APPENDIX E

ESSENTIAL FISH HABITAT ASSESSMENT

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ESSENTIAL FISH HABITAT ASSESSMENT WITH ADDITIONAL INFORMATION ON NON EFH-DESIGNATED SPECIES

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LIST OF ACRONYM AND ABBREVIATIONS

°C	degree Celsius
%	percent saturation
µS/cm	microseimens per centimeter
AET	Apparent Effects Thresholds
bbl	barrel
bcsfd	billion cubic standard feet of natural gas per day
BSC	Bethlehem Steel Corporation
BTU	British thermal unit
councils	regional fishery management councils
DMRF	dredged material recycling facility
DO	Dissolved Oxygen
EFH	Essential Fish Habitat
EIA	Energy Information Administration
ft	feet
HAPC	Habitat Areas of Particular Concern
LNG	Liquefied Natural Gas
m	meter
m^3	cubic meter
mcy	million cubic yards
MFCMA	Magnuson-Stevens Fishery Conservation and Management Act
mg/l	milligrams per liter
NMFS	National Marine Fishery Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDM	processed dredged material
PEL	Probable Effects Level
PIANC	Permanent International Association Navigation
ppt	parts per thousand
SAV	submerged aquatic vegetation
SIGTTO	Society of International Gas Tanker and Terminal Operations
SQuIRT	Screening Quick Reference Table
TEL	Threshold Effects Level
TMDL	total maximum daily load
USACE	U.S. Army Corps of Engineers
USDOC	U.S. Department of Commerce
USEPA	U.S. Environmental Protection Agency
VIMS	Virginia Institute of Marine Science
VOC	volatile organic compound
YOY	young-of-the-year

1.0 INTRODUCTION

AES Sparrows Point LNG, LLC (Sparrows Point LNG) proposes to construct, own, and operate a new liquefied natural gas (LNG) import, storage, and regasification terminal (LNG Terminal) at the Sparrows Point Industrial Complex situated on the Sparrows Point peninsula east of the Port of Baltimore in Maryland. LNG will be delivered to the LNG Terminal via LNG marine traffic, offloaded from these ships to shoreside storage tanks, regasified on the LNG Terminal site (Terminal Site), and transported to consumers via pipeline. The LNG Terminal will have a regasification capacity of 1.5 billion standard cubic feet of natural gas per day (bscfd), with potential to expand to 2.25 bscfd. Regasified natural gas will be delivered to markets in the Mid-Atlantic Region and northern portions of the South Atlantic Region, through an approximately 88-mile, 30-inch outside diameter natural gas pipeline (Pipeline) to be constructed and operated by Mid-Atlantic Express, LLC (Mid-Atlantic Express). The Pipeline will extend from the LNG Terminal to interconnections with existing natural gas pipeline systems near Eagle, Pennsylvania. Together, the LNG Terminal and Pipeline projects are referred to as the Sparrows Point Project or Project. Both Sparrows Point LNG and Mid-Atlantic Express (hereinafter collectively referred to as AES) are subsidiaries of The AES Corporation.

The Project footprint is located in the counties of Baltimore, Harford and Cecil in Maryland, and in the counties of Lancaster and Chester in Pennsylvania. The Terminal Site, which is located entirely within Baltimore County, is a parcel located within a former shipyard. The route proposed for the Pipeline (Pipeline Route), which crosses all of the listed counties, includes industrial, commercial, agricultural, and residential lands. Together, the Terminal Site and the Pipeline Route comprise the Project Area.

As described in Section 1.10 of Resource Report 1, *General Project Description*, The AES Corporation is considering the possibility of building a combined cycle cogeneration power plant (Power Plant) on the Terminal Site. The Power Plant would be configured with one F-Class combustion gas turbine, one steam turbine, and associated auxiliaries. It would operate only on natural gas and would produce approximately 300 megawatts (MW) of clean electric power within an area of high energy demand. The Power Plant would be connected to the local utility electric system via an overhead transmission line.

In accordance with the Magnuson-Stevens Fishery Conservation and Management Act (MFCMA) and in response to the National Marine Fishery Service (NMFS) letter dated May 23, 2006, this assessment identifies the potential impacts on essential fish habitat (EFH) of the proposed Sparrows Point LNG Terminal Project.

The MFCMA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), set forth several new mandates for the U.S. Department of Commerce (USDOC) National Oceanic and Atmospheric Administration (NOAA), NMFS, regional fishery management councils (councils), and other federal agencies to identify and protect important marine and anadromous fish habitat. Although the concept of EFH is similar to "critical habitat" under the Endangered Species Act of 1973, measures recommended to protect EFH are advisory, rather than prescriptive.

Figure 1. Project Location.

