ENVIRONMENTAL APPENDIX ESSENTIAL FISH HABITAT (EFH) ASSESSMENT

NEW JERSEY BACK BAYS COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

PHILADELPHIA, PENNSYLVANIA

APPENDIX F.2

December 2024

U.S. Army Corps of Engineers
Philadelphia District

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Pursuant to Section 305 (b)(2) of the Magnuson-Stevens Fishery Conservation & Management Act, the U.S. Army Corps of Engineers (USACE) is required to prepare an Essential Fish Habitat [EFH] Assessment for the New Jersey Back Bays (NJBB) Coastal Storm Risk Management (CSRM) Feasibility Study. The purpose of the U.S. Army Corps of Engineers (USACE) NJBB CSRM Feasibility Study is to identify a plan for implementation of comprehensive CSRM strategies to increase resilience and to reduce risk from future storms and compounding impacts of sea level change (SLC). The objective of the NJBB CSRM Study is to investigate CSRM problems and solutions to reduce damages from coastal flooding that affects population, critical infrastructure, critical facilities, property, and ecosystems.

The Atlantic Coast of New Jersey is fronted by an effective Federal CSRM program (USACE, 2013). However, the NJBB region currently lacks a comprehensive CSRM program. As a result, the NJBB region experienced major impacts and devastation during Hurricane Sandy and subsequent coastal events thus damaging property and disrupting millions of lives owing to the low elevation areas and highly developed residential and commercial infrastructure along the coastline.

The NJBB is one of nine focus areas identified in the North Atlantic Coast Comprehensive Study

(NACCS), whose goals are to:

a. Provide a risk management framework, consistent with NOAA/USACE Infrastructure Systems Rebuilding Principles; and
b. Support resilient coastal communities and robust, sustainable coastal landscape systems, considering future sea level and climate change scenarios, to reduce risk to vulnerable populations, property, ecosystems, and infrastructure.

While the NACCS provides a regional scale analysis, the NJBB CSRM Study will employ NACCS outcomes and apply the NACCS CSRM Framework to formulate a more refined and detailed watershed scale analysis to include potential municipal or community level implementation opportunities, strategies and measures to assist in enabling communities to understand and manage their short-term and long-term coastal risk in a systems context.

1.1 Role of National Marine Fisheries Service in Essential Fish Habitat

Congress enacted amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (PL 94-265) in 1996 that established procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries (i.e., managed under a federal fishery management plan). Rules published by the NMFS (50 CFR Sections 600.805–600.930) specify that any Federal agency that authorizes, funds, or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to the consultation provisions of the above-mentioned act and identifies consultation requirements. EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” EFH is separated into estuarine and marine components. The estuarine component is defined as “all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities); subtidal vegetation (seagrasses and algae); and adjacent intertidal vegetation (marshes and mangroves).” The marine component is defined as “all marine waters and substrates (mud, sand, shell, rock, and associated biological communities) from the shoreline to the seaward limit of the Exclusive Economic Zone” (Gulf of Mexico Fisheries Management Council [GMFMC], 2004). Adverse effect to EFH is defined as, “any impact, which reduces quality and/or quantity of EFH…” and may include direct, indirect, site specific or habitat impacts, including individual, cumulative, or synergistic consequences of actions.

The back bays and coastal waters of New Jersey have been designated as EFH for a variety of life stages of fish managed under the New England Fishery Management Council, the Mid-Atlantic Fishery Management Council and National Oceanic and Atmospheric Administration’s (NOAA) National Marine Fisheries Service (NMFS). Species designated in the NJBB area include Mid-Atlantic, New England, and coastal migratory pelagic species as well as a number of sharks and other highly migratory species (NMFS, 2016).

The NMFS and fishery management council roles in EFH are described in 67 FR 2343. Through Subpart J, fishery management councils must identify Fishery Management Plans (FMPs) EFH for each life stage of each managed species in the fishery management unit. The regulations also provide that councils: should organize information on the habitat requirements of managed species using a four-tier approach based on the type of information available, identify as EFH those habitats that are necessary to the species for spawning, breeding, feeding, or growth to maturity, describe EFH in text and must provide maps of the geographic locations of EFH or the geographic boundaries within which EFH for each species and life stage is found, identify EFH that is especially important ecologically or particularly vulnerable to degradation as “habitat areas of particular concern” (HAPC) to help provide additional focus for conservation efforts, and must evaluate the potential adverse effects of fishing activities on EFH and must include in FMPs management measures that minimize adverse effects to the extent practicable. Additionally, councils must identify other activities that may adversely affect EFH and recommend actions to reduce or eliminate these effects.

Through Subpart K, “NMFS will make available descriptions and maps of EFH to promote EFH conservation and enhancement. The regulations encourage Federal agencies to use existing environmental review procedures to fulfill the requirement to consult with NMFS on actions that may adversely affect EFH, and they contain procedures for abbreviated or expanded consultation in cases where no other environmental review process is available. Consultations may be conducted at a programmatic and/or project-specific level. In cases where adverse effects from a type of actions will be minimal, both individually and cumulatively, a General Concurrence procedure further simplifies the consultation requirements. The regulations encourage coordination between NMFS and the Councils in the development of recommendations to Federal or state agencies for actions that would adversely affect EFH. Federal agencies must respond in writing within 30 days of receiving EFH Conservation Recommendations from NMFS. If the action agency's decision is inconsistent with NMFS' EFH Conservation Recommendations, the agency must explain its reasoning and NMFS may request further review of the decision. EFH Conservation Recommendations are non-binding."

2.0 STUDY AREA

The study area includes the bays and river mouths located landward of the barrier islands and Atlantic Ocean-facing coastal areas in the State of New Jersey. The study area covers more than 950 square miles, and 3,500 linear miles of shoreline from Long Branch at the northern study area boundary to Cape May Point at the southern boundary.

The NJBB study area is divided into 5 planning regions as described below: Coastal Lakes, Shark River, North, Central, and South (see Figure 1).

2.1 Coastal Lakes Region

This region includes two discontinuous segments separated by the Shark River Region, which is discussed in the following paragraph. The Coastal Lakes region is almost entirely urbanized and includes all or portions of fifteen municipalities. In the Coastal Lakes region, four coastal lakes are in Ocean County and ten coastal lakes are in Monmouth County (an additional two coastal lakes in Monmouth County are in the Shark River Region discussed below). None of the lakes is presently connected to the Atlantic Ocean via a tidal inlet; however, 19th Century mapping shows that the lakes at the time were in fact small tidal estuaries, with each inlet subsequently closed by natural or human actions. Most of the lakes have some form of water level management that allows high lake levels to be reduced by discharge to the ocean.

2.2 Shark River Region

The Shark River Region includes the Shark River estuary and all or portions of seven highly urbanized municipalities in Monmouth County. Sylvan and Silver Lakes are coastal lakes that are included in the Shark River Region. Under ordinary tidal conditions, this is an isolated hydraulic reach; there is no tidal connection between the Shark River estuary and the Manasquan Inlet estuary to the south.

2.3 North Region

The north region of the study area extends from Manasquan Inlet and the Manasquan River Estuary south to Little Egg Harbor Inlet and the Mullica River/Great Bay estuary.

This is the largest region established for the New Jersey Back Bays analyses. It covers 536 square miles and includes all or portions of 45 municipalities in Ocean, Burlington, and Atlantic Counties. There are only three inlets – Manasquan, Barnegat, and Little Egg – along a 45-mile-long segment of the NJ coast. These three inlets are the only connections between the Atlantic Ocean and the large shallow back bays that include Barnegat Bay, Manahawkin Bay, Little Egg Harbor, and Great Bay.

The shorelines on the east side of the back bays, along the barrier spit extending from Manasquan Inlet to Barnegat Inlet and along Long Beach Island, are fully developed. The two exceptions to this generalization include the nine-mile-long reach occupied by Island Beach State Park and the three mile-long Holgate Spit at the southwest end of Long Beach Island. In contrast to the eastern shoreline of the back bays, the western shoreline on the mainland of New Jersey is much more heterogeneous. This area is characterized by medium density single family home developments surrounded by back bay wetlands. There are numerous "finger canal" communities, many of which were developed in the period following World War II by bulk heading, dredging, and filling in what were previously tidal wetlands. In between the finger canal communities are more extensive reaches of back bay shoreline with little or no development. These areas typically consist of intertidal marsh/wetlands.

2.4 Central Region

The Central Region extends from Little Egg Inlet south to Corson Inlet, with an area of 312 square miles and all or portions of 21 municipalities in Atlantic and Cape May Counties. The ocean shoreline length of this region is about 27 miles and includes five tidal inlets: Little Egg, Brigantine, Absecon, Great Egg, and Corson. There are relatively shorter distances between inlets in this region compared to those of the North Region.

As in the North Region, the back bay shorelines of the barrier islands are essentially fully developed with medium density residential and business infrastructure. However, the western (mainland) shorelines of the Central Region are significantly less densely developed than is the case in the North Region.

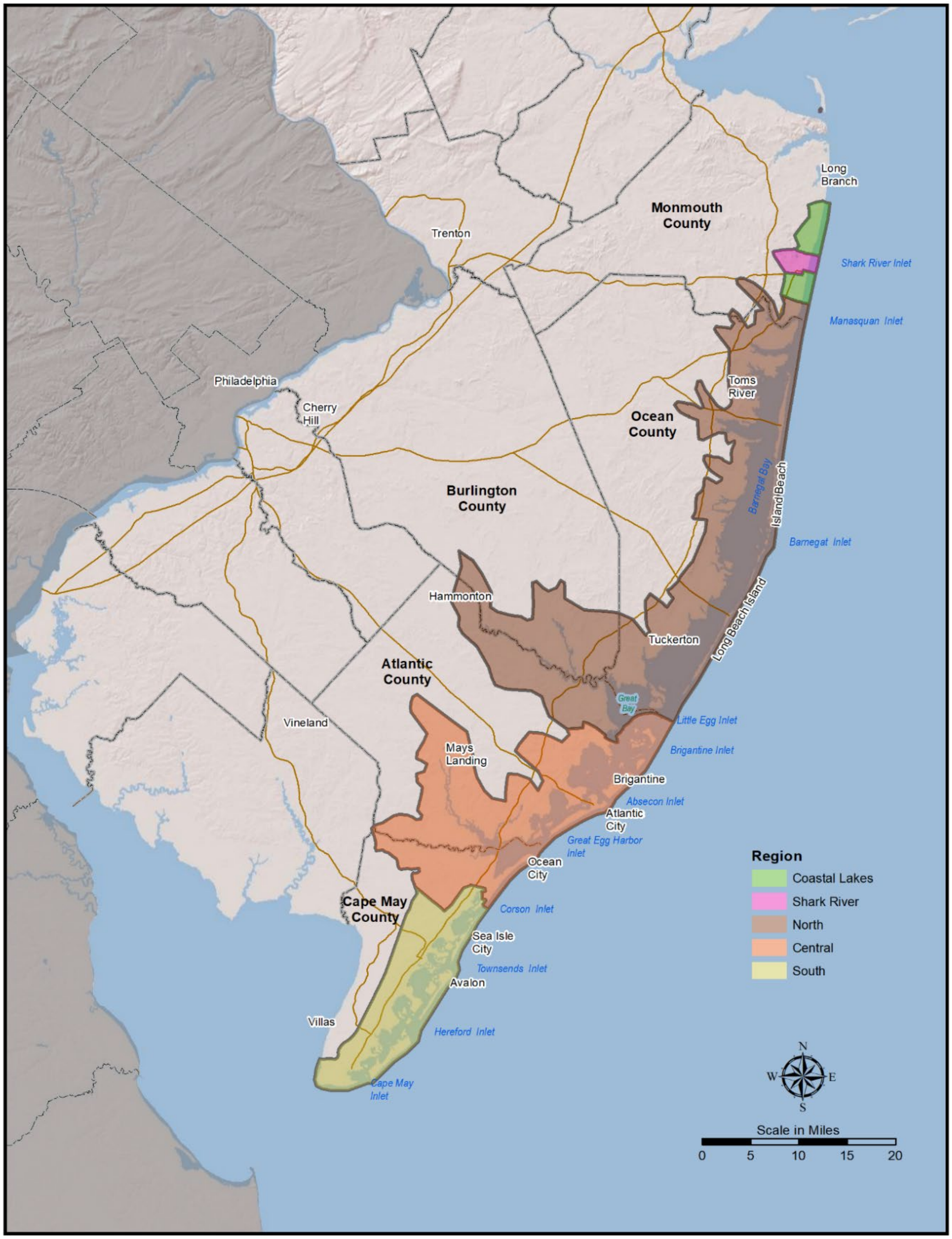

Figure 1. New Jersey Back Bay Study Area

2.5 South Region

The South Region extends from Corson Inlet south and west around Cape May Point to the west end of the Cape May Canal, with an area of 146 square miles. All or portions of 16 municipalities are included in the region, all of which are part of Cape May County. There are five inlets that connect this region to the Atlantic Ocean and Delaware Bay. They include Corson, Townsends, Hereford, and Cape May Inlets and the western entrance to the Cape May Canal on Delaware Bay. The South Region is similar to the Central region in that the most extensive and dense development is along the west (back bay) side of the barrier islands, with relatively less dense development on the mainland side of the back bays.

