US Army Corps of Engineers®
New York District

NEW YORK AND NEW JERSEY HARBOR DEEPENING CHANNEL IMPROVEMENTS

NAVIGATION STUDY

DRAFT INTEGRATED FEASIBILITY REPORT & ENVIRONMENTAL ASSESSMENT

APPENDIX A4:

Essential Fish Habitat

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1. Executive Summary

Essential fish habitat (EFH) is defined under section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (Public Law 94-265), as amended by the Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-267), as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." EFH designations emphasize the importance of habitat protection to healthy fisheries and serve to protect and conserve the habitats of marine and estuarine finfish, mollusks, and crustaceans. Under the EFH definition, necessary habitat is that which is required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.

During the planning and execution of in-water construction projects including dredging, beach nourishment, jetty repair, Federal and state regulatory agencies recommend management practices such as dredging windows (also known as environmental windows) to protect sensitive biological resources. Ideally, management practices balance the risk of detrimental effects against the need to conduct dredging and placing in a safe and cost effective manner as well as addressing beneficial uses and placement of dredge material. Management practices should be designed to reduce or avoid risk of detrimental effects based on knowledge of the likelihood of exposure to project-induced perturbation as well as the tolerance thresholds of the species of concern. Planning and execution of these projects therefore requires coordination between the U.S. Army Corps of Engineers (USACE) and the National Oceanographic and Atmospheric Administration (NOAA), as well as among other project sponsors and appropriate state agencies. This document is intended to facilitate that coordination by compiling the most up-to-date information, with special reference to New York/New Jersey Harbor (NY/NJ Harbor) and adjacent coastal waters within the jurisdiction of the New York District (District) of the USACE.

The purpose of this EFH document is to re-evaluate the potential effects to EFH from the newly authorized Harbor Deepening Channel Improvements Study (HDCI). In March 2018, an Initial Appraisal Report, per compliance with Section 216 of WRDA 1970, was completed to determine if there is potential federal interest to undertake modifications to the existing 50-foot federal navigation project. The Initial Appraisal Report states that the accelerating expansion of the volume of trade that has taken place since the existing 50-foot federal navigation project was authorized has led to the existing project's dimensions, based on the design vessel the *Regina Maersk* as recommended in the 1999 Study, being superseded in use in the Port of New York and New Jersey much sooner than anticipated in the 1999 Study. This fact has a material effect on the economics and engineering design of the 50-foot federal navigation project. The Initial Appraisal Report found "a comparison of these facts with the requirements §216 indicates that all of the requirements of §216 have been meet." The Initial Appraisal Report made the recommendation to "investigate and determine if there is a Federal interest in continuing the project with the preparation of cost-shared feasibility report for analyzing alternatives to address the identified problems though possible modifications of the project."

As an outcome of the Initial Appraisal Report, the resulting study is called the New York and New Jersey Harbor Deepening Channel Improvements, Navigation Feasibility Study. Water Resources Development Act 1970 Section 216 limits the analysis of the HDCI Study to the constructed 50-foot federal navigation project.

Per compliance with Section 305(b)(2) of the MSFCMA, as amended by the SFA of 1996 (Public Law 104-

267), a history of the NYD's EFH consultation process throughout the District's Navigation program is given, and the EFH managed species are identified. Consultation with NOAA led to a prioritization of concerns for species viewed to be especially vulnerable to project-related impacts. In particular, knowledge gaps pertaining to the early life history stages and spawning habitat of winter flounder (*Pseudopleuronectes americanus*) became the focus of long-term study.

This document presents updates to, as necessary, and heavily excerpts, incorporates, references, cites and relies upon the District's September 2013 Essential Fish Habitat Summary Report: *HDP Knowedge Gained During the Harbor Deepening Project Part I and Part II* (2013 Summary Report) document, particularly Part I of that expansive document that summarizes the findings of cumulative EFH assessments for over fourteen managed species referencing over 14 years of surveys, analyses, report preparation, including peer reviewed literature, and assessments. The 2013 Summary Report is available at https://www.nan.usace.army.mil/Missions/Navigation/New-York-New-Jersey-Harbor/Harbor-Program-Reports/ for ease of reference for the reader/reviewer.

2. Introduction

Essential fish habitat (EFH) is defined under section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (Public Law 94-265), as amended by the Sustainable Fisheries Act (SFA) of 1996 (Public Law 104-267), as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity.” The SFA requires that EFH be identified for those species actively managed under Federal fishery management plans (FMPs). This includes species managed by the eight regional Fishery Management Councils (FMCs), established under the MSFCMA, as well as those managed by National Marine Fisheries Service (NMFS) under FMPs developed by the Secretary of Commerce.

EFH designations emphasize the importance of habitat protection to healthy fisheries and serve to protect and conserve the habitats of marine and estuarine finfish, mollusks, and crustaceans. EFH embodies key physical, chemical, and biological attributes of both the water column and the underlying substrate, including sediment, hard bottom, and other submerged structures that support survival and growth of designated species. Under the EFH definition, necessary habitat is that which is required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem. EFH may be designated for the complete life cycle of a species, including spawning, feeding, and growth to maturity, or may be specific for each life stage (egg, larval, juvenile, adult, and spawning adult).

For in-water construction projects including dredging, beach nourishment, jetty repair, placement of rock for reefs and removal of material from borrow areas, Federal and state regulatory agencies recommend management practices such as dredging windows (also known as environmental windows) to protect sensitive biological resources (i.e. finfish, shellfish, sea turtles, and marine mammals). Ideally, management practices should balance the risk of potential impacts against the need to conduct dredging and placing in a safe and cost effective manner as well as addressing beneficial uses and placement of dredge material. Management practices should be designed to reduce or avoid risk of detrimental effects based on knowledge of the likelihood of exposure to project-induced perturbation as well as the tolerance thresholds of the species of concern. At the dredging site, exposures depend on site-specific conditions including depth, substrate type, and prevailing hydrodynamics with consideration of the specific dredge plant being used (Wilber and Clarke 2007). Exposures of organisms to suspended sediments, turbidity, underwater sound, or hydraulic entrainment will differ based upon many factors. For example, mechanical dredging in silty sediments will induce very different exposures to suspended sediments than will hydraulic dredging in sandy sediments, with many possible scenarios between these alternatives. The probability of encountering a dredge will also differ depending upon the behavior of the organism of concern, as mediated by its position in the water column. Likewise, the duration of exposure will be influenced by attraction to, indifference to, or avoidance of sensory cues or stimuli produced by a given dredge. Similar factors will affect exposures of organisms at the fill site for beach nourishment. Rather than the presence of a dredge, here the method of discharging and handling fill material to achieve the designed beach profile will determine the spatial and temporal scales of disturbance (Wilber et al. 2003a, 2003b, 2007).

Choice and application of appropriate management practices requires knowledge of the life history and habitat requirements of managed species to determine if a conflict with EFH mandates could occur. First, what is the probability that a species of concern would encounter the specific project construction activity, such as an operating dredge or beach discharge? Second, if an encounter does occur, what would the duration of exposure be, given the organism's mobility (e.g., sessile, passive drifter, active swimmer) and the spatial scale of the perturbation. Finally, if the tolerance levels of that species are known or can be estimated, then the potential impacts can be assessed and the need for a restrictive management practice or mitigation measure evaluated. Each assessment and determination of risk is built upon a basic understanding of the occurrences of selected species in the given project areas which is discussed in this report.

3. HDCI Study Description

Several environmental compliance documents under the National Environmental Policy Act (NEPA) have been finalized for the HDP within NY/NJ Harbor, including the Feasibility Report, including the Final Environmental Impact Statement (EIS), for New York and New Jersey Harbor Navigation Study (HDP: USACE 1999). Addtionaly, the Environmental Assessment (EA) on Consolidated Implementation of the New York and New Jersey Harbor Deepening Project was completed (USACE–NYD 2004). Subsequent NEPA analyses, such as the Newark Bay Study Area to evaluate potential impacts on the U.S. Environmental Protection Agency (EPA) Remedial Investigation and Feasibility Study (RI/FS) and the Ambrose Obstruction Removal Study, as well an EA as for the HDP mitigation plan can be found on the District's webpage at https://www.nan.usace.army.mil/Missions/Navigation/New-York-New-Jersey-Harbor/Harbor-Program-Reports/. This EFH Assessment is appended to the EA for the HDCI, which is presented in an integrated (October 2020) report that will undergo public review, per NEPA reguations.

The District's congressionally authorized HDCI Study is designed to offer safe and efficient navigation improvement solutions to conditions that have changed within the harbor since the completion of the HDP.

The National Economic Development (NED) plan is the Tentatively Selected Plan (TSP) identified for this study (see Figure 1 for TSP Overview). The TSP involves deepening Ambrose Channel, Anchorage Channel and Port Jersey Channel, the Kill Van Kull, Newark Bay Channel, South Elizabeth Channel and Elizabeth Channel, by up to 5 feet. This includes the additional width required for structural stability and for the navigation of a *Triple E Class* vessel to transit from sea to Port Elizabeth and Port Jersey. Channel configurations were designed to avoid and minimize environmental and cultural resource impacts while still meeting navigation safety requirements.

Figure 1. Tentatively Selected Plan Overview for HDCI.

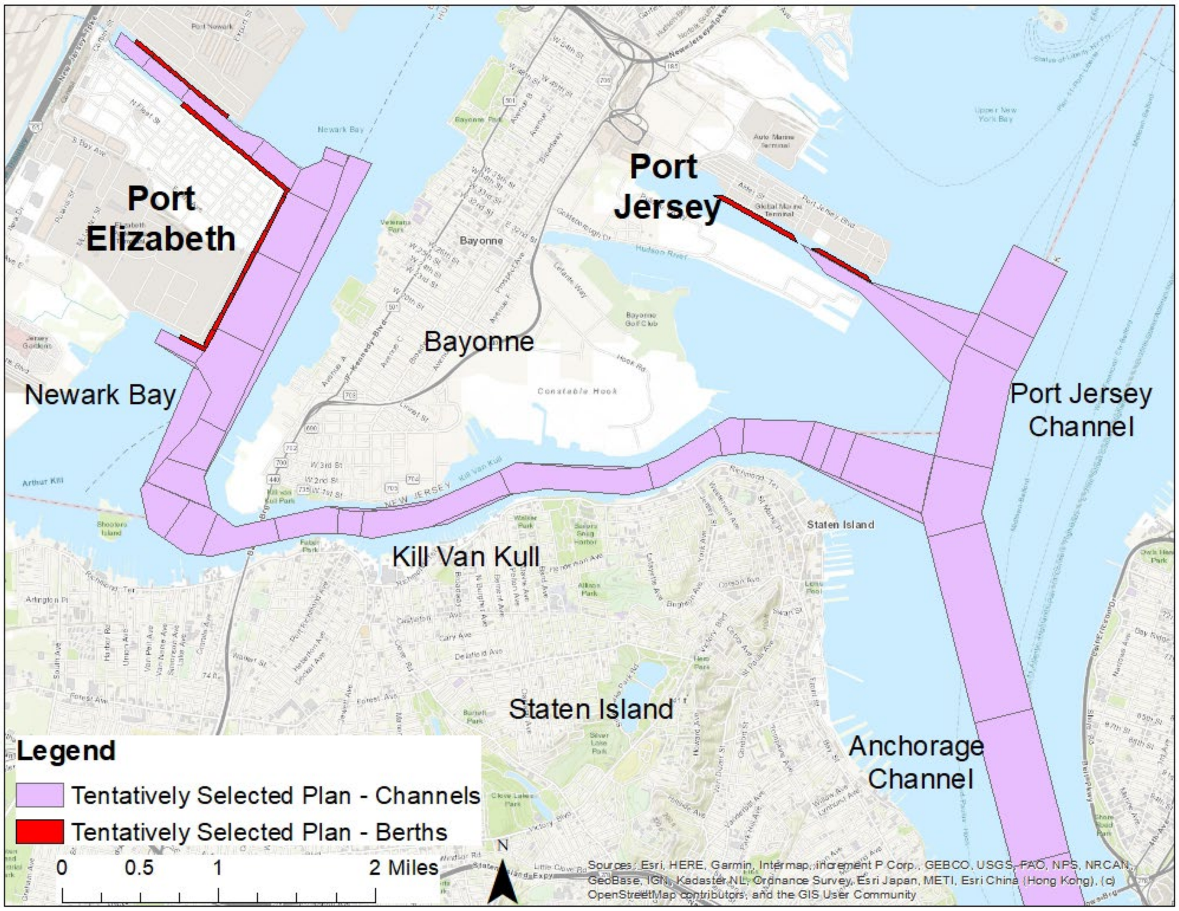

Figure 2. TSP Channel Configurations. Berth Deepening is included in the TSP as an Associated Cost, only. Berths will not be deepened under the HDCI Project.

