday 9/18/23	Friday 9/22/23
Demobilization	5 days	Monday 9/25/23	Friday 9/29/23
Project Closeout, Final Submittals	10 days	Monday 9/18/23	Friday 9/29/23

8.5 Cost Sharing and Non-Federal Partner Responsibilities

The non-Federal sponsor is responsible for the value of lands, easements, rights-of-way, relocations, and dredged or excavated material disposal areas (LERRD). This includes temporary and permanent easements as well as the cost to replace the bridge.

In accordance with the cost share provisions in Section 103 of the WRDA of 1986, as amended (33 U.S.C. § 2213), project design and implementation are cost shared 65 percent Federal and 35 percent non-Federal. The set-up of the bridge removal (i.e., mobilization, demobilization, site preparations, traffic control, excavation and disposal, cofferdams, etc.) and the bridge removal itself are project costs that are cost shared. The construction of the new bridges is considered a relocation and is the non-Federal sponsor's responsibility. The construction of the new bridges would occur immediately after the removal of each of the Route 1 bridges in sequence; one bridge will be removed and replaced per construction season, to be accomplished over two seasons.

The non-Federal sponsor's portion of the costs is estimated to be $12,151,000. The first cost is estimated to be $24,302,000 and the fully funded cost is estimated to be $27,261,000 (Table 35).

Table 35: TSP Cost Sharing Breakdown[2]

DESCRIPTION	FEDERAL SHARE	NON-FEDERAL SHARE	TOTAL
Standard 65%/35% cost share	$15,796,300	$8,505,700	$24,302,000
Minimum NF 5% cash contribution	NA	$1,215,000	$1,215,000
LERRD	NA	$11,262,000	$11,262,000
NF cash and LERRD	NA	$12,477,100	$12,477,100
Adjusted for LERRD in excess of the 35% non-Federal share	$11,825,000	$12,477,000	24,302,000
Cost share identified in E-21 of ER 1105-2-100 (non-Federal share max 5% cash 45% LERRD)	**$12,151,000**	**$12,151,000**	**24,302,000**
Amount to be reimbursed to NFS	**$326,000**	NA	

Operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) requirements are considered in the economic analysis for the project. The non-Federal sponsor is responsible for 100% of annual OMRR&R requirements, estimated at $25,000 per year. The Federal government is responsible for preparing and providing an OMRR&R manual to the sponsor.

[2] From ER 1105-2-100, "The requirements for structural projects are essentially as follows:
(1) Provide a cash contribution equal to 5 percent of structural flood control features costs.
(2) Provide all lands, easements, rights-of-way, relocations (except existing railroad bridges and approaches thereto) and suitable borrow and dredged material disposal areas (referred to as LERRD).
(3) If the sum of the above two items is less than 35 percent of the costs assigned to flood control, non-Federal sponsors will pay the difference in cash. If it is greater than 35 percent, total non-Federal costs shall not exceed 50 percent of total project costs assigned to flood control. Contributions in excess of 50 percent will be reimbursed by the Federal Government to the non- Federal sponsor. Total contributions in excess of 30 percent may be reimbursed to the Federal government over a period not to exceed 15 years."

8.6 Views of the Non-Federal Partner and Other Agencies

The non-Federal sponsor, Town of Greenwich, supports the TSP as it is presented in this report and is willing to work with USACE on coordinating implementation arrangements. Further feedback will be received following Public and Agency reviews of the report.

9. Recommendations

In making the following recommendations, I have given consideration to all significant aspects in the overall public interest, including environmental, social and economic effects, engineering feasibility and compatibility of the project with the policies, desires and capabilities of the Town of Greenwich, CT, the State of New York, and other non-Federal interests.

I recommend that the selected plan for flood risk management at Byram River Basin, Connecticut and New York, as fully detailed in this Integrated Feasibility Report and Environmental Impact Statement, be authorized for construction as a Federal project, subject to such modifications as may be prescribed by the Chief of Engineers.

The recommendations contained herein reflect the information available at this time and current departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of highest review levels within the Executive Branch. Consequently, the recommendations may be modified (by the Chief of Engineers) before they are transmitted to the Congress as proposals for authorization and implementing funding. However, prior to transmittal to Congress, the partner, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Thomas D. Asbery
Colonel, U.S. Army
District Engineer

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