DRAFT
Fish and Wildlife Coordination Act Section 2(b) Report
Flood Risk Management General Re-Evaluation Report
Mamaroneck and Sheldrake Rivers
Village of Mamaroneck

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I. Executive Summary

This is the U.S. Fish and Wildlife Service's (Service) Draft Fish and Wildlife Coordination Act Report for the U.S. Army Corps of Engineers' (Corps) proposed project entitled, "Flood Risk Management, Mamaroneck and Sheldrake Rivers, Village of Mamaroneck, NY." Pursuant to the Fish and Wildlife Coordination Act (FWCA) of 1958, as amended (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq*.), the Corps consulted with the Service to ensure that there was equal consideration for fish and wildlife resources during the planning of the Corps' proposed General Reevaluation Report. The Corps' tentatively selected plan involves channel deepening and widening along both the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, Westchester County, NY. Within the Sheldrake River, the Corps has proposed channel deepening and widening along 3,470 linear feet (ft), as well as the replacement of the Waverly Place Bridge, and the removal of the Centre Avenue Footbridge and two smaller footbridges. Within the Mamaroneck River, the Corps has proposed channel deepening and widening along 3,740 linear ft of the upstream reach and 2,400 linear ft of the downstream reach. The proposed project also includes the construction/reconstruction of concrete retaining walls, the installation of a culvert, and the placement of stone riprap along the bottom of the both rivers.

The Service has determined that the proposed project will adversely affect riverine, palustrine, and terrestrial ecosystems of the Sheldrake and Mamaroneck Rivers due to decreases in habitat availability and quality, as well as biodiversity. Channelization will have lasting impacts to the river channels and the riparian systems by altering the hydrological dynamics and restricting the biological, chemical, and physical connection between the rivers and upland areas.

Summary and Recommendations

The Service has recommended mitigation measures to avoid, minimize, or compensate for impacts, resulting from implementation of the proposed project, to Service trust resources, including migratory birds, wetlands, and inter-jurisdictional fish. The Service has also recommended monitoring measures to assess the success of measures to survey, enhance or improve species and their habitats regarding fish and wildlife opportunities and planning objectives established in this report.

The recommended mitigation measures include:

- Incorporation of nonstructural measures into the project design;
- Incorporation of best management practices to minimize erosion and sedimentation during the construction phase and to minimize adverse effects of channelization;
- Implementation of time-of-year restrictions to avoid critical life history stages for trust resources;
- Rehabilitation of riparian habitat by removing non-native species and planting native vegetation; and
- Improvement of habitat diversity and value by incorporating in-river and riparian construction techniques to emulate natural features.

Recommended monitoring measures include:

- Biological surveys to determine presence of specific species; and

- Development of a post-construction monitoring and management plan to ensure the success of the project's biological goals and objectives;

Accordingly, the Service believes that, with the incorporation of the recommended mitigation measures, the proposed action will not significantly impact fish and wildlife resources.

Service Position

The proposed alternative for the Mamaroneck and Sheldrake Rivers includes the channelization of a total of 9,610 linear ft of river habitat, reconstruction of the Waverly Place Bridge, the removal of several bridges, the installation of a culvert and retaining walls and the placement of stone riprap along the river bottom.

Although the proposed actions have the potential to impact fish and wildlife resources, the Service recognizes that the proposed project area has been previously disturbed. It is the Service's position that implementation of the mitigation measures will reduce the potential adverse impacts and meet the Service's mitigation policy goal which was established for the proposed project.

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II. Project Purpose, Scope, and Authority

A. Purpose

The U.S. Army Corps of Engineers' (Corps) General Reevaluation Report (GRR) (U.S. Army Corps of Engineers 2015b) discusses the issue of severe flooding in the Village of Mamaroneck (Village) due to a combination of factors, including low channel capacity, small bridge openings, developmental encroachment, urbanization, and poor flow conveyance. The Corps' proposed alternative [identified as 1M – locally preferred plan (LPP)] is designed to alleviate the effects of flooding through mainly structural measures including channelization, reconstruction and construction of retaining walls, removal or reconstruction of bridges, placement of riprap along the river bed, and the installation of a bypass culvert which will divert flow from the upper Mamaroneck River into the downstream channel (U.S. Army Corps of Engineers 2015a).

B. Description of the Proposed Project Area

The proposed project area is characterized as suburban and is located entirely within the Village. The Village was incorporated in 1895 with a population of roughly 1,500 people. By 2000, the population had increased to almost 19,000 people (Village of Mamaroneck 2015b). The area around the Mamaroneck River has been developed to meet the needs of the growing population.

The Mamaroneck and Sheldrake Rivers have a combined drainage area of 23.6 square miles (sq. mi.), and discharge into Long Island Sound through Mamaroneck Harbor. Approximately 2.25 mi. of the Mamaroneck River and 1.15 mi. of the Sheldrake River run through the Village (Village of Mamaroneck 2011). Much of the proposed project area is characterized by residential, commercial, and industrial developments, which have impacted natural riverine processes. The rivers are generally steeply sloped and have been stabilized. Portions of the rivers are adjacent to roadways, train tracks, and parking lots, with limited riparian areas.

The Corps' GRR study limits are defined by river flood damage areas located in the Village, exclusive of coastal flooding along the Long Island Sound shoreline. Along the Mamaroneck River, the area extends from below the Route 1 Bridge to above the Westchester County Joint Water Works Dam. On the Sheldrake River, the area extends from the confluence with the Mamaroneck River to the Village boundary at the New England Thruway (I-95) Bridge.

The Corps identified four distinct areas or reaches of the rivers for planning purposes. These include the Lower Mamaroneck, Upper Mamaroneck, Harbor Heights, and Sheldrake Reaches. The Lower Mamaroneck Reach is the section of the Mamaroneck River south of the Rail Road Bridge and is bordered by residential and commercial development. The Upper Mamaroneck Reach is the section of the Mamaroneck River north of the Rail Road Bridge and south of the New England Thruway (I-95) Bridge and is bordered by residential development, a municipal parking lot, and a train station. The Harbor Heights Reach is the section of the Mamaroneck River north of the I-95 Bridge. The Sheldrake Reach extends from Fenimore Avenue to the confluence located at Columbus Park, and is bordered by commercial and light industrial developments (see U.S. Army Corps of Engineers 2015a and 2015b) (Figure 1).

Figure 1. Aerial Photo Showing the Corps' Project Reaches. Pink – Sheldrake River, Blue – Lower Mamaroneck, Green – Upper Mamaroneck, and Orange – Harbor Heights.

C. Authority

The project was authorized by section 401(a) of the Water Resources Development Act of 1986 (Public Law 99-662; WRDA). The General Reevaluation study was approved by the Corps' North Atlantic Division, Brooklyn, NY, on April 14, 2008 (U.S. Army Corps of Engineers 2015b).

D. Past Local Projects and Studies/Corps' Planning and Service Studies in the Proposed Project Area

Over the last 100 years, the Mamaroneck River and its banks have been altered by retaining walls and bridges. A dam located upstream of Mamaroneck Harbor was constructed for a factory but was later removed in 1854 (Village of Mamaroneck 2015b). Retaining walls were built intermittently, stabilizing the banks, reducing the riparian zone, and resulting in the almost total loss of the natural floodplain within the proposed project area.

These alterations have likely affected the river's capacity to transport floodwaters resulting in increased potential for flooding (see U.S. Geological Survey 2003). Between the late 1800's and 1960, the Village experienced 81 flood events. From 1961 to 2007, another 15 flood events occurred, prompting federal, state, and local governments to develop actions to alleviate the effects of severe flooding within the Village (Table 1) (U.S. Army Corps of Engineers 2014).

Table 1. History of U.S. Army Corps of Engineers Involvement in the Proposed Project Area.

Year	**Action**
1977	Feasibility Study Completed.
1986	Project Authorized for Construction in the Water Resources Development Act (WRDA) of 1986.
1989	General Design Memorandum (detailed design) Finalized.
2010	Initiation of General Reevaluation Study

The U.S. Fish and Wildlife Service (Service) prepared a Planning Aid Report in 1989 entitled, *"An Assessment of the Impact of the U.S. Army Corps of Engineers' Flood Control Project for the Sheldrake River, Town of Mamaroneck, Westchester County, New York."* The Service stated that it did not support the project as proposed, stating that proper stream maintenance, along with other measures, could alleviate some portion of the stream flooding. The Service recommended stream cleaning as an alternative to the Corps' proposed channel modifications.

The Corps completed a Feasibility Report in October 1977 and a General Design Memorandum in 1988 (http://www.nan.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/11241/Article/487646/fact-sheet-mamaroneck-sheldrake-rivers-village-of-mamaroneck-ny.aspx).

Local interest in the project was rekindled after property damages from the April 2007 Nor'easter flood exceeded $50 million dollars (U.S. Army Corps of Engineers 2014).

