ESSENTIAL FISH HABITAT ASSESSMENT

PROPOSED BERTH AND APPROACH CHANNEL
PORT OF WILMINGTON EDGEMOOR EXPANSION
EDGEMOOR, DELAWARE

January 2020

Prepared for:

Diamond State Port Corporation
820 North French Street, 4th Floor
Wilmington, DE 19801

For Submission to:
National Marine Fisheries Service
Habitat Conservation Division
177 Admiral Cochrane Drive
Annapolis, MD 21401

Prepared by

Duffield Associates, Inc.
5400 Limestone Road
Wilmington, Delaware 19808

Rebecca L. Harris
Project Manager

M. Richard Beringer, P.E., LEED AP
Senior Environmental Consultant

Project No. 11139.LH

Table of Contents

Contents

TABLE OF CONTENTS
(CONTINUED)

FIGURES

TABLES (In Text)

APPENDICES

1 INTRODUCTION

Diamond State Port Corporation (DSPC), (hereinafter referred to as "the Applicant"), proposes to construct a new shipping container port facility on a site formerly occupied by the Chemours (DuPont) Edge Moor Plant along the Delaware River in Edgemoor, New Castle County, Delaware (see Appendix 1 – Relevant Permit Plan Sheet 1 – Location Map). DSPC has applied to the U.S. Army Corps of Engineers (USACE), Philadelphia District, for permits pursuant to Section 404 of the Clean Water Act (CWA) and Section 10 of the Rivers and Harbors Act of 1899 for dredging related to the construction of a primary harbor access channel and ship berth development (hereinafter referred to as the "proposed project") at the Applicant's Edgemoor property (hereinafter referred to as the "Edgemoor Site"), on March 25, 2019 (reference Permit Application CENAP-OP-R-2019-278). Please refer to Figure 1 – Edgemoor Site and Proposed Project Location Sketch.

1.1 Compliance

The regional fisheries management councils, with assistance from the National Marine Fisheries Service (NMFS), are required under the 1996 amendments to the Magnuson-Stevens Fishery Management and Conservation Act (MSFCMA) to delineate Essential Fish Habitat (EFH) for all managed species, minimize to the extent practicable adverse effects on EFH, and identify other actions to encourage the conservation and the enhancement of EFH.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity" (16 U.S.C. 1802(10)). In addition, the presence of adequate prey species is one of the biological properties that can define EFH. The regulations further clarify EFH by defining "waters" to include aquatic areas that are used by fish (either currently or historically) and their associated physical, chemical, and biological properties; "substrate" to include sediment, hard bottom, and structures underlying the water; areas used for "spawning, breeding, feeding, and growth to maturity" to cover a species' full life-cycle; and "prey species" as being a food source for one or more designated fish species.

Pursuant to Section 305(b)(2) of the MSFCMA, Federal agencies are required to consult with the NMFS regarding any action they authorize, fund, or undertake that may affect EFH adversely. For assessment purposes, an adverse effect has been defined in the Act as follows: "Any impact which reduces the quality and/or quantity of EFH. Adverse effects may include direct (e.g., contamination or physical disruption), indirect (e.g., loss of prey, reduction in species fecundity), site specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions."

In response, this EFH Assessment was prepared in an effort to:

1. Characterize the benthic habitat and community including substrate, seagrasses, macrobenthic organisms, and ambient water conditions within the affected environments;
2. Compare similarities and differences in the benthic community between the affected environments and adjacent areas;
3. Compare similarities and differences between shallow and deep water;

4. Compare benthic habitat and community in the affected environments to areas where EFH-designated/fisheries species and prey species are known to occur in the Delaware River Estuary; and

5. Characterize environmental water quality by measuring parameters such as dissolved oxygen, temperature, and salinity within the affected environments.

The assessment will also discuss direct impacts as well as describe conservation measures proposed to avoid, minimize or otherwise offset potential adverse effects to EFH that may occur as a result of the proposed project.

DSPC has prepared an Environmental Assessment Technical Document (EATD), in accordance with requirements set forth by the National Environmental Policy Act (NEPA) to analyze and document the potential impacts to the natural and human environment of the proposed project and reasonable alternatives. This EFH Assessment will be included in the EATD as Appendix 11. Further, the EATD will support the requirements of 33 U.S.C. 408 to obtain USACE approval prior to modification of an existing Federal project (Delaware River Navigation Channel), and to support the USACE in the determination of the Federal interest in the Assumption of Maintenance (AOM) of non-federal sponsor (NFS) improvements to the Port under Section 204(f) of Water Resources Development Act of 1986 (WRDA 1986). The area from the elevation of mean high water (MHW) line at the site to approximately 300 feet (ft) riverward of the wharf face will not be included in the AOM since it will be privately owned and maintained.

DSPC has applied to the State of Delaware for a Wetlands and Subaqueous Lands Permit and Water Quality Certification. Additionally, DSPC will have to demonstrate consistency with the federally approved Coastal Zone Management Plan for the State of Delaware and comply with other applicable county and local laws and regulations.

1.2 Project Background

1.2.1 Port of Wilmington – Operational History

DSPC is a corporate entity of the State of Delaware and was established in 1995 by an act of the Delaware General Assembly to manage and operate the Port of Wilmington after the port was purchased from the City of Wilmington by the State of Delaware (7 Del.C. Chapter 87). The Port of Wilmington, operated by the DSPC, is a deep-water port located at the confluence of the Christina River and the Delaware River in Wilmington, Delaware.

The port has been ranked as a top North American port for imports of fresh fruits and juice concentrates, dry bulk cargo and automobiles. The Port of Wilmington operates in a competitive environment that includes other facilities along the Delaware River and along the east coast of the United States of America. Access to the Port is available directly from the Delaware River federal navigation channel and from the federal channel in the Christina River. The majority of the Port's berths are located on the Christina River, which has a controlling depth of 38 ft at mean lower low water (MLLW) between the Delaware River and the upper end of the Port's turning basin, roughly adjacent to

Berth 5. Additional berths (Berths 6 and 7) upriver of the turning basin are maintained at 35 ft MLLW (see Figure 2 – Port of Wilmington Site Sketch). The Port's waterborne commerce grew in the 1990s, most notably with auto imports. Since 2000, the DSPC has continued to improve and expand its assets to serve growing market demands. A 90,000 square-foot (sf) dry cargo warehouse was constructed in 2000, the construction and commissioning of the Autoberth structure on the Delaware River was completed in 2002, and a 92,000 sf cold storage warehouse was constructed in 2006 (AECOM et al., 2016).

Cargoes handled at the Port of Wilmington are varied. During 2015, over 6.8 million tons of cargo were handled at the port mainly comprised of containerized goods (33%), dry/break bulk (32%), and liquid bulk (32%). Based on the Diamond State Port Corporation Strategic Master Plan, dated July 29, 2016, in 2015 the Port of Wilmington accounted for approximately five percent of East Coast ports' international waterborne trade. For inbound trade, 89 percent of imported commodities include: petroleum products (35%), bananas (26%), industrial salt (20%), various minerals (4%), and pineapples (4%).

The existing Port, which opened in 1923, has experienced significant changes over the last 90 years. DSPC prepared a Strategic Master Plan (AECOM et al., 2016) to evaluate future development to meet its objectives to retain and grow port business within the ever-changing dynamics of the maritime industry. The Master Plan evaluated alternatives for optimizing the existing port facility at the confluence of the Christina and Delaware Rivers while attempting to sustain and grow the existing cargo. The Master Plan also evaluated alternative off-port properties on the Delaware River that would capture additional market for development of a new terminal.

1.2.2 Forecasted Cargo Volume Increase

Following the completion of Panama Canal Lock Expansion Project in 2017, New Panamax ships, or vessels that were too large to traverse the Panama Canal prior to expansion, are able to more efficiently reach East and Gulf Coast Ports. Capacities of New Panamax ships can be as large as 12,000 twenty-foot container equivalent units (TEU) and standard draft requirements are 49 ft. With increases in capacity capability through the Panama Canal, there is an expectation that cargo volume will increase at East and Gulf Coast ports from the Asia/U.S. trade. According to the DSPC Strategic Master Plan, conservative assumptions forecast that the share of the Asian trade arriving at East Coast ports will expand between 27 to 32 percent above the average volumes experienced over the past five years.

In response to the increasing size of modern shipping vessels, and to remain competitive with other ports along the eastern seaboard, USACE embarked on the Delaware Main Channel Deeping Project in 2010. The deepening provides for more efficient transportation of cargo to the Delaware River ports. To capitalize on the economic benefits of the deepening project, existing Delaware River ports will also need to deepen their harbors and new harbors would be expected to match the depth of the navigation channel.

1.2.3 Expansion of Port of Wilmington Operations

In addition to the relatively shallow navigation channel in the Christina River, the land-based configuration of the Port of Wilmington constrains capacity. In an effort to expand port operations and acquire a portion of the projected increases in future market demand, DSPC purchased the Edgemoor Site in 2016, as recommended in the DSPC Strategic Master Plan.

The Edgemoor Site was purchased with the intent of re-developing the property into a multi-user containerized cargo port capable of accepting New Panamax cargo ships. The Edgemoor Site formerly was developed as a titanium dioxide and ferric chloride manufacturing facility, which reportedly initiated operations in the early 1930s. Production at the manufacturing facility ceased in 2015 followed by decommissioning and demolition of the process equipment by the former owner. DSPC has since demolished and removed most of the buildings that remained after decommissioning in preparation for redevelopment. The property is zoned industrial and is enclosed in its entirety by security fencing.

In October 2018, the State of Delaware signed a $600 million, 50-year concession agreement to operate and expand the Port of Wilmington and to construct a new containerized cargo port at the Edgemoor Site. The agreement included a commitment to invest approximately $400 million to construct the Edgemoor facility.

1.3 Navigation

The authorized 45 ft maintained depth of the Delaware River Main Navigation Channel traverses the Delaware River Estuary from Philadelphia, Pennsylvania to the mouth of Delaware Bay. The channel extends 102.5 river miles and borders 10 counties in the Commonwealth of Pennsylvania, and the States of New Jersey and Delaware. The upstream portion of the project area includes the cities of Philadelphia, Pennsylvania and Camden, New Jersey, which together form the fifth largest metropolitan area in the United States. In conjunction with the port of Wilmington, Delaware, this area supports the largest freshwater port in the world. The area maintains a high concentration of heavy industry, including the nation’s second largest complex of oil refineries and petrochemical plants.

The USACE, Philadelphia District is responsible for maintaining the authorized Delaware River navigation channel. The Delaware River Main Stem and Channel Deepening project was authorized by Public Law 102-580, Section 101(6) of the Water Resources Development Act of 1992 to deepen the channel from 40 ft to 45 ft MLLW and currently is nearing completion. The channel width is 400 ft in Philadelphia Harbor (length of 2.5 miles); 800 ft from the former Philadelphia Navy Yard to Bombay Hook (length of 55.7 miles); and 1,000 ft from Bombay Hook to the mouth of Delaware Bay (length of 44.3 miles).

The USACE also maintains the navigation channel in the Christina River. The existing Christina River project was adopted as HD 54-66 in 1896 and 1899, and subsequently modified several times (1922, 1930, 1935, 1940 and 1960) pursuant to the authority of Section 107 of the River and Harbor Act of 1960 (PL 86-645). The project currently provides for a channel with depths of 38, 35, 21, 10, and 7 ft from the Delaware River to Newport, Delaware, a turning basin 2,050 ft long, 640 ft wide and 38 ft deep opposite the Wilmington Marine Terminal (Port of Wilmington), and jetties at the mouths of Christina and Brandywine Rivers.

The federal government has the responsibility for providing the necessary dredged material disposal areas for placement of material dredged for Delaware River and Christina River project maintenance. For the Delaware River channel, there are currently seven upland sites and one open-water site, located in Delaware Bay that are used for dredge material disposal purposes. The seven confined upland sites are National Park, Oldmans, Pedricktown North, Pedricktown South, Penns Neck, Killcohook and Artificial Island. The open water site in Delaware Bay is located in the vicinity of Buoy 10 near the mouth of the estuary. This site is only approved for placement of sand. Historically, two confined upland facilities have been used for maintaining the Christina River channel – Wilmington Harbor North and Wilmington Harbor South.

2 PROPOSED PROJECT SETTING AND LOCATION

2.1 Physical Setting

The main stem of the Delaware River extends approximately 330 miles flowing south from the State of New York to the Delaware Bay. The river is fed by approximately 216 tributaries and drains approximately 14,000 square miles of land (www.delawareestuary.org). The proposed project is located at river mile (RM) 73.2 in the southern portion of Reach B of the Delaware River, where the Bellevue and Cherry Island navigation ranges intersect. This area is within a transition zone of the river generally characterized as a low salinity, high turbidity region. The transition zone, also known as the Estuary Turbidity Maximum (ETM), lies between the bay and riverine regions of the Delaware estuary. At the project site, water depths range between the height of tide and 45 ft below MLLW, while the width of the estuary at the site is approximately 1.5 miles. Jurisdictional boundaries, including mean high water (MHW), mean low water (MLW) and high tide line (HTL) are shown on Sheet 2 – Jurisdictional Boundary Plan in Appendix 1 – Relevant Permit Plan Sheets.

The federal navigation channel adjacent to and downriver of the proposed project is maintained at a controlling depth of -45 ft MLLW. Substrate types within the channel vary widely from silty clay to gravel (Sommerfield and Madsen, 2003). Salinity within the channel ranges from tidal freshwater/oligohaline in the upper reaches to that of seawater near the mouth of Delaware Bay (Cronin et al., 1962).

2.2 Sediment and Water Quality

Sediment and surface water quality sampling was performed in July 2019 within the footprint of the proposed project. The sampling was intended to support an assessment of human health and ecological risks associated with the substances of potential environmental concern found in sediments, soil, and surface water that would be dredged or exposed by dredging for a new container port at Edgemoor, Delaware. The results of the sediment and surface water quality sampling are detailed in a report titled "Edgemoor Sediment and Surface Water Quality Assessment", incorporated by reference, and summarized below.

In addition, as part of this EFH Assessment, water quality parameters such as salinity, water temperature, dissolved oxygen and water clarity were measured and recorded. The results are summarized below.

2.2.1 Sediment

Specifically, sediment samples were collected July 1st through July 9th, 2019 by Duffield Associates from vibracores performed by AquaSurvey, Inc. (AquaSurvey), a subcontractor to Duffield Associates. AquaSurvey used a 20-foot pontoon mounted rig to collect the vibracores. The samples were submitted to Test America for the following laboratory analyses:

- pH by EPA Method 9045C;
- Acid Volatile Sulfides/Simultaneously Extracted Metals (AVS/SEM) of Cadmium, Chromium, Copper, Lead, Nickel, Zinc and Mercury;
- Sulfate by Method D516-90;
- Sulfide by Method SM4500-S-2;
- Sulfite by Method SM4500-SO3 B;
- Alkylated PAH by EPA Method 8270D in selected ion monitoring (SIM) mode;
- TCL Pesticides by EPA Method 8081A;
- Target Analyte List (TAL) Inorganics by applicable EPA Method 6020B and 7471B;
- Total Cyanide by EPA Method 9012B;
- Polychlorinated Biphenyl (PCB) Congeners by Method 1668;
- Dioxins and Furan Isomers by EPA Method 1613B; and
- Total Organic Carbon (TOC) by Lloyd Kahn Method.

Materials of a similar physical character encountered beneath the riverbed were labeled as "stratum." Based on the assessment, the current river bottom generally consists of very soft, silty sediment deposits of varying thickness (referred to as 'stratum A'). This silt covers a layer primarily consisting of sandy sediments (referred to as 'stratum B'), with some interlayered silt sediments. These apparently fluvial sediments were underlain by apparently undisturbed clays and clayey sand typical of the Potomac Formation (referred to as 'stratum C'). Vibracores were advanced to refusal, which typically occurred due to gravel or clay material below either stratum A or stratum B. Vibracores from the July 2019 sampling event indicate that stratum A is vertically present starting at an average elevation of -9.5 feet MLLW and is laterally present across the majority of the area to be dredged at a thickness of approximately 5 feet to 15 feet. Stratum B is present at thicknesses of 12 feet to 20 feet in the portion of the site where current water depths are less than 10 feet at MLLW. Stratum B is exposed in some of the intertidal areas of the sites and thins near the navigation channel.

While the depths of each stratum varies, the photos below were taken by Duffield and show examples of the change in strata. For specific details regarding strata depths and cross-sectional views of the general distribution of each strata in the project area, please refer to the soil boring logs in Appendix A and cross-sections in Figures 3 and 4, and Section V.a of the "Edgemoor Sediment and Surface Water Quality Assessment."

VB-03 Stratum A Material (SILT, trace fine sand)

VB-23, Stratum B Material (Fine to coarse SAND, trace gravel, trace silt, gravel lenses throughout)

The assessment indicated that concentrations of PAHs, PCBs, dioxins, furans, and chlorinated pesticides in stratum A and concentrations of metals in strata A, B, and C are elevated above the ecological screening levels and/or acute standards for aquatic life in freshwater environments. Strata A and B have been evaluated to assess for current effects on aquatic life while stratum C has been evaluated for future effects of the new bottom on aquatic life post-dredging. Though metal concentrations appear to be elevated, stratum C is made up of Potomac Formation soils that have been undisturbed previously. Therefore, elevated metals concentrations likely occur naturally and are not due to anthropogenic activities. For additional information on the quality of sediment, refer to Section XII.c of Duffield's "Edgemoor Sediment and Surface Water Quality Assessment" and for more detail regarding Test America's laboratory analytical results refer to Appendix B.1 through B.5 of the "Edgemoor Sediment and Surface Water Quality Assessment."

2.2.2 Surface Water

Five surface water samples were collected in July 2019 within the footprint of the proposed project. The samples were intended to support an assessment of human health and ecological risks associated with the substances of potential environmental concern. The samples were analyzed for the following:

- pH by EPA Method 9045C;
- Alkylated PAH by EPA Method 8270D in SIM mode;
- TCL Pesticides by EPA Method 8081A;
- TAL Inorganics by applicable EPA Method 6010C and 7471;
- Total Cyanide by EPA Method 9012B;
- Polychlorinated biphenyl (PCB) Congeners by Method 1668; and
- Dioxins and Furan Isomers by EPA Method 1613B

Analytical results were compared to the acute and chronic aquatic life criterion from the Delaware River Basin Commission's (DRBC's) Water Quality Regulations for Zone 5. Metals were detected above the acute Stream Quality Objectives (SQOs) while metals and total PCBs were detected above the chronic SQOs. The river water pH values ranged from 5.9 to 7.4. For comparison, the State of Delaware Surface Water Quality Standards specify a pH range of 6.5 to 8.5 with a 0.5 standard unit difference due to human-induced change as per Section 4.5.3.1 of the Clean Water Act.

Since concentrations of substances in the surface water, in part, are a result of the substances partitioning from sediment to water, removal of the sediment from the cumulative project sites may maintain or improve water quality. Therefore, the proposed project has the potential to improve water quality for aquatic life at acute and chronic exposure levels. For additional information on the quality of surface water, refer to Section XII.f of Duffield's "Edgemoor Sediment and Surface Water Quality Assessment" and for more detail regarding Test America's laboratory analytical results refer to Appendix B.1 through B.5 of the "Edgemoor Sediment and Surface Water Quality Assessment", incorporated by reference.

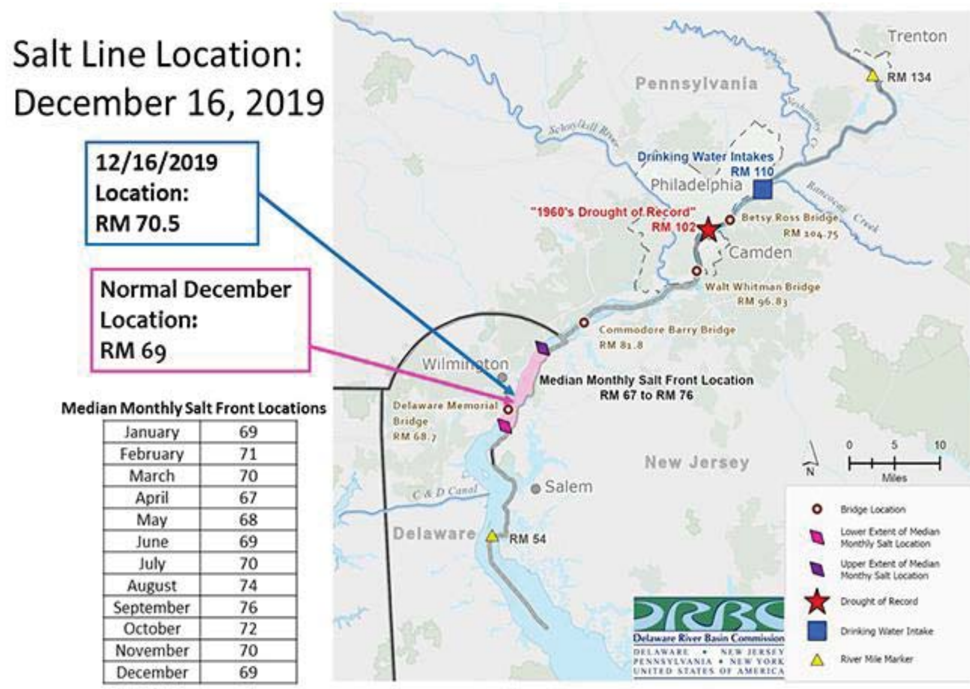
2.2.3 Water Quality Parameters

Duffield Associates contracted ECSI in July 2019 to perform an assessment of habitat and benthic resources relative to EFH within the footprint of the proposed project. As part of the assessment, titled "Plan for Benthic Resource Survey, Proposed Berth and Approach Channel, Edgemoor, Delaware" (herein referred to as "Resource Assessment"), the following water quality parameters were measured – salinity, water temperature, dissolved oxygen (DO) and water clarity. Specifically, the water quality parameters were measured during the beach seining event conducted by ECSI on July 29, 2019, in accordance with the procedures described in the Resource Assessment (see Appendix 4). ECSI recorded the water quality data on finfish monitoring processing data sheets included in Appendix 2 –ECSI Data. Additional details regarding the Resource Assessment are discussed in Section 7 – Habitat and Benthic Resource Assessment.

2.2.3.1 Salinity

Based on ECSI's data sheets, results indicated a salinity of 0.1 part per thousand (ppt) at three beach seine locations identified as "EPP_Seine1, EPP_Seine2 and EPP_Seine3" and shown on Figure 4 – Benthic Sample Location Sketch. The project area, located at RM73.2, is located within the oligohaline zone of the estuary where salinities reportedly range from 0.5 to 5 ppt. The oligohaline zone consists of water with very low salt content and indicates the initial influences of the freshwater-saltwater interface in the estuary.

Based on the DRBC website, the salt front is defined as the seven-day average location of the 250 milligram per liter (mg/L) or 0.25 ppt isochlor in the river. The location of the salt front as of December 16, 2019 was at RM70.5, very close to the normal location for the month of December at RM69, as shown in the graphic below, adapted from the DRBC website.



Median Monthly Salt Front Locations	
January	69
February	71
March	70
April	67
May	68
June	69
July	70
August	74
September	76
October	72
November	70
December	69

Seasonally, estuaries generally decrease in salinity in the spring months with increased freshwater inflows resulting in a positive (lower salinity) estuarine system, while estuaries generally increase in salinity in the summer with decreased freshwater inflows and increased evaporation, due to higher temperatures resulting in a negative (higher salinity) estuarine system.

Salinity affects chemical composition of water within an estuary, most notably the concentrations of DO and inorganic substances. Solubility, the amount of oxygen that can dissolve in water, decreases as salinity increases. Solubility is important since estuarine organisms have salinity ranges and DO ranges they can tolerate before experiencing physiological stress. Salinity levels outside of their tolerance ranges may negatively impact estuarine species such as decreased reproduction and survival rates. Fish can adapt to changing dissolved oxygen levels by practicing avoidance techniques such as swimming away to areas with tolerable salinity levels.

Salinity has also been implicated as a major factor affecting the benthic composition of estuarine ecosystems (Uwadiae, 2009), strongly influencing the abundance and distribution of benthic macroinvertebrates ("macrofauna"). Reduction of species diversity can be due to osmotic stress experienced by organisms as a result of salinity fluctuations within estuarine environments (Montagna, P.A., and Palmer, T. 2014). Salinity fluctuations can result from natural phenomenon like such as droughts or deluges. Specifically, the oligohaline and the freshwater tidal zones of an estuarine system are characterized by relatively low species richness with Oligochaeta and chironomids, and to a lesser extent amphipods and mollusks, as the dominating species (Montagna, P.A., and Palmer, T. 2014).

2.2.3.2 Water Temperature

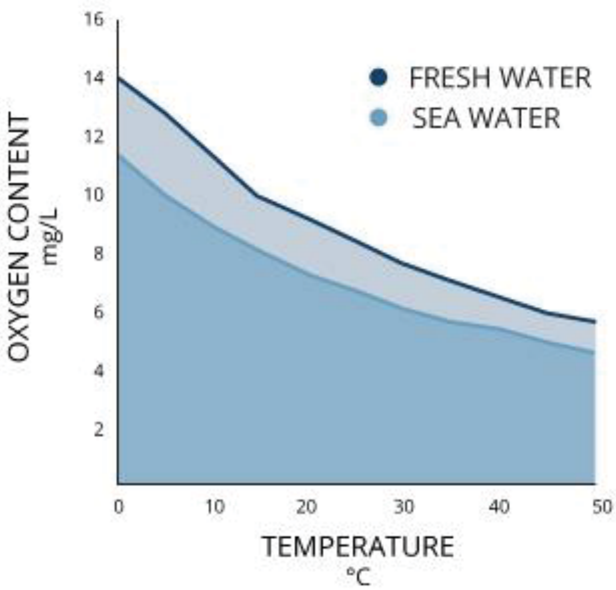
Based on ECSI's reported data included in Appendix 2, surface water temperatures ranged from 29.3 to 30.3 degrees Celsius during the July 2019 event. Similar to salinity, the solubility of oxygen in the water changes inversely to water temperatures, with DO solubility being lower in warm water than in cold water. As temperature increases, the concentration of DO at 100% saturation decreases. The DO concentration for 100% saturated water at sea level is 8.26 mg of oxygen per liter (mg_{O2}/L) at 25 degrees Celsius, but increases to 14.6 mg_{O2}/L at zero degrees Celsius. Seasonal water temperature is an important indicator of habitat quality for many estuarine species (www.oceanservice.noaa.gov).

The US Geologic Survey (USGS) has an on-line program that generates single values of DO solubility and/or percent saturation in surface water, based on inputs of water temperature, barometric pressure or measured DO (www.water.usgs.gov/software/dotables). Assuming an average water temperature of 30 degrees based on the July 2019 sampling event for the proposed project and a typical barometric pressure of 29 inches, the on-line program calculates 100% oxygen solubility at 7.32 mg_{O2}/L.

2.2.3.3 Dissolved Oxygen

Surface DO concentrations were measured by ECSI during the July 2019 beach seining event. Results indicated DO concentrations of 7.2 mg_{O2}/L, 6.9 mg_{O2}/L and 6.8 mg_{O2}/L at beach seine locations EPP_Seine1, EPP_Seine2 and EPP_Seine3, respectively. Using the USGS online calculator discussed above, corresponding DO saturation percentages are 98%, 94% and 93% at locations EPP_Seine1, EPP_Seine2 and EPP_Seine3, respectively.

DO levels in an estuary vary seasonally, with the lowest concentrations occurring during the late summer months, when temperatures typically are highest during a calendar year. As stated in Section 2.2.3.1, DO levels are influenced by salinity. To illustrate, at the same temperature and pressure, marine water holds about 20% less DO than freshwater as indicated by the following graphic: The relatively high DO measured at the project site is consistent with the low salinity measured at the project site.



2.2.3.4 *Water Clarity*

Water clarity is the distance that light can penetrate through the water column and is important for the growth of submerged aquatic vegetation (SAV) and the production of phytoplankton in the water. Using a secchi disk, ECSI personnel measured water clarity and the results indicated values of 33 inches (0.8 meters), 40 inches (1.0 meters) and 30 inches (0.7 meters) at locations EPP_Seine1, EPP_Seine2 and EPP_Seine3, respectively.

Based on the DRBC Delaware Estuary Water Quality Monitoring Program (Boat Run) Data Explorer (www.nj.gov/drbc), secchi depths (in meters) have been recorded at various RM stations within the estuary from 1999 to 2016. The data station closest to the proposed project is located at RM71 – Cherry Island. Based on the box plots shown in the data explorer, the median secchi depth measurement over the last 17 years was approximately 0.5 meters. Secchi depths measured as part of this EFH Assessment corresponded well with those measured as part of the DRBC Monitoring Program and indicate that the proposed project is located within an area of low water clarity (high turbidity), characteristic of the ETM. Like most estuaries, the Delaware Estuary has a natural area of low water clarity usually located in the vicinity of the salt line. As mentioned in Section 2.2.3.1, the salt line most recently was located at RM70.5 on December 16, 2019, just south of the proposed project.

2.3 Sedimentation

Sedimentation in the proposed berth area may be significant. Annual maintenance dredging of up to 500,000 cubic yards (cy) of sediment may be required. Maintenance dredging at the current Port of Wilmington occurs annually due to significant shoaling within the existing berth. Approximately 750,000 cy of material have been removed during each dredge cycle, typically performed at 9-month intervals and scheduled to avoid time-of-year restrictions.

With respect to the proposed project, DSPC anticipates that the responsibility for maintenance dredging of the approach channel to the port will be assumed by the USACE under Section 204(f) of the Water Resources Development Act (WRDA) of 1986. The port owner/operator will be responsible for maintenance dredging of the berth area.

2.4 Wetlands

Based on a Wetland Delineation report, dated October 2019, no wetlands were identified on the Edgemoor site. The wetland evaluation included a desktop review of available mapping and field reconnaissance. For additional details, please refer to Duffield Associates, Inc. "Wetland Delineation Report", October 2019, incorporated by reference.

3 PROPOSED ACTION

3.1 Preferred Alternative

The proposed project is offshore of the Applicant's Edgemoor Site and is bounded by the federal navigation channel in the Delaware River. The channel, which extends from Cape May and Cape Henlopen at the mouth of the Delaware Bay (RM0) to Trenton, New Jersey (RM134), recently has been deepened to a maintained depth of 45 ft MLLW between Philadelphia and the Atlantic Ocean. The Applicant proposes to deepen portions of the Delaware River adjacent to the federal navigation channel to create a primary access channel that will serve the proposed berth construction at the Edgemoor Site. Please refer to Appendix 1 – Sheets 3, 5, 6, 7 and 8 for existing and proposed conditions.

The primary harbor access channel will provide vessel passage to an approximately 2,600-ft long wharf structure (see Appendix 1 – Sheets 9 and 10 and Figure 3). The berth and access channel will be excavated to the 45-foot MLLW project depth. At the riverward edge of the wharf, the future river bottom will be shaped to slope upward to a quay wall along the landside of the wharf. The quay wall will support the elevation transition from the river bottom to the grade of land within the new port. The 45-ft MLLW project depth matches the maintained depth of the federal navigation channel.

The initial dredging for the berth and primary harbor access is anticipated to require removal of an approximate volume of 3.3 million cy of river sediments and the underlying soils. Project planning anticipates that this material will be placed in an existing USACE Confined Disposal Facility (CDF) along the Delaware River proximate to the Edgemoor Site. The Applicant will replace the volume of storage consumed at a ratio of 1.5 to 1 or will pay for the volume consumed. These compensations will mitigate adverse impacts to USACE regarding their mission to maintain navigation in the Delaware and Christina Rivers.

Proposed project activities producing direct impacts result from the proposed deepening of an area of the Delaware River approximately 4,000 feet in length and having a width extending from the boundary of the federal navigation channel to the landward side of the proposed wharf. This area encompasses approximately 1.5 million square feet (approximately 87 acres). The direct impacts are also derived from construction of the approximately 2,600-foot wharf structure that will accommodate ships and other incidental structures located water-ward of MHW as well as anticipated future maintenance dredging (see Figures 1 and 3 and Appendix 1 – Sheets 3, 5 and 6).

Due to the presence of Cherry Island Flats on the opposite site of the federal channel, the location of the wharf and turning basin were kept closer to the right descending bank of the River than would otherwise be suggested by minimizing initial dredge volume and future maintenance dredge frequency and volume at an alternative location closer to the federal navigation channel. The Applicant understands from literature and discussions with regulatory authorities that Cherry Island Flats is a key spawning area for Striped Bass (*Morone saxatilis*). Locating the wharf and turning basin further channel-ward from the bank would have necessitated extending the dredging for the turning basin into Cherry Island Flats. As such, that alternative for the project was dropped in favor of the preferred project alternative discussed in this document and in the NEPA EATD. Further, while that location would have reduced the project footprint and lessened the amount of material to be dredged, the design team decided that minimizing an impact to Cherry Island Flats outweighed the benefits of a smaller dredging footprint.

The development of infrastructure needed to support the operation of a container port and constructed on the upland portion of the Applicant's property, site of the former Chemours Edge Moor Plant, are considered incidental to the project. The Edgemoor Site previously was developed for industrial use, including chemical processing with car, truck, and rail access for moving people, raw materials, wastes, and finished products. Based on the presence of docking structure at the site and an apparent docked vessel observed in a 1992 aerial photograph, the site also included vessel access.

3.1.1 Project Purpose

The purpose of this project is to modernize the State of Delaware's international waterborne trade capabilities, allow for the State of Delaware port to remain competitive within the Delaware River international trade market, meet the rising demand for modern containerized ports, and to continue, and strengthen, waterborne trade's importance to the State of Delaware and regional economy. International waterborne trade is considered an essential part of the State of Delaware's economy. According to the DSPC Strategic Master Plan, the Port of Wilmington supports over 4,000 jobs annually, generates nearly $340 million in business revenue, over $300 million in personal revenue, and $31 million in state and regional taxes. The State of Delaware's position along the Delaware River places it within a competitive international trade market with the Port of Philadelphia, just 25 miles upriver of the Port of Wilmington.

3.1.2 Project Need

The need for this project is driven by the following considerations:

- **Vessel Capacity Constraints.** With the completion of the Panama Canal Lock Expansion, Asia/U.S. trade shipping to the eastern seaboard of the United States of America is forecasted to increase. The increase is expected to come through the use of new ships that are larger than those currently in service, due to the inherent efficiency of shipping goods in the largest vessel possible. These larger vessels will be known as New Panamax ships, several of which are now in service. To accommodate the increase in modern, New Panamax ships entering east coast ports, the Applicant anticipates that there will be demand for expansion of East Coast port operations. Ports capable of accepting vessels with 45-ft or greater drafts are positioned to most readily accept New Panamax vessels. Currently, no ports in the State of Delaware are capable of accepting New Panamax vessels. The Port of Wilmington berths capable of handling containerized cargos currently are maintained to a depth of 38 ft MLLW. Therefore, container vessels that are bound for Ports in the State of Delaware would need to be light-loaded (loaded at a reduced capacity) or lightened prior to arrival at the port. Either option decreases the efficiency of operations and increases the potential for environmental impacts due to air emissions from a larger number of ships calling at the port to handle the same forecast increase in cargo than would occur with the newer, larger ships.

- **Cargo Handling Constraints.** To meet the increasing demand of international waterborne trade, and to continue DSPC's mission to contribute to the State of Delaware's economic vitality, the volume of cargo entering and exiting Delaware's ports should expand. According to the DSPC Masterplan, there are constraints to expanding port operations at the Port of Wilmington, but arguably the most constrictive limitation is the lack of backland storage capacity. Any capital improvement project to increase berth capacity likely would require the development of additional backland storage. Expansion needed to create such backland storage is constrained by the degree of private, industrial, and commercial development along the Port of Wilmington's inland boundaries and by the USACE Wilmington Harbor South confined dredge facility (CDF) located along the Delaware River. Increases in backland use for containerized cargo would come at the loss of dry and break-bulk cargo capacity, which would work against the purpose of increasing the current economic benefits associated with the Port of Wilmington. Dry and break-bulk cargo currently accounts for 32% of the Port's annual cargo throughput.

4 FISHERIES COORDINATION

4.1 NEPA Scoping Response

In response to a NEPA scoping request from the USACE, the National Oceanic Atmospheric Administration (NOAA) National Marine Fisheries Service – Habitat Conservation Division (NMFS-HCD) provided written comments with respect to EFH. Generally, the comments included the following concerns:

- Potential loss of prey species such as juvenile *Alosa* species;
- Disruption in lifecycle of anadromous fish species including spawning migration;
- Increase in turbidity due to re-suspension of sediments during construction;
- Potential noise effects from construction activities;
- Potential for short-term and long-term physical, biological and chemical impacts from dredging and filling activities; and
- Potential alteration of sediment transport characteristics, texture, depth and overall community structure possibly resulting in changes to habitat quantity and quality.

In addition to the concerns listed above, the response letter indicated the following:

- Various life stages of species for which EFH has been designated in the area of the project include, but are not limited to, Atlantic butterfish, bluefish, black sea bass, summer flounder, windowpane flounder and Atlantic herring;
- Apparent decline in alewife and blueback herring (collectively known as “river herring”) populations due to habitat loss, habitat degradation/modification and increases in turbidity, identified as Species of Concern; and
- Project area demarcates the boundary between the mesohaline and oligohaline zones of the river.

Fish sampling performed by others in the vicinity of the project site has indicated use of this section of the estuary by a variety of species, most notably striped bass, river herring and alewife. Cherry Island flats, located on the opposite side of the federal navigation channel from the project site, is a geomorphic feature where gravid females aggregate and various other life stages of striped bass use as nursery, foraging and resting habitat.

The NEPA scoping letter and NMFS’ response letter are included in the EATD and are hereby incorporated by reference.

4.2 Additional Resource Agency Coordination

4.2.1 NMFS – Section 7 Greater Atlantic Region Fisheries Office

4.2.1.1 Endangered Species

A Biological Assessment (BA) was prepared to evaluate potential effects of construction and operation of the proposed Edgemoor container port on identified species protected by the Endangered Species Act (ESA). For the purposes of the BA, shortnose sturgeon and Atlantic sturgeon were considered species of primary concern because they are known to occur within the vicinity of the project. Sea turtles and whales were considered species of secondary concern because they do not occur in the vicinity of the project, but may occur within the larger action area (i.e., the federal navigation channel of the Delaware River and Bay downriver of the project).

The BA assessed potential impacts from the following project-related activities:

- Dredging;
- Pile driving;

- Placement of fill;
- Shoaling Fans; and
- Vessel traffic (from construction and port operation).

With the exception of vessel traffic from port operations, the BA indicated that project-related activities will have no effect or an insignificant effect on ESA-listed species. Increased vessel traffic, specifically the projected addition of 261 vessels per year (87 container ships and 174 tugs operated in support of the container ships) within the Delaware River federal navigation channel as a result of port operations may adversely affect, but will not jeopardize the continued existence, of Atlantic sturgeon. Operation of the Edgemoor port may result in one additional Atlantic sturgeon mortality every 5.5 years due to a vessel strike. The potential effect of increased vessel traffic on shortnose sturgeon was considered discountable with one additional mortality every 85 years due to a vessel strike. A copy of the BA has been submitted to the NMFS – Section 7 Greater Atlantic Regional Fisheries Office (GARFO) for review and issuance of a Biological Opinion. Duffield Associates is continuing coordination with NMFS to provide additional information, as required, to finalize Section 7 formal consultation, pursuant to the Endangered Species Act.

4.2.1.2 Critical Habitat

The entire tidal Delaware River estuary, which includes the project site, has been designated critical habitat for the New York Bight DPS of Atlantic sturgeon (NMFS 2017a). The critical habitat rule identified four "habitat units" (i.e., physical and/or biological factors (PBFs)) that are essential to the conservation of the species.

Generally, the PBFs are as follows:

- PBF 1 – Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters defined as 0.0 to 0.5 ppt generally encountered upriver of river mile 67 for settlement of fertilized eggs, refuge, growth, and development of early life stages;

- PBF 2 – Aquatic habitat with a gradual downstream salinity gradient from 0.5 up to 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;

- PBF 3: Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites; and

- PBF 4: Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support spawning, annual and inter-annual life stage survival, as well as growth, development, and recruitment.

The proposed project will not impact PBF 1 as there is no habitat meeting the criteria of PBF 1 in the dredge area or construction area or the federal navigation channel for settlement of fertilized eggs, refuge, growth, and development of early life stages. The nearest hard bottom substrate that may be used by Atlantic sturgeon for spawning is located four miles upriver of the site.

The project site contains some of the elements of PBF 2 (soft substrate for juvenile foraging and may seasonally have salinities within the specified range). While dredging will disturb the soft substrate and impact benthic organisms, the impacts will be temporary and *de minimus*. Further, the benthic organisms identified within the dredge area or construction area are common, widely distributed and can readily be found in adjacent areas of the river.

Construction and operation of the Edgemoor port will not impede the movement of various sturgeon life stages or the staging, resting or holding of subadults or spawning adults. PBF3 habitat will not be impacted as a result of the project.

Significant impact to PBF 4 habitat, specifically temperature and salinity, is not anticipated. Suspension of sediment during dredging may result in a temporary reduction in dissolved oxygen concentrations although this condition will be minimal and localized. Modeling has indicated that salinity will not change as a result of the project. Like salinity, water within the estuary is well mixed due to tidal currents resulting in relatively uniform temperatures at specific locations. The proposed deepening of the river bank to create the access channel and berth is not anticipated to alter water temperatures in a meaningful manner.