The following table (Table 1) describes the TSP Dimensions and Characteristics.

Table 1: TSP Channel Dimensions and Characteristics

	Proposed Authorized Channel Level[1] [ft MLLW]	Required Dredging Depth[2] [ft MLLW]	Length of Improve-ment [ft]	Quantity to be Dredged (cy)	Channel Bottom Width	Predom-inant Side Slope	Predominant Channel Bottom Material Type
Ambrose Channel	57	57	89,510	4,137,000	2,000	3:01	Sand
Anchorage Channel	54	54	31,262	3,800,000[9]	2,000	3:01	Sand
Port Jersey Channel	54	56[3]	5960[8]	2,744,000[4]	450 to 2,313[4]	3:1/1:1 against berths	Sand/sediment
Kill Van Kull	54	56[3]	28,047	3,237,000[5]	800 to 2,313[5]	3:1/1:1 through rock	Non-contaminated sediment & moderately hard rock and till
Newark Bay	54	56[3]	12,860	13,181,000[6]	1,740 to 2,008[6]	3:1/1:1 through rock & against berths	Contaminated sediment & moderately hard rock and till
South Elizabeth Channel	54	56[3]	1,586	423,000[7]	500 to 640[7]	3:1/1:1 through rock & against berths	Contaminated sediment & moderately hard rock and till
Port Elizabeth Channel	54	56[3]	7,689	855,000[3]	500 to 750	3:1/1:1 through rock & against berths	Contaminated sediment & moderately hard rock and till

[1] This includes the summer salt water draft, squat, salinity, wave motion, and safety clearance. The channels will be maintained at this depth.
[2] Required dredging depth / design depth is needed for initial construction and includes any additional safety clearance needed for hard bottom.
[3] Includes needed 2 feet for hard or rock bottom which must be blasted for initial deepening.
[4] Includes widening PJ-1
[5] Includes widenings KVK-1, KVK-3, KVK-4 and KVK-5
[6] Includes widenings NWK-1 and NWK-2
[7] Includes widening SE-1A
[8] Limit of disturbance ends approximately 400 ft from centerline of sewer crossing.
[9] Includes deepened area AN-1

The major channels under study in the HDCI will provide access to three main existing container terminals: The Port Newark Terminal and Elizabeth Marine Terminal in Newark Bay and the Global Marine Terminal on the Port Jersey Peninsula. HDCI Area/Site Description

The New York and New Jersey Harbor is located at the apex of the New York Bight. It serves as the port for the greater metropolitan New York area, providing maritime access to shipping terminals via a network of dredged and maintained channels and anchorages (Figure 1). The Harbor exists within the larger confines of the Hudson-Raritan estuary, a diverse and significant habitat complex strongly influenced by tidal action and the mixing of seawater and freshwater drainage (USFWS 1997). The Harbor portion of the estuary covers approximately 298 square miles of surface water (USACE 1999a) and includes for this assessment the bi-state waters of Newark Bay, Arthur Kill, Kill Van Kull, Lower New York Bay, and Upper New York Bay.

The Harbor is characterized by a network of interconnected navigation channels of a range of authorized depths down to 50 feet (ft) and surrounding shoals and shallow flats (Figure 2). The Lower Bay portion of the Harbor complex is comprised of extensive shallow flats with scattered areas of deeper waters, including borrow areas and pits. The relatively shallow bottoms exclusive of the navigation channels cover 77 percent of the total area (38 percent is <15 ft and 39 percent is 15 – 25 ft deep), whereas the Upper Bay is comprised predominantly of deep water (67 percent is >25 ft deep) and Newark Bay is dominated by shallow flats (67 percent is <15 ft deep). The Kill Van Kull and Arthur Kill are relatively narrow waterways dominated by major shipping channels. In the Upper Bay and Newark Bay, navigation channels and berthing areas comprise approximately 35 percent and 22 percent respectively of the total available substrate. The shoals and shallow flats of the Lower Bay represent approximately 152 million square meters (m^2) (91 percent of the total area in the Lower Bay), nearly 29 m^2 in the Upper Bay (65 percent), and nearly 12 m^2 in Newark Bay (78 percent). Thus the Lower Bay provides a large majority of the total shoal and shallow water acreage in the Harbor. Additionally the shallow waters of the Lower Bay are more expansive and unfragmented in comparison to other Harbor areas. Estuarine benthic communities such as are found in NY/NJ Harbor are characterized by high levels of temporal and spatial variability. This variability is caused by the interplay of many natural factors and human influences on estuarine environments. Despite this variability, a general pattern of benthic community distribution exists that is related to substrate type. Silt- and sand-dominated substrates both occur in areas scattered throughout the Harbor. Both have distinctive benthic communities depending on the relative amounts of silt and sand and organic matter. In 2011, USACE conducted a benthic survey throughout the NY/NJ Harbor to characterize the surficial sediments found at 38 historic ABS[1] transect locations. Results included grain size and TOC content of the surficial sediments of channels and surrounding shallow areas. These data describe physical characteristics of the ABS Stations/Transects and locations of winter flounder collections (Wilber et al. 2013). Composition of surficial sediments of the NY/NJ Harbor areas varied among sites. The Lower Bay consisted primarily of sandy substrates, whereas the majority

[1] Throughout the survey, a standard set of approximately 26 sampling locations have been used, but some adjustments have been made from year to year to accommodate HDP construction and changes in station bathymetry. These standard 26 are used for overall data analysis.

of the Upper Bay was transitional ranging from silt to gravelly sand, the Kill Van Kull was dominated by silts, and the Arthur Kill and Newark Bay areas were dominated by silty sediments.

Total Organic Carbon values ranged from 0.07 percent to 5.5 percent, with lowest values occurring at the Lower Bay transects and the highest values at transect locations in the Arthur Kill, followed by Newark Bay and Port Jersey. In general, the lower values were associated with sandy sediments and the higher values with silts and clays. In general, a contrast exists between the Lower Bay where sandy substrates dominate, and the Upper Bay and Newark Bay, which are subject to sedimentation of fine-grained materials and consequently are dominated by soft substrates.

Benthic macro invertebrate communities in the Harbor consist of diverse assemblages of small aquatic invertebrates which live burrowed into (i.e. infauna) or in contact with the bottom surface (i.e. epifauna), such as worms, mollusks, and amphipods (Pearce 1974). Benthic communities play an important role in the Harbor by providing winter flounder with structural habitat as well as a forage base. The majority of taxa identified in grab samples collected during USACE Harbor-wide Benthic Recovery Program in 2005 and 2009 were nematodes, annelids (oligochaetes and polychaetes), arthropods, and mollusks (bivalves and gastropods). These taxa vary considerably in the Harbor with respect to occurrence and abundance both seasonally and spatially (Iocco et al. 2000, BVA 1998, Cerrato et al. 1989, Steimle and Caracciolo-Ward 1989, Gandarillas and Brinkhuis 1981, Dean 1975). These reports provide benthic community data describing the ABS Stations/Transects and Dredging Contract Areas.

4. Potential Impacts from HDCI Improvements

Based on the 2017 HDP Conservation Recommendations, potential impacts from the proposed Federal action of deepening and widening existing deep water channels currently comprising the HDCI could include:

- Physical disturbance and re-suspended sediments/re-deposition of suspended sediments (short-term direct and indirect impacts including potential burial and/or release of contaminants)
- Entrainment of early life stages (eggs and larvae) as a form of short-term direct impact due primarily due to hydraulic dredging and capture of eggs and possibly larvae in the dredge
- Loss of EFH function (i.e. loss of habitat) as a long-term indirect impact due to increased sedimentation and/or changes in depths, currents, substrate types, and/or in-water structures that reduce or eliminate the suitability of habitat for EFH-managed species.

4.1. Direct Impacts

Direct impacts are defined as those impacts that directly affect EFH or cause mortality. These impacts include physical alterations to the habitat of a particular species. Potential direct impacts to EFH species within the project area include the entrainment of demersal eggs and larvae by hydraulic dredges, changes to and/or removal of EFH habitat, localized changes in water column depth, bathymetry, hydrodynamics, and sedimentation rates, the temporary and localized impacts from other construction activities (i.e., water disturbance, noise and vibrations), and short-term changes to water quality conditions typically associated with dredging operations including the re-suspension of sediments in the water column.

4.2. Indirect Impacts

Indirect impacts are defined as those impacts that indirectly affect the well-being of a particular species. These impacts include activities that cause the loss of forage species. The primary indirect impact to EFH species during Harbor channel improvement activities is the disturbance of benthic and epibenthic forage communities. Several of the EFH species are demersal, or benthic feeders (i.e. red hake and winter flounder), that may experience a change in feeding efficiency for some period of time during and immediately following construction activities.

4.3. Cumulative Impacts

Cumulative impacts are defined as those impacts to EFH resulting from the ongoing activities of a particular project or from the activities of multiple projects in an area. These impacts represent the cumulative effects that can result from individually minor but collectively significant actions taking place over a period of time in a particular habitat.

Short-term cumulative impacts are related to dredging operations associated with the HDCI and/or other permitted projects that are ongoing concurrently within the Harbor area. These short-term cumulative impacts to EFH would be a combination of disturbances associated with each project. Long-term cumulative impacts would be limited to localized changes in water column depth, bathymetric contours, hydrodynamics, and sedimentation rates.

5. EFH Consultation History of HDP

USACE-NYD routinely coordinates with the states (New Jersey Department of Environmental Protection (NJDEP) and New York State Department of Environmental Conservation (NYSDEC) and NMFS regarding EFH consultation through each states Water Quality Certification processes and through technical memorandums and/or meetings, as applicable, to provide updates on annual biological monitoring programs. In addition, USACE-NYD presents the results of winter flounder investigations at technical symposia such as the bi-annual NMFS sponsored flatfish conferences to continue technical outreach to regulatory agencies. Also, studies led by the District have been published in peer-reviewed scientific literature so that both the public and the scientific community can benefit from knowledge gained and lessons learned.

For the benefit of new reviewers, interested parties, stakeholders and regulators, it is worth recollecting that USACE-NYD coordinated with the New England Fisheries Management Council on the proposed winter flounder egg and larvae EFH re-designation from the current depth of 5 and 6 meters (16 and 20 ft) for eggs and larvae, respectively, to a depth of 20 meters (66 ft) as it would have impacted existing and future regional navigation channel maintenance and improvement projects. Coordination included the sharing of available ABS data and the invitation to attend a regional Fishery Management Council Habitat Plan Development Team (HPDT) meeting to present the latest ABS results relevant to the proposed re-designation. Based upon technical evidence gathered during collective HDP studies, and extensive coordination with appropriate state and Federal partners, a decision was reached by the Atlantic States Marine Fisheries Commission not to re-designate EFH within NY/NJ Harbor by inclusion of Federal channels. Currently the seasonal restriction recommendations based upon NMFS EFH Conservation Recommendations are being implemented as mitigation (i.e. avoid, minimize, compensate) for potential impacts to EFH throughout the Harbor (Appendix 1 2017 EFH CRs map).