3.0 PROPOSED ACTION/TENTATIVELY SELECTED PLAN

The tentatively selected plan (TSP) includes the following project components:

- Elevation of 6,421 residential structures (Figure 2, Figure 4, and Figure 5);
- Floodproofing of 279 critical infrastructure elements (police, fire, ambulance, hospital, pharmacy) (Figure 2 and Figure 6)
- Nature-Based Solutions (NBS) with dredged material (from confined disposal facilities [CDFs], also known as dredged material placement facilities [DMPFs], or navigation channels) used to maintain salt marsh habitat projected for conversion with sea level change to unconsolidated shore or open water at approximately 7 locations in the back bay area (Figure 3).

3.1 Nonstructural Measures

Structure Elevation. There are six (6) different design options available for elevation of private residencies. These include Extended Foundation, Piers, Posts, Columns, Piles and Fill. The extended foundation would be the most common method to elevate houses. This involves hydraulically lifting the house and building up the foundation underneath it. Figure 4 shows a concept drawing for extended foundation elevations. Figure 5 provides a rendering of a home before and after elevation.

Pile elevations methods may be the most economical and could be used if the property has enough room to slide the house off its foundation. Once a house is off the foundation, footers would be installed, and wood piles would be driven to elevate the house. Vibratory pile driving would be used to the maximum extent practicable. It is anticipated that most properties would not have enough room to use pile elevation. This method is not expected to be common.

Dry Floodproofing. Dry flood proofing maintains a structure at its current elevation but ensures that the building is impermeable to floodwaters. Large public, industrial or commercial facilities are too complex to elevate and will require dry flood proofing. This technique is also proposed to manage risk to critical infrastructure that has been identified for non-structural solutions.

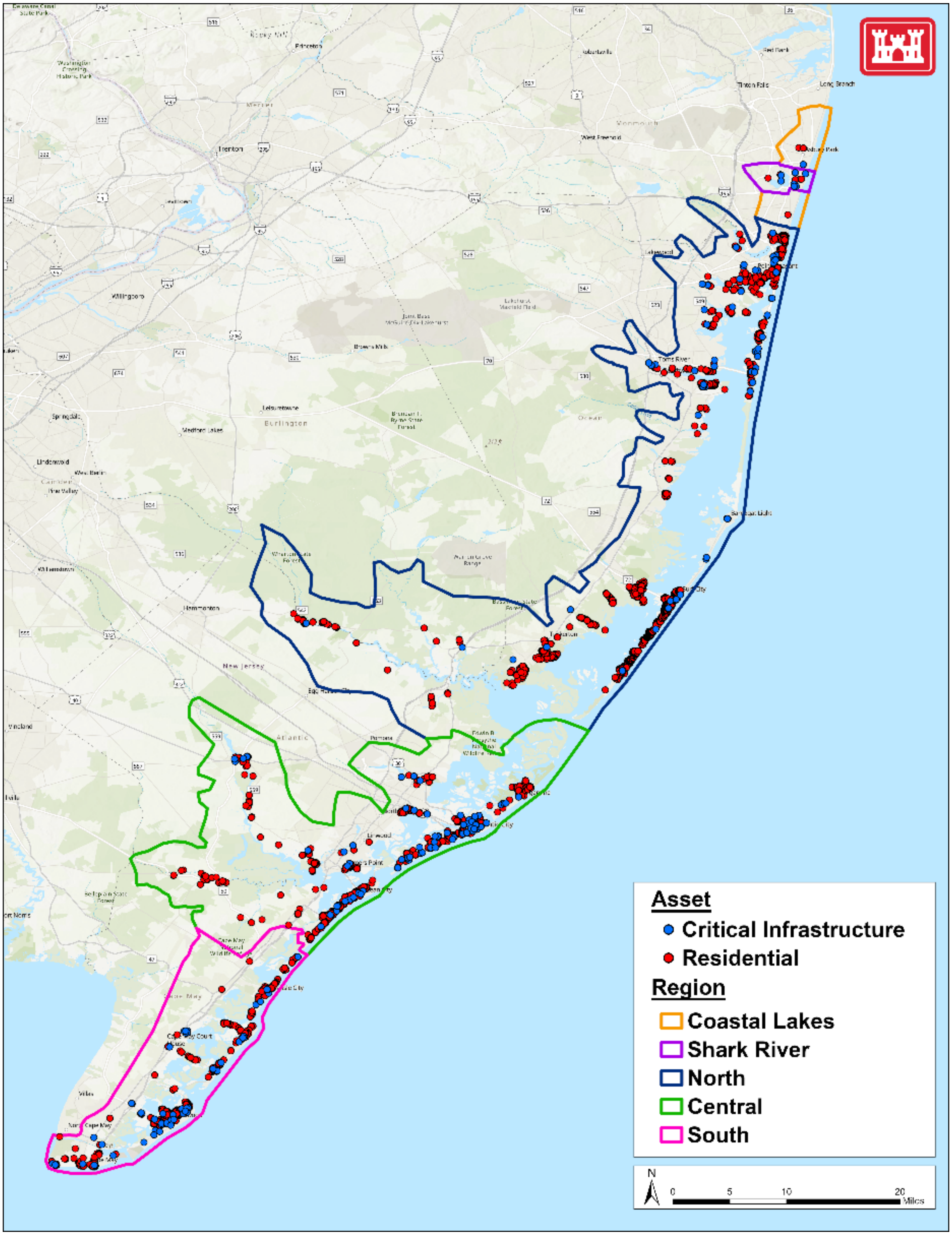

Figure 2. NJBB CSRM Non-structural Measures in the Tentatively Selected Plan

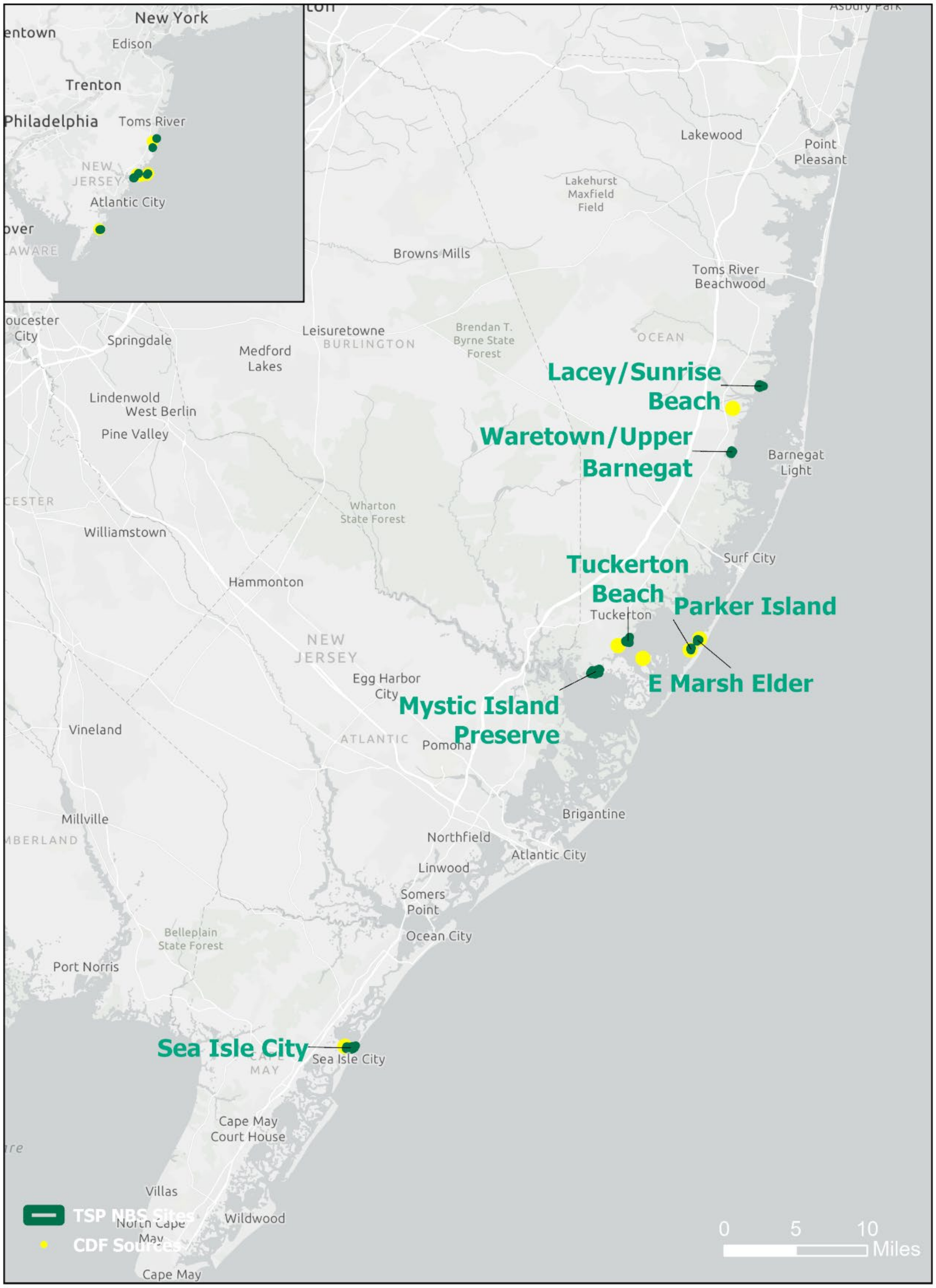

Figure 3. NJBB CSRM NBS Sites and CDFs/DMPFs in the Tentatively Selected Plan

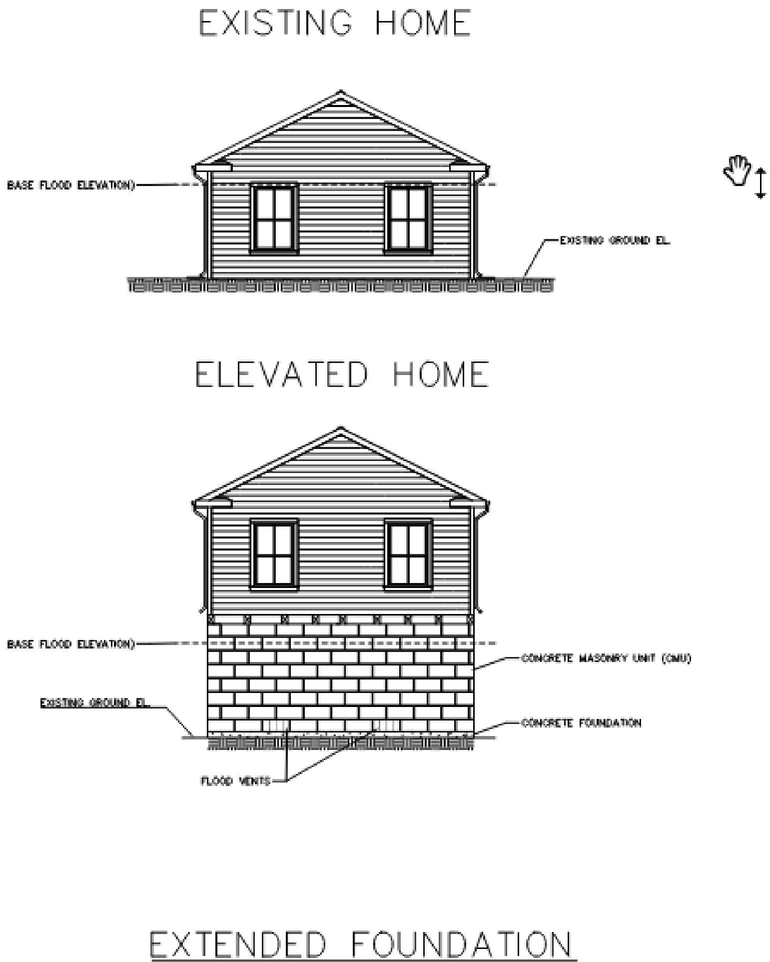

Figure 4. Home Elevation Concept Diagram – Extended Foundation

Figure 5. Before/After Home Elevation Renderings

Dry flood proofing (Figure 6) includes measures that make a structure watertight below the level that needs FRM to prevent floodwaters from entering. In this study, dry flood proofing included:

- Application of a permeable membrane (up to 3 feet above first floor elevation per NNC guidance) in the form of an epoxy paint/sealer.
- Installation of flood shields and stop logs installed in front of all openings that require ingress and egress. This includes access panels, doorways, garage openings, etc.
- Sealing of all pipe penetrations from the building exterior to ensure impermeability.
- Elevation of all external utilities susceptible to flood damage above design flood elevation.

Wet Floodproofing. Wet flood proofing is another approach to retrofitting that involves modifying a structure to allow floodwaters to enter it in such a way that damage to the structure and its contents is minimized. Wet flood proofing is often used when all other mitigation techniques are technically infeasible or are too costly. Wet flood proofing is generally appropriate if a structure has available space where damageable items can be stored temporarily. Wet flood proofing may turn out to be more applicable for specific structures based on water surface elevations (possibly greater than 3 feet above ground surface) at such structures.

Figure 6. Dry Flood Proofing Rendering

3.1.1 Pre-construction

Prior to construction detailed investigation of the eligibility of individual structures for non-structural measures would be conducted.

3.1.2 Construction

Nonstructural measures involve a construction effort similar to home renovations or reconstruction, whether it be from building retrofits such as elevation (including raising a structure on fill or foundation elements such as solid perimeter walls, pier, posts, columns, or pilings) or buyout/ relocations that are likely to involve demolition, grading, and soil stabilization/revegetation. The majority of the construction would occur within the footprint of the existing structure or adjacent developed land such as roads and would most likely be in upland urbanized settings.