4.2.2 US Fish and Wildlife Service and State of Delaware

Based on an online USFWS Information for Planning and Consultation (IPaC) environmental review process, one listed species, the Northern Long-eared Bat, was identified as being potentially present on the uplands adjacent to the project site. However, an environmental review by the Delaware Department of Natural Resources and Environmental Control's (DNREC) Species Conservation and Research Program (SCRP) indicated that no state-rare or federally listed species under the jurisdiction of the State Natural Heritage program exist at the project site. The database utilized by the DNREC-SCRP is comprehensive and site-specific unlike the IPaC review which utilizes a generalized, five-mile radius search around the project site.

As such, the project site does not lie within a State Natural Heritage site nor does it lie within a Delaware National Estuarine Research Reserve. In addition, the Delaware Division of Fish and Wildlife requested that no in-water work occur from March 15th through June 30th to minimize potential impacts to Atlantic sturgeon and shortnose sturgeon (both currently listed as endangered) and other commercially and recreationally valuable species during their spring spawning periods. No additional species were identified that differed from those identified under NMFS' jurisdiction. The certification letter provided by the USFWS and the DNREC-WSRP's environmental review response letter, dated October 16, 2019, are included in the EATD and hereby incorporated by reference.

5 EFH ENVIRONMENT, DESIGNATIONS AND LIFE HISTORIES

5.1 Existing Regional Environment

The Delaware River has one of the nation's greatest concentrations of heavy industry engaged in chemical manufacturing and oil refining. Over 90 million tons of cargo move through the region's marine terminals annually. Goods include, but are not limited to, containerized cargo, petroleum and petrochemical products, steel, fruit, cocoa beans, forest products, automobiles and construction materials (Maritime Exchange for the Delaware River). Energy production, municipal wastewater treatment plants, and industrial wastewater treatment plants are located in the vicinity of the Edgemoor site.

The Port of Wilmington is a full service Mid-Atlantic seaport strategically located to provide overnight access to 200 million North American consumers. Wilmington ranks as the world's top banana port, and the nation's leading gateway for imports of fresh fruit and juice concentrates. An economic engine for the State of Delaware and the region, Port operations are responsible for over 2,200 jobs, $439 million in business revenue impact, and $41 million in regional annual tax revenue.

Both the Port of Wilmington and the Edgemoor site are located adjacent to Reach B of the Delaware Main Navigation Channel, a heavily industrialized section of the river extending from the upstream limit of the Tinicum Range downstream to the limit of the Cherry Island Range. The Delaware River Basin Commission, formed in 1961, tracks water quality and sets standards for industrial and municipal wastewater treatment. Over the past 50 years, Delaware River water quality has improved greatly.

5.2 Local Affected Environments

Affected environments associated with potential EFH include the construction and dredging areas. These areas are generally defined as:

- Construction Area – consists of the nearshore waterfront portion of the project where the proposed wharf will be constructed. Aquatic habitat in the Construction Area is estuarine subtidal and intertidal, with existing water depths ranging from approximately 0-5 ft. Bottom substrate consists primarily of sand and gravel, with some concrete rubble. The shoreline in the Construction Area experiences high energy from wind, tide, and shipping traffic, and is armored in many areas with rip-rap, gabion baskets, bulkheads and pilings (Miller, 2018). There are no vegetated wetlands (Duffield Associates, Inc., 2018) within the Construction Area.

- Dredging Area – consists of approximately 87 acres (including side slopes) of estuarine subtidal and intertidal habitat, with existing water depths ranging from approximately 0-45 ft. Bottom substrate within the Dredging Area generally consists of fine-grained sediments (silt and clay), based on acoustic surveys conducted by Sommerfield and Madsen (2003) and the DNREC Delaware Bay Benthic Mapping Program (described by Wilson and Carter, 2008), and field observations (Duffield Associates, Inc., unpublished data; Miller, 2018). There are no vegetated wetlands (Duffield Associates, Inc., 2018) within the Dredging Area.

  Salinity in this portion of the Delaware River ranges from freshwater in the spring to oligohaline during drier periods (typically in late summer-early fall). Mean tidal range in the Delaware River at Marcus Hook, PA, located approximately six miles upriver of the Edgemoor site, is 5.59 ft (NOAA, 2019).

5.3 EFH Mapper

NMFS-HCD provides on online EFH mapping tool for viewing the spatial representations of EFH for all 39 species under Federal management in the mid-Atlantic. Utilizing the online EFH mapper provided by NMFS-HCD, a general review of potential EFH located at the proposed project was performed (see Appendix 3 – EFH Mapper Results). The review yielded the following results:

- No Habitat Areas of Particular Concern (HAPC) were identified;
- No EFH Areas Protected from Fishing (EFHA) were identified; and
- EFH for particular life stages of 12 species was identified as being potentially located at the proposed project site.

The 12 species, along with the specific life stages, are indicated in Table 5.3.1 below.

Table 5.3.1 EFH Mapper Species List

SPECIES	LIFESTAGE
Black Sea Bass* *(Centropristis striata)*	JA
Summer Flounder* *(Paralickthys dentatus)*	JA
Scup* *(Stenotomus chrysops)*	JA
Atlantic Butterfish* *(Peprilus triacanthus)*	LJA
Bluefish* *(Pomatomus saltatrix)*	JA
Windowpane Flounder* *(Scophthalmus aquosus)*	JA
Atlantic Herring *(Clupea harengus)*	JA
Red Hake *(Urophycis chuss)*	A
Winter Skate *(Leucoraja ocellata)*	JA
Little Skate *(Leucoraja erinacea)*	JA
Clearnose Skate *(Raja eglanteria)*	JA
Longfin Inshore Squid *(Doryteuthis pealeii)*	E

E=Eggs, L=Larvae, J=Juvenile, A=Adult

Using the EFH view tool tab, the Greater Atlantic region was selected and then each of the 12 species listed above were selected individually to view where EFH is mapped for that species. The results yield color-coded layers for each life stage (or yellow for all) that can be selected to view where EFH is mapped for each life stage.

Based on the State of Delaware's Wildlife Action Plan 2015-2025 (WAP) and contrary to the NMFS-HCD mapper, only six of these species have EFH mapped within the upper Delaware Bay (indicated with an asterisk), while mapped EFH for the remaining species are found in the lower Delaware Bay and/or Inland Bays. The WAP can be found here: http://www.dnrec.delaware.gov/fw/dwap/Pages/default.aspx.

5.4 EFH Designations

Under the data query tool tab, the EFH mapper results include a link to an EFH data inventory website for each identified species that provides detailed text descriptions and range mapping for preferred EFH designations for each identified species. Specifically, EFH is designated anywhere within the geographic areas shown on the maps provided the areas meet specific conditions applicable to each species and life stage.

The following summarizes the geographic areas and the required conditions for the species listed in Section 5.3.

5.4.1 Geographic areas

Based on the link to view text descriptions in the EFH data query tab for the 12 species identified in the EFH mapper, only two species include geographic areas within the entire Delaware River Estuary including the site of the proposed project. Those include the windowpane flounder (juvenile and adult stages) and Atlantic herring (juvenile stage only). Four species (red hake, clearnose skate, winter skate and little skate) include mapping in the text descriptions, but the geographic area range does not include the proposed project. For the six remaining species (Atlantic butterfish, bluefish, longfin inshore squid, scup, summer flounder and black sea bass), geographic area maps were not included in the text descriptions available as a link under the data query tool results.

5.4.2 Physical Conditions

A summary of the specific conditions (salinity and substrate) required for preferred EFH to be designated for each species listed in Section 5.3 is summarized below. The summaries are relative to inshore (as opposed to offshore) habitat species' preferences as well as the specific life stages indicated in the EFH mapper results above.

- Black Sea Bass –warmer waters with salinities greater than 18 ppt and a rough bottom (e.g., shellfish beds, sandy/shelly areas, clam beds) for juveniles; the "mixing" and "seawater" salinity zones as well as sandy and shelly substrates for adults;

- Summer Flounder – estuarine habitats used as nursery areas including seagrass beds and mudflats and the "mixing" and "seawater salinity zones (10-30 ppt) for juveniles and estuarine/"mixing" and "seawater" salinity zones for adults;

- Scup – estuarine environments with salinities greater than 15 ppt and soft substrates for juveniles. Estuarine environments in the "mixing" and "seawater" salinity zones for adults;

- Atlantic butterfish –pelagic habitats in inshore estuaries with bottom depths between 130 and 1,200 ft for larvae, juveniles and adults; salinities greater than 5 ppt for juveniles and adults;

- Bluefish – estuaries and pelagic waters though temperatures, salinities and depths are not described for juveniles. Estuarine environments in the "mixing" and "seawater" zones for the highly migratory adults, though generally found in normal shelf salinities (> 25 ppt);

- Windowpane flounder – mud and sand substrates, extending from the intertidal zone to a maximum depth of 200 ft and includes mixed and high salinity zones (juveniles). Young of the year (YOY) prefer sand over mud. Similar to juveniles, mud and sand substrates, extending from the intertidal zone to a maximum depth of 230 ft and includes mixed and high salinity zones (adults).

- Atlantic herring – mixing/seawater salinity zones (0.5 < salinity < 25 ppt) for juveniles and seawater zone (salinity > 25 ppt) for adults;

- Red hake – seawater salinity zone of the Delaware Bay (salinity > 25 ppt) for adults;

- Winter skate – juveniles and adults prefer higher salinity zones, but designation includes mixed salinities (0.5 – 25 ppt);

- Little skate – juveniles and adults prefer higher salinity zones, but designation includes mixed salinities (0.5 – 25 ppt);

- Clearnose skate – juveniles and adults prefer higher salinity zones, but designation includes mixed salinities (0.5 – 25 ppt); and

- Longfin inshore squid – salinities between 30 and 32 ppt for eggs.

Based on the mapped geographic areas and life history requirements identified by NMFS – HCD (www.habitat.noaa.gov/application/efhmapper/index.html), the 12 Federally-managed species identified above are unlikely to occur within the proposed project area based on their intolerantance of the riverine/oligohaline salinity conditions (0.5 – 3 ppt) that exist within the footprint of the proposed project. Juveniles of black sea bass, summer flounder, scup, Atlantic butterfish, bluefish, and windowpane flounder prefer salinities > 15-18 ppt. Adults do occur in the estuarine mixing zone range of salinities, however, the proposed project area is located in a heavily industrialized reach of the river with little suitable bottom habitat for feeding. Although juveniles of the remaining identified federally-managed species (*e.g.* Atlantic herring, red hake, winter skate, little skate, clearnnose skate and longfin inshore squid) may occur in low saline waters, such as occurs in the proposed project vicinity, generally the adults of these species prefer marine habitat possessing higher salinities (>25 ppt).

5.5 Other species – Life Histories

The following section presents life histories of particular species that are not Federally-managed, but are labeled "species of concern" by resource agencies, are potentially found in the vicinity of the project area and/or were identified during the benthic resource survey, but for which EFH is not designated.

5.5.1 Atlantic striped bass (*Morone saxatilis*)

Atlantic striped bass can be found along the eastern coast of North America from the St. Lawrence River in Canada to the St. Johns River in Florida. The Atlantic coastal striped bass management unit includes the coastal and estuarine areas of all states and jurisdictions from Maine through North Carolina. Stocks that occupy coastal rivers from the Tar-Pamlico River in North Carolina south to the St. Johns River in Florida are believed primarily endemic and riverine and apparently do not undertake extensive Atlantic Ocean migrations presently as do stocks from the Roanoke River north.

Coastal migratory striped bass are assessed and managed as a single stock, although the population is known to be comprised of multiple biologically distinct stocks, predominantly the Chesapeake Bay stock, the Delaware Bay stock, and the Hudson River stock. Along with the Chesapeake Bay and Hudson River, the Delaware River is one of the major striped bass spawning areas along the Atlantic coast. The main spawning grounds are located between Wilmington, Delaware and Marcus Hook, Pennsylvania (DNREC Striped Bass Spawning Stock Survey – www.dnrec.delaware.gov).

Striped bass are a relatively long-lived species: the maximum age reported was 31 years. The species exhibit sexually dimorphic growth, with females growing faster and reaching a larger maximum size than males. Recent estimates of maturity at age indicated 45% of female striped bass mature at age 6 and 100% mature by age 9.

Based on the DNREC website (www.fishspecies.dnrec.delaware.gov), striped bass is listed as "abundant" in Delaware waters. Striped bass are ranked as Tier 2 for Species of Greatest Conservation Need (SGCN). Harvest of striped bass in State of Delaware water is open year-round except for catch and release only on spawning grounds from April 1st to May 31st, while harvest of striped bass is closed in federal waters between three and 200 miles offshore.

5.5.2 Alewife (*Alosa pseudoharenqus*)

Alewife is an anadromous species of herring found in North America. As an adult, it is a marine species spending most of its life in the ocean. Alewives move into estuaries before swimming upstream to spawn in freshwater habitats. Spawning typically occurs at night in slower-moving water when water temperatures reach 51 degrees Fahrenheit. Females typically produce 60,000 to 350,000 eggs, but due to predation only a few fish will survive to spawn three to five years later.

Alewives reach a maximum length of approximately 16 inches, with an average length of about 10 inches. Like the blueback herring, alewife are planktivorous feeders and are considered an important forage base for larger predators like largemouth bass, striped bass and bluefish.

Currently in the State of Delaware, there is a moratorium on the harvest of alewife. As a marine fish, the alewife is a NMFS species of concern.

5.5.3 Blueback herring (*Alosa aestivalis)*

Blueback herring range along the Atlantic Coast from Cape Breton, Nova Scotia to St. Johns Bay, Florida. Females usually mature by age five and produce between 60,000 and 103,000 eggs. Males generally mature earlier, between three and four years of age and at a smaller size than females. Collectively, blueback herring and alewife are considered "river herring".

The species is anadromous, living in marine systems most of their life. Unlike the alewife, blueback herring prefer to spawn during daylight in deep, swift freshwater rivers with hard substrates, when water temperatures reach 57 degrees Fahrenheit. Spawning occurs from late March through mid-May, typically later than the alewife due to the difference in preferred temperature. Eggs are deposited over the stream bottom where they stick to gravel, stones, logs or other objects. After spawning, adults migrate quickly downstream to saltwater. They are believed to be capable of migrating long distances (over 1,200 miles). Juveniles spend three to seven months in fresh water, then migrate to the ocean. The blueback herring is a planktivorous forage species.

Currently in the State of Delaware, there is a moratorium on the harvest of blueback herring. In addition, the species is considered an important prey species for larger predators such as largemouth bass, striped bass and bluefish.

5.5.4 White perch (*Morone americana*)

The white perch is not a true perch, but is a fish of the temperate bass family and most notably as a food and game fish in North America. White perch have been reported up to 19.5 inches in length and up to 4.9 pounds in weight, though average length is seven to 10 inches. Although white perch favors brackish water, it is also found in fresh water and coastal areas from the St. Lawrence River, Lake Ontario and as far east as Nova Scotia south and west to the Pee Dee River in South Carolina. They are commonly encountered in the Delaware and Chesapeake Bays. White perch commonly prey upon grass shrimp, razor clams and bloodworms, all of which are common to the region.

White perch are a prolific species as females can deposit over 150,000 eggs in a spawning season, lasting just over a week. The young hatch within one to six days of fertilization. White perch are widely abundant in Delaware waters and there is currently no seasonal harvest restriction on this species.

5.5.5 Bay anchovy (*Anchoa mitchilli*)

One of the most common fish species along the coastlines of the western Atlantic Ocean, ranging from Maine in the United States of America to the Yucatan in Mexico. It is native to the western Atlantic and Gulf of Mexico and is well known as the most abundant fish species in the Chesapeake Bay. Bay anchovy are small, slender schooling fish occurring in a wide range of water temperatures and salinities, including some hypersaline environments. Adult male bay anchovy is generally two to three inches in length, with a maximum length of about four inches.

The bay anchovy is sexually mature when it reaches about 1.5 inches in length, spawning in shallow and deep waters (less than 80 ft). In the southern part of its range it spawns year-round while farther north it breeds during the warmer months. A female can spawn 50 times in one season, producing over 1,000 eggs each time. Eggs hatch in about 24 hours and larvae mature in about 45 days.

Bay anchovy are intolerant of low-oxygen waters and easily asphyxiate when deprived of oxygen. The species spends most of its time cruising the water column, though rarely entering waters deeper than 80 ft. Bay anchovy can also be found over bare substrates at the ocean floor and in tide pools and surf zones and can also live in muddy, brackish waters.

The species feeds on zooplankton including copepods, mysids and crab larvae. It is considered an important prey item for a variety of larger fish including weakfish, striped bass and bluefish. Bay anchovy is not of conservation concern as it has an extensive range, a large and stable population made up of many subpopulations and no major threats.

5.5.6 Blue Crab (*Callinectes sapidus*)

The blue crab is native to the western edge of the Atlantic Ocean from Cape Cod to Argentina and around the entire coast of the Gulf of Mexico. The blue crab is a bottom-dweller found in a variety of habitats ranging from the saltiest water of the gulf to the almost fresh water of back bays and is particularly common in estuarine environments. Habitat for the blue crab ranges from the low tide line to waters up to 120 ft deep. Females remain in higher salinity portions of an estuary system, especially for egg laying.

Spawning season for blue crabs is from December to October, with a peak both in the spring and summer. The female blue crab is highly fertile, producing up to eight million eggs per spawn. Incubation time for blue crabs is 14-17 days, which is when the eggs are brooded. During this time females migrate to the mouths of estuaries so that larvae may be released into high salinity waters, as they require a salinity of at least 20 ppt. Larvae show very poor survival below this threshold. Blue crabs have a lifespan up to three years.

5.5.7 Sturgeon

As discussed in Sections 4.2.1.1 and 4.2.1.2, two federally-listed endangered species of sturgeon, the shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrhinchus oxyrinchus*) occur in the Delaware River in the vicinity of the proposed project. As indicated in Section 4.2.1.1, pursuant to Section 7 of the ESA, a BA was prepared to evaluate potential effects of construction and operation of the proposed Edgemoor container port on species under NMFS' jurisdiction as well as designated critical habitat. A copy of the BA has been submitted to the NMFS for review and issuance of a Biological Opinion. Endangered sturgeon will not be discussed further in this assessment.

5.5.8 American eel (*Anguilla rostrata*)

The American eel is a facultative catadromous fish found along the eastern North Atlantic coast from Venezuela to as far north as Greenland, including Iceland. Inland, the species extends into the Great Lakes and the Mississippi River. They can grow up to four ft in length and to 17 pounds in weight while females are generally larger than males and lighter in color. Like all anguillid eels, American eels hunt predominantly at night and during the day hide in mud, sand, masses of plants or gravel very close to shore at depths roughly five to six ft. They feed on crustaceans, aquatic insects and small insects.

American eels live in fresh water and estuaries and only leaves these habitats to enter the Atlantic Ocean to make its spawning migration to the Sargasso Sea. Spawning takes place far offshore, where the eggs hatch. The females can lay up to four million buoyant eggs a year, but dies after egg-laying. American eels are economically important in various areas along the East Coast as bait for fishing for sport fishes such as the striped bass or as a food fish in some areas.

Despite being able to live in a wide range of temperatures and different levels of salinity, American eels are very sensitive to low dissolved oxygen levels. Contaminants including PCBs, heavy metals and pollutants from nonpoint sources can bioaccumulate within fatty tissue of the eels, causing dangerous toxicity and reduced productivity. The USFWS reviewed the status of the American eel in 2015 and found that ESA protection for the eel was not warranted.

5.5.9 American Shad (*Alosa sapidissima*)

American shad is an anadromous clupeid fish naturally distributed on the North America coast from Newfoundland to Florida. The shad spend most of their lives in the Atlantic Ocean, but swims up freshwater rivers to spawn. In the marine environment, shad are schooling fish often seen at the surface in spring, summer and fall. They are hard to find in winter as they tend to go deeper before spawning season (as deep as 390 ft). American shad filter feed at sea and during their return journey to spawn, consuming small shrimp and fish eggs. They are consumed by marine predators including striped bass and sometime harbor seals.

Sexually mature shad enter coastal rivers when river water has warmed to 10 to 13 degrees celcius, as cooler water appears to interrupt spawning. Consequently, the shad "run" correspondingly later in the year, commencing in Georgia in January and May/June in northern streams generally from Delaware to Canada. Spawning fish select sandy or pebbly shallows and deposit their eggs primarily between dusk and midnight. Females release eggs in batches of about 30,000 eggs, though as many as 156,000 eggs can be deposited by very large fish. Semibuoyant eggs hatch between six and 15 days, depending on water temperature. Juvenile shad remain in rivers until fall when they begin the journey to marine waters.

5.6 Commercial and Recreational Fisheries

The Delaware Estuary provides important spawning habitat and nursery areas for many key biological species, particularly the anadromous species that constitute the majority of the commercial and recreational fisheries. Anadromous species of fish inhabit the Delaware River for growth, migration and spawning. Species of commercial and recreational importance include striped bass, American shad, alewife, blueback herring, hickory shad (*Alosa mediocris*), bluefish (*Pomatomus saltatrix*), weakfish (*Cynoscion regalis*) and summer flounder (*Paralichthys dentatus*).

In general, anadromous species migrate from offshore or downriver overwintering areas to upriver spawning and foraging sites during the spring and early summer months. The majority of juvenile anadromous fish travel downstream in the fall to overwinter in deeper waters of the Delaware Bay or offshore. Notable exceptions to this general pattern are sturgeon. Adult and juvenile shortnose sturgeon typically stay in the Delaware River all year and generally avoid saline waters. Juvenile Atlantic sturgeon typically spend several years in fresh to low salinity portions of the estuary before migrating to saltwater.

The Delaware River Basin Fish and Wildlife Management Cooperative provides recommended time of year dredging restrictions for the protection of these species between the Delaware Memorial Bridge and the Betsy Ross Bridge from March 15 to June 30 for hopper dredging and March15 to July 31 for hydraulic dredging. The project site is located in this reach of the Delaware River and will conform to the recommended time of year restriction. These restrictions are mostly designed to protect the spring spawning run. Along with the Chesapeake Bay and Hudson River, the Delaware River is one of the major striped bass spawning areas along the Atlantic coast, with the main Delaware River spawning ground reportedly is located between Wilmington, Delaware and Marcus Hook, Pennsylvania.

Also contributing to the commercial and recreational fisheries within the Delaware River Estuary are species more akin to marine waters including weakfish, bluefish and summer flounder. Species such as weakfish, bluefish and summer flounder typically use the saline lower portion of the estuary, specifically the transition zone and the bay. During the fall months, the majority of key species move down towards the bay or to deeper offshore waters and leave the estuary during the winter, seeking deeper offshore waters.

With respect to biomass, species such as Atlantic menhaden and bay anchovy constitute a large proportion of fishery biomass within the estuary. These fish are important to commercial and recreational fisheries as prey species for the targeted species discussed above.

Since about 1880, quantitative information to describe historical trends in commercial fisheries, particularly for fish and shellfish species, has been available. The trends are associated with human activities in and around the estuary. Historically, overfishing and a decline in water quality have been linked to reductions in commercially important anadromous fish stocks such as striped bass, alewife and shad. Another impediment to the restoration of some anadromous species abundance, such as herrings and shads, are the presence of manmade physical obstructions to migration, such as dams, in tributaries to the Delaware River. Such obstructions impede fish migration/movement to historical spawning locations.

Unlike many rivers in the eastern United States of America, the main stem of the Delaware is free from manmade physical obstructions to migration. Improvements in overall water quality (mainly dissolved oxygen concentrations) since the initial enactment of the Clean Water Act in the 1972 are associated with the return of fish species to the estuary.

6 LITERATURE REVIEW

In support of the benthic resource assessment to evaluate potential EFH, a review of readily available and published literature was performed to compile fish population/abundance studies and data that was or currently is being collected in areas that overlap the project site boundaries or are in the vicinity of the project site.

Fish sampling performed by others in the vicinity of the project site has indicated use of this section of the estuary by a variety of species, most notably striped bass, blueback herring and alewife. Cherry Island flats, located on the opposite side of the federal navigation channel from the project site, is a geomorphic feature where gravid striped bass females aggregate and various other life stages of striped bass use as nursery, foraging and resting habitat.

Based on a decline in populations indicated by landing statistics and the number of fish observed on spawning runs, shad, alewife and river herring have been designated as Species of Concern by the National Oceanic and Atmospheric Administration (NOAA). The decline has been attributed to habitat loss, habitat degradation/modification and increases in turbidity. Historically, prior to improvements in water quality in the lower Delaware River, spawning runs and spawning areas associated with these species were located upriver of Trenton, New Jersey.

Several surveys used by the Atlantic State Marine Fisheries Council (ASMFC) to understand fish population trends within an area, including the project site, are listed below and summarized herein:

- Delaware River Seine Survey (1980 – present) conducted by the New Jersey Department of Environmental Protection (NJDEP);
- Delaware Finfish Trawl Survey (1966/1980 – present) facilitated by DNREC;
- Delaware River Striped Bass Spawning Stock Assessment (1991 – present) conducted by DNREC;
- Fisheries and Biological Sampling for the PSEG Power Plant (1995 – present) conducted by PSEG;

Fish population surveys used by ASFMC that have been conducted in areas adjacent to the project site include:

- Crown Landing LNG (2005 – 2006);
- Benthic Sampling (2008- 2010) – Partnership for the Delaware Estuary; and
- National Coastal Assessment (2000 – 2006) – US Environmental Protection Agency (USEPA).

6.1 Delaware River Seine Survey

The Delaware River Seine Survey, conducted by NJDEP, is the Bureau of Marine Fisheries' longest-running fishery independent monitoring program (39 consecutive years) providing an annual abundance index for striped bass as well as data for American shad and river herring populations. Seining is conducted in three regions, with region two (characterized by brackish to freshwater and extending from the Delaware Memorial Bridge (RM68.9) to the Schuylkill River (RM92) encompasses the project site located at RM73.2. Within region two there are 16 fixed sampling stations, each sampled once in June and bi-monthly from July through October.

The most recent Delaware River Seine Survey results available online were from a five-month period between June 19, 2018 and October 23, 2018 (www.nj.gov/dep/fgw). During this period, crews hauled 285 individual seines and caught a total of 30,012 fish, averaging 105 fish per haul. While striped bass are the primary target species of the survey, the five most abundant species caught were:

- American shad;
- Banded killifish;
- White perch;
- Blueback herring; and
- Spottail shiners.

Striped bass was the seventh most abundant fish caught in the 2018 survey. A total of 1,490 striped bass were caught and of those, 98% (1,453) were young-of-year (YOY) (i.e., less than one year old). Further, since 2009, YOY data derived by this survey has indicated a positive reflection of the spawning success of striped bass in the Delaware River. Several species, including three species of concern (American shad, blueback herring and alewife), had much higher catches in 2018 compared to 2017, possibly due to the fishing moratorium put in place in 2013. Two other species, white perch and spottail shiners, also had significant increases between 2017 and 2018. Results of this survey have been corroborated by other independent surveys including the Delaware Division of Fish and Wildlife's striped bass spawning stock survey (DNREC flyer – http://www.dnrec.delaware.gov), though specific data from the Delaware survey was not readily available.

6.2 Delaware Finfish Trawl Survey

The trawl survey program utilizes a small and large trawl to monitor the status of a wide variety of marine finfish and shellfish populations in the Delaware Estuary (www.dnrec.delaware.gov). Specifically, sampling locations for the small trawl extend from the Delaware Bay to Edgemoor/Cherry Island flats, including a sampling location within the proposed project area (RM73.2). Over 160 species of marine finfish and invertebrates have been recorded in survey catches since the inception of the trawl survey program. Catches typically are dominated by species such as bay anchovy, hogchokers, weakfish, Atlantic croakers and spot. Survey data acquired since 2008 has suggested that alewife populations have been trending upwards and blueback herring population abundance has remained stable, at low levels, since 2003.

In addition to developing coast wide stock assessments and fishery management plans, Delaware's trawl data is used to establish time of year restrictions for activities such as beach replenishment and dredging in an effort to minimize the potential impacts of these activities on Delaware's marine resources.

6.3 Delaware River Striped Bass Spawning Stock Assessment

The striped bass spawning stock assessment is performed using electrofishing and is conducted during the spring on the apparent main spawning grounds, which reportedly are located between Wilmington, Delaware (RM70) and Marcus Hook, Pennsylvania (RM79) (www.dnrec.delaware.gov). Specifically, the assessment is conducted from the Delaware Memorial Bridge (RM68.9) to the mouth of Big Timber Creek, New Jersey (RM95), which includes Cherry Island flats (RM73) located adjacent to the project site. Since 1991, more than

8,230 striped bass have been sampled through this assessment, providing data on relative abundance, size structure, age and sex composition, and tag return patterns.

6.4 Fisheries and Biological Sampling – PSEG Power Plant

PSEG currently conducts juvenile bottom trawl surveys in the Delaware Estuary, extending upstream to RM78 and including the footprint of the proposed project. The most recent bottom trawl survey was conducted from April to November of 2018. In addition to bottom trawl, PSEG conducted pelagic trawl and ichthyoplankton surveys from 2002 to 2004, extending upstream to RM132. The ichthyoplankton survey was conducted again in 2018. To stay consistent with the juvenile bottom trawl survey, the 2018 ichthyoplankton survey extended to RM78. The PSEG biological monitoring program annual reports are submitted to the NJDEP and include annual data on the bottom trawl effort, bay wide beach seine, and bay wide ichthyoplankton surveys.

Based on the fisheries surveys identified above, there is a large amount of existing population/abundance data that has been collected within the proposed project footprint as well as in areas adjacent to the proposed project. The surveys provide stock assessment data and status indicators that are used to monitor population trends for a wide variety of finfish and shellfish species in the Delaware estuary, including species of concern such as striped bass and river herring. Many of the surveys have been conducted annually for decades (and continue to be conducted), allowing researchers to not only be aware of population fluctuations, but also to predict future fishery management needs.

7 HABITAT AND BENTHIC RESOURCE ASSESSMENT

As introduced in Section 2.2.3, Duffield Associates contracted ECSI in July 2019 to perform a Resource Assessment relative to EFH within the footprint of the proposed project. Specifically, the purpose of the Resource Assessment was to identify benthic and aquatic resources within the dredging and construction areas (i.e. proposed berth and approach channel) that may be impacted as a result of the proposed project. The habitat and benthic resources assessed, in addition to the water quality parameters discussed in Section 2.2.3, included identification of infaunal benthic species present in the river sediments and the abundance of those species, a second effort to search for SAV, the presence of cover, beach seining and net trawls to gather information about flora, fauna and habitat at the site of the proposed project. The specific "action area" for the assessment can generally be defined as including the following affected environments:

- Dredging Area – Approximately 87 acres (including side slopes) of estuarine subtidal and intertidal habitat with existing water depths ranging from 0 to 45 ft mean lower low water (MLLW). Bottom substrate generally consists of fine-grained sediments in subtidal locations. Intertidal bottom typically consists of sandy materials. There are no vegetated wetlands within the dredging area. Dredging will be used to create the berth and the approach channel.

- Construction Area – nearshore waterfront area where the approximately 2,600 linear-foot wharf is to be constructed. Aquatic habitat is estuarine subtidal and intertidal with existing water depths ranging from 0 to 5 ft. The bottom substrate consists primarily of sand and gravel with some rubble. This area experiences high energy waves from wind, and shipping traffic. No wetlands are present within this area.

A scope of work for this Resource Assessment was prepared and submitted to NMFS-HCD for review and comment. Comments were received and appropriate comments were incorporated into this assessment. The habitat and benthic resource sampling was performed by ECSI and included beach seining, trawl haul sampling, sediment/benthos sampling and a search for SAV. A summary of ECSI's sampling methodology is provided below while specific details regarding the sampling protocols for each type of sampling are described in the Resource Assessment plan included in Appendix 4. Specific sampling locations, as performed by ECSI, for each sampling type/event are indicated on Figure 4 and identified below.

7.1 Sampling Methodology

7.1.1 Beach Seine Sampling

The beach seine sampling event was conducted on July 29, 2019 and included three samples, identified as "EPP_Seine1, EPP_Seine2 and EPP_Seine3". The sampling followed methods used by NJDEP in beach seining conducted annually within the Delaware River between RM59 RM133. The sampling gear and deployment procedure were developed following the materials and the methods described in Baum (1994) and through personal communication with the principal investigator, Thomas Baum of the New Jersey Department of Environmental Protection (NJDEP). The beach seine sampling methods are also the same as Public Service Electric & Gas (PSEG) has used for sampling since 1997.

7.1.2 Bottom Trawl Sampling

The bottom trawl sampling event was conducted on October 11, 2019 and included three (3) sample hauls performed using nine-foot trawl nets. The trawl hauls, identified as "EPP_Trawl1", "EPP_Trawl2" and "EPP_Trawl3", were performed along the river bottom within the mid-depth (16-20 ft) of the project site. The bottom trawl sampling follows procedures used in an established trawl monitoring survey conducted annually by the PSEG Estuary Enhancement Program, as a special condition of the their New Jersey Pollutant Discharge Elimination System (NJPDES) permit. The survey augments an established trawl monitoring survey conducted annually by the Delaware Department of Natural Resources and Environmental Control (DNREC) in the inshore waters (along the Delaware shore) of the Delaware Bay and lower Delaware River between RM0 and RM77.

7.1.3 Benthos/Sediment Sampling

Benthos/sediment sampling was conducted on August 1, 2019 and October 11, 2019, resulting in the collection of seventeen (17) sediment samples covering three water depths within the project site. In addition, a Sampling methods followed those used in a comprehensive survey of the epi- and infaunal benthic macroinvertebrate communities of the Delaware River from Trenton, New Jersey to the Chesapeake & Delaware Canal. A Petite Ponar dredge, which is capable of sampling a 6" by 6" area, was used to collect four sediment subsamples from each location. The Petite Ponar was dropped to the sediment and then the line was pulled sharply to close the dredge. The dredge was then raised to the surface where any free liquid was decanted through screens at the top of the dredge. The subsample was transferred to a dedicated container and this process was repeated for each subsample collected. The four subsamples were combined and preserved for transport to the laboratory for processing.

7.1.4 Submerged Aquatic Vegetation

A search for SAV was originally conducted by ECSI on October 22, 2018 at six locations within the proposed project footprint. However, NMFS-HCD personnel indicated that the search was performed one week outside of the preferred window for SAV surveys within this particular reach of the river (i.e. where the proposed project is located). NMFS-HCD advised (reportedly in consultation with regional SAV experts and other biologists within NMFS) via electronic mail correspondence that June 1 to October 15 of any given year would be the appropriate window for a SAV survey in this reach of the river.

In response, a second effort to search for SAV was performed on August 1, 2019 and October 11, 2019, at the same locations where the 17 benthos/sediment samples described above were collected. These two dates are both within the preferred window of June 1 to October 15 for SAV surveys, as indicated by NMFS-HCD.

A Petite Ponar grab sampler was used to collect the benthic samples. In addition, near shore waters, beach and hard structures in the water (e.g., parallel piers, pilings) were checked for the presence of SAV. Literature searches relevant to the historical presence of SAV within the area of the proposed project were also performed.

7.2 Data Assessment

To assess the data collected from each of the sampling efforts, the following was performed:

- Identification and count of each species found in the samples;
- Calculation of abundance to assess the relative presence of each identified species in the sample or sampling area;
- Comparison of identified species in the seine and trawl samples to the State of Delaware Endangered Species List and the list of SGCN; and
- Calculation of Benthic Polychaetes Amphipod (BPA) ratio.

As introduced in Section 5.4.2, species identified as a SGCN are assigned to a tier which determines the level of conservation need according to the responsible regulatory agency. Species listed in Tier 1 are in the highest need of conservation action, species listed in Tier 2 are in moderate need of conservation action, and Tier 3 species are in the lowest need of conservation action.

The calculated BPA can be used to infer a level of environmental quality (Jean-Claude Dauvin *et al*, 2017) by comparing the calculated value to published thresholds of Ecological Quality Status (EcoQs).

The data from the Resource Assessment, as provided by ECSI, is included in Appendix 2 and summarized below.

7.2.1 Beach Seine Sampling Results

Three (3) species and a total of 50 individual fish were identified during the beach seine sampling event. The three species included bay anchovy (*Anchoa mitchilli*), white perch (*Morone americana*), and striped bass (*Morone saxatilis*), totaling 34, 9 and 7 individual fish, respectively and summarized below in Table 7.2.1 Abundance of species identified in beach seine samples.

Table 7.2.1 Abundance of species identified in beach seine samples

SPECIES ABUNDANCE							
Species		DE Endangered Species	SGCN Species	Percentage of Species in Samples			
Scientific Name	Common Name			1S	2S	3S	All Samples
Anchoa mitchilli	bay anchovy	No	No	0%	0%	87%	68%
Morone Americana	white perch	No	No	60%	0%	8%	18%
Morone saxatilis	striped bass	No	Yes (Tier 2)	40%	100%	5%	14%

None of the species captured in the beach seine samples are Federally-managed species. As noted previously, many of the Federally-managed species identified for the region prefer higher salinity water. Adults are generally intolerant of reverine/oligohaline conditions and those of juvenile life stages that do occur in the oligohaline reach of the proposed project area are likely transient.

One species identified in the beach seine samples, striped bass, is listed as a SGCN, Tier 2 species. According to NOAA Fisheries, once heavily overfished, striped bass recovered to stable population levels due in part to a fishing moratorium implemented in the mid to late 1980s. Despite recent declines in biomass and indications that the stock is again experiencing overfishing, the stock remains above the levels that triggered the moratorium. Striped bass populations are not limited to the Delaware Estuary and are found along the Atlantic Coast from Canada to Florida.

7.2.2 Bottom Trawl Sampling Results

Fifteen (15) species were identified during the bottom trawl sampling event. These species and their relative abundances are listed in Table 7.2.2 below.

Table 7.2.2 Species abundance identified in bottom trawl samples

SPECIES ABUNDANCE							
Species		DE Endangered Species	SGCN Species	Percentage of Species in Samples			
Scientific Name	Common Name			#1	#2	#3	All Samples
Micropogonias undulatus	Atlantic croaker	No	Yes (Tier 3)	29%	60%	52%	46%
Morone americana	white perch	No	No	39%	8%	10%	19.9%
Anchoa mitchilli	bay anchovy	No	No	12%	19%	19%	16.5%
Crangon septemspinosa	sand shrimp	No	No	8%	7%	6%	7.1%
Palaemonetes paludosus	grass shrimp	No	No	0%	0%	8%	2.9%
Callinectes sapidus	Blue Crab	No	Yes (Tier 2)	4%	2%	1%	2.1%
Ictalurus punctatus	channel catfish	No	No	4%	1%	0%	1%
Morone saxatilis	striped bass	No	Yes (Tier 2)	2%	0%	1%	1.3%
Bairdiella chrysoura	silver perch	No	No	0%	2%	1%	0.6%
Cynoscion regalis	weakfish	No	Yes (Tier 2)	1%	0%	1%	0.6%
Trinectes maculatus	hogchoker	No	No	0%	1%	1%	0.6%
Etheostoma olmstedi	tessellated darter	No	No	1%	0%	0%	0.4%
Anguilla rostrata	American eel	No	Yes (Tier 1)	0%	1%	0%	0.2%
Gobiosoma bosc	naked goby	No	No	0%	0%	1%	0.2%

None of the species encountered in the bottom trawl samples are listed as an endangered species by the State of Delaware. Five species are ranked as SGCN. However, four of those exhibit a relative abundance of less than 2%. Only one species, the American eel, is ranked as a Tier 1 species. American eels are catadromous – they spawn in saltwater and live as adults in fresh water. Given the time of year of the trawls, the one eel captured may have been an adult migrating to the sea. While it is possible for American eels to be present in the vicinity of the proposed project, they are more likely to be found upriver of the proposed project in Pennsylvania where salinities are that of riverine conditions. As with other migratory species, they are significantly impacted by obstructions (*e.g.*, dams) that impede their free passage to spawning grounds.

Please refer to photographs 11 and 12, included in Appendix 6 – Photographs, for images of fish caught in one of the trawl hauls.

7.2.3 Benthos Sampling Results Assessment

Seven (7) organisms were identified during the benthos sampling event. These organisms and their relative abundances are listed in Table 7.2.3 below.