6. Essential Fish Habitat Assessment

6.1. Application of Data Sources within the Harbor

The seasonal timing and spatial distribution of each EFH species within the NY/NJ Harbor is characterized by the presentations and conclusions contained within the 2013 Summary report, and are included here by reference. The following impact analyses is excerpted from the 2013 Summary Report, with updated information and revisions, as necessary.

6.2. EFH Species Distribution and Abundance within NY/NJ Harbor

Butterfish (*Peprilus tricanthus*). Juvenile and adult butterfish were rarely collected during the winter ABS surveys, becoming more common in the spring and abundant in the late summer and fall (2013 Summary Report, Table 3). Butterfish were collected in both bottom and mid-water trawls and were more abundant near the bottom in non-channel areas (USACE 2007). Butterfish were collected most frequently in the Lower Bay, followed by Newark Bay, with very low collections in Upper Bay and Arthur Kill (USACE 2007). Size data indicate young-of-year and yearlings comprise the peak summer and early fall catches. Bottom trawl surveys conducted in the mid-1990s also did not catch butterfish in the Lower Bay in the winter and reported peak abundances during the summer (Wilk et al. 1998).

Atlantic herring (*Clupea harengus*). Atlantic herring larvae were present, but only rarely from February to June during ABS epibenthic ichthyoplankton sampling (2013 Summary Report, Table 3). Juveniles were captured in bottom trawls during ABS sampling. In the winter, juveniles were not collected at most stations and when present, were collected at low abundances throughout the harbor. Peak juvenile abundances occurred in April and May (2013 Summary Report, Table 1), with the highest spring collections at non-channel stations in Newark Bay and in Upper Bay near Port Jersey (2013 Summary Report, Fig. 3). Juveniles were not collected from June to September in the harbor in either the bottom or mid-water trawls of the MFS and were present in low abundances in October and November (Table 3). This seasonal pattern of occurrence in the harbor is consistent with distributions observed in the mid-1990s during the Hudson-Raritan Estuary Trawl Survey (Wilk et al. 1998), in which juveniles were most common in winter and spring, sometimes present at the mouth of the estuary in the summer, and were rare in the fall. Adults were most abundant in the winter in ABS bottom trawl sampling (2013 Summary Report, Table 3) and were concentrated on the eastern side of the harbor, with only two adults collected in Arthur Kill, none in Newark Bay, and few on the western side of the Lower and Upper Bays (2013 Summary report, Fig. 4).

Atlantic Mackerel (*Scomber scombrus*). Atlantic mackerel were not collected within the Harbor in either the ABS or MFS sampling efforts.

Black Sea Bass (*Centropristus striata*). Juvenile black sea bass were collected at very low densities in the Harbor throughout the year, becoming more common in the fall (2013 Summary Report, Table 3). Adults were rarely collected within the harbor regardless of season (2013 Summary Report, Table 3). This seasonal pattern of occurrence in the harbor is consistent with that observed in the mid-1990s during the Hudson-Raritan Estuary Trawl Survey in which only juveniles were collected and they were most abundant in the fall (Wilk et al. 1998). Because the abundances of both juvenile and adult black sea bass were low within the harbor, distribution maps were not created for this species.

Bluefish (*Pomatomus saltatrix*). Juvenile bluefish were not collected within the harbor during the winter and were present, but rare, in the spring (2013 Summary report, Table 3). Likewise, juvenile bluefish were not collected in the harbor in the mid-1990s during the Hudson-Raritan Estuary Trawl Survey (Wilk et al. 1998). Juveniles were collected in slightly higher abundances in bottom than mid- water trawl sampling in 2006 (USACE 2007), with peak abundances in the late summer early fall (Table 3). The majority of fish collected were young-of-year juveniles, which were more common at non-channel than channel stations and present in higher abundances in Newark Bay and Lower Bay than in Arthur Kill and Upper Bay. Adults were collected, but rare in the spring during ABS surveys (2013 Summary Report, Table 3) and were also present, but rare in the Hudson-Raritan Estuary Trawl Survey (Wilk et al. 1998). Because the abundances of both juvenile and adult bluefish were low within the harbor, harborwide distribution maps were not created for this species.

Red hake (*Urophycis chuss*). Red hake larvae were not collected in any epibenthic ichthyoplankton sampling conducted over 10 years from January through June 2002–2011 (2013 Summary Report, Table 3). Juvenile red hake were abundant in bottom trawls from January through April and were present in the harbor at lower abundances in May and June (2013 Summary Report, Table 3). Juveniles were most abundant in channels in the Upper Bay and Newark Bay areas in both the winter (Figure 5) and spring (Figure 6). The strong preference for channels was also observed in the bottom trawl surveys conducted in the Lower Bay in the mid-1990s (Wilk et al. 1998). Adult red hake were present in the Harbor, but were rare in abundance (Table 3).

Scup (*Stenotomus chrysops*). Scup eggs and larvae were not collected within the harbor in the epibenthic ichthyoplankton sampling conducted over ten years from January through June (2013

Summary Report, Table 3). Juveniles were more abundant in bottom than mid-water trawl samples (USACE 2007) and were abundant from May through August (Table 3), with highest occurrences in the Lower and Upper Bay areas (Figure 7). Abundances were highest at non-channel stations in the Upper Bay and at a single channel station in the Lower Bay (2013 Summary Report, Figure 7). The seasonal and spatial occurrences of scup in the Lower Bay in the mid-1990s were similar to that observed in the ABS study with fish collected at both channel and non-channel stations (Wilk et al. 1998).

Summer flounder (*Paralichthys dentatus*). Summer flounder larvae were present, but rare, from January through May in the Harbor and were not collected in June in any year of sampling (2013 Summary Report, Table 3). Juveniles were collected in the Harbor in all months of sampling with the exception of September, whereas adults were not collected in the Harbor in September and November (2013 Summary Report, Table 3). Adult densities were highest in the late spring and were concentrated in the Arthur Kill/Newark Bay and Upper Bay areas at both channel and non-channel stations (2013 Summary Report, Figure 8). In sampling conducted in the mid-1990s (Wilk et al. 1998), summer flounder were most abundant in the Raritan Bay portion of the Hudson-Raritan Estuary at both channel and non-channels stations. The ABS sampling program did not have many stations in this area.

Windowpane flounder (*Scophthalmus aquosus*). Windowpane flounder eggs were collected in the Harbor in high abundances in May and June (2013 Summary Report, Table 3) and were distributed widely throughout channel and non-channel stations in the Lower and Upper Bays (Figure 9). Eggs were not commonly collected in the Arthur Kill and Newark Bay areas (Figure 9). Windowpane flounder larvae were abundant in May and June in the Harbor (2013 Summary Report, Table 3) and exhibited a distribution in the Lower and Upper Bays that was similar to that of eggs, with rare collections in the Arthur Kill and Newark Bay areas (Figure 10). Juvenile windowpane flounder were more widely distributed throughout the harbor and were more common at channel stations in the Arthur Kill, Newark Bay, and Upper Bay areas of the harbor in both the winter (2013 Summary Report, Figure 11) and spring (2013 Summary Report, Figure 12). Adult windowpane flounder were common in the spring and most abundant in the Upper Bay area (2013 Summary Report, Figure 13). Bottom trawl sampling in the Lower Bay in the mid-1990s revealed the highest collections of windowpane flounder in channel areas (Wilk et al. 1998).

Winter flounder (*Pseudopleuronectes americanus*). Winter flounder eggs were common in the Harbor in January, becoming abundant in February and March and decreasing in abundance in April (2013 Summary Report, Table 3). Winter flounder eggs were most common at non-channel stations in the Lower and Upper Bay areas in the winter (2013 Summary Report, Figure 14) and in the Lower Bay in the spring (2013 Summary Report, Figure 15). Eggs were rarely collected in the Arthur Kill and Newark Bay areas (2013 Summary Report, Figures 14 and 15). Egg collections at channel stations were more common in years with strong spring tides and prolonged cold winters, both of which increase the probability of transport from shallow spawning sites via increased vertical mixing and prolonged residence time due to delayed development, respectively (USACE 2010a). Winter flounder larval abundances peaked in April (2013 Summary Report, Table 3) and were concentrated primarily in the Lower Bay at both channel and non-channel stations, with lower densities in the Upper Bay and very low occurrences in the Arthur Kill and Newark Bay areas (2013 Summary Report, Figure 16). Juvenile winter flounder were abundant from January through June and were also collected throughout the fall (2013 Summary Report, Table 3). Juveniles were collected in the Arthur Kill, Newark Bay, and Upper Bay areas, primarily at channel stations in both the winter (2013 Summary Report, Figure 17) and spring (2013 Summary Report, Figure 18). Winter flounder adults were concentrated in the channels of the Upper and Lower Bays both in the winter (2013 Summary Report, Figure 19) and spring (2013 Summary Report, Figure 20). There were very few adults collected in the Arthur Kill and Newark Bay areas. Collections of adult winter flounder in aggregations during April, the critical post-spawning feeding period, occurred only in the Upper and Lower Bays in areas close to clam, mussel and ampeliscid amphipod beds (USACE 2012a). Spatial distributions of juveniles and adults in the Lower Bay during ABS sampling were similar to that observed in the mid-1990s, with highest abundances at channel locations (Wilk et al. 1998).

Little skate (*Leucoraja erinacea*). Little skate juveniles were collected in the Harbor in the winter and early spring, but were rare. Adults were present throughout the winter and spring with highest abundances observed in January and April. In the mid-1990s, little skate were common from the fall through the spring in both channel and non-channel areas of the Lower Bay (Wilk et al. 1998).

Clearnose skate (*Raja eglanteria*). Clearnose skate juveniles were present, but rare throughout the winter and spring (2013 Summary Report, Table 1). Adult clearnose skate were collected in low numbers only in the winter. In the mid-1990s, clearnose skate were also rare in the winter and spring, with higher abundances in the summer (Wilk et al. 2998).

Winter skate (*Leucoraja ocellata*). Winter skate were present in low abundances from January through May and adults were collected only in March and April (2013 Summary Report, Table 1). Winter skate were most abundant in winter in the mid-1990s (Wilk et al. 1998).

Other EFH species. Other EFH species listed for the New York/New Jersey Harbor, but not collected at any time or any lifestage in ABS or MFS sampling include king mackerel, cobia, sand tiger shark, dusky shark, and sandbar shark. MFS mid-water trawls in August of 2006 collected two Spanish mackerel at an Arthur Kill/Kill Van Kull channel station and one cobia at an Upper Bay channel station. Winter skate, little skate, and clearnose skate are present in the area and have been collected in low numbers in the Lower Bay.

6.3. Benthic Habitat Characterizations within the Harbor

Benthic habitats within the Harbor have been studied for decades and related to the continuum of disturbance conditions that result from industrial pollution and eutrophication within the Harbor. Using SPI images and benthic grab sampling, Iocco et al. (2000) surveyed benthic habitats in the Lower Bay, Newark Bay and Upper Bay (as well as areas outside of the HDP project area, Flushing Bay, Bowery Bay and Jamaica Bay) and used a GIS format to map the distribution of major benthic habitat types in these areas. These habitat types included shellfish beds, amphipod tube mats, and both sand and silt substrates. This study found patchy distributions of habitat classes within each bay that varied seasonally in location. Shellbeds were stable in location, whereas ampeliscid amphipod mats varied spatially.

The Lower Bay was comprised primarily of sandy sediments and extensive patches of shellfish and ampeliscid habitat (2013 Summary Report, Figure 21). Ampeliscid habitat was most prevalent near Raritan Bay, whereas shellfish habitat was common near the channels. Bacterial mats, which are indicative of anoxic degraded habitat, were not observed in Lower Bay, even in borrow pits of similar bathymetry to pits in Jamaica Bay where bacterial mats were found.

