ENVIRONMENTAL APPENDIX
TIER 1 ESSENTIAL FISH HABITAT (EFH) ASSESSMENT

NEW JERSEY BACK BAYS COASTAL STORM RISK MANAGEMENT FEASIBILITY STUDY

PHILADELPHIA, PENNSYLVANIA

APPENDIX F.2

August 2021

NJBB
NEW JERSEY BACK BAYS STUDY

U.S. Army Corps of Engineers
Philadelphia District

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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. 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."

To comply with the MSA, the USACE is requesting a "Tier 1" level review of this EFH assessment from NMFS. Due to the geographic size, scope of potential actions, and complexities of the proposed actions, a "Tier 1" level review is similar to that of a programmatic EFH review, where it is intended that subsequent higher tier reviews are required based on the level of detail/refinement of the preferred actions and further information obtained on impacts on EFH in the higher tiers. A "Tier 1" is broad in scope and discusses impacts and mitigation measures for the array of structural, non-structural, NNBF and No Action alternatives likely to be carried forward into higher tier reviews. A “Tier 1” EFH assessment will identify EFH in the study areas and utilize existing information to determine potential impacts and/or range of impacts due to limited information available or uncertainty of an action’s effects. Subsequent tiers following the “Tier 1” assessment will focus on the preferred alternative(s) with site specific locational habitat information along with updated information on a proposed action’s effects on EFH.

1.2 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.

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, 19^{th} 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.

1.2.2 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.

1.2.3 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.

1.2.4 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.

1.2.5 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.

1.3 Preferred Alternative (TSP) and Alternatives

1.3.1 No Action Alternative

The forecast of the future without-project (FWOP) condition reflects the conditions expected during the period of analysis. The future without-project condition provides the basis from which alternative plans are formulated and impacts are assessed. Since impact assessment is the basis for plan evaluation, comparison and selection, clear definition and full documentation of the without-project condition are essential. Gathering information about historic and existing conditions requires an inventory. Gathering information about potential future conditions requires forecasts, which should be made for selected years over the period of analysis to indicate how changes in economic and other conditions are likely to have an impact on problems and opportunities. Information gathering and forecasts will most likely continue throughout the planning process. The most likely future without project condition is considered to be if no NJBB action is taken, and is characterized by CSRM projects and features, and socio-economic, environmental, and cultural conditions. This condition is considered as the baseline from which future measures will be evaluated with regard to reducing coastal storm risk and promoting resilience. The Future-Without Project Condition serves as the baseline for evaluating the anticipated performance of alternatives. It documents the need for Federal action to address the water resources problem.

A base year of 2030 has been identified as the year when USACE projects associated with the NJBB CSRM Feasibility Study will be implemented or constructed. Several trends have been identified for the NJBB Region which are projected to continue into the future and will likely effect the future without-project condition for this study. It is anticipated that the study area will continue to experience damages from coastal storms, and that the damages may increase as a result of more intense storm events. These coastal storm events will likely continue to effect areas of low coastal elevations within the study area with pronounced localized effects in some areas.

In the future without project condition, it is anticipated that sea level is increasing throughout the study area that shorelines are changing in response to sea level change, and historic erosion patterns will continue and accelerate. It is anticipated that there will continue to be significant economic assets within the NJBB region, and that population and development will continue to increase. Based on a desktop inventory of structures compiled for the HEC-FDA model, the New Jersey Back Bays study area experiences a total of $1,571,616,000 in FWOP Average Annual Damages (AAD) over a 50-year period of analysis based on the intermediate rate of relative sea level change (RSLC).

The FWOP condition no-action alternative would see no additional federal involvement in storm damage reduction as outlined within this study. Current projects and programs that the USACE conducts in conjunction with other Federal and non-Federal entities would continue and would be constructed by 2030.

The FWOP condition does consider those projects that have been completed (existing), are under construction, or have been authorized for construction and are anticipated to be constructed by

2030. Any proposed projects, which are not yet authorized for construction, are not considered part of the FWOP conditions for analysis.

1.3.2 Action Area

The action area is defined as all areas that may be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. It encompasses the geographic extent of environmental changes (i.e., the physical, chemical and biotic effects) that will result directly and indirectly from the action and is a subset of the NJBB Study Area.

For the NJBB Study, the action area is all areas directly and indirect affected by the tentatively selected plan (TSP), presented **Error! Reference source not found.**. The TSP includes the f ollowing project components:

- Three inlet closures or storm surge barriers (SSB)
    - Manasquan Inlet
    - Barnegat Inlet
    - Great Egg Harbor Inlet
- Two cross-bay barriers
    - Absecon Blvd
    - South Ocean City
- Non-structural measures
    - 18,800 structures eligible for elevation and floodproofing

Additionally, the action area considers the effects of the following options, which have not yet been eliminated.

- Non-structural measures only (elevation and floodproofing for 23,152 structures) in the North Region (Alternative 3A; see Figure 2).
- Non-structural measures only alternative (elevation and floodproofing for 10,895 structures) in the Central Region (Alternative 4A; see
- Figure 3).
- Non-structural measures for (elevation and floodproofing for 1,189 structures) and perimeter plan alternative in the Central Region (Alternative 4D1; see
- Figure 3).
- Non-structural measures for (elevation and floodproofing for 2,340 structures) and perimeter plan alternative in the Central Region (Alternative 4D2; see
- Figure 3).
- Non-structural (656 structures) and perimeter plan alternative in the South Region (Alternative 5D2; see
- Figure 4).

Note that non-structural measures consist of elevating or floodproofing already existing structures in previously developed areas. Therefore, the action area would primarily be defined by the direct and indirect effects of the storm surge barriers, cross-bay barriers, and perimeter plans assessed in this BA. Detailed alignments of the inlet closures, cross-bay barriers, and perimeter plans are presented in Appendix A.

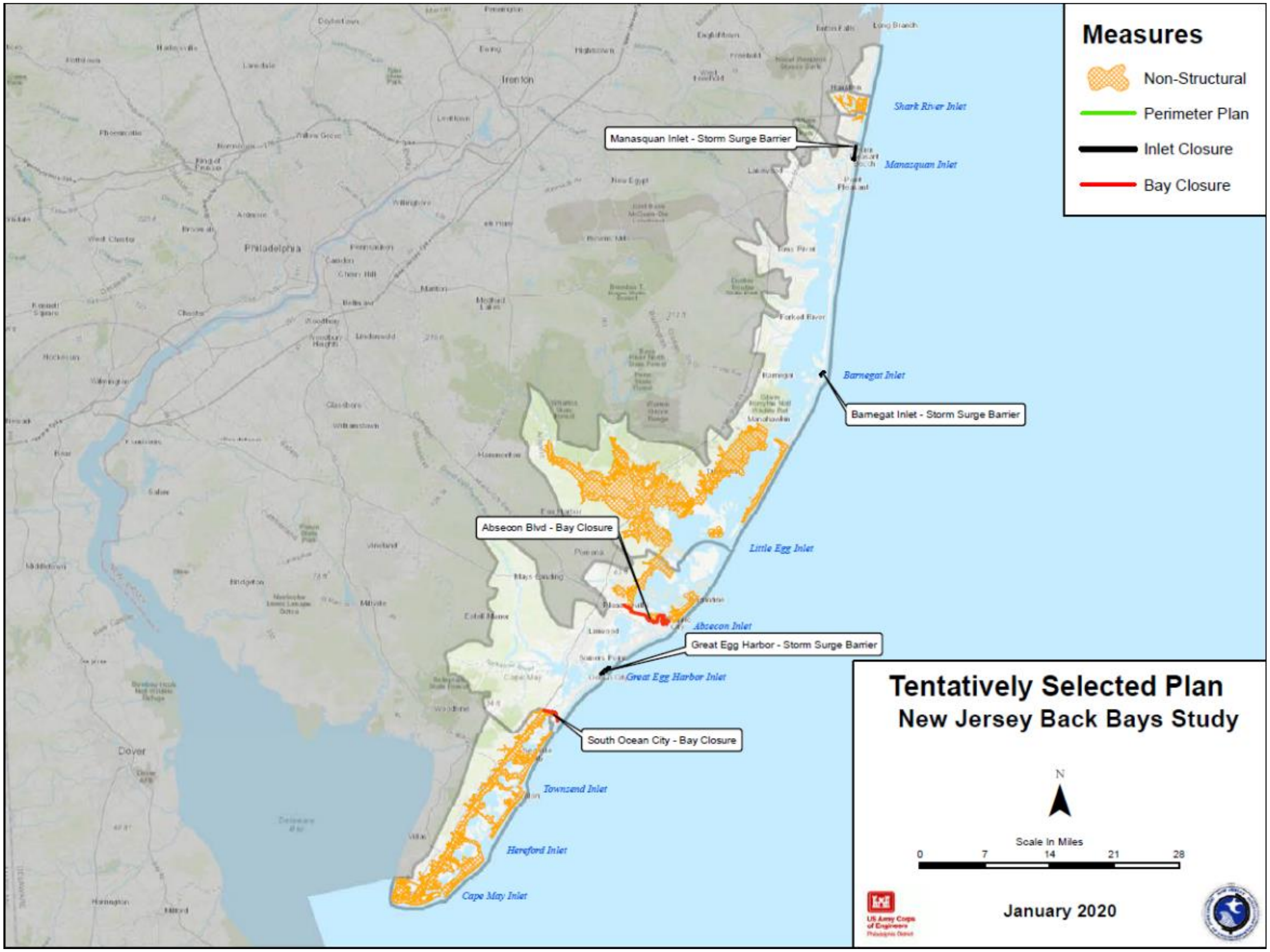


Figure 1. The TSP for the NJBE

Table 1. Final Array of Alternatives

REGION	**ALT**	**NONSTRUCTURAL** Building Raising for structures with first floor w/in 20-yr floodplain	**PERIMETER** Floodwalls, Levees and Miter Gates	**STORM SURGE BARRIER** Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	**CROSS-BAY BARRIER** Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees	**Natural and Nature-Based Features (NNBF)** **Note: The measures presented here are proof of concept measures (see Appendix xx) that have not been modeled for CSRM flood reduction and economic benefits. Further evaluation of these conceptual measures will be conducted in subsequent planning phases.**
SHARK RIVER	**2A* ▲**	**Portions of Belmar, Bradley Beach, Neptune City & Shark River Hills**				• Island Expansion in Shark River • Coastal Lakes Terracing for habitat and to increase flood storage capacity
NORTH (Manasquan Inlet to Brigantine Inlet)	**3A†**	**Point Pleasant, all communities on LBI, western shore of Barnegat Bay, Mystic Island, and along lower Mullica River Basin**				• Horizontal (ecotone) Levee at **Tuckerton Peninsula** along Great Bay Boulevard • Living Breakwaters on southwest side of **Tuckerton Peninsula** • Marsh Augmentation along **Tuckerton Peninsula** • Marsh Island Augmentation and Marsh Island Creation Along **Tuckerton Peninsula** • Beach Haven Surge Filter – island and wetland creation/expansion northeast of **Tuckerton Peninsula** and Great Bay Blvd. • **Barnegat Bay** – reforestation of maritime forests and shrublands in upland locations, • **Barnegat Bay** augmenting existing marshes by mosquito ditch filling and thin-layer placement • **Barnegat Bay** – mudflat expansion • **Barnegat Bay** - SAV bed expansion through "shallowing" and the filling-in of dredge holes.
	~~3D~~	~~All communities on LBI, western shore of Barnegat Bay, Mystic Island, and along lower Mullica River Basin~~	~~Manasquan Inlet/ Point Pleasant Area~~			
	3E(2)* ▲	**All communities on southern LBI (Cedar Bonnet Island and south), western shore of Barnegat Bay at Beach Haven West and south, Mystic Island, and along lower Mullica River Basin**		**1. Manasquan Inlet** **2. Barnegat Inlet**		
	~~3E(3)~~	~~Cedar Bonnet Island, western shore of Barnegat Bay at Beach Haven West and south, Mystic Island, and along~~	~~Along western side of S. LBI from Ship Bottom to Holgate~~	~~1. Manasquan Inlet~~ ~~2. Barnegat Inlet~~		

Table 1. Final Array of Alternatives

REGION	ALT	NONSTRUCTURAL Building Raising for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	CROSS-BAY BARRIER Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees	Natural and Nature-Based Features (NNBF) **Note: The measures presented here are proof of concept measures (see Appendix xx) that have not been modeled for CSRM flood reduction and economic benefits. Further evaluation of these conceptual measures will be conducted in subsequent planning phases.**
		~~lower Mullica River Basin~~				
CENTRAL **(Brigantine Inlet to Corson Inlet)**	4A↥	~~Brigantine, Absecon, Pleasantville, West A.C., A.C., Ventnor, Margate, Longport, Northfield, Linwood, Estell Manor, Mays Landing, Somers Point, Marmora, Ocean City, Palermo~~				• Horizontal or ecotone levee(s) • Island Creation/Expansion – Great Bay • Dune Enhancements • Wetland Creation or Restoration Great Bay, Reeds Bay, Absecon Bay, Lakes Bay,Scull Bay, Great Egg Harbor
	4D(1)▲	Brigantine, Absecon, Pleasantville, West A.C., Northfield, Linwood, Estell Manor, Mays Landing, Somers Point, Marmora, Palermo	Along South Absecon Inlet and western side of A.C., Ventnor City, Margate City, Longport, & all Ocean City			
	4D(2)↑	Absecon, Pleasantville, West A.C., Northfield, Linwood, Estell Manor, Mays Landing, Somers Point, Marmora, Palermo	Along Absecon Inlet and western side of Brigantine, A.C., Ventnor, Margate, Longport, & Ocean City			
	~~4E(2)~~	~~Absecon, Pleasantville, S.~~		~~1. Absecо~~		

Table 1. Final Array of Alternatives

REGION	**ALT**	**NONSTRUCTURAL** Building Raising for structures with first floor w/in 20-yr floodplain	**PERIMETER** Floodwalls, Levees and Miter Gates	**STORM SURGE BARRIER** Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	**CROSS-BAY BARRIER** Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees	**Natural and Nature-Based Features (NNBF)** **Note: The measures presented here are proof of concept measures (see Appendix xx) that have not been modeled for CSRM flood reduction and economic benefits. Further evaluation of these conceptual measures will be conducted in subsequent planning phases.**
		~~Ocean City, Marmora, & Palermo~~		~~n Inlet~~ ~~2. Great Egg Harbor Inlet~~		
	~~4E(3)~~	~~Absecon, Pleasantville, Marmora, & Palermo~~	~~Western side of S. Ocean City~~	~~1. Absecon Inlet~~ ~~2. Great Egg Harbor Inlet~~		
	~~4E(4)~~	~~Absecon & Pleasantville~~		~~1. Absecon Inlet~~ ~~2. Great Egg Harbor Inlet~~	~~1. Southern Ocean City (52nd St.)~~	
	~~4G(6)~~	~~Brigantine, Absecon, Pleasantville, West A.C., Marmora, S. Ocean City, Palermo,~~		~~1. Great Egg Harbor Inlet~~	~~1. Absecon Blvd.~~	
	~~4G(7)~~	~~Brigantine, Absecon, Pleasantville, West A.C., Marmora~~	~~Western side of S. Ocean City~~	~~1. Great Egg Harbor Inlet~~	~~1. Absecon Blvd.~~	
	4G(8)*	**Brigantine, Absecon, Pleasantville, West A.C.,**		**1. Great Egg Harbor Inlet**	**1. Absecon Blvd.** **2. Southern Ocean City (52nd St.)**	

Table 1. Final Array of Alternatives

REGION	ALT	NONSTRUCTURAL Building Raising for structures with first floor w/in 20-yr floodplain	PERIMETER Floodwalls, Levees and Miter Gates	STORM SURGE BARRIER Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	CROSS-BAY BARRIER Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees	Natural and Nature-Based Features (NNBF) **Note: The measures presented here are proof of concept measures (see Appendix xx) that have not been modeled for CSRM flood reduction and economic benefits. Further evaluation of these conceptual measures will be conducted in subsequent planning phases.**
	~~4G(10)~~	~~Absecon, Pleasantville, West A.C., Marmora, S. Ocean City, Palermo~~	~~Western side of Brigantine~~	~~1. Great Egg Harbor Inlet~~	~~1. Absecon Blvd.~~	
	~~4G(11)~~	~~Absecon, Pleasantville, West A.C., Marmora, Palermo~~	~~Western side of Brigantine and S. Ocean City~~	~~1. Great Egg Harbor Inlet~~	~~1. Absecon Blvd.~~	
	~~4G(12)~~	~~Brigantine, Absecon, Pleasantville, West A.C.,~~	~~Western side of Brigantine~~	~~1. Great Egg Harbor Inlet~~	~~1. Absecon Blvd.~~ ~~2. Southern Ocean City (52nd St.)~~	
SOUTH **(Corson Inlet to Cape May Inlet)**	**5A*▲**	**All Atlantic Coast and bayside communities from Ludlam Island (Upper Twp.) south to Cape May and W. Cape May**				• No defined NNBF strategies identified at this time
	~~5D(1)~~	~~All Atlantic Coast and bayside communities from Ludlam Island (Upper Twp.) south to Cape May and W. Cape May except for SIC, all WW, and Cape May~~	~~Western side of Sea Isle City, all Wildwoods, and southern shore along Cape May Harbor in Cape May~~			

Table 1. Final Array of Alternatives

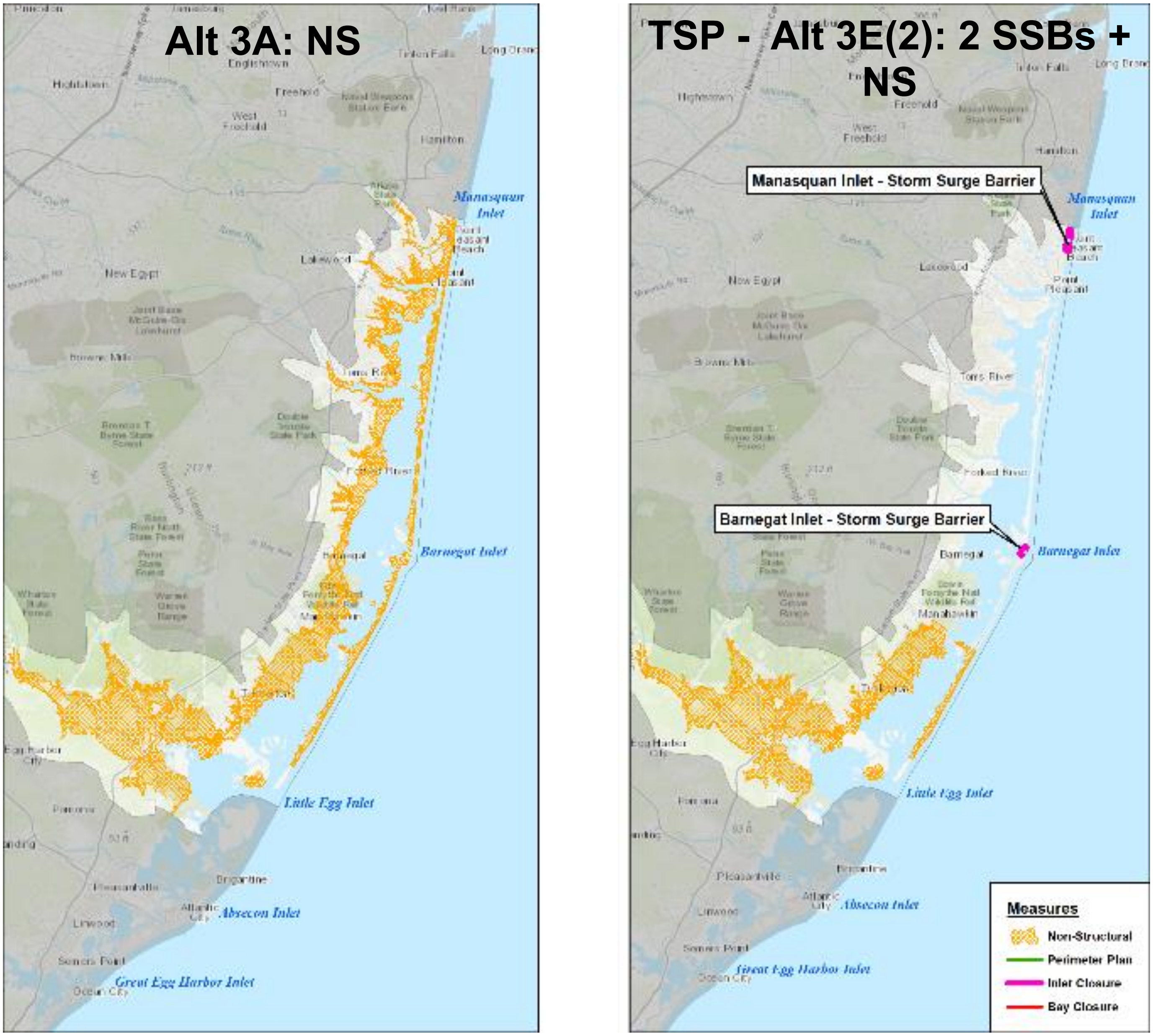
REGION	**ALT**	**NONSTRUCTURAL** Building Raising for structures with first floor w/in 20-yr floodplain	**PERIMETER** Floodwalls, Levees and Miter Gates	**STORM SURGE BARRIER** Inlet Navigable Sector Gates, Auxiliary Lift Gates, Impermeable Barriers, Levees	**CROSS-BAY BARRIER** Navigable Sector Gates, Auxiliary Lift Gates, Miter Gates, Sluice Gates, Impermeable Barriers, Levees	**Natural and Nature-Based Features (NNBF)** **Note: The measures presented here are proof of concept measures (see Appendix xx) that have not been modeled for CSRM flood reduction and economic benefits. Further evaluation of these conceptual measures will be conducted in subsequent planning phases.**
	5D(2) ᶧ	All bayside communities from Ludlam Island (Upper Twp.) south to Cape May and W. Cape May; Strathmere and N. Cape May Inlet along Atlantic Coast.	Western side of Sea Isle City, Seven Mile Island, all Wildwoods, and southern shore along Cape May Harbor in Cape May, and West Cape May			

*Tentatively Selected Plan (TSP)

▲ Apparent National Economic (NED) Plan

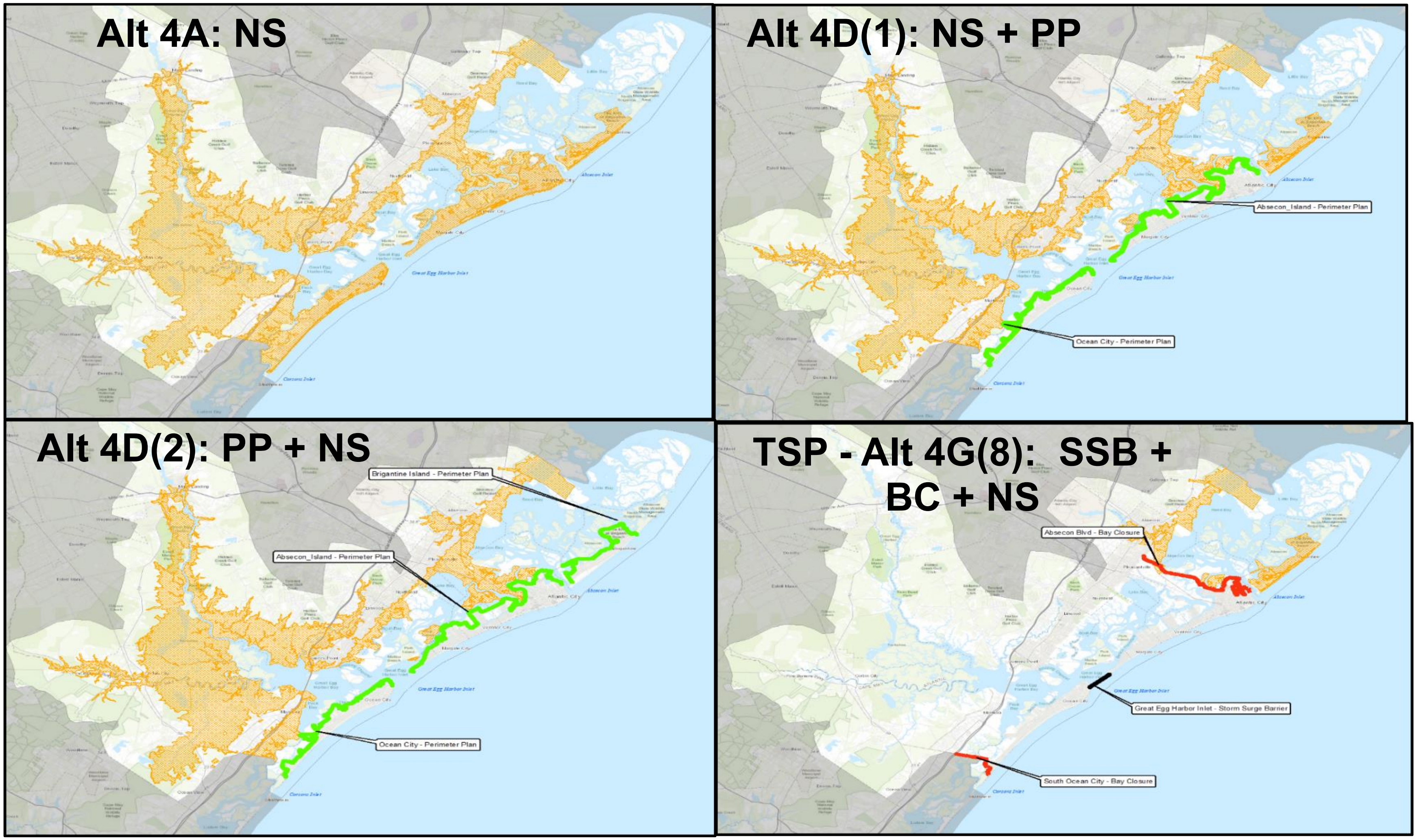
ᶧFurther Economic Analysis Warranted – Alternative or components of the alternative could be included later upon further evaluation

~~Strikethrough~~ = Alternative eliminated from consideration subsequent to Interim Report



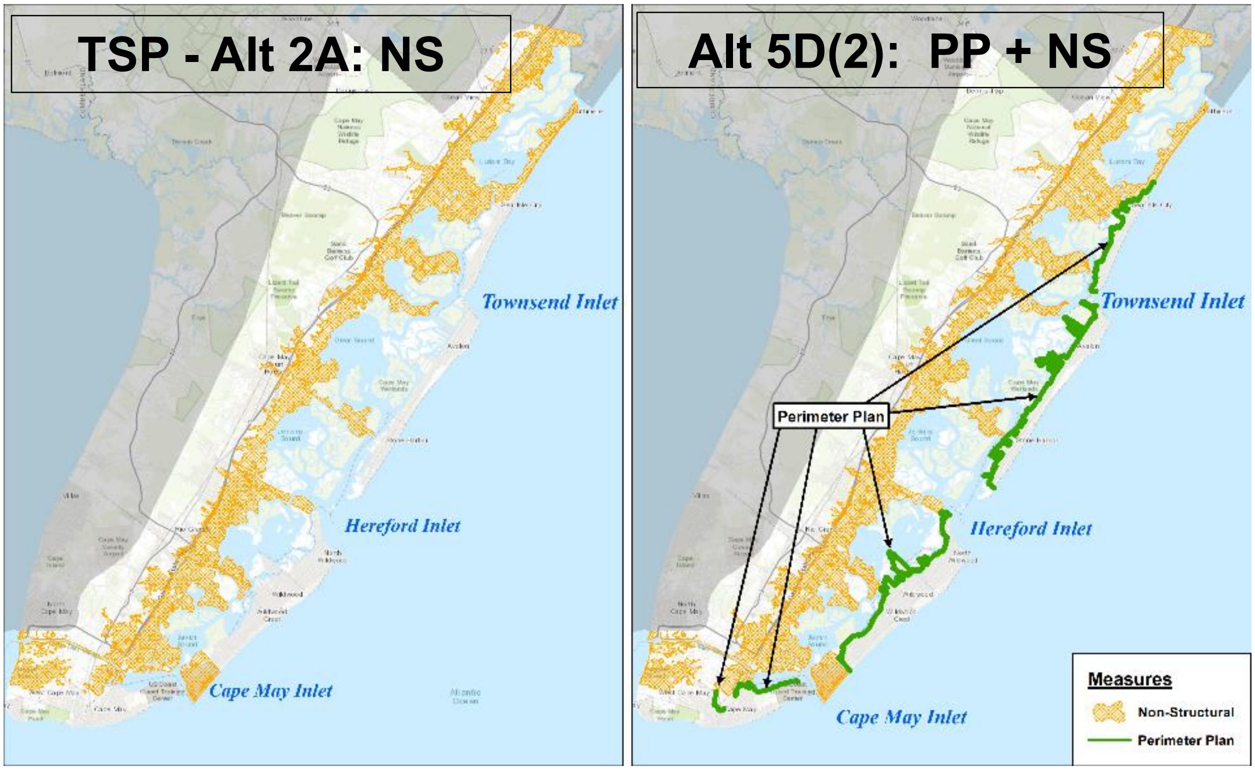
Notes: TSP = Tentatively Selected Plan; Alt = Alternative, NS = Nonstructural; SSB = Storm Surge Barrier

Figure 2. Comparison of the Non-Structural Alternative and the TSP in the North Region



Notes: TSP = Tentatively Selected Plan; Alt = Alternative, NS = Nonstructural; SSB = Storm Surge Barrier, PP = Perimeter Plan

Figure 3. Comparison of the Non-Structural and Perimeter Plan Alternatives and the TSP in the Central Region



Notes: TSP = Tentatively Selected Plan; Alt = Alternative, NS = Nonstructural; PP = Perimeter Plan

Figure 4. Comparison of the TSP and the Perimenter Plan and Nonstructural Alternative in the South Region

2.0 PROJECT DESCRIPTION

2.1 Storm Surge Barriers and Cross-Bay Barriers

Three storm surge barriers at inlets (Manasquan Inlet, Barnegat Inlet, Great Egg Harbor Inlet) and two interior cross-bay barrier barriers across the bay (Absecon Blvd and Southern Ocean City) are included in the TSP. The selected storm surge barriers reduce storm surge from propagating into the bays from the ocean during storm events lowering flood elevations. The storm surge barriers across the bay (Cross-bay barriers) reduce storm surge from propagating into Central Region from adjacent inlets (Absecon Inlet, Little Egg Inlet, and Corson's Inlet) that would remain open and unaltered in the TSP. Storm surge barriers span the inlet opening with a combination of static impermeable barriers and dynamic gates that are only closed during storm events. Each storm surge barrier includes a navigable gate (sector gate) to provide a navigable opening with unlimited vertical clearance and a series of auxiliary flow gates, vertical lift gates, to maintain tidal flow during non-storm conditions. An example of storm surge barrier at the Seabrook Flood Complex in New Orleans, LA which is constructed with a sector gate and vertical lift gates is shown in Figure 5. Detailed engineering drawings, layouts and cross-sections, for the storm surge barriers are included in Appendix B. Storm surge barrier gate types and alignments are considered tentative and may change in future phases of the study with more detailed engineer analyses and designs.

Navigable sector gates span the full width of the federal navigation channel with a 10-foot buffer on either side with opening spans ranging from 120 feet at the Cross-bay barriers to 340 feet at Manasquan Inlet. Auxiliary flow gates have an opening span of 150 feet and are located along the storm surge barrier in water depths that are deemed constructible and practical. In shallow water, where vertical lift gates are impractical, shallow water gates (SWG) consisting of 24-foot x 8-foot box culverts with sluice gates are used. Bottom sill elevations for the navigable and auxiliary flow gates are designed at or near the existing bed elevations to promote tidal flow and are well below the federally authorized depths at the federal navigation channels.

Impermeable barriers are open water structures that flank the navigable and auxiliary flow gates to tie the barrier into high ground or existing CSRM features (i.e. dunes or seawalls). Site specific impermeable barrier types have not been selected at this stage of the study but will be further investigated as the study continues. Several of the storm surge barriers, particularly the cross-bay barriers, include levees, floodwalls, and seawalls along roads, shorelines, and low-lying areas to tie into high ground or existing CSRM features (i.e. dunes or seawalls). The crest elevation of the storm surge barriers is between 17 and 20 feet NAVD88. A summary of the storm surge barrier components is provided in Table 2.

Table 2. TSP – Storm Surge Barrier Components

Storm Surge Barrier	Navigable Gate	Auxiliary Flow Gates	Impermeable Barrier	Perimeter Barrier
Manasquan Inlet Inlet Closure	1 Sector Gate Length = 340 FT Crest Elev = 20 FT Sill Elev = -18.25 FT	None	None	Levee = 7,280 FT Seawall = 2,366 FT
Barnegat Inlet	1 Sector Gate	15 Vertical Lift Gates	Length = 798 FT	Floodwall = 897 FT
Inlet Closure	Length = 320 FT	Length = 150 FT each	Area = 18,365 SF	Seawall = 795 FT
	Crest Elev = 17 FT	Crest Elev = 17 FT		1 Road Closure Gate
	Sill Elev = -25 FT	Sill Elev = -5 to -11 FT		
		18 Shallow Water Gates		
		Length = 24 FT each		
		Crest Elev = 17 FT		
		Sill Elev = -4 FT		
Great Egg Inlet Inlet Closure	1 Sector Gate Length = 320 FT Crest Elev = 19 FT Sill Elev = -35 FT	19 Vertical Lift Gates Length = 150 FT each Crest Elev = 19 FT Sill Elev = -5 to -18 FT	Length = 863 FT Area = 20,716 SF	Levee = 974 FT Seawall = 1,275 FT
Absecon Blvd.	1 Sector Gate	4 Shallow Water Gates	Length = 869 FT	Levee = 27,524 FT
Bay Closure	Length = 120 FT	Length = 24 FT each	Area = 14,772 SF	Floodwall = 28,890 FT
	Crest Elev = 13 FT	Crest Elev = 13 FT		4 Road Closure Gates
	Sill Elev = -20 FT	Sill Elev = -2 FT		5 Mitre Gates
Southern Ocean City Bay Closure	1 Sector Gate Length = 120 FT Crest Elev = 13 FT Sill Elev = -10 FT	None	None	Levee = 9,467 FT Floodwall = 4,124 FT 1 Mitre Gate 1 Sluice Gate

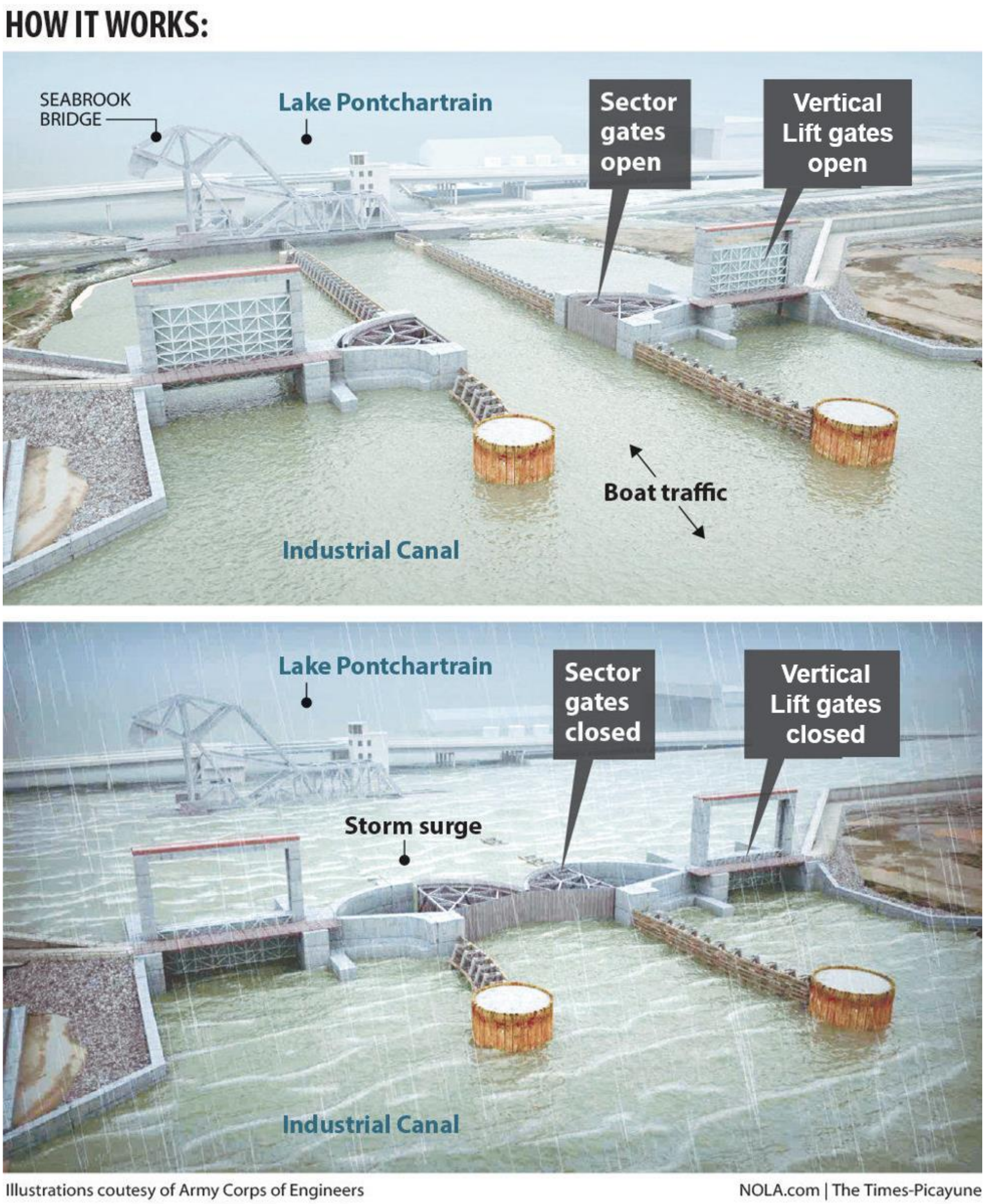


Figure 5. Example Storm Surge Barrier at Seabrook Flood Complex in New Orleans

2.1.1 Pre-construction

Prior to construction investigations may include, wetland delineation, a subsurface geotechnical investigation, and HTRW sampling. These investigations are being developed.