Table 7.2.3 Abundance of organisms in benthic samples

Order	Species	Sample Number								
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
OLIGOCHATA		29%	7%	0%	0%	50%	13%	0%	5%	0%
ISOPODA										
	Cyathaeridae	0%	20%	1%	0%	0%	7%	2%	0%	14%
AMPHIPODA										
	Gammaridae	0%	9%	99%	0%	0%	27%	90%	10%	0%
	Corophiidae	0%	4%	0%	0%	0%	0%	1%	0%	0%
DIPTERA										
e	Chironomidae	29%	0%	0%	0%	0%	33%	0%	0%	0%
BIVALVA										
	Corbculidae	0%	15%	0%	0%	0%	7%	1%	0%	0%
POLYCHAETA		43%	44%	0%	0%	50%	13%	4%	85%	86%

Order	Species	Sample Number								
		10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**Total**
OLIGOCHATA		0%	0%	0%	1%	0%	0%	0%	0%	2%
ISOPODA										
	Cyathaeridae	33%	0%	0%	18%	13%	0%	0%	0%	7%
AMPHIPODA										
	Gammaridae	19%	0%	0%	8%	47%	0%	100%	0%	62%
	Corophiidae	7%	0%	0%	0%	2%	0%	0%	0%	1%
DIPTERA										
	Chironomidae	41%	10%	33%	65%	19%	0%	0%	0%	12%
BIVALVA										
	Corbculidae	0%	0%	0%	0%	0%	0%	0%	0%	2%
POLYCHAETA		0%	90%	67%	8%	19%	0%	0%	0%	14%

The benthic Polychaetes Amphipods Ratio (BPA) can be used to infer a level of environmental quality in soft bottom communities (Jean-Claude Dauvin et al., 2017). The equation is as follows:

$$BPA = \log_{10}[(f_p/(f_a+1)) +1]$$

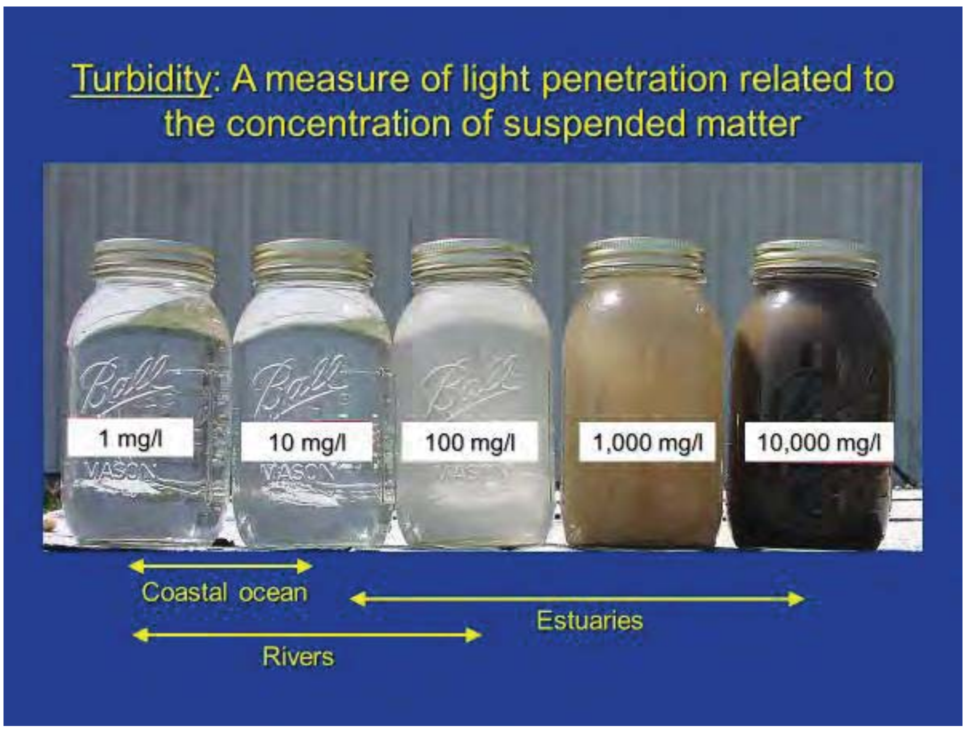
Where, fp is the polychaete frequency and fa is the amphipod frequency. The total number of species identified in all of the sampling events was 650. The total number of polychaetes identified was 91 (frequency of 0.14) and the total number of amphipods identified was 409 (frequency of 0.63). Using these values yields a BPA value of 0.35, indicating a benthic community in the poor-bad range for Ecological Quality Status (EcoQs) (Jean-Claude Dauvin et al., 2017).

Please refer to photograph 13, included in Appendix 6 – Photographs, for a representative image of Delaware River sediment obtained with a petite ponar at one of the benthos sampling locations.

7.2.4 Submerged Aquatic Vegetation

The results of the SAV survey conducted in 2018 indicated that no SAV was observed or collected from within the footprint of the proposed project. The results of the 2018 effort are summarized in a report titled, "Submerged Aquatic Vegetation Survey for the Edgemoor Site" (herein referred to as "SAV Survey"), prepared by ECSI and included in Appendix 5. The results of the second effort, performed on August 1st and October 11th, confirmed the initial results – no SAV or aquatic vegetation was observed or collected within the footprint of the proposed project.

As described in the 2018 SAV Survey report and indicated in Section 2.1, the project is located within the ETM, or transition zone, of the estuary. Within the project footprint, the littoral zone (i.e. near shore) experiences high energy from wind, tide and shipping traffic, evident from the extensive armoring (e.g., riprap, gabion baskets, pilings) along the shoreline (Miller, 2018). As expected and indicated previously, the water in this reach of the river, within the ETM, is consistently turbid with poor light penetration, as shown in the photographs included in the SAV Survey report. Turbidity values at the site of the proposed project are near the 1,000 milligrams per liter (mg/L), as illustrated in following diagram (Sommerfield, 2007):



As indicated in the SAV Survey report, ECSI performed beach seine sampling from 2002 to 2015 for a different client at the northern end of the proposed project. SAV was not observed at that sample location, identified as "Site #71", during any of the beach seining efforts performed during the 13 year period. In addition, a review of Delaware and New Jersey literature performed by ECSI did not indicate a reference to SAV within the area of the proposed project (Miller, 2018).

Typically, SAV can only grow in areas that are shallow and clear enough to receive sufficient sunlight for photosynthesis. In addition, areas that have higher tidal ranges (> two meters)/heavy wave action that impede establishment of roots and/or soft sediments are not likely to provide a suitable habitat for SAV growth (EPA, 2006). Given the heavy wave action, turbid conditions and soft, silty sediments (Section 2.2.1) observed within the affected environments (dredging and construction areas), SAV is not expected to be present within the footprint of the proposed project.

7.3 Data assessment summary

None of the species identified during the seine and trawl events are Federally-managed species. Many of the listed species do not have designated EFH mapped within the footprint of the proposed project and/or are intolerant of the riverine/oligohaline salinity conditions at the site of the proposed project.

Generally, waterbodies in healthy biological condition support a wide variety and high number of macroinvertebrate taxa, including many that are intolerant of pollution (US Environmental Protection Agency – Indicators: Benthic Macroinvertebrates). The species identified in the benthos samples for the survey predominantly are pollution tolerant species that are distributed widely throughout the estuary. In addition, there was little diversity and a low number of taxa identified in samples collected within the proposed project suggesting a less healthy waterbody.

When the biology of a waterbody is healthy, the chemical and physical components of the waterbody are also typically in good condition (US Environmental Protection Agency – Indicators: Benthic Macroinvertebrates). Based on the 2019 Sediment and Water Quality Assessment discussed in Section 2.2, the chemical components of the waters within the proposed project indicate an area that is in less than good condition. Further, the presence of these pollution tolerant benthic organisms within the proposed project area supports the findings of the 2019 Sediment and Water Quality Assessment that concluded that removal of the sediments at the project site would be beneficial due to the associated removal of substances of environmental concern.

Further, no difference between shallow (defined as depths less than two meters) and deep water with respect to habitat or benthic resources was identified.

8 POTENTIAL EFFECTS

8.1 Potential adverse effects

Potential adverse effects of construction activities associated with the project include the following:

- Removal of substrate;
- Noise generated from pile installation;
- Entrainment from dredging;
- Increased turbidity from dredging;
- Maintenance dredging; and
- Changes in hydrodynamics/salinity.

8.1.1 Removal of substrate

While construction of the port will result in the removal of substrate, based on the lack of identified resources suitable for fish spawning, breeding, feeding and growth within the dredging and construction areas, no habitat of value was identified within the affected environments. Additionally, no SAV or vegetated wetlands are present. While some benthic organisms were identified within the affected environments, they do not represent a diverse assemblage, are primarily low value (i.e., organisms that can survive in environments with reduced water/sediment quality), are widely distributed and can be found in adjacent areas of the river. To avoid potential adverse impacts to anadromous fish species, substrate removal activities (dredging) will not be performed during the spring spawning season in compliance with the currently recommended moratorium.

8.1.2 Noise

Noise and underwater sound pressure from pile driving activities can cause effects on fish ranging from alter behavior, hearing loss, tissue injuries to mortality. To minimize or avoid those effects, soft start and vibratory drive methods are anticipated to be utilized. In addition, pile installation activities are planned to occur during the fall and winter months, outside the spawning window which is typically March 1st – July 15th. The majority of key species are not expected to be present within the project area during construction and will not be subject to any construction activities during spawning runs.

8.1.3 Entrainment

Dredging activities are anticipated to occur during the fall and winter months, outside the spawning window, which is typically March 1st – July 15th. The majority of key species are not expected to be present within the project area when dredging will occur and will not be subject to construction activities during spawning runs. Young of the year that may be passing through the project area should be developed sufficiently to avoid entrainment in the dredging equipment by swimming away from the cutter head.

The use of shoaling fans (as discussed in Section 2.3) to minimize sedimentation within the berth and reduce the frequency of maintenance is being considered for the project. While the use of shoaling fans are not anticipated to impact juvenile or adult fish stages as they can move away from the water intact ends of the equipment, planktonic life stages, eggs and early larval stage fish, potentially are susceptible to being entrained by the fans. However, there should be flexibility in the operating schedule of the fans that would help to minimize the potential for adverse impacts during the spawning season (Duffield July 2014, redacted). While the use of shoaling fans is being discussed currently, the impact on fisheries should be evaluated after the berth area has been created.

8.1.4 Turbidity

While dredging may cause increases in turbidity, these conditions will be temporary. The project site is located in the turbidity maximum of the estuary and the potential increases in turbidity associated with construction activities are unlikely to adversely affect fish species that are adapted to the prevailing turbid conditions. Dredging and pile driving activities are anticipated to occur during the fall and winter months, outside the spawning window which is typically March 1^{st} – July 15^{th}. The majority of key species are no longer present within the area, minimizing the potential to impact fish movement/migration during spawning runs. Further, construction and operation of the proposed project will not impede the movement of migratory species as the project does not include the construction and/or installation of waterway obstructions.

The use of shoaling fans (discussed in more detail in Section 8.1.5 below) to minimize sedimentation within the berth and reduce the frequency of maintenance dredging is being considered for the project. Shoaling fans do not increase turbidity, but allow sediment to stay suspended within the water column rather than settling on the river bottom.

8.1.5 Maintenance dredging

While current estimates for maintenance dredging of the proposed berth includes the removal of 500,000 cy of material annually, the use of shoaling fans is being proposed. Installation of shoaling fans is intended to reduce the following:

- Frequency of maintenance dredging;
- Upland storage requirements; and
- Cost associated with maintenance dredging.

To reduce the frequency, upland storage requirements, and cost of maintenance dredging, the use of anti-sedimentation devices known as shoaling fans is being considered. Shoaling fans draw water through an intake located at the approximate mid-depth of the water column and discharge it horizontally at the mudline. The horizontal flow of water along the river bottom stirs the river water and inhibits settling of sediments in the berth area. Water flow through the units being considered is created by a four-bladed impeller, with a blade spacing of approximately 1.5 ft, operating at relatively low speed (275-500 revolutions per minute (rpm), depending on the specific site requirements. The impeller is driven by a shore-mounted hydraulic pump that uses vegetable oil as its hydraulic fluid (see SedCon Technologies, Inc. website: http://www.sedcontech.com). Please see Appendix 1 – Sheet 11 for a sectional view and conceptual images of the shoaling fan configuration.

The intake of each fan unit will have a surface area of approximately 60 sf and will be screened with bars spaced approximately four inches apart. Intake velocity will be approximately 2.5 ft per second (fps) at the screen and 0.5 fps at a distance of 4 ft (Bryant and Moseley, 2007). A concept for the Edgemoor project indicates that twelve fans would be placed along the length of the berth, grouped in three sets of four individual units. Each set of fans would be operated sequentially, in coordination with the tide, stirring the water column while rotating 90 degrees in the direction of the tidal current. The individual units within a set are anticipated to operate for 45 minutes, with each set operating for approximately three hours during each tide cycle for a total operating time of approximately 12 hours per day (4 units x 0.75 hours per unit x 4 tides).

8.1.6 Hydrodynamics/Salinity

A hydrodynamic and sediment impact analysis of the proposed project was performed by Mott MacDonald and summarized in an October 2019 report. The analysis was intended to evaluate potential impacts of the project on hydrodynamics (including salinity), sediment transport and erosion/deposition in the surrounding areas. The results of the analysis indicated that, based on current velocities, salinity and bed changes in the surrounding areas are limited to the immediate vicinity of the terminal, defined as less than half of the berth length upstream or downstream of the terminal extents.

Salinity changes are likely to be negligible even in the immediate vicinity of the terminal. Further, hydrodynamic impacts are negligible outside the immediate vicinity of the terminal. In addition, salinity, sediment transport and morphology are also unaffected outside the terminal area. For more information, please refer to the Mott MacDonald "Hydrodynamic Analysis of Proposed Edgemoor Terminal", October 2019 and incorporated by reference.

8.2 Potential cumulative impacts

This section addresses cumulative impacts (effects) anticipated to result from the proposed project that may have an adverse effect on EFH. EFH include those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity per 16 U.S.C. 1802(10). An adverse effect has been defined in the National Environmental Policy Act (NEPA) as follows: "Any impact which reduces the quality and/or quantity of EFH. Adverse effects may include direct actions such as introducing toxic conditions or physical disruptions, indirect actions such as loss of prey or reduction in species fecundity, site specific or habitat wide impacts, including individual, cumulative, or synergistic consequences of actions." EFH includes aquatic areas that are used by specieis (either currently or historically) and have adequate prey species, physical, chemical, and biological properties. While sturgeon are addressed more vigorously in a BA, a brief discussion of the potential effect to Atlantic and shortnose sturgeon, both listed as endangered, is included below.

The cumulative effects analysis considers the magnitude of the indirect and direct cumulative effect on the proposed resource health. Cumulative impacts include the impacts associated with the Port of Paulsboro project, the PhilaPort Southport Marine Terminal project, and the Gibbstown Logistics Center projects. A 'resource' for the purpose of this section refers to a subject, such as aquatic life, that could be impacted cumulatively by the proposed action. Health refers to the general overall condition or vitality of the resource and the trend of that condition. Significant cumulative effects associated with the proposed project are discussed below.

8.2.1 Removal of benthic habitat caused by dredging and upland storage of material

The removal of benthic habitat due to dredging and upland storage of material has the potential to impact shortnose sturgeon and Atlantic sturgeon depending on the type and quantity of specific habitats that are subject to dredging or filling. The past actions would not continue to have effects on the foraging grounds of the shortnose and Atlantic sturgeon since initial dredging will have long since ceased. However, periodic maintenance dredging for these projects would still occur periodically. The port projects that require initial construction dredging and future maintenance dredging could have cumulative effects on the benthic habitat of sturgeon.

8.2.2 Permanent change in water depths and removal of benthic habitat

The Delaware River extends approximately 102.5 miles from Philadelphia to the Atlantic Ocean, providing a variety of water depths, and most of the river bottom providing potential benthic habitat. The cumulative projects' impact water depth and benthic habitat in two principle ways: by deepening the river bottom when navigation channel, berths, and turning basins are excavated, and by filling as terminal facilities are built along river banks. The following are estimated initial volumes of dredge material, in cubic yards (CY) that are to be removed from the cumulative projects.

- Paulsboro Dredge Material: 334,000 CY
- Southport Dredge Material: 1,008,000 CY (Maybe additional 298,000 CY)
- Gibbstown Logistics Center Dredge Material: 457,000 CY

Sediment sampling results are discussed in Section 2.2.2 and the "Edgemoor Sediment and Surface Water Quality Assessment." Risk analysis determined that the current river bottom at the Edgemoor site has concentrations of metals that may pose risk to benthic organisms according to National Oceanic and Atmospheric Administration Screening Quick Reference Table (NOAA SQuiRT) levels. While the current benthic habitat will be removed, the removal of the current river bottom sediments may benefit the surrounding ecosystem by removing potentially harmful substances that will be stored in a confined dredge facility. The reasonably foreseeable actions involving maintenance dredging of the project area and cumulative projects would be the continued removal of harmful substances adhered to sediment settling from the water column at Edgemoor or perhaps being transported as bed load at the other sites. The removal of substances of potential ecological concern through maintenance dredging potentially would benefit the ecological health of the benthic organisms living in the undisturbed areas adjacent to the project sites. Removal of substances of potential concern to ecological health, such as but not limited to, PBCs, dioxins, and furans, could also reduce exposures to aquatic and human life. These substances have been demonstrated to bioaccumulate within the food chain.

8.2.3 Short-term effects (impingement, burial, and increased turbidity) of dredging or placement activity on Atlantic and shortnose sturgeon

Typically, the temporary effects of dredging last a few hours and extend a few thousand feet while sediments are being removed. Therefore, the most important cause and effect relationship of concern to the sturgeon is the timing and spacing of the projects and whether their effects would spatially or temporally overlap. Dredge operation methods will implement best management practices to minimize disturbance. It is standard practice for dredge operations not to engage the operation of the hydraulic dredge until it is resting on the river bottom.

The Port of Paulsboro project, the PhilaPort Southport Marine Terminal project, and the Gibbstown Logistics Center projects do not spatially overlap. Given that the effects of dredging from these projects would not overlap, due to distance, then the temporary effects to the sturgeon would not overlap either.

Dredging operations are restricted seasonally to avoid potential adverse impacts to migrating sturgeon during spring. In coordination with the NMFS and the State of Delaware, dredging and pile driving will not occur during the spawning window between March 1st and July 15th. Therefore, the proposed action's temporary localized effects to sturgeon likely would not have significant cumulative effects with the past, present, or reasonably foreseeable actions, due to either timing or project location. The same dredge distance and time of year limitations would apply to maintenance dredging, and like initial dredging, the effects during maintenance dredging would be temporary in nature, and not cumulative.

8.2.4 Effect of shoaling fans on identified species

Unlike the other projects being included in this review of potential cumulative impacts to fish habitat, the use of shoaling fans is being considered to minimize sedimentation within the berth area at Edgemoor. This action is intended to decrease the frequency of maintenance dredging within the proposed project site and reduce the volume of upland dredge material storage in the CDF. Operation of the shoaling fans is not expected to have a significant negative impact on species discussed in this EFH assessment. A foreseeable potential benefit of shoaling fan operations is the reduction in the disturbance frequency of the benthos may allow colonization in the newly exposed and cleaner river bottom. There are no significant cumulative impacts anticipated to occur from the operation of the shoaling fans, based on an entrainment and impingement assessment performed at a nearby site.

8.2.5 The effects of climate change on EFH

Climate change likely will affect the proposed project site and cumulative projects, but the cumulative projects are not expected to significantly increase the effects of climate change. Factors of climate change that have the potential to affect the proposed project site and cumulative projects include sea level rise, increased ocean temperatures, ocean acidification, changed weather patterns, and decreased DO levels. Sea level rise may cause an upstream or downstream shift of salinity and acidification in the Delaware River dependent upon whether precipitation increases or decreases within the Delaware River watershed in the future. The possible shift in salinity also could affect fish populations, their associated habitats, breeding sites, survival of early life stages (eggs, larvae, and young-of-the-year), and the abundance and distribution of prey species. DO levels in the River could be impacted by higher ocean temperatures as well as higher salinity. The proposed project and cumulative projects are not expected to change water temperature in the River, as studies have indicated that the water column of the River is well mixed within the estuary. The projects are not expected to add significant quantities of biochemical oxygen demand (BOD) or chemical oxygen demand (COD) substances to the River or industrial quantities of cooling water to the River that might alter the DO concentrations.

Habitats are expected to be at a greater depth below sea level as a result of sea level rise and to migrate up river as time progresses. This phenomenon has been occurring since the time of the last ice age, approximately 12,000 years ago. Sea level is estimated to have risen approximately 400 feet or more along the East Coast, drowning the canyons and plain now within the area now known as the continental shelf. Climate change is forecast to accelerate the rate of sea level rise when compared to the rates that occurred over the last several hundred years. How those rates compare to older rates in antiquity is not well understood. However, the species currently using the habitats now available have hand to adjust to changes of habitat locations that have occurred historically due to natural climate change.

8.3 Potential beneficial effects

Construction of the port is likely to have beneficial effects, both direct and indirect, to the commercial and recreational fisheries populations. Removal of contaminated sediment and the creation of a cleaner and deeper bottom is likely to allow for a healthier, more diverse benthic community to establish. The potential installation of shoaling fans to manage sedimentation within the berth area is intended to reduce the frequency of maintenance dredging. The reduction in disturbance frequency may promote colonization of beneficial benthic organisms in the newly exposed and cleaner river bottom in place of the pollution tolerant and invasive species currently found at the project site.

The concentrations of PAHs, PCBs, dioxins, furans, and chlorinated pesticides in stratum A and concentrations of metals in strata A and B are elevated above the ecological screening levels and/or acute standards for aquatic life in freshwater environments. The removal of these sediments likely will be beneficial to the aquatic environment of the Delaware River as many of these substances tend to bioaccumulate in aquatic organisms and biomagnify within the food chain. The removal of sediment from the project area may aid in bringing the sediment and water quality of the River closer to the long term goal of producing fish suitable for human consumption.

Fewer substances of potential concern to the environment and aquatic life will be present in the aquatic environment after dredging. The more limited presence of substances of potential concern, specifically organic compounds and chlorinated organic compounds (i.e., polychlorinated biphenyls, dioxins, and furans), will also reduce potential bio magnification of such substances in the aquatic food chain. For instance, the project is expected to remove approximately 2.7 tons of sediment containing PCBs from the local aquatic environment during the initial dredging. By removing the sediment and placing the material in the WHS CDF or an area to be reused, the material will be sequestered and aquatic life will no longer be exposed to them.

9 SUMMARY OF FINDINGS

Based on the current and ongoing fisheries surveys identified and summarized, there is a large amount of existing population/abundance data that has been collected within the proposed project footprint as well as areas adjacent to the proposed project. The surveys provide stock assessment data and status indicators that are used to monitor population trends for a wide variety of finfish and shellfish species in the Delaware estuary, including species of concern such as striped bass and river herring. Many of the surveys have been conducted annually for many years (and continue to be), allowing researchers to not only be aware of population fluctuations, but also predict future fishery management needs.

Based on the absence of resources suitable for fish spawning, breeding, feeding and growth within the dredging and construction areas, no habitat of value was identified within the affected environments. Therefore, no habitat of value is present. Additionally, no SAV or wetlands are present. While some benthic organisms were identified within the affected environments, they do not represent a diverse assemblage, are primarily low value (i.e., organisms that can survive in environments with reduced water/sediment quality) and can be found in adjacent areas of the river. Further, no difference between shallow and deep water with respect to benthic resources was identified.

None of the species identified during the survey are Federally-managed species and do not have designated EFH mapped within the vicinity of the proposed project. Most of the species for which EFH has been mapped at the proposed project area are intolerant of the low/oligohaline salinities at the site of the proposed project. Further, the affected environments are within the ETM transition zone of the estuary and the potential increases in turbidity associated with construction activities are unlikely to adversely affect fish species that are adapted to the prevailing turbid conditions.

In order to avoid impacts from dredging and pile driving, these activities are anticipated to occur during the fall and winter months (i.e., outside the migratory fish spawning window which is typically March 1st – July 15th) when the majority of spawning population of key species, which are anadromous, are no longer present within the area. Further, pile installation is anticipated to include soft start and vibratory methods to reduce noise. The project does not include the construction and/or installation of waterway obstructions that would impede passage to natal waters and/or spawning grounds.

10 REFERENCES

AECOM et al., 2016, Diamond State Port Corporation Strategic Master Plan.

Bryant, J.T., and M.D. Moseley. 2007. A potential alternative to maintenance dredging. *In*: Ports 2007. Proceedings of the 11th triennial international conference. San Diego, CA March 25-27, 2007. American Society of Civil Engineers. http://www.sedcontech.com/pdf/technicalarticle.pdf

Cronin, L. E., F. C. Daiber, and E. M. Hulbert. 1962. Quantitative seasonal aspects of zooplankton in the Delaware River estuary. Chesapeake Science 3:63-93.

Dauvin, Jean-Claude, H. Andrade, J.A. De-La-Ossa-Carretero, Y. Del-Pilar-Ruso, R. Riera. Polychaete/amphipod ratios: An approach to validating simple benthic indicators. Ecological Indicators, Elsevier, 2016, 63, pp. 89-99.

Duffield Associates, Inc. 2014, redacted. Entrainment Impact Assessment – Proposed Sedcon Turbo System Installation. Wilmington, Delaware.

Duffield Associates, Inc. 2019. Sediment and Surface Water Quality Assessment – Proposed Berth and Approach Channel. Edgemoor, Delaware.

Duffield Associates, Inc. 2018. Wetland Delineation Report. Prepared for Diamond State Port Corporation, 4600 Hay Road, Wilmington, Delaware.

Montagna, P.A., and Palmer, T. 2014. Minimum Flow and Level Analysis of Benthic Macrofauna in the Caloosahatchee Estuary. Draft Final Report to the South Florida Water Management District. Harte Research Institute, Texas A&M University-Corpus Christi, Corpus Christi, TX, 119 pp.

Miller, C.C. 2018. Submerged Aquatic Vegetation Survey for the Edgemoor Site. Environmental Consulting Services, Inc., Middletown, DE.

Miller, C. C. 2018. Unpublished data. Prepared for Duffield Associates, Inc. Environmental Consulting Services, Inc., Middletown, DE.

Mott MacDonald, 2019. Hydrodynamic Analysis of Proposed Edgemoor Terminal.

New Jersey DEP (Department of Environmental Protection) – Division of Fish and Wildlife. Studying the Delaware River – 2018 Report. http://www.state.nj.us/dep/fgw/artdelstudy19.htm

NMFS (National Marine Fisheries Service). 2017. 82 FR (Final Rule) 39160, Designation of Critical Habitat for the Gulf of Maine, New York Bight, and Chesapeake Bay Distinct Population Segments of Atlantic sturgeon. Pages 39160-39274.

NOAA (National Oceanic and Atmospheric Administration). 2019. NOAA tides and currents, station data for Marcus Hook, PA (Station 8540433) https://tidesandcurrents.noaa.gov/stationhome.html?id=8540433.

Partnership for the Delaware Estuary website. http://delawareestuary.org.

SedCon Technologies, Inc. 2019. http://www.sedcontech.com.

Sommerfield, C. K., and J. A. Madsen. 2003. Sedimentological and geophysical survey of the upper Delaware estuary: Final report to the Delaware River Basin Commission. University of Delaware Sea Grant College Program, Newark, DE.

Sommerfield, C.K. 2007: Understanding Turbidity in the Delaware Estuary, 2007 Delaware Estuary Conference.

State of Delaware – DNREC (Department of Natural Resources and Environmental Control) Division of Fish and Wildlife. Delaware Fish Facts for the Recreational Angler. http://www.fishspecies.dnrec.delaware.gov.

State of Delaware – DNREC (Department of Natural Resources and Environmental Control) Division of Fish and Wildlife. 2015 Delaware Wildlife Action Plan. http://www.dnrec.delaware.gov/fw/dwap.

State of Delaware – DNREC (Department of Natural Resources and Environmental Control) Division of Fish and Wildlife. Environmental Review Letter. October 16, 2019.

United States Environmental Protection Agency (USEPA). National Aquatic Resource Surveys. Indicators: Benthic Macroinvertebrates. www.epa.gov.

United States Environmental Protection Agency (USEPA). 2006. Voluntary Estuary Monitoring Manual Chapter 18: Submerged Aquatic Vegetation. A Methods Manual, Second Edition, EPA-842-B-06-003.

United States Fish and Wildlife Service (USFWS). Official Species List – Information for Planning and Consultation (IPaC) Certification Letter. November 5, 2019.

United States Geologic Survey (USGS). Dissolved Oxygen Solubility Tables. www.water.usgs.gov/software/DOTABLES/.

Uwadiae, R.E. 2009. Response of Benthic Macroinvertebrate Community to Salinity Gradient in a Sandwiched Coastal Lagoon. Benthic Ecology Unity, Department of Marine Sciences, University of Lagos.

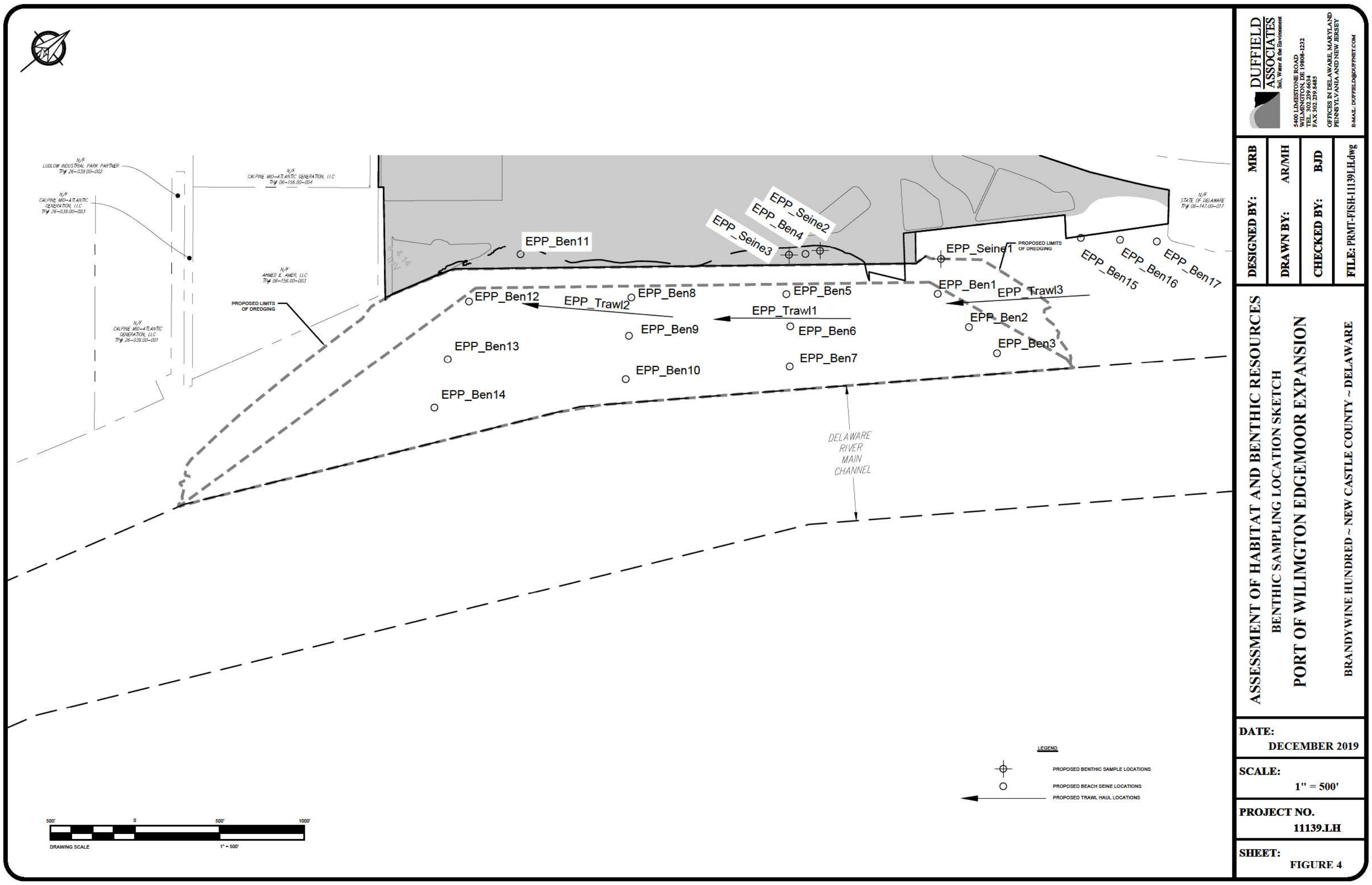
Wilson, B.D., and D.B. Carter. 2008. Delaware benthic mapping project: addressing the forgotten resource in coastal management. Abstract, *In*: Proceedings of the 2007 Delaware Estuary Science Conference & Environmental Summit. Partnership for the Delaware Estuary Report No. 08-02.

FIGURES


LEGEND
EDGEMOOR SITE BOUNDARY
PROPOSED PROJECT LOCATION BOUNDARY
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: RLH
DRAWN BY: KLS
CHECKED BY: RLH
FILE: FISH-11139LH.dwg
ASSESSMENT OF HABITAT AND BENTHIC RESOURCES
EDGEMOOR SITE AND PROPOSED PROJECT LOCATION
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: DECEMBER 2019
SCALE: 1'=600'
PROJECT NO. 11139.LH
SHEET: FIGURE 1


CHRISTINA RIVER
BERTH 7
BERTH 6
BERTH 5
BERTH 4
BERTH 3
BERTH 2
BERTH 1
PORT OF WILMINGTON
EDGEMOOR SITE AND PROPOSED PROJECT LOCATED UPRIVER
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: RLH
DRAWN BY: JLF
CHECKED BY: RLH
FILE: 11139LH.EFH.dwg
ASSESSMENT OF HABITAT AND BENTHIC RESOURCES
PORT OF WILMINGTON SITE SKETCH
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWIN HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: 18 DECEMBER 2019
SCALE: 1"=500'
PROJECT NO. 11139.LH
SHEET: FIGURE 2

LEGEND
DREDGE AREA
CONSTRUCTION AREA
PROPOSED WHARF
© 2019 Microsoft Corporation © 2019 DigitalGlobe ©CNES (2019) Distribution Airbus DS
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: RLH
DRAWN BY: KLS
CHECKED BY: RLH
FILE: FISH-11139LH.dwg
ASSESSMENT OF HABITAT AND BENTHIC RESOURCES
AFFECTED ENVIRONMENTS LOCATION SKETCH
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: DECEMBER 2019
SCALE: 1'=600'
PROJECT NO. 11139.LH
SHEET: FIGURE 3



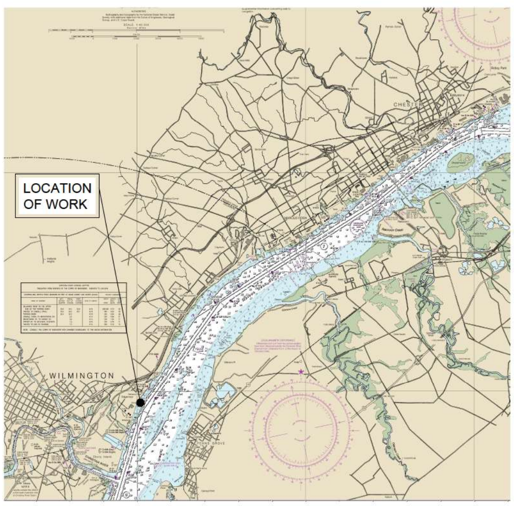
EPP_Ben11
EPP_Seine2
EPP_Ben4
EPP_Seine3
EPP_Seine1
PROPOSED LIMITS OF DREDGING
EPP_Ben15
EPP_Ben16
EPP_Ben17
EPP_Ben12
EPP_Trawl2
EPP_Ben8
EPP_Ben5
EPP_Ben1
EPP_Trawl3
EPP_Trawl1
EPP_Ben2
EPP_Ben9
EPP_Ben6
EPP_Ben3
EPP_Ben13
EPP_Ben7
EPP_Ben10
EPP_Ben14
DELAWARE RIVER MAIN CHANNEL
LEGEND
PROPOSED BENTHIC SAMPLE LOCATIONS
PROPOSED BEACH SEINE LOCATIONS
PROPOSED TRAWL HAUL LOCATIONS
DRAWING SCALE
1" = 500'
DUFFIELD ASSOCIATES
DESIGNED BY: MRB
DRAWN BY: AR/MH
CHECKED BY: BJD
ASSESSMENT OF HABITAT AND BENTHIC RESOURCES
BENTHIC SAMPLING LOCATION SKETCH
PORT OF WILIMGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: DECEMBER 2019
SCALE: 1" = 500'
PROJECT NO. 11139.LH
SHEET: FIGURE 4

APPENDIX 1

RELEVANT PERMIT PLAN SHEETS

PORT OF WILMINGTON EDGEMOOR EXPANSION
PERMIT PLANS

BRANDYWINE HUNDRED, NEW CASTLE COUNTY, DELAWARE



LOCATION MAP

SCALE: 1" = 8,000'

8,000' 0 8,000' 16,000'

SCALE IN FEET 1" = 8,000'

PURPOSE:

THE PURPOSE OF THESE PLANS IS TO PROVIDE PLANS AND DETAILS FOR THE PERMITTING OF A NEW HARBOR AND DOCK STRUCTURE AT THE PORT OF WILMINGTON EDGEMOOR FACILITY IN NEW CASTLE COUNTY, DELAWARE. THESE DRAWINGS ARE FOR PERMITTING PURPOSES ONLY ARE NOT FOR BIDDING.

SITE DATA:

1. TAX PARCEL NO.: 06-153.00-006
2. SITE ADDRESS: 4600 HAY ROAD, WILMINGTON, DE 19809
3. OWNER: DIAMOND STATE PORT CORPORATION, 1 HAUSEL ROAD, WILMINGTON, DE 19801
4. SOURCE OF TITLE: IN20170227-0010347
5. ZONING: HI - HEAVY INDUSTRIAL
6. PARCEL SITE ACREAGE: 113.29 ± AC
7. DATUM: HORIZONTAL: NAD 83 DE STATE PLANE GRID; VERTICAL: NAVD 1988
8. SURVEY: THE TOPOGRAPHIC SURVEY DEPICTED ON THIS PLAN WAS TAKEN FROM AN AERIAL SURVEY PREPARED BY COOPER AERIAL SURVEYS CO. DATED DECEMBER 23, 2018.

   BATHYMETRIC SOUNDING PERFORMED BY GAHAGAN & BRYANT ASSOCIATES IN JULY, 2018 WITH SINGLE BEAM AND MULTIBEAM SURVEY IN GENERAL ACCORDANCE WITH EM 1110-Z-1003.

   THE GROUND CONTROL POINTS UTILIZED BY COOPER AERIAL SURVEYS CO. FOR THE AERIAL SURVEY WERE SET IN THE FIELD BY VANDEMARK & LYNCH, INC. DATED DECEMBER 12-14, 2018.