Newark Bay benthic habitats were comprised primarily of muddy substrate with few infauna, dominated by opportunistic polychaetes (2013 Summary Report, Figure 22). Species abundances were lower in the fall than in the summer and spring, which probably reflected spring larval recruitment.

Upper Bay benthic habitats were characterized by multiple occurrences of mussel and clam shellfish beds, generally near channels. These shellfish beds were temporally stable. Silty sediments with pollution tolerant species were prevalent along the shoreline (2013 Summary Report, Figure 22).

Benthic communities within channels have been monitored at both baseline (pre-dredging) and post-dredging time periods at the following areas Ambrose Channel, Anchorage Channel, Newark Bay Channel, Elizabeth Channel and Kill Van Kull Channel within the Harbor (USACE 2011a and USACE 2013). Ambrose Channel sediments were comprised primarily of sand and did not change between pre- and post-dredging surveys. Post dredging, the benthic community was dominated by polychaetes and amphipods. Pollution tolerant species comprised less than 10 percent of the taxonomic assemblage in both years of sampling. In Anchorage Channel, pollution tolerant species increased from approximately 17 percent in pre-dredging surveys to 29 percent of the assemblage in the post-dredging survey and sediments were primarily silt/clay. Sediment composition in the Kill Van Kull Channel changed appreciably between the pre- and post-dredging surveys, from predominantly fine grained sediments to sediments with much coarser fractions, such as sand, rock, gravel and cobble. Pollution tolerant species comprised roughly 18 percent of all organisms in the post-dredging samples, which doubled that observed during pre-dredging monitoring. Some Anchorage Channel contract areas experienced significant increases in average density between 2005 and 2012. The increases were driven by opportunistic colonizing polchaetes of the families Capitellidae and Spionidae.

Average benthic macroinvertebrate density increased significantly from 2005 to 2012 in the Elizabeth Channel resulting from large collections of annelids (96% of the total organisms collected in 2012). These consisted largely of opportunistic species such as capitellids, and to a lesser extent *Cossura longocirrata* and Oligochaeta.

Benthic macroinvertebrate indices within the Newark Bay S-NB-1 contract area were fairly consistent between the baseline conditions observed in 2005 compared to 2012. Although average benthic density decreased in 2012, measures of diversity and evenness were consistent between sampling events (<1 percent decrease), indicating a comparatively stable community.

6.4. Total Suspended Sediment Studies within the Harbor

In the 2001 HDP EFH CRs, redeposition of sediment suspended during the dredging was identified as a concern for potential impacts on aquatic communities and EFH species. This included short- term and indirect impacts such as potential burial and smothering of early life stages. At that time research had indicated that resuspended sediments plumes could extend more than 500 meters from the dredge site and residual plumes could remain resuspended in the water column for hours.

TSS within the harbor have been monitored with relation to dredging activities to address the concern that suspended sediment plumes may block the migratory pathways of anadromous fish, and to address the potential impacts identified in the 2001 CR including burial and smothering of early life stages. The USACE Harbor-wide WQ/TSS Monitoring Program has documented the extent of plumes generated by ship traffic and harbor deepening operations. Comparisons of TSS values measured near the passage of cargo ships, following storm events, and near active dredging operations revealed that cargo ships had prominent effects on localized TSS levels (USACE 2002), exceeding those attributed to dredging operations in terms of spatial extent. Results of several ship traffic TSS surveys in Newark Bay and a typical bucket dredging operation in the Kill Van Kull were published in Clarke et al. (2007a) and Clarke et al. (2007b).

Ambient TSS in the Newark Bay-Arthur Kill system and Upper Harbor were similar to TSS ranges in other northeastern estuaries with an overall near-bottom average of 15 milligrams/liter (mg/L) (USACE 2002). In some cases, turning ships within Newark Bay created TSS concentrations that were two orders of magnitude greater than ambient TSS concentrations. Site-specific factors such as sediment type and current conditions strongly influence plume size with larger plumes in areas with finer sediment grains size and stronger currents. For instance, in the Upper Bay, where sediments are sand/silt, TSS concentrations were typically 200 mg/L or less within 500 meters of the dredge and were equal to ambient conditions within 1,000 meters of the dredge (USACE 2011a). In Newark Bay, where sediments are silt/clay, TSS plumes as high as 200 mg/L occurred within 75 meters of the dredge, with rapid dissipation to less than 100 mg/L 150 meters down current from the dredge (USACE 2009). The results of the TSS surveys in these waterbodies have consistently shown that resuspended sediment plumes rapidly descended to the bottom of the navigation channel with no evidence of plume excursion beyond the channel side slopes onto the adjacent flats.

Biological impacts of suspended sediments on aquatic organisms historically were studied based on testing TSS concentrations without including durations of exposure as a factor. In addition, salmonids were a common target organism and impacts to estuarine fishes were not commonly studied (Wilber and Clarke 2001). Of the EFH species listed for the NYD project area, only juvenile bluefish were tested in experiments that recorded both TSS concentration and exposure duration data and results indicated 100 percent mortality at a TSS level of 800 mg/L for one day (Sherk et al. 1974, Wilber and Clarke 2001). As measured in multiple TSS surveys in the Harbor (e.g., Clarke et al. 2007b), plumes generated by dredging projects produce TSS concentrations above several hundred mg/L only within a few meters of the source. Concentration gradients within dredge plumes decrease exponentially with increasing time and distance from the dredge. Within most of the volume of dredge plumes TSS concentrations fall within the range regularly produced by the passage of storms (Bohlen 1980, Sosnowski 1984, Tramontano and Bohlen 1984). The fact that plumes have been demonstrated to remain within navigation channel side slopes in NY/NJ Harbor also indicates that exposures to plumes would be of relatively short duration for most EFH species.

7. EFH species assessment

7.1. Butterfish (*Peprilus tricanthus*)

EFH has been identified within the Harbor for the larval, juvenile and adult life stages of Atlantic butterfish. Early life stages of butterfish have not been collected as part of the ABS surveys; therefore, no potential impacts are expected on these life stages.

Potential project related impacts to EFH and juveniles and adults, would be more likely to occur from late spring through fall (May through November). Because juveniles and adults prefer open and near bottom waters, potential direct impacts to Atlantic butterfish is limited to temporary disturbances within the water column. These impacts are localized and include increased turbidity within the water column. Recent sampling, however, has shown that the suspended sediment plumes associated with dredging in the Harbor follows a pattern of rapid gradient decay and settlement with the maximum spatial extent of plumes limited to the lower water column and seldom measuring more than 70 meters (230 feet) across at substantial concentrations (USACE 2010).

Indirect impacts are those resulting from the temporary loss of forage organisms and/or forage habitat and the alteration of existing habitat related to the deepening of the channels. Because Atlantic butterfish juveniles feed primarily on ctenophores and macro-zooplankton and adults on mollusks, the potential indirect impacts associated with the loss of forage species are minimal as other habitat outside of the immediate construction area is available.

Cumulative impacts are also expected to be negligible because of the species' mobility and available habitat throughout the Harbor. Therefore, no more than minimal direct impacts on Atlantic butterfish EFH are anticipated as a result of the ongoing HDP and future maintenance within the Harbor.

7.2. Atlantic herring (*Clupea harengus*)

EFH has been identified within the Harbor estuary for the larval, juvenile and adult life stages of Atlantic herring. Atlantic herring is a pelagic species that is only seasonally abundant within the project area. Potential impacts to EFH will therefore be limited to the late winter and spring

(February through May), when migrating juveniles and adults are common to the estuary.

Because larvae, juveniles and adults are pelagic, potential direct impacts to Atlantic herring EFH will be limited to temporary disturbances within the water column such as bucket hoisting operations. These impacts are localized and may include increased turbidity by settling sediments within the water column. Recent sampling, however, has shown that the suspended sediment plumes associated with dredging in the Harbor estuary follows a pattern of rapid gradient decay and settlement with the maximum spatial extent of plumes limited to the lower water column and seldom measuring more than 70 meters (230 feet) across at substantial concentrations (USACE 2010).

Since this species feeds within the water column, turbidity resulting from dredging activities may have some short-term impact on feeding success. However, the exposed individuals are likely to move to adjacent waters where feeding will be less problematic during dredging operations. These impacts will be further minimized whenever possible through BMPs as well as through seasonal restrictions.

Indirect impacts are those resulting from the temporary loss of forage organisms and/or forage habitat and the alteration of existing habitat related to the deepening of the channels. Because Atlantic herring are planktivorous and feed primarily on zooplankton, the indirect impacts associated with the loss of forage species are expected to be minimal as there is other viable habitat and food sources available outside of the construction area.

Cumulative impacts are also expected to be negligible because of the species' mobility and the availability of other EFH throughout the Harbor. Therefore, no more than minimal direct, indirect and cumulative impacts on Atlantic herring EFH are anticipated as a result of the ongoing HDP and future maintenance within the Harbor.

7.3. Atlantic Mackerel (*Scomber scombrus*)

EFH has been identified within the Harbor estuary for juveniles and adults. Atlantic mackerel were not collected within the Harbor and they are generally not expected to occur in the vicinity of dredged channels. Therefore, no potential direct, indirect and cumulative impacts to Atlantic mackerel EFH are anticipated as a result of the ongoing HDP and future maintenance within the Harbor.

7.4. Black Sea Bass (*Centropristus striata*)

EFH has been identified within the Harbor estuary for the juvenile and adult black sea bass life stages. Because juveniles and adults are demersal and occur near bottom in structured habitat such as reefs, they are generally not expected to occur in the vicinity of dredged channels. Therefore, no potential direct and indirect impacts to black sea bass EFH are anticipated.

Cumulative impacts are also expected to be negligible because of the species' mobility, occurrence in structured habitat, and the availability of EFH throughout the Harbor in areas outside of channels. Therefore, no direct, indirect and cumulative impacts on black sea bass EFH are anticipated as a result of the ongoing HDP and future maintenance within the Harbor.

7.5. Bluefish (*Pomatomus saltatrix*)

EFH has been identified within the Harbor for the juvenile and adult life stages of bluefish. Pelagic juvenile and adult bluefish are seasonally present within the HDP project area from late spring to early fall (May to September) with juveniles common in some years and adults usually rare/uncommon. Yearly fluctuations in abundances are possibly related to year class strength, prey abundance and physical conditions. The seasonal occurrence and pelagic behavior of bluefish greatly limits any potential impacts due to ongoing HDP construction and future maintenance activities. Juveniles and adults are pelagic, therefore, potential direct impacts to bluefish EFH will be limited to temporary disturbances of increased turbidity. Recent sampling, however, has shown that the suspended sediment plumes associated with dredging in the Harbor follows a pattern of rapid gradient decay and settlement with the maximum spatial extent of plumes limited to the lower water column and seldom measuring more than 70 meters (230 feet) across at substantial concentrations (USACE 2010).

7.6. Red hake (*Urophycis chuss*)

EFH has been identified within the Harbor for the egg, larval, juvenile and adult life stages of red hake. Red hake eggs and larvae were not collected in epibenthic ichthyoplankton sampling conducted over 10 years from January through June (Table 3). Because red hake eggs and larvae are pelagic, and spawning typically occurs offshore (Able and Fahay 1998; 2010), they have not been collected within the project area during recent USACE sampling efforts (USACE 2011). Therefore, no direct impacts are expected to red hake egg and larvae EFH.

Potential direct impacts to juvenile and adult EFH are limited to the short-term disruption of bottom habitat during dredging activities. Spatial distribution and relative/seasonal abundance data from previous studies suggest that both juvenile and adult red hake are seasonally present within the HDP project area from winter to spring (January to June). Any potential impact is seasonally limited during juvenile and adult inshore migrations.

Potential indirect impacts to red hake EFH will be limited to the disturbance and temporary loss of benthic species included in the juvenile and adult diets. Indirect impacts to EFH, however, would be short-term and localized to areas of dredging since red hake are able to forage for prey in areas outside of areas impacted by dredging activities.