2.1.2 Construction

In-water construction activities for the construction of storm surge barriers and cross-bay barriers include installation and removal of temporary cofferdams, temporary excavations, fill and rock placement, concrete work, and pile driving. On land construction activities include clearing, grading, excavations, backfilling, movement of construction equipment, concrete work, pile driving, and soil stockpiles.

2.1.3 Operation and Maintenance

The purpose of Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) is to sustain the constructed project. The most significant OMRR&R is associated with the Storm Surge Barriers. At this point of the study, it is estimated that storm surge barriers and cross-bay barriers would be closed for a 5-yr and higher storm surge event, with an average of one closure operation every five years. In the next phase of the study the storm surge barrier operations plan and closure criteria will be revaluated. OMRR&R for storm surge barriers typically include monthly startup of backup generators/systems, annual closure of surge barrier gates pre-hurricane season, dive inspections, gate adjustments/greasing, gate rehab and gate replacement.

2.2 Nonstructural Measures

The TSP includes Nonstructural solutions, elevating structures and floodproofing, in areas where the storm surge barriers will not significantly reduce flood elevations. These areas are concentrated in the Shark River region Ocean and Atlantic Counties (between Route 72 and Absecon Blvd.) and Cape May County. A total of 18,800 structures located within the 5% AEP floodplain (20-year return period) in these areas are targeted for nonstructural solutions under the TSP; this includes 135 structures in the Shark River Region; 8,869 structures in the North Region; 1,255 structures in the Central Region; and 8,579 structures in the South region.

In addition, to the TSP, two completely nonstructural options are still under consideration.

- Non-structural measures only (elevation and floodproofing for 23,152 structures) in the North Region (Alternative 3A; see Figure 2).
- Non-structural measures only alternative (elevation and floodproofing for 10,895 structures) in the Central Region (Alternative 4A; see Figure 3).

Additionally, the number of structures under consideration for nonstructural measure changes with the perimeter plan options considered.

2.2.1 Pre-construction

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

2.2.2 Construction

Nonstructural measures involve a significant construction effort 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 and would most likely be in upland urbanized settings.

2.2.3 Operations and Maintenance

There is no operations and maintenance associated with non-structural solutions.

2.3 Perimeter Plans

The perimeter plan options that are still being considered in the Central and South regions include floodwalls and levees that would be constructed on the western side of the barrier islands along residential bayfronts and would tie into existing dunes at the northern and southern ends of the barrier islands. Figure 6,

Figure 7, and Figure 8 show typical sections which have been used in the perimeter plan design to date.

Options. The following are the perimeter plan options still under consideration. The number of structures under consideration for nonstructural measures is noted for each perimeter plan option.

- Non-structural measures for (elevation and floodproofing for 1,189 structures) and perimeter plan alternative in the Central Region (Alternative 4D1; see Figure 3).
- Non-structural measures for (elevation and floodproofing for 2,340 structures) and perimeter plan alternative in the Central Region (Alternative 4D2; see Figure 3).
- Non-structural (656 structures) and perimeter plan alternative in the South Region (Alternative 5D2; see Figure 4).

The location, length, and construction duration for the perimeter plans for these options are presented in Table 3.

Table 3. Location, Length, and Construction Duration for Perimeter Plan Options

ALTERNATIVE	**LOCATION**	**BARRIER**	**CONSTRUCTION**
		LENGTH (LF)	**DURATION (MONTHS)**
4D1	Ocean City	78,732	89
	Absecon Is.	111,111	126
4D2	Ocean City	78,732	89
	Absecon Is.	111,111	126
	Brigantine	48,699	55
5D2	Cape May City	15,825	18
	Wildwood Is.	54,171	62
	West Wildwood	11,726	13
	Sea Isle City	35,167	40
	West Cape May	4,480	5

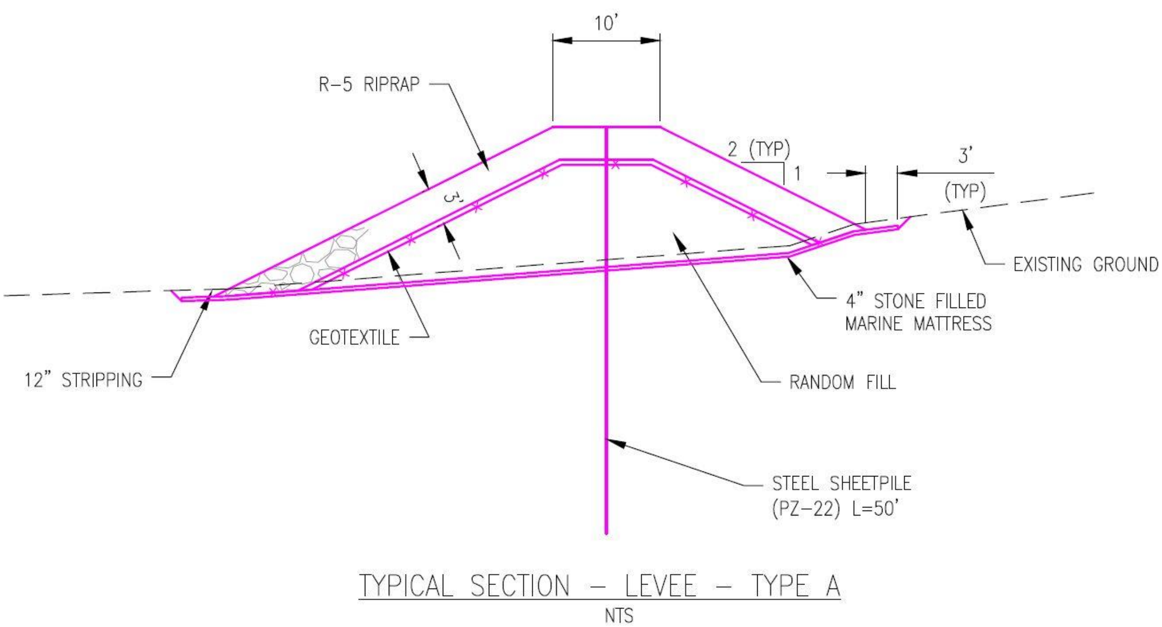


Figure 6. Typical Section – Levee – Type A

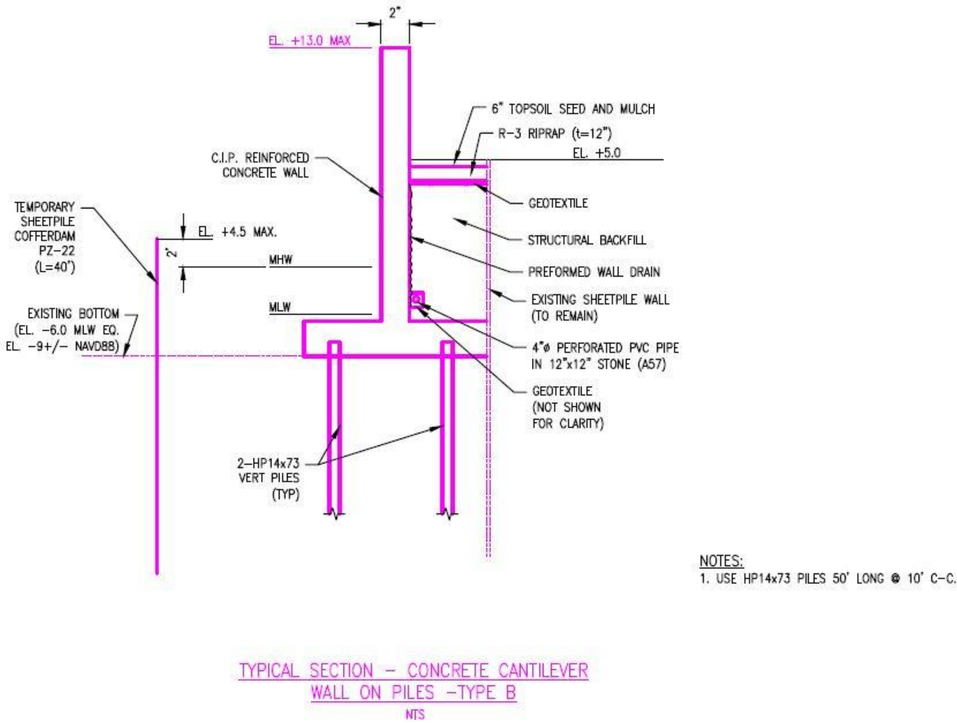


Figure 7. Typical Section – Concrete Cantilever Wall on Piles – Type B

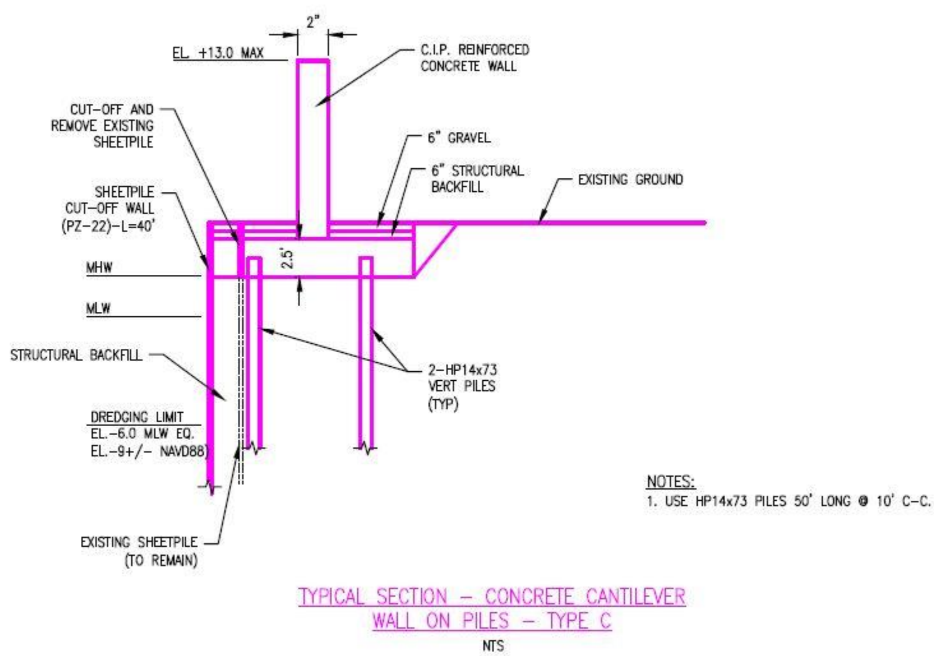


Figure 8. Typical Section – Concrete Cantilever Wall – Type C

2.3.1 Pre-construction

Prior to construction investigations may include, wetland delineation, a subsurface geotechnical investigation, and HTRW sampling. These investigations are being developed.

2.3.2 Construction

In-water construction activities for the construction of levee and floodwalls include installation and removal of temporary cofferdams, temporary excavations, fill and rock placement, concrete work, and pile driving. On land construction activities include clearing, grading, excavations, backfilling, movement of construction equipment, concrete work, pile driving, and soil stockpiles.

2.3.3 Operation and Maintenance

As part of the perimeter plan, miter gates will be installed and operated across smaller channels that require navigable access. These gates would remain open during normal conditions and would be closed during significant storm events. Regular maintenance is performed on the gates to keep the system running as designed.

2.4 Natural and Nature Based Features (NNBF)

An initial suite of NNBF opportunities for integration into the TSP are identified in this section for each of the NJBB Regions. NNBF opportunities are demonstrated in maps outlining location specific concepts. The features shown on the map are drawn to locate the general area an NNBF might be considered and are not representative of a specific design. Because these features are highly conceptual at this time, they would require subsequent rigorous site identification and planning, construction methods, impact assessments, and implementation schedules/plans. Because these features would require significant amounts of fill material, consideration would first be given to beneficial use of dredging sources and potential sources within existing dredged material confined disposal facilities (CDFs). These considerations will continue throughout the Feasibility Study Phase and into the Engineering and Design Phase as part of the Tier 2 EIS. A complete discussion of the entire range of NNBF strategies considered can be found in the Natural and Nature-Based Features Appendix G inclusive of key design concepts which are documented in Parts II and III of that Appendix.

2.4.1 Shark River and Coastal Lakes Region

Within the Coastal Lakes Region, due to the highly variable conditions of the various lakes, very few generalizable NNBF responses are possible within this region (Figure xx). The reduction of flood risk is something that must be considered on a lake-by-lake basis. However, the opportunity of terracing or lining lakes with vegetation that could serve as stormwater filters, habitat, and increased recreational amenities is one overall strategy that may be applicable. Other possibilities include the creation of islands within the river itself in order to reduce storm effects to the surrounding coastlines.

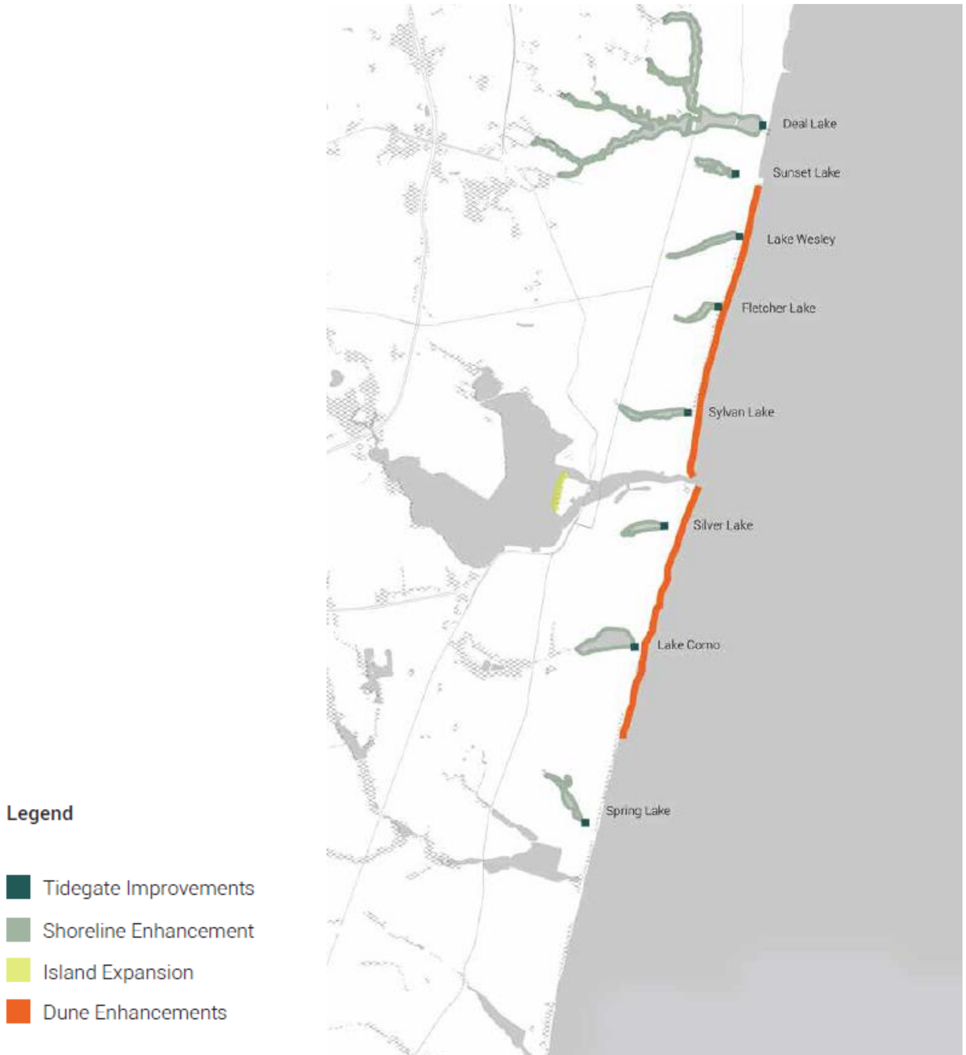


Figure 9. NNBFs within the Shark River/Coastal Lakes Region

2.4.2 North Region

As the largest region of the study, and a collection of somewhat similar conditions throughout the region, the North Region provides the opportunity to study a series of strategies that could be repeatedly deployed at large scale, calibrated to specific conditions. For this report, Barnegat Bay is used as an example for this approach, demonstrating the range of NNBF strategies that could be used at a bay-wide scale to address some of the more ubiquitous conditions there (Figure 101). Since the Holgate cross-bay barrier and the Little Egg-Brigantine Storm Surge Barrier are not included in the TSP, importance is placed on the performance of the Tuckerton Peninsula/Great Bay Boulevard wetland complex and the system of sedge islands to the northeast of the peninsula. Two possible NNBFs are included in this area, including possibilities for the Tuckerton Peninsula and the modifications of the sedge islands to enhance their performance as a surge filter.

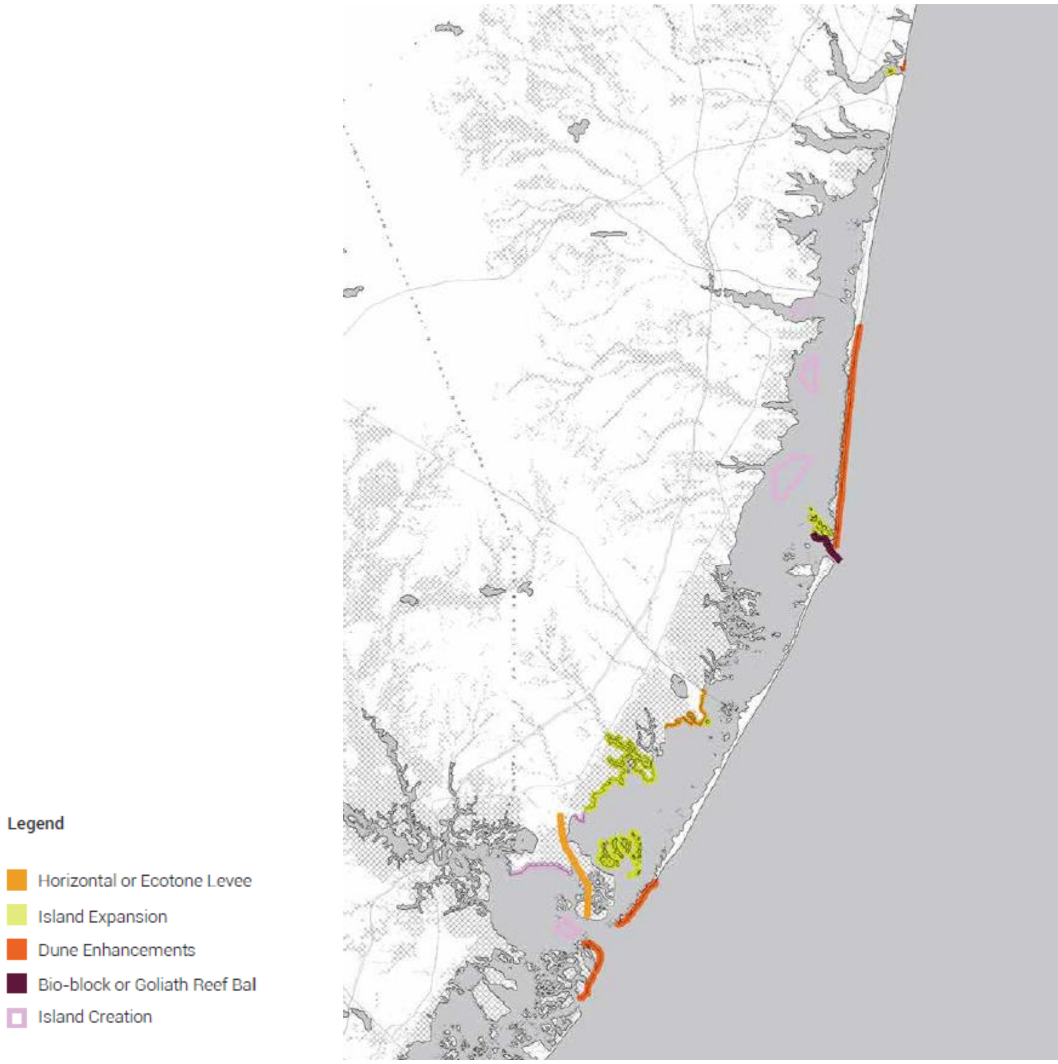


Figure 10. NNBFs within the North Region

2.4.3 Central Region

One of the significant challenges of the Central Region is the flooding of urban areas from the bay during periods of high water. In addition to the aforementioned SSB and cross-bay barriers, there is likely to be some consideration of flood wall or levee construction to protect urban populations on the barrier islands (Figure 102). Horizontal levee opportunities exist in Ocean City. Many previously wetland creation and bayfloor shallowing opportunities exist in this region particularly in and around Reed's Bay given inclusion of the Absecon cross-bay barrier in the TSP.

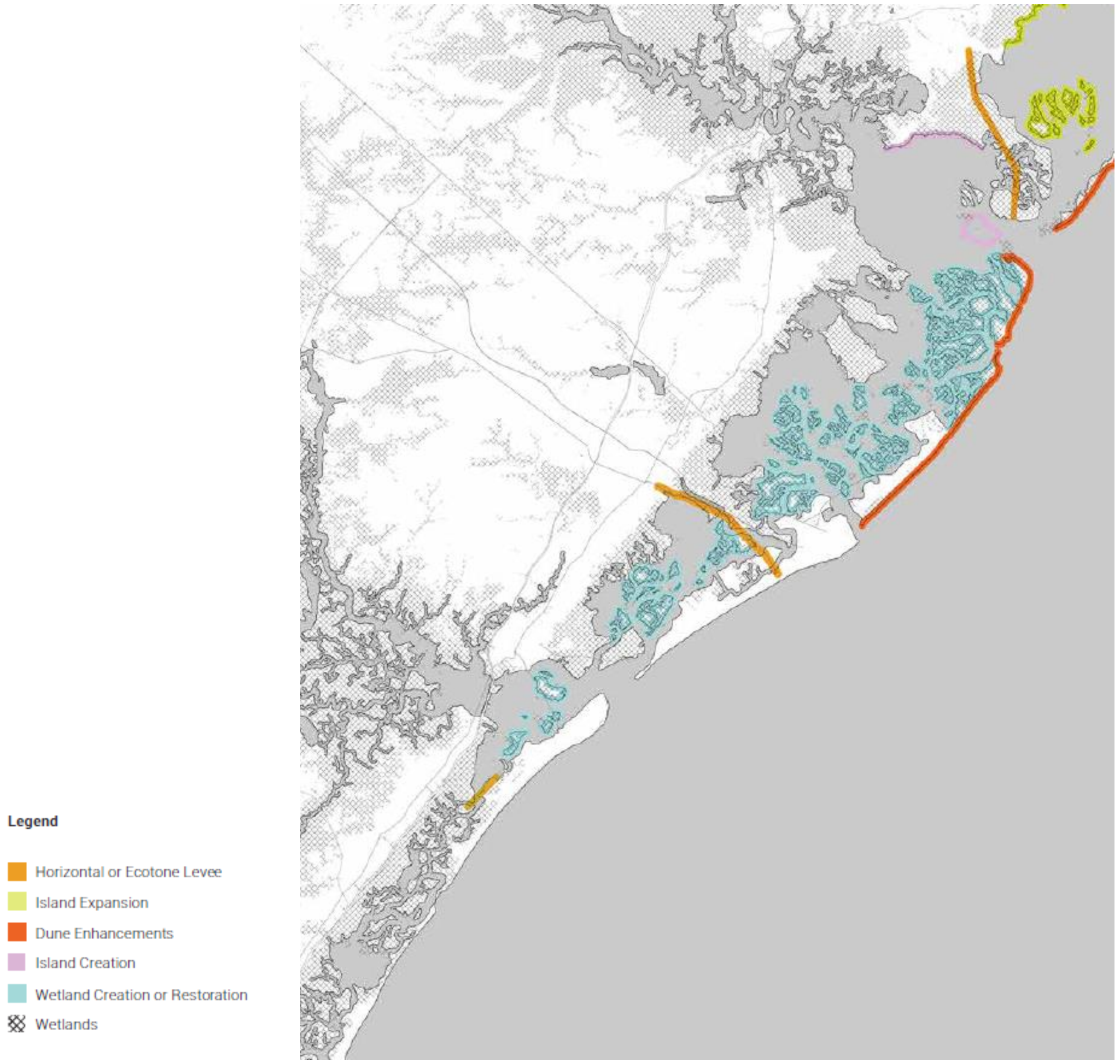


Figure 11. NNBFs within the Central Region

2.4.4 South Region

Due to the infeasibility of structural CSRM measures in the TSP in the South Region, this region will likely require significant investments to enhance wetlands to complement nonstructural strategies in order to provide enhanced storm protection (Figure 103). NNBFs similar to those described for Ocean City above or the wetland enhancement projects described elsewhere in this section may be applicable to the South Region. Dune enhancement and beach nourishment is also possible in this region as a method of protecting barrier island communities. An additional opportunity is the Seven Mile Island Innovation Lab which is a collaborative project between the USACE, the Wetlands Institute, and the State of New Jersey. It is developing innovative methods of sediment management that have significant potential to contribute to CSRM.

Figure 12. NNBFs within the South Region

2.4.5 Pre-construction

Prior to construction investigations may include, wetland delineation, a subsurface geotechnical investigation, and HTRW sampling. These investigations are being developed.

2.4.6 Construction

In-water construction activities for the construction of NNBF include installation and removal of temporary cofferdams, temporary excavations, dredging and filling and rock placement, and wetland/upland vegetation planting. On land construction activities include clearing, grading, excavations, backfilling, movement of construction equipment, and temporary roads.

2.4.7 Operation and Maintenance

As part of the perimeter plan, miter gates will be installed and operated across smaller channels that require navigable access. These gates would remain open during normal conditions and would be closed during significant storm events. Regular maintenance is performed on the gates to keep the system running as designed.

3.0 ESSENTIAL FISH HABITAT

EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act, (PL 94-265 as amended through October 11, 1996 and 1998) 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 could potentially adversely impact essential fish habitat.

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.

Managed fish species are those species that are managed under a federal fishery management plan. Managed fish species for New Jersey and the affected areas of the NJBB study area in the NOAA Fisheries EFH mapper website at . This guide is often used to evaluate the fish species that might be adversely affected by proposed developments within a project area. The coastal estuarine habitats of the project area have been designated as habitat for a number of managed species and their specific life history stages of concern.

EFH assessments also examine the potential effects on prey species for the managed fish species potentially occurring within the area. Prey species 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 project 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.

The study area is designated as Essential Fish Habitat (EFH) for species with Fishery Management Plans (FMPs) and their important prey species. The NOAA National Marine Fisheries EFH Mapper was utilized to identify EFH within the study area of the NJ Back Bays. Point data and EFH species lists were generated by using both the EFH view tool and Data Query Tool. Other sources on EFH were obtained through the NOAA EFH portal or other outside sources. NMFS has identified EFH within 10 minute X 10 minute squares. Figure 13 provides a key of the geographic areas encompassing EFH in the study area, and written descriptions of the EFH geographical areas are provided in Table 4. A total of thirty-nine Federally managed fish species may be found within the study area and are listed in Table 5. Table 5 identifies the life stage of the EFH species listed within that geographic entity and additionally, notes the location of inlets, SSB, and BC in the geographic information provided in the top rows. Table 6 provides a summary of habitat descriptions for the managed species within the NJBB study area. Several of these species including the highly migratory 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.

Table 5 aligns the EFH 10 minute x 10 minute squares with the planning regions and proposed project locations.

Figure 13. NJBB EFH 10 Minute x 10 Minute Square Key

Table 4. NJBB EFH 10 Minute Squares

SQUARE NUMBER	SQUARE COORDINATES (LAT/LONG-DM) SE CORNER	SQUARE DESCRIPTION
1	**4010/7400**	The waters within the square within the southwest 1/4 of the Shrewsbury River northeast of Oceanport, NJ., including the entrance to Parkers Creek, along with the waters east into the Atlantic Ocean east of Ocean Grove, NJ., south down to east of Belmar, NJ., and east of Lake Como and Lake Como, NJ., including the **Shark River Inlet** and the Shark River.
2	**4000/7400**	The waters within the square within the Atlantic Ocean affecting the following: from east of Lake Como, Lake Como, NJ., and Belmar, NJ., on the north, southwest past Spring Lake, NJ., Wreck Pond, Sea Girt, NJ., Brielle, NJ., Manasquan, NJ., Manasquan River**, Manasquan Inlet** (east of Riviera Beach, NJ.), Point Pleasant Beach, NJ., Bay Head, NJ., Mantoloking, NJ., and the northern part of Island Beach, south to Normandy Beach, NJ. Also the waters within the northern part of Barnegat Bay affecting the Metedeconk River southwest of Laurelton, NJ., south of Beaverdam Creek and Wardells Neck, and east of Breton Woods, NJ., and affecting Metedeconk Neck, Kettle Creek, Herring I, Havens Cove, Green I, Silver Pt., Andrew Pt., and Swan Pt.
3	**3950/7400**	Atlantic Ocean waters within the square affecting the following: east of Island Beach from Normandy Beach on the north, south past Chadwick Beach, NJ., Lavalette, NJ., Ortley Beach, NJ., Seaside Heights, NJ., and Seaside Park, NJ., Also, west within Barnegat Bay and east of mainland New Jersey from just north of the Forked River, north past Stouts Creek, Lanoka Harbor, NJ., Cedar Creek, Holly Park, NJ., Potter Creek, Bayville, NJ., Good Luck Pt. east of Ocean Gate, NJ., the Toms River east of Beachwood, NJ. and Toms River, NJ., north of Pine Beach, NJ., and south of Island Heights, NJ., then past Coates Pt., Bay Shore, NJ., Goose Creek, and Tilton Pt. and Applegate Cove, both east of Cedar Grove, NJ., to Silver Bay on the north.
4	**3940/7400**	Waters within the square east within the Atlantic Ocean and west within Barnegat Bay, affecting from just north of Surf City , NJ., north along the northern part of Long Beach past Harvey Cedars, NJ., Loveladies Harbor, NJ., Barnegat Light and **Barnegat Inlet**, the Sedge Islands to Island Beach including waters affecting Clam Island, Vol Sledge and High Bar, and along with the entrance to the Forked River on the mainland, Slope Sedge, Sandy Island, eastern Carvel Island and eastern Harvey Sedges.
5	**3940/7410**	Waters within the square within Barnegat Bay affecting the coast and wetlands east and south of the Forked River and Forked River, NJ., south to the Manahawkin Creek, which is east of the following: Manahawkin, NJ., Cedar Run, NJ., Mayetta, NJ., and Staffordville, NJ. Also, these waters affect the following: Oyster Creek, Waretown, NJ., Waretown Junction, NJ., Barnegat, NJ., Conklin Island and Gulf Pt., the Gunning River, Flat Creek, western Harvey Sedge, western Carvel Island, Bear Island, Main Pt. on Turtle Cove, Pettit Island, and northeastern Manahawkin Bay
6	**3930/7410**	The waters within the square within the Inland New Jersey Bays estuary and the Atlantic Ocean affecting the following: east of New Jersey from Surf City, NJ., southeast to Beach Haven Inlet along most of Long Beach, past Ship Bottom, NJ., Brant Beach, NJ., Beach Haven Crest, NJ., Peahala Park, NJ., Spray Beach, NJ., to Beach Haven, NJ. Also, within southwest Manahawkin Bay and **Little Egg Harbor** (except for the most western part), affecting the following islands: Cedar Bonnet, Flat, Egg, High, Ham, the Marshelder Is. Shelter, Barrel, Hither, and Story, and the wetlands along the coast from just north of Mill Creek, south past Popular Pt., Cedar Run, Horse Pt., Dinner Pt., Dinner Pt. Creek, Westcunk Creek, Long Pt., Parker Cove, Parker Run, Edge Cove east of Tuckerton, NJ., Jeremy Pt., and Shooting Thorofare around Big and Little Sheepshead Creek, West Creek, and Parkertown, NJ.
7	**3930/7420**	The waters within the square within the New Jersey Inland Bay estuary affecting the following: westernmost Little Egg Harbor, Tuckerton Creek of Tuckerton , NJ., the

Table 4. NJBB EFH 10 Minute Squares

SQUARE NUMBER	SQUARE COORDINATES (LAT/LONG-DM) SE CORNER	SQUARE DESCRIPTION
		Seven Islands, and Great Bay, including the wetlands around the Big Thorofare, and waters around Deep Pt. near Roundabout Creek, and around Graveling Pt.
8	**3920/7410**	Atlantic Ocean waters within the square affecting the following: waters within **Little Egg Harbor Inlet** and waters south and east of this inlet. Features affected within this square include Little Beach, Pullen I., **Brigantine Inlet**, Brigantine Shoal, Great Thorofare, and surrounding marshes. There is a large area with numerous research buoys towards the northwest corner of the square just outside of the inlet. ****EFH for winter flounder does not occur south of Lat 39°22' N in this square.**
9	**3920/7420**	Atlantic Ocean waters within the square within the New Jersey Inland Bays estuary affecting the following: Great Bay, Little Bay, Reed Bay, Absecon Bay, and the Atlanitc Ocean. These waters affect Brigantine, N. J., Atlantic City, N. J., **Absecon Inlet**, Egg I., Great Thorofare, Main Marsh Thorofare, Hammock Cove, Doughty Creek, Perch Cove, Simkins Thorofare, Little Mud Thorofare, Mud Thorofare, Brigantine Channel, Black Pt., Grass Bay, Turtle Cove, Somers Cove, Obes Thorofare, Wading Thorofare, Broad Cove, Newfound Thororfare, Beach Thorofare, Great I., Inside Thorofare, Ventnor City, N. J., Smithville, N. J., Leeds Pt., Conovertown, N. J., Oceanville, N. J., Absecon Creek, and surrounding marsh**.** ****EFH for winter flounder does not occur south of Lat 39°22' N in this square.**
10	**3920/7430**	Atlantic Ocean waters within the square within the New Jersey Inland Bays estuary within Lakes Bay, and Scull Bay. These waters affect the following: Pleasantville, NJ.,Lakes Channel, Dock Thorofare, Kiahs I., and Whirlpool Creek. ****EFH for winter flounder does not occur south of Lat 39°22' N in this square.**
11	**3910/7430**	The waters within the square within the Atlantic Ocean and within the New Jersey Inland Bay estuary affecting the following: south of Margate City, N. J. and south and east of Ocean City, N.J. and Peck Beach, within **Great Egg Harbor Bay** and Peck Bay. The following features are also affected by these waters: Risley Channel, Lone Cedar I., Broad Thorofare, Anchorage Pt., Rainbow Is., Somers Pt., Cowpens I., Shooting I., Golders Pt., and Beesleys Pt. These waters extend up into Great Egg Harbor Bay to the boundary of the mixing / seawater salinity zones, which extends from just west of Somers Pt., southwest across the Bay to east of the entrance to the Tuckahoe River. These waters also affect southwest of Peck Beach, along with Crook Horn Creek, Blackmon I., Devils I., **Corson Inlet**, Strathmere, N. J., Whale Beach, N. J., and Middle Thorofare.
12	**3910/7440**	The waters within the square within the Atlantic Ocean within the New Jersey Inland Bay estuary within Ludlow Bay affecting south of Whale Beach, and north of Sea Isle City, N.J. These waters also affect the following: Whale Creek, Main Channel, Flat Creek, Ben Hands Thorofare, and the surrounding marsh.
13	**3900/7440**	The waters within the Atlantic Ocean within the square within the New Jersey Inland Bay estuary affecting from Sea Isle City, N.J. on the northeast corner, southwest to N. Wildwood, N.J., just south of **Hereford Inlet** . These waters affect the following within this square as well: Ludlam Thorofare, Townsend Sound, Mill Thorofare, Middle Thorofare, Mill Creek, Stites Sound, North Channel, Swainton, N.J., **Townsends Inlet**, South Channel, Ingram Thorofare, Graven Thorofare, Long Reach, Great Sound, Gull I., Gull I. Thorofare, Crease Thorofare, Scotch Bonnet, Nichols Channel, Avalon, N.J., Seven Mile Beach, Stone Harbor, N.J., Great Channel, Nummy I., Grassy Sound Channel, Old Turtle Thorofare, Grassy Sound, Beach Creek, **Hereford Inlet**, Dung Thorofare, Drum Thorofare, Jenkins Sound, Mayville, N.J., Shelled Ledge, Jenkins Channel, and N. Wildwood N.J.
14	**3850/7440**	Atlantic Ocean waters within the square within the one square east of the square affecting Cape May, New Jersey, southeast of Wildwood, NJ., from aproximately 1/2

Table 4. NJBB EFH 10 Minute Squares

SQUARE NUMBER	SQUARE COORDINATES (LAT/LONG-DM) SE CORNER	SQUARE DESCRIPTION
		mile down Two Mile Beach east of Wildwood Crest, NJ., north to North Wildwood, NJ., at the **Hereford Inlet**.
15	**3850/7450**	Waters within the square within the Atlantic Ocean surrounding Cape May, N.J., from east of Wildwood Crest, NJ., south around the tip past **Cape May Inlet**, Sewell Pt., Cape May, NJ., Cape May Pt., Cape May Canal, up to just north of North Cape May, NJ. The waters within this square affect THE New Jersey Inland Bay estuary and the following as well: Overfalls Shoal, Eph Shoal, McCrie Shoal, Prissy Wicks Shoal, Middle Shoal, North Shoal, Cape May Channel, Bay Shore Channel, Cape May Harbor, Skunk Sound, Cape Island Creek, Middle Thorofare, Jarvis Sound, Jones Creek, Swain Channel, Taylor Sound, Sunset Lake, and Richardson Channel. The waters on the northwest corner of the square, just south and just west of the tip of the cape, are found within the salt water salinity zone of the Delaware Bay estuary.