INDEX OF SHEETS:

QUANTITY NOTES:

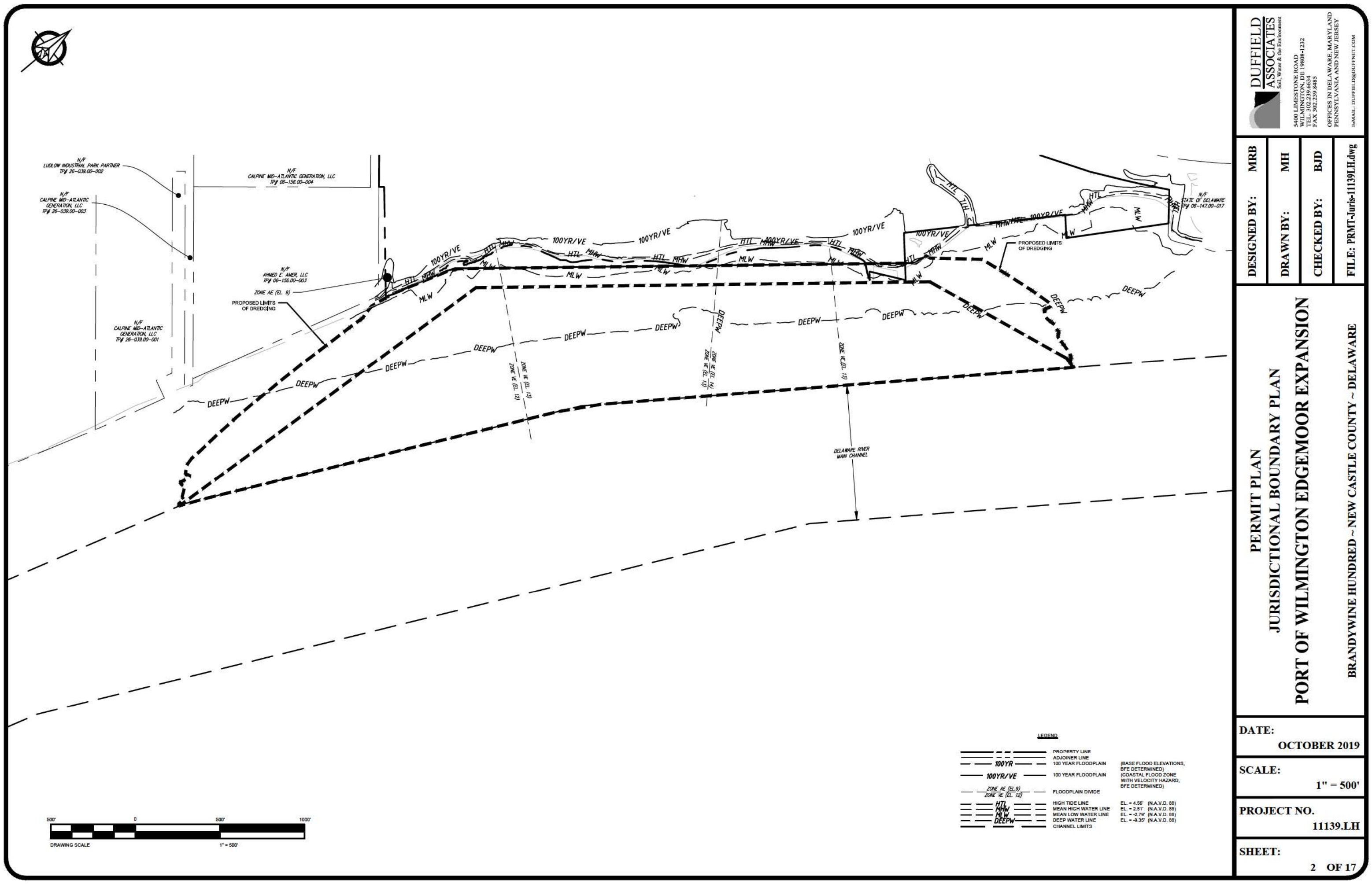
1. AREA OF DREDGE: 86.9 ACRES
2. AREA OF DREDGE TO 48': 64.5 ACRES
3. AREA OF SUBAQUEOUS FILL: 5.5 ACRES
4. VOLUME OF DREDGE: 3,325,000 CUBIC YARDS
5. VOLUME OF SUBAQUEOUS FILL: 20,107 CUBIC YARDS
6. VOLUME OF FLOODPLAIN FILL: 145,893 CUBIC YARDS
7. AREA OF WETLAND IMPACT: 0.0 ACRES
8. AREA OF SHALLOW WATER IMPACT: 35.3 ACRES
9. NUMBER OF PILES: 8,860
10. VOLUME OF PILE FILL: 3,600 CUBIC YARDS
11. "SHADED" FOOTPRINT AREA COVERED BY WHARF / FENDERS: 32,900 SQUARE FEET

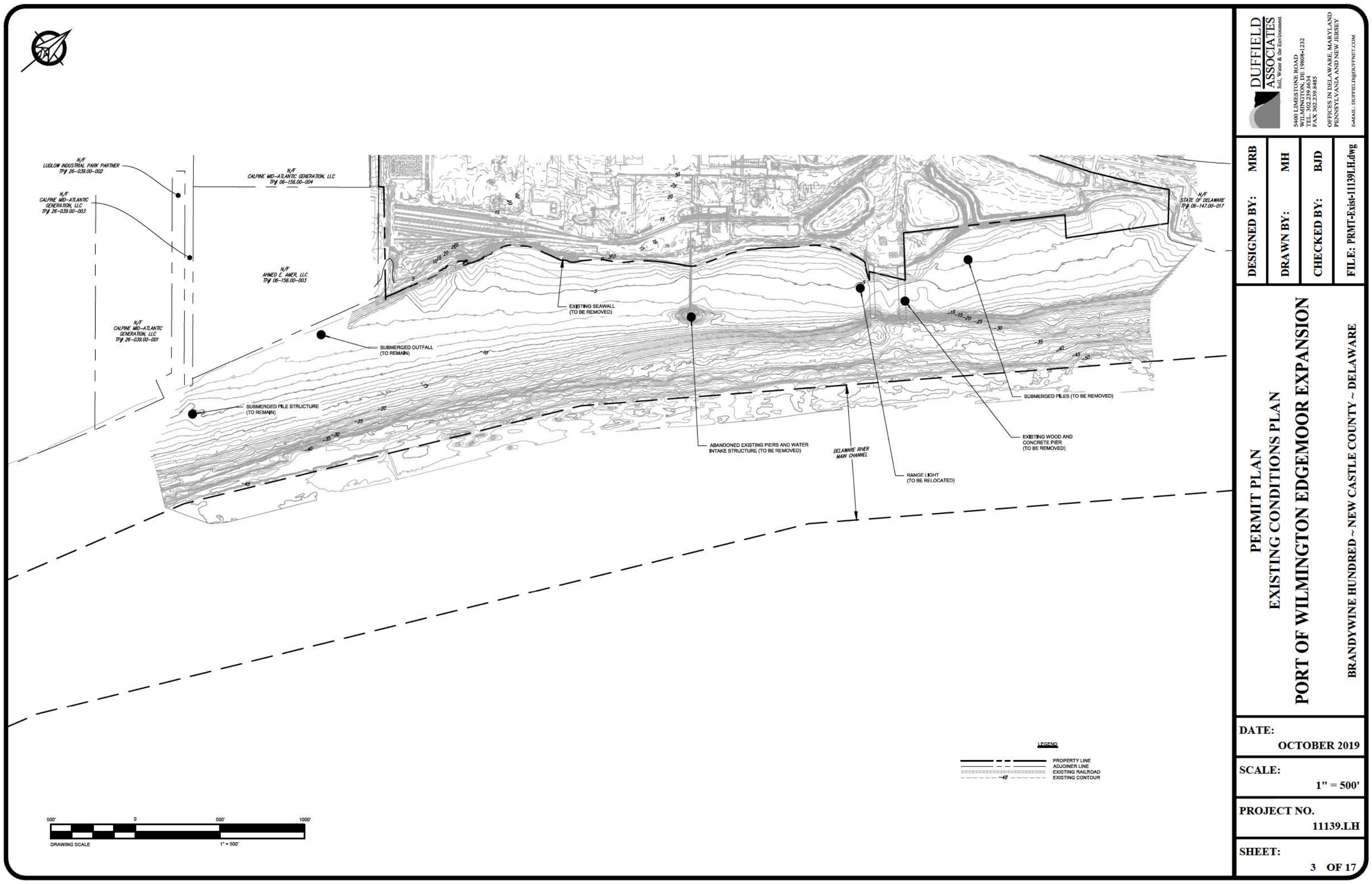
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM

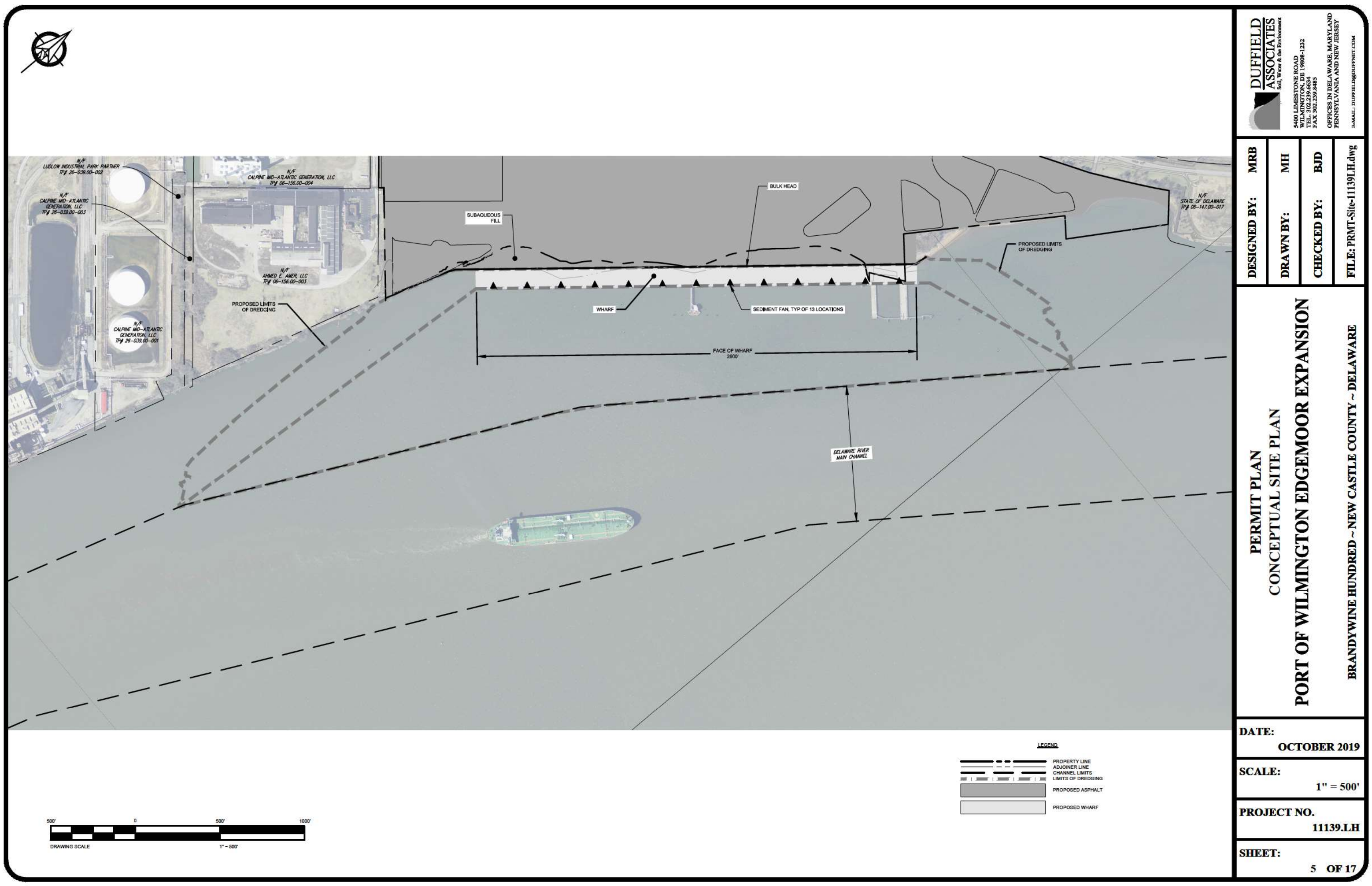
DESIGNED BY: MRB
DRAWN BY: AR
CHECKED BY: BJD
FILE: PRMT-Index-11139LH.dwg

PERMIT PLAN
COVER SHEET
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE

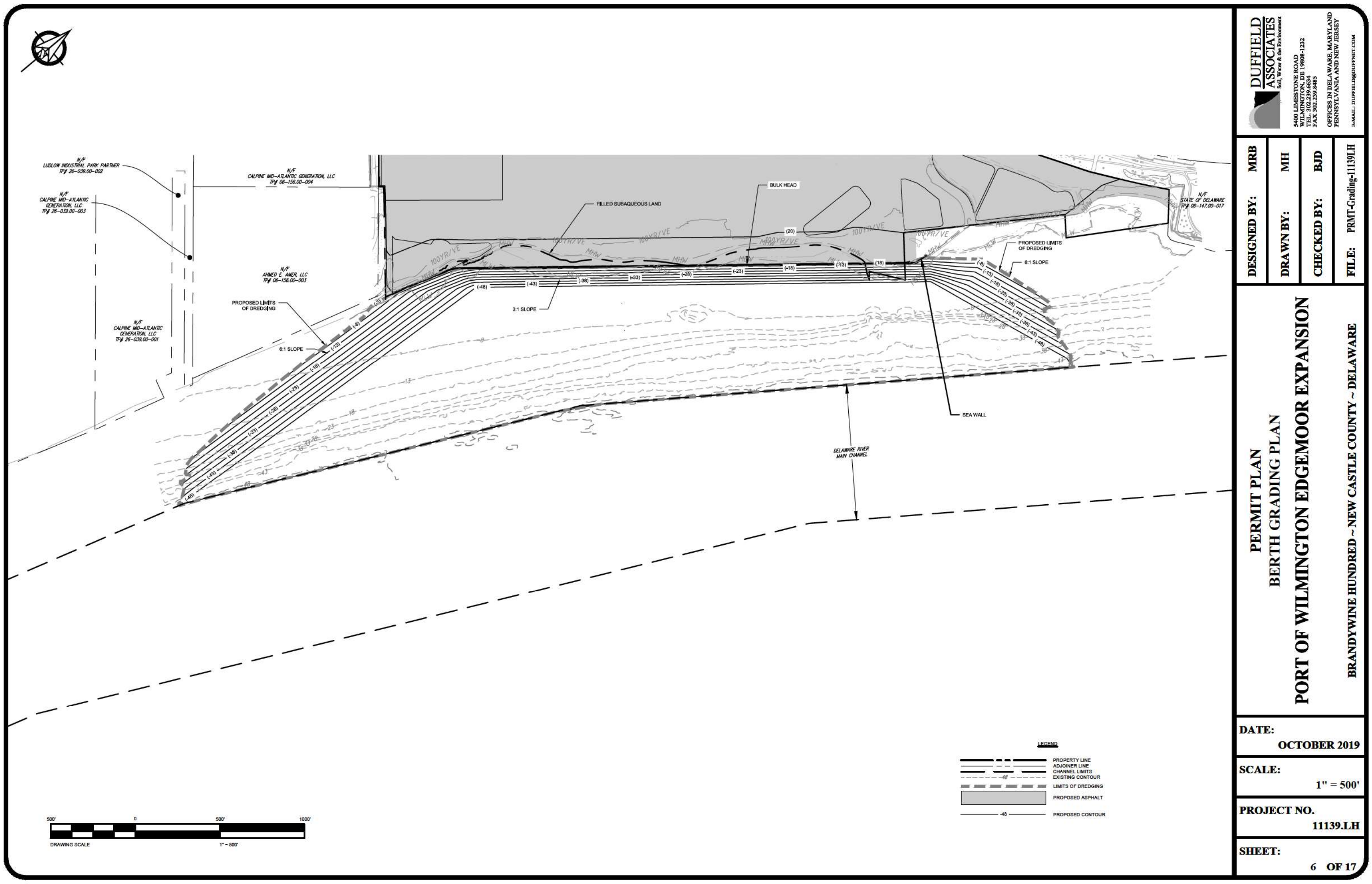
DATE: OCTOBER 2019
SCALE: 1" = 8,000'
PROJECT NO. 11139.LH
SHEET: 1 OF 17

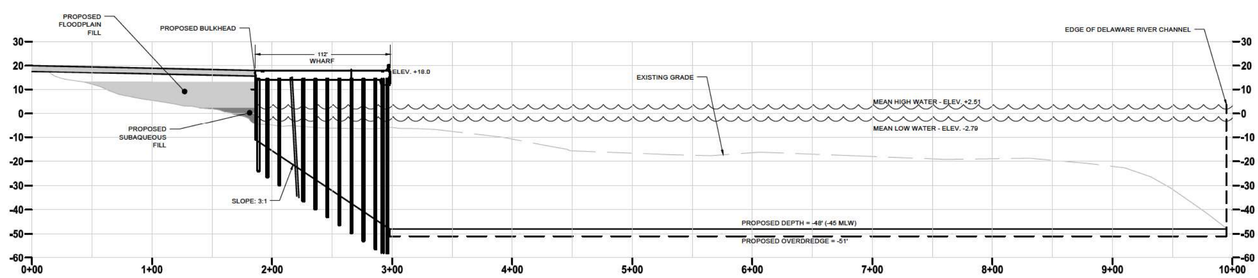

N/F
LUDLOW INDUSTRIAL PARK PARTNER
TP# 26-039.00-002
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 06-156.00-004
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 26-039.00-003
N/F
AHMED E. AMER, LLC
TP# 06-156.00-003
ZONE AE (EL 9)
PROPOSED LIMITS OF DREDGING
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 26-039.00-001
N/F
STATE OF DELAWARE
TP# 06-147.00-017
PROPOSED LIMITS OF DREDGING
100YR/VE
HTL
MHW
MLW
DEEPW
DELAWARE RIVER MAIN CHANNEL
LEGEND
PROPERTY LINE
ADJOINER LINE
100 YEAR FLOODPLAIN (BASE FLOOD ELEVATIONS, BFE DETERMINED)
100 YEAR FLOODPLAIN (COASTAL FLOOD ZONE WITH VELOCITY HAZARD, BFE DETERMINED)
FLOODPLAIN DIVIDE
HIGH TIDE LINE EL. = 4.56' (N.A.V.D. 88)
MEAN HIGH WATER LINE EL. = 2.51' (N.A.V.D. 88)
MEAN LOW WATER LINE EL. = -2.79' (N.A.V.D. 88)
DEEP WATER LINE EL. = -9.35' (N.A.V.D. 88)
CHANNEL LIMITS
DRAWING SCALE 1" = 500'
DUFFIELD ASSOCIATES
DESIGNED BY: MRB
DRAWN BY: MH
CHECKED BY: BJD
FILE: PRMT-Juris-11139LH.dwg
PERMIT PLAN
JURISDICTIONAL BOUNDARY PLAN
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: OCTOBER 2019
SCALE: 1" = 500'
PROJECT NO. 11139.LH
SHEET: 2 OF 17


N/F
LUDLOW INDUSTRIAL PARK PARTNER
TP# 26-039.00-002
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 26-039.00-003
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 06-156.00-004
N/F
AHMED E. AMER, LLC
TP# 06-156.00-003
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 26-039.00-001
N/F
STATE OF DELAWARE
TP# 06-147.00-017
EXISTING SEAWALL
(TO BE REMOVED)
SUBMERGED OUTFALL
(TO REMAIN)
SUBMERGED PILE STRUCTURE
(TO REMAIN)
SUBMERGED PILES (TO BE REMOVED)
EXISTING WOOD AND
CONCRETE PIER
(TO BE REMOVED)
ABANDONED EXISTING PIERS AND WATER
INTAKE STRUCTURE (TO BE REMOVED)
DELAWARE RIVER
MAIN CHANNEL
RANGE LIGHT
(TO BE RELOCATED)
LEGEND
PROPERTY LINE
ADJOINER LINE
EXISTING RAILROAD
EXISTING CONTOUR
500'
0
500'
1000'
DRAWING SCALE
1" = 500'
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: MRB
DRAWN BY: MH
CHECKED BY: BJD
FILE: PRMT-Exist-11139LH.dwg
PERMIT PLAN
EXISTING CONDITIONS PLAN
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE:
OCTOBER 2019
SCALE:
1" = 500'
PROJECT NO.
11139.LH
SHEET:
3 OF 17



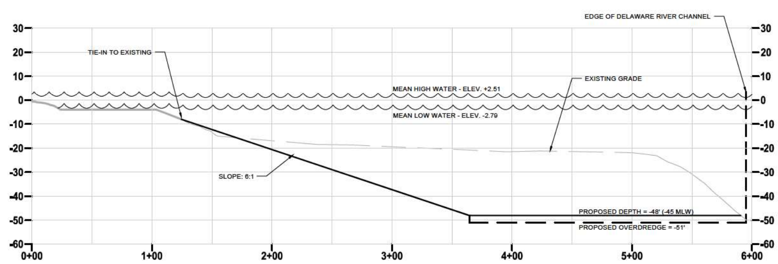
N/F
LUDLOW INDUSTRIAL PARK PARTNER
TP# 26-039.00-002
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 06-156.00-004
N/F
CALPINE MID-ATLANTIC
GENERATION, LLC
TP# 26-039.00-003
N/F
AHMED E. AMER, LLC
TP# 06-156.00-003
N/F
CALPINE MID-ATLANTIC
GENERATION, LLC
TP# 26-039.00-001
PROPOSED LIMITS
OF DREDGING
SUBAQUEOUS
FILL
BULK HEAD
WHARF
SEDIMENT FAN, TYP OF 13 LOCATIONS
FACE OF WHARF
2600'
PROPOSED LIMITS
OF DREDGING
N/F
STATE OF DELAWARE
TP# 06-147.00-017
DELAWARE RIVER
MAIN CHANNEL
LEGEND
PROPERTY LINE
ADJOINER LINE
CHANNEL LIMITS
LIMITS OF DREDGING
PROPOSED ASPHALT
PROPOSED WHARF
500' 0 500' 1000'
DRAWING SCALE 1" = 500'
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: MRB
DRAWN BY: MH
CHECKED BY: BJD
FILE: PRMT-Site-11139LH.dwg
PERMIT PLAN
CONCEPTUAL SITE PLAN
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: OCTOBER 2019
SCALE: 1" = 500'
PROJECT NO. 11139.LH
SHEET: 5 OF 17


N/F
LUDLOW INDUSTRIAL PARK PARTNER
TP# 26-039.00-002
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 06-156.00-004
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 26-039.00-003
N/F
CALPINE MID-ATLANTIC GENERATION, LLC
TP# 26-039.00-001
N/F
AHMED E. AMER, LLC
TP# 06-156.00-003
FILLED SUBAQUEOUS LAND
BULK HEAD
PROPOSED LIMITS OF DREDGING
3:1 SLOPE
6:1 SLOPE
SEA WALL
DELAWARE RIVER MAIN CHANNEL
N/F
STATE OF DELAWARE
TP# 06-147.00-017
LEGEND
PROPERTY LINE
ADJOINER LINE
CHANNEL LIMITS
EXISTING CONTOUR
LIMITS OF DREDGING
PROPOSED ASPHALT
PROPOSED CONTOUR
500' 0 500' 1000'
DRAWING SCALE
1" = 500'
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: MRB
DRAWN BY: MH
CHECKED BY: BJD
FILE: PRMT-Grading-11139LH
PERMIT PLAN
BERTH GRADING PLAN
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: OCTOBER 2019
SCALE: 1" = 500'
PROJECT NO. 11139.LH
SHEET: 6 OF 17



SECTION WHARF

SCALE: HORIZONTAL: 1" = 80'
VERTICAL: 1" = 40'



SECTION AT TIE-IN TO EXISTING SUBAQUEOUS SLOPE

SCALE: HORIZONTAL: 1" = 80'
VERTICAL: 1" = 40'

DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM

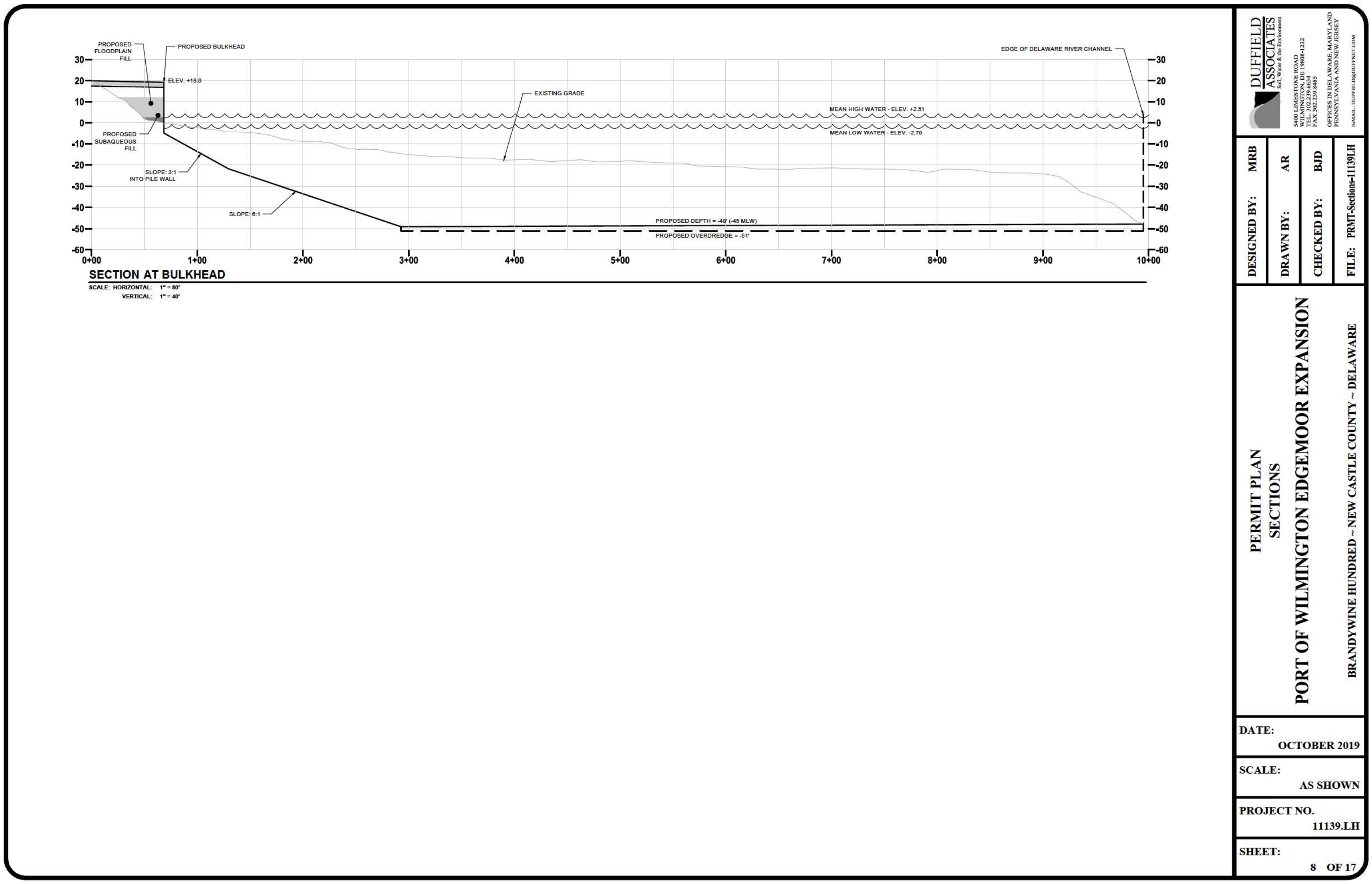
DESIGNED BY: MRB
DRAWN BY: AR
CHECKED BY: BJD
FILE: PRMT-Sections-11139LH

PERMIT PLAN
SECTIONS

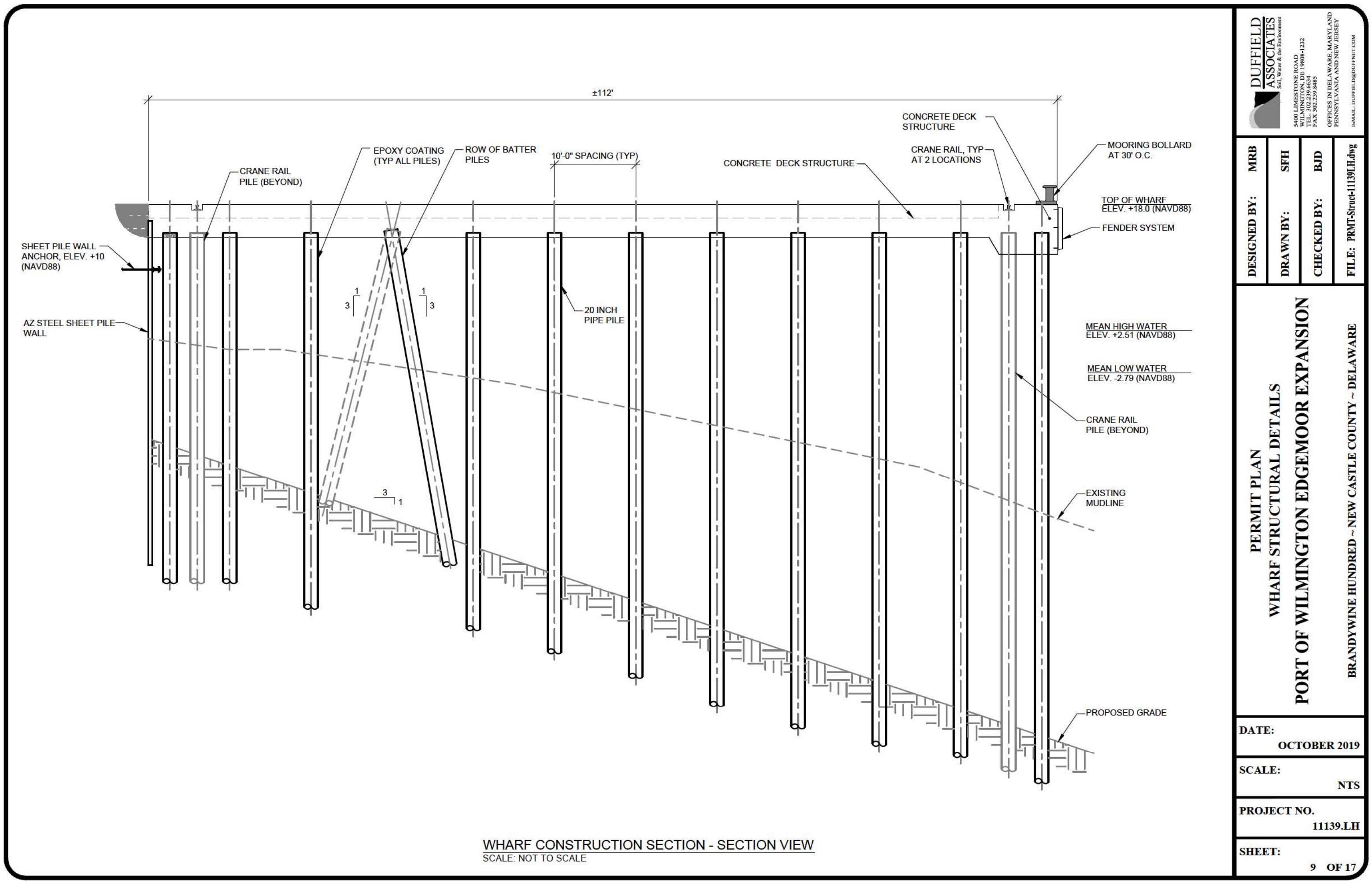
PORT OF WILMINGTON EDGEMOOR EXPANSION

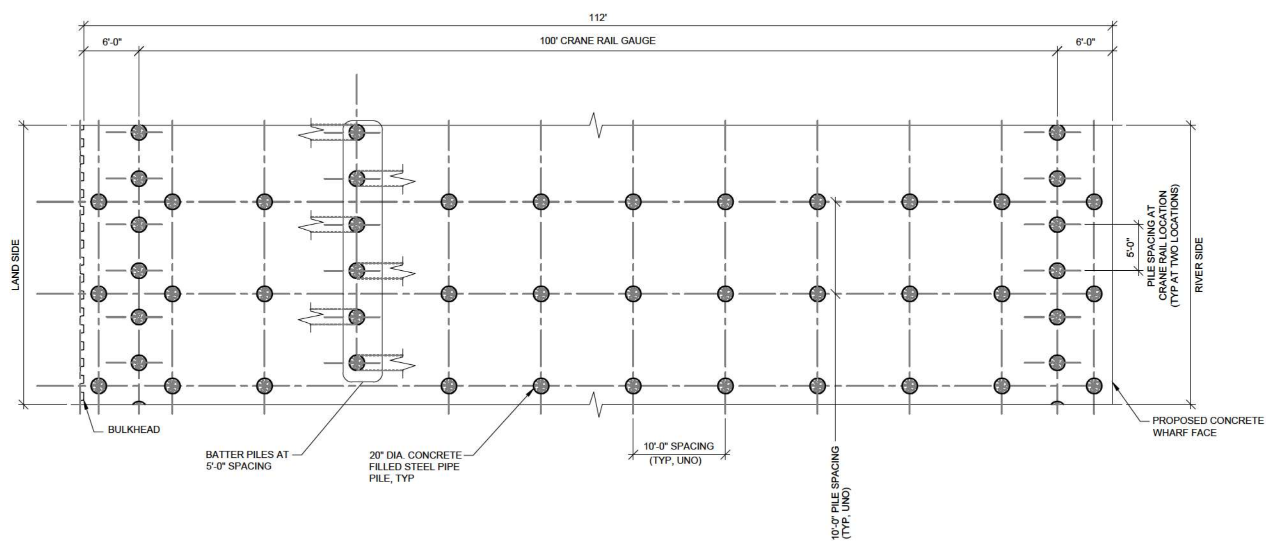
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE

DATE: OCTOBER 2019
SCALE: AS SHOWN
PROJECT NO. 11139.LH
SHEET: 7 OF 17



PROPOSED FLOODPLAIN FILL
PROPOSED BULKHEAD
ELEV. +18.0
EXISTING GRADE
EDGE OF DELAWARE RIVER CHANNEL
MEAN HIGH WATER - ELEV. +2.51
MEAN LOW WATER - ELEV. -2.79
PROPOSED SUBAQUEOUS FILL
SLOPE: 3:1 INTO PILE WALL
SLOPE: 6:1
PROPOSED DEPTH = -48' (-45 MLW)
PROPOSED OVERDREDGE = -51'
30
20
10
0
-10
-20
-30
-40
-50
-60
0+00
1+00
2+00
3+00
4+00
5+00
6+00
7+00
8+00
9+00
10+00
SECTION AT BULKHEAD
SCALE: HORIZONTAL: 1" = 80'
VERTICAL: 1" = 40'
DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM
DESIGNED BY: MRB
DRAWN BY: AR
CHECKED BY: BJD
FILE: PRMT-Sections-11139LH
PERMIT PLAN
SECTIONS
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: OCTOBER 2019
SCALE: AS SHOWN
PROJECT NO. 11139.LH
SHEET: 8 OF 17


±112'
CONCRETE DECK STRUCTURE
MOORING BOLLARD AT 30' O.C.
CRANE RAIL, TYP AT 2 LOCATIONS
EPOXY COATING (TYP ALL PILES)
ROW OF BATTER PILES
10'-0" SPACING (TYP)
CONCRETE DECK STRUCTURE
CRANE RAIL PILE (BEYOND)
TOP OF WHARF ELEV. +18.0 (NAVD88)
FENDER SYSTEM
SHEET PILE WALL ANCHOR, ELEV. +10 (NAVD88)
AZ STEEL SHEET PILE WALL
20 INCH PIPE PILE
MEAN HIGH WATER ELEV. +2.51 (NAVD88)
MEAN LOW WATER ELEV. -2.79 (NAVD88)
CRANE RAIL PILE (BEYOND)
EXISTING MUDLINE
PROPOSED GRADE
WHARF CONSTRUCTION SECTION - SECTION VIEW
SCALE: NOT TO SCALE
DUFFIELD ASSOCIATES
DESIGNED BY: MRB
DRAWN BY: SFH
CHECKED BY: BJD
PERMIT PLAN
WHARF STRUCTURAL DETAILS
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE
DATE: OCTOBER 2019
SCALE: NTS
PROJECT NO. 11139.LH
SHEET: 9 OF 17



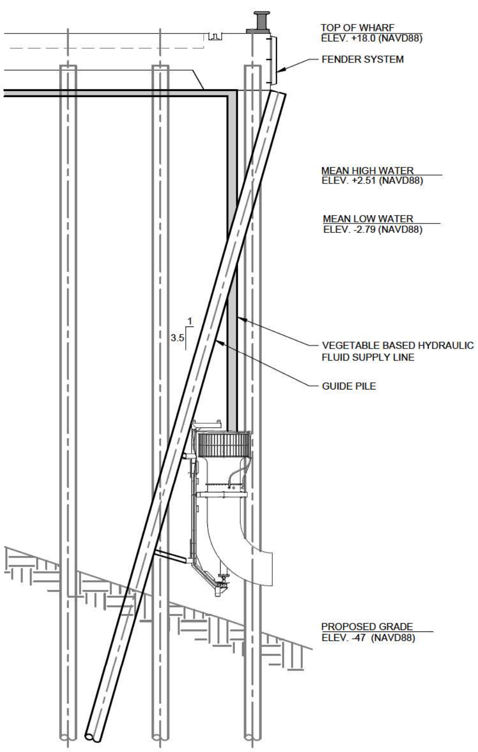
WHARF CONSTRUCTION SECTION - PLAN VIEW
SCALE: NOT TO SCALE

DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND PENNSYLVANIA AND NEW JERSEY
E-MAIL: DUFFIELD@DUFFNET.COM

DESIGNED BY: MRB
DRAWN BY: SFH
CHECKED BY: BJD
FILE: PRMT-Struct-11139LH.dwg

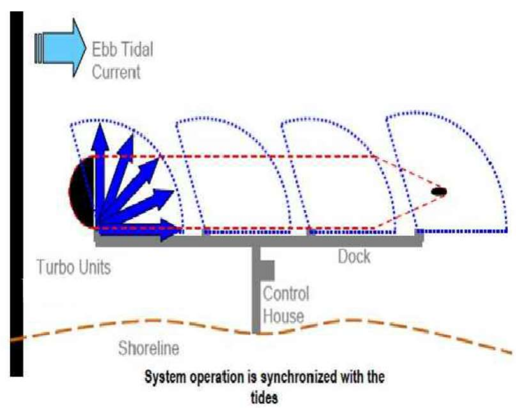
PERMIT PLAN
WHARF STRUCTURAL DETAILS
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE

DATE: OCTOBER 2019
SCALE: NTS
PROJECT NO. 11139.LH
SHEET: 10 OF 17



SEDCON SHOALING FAN CONFIGURATION - SECTION VIEW
SCALE: NOT TO SCALE

SEDCON SHOALING FAN - CONCEPTUAL IMAGE
SCALE: NOT TO SCALE



SEDCON SHOALING FAN - CONCEPTUAL IMAGE
SCALE: NOT TO SCALE

DUFFIELD ASSOCIATES
Soil, Water & the Environment
5400 LIMESTONE ROAD
WILMINGTON, DE 19808-1232
TEL. 302.239.6634
FAX 302.239.8485
OFFICES IN DELAWARE, MARYLAND
PENNSYLVANIA AND NEW JERSEY
EMAIL: DUFFIELD@DUFFNET.COM

DESIGNED BY: MRB
DRAWN BY: SFH
CHECKED BY: BJD
FILE: PRMT-Struct-11139LH.dwg

PERMIT PLAN
SEDIMENT FAN DETAILS
PORT OF WILMINGTON EDGEMOOR EXPANSION
BRANDYWINE HUNDRED ~ NEW CASTLE COUNTY ~ DELAWARE

DATE: OCTOBER 2019
SCALE: NTS
PROJECT NO. 11139.LH
SHEET: 11 OF 17

APPENDIX 2

ECSI DATA

ENVIRONMENTAL CONSULTING SERVICES, INC.
BEACH SEINE
PRE-JOB SAFETY BRIEF

ECSI believes that our most valuable resource is our employees. To protect this resource and to foster a safety sensitive corporate culture, make the following safety highlights and their underlying details and procedures part of every working day. Crew Chief note site-specific cautions on the back.

1. WEAR all appropriate Personal Protective Equipment (PPE) as required by conditions and common sense judgment. WEAR gloves when operating winches, when playing-out/retrieving lines, and when handling potentially harmful fish species. Routinely inspect PPE for damage or wear, and replace ASAP. Remember to protect your eyes, ears, hands, feet and head as work conditions dictate.
2. WEAR Personal Floatation Device (PFD) at all times while aboard the R/V.
3. STAY dry and hydrated as cold and hot weather dictates; hypothermia and heat stroke can be DEADLY.
4. CLIMB in and out of the R/V with CARE. Always be sure of your footing before entering or exiting the R/V.
5. LIFT & PULL with care. Use the proper "working posture", using body weight and legs before back and arms. When pulling the seine aboard, position your body to directly face the gear, extend your arms in front of the body, bend your knees, and pull directly toward you.
6. MAINTAIN the deck as clear of debris as possible to prevent slipping hazards; in cold weather clear ice that may form.
7. CHECK R/V operating equipment periodically. REPORT any apparently abnormal operating conditions such as temperature, noises and/or smells to your supervisor so they can be evaluated and remedial actions taken.
8. NEVER HESITATE to report any safety concerns to your supervisor. Obviously if a circumstance has dire safety ramifications, call your supervisor immediately.

To monitor your regular review of the above safety highlights, you are required to initial and date where provided above, and attach this Pre-job Safety Brief to your field data sheets.

Sampling Date:
Crew Acknowledgement:
(initial after reading)

7/29/19 - LEC, BAW, AAB

(1)

ESD Observation Event ID:

DATA FORM
BAYWIDE FINFISH MONITORING FISH PROCESSING

Serial No. ______ Date: 7/29/19 Investigators: LEC, BMW, AAB Project: Baywide Beach Seine Site ______

GPS Group: ______ Survey Method: **Beach Seine** Gear: **100' Haul Seine** Tide Stage: F1 F2 FS (E1) E2 ES Other

Weather: (1) 2 3 4 5 6 7 8 9 Wind: N NE E SE (S) SW W NW Wave Height: (1) 2 3 4 5.

Start Time: 1207 End Time: 1209 Air Temp: 34.0 Surface Water Temp: 29.3 Mid- Water Temp: ___.___ Bot Water Temp: ___.___

Surface Sal: 0.1 Mid-Sal: ___.___ Bot Sal: ___.___ Surface DO: 7.2 Mid DO: ___.___ Bot DO: ___.___ DEPTH Min: ______ Max ______

Depth of Sample: Min: ______ Max: ______ Depth Strata: ______ Water Clarity: 33".

Start Lat: 39° 44.905" Start Long 075° 29.830 Stop Lat: ___° ___' ___" Stop Long: ___° ___' ___"

Start Flowmeter: ______ Stop Flowmeter: ______ Notes NO. 41

NON TARGET SPECIES	LIFE STAGE	TOTAL COUNTED	TOTAL WEIGHT	WEIGHT UNITS	TOTAL MEASURED	MEASUREMENT UNIT	MEASURE TECHNIQUE	MIN LENGTH	MAX LENGTH	NOTES
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			

Page 1 of 1 Proof 1 By: LEC Proof 2 By: ______ Input By: ______

Date: Time Location Note:

Species: M. americana				Species: M. saxatilis (STB)				Species				Species			
# Taken 6			F (circled)	# Taken 4 (circled)			F (circled)	#Taken			F	#Taken			F
# Measured 6			T	# Measured 4			T	#Measured			T	#Measured			T
1	95	51		1	42	51		1		51		1		51	
2	86	52		2	70	52		2		52		2		52	
3	89	53		3	75	53		3		53		3		53	
4	111	54		4	50	54		4		54		4		54	
5	101	55		5		55		5		55		5		55	
6	104	56		6		56		6		56		6		56	
7		57		7		57		7		57		7		57	
8		58		8		58		8		58		8		58	
9		59		9		59		9		59		9		59	
10		60		10		60		10		60		10		60	
11		61		11		61		11		61		11		61	
12		62		12		62		12		62		12		62	
13		63		13		63		13		63		13		63	
14		64		14		64		14		64		14		64	
15		65		15		65		15		65		15		65	
16		66		16		66		16		66		16		66	
17		67		17		67		17		67		17		67	
18		68		18		68		18		68		18		68	
19		69		19		69		19		69		19		69	
20		70		20		70		20		70		20		70	
21		71		21		71		21		71		21		71	
22		72		22		72		22		72		22		72	
23		73		23		73		23		73		23		73	
24		74		24		74		24		74		24		74	
25		75		25		75		25		75		25		75	
26		76		26		76		26		76		26		76	
27		77		27		77		27		77		27		77	
28		78		28		78		28		78		28		78	
29		79		29		79		29		79		29		79	
30		80		30		80		30		80		30		80	
31		81		31		81		31		81		31		81	
32		82		32		82		32		82		32		82	
33		83		33		83		33		83		33		83	
34		84		34		84		34		84		34		84	
35		85		35		85		35		85		35		85	
36		86		36		86		36		86		36		86	
37		87		37		87		37		87		37		87	
38		88		38		88		38		88		38		88	
39		89		39		89		39		89		39		89	
40		90		40		90		40		90		40		90	
41		91		41		91		41		91		41		91	
42		92		42		92		42		92		42		92	
43		93		43		93		43		93		43		93	
44		94		44		94		44		94		44		94	
45		95		45		95		45		95		45		95	
46		96		46		96		46		96		46		96	
47		97		47		97		47		97		47		97	
48		98		48		98		48		98		48		98	
49		99		49		99		49		99		49		99	
50		100		50		100		50		100		50		100	

(2)

ESD Observation Event ID:

DATA FORM
BAYWIDE FINFISH MONITORING FISH PROCESSING

Serial No. ________ Date: 7/29/19 Investigators: LEC, BMW, AAB Project: Baywide Beach Seine Site ________

GPS Group: ________ Survey Method: Beach Seine Gear: 100' Haul Seine Tide Stage: F1 F2 FS (E1) E2 ES Other

Weather: (1) 2 3 4 5 6 7 8 9 Wind: N NE E SE (S) SW W NW Wave Height: (1) 2 3 4 5.