The councils, with assistance from NMFS, are required to delineate "essential fish habitat" for all managed species. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 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" includes sediment, hard bottom, and structures underlying the water; and, areas used for "spawning, breeding, feeding, and growth to maturity" to cover a species' full life cycle. Prey species are defined as being food sources for one or more designated fish species; the presence of adequate prey is one of the biological properties that can make a habitat EFH-designated.

Federal agencies that fund, permit, or carry out activities that may impact EFH adversely are required to consult with NMFS regarding the potential effects of their actions on EFH. According to USDOC (1999a), the contents of an EFH assessment should include:

- A description of the proposed action;
- An analysis of the effects (including cumulative) of the proposed action on EFH, the managed fish species, and major prey species;
- The federal agency's views regarding the effects of the action on EFH; and,
- Proposed mitigation, if applicable.

This EFH assessment includes:

- A description of proposed construction activity in the Chesapeake Bay;
- A description of the existing environment;
- A listing of EFH-designated species for the Sparrows Point LNG Terminal Project Area;
- Information relating to the habitat suitability and relative abundance of EFH-designated species, with life history stages, in the Sparrows Point LNG Terminal Project Area;
- A summary of the diets of EFH-designated species (e.g., prey species) in the Sparrows Point LNG Terminal Project Area;
- An analysis of the potential impacts of project activities on EFH-designated species and species of special interest in the Sparrows Point LNG Terminal Project Area; and,
- An analysis of the potential indirect, cumulative, and synergistic impacts of project activities on EFH-designated species and species of special interest in the Sparrows Point LNG Terminal Project Area of the Chesapeake Bay.

2.0 PROJECT DESCRIPTION

2.1 PROJECT AREA

The Sparrows Point LNG Terminal will be located on an approximately 80-acre parcel within the existing Sparrows Point Industrial Complex located in Baltimore County, Maryland. Approximately 45 acres of the site is upland area and the remainder is a nearshore riparian rights area. Previously, the site was owned and operated by Bethlehem Steel Corporation (BSC) as a steel manufacturing and shipbuilding facility. The Sparrows Point Shipyard is situated on a promontory that extends into the Chesapeake Bay east of the Port of Baltimore. More specifically, the Sparrows Point LNG Terminal

Site is located on the marine channel adjacent to the Fort McHenry channel, near the confluence of the Fort McHenry Channel and the Brewerton Angle.

The approximately 80-acre project site consists of a parcel of land located between an existing graving dock (southern boundary) and a floating dry dock (northern boundary). The water's edge is on the western boundary of the project site, and the eastern boundary extends just beyond the existing fabrication building located on the property. The project site was owned previously by the BSC, and was used for steel manufacturing and shipbuilding. Currently, the project site is used to store scrap metal and to perform some light industrial maintenance work and warehousing.

The proposed LNG Terminal will include a marine terminal consisting of a pier with berthing areas on both sides, LNG unloading equipment, a LNG storage facility, vaporization and vapor handling systems, a gas send-out system, and administrative and support buildings. The marine terminal will be located on the Patapsco River just off of the Brewerton Channel, adjacent to the existing graving dock at the Sparrows Point Shipyard. The western edge of the project parcel will be sheet-piled and the berth will be located approximately 75 feet (ft) west of this bulkhead.

2.2 PROPOSED ACTION

In order to support berthing operations at the facility, AES will need to deepen and widen the existing marine channel to a depth of approximately 45 ft and width of approximately 440 ft. Additionally, AES will dredge a turning basin to allow ships to be turned under tug support and berthed at the marine terminal bow out. The turning basin will be approximately 1,640 ft in diameter. The areas adjacent to each of the berths will also be dredged to a depth of approximately 45 ft. Total dredge quantity is expected to be from 2.5 to 4 million cubic yards (mcy).

The LNG berths will be designed to accommodate the dimensional characteristics of the majority of existing LNG tankers with storage capacities in excess of 786,225 barrels (bbl) or 125,000 cubic meters (m^3). The marine facility will also be designed to accommodate proposed LNG tankers with a capacity of up to 1,364,891 bbl (217,000 m^3). Normally, the LNG carriers will arrive at the pier loaded and will leave in ballast condition.

A new shoreward bulkhead line will also be established to straighten out the waterfront in the proposed LNG Terminal area. A description of the individual components for the proposed LNG terminal is provided below.

2.2.1 LNG Finger Pier/Access Trestle for Vehicles and a Pipeway

Access between land and the unloading platform will be provided by a pile-supported trestle. The steel pipe piles will support a pre-cast/cast-in-place concrete superstructure that will serve as a roadway and a pipeway. The superstructure will consist of pre-cast concrete pile caps placed on top of the steel pipe piles. A concrete deck structure consisting of pre-stressed, pre-cast concrete planks, with a cast-in-place concrete topping will span between the pile caps. A concrete spillway will be installed beneath the piping as part of the pipeway structure, and the trestle will be sloped to the shoreline to provide for equipment access and collection of any LNG leaks or spills. The unloading platform will be located at the end of the trestle. A single LNG berth will be located on both the north and south sides of the finger pier.