Table 5. EFH Species in NJBB Study Area

Table 3. EFH Species in NJBB Study Area	EFH 10x10 Minute Square															Unlikely to occur in study area
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
NJBB Coastal Lakes Region - not further considered																
NJBB Shark River - not further considered																
NJBB North Region		Manasquan		Barnegat					Absecon							
NJBB Central Region									Absecon		GEH / OC					
NJBB South Region															C.May	
Managed Species																
Mid-Atlantic Species*																
Atlantic butterfish *(Peprilus tricanthus)*	JA		JA	JA	JA	JA	JA	EJA	JA	JA	JA	JA	JA	EJA	JA	
Atlantic mackerel (*Scomber scrombrus*)				E	E											
Atlantic surfclam *(Spisula solidissima)*			JA	JA				JA			JA			JA		
Black sea bass *(Centropristus striata)*		JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	
Bluefish *(Pomatomus saltatrix)*	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	
Long finned inshore squid *(Loligo pealei)*	EJA	EJA	EJA	EJA	EJA	EJA	EJA	EJA	JA	JA	JA	JA	EJA	EJA	EJA	
Scup *(Stenotomus chrysops)*			JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	
Spiny dogfish *(Squalus acanthias)*	J_FA	J_FA	J_FA	J_FA	J_FA	J_FA	J_FA	J_FA	J_FA	J_FA	J_FA			J_MJ_FA	J_MJ_FA	
Summer flounder *(Paralicthys dentatus)*		LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	LJA	
New England Species*																
Atlantic sea herring *(* Clupea harengus*)*	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	
Atlantic cod *(Gadus morhua)*		L	E													
Ocean pout *(Macrozoarces americanus*)	A	A	EA	EA	EA	EA	EA									
Pollock (*Pollachius virens*)				L												
White hake (Urophycis tenuis)				E					E		E				E	
Windowpane flounder *(Scopthalmus aquosus)*	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	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**	ELJA**	ELJA**	ELJA**	ELJA**						
Witch flounder (*Glyptocephalus cynoglossus*)				E							E			E		
Yellowtail flounder (*Limanda ferruginea*)		ELJA	E	ELJA										J		
Silver hake/whiting (*Merluccius bilinearis*)	EL	ELA	EL	EL		EL		EL	EL		EL		EL	EL	EL	
Red hake *(Urophycis chuss)*	ELJA	ELJA	ELJA	ELJA	ELJ	ELJ	ELJ	ELJA	ELJ	ELJA	ELJA	ELJ	ELJA	ELJA	ELJA	
Monkfish *(Lophius americanus)*	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	EL	X
Little skate (*Raja erinacea*)	JA	JA	JA	JA	JA	JA	JA	JA	J	JA	JA	JA	JA	JA	JA	
Winter skate (*Raja ocellata*)	JA	J	JA	JA	JA	JA	JA	JA	J	J	J	J	J	J	J	
Clearnose skate (*Raja eglanteria*)	JA	A	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	
Coastal Migratory Pelagic Species																
King mackerel *(Scomberomorus cavalla)*	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	X
Spanish mackerel *(Scomberomorus maculatus)*	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	X
Cobia *(Rachycentron canadum)*	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	ELJA	X
Highly Migratory Species																
Bluefin Tuna (*Thunnus thynnus)*	JA	JA	JA	J									J	J		X
Skipjack Tuna (*Katsuwonus pelamis)*	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	X
Yellowfin Tuna (*Thunnus albacares*)						J	J	J	J	J	J	J	J	J		X
Shark Species																
Sand tiger shark *(Carcharias taurus)*	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJ	NJA	NJA	
Sand tiger shark *(Charcharias taurus) HAPC*															NJA	
Atlantic angel shark *(Squatina dumerili)*													NJA	NJA	NJA	X
Common thresher shark (*Alopias vulpinus)*	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	
Dusky shark *(Charcharinus obscurus)*	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	
Sandbar shark *(Charcharinus plumbeus)*	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	
Sandbar shark *(Charcharinus plumbeus) HAPC*						NJA	NJA	NJA	NJA	NJA					NJA	
Smoothhound shark (Mustelus mustelus)	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	NJA	
Tiger shark *(Galeocerdo cuvieri)*	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	JA	
White shark *(Carcharodon carcharias)*	NJA	NJA	NJA	NJA	NA	N	N	N	N	N	N					

E = eggs, L = larvae, J = juvenile, J_M = juvenile male, J_F = juvenile female, A = adult, N = neonate; GEH = Great Egg Harbor, OC = South Ocean City

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Atlantic butterfish *(Peprilus tricanthus)*	**Habitat:** pelagic waters from outer continental shelf to the lower, high salinity parts of estuaries in the Middle Atlantic Bight. water temperatures between 12-23ºC; estuarine to full strength seawater.		**Habitat:** Pelagic waters in 10 – 360 m, water temperatures between 3°C and 28°C, and a salinity range of 3 to 37%.	**Habitat:** 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*)	**Habitat:** pelagic in waters with salinity >34%			
Atlantic surfclam *(Spisula solidissima)*			**Habitat**: 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	**Habitat**: 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)*			**Habitat:** Demersal waters over rough bottom, shellfish and eelgrass beds, man-made structures in sandy-shelly areas	**Habitat:** 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)*			**Habitat:** Pelagic waters of continental shelf and in Mid Atlantic estuaries from May-Oct. **Prey:** Squid, smaller fish	**Habitat:** Pelagic waters; found in Mid Atlantic estuaries April – Oct. **Prey:** Squid, smaller fish
Longfin inshore squid *(Loligo pealeii)*	**Habitat:** 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.	**Habitat:** pelagic waters near the surface	**Habitat**: 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.	**Habitat:** 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.

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

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)*			**Habitat:** 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	**Habitat:** 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)*			**Habitat:** 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	**Habitat:** 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 *(Paralicthys dentatus)*		**Habitat:** Pelagic waters, nearshore at depths of 10 – 70 m, migrate inshore from Oct – May **Prey**: zooplankton, small crustaceans	**Habitat:** 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	**Habitat:** 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)*			**Habitat:** Pelagic waters and bottom, < 10 C and 15-130 m depths **Prey:** zooplankton (copepods, decapod larvae, cirriped larvae, cladocerans, and pelecypod larvae)	**Habitat:** Pelagic waters and bottom habitats; **Prey:** fish eggs and larvae, chaetognath, euphausiids, pteropods and copepods.

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Atlantic cod (*Gadus morhua*)	**Habitat**: Pelagic in offshore and coastal waters	**Habita**t: Pelagic in offshore and coastal waters; utilize increasing water depths with growth		
Ocean pout *(Macrozoarces americanus*)	**Habitat**: Demersal in high salinity estuaries and bays; spawn in hard-bottom, protected areas (e.g. rocks)			**Habitat**: demersal in high salinity waters; mud and sandy bottom with structure; prey - benthic invertebrates, primarily mollusks and crustaceans
Pollock (*Pollachius virens*)		**Habitat:** Pelagic inshore and offshore waters		
Monkfish *(Lophius americanus)*	**Habitat:** Surface waters, Mar. – Sept. peak in June in upper water column of inner to mid continental shelf	**Habitat:** 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)*	**Habitat:** Surface waters, May – Nov.	**Habitat:** 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.	**Habitat:** Pelagic at 25-30 mm and bottom at 35-40 mm. Young inhabit depressions on open seabed. Older juveniles inhabit shelter provided by shells and shell fragments. **Prey:** small benthic and pelagic crustaceans (decapod shrimp, crabs, mysids, euphausiids, and amphipods) and polychaetes.	**Habitat:** Benthic habitats in the Gulf of Maine and the outer continental shelf and slope in depths of 50 – 750 meters and as shallow as 20 meters in a number of inshore estuaries and embayments as far south as Chesapeake Bay. Shell beds, soft sediments (mud and sand), and artificial reefs, depressions in softer sediments or in shell beds and not on open sandy bottom. **Prey:** crustaceans, variety of demersal and pelagic fish and squid.

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Silver hake/whiting (*Merluccius bilinearis)*	**Habitat:** Pelagic habitats from the Gulf of Maine to Cape May, New Jersey	**Habitat**: Pelagic habitats from the Gulf of Maine to Cape May, New Jersey	**Habitat:** Pelagic and benthic habitats including the coastal bays and estuaries, and on the continental shelf at depths greater than 10 meters in coastal waters in the Mid-Atlantic and between 40 and 400 meters on the continental shelf in the Mid-Atlantic, on sandy substrates. Juvenile silver hake are found in association with sand-waves, flat sand with amphipod tubes, and shells, and in biogenic depressions.	
White hake (*Urophycis tenuis*)	**Habitat:** Occur near the surface in pelagic habitats			
Windowpane flounder *(Scopthalmus aquosus)*	**Habitat:** Surface waters <70 m, mixed and high salinity zones; Feb-July; Sept-Nov.	**Habitat:** Initially in pelagic waters, then bottom <70m,. May-July and Oct-Nov. **Prey:** copepods and other zooplankton	**Habitat:** 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	**Habitat:** 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)*	**Habitat:** Estuarine 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	**Habitat:** 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	**Habitat**: 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	**Habitat:** 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
Witch flounder (*Glyptocephalus cynoglossus*)	**Habitat:** Pelagic habitats on the continental shelf throughout the Northeast region			

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Yellowtail flounder (*Limanda ferruginea*)	**Habitat:** Coastal and continental shelf pelagic habitats including high salinity zones of bays and estuaries	**Habitat:** Coastal and continental shelf pelagic habitats including high salinity zones of bays and estuaries	**Habitat:** Sub-tidal benthic habitats in coastal waters; sand and muddy sand between 20 and 80 meters	**Habitat:** Sub-tidal benthic habitats in coastal waters including high salinity zones of bays and estuaries; sand and sand with mud, shell hash, gravel, and rocks at depths between 25 and 90 meters
Clearnose skate (*Raja egianteria*)			**Habitat:** 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)	**Habitat:** 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*)			**Habitat:** 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	**Habitat:** 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*)			**Habitat:** 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	**Habitat:** 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

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
King mackerel *(Scomberomorus cavalla)*	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone.	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone **Prey:** Zooplankton, fish eggs	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone **Prey:** Zooplankton, shrimp, crab larvae, squid, herring	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone
Spanish mackerel *(Scomberomorus maculatus)*	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone. Migratory	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone. Migratory **Prey:** Zooplankton, fish eggs	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone. Migratory **Prey:** Zooplankton, shrimp, crab larvae, squid, herring	**Habitat:** Pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone. Migratory **Prey:** Squid, herring, silverside, lances
Bluefin Tuna (*Thunnus thynnus)*			**Habitat:** 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	**Habitat:** Offshore and coastal waters from Gulf of Maine to mouth of Chesapeake Bay and Onslow Bay, NC; forage off eastern U.S. and Canada from June through March; migrate to spawning grounds in April - June); utilize upper 10 m of water column at temperatures between 16 and 19°C **Prey:** opportunistic; schooling fish, cephalopods, and benthic invertebrates, including silver hake, Atlantic mackerel, Atlantic herring, krill, sandlance, menhaden, and squid
Skipjack Tuna (*Katsuwonus pelamis*)				**Habitat:** 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.

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
				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*)			**Habitat**: 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	
Sand tiger shark *(Odontaspis taurus)*		**Habitat:** Shallow coastal waters, bottom or demersal; Delaware Bay and adjacent coastal areas, when water temperatures are from 19 to 25°C, salinities of 23-30 ppt at depths of 2.8-7.0 m in sand and mud areas	**Habitat:** Shallow coastal waters, bottom or demersal; Delaware Bay and adjacent coastal areas where temperatures range from 19 to 25°C, salinities range from 23 to 30 ppt at depths of 2.8 -7.0 m in sand and mud areas; migrate from area in fall	**Habitat:** Shallow coastal waters in the Atlantic along the mid-east coast of Florida through Delaware Bay, bottom or demersal. Spend 95% of time in lower Chesapeake Bay and Delaware Bay in waters between 17 and 23°C; migrate from area in fall **Prey**: Crabs, squid, small fish
Sand tiger shark (*Odontaspis taurus*) HAPC		Lower portions of Delaware Bay to areas adjacent to the mouth of Delaware Bay for all life stages, spanning the mouth of Delaware Bay and includes adjacent coast areas offshore of Delaware Bay and areas south		
Atlantic angel shark (*Squatina dumerili*)		**Habitat:** Shallow coastal waters	**Habitat:** Shallow coastal waters	**Habitat:** Shallow coastal waters, bottom (sand or mud near reefs)
Common thresher shark (*Alopias vulpinus*)		**Habitat:** Shallow coastal waters	**Habitat:** Shallow coastal waters	**Habitat:** Shallow coastal waters
Dusky shark *(Charcharinus obscurus)*		**Habitat:** Shallow coastal waters		

Table 6. NJBB EFH Life Stages Identified in EFH Mapper

MANAGED SPECIES	EGGS	LARVAE	JUVENILES	ADULTS
Sandbar shark *(Charcharinus plumbeus)*		**Habitat:** Shallow coastal waters; migrate to warmer waters in the fall; return to natal grounds as juveniles for the summer	**Habitat:** 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	**Habitat:** 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
Sandbar shark (*Charcharinus plumbeus*) HAPC		Important nursery and pupping grounds in shallow areas in lower and middle Delaware Bay, associated with 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 and mud habitats		
Smoothhound shark (*Mustelus mustelus*)		**Habitat:** Shallow coastal waters		
Tiger shark *(Galeocerdo cuvieri)*			**Habitat:** Shallow coastal waters to the 200 meter isobath	**Habitat:** Shallow coastal waters to the 200 meter isobath
White shark *(Carcharodon carcharias)*		**Habitat**: Inshore and offshore waters from Cape May, MA to Ocean City, NJ	**Habitat:** Inshore waters to 105 km from shore, in temperatures ranging from 9 to 28° C from Cape Ann, MA to Barnegat Bay, NJ	**Habitat:** Inshore waters to 105 km from shore, in temperatures ranging from 9 to 28°C from Cape Ann, MA to Barnegat Bay, NJ

Table 7. Comparison of EFH 10 minute X 10 minute squares, planning regions, and proposed project components

Study Region	**Description**			**EFH 10x10 square**
Coastal Lakes Region				EFH NA
Shark River Region	no project components			1,2
North Region	Manasquan to Little Egg Inlet			2,3,4,5,6,7,8,9
Central Region	Brigantine to Corsons Inlet			8,9,10,11,12
South Region	Strathmere to Cape May			11,12,13,14,15
NJBB TSP alternatives	**Measure**	**Region**	**Location of Structural Components**	**Corresponding EFH 10' x 10' squares**
2A	NS	Shark River		NA
3E(2)	SSB+NS	North	SSB - Barnegat and Manasquan Inlets	2,3,4,5,6,7,8,9
4G(8)	SSB+NS+BC	Central	SSB - Great Egg Harbor Inlet, BC - Absecon Blvd	8,9,10,11,12
5A	NS + BC	South	BC - South Ocean City	11,12,13,14,15
NJBB alternatives - Further Analysis Warranted				
3A	NS	North		NA
4A	NS	Central		NA
4D(2)	PP+NS	Central	PP - Ocean City, Absecon Island, and Brigatine Island	8,9,10,11,12
5D(2)	PP+NS	South		11,12,13,14,15

3.1 Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPC) are areas of EFH that are judged to be particularly important to the long-term productivity of populations of one or more managed species, or to be particularly vulnerable to degradation (NOAA, 1999a). Species-related HAPC's were identified in three areas within the study area. Additionally, submerged aquatic vegetation (SAV) beds in the back bays system are considered HAPC. A HAPC exists near the mouth of the Delaware Bay, which includes the entrance to the Cape May Inlet on the Delaware Bay side for the sand tiger shark (*Carcharias taurus*), and two HAPC areas exist for the sandbar shark (*Charcharinus plumbeus*) occurring in the lower Delaware Bay (including the entrance to Cape May Inlet) and the Great Bay estuary complex including Little Egg Inlet, Little Bay, Reed Bay, Absecon Bay, Lakes Bay, and Absecon Inlet along with the nearshore Atlantic Ocean along Brigantine Island and the northern half of Absecon Island. HAPCs occur within the study area for summer flounder (*Paralicthys dentatus*) in areas where "all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH is HAPC."

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. Figures 6 – 9. depict available mapping of SAV beds in the back bays system. 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).

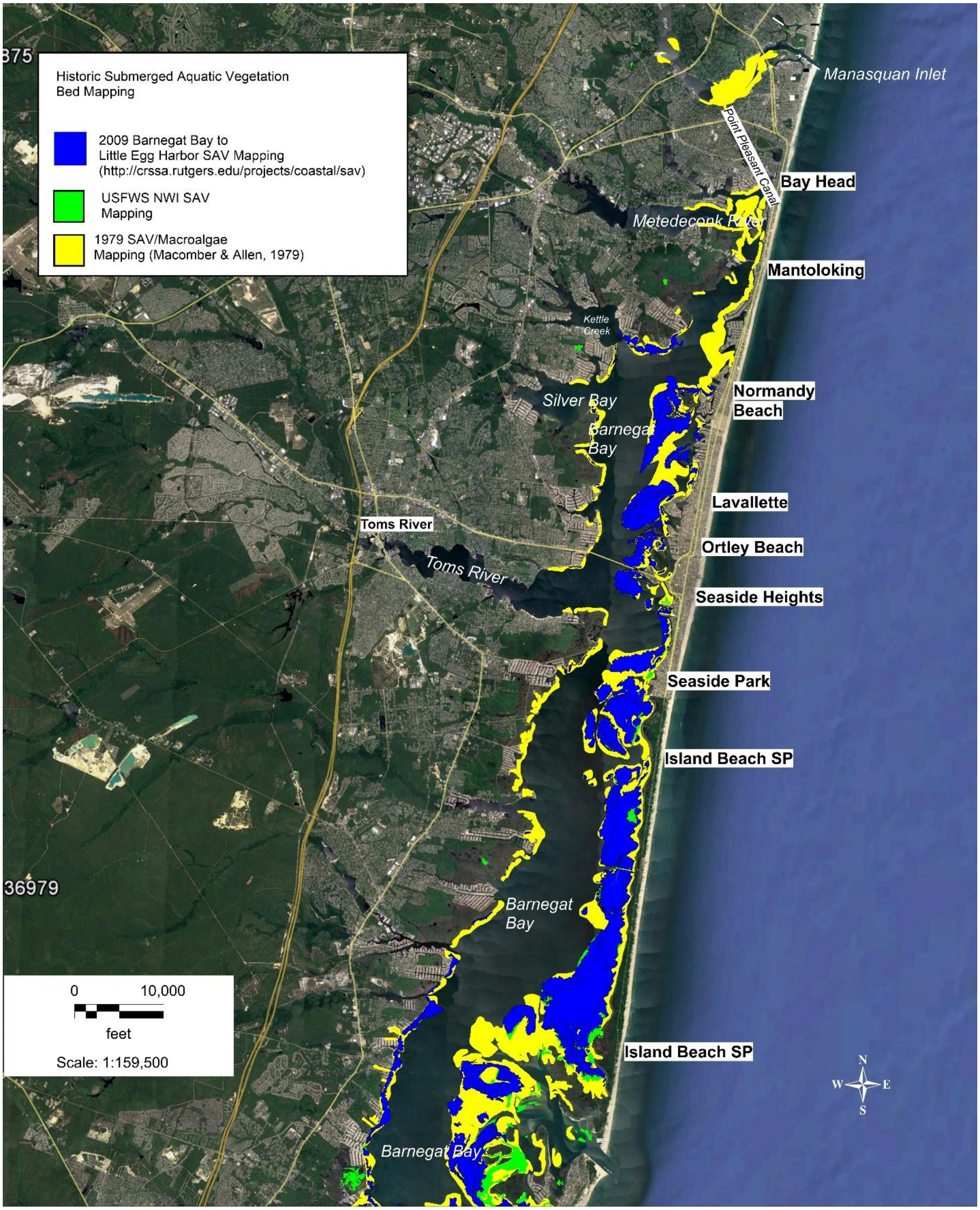


Figure 14. Available SAV mapping – North Region, part 1

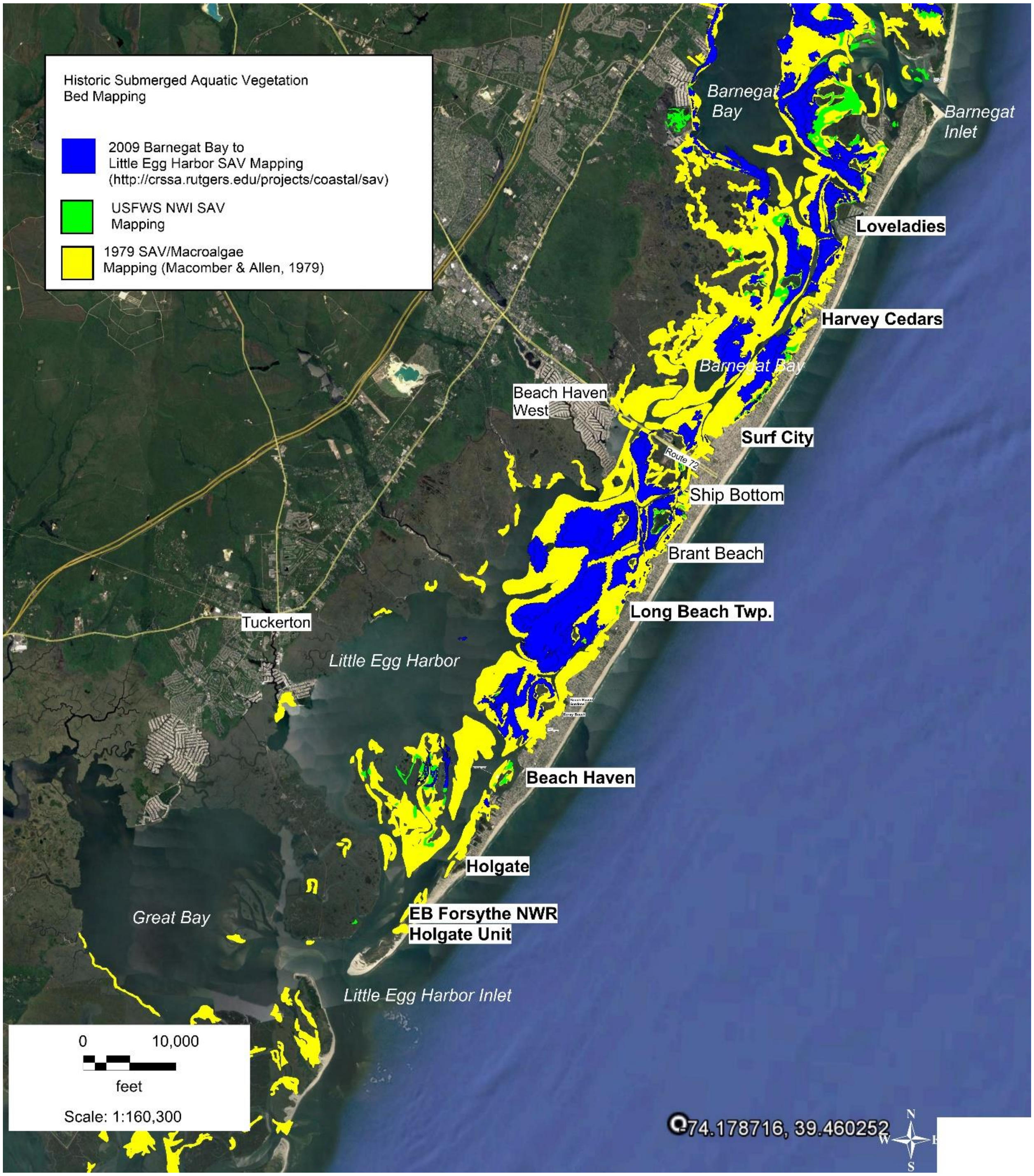


Figure 15. Available SAV mapping – North Region, part 2

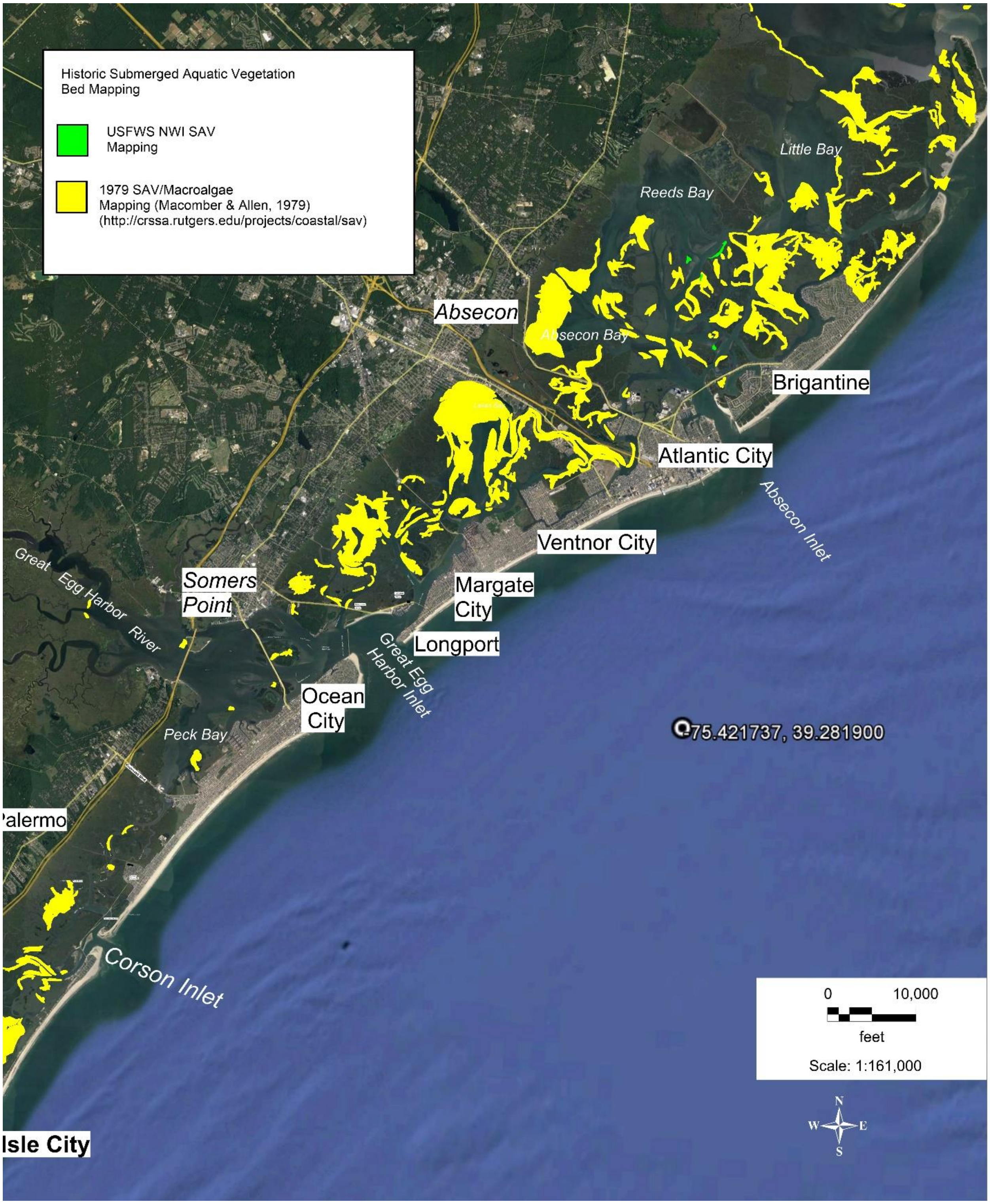


Figure 16. Available SAV mapping – Central Region

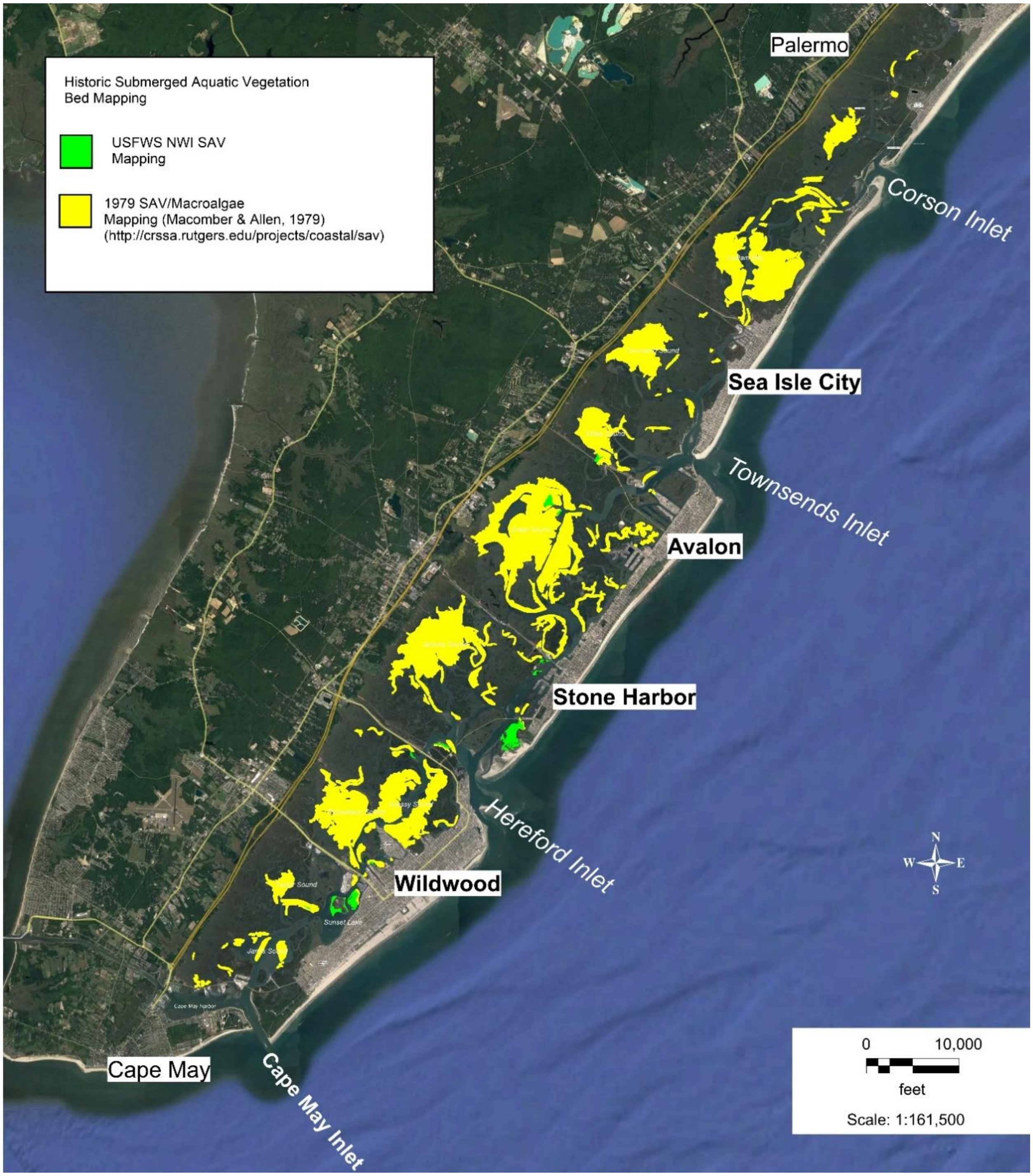
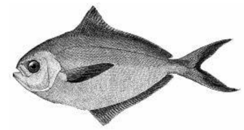


Figure 17. Available SAV mapping – South Region

3.2 Mid-Atlantic Species

3.2.1 Atlantic Butterfish (*Peprilus triacanthus*)



The project site is designated as EFH for Atlantic butterfish eggs, juveniles, and adults. The habitat parameters for the applicable life stages are as follows.

Eggs and Larvae: Butterfish eggs and larvae are pelagic and occur from the outer continental shelf to the lower, high salinity parts of estuaries in the Middle Atlantic Bight. Eggs have been collected between 12 – 23ºC and larvae have been collected between 4 – 28ºC; eggs and larvae occur at salinities that range from estuarine to full strength seawater. No larvae EFH is identified within the affected areas.

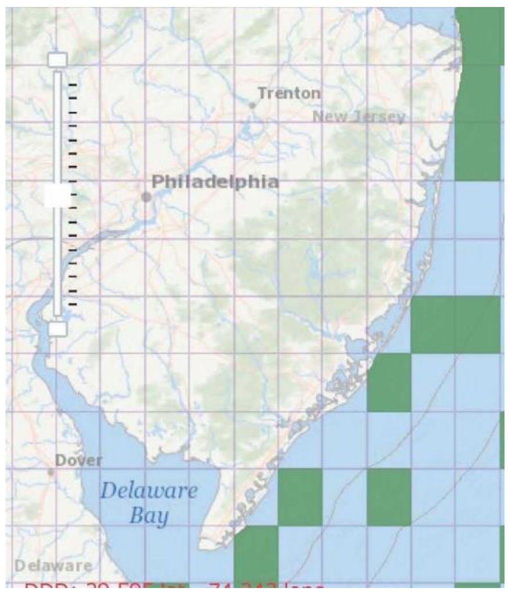


Figure 18. Atlantic Butterfish Egg EFH

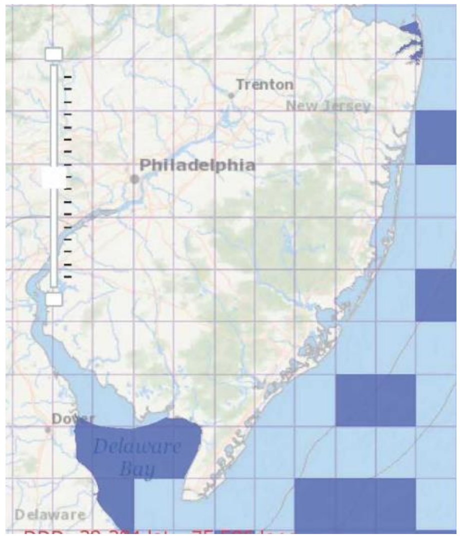


Figure 19. Atlantic Butterfish Larvae EFH

Juveniles: Generally, juvenile butterfish are pelagic, and occur in water depths between 10 and 365 meters, water temperatures between 3°C and 28°C, and a salinity range of 3 to 37%.

Adults: Juvenile and adult butterfish are pelagic and are common to abundant in the high salinity and mixing zones of estuaries from Massachusetts Bay to the mid-Atlantic. Generally, adult butterfish occur in 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 and small fishes.

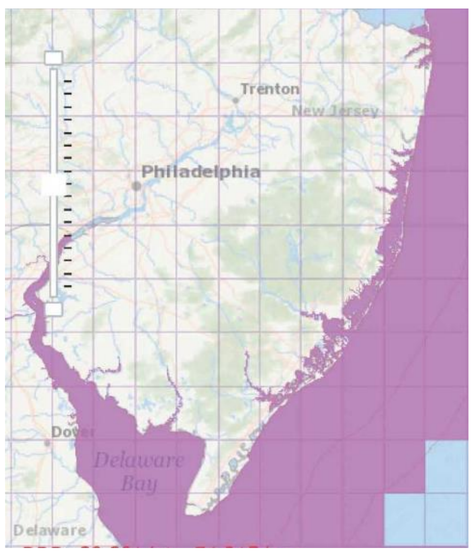


Figure 20. Atlantic Butterfish Juvenile EFH

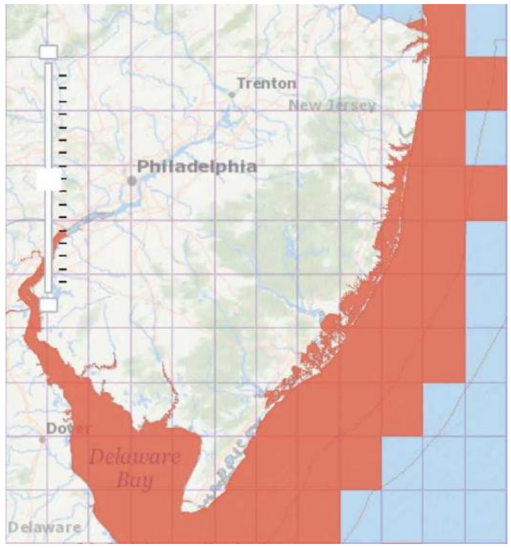
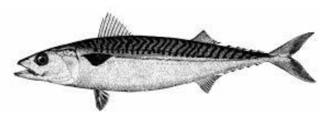


Figure 21. Atlantic Butterfish Adult EFH

3.2.2 Atlantic mackerel (*Scomber scrombrus*) (NMFS, 1999)



Some of the affected areas of the NJBB are designated as EFH for Atlantic mackerel eggs, which is primarily located within Atlantic Ocean nearshore waters, and within Barnegat Inlet and Bay. The habitat parameters for the applicable life stages are as follows.

Eggs: Eggs are pelagic in salinities over 34%, and can be found floating in surface waters above the thermocline or in the upper 10 – 15 meters of the water column at a mean temperature of 11°C.

Larvae: No EFH identified within affected areas.

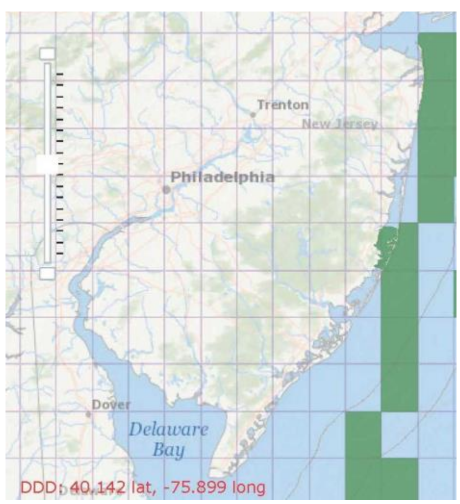


Figure 22. Atlantic Mackerel Egg EFH

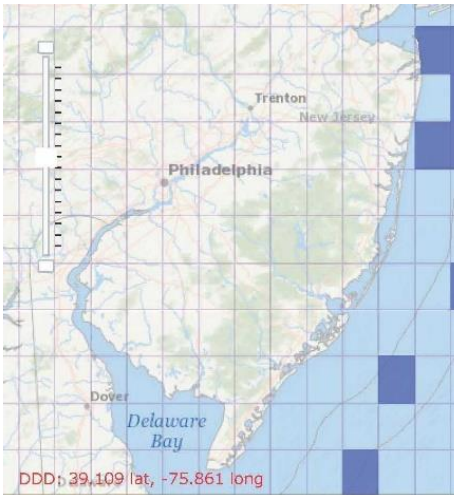


Figure 23. Atlantic Mackerel Larval EFH

Juveniles: No EFH identified within affected areas.