Start Time: 1221 End Time: 1224 Air Temp: 37.0 Surface Water Temp: 30.3 Mid- Water Temp: ___.___ Bot Water Temp: ___.___

Surface Sal: 0.1 Mid-Sal: ___.___ Bot Sal: ___.___ Surface DO: 6.9 Mid DO: ___.___ Bot DO: ___.___ DEPTH Min: ______ Max ______.

Depth of Sample: Min: ______ Max: ______ Depth Strata: ______ Water Clarity: 40".

Start Lat: 39° 45.037" Start Long 075° 29.709" Stop Lat: ° ' " Stop Long: ° ' "

Start Flowmeter: ________ Stop Flowmeter: ________ Notes No-33

NON TARGET SPECIES	LIFE STAGE	TOTAL COUNTED	TOTAL WEIGHT	WEIGHT UNITS	TOTAL MEASURED	MEASUREMENT UNIT	MEASURE TECHNIQUE	MIN LENGTH	MAX LENGTH	NOTES
M. americana		1			1	(mm) m in ft	(F) T Other	150		
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			

Page 1 of 1 Proof 1 By: LEC Proof 2 By: ________ Input By: ________

Date:		Time		Location				Note:							
Species				Species				Species				Species			
# Taken			F	# Taken			F	#Taken			F	#Taken			F
# Measured			T	# Measured			T	#Measured			T	#Measured			T
1		51		1		51		1		51		1		51	
2		52		2		52		2		52		2		52	
3		53		3		53		3		53		3		53	
4		54		4		54		4		54		4		54	
5		55		5		55		5		55		5		55	
6		56		6		56		6		56		6		56	
7		57		7		57		7		57		7		57	
8		58		8		58		8		58		8		58	
9		59		9		59		9		59		9		59	
10		60		10		60		10		60		10		60	
11		61		11		61		11		61		11		61	
12		62		12		62		12		62		12		62	
13		63		13		63		13		63		13		63	
14		64		14		64		14		64		14		64	
15		65		15		65		15		65		15		65	
16		66		16		66		16		66		16		66	
17		67		17		67		17		67		17		67	
18		68		18		68		18		68		18		68	
19		69		19		69		19		69		19		69	
20		70		20		70		20		70		20		70	
21		71		21		71		21		71		21		71	
22		72		22		72		22		72		22		72	
23		73		23		73		23		73		23		73	
24		74		24		74		24		74		24		74	
25		75		25		75		25		75		25		75	
26		76		26		76		26		76		26		76	
27		77		27		77		27		77		27		77	
28		78		28		78		28		78		28		78	
29		79		29		79		29		79		29		79	
30		80		30		80		30		80		30		80	
31		81		31		81		31		81		31		81	
32		82		32		82		32		82		32		82	
33		83		33		83		33		83		33		83	
34		84		34		84		34		84		34		84	
35		85		35		85		35		85		35		85	
36		86		36		86		36		86		36		86	
37		87		37		87		37		87		37		87	
38		88		38		88		38		88		38		88	
39		89		39		89		39		89		39		89	
40		90		40		90		40		90		40		90	
41		91		41		91		41		91		41		91	
42		92		42		92		42		92		42		92	
43		93		43		93		43		93		43		93	
44		94		44		94		44		94		44		94	
45		95		45		95		45		95		45		95	
46		96		46		96		46		96		46		96	
47		97		47		97		47		97		47		97	
48		98		48		98		48		98		48		98	
49		99		49		99		49		99		49		99	
50		100		50		100		50		100		50		100	

(3)

ESD Observation Event ID:

DATA FORM
BAYWIDE FINFISH MONITORING FISH PROCESSING

Serial No. ______ Date: 7/29/19 Investigators: LEC, BMW, AMB Project: **Baywide Beach Seine** Site______

GPS Group: ______ Survey Method: **Beach Seine** Gear: **100' Haul Seine** Tide Stage: F1 F2 FS (E1) E2 ES Other

Weather: (1) 2 3 4 5 6 7 8 9 Wind: N NE E SE (S) SW W NW Wave Height: (1) 2 3 4 5.

Start Time: 1243 End Time: 1247 Air Temp: 35.0 Surface Water Temp: 30.2 Mid- Water Temp: __.__ Bot Water Temp: __.__

Surface Sal: 0.1 Mid-Sal: __.__ Bot Sal: __.__ Surface DO: 6.8 Mid DO: __.__ Bot DO: __.__ DEPTH Min: ____ Max ____.

Depth of Sample: Min: ____ Max: ____ Depth Strata: ____ Water Clarity: 30".

~~Start Lat: 39°45.283" Start Long: 75°29.527 Stop Lat: ° ' " Stop Long: ° ' "~~

Start Flowmeter: ______ Stop Flowmeter: ______ Notes NO-34

NON TARGET SPECIES	LIFE STAGE	TOTAL COUNTED	TOTAL WEIGHT	WEIGHT UNITS	TOTAL MEASURED	MEASUREMENT UNIT	MEASURE TECHNIQUE	MIN LENGTH	MAX LENGTH	NOTES
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			
						mm m in ft	F T Other			

Page 1 of 1 Proof 1 By: LEC Proof 2 By: ______ Input By: ______

Date: Time Location Note:

Species: M. saxatilis (STB)

Taken: 2 (F circled) F / T

Measured: 2

#	Length	#	Length
1	43	51	
2	55	52	
3		53	
4		54	
5		55	
6		56	
7		57	
8		58	
9		59	
10		60	
11		61	
12		62	
13		63	
14		64	
15		65	
16		66	
17		67	
18		68	
19		69	
20		70	
21		71	
22		72	
23		73	
24		74	
25		75	
26		76	
27		77	
28		78	
29		79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	

Species: M americana

Taken: 3 (F circled) F / T

Measured: 3

#	Length	#	Length
1	39	51	
2	42	52	
3	37	53	
4		54	
5		55	
6		56	
7		57	
8		58	
9		59	
10		60	
11		61	
12		62	
13		63	
14		64	
15		65	
16		66	
17		67	
18		68	
19		69	
20		70	
21		71	
22		72	
23		73	
24		74	
25		75	
26		76	
27		77	
28		78	
29		79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	

Species: A mitchilli +1

#Taken: 35 (F circled) F / T

#Measured: 34

#	Length	#	Length
1	26	51	
2	22	52	
3	32	53	
4	26	54	
5	23	55	
6	27	56	
7	32	57	
8	27	58	
9	22	59	
10	21	60	
11	22	61	
12	25	62	
13	22	63	
14	27	64	
15	23	65	
16	25	66	
17	21	67	
18	27	68	
19	20	69	
20	22	70	
21	30	71	
22	33	72	
23	20	73	
24	27	74	
25	22	75	
26	30	76	
27	19	77	
28	30	78	
29	18	79	
30	20	80	
31	22	81	
32	27	82	
33	21	83	
34	22	84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	

Species:

#Taken: F / T

#Measured:

#	Length	#	Length
1		51	
2		52	
3		53	
4		54	
5		55	
6		56	
7		57	
8		58	
9		59	
10		60	
11		61	
12		62	
13		63	
14		64	
15		65	
16		66	
17		67	
18		68	
19		69	
20		70	
21		71	
22		72	
23		73	
24		74	
25		75	
26		76	
27		77	
28		78	
29		79	
30		80	
31		81	
32		82	
33		83	
34		84	
35		85	
36		86	
37		87	
38		88	
39		89	
40		90	
41		91	
42		92	
43		93	
44		94	
45		95	
46		96	
47		97	
48		98	
49		99	
50		100	

Benthos Sampling Results
Edgemoor Dredging Site

	1B	2B	3B	4B	5B	6B	7B	8B	9B	10B	11B	12B	13B	14B	**21B**	**22B**	**23B**	**Total**
Oligochaeta	2	4			2	2	1	1					1					**13**
Isopoda																		
Cyathauridae		11	1			1	5		1	9			13	6				**47**
Amphipoda																		
Gammaridae		5	128			4	227	2		5			6	22		**2**		**401**
Corophiidae		2					3			2				1				**8**
Diptera																		
Charonomidae	2					5	1			11	1	1	48	9				**78**
Bivalvia																		
Corbiculidae		8				1	3											**12**
Polychaeta	3	24			2	2	11	17	6		9	2	6	9				**91**
Total	**7**	**54**	**129**	**0**	**4**	**15**	**251**	**20**	**7**	**27**	**10**	**3**	**74**	**47**	**0**	**2**	**0**	**650**

Note: Original sample IDs 21B, 22B and 23B correspond to samples EPP_Ben15, EPP_Ben16 and EPP_Ben17, respectively.

Beach Seine Results
Edgemoor Dredging Site

	1S	2S	3S
Anchoa mitchilli (Bay Anchovy)			34
Morone americana (White Perch)	6		3
Morone saxatilis (Striped Bass)	4	1	2
	10	1	39

Trawl Haul Results
Edgemoor Dredging Site

	Trawl #1	Trawl #2	Trawl #3
American Eel		1	
Bay Anchovy	20	25	34
Silver Perch		2	1
White Perch	66	11	18
Striped Bass	4		2
Weakfish	2		1
Atlantic Croaker	50	78	92
Channel Catfish	6	1	
Tessellated Darter	2		
Naked Goby			1
Hogchoker		1	2
Blue Crab	6	3	1
Grass Shrimp			14
Sand Shrimp	14	9	11

APPENDIX 3

ESSENTIAL FISH HABITAT MAPPER RESULTS

EFH Data Notice: Essential Fish Habitat (EFH) is defined by textual descriptions contained in the fishery management plans developed by the regional Fishery Management Councils. In most cases mapping data can not fully represent the complexity of the habitats that make up EFH. This report should be used for general interest queries only and should not be interpreted as a definitive evaluation of EFH at this location. A location-specific evaluation of EFH for any official purposes must be performed by a regional expert. Please refer to the following links for the appropriate regional resources.

Greater Atlantic Regional Office
Atlantic Highly Migratory Species Management Division

Query Results

Degrees, Minutes, Seconds: Latitude = 39º44'57" N, Longitude = 76º30'15" W
Decimal Degrees: Latitude = 39.75, Longitude = -75.50

The query location intersects with spatial data representing EFH and/or HAPCs for the following species/management units.

*** W A R N I N G ***

Please note under "Life Stage(s) Found at Location" the category "ALL" indicates that all life stages of that species share the same map and are designated at the queried location.

EFH

Show	Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
			Little Skate	Juvenile Adult	New England	Amendment 2 to the Northeast Skate Complex FMP
			Atlantic Herring	Juvenile Adult	New England	Amendment 3 to the Atlantic Herring FMP
			Red Hake	Adult	New England	Amendment 14 to the Northeast Multispecies FMP
			Windowpane Flounder	Adult Juvenile	New England	Amendment 14 to the Northeast Multispecies FMP
			Winter Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP

Show	Link	Data Caveats	Species/Management Unit	Lifestage(s) Found at Location	Management Council	FMP
			Clearnose Skate	Adult Juvenile	New England	Amendment 2 to the Northeast Skate Complex FMP
			Longfin Inshore Squid	Eggs	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
			Bluefish	Adult Juvenile	Mid-Atlantic	Bluefish
			Atlantic Butterfish	Larvae Adult Juvenile	Mid-Atlantic	Atlantic Mackerel, Squid,& Butterfish Amendment 11
			Scup	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
			Summer Flounder	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass
			Black Sea Bass	Juvenile Adult	Mid-Atlantic	Summer Flounder, Scup, Black Sea Bass

HAPCs

No Habitat Areas of Particular Concern (HAPC) were identified at the report location.

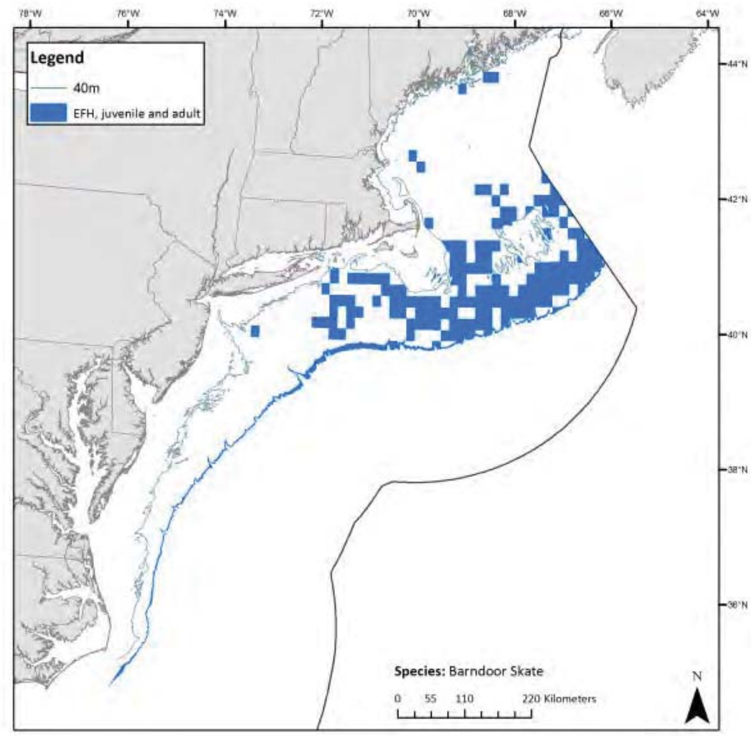
EFH Areas Protected from Fishing

No EFH Areas Protected from Fishing (EFHA) were identified at the report location.

Spatial data does not currently exist for all the managed species in this area. The following is a list of species or management units for which there is no spatial data. ****For links to all EFH text descriptions see the complete data inventory: open data inventory -->**
Mid-Atlantic Council HAPCs, No spatial data for summer flounder SAV HAPC.

LITTLE SKATE

Map 89 – Barndoor skate juvenile and adult EFH.



2.2.4.4 Little skate

The proposed EFH maps for juvenile and adult little skate are based on the distribution of depths and bottom temperatures that are associated with high catch rates of juveniles or adults in the 1963-2003 spring and fall NMFS trawl surveys. Depth and bottom temperature information from the EFH Source Document was used to supplement survey information as needed. The proposed new maps are also based on average catch per tow data for juveniles and adults, respectively, in ten minute squares of latitude and longitude in the 1968-2005 spring and fall NMFS trawl surveys at the 75th percentile of catch level, and they include inshore areas where juvenile or adult little skate were caught in 10% or more of tows made in individual ten minute squares during state trawl surveys and ELMR information. The ELMR information for the Mid-Atlantic area was re-interpreted to add EFH for juvenile little skate to five inshore areas south of Raritan Bay, including Delaware Bay, and to eliminate the no action designations for juveniles and adults in Chesapeake Bay (see Appendix A). Some of the estuaries and embayments north of Cape Cod that were not originally designated as EFH were also added to the new maps.[34] These juvenile and adult designations were referred to as 3C alternatives in the Phase 1 DEIS.

---

[34] For some reason, none of the original EFH designations for any of the skate species (NMFS 2002) included the ELMR areas north of Cape Cod, even though the abundance of "skates" (unidentified to species) were evaluated in the North and Mid-Atlantic regions (see Jury et al. 1994 and Stone et al. 1994). This was an oversight since four of the skate species managed by the New England Fishery Management Council – including little skate – are common in the Gulf of Maine (see Appendix A).

The proposed EFH map for juvenile little skate extends over most of the continental shelf from Delaware Bay to Georges Bank (to a maximum depth of 80 meters) and includes considerably more coastal waters in the Gulf of Maine than the original EFH map. The no action map – because it was based on 100% of the NMFS survey data – extends all the way to the shelf break. The no action and proposed new EFH maps for adult little skate are more similar than the juvenile maps, but there are some differences. As proposed, EFH would include more coastal waters in New Jersey and the Gulf of Maine. Chesapeake Bay would no longer be designated as EFH for little skate (juveniles or adults) if the proposed designations are approved and the high salinity zones of nearly all the ELMR areas north of Cape Cod would be added to the designations. The level 2 EFH depth information provided for both life stages in the no action text descriptions is the same, and is very restricted (73-91 m), as opposed to the broader depth ranges identified in the proposed descriptions, which would extend EFH more explicitly into nearshore waters with maximum depths of 80 (juveniles) and 100 (adults) meters. The substrate information in the no action and proposed new designations is the same.

As modified, the proposed map for juvenile little skates extends into deeper water (80 vs. 70 meters) and thus includes more of the continental shelf than the map that was approved in June 2007; it also excludes Chesapeake Bay. The modified adult map is very similar to the original approved map since the maximum depth did not change. The only noticeable changes are the addition of shallow water on Georges Bank (the minimum depth on the shelf was reduced from 30 to 20 meters) and the elimination of Chesapeake Bay.

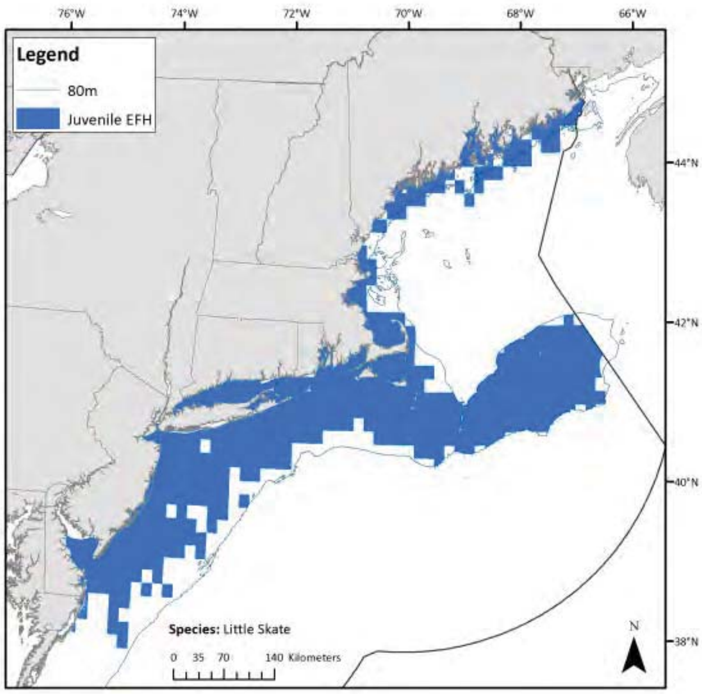
Text descriptions:

For little skate (*Leucoraja erinacea*), essential fish habitat is designated anywhere within the geographic areas that are shown on the following maps and listed in Table 28 and meets the conditions described below. Additional habitat-related information for this species can be found in Appendix B.

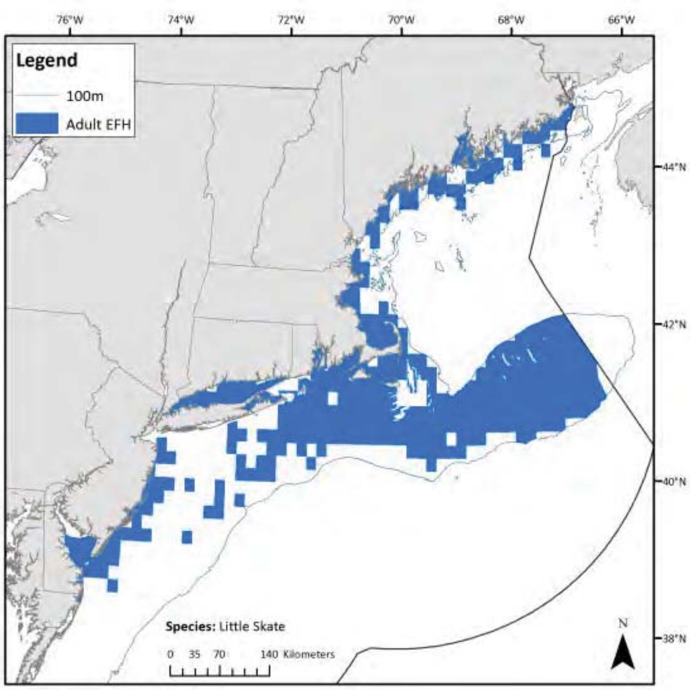
Juveniles: Intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the Mid-Atlantic region as far south as Delaware Bay, and on Georges Bank, extending to a maximum depth of 80 meters, as shown on Map 90, and including high salinity zones in the bays and estuaries listed in Table 28. Essential fish habitat 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 100 meters, as shown on Map 91, and including high salinity zones in the bays and estuaries listed in Table 28. Essential fish habitat for adult little skates occurs on sand and gravel substrates, but they are also found on mud.

Map 90 – Little skate juvenile EFH.



Map 91 – Little skate adult EFH.

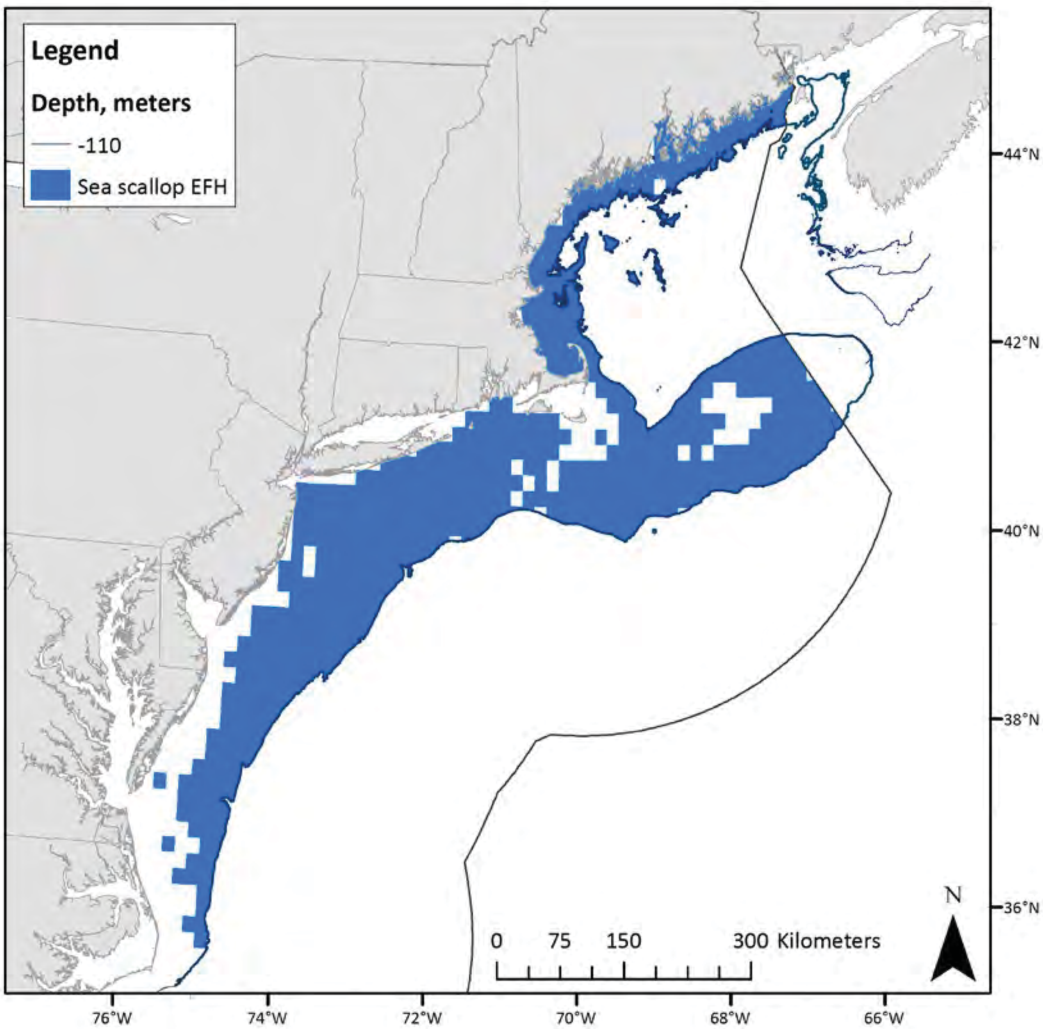


ATLANTIC HERRING

Estuaries and Embayments	Eggs	Larvae	Juvenile	Adults
Massachusetts Bay	S	S	S	S
Cape Cod Bay	S	S	S	S

S ≡ The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).
M ≡ The EFH designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).

Map 97 – Atlantic sea scallop EFH, all life stages.



2.2.6 Atlantic herring

Although herring are a pelagic species, their eggs are deposited in mats on the seafloor. The proposed Atlantic herring egg EFH designation includes two sources of information:

(1) Ten minute squares where larvae <=10mm were found in various ichthyoplankton surveys conducted between 1971 and 2013[37]. Mapped squares encompass the top 50% of larval abundance. Herring larvae hatch at between 4 and 10 mm total length (Fahay 2007), so larvae that are 10 mm or smaller in size are expected to be close to the location where their eggs were incubated.
(2) Observations of herring eggs on seafloor, identified based on a review of all available information on current and historical observations (see Appendix B).

The proposed EFH map for larval Atlantic herring is based on the relative abundance of larvae during 1978-1987 in the MARMAP ichthyoplankton surveys at the 90th percentile area level and ELMR bays and estuaries where herring larvae were identified as being "common" or abundant." More recent larval survey data used in the EFH map for eggs were not used in the larval map. The larval map is the same map used in the No Action alternative, but without any filled in squares.

The proposed EFH designation map differs from the no action map in that it includes additional areas where small larvae were found, and eliminates "filled in" ten minute squares. The map proposed in 2007 focused on the egg bed locations and ELMR embayments and did not include a comprehensive analysis of current larval data. The herring egg EFH domain is bounded at 40° N and 71° 30' W. Herring are not known to spawn south or west of Nantucket Shoals.

The proposed EFH designations for juvenile and adult Atlantic herring are based upon average catch per tow at the 75th percentile of area level in ten minute squares of latitude and longitude in the 1968-2005 fall and spring NMFS trawl survey data, plus several squares that either were not surveyed, or that the Council's Habitat Committee determined were not well represented in the survey data.[38] The proposed new EFH maps also include ten minute squares in inshore areas where juvenile or adult Atlantic herring were caught in state trawl surveys in more than 10% of the tows, as well as those bays and estuaries identified by the NOAA ELMR program where they were "common" or "abundant." A few more ten minute squares on the coasts of Maine, Connecticut, and Rhode Island that were either unsurveyed (fewer than four tows) or identified by fishing industry members of the Habitat Committee were also added to both maps. These designations were referred to as Juvenile/Adult Alternative 2E in the Phase 1 DEIS.

The proposed EFH designation map for Atlantic herring eggs covers much more seafloor than the no action map, extending more broadly into the Great South Channel and on Nantucket Shoals and Georges Bank. The depth range was slightly expanded from 20-80 meters to 5-90 meters.[39] The proposed EFH maps for juveniles and adults extend over the same geographic area as the no action maps, but include more ten minute squares. The most significant changes are in the proposed EFH descriptions, both of which define a much broader depth range (0 to 300

[37] ICNAF 1971-1978, MARMAP 1977-1994, GLOBEC 1995-1999, and EcoMon 1992-present (data through May 2013)

[38] Because Atlantic herring are pelagic, like eggs and larvae of other managed species, this is the only species for which percent area instead of percent catch was used to map EFH for juveniles and adults (see explanation in Appendix A).

[39] As with all the proposed EFH text descriptions, the depth ranges are now a required component of the EFH designation and are no longer "generally" applicable.

m and, for the juveniles, include the intertidal zone). Also, the juvenile EFH description includes some temperature and salinity information specific to young-of-the-year juveniles.

Text descriptions:

Essential fish habitat for Atlantic herring (*Clupea harengus*) is designated anywhere within the geographic areas that are listed in Table 30 and the following maps which exhibit the environmental conditions defined in the text descriptions.

Eggs: Inshore and offshore benthic habitats in the Gulf of Maine and on Georges Bank and Nantucket Shoals in depths of 5 – 90 meters on coarse sand, pebbles, cobbles, and boulders and/or macroalgae at the locations shown in Map 98. Eggs adhere to the bottom, often in areas with strong bottom currents, forming egg “beds” that may be many layers deep.

Larvae: Inshore and offshore pelagic habitats in the Gulf of Maine, on Georges Bank, and in the upper Mid-Atlantic Bight, as shown on Map 99, and in the bays and estuaries listed in Table 30. Atlantic herring have a very long larval stage, lasting 4-8 months, and are transported long distances to inshore and estuarine waters where they metamorphose into early stage juveniles (“brit”) in the spring.

Juveniles: Intertidal and sub-tidal pelagic habitats to 300 meters throughout the region, as shown on Map 100, including the bays and estuaries listed in Table 30. 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 in the northern part of their range and as high as 22°C 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, as shown on Map 100, including the bays and estuaries listed in Table 30. 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 and low salinities. Spawning takes place on the bottom, generally in depths of 5 – 90 meters on a variety of substrates (see eggs).

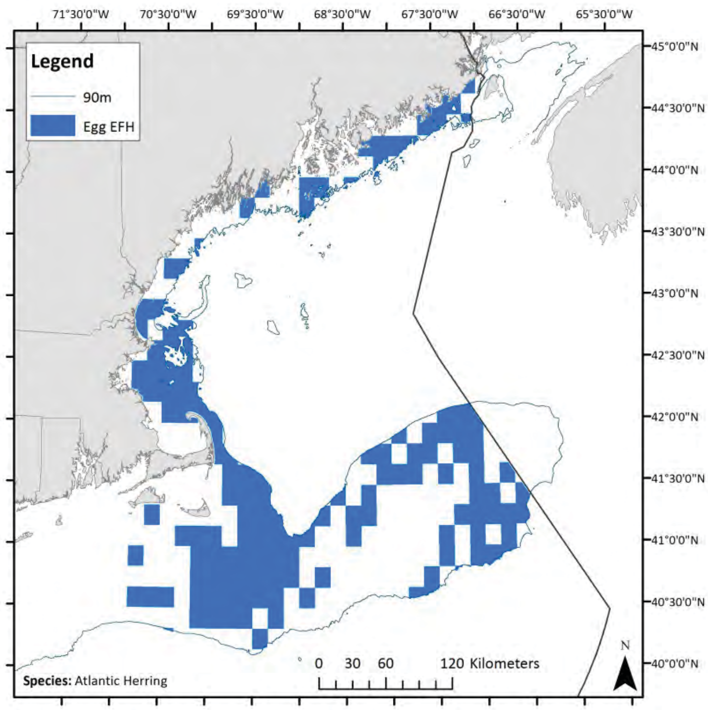
Table 30 – Atlantic herring EFH designation for estuaries and embayments.

Estuaries and Embayments	Larvae	Juveniles	Adults
Passamaquoddy Bay	S,M	S,M	S,M
Englishman/Machias Bay	S,M	S,M	S,M
Narraguagus Bay	S,M	S,M	S,M
Blue Hill Bay	S,M	S,M	S,M
Penobscot Bay	S,M	S,M	S,M
Muscongus Bay	S,M	S,M	S,M

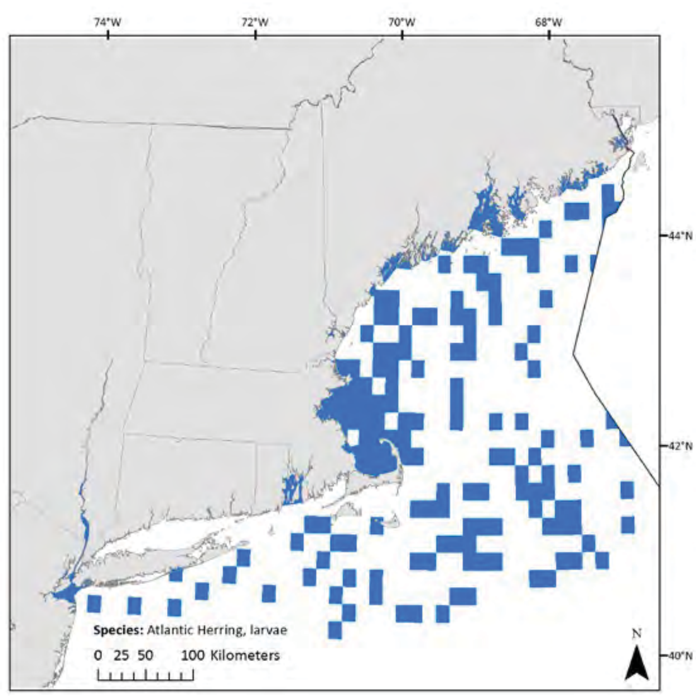
Estuaries and Embayments	Larvae	Juveniles	Adults
Damariscotta River	S,M	S,M	S,M
Sheepscot River	S,M	S,M	S,M
Kennebec / Androscoggin	S,M	S,M	S,M
Casco Bay	S,M	S,M	S
Saco Bay	S,M	S,M	S
Wells Harbor	S,M	S,M	S
Great Bay	S,M	S,M	S
Hampton Harbor*	S,M	S,M	S
Merrimack River	M	M	
Plum Island Sound*	S,M	S,M	S
Massachusetts Bay	S	S	S
Boston Harbor	S	S,M	S,M
Cape Cod Bay	S	S,M	S,M
Buzzards Bay		S,M	S,M
Narragansett Bay	S	S,M	S,M
Long Island Sound		S,M	S,M
Gardiners Bay		S	S
Great South Bay		S	S
Hudson River / Raritan Bay	S,M	S,M	S,M
Barnegat Bay		S,M	S,M
New Jersey Inland Bays		S,M	S,M
Delaware Bay		S,M	S
Chesapeake Bay			S

S ≡ The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).
M ≡ The EFH designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).
** = This water body was not included in the original ELMR reports, but it was included in the salinity zone maps that were appended to all the relevant fishery management plans and amendments which implemented the no action EFH designations; EFH designations were inferred in these locations if there were ELMR-based designations in the adjacent north and south locations.*

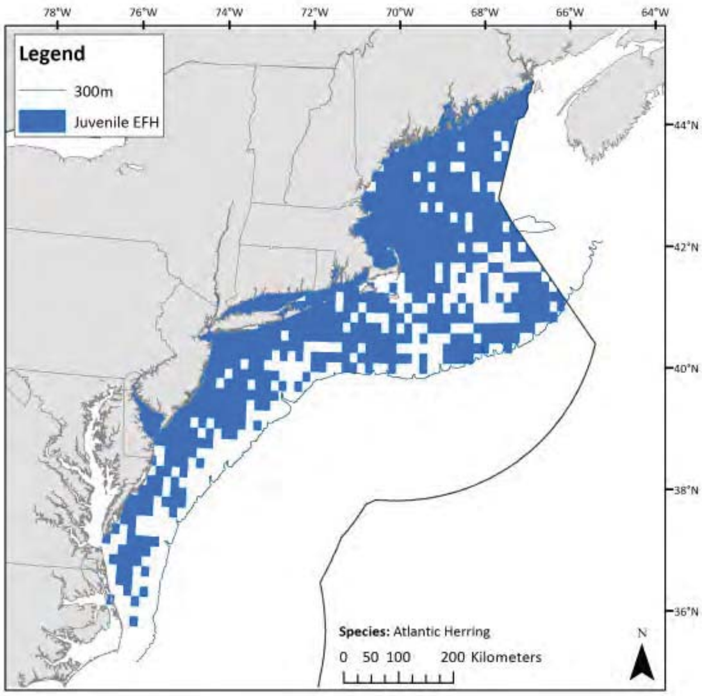
Map 98 – Atlantic herring egg EFH.



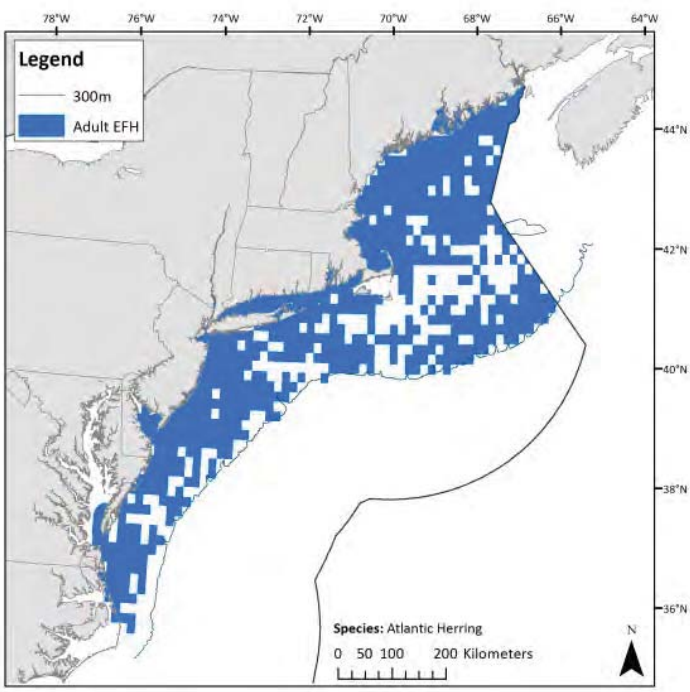
Map 99 – Atlantic herring larval EFH.



Map 100 – Atlantic herring juvenile EFH.



Map 101 – Atlantic herring adult EFH.



RED HAKE

2.2.2.2 Red hake

The proposed EFH map for red hake eggs, larvae, and juveniles is based on the distributions of depths and bottom temperatures that are associated with high catch rates of juveniles in the 1963-2003 spring and fall NMFS trawl surveys.[30] This designation is also based on average catch rates of juveniles in ten minute squares of latitude and longitude in the 1968-2005 spring and fall NMFS trawl surveys at the 75th percentile of catch level, includes inshore areas where juvenile red hake were caught in 10% or more of tows made in individual ten minute squares during state trawl surveys and ELMR areas for eggs, larvae, and juveniles. This was Alternative 3C in the Phase 1 DEIS.

The proposed EFH map for adults was created in the same way, except that the 1968-2005 trawl survey data were mapped at the 90th percentile and the map includes the continental slope down to 750 meters, the reported maximum depth for adult red hake in the Northeast region (Alternative 3D in the Phase 1 DEIS).

Compared to the no action EFH descriptions, the proposed juvenile text description refers to estuarine and coastal marine benthic habitats, including the intertidal zone, not just the continental shelf, and to a much wider variety of substrates for young-of-the-year and older juveniles than the no action description. The proposed adult EFH designation defines a much broader depth range than the no action designation and extends EFH on to the continental slope to a depth of 750 meters.

The proposed EFH map for red hake eggs, larvae, and juveniles covers roughly the same geographic area as the individual no action maps for these three life stages, but with some added detail – notably a considerable amount of non-EFH area at intermediate depths and in deep water (>80 m) on the continental shelf, in shallow water on Georges Bank, and in the outer Gulf of Maine. The proposed EFH map for adults is very similar to the no action map. As is true for other species, EFH would be defined more realistically in the proposed designations because of the use of level 2 depth information (50-300 meters for adults) on the shelf, rather than only relying on survey data binned into ten minute squares.

When the designations that were approved in 2007 were modified by the Habitat Committee in 2011, annual depth ranges replaced seasonal depth ranges for this species. This caused the gap between 30 m (the maximum depth in the spring) and 40 m (the maximum depth in the fall) to be filled in. In the modified adult map, the gap between 300 m (the maximum annual depth as defined by Level 2 survey data on the shelf) and 400 m (the minimum annual depth of the Level 1 continental slope spatial area) was filled in.

Text descriptions:

[30] Red hake eggs and larvae were not differentiated from eggs and larvae of white, spotted and longfin hake in all of the 1978-1987 MARMAP survey collections. In the original (status quo) designations, the egg and larval maps were based on egg survey data for all four species plus juvenile trawl survey data and ELMR data. When the proposed new EFH maps were developed, no MARMAP data for either life stage were used.

Essential fish habitat for red hake (*Urophycis chuss*) is designated anywhere within the geographic areas that are shown on the following maps and listed in Table 27 and meets the conditions described below.

Eggs and Larvae: Pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic, as shown on Map 77, and in the bays and estuaries listed in Table 27.

Juveniles: Intertidal and sub-tidal benthic habitats throughout the region on mud and sand substrates, to a maximum depth of 80 meters, as shown on Map 77, including the bays and estuaries listed in Table 27. 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 (see Map 78) and as shallow as 20 meters in a number of inshore estuaries and embayments (see Table 27) 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.