1. Recent Local Flood Protection and Habitat Restoration Measures

The Village has completed several dredging projects within the proposed project area in the recent past. For example, in 2010, the Village dredged both sides of Fenimore Bridge due to silt damming and narrowing of the Sheldrake River, and removed a large boulder from the river (Village of Mamaroneck 2010; Sarnoff 2015). During 2010 and 2012, additional dredging took place at North Barry Avenue Extension, Grove Street, the confluence by Columbus Park, and between Anita Lane and Valley Place (Village of Mamaroneck 2010, 2012; Sarnoff 2015). The Village has also discussed the removal of Glendale Road as a means to alleviate flooding in the Village. This action has not occurred and is included as part of the locally preferred alternative proposed by the Corps.

Other local governments have also taken action in recent years to restore the watershed. Westchester County has completed a number of habitat restoration projects throughout the county, including a restoration project within the proposed project area at Columbus Park along the Sheldrake River. The project included the re-vegetation of the river banks to stabilize the banks and provide wildlife habitat, reinforcement of bridge pilings with stonework to prevent soil erosion during high water, and the reconstruction of a weir which added riffles to the river (Westchester County Soil and Water Conservation District 2015). Other restoration project undertaken by Westchester County along the banks of the Sheldrake and Mamaroneck Rivers include those at: (1) Sheldrake River at Bonnie Briar Country Club; (2) Mamaroneck River at Maple Moor Golf Course; (3) Carpenter's Pond in Sheldrake River; and (4) Mamaroneck River at Saxon Woods Park Gardens Lake in Sheldrake River.

In 2015, the Village, along with volunteers and workers, removed nearly three tons of garbage from the rivers and streams in an effort to improve habitat conditions and water quality. The amount of garbage that was removed in 2015 was substantially lower than the 10-15 tons of waste that was removed in 2009 (Village of Mamaroneck 2015a). Additional efforts to improve water quality were carried out by the Village in coordination with Save the Sound, New Haven, Connecticut. That effort was focused on identifying and reducing the discharge of raw sewage into stormwater drains, and resulted in lower bacteria levels as reported by the Westchester County Health Department (Village of Mamaroneck 2014).

III. Fish and Wildlife Resource Concerns and Planning Objectives

The purpose of consultation between the Corps and the Service under the Fish and Wildlife Coordination Act (FWCA) of 1958, as amended (48 Stat. 401, as amended; 16 U.S.C. 661 *et seq*.) is to ensure equal consideration of fish and wildlife resources in the planning of water resource development projects. The Service's emphasis in this regard is to identify means and measures to mitigate the potential adverse impacts of the proposed project and to make positive contributions to fish and wildlife resource problems and opportunities.

From the Service's perspective, a desired output of the proposed project is to avoid and minimize further losses of habitat value.

The Service applied and incorporated our Mitigation Policy (January 23, 1981, Federal Register v. 46 n 15, pp. 7644-7663) in addressing criteria necessary to support the proposed project.

The applied criteria include:

- The projects are ecologically sound;
- The least environmentally damaging alternative is selected;
- Every reasonable effort has been made to avoid or minimize damage or loss of fish and wildlife resources and uses;
- All mitigation recommendations have been adopted with guaranteed implementation to satisfactorily compensate for unavoidable damage or loss consistent with the appropriate mitigation goal; and

- For wetlands and shallow water habitat, the proposed activity is clearly water dependent and there is a demonstrated public need.

In developing mitigation recommendations, the Service also relied on professional experience, literature searches, and local, state, and federal conservation plans (*e.g.*, bird conservation plans and local, state, and federal land and water conservation plans) to derive appropriate recommendations for mitigation and fish and wildlife enhancement opportunities.

IV. Evaluation Methods

The Corps' planning schedule and funding limitations precluded the Service from conducting extensive field surveys and investigations for Service trust resources in the proposed project area. Service biologists conducted a single site inspection on June 23, 2015. In addition to the observations made during the June inspection, descriptions of natural resources are based on previous studies for this and similar projects, relevant grey and peer-reviewed literature, local, state, and federal fish and wildlife reports and plans, and personal communications with knowledgeable biologists, planners, coastal geologists, and engineers.

As discussed in more detail in the following section, this report discusses fish and wildlife resources which use the three major ecological systems (riverine, palustrine, and terrestrial) found in the proposed project area.

V. Description of Fish and Wildlife Resources

A. Community, Habitat, and Ecosystem Classifications

1. Physical Processes and Habitat Formation

The proposed project area contains rivers within a mix of residential, commercial, and light industrial development. In its natural state, watersheds, and more specifically, the rivers and associated floodplains, are a complex, dynamic system with different hydrological, geomorphological, and ecological characteristics (Gurnell *et al.* 2007). The balance between these characteristics influences the ecosystem services provided by stream and riparian systems including the cycling of water, energy, and material; water storage; biodiversity; nutrient retention; thermal buffering; bank stability; and sources of habitat (Bukaveckas 2007). Habitat creation is dependent on the disturbance and recovery of the channel and riparian system (Gurnell *et al.* 2007), which is constantly in flux. During high flows, for instance, the channels may be cleared of sediment and debris which is carried downstream.

Urban development and the associated alterations to rivers drastically change the form and function of these systems, ultimately restricting the ecosystem services, limiting habitat availability and habitat quality by homogenizing the flow and depth of the water and decreasing the biodiversity (Jungwirth *et al.* 1995).

Erosion, sediment transport, and sedimentation are the channel processes that form the rivers and influence the width and depth of the channel, as well as the creation of specialized habitats like riffles and pools. Within alluvial streams, equilibrium within a river is achieved by balancing the sediment discharge, sediment particle size, streamflow, and stream slope. These variables strive to be in equilibrium and if one variable changes, another will respond until equilibrium is reached (Federal Interagency Stream Restoration Working Group 1998).

The flow regime of a river connects the river laterally to the floodplain and longitudinally connects the upstream to the downstream. High flows physically reconnect the channel and floodplains, which are used as spawning and nursery habitat for fish and foraging waterfowl while low flows allow plant communities to grow and colonize the floodplain and river banks (Federal Interagency Stream Restoration Working Group 1998). The stream flow influences formation of sediment shoals and riffles. Channel processes and flow regime work together to create a variety of habitats for riverine species, which require different habitat types to complete their life cycle (Federal Interagency Stream Restoration Working Group 1998). Riverine species utilize different substrate, flow velocities, and depths for foraging, migration, and reproduction.

The Mamaroneck and Sheldrake River corridors are limited by existing development, and largely exhibit the characteristics of an urbanized river. The characteristics of urban watersheds are different from forested, rural, or agricultural watersheds (Federal Interagency Stream Restoration Working Group 1998) in that urban river hydrological systems are transformed by urban development, primarily the construction of impervious surfaces and stormwater drainage systems (Gurnell *et al.* 2007; U.S. Geological Survey 2003). These alterations affect the rivers' ability to transport floodwaters, can contribute to increased flooding during storm events or high river flow, and can affect the establishment of plant communities, as well as the distribution and abundance of wildlife.

Within the proposed project area, riverine and palustrine systems were identified using *"Ecological Communities of New York State Second Edition"* (Reschke 2014), and observations of flora and fauna which were made during the Service's June 23, 2015, field visit of the proposed project area.

2. Plant, Fish, and Wildlife Species of the Riverine Ecosystem

Riverine systems are non-tidal waters with a discrete channel with persistent emergent vegetation sparse or lacking, but may include areas with abundant submerged or floating-leaved aquatic vegetation (Reschke 2014). Both the Mamaroneck and Sheldrake River sections in the proposed project area could be described as a medium-sized streams, which have average widths from about 3 to 30 meters (m) (10 feet [ft] to 100 ft) (see Reschke 2014).

The Mamaroneck and Sheldrake Rivers have been altered by human activity and have been classified as riverine cultural by Reschke (2014). Both the Mamaroneck and Sheldrake Rivers could be further classified as the subsystem riverine submerged structure; a community associated with introduced structures such as retaining walls and bridge abutments, which provides habitat for some riverine species (Reschke 2014).

Despite the development along the river corridors, the proposed project area maintains several remnant communities of a riverine and palustrine nature. During the Service's June 23, 2015, site visit, finer-scale habitats, including riffles and pools, were observed in the lower Mamaroneck Reach. A riffle is a part of the stream that is shallow and has a comparatively fast current; the water surface is disturbed by the current and may form standing waves (*i.e.*, it is “turbulent”). A pool is a part of the stream that is deep and has a comparatively slow current; the water surface is calm unless disturbed by wind (Reschke 2014).