Cumulative impacts are expected to be minimal because red hake eggs and larvae are pelagic and juveniles and adults typically forage outside of the navigation channels.

7.7. Scup (*Stenotomus chrysops*)

EFH has been identified within the Harbor for the egg, larval, juvenile and adult life stages of scup. Scup eggs and larvae were not collected within the harbor in the epibenthic ichthyoplankton sampling conducted over ten years from January through June (Table 3).

Therefore, no potential direct, indirect and cumulative impacts are anticipated to eggs and larvae.

Potential short-term impacts to juvenile and adult scup EFH are related to the temporary disruption of bottom and, to a lesser extent, water column habitats during HDP and maintenance activities. These impacts will continue to be localized and confined to the immediate dredging area and include increased turbidity and disruption/burial of substrate by settling sediments. Recent sampling, however, has shown that the suspended sediment plumes associated with dredging in the Harbor follows a pattern of rapid gradient decay and settlement with the maximum spatial extent of plumes limited to the lower water column and seldom measuring more than 70 meters (230 feet) across at substantial concentrations (USACE 2010).

Most of the project area, however, remains available for foraging and growth and scup will take advantage of the undisturbed habitat elsewhere in the Harbor. Potential impacts to EFH for this species is restricted to May through October, when adults and juveniles are most common.

Potential indirect impacts to scup EFH will continue to be limited to the disturbance and temporary loss of benthic species included in the juvenile and adult diets. Indirect impacts to EFH will also be short-term and localized to areas of construction and dredging. Scup will be able to forage for prey in areas outside of that impacted by these activities.

Cumulative impacts are also expected to be negligible because of the species' mobility, seasonal occurrences, and the availability of other EFH throughout the Harbor. Therefore, minimal direct, indirect and cumulative impacts on scup EFH are anticipated as a result of the ongoing HDP and future maintenance within the Harbor.

7.8. Summer flounder (*Paralichthys dentatus*)

EFH has been identified within the Harbor for the larval, juvenile and adult life stages of summer flounder. Summer flounder larvae were present, but rare, from January through May in the Harbor and were not collected in June in any year of sampling (2013 Summary Report, Table 3). Juveniles were collected in the Harbor in all months of sampling with the exception of September, whereas adults were not collected in the Harbor in September and November (2013 Summary Report, Table 3). Adult densities were highest in the late spring and were concentrated in the Arthur Kill/Newark Bay and Upper Bay areas at both channel and non-channel stations (2013 Summary Report, Figure 8).

Potential direct impacts to summer flounder EFH from the project include the temporary disruption and direct loss of summer flounder larvae and juvenile life stage habitat. Changes in bathymetry are limited to the channels and the side slope areas and will therefore minimally impact shallow/non-channel areas during the HDCI. However, these impacts would not occur during future maintenance dredging. Short-term impacts would include increased turbidity associated with dredging activities. Recent surveys have shown that the suspended sediment plumes associated with dredging in the Harbor exhibit a pattern of rapid gradient decay and settlement with the maximum spatial extent of plumes limited to the lower water column and seldom measuring more than 70 meters (230 feet) across at substantial concentrations (USACE-

NYD 2010).

Potential indirect impacts to summer flounder EFH include the removal and/or burial of benthic and epibenthic forage species habitat and the disruption and loss of forage species through increased turbidity and sediment re-suspension during dredging and the exclusion of some forage fish from the project area during construction. These indirect impacts are short-term as finfish prey species will return to the area immediately and benthic communities will begin to re-establish themselves within a few months following construction (Wilber and Clarke 2007). Moreover, adult summer flounder are opportunistic feeders and prey on a variety of on fish including sand lance, bay anchovy, and other flatfish (Klein-MacPhee 2002), while juveniles forage on sand shrimp and small fish. The loss of forage habitat would likely cause summer flounder to relocate to other feeding habitats within the Harbor since the total aquatic habitat area impacted during the construction phase is a small fraction of the total estuary available to summer flounder. The majority of this disturbed habitat has undergone natural re-colonization from contiguous areas shortly after the construction phase and return to the same productivity levels as currently exists with larval infauna and epifauna representing the first generation of re-colonization to settle on the new substrate.

Potential cumulative impacts of Harbor deepening activities will continue to be avoided and minimized whenever possible through integration of a variety of best management practices that include the use of the most efficient and environmentally compatible dredging equipment and operating practices. Moreover, dredging activities associated with the ongoing HDP will occur primarily within the existing boundaries of channels with minimal loss of shallow water EFH. Shallow water habitat has been created and enhanced through various USACE projects.

7.9. Windowpane flounder (*Scophthalmus aquosus*)

EFH has been identified within the Harbor for the egg, larval, juvenile and adult life stages of windowpane flounder. Windowpane flounder eggs and larvae were collected in epibenthic ichthyoplankton sampling conducted over 10 years from January through June (2013 Summary Report, Table 3). Eggs were first collected in April and larvae in May. Juvenile and adult windowpane flounder are present throughout the year with the lowest abundance during the summer within the HDP area.

Potential direct impacts to windowpane flounder EFH include the temporary disruption of nursery EFH during deepening dredging operations. Windowpane flounder spawning may occur within the project area during the spring and early summer months. However, direct impacts to egg and larval stages are minimal because prevailing tidal currents will transport most eggs and larvae away from the project site. Spawning adults should be able to locate other suitable habitat within the estuary.

Potential indirect impacts to windowpane flounder EFH are related to bottom habitat disturbance and the potential temporary loss of forage organisms in the immediate vicinity of dredging. Impacts to windowpane flounder EFH would be short-term since natural sedimentation and subsequent re-colonization by benthic invertebrates and other prey are expected to occur within six months to several years depending on sediment characteristics and the scale, timing and frequency of disturbance (Wilber and Clarke 2007). A significant portion of the windowpane flounder's prey is pelagic. In-water construction activity would induce temporary avoidance behavior in most of these prey species. The resulting impact on windowpane flounder would be the need to follow their prey to other suitable habitats.

No long-term, direct, indirect or cumulative impacts on windowpane flounder are anticipated as a result of the HDCI because impacts to spawning and nursery EFH will be short-term and impacts to benthic habitat are temporary, allowing for re-colonization. Lastly, shallow water habitat has been created and enhanced through various USACE-sponsored programs.

7.10. Winter flounder (*Pseudopleuronectes americanus*)

Potential direct impacts to winter flounder EFH from the proposed HDCI project include the temporary disruption and direct loss of winter flounder spawning and early life stage habitat due to any required widening of the navigation channels. The permanent loss of habitat would not be associated with maintenance dredging. Potential short-term impacts include increased turbidity and sediment re-suspension associated with dredging activities, the direct loss of eggs and larvae due to physical removal, exposure of eggs and larvae to suspended or deposited sediments due to re-suspension and transport of sediments (Berry et al. 2011).

Results of the long-term ABS sampling (2002–2010) that focused on winter flounder early life stage utilization of the Harbor provide strong evidence consistent with existing literature that navigation channels are not high value spawning habitat (USACE 2010, Wilber et al. 2013). In addition, the robust dataset has been used to better define the timing of winter flounder spawning activity in the Harbor, and thus, refine existing dredge windows associated with the HDCI In addition, Harbor-wide TSS surveys demonstrated that the lateral extent of the TSS plumes was confined to the channel basins and suspended sediments rapidly decayed from the dredge platform, thereby minimizing any potential impacts to shallow water habitats.

Entrainment during dredging or physical injury to juvenile and adult winter flounder is considered possible, yet improbable, as these stages are highly mobile and capable of avoiding the adverse impacts associated with the physical modification of the benthic substrate. Changes in bathymetry is limited to the channels and the side slope areas for the HDCI and therefore minimally impacting shallow/non-channel winter flounder spawning EFH.

Potential indirect impacts to winter flounder EFH would include the removal and/or burial of benthic and epibenthic forage species habitat and the disruption and loss of forage species through increased turbidity and sediment re-suspension during dredging, and the exclusion of some forage fish from the project area during construction. These indirect impacts are expected to be short-term as finfish prey species will return to the area and benthic communities will begin to re-establish themselves within a few months following construction (Wilber and Clarke 2001, 2007). Moreover, adult winter flounder are opportunistic feeders and the loss of forage habitat would cause winter flounder to locate to other feeding habitats within the Harbor since the total aquatic habitat area impacted during the construction phase is a small fraction of the total estuary available to winter flounder. The majority of this disturbed habitat is expected to undergo natural re-colonization from contiguous areas shortly after the construction phase and return to the same productivity levels as currently exists with larval infauna and epifauna representing the first generation of re-colonization to settle on the new substrate.

Potential cumulative impacts of HDCI activities have been avoided and minimized whenever possible through integration of a variety of BMPs that include the use of the most efficient and environmentally compatible dredging equipment and operating practices as well as the use of dredge windows and blasting restrictions that protect the spawning and nursery habitat of winter flounder EFH. Moreover, dredging activities associated with the HDCI and maintenance dredging will continue to occur primarily within the linear framework of existing channels with minimal loss of shallow water nursery EFH. Lastly, shallow water habitat has been created and enhanced through various USACE-sponsored programs described in further detail in Section 9.

7.11. Little skate (*Raja erinacea*)

EFH has been identified within the Harbor for the juvenile and adult life stages of little skate. Juvenile little skate were collected at very low densities in the Harbor from late fall through spring, adults were slightly more common than juveniles (2013 Summary Report, Table 3). Juveniles were collected during winter and spring in low abundances (rare). Adults were common in January, April and November (2013 Summary Report, Table 3).

Because little skate are collected in relatively low abundance within the estuary and because they are limited to the higher salinity zones of the Lower and Upper Bays, no more than minimal direct impacts are anticipated as a result of HDCI activities and future maintenance dredging. Potential indirect impacts to little skate EFH are related to direct impacts to benthic prey resources. These indirect impacts are temporary and limited to the area of bottom disturbance. The potential loss of prey resources within the construction area may induce individual skates to relocate to alternative foraging areas. Given the limited extent of the impact area and the relatively low abundance of little skates in the project area, no direct, long-term indirect or cumulative impacts are anticipated as a result of the HDCI and future maintenance.

7.12. Clearnose skate (*Raja eglanteria*)

EFH has been identified within the Harbor for the juvenile and adult life stages of clearnose skate. Since 2002 clearnose skate were collected during the ABS bottom trawl sampling primarily from channel stations in the Lower Bay and Upper Bay. Because typically less than 20 individuals were collected in any given year, no more than minimal direct impacts are anticipated as a result of HDCI and maintenance dredging activities. Potential indirect impacts to clearnose skate EFH are related to impacts to benthic prey resources. These indirect impacts are temporary and limited to the area of bottom disturbance. The potential loss of prey resources within the construction area may induce individual skates to relocate to alternative foraging areas. Given the limited extent of the impact area and the low abundance of clearnose skates in the project area, no direct, long-term, indirect impacts or cumulative impacts are anticipated as a result of the HDCI and future maintenance.

7.13. Winter skate (*Leucorja ocellata)*

EFH has been identified within the Harbor for the juvenile and adult life stages of winter skate. Winter skate are occasionally (0 to 11/year) collected in the study area and these occurred primarily in the channel stations of the Lower Bay and Upper Bay. No more than minimal direct impacts are therefore anticipated as a result of HDCI and future maintenance activities. Potential indirect impacts to winter skate EFH are related to direct impacts to benthic prey resources. These indirect impacts are temporary and limited to the area of bottom disturbance. The potential loss of prey resources within the construction area may induce individual skates to relocate to alternative foraging areas. Given the limited extent of the impact area and the relatively low abundance of winter skates in the project area, no long-term, direct, indirect and cumulative impacts are anticipated as a result of the HDCI and future maintenance.

7.14. Other EFH species

There are five other EFH-managed species in the HDCI study area (Atlantic mackerel, king mackerel, sand tiger shark, dusky shark, and sandbar shark), none of which have been collected during the ABS or MFS surveys (2013 Summary Report, Table 3). Another two EFH managed species were very rarely collected in the HDP (two Spanish mackerel were collected in a mid-water trawl at an Arthur Kill/Kill Van Kull channel station in August of 2006, and one cobia was collected at an Upper Bay channel station).

