SCOPING DOCUMENT

WOODBRIDGE RIVER BASIN, NEW JERSEY
FLOOD CONTROL & ECOSYSTEM RESTORATION STUDY

September 2003

Prepared by:

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TABLE OF CONTENTS

LIST OF TABLES

TABLE **PAGE**

LIST OF FIGURES

FIGURE **PAGE**

LIST OF ACRONYMS AND ABBREVIATIONS

BCR	Benefit Cost Ratio
CFR	Code of Federal Regulations
District	New York District
ER	Environmental Regulations
FWCA	Fish and Wildlife Coordination Act
FW2	Freshwater 2
FW2-NT/SE3	Freshwater 2 – Non-trout/Saline Estuarine – 3
NED	National Economic Development
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NJAC	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJNHP	New Jersey Natural Heritage Program
NT	Non-trout
NWI	National Wetland Inventory
SE3	Saline Estuarine – 3
Study	Woodbridge River Basin Flood Control and Ecosystem Restoration Study
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

EXECUTIVE SUMMARY

The United States Army Corps of Engineers (USACE), New York District (District) is the lead Federal agency, and the New Jersey Department of Environmental Protection (NJDEP) is the lead State agency and non-federal partner for the Woodbridge River Basin Flood Control and Ecosystem Restoration Study, Middlesex County, New Jersey, herein referred to as the Study. The Study area begins at the headwaters of the Woodbridge River in the northeastern corner of Woodbridge Township near the Carteret/Rahway Township line and ends at the river's confluence with the Arthur Kill. The Study area is approximately five miles in length and 10 square miles in area, and includes Heards Brook, Wedgewood Brook, and Spa Spring. The District was authorized by the U.S. House of Representatives Committee on Transportation and Infrastructure resolution dated May 6, 1998, to identify recommendations in the interest of water resources development, including flood control and ecosystem restoration. The Rahway & Woodbridge River Basins Reconnaissance Study (USACE 1999) evaluated Federal interest for providing flood control and ecosystem restoration measures in the Study area.

The purpose of this scoping document is to formally coordinate with local, county, state, and Federal agencies, and to identify issues and concerns that may be associated with the Study. This scoping document provides a description of potential solutions for flood control and opportunities for ecosystem restoration; a discussion of the existing water, biological, and cultural resources within the Study area; a preliminary assessment of potential direct, indirect, and cumulative impacts of the Study; and, a discussion of the local, county, state and Federal policies and permits applicable to the Study. The scoping document was prepared in accordance with U.S. Environmental Protection Agency (USEPA) guidelines (40 Code of Federal Regulations [CFR] 1500-1508) and USACE guidelines (Environmental Regulations [ER]-200-2-2) as a precursor to preparation of an Environmental Impact Statement as required by the National Environmental Policy Act (NEPA).

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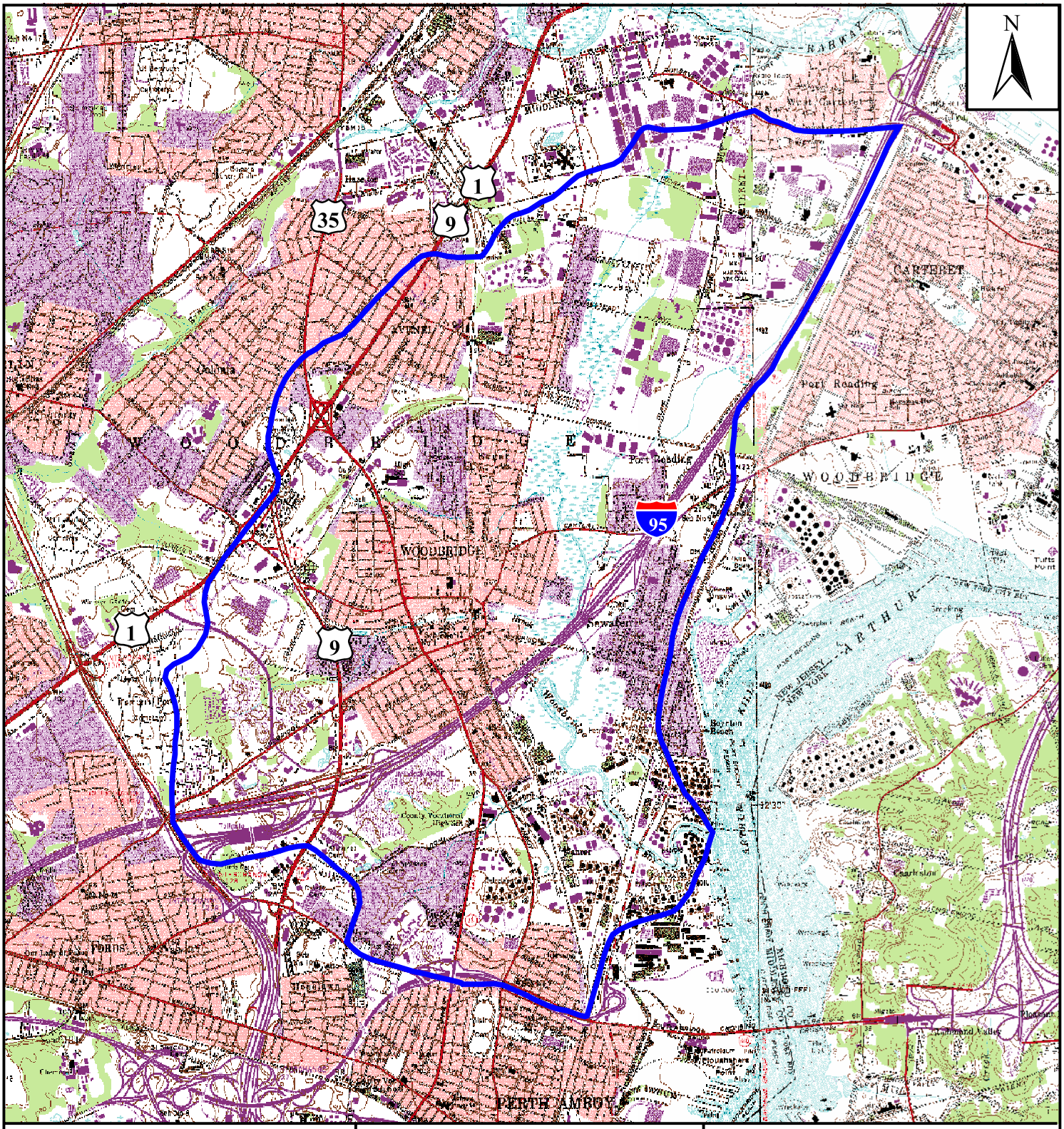
1.0 INTRODUCTION

The United States Army Corps of Engineers (USACE), New York District (District), was authorized by the U.S. House of Representatives Committee on Transportation and Infrastructure resolution dated May 6, 1998, to identify recommendations in the interest of water resources development, including flood control and ecosystem restoration. Accordingly, the Rahway & Woodbridge River Basins Reconnaissance Study (USACE 1999) established Federal interest for providing flood control and ecosystem restoration measures in the Woodbridge River Basin. As a result of the reconnaissance study (1999), the District initiated the Woodbridge River Basin Flood Control and Ecosystem Restoration Study (Study) for which they are the lead Federal agency, and the New Jersey Department of Environmental Protection (NJDEP) is the non-Federal partner agency.