3.1.3 Operations and Maintenance

The non-federal sponsor will conduct periodic inspections at each elevated or floodproofed structure. Required repair or maintenance would be conducted on a structure-by-structure basis and would be negligible. It is anticipated that any required maintenance be similar to home or building renovation.

3.2 Nature-based Solutions

The NBS consist of augmenting sediment supply to seven strategic and saltmarshes projected to degrade due to sea level change, while avoiding converting the marsh tidal regime/elevation (e.g., low marsh would not be converted to high marsh and high marsh would not be converted to upland) (see Table 1 and Figure 3). These seven marsh complexes were identified as having clear potential CSRM benefits, as well as several factors that support constructability within the near future. Additional information on the formulation of NBS is provided in Appendix G.

Table 1. Proposed Nature-Based Solutions Locations, Size, and Estimated Sediment Need

Marsh Maintenance Candidate		**Est Acres**	**Estimated Cumulative Sediment Amount (CY)**
Lacey/Sunrise Beach	(-74.152941°, 39.836079°)	26	63,000
Waretown/Upper Barnegat	(-74.191295°, 39.769090°)	12	30,000
East Marsh Elder	(-74.236227°, 39.579067°)	7	6,000
Parker Island	(-74.245257°, 39.570439°)	5	4,000
Mystic Island Preserve	(-74.371060°, 39.545776°)	79	64,000
Tuckerton Beach	(-74.328494°, 39.577697°)	29	24,000
Sea Isle City	(-74.690486°, 39.165470°)	59	50,000
Total		217	241,000

Future without project conditions in the Main Report illustrate significant marsh loss across the study area associated with sea level change and other sources of erosion (e.g., waves). DMPFs and shoaling in maintained navigation channels represent a significant supply of leverageable sediment to nourish the strategic marsh complexes. Traditional navigation channel dredging and placement/spraying on the marsh will also be used.

A complete discussion of the NBS strategy can be found in the Nature-Based Solutions Appendix (Appendix G).

3.2.1 Pre-construction

Prior to construction of NBS, investigations may include wetland characterizations or delineations, subsurface geotechnical investigations, HTRW sampling, and Submerged aquatic vegetation (SAV) mapping. If needed, sediments to be used within the saltmarshes will be tested for contaminants and determined to be acceptable for beneficial use placement within the local system prior to implementation in accordance with New Jersey criteria to meet sediment quality objectives appropriate for these uses. If it is determined that a potential conflict with SAV exists, SAV would be mapped near NBS sites. These investigations are currently being developed.

USACE has previously characterized many of the DMPFs proposed for sediment mining as suitable candidates in past Environmental Restoration studies along the NJIWW in the 2000s, although additional sediment suitability characterization would be required going forward. If sediments in a DMPF are not suitable for reuse in a habitat restoration project, they would not be used.

3.2.2 Construction

While the following describes construction of the NBS, construction methods will be further refined and optimized to each site.

Construction of the NBS require significant amounts of fill material. Dredged material obtained from existing DMPFs and existing navigation channels will be used to augment the marshes at the NBS sites. The selected NBS marsh sites would be maintained through the strategic placement of dredged material. If the need for dredging Federal, State, or local navigation channels, does not align with these placements, sediment would originate from formerly dredged materials placed in upland DMPFs along the NJBB study area. Sediment within these DMPFs will be hydraulically mined or transported by scow or truck. For scow or truck, backhoes would mine and place material. For hydraulic pumping, backhoe or eductor systems would be used to combined dried sediment with water to create a pumpable slurry and transferred via high-solids pumps to the target locations via pipeline (and or scow if necessary). The water source for the slurry would be obtained from within nearby tidal waterways. Temporary moorings would be installed as necessary.

Methods to transport sediment to each NBS site are provided in Table 2. Considerations for Transporting Sediments to NBS Sites. It is assumed that permanent docks and roads would not be constructed. If it is necessary to access marshes with vehicles or pipelines, marsh buggies and mats would be used to minimize impacts. Temporary impacts to marshes would be restored to the maximum extent possible.

Table 2. Considerations for Transporting Sediments to NBS Sites

Marsh Maintenance Candidate	Source Note	Direct Distance (miles)	Approx. Waterway Distance (mi)	Approx. Road Distance (mi)	Crossed within Direct Distance	Potential Placement Method
Lacey/Sunrise Beach	Oyster Creek total quantity affects share between this and Waretown	2.5	4.4	5	Communities to avoid in between. Scow may be easier than pipeline cross.	Scow or Truck, then Re-fluidize sediments at Site
Waretown/Upper Barnegat	Oyster Creek total quantity affects share between this and Lacey/Sunrise Beach	3	3	4.2	Roads/Marsh or Communities or Water	Scow or Truck, then Re-fluidize sediments at Site
E. Marsh Elder Island	DMPF Source on Same Island	0.2	0.2	NA	Marsh	Direct Re-fluidize sediments and pipe
Parker Island	DMPF Source on Same Island	0 or 1	0 or 1	NA	Marsh	Direct Re-fluidize sediments and pipe
Tuckerton Beach	DMPF within mile as well (but assumed that goes to Mystic Island Preserve)	1.6 or 0.7	1.6 / 0.7	NA or 5	Water	Scow, then Re-fluidize sediments at Site
Mystic Island Preserve	Nearest sources north across marsh peninsula, complicate access	2.5	13.5	4.2	Significant Area of Marsh/marsh tributaries	Pipeline or Truck
Sea Isle City	DMPF Immediately Next to Placement Site	0.5	0.5	NA	Marsh	Direct Re-fluidize sediments and pipe

Strategic placement will occur approximately three times per placement site across the project period (50-year span), with those sites in more microtidal zones possibly requiring additional lifts. The approach would be to place material centrally on the marsh platform target areas across multiple lifts. The approach of several placements is designed to provide continued sediment supply (i.e., augmentation of accretion rates), while leveraging the natural accretion. These actions assume that plan implementation will begin prior to such significant marsh degradation that sediment augmentation is no longer enough to maintain the NBS sites. Placing through time avoids converting the tidal elevation regimes of the targeted marshes and thereby requiring additional mitigation for the implementation of the NBSs themselves for the conversion of upland.

Sediment would be piped or sprayed to a depth of 2 to 4 inches over the marsh complex (i.e., an average cumulative rate of 800-1,000 cubic yards per acre). This would occur 2 to 3 times between 2030 and 2080 for most marsh complexes. A total of approximately 0.5 feet of material would be placed on most marsh complexes over the 50 years. Monitoring would occur during construction. Two northern Barnegat Bay (Lacey/Sunrise Beach and Waretown/Upper Barnegat) sites would require approximately 18 inches of material, which would be placed during 4 placements over the 50 years. Coir logs may be used to maintain sediments on the marsh platform. Site-specific containment and shoreline enhancement needed to maintain placement will be designed in the next phase of the study.

Vegetation in the DMPFs, most likely Phragmites, would be treated prior to use so the potential for spreading invasives is minimized. In general, the material will be fluidized in the DMPF using water pumped from the nearby navigational channel. The dried sediments and water would be mixed with a longreach backhoe or eductor system. The slurry could be pumped from the DMPF and piped over the marsh, using a high solids pump (similar to a hydraulic dredge). A bobcat/marsh buggy may also be used in the DMPF. Construction activities in the DMPF may include clearing, grading, excavations, and backfilling.

Other construction activities may also include temporary excavations, and wetland/upland vegetation planting.

3.2.3 Operation and Maintenance

There is no operation or maintenance associated with NBS. However, given that this plan is formulated based on periodic sediment placements (3 to 4 times over 50 years), a monitoring and adaptive management plan is appropriate. Over a 50-year period, monitoring of marsh vegetative vigor, coverage, and elevations would be conducted every five to ten years to ensure that the marsh platform is functioning for CSRM purposes and to monitor resilience at the placement site.

An adaptive management and monitoring plan will be developed and implemented for the NBS. Survey results from pre-construction, construction, and post-construction surveys will provide information about opportunities to apply adaptive management to future placements at the seven selected sites and at other estuarine saltmarshes with comparable hydrodynamic and morphologic conditions.

3.2.4 Measures to Avoid and Minimize Effects on Fish and Wildlife

The following measures would be implemented during construction of NBS, to the maximum extent practicable, to avoid effects on essential fish habitat and marine species.

- No roads or docks would be constructed for NBS construction. Marsh mats would be used if vehicles need to access marshes for removal of sediments from a DMPF or placement on a NBS site. Temporary moorings would be used as necessary. All temporary structures would be removed after construction and ground/sediment disturbance would be restored to the extent possible.
- Vessels would operate at speeds of less than 10 knots.
- Whenever operating in areas where sea turtles or marine mammals may be present, surrounding waters would be monitored during dredging or vessel operations. If sea turtles or marine mammals are observed, measures would be taken to avoid them.
- SAV surveys would be conducted, if it is deemed necessary to avoid impacts on surrounding SAV.
- Construction of NBS would comply with the seasonal restrictions in Table 3, to the maximum extent practicable.

Table 3. Seasonal Restrictions for NBS construction

Restricted Activity	Time of Year	Resource of Concern
Dredging and placement on NBS in areas south of Absecon Inlet	March 1 -June 30	Peak fish migration
Dredging and placement on NBS in areas north of Absecon Inlet	January 1 – June 30	Winter flounder/peak fish migration

.

4.0 ESSENTIAL FISH HABITAT

EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act, (16 United States Code [U.S.C.] 1802 [10]) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". Regulations further clarify EFH by defining "waters" to include aquatic areas that are used by fish and may include aquatic areas that were historically used by fish where appropriate. A purpose of the act is to "promote the protection of essential fish habitat in the review of projects conducted under federal permits, licenses, or other authorities that affect, or have the potential to affect such habitat". An EFH assessment is required for a federal action that may adversely affect EFH (50 CFR 600.920 [a]). A query of the NMFS EFH mapper, conducted on November 27, 2024, indicates that the EFH for 31 species that the NBS Sites (Table 4).

Habitat Areas of Particular Concern (HAPC) are areas of EFH that are particularly important to the long-term productivity of populations of one or more managed species, or to be particularly vulnerable to degradation (NOAA, 1999a). Submerged aquatic vegetation (SAV) beds in the back bays system are considered HAPC for summer flounder (*Paralicthys dentatus*) in areas within adult and juvenile summer flounder EFH. Specifically, the summer flounder HAPC includes "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations."

Nonstructural measures would have no direct or indirect effects on EFH. Nonstructural measures consist of elevating or floodproofing already existing structures in previously developed upland areas. Nonstructural measures involve a construction effort similar to home renovations or reconstruction, whether it be from building retrofits such as elevation (including raising a structure on fill or foundation elements such as solid perimeter walls, pier, posts, columns, or pilings) or buyout/ relocations that are likely to involve demolition, grading, and soil stabilization/revegetation. The majority of the construction would occur within the footprint of the existing structure or adjacent developed land such as roads and would most likely be in upland urbanized settings. Erosion and sediment control measures would be implemented, so that impacts on adjacent waterbodies would be avoided. Home elevations would comply with all Federal, state, and local environmental requirements. Nonstructural measures would not result in an adverse effect on EFH. Therefore, only the NBS are assessed for potential adverse effects on EFH.

Table 5 provides a summary of descriptions of EFH near the NBS locations. Table 6 provides the time of year eggs and larvae occur at the NBS sites. Several of these species primarily inhabit marine offshore habitats throughout their lives and are not of major concern since they are largely outside of the back bays study area for all or part of their life stages. A large number of the remaining fish species can be found within inshore habitats and estuarine mixing zones during at least part of their life cycle.

Prey species are included in the definitions of EFH and are defined as being a forage source for one or more designated fish species. They are normally found at the bottom of the food web in a healthy environment. Prey species found in the study area estuaries include killifish, mummichogs, silversides and herrings. Actions that reduce the availability of prey species, either through direct harm or capture, or through adverse impacts to the prey species' habitat may also be considered adverse effects on EFH.