2.2.2 Turning Basin and Entrance Channel

To support the proposed marine terminal operations, an approach channel and turning basin will be constructed by expanding existing channels through dredging. The Sparrows Point LNG terminal turning basin and approach channel will provide an access point for approaching LNG carriers from the existing Brewerton Channel to the southeast. LNG carriers transiting to the proposed marine terminal will do so under active tractor tug escort. The speed of an incoming LNG carrier will be reduced gradually during its transit of the Brewerton Channel until the ship is brought to full stop at the entrance of the approach channel to the marine terminal. The tug boats will then assist the ship to turn into the approach channel. The incoming vessel will transit the approach channel again under active tractor tug control. The LNG carrier will be brought to full stop in the approach channel, and will be turned and berthed with tug assistance at either berth with bow pointing out. The departure procedures for LNG carriers will be similar to the incoming transiting LNG carriers as described above, except that the outgoing vessels will not be turned in the turning basin.

Preliminary layout of the approach channel and turning basin has been formulated using the following considerations:

- LNG tanker vessel design capacities and size (including anticipated future generations of vessel designs not currently in service) expected to call at the terminal.
- Channel design guidance references (Society of International Gas Tanker and Terminal Operations [SIGTTO] 1997) and Permanent International Association Navigation Congress [PIANC] 1997) for use in calculating the minimum channel width (such as vessel speed, wind speed and direction, current speed and direction, wave height, period, and direction, navigation aid, type of seabed, channel depth, type of side slopes, and hazard level of cargo).
- Factors and guidance reference information (SIGTTO 1997) affecting channel depth design (including vessel design draft, vertical ship motion due to wave action, squat, keel clearance, and water density effects).

Based on the above considerations, the approach channel preliminary layout is approximately 45 ft deep and 440 ft wide. The proposed turning circle has a 1,640-foot diameter, also with a nominal water depth of 45 ft, to allow the turning of all fully-loaded LNG carriers with tug assistance. The final geometry and layout of the approach channel and turning basin is determined through fast-time and real-time simulation studies, which are conducted in close collaboration with the local pilot association.

The area to be used for LNG vessel approach and maneuvering has been dredged in the past and maintains a permit issued by the United States Army Corps of Engineers (USACE) and Water Quality Certification from the State of Maryland to perform dredging using hydraulic or mechanical techniques. Dredging is allowed under existing permit for maintenance and waterfront operations to a depth of 39 ft in approximately the same area as proposed for the Sparrows Point LNG terminal project.

An estimated 3.0 to 4.5 million cubic yards (mcy) of material may be removed through dredging of the approach channel, turning basin, and berths. Dredging within the project limits is anticipated to begin in the berthing area, and progress towards the outer channel to allow for earlier commencement of pier/dock construction operations. Depending on the bathymetric configuration of this area at the time of project construction, actual volume to be dredged and material handling requirements may be less than currently envisioned. However, the proposed approach has been developed to anticipate dredge operations consistent with this location's dredge approvals and remaining volumes needed for LNG terminal development. The project has also allowed for methods that may be needed if dredge volumes are greater and/or environmental quality of dredge material in sections of the dredge area are degraded relative to currently permitted dredge materials. AES will follow procedures for dredge performance consistent with recent past dredge approvals for this location, updated based on data collected for this project.

The approach channel expansions will be performed primarily by use of mechanical clamshell dredge or an environmental bucket technology if required, with some limited areas near shore excavated by backhoe dredge. Conventional mechanical dredge techniques will be used, or if chemical analyses obtained for dredge planning indicate sediment quality is degraded more significantly than is allowed by current dredge permits, environmental dredge bucket removal or an equivalent would be used. The material dredged will be managed at an on-shore dredge material recycling facility that will be developed for this project and ultimately disposed of at an appropriate, off-site upland location.

2.2.3 Dredged Material Recycling Facility

As part of the project construction phase, AES will construct a dredged material processing facility adjacent to the existing waterway at the Sparrows Point Facility. This phase will precede actual dredging operations.

The initial step in processing is the reduction of the water content of the dredged sediments. The proposed dewatering process would involve dewatering of loaded barges at the dredging site or the dredge material recycling facility (DMRF). The proposed 10,000 cubic yards per day DMRF will occupy approximately five acres of the 15 acres of upland property located immediately to the south of the Terminal Site (see Figure 1C-3 in Appendix C of Resource Report 1, *General Project Description*). Loaded scows would be allowed to settle so that the free-liquid portion would be visibly free of suspended sediments prior to pumping the decant water to the cargo area of a dedicated dewatering barge. After settling, the decant water from dewatered dredged material at the processing facility will pass through a settling tank system and be filtered prior to discharge back to the harbor. Chemical and physical analysis will be conducted on the decant water in accordance with a MDE Water Management Program Individual Permit for Industrial Water Discharge that will be issued for the DMRF. Threshold values for discharge will be set forth in that permit. Alternately, after the initial barge settling period, portable pumps will be utilized to pump the water to land based tanks (i.e. frac tanks) for additional settling. Following this secondary settling, the water will be filtered and discharged under applicable permit conditions.