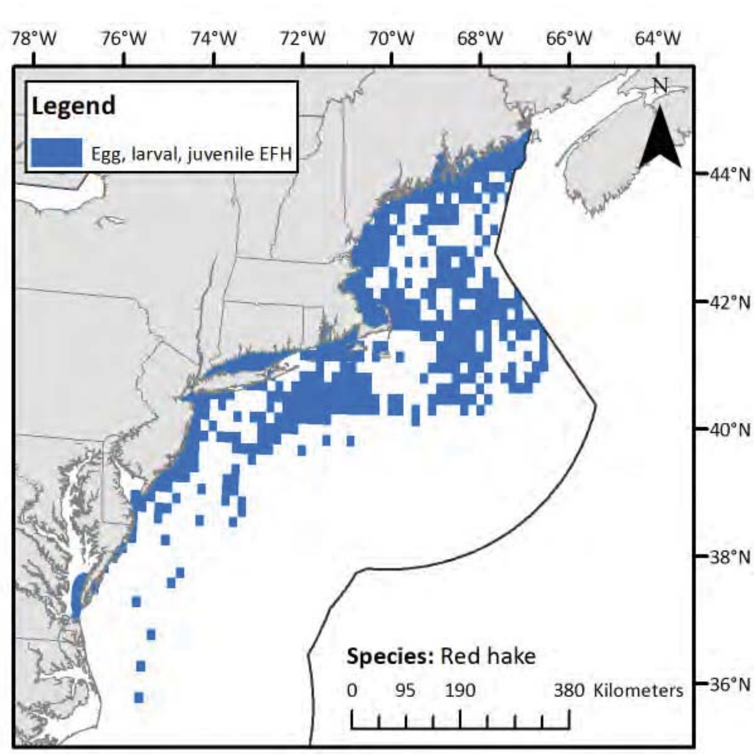
Table 27 – Red hake EFH designation for estuaries and embayments

Estuaries and Embayments	Eggs	Larvae	Juveniles	Adults
Passamaquoddy Bay			S,M	S,M
Englishman/Machias Bay			S	S
Narraguagus Bay			S	S
Blue Hill Bay			S	S
Penobscot Bay			S,M	S,M
Muscongus Bay			S,M	S,M
Damariscotta River			S,M	S
Sheepscot River			S,M	S,M
Kennebec / Androscoggin			S,M	S,M
Casco Bay			S	S
Saco Bay			S	S
Great Bay		S	S	S
Hampton Harbor*			S	S
Merrimack River	M			
Plum Island Sound*			S	S
Massachusetts Bay	S	S	S	S
Boston Harbor	S	S	S,M	S,M
Cape Cod Bay		S	S,M	S,M
Buzzards Bay	S	S	S,M	S,M

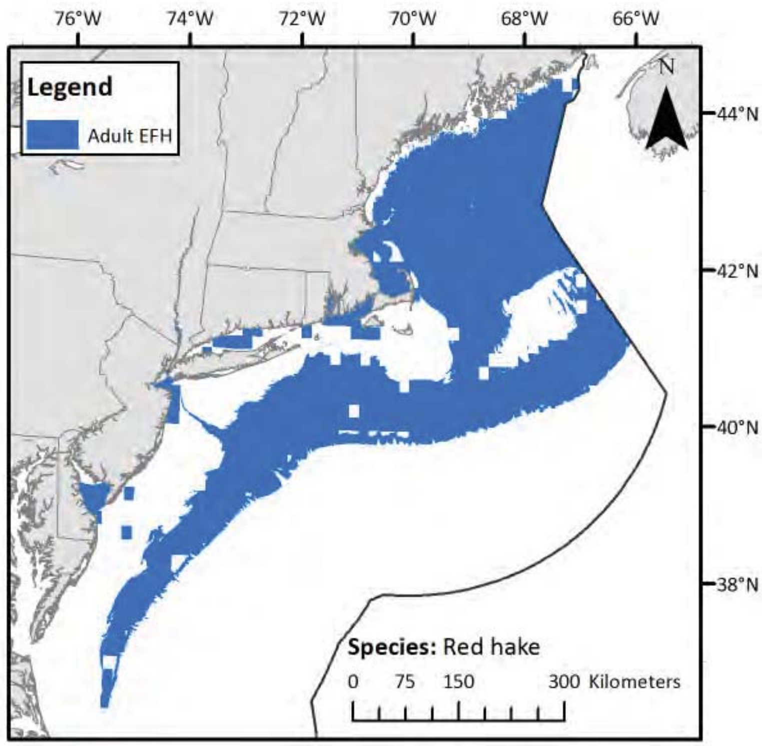
Narragansett Bay	S	S	S	S
Long Island Sound			S,M	S,M
Connecticut River			M	M
Hudson River / Raritan Bay		S,M	S,M	S,M
Delaware Bay				S
Chesapeake Bay			S	S

S ≡ The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).
M ≡ The EFH designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).
** = This water body was not included in the original ELMR reports, but it was included in the salinity zone maps that were appended to all the relevant fishery management plans and amendments which implemented the no action EFH designations; EFH designations were inferred in these locations if there were ELMR-based designations in the adjacent north and south locations.*

Map 77 – Red hake egg, larval and juvenile EFH.



Map 78 – Red hake adult EFH.



2.2.2.3 Offshore hake

As in the original EFH designations, the proposed egg and larval EFH maps are based on the 75th percentile of the observed range of the MARMAP survey data. The continental slope was added to the proposed EFH text descriptions.

There is a single proposed EFH map for juvenile and adult offshore hake which is based on the distributions of depths and bottom temperatures that were associated with high catch rates of juveniles and adults in the 1963-2003 spring and fall NMFS trawl surveys and on the abundance of juveniles in the 1968-2005 spring and fall NMFS trawl surveys at the 90th percentile of catch level, but excludes a couple of ten minute squares in the Gulf of Maine.[31] It also includes continental slope habitats that were defined using known maximum depth and geographic range information (see Table A-10). The range of this species extends to Florida and into the Gulf of Mexico in deep water, but EFH was not designated south of Cape Fear, North Carolina, because no survey data are available. The combined juvenile and adult designation was referred to as Alternative 5 (juvenile 3E and adult 3D) in the Phase 1 DEIS.

The proposed new map for juvenile and adult offshore hake defines EFH as a depth range along the outer continental shelf and slope rather than discrete ten minute squares. It also eliminates the few scattered ten minute squares in the Gulf of Maine that are in the no action map for

[31] Catch rates of adults in the spring and fall surveys during 1968-2005 were very low, so only the juvenile catch data were used in the map.

WINDOWPANE FLOUNDER

2.2.1.10 Windowpane flounder

As in the original EFH designations, the proposed egg and larval EFH maps are based on the 90th percentile of the observed range of the MARMAP survey data. These designations also include those bays and estuaries identified by the ELMR program as supporting windowpane flounder eggs or larvae at the "common" or "abundant" level.

The proposed EFH maps for juvenile and adult windowpane flounder are based on the distributions of depths and bottom temperatures that are associated with high catch rates of juveniles and adults, respectively, in the 1963-2003 spring and fall NMFS trawl surveys. They are also based on average catch per tow data in ten minute squares of latitude and longitude in the 1968-2005 spring and fall NMFS trawl surveys at the 90th percentile of catch level, and they include inshore areas where juvenile or adult windowpane were caught in 10% or more of the tows made in individual ten minute squares during state trawl surveys and ELMR information. Inshore survey data used in the proposed map of juvenile EFH includes SEAMAP survey data between Cape Hatteras and northern Florida.[25] These designations were 3E alternatives in the Phase 1 DEIS.[26]

The new designation for juvenile windowpane flounder would limit EFH to a maximum depth of 60 meters, not 100 meters as defined in the no action designation. The maximum depth for adult EFH would only change from 75 to 70 meters. Under the proposed designations, EFH for the juveniles and adults would explicitly include the intertidal zone. The preferred sediment types (mud and sand) are the same in the proposed and no action EFH descriptions for both life stages.

The proposed and the no action EFH maps for the juveniles and adults include coastal areas throughout the entire Northeast region, plus the shallower portion of Georges Bank. The addition of trawl survey data from the Gulf of Maine caused more ten minute squares along the Maine coast to be designated, especially for juveniles. The primary difference between the no action and the proposed designations is the addition of coastal waters south of Cape Hatteras to the juvenile EFH map. The approved 3D alternative for juveniles in the DEIS did not include the SEAMAP survey data. Modification of the approved maps for juvenile and adult windowpane flounder resulted in the removal of a few isolated ten minute squares on the outer continental shelf that met the 90th percentile catch criterion, but were deeper than the defined maximum depths of 60 and 70 meters.

Text descriptions:

Essential fish habitat for windowpane flounder (*Scophthalmus aquosus*) is designated anywhere within the geographic areas that are shown on the following maps and listed in Table 23 and meets the conditions described below.

---

[25] SEAMAP is an acronym for the Southeast Area Monitoring and Assessment Program. This trawl survey of coastal waters between Cape Hatteras, North Carolina, and Cape Canaveral, Florida, began in 1986 and is conducted by the South Carolina Department of Natural Resources. According to SCDNR staff, the great majority of windowpane flounder caught in this survey are juveniles (no length data are collected).

[26] The preferred alternatives in the DEIS were called 3E alternatives because a few unsurveyed ten minute squares were added to the 3D maps.

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 (see Map 59, Map 60, and Table 23).

Juveniles: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to northern Florida, as shown on Map 61, including mixed and high salinity zones in the bays and estuaries listed inTable 23. Essential fish habitat for juvenile windowpane flounder 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.

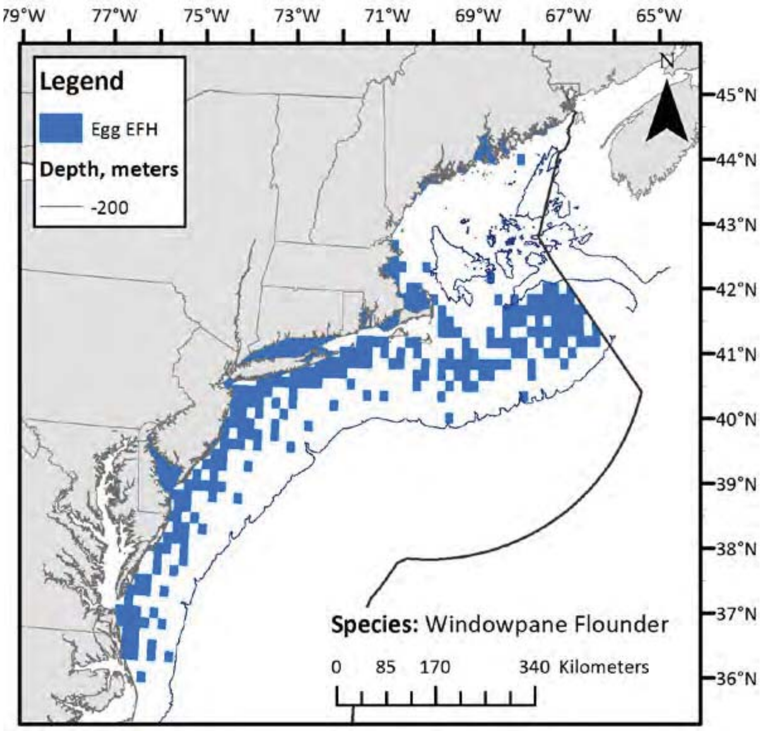
Adults: Intertidal and sub-tidal benthic habitats in estuarine, coastal marine, and continental shelf waters from the Gulf of Maine to Cape Hatteras, as shown on Map 62, including mixed and high salinity zones in the bays and estuaries listed in Table 23. Essential fish habitat for adult windowpane flounder is found on mud and sand substrates and extends from the intertidal zone to a maximum depth of 70 meters.

Table 23 – Windowpane flounder EFH designation for estuaries and embayments

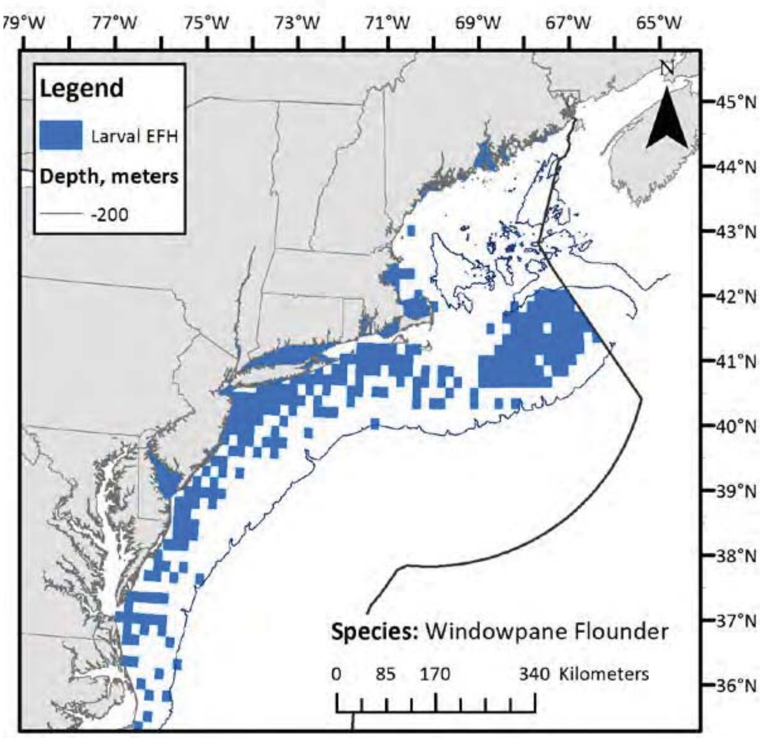
Estuaries and Embayments	Eggs	Larvae	Juveniles	Adults
Passamaquoddy Bay	S,M	S,M	S,M	S,M
Englishman/Machias Bay	S,M	S,M	S,M	S,M
Narraguagus Bay	S,M	S,M	S,M	S,M
Blue Hill Bay	S,M	S,M	S,M	S,M
Penobscot Bay	S,M	S,M	S,M	S,M
Muscongus Bay	S,M	S,M	S,M	S,M
Damariscotta River	S,M	S,M	S,M	S,M
Sheepscot River	S,M	S,M	S,M	S,M
Kennebec / Androscoggin	S,M	S,M	S,M	S,M
Casco Bay	S,M	S,M	S,M	S,M
Saco Bay	S,M	S,M	S,M	S,M
Wells Harbor	S,M	S,M	S,M	S,M
Great Bay	S	S	S	S
Hampton Harbor*	S,M	S,M	S,M	S,M
Plum Island Sound*	S,M	S,M	S,M	S,M
Massachusetts Bay	S	S	S	S
Boston Harbor	S,M	S,M	S,M	S,M
Cape Cod Bay	S,M	S,M	S,M	S,M
Waquoit Bay	S,M	S,M	S,M	S,M
Buzzards Bay	S,M	S,M	S,M	S,M
Narragansett Bay	S,M	S,M	S,M	S,M
Long Island Sound	S,M	S,M	S,M	S,M
Connecticut River	M	M	M	M
Gardiners Bay	S,M	S,M	S,M	S,M
Great South Bay	S,M	S,M	S,M	S,M
Hudson River / Raritan Bay	S	S,M	S,M	S,M
Barnegat Bay	S,M	S,M	S,M	S,M
New Jersey Inland Bays	S,M	S,M	S,M	S,M
Delaware Bay			S,M	S,M
Delaware Inland Bays*	S,M	S,M	S,M	S,M
Maryland Inland Bays*	S,M	S,M	S,M	S,M
Chincoteague Bay			S	S
Chesapeake Bay			S,M	S,M
Tangier/Pocomoke Sound			M	M

S ≡ The EFH designation for this species includes the seawater salinity zone of this bay or estuary (salinity > 25.0‰).
M ≡ The EFH designation for this species includes the mixing water / brackish salinity zone of this bay or estuary (0.5 < salinity < 25.0‰).
** = This water body was not included in the original ELMR reports, but it was included in the salinity zone maps that were appended to all the relevant fishery management plans and amendments which implemented the no action EFH designations; EFH designations were inferred in these locations if there were ELMR-based designations in the adjacent north and south locations.*

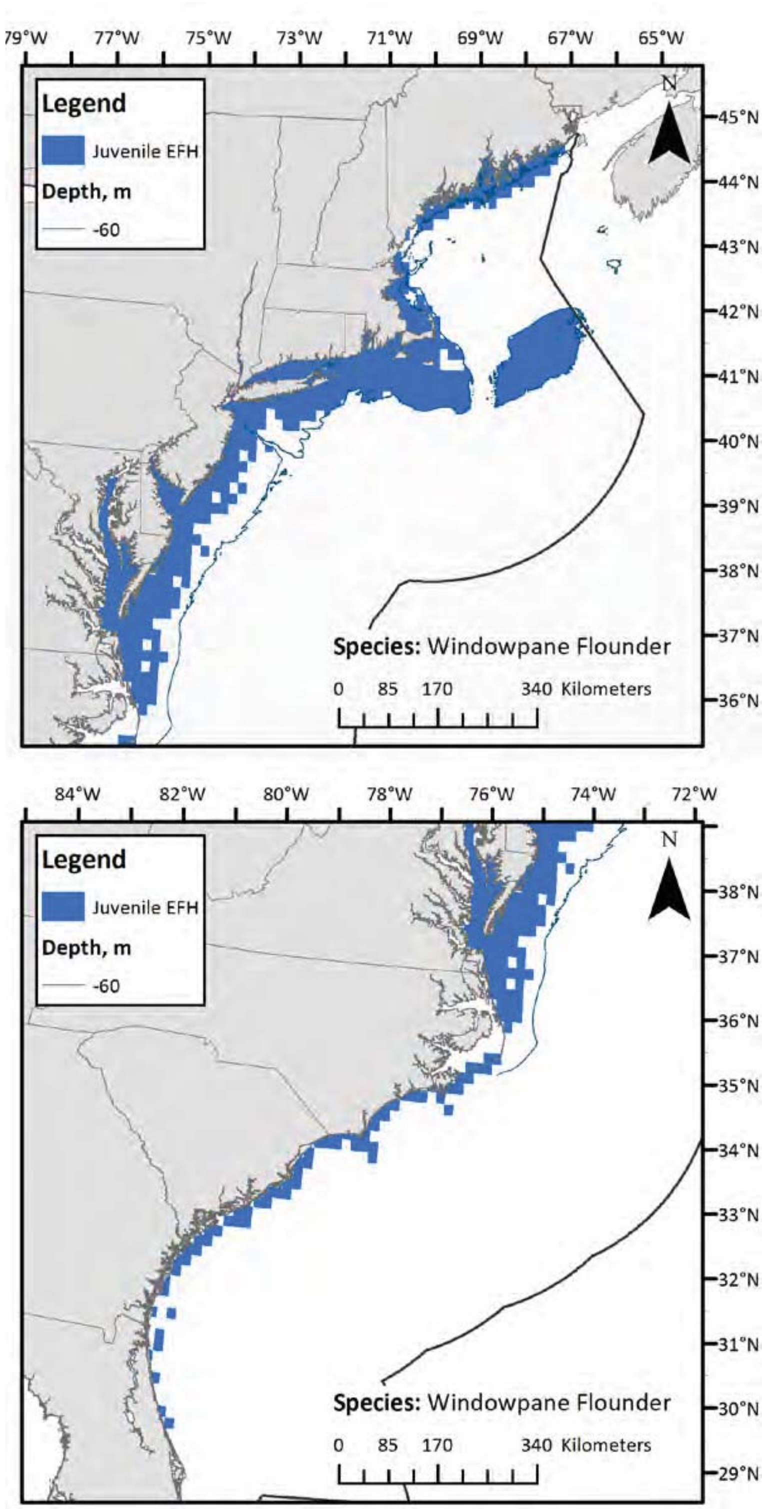
Map 59 – Windowpane flounder egg EFH.



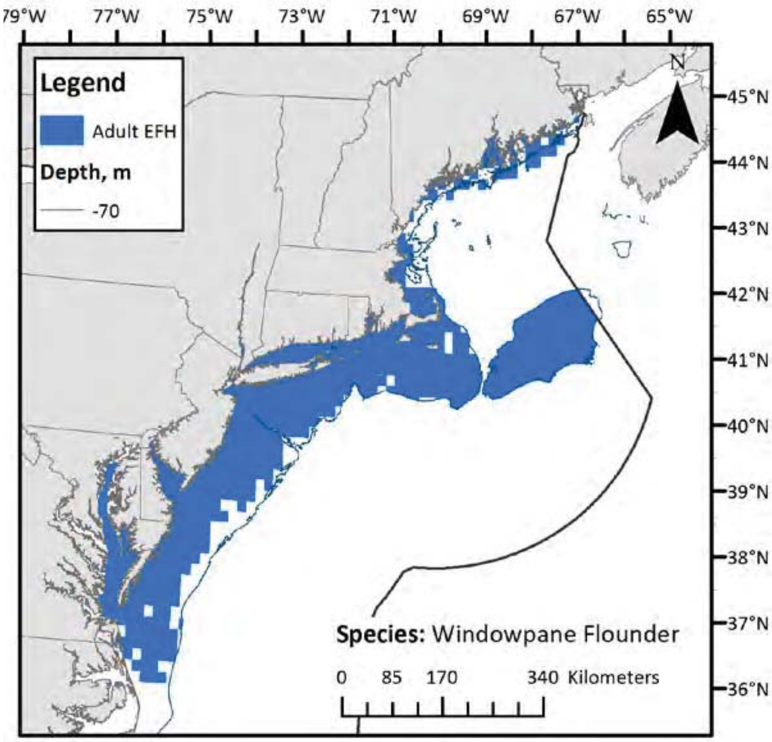
Map 60 – Windowpane flounder larval EFH.



Map 61 – Windowpane flounder juvenile EFH. Upper panel shows northern portion of range; lower panel shows southern portion of range.



Map 62 – Windowpane flounder adult EFH.



2.2.1.11 Winter flounder

The preferred designation for winter flounder eggs defines EFH as sub-tidal coastal waters from the shoreline to a maximum depth of 5 meters[27] from Cape Cod to Absecon Inlet, New Jersey, and from the shoreline to a maximum depth of 70 meters in the Gulf of Maine and on Georges Bank, and includes bays and estuaries within this geographic range where eggs were identified as "common" or "abundant" by the ELMR program. Depth is relative to mean low water. In coastal waters, the geographic extent of EFH for the eggs is based on the geographic range of the adults and, south of Cape Cod, the maximum depth where eggs have been observed on the bottom, and on Georges Bank and in the Gulf of Maine, the reported maximum depth for spawning adults on Georges Bank. Survey data in support of the southern limit of EFH are provided in Appendix I.

The 5 meter depth area begins at the tip of Cape Cod at Provincetown, Massachusetts, and includes waters along the eastern and southern sides of the Cape, south to New Jersey. The maximum egg depth in southern New England and the Mid-Atlantic is the same as in the no action designation for the entire coast. It was not changed because data collected during a series of benthic winter flounder egg surveys by the U.S. Army Corps of Engineers in the New York Harbor area in recent years indicate that many more eggs are deposited on the bottom in shallow water areas, not in the deeper shipping channels (Wilber et al. 2013). Based on this information, the Council concluded that the shoal water areas in New York harbor were the primary habitat

[27] Note that 20 meters is actually shown on the map due to the difficulty of depicting a 5 meter depth contour on a regional scale map. However, only areas where the depth is 5 meters or less are actually part of the designation.

WINTER SKATE

2.2.4.5 Winter skate

The proposed EFH maps for juvenile and adult winter skate are based on the distributions of depths and bottom temperatures that were either associated with high catch rates of juveniles and adults, respectively, in the 1963-2003 spring and fall NMFS trawl surveys. The proposed maps are also based on average catch per tow data in ten minute squares of latitude and longitude for juveniles and adults, respectively, in the 1968-2005 spring and fall NMFS trawl surveys at the 90th percentile of catch, and they include inshore areas where juvenile or adult white hake were caught in 10% or more of the tows made in individual ten minute squares during state trawl surveys as well as coastal bays and estuaries identified in the ELMR reports. The ELMR information for the Mid-Atlantic area was re-interpreted to add EFH for juvenile winter skate to five inshore areas south of Raritan Bay, including Delaware Bay, and to eliminate the no action designations for juveniles and adults in Chesapeake Bay (see Appendix A). Some of the ELMR estuaries and embayments north of Cape Cod that were not originally designated as EFH were also added to the new maps (see footnote for little skates). A few unsurveyed ten minute squares were filled in along the Rhode Island and Connecticut coasts and southeast of Nantucket Island. The designations are 3E alternatives in the Phase 1 DEIS.

The proposed designations would limit EFH to a maximum depth of 90 meters for juvenile winter skates and 80 meters for the adults. The depth ranges given in the no action designations are much less specific (shoreline to 400 or 371 meters, more abundant less than 111 meters). The proposed EFH map for juvenile winter skate includes more considerably more area in the Mid-Atlantic Bight compared to the no action map. The no action adult map is almost completely limited to Georges Bank and the waters directly south of Cape Cod; the proposed new map extends EFH for adult winter skate to continental shelf waters south of Delaware Bay and adds more of the southwestern Gulf of Maine.

Modification of the juvenile EFH designation to include shelf waters out to 90 meters instead of 80 meters caused most of Georges Bank to “fill in” and extended EFH westwards without interruption into the Mid-Atlantic and farther out on the shelf. The other significant change was the elimination of EFH in Chesapeake Bay. Maximum depth for the adults increased by 20 meters (from 60 to 80) and had a similar effect on the proposed map; EFH now extends across the Great South Channel (except for the shoal water east of Nantucket) and Chesapeake Bay has been removed. The rest of the new map looks very much like the map that was approved in 2007.

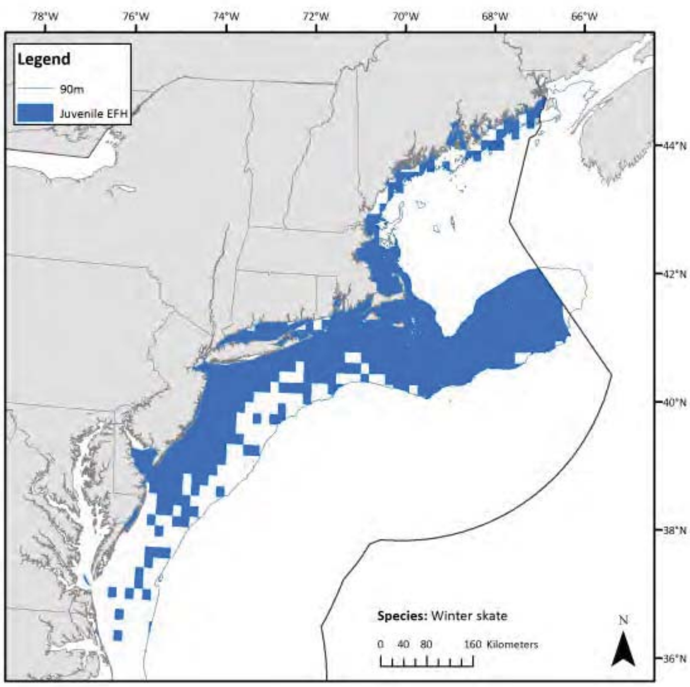
Text descriptions:

For winter skate (*Leucoraja ocellata*), essential fish habitat is designated anywhere within the geographic areas that are shown on the following maps and listed in Table 28 and meets the conditions described below.

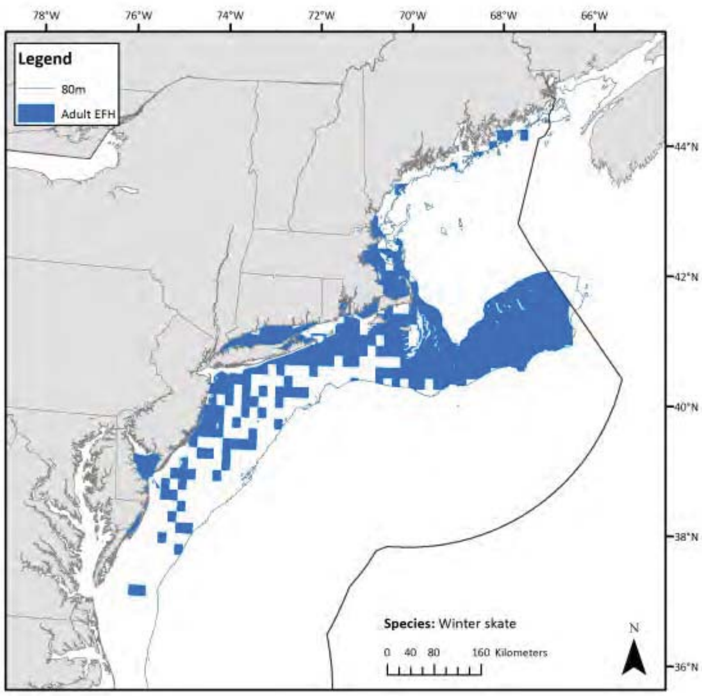
Juveniles: Sub-tidal benthic habitats in coastal waters from eastern Maine to Delaware Bay and on the continental shelf in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 90 meters, as shown on Map 92, including the high salinity zones of the bays and estuaries listed in Table 28. Essential fish habitat for juvenile winter skates occurs on sand and gravel substrates, but they are also found on mud.

Adults: Sub-tidal benthic habitats in coastal waters in the southwestern Gulf of Maine, in coastal and continental shelf waters in southern New England and the Mid-Atlantic region, and on Georges Bank, from the shoreline to a maximum depth of 80 meters, as shown on Map 93, including the high salinity zones of the bays and estuaries listed in Table 28. Essential fish habitat for adult winter skates occurs on sand and gravel substrates, but they are also found on mud.

Map 92 – Winter skate juvenile EFH.



Map 93 – Winter skate adult EFH.



2.2.4.6 Rosette skate

Because very few adults are caught in the NMFS bottom trawl survey, the proposed EFH map for juvenile and adult rosette skate is based on the distribution of depths and bottom temperatures that were either associated with high catch rates of juveniles in the 1963-2003 spring and fall NMFS trawl surveys. The map is also based on average catch per tow data for juveniles in ten minute squares of latitude and longitude in the 1968-2005 spring and fall NMFS trawl surveys at the 75th percentile of catch level. It was referred to as Alternative 3C in the Phase 1 DEIS.

The proposed text description is very similar to the no action descriptions, which were developed separately, but are identical. The no action map for juvenile rosette skates includes the same portion of the outer continental shelf (Hudson Canyon to Cape Hatteras) as the proposed juvenile/adult map, from approximately 40˚N to Cape Hatteras.[35] As modified, the proposed designation covers a broader depth range than what was approved in the DEIS (80-400 vs 70-300 meters), but the two maps look the same. The range of this species extends to the Dry Tortugas in Florida in deep water, but in the absence of any survey data upon which to base a map, the EFH designation does not extend south of Cape Hatteras.

Text descriptions:

---

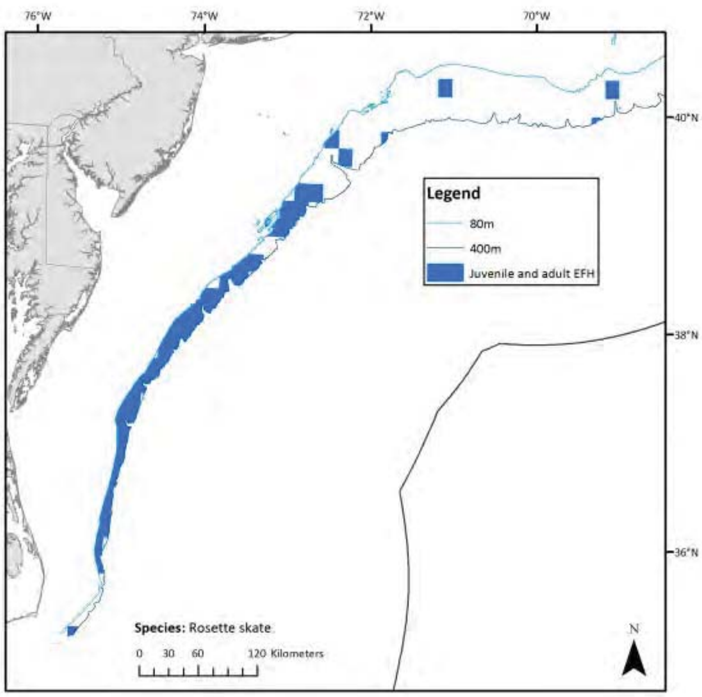
[35] There are two status quo EFH maps, one for juvenile rosette skates and one for adults. There are only seven ten minute squares in the adult map; they are located southeast of Long Island on the outer shelf at the northern end of the juvenile distribution.

CLEARNOSE SKATE

For rosette skate (*Leucoraja garmani*), essential fish habitat is designated anywhere within the geographic areas that are shown on Map 94 and meets the conditions described below. Additional habitat-related information for this species can be found in Appendix B.

Juveniles and Adults: Benthic habitats with mud and sand substrates on the outer continental shelf in depths of 80 – 400 meters from approximately 40˚N latitude to Cape Hatteras, North Carolina, as shown on Map 94.

Map 94 – Rosette skate juvenile and adult EFH.



2.2.4.7 Clearnose skate

The proposed EFH maps for juvenile and adult clearnose skate within the NMFS trawl survey area were developed using a GIS depiction of preferred depth and bottom temperature ranges for each life stage that were determined from graphical 1963-2003 spring and fall NMFS trawl survey data in Packer et al. (2003b). The maps are also based on average catch per tow data for juveniles and adults in ten minute squares of latitude and longitude in the 1968-2005 spring and fall NMFS trawl surveys at the 75th percentile of catch level, and include inshore areas between New Jersey and Florida where juveniles or adults were caught in 10% or more of tows made in individual ten minute squares during state trawl surveys andeight embayments between Raritan Bay and Chesapeake Bay, including Delaware Bay. These juvenile and adult designations were referred to as 3C alternatives in the Phase 1 DEIS.

The proposed new EFH designation for adult clearnose skates extends over the same geographic area as the no action map – continental shelf waters from Raritan Bay, New Jersey, to Cape Fear, North Carolina.[36] The new maps exclude portions of survey-defined ten minute squares that are deeper than the maximum depths defined in the text descriptions (30 m for juveniles and 40 m for adults) and, therefore, limit EFH to the inner portion of the continental shelf. These maximum depths are much lower than what was included in the no action descriptions ("most abundant less than 111 meters") and match what is mapped much more explicitly. The other change relative to the no action designations was the addition of gravel and rocky bottom to the proposed new text descriptions: the original descriptions only defined EFH as occurring on "soft bottom" (interpreted to mean mud and sand).

Four modifications were made to the proposed EFH maps that were approved in the 2007 DEIS: 1) The maximum depth for adults was changed from 30 to 40 meters; 2) the mixed salinity zones in the Mid-Atlantic were removed from the adult designation (see salinity data in Appendix B); 3) EFH designations for the juveniles and adults now include fully saline waters in several coastal bays in the Mid-Atlantic that were not designated at all originally, or were only designated for adults; and 4) inshore trawl survey data (SEAMAP survey) collected south of Cape Hatteras were analyzed for the new juvenile map, extending EFH all the way to northern Florida. In addition, intertidal habitat was removed from the approved text descriptions in the DEIS for lack of evidence.

Text descriptions:

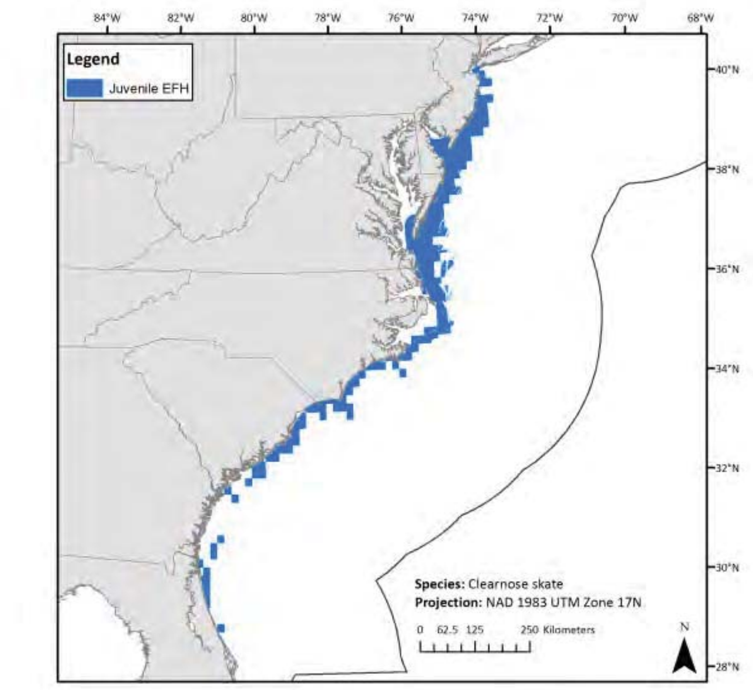
For clearnose skate (*Raja eglanteria*), essential fish habitat is designated anywhere within the geographic areas that are shown on the following maps and listed in Table 28 and meets the conditions described below. Additional habitat-related information for this species can be found in Appendix B.

Juveniles: Sub-tidal benthic habitats in coastal and inner continental shelf waters from New Jersey to the St. Johns River in Florida as shown on Table 28, including the high salinity zones of Chesapeake Bay, Delaware Bay, and the other bays and estuaries listed in Table 28. 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 as shown on Map 96, including the high salinity zones of Chesapeake Bay, Delaware Bay, and the other bays and estuaries listed in Table 28. 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.

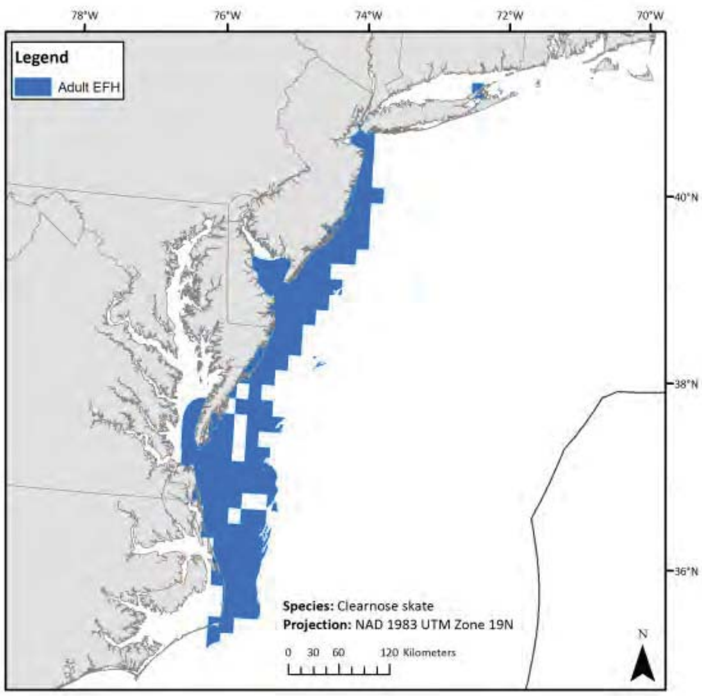
[36] The original EFH maps for all the skates do not show the coastal ELMR areas that were included in the designations – they were listed in tables only. Thus, Chesapeake Bay was designated for juvenile and adult clearnose skates, but is not shown on the maps.

Map 95 – Clearnose skate juvenile EFH.



Note that this map is in a different projection than the other EFH maps because it extends so far to the south.

Map 96 – Clearnose skate adult EFH.



2.2.5 Atlantic sea scallop

The EFH map for all life stages of Atlantic sea scallops includes all the ten minute squares where scallops of any size were caught during the following surveys: 1968-2011 NMFS trawl (fall and spring), 1981-2012 NMFS summer scallop dredge, 2000-2013 Maine/NH trawl, and 2005-2013 Maine scallop dredge. For each survey, scallop EFH was only identified if at least three tows were conducted in a particular ten minute square. Thus, some ten minute squares with very low sampling rates could not be designated EFH on the basis of some surveys, despite having positive catches of scallops. In addition, the map includes bays and estuaries identified by the NOAA ELMR program where juvenile or adult Atlantic sea scallops were "common" or "abundant."

Text descriptions:

Essential fish habitat for Atlantic sea scallops (*Placopecten magellanicus*) is designated anywhere within the geographic areas that are shown on Map 97 and listed in Table 29 which exhibit the environmental conditions defined in the following text descriptions.

Eggs: Benthic habitats in inshore areas and on the continental shelf as shown on Map 97, in the vicinity of adult scallops. Eggs are heavier than seawater and remain on the seafloor until they develop into the first free-swimming larval stage.

LONGFIN INSHORE SQUID

EFH Text Descriptions for Longfin Inshore Squid (*Doryteuthis pealeii*)

Eggs: EFH for *Doryteuthis pealeii* eggs occurs in inshore and offshore bottom habitats from Georges Bank southward to Cape Hatteras, generally where bottom water temperatures are between 10°C and 23°C, salinities are between 30 and 32 ppt, and depth is less than 50 meters. *Doryteuthis pealeii* eggs have also been collected in bottom trawls in deeper water at various places on the continental shelf. Like most loliginid squids, *D. pealeii* egg masses or “mops” are demersal and anchored to the substrates on which they are laid, which include a variety of hard bottom types (e.g., shells, lobster pots, piers, fish traps, boulders, and rocks), submerged aquatic vegetation (e.g., *Fucus* sp.), sand, and mud.

Pre-recruits (≤8 cm DML): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in the southwestern Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, and Raritan Bay. EFH for recruit longfin inshore squid is generally found over bottom depths between 6 and 160 meters where bottom water temperatures are 8.5-24.5°C and salinities are 28.5-36.5 ppt. Pre-recruits migrate offshore in the fall where they overwinter in deeper waters along the edge of the shelf. They make daily vertical migrations, moving up in the water column at night and down in the daytime. Small immature individuals feed on planktonic organisms while larger individuals feed on crustaceans and small fish.