Table 4. Species with EFH at the NBS Sites

	NBS						
	Sea Isle	**Mystic Island**	**Tuckerton Beach**	**Parker Island**	**East Marsh Elder Island**	**Waretown/ Upper Barnegat**	**Lacey/ Sunrise**
Managed Species							
Mid-Atlantic Species							
Atlantic butterfish *(Peprilus tricanthus)*	A	A	A	JA	JA	JA	JA
Atlantic mackerel (*Scomber scrombrus*)						E	E
Atlantic surfclam *(Spisula solidissima)*							JA
Black sea bass *(Centropristus striata)*	JA	JA	JA	JA	JA	JA	JA
Bluefish *(Pomatomus saltatrix)*	JA	JA	JA	JA	JA	JA	JA
Lonfin inshore squid *(Loligo pealei)*	EJA	EJA	EJA	EJA	EJA	EJA	EJA
Scup *(Stenotomus chrysops)*	J	J	J	JA	JA	J	JA
Spiny dogfish *(Squalus acanthias)*	JA	JA	JA	JA	JA	JA	JA
Summer flounder *(Paralicthys dentatus)* **HAPC potentially occurs within 150 ft of NBS location*	LJA*	LJA*	LJA*	LJA*	LJA*	LJA*	LJA*
New England Species							
Atlantic herring *(Clupea harengus)*	JA	JA	JA	JA	JA	JA	JA
Atlantic cod *(Gadus morhua)*							E
Ocean pout *(Macrozoarces americanus*)				EA	EA		
Windowpane flounder *(Scopthalmus aquosus)*	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA
Winter flounder (*Pleuronectes americanus*)** ***EFH for winter flounder does not occur south of Lat 39°22' N (below the squares 8,9,10).*		ELJA**	ELJA**	ELJA**	ELJA**	ELJA**	ELJA**
Yellowtail flounder (*Limanda ferruginea*)							E
Silver hake/whiting (*Merluccius bilinearis*)				EL	EL		EL
Red hake *(Urophycis chuss)*				ELJ	ELJ		ELJA
Monkfish *(Lophius americanus)*							EL
Little skate (*Raja erinacea*)	JA	JA	JA	JA	JA	JA	JA
Winter skate (*Raja ocellata*)	JA	JA	JA	JA	JA	JA	JA
Clearnose skate (*Raja eglanteria*)	JA	JA	JA	JA	JA	JA	JA
Highly Migratory Species							
Bluefin Tuna (*Thunnus thynnus)*							J
Skipjack Tuna (*Katsuwonus pelamis)*	A		A	A	A	A	A
Yellowfin Tuna (*Thunnus albacares*)				J	J		
Shark Species							
Sand tiger shark *(Carcharias taurus)* ****HAPC not designated near NBS locations*	NJ		NJ	NJ		NJ	
Common thresher shark (*Alopias vulpinus)*	NJA		NJA	NJA	NJA	NJA	NJA
Dusky shark *(Charcharinus obscurus)*	N		N	N	N	N	
Sandbar shark *(Charcharinus plumbeus)* *****HAPC not designated near NBS locations*	NJA		NJA	NJA	NJA	NJA	NJ
Smoothhound shark *(Mustelus mustelus)*	NJA		NJA	JA	NJA	NJA	NJA
Tiger shark *(Galeocerdo cuvieri)*	JA			JA	JA	JA	JA
White shark *(Carcharodon carcharias)*				N	N		
E = eggs, L = larvae, J = juvenile, A = adult, N = neonate							

Table 5. Descriptions of EFH at NBS Sites

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Atlantic butterfish *(Peprilus tricanthus)*	*	*	Pelagic waters in 10 – 360 m, water temperatures between 3°C and 28°C, and a salinity range of 3 to 37%.	Pelagic waters, water depths between 10 and 365 meters, water temperatures between 3°C and 28°C, and a salinity range of 4 to 26%. **Prey:** Jellyfish, crustaceans, worms, small fish
Atlantic mackerel (*Scomber scrombrus*)	pelagic in waters with salinity >34%	*	*	*
Atlantic surfclam (*Spisula solidissima*)	*	*	benthic; fine to medium sands in turbulent waters; throughout bottom sandy substrate to 3' in depth from beach zone to 60 m; sensitive to low DO	benthic; fine to medium sands in turbulent waters; throughout bottom sandy substrate to 3' in depth from beach zone to 60 m
Black sea bass (*Centropristus striata*)	*	*	Demersal waters over rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas	Demersal waters over structured habitats (natural and man-made), and sand and shell areas **Prey:** Benthic and near bottom invertebrates, small fish, squid
Bluefish (*Pomatomus saltatrix*)	*	*	Pelagic waters of continental shelf and in Mid Atlantic estuaries from May-Oct. **Prey:** Squid, smaller fish	Pelagic waters; found in Mid Atlantic estuaries April – Oct. **Prey:** Squid, smaller fish
Longfin inshore squid *(Loligo pealeii)*	Egg masses are demersal in polyhaline waters <50 m in depth and 10-23°C, and are commonly found attached to rocks and small boulders on sandy/muddy bottom and on aquatic vegetation.	*	Pre-recruits (unexploited, $\leq$ 8 cm) are pelagic, and inhabit upper 10 m at depths of 50-100 m on continental shelf. Pre-recruits are found in coastal inshore waters in spring-fall, offshore in winter when water temperatures are 10 - 26° C. Exhibit diel migrations - move up at night and down during the day.	Adult recruits (exploited, $\geq$ 9 cm) are demersal during the day, and pelagic at night, and inhabit the continental shelf and upper continental slope in seasonally variable depths to depths of 400 m. Adults may occur in depth of 110-200 m in the spring, but may migrate to inshore waters as shallow as 6 m in the summer and autumn. In the winter, adults migrate offshore to depths of 365 m.

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
			Prey: euphausiids, arrow worms, small crabs, polychaetes and shrimp	**Prey:** fish (silver hake, mackerel, herring, menhaden, sand lance, bay anchovy, weakfish, and silversides) and other squid larvae/juveniles.
Scup (Stenotomus chrysops)	*	*	Demersal, prefer sands, mud, mussel, and eelgrass beds; present in spring and summer in estuaries and bay; water depths to 38 m **Prey**: bottom feeders – polychaetes, amphipods, small crustaceans, mollusks, fish eggs and larvae	Demersal waters offshore from spring to fall; open sandy bottom to structured habitats such as mussel beds, reefs, or rough bottom; smaller scup in estuaries; larger in deeper waters; some winter offshore from November to April **Prey:** Small benthic invertebrates, insect larvae, small fish
Spiny dogfish (*Squalus acanthias*)	NA	*Neonate	Demersal by day, but may vertically migrate at night to feed. Spiny dogfish prefer muddy/silty and sandy bottoms in polyhaline baymouths and continental slope waters in depths of 1-500 m. **Prey:** Flatfishes, blennies, sculpins, capelin, ctenophores, jellyfish, polychaetes, sipunculids, amphipods, shrimps, crabs, snails, octopods, squids, and sea cucumbers	Demersal by day, but may vertically migrate at night to feed. Spiny dogfish prefer muddy/silty and sandy bottoms in polyhaline baymouths and continental slope waters in depths of 1-500 m. **Prey:** Flatfishes, blennies, sculpins, capelin, ctenophores, jellyfish, polychaetes, sipunculids, amphipods, shrimps, crabs, snails, octopods, squids, and sea cucumbers
Summer flounder (*Paralic Thys dentatus*)	*	Pelagic waters, nearshore at depths of 10 – 70 m, migrate inshore from Oct – May **Prey**: zooplankton, small crustaceans	Demersal waters (mud and sandy substrates); water temperatures greater than 11°C, water depths from 0.5 to 5 m **Prey:** crustaceans, polychaetes, mysid shrimp; larger juveniles - fish	Demersal waters (mud and sandy substrates). Shallow coastal waters (< 25 m) in warm months, offshore in cold months (> 150 m) **Prey:** opportunistic- fish, squid, shrimp, worms
Atlantic sea herring *(Clupea harengus)*	*	*	Pelagic waters and bottom, < 10 C and 15-130 m depths	Pelagic waters and bottom habitats;

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
			Prey: zooplankton (copepods, decapod larvae, cirriped larvae, cladocerans, and pelecypod larvae)	**Prey:** fish eggs and larvae, chaetognath, euphausiids, pteropods and copepods.
Atlantic cod (*Gadus morhua*)	Pelagic in offshore and coastal waters	*	*	*
Ocean pout (*Macrozoarces americanus*)	Demersal in high salinity estuaries and bays; spawn in hard-bottom, protected areas (e.g. rocks)	*	*	Demersal in high salinity waters; mud and sandy bottom with structure; prey - benthic invertebrates, primarily mollusks and crustaceans
Monkfish (*Lophius americanus*)	Surface waters, Mar. – Sept. peak in June in upper water column of inner to mid continental shelf	Pelagic waters in depths of 15 – 1000 m along mid-shelf also found in surf zone **Prey:** zooplankton (copepods, crustacean larvae, chaetognaths)	*	*
Red hake (*Urophycis chuss*)	Surface waters, May – Nov.	Intertidal and sub-tidal benthic habitats on mud and sand substrates with structure or depressions for shelter, May – Dec. **Prey:** copepods and other microcrustaceans under floating eelgrass or algae.	*	*

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Silver hake/whiting (*Merluccius bilinearis*)	Pelagic habitats from the Gulf of Maine to Cape May, New Jersey	Pelagic habitats from the Gulf of Maine to Cape May, New Jersey	*	*
Windowpane flounder (*Scopthalmus aquosus*)	Surface waters <70 m, mixed and high salinity zones; Feb-July; Sept-Nov.	Initially in pelagic waters, then bottom <70m,. May-July and Oct-Nov. **Prey:** copepods and other zooplankton	Bottom (fine sands) 5-125m in depth, in nearshore bays and estuaries less than 75 m **Prey**: small crustaceans (mysids and decapod shrimp) polychaetes and various fish larvae	Bottom (fine sands), peak spawning in May , in nearshore bays and estuaries less than 75 m **Prey**: small crustaceans (mysids and decapod shrimp) polychaetes and various fish larvae
Winter flounder (*Pseudopleuronectes americanus*)	E**s**tuarine and coastal bottom habitats from the Gulf of Maine to Absecon Inlet (39° 22' N); mud, muddy sand, sand, gravel, macroalgae, and SAV; depths <5m; sensitive to sedimentation	Pelagic, estuarine, coastal, and continental shelf water column habitats from the Gulf of Maine to Absecon Inlet (39° 22' N); Initially pelagic, but become benthic with growth **Prey:** nauplii, harpacticoids, calanoids, polychaetes, invertebrate eggs, and phytoplankton	Estuarine, coastal, and continental shelf benthic habitats from the Gulf of Maine to Absecon Inlet (39° 22' N); mud, sand, rocky substrates with attached macroalgae, tidal wetlands, and eelgrass; young-of-year prefer soft sediments and move to coarser sediments with growth **Prey:** Polychaetes and crustaceans (mostly amphipods) generally make up the bulk of the diet, but also include bivalves, capelin eggs and fish	Estuarine, coastal, and continental shelf benthic habitats extending from the intertidal zone (mean high water) to a maximum depth of 70 meters from the Gulf of Maine to Absecon Inlet (39° 22' N); muddy and sandy substrates, and on hard bottom on offshore banks **Prey**: Polychaetes and crustaceans (mostly amphipods) generally make up the bulk of the diet, but also include bivalves, capelin eggs and fish
Yellowtail flounder (*Limanda ferruginea*)	Coastal and continental shelf pelagic habitats including high salinity zones of bays and estuaries	*	*	*

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Clearnose skate (*Raja egianteria*)	*	*	shoreline to 30 meters, primarily on mud and sand, but also on gravelly and rocky bottom **Prey:** Amphipods, polychaetes, mysid shrimp, crabs, bivalves, squids, small fishes (soles, weakfish, butterfish, scup)	shoreline to 40 meters, primarily on mud and sand, but also on gravelly and rocky bottom **Prey:** Amphipods, mysid shrimp, rock crabs, razor clams, juvenile flounder, croaker and spot
Little skate (*Raja erinacea*)	*	*	Intertidal and sub-tidal benthic habitats in coastal waters extending to a maximum depth of 80 meters, and including high salinity zones in the bays and estuaries. EFH occurs on sand and gravel substrates, but they are also found on mud **Prey:** Benthic macrofauna primarily decapod crustaceans, amphipods and polychaetes	Intertidal and sub-tidal benthic habitats in coastal waters extending to a maximum depth of 80 meters, and including high salinity zones in the bays and estuaries. EFH occurs on sand and gravel substrates, but they are also found on mud **Prey:** Benthic macrofauna primarily decapod crustaceans, amphipods and polychaetes
Winter skate (*Raja ocellata*)	*	*	Sub-tidal benthic habitats in coastal waters from the shoreline to a maximum depth of 90 meters including the high salinity zones of the bays and estuaries. EFH occurs on sand and gravel substrates, but they are also found on mud. **Prey:** Polychaetes and amphipods are the most important prey items in terms of numbers or occurrence, followed by decapods, isopods, bivalves, and fishes	Sub-tidal benthic habitats in coastal waters from the shoreline to a maximum depth of 90 meters including the high salinity zones of the bays and estuaries. EFH occurs on sand and gravel substrates, but they are also found on mud. **Prey:** Polychaetes and amphipods are the most important prey items in terms of numbers or occurrence, followed by decapods, isopods, bivalves, and fishes

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Bluefin Tuna (*Thunnus thynnus*)	*	*	Coastal and pelagic habitats of the Mid-Atlantic Bight and the Gulf of Maine, between southern Main and cape Lookout, from shore (excluding Long Island Sound, Delaware Bay, Chesapeake Bay, and Pamlico Sound) to the continental shelf break; temperatures from 4 to 26°C, water depths range from 40 - 100 m, but typically < 20m **Prey:** zooplanktivorous fish and crustaceans	*
Skipjack Tuna (*Katsuwonus pelamis*)	*	*	*	The skipjack tuna is an epipelagic fish, occurring in waters ranging in temperature from 14.7 to 30°C. While skipjacks remain at the surface during the day, they may descend to depths of 260 m at night. **Prey:** Skipjack tuna are opportunistic feeders, preying on a variety of fish (e.g., herrings), crustaceans, cephalopods, mollusks, and sometimes other skipjack tunas
Yellowfin Tuna (*Thunnus albacares*)	*	*	Offshore pelagic habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau; spawn throughout the year between 15°N lat. and 15° S lat. (Gulf of Mexico, waters of southern Florida, Caribbean) **Prey**: Opportunistic; including cephalopods, fish, and crustaceans	*
Common thresher shark (*Alopias vulpinus*)	*	**Neonate:** Shallow coastal waters	Shallow coastal waters	Shallow coastal waters
Dusky shark (Charcharinus obscurus)	*	Shallow coastal waters	*	*