Following processing, the processed dredged material (PDM) will be transported via onsite trucks to the designated stockpile/staging area of the Sparrows Point site. At the stockpile area, the trucks will deposit the PDM material into the designated staging area within the permitted temporary storage site. The PDM will be placed using hydraulic excavators, bulldozers and vibratory compactors into large stockpiles for temporary storage in inventory until the material is sold for beneficial use. The PDM will be trans-loaded by wheel loaders or hydraulic excavators into over road trucks for off-site shipment to ultimate destination sites. The processed dredged material will be transported off-site at an anticipated rate of approximately 5,000 cubic yards per day.

Other potential options for management of dredged material include off-site disposal, open ocean disposal at approved off-shore locations, and upland fill sites. These options also depend on chemical makeup of the dredged material, approvals from applicable agencies and, in some cases, approval by the receiving facility(s). Currently, none of these alternatives are considered to be viable as the recycling alternative, and they are not as consistent with Port of Baltimore long-term goals for management of dredged material as the proposed recycling option.

2.3 BENEFITS

In addition to serving the Mid-Atlantic energy market, the Sparrows Point Project will serve sections of the south Atlantic market, specifically focusing on the Maryland, Virginia, and Washington, DC markets. Because of its location, the Sparrows Point Project will be a more efficient supplier of gas to its target markets than gas suppliers in the Gulf of Mexico. The result will be a reduction in the "basis" in the Sparrows Point Project's market. Thus, the Sparrows Point Project will serve a need for additional natural gas (discussed below in Section 2.4) by providing the market with a new supply of reliable, competitively priced LNG.

2.4 NEED AND ALTERNATIVES

Energy demand in the United States continues to grow at a relatively constant pace. According to the U.S. Energy Information Administration (EIA) (EIA 2006), total energy consumption in the United States is projected to increase from the 100 quadrillion British thermal units (BTU) used in 2004 to the projected use of 127 quadrillion BTU per year in 2025 (an increase of 27%). The projected growth in energy demand (from present to 2025) will vary by fuel type. For example, demand for coal and petroleum are expected to increase, with coal expecting a steep increase after 2020. Demand for natural gas is expected to continue with strong growth to 2020, after which it is expected to level off.

Most importantly, natural gas has increasingly become the fuel of choice in the United States. There are a number of underlying conditions that characterize the U.S. gas market's supply and demand, including:

- Increased gas demand driven by 200 gigawatts of gas-fired generation investment since 1999 with limited amounts of alternative fuel capability;
- Declining domestic gas production throughout the lower 48 states and offshore;
- Increased gas imports from Canada nearing current maximum capacity;
- Decreased gas supply deliverability in the current transmission infrastructure;
- Curtailment of demand destruction that began during the sustained high price environment; and,
- Stabilization of gas demand due to the rebound in the U.S. economy beginning in 2003.

These conditions have led to supply constraints and a steadily increasing gas price floor, well above pre-2000 historical levels of below $3/thousand cubic feet The North American natural gas industry is facing a critical period over the next ten to fifteen years, where increased supply availability will be essential. Moreover, with continuing worldwide gas demand, the balance between natural gas supply and demand will likely continue to tighten leading to sustained and higher prices unless new sources of natural gas supply, including LNG, are developed and delivered to the market via import terminals and associated pipeline facilities.

The need for incremental sources of natural gas supply to meet growing demand is particularly acute in the Mid-Atlantic and surrounding regions of the United States. The EIA is forecasting significant natural gas growth in the Mid-Atlantic region for the 15-year period from 2005 to 2020 (EIA 2006). Other alternate fuel types (such as coal and oil) are not as environmentally benign as natural gas and are short-term viable alternatives to meet the growing demand for energy in the region. Compared with fuel oil or coal, natural gas is a relatively clean and efficient fuel that can reduce relative impacts on air quality (e.g., reduce emissions of nitrogen oxides, sulfur dioxide, particulate matter, and carbon dioxide) and generate the same amount of electricity.