The Study area is located in Middlesex County in northeastern New Jersey (Figure 1). The watershed is approximately five miles in length from its headwaters, or the upper portion of the river, located in the northeastern corner of Woodbridge Township near the Carteret/Rahway Township line to its mouth at the Arthur Kill. The drainage area of the Woodbridge River Basin is approximately 10 square miles and includes Heards Brook, Wedgewood Brook, and Spa Spring.

The Study area has experienced multiple, significant flood events, particularly in the areas between the New Jersey Turnpike (Interstate 95) and Port Reading Avenue, and along the Woodbridge River from the Port Reading railroad north to Crampton Ave. The Rahway and Woodbridge River Basins Reconnaissance Report identified the Crampton Ave neighborhood and the Rahway Ave Mobile Home Park as the most flood prone communities within the Study area. Flooding in these areas is mainly associated with storm tides. Flood events have resulted in physical damage to mainly residential and public property, as well as a loss of economic activity. For example, the storm event in October 1996 damaged over 170 homes near Crampton Avenue and the Rahway Avenue Mobile Home Park, and totaled approximately $600,000 in damages (Killam 1997). The recurring nature of flood events in the Study area presents a threat to human life and safety for those that reside in the area (USACE 1999). The District identified additional floodprone communities in site investigations subsequent of the Rahway and Woodbridge River Basins Reconnaissance Report. Further investigation in these areas indicated that flooding is primarily due to increased rates and volumes of stormwater runoff, which should be addressed by local agencies.

Intense urbanization and development have also led to the degradation of the environment within the Study area. For example, direct development impacts on ecological resources in the Study area include increased streambank erosion, loss of wetland acreage, increased sedimentation, nutrient and pollutant loading, and channel siltation. Indirect impacts include increased rates and volumes of stormwater runoff, reduced groundwater recharge, increased stream temperatures, and increased acreage of invasive species. As a result of these direct and indirect impacts, opportunities for ecosystem restoration, including fish and wildlife habitat enhancement, water



Source: USGS 7.5' series Quadrangles Perth Amboy, N.J.-N.Y., 1956, Photorevised 1981, and Arthur Kill, N.Y.-N.J., 1966, Photorevised 1981.

Figure 1. Location of the Woodbridge River Basin, Middlesex County, New Jersey.

Prepared For: U.S. Army Corps of Engineers New York District

Prepared By: NEA Northern Ecological Associates, Inc.

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quality improvement, and restoration of natural floodplain values exist within the Woodbridge River Basin (USACE 1999).

This scoping document was prepared in accordance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality's *Guidance Regarding NEPA Regulations*, and the USACE's *Procedures for Implementing NEPA* (Environmental Regulations [ER]-200-2-2) for distribution to local, county, state, and Federal agencies that may have an interest in the impacts and benefits derived from implementation of flood control and ecosystem restoration measures. This document provides a description of potential solutions for flood control and ecosystem restoration; a discussion of the existing water, biological, and cultural resources within the Study area; a preliminary assessment of the direct, indirect, and cumulative impacts and benefits of the Study; and, a discussion of the local, county, state, and Federal policies and permits applicable to the Study. The purpose of this scoping document is to 1) formally coordinate with local, county, state, and Federal agencies; 2) inform the public of the District's proposed Study; and, 3) identify issues and concerns that may be associated with the Study.

2.0 STUDY DESCRIPTION

The Rahway River and Woodbridge River Basins Reconnaissance Study (USACE 1999) preliminarily evaluated potential flood control solutions and ecosystem restoration measures to demonstrate Federal interest in implementing solutions to frequent flooding problems, environmental degradation, and other related water resource issues. This section briefly describes potential non-structural and structural flood control solutions, as well as potential flood control scenarios, and discusses the potential ecosystem restoration areas and measures that might be implemented within the Study area.

2.1 FLOOD CONTROL COMPONENT

The USACE and NJDEP are evaluating a number of potential non-structural and structural flood control solutions. In general, non-structural flood control solutions are used to alleviate the damage from future flooding events by keeping water out of buildings and reducing the effects of water that does enter structures. Structural flood control solutions are intended to provide protection against flooding to homes, buildings, roadways, and bridges by forming physical barriers that prohibit floodwaters from reaching these structures.

2.1.1 Potential Flood Control Solutions

Based on preliminary analyses by the USACE (1999), potential non-structural flood control solutions that were considered for the Study include property buy-outs, elevating structures, and floodproofing buildings. Potential structural flood control solutions that were considered for the Study include floodwalls, levees, and storm gates. These potential solutions are briefly described below.

- Property Buy-Outs: Buy-outs involve the acquisition of property and its structures and/or the purchase of development rights. A buy-out plan would result in the permanent evacuation of the floodplain in areas of frequent and severe inundation. Development in the areas would cease and structures would be demolished or relocated. A buy-out plan would be successful in re-establishing and maintaining a natural state of the floodplain for purposes that would not be jeopardized by the flood hazard. However, this type of program causes emotional hardship, involves expensive relocation costs, and results in the loss of a community/local tax base.

- Elevating Structures: Elevating structures is the process of raising the main living area above the level of the most severe and recurrent floods. Usually, structures are held by hydraulic jacks and temporary supports while a new or extended foundation of piers, posts, columns, or pilings is constructed. After the structure is elevated, only the foundation would remain exposed to flooding.

- Floodproofing Buildings: Floodproofing is the process of making adjustments in the design or construction of buildings to reduce potential flood damages. Buildings

could be dry or wet floodproofed. Dry floodproofing would protect a building by sealing its exterior walls and providing removable shields at structure openings to prevent the influx of floodwaters. Wet floodproofing would protect a building by allowing floodwaters to enter and exit freely, which reduces the load imposed on the structure.

- Floodwalls: Floodwalls are structures composed of steel, concrete, rock, or aluminum, and are used when residential properties directly abut a channel or the shoreline and there is not enough space to construct a levee, or in cases where storm induced flooding is too severe for a levee. Interior drainage facilities, located on the landward side of the levees, would be needed to collect, control, and disperse water trapped behind the barriers. Otherwise, floodwaters would pond behind the barrier.

- Road Raising: Roads that currently experience flooding during storms due to tidal waters or surface runoff will be elevated to heights that would minimize or eliminate the impacts of such events.