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Sandbar shark (Charcharinus plumbeus)	*	Shallow coastal waters; migrate to warmer waters in the fall; return to natal grounds as juveniles for the summer	Shallow coastal waters; water temperatures ranging from 15 to 30°C, salinities at least from 15 to 35 ppt, and water depth ranging from 0.8 to 23 m in sand, mud, shell and rocky habitats; migrate to warmer waters in the fall	Shallow coastal waters, inland waters of Delaware Bay; bottom-dwelling most common in 20 - 55 m; pregnant females in the study area between late spring and early summer, give birth and depart
Smoothhound shark (*Mustelus mustelus*)	*	**Neonate:** Shallow coastal waters	*	*
Tiger shark (Galeocerdo cuvieri)	*	*	Shallow coastal waters to the 200-meter isobath	Shallow coastal waters to the 200-meter isobath
White shark (Carcharodon carcharias)	*	**Neonate:** Inshore and offshore waters from Cape May, MA to Ocean City, NJ	*	*

*EFH for this lifestage not designated near NBS sites. NA = Not Applicable

Table 6. Time of Year Eggs or Larvae Potentially Occur at NBS Sites

Species and Lifestage with EFH at NBS Sites	J	F	M	A	M	J	J	A	S	O	N	D	Notes
Atlantic Mackerel **(Eggs - Lacey, Waretown)**													EFH Source Documents Figures 9 and 10.
Longfin Squid **(Eggs - All NBS Sites)**													EFH Source Document page 2. - eggs demersal
Summer Flounder **(Larvae - All NBS Sites)**													EFH Source Document Figures 14, 15, Stone et al. 1994, shows larvae as rare in Barnegat and NJ Inland Bays.
Atlantic Cod **(Eggs - Lacey Only)**													EFH Source Document Figures 5 and 7 -expected to be rare
Ocean Pout **(Eggs - Parker Island, East**													EFH Source Document Table, spawning and eggs on continental shelf, GOM to NYB

Marshe Elder Island)													and New England estuaries. Eggs demersal, data sparse.
Windowpane Flounder **(Eggs/Larvae - All NBS sites)**													EFH Source Document, page 2 larvae, spring spawned in estuaries, fall - on shelf - demersal, unlikely to occur in NJ inland bays
Winter Flounder **(Eggs/Larvae - All NBS sites, except Sea Isle)**													Mid-Atlantic Estuaries and current seasonal restriction - eggs are demersal and adhesive
Yellowtail Flounder **(Eggs - Lacey Only)**													EFH Source Document, page 3 "Yellowtail flounder are rare in most estuaries."
Silver Hake/Whiting **(Eggs/Larvae = Parker Island, East Marsh Elder Island, Lacey)**													EFH Source Document Table 3 (shows no eggs in estuaries south of Montauk and no larvae in estuaries south of Block Island) and Table 5 (no data for study area).
Red Hake **(Eggs/Larvae - Parker Island, East Marsh Elder Island, Lacey)**													EFH Source Document page 5 does not include NJ estuaries for eggs or larvae. Stone et al. 1994, eggs and larvae not expected in Barnegat Bay or NJ Inland Bays.
Monkfish **(Eggs/Larvae - Lacey Only)**													EFH Source Document Eggs in mucuous veil in upper part of water column. Reported in open coastal bays in low numbers (p. 5). Larvae on shelf and rarely inshore (p.5).

Notes: Yellow cells indicate when the eggs or larvae are expected to be present at the NBS Sites. Diagonal line indicates that eggs or larvae are expected to be rare for the reasons provide under notes.

5.0 EXISTING ENVIRONMENT (EFH IN THE STUDY AREA)

The following sections describe the existing habitat throughout the study area. Relevant information pertaining specifically to NBS sites is discussed at the end of each subsection as appropriate.

5.1 Wetlands

"Wetland Habitats" include intertidal saltmarsh, scrub shrub marshes, and supratidal wetlands. Scrub shrub marshes include estuarine and palustrine deciduous and coniferous scrub shrub. Intertidal saltmarshes include high and low saltmarshes. Supratidal marshes are occasionally inundated by exceptionally high spring tides or by tides that are extremely high due storm surge and include palustrine and estuarine emergent marshes (herbaceous wetlands), disturbed wetlands, managed wetlands, and phragmites-dominated marshes.

Intertidal habitat occurs between the high and low tide lines and is subject to daily tidal fluctuations. Intertidal substrates within the study area are primarily sand and mud. Subtidal habitat includes the waters seaward of the low tide, meaning the substrate, primarily sand and mud, is constantly inundated. Rip rap and other hardened manmade structures can also provide intertidal habitat, but natural hard structures are uncommon in the study area. Intertidal mudflats or sand flats often border saltmarsh habitats, pocket beaches along developed shorelines, or locations where either erosion or marsh dieback has removed vegetation or depositional shoals have formed in areas that were previously subtidal. Natural structure habitat (such as rocky outcrops and boulders) is expected to be uncommon in the action area. Riprap and other hardened manmade structures occur in intertidal zone. Intertidal habitats are often rich in benthic food sources available to wading birds and shorebirds that forage at low tide.

These habitats are principally associated with backwater sound and bay areas such as Richardson Sound and Grassy Sound, Great Sound, Jenkins Sound, Townsend Sound, Corson's Sound, Great Egg Harbor, Peckman Bay, Lakes Bay, Absecon Bay, Great Bay, Little Bay, Little Egg Harbor, and Barnegat Bay. In addition, nearshore and intertidal habitats are present within various channels and thoroughfares.

Subtidal habitats are always inundated and subtidal substrates within the study area are primarily sand and mud. Other than SAV, natural structure habitat (such as rocky outcrops and boulders) is expected to be uncommon in the action area. Rip rap and other hardened manmade structures occur in subtidal zone. Nearshore waters are strongly influenced by weather and the adjacent high-energy sandy beach which influence sediment transport. Along beach areas, shifting sands and pounding surf affect the available habitat. Subtidal benthic habitats occur within the footprints of all storm surge barriers, bay closures, and perimeter plans.

Shellfish habitats are located throughout the intertidal and subtidal study area, which include beds containing hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), and eastern oysters (*Crassostrea virginica*). Other notable benthic invertebrates common to estuarine and marine habitats within the New Jersey coast include mollusks such as bay scallop (*Aequipecten irradians*), hard clam, common blue mussel (*Mytilus edulis*), moon snail (*Lunatia heros)*, and knobbed whelk (*Busycon carica)*; crustaceans such as common rock crab (*Cancer irroratus*), blue crab (*Calinectes sapidus*), snapping shrimp (*Crangon septemspinosa*), and grass shrimp (*Palaemontes spp*.); and sea stars (*Asterias forbesi*), which are echinoderms. The horseshoe crab (*Limulus polyphemus*) is a common, yet important, invertebrate inhabiting the New Jersey Back Bays and nearby Atlantic Ocean waters, and is notable for pharmaceutical applications, and their eggs are a critical food source for the red knot migratory shorebirds. Benthic macroinvertebrates such as marine worms, mollusks and amphipods also live in nearshore waters and may provide prey for Atlantic sturgeon. Tunicates may provide prey for sea turtles.

Coastal wetlands can adapt and keep pace with sea level change through vertical accretion and inland migration, but must remain at the same elevation relative to the tidal range and have a stable source of sediment. Under intermediate and high sea level change scenarios, marsh accretion at a rate of 4 mm per year would not keep pace with sea level change. Estuarine wetlands may transition to another habitat type such as brackish wetlands, palustrine emergent wetlands, unconsolidated shore, or open water.

In the future without the project during the 2030 – 2080 study period, estuarine wetlands in the study area are projected to decrease by approximately 12,000 acres and 95,700 acres under the intermediate and high sea level change scenarios, respectively. This loss is accompanied by increases other habitat types. Under the intermediate and high sea level change scenarios:

- Brackish water wetlands would increase by approximately 7,400 acres and 7,000 acres, respectively.
- Palustrine emergent wetlands would increase by approximately 280 acres and 220 acres, respectively.
- Unconsolidated shoreline is also expected to increase by approximately 17,500 acres and 72,300 acres under the intermediate and high sea level change scenarios, respectively.
- Open water habitat is projected to increase by approximately 6,700 acres under the intermediate sea level change scenario and 51,700 acres under the high sea level change scenario.

In response to sea level change, intertidal habitats could experience increased inundation and/or their tidal regimes could change from intertidal to subtidal. Some habitats may transition to unconsolidated shoreline. Distributions of intertidal and subtidal shellfish beds could change in New Jersey Back Bays in response to changing sea levels and habitats.

Habitat at the NBS sites is currently predominantly saltmarsh, which some unconsolidated shore (i.e., mudflat). Table 7 provides more detail on the existing habitat in the NBS saltmarshes. In the future without the project, habitat in the NBS sites is expected to convert to mudflat and open water. Table 8 provides more detail on the habitat in the NBS saltmarshes in the future, without the project. In general, SLR would result in decreases in saltmarsh habitat with a conversion to unconsolidated shore, mudflats, and open water.

Table 7. Existing Habitat in the NBS Satlmarshes

NBS	**Saltmarsh (acres)**	**Unconsolidated Shore (mudflat) (acres)**	**Open Water (acres)**
Sea Isle City	60.07	6.77	3.5
Mystic Island	90.43	0	1.94
Tuckerton Beach	29.61	0	0
Parker Island	3.97	0	0
Marsh Elder Island	5.79	0	0.34
Waretown/Upper Barnegat	11.71	0	0
Lacey/Sunrise Beach	26.2	0	0

Table 8. Habitat in the NBS Saltmarshes in the Future without the Project

NBS	Saltmarsh (acres)	Unconsolidated Shore (mudflat) (acres)	Open Water (acres)
Sea Isle City	50.33	15.13	4.88
Mystic Island	2.71	85	2.72
Tuckerton Beach	4.71	23.37	1.53
Parker Island	0.86	3.92	0.05
Marsh Elder Island	0.24	5.26	0.63
Waretown/Upper Barnegat	0	0.12	11.59
Lacey/Sunrise Beach	0	0	26.2

5.2 Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) are rooted vascular flowering plants that exist within the water column and are exposed to sunlight in subtidal waters (below the low tide line) of the study area. SAV provide important food and cover resources for a variety of species including threatened and endangered sea turtles, small fish, shellfish, and other invertebrates.

SAV habitats are among the most productive ecosystems in the world and perform a number of irreplaceable ecological functions which range from chemical cycling and physical modification of the water column and sediments to providing food and shelter for commercial, recreational, as well as economically important organisms (Stephan and Bigford, 1997). Larvae and juveniles of many important commercial and sport fish such as bluefish, summer flounder, spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogonias undulatus*), herrings (Clupeidae) and many others appear in eelgrass beds in the spring and early summer (Fonseca et al, 1992 as reported in NMFS, 2016).

Studies from the lower Chesapeake Bay found that SAV beds are important for the brooding of eggs and for fishes with demersal eggs, and as habitat for the larvae of spring-summer spawners such as anchovies (*Anchoa* spp.), gobies (*Gobiosoma* spp.), weakfish and silver perch (*Bairdiella chrysoura*) (Stephan and Bigford 1997 as reported in NMFS, 2016). Heckman and Thoman (1984) concluded that SAV beds are also important nursery habitats for blue crabs. According to Perterson (1982), in Kentworthy (1988) (as reported in NMFS, 2016) shallow dwelling hard clams may be protected from predation by the rhizome layer of seagrass beds.

SAV beds exist in localized areas of the New Jersey Back Bay estuarine system. Figure 7 through Figure 10 depict available mapping of SAV beds near the NBS. All seven NBS saltmarsh placement sites in Upper Barnegat Bay and Little Egg Harbor are within 150 m of current or historic SAV beds.