Adults: No EFH identified within affected areas.

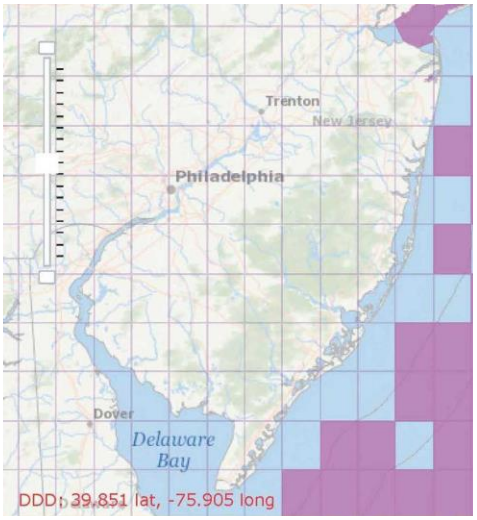


Figure 24. Atlantic Mackerel Juvenile EFH

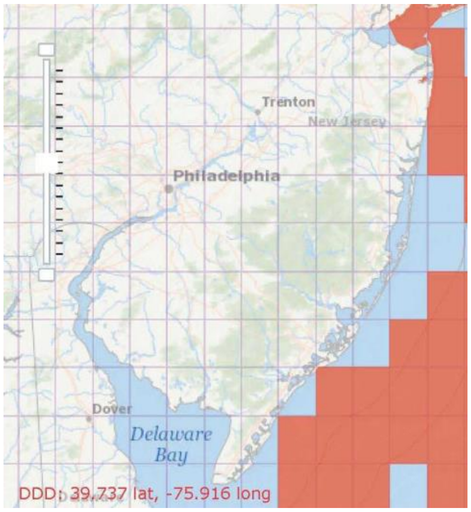


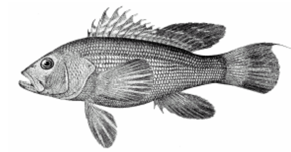
Figure 25. Atlantic Mackerel Adult EFH

3.2.3 Atlantic surfclam (*Spisula solidissima*) (NMFS, 1999)

Juveniles and Adults: Some of the affected areas of the NJBB are designated as EFH for juvenile and adult Atlantic surfclam, which is primarily located within Atlantic Ocean continental shelf waters in fine to medium sands in turbulent waters just beyond the breakers in depths of 8 to 66 m. Juvenile and adult Atlantic surfclams are benthic, and are primarily found in salinities greater than 28%, and are susceptible to low dissolved oxygen. Because of their habitat requirements, this species is more likely to be found in high energy inlet ebb and flood shoal complexes of inlets within the affected areas.

Figure 26. Atlantic Surfclam Juvenile and Adult EFH

3.2.4 Black sea bass (*Centropristus striata*) (NMFS, 2007)



The project site is designated as EFH for black sea bass juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles: Juvenile black sea bass are demersal, and are usually found in association with rough bottom, shellfish and eelgrass beds, and man-made structures in sandy-shelly areas. Typical conditions are: water temperatures less than 6°C, water depths between 1 and 38 meters, and salinities less than 18%.

Adults: Demersal on structured habitats including rocky reefs, cobble and rock fields, stone coral patches, exposed stiff clay, and mussel beds and man-made structures. Sand and shell are usually the substrate preference of adult black sea bass. Typical conditions are: water temperatures less than 6°C, water depths between 20 and 50 meters, and salinities less than 20%.

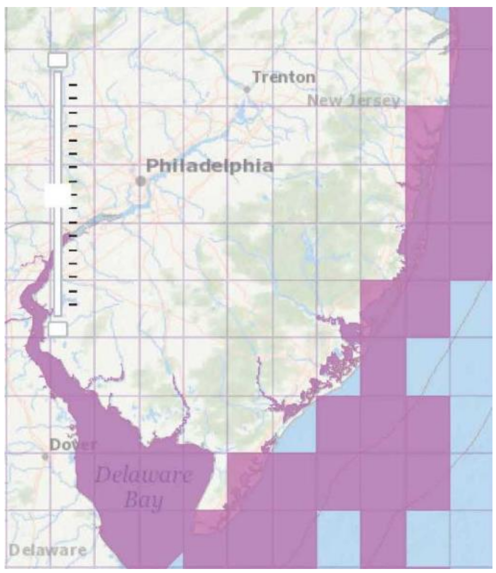


Figure 27. Black Seabass Juvenile EFH

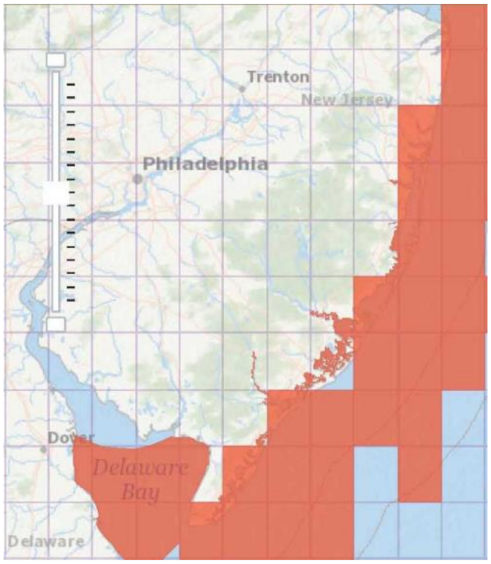
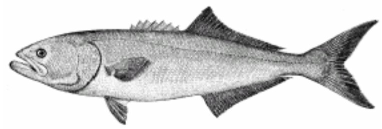


Figure 28. Black Seabass Adult EFH

Prey: Juveniles, which are diurnal, visual predators, prey on benthic and epibenthic crustaceans (isopods,amphipods, small crabs, sand shrimp, copepods, mysids) and small fish. Adult black sea bass are generalist carnivores that feed on a variety of infaunal and epibenthic invertebrates, especially crustaceans (including juvenile American lobster *Homarus americanus*, crabs, and shrimp) small fish, and squid.

3.2.5 Bluefish (*Pomatomus saltatrix*) (NMFS, 2006)

The project site is designated as EFH for bluefish juveniles and adults. The habitat parameters for the applicable life stages are as follows:



Juveniles: Generally juvenile bluefish are pelagic in habits and occur in estuaries from May through October. Typical conditions for juveniles are water temperatures between 19°C and 24°C and salinities between 23 and 36%.

Adults: Adult bluefish are pelagic and found in Mid-Atlantic estuaries from April through October. Typical conditions for adults are water temperatures from 14°C to 16°C and salinities greater than 25%.

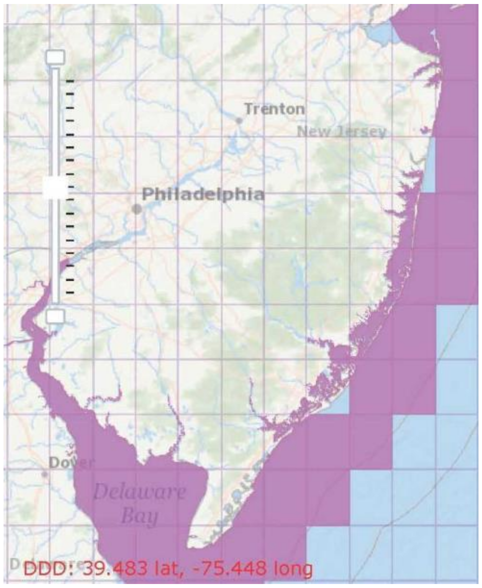
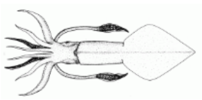


Figure 29. Bluefish Juvenile EFH

Figure 30. Bluefish Adult EFH

Prey: Juvenile and adult bluefish have a very widespread and varied diet of invertebrates and fishes.

Long finned inshore squid (*Loligo pealei*) (NMFS, 2005)



Eggs: 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.

Juveniles: Pre-recruits 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. Typical conditions for pre-recruit juveniles are found at water temperatures between 10°C and 26°C and salinities between 31.5 and 34%.

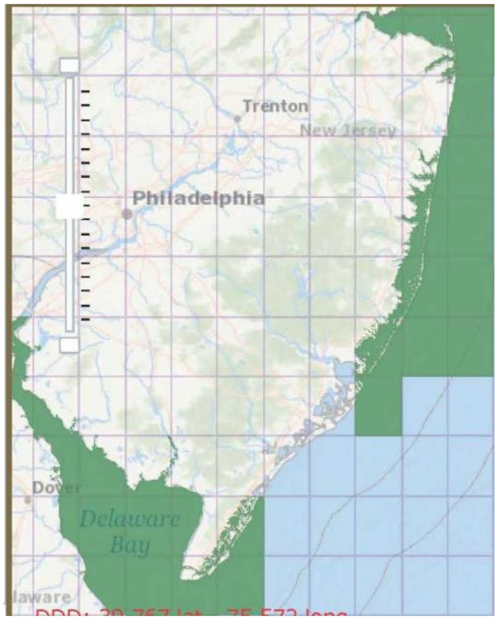


Figure 31. Long Finned Inshore Squid Egg EFH

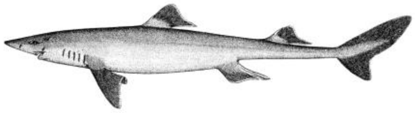
Figure 32. Long Finned Inshore Squid Juvenile EFH

Adults: Adult recruits 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. Adults are typically found in surface temperatures ranging from 9 to 21°C, and bottom temperatures ranging from 8 to 16°C. They are typically found on mud or sand/mud substrate. Adults, like juveniles, migrate up and down in the water column in response to light conditions.

Figure 33. Long Finned Inshore Squid Adult EFH

Prey: Juveniles may feed on euphausiids, arrow worms, small crabs, polychaetes and shrimp. Adults may feed on fish (clupeids, myctophids, silver hake, mackerel,herring, menhaden, sand lance, bay anchovy, weakfish, and silversides) and other squid larvae/juveniles.

3.2.6 Spiny dogfish *(Squalus acanthias)* (NMFS, 2007)



The affected areas are designated as EFH for spiny dogfish sub-adult males, sub-adult females, adult males and adult females. The habitat parameters for the applicable life stages are as follows:

Sub-adult males and sub-adult females: EFH is identified for sub-adult males along the southern NJ coast, while sub-adult females have a widespread distribution in NJ coastal waters. Spiny dogfish are demersal by day, but may vertically migrate at night to feed. Spiny dogfish prefer muddy/silty and sandy bottoms in polyhaline baymouths and contenintal slope waters in depths of 1-500 m. Summer and fall bring seasonal migrants into outer estuaries where the water is cooler and more saline. North-south migrations of spiny dogfish are also documented.

Figure 34. Spiny Dogfish Sub-Adult Male EFH

Figure 35. Spiny Dogfish Sub-Adult Female EFH

Spiny dogfish adults: EFH for adult males and females is widely distributed in NJ coastal waters, and have similar habitat requirements as sub-adults.

Prey: Flatfishes, blennies, sculpins,capelin, ctenophores, jellyfish, polychaetes,sipunculids, amphipods, shrimps, crabs, snails,octopods, squids, and sea cucumbers off the U.S. east coast.

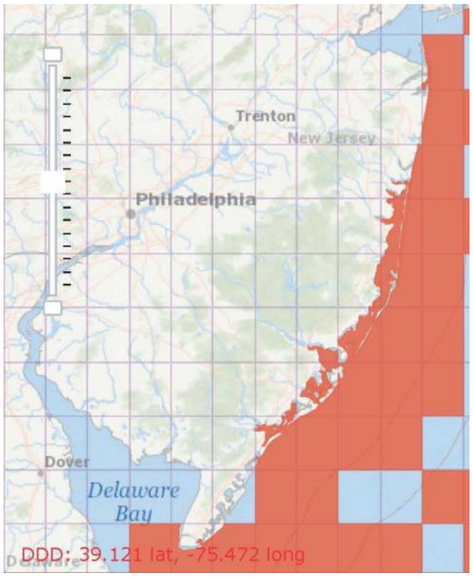
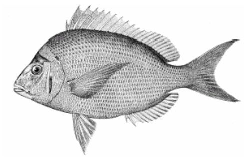


Figure 36. Spiny Dogfish Adult Male EFH

Figure 37. Spiny Dogfish Adult Female EFH

3.2.7 Scup (*Stenotomus chrysops*) (NMFS, 1999)



The project site is designated as EFH for scup juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles: In general, juvenile scup during the spring and summer are found in estuaries and bays, and are demersal in association with various sands, mud, mussel, and eelgrass bed type substrates, between the shore and water depths of 38 meters. Typical conditions are: water temperatures above 7°C (45°F) and salinities greater than 15%.

Adults: Adult scup are common residents in the Middle Atlantic Bight from spring to fall and are generally demersal, and found in schools on a variety of habitats, from open sandy bottom to structured habitats such as mussel beds, reefs or rough bottom. Smaller-sized adult scup are common in larger bays and estuaries but larger sizes tend to be in deeper waters. Generally, adult scup are found in water temperatures above 7°C, water depths between 2 and 185 meters, and salinities greater than 15%. Seasonally, wintering adults (November through April) are usually offshore.

Prey: Juveniles primarily eat: polychaetes (e.g., maldanids, nephthids, nereids, and flabelligerids), epibenthic amphipods and other small crustaceans, mollusks, and fish eggs and larvae. Adult scup are also benthic feeders and forage on a variety of prey, including small crustaceans (including zooplankton), polychaetes, mollusks, small squid, vegetable detritus, insect larvae, hydroids, sand dollars, and small fish.

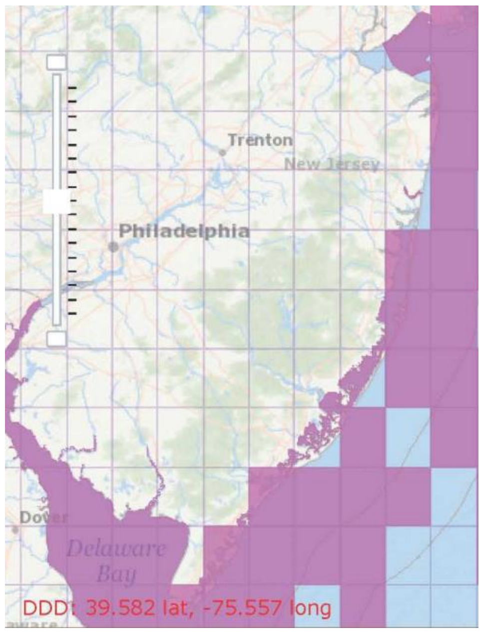


Figure 38. Scup Juvenile EFH

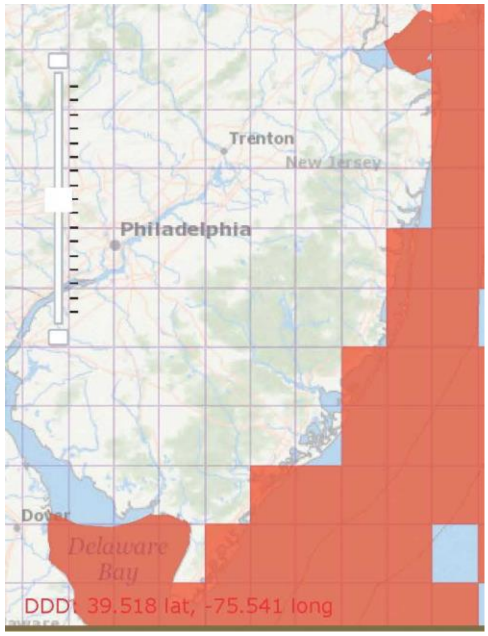
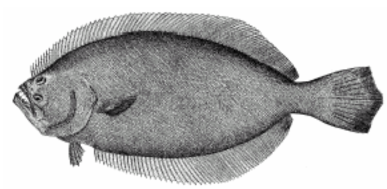


Figure 39. Scup Adult EFH

3.2.8 Summer flounder *(Paralicthys dentatus)* (NMFS, 1999)



The affected areas are designated as EFH for summer flounder larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Larvae: In general, summer flounder larvae are pelagic in habit, and most abundant nearshore at water depths between 10 and 70 meters, in water temperatures between 9°C (48 °F) and 12°C (53°F), and salinities between 23 to 33‰. From October to May, larvae and postlarvae migrate inshore, entering coastal and estuarine nursery areas to complete transformation.

Juveniles: In general, juveniles are demersal in habit (mud and sandy substrates), and use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 11°C (52°F), water depths from 0.5 to 5 meters, and salinities ranging from 10 to 30%.

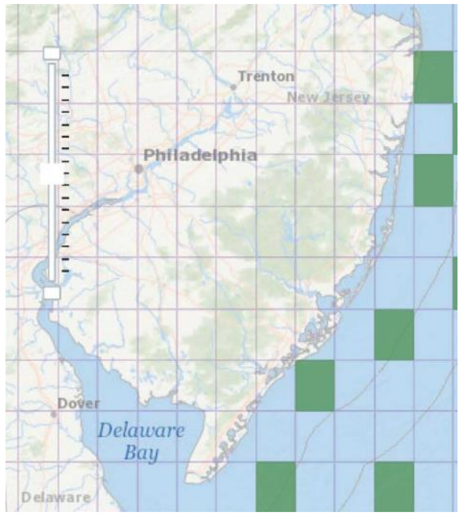


Figure 40. Summer Flounder Egg EFH

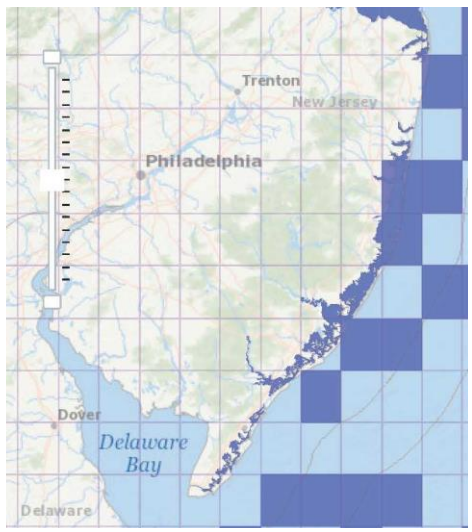


Figure 41. Summer Flounder Larvae EFH

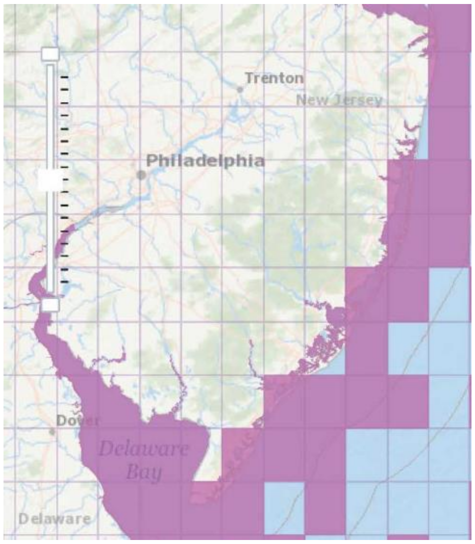


Figure 42. Summer Flounder Juvenile EFH

Figure 43. Summer Flounder Adult EFH

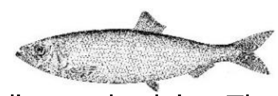
Adults: Generally, summer flounder are demersal in habit (mud and sandy substrates), and occur in water depths between the shore and 25 meters. Seasonally, they inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer Continental Shelf at depths of 150 meters in colder months.

Prey: Larval and postlarval summer flounder initially feed on zooplankton and small crustaceans**.** Smaller juvenile flounder (usually <100 mm) appear to focus on crustaceans and polychaetes while fish become a little more important in the diets of the larger juveniles. Adult summer flounder are opportunistic feeders with fish and crustaceans making up a large part of their diet, which include: windowpane, winter flounder, northern pipefish, Atlantic menhaden, bay anchovy, red hake, silver hake, scup, Atlantic silverside, sand lance, bluefish, weakfish, mummichog, rock crabs, squids, shrimps, small bivalves, small gastropods, sand dollars, and marine worms.

HAPC: HAPC for summer flounder was identified as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH is HAPC. Macroalgae and seagrass beds occur throughout the study area particularly in the Barnegat Bay/Little Egg Harbor estuaries where summer flounder HAPC are likely to be encountered.

3.3 New England Species

3.3.1 Atlantic Sea Herring (*Clupea harengus*) (NMFS, 2005) (NEFMC, 2017)



The affected areas are designated as EFH for Atlantic sea herring juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles: Intertidal and sub-tidal pelagic habitats to 300 meters throughout the region including the NJ inland bays and estuaries. One and two-year old juveniles form large schools and make limited seasonal inshore-offshore migrations. Older juveniles are usually found in water temperatures of 3 to 15°C (37 - 59°F) in the northern part of their range and as high as 22°C (72°F) in the Mid-Atlantic. Young-of-the-year juveniles can tolerate low salinities, but older juveniles avoid brackish water.

Adults: Sub-tidal pelagic habitats with maximum depths of 300 meters throughout the region including the NJ inland bays and estuaries. Adults make extensive seasonal migrations between summer and fall spawning grounds on Georges Bank and the Gulf of Maine and overwintering areas in southern New England and the Mid-Atlantic region. They seldom migrate beyond a depth of about 100 meters and – unless they are preparing to spawn – usually remain near the surface. They generally avoid water temperatures above 10°C (50°F) and low salinities. Spawning takes place on the bottom, generally in depths of 5 – 90 meters on a variety of substrates.

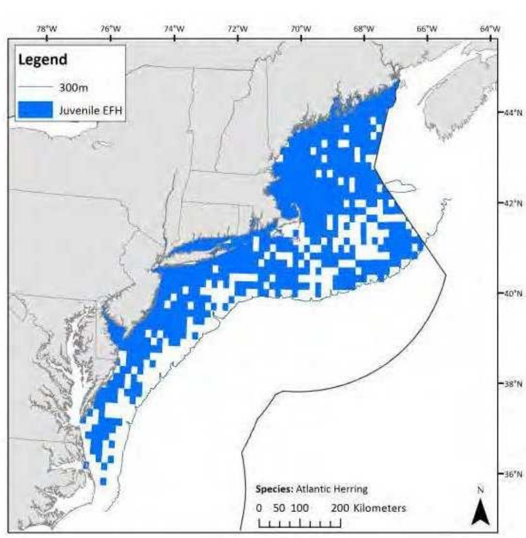


Figure 44. Atlantic Sea Herring Juvenile EFH

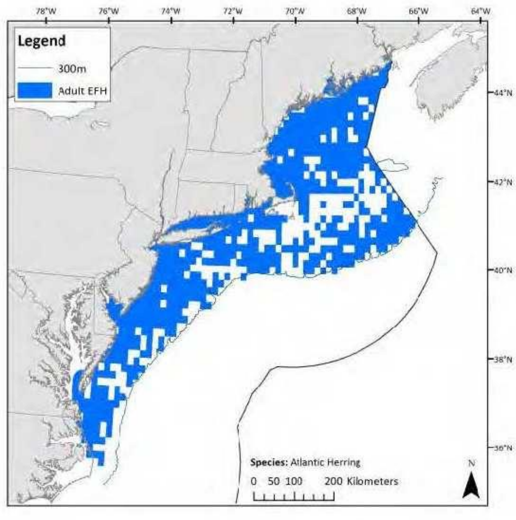
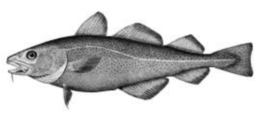


Figure 45. Atlantic Sea Herring Adult EFH

Prey: Juveniles feed on up to 15 different groups of zooplankton; the most common are copepods, decapod larvae, barnacle larvae, cladocerans, and molluscan larvae (Sherman and Perkins 1971). Adults have a diet dominated by euphausiids, chaetognaths, and copepods (Bigelow and Schroeder 1953; Maurer and Bowman 1975). In addition, adults also consume fish eggs and larvae, including larval herring, sand lance, and silversides.

3.3.2 Atlantic Cod *(Gadus morhua)* (NMFS, 2004)



The affected area has a limited designation as EFH for Atlantic cod eggs and larvae. The habitat parameters for the applicable life stages are as follows:

Eggs: Atlantic cod eggs are pelagic with wide distribution in offshore and coastal waters from the Gulf of Maine to Cape Hatteras.

Larvae: Atlantic cod larvae are pelagic and occur from near-surface to depths of 75 m, and they move deeper with growth as they transform into a more bottom-oriented fish. Atlantic cod larval distribution is similar to the egg distribution.

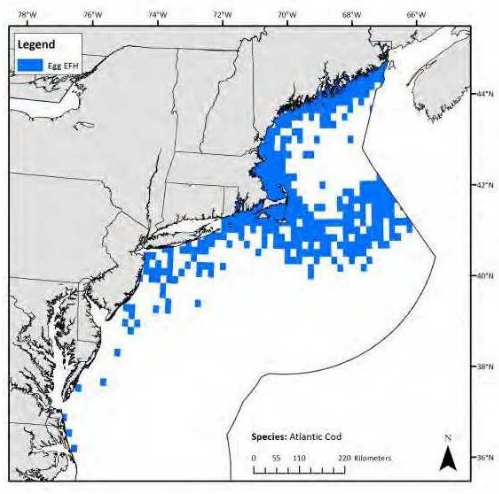


Figure 46. Atlantic Cod Egg EFH

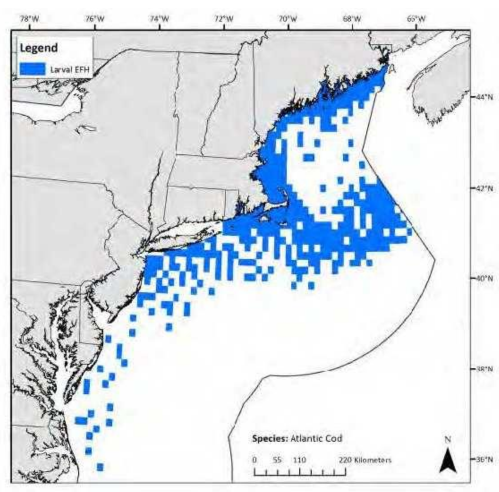


Figure 47. Atlantic Cod Larval EFH

3.3.3 Ocean Pout *(Macrozoarces americanus)* (NMFS, 1999) (NEFMC, 2017)

The affected areas are designated as EFH for ocean pout eggs and adult. The habitat parameters for the applicable life stages are as follows:

Eggs: Ocean pout eggs are demersal in offshore and high salinity zones of bays and estuaries. Spawning occurs on hard bottom protected habitats, such as rock crevices and man-made artifacts, where eggs are deposited in guarded nests.

Larvae: No larvae EFH identified in affected areas.

Juveniles: No Juvenile EFH identified in affected areas.

Adults: Generally are demersal in subtidal benthic habitats 20 to 140 meters in depth, but can be found in high salinity zones of bays and estuaries. Associated with mud and sandy bottoms that have structure such as shells, gravel or boulders.

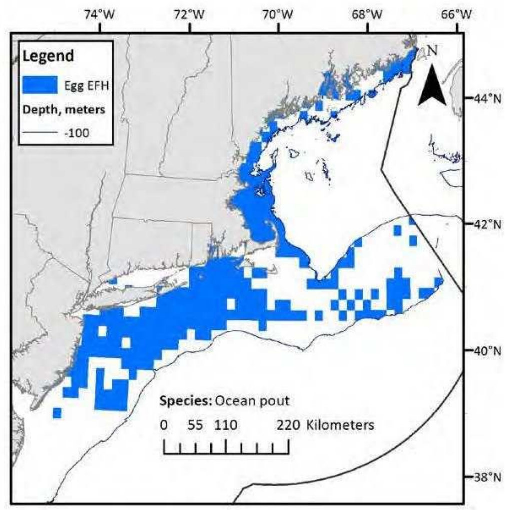


Figure 48. Ocean Pout Egg EFH

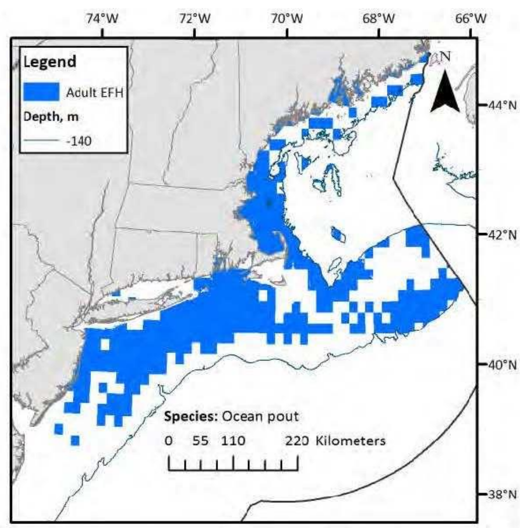
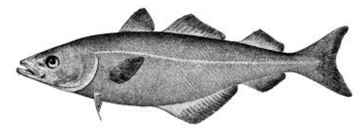


Figure 49. Ocean Pout Adult EFH

Prey: Principal prey items are benthic invertebrates consisting primarily of mollusks and crustaceans.

3.3.4 Pollock (*Pollachius virens*) (NEFMC, 2017) (NMFS, 1999)



The affected areas are designated as EFH for pollock larvae. The habitat parameters for the applicable life stages are as follows:

Larvae: Pelagic inshore and offshore habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region. The identified EFH square is located at Barnegat Inlet/Bay and Ocean.

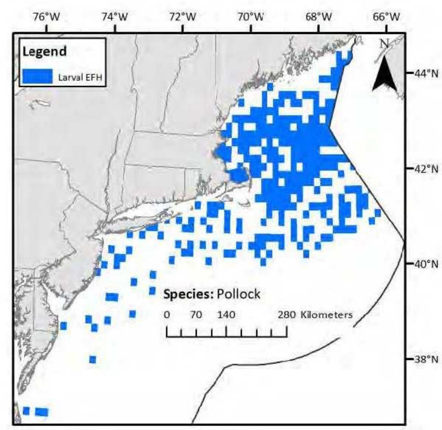
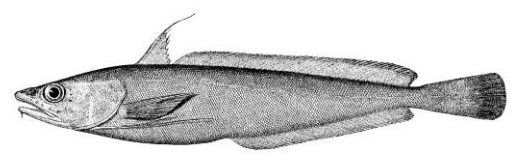


Figure 50. Pollock Larval EFH

3.3.5 White hake (*Urophycis tenuis*) (NMFS, 1999) (NEFMC, 2017)



The affected areas are designated as EFH for white hake eggs. The habitat parameters for the applicable life stages are as follows:

Eggs: Occur near the surface in pelagic habitats in the Gulf of Maine, including Massachusetts and Cape Cod bays, and the outer continental shelf and slope. Figure 43 shows several locations along the NJ Coast where white hake egg EFH is present.

Larvae: No larvae EFH identified in affected areas.

Juveniles: No juvenile EFH identified in affected areas.

Adults: No adult EFH identified in affected areas.

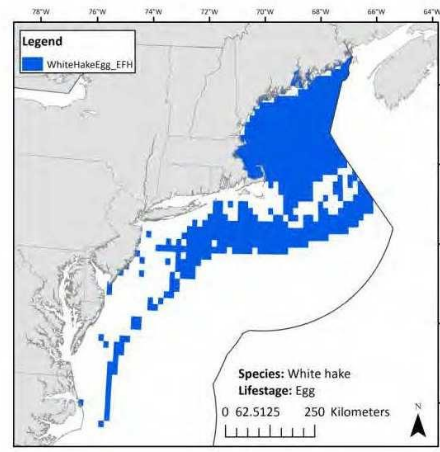
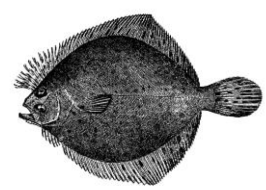


Figure 51. White Hake Egg EFH

3.3.6 Windowpane Flounder *(Scopthalmus aquosus)* (NMFS, 1999) (NEFMC, 2017)



The affected areas are designated as EFH for windowpane eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Eggs and Larvae: Pelagic habitats on the continental shelf from Georges Bank to Cape Hatteras and in mixed and high salinity zones of coastal bays and estuaries throughout the region.

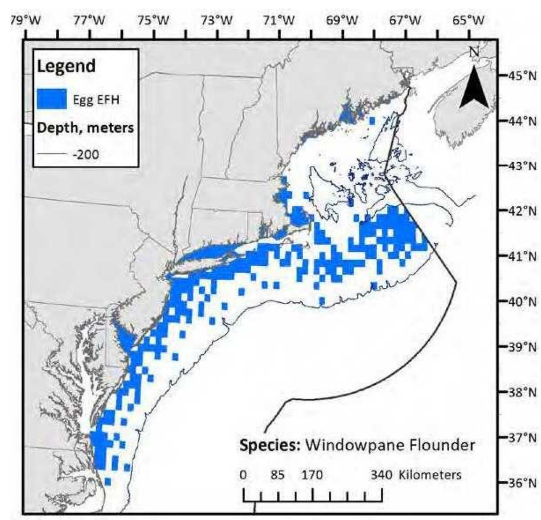


Figure 52. Windowpane Flounder Egg EFH

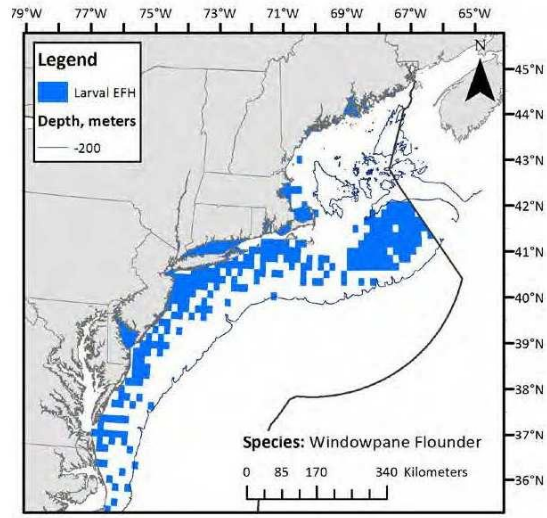


Figure 53. Windowpane Flounder Larval EFH

Juveniles: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida, including mixed and high salinity zones in the bays and estuaries. EFH for juveniles is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 60 meters. Young-of-the-year juveniles prefer sand over mud

Adults: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to Cape Hatteras including mixed and high salinity zones in the bays and estuaries. Essential fish habitat for adults is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 70 meters.

Prey: Small crustaceans (e.g., mysids and decapod shrimp) and various fish larvae including hakes and tomcod, as well as their own species.

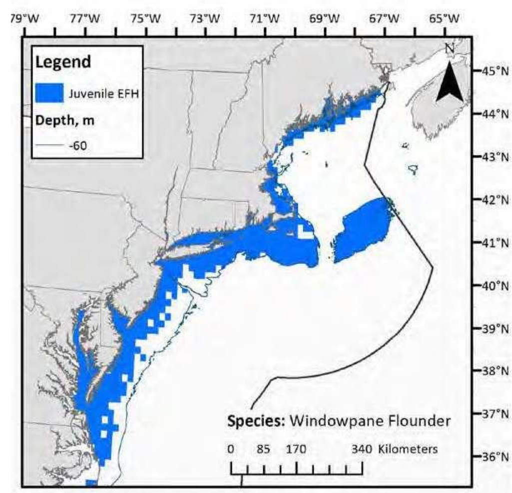


Figure 54. Windowpane Flounder Juvenile EFH

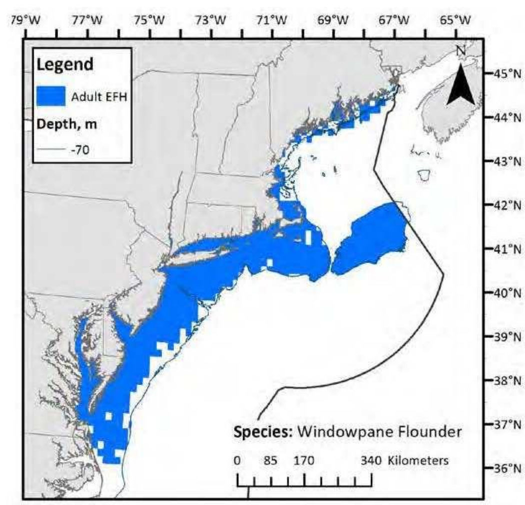
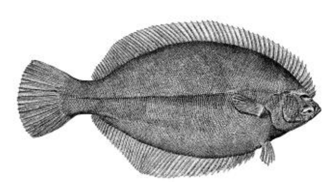


Figure 55. Windowpane Flounder Adult EFH

3.3.7 Winter flounder (*Pleuronectes americanus*) (NMFS, 1999) (NEFMC, 2017)



The affected areas are designated as EFH for winter flounder eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Eggs: Sub-tidal estuarine and coastal benthic habitats from mean low water to 5 meters from Cape Cod to Absecon Inlet (39° 22' N), and as deep as 70 meters on Georges Bank and in the Gulf of Maine including mixed and high salinity zones in the bays and estuaries. The eggs are adhesive and deposited in clusters on the bottom. Essential habitats for winter flounder eggs include mud, muddy sand, sand, gravel, macroalgae, and SAV. Bottom habitats are unsuitable if exposed to excessive sedimentation which can reduce hatching success.

Larvae: Pelagic. Estuarine, coastal, and continental shelf water column habitats from the shoreline to a maximum depth of 70 meters from the Gulf of Maine to Absecon Inlet (39° 22’ N) and including Georges Bank including mixed and high salinity zones in the bays and estuaries. Larvae hatch in nearshore waters and estuaries or are transported shoreward from offshore spawning sites where they metamorphose and settle to the bottom as juveniles. They are initially planktonic but become increasingly less buoyant and occupy the lower water column as they get older.

Juveniles: Estuarine, coastal, and continental shelf benthic habitats from the Gulf of Maine to Absecon Inlet (39° 22’ N), and including Georges Bank, and in mixed and high salinity zones in the bays and estuaries. EFH for juveniles extends from the intertidal zone (mean high water) to a maximum depth of 60 meters and occurs on a variety of bottom types, such as mud, sand, rocky substrates with attached macroalgae, tidal wetlands, and eelgrass. Young-of-the-year juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. They tend to settle to the bottom in soft-sediment depositional areas where currents concentrate late-stage larvae and disperse into coarser-grained substrates as they get older.