- Levees: Levees are typically low, wide earthen embankments built to retain floodwater inside a channel. Interior drainage facilities, located on the landward side of the levees, would be needed to collect, control, and disperse water trapped behind the barriers. Otherwise, floodwaters would pond behind the barrier and potentially breach the levee.

- Storm Gates: Structures are used to alleviate the inundation of landward areas as floodwaters enter canals and creeks. During flood events, storm gates placed across waterways would be closed, and high flows in the creeks would be pumped around the closure.

2.1.2 Potential Flood Control Scenarios

Potential flood control scenarios have been evaluated based on each alternative's ability to protect life and property, taking into consideration engineering feasibility, environmental impacts, economic implications, and social consequences. During the feasibility phase, these factors would be applied to calculating a Benefit Cost Ratio (BCR) for each scenario and determining the National Economic Development (NED) plan. For all project purposes except ecosystem restoration, the alternative plan that reasonably maximizes net economic benefits consistent with protecting the Nation's environment, the NED plan shall be selected. Only potential flood control scenarios with a BCR greater than one will be considered for further analysis.

To date, the USACE has preliminarily identified four potential flood control scenarios. However, in order to maximize the net benefits, the identified flood control scenarios will not directly protect isolated homes or businesses that currently suffer damages due to flooding events.

- No Action Scenario: Under this alternative, no changes would be made to reduce or alter the current storm related tidal flooding. There would be no anticipated increase or decrease in the impact of tidal flooding or associated damages under this scenario.

- Scenario 1: Elevating approximately 203 homes in the Rahway Avenue Mobile Home Park and approximately 137 homes in the Crampton Avenue neighborhood (Figure 2).

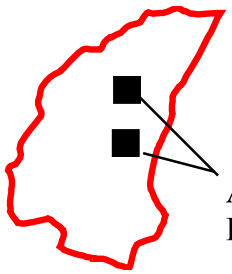
- Scenario 2: An approximately 4,200 foot-long floodwall placed around the Crampton Avenue neighborhood with an elevation of between 4 to 10 feet above ground. The floodwall would require a 100 cubic feet per second pump station and outfalls as necessary to remove excess runoff that would accumulate on the landward side of the floodwall along with raising Port Reading Ave. This potential flood control scenario would also include elevating approximately 203 homes in the Rahway Avenue Mobile Home Park (Figure 3).

- Scenario 3: This scenario would involve the same structural solutions as Scenario 2 (i.e., floodwall, pump station, and drainage structures) and would also include raising Port Reading Ave, but would not involve any home raisings. Instead, this potential flood control scenario would include placing a 4 to10 foot-above ground floodwall around the Rahway Avenue Mobile Home Park. This floodwall would extend approximately 1,850 feet and would require a 40 cubic feet per second pump station and outfalls as necessary to remove excess runoff that would accumulate on the landward side of the floodwall (Figure 4).

- Scenario 4: This alternative would involve constructing a storm gate at the downstream end of the New Jersey Turnpike (Interstate 95). The storm gate would have 10, 5-foot by 5-foot openings and would be 60 feet wide. Depending on the availability of a ponding area behind the gate, ranging from 1,000 cubic feet per second or 2,500 cubic feet per second pump station would be required to transport water downstream around the structure (Figure 5).

- Scenario 5: This scenario would be a low scale version of Scenario 4 with minimal interior drainage facilities.

Preliminary analysis indicates that all currently identified flood control scenarios are not practical due to limited cost-effectiveness for the benefits predicted (i.e., a BCR less than 1). However, further investigation during the Feasibility Study may identify additional solutions and examine additional flood control scenarios that may meet the BCR requirement. Other scenarios



Source: New Jersey DEP Geographic Information System CR-ROM, series 3, vo. 2 1995/97 imagery

500 0 500 1000 Feet

LEGEND

- Proposed Non-structural Protection
- Watershed Boundary

Figure 2. Location of Flood Control Scenario 1 for the Woodbridge River Basin, Middlesex County, New Jersey.

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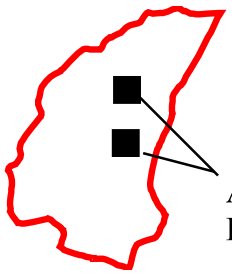
Prepared By: NEA Northern Ecological Associates, Inc.

Date: 09/08/03



Source: New Jersey DEP Geographic Information System CR-ROM, series 3, vo. 2 1995/97 imagery

800 0 800 1600 Feet

LEGEND

- Proposed Floodwall
- Road Raising
- Proposed Non-structural Protection
- Watershed Boundary

Figure 3. Location of Flood Control Scenario 2 for the Woodbridge River Basin, Middlesex County, New Jersey.

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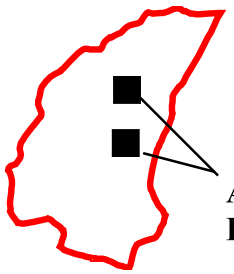

Source: New Jersey DEP Geographic Information System CR-ROM, series 3, vo. 2 1995/97 imagery

700 0 700 1400 Feet

LEGEND

- Proposed Floodwall
- Road Raising
- Watershed Boundary

Figure 4. Location of Flood Control Scenario 3 for the Woodbridge River Basin, Middlesex County, New Jersey.