Figure 7. Available SAV mapping near the Lacey/Sunrise Beach NBS Site

Figure 8. Available SAV mapping near the Waretown/Upper Barnegat Site

Figure 9. Available SAV mapping near the Marsh Elder Island and Parker Island NBS sites

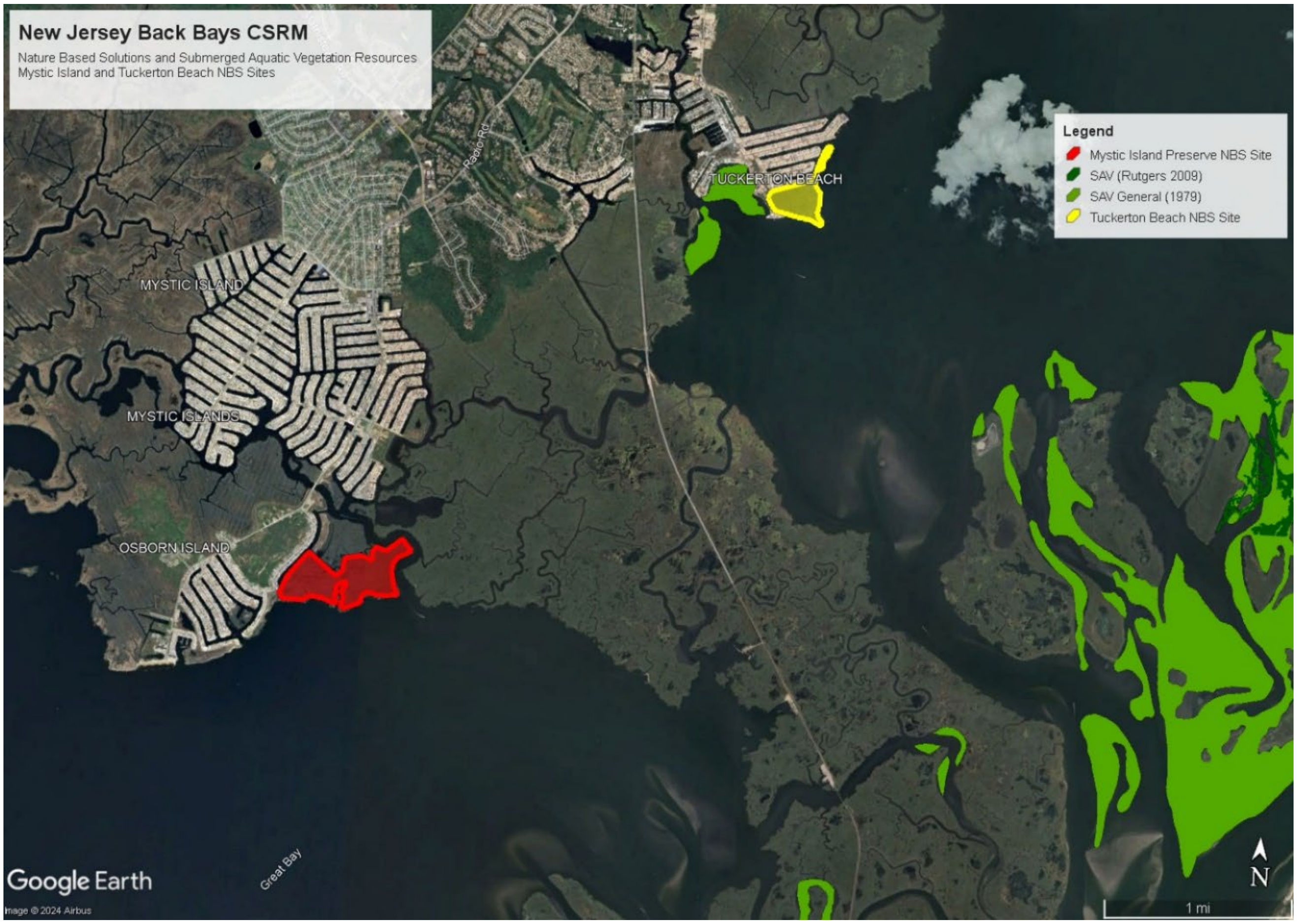

Figure 10. Available SAV mapping near the Mystic Island and Tuckerton Beach NBS sites

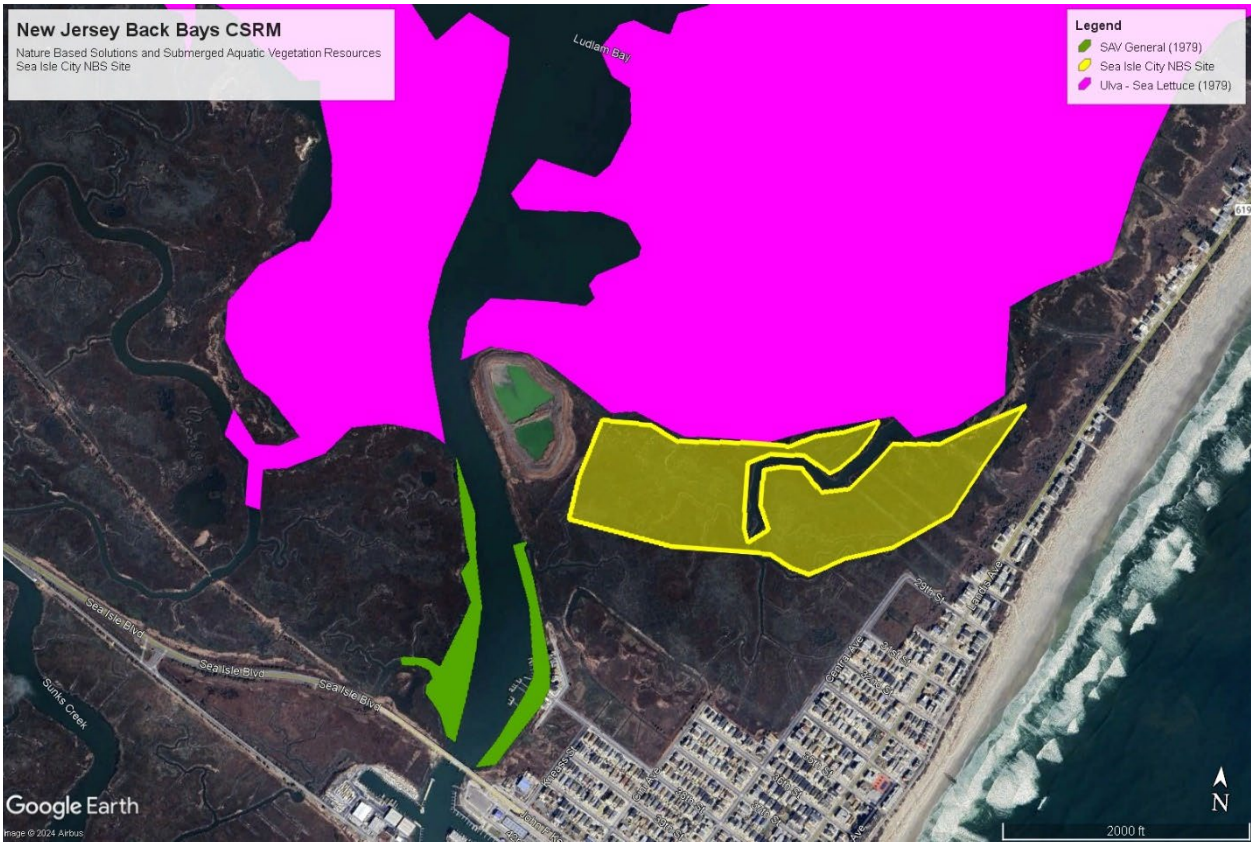

Figure 11. SAV and Sea Lettuce Near the Sea Isle City NBS site

The Barnegat Bay – Little Egg Harbor Estuary have the most extensive beds and account for nearly 75% of the beds in New Jersey (Kennish et al. 2010). The most important species of SAV in New Jersey is eelgrass (*Zostera marina*), which is also the most common SAV that can form extensive beds important for fish, shellfish and other wildlife species. Other species of submerged vegetation found in the more brackish waters of the estuary that are also of ecological importance include widgeon grass (*Ruppia maritima*) and other more freshwater and slightly brackish species of pondweeds (*Zanichellia palustris* and *Potomogeton* spp.) and wild celery (*Vallisneria americana*) as reported in the Great Egg Harbor River, Tuckahoe River, Patcong Creek, and the Mullica River (USFWS, 1997). As discussed in Section 4.1 SAV is designated as a HAPC for juvenile summer flounder.

5.3 Benthic Habitats

Benthic habitats near the NBS sites are expected to be primarily soft sediments (e.g., sand, silt, mud). All NBS sites are within 150 m of a NJDEP-mapped shellfish bed. Table 9 presents the mapped shellfish beds associated with each NBS site.

Table 9. Shellfish near the NBS Locations.

NBS Sites	Shellfish Mapping within 150 m of Site
Sea Isle City (-74.690486°, 39.165470°)	-1963 Hard clam high commercial value
Mystic Island (-74.371060°, 39.545776°)	-1963 Hard clam moderate commercial value -1963 Oyster seed production area -1988 Hard clam occurrence -2023 Cape Horn Aquaculture Lease lots (18) -2023 Cape Horn Lease Exclusion Area
Tuckerton Beach (-74.328494°, 39.577697°)	-1963 Hard clam moderate commercial value -1963 Hard clam recreation value -2011 Hard clam occurrence -2023 Gaunt Point Aquaculture lease lots (2) -2023 Kings Grant Exclusion Area
Parker Island (-74.245257°, 39.570439°)	-1963 Hard clam moderate commercial value -2011 Hard clam occurrence
Marsh Elder Island (-74.236227°, 39.579067°)	-1963 Hard clam moderate commercial value -2011 Hard clam occurrence -2023 Marsh Elder Island Aquaculture lease lots (2)

Waretown/Upper Barnegat (-74.191295°, 39.769090°)	-1963 Hard clam moderate commercial value -1963 Scallop production area -1986 Hard clam moderate density -1986 Hard clam occurrence -2012 Hard clam moderate density -2012 Hard clam low density
West Barnegat Lacey Twp. (-74.152941°, 39.836079°)	-1963 Hard clam recreation value -1986 Hard clam moderate density -2011 Hard clam moderate density -2023 Forked River Title 50 Lease Exclusion Area (approximately 1,600 feet from site)

5.4 Estuarine Open Waters

Estuarine open waters in the study area include Richardson Sound and Grassy Sound, Great Sound, Jenkins Sound, Townsend Sound, Corson's Sound, Great Egg Harbor, Peckman Bay, Lakes Bay, Absecon Bay, Great Bay, Little Bay, Little Egg Harbor, and Barnegat Bay and various channels and thoroughfares, present throughout the study area. The estuarine open waters of the New Jersey back bays provide EFH.

Water quality is a primary determinant of habitat quality for fish and wildlife. Water quality within the coastal waters of the New Jersey Atlantic Coast was comparable to that of similar coastal water bodies along the New York Bight and was indicative of similar coastal tidal river and estuary complexes along the Mid-Atlantic coast (USFWS, 1997). In 2017, the coastal waters and estuaries of NJ were generally good for recreation and shellfish harvesting (NJDEP 2017). However, there remain some areas where dissolved oxygen does not meet water quality criteria, which is a concern relative to aquatic life support particularly in Barnegat Bay.

Water quality in this coastal region is dependent largely on the influence of the major coastal freshwater rivers that flow into the bays that make up the study area reaches (e.g. the Mullica River empties in the Great Bay). Other factors that influence water quality over time include tides, time of year, ocean current fluctuations, nutrient enrichment, water depth, biotic communities, and other temporal and spatial variables. The results of prior studies conducted on the bays and estuaries within the study area indicate that the water quality has historically been impacted by pollutants such as nutrients, pathogens, heavy metals (cadmium, lead, and zinc) and fecal coliform bacteria. (USACE, 1998; BBEP, 2001; Zimmer and Groppenbacher, 1999). As a result, fish and wildlife habitat has been degraded in many areas relative to historical pre-developed conditions. In recent years, however, improvements in water quality have been seen in the region resulting from implementation of the Clean Water Act, and state programs such as discharge permitting programs, coupled with improvements in wastewater treatment technology.

The back bays generally exhibit lower mean salinities and higher water temperatures than the ocean. The lower salinities reflect the stronger influence of ocean dynamics on water within these bays as opposed to adjacent rivers which are more distant from the ocean. Warmer mean water temperatures in the back bays result from greater heating capability owing to shallow water depth, productivity, mixing, and influx of freshwater which may be warmed by seasonal shifts in sun strength, predominant winds, weather, and ambient air temperature. Summer water temperatures along New Jersey coastal waters averages between 20°C and 30°C throughout most of the coastal waters. During winter months the average water temperature ranges from 0°C and 10°C (Zimmer and Groppenbacher, 1999).

Turbidity is a measure of the clarity of the water column, which is a function of suspended particles (Thurman, 1975) and is recorded as nephelometric turbidity units (NTUs). Turbid (cloudy) water can be caused by natural conditions (e.g., tidal flushing and resultant suspension of sediments), water from aquifer formations that is naturally elevated in total dissolved solids, or human activities, such as the release of suspended particles in urban runoff or wastewater discharges into the river. As a general trend, turbidity is somewhat lower in the winter months when biological productivity is lowest (Zimmer and Groppenbacher, 1999). Conversely high phytoplankton biomass and production during the warmer months of the year contribute to elevated turbidity readings. Other factors that may influence turbidity over the short term include storms, wind, and rain supplying energy that causes erosional processes that entrain suspended particles. Turbidity is also often elevated in areas near the mouth of estuaries, where tidal action and river flows result in great mixing.

Dissolved oxygen is one of the most important water quality parameters, as most biota cannot survive without adequate DO levels. Dissolved oxygen concentrations in the water column are influenced by temperature, photosynthesis, respiration of aquatic life, aeration from physical processes, amount of organic matter, and pollutant inputs (USEPA, 1986). Generally, DO is highest in the winter months and lowest in summer months (Zimmer and Groppenbacher, 1999), as its solubility increases when temperature decreases. DO can vary greatly over time within a specific area due to changes in presence of other nutrients that stimulate productivity. Furthermore, DO is highly dependent on salinity as the latter affects the solubility of oxygen in water.

The level of nutrients currently measured in coastal waters as a measure of non-point source pollution is among one of the higher priority management issues for the state and federal agencies (CBP, 2002). Two major nutrients (nitrogen and phosphorus) are monitored in water quality studies, although they may take many forms. Nitrogen is always present in aquatic systems although it exists in many forms simultaneously as ammonia (NH_4^+), nitrate (NO_3^-), nitrite (NO_2^-), and urea. The availability of the various nitrogen compounds generally influences the variety, abundance, and nutritional value of aquatic plants and eventually animals in an aquatic system.