The Service did not undertake any systematic surveys for aquatic resources in the rivers of proposed project area, but noted the following aquatic plant and fish resources during the June site visit: submerged aquatic vegetation, unknown emergent grass species, redbreast sunfish (*Lepomis auritus*), and carp (*Cyprinus* spp.). A more comprehensive but dated list of fish species found during surveys of the proposed project area can be found in U.S. Fish and Wildlife Service (1989). Tessellated darter (*Etheostoma olmstedi*), white sucker (*Catostomus commersonii*), American eel (*Anguilla rostrata*), redbreast sunfish, and Eastern blacknose dace (*Rhinichthys atratulus*) were identified in the project area as numerically dominant species based on survey results of New York State Department of Environmental Conservation (NYSDEC) (New York State Department of Environmental Conservation 2010). Species found in lower abundances in that survey included creek chub (*Semotilus atromaculatus*), brown bullhead (*Ameiurus nebulosus*), banded killifish (*Fundulus diaphanus*), bluegill (*Lepomis macrochirus*), and largemouth bass (*Micropterus salmoides*) (Table 2).

Table 2. Summary Table of Reproductive Requirements of Fresh Water Fish Present within Mamaroneck River.

Fish Species	**Substrate/Spawning**	**Time of Year**
Tessellated darter	Rubble, gravel, and sand Usually on bottom of rock (Lane *et*	Spring; 13° C - 19° C (Lane *et al.* 1996)

	al. 1996)	
White sucker	Rubble, gravel, and sand (Lane *et al.* 1996)	Spring; April - June (Werner 1980)
Redbreast sunfish	Rubble, gravel, and sand (Thorp 1988)	June - Mid-August (New York State Department of Environmental Conservation 2004)
Eastern blacknose dace	Riffle, gravel, and rubble (Kraft *et al.* 2006)	April - June (Werner 1980)
Creek chub	Gravel (Kraft *et al.* 2006)	Spring (Kraft *et al.* 2006)
Brown bullhead	Conceal eggs in cavities, logs, tree roots, and debris (Lane *et al.* 1996)	Spring; 14° C - 29° C (Lane *et al.* 1996)
Banded Killifish	Eggs adhered to vegetation (Lane *et al.* 1996)	Spring - Summer; 21° C - 32° C
Bluegill (non-native to study area)	Gravel, sand, and silt (Kraft *et al.* 2006)	May - July (New York State Department of Environmental Conservation 2004)
Largemouth bass (non-native to study area)	Rubble, gravel, sand, silt, and clay (Lane *et al.* 1996)	Spring; 14° C - 21° C (Lane *et al.* 1996)

As summarized in Table 2, the fish present in the study area primarily prefer rubble, gravel, and sand as the substrate used for spawning, which occurs in spring and summer or when temperatures are between 13° C and 32° C.

One of the species identified in the project area is the American eel. In 2011, the Service determined that the American eel may warrant protection under the Endangered Species Act (ESA) and initiated a status review. The species is faced with numerous challenges including access to estuaries and freshwater habitats during the glass eel, elver, and yellow eel phases (Atlantic States Marine Fisheries Commission 2000).

The American eel is a catadromous fish (migrates from freshwater to spawn in the sea), which uses different habitats throughout its life stages (U.S. Fish and Wildlife Service 2011). Eels spawn in the Sargasso Sea where the eggs hatch into larvae and are transported on the currents towards the coast of the United States. As they drift, the larvae mature into glass eels which are 2-3 inches (in.) long and transparent. Glass eels begin to arrive into the estuaries and mature into elvers which are greater than 4 in. in length and begin to develop pigmentation. Elvers migrate into brackish waters and continue to develop while some migrate into streams, lakes, ponds, and rivers. Before the eels sexually mature, they are called yellow eels. It may take the eels another 3-40 years to reach maturation before they head back to the Sargasso Sea (U.S. Fish and Wildlife Service 2011).

Within the Long Island Sound Watershed, eels migrate into the estuaries and freshwater streams and rivers in the spring (March through June) and, once sexually mature, begin migrating to natal waters from late August/September to November (Hoffmann 2015). Surveys conducted by the NYSDEC in the Hudson River from 2008 and 2013 found glass eels present in the Hudson River as early as March 4 (New York State Department of Environmental Conservation 2014).

During the Service's June 23, 2015, field visit, carp and sunfish were observed within the restored habitat area of the Sheldrake River and within the Mamaroneck River near Columbus

Park. Carp are native to Asia and were first introduced to the U.S. in the late 1800's as a source of food. They have since become ubiquitous in freshwater bodies throughout the U.S. and have a negative impact on the health of these water bodies. Parkos *et al.* (2003) found that systems with carp were characterized by highly turbid, nutrient-rich water with very few aquatic plants and low numbers of macroinvertebrate predators, many zooplankton grazers, and high numbers of phytoplankton. Waterbodies without carp were characterized by clear water, with extensive aquatic macrophyte structure, numerous macroinvertebrate predators, and small-bodied zooplankton grazers (Parkos *et al.* 2003). Carp directly reduced macrophytes through ingestion of plant matter and/or uprooting during feeding activity. Macrophytes play a critical role in the ecosystem by providing stabilization of sediment through their root structures, competing directly with phytoplankton for light and nutrients and providing habitat for zooplankton which in turn keeps the phytoplankton population down (Parkos *et al.* 2003).

Macroinvertebrate studies were conducted by the NYSDEC in 1999, 2003, 2008, and 2009. One of survey sites along the Mamaroneck River is within the Corps' study area. Dominant species recorded in the Mamaroneck River during all 4 survey years include: *Stenelmis* spp., *Polypedilum flavum*, *Cheumatopsyche* spp., *Gammarus* spp. and *Hydropsyche betteni* (Duffy 2015).

The Corps conducted surveys at a single location within the study area in both the Mamaroneck and Sheldrake Rivers in 2011. The dominant species in the Mamaroneck River identified by the Corps are consistent with those identified by the NYSDEC in previous survey years. The dominant species observed in the Sheldrake River included *Cheumatopsyche* spp., *Cricotopus bicinctus*, and unidentified species from the Naididae family.

3. Plant, Fish, and Wildlife Species of the Palustrine Ecosystem

Palustrine systems are defined as non-tidal, perennial wetlands with emergent vegetation. These systems are distinguished by their hydrologic regime, substrate material, and vegetation composition (Reschke 2014). Finer-scale habitats associated with this system include shallow emergent marsh, deep emergent marsh, and floodplain forest (Reschke 2014). At least two sites located in the Harbor Heights Reach provided a limited palustrine floodplain.

Cattail (*Typha latifolia*), pickerel weed (*Pontederia cordata*), skunk cabbage (*Symplocarpus foetidus*), rice cutgrass (*Leersia orzoides*), and various emergent grass species consistent with the deep emergent marsh subsystem were observed by the Service near the Fenimore Bridge at the north end of the Sheldrake River at Columbus Park. Species indicative of a shallow emergent marsh that were observed included awl-fruited sedge (*Carex stipata*), blue flag iris (*Iris versicolor*), and red twig dogwood (*Cornus sericea*) (Reschke 2014) were observed at the north end of the Sheldrake River at Columbus Park. Both of these areas have experienced some degree of human disturbance or intervention in recent years. The Fenimore Bridge location was dredged by the Village in 2010/2011. The Sheldrake location was a part of the ongoing Westchester County stream rehabilitation efforts, which involved the planting of native riparian species such as red twig dogwood, witch hazel (*Hamamelis virginiana*), ninebark (*Physocarpus opulifolius*), riverbank wild rye (*Elymus riparius*), Virginia wild rye (*Elymus virginicus*), blue flag iris, awl-fruited sedge, rice cutgrass, switchgrass (*Panicum virgatum*), little bluestem (*Schizachyrium scoparium*), and Indian grass (*Sorghastrum nutans*) (Kvinge 2015).

A floodplain forest system was observed in the northern reach of the Mamaroneck River, and is often found on low terraces of floodplains and experience annual flooding (Reschke 2014). The vegetation observed was consistent with this system: maple spp. (*Acer* spp.), ash spp. (*Fraxinus* spp.), poison ivy (*Toxicodendron radicans*), sycamore (*Platanus occidentalis*), jewelweed (*Impatiens capensis*), and spicebush (*Lindera benzoia*).

4. Plant and Wildlife Species of the Terrestrial Ecosystem

a) Vegetation

The terrestrial system consists of upland habitats, exhibiting well-drained soils that are dry to mesic, and vegetative cover that is never predominantly hydrophytic, even if the soil surface is occasionally or seasonally flooded or saturated (Reschke 2014). Overall, the terrestrial system is a broadly defined system of various habitats excluding aquatic, wetland, and subterranean communities.