The contribution of renewable fuels to the U.S. electricity supply mix remains relatively small as reported in the EIA's Annual Energy outlook for 2006 (EIA 2006). Although conventional hydropower remains the largest projected source of renewable generation through 2030, a lack of untapped large-scale sites, coupled with environmental concerns, limits its growth; its projected share of total generation falls from 6.8 percent in 2004 to 5.1 percent in 2030 (EIA 2006). While wind generation will be among the leaders in renewable energy generation, the anticipated expansion over current capacity will only increase by a modest 0.4 percent of total generation in 2004 to 1.1 percent in 2030 (EIA 2006). Energy from wind power, while important to the overall energy mix, is not projected to grow significantly to be a commercially viable alternative to the Project. Additionally, energy from nuclear power is not a commercially viable substitute able to replace or significantly offset the demand for natural gas over the next 20 years (EIA 2006).

While several LNG terminals have been proposed in the Northeast United States, most of these terminals are substantially north or south of the proposed Sparrows Point Project. Therefore, they would not serve the intended market need. While two other projects could potentially serve a portion of the mid-Atlantic Market (the Crown Landing and Cove Point expansion project) by 2020, AES forecasts that the Mid-Atlantic region would have sufficient demand to not only absorb the Sparrows Point volume but also the Crown Landing volume, the Cove Point expansion, and still require additional other supply.

For these reasons, there is no viable alternative to the Sparrows Point Project.

3.0 EXISTING ENVIRONMENT

The Baltimore Harbor watershed is located to the east of Baltimore City, and includes numerous small tributaries to the north side of the Patapsco River. The tributaries drain to tidal estuaries. The watershed is entirely within the Maryland coastal plain and streams tend to be short and tidally influenced. Many streams in the industrial area have been channelized and the natural drainage pattern has been altered (e.g., cooling water for BSC is withdrawn from Jones Creek and discharged to Bear Creek). It is estimated that 60% of the freshwater in the harbor originates from Patapsco River (Maryland Department of the Environment [MDE] 2004).

The Patapsco River estuary is highly developed and is mainly urban residential, commercial, and industrial. A large wastewater treatment plant owned by the City of Baltimore discharges into the middle tidal region of the Patapsco (MDE 2004).

No Habitat Areas of Particular Concern (HAPC) are known to occur within the proposed Project Terminal Area but several may occur along potential vessel transit routes (although these routes have not been determined as of yet and will most likely depend on fluctuating factors such as weather and market trends). All but one of these areas can be found of the south Atlantic coasts of North and South Carolina; specifically within the areas of The Point, 10 Fathom Ledge, Big Rock, Georgetown Hole, the Charleston Bump Complex, and in areas adjacent to the Outer Banks, Cape Hatteras, and the Ocracoke Islands (NMFS 2006b; SAMFC 1998). The remaining HAPC has been identified in the lower region of Chesapeake Bay and is thought to be used by sandbar sharks as nursery and pupping grounds (NMFS 2006b). The nearest submerged aquatic vegetation (SAV) location recently reported by Orth et al. (2005) was approximately three miles south of the Project Area on the western side of the Patapsco River in Stony Creek. Older records suggest a similar lack of SAV historically within three miles of the Project Area (Orth et al. 1994). Field surveys performed by AES in June 2006 confirmed the absence of SAV within the Project footprint, and no SAV was located within approximately two miles of the Project Area.

3.1 SEDIMENTS

During the past several years, extensive studies have been conducted on the levels of metals, mercury and organic contaminants in Baltimore Harbor sediments (Ashley and Baker 1999; McGee et al. 1999; Mason and Lawrence 1999). Large spatial gradients in contaminant levels in the sediments due to relatively poor mixing result in contaminant "hot spots" near storm water outfalls and industrial areas. Elevated levels of polycyclic aromatic hydrocarbons (PAHs) and metals are found around Sparrows Point, historically the site of intensive coal coking and steel production. Organochlorines, including polychlorinated biphenyls (PCBs), are elevated adjacent to storm water outfalls. Forty percent of the sites within the Baltimore Harbor have PCB levels that exceed the "effects range-medium" value of Long et al. (1995). Survival of the estuarine amphipod *Leptocheirus plumulosus* was reduced in seven of twenty-five Baltimore Harbor sediment sites studied by McGee et al. (1999). Toxicity at monitoring stations in Bear and Colgate Creeks may have been due to sediment-associated metals, while sediment toxicity in the Inner Harbor was likely due to both metals and organic contaminants (PAH).

In June 2006, AES collected sediment samples from a floating barge using a vibracore sampler at three (3) depths identified as “shallow” (0–2 feet below the sediment surface), “intermediate” (depths greater than two (2) feet below the sediment surface but less than the anticipated depth of dredging) and “deep” (depths at approximately 40 feet below the sediment surface). Shallow and intermediate samples were assumed to be representative of the sediment that would be removed as part of the proposed channel dredging and deep samples were assumed to be representative of the channel that would be exposed to the benthic environment after the completion of dredging operations. Fifteen (15) sediment samples were collected for off-site laboratory analysis: eight (8) shallow, three (3) intermediate, and four (4) deep. Each sample was submitted to an on-shore laboratory for the analysis of organic and inorganic parameters in accordance with U.S. Environmental Protection

Agency (USEPA) promulgated methods. Analyzed parameters included volatile organic compounds (VOCs), semi-VOCs, chlorinated pesticides, PCBs, priority pollutant metals, cyanide, total organic carbon, tributyl tin, and hexavalent chromium.