Adults: 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), and including Georges Bank, and in mixed and high salinity zones in the bays and estuaries. EFH for adults occurs on muddy and sandy substrates, and on hard bottom on offshore banks. In inshore spawning areas. EFH includes a variety of substrates where eggs are deposited on the bottom.

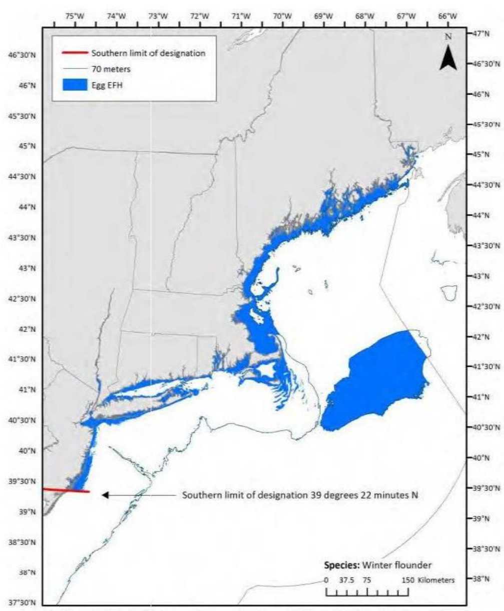


Figure 56. Winter Flounder Egg EFH

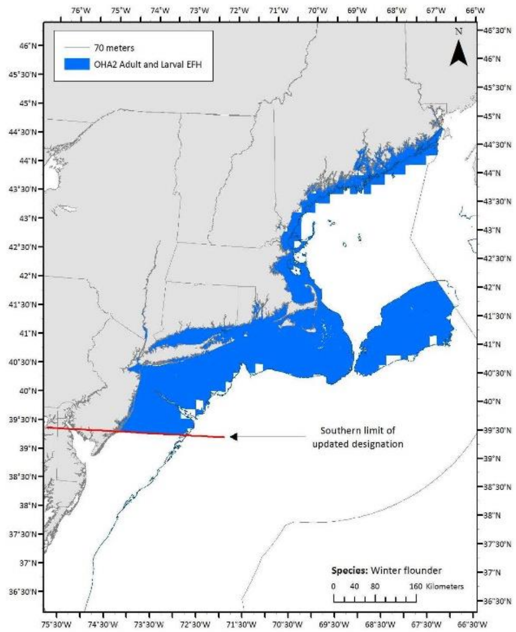
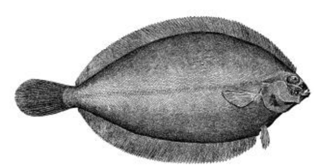


Figure 57. Winter Flounder Larval and Adult EFH

Prey: Larvae- nauplii, harpacticoids, calanoids, polychaetes, invertebrate eggs, and phytoplankton. Juveniles and adults - Polychaetes and crustaceans (mostly amphipods) generally make up the bulk of the diet, but also include bivalves, capelin eggs and fish.

3.3.8 Witch flounder (*Glyptocephalus cynoglossus*) (NMFS, 1999) (NEFMC, 2017)



The affected areas are designated as EFH for witch flounder eggs. The habitat parameters for the applicable life stages are as follows:

Eggs: Pelagic habitats on the continental shelf throughout the Northeast region.

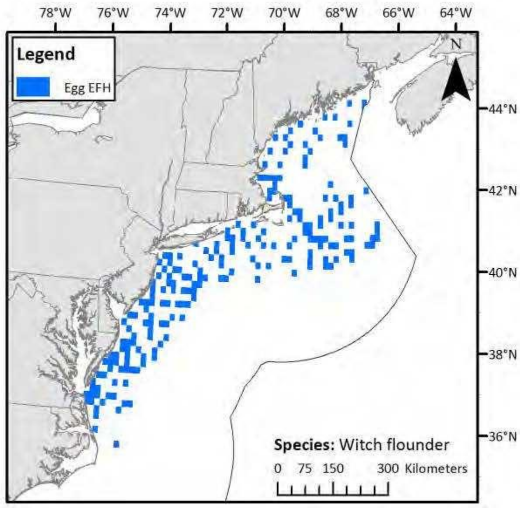
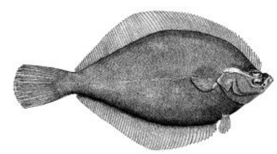


Figure 58. Witch Flounder



3.3.9 Yellowtail flounder (Limanda ferruginea) (NMFS, 1999) (NEFMC, 2017)

The affected areas are designated as EFH for yellowtail flounder eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Eggs: Occur in coastal and continental shelf pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region as far south as the upper Delmarva Peninsula, including the high salinity zones of the bays and estuaries.

Larvae: Occur in coastal and continental shelf pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region as far south as the upper Delmarva Peninsula, including the high salinity zones of the bays and estuaries.

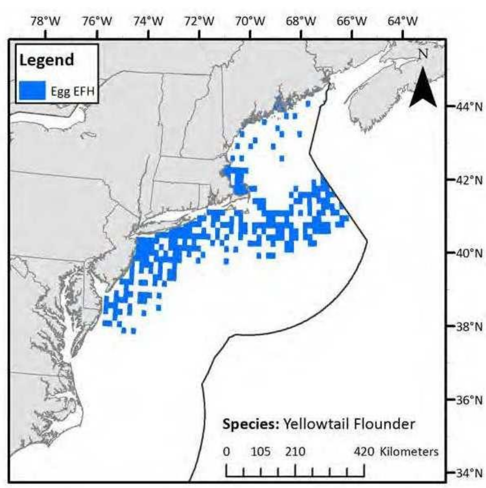


Figure 59. Yellowtail Flounder Egg EFH

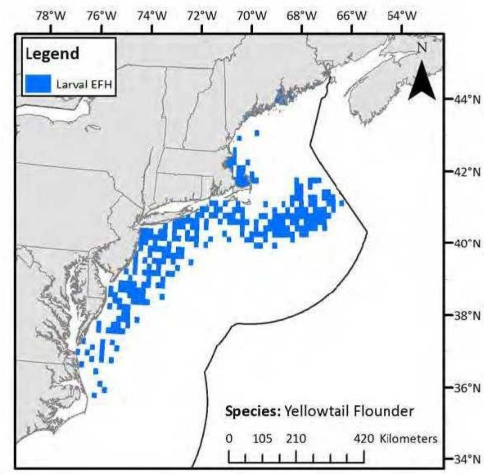


Figure 60. Yellowtail Flounder Larval EFH

Juveniles: Sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic including the high salinity zones of the bays and estuaries. Essential fish habitat for juvenile yellowtail flounder occurs on sand and muddy sand between 20 and 80 meters. In the Mid- Atlantic, young-of-the-year juveniles settle to the bottom on the continental shelf, primarily at depths of 40-70 meters, on sandy substrates.

Adults: Sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic including the high salinity zones of the bays and estuaries. Essential fish habitat for adult yellowtail flounder occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 25 and 90 meters.

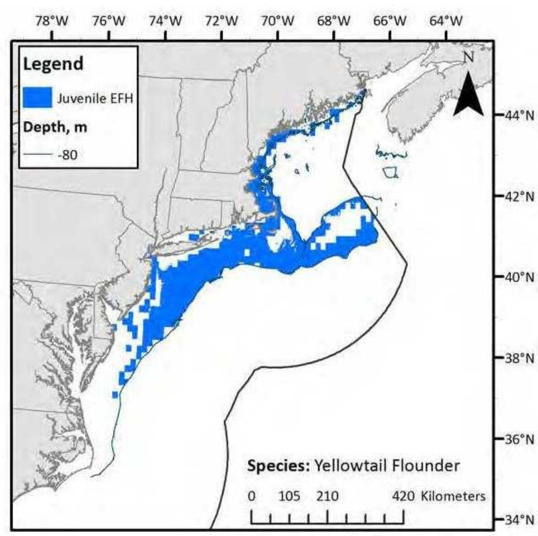


Figure 61. Yellowtail Flounder Juvenile EFH

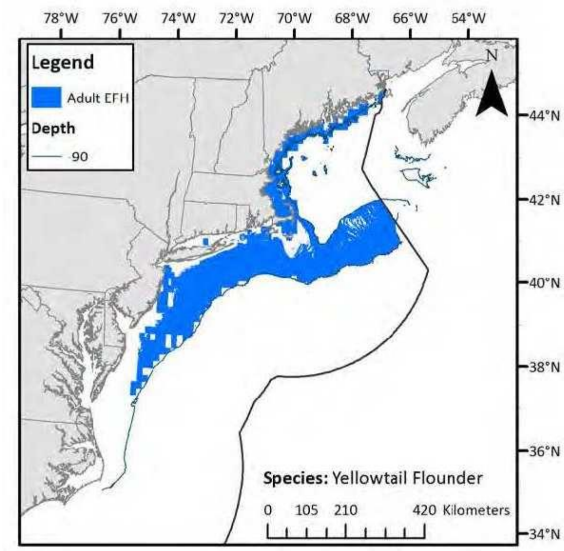
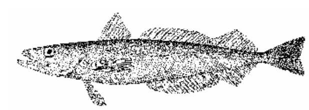


Figure 62. Yellowtail Flounder Adult EFH

Prey: The diet of yellowtail flounder are primarily benthic macrofauna consisting of amphipods and polychaetes. Juveniles primarily prey on polychaetes whereas, adults primarily prey on crustaceans.

3.3.10 Silver hake (whiting) (*Merluccius bilinearis*) (NMFS, 2004) (NEFMC, 2017)



The affected areas are designated as EFH for silver hake eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Eggs and Larvae: Pelagic habitats from the Gulf of Maine to Cape May, New Jersey, including Cape Cod and Massachusetts Bays.

Juveniles: Pelagic and benthic habitats in the Gulf of Maine, including the coastal bays and estuaries, and on the continental shelf as far south as Cape May, New Jersey, at depths greater than 10 meters in coastal waters in the Mid-Atlantic and between 40 and 400 meters in the Gulf of Maine, on Georges Bank, and in the middle continental shelf in the Mid- Atlantic, on sandy substrates. Juvenile silver hake are found in association with sand-waves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juveniles in the New York Bight settle to the bottom at mid-shelf depths on muddy sand substrates and find refuge in amphipod tube mats.

Adults: Pelagic and benthic habitats at depths greater than 35 meters in the Gulf of Maine and the coastal bays and estuaries between 70 and 400 meters on Georges Bank and the outer continental shelf in the northern portion of the Mid-Atlantic Bight, and in some shallower locations nearer the coast, on sandy substrates. Adult silver hake are often found in bottom depressions or in association with sand waves and shell fragments. They have also been observed at high densities in mud habitats bordering deep boulder reefs, resting on boulder surfaces, and foraging over deep boulder reefs in the southwestern Gulf of Maine. This species makes greater use of the water column (for feeding, at night) than red or white hake.

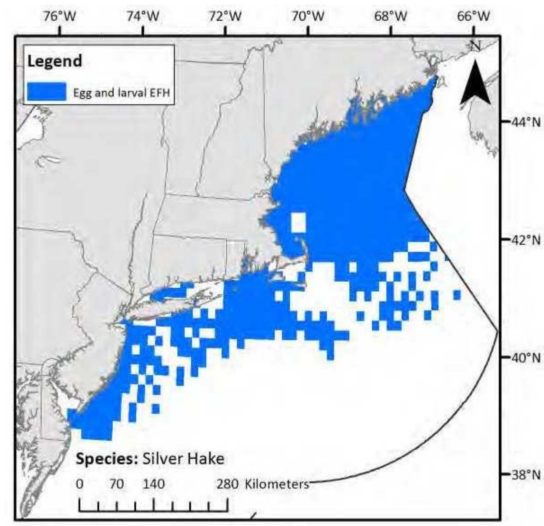


Figure 63. Silver Hake Eggs and Larval EFH

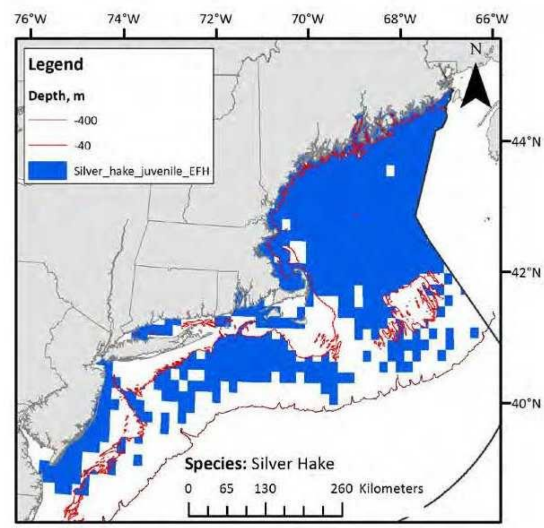


Figure 64. Silver Hake Juvenile EFH

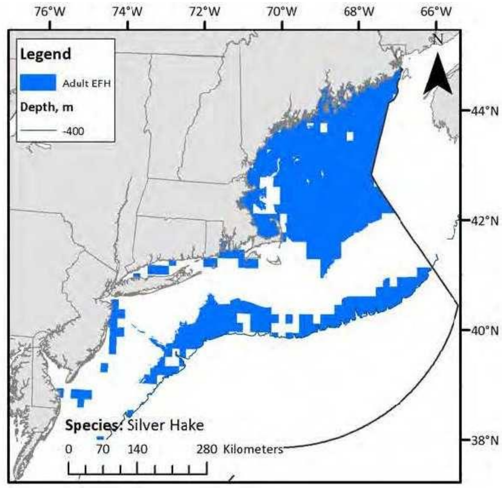
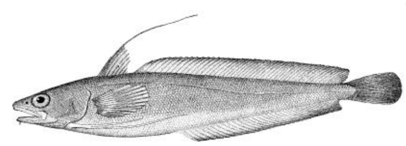


Figure 65. Silver Hake Adult EFH

Prey: The diet of young silver hake consists of euphausiids, shrimp, amphipods, and decapods. However, they become more piscivorous as juveniles and adults feeding on smaller hake and other schooling fishes such as young herring, mackerel, menhaden, alewives, sand lance**,** or silversides. Their diet also includes crustaceans and squids.

3.3.11 Red hake (*Urophycis chuss*) (NMFS, 1999) (NEFMC, 2017)



The affected areas are designated as EFH for red hake eggs, larvae, juveniles, and adults. The habitat parameters for the applicable life stages are as follows:

Eggs and Larvae: Pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic, and in the bays and estuaries.

Juveniles: Intertidal and sub-tidal benthic habitats throughout the region on mud and sand substrates, to a maximum depth of 80 meters including the bays and estuaries. Bottom habitats providing shelter are essential for juvenile red hake, including: mud substrates with biogenic depressions, substrates providing biogenic complexity (e.g., eelgrass, macroalgae, shells, anemone and polychaete tubes), and artificial reefs. Newly settled juveniles occur in depressions on the open seabed. Older juveniles are commonly associated with shelter or structure and often inside live bivalves.

Adults: Benthic habitats in the Gulf of Maine and the outer continental shelf and slope in depths of 50 – 750 meters and as shallow as 20 meters in a number of inshore estuaries and embayments as far south as Chesapeake Bay. Shell beds, soft sediments (mud and sand), and artificial reefs provide essential habitats for adult red hake. They are usually found in depressions in softer sediments or in shell beds and not on open sandy bottom. In the Gulf of Maine, they are much less common on gravel or hard bottom, but they are reported to be abundant on hard bottoms in temperate reef areas of Maryland and northern Virginia.

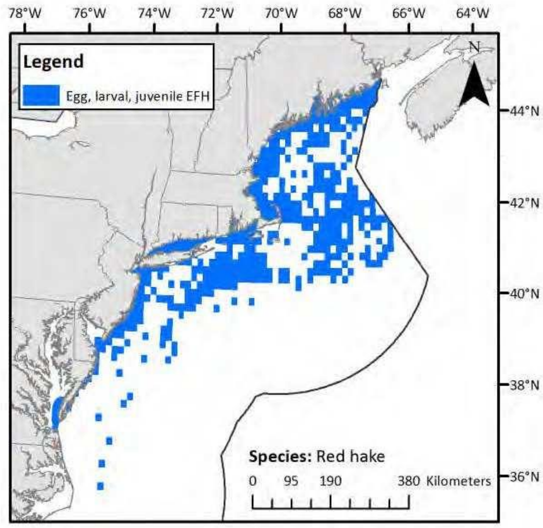


Figure 66. Red Hake Egg, Larval, Juvenile EFH

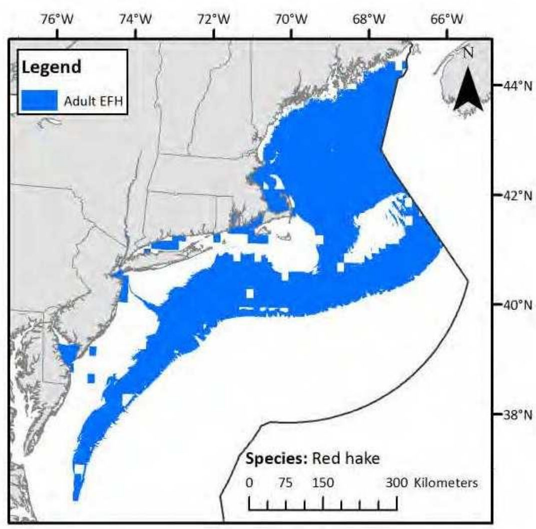


Figure 67. Red Hake Adult EFH

Prey: Larvae prey mainly on copepods and other microcrustaceans, and are sometimes found under floating eelgrass or algae looking for prey. Juveniles leave shelter at night and commonly prey on small benthic and pelagic crustaceans, including larval and small decapod shrimp and crabs, mysids, euphausiids, and amphipods. Adults prey upon crustaceans, but also consume a variety of demersal and pelagic fish and squid.

3.3.12 Monkfish *(Lophius americanus)* (NMFS, 1999) (NEFMC, 2017)

The affected areas are designated as EFH for monkfish eggs and larvae. The habitat parameters for the applicable life stages are as follows:

Eggs and Larvae: Pelagic habitats in inshore areas, and on the continental shelf and slope throughout the Northeast region. Monkfish eggs are shed in very large buoyant mucoidal egg "veils." Monkfish larvae are more abundant in the Mid-Atlantic region and occur over a wide depth range, from the surf zone to depths of 1,000 to 1,500 meters on the continental slope.

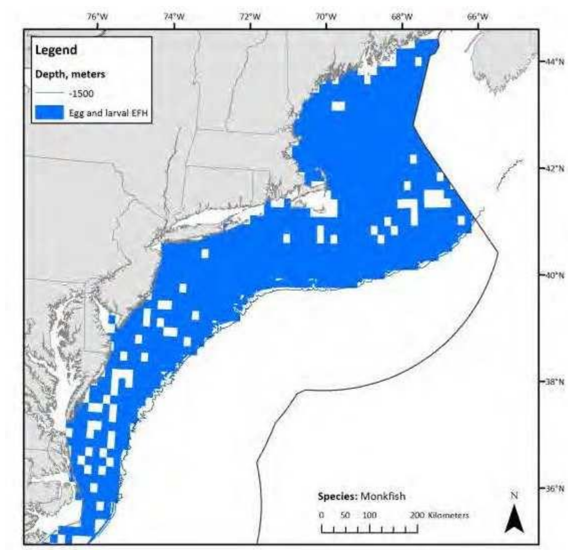
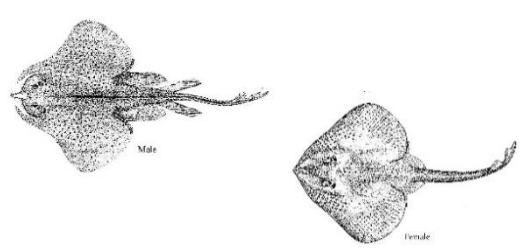


Figure 68. Monkfish Eggs and Larvae

Juveniles: No EFH identified within the affected areas.

Adults: No EFH identified within the affected areas.

Prey: Larvae feed on zooplankton, including copepods, crustacean larvae, and chaetognaths. Small juveniles (5-20 cm TL) start eating fish, such as sand lance, soon after they settle to the bottom, but invertebrates, especially crustaceans and squid are a large part of their diet.



3.3.13 Little skate (*Raja erinacea*) (NMFS, 2003) (NEFMC, 2017)

The affected areas are designated as EFH for little skate juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles: Intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 80 meters, and including high salinity zones in the bays and estuaries. EFH for juvenile little skates occurs on sand and gravel substrates, but they are also found on mud.

Adults: Intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 80 meters, and including high salinity zones in the bays and estuaries. EFH for juvenile little skates occurs on sand and gravel substrates, but they are also found on mud.

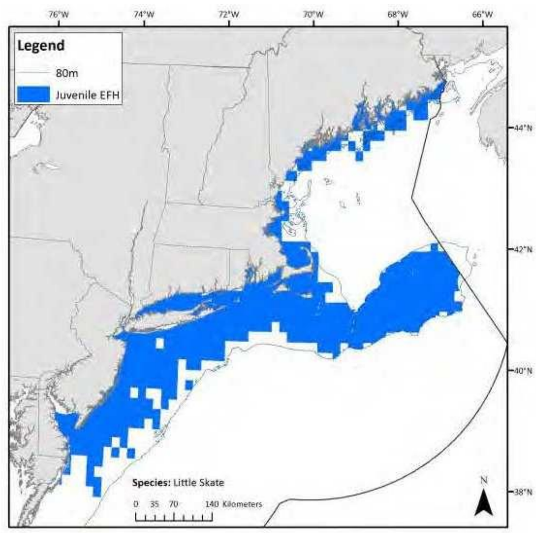


Figure 69. Little Skate Juvenile EFH

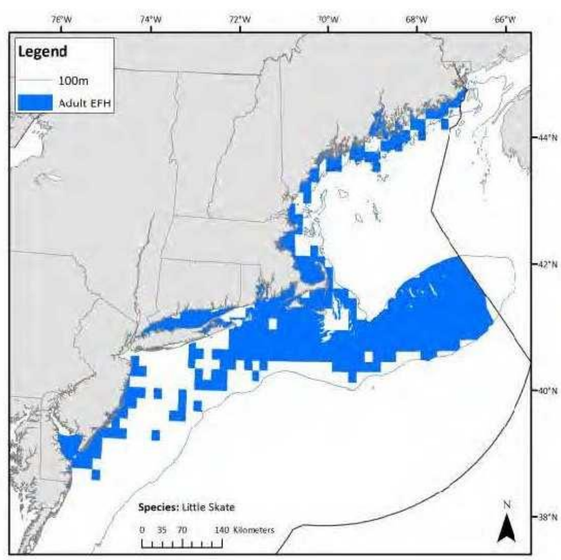
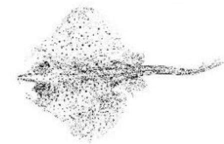


Figure 70. Little Skate Adult EFH

Prey: Benthic macrofauna primarily decapod crustaceans, amphipods and polychaetes.

3.3.14 Winter skate (*Raja ocellata*) (NMFS, 2003) (NEFMC, 2018)



The affected areas are designated as EFH for winter skate juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles: Sub-tidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 90 meters including the high salinity zones of the bays and estuaries. EFH for juveniles occurs on sand and gravel substrates, but they are also found on mud.

Adults: Sub-tidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 90 meters including the high salinity zones of the bays and estuaries. EFH for juveniles occurs on sand and gravel substrates, but they are also found on mud.

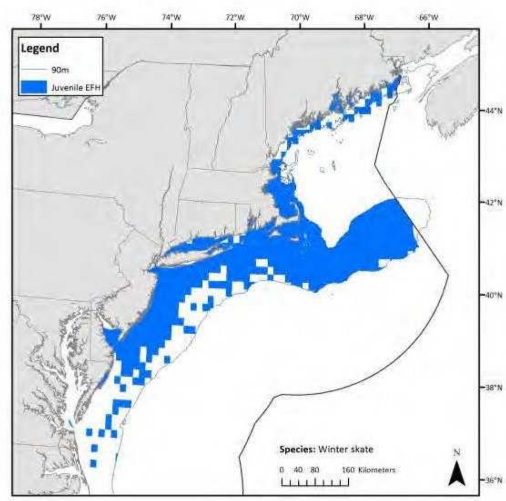


Figure 71. Winter Skate Juvenile EFH

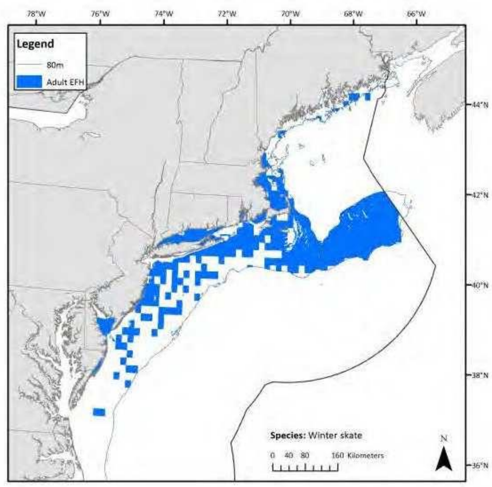
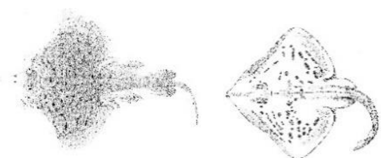


Figure 72. Winter Skate Adult EFH

Prey: Polychaetes and amphipods are the most important prey items in terms of numbers or occurrence, followed by decapods, isopods, bivalves, and fishes.

3.3.15 Clearnose skate (*Raja eglanteria*) (NMFS,2003)(NEFMC,2017)



The affected areas are designated as EFH for clearnose skate juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles: Sub-tidal benthic habitats in coastal and inner continental shelf waters from New Jersey to the St. Johns River in Florida, including the high salinity zones of Chesapeake Bay, Delaware Bay, and the NJ inland bays and estuaries. Essential fish habitat for juvenile clearnose skates occurs from the shoreline to 30 meters, primarily on mud and sand, but also on gravelly and rocky bottom.

Adults: Sub-tidal benthic habitats in coastal and inner continental shelf waters from New Jersey to Cape Hatteras, including the high salinity zones of Chesapeake Bay, Delaware Bay, and the NJ inland bays and estuaries. Essential fish habitat for adult clearnose skates occurs from the shoreline to 40 meters, primarily on mud and sand, but also on gravelly and rocky bottom.

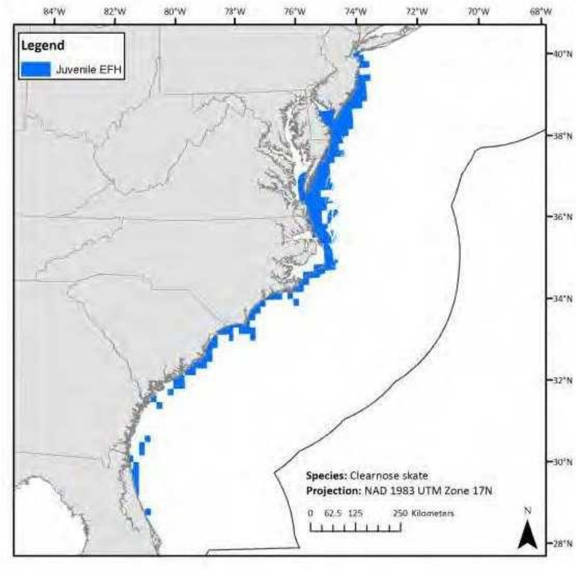


Figure 73. Clearnose Skate Juvenile EFH

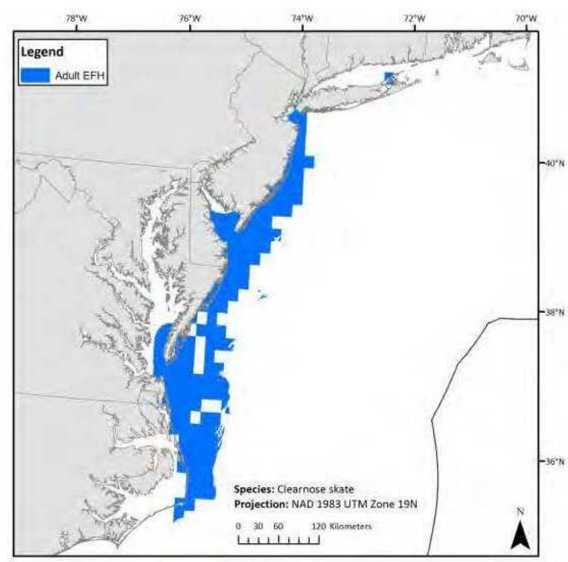


Figure 74. Clearnose Skate Adult EFH

Prey: Clearnose skates feed on polychaetes, amphipods, mysid shrimps (e.g. *Neomysis americana*), the shrimp, *Crangon septemspinosa*, mantis shrimps, crabs including *Cancer*, mud, hermit, and spider crabs, *Ovalipes ocellatus*, bivalves (e.g. *Ensis directus*), squids, and small fishes such as soles, weakfish, butterfish, and scup.

3.4 Coastal Migratory Pelagic Species (SAFMC)

King Mackerel (*Scomberomorus cavalla*)

The affected areas are designated as EFH for king mackerel all life stages. The habitat parameters for the applicable life stages are as follows:

All life Stages: EFH for all stages of king mackerel includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, from the Gulf Stream shoreward, including *Sargassum.* For king mackerel, EFH also includes high salinity bays, estuaries, and seagrass habitat. In addition, the Gulf Stream is considered EFH because it provides a mechanism to disperse coastal migratory pelagic larvae. For king mackerel, EFH occurs in the South Atlantic and Mid-Atlantic Bights (USACE, 2009). King mackerel live in large schools in pelagic waters at depths from about 23 to 34 meters (75 to 112 feet). Spawning takes place over the Outer Continental Shelf from May through October, with peaks between late May and early July, and between late July and early August. The larval stage of this species is very brief, with growth rates of 0.51 mm to 1.27 mm (0.02 to 0.05 inches) per day (Florida Museum of Natural History, 2009). Larvae are found in estuaries with water temperatures from 26° to 31° C (79° to 88° F). The adult king mackerel is present in waters with temperatures above 20° C (68° F), so their migration along the Atlantic coast migration depends heavily on the temperature of the coastal waters.

Prey: Juveniles prey on fish larvae, small fish such as anchovies, and squid. In addition to pelagic fish and squid, adults prey on mollusks, shrimp, and other crustaceans.

3.4.1 Spanish Mackerel (*Scomberomorus maculatus*)

The affected areas are designated as EFH for Spanish mackerel all life stages. The habitat parameters for the applicable life stages are as follows:

All life Stages: EFH for all stages of Spanish mackerel includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone, but from the Gulf Stream shoreward, including *Sargassum.* All coastal inlets and all state designated nursery habitats are of particular importance to Spanish mackerel. EFH also includes high salinity bays, estuaries, and seagrass habitat. In addition, the Gulf Stream is considered EFH because it provides a mechanism to disperse coastal migratory pelagic larvae. For Spanish mackerel, EFH occurs in the South Atlantic and Mid-Atlantic Bights. Spanish mackerel eggs are found in open water off the coast of Virginia from April through September. Spanish mackerel is most commonly found in waters with a temperature above 20° C (68° F) and salinity greater than 30 ppt. The species prefers the waters from the surf zone to shelf break from the Gulf Stream shoreward, especially sandy shoal and reef areas, and can occasionally be found in shallow estuaries and in grass beds.

Spanish mackerel are a fast-swimming, highly migratory species which is found in large schools. They winter in the warm pelagic waters of Florida, moving north along the coast to Virginia waters in April or May.

Prey: In the open ocean, Spanish mackerel feed on pelagic fish including herring, sardines, mullet, and anchovy; shrimp; crabs; and squid (NOAA, 2009).

3.5 Highly Migratory Species

Bluefin Tuna (*Thunnus thynnus*) (NMFS, 2017)

The affected areas are designated as EFH for bluefin tuna juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles and Adults: Spawning, eggs, and larvae: In the Gulf of Mexico from the 100 meter depth contour to the EEZ, continuing to the mid-east coast of Florida. Juveniles (<231 cm FL): In waters off North Carolina, south of Cape Hatteras, to Cape Cod. Adults (≥231 cm FL): In pelagic waters of the central Gulf of Mexico and the mideast coast of Florida. North Carolina from Cape Lookout to Cape Hatteras, and New England from Connecticut to the mid-coast of Maine.

Prey: Adults are opportunistic feeders, preying on a variety of schooling fish, cephalopods, and benthic invertebrates, including silver hake, Atlantic mackerel, Atlantic herring, krill, sandlance, and squid (Dragovich, 1969, 1970a; Mathews et al., 1977; Estrada et. al. 2005). Butler et al*.* (2010) found that menhaden (*Brevoortia brevoortia*) comprised almost 95 percent (by weight) of the diet of sampled bluefin tuna off the North Carolina coast during the winters of 2006-2009. Logan et al*.* 2011 found that juvenile bluefin tuna (60-150 cm curved fork length (CFL)) fed mainly on zooplanktivorous fishes and crustaceans. Sand lance was the main prey of young bluefin in the mid-Atlantic bight.

Figure 75. Bluefin Tuna Juvenile EFH

Figure 76. Bluefin Tuna Adult EFH

3.5.1 Skipjack Tuna (*Katsuwonus pelamis*) (NMFS, 2017)

The affected areas are designated as EFH for skipjack tuna adults. The habitat parameters for the applicable life stages are as follows:

Adults: Skipjack tuna are circumglobal in tropical and warm-temperate waters, generally limited by the 15°C isotherm. In the western Atlantic skipjack tuna range as far north as Newfoundland (Vinnichenko, 1996) and as far south as Brazil (Collette and Nauen 1983). Skipjack tuna are an epipelagic and oceanic species and may dive to a depth of 260 m during the day. Skipjack tuna is also a schooling species, forming aggregations associated with hydrographic fronts (Collette and Nauen 1983). Adults occur in coastal and offshore habitats between Massachusetts and Cape Lookout, North Carolina and localized areas in the Atlantic off South Carolina and Georgia, and the northern east coast of Florida. Aggregations of skipjack tuna are associated with convergences and other hydrographic discontinuities. Skipjack tuna also associate with birds, drifting objects, whales, sharks and other tuna species (Colette and Nauen, 1983). The optimum temperature for the species is 27 ºC, with a range from 20 to 31° C (ICCAT, 1995).

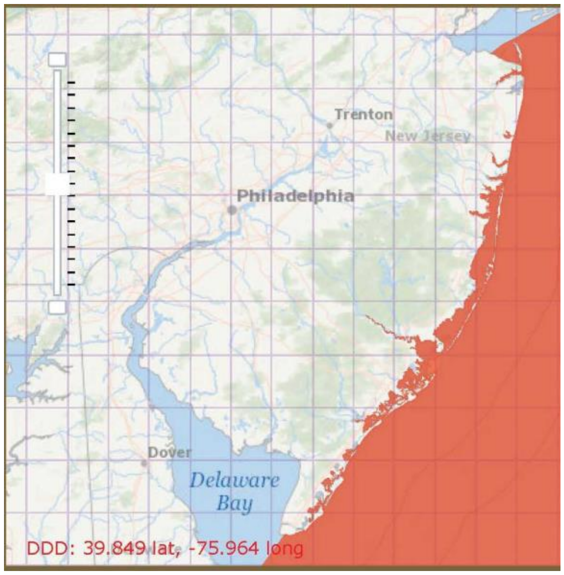


Figure 77. Skipjack Tuna Adult EFH

Prey: Skipjack tuna is an opportunistic species, which preys upon fishes, cephalopods, and crustaceans (Dragovich 1969 and 1970b; Dragovich and Potthoff 1972; Collette and Nauen 1983; ICCAT 113 1997). Skipjack tuna are believed to feed in surface waters; however, they are caught as bycatch on longlines at greater depths. Stomach contents often include *Sargassum* or associated species (Morgan et al. 1985).

3.5.2 Atlantic Yellowfin Tuna (*Thunnus albacares*) (NMFS, 2017)

The affected areas are designated as EFH for yellowfin tuna juvenile. The habitat parameters for the applicable life stages are as follows:

Juvenile: Atlantic yellowfin tuna is an epipelagic, oceanic species, found in water temperatures between 18 and 31 °C. The species is circumglobal in tropical and temperate waters, and in the western Atlantic they range from 45° N lat. to 40° S lat. It is a schooling species, with juveniles found at the surface in mixed schools of skipjack and bigeye tuna. Larger fish are found in deeper water and also extend their ranges into higher latitudes. All individuals in the Atlantic probably comprise a single population, although movement patterns are not well known (Collette and Nauen 1983; SCRS 1997). Adult yellowfin tuna are generally confined to the upper 100 m of the water column due to their intolerance of oxygen concentrations less than 2 mL/L (Collette and Nauen, 1983). Yellowfin distribution has been associated with thermocline depth (Block et al. 1997; Kuo-We Lan et al. 2011). Association with floating objects has been observed, and in the Pacific larger individuals often school with porpoises (Collette and Nauen 1983). Juveniles occur in offshore pelagic habitats seaward of the continental shelf break between the seaward extent of the U.S. EEZ boundary on Georges Bank and Cape Cod, Massachusetts. Offshore and coastal habitats from Cape Cod to the mid-east coast of Florida and the Blake Plateau.