Due to the developed nature of the proposed project area, the steep river banks provide limited terrestrial habitat for plants and wildlife. Native vegetation in these habitats is often out-competed by non-natives which readily colonize these disturbed areas. Dominant vegetation observed along the terrestrial zones of both rivers during the June 23, 2015, field visit included: Norway maple (*Acer platanoides*), sycamore, red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), and tree-of-heaven (*Ailanthus altissima*) in the overstory; Japanese knotweed

(*Polygonum cuspidatum*) and multiflora rose (*Rosa multiflora*) in the understory; and mugwort (*Artemisia vulgaris*), garlic mustard (*Alliaria petiolata*), and Virginia creeper (*Parthenocissus quinquefolia*) in the herbaceous layer. Many of the species identified are non-native, invasive, and ubiquitous throughout the proposed project area and include: Norway maple, tree-of-heaven, mugwort, oriental bittersweet (*Celastrus orbiculatus*), multiflora rose, wineberry (*Rubus phoenicolasius*) and bamboo (*Bambusa* spp.). These plants are of great concern as they out-compete native vegetation and degrade the riparian zone (Davenport *et al.* 2004).

b) Avian Species

The Migratory Bird Treaty Act (16 U.S.C. 703-712; MBTA) implements four treaties that provide for international protection of migratory birds. The MBTA prohibits taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. Bald and golden eagles are afforded additional legal protection under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). Unlike the ESA (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq*.), neither the MBTA nor its implementing regulations at 50 Code of Federal Regulations (CFR) Part 21, provide for permitting of “incidental take” of migratory birds.

The Service did not undertake any systematic seasonal surveys for avian species in the terrestrial, riverine, or palustrine zones in the proposed project area. However, avian species were noted and recorded during the June 23, 2015, field visit. The Service observed osprey (*Pandion haliaetus*) (which were observed nesting on a tower near the Fenimore Bridge), house sparrow

(*Passer domesticus*), grackle (*Quiscalus quiscula*), mallard (*Anas platyrhynchos*), rock pigeon (*Columbia livia*), Baltimore oriole (*Icterus galbula*), barn swallow (*Hirundo rustica*), red wing blackbird (*Agelaius phoeniceus*), and northern cardinal (*Cardinalis cardinalis*). The Service's Information for Planning and Conservation (IPaC) website (http://ecos.fws.gov/ipac/) identified 26 species of migratory birds that may be found in the proposed project area utilizing the habitat year round, for breeding or wintering purposes (Appendix 1). Of the 26 species identified by using the IPaC system, one is designated as state-endangered - short eared owl (*Asio flammeus*); five are state-threatened - upland sandpiper (*Bartramia longicauda*), pied-billed grebe (*Podilymbus podiceps*), least tern (*Sterna antillarum*), least bittern (*Ixobrychus exilis*), and the bald eagle (*Haliaeetus leucocephalus*); and five are listed as special concern - American bittern (*Botaurus lentiginosus*), black skimmer (*Rynchops niger*), cerulean warbler (*Dendroica cerulean*), golden-winged warbler (*Vermivora chrysoptera*), and the seaside sparrow (*Ammodramus maritimus*). The proposed project area is included in the 2000-2005 NYS Breeding Bird Atlas block number 6053C. Records for this block indicate a total of 86 species, with 5 possible, 10 probable, and 71 confirmed breeders.

c) Mammals

Thirty species of mammals have been identified in, and in the vicinity of, the proposed project area (U.S. Fish and Wildlife Service 1989). Some of these mammals include, but are not limited to, the eastern cottontail (*Sylvilagus floridanus*), eastern chipmunk (*Tamias striatus*), raccoon (*Procyon lotor*), and eastern gray squirrel (*Sciurus carolinensis*). The Service did not undertake any systematic seasonal surveys for mammalian species in the terrestrial, riverine, or palustrine zones in the proposed project area. However, two mammalian species, the eastern gray squirrel (black morph) and eastern chipmunk were noted and recorded during the June 23, 2015, field visit.

d) Reptiles and Amphibians

Eastern box turtle (*Terrapene carolina carolina*), eastern garter snake (*Thamnophis sirtalis*), American toad (*Anaxyrus americanus*), common snapping turtle (*Chelydra serpentine*), marbled salamander (*Ambystoma opacum*), and northern dusky salamander (*Desmognathus fuscus*) have been known to occur in the proposed project area (U.S. Fish and Wildlife Service 1989). This list would need to be updated with recent surveys, in order to accurately characterize reptile and amphibian species in the proposed project area.

5. Threatened and Endangered Species

The ESA directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the ESA. Section 7 of the ESA, called "Interagency Cooperation," is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the continued existence of any listed species.

Under section 7, federal agencies must consult with the Service when any action the agency carries out, funds, or authorizes (such as through a permit) may affect a listed endangered or threatened species. This process usually begins as informal consultation. A federal agency, in the early stages of project planning, approaches the Service and requests informal consultation. Discussions between the two agencies may include what types of listed species may occur in the proposed action area, and what effect the proposed action may have on those species.

If it appears that the agency's action may affect a listed species, that agency may then prepare a biological assessment or evaluation to assist in its determination of the project's effect on a species. If the agency, after discussions with the Service, determines that the proposed action is not likely to affect any listed species in the project area, and if the Service concurs, the informal consultation is complete and the proposed project moves ahead.

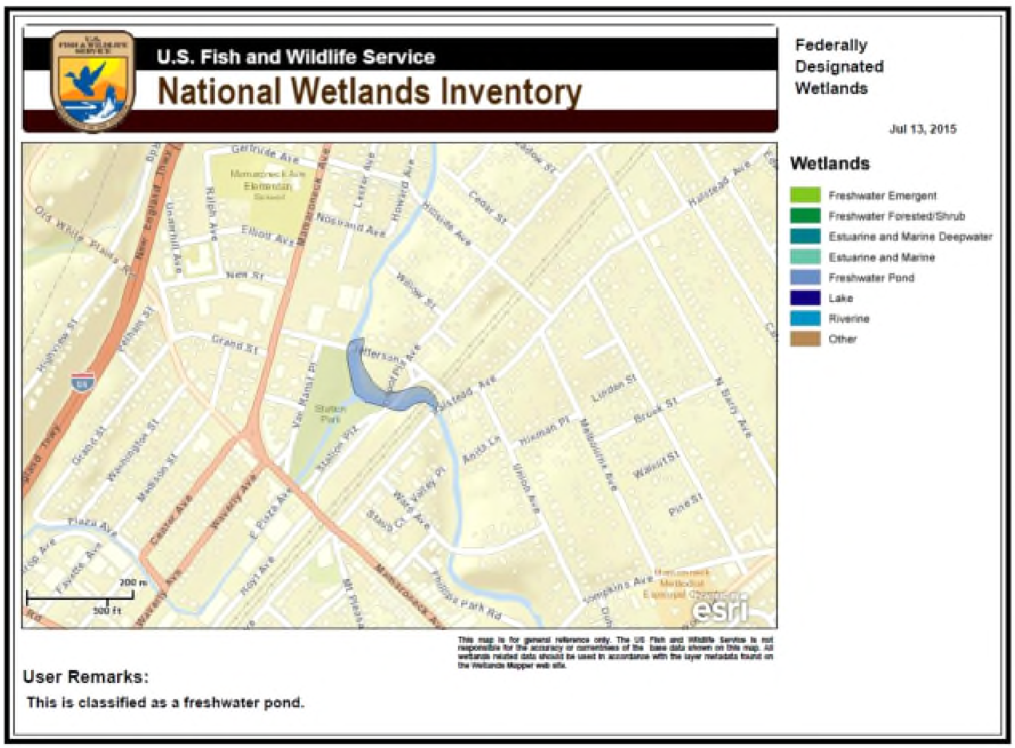
There are no federally-listed or proposed species that are identified as having the potential to occur in the project area. In addition, there is no federally-designated critical habitat within the proposed project area.

One candidate species was identified in the IPaC report, the New England Cottontail (*Sylvilagus transitionalis*), a medium-sized rabbit which prefers a very specific habitat and is usually associated with early successional habitat, native shrub lands with sandy soils, wetlands, or "forests associated with small scale disturbances" (U.S. Fish and Wildlife Service 2015). Due to the suburban quality of habitat and the absence of the preferred habitat of the New England cottontail, it is unlikely that this species would be found in the proposed project area. No further coordination is required for this species.

6. Wetland Habitats

The confluence of the Mamaroneck and Sheldrake Rivers contains a federally-designated wetland, and is classified as a freshwater pond (Figure 2) by the Service's National Wetland Inventory program.

Figure 2. Federally-designated Wetlands Present in the Proposed Project Area.



7. Water Quality

The Mamaroneck River is listed on the NYS 2010 section 303 (d) list of impaired waters and is considered to be impaired by low dissolved oxygen, nutrient loads, and silt and sediment due to urban stormwater runoff and other nonpoint sources. The Sheldrake River is also listed on the NYS 2010 section 303 (d) list of impaired waters due to pesticide levels in contaminated sediment and silt; and sediment due to urban stormwater runoff and other nonpoint sources. Floatables were observed during the Service's June 23, 2015, field visit in both rivers.