8. EFH Assessment Summary

Direct impacts include all physical and environmental alterations to the useable habitat for each species. The potential direct impacts to EFH associated with constructing both the HDCI and future maintenance of the HDCI footprint is limited primarily to demersal fish species, including winter flounder, windowpane flounder, summer flounder and red hake. Water quality impacts to EFH due to project in-water activities is limited to changes in turbidity levels and suspended solids in the immediate dredging area. Potential increases in suspended solids and turbidity can be minimized by using best management practices, such as specific equipment type, required by the state- issued water quality certificate for each contract area. Moreover, recent surveys have shown that the suspended sediment plumes associated with dredging in the Harbor follow a pattern of rapid gradient decay and settlement with the maximum spatial extent of plumes limited to the lower water column and seldom measuring more than 70 meters (230 feet) across at substantial concentrations (USACE 2010).

Juveniles and adults that use the project area will actively avoid most in-water work areas opting for other appropriate habitat within the NY/NJ Harbor. It is anticipated that most of the direct impacts would be associated with short-term effects. These temporary effects would result in the exclusion of the fish species from very localized sites in the project area during construction due to localized increased turbidity (in fine grained sediments only), water disturbance, noise and vibration associated with dredging equipment operation. These effects would be very spatially limited to local waters and benthic habitat and would cause mobile organisms to move to other available habitat. This avoidance behavior would occur only in those areas where active dredging is underway.

Changes in water depth and bathymetry could result in long-term impacts, since both channel side slopes, and shoal and/or adjacent regulated littoral areas included as EFH for some species will been excavated during the HDCI. Maintained navigational channels have been a long-term baseline condition in the Harbor and the HDCI would represent only a minor incremental change to an already established habitat type.

The widening of channels during the construction of the HDCI project will result in the removal of less than 2 acres of regulated shallow habitat (-6'MLLW) under the State of New Jersey's jurisdiction, therefore, compensatory mitigation is required. The District will implement compensatory mitigation for the impacts to this shallow water or littoral (6'MLLW) habitat, while also incorporating into the mitigation plan any benefits of the channel improvements, such as the creation or expansion of deep-water areas beneficial to other EFH species, such as migratory finfish, as well as the conversion of deep water habitat to shallower habitat associated widening of the side slopes. It is anticipated that the replacement of the existing EFH habitat down to the 20' elevation with new 20' elevation habitat as a result of widening the side slopes to stabilize the newly deepened channel configuration would effect no more than a local and temporary impact since the habitat to -20‘ MLLW would be unavailable only during construction operations. The removal of regulated sediments currently being resuspended by both anthropogenic and non-anthropogenic sources within the channels as a result of natural shoaling since the last maintenance cycle, and the beneficial use of dredged material that would enhance other EFH (*eg.* reefs, wetland restoration, beach nourishment, etc.), and serve as a benefit to EFH resulting from the Federal action are also considered and included in this assessment.

Other potential direct impacts from the HDCI include changes in underlying substrate. Impacts to sediment type could result from the removal of fine-grained sediments from channel areas that had accumulated since the last maintenance cycle. Potential fine sediment removal effects could be realized in areas exhibiting such characteristics (southern portion of the Newark Bay Channel, portion of N. Anchorage Channel-PJ channel). Only minor impacts to sediment type would occur in other areas of the project since sediment type below existing bottom sediments is expected to be similar to the bottom sediments (ex. KVK, Ambrose). Since it is anticipated that both anthropogenic and non-anthropogenic sources would quickly resuspend fine grained sediments into those channels, hence the requirement for regular maintenance of those channels to maintain channel depth (safety, efficiency), the short term and localized nature of those effects are concluded to be negligible.

The primary indirect impact to EFH species from the HDCI is the effect of construction activities on benthic communities in the project area. Many of the listed finfish are demersal, or benthic feeders, which may experience a reduction in feeding efficiency for some short period of time during and immediately following dredging. Indirect impacts are those that impact forage species in the form of displacement, temporary loss of forage species habitat and/or temporary loss of forage species individuals. The potential indirect impacts for EFH would be related to bottom habitat disturbance and the potential loss of forage organisms in the immediate vicinity of dredging. However, the HDCI contract areas are a small percentage of the overall NY/NJ Harbor and mobile fish species will be able to forage in areas adjacent to the HDCI project area.

Based on previous studies, the re-establishment of benthic communities in those areas of effect varies between six months to a year after the project's completion depending on substrate type (USACE 2007c, Wilber and Clarke 2007). Thus no long-term indirect impacts are expected as a result of the HDCI, therefore, the potential indirect impacts to EFH are negligible.

Because the HDCI study area (i.e. NY/NJ Harbor) is densely populated and heavily industrialized, the potential for a variety of ongoing and future activities to cumulatively affect EFH-managed species does exist. Other permitted and pending projects located within the project area have been authorized by permits issued under the USACE's Permits Program for the Clean Water Act Section 404 and Section 10 of the Rivers and Harbors Act of 1899. Some of these applicants have already completed some dredging; others have not begun or scheduled the work. Other than the Port Authority and USACE, the permitted and pending work typically represents maintenance of the Federal channels, maintenance around pier/berth areas and includes dredging, pier rehabilitation, and pier maintenance, rehabilitation of wave breaks, bridge abutment rehabilitation, and wharf reinforcements. Additional and updated information regarding specific permit actions is available on the USACE web page at:

http://www.nan.usace.army.mil/Missions/Regulatory/RegulatoryPublicNotices/tabid/4166/Year/2020/ Default.aspx.

Relevant environmental documents and the Statement of Findings or Record of Decision containing these evaluations are also available from USACE.

Short-term cumulative impacts would be related to dredging associated with other permitted or maintenance projects that are ongoing concurrently within the Harbor. Impacts to EFH would be the combined effect on EFH related to avoidance of turbidity and temporary loss of benthic communities in the dredged areas. However, the impact to EFH in the project area is only a small percentage of the total EFH that exists in the Harbor for any one of the managed species (see Main Report/EA).

Specifically, in response to cumulative impacts, mobile life stages are expected to find acceptable habitat elsewhere within the Harbor beyond the localized dredging plumes. Early life stages that are pelagic and planktonic will be carried through areas of dredging by tidal currents resulting in little effect on them. The life stages that would be most susceptible to the deepening dredging are eggs and larvae. Eggs are demersal and adhesive for a short period following fertilization; larvae are largely passive drifters with limited capabilities to move within the water column. The magnitude of cumulative impacts from this and other projects would be directly related to work occurring in specific areas that EFH species had used as spawning grounds the past winter and spring, and then only if the eggs and/or larvae were still present.

In summary, and based on the 2017 HDP Conservation Recommendations, potential impacts from the proposed Federal action of deepening and widening existing deep- water channels currently comprising the HDCI could include:

- Physical disturbance and re-suspended sediments/re-deposition of suspended sediments (short-term direct and indirect impacts including potential burial and/or release of contaminants)
- Entrainment of early life stages (eggs and larvae) as a form of short-term direct impact due primarily due to hydraulic dredging and capture of eggs and possibly larvae in the dredge
- Loss of EFH function (i.e. loss of habitat) as a long-term indirect impact due to increased sedimentation and/or changes in depths, currents, substrate types, and/or in-water structures that reduce or eliminate the suitability of habitat for EFH-managed species.

Compensator mitigation will be undertaken to replace regulated littoral habitat directly impacted by removal down to the -6'MLLW elevation.

Construction operations will implement Best Management Practices, as required by the affected state, such as using closed clamshell buckets, restricted hoist speeds, no barge overflows and other mitigating measures, as appropriate.

Mitigation (*eg.* Avoidance and Minimization), such as implementation of Seasonal Restrictions (i.e. no dredge windows), will be integrated into the construction schedules, based upon the 2017 Conservation Recommendations issued by NMFS on the HDP, as follows:

- Port Jersey Outer Channel- January 15 to May 31 to be protective of Winter Flounder
- Kill Van Kull- March 1 to May 31 to be protective of migratory finfish
- Newark Bay- March 1 to May 31 to be protective of migratory finfish

9. Habitat Enhancement and Beneficial Use

The USACE has been conducting several large-scale environmental programs in the NY/NJ Harbor that focus on improving shallow, aquatic habitat through the beneficial use of dredged material. These habitat enhancement and beneficial use projects will yield water quality improvements, which will enhance inter-tidal and sub-tidal habitat functions, contribute to increased production of benthic assemblages, shellfish and finfish populations, and subsequent increases in resident and migratory fish species that rely on the Harbor. Examples of past projects resulting from the Navigation program are highlighted below. It is anticipated that the HDCI navigation project will implement similar projects:

a. Multi-year biological sampling programs: As a result of USACE-NMFS collaboration, it was agreed that as part of mitigation for potential adverse effects to unregulated aquatic habitat for the HDP, the District would conduct long-term aquatic biological sampling programs to collect spatial and temporal data on aquatic species of concern in NY/NJ

Harbor.

b. Port Jersey Project: As part of the Port Jersey Deepening and Navigation Safety Improvement Project, the District, in collaboration with NMFS, designed and implemented a Habitat Enhancement Project (HEP) which utilized clean subsurface sediments (e.g., sand and glacial till) dredged from the Port Jersey Federal Navigation Channel to re-establish shallow depth habitat within a portion of the adjacent, but no longer used, Military Ocean Terminal Bayonne (MOTBY). This beneficial use of dredged material was designed to fill in a large section of the MOTBY channel and re-establish continuity with the adjacent shoals from which the original MOTBY channel was cut. During an existing conditions study, the MOTBY channel bottom was found to offer little in the way of habitat variation and supported low biological diversity. The HEP was designed to bury and replace the unconsolidated, low- quality mud and silt bottom sediments with clean, coarse glacial till. The shallower post- construction depth of the channel has the potential to improve water quality via more effective circulation and flushing. These enhancements provide higher quality benthic habitat capable of supporting a greater diversity of estuarine organisms in comparison to previous conditions. The habitat improvements are expected to benefit many estuarine and marine species including the commercially important winter flounder (*Pseudopleuronectes americanus*).

c. The HDCI will remove regulated (contaminated) sediments from the Harbor.

d. Rock material from the HDCI will be used to continue to create or enhance artificial reefs within NY and NJ waters.

e. Another HDP benefit, which is expected to continue for the HDCI, will be the continued reduction in nitrous oxide (NOx) emissions, of which the oceans and bays are recipients, acting as a sink. Compliance with the Clean Air Act led to improved air quality in the region due to the reduction of NOx in the region, beyond the construction timeframe of the HDP, as a result of the District's Navigation Program. The HDCI will similarly implement a NOx reduction program.

f. Under USACE's Continuing Authorities Program (CAP), the New York City Department of Environmental Protection (NYCDEP) and NYSDEC requested assistance in implementing one or more restoration projects, that which would beneficially utilize dredged material from the Navigation Program. A feasibility report titled Jamaica Bay Marsh Islands, Jamaica Bay, NY, Integrated Ecosystem Restoration Report, Environmental Assessment and Finding of No Significant Impact led to the restoration of three marsh islands: Yellow Bar Hassock, Elders Point East, and Elders Point West. Restoration of the Jamaica Bay Marsh Islands, which involved using HDP dredged material to restore island elevation and replanting salt marsh vegetation. There will be similar opportunities under the HDCI.

    i. Construction of the Elders Point East marsh island took place in 2006-2007 and

Elders Point West in 2009-2010 restoring approximately 80 acres of marshland. The Engineering Documentation Report for Yellow Bar Hassock and the Amendment to the Project Cooperation Agreement for the NY&NJ Harbor Deepening Project were both approved by the Assistant Secretary of the Army in June and September 2011, respectively.

ii. Yellow Bar Hassock was constructed through the beneficial use of dredged material from the New York & New Jersey Harbor Navigation Project per Section 207 authority in cooperation with The Port Authority of New York & New Jersey, the non-Federal sponsor. The NYSDEC and NYCDEP funded the local share (35 percent) of the Yellow Bar marsh restoration project.

iii. Approximately 44 acres of salt marsh habitat were restored at Yellow Bar Hassock via placement of ~375,000 cubic yards of sand from Ambrose Channel. The 44 acres of marsh is comprised of approximately 14 acres of transplanted low marsh plant hummocks, 21,859 newly planted high marsh transition plants and 17,175 high marsh plants and more than 330 pounds of dispersed seed.

iv. Ambrose Channel sand was also beneficially used in September and October 2012 to restore an additional 30 acres of marsh islands at Black Wall (155,000 cubic yards of sand – 20.5 acres) and Rulers Bar (95,000 cubic yards of sand – 9.8 acres). Black Wall and Rulers Bar Marsh Islands were constructed as part of the USACE Beneficial Use Program along with USACE partners NYCDEP, NYSDEC, and The Port Authority of New York and New Jersey. The NYSDEC and NYDEP paid 100 percent of the costs associated with sand placement.

v. The marsh island restoration efforts are being monitored and are providing valuable data on the most effective future restoration options. This program also has significant implications for the future success of restoration activities from beneficially using sand from the Operations and Maintenance (O&M) Program.