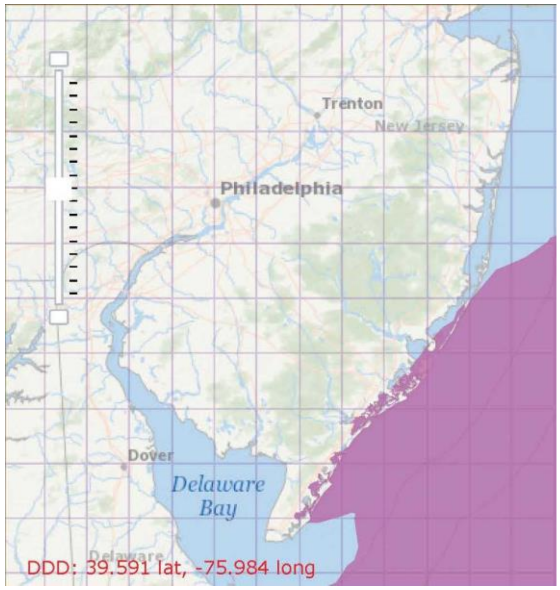


Figure 78. Atlantic Yellowfin Tuna Juvenile EFH

Prey: Atlantic yellowfin tuna are opportunistic feeders and are believed to feed primarily in surface waters down to a depth of 100 m. Gut analyses have identified a wide variety of prey items including fish and invertebrates (Dragovich, 1969, 1970b; Dragovich and Potthoff, 1972; Matthews et al., 1977). Morgan et al. (1985) found that gut contents often include *Sargassum* or *Sargassum* associated fauna. Logan et al. (2012) found that cephalopods, fish, and crustaceans are important prey for yellowfin tuna in the North Atlantic Ocean, with diet composition varying spatially and prey size positively correlated with yellowfin size.

3.6 Sharks

3.6.1 Sand Tiger Shark (*Carcharias taurus*) (NMFS, 2017)

The affected areas are designated as EFH and HAPC for sand tiger sharks: neonates, juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Neonates/YOY and juveniles: Neonate EFH ranges from Massachusetts to Florida, specifically the PKD bay system, Sandy Hook, and Narragansett Bays as well as coastal sounds, lower Chesapeake Bay, Delaware Bay (and adjacent coastal areas), Raleigh Bay and habitats surrounding Cape Hatteras. Juvenile EFH includes habitats between Massachusetts and New York (notably the PKD bay system), and between mid-New Jersey and the mid-east coast of Florida. EFH can be described via known habitat associations in the lower Chesapeake Bay and Delaware Bay (and adjacent coastal areas) where temperatures range from 19 to 25 °C, salinities range from 23 to 30 ppt at depths of 2.8-7.0 m in sand and mud areas, and in coastal North Carolina habitats with temperatures from 19 to 27 °C, salinities from 30 to 31 ppt, depths of 8.2-13.7 m, in rocky and mud substrate or in areas surrounding Cape Lookout that contain benthic structure.

Adults: Adult EFH in the Atlantic extends from along the mid-east coast of Florida (Cape Canaveral) through Delaware Bay. Important habitats include lower Chesapeake Bay and Delaware Bay (and adjacent coastal areas) where sand tiger sharks spend 95 percent of their time in waters between 17 and 23 °C. EFH is restricted off the coast of Florida to habitats that are less than 200 meters in depth.

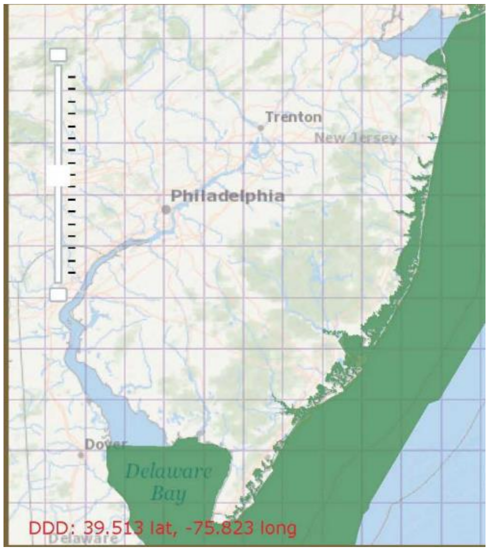


Figure 79. Sand Tiger Shark Neonates and Juvenile EFH

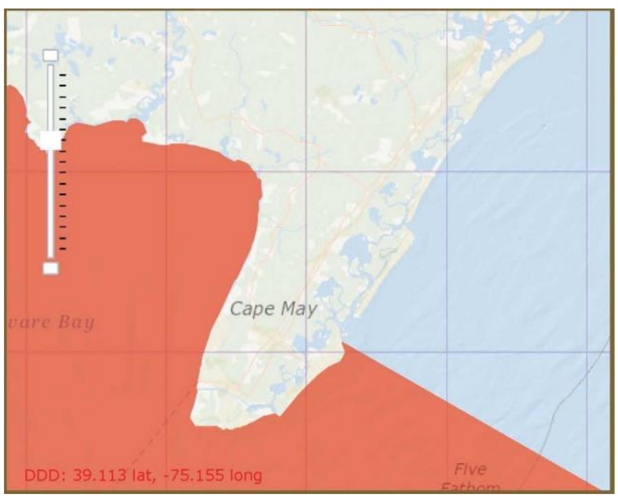


Figure 80. Sandtiger Shark Adult EFH

HAPC: Lower portions of Delaware Bay to areas adjacent to the mouth of Delaware Bay for all life stages. The inshore extent of the HAPC reflects a line drawn from Port Mahon east to Egg Point Island (39º11'N lat.), and from Egg Point Island southeast to Bidwell Creek. The HAPC excludes an area rarely used by sand tiger sharks, which is north of a line between Egg Point Island and Bidwell Creek that includes Maurice Cove. The HAPC spans the mouth of Delaware

Bay between Cape Henlopen and Cape May, and also includes adjacent coastal areas offshore of Delaware Bay and areas south (between the Indian River inlet and Cape Henlopen, Delaware).

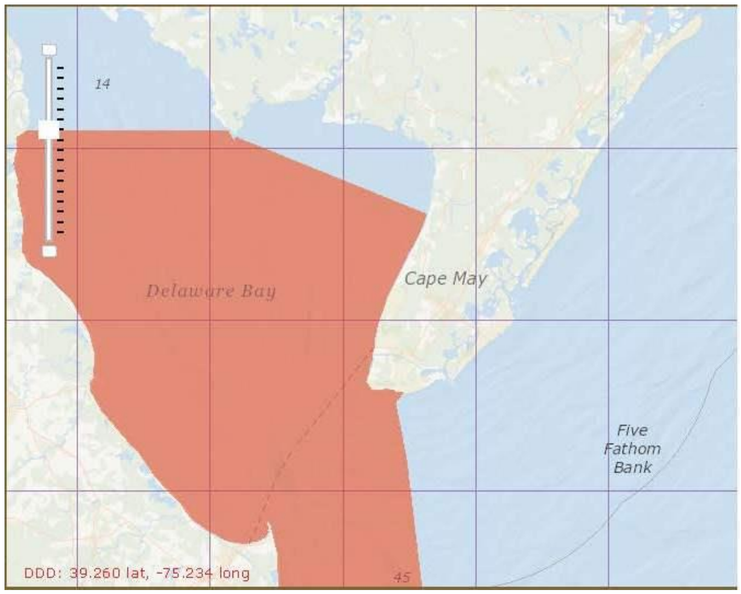
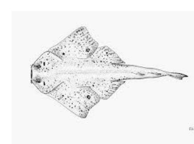


Figure 81. Sand Tiger Shark HAPC

Prey: The species is a generalized feeder, consuming a variety of teleost and elasmobranch prey (Gelsleichter et al., 1999).

3.6.2 Atlantic Angel Shark (*Squatina dumerili*) (NMFS, 2017)



The affected areas are designated as EFH for Atlantic angel sharks: neonates, juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Neonates/YOY, Juveniles and Adults: At this time, insufficient data is available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages. EFH in the Atlantic Ocean includes continental shelf habitats from Cape May, New Jersey to Cape Lookout, North Carolina. The angel shark is a benthic species inhabiting coastal waters of the United States from Massachusetts to the Florida Keys, the Gulf of Mexico, and the Caribbean. It is common from southern New England to the Maryland coast (Castro, 1983). The angel shark migrates seasonally from shallow to deep water (Castro, 2011).

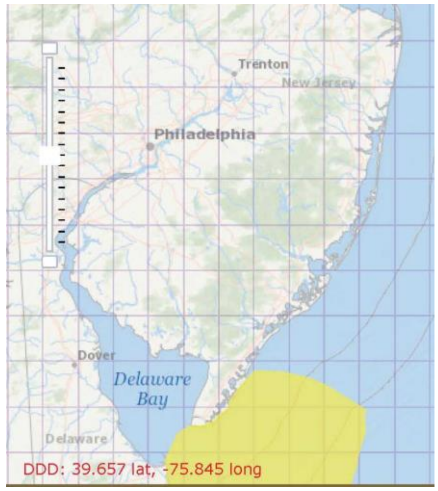
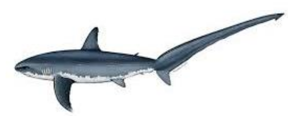


Figure 82. Atlantic Angel Shark All Life Stages EFH

Prey: Baremore et al. (2008) found that teleost fishes dominated the diet of angel sharks of all sizes in the Gulf of Mexico. Squid, crustaceans, and portunid crabs were also eaten by angel sharks of all sizes and in all seasons sampled (Baremore et al. 2010).

3.6.3 Common Thresher Shark (*Alopias vulpinus*) (NMFS, 2017)



The affected areas are designated as EFH for common thresher sharks: neonates, juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Neonates/YOY, Juveniles and Adults: At this time, insufficient data is available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages. EFH is located in the Atlantic Ocean, from Georges Bank (at the offshore extent of the U.S. EEZ boundary) to Cape Lookout, North Carolina; and from Maine to locations offshore of Cape Ann, Massachusetts. EFH occurs with certain habitat associations in nearshore waters of North Carolina, especially in areas with temperatures from 18.2 to 20.9 °C and at depths from 4.6 to 13.7 m (McCandless et al. 2002). Thresher sharks are found in both coastal and oceanic waters, but according to Strasburg (1958), it is more abundant near land, with some seasonal abundance and north-south migrations along the U.S. East Coast (Castro, 2011), particularly in the offshore and cold inshore waters during the summer months (Gervelis and Natanson 2013).

Figure 83. Common Thresher Shark All Life Stages EFH

Prey: Thresher sharks feed on invertebrates such as squid and pelagic crabs as well as small fishes such as anchovy, sardines, hakes, and small mackerels (Preti et al. 2004).

3.6.4 Dusky Shark (*Charcharinus obscurus*) (NMFS, 2017)

The affected areas are designated as EFH for dusky shark neonates. The habitat parameters for the applicable life stages are as follows:

Neonates/YOY: Dusky shark neonates often inhabit nursery areas in coastal waters. EFH in the Atlantic Ocean includes offshore areas of southern New England to Cape Lookout, North Carolina. Specifically, EFH is associated with habitat conditions including temperatures from 18.1 to 22.2 °C, salinities of 25 to 35 ppt and depths at 4.3 to 15.5 m. Seaward extent of EFH for this life stage in the Atlantic is 60 m in depth.

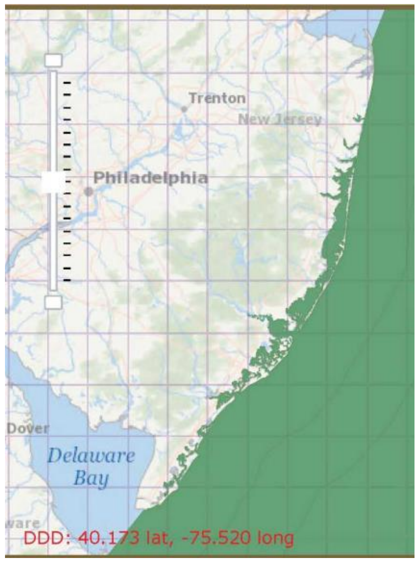


Figure 84. Dusky Shark Neonates and YOY EFH

Prey: Dusky shark prey on a variety of fish and invertebrates, including herring, grouper, sharks, skates, rays, crabs, squid, and starfish.

3.6.5 Sandbar Shark (*Charcharinus plumbeus*) (NMFS, 2017)

The affected areas are designated as EFH for sandbar shark neonates/YOY, juveniles, adults and HAPC. The habitat parameters for the applicable life stages are as follows: The sharks are bottom-dwellers found in relatively shallow coastal waters 18 to 61 meters (60 to 200 feet) deep on oceanic banks and sand bars with smooth, sandy substrates. The adults can also occasionally be found in estuaries in turbid waters with higher salinity (Florida Museum of Natural History, 2009).

Neonates/YOY: EFH consists of shallow coastal areas to the 25-meter (82-foot) isobath from Montauk, Long Island, New York, south to Cape Canaveral, Florida (all year); nursery areas in shallow coastal waters from Great Bay, New Jersey, to Cape Canaveral, Florida, especially Delaware and Chesapeake Bays (seasonal-summer); shallow coastal waters to up to a depth of 50 meters (164 feet) on the west coast of Florida and the Florida Keys from Key Largo to south of Cape San Blas, Florida. Typical parameters include salinity greater than 22 ppt and temperatures greater than 21° C (70° F).

Juveniles: For late juveniles/subadults, EFH includes offshore southern New England and Long Island, both coastal and pelagic waters; also, south of Barnegat Inlet, New Jersey, to Cape Canaveral, Florida, shallow coastal areas to the 25–meter (82-foot) isobath; also, in the winter, in the Mid-Atlantic Bight, at the shelf break, benthic areas between the 100- and 200-meter (328- and 656-foot) isobaths; also, on the west coast of Florida, from shallow coastal waters to the 50–meter (164-foot) isobath, from Florida Bay and the Keys at Key Largo north to Cape San Blas, Florida**.**

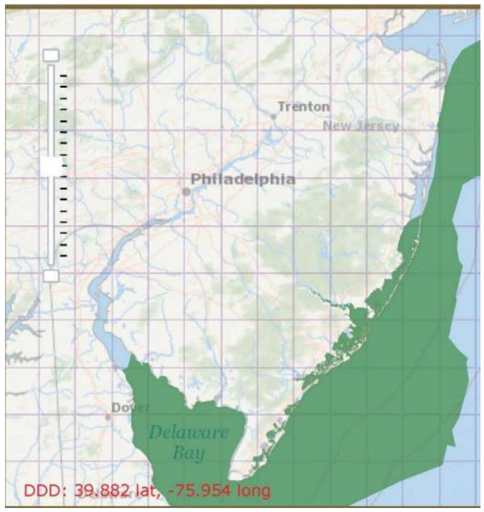


Figure 85. Sandbar Shark Neonates/YOY EFH

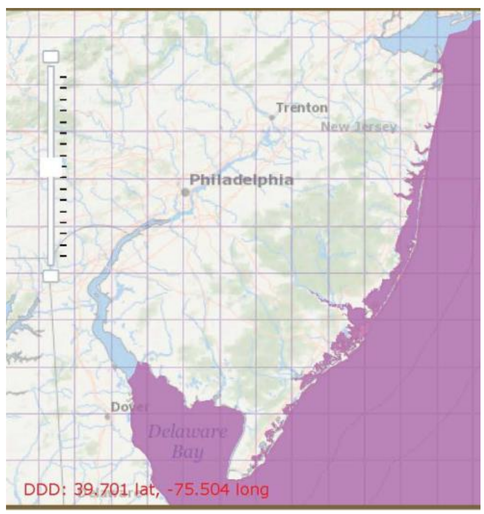


Figure 86. Sandbar Shark Juvenile EFH

Adults: For adults, EFH is on the east coast of the United States, shallow coastal areas from the coast to the 50-meter (164-foot) isobath from Nantucket, Massachusetts, south to Miami, Florida; also, shallow coastal areas from the coast to the 100-meter (328-foot) isobath around peninsular Florida to the Florida panhandle near Cape San Blas, Florida, including the Keys and saline portions of Florida Bay. The sandbar shark is the most common gray shark along the Mid-Atlantic Coast (Chesapeake Bay Program, 2009). From late May to early June, females head to the inlets and coastal bays of Virginia to give birth to litters of between 6 and 13 pups. The pups remain in the area until September or October, when they school and migrate south, along with the adults, to the warmer waters of North Carolina and Florida. The sharks begin to return to the coastal waters of Virginia around April.

HAPC: HAPC constitutes important nursery and pupping grounds which have been identified in shallow areas and at the mouth of Great Bay, New Jersey, in lower and middle Delaware Bay, Delaware, lower Chesapeake Bay, Maryland, and offshore of the Outer Banks of North Carolina in water temperatures ranging from 15 to 30 °C; salinities at least from 15 to 35 ppt; water depth ranging from 0.8 to 23 m; and in sand and mud habitats.

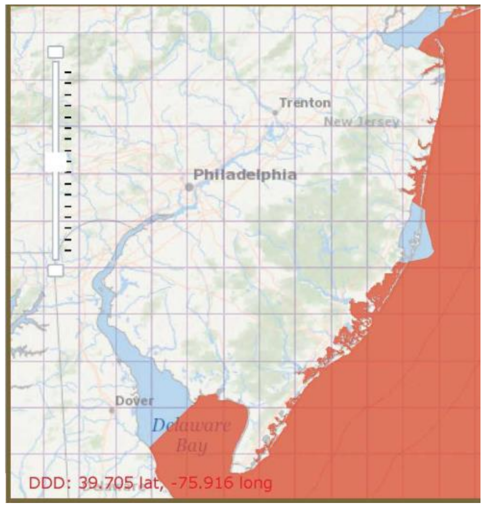


Figure 87. Sandbar Shark Adult EFH

Figure 88. Sandbar Shark HAPC

Prey: Pups and juveniles feed primarily on crustaceans, graduating to a more diverse diet of fish from higher in the water column, as well as rays skates, mollusks, and crustaceans near or in the benthic layer.

Smoothhound Shark (*Mustelus sp.*) (*Mustelus canis*) (NFMS, 2017)

The affected areas are designated as EFH for smoothhound shark neonates/YOY, juveniles, and adults. Although there are EFH designations for *Mustelus mustelus*, information pertaining to their habitat preferences in the NJBB affected areas could not be found. Information generally describes that this species mainly occurs in waters of the northeastern Atlantic (Europe) and southeastern Atlantic (Africa). However, NMFS (2017) identifies three species of *Mustelus* as the "smoothhound complex" within the western Atlantic and Gulf of Mexico waters. The smooth dogfish, *Mustelus canis*, was identified within the affected area. The habitat parameters for the applicable life stages of smoothhound dogfish are as follows:

Neonates/YOY, Juveniles and adults (*Mustelus canis*): At this time, available information is insufficient for the identification of EFH for this life stage, therefore all life stages are combined in the EFH designation. Smoothhound shark EFH identified in the Atlantic is exclusively for smooth dogfish. EFH in Atlantic coastal areas ranges from Cape Cod Bay, Massachusetts to South Carolina, inclusive of inshore bays and estuaries (e.g., Pamlico Sound, Core Sound, Delaware Bay, Long Island Sound, Narragansett Bay, etc.). EFH also includes continental shelf habitats between southern New Jersey and Cape Hatteras, North Carolina.

Prey: In Delaware Bay, smooth dogfish fed on invertebrates with larger sharks shifting to large crabs and teleosts (McElroy 2009).

Figure 89. Smoothhound Shark All Life Stages EFH

3.6.6 Tiger Shark (*Galeocerdo cuvieri*)

The affected areas are designated as EFH for tiger shark juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Juveniles and adults: The tiger shark is found in turbid coastal and pelagic waters of the Continental shelf, at depths of up to 350 meters (1,148 feet), although the shark has a tolerance for a wide variety of marine habitats (MBS, 2009). Tiger sharks have been found in estuaries and inshore as well. Little is known about the nursery areas for tiger sharks, though they are believed to occur in offshore areas (NMFS, 2006b). Females are thought to produce a litter of pups every other year.

Prey: Prey items for the tiger shark include fish, crustaceans, mollusks, and plankton.

Figure 90. Tiger Shark Juvenile and Adult EFH

3.6.7 White Shark (*Carcharodon carcharias*)

The affected areas are designated as EFH for white sharks sharks: neonates, juveniles and adults. The habitat parameters for the applicable life stages are as follows:

Neonate/YOY: EFH includes inshore waters out to 105 km from Cape Cod, Massachusetts, to an area offshore of Ocean City, New Jersey.

Juveniles, and Adults:

Known EFH includes inshore waters to habitats 105 km from shore, in water temperatures ranging from 9 to 28 °C, but more commonly found in water temperatures from 14 to 23 °C from Cape Ann, Massachusetts, including parts of the Gulf of Maine, to Long Island, New York, and from Jacksonville to Cape Canaveral, Florida.

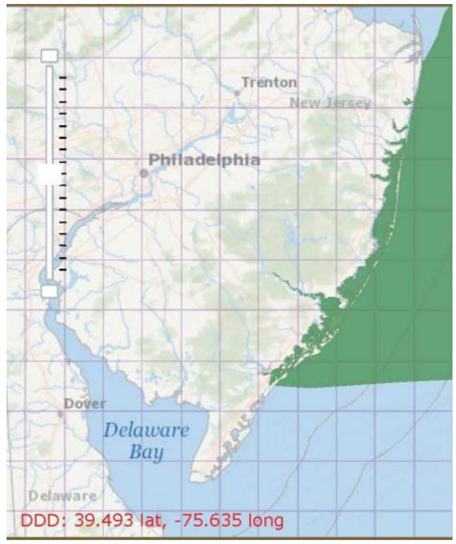


Figure 91. White Shark Neonate/YOY EFH

Figure 92. White Shark Juvenile and Adult EFH

4.0 POTENTIAL IMPACTS TO 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. Table 6 summarizes the direct impacts from all the TSP while Table 7 summarizes the direct impacts of the perimeter plans being considered. Alternatively, permanent habitat conversions could result from natural causes or management measures. For example, a tidal marsh could be converted to an intertidal mudflat stemming from erosion and/or sea level rise; or a physical change in grade such as a fill placement for an NNBF converting a subtidal environment into an intertidal environment.

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.

4.1 No Action/Future without Project (FWOP)

Under the No-Action Alternative there would be no direct impacts to EFH resources. Existing EFH (including estuarine water column, estuarine mud and sand bottoms [unvegetated estuarine benthic habitats], estuarine shell substrate [oyster reefs and shell substrate], estuarine emergent wetlands, seagrasses, marine water column, unconsolidated marine water bottoms, and natural structural features) would continue and be available to Federally managed species for which EFH has been designated (managed species).

The main significance of the predicted global climate change is its possible contribution to increasing sea levels, coastal flooding, changing estuarine salinity regimes, and biological communities. Indirect impacts due to climate change stressors (sea level rise, temperature increases, salinity changes, and wind and water circulation changes), storm severity and frequency, and dredging and maintenance dredging operations would impact the aquatic communities. Trends of tidal wetland loss are expected to continue. Increased development, hydrologic alterations, drought, flooding, and temperature extremes could affect wetlands. Sea level rise and climate change, including changes to hydrology, nutrient inputs, and flood or tide timing and intensity could have a variety of impacts on wetlands.

Although marshes throughout the New Jersey coast are declining and would likely continue this trend as sea level rise continues, there is a potential for marshes to migrate farther inland where the elevation and topography are conducive for establishment in response to rising sea levels (Borchert et al., 2018; Guannel et al., 2014; Murdock and Brenner, 2016; Scavia et al., 2002).

4.2 Effects by Action: Tentatively Selected Plan

The measures that make up the tentatively selected plan and alternatives being further considered, including non-structural, storm surge barriers, cross-bay barriers, and perimeter plans, have the potential to result in direct and indirect effects to EFH. Table 6 provides an estimate of habitats impacted by the TSP and Table 7 provides an estimate of those impacted by the perimeter plans being further considered (all totals are rounded to the nearest integer). The numbers provided in Tables 6 and 7 are rounded to the closest whole number.

[To develop these tables, wetlands data from different agencies with various classifications, were grouped into the broad category of "Wetland Habitats" (USFWS Cowardin et. al, 1979, NJDEP 2012). The “Wetland Habitats” category includes estuarine marshes (saline marshes), scrub shrub marshes, and supratidal wetlands. Scrub shrub marshes include estuarine and palustrine deciduous and coniferous scrub shrub. Estuarine marshes includes saline high and low marshes. Supratidal marshes are occasionally inundated by exceptionally high spring tides or by tides that are extremely high due to storm surge and include palustrine and estuarine emergent marshes (herbaceous wetlands), disturbed wetlands, managed wetlands, and phragmites-dominated marshes. Intertidal rocky shoreline (artificial) refers to shorelines that have been hardened with rip-rap, jetties, or revetments.]

It should be noted that, to date, no jurisdictional wetland delineations have been conducted along any of the preliminary perimeter plan, storm surge barrier and cross-bay barrier alignments at this point. Therefore, these impact estimates may be modified and refined based on a higher level of design detail that include surveyed wetland jurisdictional lines, and mitigation measures that first employ avoidance and minimization. However, it is assumed that for unavoidable wetland and aquatic habitats, compensatory mitigation would be required based on habitat modeling. Ecosystem modeling being considered for wetlands and aquatic habitat impacts and mitigation include the USACE EcoPcX approved New England Marsh Model (McKinney et al., 2009) and the New York Bight Ecological Model (NYBEM) that is currently in development.

Table 8. Direct Impacts to EFH for the Tentatively Selected Plan

	Shark River Region	North Region			Central Region				South Region	Total Impact
	NS	**NS**	**Barnegat Inlet SSB (A1)**	**Manasquan Inlet SSB (A1)**	**NS**	**Great Egg Harbor Inlet SSB (A1)**	**Absecon Blvd. Cross Bay Barrier (CBB)**	**South Ocean City 52ND ST Cross Bay Barrier (CBB)**	**NS**	**All Measures**
Habitat	**Impact**									
Estuarine Marshes (acres)	0	0	0	0	0	0	50	24	0	**73**
Scrub Shrub Wetlands (acres)	0	0	0	0	0	0	1	2	0	**3**
Supratidal Marshes (acres)	0	0	0	0	0	0	4	0	0	**4**
Intertidal Sandy Beach	0	0	0	0	0	6	1	0	0	**7**
Intertidal Sandy Beach (shellfish) (acres)	0	0	1	0	0	0	2	0	0	**2**
Intertidal Mudflat	0	0	0	0	0	0	2	0	0	**2**
Intertidal Mudflat (shellfish) (acres)	0	0	0	0	0	0	1	0	0	**1**
Intertidal Rocky SL (artificial) (linear feet)	0	0	0	2,280	0	0	1,831	0	0	**4,111**
Subtidal Soft Bottom (acres)	0	0	0	2	0	20	1	0	0	**23**
Subtidal Soft Bottom (shellfish)	0	0	12	0	0	0	2	2	0	**16**
Subtidal Hardened Shoreline (acres)	0	0	0	0	0	0	4	0	0	**4**
Subtidal Hardened Shoreline (shellfish) (acres)	0	0	0	0	0	0	13	0	0	**13**
SAV Beds (subtidal)	0	0	3	0	0	0	0	0	0	**3**
Total Acres and Linear Feet of Impacts *	**0**	**0**	**16**	**2**	**0**	**26**	**82**	**28**	**0**	**153**

*does not include intertidal rocky shoreline (artificial)

Table 9. Direct Impacts to EFH from the Perimeter Plans Under Consideration

Habitat	Central Region			Central Region				South Region				
	Ocean City	**Absecon Island**	**Total**	**Ocean City**	**Absecon Island**	**Brigantine**	**Total**	**Cape May**	**Wildwood**	**Stone Harbor/ Avalon**	**Sea Isle City**	**Total**
	Impact			**Impact**				**Impact**				
Estuarine Marshes (acres)	41	21	**62**	41	21	18	**80**	6	33	24	33	**96**
Scrub Shrub Wetla.5nds (acres)	6	4	**10**	6	4	0.1	**10**	4	8	4	3	**20**
Supratidal Marshes (acres)	28	1	**29**	28	1	0.4	**29**	3	1	1	6	**12**
Intertidal Sandy Beach	0	9	**9**	0	9	0.3	**9**	0	0	1	0	**1**
Intertidal Sandy Beach (shellfish) (acres)	1	2	**2**	1	2	1	**3**	7	2	0	0	**9**
Intertidal Mudflat	2	6	**8**	2	6	2	**10**	0.5	0	1	0	**1**
Intertidal Mudflat (shellfish) (acres)	2	7	**9**	2	7	8	**17**	0.5	22	9	0.5	**31**
Intertidal Rocky SL (artificial) (linear feet)	0	4196	**4196**	0	4196	0	**4196**	2324	0	80	0	**2404**
Subtidal Soft Bottom (acres)	0	1	**1**	0	1	0	**1**	0.1	0	0	0	**0**
Subtidal Soft Bottom (shellfish)	1	2	**3**	1	2	1	**4**	0	0.5	0.4	0.4	**1**
Subtidal Hardened Shoreline (acres)	10	33	**43**	10	33	2	**45**	0	0	3	0	**3**
Subtidal Hardened Shoreline (shellfish) (acres)	24	12	**36**	24	12	14	**50**	6	19	63	13	**102**
SAV Beds (subtidal)	0	0	**0**	0	0	0	**0**	0	0	0	0	**0**
Total Acres and Linear Feet of Impacts *	114	97	**212**	114	97	46	**258**	27	85	107	57	**277**

4.2.1 Storm Surge Barriers

In general, the storm surge barrier alignments would be constructed at the specified inlets and would tie into existing dunes at the northern and southern ends of the barrier islands. Some exceptions include:

- The Manasquan Inlet SSB would require seawalls within the tidal inlet and a 1-mile levee/dune structure constructed along the upper beach.
- Barnegat Inlet Alignment C1 would tie into the existing dunes at Island Beach State Park and the spit inside the inlet with the surge barrier in Barnegat Bay rather than Barnegat Inlet.
- Great Egg Harbor Inlet Alignments B1 would tie into the north end of Ocean City and into a levee and raised road at the Malibu Beach Wildlife Management area. It would also be tied to an impermeable barrier on the back bay side of Longport with a sea wall at the inlet.
- Great Egg Harbor Inlet Alignments C1 would tie into the north end of Ocean City and into a levee and raised road at the Malibu Beach Wildlife Management area. It would then be tied to a floodwall on the back bay side of Longport with a sea wall at the inlet.

Table 6 provides estimates of habitats affected by the proposed storm surge barriers. The footprints of the SSB pass through subtidal soft bottom (with and without shellfish), intertidal rocky shoreline (artificial), intertidal sandy beach (with and without shellfish), and SAV beds. The natural habitats affected by each individual SSB would be the permanent loss of 20 acres of subtidal soft bottom and 6 acres of intertidal sandy beach by the Great Egg Harbor Inlet SSB; 12 acres of subtidal soft bottom (shellfish), 3 acres of SAV beds, and 1 acre of intertidal sandy beach by the Barnegat Bay Inlet; and 2 acres of subtidal soft bottom by the Manasquan Inlet SSB. Additionally, the Manasquan Inlet SSB would result in the permanent loss of 2,280 lf of intertidal rocky shoreline. In total, the direct impact to habitats utilized by EFH from the implementation of all three SSB would be the permanent loss of 44 acres:

- 22 acres of subtidal soft bottom,
- 12 acres of subtidal soft bottom (shellfish),
- 6 acres of intertidal sandy beach,
- 1 acre of intertidal sandy beach (shellfish),
- 3 acres of SAV, and
- 2,280 linear feet of intertidal rocky shoreline.

4.2.1.1 Estuarine Open Waters and Subtidal Habitats

Construction of SSB would cause the permanent loss of 34 acres of subtidal soft bottom habitat: 20 acres at Great Egg Harbor Inlet SSB, 12 acres (shellfish) at Barnegat Inlet SSB, and 2 acres at Manasquan Inlet SSB. Benthic-oriented estuarine species would be impacted directly. Based on their habitat needs, black sea bass, Atlantic mackerel, Atlantic surfclam, red hake, silver hake, scup, flounders (summer, winter, and windowpane), sand tiger sharks, and skates (clearnose, winter, little) would be expected to be most susceptible to direct and indirect effects from SSB from the loss or disruption of subtidal bottom habitats. Pelagic species would be affected by water quality impacts to estuarine open waters.

Construction of the SSB would result in direct, but temporary impacts on water quality of estuarine open waters, which provide habitat for EFH. These impacts would result from temporary localized increases in turbidity and total suspended solids during construction. Minor and temporary increases in turbidity are expected during construction from activities such as the installation and removal of temporary cofferdams, temporary excavations, fill and rock placement, concrete work, and vibrations during the driving of sheet piles. Other activities such as earth disturbances resulting from construction access activities, staging/storage areas and upland excavations and soil stockpiles have the potential to generate turbidity as a non-point source. In accordance with Section 402 of the Clean Water Act, a sediment/erosion control plan would be submitted to the county conservation districts for their review and approval. Best management practices to avoid and minimize stormwater runoff from the construction sites, such as rock entrances, silt fencing, and physical runoff control, would be in the plan. Areas disturbed during construction would be subsequently stabilized upon completion of construction activities and the potential for turbidity would be expected to return to pre-construction conditions.

The operation of SSB have the potential for significant, indirect impacts on water quality in the estuarine systems based on their potential for altering flow, circulation patterns, and residence time. These impacts are inherently based on the design of the barrier/closure such as the number of openings and widths of these openings, which could significantly alter the flow patterns through the inlets and bays by constricting flows and affecting current velocities.

A number of design components make up these barriers/closures, which include navigable sector gates, auxiliary flow lift gates, impermeable barriers, levees and seawalls. For the storm surge barriers, the navigable sector gates and auxiliary flow lift gates are the predominant in-water structures. The impermeable barrier structure is a hardened structure that is also an in-water structure that ties the gates into features on the adjacent land such as a levee, seawall or existing dune.

The navigable sector gate is open under normal conditions to allow for navigation traffic and tidal exchange. The auxiliary lift gates are vertical gates that are “up” during normal conditions to allow for tidal exchange. These gates would be designed to remain open during normal conditions. However, even with the gates in opened positions, there would be a net reduction (22% to 46%) in channel cross-sectional area that would act as a constriction to flood and ebb tidal currents through the inlets. Thus, increases in velocity through these gates are expected and decreases in velocity may occur in other parts of the bays that are farther removed from the inlet barriers and cross-bay barriers. These flow pattern changes may result in changes to circulation and increased residence times, which could have more profound effects in backwater areas that are already poorly flushed.

Restrictions in tidal flows and increases in residence times could affect salinity levels, nutrients, chlorophyll *a* and dissolved oxygen concentrations. These effects could be exacerbated at times when the gates are closed during a significant storm event when increased freshwater inputs, nutrients, bacteria and other pollutants discharged from tributaries and point and non-point sources are held in the bays for a longer period. Hydrodynamic and water quality modeling is being conducted to better understand the indirect effects of the SSB in the TSP. The detailed hydrodynamic and water quality modeling will consider the various design configurations coupled with sea level rise projections.

The action area is in the highly energetic, nearshore area and increases in suspended sediments are expected to be in the range of normal variability, which these marine species would regularly experience. The net reduction in channel cross-sectional area and associated increase in flood and ebb tidal current velocities through the inlets may result in the potential for some EFH species to be trapped against the impermeable barriers of the storm surge barriers. This risk may increase in storm conditions when storm surge barriers are closed. Hydrodynamic and water quality modeling is being conducted to better understand potential indirect effects on water quality and how EFH species may be affected.

4.2.1.2 Open Ocean Waters

Storm surge barriers would have no direct impacts on open ocean waters. However, benthic oceanic habitat for surfclam could be impacted. Surfclams utilize benthic habitat within Atlantic Ocean continental shelf waters in high energy inlet ebb and flood shoal complexes of inlets within the study area. Construction of the SSB would be expected to have a direct impact and result in the loss of individuals given their immobility for Atlantic surfclam in Barnegat Bay and Great Egg Harbor Inlets. EFH is not designated for Manasquan Inlet, but is designated in adjacent squares.

Indirect impacts could occur during construction of SSB, which are near open ocean waters. This would be especially prevalent at the Great Egg Harbor Inlet SSB which is directly adjacent to open ocean waters. There is the potential for habitat impacts to Atlantic surfclam EFH, specifically from the Barnegat Inlet component. Indirect effects would be similar to those in estuarine open water. Minor and temporary increases in turbidity are expected during construction from activities such as the installation and removal of temporary cofferdams, temporary excavations, fill and rock placement, concrete work, and vibrations during the driving of sheet piles. Any impacts are expected to be localized. Because nearshore open ocean water is an energetic environment subject to wind and waves, turbidity is expected to diminish quickly and with distance.

Design and construction details are limited at this time and the sound-producing components of storm surge barrier construction and operation are unknown. Sounds associated with construction could cause injury or behavioral disturbance to marine species. Increases in vessel traffic could also result in an increased risk of collisions with protected marine species.

Species such as the Atlantic cod, king mackerel, Spanish mackerel, tuna species (Bluefin, skipjack, and yellowfin) that typically occur in offshore waters are not expected to be affected by impacts associated with project construction, or noise or vessel traffic associated with the construction of storm surge barriers. Species that winter in offshore waters (longfin inshore squid, some adult scup, and adult summer flounder) would not be anticipated to be affected if construction were to occur in the winter.

Once the design and construction details are known, NMFS would be consulted to determine measures needed to avoid and minimized impacts to EFH and HAPC. These would be expected to include seasonal restrictions for construction.

4.2.1.3 Intertidal Habitats

SSB would have a direct impact on intertidal habitats. The construction of the Barnegat Inlet SSB would cause the permanent loss of 6 acres of intertidal sandy beach and 1 acre of intertidal sandy beach (shellfish). Additionally, the construction of the Manasquan Inlet SSB would affect 2,280 linear feet of intertidal rocky shoreline (artificial) that is existing hardened shoreline. Species that utilize intertidal habitats would be affected to the greatest extent red hake (May – December), Atlantic mackerel, winter flounder, and little skate.

The operation of SSB could potentially affect intertidal habitats by altering sediment scour and deposition which could lead to changes in the dimensions of the existing beach habitat.

4.2.1.4 SAV

No SAV surveys have been conducted along the alignments for the preliminary SSB. Additionally, mapping of SAV beds are only available for Barnegat Bay (spatial data adopted from http://crssa.rutgers.edu/projects/coastal/sav/ and Lathrop and Haag, 2010). Therefore, the only alternatives with a storm surge barrier plan in the general vicinity where SAV bed mapping is available are 3E(2) and 3E(3), which includes a storm surge barrier across Barnegat Inlet (See figures of alternatives provided in appendix F.1). The Barnegat Inlet SSB 3E(2) A1 alignment encroaches on two small SAV areas mapped in the NWI map as "E1AB3L" and would directly impact approximately 2.6 acres based on the mapping. Additionally, two historic SAV beds (1979 Barnegat Map 032) occurred where one bed was about 600 feet northwest of the vertical lift gates crossing the bay and another bed occurred about 1,000 feet southwest of the navigable sector gates of the Barnegat Inlet SSB A1 alignment. No SAV beds were in the vicinity of the Barnegat Inlet SSB mapped in the more recent CRSSA Rutgers mapping from 2009. No SAVs have been mapped within the Great Egg Harbor Inlet and Manasquan Inlet SSB alignments. A more precise estimate of temporary and permanent disturbance will be available upon completion of SAV surveys in all locations/ waterways with SSB structures and with a higher level of design and construction plan of the structures involved.