The Mamaroneck and Sheldrake Rivers are classified as Class C Rivers (New York State Department of Environmental Conservation 2010). A Class C waterbody is defined as supporting fisheries and suitable for non-contact activities (New York State Department of Environmental Conservation 2010). Due to the limited accessibility to the Sheldrake River and the pesticide contamination in the sediment, the river does not support a high quality recreational fishery. Additionally, high levels of pesticides have been recorded in various fish species found in the Sheldrake River (Spodaryk *et al.* 1999). Levels of dieldrin and chlordane found in fish exceed the Food and Drug Administrations (FDA) limit, and, as a result, fish advisories are in effect for the Sheldrake River (Table 3).

Table 3. NYSDEC's Hudson Valley Region Fish Advisories for the Sheldrake River.

Category	**Goldfish**	**American Eel**	**Other Fish**
Women < 50 and Children < 15	Do not consume	Do not consume	Do not consume

Men > 15 and Women > 50	1 Meal/month	Never	4 Meals/month

VI. Description of Selected Plan

A. Description of the Locally Preferred Plan

The Corps' tentatively selected plan is the locally-preferred plan (termed Alternative 1M and referred to as the LPP) and involves the channel deepening and widening along both the Mamaroneck and Sheldrake Rivers in the Village of Mamaroneck, Westchester County, NY (U.S. Army Corps of Engineers 2015a). In addition to the LPP, the Corps is analyzing the National Economic Development Plan (termed Alternative 1F and referred to as the NED). In brief, the differences between these alternatives are the changes in channel widths, the inclusion of non-structural measures, and the exclusion of channel modifications to the Harbor Height Reach in the NED (U.S. Army Corps of Engineers 2015a). However, the Corps has indicated that they anticipate implementing the LPP (Alternative 1M) (Voisine 2015) and therefore this report analyzes the potential impacts of the LPP on the fish and wildlife trust resources within the project area. The Corps provided the following description for the LPP (U.S. Army Corps of Engineers 2015a):

In the Sheldrake River Reach, the Corps proposes channel deepening and widening along 3,740 ft of the river. Side slopes would be 1 horizontal (H):2.5 vertical (V), or rectangular where needed (*i.e.*, upstream of Mamaroneck Avenue Bridge). Channel bottom width would vary in proposed project area with 20 ft from the confluence to Mamaroneck Avenue Bridge; 33 ft from Mamaroneck Avenue Bridge to 1000 ft downstream and 30 ft rectangular and semi-trapezoidal to Fenimore Avenue Bridge. The slope of the channel would also be varied with a 1.0 percent slope from the confluence to 390 ft upstream and then 0.1 percent grade to Fenimore Road. The project would also include the removal and replacement of utilities in certain locations.

This alternative also includes the replacement of the Waverly Place Bridge, and removal of the Centre Avenue Footbridge and footbridges No. 1 and No. 2.

In the Mamaroneck River, the proposed work will encompass 3,740 linear ft of the upstream reach and 2,400 linear ft of the downstream reach.   In the upstream reach, channel deepening and widening are proposed. The side slopes would be 1H:2.5V and channel bottom width would be variable: 25 ft wide from 200 ft upstream of Glendale Avenue and 35 ft wide for the next 650 ft downstream of Glendale Avenue. Slopes would vary from 0.6 percent and 0.2 percent for approximately 1,340 feet. Upstream of the confluence the river would be 45 ft wide with a 0.25 percent slope for about 2,400 feet. The removal and replacement of the retaining wall and utilities will be necessary in certain locations.

In the Mamaroneck River, Downstream Reach, channel deepening and widening are proposed, with 1H:2.5V slopes. The channel bottom width would be maintained at 45 ft from the confluence to just downstream of Tompkins Avenue Bridge, with a slope 0.25 percent. Retaining wall and utilities removal and replacement will be necessary in certain locations.

Additionally, the Corps has included the construction/reconstruction of retaining walls and the placement of riprap along the bottom of the rivers. The pre-existing retaining wall will be replaced as needed and new retaining walls will be constructed where space is limited. The

Corps is proposing the placement of 1,200 linear ft of riprap along the bottom of the Mamaroneck and Sheldrake Rivers. The Corps provided the following information regarding the riprap (U.S. Army Corps of Engineers 2015a):

> "About 500 feet of riprap will be located roughly 200 feet both upstream and downstream of the North Barry Ave Extension Bridge over the Mamaroneck River and 700 ft of riprap will be placed at the 90 degree turn in the Sheldrake River located downstream of the Fenimore Road Bridge. Also, due to high velocities and structural considerations along the Mamaroneck River from the Station Plaza Bridge to just downstream of the Halstead Avenue Bridge, 300 linear ft of concrete is proposed along the bottom of the stream to prevent scour under and around the footings of these three bridges.
>
> All the riprap evaluated for the Mamaroneck and Sheldrake River consists of a 12 inch thick layer of riprap applied over a 6 inch stone bedding layer. If a geo-textile material is used instead of a 6 inch granular bedding layer for the bottom riprap a non-woven or geo-web product will be specified. The riprap on the side slopes will be extended to the top of the riverbank. A series of velocities from the 1 year to the 100 years where used to determine the necessary riprap stone sizes."

The Corps has not provided a schedule for the proposed work at this time; however, correspondence with the project's biologist indicates that the Corps will conduct tree removal to avoid impacts to most nesting birds and roosting bats (Voisine 2015).

VII. Future without Project Conditions

As described by the Corps (2015a), future trends do not indicate a significant decrease in land use or rainfall and as such continued and future flooding is an on-going concern for the Village. The proposed project area is surrounded by extensive development which limits or precludes the natural riverine processes. The river has undergone numerous shore hardening modifications, and dredging activities and the water quality is degraded by the upland uses. The natural processes are altered by submerged structures such as the bridge abutments and retaining walls found throughout the proposed project area. The upland is heavily-developed with impervious structures, which have multiple effects on the river. Impervious structures prevent the infiltration of water and reduce the amount of recharge entering the ground water. The water runs along the impervious structures, raising the water temperature and picking up sediment and pollutants, and enters the river. In brief, these structures increase runoff and the stormflow (Federal Interagency Stream Restoration Working Group 1998). Due to ongoing development and the continued use of the upland, the effects of urbanization will continue to compromise the condition of the rivers. The ongoing habitat protection and restoration efforts of the local governments will restore some degree of natural processes and provide areas of restored habitat. But, based on the extensive development extending throughout the proposed project area, flood damage protection efforts are likely to continue into the future.

VIII. Description of Impacts on Fish and Wildlife Resources

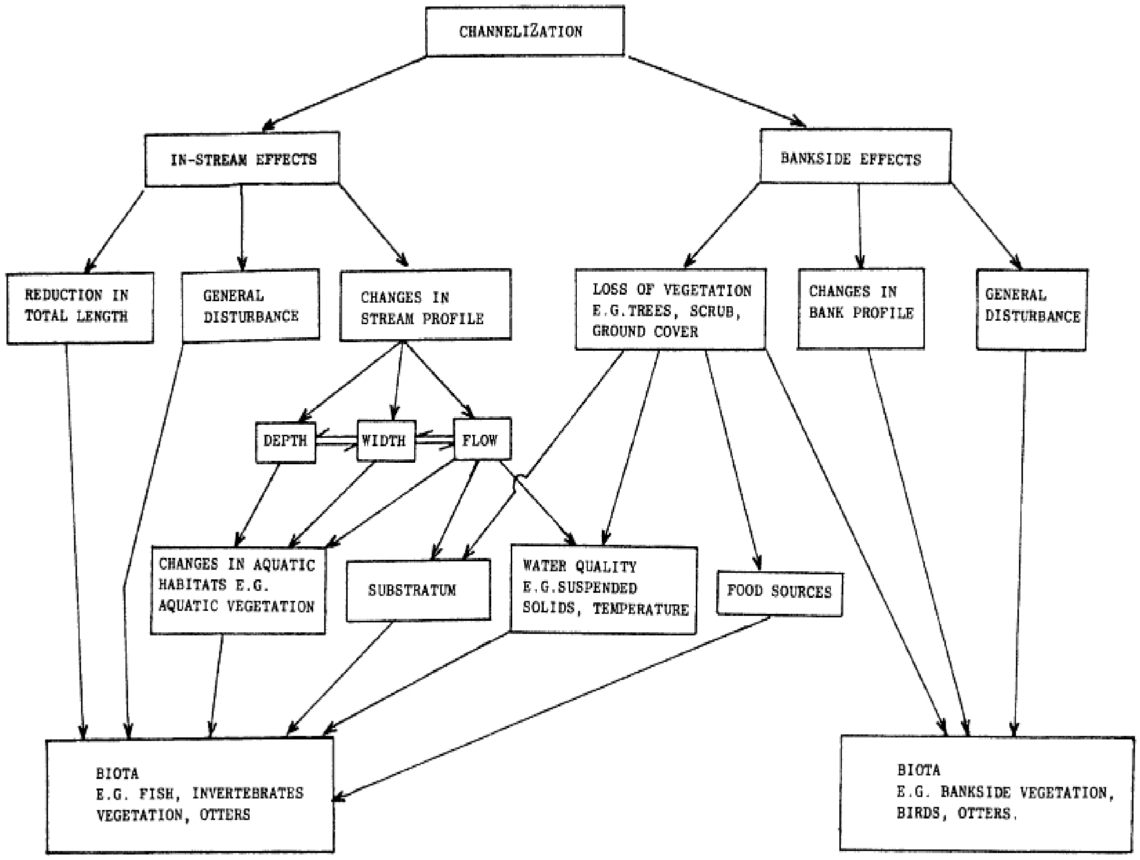
The Corps' tentatively selected plan does not include any environmental features specific to enhancing or restoring fish and wildlife habitat in the Mamaroneck and Sheldrake Rivers. The tentatively selected plan also does not include measures that would avoid, minimize, or compensate for impacts to fish and wildlife resources, except for time-of-year restrictions for certain fish species. Direct, indirect, and cumulative impacts of the proposed project on the fish and wildlife resources are anticipated and include habitat loss, modification, and reduction in functional values due to channelization, and shoreline and bottom hardening, and the resultant increases in turbidity of the water column, sedimentation, and visual and sound stimuli associated with construction activities.