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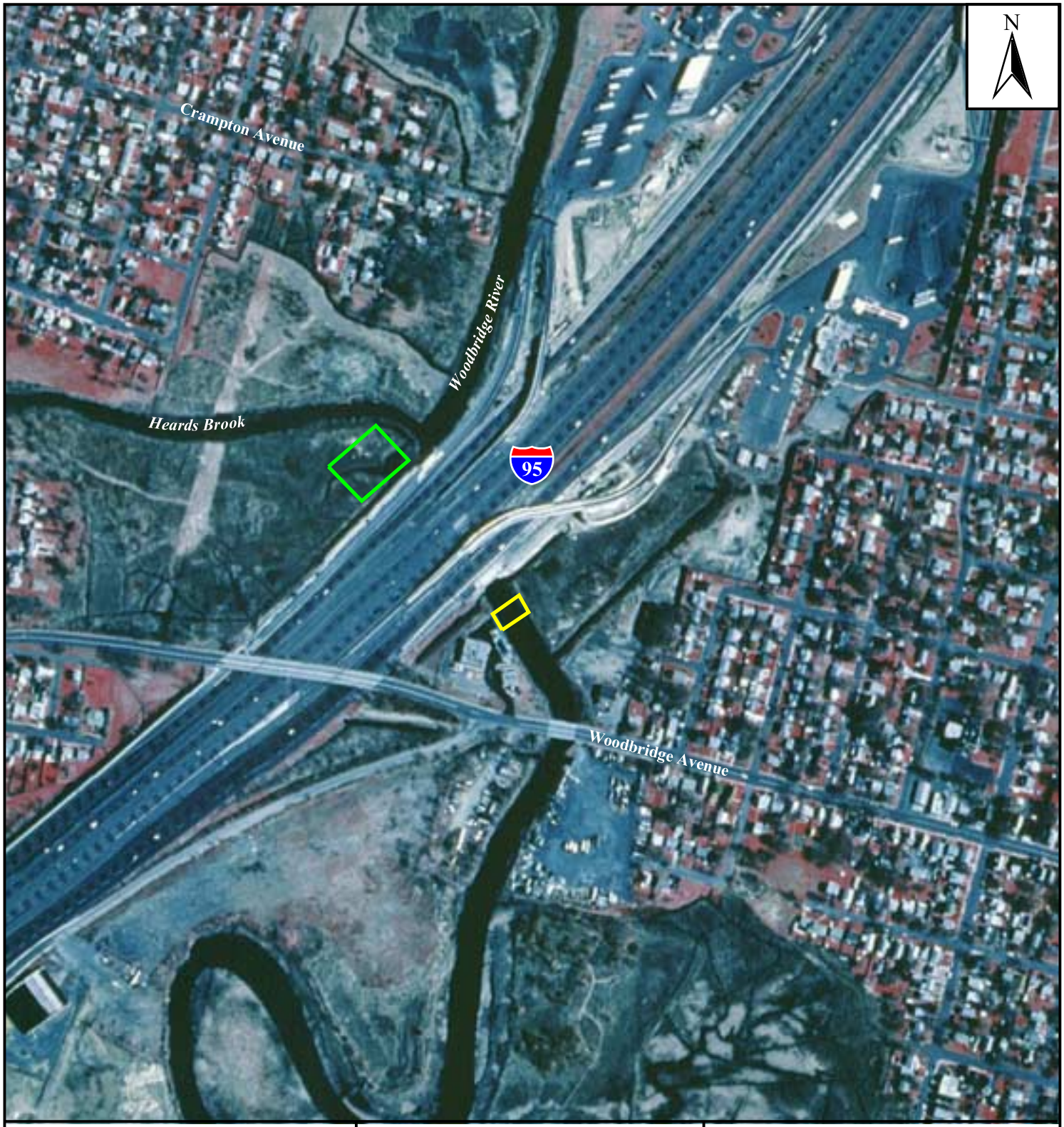

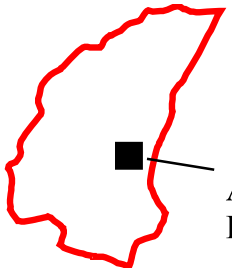

Source: New Jersey DEP Geographic Information System CR-ROM, series 3, vo. 2 1995/97 imagery

200 0 200 400 Feet

LEGEND

- Proposed Pump Station
- Proposed Tide Gate
- Watershed Boundary

Figure 5. Location of Flood Control Scenario 4 for the Woodbridge River Basin, Middlesex County, New Jersey.

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may include different sizes, volumes, and/or lengths of flood control structures, alternative placement and layout of structures, or various combinations of the flood control solutions currently identified.

2.2 ECOSYSTEM RESTORATION COMPONENT

In conjunction with potential flood control solutions and alternative plans, the District identified potential ecosystem restoration areas based on a thorough review of previous studies, maps, and restoration proposals, as well as site visits and several meetings and interviews with stakeholders, local organizations, and individuals. Potential ecosystem restoration measures were evaluated based on their ability to achieve the following objectives (Peck 1999):

- Restore ecosystem structure and function;
- Expand and improve habitat;
- Restore natural vegetation;
- Connect or enlarge wetlands and critical habitat areas; and,
- Improve public access and recreational opportunities.

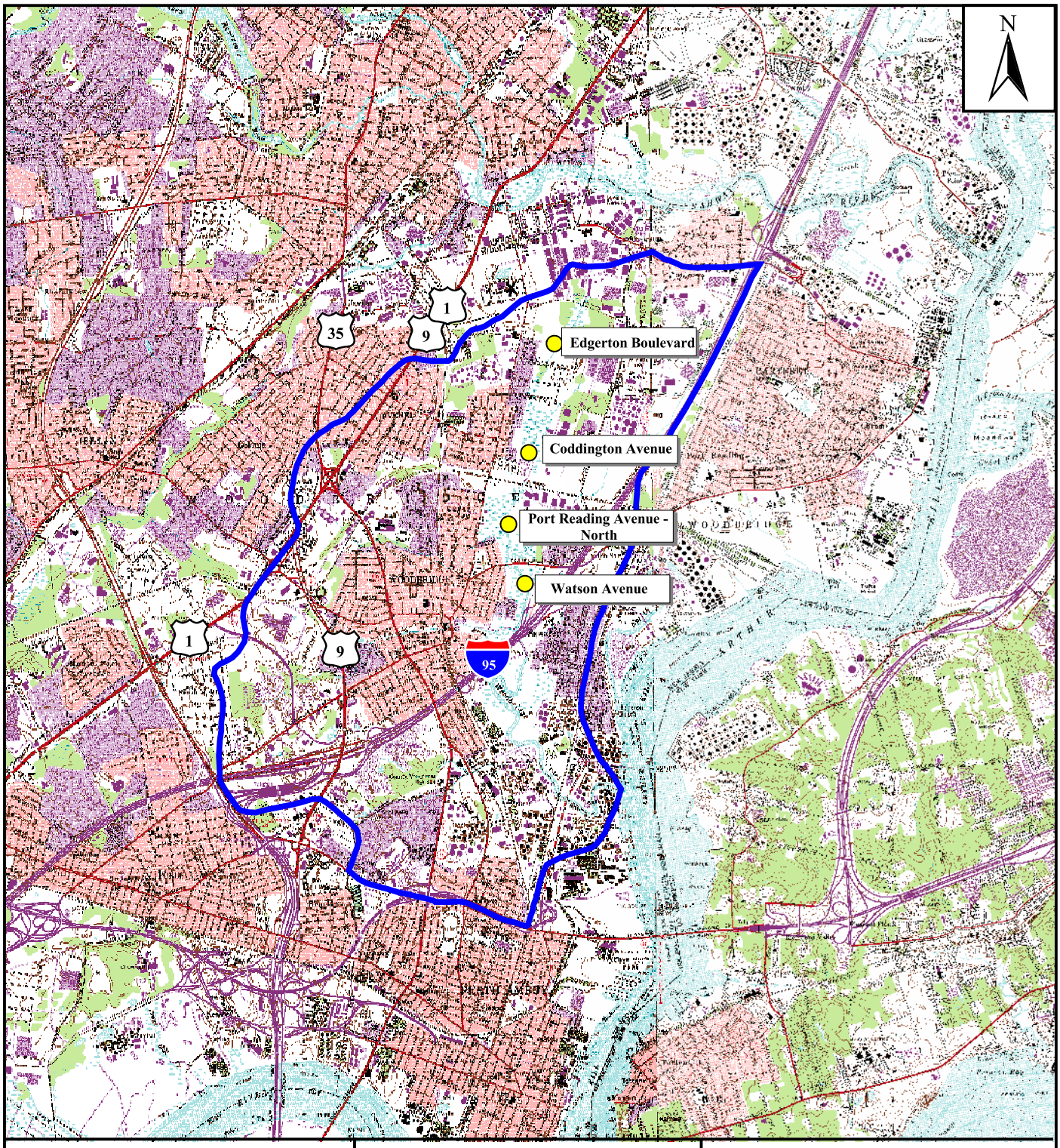
Ecosystem restoration projects would also provide secondary benefits including improved water quality and enhanced aesthetics.