10. References

Able, K.W. and M.P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press. 342p.

Atlantic States Marine Fisheries Commission (ASMFC). 1998. Assessment of the Southern New England/Mid-Atlantic and Gulf of Maine Winter Flounder Stocks. A report by the ASMFC's Winter Flounder Technical Committee.

Barry A. Vittor & Associates, Inc. (BVA). 1998. Hudson/Raritan Bay Estuary Benthic Community Assessment. Prepared for US Department of Commerce – NOAA.

Berry, W. J., N. I. Rubenstein, E. K. Hinchey, G. Klein-MacPhee and D. G. Clarke. 2011 Assessment of dredging-induced sedimentation effects on winter flounder (*Pseudopleuronectes americanus*) hatching success: results of laboratory investigations. Proceedings of the Western Dredging Association Thirty-first Technical Conference, Nashville, TN, pp.47-57.

Bohlen, W. F. 1980. A comparison between dredge induced sediment resuspension and that produced by natural storm events. Proceedings of the Seventeenth Coastal Engineering Conference, Sydney, Australia, pp.1700-1707

Cerrato, R.M., H.J. Bokuniewicz, and M.H. Wiggins. 1989. A Spatial and Seasonal Study of the Benthic Fauna of Lower Bay of New York Harbor. Special Report 84. Marine Science Research Center, State University of New York, Stony Brook, NY.Able, K.W. and M.P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press. 342p.

Clarke, D., Dickerson, C., Reine, K., Zappala, S., Pinzon, R., and J. Gallo. 2007a. Preliminary assessment of sediment resuspension by ship traffic in Newark Bay, New Jersey. Proceedings of the Eighteenth World Dredging Congress, Lake Buena Vista, FL, 20pp.

Clarke, D., Reine, K., Dickerson, C., Zappala, S., Pinzon, R., and J. Gallo. 2007b. Suspended sediment plumes associated with navigation dredging in the Arthur Kill Waterway, New Jersey. Proceedings of the Eighteenth World Dredging Congress, Lake Buena Vista, FL, 20pp.

Dean D. 1975. Raritan Bay Macrobenthos Survey, 1957-1960. Data Report 99. National Marine Fisheries Service (NMFS), Seattle, WA.

Gandarillas, F.E. and B.H. Brinkhuis. 1981. Benthic Faunal Assemblages in the Lower Bay of New York Harbor. Marine Sciences Research Center, State University of New York. Stony Brook, New York.

Iocco, L.E., P. Wilber, R.J. Diaz, D.G. Clarke and R.J. Will. 2000. Benthic Habitats of New York/New Jersey Harbor: 1995 Survey of Jamaica, Upper, Newark, Bowery, and Flushing Bays. Final Report – October 2000. NOAA Coastal Services Center, NOAA/CSC/2123-CD.

Klein-MacPhee, G. 2002. Sand Flounders. Family Paralichthyidae. Pp. 551-560 in B.B. Colletteand G. Klein-MacPhee, eds. Bigelow and Schroeder's Fishes of the Gulf of Maine. 3rd

Ed. Smithsonian Institution Press, Washington, D.C.

National Marine Fisheries Service (NMFS) – Northeast Region. 2001. Conservation Recommendation Letter from Peter D. Colosi, Jr. (Assistant Regional Administrator for Habitat Conservation) to Frank Santomauro (Chief, Planning Division, U.S. Army Corps of Engineers) dated 27 July 2001.

Sherk, J. A., J. M. O'Connor, D. A. Neumann, R. D. Prince, and K. V. Wood. 1974. Effects of suspended and deposited sediments on estuarine organisms, Phase 11. Reference No. 74- 20, Natural Research Institute, University of Maryland, College Park, Maryland.

Sosnowski, R. A. 1984. Sediment resuspension due to dredging and storms: an analogous pair. Proceedings of the Conference Dredging '84, American Society of Civil Engineers, Clearwater Beach, FL, pp.609-618

Steimle, F.W. and J. Caracciolo-Ward. 1989. A reassessment of the status of the benthic macrofauna of the Raritan Estuary. Estuaries 12(3):145-156.

Tramontano, J. M., and W. F. Bohlen. 1984. The nutrient and trace metal geochemistry of a dredge plume. Estuarine, Coastal and Shelf Science 18:385-401

United States Army Corps of Engineers (USACE). 1999. The Final Environmental Impact Statement (FEIS) for the New York and New Jersey Harbor Study (includes descriptions of sediments in some of navigation channels 5.4-6)

United States Army Corps of Engineers – New York District (USACE-NYD). 2002. 2001 Total Suspended Sediment and Turbidity Monitoring in Newark Bay, Kill Van Kull, and Port Jersey.

United States Army Corps of Engineers – New York District (USACE-NYD). 2007a. Suspended Sediment Plumes Associated With Navigation Dredging In The Arthur Kill Waterway, New Jersey. Appendix 3-1 of the Final Environmental Assessment: Effects of the NY/NJ Harbor Deepening Project on the Remedial Investigation/Feasibility Study of the Newark Bay Study Area. June 2007.

United States Army Corps of Engineers – New York District (USACE-NYD). 2007b. Assessment of Ship-Induced Suspended Sediment Plumes In Newark Bay, New Jersey. Appendix 4-1 of the Final Environmental Assessment: Effects of the NY/NJ Harbor Deepening Project on the Remedial Investigation/Feasibility Study of the Newark Bay Study Area. June 2007.

United States Army Corps of Engineers – New York District (USACE-NYD). 2007c. 2006 Migratory Finfish Report.

United States Army Corps of Engineers – New York District (USACE-NYD). 2009. Far-field Surveys of Suspended Sediment Plumes Associated With Harbor Deepening Dredging In Newark Bay. S-NB-1 Contract Area. S-NB-1 Contract Area Survey #2. June 2009.

United States Army Corps of Engineers – New York District (USACE-NYD). 2010a. Application of Winter Flounder Early Life History Data to Seasonal Dredging Constraints and

Essential Fish Habitat Designations. November 2010.

United States Army Corps of Engineers – New York District (USACE-NYD). 2010b. Far Field Surveys of Suspended Sediment Plumes Associated With Harbor Deepening Dredging In Newark Bay. S-E-1 Contract Area. S-NB-1 Contract Area (Port Elizabeth Channel Survey #1 & #2). February 2010.

United States Army Corps of Engineers – New York District (USACE-NYD). 2011a. Benthic habitat recovery Report

United States Army Corps of Engineers – New York District (USACE-NYD). 2011b. Far Field Surveys of Suspended Sediment Plumes Associated With Harbor Deepening Dredging In Upper Bay. S-AN-2 Contract Area (Anchorage Channel). June 2011.

United States Army Corps of Engineers – New York District (USACE-NYD). 2012a. Application of Adult and Juvenile Winter Flounder Data to Habitat Uses in New York/New Jersey Harbor. November 2012.

United States Army Corps of Engineers – New York District (USACE-NYD). 2012b. 2011 Migratory Finfish Report.

United States Army Corps of Engineers – New York District (USACE-NYD). 2013a. Benthic Recovery Monitoring Report Contract areas: S-AN-2, S-AN-1b, S-E-1, and S-NB-1.

United States Army Corps of Engineers – New York District (USACE-NYD). 2013b. Far Field Surveys of Suspended Sediment Plumes Associated With Harbor Deepening Dredging In Upper Bay. S-KVK-1 Contract Area (Kill Van Kull). January 2013.

United States Army Corps of Engineers (USACE) – New York District (USACE-NYD). 2013c. Far Field Surveys of Suspended Sediment Plumes Associated With Harbor Deepening Dredging In Newark Bay. S-NB-2/S-AK-1 Contract Area (South Elizabeth Channel) Surveys #1 & #2. January 2013.

United States Army Corps of Engineers (USACE) – New York District (USACE-NYD). 2013d. Far-Field Surveys of Suspended Sediment Plumes Associated With Harbor Deepening Dredging In Arthur Kill. S-AK-2 Contract Area. February 2013.

United States Army Corps of Engineers (USACE)- New York District (USACE-NYD). 2013.

Essential Fish Habitat: Knowledge Gained During the Harbor Deepening Project, Part I and Part II (2013 Summary Report).

Wilber, D. H. and D. G. Clarke. 2007. Defining and assessing benthic recovery following dredging and dredged material disposal. Proceedings of the Eighteenth World Dredging Congress. Pp. 603-618. Robert E. Randall, editor. Newman Printing Company, Bryan, Texas 77801.

Wilber, D. H., Clarke, D. G., Gallo, J., Alcoba, C. J., Dilorenzo, A. M., and S. E. Zappala. 2013. Identification of winter flounder (*Pseudopleuronectes americanus*) estuarine spawning habitat and factors influencing egg and larval distributions. Estuaries and Coasts. DOI 10.1007/s12237-013- 9642-z.

Wilk, S.J.; Pikanowski, R.A.; McMillan, D.G.; MacHaffie, E.M. 1998. Seasonal Distribution and Abundance of 26 Species of Fish and Megainvertebrates Collected in the Hudson-Raritan Estuary, January 1992- December 1997. Northeast Fish. Sci. Cent. Ref. Doc. 98-10; 145p. National Marine Fisheries Service, James J. Howard Maine Science Lab., Highlands, New Jersey.