A. Direct and Indirect Effects

1. Channelization

Channelization of rivers involves several engineering practices to control flooding, drain wetlands, improve river channels for navigational purposes, control stream bank erosion, and modify river alignments (Brooker 1985). A direct effect of the project will be a change in river morphology due to channelization, which will significantly alter the depth, width, and slope of the rivers. The indirect effects of this include implications for the chemical, physical, and biological properties of the river channel and banks, affecting river bottom, water column, and riparian habitats. These effects are summarized in Figure 3 (from Brooker 1985).

Figure 3. The Potential Effects of Channelization on In-stream and Bankside Biota. From Brooker (1985).



Channelization alters the channel processes and flow regimes which are the driving force within the stream ecosystem. These processes, along with flow regime, are responsible for the varied habitats available to riverine species. A loss of flow variability will likely lead to homogenization of habitat (Kennedy and Turner 2011) and a subsequent decrease in species' numbers and diversity (Jungwirth *et al.* 1995). The resulting homogenization from channelization will likely decrease the variety of habitat and reduce the connectivity between the channel and the flood plain, thereby reducing the nursery habitat for juvenile fish species. Creation of a river channel with uniform depth will also reduce finer-scale habitats like riffles and pools. Loss of bankside vegetation may result in altered water temperatures; decreased allochthonous organic material (material found somewhere other than where it was formed); and reduced habitat for animals (Brooker 1985). Kennedy and Turner (2011) noted that channelized reaches exhibited 50 percent lower density and taxonomic richness of aquatic invertebrates in the aquatic terrestrial transition zone compared to non-channelized reaches. Decreases in density and richness may be attributed to the loss of area, nutrient input, and decreased food availability. These factors act synergistically to decrease reproductive success (Kennedy and Turner 2011) of many riverine species.

2. Turbidity

Turbidity, or increases in the concentration of suspended sediments in the water column, along with increases in sediment transport, will likely occur during the removal and construction of bridges and retaining walls, removal of trees and bankside vegetation, dredging, placement of riprap and concrete retaining walls throughout the construction phase of the project and if water flows increase as a result of the proposed project.

Turbidity is considered the most important factor limiting fish habitat according to fishery biologists (Henley *et al.* 2000). Increases in turbidity will have negative effects on both benthic organisms and fish populations. Suspended solids can affect fish species at all stages of their life history, including breeding, spawning, and hatching of fish eggs. Severe turbidity can suffocate eggs and aquatic insect larvae, fill in the pore space between bottom cobbles used by fish for reproduction (Federal Interagency Stream Restoration Working Group 1998), and reduce primary production. Increased turbidity and sedimentation can bury sediments utilized for spawning, delay hatch time of eggs (Schubel and Wang 1973), and can result in suffocation due to coating or abrasion of fish gills (O'Connor *et al.* 1976). Sedimentation may also result in the loss of specific substrate types required by species for reproduction.

Turbidity is a significant contributor to declines in aquatic organisms and is associated with trophic cascades and community changes due to alterations between predator–prey interactions, mortality, reduced physiological function and avoidance, and primary productivity (Henley *et al.* 2000; Chivers *et al.* 2012). Additionally, high sediment transport loads can have an abrasive quality and can scour periphyton, resulting in reduced abundance of periphyton (Henley *et al*. 2000).

Sediment transport may carry polluted sediments downstream (Federal Interagency Stream Restoration Working Group 1998). The Sheldrake River has fish consumption advisories in effect due to chlordane residue levels found in fish (Spodaryk *et al.* 1999). Dieldrin and chlordane are persistent organopesticides that were banned from use and maybe present in the sediment. According to the NYSDEC, the Sheldrake River is impaired by pesticide levels in contaminated sediment and silt. Construction activities may result in resuspension of contaminated pesticides.

3. Habitat Loss and Modification

Habitat modification and loss is considered one of the top five drivers of biodiversity loss (*e.g.*, Chivers *at al.* 2012) and will result from riprap and concrete channelization of the rivers. Indirectly, these will also contribute to a decrease in functional value of the riverine, palustrine and terrestrial ecosystems in the proposed project area. The construction of concrete retaining walls and placement of riprap along the riverbank and riverbed will alter/modify the habitat, and result in decreased infiltration of surface runoff, increased flow velocities as well as decreased opportunity for habitat development, and loss of edge (Federal Interagency Stream Restoration Working Group 1998), and riverbed habitats. As mentioned previously, Kennedy and Turner (2011) found that non-channelized reaches had higher density and taxonomic richness of aquatic invertebrates in the transition zone and a greater abundance of predaceous macroinvertebrates.

Channelization of rivers results in the loss of riverine features that create specific habitat required by aquatic species (Brooker 1985). Species must have access to high quality habitats that satisfy specific needs. Channelization decreases habitat diversity by creating a more uniform environment resulting in overall decreased biodiversity. Riverine fish utilize wide range of habitats and may exhibit habitat preference during a portion of their life or throughout their lives (Pretty *at al.* 2003). Brooker (1985) reported that channelized reaches of rivers have fewer fish species than unmanaged reaches and this effect was credited to loss of space, loss of distinct habitat patches (*i.e.* riffles and pools), decreased habitat diversity, loss of stable substrate and greater fluctuations of water temperature.

Stabilization impacts associated with the use of riprap include the alteration of stream evolution processes, riparian succession, sedimentation processes, habitat, and biological community interactions (Fischenich 2003). The proposed placement of the riprap is along the river bed and river banks. Most studies report on the effects of riprap placement along the shore, with only a limited amount of information available concerning the effects of riprap placed along the river bottom. White *et al.* (2010) found that when used in small areas along the river bank, riprap results in increased abundance and biomass of habitat generalists. However, large-scale alterations result in decreased habitat availability, decreased biotic integrity, and reduced growth and abundance of fish (White *et al.* 2010).

During spawning, fish prefer specific habitat with the appropriate water velocity, substrate, vegetation, and temperature (Wootton 1998). Fish prefer a variety of habitats; some species select substrate that is free of boulders, low in fine sediment and high in gravel, while others may prefer debris, muddy bottoms, or vegetation (Hamilton and Bergersen 1984). As summarized in Table 2, many of the fish found within the proposed project area prefer riffle habitats comprised of rubble, pebbles, gravel, and sand during reproduction. The blacknose dace prefers sand, gravel, and cobble smaller than 2.5 centimeters (cm) (Trial *et al.* 1983), creek chub prefer well-defined riffles to make their gravel nests (McMahon 1982), bluegill prefer fine gravel and sand (Stuber *et al.* 1982), and the white sucker uses riffles to spawn on 2-16 millimeters (mm) sized gravel (Twomey *et al.* 1984). Throughout their various life stages, these fish utilize different areas of the river based on their temperature, velocity, and food requirements. The replacement of these critical patch habitats with a uniform layer of riprap along the river bottom may result in the loss spawning habitat for the freshwater fish found in the proposed project area.

4. Visual and Auditory Impacts from Construction Activities

Fish and wildlife may be disturbed due to the visual and sound stimuli associated with construction activities. For example construction may result in the following behavioral responses of migratory birds:

- Flushing an adult or juvenile from an active nest during the reproductive period;

- Precluding adult feeding of the young for a daily feeding cycle; and
- Precluding feeding attempts of the young during part of multiple feeding cycles.

These responses may then result in decreased survival or reproductive success.