2.2.1 Ecosystem Restoration Areas

At this time, the District has identified four potential ecosystem restoration areas within the Study area (Figure 6). The following provides a brief description of each of the potential ecosystem restoration areas.

- Edgerton Boulevard Area: Edgerton Boulevard, off of Rahway Avenue, runs adjacent to the Woodbridge River south of its headwaters above Omar Avenue. Formerly crossing the River, the road is now an unused, dirt path with an undersized culvert connecting upstream and downstream flows. Modification or removal of the culvert would enable a more naturalized flow of water downstream, and may enhance fish movement between habitats. Additionally, stream corridor improvements may provide additional fish and wildlife habitat and enhance water quality through the reduction and filtration of stormwater runoff associated with the nearby residential development.

- Coddington Avenue Area: Adjacent to the Rahway Avenue Mobile Home park is a series of utility right-of-ways and an established colony of an opportunistic, non-native, invasive plant species. Overgrown vegetation is partly the cause of increased sedimentation of the River channel through this area, and the restoration of a more natural plant community and streambank/channel may assist in improving water quality, enhancing fish and wildlife habitat, and restoring natural water flows.



Source: USGS 7.5' series Quadrangles Perth Amboy, N.J.-N.Y., 1956, Photorevised 1981, and Arthur Kill, N.Y.-N.J., 1966, Photorevised 1981.

2000 0 2000 4000 Feet

LEGEND

Watershed Boundary

Ecosystem Restoration Area

Figure 6. Location of Potential Ecosystem Restoration Areas in the Woodbridge River Basin, Middlesex County, New Jersey.

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Reestablishing a freshwater wetland in this area may be accomplished by fill removal and grading, followed by planting of native vegetation.

- Port Reading Avenue – North Area: The NJDEP and National Oceanic and Atmospheric (NOAA) Restoration Center have designed an approximately 16-acre tidal wetland restoration project on Township-owned land north of Port Reading Avenue. This proposed restoration project includes the removal of approximately 26,000 cubic yards of fill material, contouring the site to eliminate non-desirable species, and reestablishing native vegetation. The District has identified additional restoration opportunities that would compliment the NJDEP/NOAA restoration project at the site, including the removal of fill material and restoration of more acres of tidal marsh. In addition, a small, partially exposed dam sill is located near the Port Reading Avenue bridge and could be removed to improve tidal exchange and flushing between the upstream and downstream reaches.

- Watson Avenue Area: Interpretation of aerial photography and site visits by the District has identified a large fill site within the wetlands located behind Watson Avenue. The removal of fill and regrading of the site to appropriate contours would restore the tidal marsh below the Port Reading Avenue bridge, and provide an increase in the acreage and diversity of fish habitat, which may promote increased anadromous and catadromous fish movement. Restoration of the site would also improve habitat for birds and other wildlife, and may additionally reduce nuisance mosquito populations.

2.2.2 Potential Ecosystem Restoration Measures

Restoration actions that may be implemented at the potential ecosystem restoration areas include stream corridor and water quality improvements, restoration and/or creation of riparian wetlands, stormwater management, and bridge and dam restoration and/or removal. The following provides a brief description of these potential ecosystem restoration measures.

- Stream Corridor and Water Quality Improvements: This restoration action would include projects that use vegetation and/or approved bioengineering techniques to stabilize the streambank and reduce erosion and sedimentation. Additionally, debris and invasive or opportunistic vegetation would be removed to restore natural stream depths, and flows in the waterway.

- Restoration of Riparian Wetlands: This restoration action would target projects that restore degraded or altered wetlands. Fill material would be removed to restore natural water regimes, and vegetation would be planted to reduce sedimentation and pollution, and to increase fish and wildlife habitat.

- Culvert Replacement and/or Modification: This restoration action would include the removal and replacement of undersized or inappropriate culverts and drains which

currently reduce natural water flow or tidal exchange. Undersized culverts and drains also limit the movement of fish species between downstream and upstream habitats. Also, some culverts deemed to be unnecessary may be removed to restore the natural stream channel and course.

- Bridge and Dam Restoration and/or Removal: This restoration action would include projects that use vegetation to stabilize streambanks around bridges. In addition, some minor water control structures may be removed and/or modified to improve water flow and fish habitat.

The following table summarizes the ecosystem restoration measures that may be implemented at each of the potential ecosystem restoration areas.

Table 1. Summary of Potential Ecosystem Restoration Areas and Measures.

Restoration Location	No. of Sites	Proposed Restoration Action(s)
Edgerton Boulevard Area	2	▪ Stream Corridor/Water Quality ▪ Wetlands Restoration ▪ Culvert Replacement and/or Modification
Coddington Avenue Area	1	▪ Stream Corridor/Water Quality ▪ Wetlands Restoration
Port Reading Avenue – North	2	▪ Stream Corridor/Water Quality ▪ Wetlands Restoration ▪ Bridge/Dam Restoration/Removal
Watson Avenue Area	2	▪ Wetlands Restoration ▪ Stream Corridor/Water Quality

2.3 BENEFITS DERIVED FROM STUDY

Benefits are expected to be realized from the District's proposed Flood Control and Ecosystem Restoration Study. The benefits derived from potential flood control scenarios include a reduction in the potential for loss of life and property damage, reduced public emergency costs, reduced evacuation expenses, reduced traffic delays, and, reduced flood insurance costs. Benefits associated with the potential ecosystem restoration alternatives include improved water quality, increased biodiversity, enhanced fish and wildlife habitat, and improved recreational opportunities. It should be noted whether there are sufficient benefits to justify the project. This will be studied in further detail in later phases of the Feasibility Study.

3.0 EXISTING CONDITIONS WITHIN THE STUDY AREA

This section discusses existing conditions within the Woodbridge River Basin Study area. In particular, water resources, biological resources, cultural resources, and hazardous waste sites known to occur in the Study area are identified and briefly discussed.