Many of New Jersey's coastal waters experience high nutrient loadings that negatively impact water quality and biotic communities. For example, high nutrient inputs (especially nitrogen) can lead to a variety of adverse conditions that can severely impact the water quality of an estuary (BBEP, 2001). These include increased algal biomass and production, toxic or nuisance algal blooms, elevated turbidity, loss of SAV, exhausted DO levels, and a decline in biodiversity.

Kennish (2010) describes that the "nutrient enrichment of the Barnegat Bay-Little Egg Harbor Estuary is closely linked to a series of cascading environmental problems, notably increased growth of phytoplankton and benthic macroalgae (including both harmful and nuisance forms), loss of SAV, and declining shellfish resources. These problems have also led to deterioration of sediment and water quality, loss of biodiversity, and disruption of ecosystem health and function. Human uses of estuarine resources have also been impaired."

Poor flushing (i.e., water exchange) and long residence times (i.e., length of time a parcel of water will remain in a water body) could result in the retention of nutrients longer in the system, which could lead to higher primary production rates, making waters more susceptible to eutrophication. Whereas, well-flushed estuaries demonstrate greater resilience to nutrient loading attributed to reduced residence time and greater exchange with less impacted coastal waters (Lancelot and Billen, 1984 as cited in Defne and Ganju, 2015). Barnegat Bay and Little Egg Harbor estuaries are the most studied concerning hydrodynamic modeling and residence times where Guo and Lordi (2000) estimated an average residence time at Barnegat Inlet based on velocity and salinity as occurring between 24 and 74 days (depending on season). Defne and Ganju (2015) performed systemic modeling using a combination of hydrodynamic and particle tracking modeling of the Barnegat Bay and Little Egg Harbor estuaries to determine a mean residence time of 13 days, but ranged between 0 and 30 days depending on the initial particle location. This modeling also demonstrated that there is a pronounced northward subtidal flow from Little Egg Inlet in the south towards Point Pleasant Canal in the north attributed to frictional effects in the inlets. This effect resulted in better flushing of the southern half of the estuary and more particle retention (poor flushing) in the northern estuary.

In the future without project, as other habitats decrease in response to sea level change, estuarine open waters would increase in the study area. Estuarine open waters will experience changes similar to those expected in the open ocean due to climate change (NMFS 2016). These include increases in temperature including associated decreases in dissolved oxygen, ocean acidification, and changes in currents. These changes could change the productivity and species diversity of estuaries, which could in turn influence or changes abundance and distribution of prey of federally managed species, including floating and benthic invertebrates and SAV (NMFS 2016).

All NBS sites are adjacent to estuarine open water. The following NBS sites contain open water:

- Sea Isle City

- Mystic Island
- Marsh Elder Island

5.5 Open Ocean Waters

Open ocean waters occur within the study area, but no NBS project features are planned in open ocean waters. Open ocean waters provide migratory and foraging habitat for many species with EFH in the study area.

Climate change and natural variability have been resulting in changes in the Northeast Shelf Ecosystem over the past 30-40 years and are expected to continue (NMFS 2016). These changes include increases in air and ocean temperatures, and associated ocean acifdification and decreases in dissolved oxygen. These changes can impact organisms such as fish, invertebrates, marine mammals, sea turtles, and marine plants and their habitats. Populations of marine organisms are changing as a result of indirect effects of climate change such as ocean acidification, predator-prey relationships, and shifts in distributions of a large number of species. Specifically, climate change may result in changes such as:

- changes in distribution of diadromous fish benthic and prey habitat,
- changes in the timing of migration cues and streamflow on the migration of diadromous fish and associated effect of the conditions on early life stages
- changes in fish and shellfish productivity (NMFS 2016).

6.0 IMPACTS OF THE TSP ON EFH

The EFH final rule published in the Federal Register on January 17, 2002 defines an adverse effect as: “any impact which reduces the quality and/or quantity of EFH.” The rule further states that: “An adverse effect may include direct or indirect physical, chemical or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts including individual, cumulative, or synergistic consequences of actions.

Direct impacts are either temporary or permanent. For the purposes of this assessment, permanent impacts are assumed to be a permanent (or long-term) loss of a habitat or conversion to another habitat. Permanent losses of habitats may arise from direct displacement of a habitat resulting from construction activities such as filling in an aquatic habitat with permanent fill and/or a structure. This impact could extend horizontally (aerially) and vertically. For purposes of this impact assessment, direct impacts are quantified by the aerial displacement in acres, which includes the vertical water column (if applicable) above an affected substrate.

Temporary direct impacts may occur during construction activities, which may include temporary de-watering, placement of de-watering structures, equipment access fills, temporary dredging, and other habitat disturbances where these disturbances may occur until the cessation of construction activities. In many cases, temporary direct impacts may require restoration such as return to original grades, substrates, vegetation, and implementing best management practices for sediment and erosion control.

Indirect impacts can be fairly complex as they may involve physical, chemical or biological alterations that may not necessarily be immediate or constant but can result in cascading effects through an ecosystem. An example of this could be a physical change in flow patterns that cause a physical change in sediment deposition that results in a different tidal regime (subtidal to intertidal). A change in tidal regime could cause a shift in the benthic community that may affect predator/prey interactions of a higher consumer such as a fish. Indirect impacts are still being evaluated and will be available at a future time.

The measures that make up the tentatively selected plan included non-structural and nature-based solutions, have the potential to result in direct and indirect effects to EFH.

The NBS measures involve the placement of sediments into existing saltmarshes that are projected to convert to unconsolidated shore and open water habitats with SLR, and will have limited and short-term impacts on EFH. In areas south of Absecon Inlet, a dredging and/or placement restriction would be imposed from March 1 to June 30 to avoid disturbing peak fish migrations; and from north of Absecon Inlet, dredging would be restricted from January 1 through June 30 for winter flounder and migratory fish.

During dredging and/or placement activities, the majority of fish (including resident and migratory), with the exception of young life stages and demersal fishes, are highly mobile and capable of leaving the areas during the dredging and placement operations.

The mining of existing DMPFs is not expected to have adverse effects on fish and shellfish as these areas are contained within existing dike systems. The placement of sediment into the target saltmarsh areas would have similar effects on fisheries as the dredging/placement described above.

6.1.1 Wetlands

Construction of the NBS would require the aquatic placement of sediments on the wetland being restored. There would be 3 to 4 placements every 10 to 15 years of about 2-4 inches thickness of sediment at a time. Sediments would be placed on salt marsh and intertidal habitat, but not directly on subtidal habitat. Coir logs would be used to help intercept sediments from leaving the marsh platform, if necessary.

Changes to intertidal habitat are expected to be imperceptible. The placement of sediments at the NBS sites is designed to maintain habitat present at the time of placement and would not result in conversion of saltmarsh habitat (see Table 7 and Table 8). Placement at the target saltmarsh areas would maintain areas of intertidal mudflat and vegetated low marsh, which would remain accessible to finfish and benthos. Therefore, all effects are expected to be temporary and would end after construction is complete and the areas become stabilized with vegetation or other biogenic processes. Overall, the construction of NBS would have beneficial impacts, by allowing 7 marsh sites vulnerable to conversion to unconsolidated shores or open water to keep pace with sea level change.

Table 9. Habitat in the NBS Sites in the Future with the Project

NBS	Saltmarsh (acres)	Unconsolidated Shore (mudflat) (acres)	Open Water (acres)
Sea Isle City	58.21	7.9	4.23
Mystic Island	49.2	39.18	2.05
Tuckerton Beach	21.75	6.68	1.18
Parker Island	3.27	0.7	0
Marsh Elder Island	4.96	0.43	0.74
Waretown/Upper Barnegat Bay	7.98	3.02	0.71
Lacey/Sunrise Beach	23.59	1.83	0.78

Macroinvertebrate benthic organisms in the NBS placement areas will be smothered by pumping the dredged material into targeted areas of the low marsh saltmarsh substrate areas including unconsolidated shore/mudflat and open water areas of the marsh platform, resulting in a temporary disruption of the food chain within the footprint of the area. This effect would be minimized by implementing three or four placements over the 50-year project, which would minimize fill thicknesses to 2 to 4 inches at a time where some vertical migration within the sediments is possible. Overall, elevating the substrate in the saltmarshes is expected to have long-term positive impacts on fish by enhancing the marsh platform and providing a mosaic of marsh and intertidal mudflat, which would serve as habitat for feeding, refuge and nursery areas for a number of important finfish.

To avoid or minimize permanent impacts on marshes, roads would not be constructed in wetlands. If vehicles are needed to access marshes, marsh buggies and marsh mats would be used. All mats would be removed after placement and temporary impacts would be restored.

6.1.2 Submerged Aquatic Vegetation

The NBS measures involve the placement of dredged material sediments composed of sands and silts, which would be distributed over the target saltmarsh areas at an average cumulative rate of 800 cubic yards per acre to provide needed sediment nourishment. No sediments are expected to be placed directly in open waters. Placed sediments would be maintained on the saltmarsh to be restored, to the maximum extent possible. Coir logs would be used to help intercept sediments from leaving the marsh platform, if necessary. Therefore, SAV habitat is not expected to be affected.

Short-term effects would involve the resuspension of fine-grained materials either at the sediment sources (i.e., the existing DMPFs or navigation channel dredging) and at the placement locations (saltmarshes). All the NBS placement sites in Upper Barnegat Bay and Little Egg Harbor have SAV either presently or historically within 150 m of the marsh platforms. The short-term resuspension of sediments would be localized but would likely temporarily increase turbidity. This could result in a temporary effect on photosynthesis of adjacent SAV. Additionally, the generation of turbidity could release nutrients associated with organic materials in the sediments and may contribute to a short-term increase in algal uptake and associated blooms, which could have a temporary effect on SAV. At the most, SAV effects are expected to last one season. This is because the NBS will not affect SAV habitat and SAV distribution changes seasonally. The long-term benefits for saltmarshes would be the maintenance of existing saltmarshes, which are instrumental in nutrient uptake and nutrient cycling and could have beneficial effects on regulating algal blooms and SAV health.

The mining of sediments from within a DMPF would not have any direct effects on eelgrasses or other important SAV since these areas are separate from the adjacent waterways. Any dredging activity would be limited to existing navigation channels, which are not expected to contain SAV due to repeated disturbance associated with channel maintenance.

6.1.3 Benthic Habitats

The NBS measures involve the placement of dredged material sediments composed of sands and silts, which would be sprayed over the target saltmarsh areas to provide needed sediment nourishment. No sediments are expected to be placed directly in open waters. Placed sediments would be maintained on the saltmarsh to be restored, to the maximum extent possible.

Shellfish beds are not expected to be within the vegetated saltmarshes; however, shellfish beds are present within the tidal creeks and unconsolidated shores, and shallows within and near the placement sites (see Table 9). Direct sediment placement within these areas would be avoided to the maximum extent practicable and turbidity can be managed by directional placement of sediments via "Y" valves on the distribution pipeline that allows for better control of the distribution. If necessary, sedimentation into nearby waterways can be managed by using coir logs to intercept sediments before exiting the saltmarsh platform.

Dredging within the navigation channel will result in the temporary loss of benthos that may be prey items for benthic fish species. All dredging would occur in an already maintained (and disturbed) navigation channels. There, other than a temporary reduction in prey, no loss of EFH would occur.

Dredged material placement is not expected to introduce significant contaminants as pre-dredge testing and/or testing of sediments within a DMPF would be conducted and reviewed prior to use for placement and ensure that sediment concentrations meet the most current NJ criteria for beneficial use in saltmarshes.

The mining of sediments from within a DMPF would not have any direct effects on benthic habitats or shellfish beds adjacent to the NBS sites. DMPFs are separate from the adjacent waterways. Any dredging activity would be limited to existing navigation channels, which are not expected to contain shellfish beds or other important benthic habitat due to repeated disturbance associated with channel maintenance.

6.1.4 Estuarine Open Waters

Dredging and placement associated with NBS construction could result in water quality impacts.

Dredge cutterhead movement can create a turbidity plume in the vicinity of the dredging. Increased turbidity results from the resuspension of sediments during operations and can impact water quality, primary productivity and respiration of organisms in the immediate study area. Increased turbidity can also impact prey species' predator avoidance ability due to decreased clarity in the water column. Turbidity levels decrease exponentially with increasing distance from the dredge due to settling, dispersion and tidal flushing.

Activities for the mining of sediments within existing DMPFs are not expected to generate significant turbidity in nearby waterways since this activity would be confined to within existing dike structures that isolate the activity.

At the placement site, the silty dredged sediments would temporarily increase turbidity, but are expected to settle out in the immediate area quickly. Fall et al. (2022) evaluated strategic beneficial used of dredged material placement operations under the Seven Mile Island Innovation Laboratory at Gull Island in Great Sound. They observed that turbidity plumes were localized even for predominantly fine-grained material. Monitoring has shown that near-bed turbidities during active placement were temporarily greater than background conditions but were often less than those observed during high wind or storm events. Post-placement monitoring just one week after dredging had ceased showed that turbidity levels in the area were similar to levels documented for an area where no placement had occurred. Additional information is provided in the “Water Quality” section in the Main Report/EIS.

Best Management Practices already in place for maintenance dredging would be used to further minimize water quality and sound impacts during dredging and placement operations. For example, sediments within the study area will be tested for contaminants and determined to be acceptable for beneficial use placement within the local system prior to implementation in accordance with New Jersey criteria to meet sediment quality objectives appropriate for these uses.