The implementation of storm surge barriers (SSBs) and cross-bay barriers (BCs) could potentially have significant effects on SAV abundance and distribution in the affected bays by potentially altering velocities, sediment scour and deposition, water quality, salinity levels and nutrient levels. These changes may be most significant in the Barnegat Bay – Little Egg Harbor Estuary, which have the most extensive beds, and account for nearly 75% of the beds in New Jersey (Kennish et al. 2010). The potential changes associated with constrictions of flow while the gates are open during normal conditions may be negligible to significant depending on the gate design and associated cross-sectional areas. Localized changes in velocity are expected; however SAV beds are not expected within the immediate vicinity of the SSBs within the inlet areas. Modeled AdH hydrodynamic modeling for the open gate scenario supports that velocity increase-changes would be localized at the location of the gates, but do not have much influence on velocities beyond these areas. Additionally, the AdH suggests minor effects on tidal prism, tidal amplitude and residence time in the affected areas. There are no cross-bay barriers identified in the TSP in the Barnegat Bay and Little Egg Harbor estuaries. No recent SAV information is currently available for cross-bay barrier locations in Absecon Blvd. (Atlantic City) and 52nd St. (Ocean City).

When the gates are closed during storm events, hydrodynamic changes would be expected to be more profound, albeit temporary, and could have the potential to affect the survival rate of SAV due to fluctuations in temperature and salinity. Kukola (undated) reports that coarse-grained sediment substrates with less than 4% organic matter are ideal for eelgrass and that dark anaerobic silty sediments are not suitable. Therefore, any changes in sediment deposition patterns could affect their distribution in the bay. Although species such as eelgrass can be found in a wide range of salinity (0-30 ppt), it is unknown how SAV in the back bays system would respond to salinity changes associated with SSB. Additionally, eelgrass may become stressed and more susceptible to wasting disease from these changes (Kukola, undated). Thus, any significant fluctuations in salinity and nutrients could potentially affect eel grass populations within the estuary. Impacts to SAV would be expected to affect species that utilize SAV such as winter flounder, scup, red hake larvae, Spanish mackerel, and the egg lifestage of long finned inshore squid. Additional impacts would likely affect the larvae and juveniles of bluefish and summer flounder which appear in eelgrass beds in the spring and early summer (Fonseca et al, 1992 as reported in NMFS, 2016).

Predictive alterations in hydrodynamics through changes in bay circulation and flushing would require hydrodynamic modeling to determine changes in residence time with gates open and closed. Significant changes in residence time could affect nutrient levels, salinity and temperature, which could potentially promote phytoplankton and certain macroalgae blooms including the more problematic harmful algal blooms (HABs). HABs can adversely affect aquatic life including fish, shellfish and SAV beds along with some human health implications. The degree of measured changes to residence times based on SSB gate openings and closure scenarios through the use of hydrodynamic and water quality modeling will inform the level of concern for the potential of promoting phytoplankton blooms including HABs.

4.2.1.5 Wetlands

Temporary indirect impacts from construction of the storm surge barriers on wetlands are expected to be minimal to moderate, and are related to impacts such as sedimentation during construction. Long-term indirect impacts are related to hardened structures potentially halting landward migration of marshes, particularly with sea level rise. However, this effect is not expected to be significant since the majority of the shorelines along the back bays already are hardened with bulkheads, concrete revetments and riprap. Juvenile winter flounder could be particularly susceptible to wetland impacts.

4.2.2 Cross-Bay Barriers

Table 6 provides estimates of habitats affected by the proposed cross-bay barriers. The footprints of the BC pass through estuarine marshes, scrub shrub wetlands, supratidal marshes, intertidal mudflat (with and without shellfish), subtidal soft bottom (with and without shellfish), intertidal rocky shoreline (artificial), intertidal sandy beach (with and without shellfish), and subtidal hardened shoreline (with and without shellfish). The natural habitat most affected by each individual BC would be the permanent loss of 24 – 74 acres of estuarine marsh. In total, the direct impact to habitats utilized by EFH from the implementation of the two proposed BC would be the permanent loss of 109 acres:

- 74 acres of estuarine marshes,
- 3 acres of scrub shrub wetlands,
- 4 acres of supratidal marshes,
- 1 acre of intertidal sandy beach,

- 2 acres of intertidal sandy beach (shellfish),
- 2 acres of intertidal mudflat,
- 1 acre of intertidal mudflat (shellfish),
- 1,831 linear feet of intertidal rocky shoreline (artificial),
- 1 acre of subtidal soft bottom,
- 4 acres of subtidal soft bottom (shellfish),
- 4 acres of subtidal hardened shoreline, and
- 13 acres of subtidal hardened shoreline (shellfish)

4.2.2.1 Estuarine Open Water and Subtidal Habitats

BC would have a direct impact on estuarine subtidal soft bottom habitats. The construction of the Absecon Boulevard BC would cause the permanent loss of 3 acres of subtidal soft bottom (2 acres with and 1 acre without shellfish). The construction of the South Ocean City 52nd Street BC would cause the permanent loss of 2 acres of subtidal soft bottom (with shellfish).

The construction of and operation of BC would be expected to have similar impacts to estuarine open waters as those documented for SSB. The cross-bay barriers have the same components as the inlet barriers, but the cross-bay barriers also have other features such as road closures and miter gates and sluice gates, which are for smaller channels and tidal guts.

4.2.2.2 Open Ocean Waters

Cross-bay barriers are not expected to affect open ocean water habitats.

4.2.2.3 Intertidal Habitats

BC would have a direct impact on intertidal habitats. The construction of the Absecon Boulevard BC would cause the permanent loss of 3 acres of intertidal sandy beach (with and without shellfish), 3 acres of intertidal mudflat (with and without shellfish), and 1,831 linear feet of intertidal rocky shoreline (artificial – existing hardened shoreline). The construction of the South Ocean City 52nd Street BC is not projected to impact intertidal habitats.

The operation of BC could potentially affect intertidal habitats by altering sediment scour and deposition which could lead to changes in the dimensions of the existing beach habitat. Species that utilize intertidal habitats would be affected to the greatest extent red hake (May – December), Atlantic mackerel, winter flounder, and little skate.

4.2.2.4 SAV

No SAV surveys have been conducted along the alignments for the preliminary BC. The two cross-bay barriers (BCs) are located at Absecon Blvd (Atlantic City) and one at Southern Ocean City. No current SAV mapping is available for these locales, therefore, it is not clear whether there will be direct impacts to SAV from construction of any of the BC components. However, no direct impacts to SAV are anticipated based on existing mapping. A more precise estimate of temporary and permanent disturbance will be available upon completion of SAV surveys in all locations/waterways with BC structures and with a higher level of design and construction plan of the structures involved. Effects on SAV from BC is expected to be similar to those from SSB.

The operation of BC could potentially have significant effects on SAV abundance and distribution in the affected bays by altering velocities, sediment scour and deposition, water quality, salinity levels, residence times, and nutrient levels. These changes may be most significant in the Barnegat Bay – Little Egg Harbor Estuary, which have the most extensive beds and account for nearly 75% of the beds in New Jersey (Kennish et al. 2010). Impacts would be expected to be similar to those discussed for SSB.

4.2.2.5 Wetlands

The proposed BC would directly impact an array of estuarine wetlands. The closure at Absecon Boulevard would cause the permanent loss of 55 acres of wetland habitat: 50 acres of estuarine marshes, 1 acre of scrub shrub wetland, and 4 acres of supratidal marsh. The closure at South Ocean City 52nd Street would cause the permanent loss of 26 acres of wetland habitat: 24 acres of estuarine marshes and 2 acres of scrub shrub wetland. In total, there could be 26 – 81 acres of permanent loss of wetland habitat (direct impact). Preliminary estimates of the affected wetland and shallow water habitats are based on existing mapping (NJDEP wetland mapping and National Wetlands Inventory - NWI), the current (preliminary) alignments, and an assumed width of the disturbance offset from the structure.

Temporary, indirect impacts from construction of the cross-bay barriers on wetlands are expected to be minimal to moderate and are related to impacts such as sedimentation during construction. Long-term, indirect impacts are related to hardened structures potential halting landward migration of marshes, particularly with sea level rise. However, this effect is not expected to be significant since the majority of the shorelines along the back bays already are hardened with bulkheads, concrete revetments and riprap. Juvenile winter flounder could be particularly susceptible to wetland impacts.

4.2.3 Alternatives with Further Analysis Warranted - Perimeter Plan

In general, the perimeter plan options that are still being considered in the Central and South regions include floodwalls and levees that would be constructed on the western side of the barrier islands along residential bayfronts and would tie into existing dunes at the northern and southern ends of the barrier islands.

The footprints of the perimeter plans pass through subtidal, intertidal, and supratidal regimes, which include 14 different aquatic and wetland habitat types. The habitats affected by the perimeter plans include low and high tidal estuarine marshes (some of which are *Phragmites*-

dominated), scrub shrub wetlands, supratidal marshes, subtidal softbottom habitats, hardened subtidal soft bottom areas (bulkhead, concrete wall) shorelines, and intertidal mudflats, sandy beaches, and rocky shorelines (artificial) (with and without shellfish). A high number of these habitats are encountered as small pockets along heavily developed bay shorelines of the barrier islands. However, since the perimeter plan segments tend to be several miles long, the impacts are cumulative and significant. Table 7 provides preliminary estimates of permanent habitat impacts of the perimeter plans. In the Central Region, 212 - 258 acres of habitat and 4,196 linear feet of rocky shoreline (artificial) would be directly impacted by the proposed perimeter plan. In the South Region, 277 acres of habitat and 2,404 linear feet of rocky shoreline (artificial) would be directly impacted by the proposed perimeter plan.

4.2.3.1 Estuarine Open Water and Subtidal Habitats

The footprints of the perimeter plans pass through subtidal habitat. In the Central Region, the Perimeter Plan would result in the permanent loss of 4 – 5 acres of subtidal soft bottom habitat (with and without shellfish), and 80 – 95 acres of subtidal hardened shoreline (with and without shellfish). In the South Region, the Perimeter Plan would result in the permanent loss of 1 acre of subtidal soft bottom habitat (with shellfish), and 106 acres of subtidal hardened shoreline. Losses would result from excavation or fill. Additionally, temporary losses of subtidal habitats may be experienced through the placement of de-watering structures and either temporary fills or excavations for temporary access points to the work segment. Based on their habitat needs, black sea bass, Atlantic mackerel, scup, flounders (summer, winter, and windowpane), and skates (clearnose, winter, little) would be expected to be most susceptible to direct and indirect effects of the perimeter plan options to subtidal habitats.

Construction of floodwalls, levees, and miter gates would result in minor and temporary increases in turbidity and total suspended solids in adjacent estuarine open waters during construction. This is anticipated to be a minor impact as the action area is in the highly energetic, nearshore area and increases in suspended sediments are expected to be in the range of normal variability, which these species would regularly experience. Increases in turbidity would result from activities such as the installation and removal of temporary cofferdams, temporary excavations, fill and rock placement, and vibrations during the driving of sheet piles. Other activities such as earth disturbances resulting from construction access activities, staging/storage areas and upland excavations and soil stockpiles have the potential to generate turbidity as a non-point source. In accordance with Section 402 of the Clean Water Act, a sediment/erosion control plan will be submitted to the county conservation districts for their review and approval. The plan will include measures to avoid and minimize these effects, such as rock entrances, silt fencing, physical runoff control, as well as other best management practices. Areas disturbed during construction would be subsequently stabilized upon completion of construction activities and turbidity is expected to return to normal levels.

The perimeter plans would require pump stations to collect interior drainage from significant precipitation events. These pump stations would generally receive urban run-off from impermeable surfaces such as buildings, streets, and parking lots that may contain typical urban non-point source pollutants such as sediments, bacteria, nutrients, and oil and grease. The pumps would not necessarily increase these stormwater discharge, but might focus stormwater at fewer locations based on the pump station location, rather than the current stormwater drainage systems. Currently, stormwater drainage systems might discharge directly into the bays at the street ends or through combined sewers. Stormwater drainage systems vary by community, and would require further investigation to determine the appropriate locations and design for the interior drainage pumps and outfalls, as well as associated impacts to estuarine waters.

Miter gates would be installed and operated across smaller channels that require navigable access. These gates would remain open during normal conditions and would be closed during significant storm events. Some localized, but minor changes in hydrodynamics around the gates are expected, however, no significant changes in water quality are expected while the gates are open. Miter gate closures during storms may temporarily affect water quality in a localized area by inhibiting circulation and mixing, and make upstream habitat unavailable.

4.2.3.2 Open Ocean Water Habitats

The perimeter plan would not be expected to affect open ocean water habitats or the species that inhabit them.

4.2.3.3 Intertidal Habitats

The footprints of the perimeter plans pass through intertidal mudflats, sandy beaches, and rocky shorelines (artificial) (with and without shellfish) habitats. In the Central Region, the Perimeter Plan would result in the permanent loss of 11 – 12 acres of impacts on intertidal sand (with and without shellfish), 16 – 26 acres of impact on intertidal mudflat (with and without shellfish), and 4,196 linear feet of intertidal artificial rocky shoreline (artificial). In the South Region, the Perimeter Plan would result in the permanent loss of 10 acres of impacts on intertidal sandy beach (with and without shellfish), 32 acres impacts on intertidal mudflat (with and without shellfish), and 2,404 linear feet of intertidal artificial rocky shoreline (artificial). Losses would result from excavation or fill. Temporary losses of intertidal habitats may be experienced through the placement of de-watering structures and either temporary fills or excavations for temporary access points to the work segment. Species that utilize intertidal habitats would be affected to the greatest extent red hake (May – December), Atlantic mackerel, winter flounder, and little skate.

4.2.3.4 Wetland Habitats

Construction of the floodwalls, levees and miter gate structures within coastal wetlands and shallow bay waters result in the loss of these habitats within the footprint of the structures. In the Central Region the perimeter plan would result in losses of 62 – 80 acres of estuarine marshes, 10 acres of scrub shrub, and 29 acres of supratidal marshes. In the South Region the perimeter plan would result in losses of 96 acres of estuarine marshes, 20 acres of scrub shrub, and 12 acres of supratidal marshes. These losses would result from either their removal via excavations or burial from fill placement. Additionally, temporary losses may be experienced through the placement of de-watering structures and either temporary fills or excavations for temporary access points to the work segment. Preliminary estimates of the affected wetland and shallow water habitats are based on existing mapping (NJDEP wetland mapping and National Wetlands Inventory - NWI), the current (preliminary) alignments, and an assumed width of the disturbance offset from the structure. Juvenile winter flounder could be particularly susceptible to wetland impacts.

4.2.3.5 SAV

Although, existing maps do not identify SAV beds within the footprint of the Perimeter Plan, updated surveys are needed to confirm presence or absence of SAV. If SAV were to be identified, construction of floodwalls and miter gate structures within shallow bay waters could result in the loss of SAV within the footprint of the perimeter plans. Impacts would result through either removal via excavations, and/or burial from fill placement and/or excessive turbidity which may inhibit photosynthesis. Additionally, temporary losses of SAV may be experienced through the placement of de-watering structures and either temporary fills or excavation for temporary access points to the work segment. SAV estimates are not available for the Central and South regions; therefore, preliminary estimates of SAV beds for the perimeter plan options cannot be made at this time. An estimate of temporary and permanent disturbance will be available upon completion of SAV surveys in all locations/waterways with perimeter structures and with a higher level of design and construction plan of the structures involved.

Indirect impacts of the perimeter plan are not expected to be significant due to the duration of impact but could contribute additional stressors on an already biologically stressed community. Indirect impacts on SAV could result from resuspension of sediments containing nutrients and a decrease of transitional upland areas (by increasing hardened shoreline) that act as filters for non-point source run-off. Increased run-off and nutrients would contribute to increased turbidity, eutrophication and phytoplankton/filamentous algae and macroalgae blooms. Increased phytoplankton blooms could contribute to significant declines in SAV beds or a decrease in the density of the beds, by interfering with photosynthesis from shading of the water column and/or promoting the epiphytic growth on the leaves (wasting disease), and the smothering of beds with decaying algae. Reductions in SAV beds have further indirect impacts on the ecological services provided by SAV including benthic invertebrate communities, shellfish beds, fish nurseries, sediment stabilization and wave attenuation. The level of these effects are difficult to quantify, but the temporary impacts can be managed by implementing best management practices during construction to minimize sedimentation and turbidity. Additionally, the perimeter plan options would be designed so that no increase in runoff would occur post-construction.

Impacts to SAV would be expected to affect species that utilize SAV such as winter flounder, scup, red hake larvae, Spanish mackerel, and the egg lifestage of long finned inshore squid. Additional impacts would likely affect the larvae and juveniles of bluefish and summer flounder which appear in eelgrass beds in the spring and early summer (Fonseca et al, 1992 as reported in NMFS, 2016).

4.3 Effects by Species: MID-ATLANTIC SPECIES

The following section provides an analysis of the direct, secondary, and cumulative impacts of the TSP and perimeter plans on federally managed species, and prey species consumed by managed species that occur in the project vicinity.

4.3.1 Atlantic Butterfish (Peprilus triacanthus)

Butterfish eggs are pelagic and could be present in the study area at temperatures above 12°C (mid-May to mid-November) in the Central (square 8) and South (square 14) region. Juvenile and adult Atlantic butterfish are pelagic and are expected to be common to abundant in the New Jersey Back Bays ecosystem. EFH is not designated for Atlantic butterfish larvae in the study area. All applicable life stages and their prey may be adversely impacted temporarily through water quality impacts such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column during construction of project features. These impacts would subside upon project completion. Atlantic butterfish and their prey are mobile species and would likely leave the project area during construction to avoid these impacts. Operation of the SSB and BC could trap individuals, and impact ingress and egress, and movement of juveniles and adults within the back bays environment. The offshore areas where EFH is designated for eggs are not in proximity to any proposed SSB or BC. No significant direct effects are anticipated. Impact level is expected to be low.

4.3.2 Atlantic mackerel (*Scomber scrombrus*)

Atlantic mackerel has EFH designated only for eggs in the North Region (squares 4 and 5) offshore and within the Barnegat Bay and Inlet. Eggs are pelagic and can be found floating in surface waters above the thermocline or in the upper 10 – 15 meters of the water column at a mean temperature of 11°C. Eggs may be adversely impacted through water quality impacts such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column during construction of project features. These impacts would subside upon project completion. Operation of the Barnegat Inlet SSB could impact ingress and egress, and movement within the back bays environment by Atlantic mackerel eggs. No significant direct effects are anticipated. Impact level is expected to be low.

4.3.3 Atlantic surfclam (*Spisula solidissima*)

EFH is designated for juvenile and adult lifestages of Atlantic surfclam sporadically through the study region in the North Region (squares 3 and 4), Central Region (square 8), and South Region (square 11 and 14). Surfclams utilize benthic habitat within Atlantic Ocean continental shelf waters in fine to medium sands in turbulent waters just beyond the breakers in depths of 8 to 66 m. Because of their habitat requirements, this species is most likely to be found in high energy inlet ebb and flood shoal complexes of inlets within the study area. Construction of the SSB would be expected to have a direct impact and result in the loss of individuals given their immobility as well as bottom habitat for Atlantic surfclam in Barnegat Bay (12 acres of subtidal soft bottom with shellfish) and Great Egg Harbor Inlets (20 acres of subtidal soft bottom). EFH is not designated for Manasquan Inlet, but is designated in adjacent squares. BC and perimeter plans would also result in the loss of benthic habitat, but these areas may not be suitable for surfclams because of their locations/positions within the estuary where salinities are highly variable and substrates are unsuitable.

4.3.4 Black sea bass (*Centropristis striata*)

EFH is designated for juveniles and adults across the entirety of the North, Central, and South Regions. Juvenile and adult black sea bass are both demersal and present in the area when water temperatures are below 6°C, approximately December through March. Juveniles prefer offshore habitat with rough bottom, shellfish and eelgrass beds, and man-made structures in sandy-shelly areas. Adults prefer structured habitats including rocky reefs, cobble and rock fields, and man-made structures; and sand and shell bottom. Black sea bass are transient and would be expected to relocate from the project area during construction. Therefore, direct impacts to individuals from construction is not anticipated. However, the construction of SSB and BC would impact habitats that may be used by juvenile and adult black sea bass: Barnegat Inlet SSB - 12 acres of soft bottom with shellfish and 3 acres of SAV; Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 1 acre of soft bottom, 2 acres of soft bottom with shellfish, 4 acres of hardened shoreline, and 13 acres of hardened shoreline with shellfish; and South Ocean City BC – 2 acres of subtidal soft bottom. The Manasquan Inlet SSB and Absecon Blvd BC would also impact a large extent of intertidal rocky shoreline (artificial), 2,280 and 1,831 lf, respectively. These habitats would be lost, permanently reducing potential habitat and benthic foraging habitat for black sea bass. The perimeter plans would also affect 1 – 6 acres of soft bottom habitats (with and without shellfish), but would have the most extensive impact on subtidal hardened habitats (with and without shellfish) (79 – 200 acres) and intertidal rocky shorelines (2,404 – 6,600 lf) depending on which components are implemented. Any subtidal hardened structure associated with the measures implemented (SSB, BC, and perimenter plans) could provide replacement structured habitat that black sea bass would utilize.

In-water placement sites at inlets for SSB are sandy bottom and as such, there may be an indirect negative, but temporary impact to immobile prey during placement due to the potential to be smothered. Additionally, juveniles are visual predators, and may experience temporary impaired conditions during dredging and in-water placement, but would likely avoid the area during dredging activities. Impact level is expected to be moderate as substantial amounts of acreage would be impacted. However, black sea bass individuals should be able to move from the area to avoid direct impacts, the subtidal portions of the completed structures would provide some degree of replacement for affected hardened habitats, and foraging habitat is not limited in the study area. Undertaking construction outside the December to March timeframe would avoid construction impacts to black sea bass (but would conflict with the typical timeframe to complete construction during the winter to avoid impacts to other species). Operation of the SSB and BC could trap individuals, and impact ingress and egress, and movement of juveniles and adults within the back bays environment. However, the timing of likely operations and presence of black sea bass within the study area do not align which would minimize the potential for this impact.

4.3.5 Bluefish (*Pomatomus saltatrix*)

EFH is designated for bluefish adult and juveniles throughout the action area. Adult and juvenile bluefish are pelagic. Juveniles would likely be in the project area from May through October; adults from April through October. Juvenile and adult bluefish eat a wide array of invertebrates and fishes. Both life stages and their prey may be adversely impacted temporarily through water quality impacts such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column during construction. These impacts would subside upon project completion. However, bluefish and their prey are mobile species, and would likely leave the project area during construction to avoid these impacts. Operation of the SSB and BC could trap individuals, and impact ingress and egress, and movement of juveniles and adults within the back bays environment. No significant direct effects are anticipated. Impact level is expected to be low. Undertaking construction in the fall or winter would minimize any interactions with or impacts to bluefish.

4.3.6 Long finned inshore squid (*Loligo pealei*)

EFH is designated for eggs, juveniles, and adult long finned inshore squid across the entire project area. Eggs are demersal and may be present once water temperatures reach 10°C in warm months. Eggs are commonly found attached to rocks and small boulders on sandy/muddy bottom and on aquatic vegetation. Juveniles are pelagic. Juvenile pre-recruits are found in coastal inshore waters in spring/fall above water temperatures of 10°C and offshore in winter. Adults typically utilize deeper waters of the continental shelf, but may migrate to inshore waters as shallow as 6 m in the summer and autumn at water temperatures above 9°C. Adult recruits are demersal during the day and pelagic at night. They are typically found on mud or sand/mud substrate.

Eggs and adult lifestages would be affected more than juveniles by the proposed project. Construction of SSB, BC, and perimeter plans that affect SAV and subtidal hardened habitats would affect EFH for eggs. These habitats would be lost or altered reducing potential habitat for eggs: Barnegat Inlet SSB - 3 acres of SAV; Absecon Blvd BC –2 acres of soft bottom with shellfish, 4 acres of subtidal, hardened shoreline, and 13 acres of hardened shoreline with shellfish; and South Ocean City BC – 2 acres of subtidal soft bottom. The perimeter plans would also affect 1 – 6 acres of soft bottom habitat (with and without shellfish) but would have the most extensive impact on subtidal hardened habitats (with and without shellfish) (79 – 184 acres). Any subtidal hardened structure associated with the measures implemented (SSB, BC, and perimeter plans) could provide replacement structured habitat that eggs could utilize.

As juveniles are pelagic and mobile, there would likely be minimal impacts to this life stage during construction. Juveniles could move from the area to avoid construction impacts, and there is abundant habitat in the project area. Construction of SSB, BC, and perimeter plans that affect soft bottom and sand habitats could impact adult long finned inshore squid. These habitat would be lost to use: Barnegat Inlet SSB - 12 acres of soft bottom with shellfish; Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 1 acre of soft bottom, and 2 acres of soft bottom with shellfish; South Ocean City 52nd St BC – 2 acres of subtidal soft bottom with shellfish; and perimeter plans – 1 – 6 acres of soft bottom habitats (with and without shellfish). Adults would be expected to move from the area during construction to avoid direct impacts to individuals. Increased turbidity during construction could impair feeding by juveniles and adults.

Operation of the SSB and BC could trap individuals, and impact ingress and egress, and movement of juveniles and adults within the back bays environment.

Overall, impacts would be low to moderate depending on the extent to which new structures could provide hardened habitat for eggs. If substantial, the most extensive impacts would be to habitats for adults. Undertaking construction in the fall or winter would minimize any interactions with or impacts to juvenile long finned inshore squid.

4.3.7 Scup (*Stenotomus chrysops*)

EFH is designated for juvenile and adult scup throughout the project area south of the northern portion of Barnegat Bay (Square 3 – 15). EFH is not designated for scup at Manasquan Inlet. Juvenile and adult scup are both demersal utilizing a variety of habitats including sandy bottom or structured habitats. Scup would be expected to be present in the project area in spring through fall; some adults may winter offshore.

Impacts to physical habitat from construction of SSB, BC, and perimeters plans would be expected to result in loss of habitat used by scup: Barnegat Inlet SSB - 12 acres of subtidal soft bottom with shellfish and 3 acres of SAV; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 1 acre of subtidal soft bottom, 2 acres of subtidal soft bottom with shellfish, 4 acres of hardened shoreline, and 13 acres of hardened shoreline with shellfish; and South Ocean City BC – 2 acres of subtidal soft bottom. The perimeter plans would also affect 1 – 6 acres of subtidal soft bottom habitats (with and without shellfish). Given that scup are bottom feeders, there could be permanent and temporary impacts to scup and their prey from disturbance of bottom habitats; smothering from construction; and water quality impacts. Prey availability could be reduced during and following construction activities. Impacts associated with impaired water quality include a temporary, but localized increase in turbidity and decreased dissolved oxygen content in the water column during construction. Operation of the SSB and BC (excluding Manasquan Inlet component) could trap individuals, and impact ingress and egress, and movement of juveniles and adults within the back bays environment. Overall, impacts would be anticipated to be moderate since scup are demersal and benthic feeders, but able to move from the area and similar habitat is abundant in the region. Undertaking the project in the winter would minimize any interactions with or impacts to scup.

4.3.8 Spiny dogfish (*Squalus acanthias*)

EFH is identified for sub-adult males along the southern NJ coast near the mouth of Delaware Bay (squares 14 and 15), while sub-adult females and adults have a widespread distribution in the study (squares 1 – 11, 14, and 15) . Spiny dogfish are demersal by day, but may vertically migrate at night to feed. Spiny dogfish prefer muddy/silty and sandy bottoms in polyhaline baymouths and contenintal slope waters in depths of 1– 500 m. Summer and fall bring seasonal migrants into outer estuaries where the water is cooler and more saline.

Direct impacts from construction are expected to be low as sub-adults and adults are mobile and would likely to move from the project area due to disruptions during construction. Impacts to physical habitat from construction of SSB, BC, and perimeters plans would be expected to result in loss of habitat used by spiny dogfish: Barnegat Inlet SSB - 12 acres of subtidal soft bottom with shellfish and 3 acres of SAV; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 1 acre of subtidal soft bottom and 2 acres of subtidal soft bottom with shellfish; and South Ocean City 52nd St. BC – 2 acres of subtidal soft bottom. The perimeter plans would also affect 1 – 6 acres of subtidal soft bottom habitats (with and without shellfish). Impacts associated with impaired water quality include a temporary, but localized increase in turbidity and decreased dissolved oxygen content in the water column during construction. Operation of SSB and BC could trap individuals, and impact ingress and egress, and movement within the back bays environment. Overall, impacts would be anticipated to be moderate to spiny dogfish since they are demersel and a substantial amount of potential habitat would be disturbed. However, they are able to move from the area and similar habitat is abundant for feeding in the region. Undertaking the project in the winter would minimize any interactions with or impacts to spiny dogfish.

4.3.9 Summer flounder (*Paralicthys dentatus*)

EFH is designated for summer flounder larvae, juveniles, and adults throughout the entire North, Central, and South regions (only square 1 is not designated in the study area). Summer flounder larvae are pelagic and most likely to be in the project area between October to May when they use coastal and estuarine habitats as nursery grounds. Larvae prey upon zooplankton and small crustaceans. Summer flounder juvenile and adults are demersal, associated with mud and sandy substrates in shallow coastal and estuarine waters (juvenile < 5 m; adult < 25 m) in warmer months. Adults move offshore to depths greater than 150 m in colder months.

Summer flounder larvae would be impacted by construction activities occurring between October and May. They are mobile and would likely avoid construction areas. Impacts to larvae could include loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts) that would affect habitat condition and feeding.

Juveniles and adults are demersal and inhabit the project area during warmer months. There could be impacts to juveniles and adults as loss of individuals from construction activities (direct impact), loss of habitat, and reduced availability of benthic food prey. Direct impacts are expected to be moderate as juvenile and adults are mobile and would likely move from the project area due to disruptions from construction. However, a broad array of habitats utilized by summer flounder would likely be lost due to construction of SSB, BC, and perimeter plans: Barnegat Inlet SSB - 12 acres of soft bottom with shellfish and 3 acres of SAV; Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 1 acre of subtidal soft bottom, 2 acres of soft bottom with shellfish, 50 acres of estuarine marsh, and 1 acre of mudflat without shellfish and 2 acres with shellfish; and South Ocean City 52^{nd} St. BC – 2 acres of subtidal soft bottom and 24 acres of estuarine marsh; and perimeter plans – 1 – 6 acres of soft bottom habitats (with and without shellfish), 62 – 176 acres of estuarine marsh, and 17 – 59 acres of mudflat (with and without shellfish).

Operation of SSB and BC could trap individuals, and impact ingress and egress, and movement within the back bays environment.

The impact to summer flounder is projected to be high due to the broad impact to habitat. Additionally, HAPC would be affected. Conducting construction in fall and winter months would reduce the likelihood of interactions with juvenile and adult summer flounder, but not larvae. Impacts to summer flounder larvae could still be likely during winter months as they would remain in the study area, but would be anticipated to be low since they are pelagic.

4.4 Effects by Species: NEW ENGLAND SPECIES

4.4.1 Atlantic sea herring (*Clupea harengus*)

EFH is designated for juvenile and adult Atlantic sea herring throughout the entire study area. Atlantic sea herring juveniles and adults typically avoid warmer waters (juvenile < 22°C; adult < 10 ° C) and low salinities. Atlantic sea herring are most likely to be in the project area during fall and winter. However, waters within the study area, particularly in the north, could provide suitable water temperatures for juveniles throughout the year. Juveniles and adults are pelagic. Adults are typically found near the surface, but spawning occurs on the bottom at depths of 5 – 90 m in late summer/fall. Both life stages and their prey may be adversely impacted (indirect impact) temporarily through water quality impacts such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column during construction. These impacts would subside upon project completion. Atlantic sea herring and their prey are mobile species and would likely leave the project area during construction to avoid these impacts. Conducting construction in fall and winter months would reduce the likelihood of interactions with juvenile and adult Atlantic sea herring. Operation of the SSB and BC could trap individuals, and impact ingress and egress, and movement within the back bays environment. Effects are anticipated to be low due to use of pelagic habitats and mobility. No significant direct effects are anticipated.

4.4.2 Atlantic cod (*Gadus morhua*)

EFH is designated for Atlantic cod eggs and larvae in the North Region on a limited basis: eggs in northern Barnegat Bay (square 3) and larvae in the vicinity of Manasquan Inlet (square 2). As cod eggs and larvae are pelagic and prefer offshore and coastal waters, impacts to Atlantic cod would be expected to be minimal. Given the limited spatial extent of the EFH designations in the North Region, the perimeter plans would have no impact on Atlantic cod. Potential impacts from construction would be limited to the Manasquan Inlet SSB. Eggs and larvae could be adversely impacted (indirect impact) temporarily through water quality impacts such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column during construction, or by operation of the Manasquan Inlet SSB. Operation of the both the Manasquan Inlet and Barnegat Inlet SSBs could trap individuals, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon project completion or opening of the SSB. Impacts are anticipated to be low to Atlantic cod EFH.

4.4.3 Ocean pout (*Macrozoarces americanus*)

EFH is designated for ocean pout eggs and adults in the North Region: eggs are listed in squares 3 to 7 and adults are listed is squares 1 to 7. Eggs would only be affected by projects ranging from northern Barnegat Bay to Little Egg Harbor Inlet. The potential to impact adults spans from Little Egg Harbor throughout the northern extent. The perimeter plans still under consideration would not affect ocean pout. The Manasquan Inlet SSB would be limited to potential adult impacts. The Barnegat Bay Inlet SSB could impact both eggs and adults.

Ocean pout eggs are demersal, may utilize high salinity zones of bays and estuaries. Ocean pout spawn on hard bottom protected habitats, such as rock crevices and man-made artifacts. Adults are demersal and prefer benthic habitats deeper than 20 m, but may use high salinity zones of bays and estuaries in mud and sandy bottoms with structure. Additionally, prey items are benthic invertebrates. The Barnegat Inlet SSB would result in the loss of 12 acres of subtidal soft bottom with shellfish habitat, while the Manasquan Inlet SSB would impact 2 acres of subtidal soft bottom without shellfish. There would be expected to be losses to eggs within the Barnegat Inlet due to their immobility. The loss of 2,280 lf of intertidal (artificial) rocky shoreline from the Manasquan Inlet could also reduce rocky habitat for ocean pout. Adults would be expected to be able to move from the area during construction. Eggs and adults could be adversely impacted (indirect impact) temporarily through water quality impacts such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column during construction. Operation of these SSB could trap individuals, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon completion of construction or opening of the SSB. Impacts are projected to be low to moderate for eggs, but low for adults.

4.4.4 Pollock (*Pollachius virens*)

EFH is designated for pollock larvae at Barnegat Inlet/Bay (square 4) in the North Region. Pollock larvae use pelagic inshore and offshore waters. Adverse, temporary impacts (indirect impact) could stem from water quality impacts associated with a localized increase in turbidity and decreased dissolved oxygen content in the water column during construction. Operation of the Barnegat Bay SSB could trap individuals, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon completion of construction or opening of the SSB. Given their mobility, the limited spatial extent of the EFH designation and potential project, impacts are expected to be low.

4.4.5 White hake (*Urophycis tenuis*)

EFH is designated for white hake eggs in isolated areas throughout the study area: North Region/Barnegat Inlet (square 4), Central Region/Absecon Inlet (square 9), Central Region/Great Egg Harbor and Corson Inlets (square 11), and South Region/Cold Spring Inlet (square 15). White hake eggs occur near the surface in pelagic habitats. Adverse, temporary impacts (indirect impact) could stem from water quality impacts associated with a localized increase in turbidity and decreased dissolved oxygen content in the water column during construction of SSB, BC, and perimeter plans. The potential for impacts would be associated with all potential SSB, BC, and perimeter plan proposals except the Manasquan Inlet SSB, but would subside upon project completion. Operation of these SSB could trap individuals, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon completion of construction or opening of the SSB. Impacts are projected to be low as white hake eggs are pelagic.

4.4.6 Windowpane Flounder (*Scopthalmus aquosus*)

EFH is designated for windowpane flounder eggs, larvae, juveniles, and adults throughout the entire study area. Windowpane flounder eggs and larvae are pelagic. Eggs are likely in the study area between February to July and September to November. Larvae are likely found between May to July and October and November. As larvae age, they start to utilize benthic habitats. Windowpane flounder juvenile and adults are demersal, associated with mud and sandy substrates in shallow coastal and estuarine waters.

Windowpane flounder eggs and larvae would be impacted by construction activities occurring between February and November. Larvae are mobile and would likely avoid construction areas. Impacts could include loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts). Undertaking construction in winter months would avoid impacts to eggs and larvae.

Juveniles and adults are demersal and therefore, at higher risk from project impacts. There could be impacts to juveniles and adults as loss of individuals from construction activities (direct impact), loss of habitat, and reduced availability of benthic food prey. Direct impacts are expected to be moderate as juvenile and adults are mobile and would likely move from the project area due to disruptions from construction. However, a broad array of habitats utilized by windowpane flounder would likely be lost due to construction of SSB, BC, and perimeter plans:

Barnegat Inlet SSB - 12 acres of soft bottom with shellfish and 3 acres of SAV; Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 1 acre of subtidal soft bottom, 2 acres of soft bottom with shellfish, 50 acres of estuarine marsh, and 1 acre of mudflat without shellfish and 2 acres with shellfish; and South Ocean City 52nd St. BC – 2 acres of subtidal soft bottom and 24 acres of estuarine marsh; and perimeter plans – 1 – 6 acres of soft bottom habitats (with and without shellfish), 62 – 176 acres of estuarine marsh, and 16 – 58 acres of mudflat (with and without shellfish).