3.1 WATER RESOURCES

The Woodbridge River is the principal waterbody in the Study area. The headwaters originate within the rare, forested wetland community locally known as the Pin Oak forest, located along Omar Avenue and Rahway Avenue, and flow in a southerly direction, before emptying into the Arthur Kill. In addition, a number of smaller creeks such as Wedgewood Brook, Cove Creek, Heards Brook, and Spa Spring Creek occur within the Study area. The characteristics of these tributaries are primarily meandering, low to moderate gradient streams that drain wetland complexes and residential/developed areas.

The entire length of the Woodbridge River and its associated tributaries are classified as freshwater 2 – non-trout, saline estuarine – 3 (FW2-NT/SE3) waters (NJDEP 2002). The NJDEP (2002) defines FW2 waters as those freshwaters not originating in or wholly contained within federal or state parks, forests, fish and wildlife lands, and other special holdings; not maintained in their natural state of quality; and, possibly subjected to man-made wastewater discharges. Non-trout (NT) waters are those freshwaters generally not considered suitable for trout because of physical, chemical, or biological characteristics, but are suitable for a wide range of other fish species. Saline estuarine (SE3) is a "general surface water classification applied to saline waters of estuaries".

According to the New Jersey Administrative Code (NJAC) 7:9B (NJDEP 2002), the designated uses of FW2 waters include:

- Maintenance, migration, and propagation of the natural and established biota;
- Primary and secondary contact recreation;
- Industrial and agricultural water supply;
- Public potable water supply after such treatment as required by law or regulation; and,
- Any other reasonable uses.

In addition, the designated uses of SE3 waters include (NJDEP 2002):

- Secondary contact recreation;
- Maintenance and migration of fish populations;
- Migration of diadromous fish;
- Maintenance of wildlife; and,
- Any other reasonable uses.

In terms of contamination, water quality of the Woodbridge River and its associated tributaries has been adversely affected. Increased pollutant loads as a result of intense urbanization within the Study area pose potential threats to environmental resources, fish and wildlife habitat, and those using the waterway for recreational use (USACE 1999). The District has investigated the stream characteristics of the full length of the Woodbridge River and has observed reaches of reduced water flow associated with increased siltation and sediment transport, degraded and eroding streambanks, areas of water flow obstructions due to snags and debris, and changes in salinity levels caused by increased stormwater runoff.

3.2 BIOLOGICAL RESOURCES

This section provides a brief description of the wetlands, terrestrial habitats, fish and wildlife, threatened and endangered species, and areas of special concern and/or management located in the Study area.

3.2.1 Wetlands

Wetlands and deepwater habitats located within the Study area include the Woodbridge River and its tributaries and their adjacent tidal and freshwater wetlands. Two general wetland types, including palustrine and estuarine, are identified on the National Wetland Inventory (NWI) maps of the Study area (US Fish and Wildlife Service 1981).

Palustrine wetlands in the Study area include all inland, freshwater (saline content of <0.5 parts per thousand) wetlands which lack flowing water. Considerable differences in vegetation types exist among palustrine wetlands due to hydrology, water chemistry, soils, and human disturbance (Tiner 1987). Palustrine wetlands identified within the Woodbridge River Study area are broad-leaved deciduous forests, such as the Pin Oak forest community near Omar Avenue; palustrine broad-leaved deciduous scrub-shrub areas, such as those found in the riparian corridor from Edgerton Avenue to the Rahway Avenue Mobile Home Park; and, emergent wetland communities including the area located south of the Mobile Home park. A few of the more common palustrine wetland species found within the Study area include groundsel bush (*Baccharis halimifolia*), common reed (*Phragmites australis*), cattails (*Typha* spp.), and willow (*Salix* spp.).

Estuarine wetlands are characterized as deepwater tidal habitats and adjacent tidal wetlands with low energy and variable salinity, influenced and often semi-enclosed by land (Tiner 1987). Estuarine wetlands identified within the Study area include intertidal flats, intertidal emergent, subtidal open water, and intertidal broad-leaved deciduous scrub-shrub. Some common wetland species found within the estuarine wetlands in the Study area include cord grass (*Spartina alterniflora*), salt meadow grass (*Spartina patens*), marsh elder (*Iva fructescens*), spike grass (*Distichlis spicata*), and common reed.

Many wetland communities within the Study area have been impaired or degraded by development, reduced water quality, increased water velocities, and invasive plant colonization. The results of these impairments include reductions in fish and wildlife spawning and rearing

habitat, decreases in recreation and aesthetic benefits, and increases in nuisance mosquito populations.

3.2.2 Upland Habitats

The upland habitats are in the Study area primarily consists of scrub-shrub, forest, open and disturbed lands including athletic fields, recreational areas, and disturbed or developed areas. Although the watershed is predominantly developed, there are areas of upland vegetation scattered throughout. Upland species commonly found within the Study area include oaks (*Quercus* spp.), goldenrods (*Solidago* spp.), tree-of-heaven (*Ailanthus altissima*), Norway maple (*Acer platanoides*), eastern red cedar (*Juniperus virginiana*), multiflora rose (*Rosa multiflora*), and sumac (*Rhus* spp.). Open fields, residential communities, and athletic fields include habitats of maintained ornamental lawns and grasses, as well as disturbed open fields.

3.2.3 Fish and Wildlife

A comprehensive biological inventory has not been completed for the Woodbridge River Basin, although several site-specific assessments have been completed (Sturdevant & Craft 2002). Fish species identified within the Woodbridge River system include freshwater, marine, anadromous, and catadromous species. Freshwater species, such as pumpkinseed (*Lepomis gibbosus*) and common carp (*Cyprinus carpio*) have been identified in the upstream, freshwater reaches. Anadromous and catadromous species such as alewife (*Alosa pseudoharengus*) and American eel (*Anguilla rostrata*) utilize the interface between freshwater and saline water (NOAA 2003). Estuarine and open water species, including bay anchovy (*Anchoa mitchilli*), Atlantic silversides (*Menidia menidia*), and mummichog *(Fundulus heteroclitus*), are common to the Arthur Kill (Rachlin 1990, USFWS 1997, USACE 1998). Shellfish species found within the Study area include Blue crab (*Callinectes sapidus*), fiddler crab *(Uca spp.)*, and ribbed mussel (*Geukensia demissa)* (USFWS 1997).

Site-specific studies and/or surveys describing the diversity and abundance of wildlife within the Study area are not available. However, wildlife species most likely to occur within urbanized portions of the Study area are habitat generalists tolerant of development. For example, mammal species likely to be present in urbanized areas located in the Study area include eastern gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus floridanus*), house mouse (*Mus musculus*), muskrat *(Ondatra zibethicus)*, Norway rat *(Rattus norvegicus)*, raccoon *(Procyon lotor)*, and white-tailed deer (*Odocoileus virginianus*) (NOAA 2003). Some of the common avian species include red-winged blackbird (*Agelaius phoeniceus*), blue jay (*Cyanocitta cristata*), American robin (*Turdus migratorius*), marsh wren *(Cistothorus palustris)*, house sparrow (*Passer domesticus*), American goldfinch (*Carduelis tristis*), American crow (*Corvus brachyrhynchos*), and mourning dove (*Zenaida macroura*) (USFWS 1997). Waterfowl and waterbirds in the area may include mallard (*Anas platyrhynchos*), black duck (*Anas rubribes*), herring gull *(Larus argentatus)*, and snowy egret *(Egretta thula)* (USFWS 1997). Reptiles, such as the eastern painted turtle (*Chrysemys picta*), common garter snake *(Thamnophis sirtalis)*, common snapping turtle *(Chelydra serpentina)*, and red-eared slider *(Pseudemys scripta)* may be found in wooded areas and wetlands within the watershed (NOAA 2003).