To evaluate the results of the laboratory analyses, the reported data were compared to the NOAA's Screening Quick Reference Tables (SQuIRT), updated September 1999. The SQuIRT reference cards were developed by NOAA to identify levels of contaminants that could potentially impact to coastal resources and habitats. For this evaluation, the marine sediment criteria were used for comparison of the AES Sparrows Point sediment samples. The marine sediment criteria are defined over a range of potential toxicity to biological resources as the Threshold Effects Level (TEL) (the level below which no observable adverse effects are anticipated), the Probable Effects Level (PEL) (the level where observable adverse effects are frequently expected) and the Apparent Effects Thresholds (AET) (the level above which adverse effects are always expected).

PAHs were detected in each of the sediment samples collected from the "shallow" and "intermediate" sampling depths. The "shallow" sediment samples generally exhibited concentrations of PAHs that exceeded the AET, indicating that adverse effects to biological resources were expected from interaction with these sediments. The "intermediate" sample PAH concentrations generally exceeded TEL but fell below the PEL indicating that observable adverse impacts to biological resources from exposure to these sediments were likely.

Elevated levels of several PPL metals were also detected in the "shallow" and "intermediate" samples collected. Generally, the concentrations of PPL metals fell above the TEL but below the AET and with two notable exceptions. Concentrations of lead and zinc exceeded the AET in each "shallow" sample indicating that adverse effects to biological resources would always be expected due to the presence of these contaminants. These data indicate that the removal of the "shallow" and some of the "intermediate" sediment during dredging operations should reduce potential contaminant impacts to biological resources in the areas tested.

Generally, the results of the "deep" sediment samples fell below the TEL indicating that no observable adverse effects are anticipated from interaction with these sediments. One parameter of interest, benzo (a) pyrene was detected at a concentration greater than the TEL but below the AET, indicating that observable adverse effects could be expected. The results of the "deep" samples collected and analyzed indicate that no observable adverse effects are likely for biological resources that could be exposed to these sediments after dredging.

3.2 WATER QUALITY

The Maryland 2004 303(d) List contains basins and sub-basins that have measured water quality impairment. The tidal portion of Baltimore Harbor, including the Patapsco River, is on the list with the following impairments: poor biological community, nutrients, sediments, and PCBs in sediments (MDE 2004).

Water quality in Baltimore Harbor is impaired by several compounds and metals including PCBs, chromium, zinc, lead, mercury, nickel, copper, cyanide and chlordane. According to the 2002 305(b) report (MDE 2002), chlordane, PCBs, metal, low dissolved oxygen, and bacteria in the tidal waters of Baltimore Harbor were attributed to industrial and municipal discharges, nonpoint sources, poor tidal flushing, and unknown sources. Fish consumption advisories were issued in 1986 and expanded in 2001 for Chlordane, PCBs, and dieldrin.

Baltimore Harbor is also classified as Category 3, a pristine or sensitive watershed in need of protection because of failing indicators such as high phosphorus and nitrogen loadings, poor SAV abundance and habitat index, poor tidal benthic index of biotic integrity, high percent impervious surface, and high population density (MDE 2004). A total maximum daily load (TMDL) study was completed for Chlordane in the Baltimore Harbor (MDE 2001). Chlordane is a broad-spectrum pesticide that was used from 1940s until 1988, at which point it was banned. Since chlordane is found in fish tissue here, MDE issued a fish consumption advisory for this waterway.

In June and October 2006, AES collected water quality data at 46 stations in the Project Area (26 stations in June and an additional 20 stations in October). At each station, water quality data were collected near the surface, in mid-water column and near the bottom (only surface readings were collected at 10 of the 44 stations that were sampled during the October effort). The water quality data included pH, temperature in degrees Celsius (°C), dissolved oxygen as milligrams per liter (mg/l) and percent saturation (%), salinity in parts per thousand (ppt), conductivity in microseimens per centimeter (µS/cm), and turbidity in nephelometric turbidity units (NTU). Data were collected with a YSI model 6920 meter.