Recruits (≥9 cm DML): EFH is pelagic habitats in inshore and offshore continental shelf waters from Georges Bank to South Carolina, in inshore waters of the Gulf of Maine, and in embayments such as Narragansett Bay, Long Island Sound, Raritan Bay, and Delaware Bay. EFH for recruit longfin inshore squid is generally found over bottom depths between 6 and 200 meters where bottom water temperatures are 8.5-14°C and salinities are 24-36.5 ppt. Recruits inhabit the continental shelf and upper continental slope to depths of 400 meters. They migrate offshore in the fall and overwinter in warmer waters along the edge of the shelf. Like the pre-recruits, they make daily vertical migrations. Individuals larger than 12 cm feed on fish and those larger than 16 cm feed on fish and squid. Females deposit eggs in gelatinous capsules which are attached in clusters to rocks, boulders, and aquatic vegetation and on sand or mud bottom, generally in depths less than 50 meters.

Source: Amendment 11 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan. Mid-Atlantic Fishery Management Council, May 2011.

BLUEFISH

EFH Text Descriptions for Bluefish (*Pomatomus saltatrix*)

Eggs: 1) North of Cape Hatteras, pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) at mid-shelf depths, from Montauk Point, NY south to Cape Hatteras in the highest 90% of the area where bluefish eggs were collected in the MARMAP surveys; and 2) South of Cape Hatteras, 100% of the pelagic waters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida at mid-shelf depths. Bluefish eggs are generally not collected in estuarine waters and thus there is no EFH designation inshore. Generally, bluefish eggs are collected between April through August in temperatures greater than 64°F (18 °C) and normal shelf salinities (> 31 ppt).

Larvae: 1) North of Cape Hatteras, pelagic waters found over the continental shelf (from the coast out to the limits of the EEZl most commonly above 49 ft (15 m), from Montauk Point, New York south to Cape Hatteras, in the highest 90% of the area where bluefish larvae were collected during the MARMAP surveys; 2) South of Cape Hatteras, 100% of the pelagic waters greater than 15 meters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida; and 3) the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N. Bluefish larvae are not generally collected inshore, so there is no EFH designation inshore for larvae. Generally, bluefish larvae are collected April through September in temperatures greater than 64 °F (18 °C) in normal shelf salinities (> 30 ppt).

Juveniles (<35 cm TL): 1) North of Cape Hatteras, pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ) from Nantucket Island, Massachusetts south to Cape Hatteras, in the highest 90% of the area where juvenile bluefish are collected in the NEFSC trawl survey; 2) South of Cape Hatteras, 100% of the pelagic waters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida; 3) the "slope sea" and Gulf Stream between latitudes 29° 00 N and 40° 00 N; and 4) all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Generally juvenile bluefish occur in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from May through October, and South Atlantic estuaries March through December, within the "mixing" and "seawater" zones. Distribution of juveniles by temperature, salinity, and depth over the continental shelf is undescribed

Adults (≥35 cm TL): 1) North of Cape Hatteras, over the continental shelf (from the coast out to the limits of the EEZ), from Cape Cod Bay, Massachusetts south to Cape Hatteras, in the highest 90% of the area where adult bluefish were collected in the NEFSC trawl survey; 2) South of Cape Hatteras, 100% of the pelagic waters over the continental shelf (from the coast out to the eastern wall of the Gulf Stream) through Key West, Florida; and 3) all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. Adult bluefish are found in North Atlantic estuaries from June through October, Mid-Atlantic estuaries from April through October, and in South Atlantic estuaries from May through January in the "mixing" and "seawater" zones. Bluefish adults are highly migratory and distribution varies seasonally end according to the size of the individuals comprising the schools. Bluefish are generally found in normal shelf salinities (> 25 ppt).

Source: Amendment 1 to the Bluefish Fishery Management Plan, Mid-Atlantic Fishery Management Council, 1998.

ATLANTIC BUTTERFISH

EFH Text Descriptions for Atlantic butterfish (*Peprilus triacanthus*)

Eggs: EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to the south shore of Long Island, New York, in Chesapeake Bay, and on the continental shelf and slope, primarily from Georges Bank to Cape Hatteras, North Carolina. EFH for Atlantic butterfish eggs is generally found over bottom depths of 1,500 meters or less where average temperatures in the upper 200 meters of the water column are 6.5-21.5°C.

Larvae: EFH is pelagic habitats in inshore estuaries and embayments in Boston harbor, from the south shore of Cape Cod to the Hudson River, and in Delaware and Chesapeake bays, and on the continental shelf from the Great South Channel (western Georges Bank) to Cape Hatteras, North Carolina. EFH for Atlantic butterfish larvae is generally found over bottom depths between 41 and 350 meters where average temperatures in the upper 200 meters of the water column are 8.5-21.5°C.

Juveniles (≤11 cm FL): EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, in inshore waters of the Gulf of Maine and the South Atlantic Bight, and on the inner and outer continental shelf from southern New England to South Carolina. EFH for juvenile Atlantic butterfish is generally found over bottom depths between 10 and 280 meters where bottom water temperatures are between 6.5 and 27°C and salinities are above 5 ppt. Juvenile butterfish feed mainly on planktonic prey.

Adults (≥12 cm FL): EFH is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound, North Carolina, inshore waters of the Gulf of Maine and the South Atlantic Bight, on Georges Bank, on the inner continental shelf south of Delaware Bay, and on the outer continental shelf from southern New England to South Carolina. EFH for adult Atlantic butterfish is generally found over bottom depths between 10 and 250 meters where bottom water temperatures are between 4.5 and 27.5°C and salinities are above 5 ppt. Spawning probably does not occur at temperatures below 15°C. Adult butterfish feed mainly on planktonic prey, including squids and fishes.

Source: Amendment 11 to the Atlantic Mackerel, Squid, and Butterfish Fishery Management Plan. Mid-Atlantic Fishery Management Council, May 2011.

SCUP

EFH Text Descriptions for Scup (*Stenotomus chrysops*)

Eggs: EFH is estuaries where scup eggs were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, scup eggs are found from May through August in southern New England to coastal Virginia, in waters between 55 and 73 °F and in salinities greater than 15 ppt.

Larvae: EFH is estuaries where scup were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones . In general, scup larvae are most abundant nearshore from May through September, in waters between 55 and 73 °F and in salinities greater than 15 ppt.

Juveniles (≤15 cm TL): 1) Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ, from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where juvenile scup are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where scup are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juvenile scup are found during the summer and spring in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel and eelgrass bed type substrates and in water temperatures greater than 45 °F and salinities greater than 15 ppt.

Adults (>15 cm TL): 1) Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where adult scup are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where scup were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing and "seawater" salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45 °F.

Source: Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan, Mid-Atlantic Fishery Management Council, 1998.

SUMMER FLOUNDER

EFH Text Descriptions for Summer Flounder (*Paralichthys dentatus*)

<u>Eggs</u>: 1) North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of the all the ranked ten-minute squares for the area where summer flounder eggs are collected in the MARMAP survey. 2) South of Cape Hatteras, EFH is the waters over the continental shelf (from the coast out to the limits of the EEZ), from Cape Hatteras, North Carolina to Cape Canaveral, Florida, to depths of 360 ft. In general, summer flounder eggs are found between October and May, being most abundant between Cape Cod and Cape Hatteras, with the heaviest concentrations within 9 miles of shore off New Jersey and New York. Eggs are most commonly collected at depths of 30 to 360 ft.

<u>Larvae</u>: 1) North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where summer flounder larvae are collected in the MARMAP survey. 2) South of Cape Hatteras, EFH is the nearshore waters of the continental shelf (from the coast out to the limits of the EEZ), from Cape Hatteras, North Carolina to Cape Canaveral Florida, in nearshore waters out to 50 miles from shore. 3) Inshore, EFH is all the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database, in the "mixing" (defined in ELMR as 0.5 to 25.0 ppt) and "seawater" (defined in ELMR as greater than 25 ppt) salinity zones. In general, summer flounder larvae are most abundant nearshore (12-50 miles from shore) at depths between 30 to 230 ft. They are most frequently found in the northern part of the Mid-Atlantic Bight from September to February, and in the southern part from November to May.

<u>Juveniles (<28 cm TL)</u>: 1) North of Cape Hatteras, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where juvenile summer flounder are collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is the waters over the continental shelf (from the coast out to the limits of the EEZ) to depths of 500 ft, from Cape Hatteras, North Carolina to Cape Canaveral, Florida. 3) Inshore, EFH is all of the estuaries where summer flounder were identified as being present (rare, common, abundant, or highly abundant) in the ELMR database for the "mixing" and "seawater" salinity zones. In general, juveniles use several estuarine habitats as nursery areas, including salt marsh creeks, seagrass beds, mudflats, and open bay areas in water temperatures greater than 37 °F and salinities from 10 to 30 ppt range.

<u>Adults (≥28 cm TL)</u>: 1) North of Cape Hatteras, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares for the area where adult summer flounder are collected in the NEFSC trawl survey. 2) South of Cape Hatteras, EFH is the waters over the continental shelf (from the coast out to the limits of the EEZ) to depths of

500 ft, from Cape Hatteras, North Carolina to Cape Canaveral, Florida. 3) Inshore, EFH is the estuaries where summer flounder were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater" salinity zones. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer continental shelf at depths of 500 ft in colder months.

Source: Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan, Mid-Atlantic Fishery Management Council, 1998.

BLACK SEA BASS

EFH Text Descriptions for Black Sea Bass (*Centropristis striata*)

Eggs: EFH is the estuaries where black sea bass eggs were identified in the ELMR database as common, abundant, or highly abundant for the "mixing" and "seawater" salinity zones. Generally, black sea bass eggs are found from May through October on the continental shelf, from southern New England to North Carolina.

Larvae: 1) North of Cape Hatteras, EFH is the pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all ranked ten-minute squares of the area where black sea bass larvae are collected in the MARMAP survey. 2) EFH also is estuaries where black sea bass were identified as common, abundant, or highly abundant in the ELMR database for the "mixing" and "seawater salinity zones. Generally, the habitats for the transforming (to juveniles) larvae are near the coastal areas and into marine parts of estuaries between Virginia and New York. When larvae become demersal, they are generally found on structured inshore habitat such as sponge beds.

Juveniles (<19 cm TL): 1) Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked squares of the area where juvenile black sea bass are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where black sea bass are identified as being common, abundant, or highly abundant in the ELMR database for the mixing" and "seawater" salinity zones. Juveniles are found in the estuaries in the summer and spring. Generally, juvenile black sea bass are found in waters warmer than 43°F with salinities greater than 18 ppt and coastal areas between Virginia and Massachusetts, but winter offshore from New Jersey and south. Juvenile black sea bass are usually found in association with rough bottom, shellfish and eelgrass beds, man-made structures in sandy shelly areas; offshore clam beds and shell patches may also be used during the wintering.

Adults (≥19 cm TL: 1) Offshore, EFH is the demersal waters over the continental shelf (from the coast out to the limits of the EEZ), from the Gulf of Maine to Cape Hatteras, North Carolina, in the highest 90% of all the ranked ten-minute squares of the area where adult black sea bass are collected in the NEFSC trawl survey. 2) Inshore, EFH is the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" and seawater" salinity zones. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43°F seem to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are usually the substrate preference.

Source: Amendment 12 to the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan, Mid-Atlantic Fishery Management Council, 1998.

APPENDIX 4

BENTHIC RESOURCE SURVEY SCOPE OF WORK

PLAN FOR BENTHIC RESOURCE SURVEY
PROPOSED BERTH AND APPROACH CHANNEL
EDGEMOOR, DELAWARE

June 2019

Prepared for

Diamond State Port Corporation
1 Hausel Road
Wilmington, DE 19801

Prepared by

Duffield Associates, Inc.
5400 Limestone Road
Wilmington, Delaware 19808

Rebecca L. Harris
Project Manager

M. Richard Beringer, P.E., LEED AP
Senior Environmental Consultant

Project No. 11139.LH

Table of Contents

TABLE OF CONTENTS
(CONTINUED)

FIGURES

TABLE

ATTACHMENTS

1. INTRODUCTION

1.1. Purpose

The purpose of the sampling is to assess benthic and aquatic resources associated with Essential Fish Habitat (EFH) within the proposed berth and approach channel (hereinafter referred to as the "action area") of the Proposed Edgemoor Container Port project site (see Figure 1 – Action Area Location Sketch). Specifically, these aquatic resources include benthic prey species, fish and submerged aquatic vegetation (SAV). The sampling program will include beach seining, trawl sampling, benthos sampling, SAV sampling, and sediment grainsize analysis within the action area.

Points of contact for the project include:

Charlii Miller
Environmental Consulting Services Inc.
P.O. Box 138
Middletown, DE 19709
302.378.9881

Rebecca L. Harris
Duffield Associates, Inc.
5400 Limestone Road
Wilmington, DE 19808
302.239.6634

1.2. Project Description

The Diamond State Port Corporation, hereafter referred to as "the Applicant", intends to apply to the Corps for a Clean Water Act Section 404 Permit and a Rivers and Harbors Act Section 10 Permit for dredging related to the construction of a primary harbor entrance channel and ship berths (hereinafter referred to as the "proposed project" or "proposed action") at the Applicant's Edgemoor property located in Edgemoor, New Castle County, Delaware (hereinafter referred to as the "Edgemoor Site" – see Figure 1). Likewise, the Applicant will be applying for a State of Delaware Subaqueous Lands and Wetlands Permit for the project. The proposed project is located on the Delaware River in the southern portion of Reach B at the intersection of the Cherry Island and Bellevue Ranges, approximately two miles north of the Port of Wilmington.

The action area adjoins lands formerly occupied by the Chemours (DuPont) Edge Moor Facility. The former Edge Moor Facility was purchased by the Applicant in 2017 with the intention to expand port operations to this site and is currently unoccupied. The proposed container port is intended to acquire a portion of the projected increases in containerized cargo market demand that is anticipated to follow the expansion of the Panama Canal. The proposed project is anticipated to attract new containerized shipping commerce to the region rather than displace existing container operations, resulting in economic expansion and an employment boost for Delaware.

The proposed dredging of the approach channel and berth for the new port will be on State of Delaware subaqueous lands located offshore of the Applicant's property. The Applicant proposes to deepen portions of the Delaware River adjacent to the Federal navigation channel to create a primary access channel that will serve the proposed ship berth. The proposed project supports the redevelopment of the former industrial site into a multi-user containerized cargo port.

The proposed new entrance channel and berth area (approximately 85 acres) would be constructed by excavating the riverbank between the existing shore and the existing western side of the Federal navigation channel in the Delaware River. The Applicant currently is evaluating a range of proposed dredging depths from 38 feet mean lower low water (MLLW) to 45 feet MLLW. The estimated volume of sediment to be excavated to achieve the 45-foot depth is 3.7 million cubic yards. The maintained depth of the Federal navigation channel is 45 feet MLLW. The wharf along the shoreline, estimated to be 2,500 linear feet, would be constructed to secure container ships during loading and unloading and support large container cranes. Upland areas of the site would be graded to facilitate storage and land-based transport of cargo containers. Initial plans for the proposed port facility include the capability to berth two New Panamax container ships simultaneously.

During pre-application coordination with State and Federal agencies, the National Marine Fisheries Service (NMFS) Mid-Atlantic Regional Office, Protected Resources Division, provided a list of comments to the U.S. Army Corps of Engineers (USACE) Philadelphia District by letter, dated February 28, 2019 in response to the USACE's National Environmental Policy Act (NEPA) scoping letter, dated December 17, 2018. The comments indicated concern for potential project-related impacts to Essential Fish Habitat, Federally-managed species and their prey, aquatic organisms and SAV. They also responded with comments regarding the need to disclose contaminants in the dredging footprint adequately and the potential impacts from dredging on aquatic organisms.

As a result of these comments, the USACE and Duffield Associates, Inc. (Duffield) engaged in a discussion with the agencies to determine what information would be necessary to estimate impacts to habitat, aquatic resources, prey species, and other aquatic organisms, including fisheries species. A consensus was reached that an assessment of potential aquatic resources within the proposed project footprint/action area would be necessary to address these concerns. Contaminants within the dredging footprint are being addressed by a separate assessment.

1.3. Benthic Survey Objectives

The EFH Assessment is being performed to:

1. Characterize the benthic habitat and community including substrate, seagrasses, microbenthic organisms, and ambient water conditions within the proposed action area;

2. Compare similarities and differences in the benthic community between the proposed action area and adjacent areas;

3. Compare benthic habitat and community in the action area to areas where EFH-designated/fisheries species and prey species are known to occur in the Delaware River estuary; and

4. Characterize environmental water quality by measuring parameters such as dissolved oxygen, temperature, and salinity within the action area.

The data collected in this assessment will be used in the Environmental Assessment (EA) for the project to describe potential beneficial and adverse impacts from proposed dredging operations and construction of the proposed port on EFH, EFH-designated species, and fisheries species. It is important to note that a separate Biological Assessment (BA) is being prepared to address potential impacts specific to Atlantic and shortnose sturgeon as well as efforts to avoid and/or minimize those impacts.

2. INFORMATION COLLECTION

2.1. <u>Beach Seine</u>

The beach seine sampling follows methods used by NJDEP in beach seining conducted annually within the Delaware River between river kilometers (rkm) 94 and 213 (also known as river miles (RM) 59 and133). The primary focus of this seining is on white perch, striped bass, American shad, blueback herring and alewife, bay anchovy, spot, weakfish, bluefish, Atlantic silversides and Atlantic menhaden. The sampling gear and deployment procedure have been developed following the materials and methods described in Baum (1994) and personal communication with the principal investigator, Thomas Baum of the New Jersey Department of Environmental Protection (NJDEP). The beach seine sampling methods are also the same as Public Service Electric & Gas (PSEG) used for sampling since 1997.

Finfish and blue crabs collected will be identified to the lowest practicable taxonomic level, sorted by species, and counted. Length measurements will be determined in a representative subsample of each target species. In addition, water temperature, dissolved oxygen, and salinity will be recorded for each sample.

2.1.1. <u>Sampling Location</u>

Finfish, blue crabs, SAV, and other organisms will be sampled by deploying a beach seine in the near shore waters of the Delaware River off the Edgemoor Site during daylight hours. Daylight is defined as the period one hour after sunrise to one hour before sunset. The site will not be sampled by other gear for several days. Sampling will be at two locations shown on Figure 2 – Proposed Benthic Sample Location Sketch.

2.1.2 Sampling Gear and Implementation

Seine hauls are taken with a 100 x 6-ft bagged haul seine with a nylon mesh of 1/4 inch (square measure) following the PSEG and NJDEP beach seine programs. The haul seine is set from shore, by boat, perpendicularly until the bag is reached, at which time the remainder of the net is set in the direction of the tide in an arc-like fashion back to shore. The net is then hauled ashore by simultaneous pulling from each end of the net. During this process, crewmembers from each end of the net should gradually move toward each other; this serves to concentrate the catch in the center or bag of the net. During the entire retrieval process, effort should be made to keep the lead line in direct contact with the bottom and the float line at the surface. The standard sampling effort is a single haul at each station.

2.1.3 Sample Processing

After completion of the haul, the net is emptied and all finfish, blue crab, and other organisms are identified to the lowest practicable taxonomic level (usually species) and enumerated. Only specimens on the inside of the net and any gilled specimens whose body is inside the net (head outside) are considered as part of the catch. Any SAV encountered will be retained.

Identification keys are to be included in the equipment package on each vessel. Selected taxonomic references are provided in Table 1 – Taxonomic Keys and References. Any unidentifiable specimens will be preserved, size permitting, in a 10 percent formalin solution in a labeled jar for subsequent examination. To enhance preservation of specimens greater than 150 mm, cut a small slit in the abdominal cavity on the right side of the fish and puncture the swim bladder. If specimens are too large for preservation or retention (e.g., sharks and rays), note and record as many morphological and structural characteristics as possible and take a photograph (camera aboard) of specimen prior to release.

If an extremely large number (more than 1,000 specimens) of a species is taken, their number may be estimated by representative sub-sampling. The following sub-sampling technique is to be utilized. Fill an appropriate size container for the particular species to an identified level and count the specimens in this sub-sample. Repeat this procedure for three sub-samples. Compute the average number of specimens per sub-sample. Process the entire species catch by repeated filling of the container, maintaining a count of the number of sub-samples required. The estimated total number taken is computed as the product of the number per sub-sample times the number of sub-samples required to process the catch.

With each collection, a random sub-sample of 100 specimens of each target species is to be measured by 1-mm interval. **Target species are blueback herring, alewife, American shad, bay anchovy, weakfish, spot, Atlantic croaker, white perch, striped bass, bluefish, Atlantic silversides and Atlantic menhaden.** Species with emarginated or forked caudal fins are measured from the tip of the snout to the caudal fork (FL). Species without a caudal fork are measured to the tip of the longest caudal ray (TL). If fewer than 100 specimens of a target species are collected, all should be measured. Sub-samples are obtained by dip net or an alternate suitable device. The Finfish Monitoring Fish Processing Data Form, (see Attachment 1), can be utilized to aid in recording length measurements when large numbers of target fish are collected during a specific seine sample. The form includes four columns, each with spaces numbering from 0 - 100. Hash marks are entered on the lines that correspond to the specific measurement of a particular fish species. Additional boxes located at the top of the form allow for entering information that corresponds with the main data form, and includes the date, time, location, species name, species length, and number taken.

All fish are returned to the water except those retained for ID. Retained specimens are put in labeled jars and preserved in a 10 percent formalin. All labels must be rag paper (waterproof) and inscribed using indelible ink.

Water chemistry measurements are made in conjunction with all collections following sample processing. Air temperature, water temperature, dissolved oxygen, salinity, and water transparency are each measured with appropriate instrumentation that has been calibrated in accordance with the manufacturer's instructions. Surface measurements are made for all collections. Any value that appears abnormally high or low is re-measured and noted on the field sheet that the value was checked. In addition, record tidal stage and weather/water conditions with all collections.

2.1.4 Threatened or Endangered Species

The capture of either shortnose sturgeon, Atlantic sturgeon, or any species of sea turtle invokes special handling. These specimens are processed immediately and returned to the River. An identification key for sea turtles and sturgeon can be found in Attachment 2.

2.1.5 Laboratory Methods

Fishes not identifiable by field personnel are brought to the laboratory for identification by laboratory personnel. A reference collection is to be kept in the laboratory to supplement taxonomic keys and references. When neither field nor laboratory personnel are able to identify a specimen, it is forwarded to an expert in fish identification. Table 1 provides a bibliographic listing of the current taxonomic keys and references. Fishes retained for subsequent study are preserved in the following manner:

- Maintained in the field preservative (10 percent formalin) for 7 to 10 days.
- Washed in fresh water and allowed to remain in fresh water for 24 hrs.
- Washed again in fresh water and allowed to remain in fresh water for 24 hrs.
- Stored in 40 percent isopropyl alcohol solution.

2.1.6 Data Form Instructions

Data forms, similar to the one in Attachment 1, are to be filled out in accordance with the following set of instructions:

Serial Number – Unique serial number generated by contractor

Date - Enter the date of the sample collection (DD/MM/YYYY)

Investigators – Enter the initials of the personnel collecting the sample

Project – Enter the project (Edgemoor Beach Seine)

Site – Enter the Seine Station (1-2)

GPS Group – N/A

Survey Method – Enter “Beach Seine”

Gear – Enter “100’ Haul Seine”

Tide stage – Circle the appropriate entry according the following guidelines:

- F1 – Flood 1 – First half of the flood tide
- F2 – Flood 2 – Second half of the flood tide
- FS – Flood Slack
- E1 – Ebb 1 – First half of the ebb tide
- E2 – Ebb 2 – Second half of the ebb tide
- ES – Ebb Slack
- Other – Extremely high or low tides (provide detail in “notes”)

Weather – Circle the appropriate entry according to the following guidelines:

- 1 – Clear/Sunny
- 2 – Partly Cloudy
- 3 – Overcast

- 4 – Light Rain
- 5 – Heavy Rain
- 6 – Fog
- 7 – Snow
- 8 – Other
- 9 – Hazy

Wind direction – Circle the appropriate wind direction

Wave Height – Circle the appropriate wave height according to the following guidelines:

- 1 – Calm (0 inches)
- 2 – Slight (0-6 inches)
- 3 – Moderate (6-18 inches)
- 4 – Rough (18 inches to 4 feet)
- 5 – Very Rough (4-8 feet)

Start Time – Record the start time using a 24-hour format (military time).

End Time - Record the end time using a 24-hour format (military time).

Air Temp – Record the air temperature to the nearest 0.5ºC

Surface Temperature – Record the surface water temperature to the nearest 0.5ºC

Surface Salinity – Record the surface water salinity to the nearest 0.5 parts per thousand (ppth)

Surface DO – Record the surface water dissolved oxygen to the nearest 0.5 milligrams per liter (mg/l)

Depth – Record the minimum and maximum water depth during the sampling

Depth of sample – N/A

Depth strata – N/A

Water Clarity – Record the Secchi disk measurement in inches

Start Latitude – Record the station latitude in degrees, minutes, and seconds

Start Longitude – N/A

Stop Latitude – N/A

Stop Longitude – N/A

Start Flowmeter – N/A

Stop Flowmeter – N/A

Notes – Any comments, observations, or notes not covered in the above fields

Species – Enter the scientific name of the species collected (Spell out genera when ambiguities may occur (e.g. *M. saxatalis* could be either *Morone saxatalis* or *Menticirrus saxatalis*)

Life stage – N/A

Total counted – record the total number of the individual fish species collected for the appropriate species (if sub-sampling is utilized, use the "Notes" box to the right for recording the number per container and numbers of containers counted)

Total Weight – N/A

Weight Units – N/A

Total Measured – Record the number of individual fish measured (cannot exceed total taken)

Measurement Technique – Circle the appropriate option (F=Fork Length, T=Total Length, Other = Carapace width, wingspan, etc.)

Min Length – For non-target species, record the length of the smallest fish (of the applicable species) collected in the sample

Max Length – For non-target species, record the length of the largest fish (of the applicable species) collected in the sample

Notes – Record any fish anomalies, sub-sampling data, etc. in this box.

Length – For target species in small numbers, record the individual measurements on the front of the field sheet on the line for that species. For larger numbers, use the space provided on the back of the field sheet, recording "tic-marks" beside the appropriate length.

Continue as above until the entire catch has been processed. Upon completion of a day's sampling, the field biologist proofs the data form for any errors or omissions that may have occurred. The field biologist should initial the field "Proof 1 by:" at the bottom of the field after proofing the data. A second proof will be performed prior to data entry. The examiner should initial the field "Proof 2 by:" at the bottom of the field after proofing the data. The data entry technician will initial the field "Input By:" upon entering the data into the computerized database.

2.1.7 Quality Assurance

A quality assurance program is to be implemented for all field, laboratory, and data handling activities of this beach seine survey to ensure that work protocols meet high standards of accuracy. The following defines personnel responsibilities associated with field aspects of this program.

The sampling crew leader is responsible for ensuring that all field-related functions are performed according to approved Standard Operating Procedures (SOP) and is accountable for verifying data sheet accuracy. Sampling crew leaders must have at least two years of fisheries collection experience before being assigned to this position.

The project principal investigator (PI) conducts audits of the performances of the field crews by observing their activities directly. While in the field on selected days, the PI functions as an independent observer of activities, comparing the procedures used against the SOP and the program work plan. The PI must be a trained biologist with a minimum of five years' experience in the conduct of similar research projects.

3. BOTTOM TRAWL SAMPLING

The bottom trawl sampling follows procedures used in an established trawl monitoring survey conducted annually by the PSEG Estuary Enhancement Program, as a special condition of the their New Jersey Pollutant Discharge Elimination System (NJPDES) P permit. The survey augments an established trawl monitoring survey conducted annually by the Delaware Department of Natural Resources and Environmental Control (DNREC) in the inshore waters (along the Delaware shore) of the Delaware Bay and lower Delaware River between rkm 0 and 123 (RM 0 and 77).

For the purposes of this study, daylight is defined as the period beginning one hour after sunrise and ending one hour before the subsequent sunset. All sampling is at a standard speed, against the direction of the prevailing tide. Duration of the sampling is limited by the extents of the site.

3.1. Sampling Location

Finfish, blue crabs, SAV, and other organisms will be sampled by deploying a bottom trawl in the near shore waters of the Delaware River off the Edgemoor Site during daylight hours. Daylight is defined as the period one hour after sunrise to one hour before sunset. The site will not be sampled by other gear for several days. Sampling will be at three locations shown on Figure 1.

3.2 Sampling Gear and Implementation

Bottom hauls are taken with a 4.9-m (16 ft) semi-balloon otter trawl. The otter trawl used in this study is identical to the one utilized in the DNREC Small Trawl Survey and is described as follows:

> *Sixteen feet (ft) semi-balloon trawl; 17 ft head rope; 21 ft footrope; net made of nylon netting of the following size mesh and thread; 1½-inch (") stretch (3/4" square) mesh no. 9 thread body; 11/4" stretch (5/8" square) mesh no. 15 thread cod end, fully rigged with four 2" I.D. net rings at top and bottom for lazy line and purse rope. Inner liner of 1/2" stretch (1/4" square) mesh*

> *no. 63 knotless nylon netting inserted and hogtied in cod end. Head and footropes of 3/8" diameter poly-Dacron net rope with legs extended 3 ft and galvanized wire rope thimbles spliced in at each end. Six 11/2" x 2 1/2" sponge floats spaced evenly on bosom of head rope. Net treated in green net dip. Trawl doors are 24" in length and 12" in width. Doors made of 3/4" marine ply board 11/4 x 11/4" straps and braces, and 1/2 x 2" bottom shoe runner. 3/16" chain bridle, lap links and 5/16" swivels at the head of each bridle. 40-foot leg lines to common tow line. Towline = ½ inch.*

The trawl (and doors) is fished as rigged by the manufacturer (all links on doors free and functional). A towline to water depth ratio of 10:1 is to be maintained. If, in the judgment of the field crew leader, conditions (e.g. depth and or current, bottom substrate, etc.) preclude this ratio, the scope may be shortened to a minimum of 6:1.

A minimum water depth of five feet is required for bottom trawl sampling. Water depth is determined by the vessels' depth finder. Include the bridle length in the calculation.

To ensure that the trawl net will fish properly, make certain that:

- The towrope is attached securely to the bridle, and that the bridle is securely attached to the net.
- The cod-end of the net is tied securely along with the cod-end liner within.
- The net is not torn.
- All shackles are connected tightly.
- The doors have curved edges forward and the metal runners on the bottom, and the net and the cod-end are not twisted or knotted.
- The trawl and doors are fished as rigged by the manufacturer (all links on the doors free and functional).
- The net should not be separating from the float or chain lines.

Note: Spare rigged nets are carried onboard as replacements for damaged nets. Minor tears can be repaired in the field using net mending twine or plastic cable ties.

PSEG collections have used 10-min (timed by mechanical timer or stopwatch) durations at a standard speed of 6.0 feet per second (fps), against the prevailing tide. Fishing time commences when all required towline is deployed, and the deck crew informs the helmsman that the net is "fishing". The duration of Edgemoor collections may be limited by the length of the site in the direction of the current. While a 10-min, 6 fps trawl will be attempted, a lesser duration may be necessary.

At the commencement of sample collection, data are entered into the appropriate fields on the data form (Attachment 1). These include start time, and start latitude and longitude coordinates. While trawling, the boat operator is responsible for maintaining the established boat speed, monitor water depth, and navigate around any surface or submerged obstacle in the path of the net. During this period, the crew must maintain vigilance of the towrope to ensure maintenance of a proper scope angle and tautness such that a departure from normal fishing attitude is readily detected and corrective actions (speed or towline adjustment) can be affected.

If the trawl becomes hung on a bottom obstruction, abort the tow, empty the net, inspect it for damage, and repeat the collection. At completion of the time interval the boat is stopped and the trawl retrieved. If upon retrieval, it is discovered that obstructions (e.g., crab pots) have become entangled within the net mouth, repeat the tow.

Upon retrieval of the net, all appropriate fields are completed on the data form. These include ending time, and ending latitude and longitude coordinates. In addition, physicochemical measurements are collected at this time.

Tow speed standardization is required at the commencement of each tow. To standardize to 6.0 fps (water speed):

- Deploy Bottom Trawl
- Place flowmeter or speedometer probe over side of the boat (beyond bow wake turbulence) and adjust boat rpm to achieve 6.0 fps.

3.3 Sample Processing

After completion of the haul, the net is emptied and finfish, blue crab, and SAV specimens are identified to the lowest practicable taxonomic level (usually species), and enumerated. To assure removal of all specimens be sure to shake down cod end and examine the full-length net for small specimens entangled or gilled in the mesh, and specimens (e.g., blue crab), which may be clinging to the liner.

Identification keys are to be included in the equipment package on each vessel. Any unidentifiable specimens should be preserved, size permitting, in a 10 percent formalin solution in a labeled jar for subsequent examination. To enhance preservation of specimens greater than 150 mm, cut a small slit in the abdominal cavity on the right side of the fish and puncture the swim bladder. If specimens are too large for preservation or retention (e.g., sharks and rays), note and record as many morphological and structural characteristics as possible and take a photograph (camera on board) of specimens prior to release.

When an extremely large number of a species is taken (more than 2,000 specimens), their number may be estimated by representative sub-sampling. The following sub-sampling technique is to be utilized. Fill an appropriate size container for the particular species to an identified level and count the specimens in this sub-sample. Repeat this procedure for three sub-samples. Compute the average number of specimens per sub-sample. Process the entire species' catch by repeated filling of the container, maintaining a count of the number of sub-samples required. The estimated total number taken is computed as the product of the number per sub-sample times the number of sub-samples required to process the catch.

With each collection, a sub-sample of 100 specimens of each target species is to be measured by 1-mm interval. Target species include:

- Blueback herring;
- Alewife;
- American shad
- Bay anchovy;
- Weakfish;
- Spot;
- Atlantic croaker;
- White perch
- Striped bass
- Bluefish
- Atlantic silversides;
- Atlantic menhaden; and
- Blue crab.

Species with emarginated or forked caudal fins are measured from the tip of the snout to the caudal fork (FL). Species without a caudal fork are measured to the tip of the longest caudal ray (TL). If fewer than 100 specimens of a target species are collected, all should be measured. Non-target species are enumerated. The Baywide Finfish Monitoring Fish Processing Data Form, (Attachment 1), can be utilized to aid in recording length measurements when large numbers of target fish are collected during a specific trawl sample. The form includes four columns, each with spaces numbering from 0-100. Hash marks are entered on the lines that correspond to the specific measurement of a particular fish species. Additional boxes located at the top of the form allow for entering information that corresponds with the main data form, and includes the date, time, location, species name, species length, and number taken.

All fish are returned to the water except those for future designated use in specific fisheries programs (e.g., food habits). Retained specimens are put in labeled jars and preserved in a 10 percent formalin solution or an alternate preservative as a special study may require. All labels must be made of rag paper (waterproof) and inscribed using indelible ink.

Water chemistry measurements are made in conjunction with all collections. Air temperature, water temperature, dissolved oxygen, and salinity are recorded using the appropriate instrumentation (e.g. YSI Model 85, Cole Parmer, etc.). Water transparency is measured with a limnological secchi disk. Surface, mid-depth and bottom measurements are made with all collections where water depth is greater than 10 feet. Depths of less than 10 feet require only surface measurements. Any value that appears abnormally high or low is re-measured and noted on the field sheet that the value was checked. In addition, record tidal stage and weather/water conditions with all collections.

3.4 Threatened or Endangered Species

The capture of either shortnose sturgeon, Atlantic sturgeon, or any species of sea turtle invokes special handling. These specimens are processed immediately and returned to the River. As stated previously, an identification key is included in Attachment 2.

Return those fishes not identifiable by field personnel to the laboratory for identification. A reference collection is kept in the laboratory to supplement taxonomic keys and references. When neither field nor laboratory personnel are able to identify a specimen, it is forwarded to an expert in fish identification. Table 1 provides a bibliographic listing of the current taxonomic keys and references. Fishes retained for subsequent study are preserved in the following manner:

- Fish are maintained in the field preservative (10 percent formalin) for 7 to 10 days.
- Fish are then washed in fresh water and allowed to remain in fresh water for 24 hrs.
- Fish are then washed in fresh water and allowed to remain in fresh water for 24 hrs.
- Fish are stored in 40 percent isopropyl alcohol solution.

3.5 Data Form Instructions

Data forms for bottom trawl sampling, similar to Attachment 1, are to be filled out in accordance with the following set of instructions:

Serial Number – Unique serial number generated by contractor

Date - Enter the date of the sample collection (DD/MM/YYYY)

Investigators – Enter the initials of the personnel collecting the sample

Project – Enter the project (Edgemoor Bottom Trawl)

Site – Enter the Trawl Zone (1-8)

GPS Group – Enter the number of the "cell" sampled

Survey Method – Enter "Bottom Trawl"

Gear – Enter "16 ft. Bottom Trawl" or "02"

Tide stage – Circle the appropriate entry according the following guidelines:

- F1 – Flood 1 – First half of the flood tide
- F2 – Flood 2 – Second half of the flood tide
- FS – Flood Slack
- E1 – Ebb 1 – First half of the ebb tide
- E2 – Ebb 2 – Second half of the ebb tide
- ES – Ebb Slack
- Other – Extremely high or low tides (provide detail in "notes")

Weather – Circle the appropriate entry according to the following guidelines:

1 – Clear/Sunny

2 – Partly Cloudy

3 – Overcast

4 – Light Rain

5 – Heavy Rain

6– Fog

7– Snow

8– Other

9– Hazy

Wind direction – Circle the appropriate wind direction

Wave Height – Circle the appropriate wave height according to the following guidelines:

1 – Calm (0 inches)

2 – Slight (0-6 inches)

3 – Moderate (6-18 inches)

4 – Rough (18 inches to 4 feet)

5 – Very Rough (4-8 feet)

Notes – Any comments, observations, or notes not covered in the above fields.

Target and Non-Target Species – Enter the scientific name of the species collected (Spell out genera when ambiguities may occur (e.g. *M. saxatalis* could be either *Morone saxatalis* or *Menticirrus saxatalis*)

Total counted/taken – record the total number of the individual fish species collected for the appropriate species (if sub-sampling is utilized, use the "Notes" box to the right for recording the number per container and numbers of containers counted)

No. Measured – Record the number of individual fish measured (cannot exceed total taken)

Units – Circle the appropriate units used for measurement (mm, m, in, or ft)

Technique – Circle the appropriate measurement technique used (F=Fork Length, T=Total Length, CW = Carapace width)

Notes – Record any fish anomalies, sub-sampling data, etc. in this box.

Length – For target species, enter the length of each individual measured up to 100 specimens.

Continue as above until the entire catch has been processed. Upon completion of a day's sampling, the field biologist proofs the data form for any errors or omissions that may have occurred. The field biologist should initial the field "Proof 1 by:" at the bottom of the field after proofing the data. A second proof will be performed prior to data entry. The examiner should initial the field "Proof 1 by:" at the bottom of the field after proofing the data. The data entry technician will initial the field "Input By:" upon entering the data into the computerized database.

3.6 Quality Assurance

A quality assurance program is to be implemented for all field, laboratory, and data handling activities of the bay-wide trawl survey to ensure that work protocols meet high standards of accuracy. The following defines personnel responsibilities associated with field aspects of this program.

The sampling crew leader is responsible for ensuring that all field-related functions are performed according to approved Standard Operating Procedures (SOP) and is accountable for verifying data sheet accuracy. Field crew leaders must have at least two years of fisheries collection experience before being assigned to this position.

The project principal investigator (PI) conducts audits of the performances of the field crews by observing their activities directly. While in the field on selected days, the PI functions as an independent observer of activities, comparing the procedures used against the SOP and the program work plan. The PI must be a trained biologist with a minimum of five years' experience in the conduct of similar research projects.

4. BENTHOS AND SEDIMENT SAMPLING

4.1. Sampling Locations

Benthos samples will be collected from 14 locations within three depth stratums as shown in Figure 1. Depth zones will be defined as:

- Shallow - <10 ft;
- Intermediate - 10-20 ft.; and
- Deep - >20 ft.

4.2 Sampling Gear and Implementation

Sampling methods follow those used in a comprehensive survey of the epi- and infaunal benthic macroinvertebrate communities of the Delaware River from Trenton, NJ to the C&D Canal. That survey provided current and seasonal data regarding the community composition, diversity, abundance and distribution of benthic macroinvertebrates.

A petite Ponar, shown in Attachment 3, will be used to collect four sediment samples. A Petite Ponar is capable of sampling a 6" x 6" area. An additional sample, for a total of five samples at each of the 14 locations, will be retained for grain size analysis.

4.3 Sample Processing

Samples will be preserved in the field with pH buffered 10% formalin in ambient water. Rose bengal is added to stain the organisms.

4.4 Laboratory Methods

Samples are first washed in a 500 micron mesh sieve. All material retained in the sieve is placed in a container with 40 percent isopropyl alcohol. The sample is subsequently placed in a tray on a light table and the stained organisms or parts are removed and placed in vials with 40 percent isopropyl alcohol.

The specimens are identified, measured, and counted using a dissecting microscope.

4.5 Data Form Instructions

Benthic organisms will be identified to Family and recorded on a Benthic Macroinvertebrate data sheet (see Attachment 4).

4.6 Quality Assurance

A quality assurance program is to be implemented for all field, laboratory, and data handling activities of the benthos and sediment sampling to ensure that work protocols meet high standards of accuracy. The following defines personnel responsibilities associated with field aspects of this program.

The sampling crew leader is responsible for ensuring that all field-related functions are performed according to approved Standard Operating Procedures (SOP) and is accountable for verifying data sheet accuracy. Field crew leaders must have at least two years of collection experience before being assigned to this position.

The project principal investigator (PI) conducts audits of the performances of the field crews by observing their activities directly. While in the field on selected days, the PI functions as an independent observer of activities, comparing the procedures used against the SOP and the program work plan. The PI must be a trained biologist with a minimum of five years' experience in the conduct of similar research projects.

5. SUBMERGED AQUATIC VEGETATION

5.1 Sampling Locations

SAV sampling will occur at the same 14 locations as the benthic sampling (see Figure 1).