The impact to windowpane flounder is projected to be moderate to high. Operation of the SSB could trap individuals, and impact ingress and egress, and movement within the back bays environment. There would be broad impacts to habitat, but juveniles and adults would be able to move from the area. Conducting construction in fall and winter months would reduce the likelihood of interactions with eggs and larvae, but not juvenile and adults.

4.4.7 Winter flounder (Pseudopleuronectes americanus)

EFH is designated for eggs, larvae, juvenile, and adult winter flounder in the portion of the study area north of Latitude 39°22' N. This includes the entire North Region and a portion of the Central Region (boxes 8, 9, and 10) to Absecon Inlet. The following measures would not affect winter flounder: perimeter plans for the South Region, or the Ocean City component in the Central Region, and the Ocean City 52nd St BC.

All life stages of winter flounder are associated with benthic habitats. At first, larvae use pelagic habitats, but become benthic with growth. Prey include benthic invertebrates, phytoplankton, and fish. There could be impacts to winter flounder as loss of individuals from construction activities (direct impact), loss of habitat (indirect), water quality impacts during construction such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column (indirect), and reduced availability of benthic food prey (indirect). Operation of the SSB could trap individuals, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon completion of construction or opening of the SSB.

Winter flounder eggs are sensitive to sedimentation and could be particularly affected by turbidity increases associated with construction. However, winter flounders and their prey are mobile and would likely leave the project area during construction to avoid these impacts.

Although mobile, a broad array of habitats utilized by winter flounder would likely be lost due to construction of SSB, BC, and perimeter plans: Barnegat Inlet SSB - 12 acres of soft bottom with shellfish and 3 acres of SAV; Manasquan Inlet SSB – 2 acres of soft bottom and 2,280 lf of intertidal rocky shoreline (artificial); Great Egg Harbor Inlet SSB – 20 acres of soft bottom; and Absecon Blvd BC – 1 acre of subtidal soft bottom, 2 acres of soft bottom with shellfish, 50 acres of estuarine marsh, 1 acre of mudflat without shellfish and 2 acres with shellfish, 4 and 13 acres of subtidal hardened shoreline (with and without shellfish, respectively), and 1,831 lf of intertidal rocky shoreline (artificial); and perimeter plans – 1 – 4 acres of soft bottom habitats (with and without shellfish), 21 – 39 acres of estuarine marsh, 13 – 23 acres of mudflat (with and without shellfish). 4,196 lf of intertidal rocky shoreline (artificial), and 45 – 61 acres of subtidal hardened shoreline (with and without shellfish).

The impact to winter flounder is projected to be high. Prior coordination with NMFS on related dredging projects, identified an environmental conservation recommendation to not conduct dredging activities from January 1 through May 31. If applicable, this recommendation would apply to activities north of Absecon Inlet. If that recommendation were adhered to for construction, the likelihood of impacts to winter flounder is reduced.

4.4.8 Witch flounder (*Glyptocephalus cynoglossus*)

EFH is designated for eggs for witch flounder in discrete locations in the study area: North Region – Barnegat Inlet (square 4), Central Region – Great Egg Harbor and Corson Inlets (square 11), and South Region – Atlantic Ocean waters (square 14). Eggs utilize pelagic habitats. No projects would affect EFH in the South Region Atlantic Ocean waters of square 14. The following project measures could potentially impact witch flounder EFH: Barnegat Inlet and Great Egg Harbor SSBs, and the Central Region perimeter plans. Impacts in the North and Central Region would be limited to loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts). Operation of the SSB could trap individuals, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon completion of construction or opening of the SSB. Impacts would be expected to be low.

4.4.9 Yellowtail flounder (*Limanda ferruginea*)

EFH for yellowtail flounder is designated for all lifestages in discrete locations in the North Region – egg, larvae, juvenile, and adult in Manasquan and Barnegat Inlets (squares 2 and 4), eggs in the back bays and Atlantic Ocean waters between Manasquan and Barnegat Inlets (square 3). There are no designations in the Central Region. The only designation in the South Region is for juveniles in the Atlantic Ocean waters (square 14). No projects would affect EFH in the South Region Atlantic Ocean waters of square 14. The Manasquan and Barnegat Inlet SSB are the only project measures that could potentially impact yellowtail flounder EFH.

Eggs and larvae use pelagic habitats. Impacts to eggs and larvae would include loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts). Juveniles, adults, and prey utilize benthic habitats. However, juveniles and adults are limited to deeper waters greater than 20 m, and are therefore unlikely to be in the project area. Operation of the SSB could trap individuals of all life stages, and impact ingress and egress, and movement within the back bays environment. These impacts would subside upon completion of construction or opening of the SSB. Impacts are expected to be low given the pelagic lifestyle of eggs and larvae, as well as mobility of juveniles and adults and their use of deep habitats.

4.4.10 Silver hake/whiting (*Merluccius bilinearis*)

EFH is designated for silver hake for eggs and larvae, and adults in the study area. The EFH habitat for eggs and larvae covers the eastern portions of the study area (squares 1 – 4, 6, 8, 9, 11 – 15). EFH habitat for adults is limited to Manasquan Inlet in the North Region (square 2). The EFH mapper does not identify juvenile EFH within the study area, however, it is identified in the Omnibus EFH Assessment 2 (NEFMC, 2017).

All life stages utilize pelagic habitats. Juveniles and adults also use benthic habitats, but at depths greater than 10 meters for juveniles and 35 meters for adults which reduces the likelihood of impacts from the project components. Benthic habitats include sandy substrates with depressions and shells or other structure. Adults use the water column for feeding.

All project components have the potential to impact eggs and larvae. Impacts to eggs and larvae would be limited to loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts). Operation of all SSB and BC could trap individuals, and impact ingress and egress, and movement within the back bays environment.

Impacts to adults from construction could result from the Manasquan Inlet SSB and could include loss of individuals from construction activities (direct impact), loss of 2 acres of subtidal soft bottom habitat (indirect) (potentially, depending on water depth), water quality impacts during construction such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column (indirect), and reduced availability of prey or impacts to feeding (indirect). Operation of the Manasquan Inlet SSB does have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment.

Due to limited coverage of EFH designations, utilization of pelagic habitats, and preference for deeper waters, impacts to silver hake are anticipated to be low.

4.4.11 Red hake (*Urophycis chuss*)

EFH is designated for red hake for all life stages throughout the study area. Adult life stages, however, are not listed for back bay areas south of Corson Inlet (square 12); north of Absecon Inlet, including Little Egg Harbor Inlet, and within Great Bay and Little Egg Harbor; and the western edges of southern Barnegat Bay (squares 5, 6, 7, and 9). EFH for adults would not be affected by the Absecon Inlet BC or Absecon and Brigantine components of the Central Region Perimeter Plans.

Red hake eggs can be found in pelagic habitats from May through November. Impacts to eggs would be limited to loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts). Operation of the SSB have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment, but would cease upon opening of the SSB. Impacts would be anticipated to be low, and could be minimized or eliminated by constructing in winter months.

Larvae utilize intertidal and sub-tidal benthic habitats on mud and sand that contain structure or biogenic depressions for shelter from May to December. Smaller juveniles are pelagic but shift to bottom habitats as they grow including shell beds, soft sediments (mud and sand), and artificial reefs. Larvae prey on copepods or other microcrustaceans, often under floating eelgrass or algae. Although juveniles are pelagic, they utilize open depressions and shells for shelter. Adults utilize benthic habitats, but at depths greater than 20 m in estuaries and embayments. They prefer depressions in softer sediments or in shell beds. There could be impacts to red hake as loss of individuals from construction activities (direct impact), loss of habitat (indirect), water quality impacts during construction such as a temporary and localized increase in turbidity and decreased dissolved oxygen content in the water column (indirect), and reduced availability of benthic food prey (indirect). Operation of the SSB have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment, but would cease upon opening of the SSB.

Larvae, juvenile, and adults are mobile and would likely move from the project area due to disruptions from construction. However, a broad array of habitats utilized by red hake would likely be lost due to construction of SSB, BC, and perimeter plans: Barnegat Inlet SSB – 12 acres of soft bottom with shellfish, 1 acre of intertidal sandy beach, and 3 acres of SAV; and Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom and 6 acres of intertidal sandy beach; and Absecon Blvd BC (juvenile only) –3 acres of intertidal sandy beach (with and without shellfish), 3 acres of intertidal mudflat (with and without shellfish), 3 acres of subtidal soft bottom (with and without shellfish); South Ocean City 52nd Street BC – 2 acres of subtidal soft bottom; Central Region perimeter plans – 11 – 12 acres of intertidal sandy beach (with and without shellfish), 17 – 27 acres of intertidal mudflat (with and without shellfish), 4 – 5 acres of soft bottom habitats (with and without shellfish); and South Region perimeter plans – 10 acres of intertidal sandy beach (with and without shellfish), 32 acres of intertidal mudflat (with and without shellfish), 1 acre of soft bottom habitat with shellfish.

Impacts to eggs and juvenile could be minimized by winter construction (after December). Affects to adults would be limited to do their preference for deeper water depths. Cumulatively, impacts would be expected to be moderate. Red hake eggs and larvae presence in the study area is limited to May through December, and adult presence is limited by water depths. However, a diversity of habitats used by various red hake life stages that would be impacted.

4.4.12 Monkfish (*Lophius americanus*)

EFH is designated for eggs and larvae monkfish throughout the study area. Eggs and larvae utilize pelagic areas in inshore areas. Impacts to eggs and larvae would be limited to loss of individuals during construction (direct impact), and increased turbidity and reduced water quality (indirect impacts). Operation of the SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. Impacts are projected to be low to monkfish.

4.4.13 Little skate (*Raja erinacea)*

EFH is designated for juvenile and adult little skate throughout the study area. However, EFH is not listed for adult little skate at Absecon Inlet (square 9). Juvenile and adult little skate are found in intertidal and sub-tidal benthic habitats in the project area, utilizing gravel, sand, and mud bottom. Little skate prey upon benthic macrofauna.

There could be impacts to little skate as loss of individuals from construction activities (direct impact); loss of habitat (indirect); water quality impacts during construction such as a temporary and localized increase in turbidity, decreased dissolved oxygen content in the water column (indirect), and reduced availability of benthic food prey (indirect); and impacts during operation of SSB and BC. Operation of the SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment.

Juveniles and adults are mobile and would likely move from the project area due to disruptions from construction. However, a broad array of habitats utilized by little skate would likely be lost due to construction of SSB, BC, and perimeter plans: Barnegat Inlet SSB – 12 acres of soft bottom with shellfish, 1 acre of intertidal sandy beach, and 3 acres of SAV; and Manasquan Inlet SSB – 2 acres of soft bottom and 2,280 lf of intertidal rocky shoreline (artificial); Great Egg Harbor Inlet SSB – 20 acres of soft bottom and 6 acres of intertidal sandy beach; and Absecon Blvd BC (juvenile only) – 3 acres of intertidal sandy beach (with and without shellfish), 3 acres of intertidal mudflat (with and without shellfish), 3 acres of subtidal soft bottom (with and without shellfish), 17 acres of subtidal hardened shoreline (with and without shellfish), and 1,831 lf of intertidal rocky shoreline (artificial); South Ocean City 52nd Street BC – 2 acres of subtidal soft bottom; Central Region perimeter plans – 11 – 12 acres of intertidal sandy beach (with and without shellfish), 17 – 27 acres of intertidal mudflat (with and without shellfish), 4 – 5 acres of soft bottom habitats (with and without shellfish), 16 – 95 acres of subtidal hardened shoreline (with and without shellfish), and 4,196 lf. of intertidal rocky shoreline (artificial), and South Region perimeter plans – 10 acres of intertidal sandy beach (with and without shellfish), 32 acres of intertidal mudflat (with and without shellfish), 1 acres of subtidal soft bottom habitats (with shellfish), 105 acres of subtidal hardened shoreline (with and without shellfish), and 2,404 lf of intertidal rocky shoreline. EFH for adults would not be affected by the Absecon Inlet BC or the components of the Central Region Perimeter Plans in the Absecon Inlet area (square 9). Impacts would be expected to potentially be high given the extent and diversity of habitats impacted by construction and operation.

4.4.14 Winter skate (*Raja ocellata*)

EFH is designated for juvenile and adult winter skate throughout the study area. However, EFH is not listed for adult winter skate at Manasquan Inlet (square 2) nor south of Little Egg Harbor (squares 8 – 15). Juvenile and adult winter skate are found in sub-tidal benthic habitats in the project area, utilizing gravel, sand, and mud bottom. Winter skate prey upon benthic macrofauna. Impacts would be similar to those outlined for little skate, excluding intertidal habitats. Further, adult winter skate would not be impacted by project components south of Little Egg Harbor or at Manasquan Inlet. The habitats directly impacted include: Barnegat Inlet SSB – 12 acres of soft bottom with shellfish and 3 acres of SAV; Manasquan Inlet SSB – 2 acres of soft bottom (juvenile only); Great Egg Harbor Inlet SSB (juvenile only) – 20 acres of soft bottom; Absecon Blvd BC (juvenile only) – 3 acres of subtidal soft bottom (with and without shellfish) and 17 acres of subtidal hardened shoreline (with and without shellfish); South Ocean City 52nd Street BC (juvenile only)

– 2 acres of subtidal soft bottom; Central Region perimeter plans (juvenile only) – 4 – 5 acres of soft bottom habitats (with and without shellfish) and 16 – 95 acres of subtidal hardened shoreline (with and without shellfish); and South Region perimeter plans (juvenile only) –1 acres of subtidal soft bottom habitats (with shellfish) and 105 acres of subtidal hardened shoreline (with and without shellfish).

Impacts would be expected to potentially be high given the extent and diversity of habitats impacted by construction and operation.

4.4.15 Clearnose skate (*Raja egianteria*)

EFH is designated for juvenile and adult clearnose skate throughout the study area. However, EFH is not listed for juvenile clearnose skate at Manasquan Inlet (square 2). Juvenile and adult clearnose skate are found in sub-tidal benthic habitats in the project area. Compared to winter skate, clearnose skate show a preference for sand and mud over gravelly and rocky bottom. Adults are known to be associated with the high salinity zone in Delaware Bay. Prey include a mix of benthic and pelagic invertebrates and small fish. Impacts would be similar to those outlined for little skate, excluding intertidal habitats. However, juvenile clearnose skate would not be impacted by project components at Manasquan Inlet (square 2), and adult clearnose skates would be impacted by those at Absecon Inlet (square 9).

The habitats directly impacted include: Barnegat Inlet SSB – 12 acres of soft bottom with shellfish and 3 acres of SAV; Manasquan Inlet SSB (adult only) – 2 acres of soft bottom (juvenile only); Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC– 3 acres of subtidal soft bottom (with and without shellfish) and 17 acres of subtidal hardened shoreline (with and without shellfish); South Ocean City 52nd Street BC – 2 acres of subtidal soft bottom; Central Region perimeter plans – 4 – 5 acres of soft bottom habitats (with and without shellfish) and 16 – 95 acres of subtidal hardened shoreline (with and without shellfish); and South Region perimeter plans –1 acres of subtidal soft bottom habitats (with shellfish) and 105 acres of subtidal hardened shoreline (with and without shellfish). Impacts would be expected to potentially be high given the extent and diversity of habitats impacted by construction and operation.

4.5 Effects by Species: COASTAL MIGRATORY PELAGIC SPECIES

4.5.1 King Mackerel (*Scomberomorus cavalla*)

EFH is designated for all lifes stages of king mackerel throughout the entire study area. All life stages inhabit pelagic waters with sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters from the surf to the shelf break zone. Larvae are found in estuaries with water temperatures from 26° to 31° C (79° to 88° F). The adult king mackerel is present in waters with temperatures above 20° C (68° F) (typically June through September). King mackerel are highly mobile and would be expected to vacate and avoid areas during construction. Construction of perimeter plans along the shoreline would not be expected to affect king mackerel. Any construction impacts would be limited to those associated with SSB and BC, including loss of individuals during construction (direct impact), and those associated with increased turbidity and reduced water quality (indirect impacts). Construction during winter months would avoid impacts to king mackerel. The risk of impacts to king mackerel are likely greater from operation of SSB and BC in summer and early fall compared to construction.

Operation of the SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. Impacts are projected to be low to king mackerel due to their mobility, pelagic habitat use, and seasonal presence of the study area.

4.5.2 Spanish Mackerel (*Scomberomorus maculatus*)

EFH is designated for all lifes stages of Spanish mackerel throughout the entire study area. All life stages inhabit pelagic waters. EFH for all life stages typically is located in ocean waters to the shelf break zone, but coastal inlets and all state designated nursery habitats are of particular importance to Spanish mackerel. EFH also includes high salinity bays, estuaries, and seagrass habitat. Spanish mackerel is most commonly found in waters with a temperature above 20° C (68° F) and salinity greater than 30 ppt. Temperatures limit Spanish mackerel presence in the back bays to summer months (June through September), however, salinities in the back bays are likely further limiting as they typically range from 20 to 30 ppt.

Based on the habitat requirements, Spanish mackerel are expected to only occasionally be found in the back bays area. Impacts would be similar to those described for king mackerel and are projected to be low due to their mobility, pelagic habitat use, and limited and seasonal presence in the study area.

4.6 Effects by Species: HIGHLY MIGRATORY SPECIES

4.6.1 Bluefin Tuna (*Thunnus thynnus*) (NMFS, 2017)

EFH is designated for adult bluefin tuna in the northern portion (squares 1 – 3) of the study area. EFH is designated for juvenile bluefin tuna in northern (squares 1 – 4) and southern portions (squares 13 and 14) of the study area. Bluefin tuna are a pelagic species that feeds opportunistically on an array of fish and benthic invertebrates. The only project components that are likely to impact bluefin tuna is the Manasquan Inlet SSB. Construction impacts include loss of individuals during construction (direct impact), and those associated with increased turbidity and reduced water quality (indirect impacts). The risk of impacts to bluefin tuna are likely greater from operation of the Manasquan SSB compared to construction. Operation of the SSB do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. Impacts are projected to be low to bluefin tuna due to their mobility, pelagic habitat use, and the limited extent of EFH in the study area.

4.6.2 Skipjack Tuna (*Katsuwonus pelamis*) (NMFS, 2017)

EFH is designated for adult skipjack tuna throughout the entire study area. Skipjack tuna are an epipelagic and oceanic species. The optimum temperature for the species is 27 ºC, with a range from 20 to 31° C (ICCAT, 1995). Skipjack tuna is an opportunistic species, which preys upon fishes, cephalopods, and crustaceans (Dragovich 1969 and 1970b; Dragovich and Potthoff 1972; Collette and Nauen 1983; ICCAT 113 1997). All SSB and BC have the potential to impact skipjack tuna EFH. Construction impacts include loss of individuals during construction (direct impact), and those associated with increased turbidity and reduced water quality (indirect impacts). The risk of impacts to skipjack tuna are likely greater from operation of SSB and BC compared to construction. Operation of SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. Impacts are projected to be low to skipjack tuna due to their mobility, pelagic habitat use, and their seasonal use of EFH in the study area.

4.6.3 Atlantic Yellowfin Tuna (*Thunnus albacares*) (NMFS, 2017)

EFH is designated for juvenile yellowfin tuna in the south and central regions of the study area (squares 6 – 14), covering back bay environments south of Manahawkin Bay to Atlantic Ocean waters east of Cape May. Atlantic yellowfin tuna is an epipelagic, oceanic species, found in water temperatures between 18 and 31 °C (June through September). Yellowfin tuna are opportunistic feeders, preying on a diversity of fish and invertebrates. The proposed Great Egg Harbor Inlet SSB, Absecon Blvd BC, and South Ocean City 52nd Street BC would potentially impact yellowfin tuna. Construction impacts include loss of individuals during construction (direct impact), and those associated with increased turbidity and reduced water quality (indirect impacts). The risk of impacts to yellowfin tuna are likely greater from operation of SSB and BC compared to construction. Operation of SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. Impacts are projected to be low to yellowfin tuna due to their mobility, pelagic habitat use, and their seasonal use of EFH in the study area.

4.7 Effects by Species: SHARKS

4.7.1 Sand tiger shark (*Carcharias taurus*)

Sand tiger shark is listed as a Species of Concern by NOAA. EFH is designated for neonates and juveniles throughout the study area; and for adults in the south region (squares 14 and 15). Additionally, HAPC is designated in the South Region at the mouth of Delaware Bay (square 15). Sand tiger sharks utilize shallow coastal waters and bottom habitats where temperatures range from 19 to 25 °C (66.2 to 77 °F) (June through October) and salinities range from 23 to 30 ppt at depths of 2.8 – 7.0 m in sand and mud. Sand tiger sharks consistently and extensively use Delaware Bay and adjacent coastal areas seasonally. Through tagging it has been determined that sand tiger sharks spend 95% of their time in the lower Chesapeake Bay and Delaware Bay when temperatures range from 17 to 23 °C (62.6 to 73.4 °F) (Teter et al., 2015). They prey upon crabs, squid, and small fish. The estuarine, sub-tidal and marine, near-shore and intertidal habitat impacted by the project could support sand tiger shark neonates, juveniles, and adults.

There could be impacts to all lifestages of sand tiger shark as loss of individuals from construction activities (direct impact); loss of habitat (indirect); water quality impacts during construction such as a temporary and localized increase in turbidity, decreased dissolved oxygen content in the water column (indirect), and reduced availability of benthic food prey (indirect); and impacts during operation of SSB and BC. Operation of the SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. HAPC is limited to marine environments in square 15 is are not anticipated to experience impacts.

Neonates, juveniles and adults are mobile and would likely move from the project area due to disruptions from construction. However, subtidal habitats utilized by sand tiger sharks would likely be lost throughout the study area due to construction of SSB, BC, and perimeter plans: Barnegat Inlet SSB – 12 acres of soft bottom with shellfish; Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 3 acres of subtidal soft bottom (with and without shellfish); South Ocean City 52nd Street BC – 2 acres of subtidal soft bottom; Central Region perimeter plans – 4 – 5 acres of soft bottom habitats (with and without shellfish); and South Region perimeter plans – 1 acres of soft bottom habitat (with shellfish).

Impacts are projected to be low to sand tiger shark due to their mobility, pelagic habitat use, and their seasonal use of EFH in the study area. No impacts to sand tiger shark HAPC are expected.

4.7.2 Atlantic Angel Shark (*Squatina dumerili*

EFH is designated for all life stages (neonates/YOY, juveniles, and adults) in coastal waters of the South Region (squares 13, 14, and 15). At this time, insufficient data is available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages. EFH in the Atlantic Ocean includes continental shelf habitats from Cape May, New Jersey to Cape Lookout, North Carolina. The angel shark is a benthic species inhabiting coastal waters. No project components are proposed in coastal waters. Therefore, no impacts are anticipated to the Atlantic angel shark.

4.7.3 Common Thresher Shark (*Alopias vulpinus)*

EFH is designated for all life stages (neonates/YOY, juveniles, and adults) for common thresher shark throughout the study area. At this time, insufficient data is available to differentiate EFH between the juvenile and adult size classes; therefore, EFH is the same for those life stages. Common thresher shark is a pelagic species that preys on invertebrates such as squid and pelagic crabs as well as small fishes such as anchovy, sardines, hakes, and small mackerels (Preti et al. 2004).

There could be impacts to all lifestages of common thresher shark as loss of individuals from construction activities (direct impact); loss of habitat (indirect); water quality impacts during construction such as a temporary and localized increase in turbidity, decreased dissolved oxygen content in the water column (indirect), and reduced availability of benthic food prey (indirect); as well as impacts during operation of SSB and BC. Operation of the SSB and BC do have the potential to trap individuals, and impact ingress and egress, and movement within the back bays environment. HAPC is limited to marine environments in square 15 and are not anticipated to experience impacts.

Neonates, juveniles and adults are mobile and would likely move from the project area due to disruptions from construction. However, subtidal habitats utilized by common thresher sharks would likely be lost broadly throughout the study area due to construction of SSB, BC, and perimeter plans: Barnegat Inlet SSB – 12 acres of soft bottom with shellfish; Manasquan Inlet SSB – 2 acres of soft bottom; Great Egg Harbor Inlet SSB – 20 acres of soft bottom; Absecon Blvd BC – 3 acres of subtidal soft bottom (with and without shellfish); South Ocean City 52nd Street BC – 2 acres of subtidal soft bottom; Central Region perimeter plans – 4 – 5 acres of soft bottom habitats (with and without shellfish); and South Region perimeter plans – 1 acres of soft bottom habitat (with shellfish). Impacts are projected to be low to common thresher shark due to their mobility and use of pelagic habitats.

4.7.4 Dusky Shark (*Charcharinus obscurus*)

Dusky shark is listed as a Species of Concern by NOAA and has EFH designated for neonates throughout the study area. Dusky shark neonates inhabit shallow coastal waters, and would be expected to be present in the study area from June to September. Impacts are projected to be low in magnitude and would be similar to those to sand tiger shark, except only to neonate.

4.7.5 Sandbar shark (*Charcharinus plumbeus*)

EFH is designated for all life stages (neonates/YOY, juveniles, and adults) of sandbar shark throughout the study area. HAPC is designated for sandbar shark in the Central Region from the for the Great Bay estuary complex (squares 7, 8, 9, and 10) and in the South Region at the mouth of Delaware Bay (square 15). The Great Bay estuary complex includes Little Egg Inlet, Little Bay, Reed Bay, Absecon Bay, Lakes Bay, and Absecon Inlet along with the nearshore Atlantic Ocean along Brigantine Island and the northern half of Absecon Island. HAPC are shallow coastal waters that serve as nursery grounds for the sandbar shark. Studies indicate that juvenile sandbar sharks are generally found in water temperatures ranging from 15 to 30 °C (59 – 86 °F) (June through October), 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 from Massachusetts to North Carolina (Grubbs and Musick 2007, Grubbs et al.2007; McCandless et al. 2002, 2007; Merson and Pratt 2007). Pregnant sandbar shark females are typically in the area between late spring and early summer, give birth and depart shortly after while neonates (young-of-year) and juveniles (ages one and over) occupy the nursery grounds until migration to warmer waters in the fall (Rechisky and Wetherbee 2003 and Springer 1960). Neonates return to their natal grounds as juveniles and remain there for the summer.

Impacts to neonate/YOY, juvenile, and adult sandbar shark from the project components would be similar, but more expansive to those to sand tiger shark. Utilizing a diversity of benthic habitats (mud, sand, rock, and shell), all subtidal habitats (Tables 6 and 7) lost by project construction have the potential to reduce EFH for sandbar sharks. The HAPC at the mouth of Delaware Bay is limited to marine environments in square 15 is are not anticipated to experience impacts. However, the HAPC associated with the Great Bay estuary complex would be affected by construction of the Great Egg Harbor SSB, Absecon Blvd BC, and Central Region perimeter plan components (Absecon Island and Brigantine). HAPC would further be impacted by operation of the Great Egg Harbor SSB and Absecon Blvd BC, possibly during the birthing season, affecting ingress and egress, and potentially trap individuals. Overall, impacts to sandbar shark and HAPC is anticipated to be moderate to high. Construction impacts could be largely avoided by conducting activities in the winter, but there still remains the potential to affect individuals and HAPC during operations of SSB and BC.

4.7.6 Smoothhound Shark (*Mustelus* sp.) (*Mustelus canis*)

EFH is designated for all life stages (neonates/YOY, juveniles, and adults) for smoothhound shark throughout the study area. At this time, available information is insufficient for the identification of EFH for specific life stages, therefore all life stages are combined in the EFH designation. Smoothhound shark EFH identified in the Atlantic is exclusively for smooth dogfish, and is identified as shallow, coastal waters. Impacts are projected to be low to common thresher shark due to their mobility and use of pelagic habitats, and similar to those of common thresher shark.

4.7.7 Tiger Shark (*Galeocerdo cuvieri*)

EFH is designated for tiger shark juveniles and adults throughout the study area. Tiger sharks inhabit turbid coastal and pelagic waters of the Continental shelf, as well as estuaries and inshore subtidal habitats. Prey includes fish, crustaceans, mollusks, and plankton. Impacts are anticipated to be low and similar to those for projected for common thresher shark.

4.7.8 White Shark (*Carcharodon carcharias*)

EFH is designated for white shark neonates/YOY, juveniles, and adults. EFH for neonates/YOY extends from the North Region to waters offshore of Ocean City, NJ below the Great Egg Harbor inlet (squares 1 to 11). EFH for juveniles and adults is designated in the North Region and ends slightly north of Barnegat Inlet. White shark is a pelagic species. Within the areas designated, impacts would be expected to be low and similar to those described for common thresher shark.

4.8 Indirect Effects on EFH

The indirect impacts of SSBs and BCs on EFH are potentially significant. Under normal conditions, the gates of SSBs and BCs would remain open and fish and other aquatic organisms should be able to transit through these structures. However, because SSBs require large in-water structural components such as the gate housing and abutments/piers, preliminary estimates indicate significant cross-sectional restrictions where 23% of the Manasquan Inlet, 46% of the Barnegat Inlet and 42% of the Great Egg Harbor Inlet would be blocked by these SSB structures in an open-gate scenario. These constrictions would produce changes in velocity as tidal flows have less area to push into and out of the inlets, thus flow velocities will increase significantly at the gate locations to compensate for tidal forcing. It is not well understood if these velocities would change migratory fish patterns for fish traversing through the inlet areas. Migratory fish potentially affected include obligate migrators (diadromous fishes such as eels, alosines, and Atlantic sturgeon) and marine fishes and other facultative migrators (eg. bluefish, flounders and weakfish) and forage fishes (eg. menhaden, bay anchovy, Atlantic silversides) (Orton et al. 2020). Anadromous fish such as river herrings seek higher velocities to ascend into their natal rivers, but there is little known on what the effects of these velocity changes would have on fish at the inlet areas, and if the fish would adapt to these changes. Observations in the UK noted that adult and juvenile salmon upstream and downstream migrations were delayed after a barrier was implemented (Orton et al. 2020). Additionally, fish larval transport is also likely to be affected by the changes where the gate structures may block or inhibit larvae from entering or exiting the inlet or the increased velocities may have a “jettison” effect on them. Because these effects of SSBs are relatively unknown, there is a high risk for significant effects on fisheries. Additional modeling and fish census studies would need to be conducted to better understand these effects before proceeding with implementation. These actions can be implemented prior to the completion of the Final Tier 1 EIS and/or during the Tier 2 – Engineering and Design phase.

With the gates open, the small salinity changes could potentially result in minor to significant effects on the abundance and distribution of fisheries. The AdH modeling did not demonstrate large changes in the mean salinity (the highest mean salinity change was slightly above 1 ppt) with the TSP SSB/BCs but even small changes on the margins may be enough to stress these organisms. Because of normal fluctuations of salinities within the estuarine mixing zones, the effects on EFH may not be severe, however, additional evaluations are required in subsequent phases to evaluate changes from the TSP structures on the extremes and salinity tolerances for the most affected EFH species.

Gate closures may have even more of an effect on fisheries/EFH, although temporary. Extreme storm and high tide events would trigger the closure of SSBs and BCs, causing shifts in water quality and flow rates. During these closures, tidal fluxes in water would cease for a period of time, potentially reducing water quality and dissolved oxygen (DO), while increasing the number of harmful nutrients in the water. The changes in water quality, DO, and nutrients could have compound and/or cumulative interactions, causing increased stress levels to fish populations, which may lead to increased susceptibility to disease or even a mortality event (Tietze 2016; Bachman and Rand 2008). Additionally, periodic maintenance of the structures proposed would be necessary over time; the maintenance would likely result in localized disturbances caused by increased underwater noise and turbidity. The operation and maintenance of SSBs and BCs could potentially result in temporary to permanent significant adverse impacts to fish and fisheries resources (USACE, 2017).

4.9 Cumulative Effects

The direct cumulative losses of aquatic habitats for finfish, shellfish, and EFH over long distances of SSBs, BCs and perimeters are significant based on the current estimated impacts. Operation of SSBs and BCs could potentially affect bay-wide fisheries by affecting hydrodynamics and water quality. These effects coupled with the effects of climate change and sea level rise are likely to contribute to stressors on finfish and shellfish habitats, population abundances, and distributions. To compensate for the effects of the structural components in the TSP, compensatory mitigation is estimated in Appendix F.4.

4.10 Summary of Findings

In an effort to summarize the species-specific evaluations presented and provide an overview of potential impacts, Table 8 qualitatively categorizes the EFH species by projected magnitude of impacts resulting from project implementation. The reasoning used to assign the low, moderate, and high categories is provided in Table 8.

Within the project 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 the permanent loss of a diversity of habitats as outlined in Tables 6 and 7, as well as a range of indirect, temporary impacts to water quality, prey, and feeding. Operation of SSB would affect ingress and egress to the back bays. For any given species, impacts depend on the proximity of utilized habitats to project components. Time of year restrictions could be utilized to reduce impacts to some species. This assessment discussed the range of impacts that could result from project implementation. However, future refinement of the TSP and subsequent surveys (such as wetlands and SAV) is needed before a final EFH assessment can be completed.

Table 10. Qualitative categorization of impacts by species

<table>
<tr><td colspan="3">Projected Impact Level</td></tr>
<tr><td>Low</td><td>Moderate</td><td>High</td></tr>
<tr><td colspan="3">Reasoning for rating</td></tr>
<tr><td>Pelagic and/or TOY would avoid</td><td>Demersal or benthic, timing could reduce impacts for some</td><td>Expansive and diverse habitat use would be impacted, could include HAPC</td></tr>
<tr><td>Atlantic butterfish</td><td>Atlantic surfclam</td><td>summer flounder/HAPC</td></tr>
<tr><td>Atlantic mackerel</td><td colspan="2">windowpane flounder</td></tr>
<tr><td></td><td>black sea bass</td><td>winter flounder</td></tr>
<tr><td colspan="2">inshore long finned squid</td><td>little skate</td></tr>
<tr><td>bluefish</td><td>scup</td><td>winter skate</td></tr>
<tr><td>Atlantic sea herring</td><td>spiny dogfish</td><td>clearnose skate</td></tr>
<tr><td>Atlantic cod</td><td>red hake</td><td></td></tr>
<tr><td>Ocean pout</td><td colspan="2">sandbar shark/HAPC</td></tr>
<tr><td>pollock</td><td></td><td></td></tr>
<tr><td>white hake</td><td></td><td></td></tr>
<tr><td>witch flounder</td><td></td><td></td></tr>
<tr><td>yellowtail flounder</td><td></td><td></td></tr>
<tr><td>silver hake</td><td></td><td></td></tr>
<tr><td>monkfish</td><td></td><td></td></tr>
<tr><td>king mackerel</td><td></td><td></td></tr>
<tr><td>Spanish mackerel</td><td></td><td></td></tr>
<tr><td>cobia</td><td></td><td></td></tr>
<tr><td>bluefin tuna</td><td></td><td></td></tr>
<tr><td>skipjack tuna</td><td></td><td></td></tr>
<tr><td>sand tiger shark</td><td></td><td></td></tr>
<tr><td>common thresher shark</td><td></td><td></td></tr>
<tr><td>dusky shark</td><td></td><td></td></tr>
<tr><td>smoothhound shark</td><td></td><td></td></tr>
</table>

5.0 MITIGATION

Because of the direct impacts that TSP structural components will have on aquatic habitats, a compensatory mitigation plan is being developed that would account for the functional losses of ecosystem services that these habitats provide. The TSP components would directly affect over 153 acres of aquatic habitats, which includes about 60 acres of subtidal soft-bottom habitats, about 2 acres of intertidal mud/sand flats, about 9 acres of intertidal sandy beach, and 73 acres of low and high marshes. The remaining 10 acres are adjacent scrub-shrub and other supratidal wetlands. Mitigation estimates for losses of saltmarshes were determined by the use of the New England Marsh Model and the subtidal and intertidal habitat impacts were based on the presence of shellfish bed or SAV mapping. Mitigation estimates for these habitats were based on a replacement of a higher quality habitat such as an SAV bed (subtidal) or a living shoreline (intertidal). The New York Bight Ecological Model (NYBEM) ecosystem model that considers all key aspects of the various marine, estuarine, and freshwater aquatic habitats within the affected area is currently in development and will be applied in subsequent phases to better determine the functional aspects and effects on habitat suitability and new mitigation estimates will be derived.

Table 11. Preliminary Estimates of Direct Habitat Impacts and Compensatory Mitigation Estimates of the TSP

		Subtidal		Intertidal		Saltmarsh		Other Supratidal wetlands	
TSP Alt.	Structural Feature	Est. Losses (acres)	Est. Mitigation* (acres)	Est. Losses (acres)	Est. Mitigation (acres)	Est. Losses (acres)	Est. Mitigation (acres)	Est. Losses (acres)	Est. Mitigation (acres)
3E(2)	Manasquan Inlet SSB	2.1	1.7	0	0	0	0	0	0
	Barnegat Inlet SSB	14.8	21.5	0.8	1.1	0	0	0	0
4G(8)	GEHI SSB	20	16	5.6	4.4				
	Absecon Blvd. BC	21	25.2	6.0	6.4	49.7	83	6.7	9.7
	SOC BC	1.6	2.1	0	0	23.5	44.4	2.1	3.6
	TOTAL	**59.5**	**66.5**	**12.4**	**11.9**	**73.2**	**127.4**	**8.8**	**13.3**

Compensatory mitigation estimates for indirect effects have not been fully assessed at this time. It is assumed that there could be significant losses of saltmarsh and intertidal habitats over large areas due to small tidal amplitude changes along with potential effects on fish larval/egg transport with increases in velocity in the vicinity of the SSB and BC gates. Therefore, the cost estimates currently include a 5% contingency (based on first construction costs of the TSP feature) for indirect effects for compensatory mitigation and adaptive management. It is assumed that as modeling is further advanced (AdH -closed gates scenarios and NYBEM), impact estimates would become better quantified and compensatory mitigation can be derived based on applying the available NYBEM ecosystem model. Additionally, subsequent design phases will continually investigate avoid/minimization measures that would reduce hydrodynamic changes that drive these indirect effects.

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