No long-term adverse effects are anticipated in this eroding marsh system and no sediments are expected to be placed directly in open waters. Overall, the project will have a positive impact on water quality by furthering re-establishment of elevations suitable for saltmarsh vegetation that in turn, reduces erosion. Vegetative wetlands are highly effective at trapping particulates and removing excess nutrients (i.e. nitrogen and phosphorus) from the water through absorption by the plant systems.

Underwater noise associated with dredging consists of the dredge engine and the sound of dredged material passing through the pipe. Hydraulic suction dredging involves raising loosened material to the sea surface by way of a pipe and centrifugal pump along with large quantities of water. Suction dredgers produce a combination of sounds from relatively continuous sources including engine and propeller noise from the operating vessel and pumps and the sound of the drag head moving across the substrate. Noise associated with soft sediment removal is expected to be less than with harder substrates, such as rock (which might require fracturing). Dredge noise not expected to discernible from ambient noise (such as winds, waves, and boat traffic) approximately 1 meter from dredging.

Dredging and engine noise levels are not expected to be sufficient to cause hearing loss or other auditory damage to fish (Richardson et al., 1995; Suedel et al., 2019). Some studies near dredging and other industrial activities have observed marine species avoiding the noise, while in other cases, animals seem to develop a tolerance for it (Malme et al., 1983; Richardson et al., 1995; Suedel et al. 2019).

The noise associated with NBS construction activities will be continuous or at times sporadic. Noise generated by the dredging activities in is expected to be similar to other common noise sources, in the study area such as commercial vessels. Impacts to mobile marine species, such as fish, are not expected as individuals will move away from the disturbance, thereby reducing effects. Any resulting effects or loss of use of EFH would be negligible (temporary and localized).

Habitat changes within the navigation channel for migratory and resident finfish are not significant as dredging will not expose a different type of sediment substrate, encroach on areas outside of the authorized channel, or increase the channel's existing authorized dimensions. The NBS placements will not significantly alter migratory or resident fish habitats.

Water from adjacent waterways, used to repulp (fluidize) the sediments in the DMPF could result in the uptake of fish eggs and larvae for species that have EFH for eggs and larvae in the waterways (see Table 6). Water volumes are expected to be about 5 times the volume of sediments. Time of year restrictions such as those for winter flounder and migratory fish would help to avoid and minimize those effects. Additionally, operational controls may be built into the construction process to avoid and minimize the uptake of eggs and larvae, for example, the location the water is drawn from. These impacts would be temporary and would only occur during construction.

6.1.5 Open Ocean Waters

Construction and maintenance of natural and nature-based features would not result in direct or indirect impacts on open ocean waters or the protected marine species that use them.

6.2 Summary of Findings

Within the study area, there is a diversity of species with EFH designations. The listed species utilize a broad array of habitats and includes pelagic and benthic species as well as those that inhabit multiple types of habitats across their life stages. Impacts from construction would result in localized, temporary impacts on habitat, including prey. For any given species, impacts depend on the proximity of utilized habitats to NBS components. Overall, temporary impacts are expected to be minor, due to the localized nature of the impacts at 7 NBS sites. Time of year restrictions and other controls would be used to reduce impacts on EFH near the NBS sites.

7.0 MONITORING, ADAPTIVE MANAGEMENT, AND MITIGATION

The goal of employing NBSs is to combat marsh degradation and thereby cost-effectively protect the existing flood risk mitigation roles served by existing marsh complexes to filter out elevated water levels and wave energy. NBS sites will be monitored before, during, and after each placement, to determine performance and effectiveness. Monitoring will provide information essential to assessing ways in which adaptive management can be applied to future placements both here, and for other comparable salt marsh beneficial use placements. Monitoring will also help to detect unforeseen impacts and effectiveness of the measures to avoid and minimize construction impacts.

The monitoring and adaptive management plan and has been developed through the lessons learned from Seven Mile Island Innovation Laboratory (SMIIL) beneficial use projects, such as the Gull Island restoration, and other beneficial use projects conducted by the Philadelphia District in New Jersey and Delaware, as well as across USACE nationally. The projects provide evidence that dredged sediments are a valuable resource for creating NBS.

7.1 Monitoring

During construction, dredged material will be placed at these sites to augment the sediment shortfall relative to sea-level change, minimize elevation loss of the salt marsh platform, and prevent marsh edge erosion over several placements. The initial placement will be monitored to observe sediment properties and will inform the second placement operation. Keeping sediment in this eroding system is critical to the future of habitats and overall resilience of this important system. The proposed NBS placement is considered to be low risk and high yield for restoring varied habitats to build a more resilient system.

Monitoring before, during, and after placement operations will document the outcome of the NBS sites. While the monitoring plan is still being developed, aspects of the placement and marsh that could be monitored include:

- Water quality of adjacent waters
- Nearby SAV
- Marsh surface elevation change
- Marsh accretion and erosion
- Tidal marsh plant community (e.g., species composition, percent cover, areal coverage).
- Unvegetated to Vegetated Ratio (UVVR)

7.2 Adaptive Management

Adaptive management will allow us to learn from the monitoring results of each sediment placement and adapt the approach of the subsequent placements and may be used to:

- Avoid environmental impacts for future placements.
- Guide the sediment sources used, given the lack of long-term history and forecasting of shoaling and dredging needs at each site.
- Identify target sediment placement locations, depending on factors such as marsh degradation and developing CSRM needs.

7.3 Mitigation

No mitigation is expected to be required. Impacts of the proposed action would be minor, temporary, and localized. USACE would coordinate with NMFS, if monitoring shows that construction causes unforeseen impacts.

8.0 REFERENCES

Baremore I.E., Murie D.J., and J.K. Carlson. 2008. Prey selection by the Atlantic angel shark *Squatina dumeril* in the northeastern Gulf of Mexico. Bull Mar Sci. 82(3):297-313.

Baremore I.E., Murie D.J., and J.K. Carlson. 2010. Seasonal and size-related differences in the diet of the Atlantic angel shark *Squatina dumeril* in the northeastern Gulf of Mexico. Aquat. Biol. 8:125-136.

Block, E.A., J.E. Keen, B. Castillo, H. Dewar, E.V. Freund, D.J. Marcinek, R.W. Brill, and C. Farwell. 1997. Environmental preferences of yellowfin tuna (*Thunnus albacares*) at the northern extent of its range. Marine Biology 130: 119-132.

Butler CM, Rudershausen PJ, Buckel JA. 2010. Feeding ecology of Atlantic bluefin tuna (*Thunnus thynnus*) in North Carolina: diet, daily ration, and consumption of Atlantic menhaden (*Brevoortia tyrannus*). Fish Bull. 108: 56-69.

Castro, J.I. 1983. The sharks of North American waters. Tex. A&M Univ. Press, College Station: 180pp.

Castro, J.I. 2011. The sharks of North America. Oxford University Press. ISBN 978-0-19-539294-4.

Collette, B.B and C.E. Nauen. 1983. FAO species catalogue Vol. 2. Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date. FAO Fish. Synop., (125) Vol. 2: 137 p.

Dragovich, A. 1969. Review of studies of tuna food in the Atlantic Ocean. U. S. Fish wildl. Serv.Spec. Sci. Rep.-Fish. 593:21 p.

Dragovich, A. 1970b. The food of bluefin tuna (*Thunnus thynnus*) in the western North Atlantic Ocean. Trans. Am. Fish. Soc. 99(4):726-731.

Dragovich, A. and T. Potthoff. 1972. Comparative study of food of skipjack and yellowfin tunas off the west coast of West Africa. Fish. Bull. U. S. 70(4): 1087-1110.

Fall, K., Perkey, D., Tedesco, L., Chasten, M., 2022. Impact of Strategic, Unconfined, Dredged Material Placement on Turbidity Within A Shallow Back Bay System: Observations from Seven Mile Island Innovation Laboratory, NJ. WEDA Journal of Dredging, Official Journal of the Western Dredging Association, 20 (1). Available online: http://www.westerndredging.org/phocadownload/WEDA_Journal_of_Dredging_Vol_20_No_1.pdf. Accessed on October 17, 2024.

Gervelis B.J., and L.J. Natanson. 2013. Age and growth of the common thresher in the western North Atlantic Ocean. Trans Am Fish Soc. 142:1535-1545. doi:10.1080/00028487.2013.815658.

Grubbs, R.D. and J.A. Musick. 2002. Shark nurseries of Virginia: spatial and temporal delineation, migratory patterns, and habitat selection; a case study. In: McCandless et al. 2002. Shark nursery grounds of the Gulf of Mexico and the East Coast waters of the United States: an overview. 286 pp.

Grubbs, RD, Musick, JA, Conrath, CL, Romine, JG. 2007. Long-term movements,

migration, and temporal delineation of a summer nursery for juvenile sandbar sharks in the Chesapeake Bay region. Pages 87-107. *In* C.T. McCandless, N.E. Kohler, and H.L. Pratt, Jr. editors. Shark nursery grounds of the Gulf of Mexico and the east coast waters of the United States. American Fisheries Society Symposium 50, Bethesda, Maryland.

ICCAT. 1997. Report for biennial period 1996-97, 1(2).

Kuo-Wei L, Lee MA, Lu HJ, Shie WJ, Lin WK, Kao SC. 2011. Ocean variations associated with fishing conditions for yellowfin tuna (*Thunnus albacares*) in the equatorial Atlantic Ocean. ICES J Mar Sci 68(6): 1063-1071.

Logan J.M., Rodriguez-Marin, E., Goni, N., Barreiro, S., Arrizabalaga, H., Golet, W., Lutcavage, M. 2011. Diet of young Atlantic bluefin tuna (*Thunnus thynnus*) in eastern and western Atlantic foraging grounds. Mar Biol. 158: 73-85.

Malme, C.I., P.R. Miles, C.W. Clark, P. Tyak, and J.E. Bird. 1983. *Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior*. BBN Report 5366, Report from Bolt Beranek & Newman Inc., Cambridge, MA, for U.S. Minerals Management Service, Anchorage, AK. NTIS PB86-174174.

Matthews, F.D., D.M. Damkaer, L.W. Knapp, and B.B. Collette. 1977. Food of western North Atlantic tunas (Thunnus) and lancetfishes (Alepisaurus). NOAA Tech. Rep. NMFS SSRF-706:19 p.

McCandless, C.T., H.L. Pratt, Jr., and, N.E Kohler, editors. 2002. Shark nursery grounds of the Gulf of Mexico and the east coast waters of the United States: an overview. An internal report to NOAA's Highly Migratory Species. NOAA Fisheries Narragansett Lab, 28 Tarzwell Drive, Narragansett, Rhode Island 02882, USA

McElroy WD. 2009. Diet feeding ecology, trophic relationships, morphometric condition , and ontogeny for the sandbar shark, *Carcharhinus plumbeus*, and smooth dogfish, *Mustelus canis*, within the Delaware Bay estuary [dissertation]. [Kingston (RI)]: University of Rhode Island.

Merson, R.R., and H.L. Pratt Jr. 2007. Sandbar shark nurseries in New Jersey and New

York: Evidence of northern pupping grounds along the United States east coast. Pages 35-43 *In* C.T. McCandless, N.E. Kohler, and H.L. Pratt, Jr. editors. Shark nursery grounds of the Gulf of Mexico and the east coast waters of the

United States. American Fisheries Society Symposium 50, Bethesda, Maryland.

Morgan, S. G., C. S. Manooch III, D. L. Mason and J. W. Goy. 1985. Pelagic fish predation on *Cerataspis*, a rare larval genus of oceanic penaeoid. Bull. Mar. Sci. 36(2): 249-259.

National Marine Fisheries Service (NMFS). 2016. Letter dated 9/26/2016 to Philadelphia District U.S. Army Corps of Engineers.

National Marine Fisheries Service. 2017. Final Amendment 10 to the 2006 Consolidated Atlantic Highly Migratory Species Fishery Management Plan: Essential Fish Habitat and Environmental Assessment. NOAA Fisheries, Office of Sustainable Fisheries, Atlantic Highly Migratory Species Management Division.

New England Fishery Management Council (NEMFC). 2017. Omnibus Essential Fish Habitat Amendment 2 - Volume 2: EFH and HAPC Designation Alternatives and Environmental Impacts.

Preti, A.; S.E. Smith; and D.A. Ramon. 2004. Diet differences in the thresher shark (*Alopias vulpinus*) during transition from a warm-water regime to a cool-water regime off California-Oregon, 1998-2000.

Rechisky, E.L. and B. M. Wetherbee. 2003. Sort-term movements of juvenile and neonate sandbar sharks, *Carcharhinus plumbeus,* on their nursery grounds in Delaware Bay. *Envir. Bio.of Fishes.* 68:113-128.

Richardson, W.J., C.R. Greene, C.I. Malme, and D.H. Thomson. 1995. *Marine mammals and noise.* Academic Press, San Diego, CA. 576 pp.

Standing Committee of Research and Statistics (SCRS). 1997. Report of the International Commission for the Conservation of Atlantic Tunas (ICCAT) SCRS bluefin tuna stock assessment session. Collective Volume of Scientific Papers. ICCAT 46(1):1-186.

Suedel, B.C., A.D. McQueen, J. L. Wilkens, and M. P. Fields. 2019. Evaluating Effects of Dredging-Induced Underwater Sound on Aquatic Species: A Literature Review. ERDC/EL TR-19-18.