3.2.4 Threatened and Endangered Species

Except for the occasional, transient osprey (*Pandion haliaetus*), no Federally or state listed threatened or endangered species are known to occur in the Study area (NOAA 2003). However, a number of Federal and state listed threatened and endangered species may potentially occur within the Study area. Table 2 provides a list of threatened and endangered species known to occur in Middlesex County.

3.2.5 Areas of Special Concern and/or Management

A review of the New Jersey Natural Heritage Program (NJNHP) database indicated no known areas of special concern or management are located within the Study area. However, tidal saltmarsh ecosystems of various sizes exist within the Study area, providing a potentially rare habitat within the Arthur Kill system. Additionally, open space preservation at the local level may also provide unique areas. The Woodbridge River Watch Wildlife Sanctuary begins near Rahway Avenue and continues south to Port Reading Avenue, establishing a preserved riverine habitat corridor through an otherwise urbanized setting. This habitat provides waterbird foraging areas, fish and wildlife habitat, and passive recreational opportunities along the River. The Pin Oak Forest, and approximately 80-acre site acquired in 2003 through the NJDEP Green Acres Program, includes a rare woody swamp, pin oak (*Quercus palustris*) forest community, and forms the headwaters to the Woodbridge River. Additional parcels located south of Port Reading Avenue have been acquired by the Township and are managed as open space.

3.3 CULTURAL RESOURCES

Area residents have indicated the potential for undocumented cultural resources to be located within the Study area. Specific resources may include a historic structure known locally as the Coddington Mill. In addition, the 1st Presbyterian Church, known locally as the "White Church", and its cemetery were established in the 1600s. The District will conduct a full inventory of cultural and historic resources as part of the feasibility study phase.

3.4 HAZARDOUS WASTE SITES/CONTAMINATED SEDIMENTS

Hazardous materials may be present within the Study area as a result, in part, of past land uses. A wire plating/pickling plant was reportedly located near the headwaters to Woodbridge River and may have discharged wastes until approximately 1960. Additional wastes from both industrial and commercial sources may be located throughout the Study area. The District will conduct a full inventory of hazardous waste sites as part of the feasibility study phase.

Table 2. Federal and State Listed Threatened and Endangered Species Known to Occur in Middlesex County, New Jersey.

Common Name	Scientific Name	Federal Status	State Status
Amphibians			
Pine barrens tree frog	*Hyla andersonii*		Endangered
Birds			
Bobolink	*Dolichonyx oryzivorus*		Threatened
Grasshopper sparrow	*Ammodramus savannarum*		Threatened
Henslow's sparrow	*Ammodramus henslowii*		Endangered
Long-eared owl	*Asio otus*		Threatened
Migrant loggerhead shrike	*Lanius ludovicianus migrans*		Endangered
Northern harrier	*Circus cyaneus*		Endangered
Peregrine falcon	*Falco Peregrinus*		Endangered
Pied-billed grebe	*Podilymbus podiceps*		Endangered
Savannah sparrow	*Passerculus sandwichensis*		Threatened
Upland sandpiper	*Bartramia longicauda*		Endangered
Yellow-crowned night-heron	*Nyctanassa violacea*		Threatened
Plants			
Low rough aster	*Aster radula*		Endangered
Eaton's beggar-ticks	*Bidens eatonii*		Endangered
Louisiana sedge	*Carex louisianica*		Endangered
Variable sedge	*Carex polymorpha*		Endangered
Pear hawthorn	*Crataegus calpodendron*		Endangered
Lancaster flat sedge	*Cyperus lancastriensis*		Endangered
Carolina whitlow-grass	*Draba reptans*		Endangered
Swamp-pink	*Helonias bullata*	Threatened	Endangered
Featherfoil	*Hottonia inflata*		Endangered
Floating marsh-pennywort	*Hydrocotyle ranunculoides*		Endangered
Cream vetchling	*Lathyrus ochroleucus*		Endangered
Northern blazing-star	*Liatris scariosa* var. *novae-angliae*		Endangered
Virginia bunchflower	*Melanthium virginicum*		Endangered
Nuttall's mudwort	*Micranthemum micranthemoides*		Endangered
Slender water-milfoil	*Myriophyllum tenellum*		Endangered
Whorled water-milfoil	*Myriophyllum verticillatum*		Endangered
Purple fringeless orchid	*Platanthera peramoena*		Endangered
Sea-beach knotweed	*Polygonum glaucum*		Endangered
Torrey's mountain-mint	*Pycnanthemum torrei*		Endangered
Rhodora	*Rhododendron canadense*		Endangered

Table 2. Federal and State Listed Threatened and Endangered Species Known to Occur in Middlesex County, New Jersey (continued).

Common Name	Scientific Name	Federal Status	State Status
Plants (Cont.)			
Southern arrowhead	*Sagittaria australis*		Endangered
Saltmarch bulrush	*Scirpus maritimus*		Endangered
Small skullcap	*Scutellaria leonardii*		Endangered
Prairie goldenrod	*Solidago rigida*		Endangered
Seaside arrow-grass	*Triglochin maritima*		Endangered
Narrow-leaf vervain	*Verbena simplex*		Endangered
Death-camus	*Zigadenus leimanthoides*		Endangered
Reptiles			
Wood turtle	*Clemmys insculpta*		Threatened
Bog turtle	*Clemmys muhlenbergii*	Threatened	Endangered

Source: NJDEP 2001.

4.0 POTENTIAL DIRECT, INDIRECT, AND CUMULATIVE IMPACTS

Although, specific adverse and beneficial impacts to existing resources will depend on the final design of the flood control and ecosystem restoration components, potential impacts to water resources, biological resources, and cultural resources are identified and briefly discussed in the following sections.

4.1 WATER RESOURCES

Construction activities are likely to result in a short-term, temporary decrease in water quality of the Woodbridge River due to localized increases in runoff and turbidity. In addition, disturbance of contaminated soils or sediments during construction may release contaminants into the water column, thereby degrading water quality.