The water quality results from these sampling events were similar to previous studies of the relatively well-studied harbor (e.g., Dail et al. 1998; Hall et al. 2002; Maryland Department of National Resources [MDDNR] 2005) and indicated that dissolved oxygen, particularly at depths lower in the water column, was frequently recorded at levels low enough to inhibit biological productivity (e.g., approximately 2.0 mg/L) during the June effort, with a substantial increase to over 5.0 mg/l during the October effort. Water quality results also indicated that water temperatures were typically warm (averaging approximately 25°C in June and 18°C in October) and had salinities at typically low levels (approximately 7–8 ppt) for this mesohaline system.

4.0 SPECIES OVERVIEWS

This section describes the habitat requirements of the EFH-designated species, non-EFH designated fish and shellfish species (with special focus placed on those most likely to occur within the proposed Project construction area [Project Terminal Area]), and rare and endangered species that potentially occur within the proposed Project Area. Specifically, Section 4.1 provides individual species assessments of EFH-designated species, and Section 4.2 provides individual species assessments of non-EFH designated fish and shellfish species.

4.1 EFH-DESIGNATED SPECIES

A summary EFH designations specific to the Patapsco River does not exist at this time but consultation with local NMFS staff indicates that the Chester River estuary in Kent and Queen Anne's County on Maryland's Eastern Shore could be used as proxy data in the preparation of the EFH assessment for the proposed Terminal Site (NMFS 2006a). However, documentation regarding EFH and HAPC along the proposed vessel traffic routes does exist. Although U.S. Territorial Waters extend to some 200 miles offshore, information regarding EFH and HAPC designations along possible vessel traffic routes extends to a maximum of approximately 135 miles seaward and will be the focus of this discussion. EFH and HAPC designations for coastal finfish and shellfish species in this area were based on information compiled by the New England Fisheries Management Council, the Mid-Atlantic Fisheries Management Council, the South Atlantic Fisheries Management Council, and the Highly Migratory Species Division of the National Marine Fisheries Service.

Available information on life history and habitat requirements for each EFH-designated species is summarized in this section, along with relevant survey information. Primary reference sources are cited once, at the beginning of each summary. For most species, the primary source was one of a series of EFH source documents prepared by the NMFS in 1999. Designated life history stages (eggs, larvae, juveniles, and adults for finfish and juveniles and adults for sharks) for the 10 minute x 10 minute "square" of latitude and longitude that includes the proposed Project Area are identified at the beginning of each species assessment and in Table 1.

Conclusions regarding the likelihood of occurrence of each species and life history stage in the proposed Project Area are presented at the end of each species assessment. In reaching these conclusions, emphasis was given to the depth, water quality, and bottom substrate preferences of each individual species. Another important factor is whether the dominant bottom sediments in the proposed Project Area provide suitable habitat for invertebrates that are preyed upon by bottom feeding EFH species. Available information on feeding habits of EFH-designated species and on benthic resources in the proposed Project Area is presented in Section 4.4 of this EFH assessment report.

A previous EFH assessment conducted by USACE and performed in part for this area of the Patapsco indicated that, of the species listed in Table 1, only juvenile and adult summer flounder and juvenile and adult bluefish were likely to occur in the proposed Terminal Site (USACE 2006). Additional sampling performed in support of that EFH assessment further confirmed those conclusions as the sampling resulted in the capture of bluefish and summer flounder (USACE 2006).

A total of 99 bony finfish (this estimate includes 26 species in addition to the snapper-grouper complex that is recognized as such by SAFMC [1998] and is comprised of 73 species), 13 shark/skate species, and 5 invertebrate species, are currently designated as EFH species in both the proposed Project Terminal Site and the area that encompasses proposed vessel traffic routes within U.S Territorial Waters (Table 1). Each EFH-designated species and the corresponding designated life stages are presented in Table 1.

Table 1. EFH Designated Fish and Invertebrate Species and Life History Stages in the Project Area (USACE 2006; USDOC 1999a, 1999b; and SAFMC 1998).