5. Cumulative Impacts

The structural measures proposed in the Corps' LPP will have a negative impact to the in-stream ecology through the channelization of 3,470 ft of the Sheldrake River and 6,140 ft of the Mamaroneck River. Disruption to life history events, alteration to river profile, loss of habitat, and mortality associated with increased turbidity are likely to have negative effects on the Mamaroneck and Sheldrake River ecosystems. While both rivers exhibit characteristics of urbanized rivers associated with riparian degradation due to non-native species and armoring structures; this project will create a more uniform environment that will likely result in further deterioration of the riverine and riparian ecosystem. The goal of channelization is to facilitate the conveyance of floodwaters. The structural measures proposed by the Corps will result in the loss of habitat, the decrease of habitat quality, and the loss of biodiversity.

IX. Recommended Mitigation Measures and Fish and Wildlife Enhancement Measures

A. Service Mitigation Policy

The President's Council on Environmental Quality defined the term "mitigation" in the National Environmental Policy Act (42 U.S.C. § 4321 *et seq.*) regulations to include: (a) avoiding the impact altogether by not taking a certain action or parts of an action; (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation; (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the actions; and (e) compensation for the impact by replacing or providing substitute resources or environments.

The Service's Mitigation Policy (Policy) (U.S. Fish and Wildlife Service 1981) was developed to guide our preparation of recommendations on mitigating the adverse impacts of land and water developments on fish, wildlife, their habitats, and uses thereof. It assists both the Service and Corps by assuring consistent and effective recommendations, outlining policy for the levels of habitat mitigation needed, and the various methods for accomplishing mitigation for habitat losses associated with such projects. Overall, it allows federal action agencies to anticipate Service recommendations and to assist in preparation of mitigation measures early, thus avoiding delays and assuring equal consideration of fish and wildlife resources with other project features and purposes (Fish and Wildlife Coordination Act 16 USC 661-667[e]).

The Service's Policy instructs us to evaluate the habitat that may be adversely impacted and to determine whether it is of: 1) high value for evaluation species and is unique and irreplaceable on a national basis or in the eco-region; for which our goal would be no loss of existing habitat value, because these one-of-a-kind areas cannot be replaced; 2) high value for evaluation species and is relatively scarce or becoming scarce on a national basis or in the eco-region section; for which our goal is no net loss of in-kind habitat value; 3) high to medium value for evaluation species and is relatively abundant on a national basis; for which our goal would be no net loss of habitat value, while minimizing loss of in-kind habitat value; or 4) medium to low value for evaluation species; for which our goal would be to avoid or minimize losses of habitat value.

The habitats present in the proposed project area are characterized by the Service as Category 4 due to the steep river bank slopes, the presence of river bank armoring, the proximity to paved roadways and commercial development, and the presence of non-native and invasive vegetation. Based on this determination, the Service has proposed measures that will avoid or minimize losses to this resource category. If losses are likely to occur, then the Service will recommend ways to immediately rectify, reduce, or eliminate them over time. If losses remain likely to occur, then the Service may make a recommendation for compensation, depending on the significance of the potential loss.

B. Recommended Mitigation Measures

The National Research Council (1992) noted that the cornerstone of modern floodplain restoration and integrated floodplain management rests on the understanding that "…rivers and their floodplains are so intimately linked that they should be understood, managed, and restored as integral parts of a single system." To underscore the importance of floodplains as an integral part of the river ecosystem, Executive Order 11988 on floodplain management states that federal agencies should avoid undertaking actions that directly or indirectly adversely affect natural floodplain functions and values. The above authorities' direct agencies to take advantage of every opportunity to protect, improve, and restore wetland habitat in the study area and enhance regional fish and wildlife resources.

More recently, scientific recognition of our changing climate has led to greater considerations of effects of climate change on federal infrastructure investment and planning. In 2012, the Department of the Interior added policy guidance to its manual to address climate change in project planning. Among the policies are: 1) Promote landscape-scale ecosystem-based management approaches to enhance resilience and sustainability of linked human and natural systems; 2) Protect diversity of habitat communities and species; 3) Protect and restore core, unfragmented habitat areas and the key habitat linkages among them; and 4) Maintain key ecosystem services (U.S. Fish and Wildlife Service 2013).

Based on a consideration of the above, the Service has developed the following mitigation measures that the Corps should incorporate into the project design to avoid and/or minimize the proposed project's adverse effects, facilitate floodplain management, and promote landscape level approach to resiliency planning.

1. Improved Public Access

The Village of Mamaroneck (2011) identifies the lack of public access available to the rivers and suggests the development of a river walk to enhance public access. The incorporation of green infrastructure into the project design will provide opportunities to enhance public access and provide the public with the opportunity to view wildlife found along the river corridor. The Service recommends that the Corps evaluate the possibility of adopting green infrastructure features such as open space, green space, and greenways into the project plan to increase public access.

2. **Nonstructural Measures**

The Service recommends the implementation of nonstructural measures to address flooding related impacts as supplemental to the structural measures being proposed. Nonstructural measures can include: (1) reduction of impervious features in areas adjacent to river where practical, (2) incorporation of pervious materials into the design of parking lots and walkways, and (3) elevation and other flood-proofing measures of buildings within flood prone areas.

3. **Best Management Practices**

Guidelines for channel renovation/design principles (Nunnally 1978) should be considered as best management practices and include the following:

- Straighten the channel and increase the slope as little as possible;
- Promote bank stability by leaving as many trees as possible, minimizing channel reshaping, early seeding of vegetation in disturbed areas, and judicious placement of riprap; and
- Emulate nature in designing channel form; existing meanders should be maintained.

4. **Surveys**

In the event that vegetation clearing cannot occur between September and January, breeding bird surveys should be conducted. This time-of-year restriction was developed utilizing data obtained from the NYSDEC Breeding Season Table (1980-1985). While most raptors may begin nesting in March, the great horned owl may lay eggs as early as late January. Should the Corps wish to refine this time-of-year restriction, the Service recommends nesting surveys be conducted prior to construction to identify raptor breeding activities and nest locations in the vicinity of the proposed project area. Once breeding areas have been identified, the Corps and the Service would assess which nests would be directly impacted by project activities and which nests would likely be rendered unproductive because of the proximity of the proposed project. The assessment of nest activity would take into account circumstances such as landforms and surrounding land uses that would factor into the assessment of direct project related activities to the species. Construction buffers may be incorporated into the project activities to avoid the take of migratory birds, their nests, eggs, or young.

5. **Time-of-Year Restrictions**

The Service also recommends conducting in-water and stream bank construction activities from November to March to avoid the spawning season of freshwater fish species and the migration of American eels. The freshwater species (white sucker, blacknose dace, tessellated darter, etc.) identified within the proposed project area spawn in spring and summer (April to mid-August) or when water temperatures are between 13° C and 32° C (Werner 1980; Lane *et al.* 1996;

http://www.dec.ny.gov/animals/94473.html accessed August 10, 2015; Kraft *et al.* 2006). As noted in Section VI, eels may begin migrating into brackish and fresh waters between March and June as juveniles and migrate into the marine environment to reproduce between August and November (Hoffmann 2015). The Atlantic States Marine Fisheries Commission (2000) recommends that federal and state agencies mitigate (when practical) the effects of construction hazards to the migration of American eel.

At this time, the Service recommends cutting trees between September and January for the protection of breeding birds, and recommends avoiding any in-stream activities during March-November for the protection of spawning freshwater fish and migrating American eels. The Corps may opt to conduct specific seasonal surveys for avian and fish species to better delineate the time periods of species activity in the proposed project area. Should the Corps be interested in pursuing potential alternative mitigation measures, in lieu of time-of-year restrictions, such as the construction of fish passageways for aquatic resources, further coordination with the Service is recommended.

6. **Rehabilitation of Riparian Habitat**

The removal of native stream bank vegetation should be minimized and total removal and grubbing of non-native/invasive species should occur with native plantings occurring as soon as possible to reduce erosion and avoid increased turbidity of the water column. The removal of non-native vegetation and the seeding/planting of native species will improve habitat conditions, while increasing ecosystem diversity and storm damage protection. The planting of woody vegetation on the river banks may: a) increase shading and decrease water temperature; b) increase dissolved oxygen solubility; and c) improve habitat suitability for aquatic species, songbirds, wading birds, and waterfowl (Federal Interagency Stream Restoration Working Group 1998).

Many entities within Westchester County are dedicated to the restoration and cleanup of the Mamaroneck and Sheldrake Rivers and overall use and enjoyment of the rivers. Towards this end, the Village has taken measures to improve the water quality by targeting discharge of raw sewage and hosting an annual river cleanup. Specifically, the Westchester Soil and Water Conservation District (District) 2015 plan outlines the District's priorities to advance the aquatic restoration program as follows: (1) restoring, protecting, managing natural resources; (2) installing and retrofitting stormwater management facilities to improve water quality and mitigate flooding; (3) controlling erosion and sedimentation and polluted stormwater by advocating best management practices through professional training and watershed-based analyses and recommendations; and (4) promoting sound soil and water resources conservation techniques and natural resources stewardship through public outreach and education.

Due to the experience of Westchester County in undertaking restoration projects in the proposed project area, the Service recommends that the Corps coordinate with Westchester County regarding priorities and approaches in restoring the habitat within the proposed project study area and utilizing similar methods and materials.