5.2 Sampling Gear and Implementation

The five Petite Ponar grabs described in Section 4.2 will also be used to sample SAV (if present) at each of the 14 locations identified on Figure 1.

After completion of the Petite Ponar sampling, a 32-inch sampling rake will be used, if necessary, to cover a larger area (see Attachment 5).

5.3 Sample Processing

SAV, if present, will be photographed and the samples will be retained in plastic bags on ice for transport to the laboratory.

5.4 Laboratory Methods

SAV will be retained on ice in the laboratory and identified, if warranted.

5.5 Data Form Instructions

SAV species and sample locations will be recorded.

5.6 Quality Assurance

A quality assurance program is to be implemented for all field, laboratory, and data handling activities of the SAV survey to ensure that work protocols meet high standards of accuracy. The following defines personnel responsibilities associated with field aspects of this program.

The sampling crew leader is responsible for ensuring that all field-related functions are performed according to approved Standard Operating Procedures (SOP) and is accountable for verifying data sheet accuracy. Field crew leaders must have at least two years of collection experience before being assigned to this position.

The project principal investigator (PI) conducts audits of the performances of the field crews by observing their activities directly. While in the field on selected days, the PI functions as an independent observer of activities, comparing the procedures used against the SOP and the program work plan. The PI must be a trained biologist with a minimum of five years' experience in the conduct of similar research projects.

6. SCHEDULE

The sampling is anticipated to start mid-July 2019. The trawl hauls, benthos/SAV collection and beach seining efforts are each expected to take approximately one day to complete. Overall, including travel time, the field/sampling effort is expected to be completed in one week. Following collection of the benthos and aquatic samples, processing of the samples will be completed in approximately 4 - 6 weeks.

7. REPORTING

Duffield will prepare a report summarizing and assessing the results of the field effort and specimen analyses. Professional opinions regarding the potential impact and/or recovery of organisms and the benthic community post-dredging will be included in the report. Field data sheets and lab processing sheets will be provided as attachments to the report.

Based on the results of the survey, Duffield will discuss recommendations and potential strategies to avoid and/or minimize impact, if warranted, with the Client, NMFS-Protected Resource Division (NMFS-PRD) and Delaware's Department of Natural Resources and Environmental Control's (DNREC) Fish and Wildlife Section (FWS). The final report will be submitted directly to NMFS-PRD and DNREC-FWS and will be included as an appendix to our federal and State of Delaware permit application packages.

11139LH.0619-BenthicResource SurveyScopeOfWork.RPT

FIGURE 1

ACTION AREA LOCATION SKETCH

Date: 06/2019	PROPOSED EDGEMOOR CONTAINER PORT PROJECT SITE	DESIGNED BY: JLF	DUFFIELD ASSOCIATES Soil, Water & the Environment
SCALE: AS SHOWN	**ACTION AREA LOCATION SKETCH**	DRAWN BY: JLF	5400 LIMESTONE ROAD WILMINGTON, DE 19808-1232 TEL. (302)239-6634 FAX (302)239-8485
PROJECT NO. 11139.LH		CHECKED BY: RLH	OFFICES IN PENNSYLVANIA, SOUTHERN DELAWARE, MARYLAND AND NEW JERSEY
FIGURE 1	WILMINGTON~NEW CASTLE COUNTY~DE	FILE: 11139LH.0519.EFHFigure1.mxd	EMAIL: DUFFIELD@DUFFNET.COM

FIGURE 2

PROPOSED BENTHIC SAMPLE LOCATION SKETCH

Date: 06/2019	PROPOSED EDGEMOOR CONTAINER PORT PROJECT SITE	DESIGNED BY: JLF	DUFFIELD ASSOCIATES Soil, Water & the Environment
SCALE: AS SHOWN	**PROPOSED BENTHIC SAMPLING LOCATIONS**	DRAWN BY: JLF	5400 LIMESTONE ROAD WILMINGTON, DE 19808-1232 TEL. (302)239-6634 FAX (302)239-8485
PROJECT NO. 11139.LH		CHECKED BY: RLH	OFFICES IN PENNSYLVANIA, SOUTHERN DELAWARE, MARYLAND AND NEW JERSEY
FIGURE 2	WILMINGTON~NEW CASTLE COUNTY~DE	FILE: 11139LH.0519 Benthic SamplingLocations..mxd	EMAIL: DUFFIELD@DUFFNET.COM

TABLE 1

TAXONOMIC KEYS AND REFERENCES

Table 1 - Taxonomic Keys and Reference

Bigelow, H. B., and W. C. Schroeder. 1953. Fishes of the Gulf of Maine. U.S. Fish Wildl. Serv. Fish. Bull. 74, Vol. 53:577 p.

Breder, C. M., Jr. 1948. Field book of marine fishes of the Atlantic Coast. G. P. Putnams and Sons, New York. 332 p.

Eddy, S. 1957. The freshwater fishes. Wm. C. Brown Co., Dubuque, Iowa. 253 p.

Flescher, D. D. 1980. Guide to some trawl-caught marine fishes from Maine to Cape Hatteras, North Carolina. NOAA Tech. Rept., NMFS Circ. 431. 35 p.

Hildebrand, S. F., and W. C. Schroeder. 1928. Fishes of Chesapeake Bay. U.S. Fish Wildl. Serv. Bull. Pt. 1, Vol. 53:388 p.

Kathman, R.D., and R.O. Brinkhurst. 1999. Guide to the freshwater oligochaetes of North America, Aquatic Resources Center, College Grove, TN. 264 pp.

Merritt, R. W., and K. W. Cummins (eds.). 1984. An introduction to the aquatic insects of North America, 2nd edition. Kendall/Hunt Publ. Co., Dubuque, Iowa. 722 pp.

Robins, C. R., R. M. Bailey, C. E. Bond, J. R. Brooker, E. A. Lachner, R. N. Lea, and W. B. Scott. 1991. A list of common and scientific names of fishes from the United States and Canada. 5th ed. American Fisheries Society. Special Publ. No. 20. 183 p.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Fish. Res. Bd. Can., Bull. 184:966 p.

U.S. Fish & Wildlife Service. 1978. Development of fishes of the mid-Atlantic Bight: an atlas of egg, larval and juvenile stages. U.S. Fish Wildl. Serv. Doc. FWS/OBS-78/12.

Wang, J.C.S., and R. J. Kernehan. 1979. Fishes of the Delaware Estuaries: A guide to early life histories. Ecological Analysts, Inc. 410 p.

Ward, W.B., and G.C. Whipple(eds.). 1959. Fresh-Water Biology, 2nd edition. J Wiley & Sons, New York. 1248 pp.

Wiggins, G.B. 1977. Larvae of the North American caddisfly genera (Trichoptera). Univ. of Toronto Press, Toronto. 401pp

ATTACHMENT 1

FINFISH MONITORING DATA SHEET

ESD Observation Event ID:

DATA FORM
BAYWIDE FINFISH MONITORING FISH PROCESSING

PSEG ESTUARY ENHANCEMENT PROGRAM

Serial No. ____________ Date:__________ Investigators:______________ Project: **Baywide Bottom Trawl** Site:____________

GPS Group:____________ Survey Method:_____**BT**_____Gear: _____**02**_____ Tide Stage: F1 F2 FS E1 E2 ES Other

Weather: 1 2 3 4 5 6 7 8 9 Wind: N NE E SE S SW W NW Wave Height: 1 2 3 4 5 Start Time:_______End Time:______

Air Temp:____.__Surface Water Temp:____.__ Mid- Water Temp:____.__Bot Water Temp:____.__ Surface Sal:____.__ Mid-Sal:____.__ Bot Sal:____.__

Surface DO:____.__Mid DO:____.__ Bot DO:____.__ DEPTH Min:______ Max ______ Depth of Sample: Min:______ Max:______ Depth Strata:__________

Water Clarity:________ Start Lat:____°_____.______' Start Long. :____°_____.______' Stop Lat:____°_____.______' Stop Long.:____°_____.______'

Start Flowmeter:____________ Stop Flowmeter:______________ Flow Meter #:_________ WQ Meter #:_________Notes:________________

NON TARGET SPECIES	TOTAL COUNTED	NOTES		NON-TARGET SPECIES	TOTAL COUNTED	NOTES

Revised July 2010

Page _____ of _____ Proof 1 By:__________ Proof 2 By:______________ Input By:____________

DATA FORM

BAYWIDE FINFISH MONITORING FISH PROCESSING

Date: Time: Location: Note:

Target Species:						Target Species:						Target Species:						Target Species:					
# Taken:						# Taken:						# Taken:						# Taken:					
# Measured:						# Measured:						# Measured:						# Measured:					
Units: mm m in ft						Units: mm m in ft						Units: mm m in ft						Units: mm m in ft					
Technique: F T CW						Technique: F T CW						Technique: F T CW						Technique: F T CW					
1		35		69		1		35		69		1		35		69		1		35		69	
2		36		70		2		36		70		2		36		70		2		36		70	
3		37		71		3		37		71		3		37		71		3		37		71	
4		38		72		4		38		72		4		38		72		4		38		72	
5		39		73		5		39		73		5		39		73		5		39		73	
6		40		74		6		40		74		6		40		74		6		40		74	
7		41		75		7		41		75		7		41		75		7		41		75	
8		42		76		8		42		76		8		42		76		8		42		76	
9		43		77		9		43		77		9		43		77		9		43		77	
10		44		78		10		44		78		10		44		78		10		44		78	
11		45		79		11		45		79		11		45		79		11		45		79	
12		46		80		12		46		80		12		46		80		12		46		80	
13		47		81		13		47		81		13		47		81		13		47		81	
14		48		82		14		48		82		14		48		82		14		48		82	
15		49		83		15		49		83		15		49		83		15		49		83	
16		50		84		16		50		84		16		50		84		16		50		84	
17		51		85		17		51		85		17		51		85		17		51		85	
18		52		86		18		52		86		18		52		86		18		52		86	
19		53		87		19		53		87		19		53		87		19		53		87	
20		54		88		20		54		88		20		54		88		20		54		88	
21		55		89		21		55		89		21		55		89		21		55		89	
22		56		90		22		56		90		22		56		90		22		56		90	
23		57		91		23		57		91		23		57		91		23		57		91	
24		58		92		24		58		92		24		58		92		24		58		92	
25		59		93		25		59		93		25		59		93		25		59		93	
26		60		94		26		60		94		26		60		94		26		60		94	
27		61		95		27		61		95		27		61		95		27		61		95	
28		62		96		28		62		96		28		62		96		28		62		96	
29		63		97		29		63		97		29		63		97		29		63		97	
30		64		98		30		64		98		30		64		98		30		64		98	
31		65		99		31		65		99		31		65		99		31		65		99	
32		66		100		32		66		100		32		66		100		32		66		100	
33		67				33		67				33		67				33		67			
34		68				34		68				34		68				34		68			

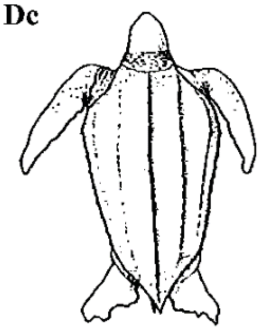
ATTACHMENT 2

SEA TURTLE AND STURGEON IDENTIFICATION KEY

Identification Key for Sea Turtles and Sturgeon Found in Northeast U.S. Waters

SEA TURTLES

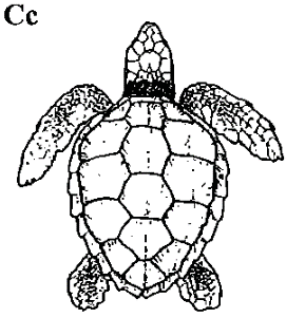
Dc



Leatherback (*Dermocheyls coriacea*)

Found in open water throughout the Northeast from spring through fall. Leathery shell with 5-7 ridges along the back. Largest sea turtle (4-6 feet). Dark green to black; may have white spots on flippers and underside.

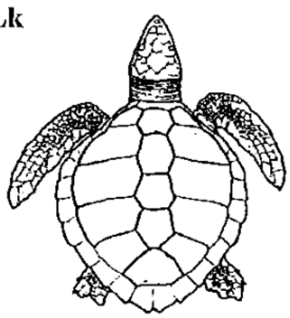
Cc



Loggerhead (*Caretta caretta*)

Bony shell, reddish-brown in color. Mid-sized sea turtle (2-4 feet). Commonly seen from Cape Cod to Hatteras from spring through fall, especially in southern portion of range. Head large in relation to body.

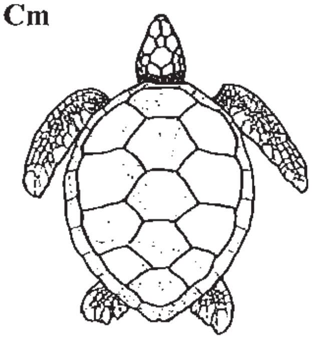
Lk



Kemp's ridley (*Lepidochelys kempi*)

Most often found in Bays and coastal waters from Cape Cod to Hatteras from summer through fall. Offshore occurrence undetermined. Bony shell, olive green to grey in color. Smallest sea turtle in Northeast (9-24 inches). Width equal to or greater than length.

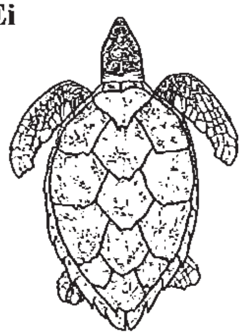
Cm



Green turtle (*Chelonia mydas*)

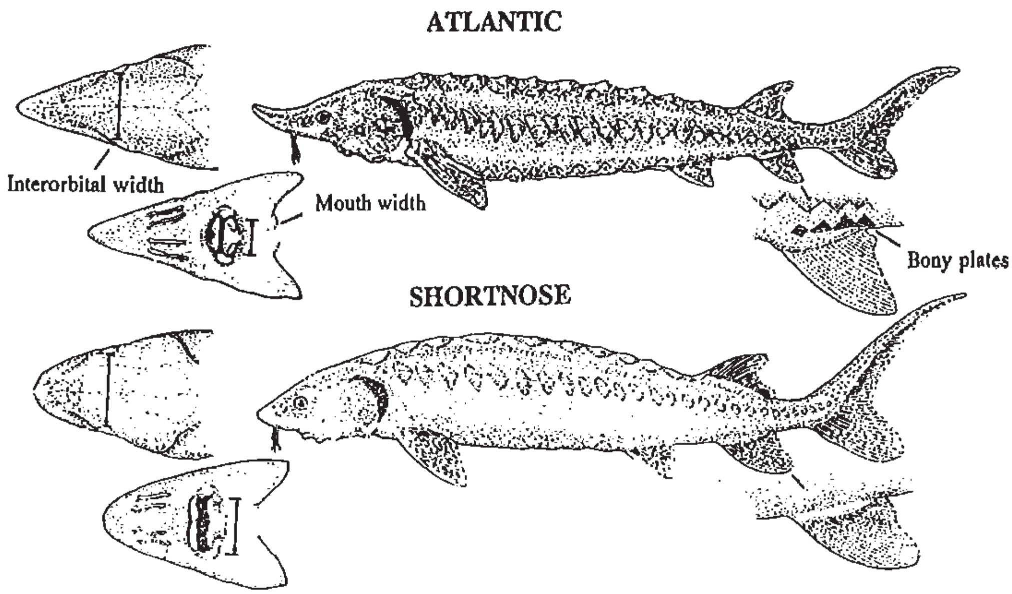
Uncommon in the Northeast. Occur in Bays and coastal waters from Cape Cod to Hatteras in summer. Bony shell, variably colored; usually dark brown with lighter stripes and spots. Small to mid-sized sea turtle (1-3 feet). Head small in comparison to body size.

Ei



Hawksbill (*Eretmochelys imbricata*)

Rarely seen in Northeast. Elongate bony shell with overlapping scales. Color variable, usually dark brown with yellow streaks and spots (tortoise-shell). Small to mid-sized sea turtle (1-3 feet). Head relatively small, neck long.



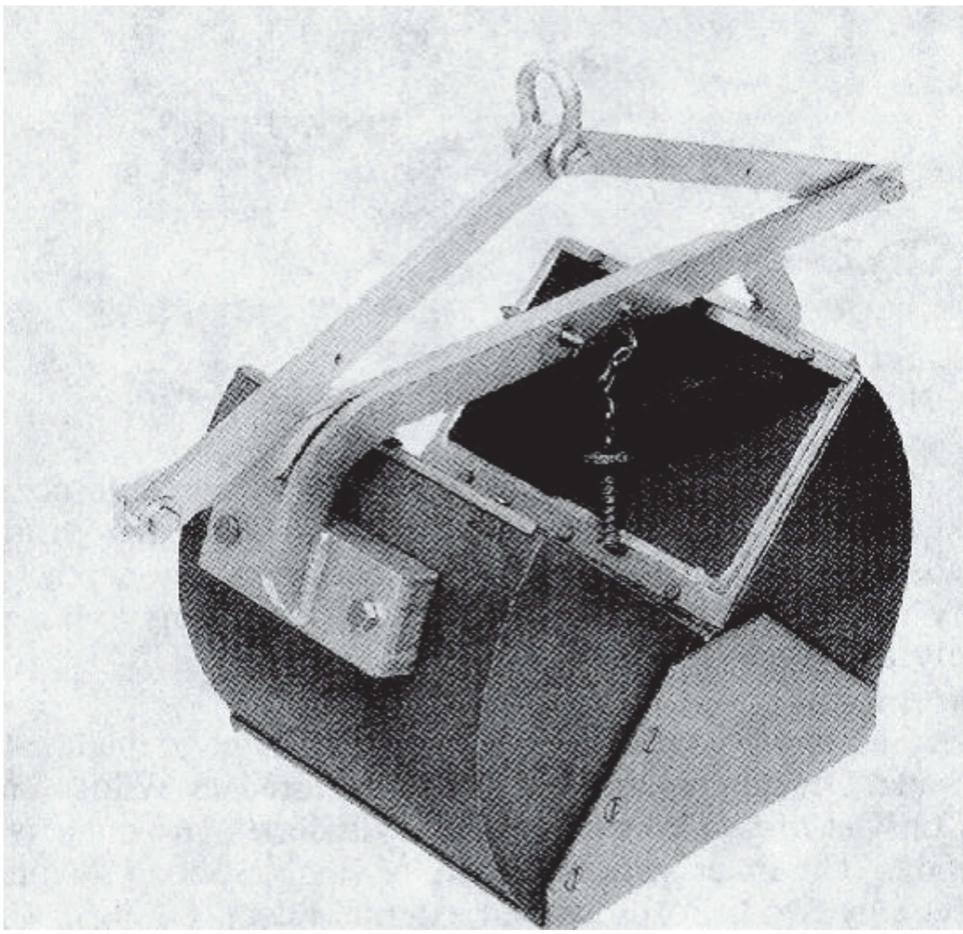
Distinguishing Characteristics of Atlantic and Shortnose Sturgeon

Characteristic	Atlantic Sturgeon, *Acipenser oxyrinchus*	Shortnose Sturgeon, *Acipenser brevirostrum*
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004

ATTACHMENT 3

PETITE PONAR SKETCH



ATTACHMENT 4

BENTHIC MACROINVERTEBRATE DATA SHEET

Environmental Consulting Services, Inc.

Rapid Bioassessment Protocol

BENTHIC MACROINVERTEBRATE LABORATORY DATA SHEET

Site Name		Location
Collected by	Date	Station #
Taxonomist	Date	
		Subsample target

Organisms	No.	LS	Tol Val	FFG	Organisms	No.	LS	Tol Val	FFG
Oligochaeta					**Megaloptera**				
Hirudinae									
					Coleoptera				
Turbellaria									
Isopoda									
					Diptera				
Amphipoda									
Decopoda									
Ephemeroptera									
					Gastropoda				
					Pelecypoda				

Plecoptera									
					Odonata				
Trichoptera									
					Other				
Hemiptera									

LS = Lifestage; I = immature, P = pupa, A = adult,

Tol Val = Tolerance value FFG = Functional feeding group

Total No. Organisms ________________ **Total No. Taxa** _______________

ATTACHMENT 5

SUBMERGED AQUATIC VEGETATION
RAKE SKETCH

APPENDIX 5

2018 SUBMERGED AQUATIC VEGETATION SURVEY

Submerged Aquatic Vegetation Survey
for the Edgemoor Site

Prepared for

Duffield Associates, Inc.
5400 Limestone Rd.
Wilmington, DE 19808

Prepared by

Charles C. Miller, MS.

Environmental Consulting Services, Inc.
100 South Cass Street
Middletown, Delaware 19709

October 29, 2018

Introduction

This report is a Submerged Aquatic Vegetation (SAV) survey of the proposed Edgemoor Dredging Site adjacent to the old Dupont titanium dioxide production center on 114 Hay Road.

Methods

The near shore waters, beach and hard structures in the water will be checked for SAV, other aquatic vegetation, or plant debris. Six or more random benthic grabs will be taken in shallow water to look for SAV. Delaware and New Jersey literature will be checked for historical references to SAV for the area.

A Petite Ponar grab sampler was used to collect benthic samples.

Six benthic grabs were collected from 4 to 6 feet of water at about mean low water. If SAV was observed additional sample would have been taken to define the area utilized by SAV.

Edgemoor Site benthic sampling locations (10/22/2018).

Results

Benthic grab sample #1 (10/22/2018).

The benthic sample was soft sediment with no observed SAV.

No SAV or other aquatic vegetation was observed on or around the two parallel piers at the north end of the site.

No SAV or other aquatic vegetation was observed on or around the base of the metal tower to the south of the piers.

Beach behind benthic grab sample #1 location (10/22/2018).

The beach area adjacent to benthic sample #1 contained no SAV or other aquatic vegetation. The upper portion of the beach contained large tree trunks. There was no observed emergent aquatic vegetation. The lower portion was composed of sand gravel and concrete rubble.

Benthic grab sample #2 (10/22/2018).

The benthic sample was soft sediment and gravel with no observed SAV.

Beach behind benthic grab sample #2 location.

The beach area adjacent to benthic sample #2 contained no SAV or other aquatic vegetation. The upper portion of the beach contained rip-rap and rubble. There was no observed emergent aquatic vegetation. The lower portion was composed of sand gravel and concrete rubble.

Benthic grab sample #3 (10/22/2018).

The benthic sample was soft sediment and gravel with no observed SAV.

Beach behind benthic grab sample #3 location.

The narrow beach area adjacent to benthic sample #3 contained no SAV or other aquatic vegetation. The upper portion of the beach contained gabion baskets, rip-rap and rubble. There was no observed emergent aquatic vegetation. The lower portion was composed of sand gravel and concrete rubble.

The pilings contained no SAV or other aquatic vegetation.

Beach behind benthic grab sample #3 location.

Benthic grab sample #4 (10/22/2018).

The benthic sample was soft sediment and gravel with no observed SAV.

Beach behind benthic grab sample #4 location.

The shoreline adjacent to benthic sample #4 contained no SAV or other aquatic vegetation. The shoreline contained pilings, rip-rap and concrete rubble.

The pilings contained no SAV or other aquatic vegetation.

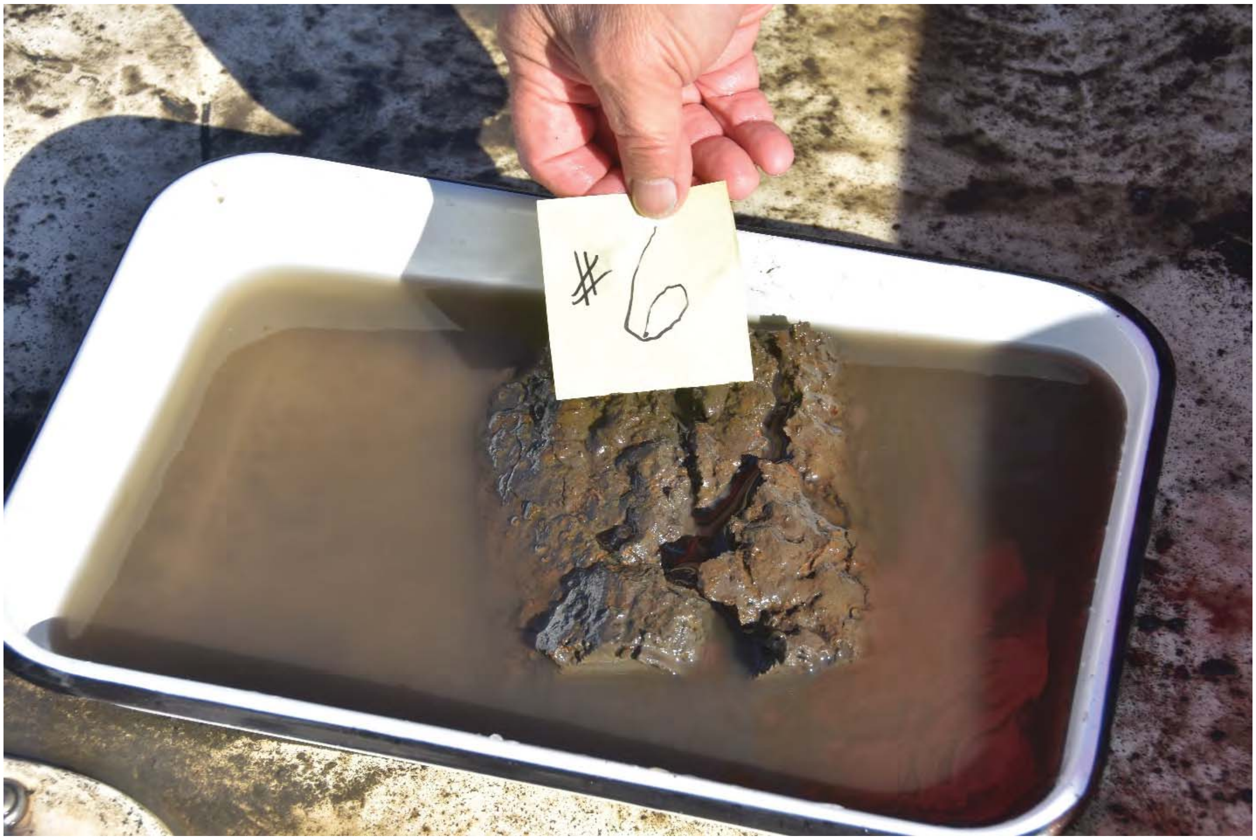
Benthic grab sample #5 (10/22/2018).

The benthic sample was soft sediment with no observed SAV.

Beach behind benthic grab sample #5 location.

The shoreline adjacent to benthic sample #5 contained no SAV or other aquatic vegetation. The shoreline contained pilings, rip-rap and concrete rubble.

The pilings contained no SAV or other aquatic vegetation.



Benthic grab sample #6 (10/22/2018).

The benthic sample was soft sediment with no observed SAV.

Beach behind benthic grab sample #6 location.

The shoreline adjacent to benthic sample #6 contained no SAV or other aquatic vegetation. The shoreline contained pilings, rip-rap and concrete rubble.

The pilings contained no SAV or other aquatic vegetation.

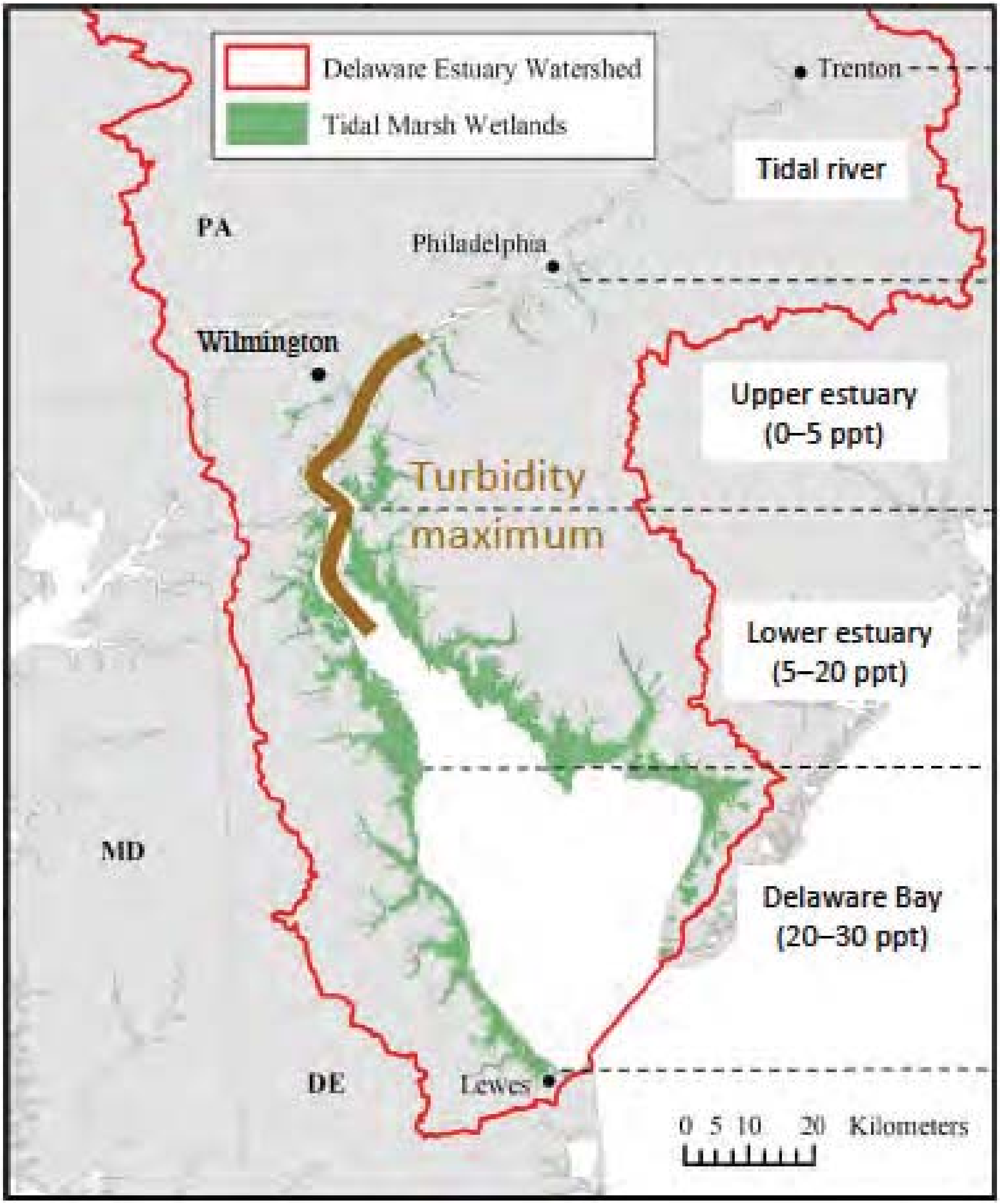
Observations

This reach of the river experiences high energy in the littoral zone from wind, tide, and shipping traffic. Evidence is the extensive armoring of the shoreline with Rip-rap, gabion baskets, and pilings. The area had very little emergent aquatic vegetation.

The water in this reach of the river is consistently turbid which is apparent in the photographs. Turbidity is to be expected as this is the area where fresh water from the Delaware River begins mixing with the saline waters of Delaware Bay and clay minerals precipitate.

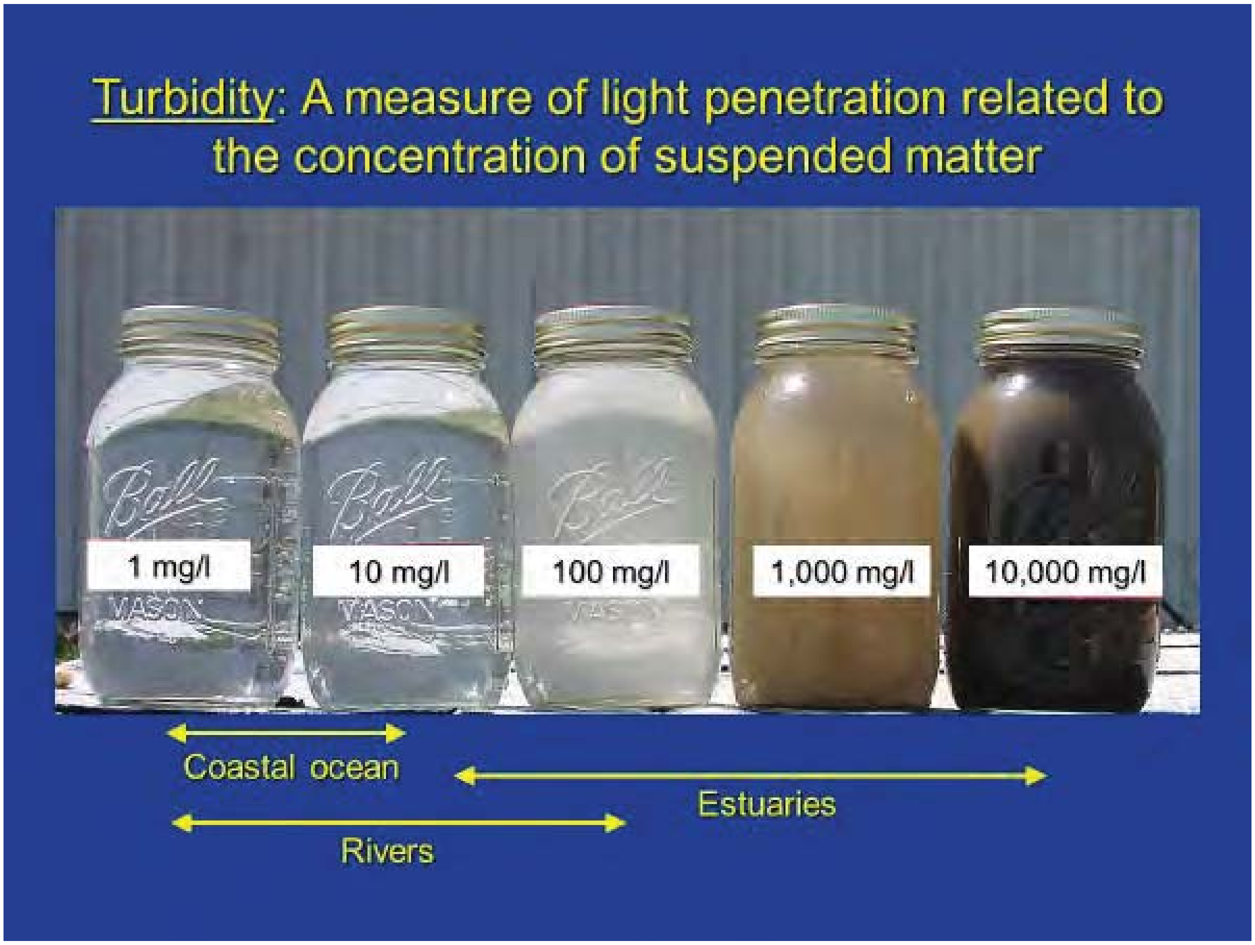
ECSI Beach seine site #71, for another client, at the north end of the Edgemoor Site, and sampled from 2002 through 2015, produced no SAV.

Delaware and New Jersey literature reviewed contained no reference to SAV in the Proposed Edgemoor Dredging site.



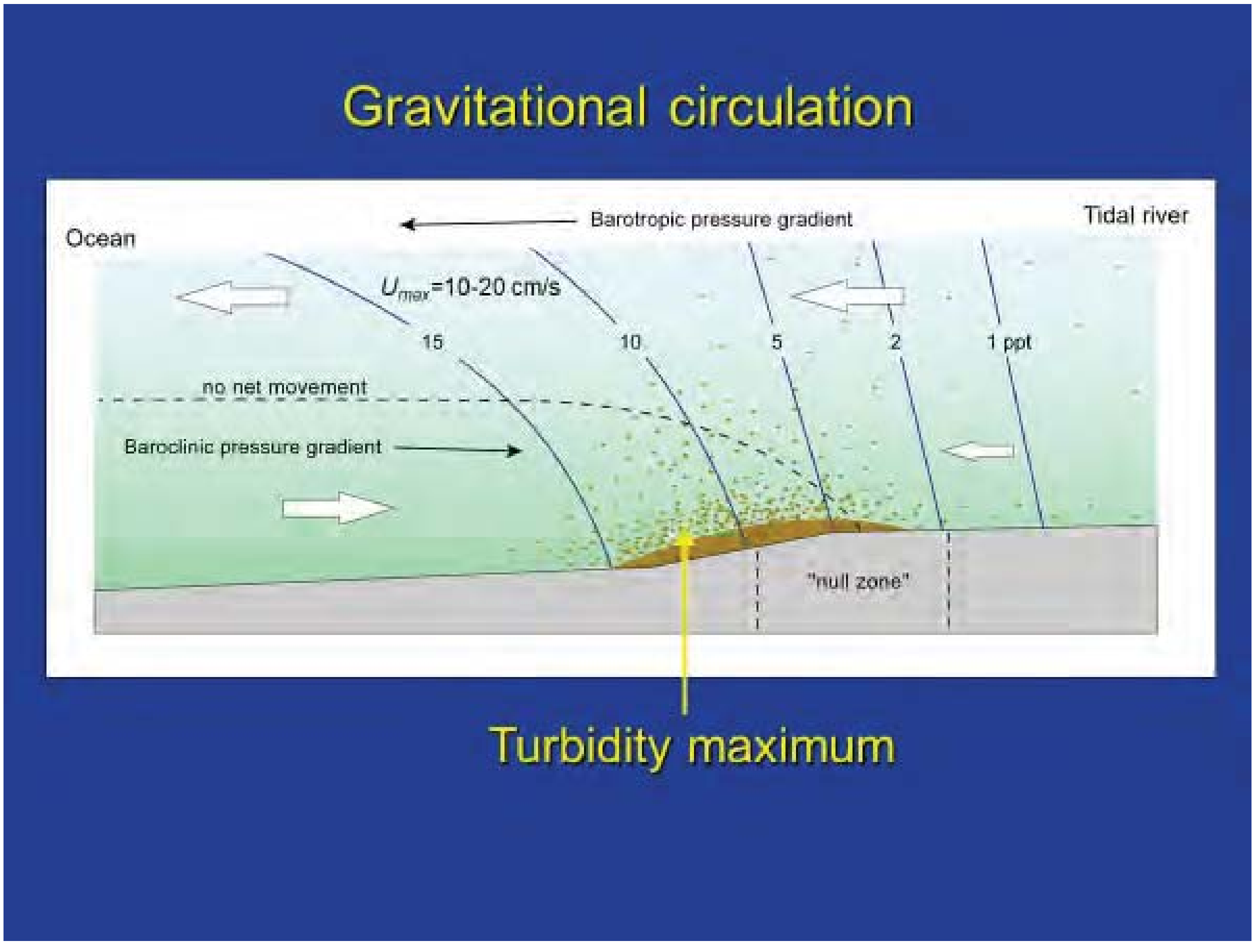
Sommerfield, 2010

Location of the Turbidity Maximum reach of the Delaware River.



Sommerfield, 2007.

Examples of the water clarity associated with turbidity and the estuary. Turbidity at the Edgemoor site is near the 1,000 mg/l.



Sommerfield, 2007

Discussion

"**SAV Habitat Requirements**

Once established and under optimal conditions, these plants can spread quickly into large, thick stands. SAV habitat requirements are as follows (adapted from Bergstrom, 1999):

Adequate Light Penetration

SAV can grow only in those portions of the estuary shallow enough and clear enough to receive sufficient sunlight for photosynthesis. The plants tend to grow in shallow water, but may grow in deeper areas where the water is particularly clear." (USEPA, 2006)

No Submerged Aquatic Vegetation was observed or collected from the proposed Edgemoor Dredging Site. The site falls within the Turbidity Maximum zone for the Delaware River which is the area that would have the least light penetration to the bottom.

"Not all healthy estuarine and near coastal areas have the physical and chemical properties necessary to support SAV. For example, areas with very high tidal ranges (e.g., more than two meters) or soft sediments may not provide a suitable habitat for the plants" (USEPA, 2006).

References

Bergstrom, P. 1999. "Using Monitoring Data to Choose Planting Sites for Underwater Grasses." The Volunteer Monitor 11(1): 16-17.

Sommerfield, 2010: Regional Sediment Management Workshop, John Heinz National Wildlife Refuge, Philadelphia, PA

Sommerfield, 2007: Understanding Turbidity in the Delaware Estuary, 2007 Delaware Estuary Conference.

USEPA, 2006. Voluntary Estuary Monitoring Manual Chapter 18: Submerged Aquatic Vegetation. A Methods Manual, Second Edition, EPA-842-B-06-003.

APPENDIX 6

PHOTOGRAPHS

Photograph 1 -View of southern portion of the Delaware Riverbank on the project site.

Photograph 2 - View of central portion of the Delaware Riverbank on the project site.

Photograph 3 – View of seawall along the Delaware River, looking south. Drift deposits along the seawall depict the approximate location of the Mean High Waterline.

Photograph 4 – Trash and driftwood along the Delaware Riverbank depicting the approximate location of the Mean High Waterline.

Photograph 5 – View of channel located on the project site, looking west. The channel drains from an offsite location into the Delaware River.

Photograph 6 – View of channel flowing into the Delaware River, looking east.

Photograph 7 – Offshore North End of Proposed Project Location in Delaware River Facing Shoreline

Photograph 8 - Offshore of Delaware River Facing Shoreline

Photograph 9 - Offshore of Delaware River Facing Shoreline

Photograph 10 - Offshore South End of Proposed Project Location in Delaware River Facing Shoreline

Photograph 11 – Bottom Trawl Sampling and Petite Ponar Dredge Sampler

Photograph 12 – Bottom Trawl Sampling and Petite Ponar Dredge Sampler

Photograph 13 – Delaware River Sediments from Benthic Sampling