11. Tables

Table 1: HDCI Contract Areas

Water Body	Contract Area	Status
Newark Bay	S-NB-1	Completed
	S-NB-2	Completed
	S-E-1	Completed
Arthur Kill	S-AK-1	Completed
	S-AK-2	Ongoing
	S-AK-3	Currently in Construction
	S-SR-1	Awarded July 2013; construction anticipated to begin Fall 2013
	S-SR-2	To be awarded by the end of September 2013; construction anticipated to begin late 2013
	S-UC-1	Advertise and award dependent upon FY14 & FY14 appropriations
Kill van Kull	S-KVK-1	Completed
	S-KVK-2	Completed
	S-KVK-5	Completed
Upper Bay	PJ- 3	Completed
	PJ-4	Completed
	S-AN-1a	Completed
	S-AN-2	Completed
Lower bay	S-AN-1b/S-AM-2b	Completed
	S-AM-1a	Completed
	S-AM-2a	Completed
	S-AM-3a	Completed
	S-AM-3b	Completed

Table 2: EFH Designated Species within the HDCI Project Area

Species	Eggs	Larvae	Juveniles	Adults	Spawning Adults
red hake (Urophycis chuss)		M,S	M,S	M,S	
winter flounder (Pseudopleuronectes americanus)	M,S	M,S	M,S	M,S	M,S
windowpane flounder (Scophthalmus aquosus)	M,S	M,S	M,S	M,S	M,S
Atlantic sea herring (Clupea harengus)		M,S	M,S	M,S	
bluefish (Pomatomus saltatrix)			M,S	M,S	
Atlantic butterfish (Peprilus triacanthus)		M	M,S	M,S	
Atlantic mackerel (Scomber scombrus)			S	S	
summer flounder (Paralichthys dentatus)		F,M,S	M,S	M,S	
scup (Stenotomus chrysops)	S	S	S	S	
black sea bass (Centropristus striata)			M,S	M,S	
king mackerel (Scomberomorus cavalla)	X	X	X	X	
Spanish mackerel (Scomberomorus maculatus)	X	X	X	X	
cobia (Rachycentron canadum)	X	X	X	X	
clearnose skate (Raja eglanteria)			X	X	
little skate (Leucoraja erinacea)			X	X	
winter skate (Leucoraja ocellata)			X	X	
dusky shark (Carcharhinus obscurus)			X (neonate)		
sand tiger shark (Odontaspis taurus)			X (neonate)		
sandbar shark (Carcharinus plumbeus)			X (neonate)	X	

Source: National Marine Fisheries Service (2013) http://www.nero.noaa.gov/hcd/ny3.html Hudson River/Raritan, Sandy Hook Bays/New York/New Jersey Harbor Estuary. As well as 10' x 10' grids 40207400 and 40407400.

Legend:

S = Includes the seawater salinity zone (salinity ≥ 25.0 ppt)

M = Includes mixing water / brackish salinity zone (0.5 ppt < salinity < 25.0 ppt) F = Includes tidal freshwater salinity zone (0.0 ppt < salinity < 0.5 ppt)

X = Designated EFH but no salinity zone specified

12. Appendix I: Summary of EFH and General Habitat Parameters for Selected Federally Managed Species

Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description	Comments
Atlantic herring	Eggs	<15	32 - 33	20 - 80	July through November	Bottom habitats with a substrate of gravel, sand, cobble, shell fragments & aquatic macrophytes.	Eggs adhere to bottom forming extensive beds. Eggs most often found in areas of well-mixed water, with tidal currents between 1.5 and 3.0 knots (Egg beds can range from 4500 to 10,000 Km2 on GB. Eggs susceptible to suffocation from high densities and siltation)
	Larvae	<16	32	50 - 90	Between August and April, peaks from Sept. - Nov.	Pelagic waters	
	Juveniles	<10	26 - 32	15-135		Pelagic waters and bottom habitats	
	Adults	<10	>28	20-130		Pelagic waters and bottom habitats	(major prey: zooplankton)
	Spawning Adults	<15	32 - 33	20 - 80	July through November	Bottom habitats with a substrate of gravel, sand, cobble and shell fragments, also on aquatic macrophytes	Herring eggs are spawned in areas of well-mixed water, with tidal currents between 1.5 and 3.0 knots
Red hake	Eggs	<10	< 25		May to November, peaks in June and July	Surface waters of inner continental shelf	
	Larvae	<19	>0.5	<200	May to December, peaks in Sept. and October	Surface waters	(newly settled larvae need shelter, including live sea scallops, also use floating or mid-water objects for shelter)
	Juveniles	<16	31 - 33	<100		Bottom habitats with substrate of shell fragments, including areas with an abundance of live scallops	
	Adults	<12	33 - 34	10-130		Bottom habitats in depressions with a substrate of sand and mud	(major prey: fish and crustaceans)

Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description	Comments
	Spawning Adults	<10	>25	<100	May to November, peaks in June and July	Bottom habitats in depressions with a substrate of sand and mud	
Window-pane flounder	Eggs	<20		<70	February to November, peaks May and October in middle Atlantic July - August on GB	Surface waters	
	Larvae	<20		<70	February to November, peaks May and October in middle Atlantic July - August on GB	Pelagic waters	
	Juveniles	<25	5.5 - 36	1 - 100		Bottom habitats with substrate of mud or fine grained sand	
	Adults	<26.8	5.5 - 36	1 - 75		Bottom habitats with substrate of mud or fine grained sand	(major prey: polychaetes, small crustaceans, mysids, small fish)
	Spawning Adults	<21	5.5 - 36	1 - 75	February - December, peak in May in middle Atlantic	Bottom habitats with substrate of mud or fine grained sand	
Winter flounder	Eggs	<10	10 - 30	<5	February to June, peak in April on GB	Bottom habitats with a substrate of sand, muddy sand, mud, and gravel	* On GB, eggs are generally found in water temp < 8EC, and < 90m deep.
	Larvae	<15	4 - 30	<6	March to July, peaks in April and May on GB	Pelagic and bottom waters	* On GB, larvae are generally found in water temp < 8EC, and < 90m deep.
	Juveniles (age 1+)	<25	10 - 30	1 - 50		Bottom habitats with a substrate of mud or fine grained sand	* Young-of-year exist where water temp <28, depths 0.1 - 10m, salinities 5 - 33 (major prey: amphipods, copepods, polychaetes, bivalve siphons)

	Adults	<25	15 - 33	1 - 100		Bottom habitats including estuaries with substrate of mud, sand, gravel	(major prey: amphipods, polychaetes, bivalve siphons, crustaceans)

Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description	Comments
	Spawning Adults	<15	5.5 - 36	<6*	February to June	Bottom habitats including estuaries with substrate of mud, sand, gravel	*except on GB where they spawn as deep as 80m
Atlantic mackerel	Eggs	5-23	(18 - >30)	0 - 15		Pelagic waters	(peak spawning in salinities >30ppt)
	Larvae	6-22	(>30)	10-130		Pelagic waters	
	Juveniles	4 - 22	(>25)	0 - 320		Pelagic waters	
	Adults	4 - 16	(>25)	0 - 380		Pelagic waters	(opportunistic feeding: can filter feed or select individual prey. Major prey: crustaceans, pelagic mullosks, polychaetes, squid, fish)
Black sea bass	Eggs			0 - 200	May to October	Water column of coastal Mid-Atlantic Bight and Buzzards Bay	
	Larvae	(11-26)	(30 - 35)	(<100)	(May - Nov, peak Jun - Jul)	Habitats for transforming (to juveniles) larvae are near coastal areas and into marine parts of estuaries between Virginia and NY. When larvae become demersal, found on structured inshore habitat such as sponge beds.	
	Juveniles	>6	>18	(1 - 38)	Found in coastal areas (Apr -Dec , peak Jun - Nov) between VA and MA, but winter offshore from NJ and south; Estuaries in summer and spring	Rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas, offshore clam beds and shell patches may be used during wintering	(YOY use salt marsh edges and channels; high habitat fidelity)

	Adults	>6	(>20)	(20- 50)	Wintering adults (Nov. to April) offshore, south of NY to NC Inshore, estuaries from May to October	Structured habitats (natural & man-made) sand and shell substrates preferred	(spawn in coastal bays but not estuaries; change sex to males with growth; prey: benthic and near bottom inverts, small fish, squid)

Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description	Comments
Bluefish	Eggs	>18	>31ppt	Mid-shelf depths	April to August	Pelagic waters	*No EFH designation inshore
	Larvae	>18	>30ppt	>15	April to September	Pelagic waters	No EFH designation inshore for larvae
	Juveniles	(19-24)	(23 - 36) freshwat er zone in Albemarie Sound		North Atlantic estuaries from June to October Mid-Atlantic estuaries from May to October South Atlantic estuaries from March to December	Pelagic waters	(use estuaries as nursery areas; can intrude into areas with salinities as low as 3 ppt)
	Adults	(14-16)	>25ppt		North Atlantic estuaries from June to October Mid-Atlantic estuaries from April to October South Atlantic estuaries from May to January	Pelagic waters	Highly migratory (major prey: fish)
Butterfish	Eggs	11 - 17	(25 - 33)	0-1829	(spring and summer)	Pelagic waters	
	Larvae	9 - 19	(6.4 - 37)	10-1829	(summer and fall)	Pelagic waters	
	Juveniles	3 - 28	(3 - 37)	10-365 (most <120)	(winter - shelf spring to fall - estuaries)	Pelagic waters (larger individuals found over sandy and muddy substrates)	(pelagic schooling - smaller individuals associated with floating objects including jellyfish)
	Adults	3 - 28	(4 - 26)	10-365 (most <120)	(winter - shelf summer to fall - estuaries)	Pelagic waters (schools form over sandy, sandy-silt and muddy substrates)	(common in inshore areas and surf zone; prey: planktonic, thaliacians, squid, copepods)

Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description	Comments
Scup	Eggs	13 - 23	>15	(<30)	May - August	Pelagic waters in estuaries	
	Larvae	13 - 23	>15	(<20)	May - September	Pelagic waters in estuaries	
	Juveniles	>7	>15	(0 - 38)	Spring and summer in estuaries and bays	Dermersal waters north of Cape Hatteras and Inshore on various sands, mud, mussel, and eelgrass bed type substrates	
	Adults	>7	>15	(2 -185)	Wintering adults (November April) are usually offshore, south of NY to NC	Dermersal waters north of Cape Hatteras and Inshore estuaries (various substrate types)	(spawn < 30m during inshore migration - May - Aug; prey: small benthic inverts)
Summer flounder	Eggs			30-70 fall; 110 winter; 9-30 spring	October to May	Pelagic waters , heaviest concentrations within 9miles of shore off NJ and NY	
	Larvae	(9 - 12)	(23-33) Fresh in Hudson R. Raritan Bay area	10-70	mid-Atlantic Bight from Sept. to Feb.; Southern part from Nov. to May at depths 9-30m	Pelagic waters, larvae most abundant 19 83km from shore; Southern areas 12 - 52 miles from shore	(high use of tidal creeks and creek mouths)
	Juveniles	>11	10 -30 Fresh in Narrag. Bay, Albem/ Pamlico Sound, & St. Johns R.	(0.5-5) in estuary		Demersal waters, muddy substrate but prefer mostly sand; found in the lower estuaries in flats, channels, salt marsh creeks, and eelgrass beds	HAPC - All native species of macroalgae, seagrasses and freshwater and tidal macrophytes in any size bed as well as loose aggregations, within adult and juvenile EFH. (Major prey: mysid shrimp)

Species	Life Stage	Temp (°C)	Salinity (‰)	Depth (m)	Seasonal Occurrence	Habitat Description	Comments
	Adults		Fresh in Albemarie Sound, Pamlico Sound, & St. Johns R.	(0 - 25)	Inhabit shallow coastal and estuarine waters during warmer months and move offshore on outer Continental Shelf at depths of 150m in colder months	Demersal waters and estuaries	HAPC - All native species of macroalgae, seagrasses and freshwater and tidal macrophytes in any size bed as well as loose aggregations, within adult and juvenile EFH. (Major prey: fish, shrimp, squid, polychaetes)
Spanish mackerel		>20	>30			Sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island ocean side waters from surf zone to shelf	All coastal inlets
						break but from the Gulf Stream shoreward;	
Cobia		>20	>25			Sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island ocean side waters from surf zone to shelf break but from the Gulf Stream shoreward; high salinity bays, estuaries, seagrass habitat.	All coastal inlets
King mackerel		>20	>30			Sandy shoals of capes and offshore bars, high profile rock bottoms and barrier island ocean side waters from surf zone to shelf break but from the Gulf Stream shoreward;	All coastal inlets

This table was compiled by NMFS Northeast Regional Office, Habitat Conservation Division. All information presented is part of the Regional Fishery Management Council's EFH designations except for that contained within ( ) which is provided as important additional ecological information. Definitions: GOME – Gulf of Maine; GB – George's Bank; HAPC – Habitat Area of Particular Concern; YOY – Young-of-Year. Please note: This Table does not contain EFH info on Highly Migratory Species (sharks, tunas, billfish).

13. Appendix 2. 2017 EFH Conservation Recommendations Map