7. **Improvements for Habitat Diversity and Value**

Channelization results in the loss of habitat diversity and functionality. As discussed above, loss of habitat diversity results in decreased abundance and species richness. We recommend making natural stream design features part of the engineering design rather than solely proposing a series of measures to mitigate for adverse effects. Provided below are measures that may be taken to avoid the negative impacts of the study or to restore the habitat post construction.

Structural measures can be incorporated into the engineering design to improve habitat suitability for invertebrates, aquatic vegetation, and fish species in the riverine ecosystem. As described above, many riverine species require varied habitat requirements to complete their life history. The white sucker and blacknose dace prefer shallow riffles and gravel bottom for spawning. This habitat is preferred by numerous other fish species but mud bottoms, deep weed beds, and sandy bottoms are also utilized by species during specific life stages. Measures could be implemented to create shallow riffles, gravel bottom, and deep pools. Creating varied habitat can be achieved by placing structures or boulders within the channel. Additional structures that create habitat include wing deflectors, which protrude from either stream bank but do not extend across the river. These structures deflect flows away from the bank and scour pools by constricting the river and accelerating flow (Federal Interagency Stream Restoration Working Group 1998). Pretty *et al.* (2003) found that wing deflectors increased the flow heterogeneity resulting in varied channel depth, which increased localized abundance and numbers. These measures must be utilized in areas where the velocity of the water is substantial enough to transport material and form riffle and pool habitats.

In order to improve water quality, structural measures may be incorporated into the project design to reduce sediment and debris from entering the river during storm events and ultimately improve water quality. These measures may include (See Environmental Protection Agency 2012 for complete list of Stormwater Management Best Practices):

Bioretention Cells or Rain Gardens: A depressed area with porous backfill (material used to refill an excavation) under a vegetated surface. These areas often have an underdrain to encourage filtration and infiltration, especially in clayey soils. Bioretention cells provide groundwater recharge, pollutant removal, and runoff detention. Bioretention cells are an effective solution in parking lots or urban areas where green space is limited (Environmental Protection Agency 2012).

Curb and Gutter Elimination: Curbs and gutters transport flow as quickly as possible to a stormwater drain without allowing for infiltration or pollutant removal. Eliminating curbs and gutters can increase sheet flow and reduce runoff volumes. Sheet flow, the form runoff takes when it is uniformly dispersed across a surface, can be established and maintained in an area that does not naturally concentrate flow, such as parking lots. Maintaining sheet flow by eliminating curbs and gutters and directing runoff into vegetated swales or bioretention basins helps to prevent erosion and more closely replicate predevelopment hydraulic conditions. A level spreader, which is an outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope, may also be incorporated to prevent erosion (Environmental Protection Agency 2012).

Green Parking Design: Refers to several techniques that, applied together, reduce the contribution of parking lots to total impervious cover. Green parking lot techniques include: setting maximums for the number of parking lots created; minimizing the dimensions of parking lot spaces; utilizing alternative pavers in overflow parking areas; using bioretention areas to treat stormwater; encouraging shared parking; and providing economic incentives for structured parking (Environmental Protection Agency 2012).

Stormwater Planters: Are small landscaped stormwater treatment devices that can be placed above or below ground and can be designed as infiltration or filtering practices. Stormwater planters use soil infiltration and biogeochemical processes to decrease stormwater quantity and improve water quality, similar to rain gardens and green roofs but smaller in size — stormwater planters are typically a few square feet of surface area compared to hundreds or thousands of square feet for rain gardens and green roofs. Types of stormwater planters include contained planters, infiltration planters, and flow-through planters (Environmental Protection Agency 2012).

As discussed above, American eel are catadromous fish which requires migration upstream in order to mature. Access for catadromous/diadromous fish is essential to the success of the population. American eel are faced with numerous challenges, one of which is lack of access to current and historical habitats from barriers (Atlantic States Marine Fisheries Commission 2000). The Atlantic State Marine Fisheries Commission's Interstate Fishery Management Plan for American eel (2000) recommends:

> "In areas where residential and commercial development is adjacent to American eel habitat, state marine fisheries agencies should coordinate efforts with their inland fisheries/wildlife agencies and others (for example, state agencies with responsibility for soil and water conservation and water quality) to implement remedial actions to restore habitat. State marine fisheries agencies should also coordinate with their state water quality agencies responsible for developing and implementing river basin and wetland restoration plans, to ensure that American eel habitat is identified and considered in these plans, and that these plans are implemented. Also, state marine fisheries agencies should coordinate their concerns with the Army Corps of Engineers since they have authority to investigate, study, modify, and construct projects for habitat restoration, under Section 1135(b) of the Water Resources Development Act of 1986, and also under Section 206 of this same Act. State marine fisheries agencies should coordinate with their state inland fisheries/wildlife agencies to identify migration times, through site-specific data collection and monitoring."

While this is geared toward state agencies, it may prove to be prudent for the Corps to consider these recommendations and implement as appropriate into their project design.

Non-structural measures may be taken to restore the habitat within the project area. As discussed in Section VI, carp have a significant effect on the riverine ecosystem resulting in degraded systems. The Service recommends the consideration of a carp removal/eradication program in order to improve the habitat quality. The Service recommends coordination with the Service, NYSDEC, and local entities to explore the possibility of a carp removal/control program in order to improve and maintain habitat value.

Bioengineering

The use of bioengineering along steeply-sloped banks will stabilize the river bank and reduce turbidity and suspended particles in the river while also providing riparian and edge habitat, decreasing flow velocities, and increasing the capacity of the river to accumulate/store/filter materials, sediment, and energy (Federal Interagency Stream Restoration Working Group 1998). The Service understands that the feasibility of these measures may be limited due to steep slopes and high river velocities, but recommends that these techniques be implemented where practical. These techniques are described as follows and have been recommended for similar Corps' projects (*i.e.*, Westchester County Center and Yonkers Avenue Streambank and Shoreline Erosion Protection Projects):

> Articulated Concrete: This technique utilizes concrete mats with spaces to allow for vegetation growth within the mats. This technique was successfully used to stabilize the eroding Gulf Intracoastal Waterway shoreline on the Texas Gulf Coast within the Aransas National Wildlife Refuge (U.S. Army Corps of Engineers 2005).
>
> Brush Layering: This technique is generally used to stabilize slope areas above the flowline of streambanks. It involves the use of long branches that are placed with cut ends into the slope on bulldozed terraces and the tops protruding outside the finished slope (Urban Soil Erosion and Sediment Control Committee 1991).

Brush Matting: This method uses hardwood brush layered along a stream bank as a mattress and anchored in place with a grid of stakes and wire. The toe below the waterline is anchored by rock. This living blanket acts as mulch for seedlings and plantings established in the bank (Urban Soil Erosion and Sediment Control Committee 1991).

Live Cribwall: This is a combination of vegetation and structural elements generally used along streams where flowing water is a hazard. Layers of logs are alternated with long branches protruding out between them. The logs are spiked together and anchored into the bank with earthfill behind them to create a wall. The live stems help tie the logs together and screen the wall (Urban Soil Erosion and Sediment Control Committee 1991).

Live Staking: These are large stakes or poles sharpened at the bottom end and forced vertically into the soft earth along the waterline about 1 foot apart. The poles will grow into a thick barrier (Urban Soil Erosion and Sediment Control Committee 1991).

Vegetated Gabions: This method involves wire-mesh rectangular baskets filled with small to medium size rock and soil which are laced together to form a structural toe. Live branch cuttings are placed on each consecutive layer between the rock filled baskets to take root, consolidate the structure, and bind it to the slope (Federal Interagency Stream Restoration Working Group 1998).

Wattling: This technique uses bundles of branches which are staked into shallow trenches, then covered with soil. They are oriented along the contour and are placed in multiple rows to help stabilize the slope (Urban Soil Erosion and Sediment Control Committee 1991).

8. Post-Construction Monitoring and Management

The Corps should develop and implement a post-construction monitoring and management plan to ensure the success of the completed project and to ensure conservation benefit to the proposed project area. As an integral part of the proposed project, the monitoring plans should be developed with the Service to establish the monitoring time-frame and specific biological goals and objectives. The plan should include: invasive species monitoring, habitat monitoring to ensure success of increased habitat value and management of water quality with regards to pollution.

X. Service Position

The proposed alternative for the Mamaroneck and Sheldrake Rivers, General Reevaluation Report includes the channelization of 9,610 linear ft of river, reconstruction of the Waverly Avenue Bridge, removal of several bridges, the installation of a culvert and retaining walls, and the placement of riprap along the river bottom.

Although the proposed actions have the potential to impact fish and wildlife resources, the Service recognizes that the study area has been previously disturbed. It is the Service's recommendation that the Corps implement all practicable mitigation measures provided in an effort to retain and/or improve the current resource values within the project area.

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