Long-term impacts on water resources associated with the floodwall scenario (Scenarios 2 & 3) may include an increase in the velocity of flow in the vicinity of floodwalls during storm surge flooding conditions. Depending on channel substrates, this may lead to increased scour and erosion in the vicinity of the floodwalls. Increased water velocities may also increase turbidity in the river for the duration of flooding, and over time, storm surge activity may cause shoaling upstream and downstream of the floodwalls.

The installation of a storm gate and pumping station (Scenario 4) may result in temporary impacts and disturbances to finfish species. Although many fish species are mobile and will avoid direct mortality, a few may be impacted indirectly because construction activities may limit access to feeding or nesting habitats. Additionally, operation of the gate may temporarily impede anadromous fish species from reaching spawning, nursery, or feeding grounds when the structure is closed during storm events.

The ecosystem restoration component of the Study would likely result in a long-term improvement to water quality throughout the watershed. Although specific benefits depend on the selected plan and location, restored wetland and riparian habitats will increase floodwater detention times, potentially lowering in-stream sedimentation rates, and act as natural filters, removing pollutants. Additionally, modifications to the stream channel and/or dams could result in increased dissolved oxygen levels, decreased sedimentation, and improved fish habitat.

4.2 BIOLOGICAL RESOURCES

This section identifies potential impacts to wetlands, upland habitats, fish and wildlife, threatened and endangered species, and areas of special concern and/or management that occur within the Study area.

4.2.1 Wetlands

Implementation of the proposed Study may have direct and indirect impacts on wetland resources in the Study area. Prior to implementing the proposed Study, the USACE will conduct wetland surveys of all areas that could be directly or indirectly impacted. The proposed action will also affect wetlands if it involves development in a wetland area, including: dredging, filling, draining, channelizing, diking, impounding, or otherwise directly impacting a wetland area; disturbing the water table of an area where a wetland exists; or, indirectly affecting a wetland by impacting regions upstream or downstream, including secondary development. Specifically, the footprint of the floodwall(s) and/or tide gates may be partially located in wetlands and could result in a direct permanent loss of wetland habitat.

The ecosystem restoration component of the Study would result in beneficial impacts to wetlands by increasing wetland acreage, and providing improved wetland functions and values throughout the watershed. Restoring and/or improving wetland habitat will increase stormwater retention time, resulting in increased water quality, and would provide improved habitat for a variety of fish and wildlife species.

4.2.2 Upland Habitats

Impacts to upland habitats affected during construction of the flood control scenarios include short-term, temporary impacts due to construction access and stockpiling, and long-term or permanent impacts due to vegetation removal and paving for access. Soils would be excavated and relocated to accommodate the floodwall(s) and pump station, and urban areas would be temporarily impacted as equipment is used to raise homes within the Rahway Avenue Mobile Home Park and the Crampton Avenue neighborhood.

The ecosystem restoration component of the Study would have no direct or adverse impact to upland habitats, but may provide indirect benefits by establishing improved habitat diversity and foraging opportunity for upland species.

4.2.3 Fish and Wildlife

Fish and wildlife species may be temporarily impacted during construction activities. Temporary disturbances may be associated with construction of access roads and structural flood control measures, general construction activity, and increased noise levels, all of which may prohibit the use of certain habitats by wildlife species. Although many mammalian and avian species are mobile and tend to avoid direct mortality, some may be impacted indirectly by limited access to feeding or nesting habitats due to construction activities. Permanent impacts resulting from the proposed structural solution may include direct mortality of less mobile wildlife species. Additionally, the construction of floodwalls may preclude mammalian, reptile, and amphibian access to feeding or nesting habitats.

Direct impacts to finfish species may occur because of construction activities, reduced water quality, and the operation of the tide gate may temporarily impede anadromous fish species from reaching spawning, nursery, or feeding grounds during storms.

Numerous species of fish and wildlife would benefit from ecosystem restoration. Specifically, fish will benefit from habitat restoration activities and stormwater management activities that result in increased water quality (i.e., decreased sediment and pollutant loadings, increased dissolved oxygen levels), and from enhanced foraging, refuge, and spawning habitat associated with wetland restoration. Modifying the stream channel by restoring open water and marsh fringe habitats would also increase habitat suitability for a number of fish and bird species. Additionally, improving riparian habitats, either by stabilizing bank habitat, creating vegetated buffers, or improving riparian wetland habitat will benefit wildlife species that utilize the river corridor.

4.2.4 Threatened and Endangered Species

The USACE will coordinate with the United States Fish and Wildlife Society (USFWS) and NJDEP to ensure that there are no adverse effects to Federally or state listed species will result from the proposed Study. Similarly, the USACE will coordinate with the USFWS and NJDEP to incorporate the needs of Federal and state listed species into the ecosystem restoration design.

4.2.5 Areas of Special Concern and/or Management

Implementation of the flood control scenarios would not impact any areas of special concern and/or management. However, implementation of ecosystem restoration measures throughout the Woodbridge River watershed is likely to positively benefit, directly and indirectly, areas of special concern and/or management by improving water quality, fish and wildlife habitat, and biodiversity.

4.3 CULTURAL RESOURCES

Impacts associated with the implementation of the Study will be investigated during the next phase of the Study following an inventory of cultural and historic resources.

4.4 HAZARDOUS WASTE SITES/CONTAMINATED SEDIMENTS

Impacts associated with the implementation of the Study will be investigated during the next phase of the Study following an inventory of hazardous waste sites and contaminated sediment.

5.0 APPLICABLE POLICIES AND PERMITS

The USACE is aware that the Study will require obtaining a variety of different permits and satisfying a number of different policies. For example, numerous parcels scattered throughout the watershed have been acquired with funds appropriated through the New Jersey Green Acres Program. Based on stipulations of this program, any changes in land use on Green Acres parcels must be consistent with preservation of recreational use, and consideration of the Study in relation to this policy must be warranted. Additionally, a number of policies are described in master plans for municipalities throughout the watershed. Accordingly, prior to construction and/or restoration activities, the USACE will identify all of the publicly owned properties and respective policies, evaluate potential impacts on these properties, and develop mitigation plans if required. In addition, the USACE will notify and coordinate with the appropriate municipal or county agency.

In accordance with NEPA, the USACE will identify all Federal, state, local, and municipal environmental requirements prior to implementation of the proposed Study. For example, the USACE will coordinate with the appropriate Federal agencies to implement the Study in accordance with relevant environmental statutes including, but not limited to, Section 106 of the National Historic Preservation Act, the Fish and Wildlife Coordination Act (FWCA), the Clean Water Act, the Clean Air Act, the Endangered Species Act, and a number of Environmental Operating Principles set forth by the USACE. Local regulatory permitting requirements, including the approval of a soil erosion reduction plan by the Freehold Soil and Water Conservation District, and coordination with local utility agencies, such as the Middlesex Water Company, will also be required for both flood control and ecosystem restoration projects. A detailed list of all applicable policies, permits, and regulations will be prepared and presented in the required NEPA documentation.

6.0 REFERENCES

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