Species	Eggs	Larvae	Juveniles	Adults
Fish Species	**E**	**L**	**J**	**A**
Albacore tuna (*Thunnus alalunga*)			X	
Atlantic butterfish (*Peprilus triacanthus*)	X	X	X	X
Atlantic mackerel (*Scomber scombrus*)			X	X
Atlantic sea herring (*Clupea harengus*)			X	X
Black sea bass (*Centropristus striata*)		X	X	X
Bluefin tuna (*Thunnus thynnus*)			X	X
Bluefish (*Pomatomus saltatrix*)	X	X	X	X
Cero (*Scomberomorus regalis*)			X	X
Cobia (*Rachycentron canadum*)	X	X	X	X
Dolphinfish (*Coryphaena hippurus*)	HAPC	HAPC	HAPC	HAPC
King mackerel (*Scomberomorus cavalla*)	X	X	X	X
Little tunny (Euthynnus alletteratus)			X	X
Monkfish (*Lophius americanus*)	X	X	X	
Red drum (*Sciaenops ocellatus*)	HAPC	HAPC	HAPC	HAPC
Red hake (*Urophycis chuss*)	X	X	X	X
Scup (*Stenotomus chrysops*)			X	X
Skipjack tuna (*Katsuwonus pelamis*)				X
Snapper-grouper complex (73 species)*	HAPC	HAPC	HAPC	HAPC
Spanish mackerel (*Scomberomorus maculatus*)	X	X	X	X
Summer flounder (*Paralichthys dentatus*)	X	X	X	X
Swordfish (*Xiphias gladius*)			X	
Whiting (*Merluccius bilinearis*)			X	X
Windowpane (*Scophthalmus aquosus*)	X	X	X	X
Winter flounder (*Pseudopleuronectes americanus*)			X	X
Witch flounder (*Glyptocephalus cynoglossus*)	X	X		
Yellowfin tuna (*Thunnus albacares*)			X	X
Yellowtail flounder (*Pleuronectes ferruginea*)		X		
Invertebrate Species	**E**	**L**	**J**	**A**
Long finned squid (*Loligo pealei*)			X	X
Ocean quahog (*Artica islandica*)			X	X
Rock shrimp (*Sicyonia brevirostris*)	X	X	X	X
Royal shrimp (*Pleoticus robustus*)	X	X	X	X
Surf clam (*Spisula solidissima*)			X	X
Shark Species	**E**	**L**	**J**	**A**
Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)				X
Blue shark (*Prionace gluaca*)				X
Dusky shark (*Carcharinus obscurus*)			X	
Sandbar shark (*Carcharinus plumbeus*)			HAPC	HAPC
Sand tiger shark (*Carcharius taurus*)			X	X
Scalloped hammerhead shark (*Sphyrna lewini*)			X	

Species	Eggs	Larvae	Juveniles	Adults
Fish Species	**E**	**L**	**J**	**A**
Shortfin mako shark (*Isurus oxyrhincus*)			X	X
Spiny dogfish (*Squalus acanthias*)			X	X
Tiger shark (*Galeocerdo cuvieri*)			X	X
Skate Species	**E**	**L**	**J**	**A**
Clearnose skate (*Raja eglanteria*)			X	X
Little skate (*Leucoraja erinacea*)			X	X
Rosette Skate (*Leucoraja garmani virginica*)			X	
Winter skate (*Leucoraja ocellata*)			X	X

* The snapper-grouper complex is treated as a grouped species as defined by the SAMFC (1998).

Key:

E = eggs
L = larvae
J = juveniles
A = adults

AES conducted two fish-sampling studies in the Project Area in June and October of 2006. The study consisted of towing a 30-foot otter-trawl from a research vessel at a speed of approximately 1.7 to 2.2 knots for a straight-line distance of approximately 0.33 nautical miles; the tow time for each trawl was 10 minutes. Two of the species listed in Table 1, bluefish and summer flounder, were recovered during the course of this study.

4.1.1 Fish Species

Albacore Tuna (*Thunnus alalunga*): Juveniles

Primary Source: USDOC 1999b

Albacore is a circumglobal, epipelagic, and oceanic species. Juveniles and subadults prefer surface waters off the coast of the Mid-Atlantic Bight with a temperature preference between 16 and 19°C, although larger individuals have a wider depth and temperature range (between 14 to 25°C). This species tends to aggregate near temperature discontinuities and migrate within water masses. However, this species does not seem to cross temperature and oxygen boundaries, as it does not tolerate oxygen levels lower than 2 milligrams per liter (mg/l). This species may also be associated with floating objects, including *Sargassum* weed.

Project Area: Albacore tuna are highly migratory and pelagic, and may pass through the Project Area to feed during their annual migration.

Atlantic Butterfish (*Peprilus triacanthus*): All Stages

Primary Source: Cross *et al.* (1999)

Butterfish are fast-growing, short-lived, pelagic fish that form loose schools, often near the surface. Eggs and larvae are pelagic and common in the high salinity zones of some estuaries in southern New England and the Middle Atlantic Bight and in the mixing zone in Chesapeake Bay. Additionally, eggs have a temperature preference between 12 to 23°C and larvae have a temperature preference between 4 to 28°C.

Juvenile and adult butterfish are pelagic that form loose schools, often near the surface. They are eurythermal with a temperature preference between 4 and 22°C and can tolerate a range of salinities with preferences between 5 to 32 ppt. They are frequently found over sand, mud, and mixed substrates.

Project Area: All stages of the butterfish are expected to be found in the Project Area.

Atlantic Mackerel (*Scomber scombrus*): Juveniles and Adults

Primary source: Studholme *et al*. (1999)

Atlantic mackerel are found in deep water during winter on the continental shelf from Sable Island Bank (Canada) to Chesapeake Bay and move inshore and northeast during the spring. This pattern is reversed in the fall. Juveniles are typically collected from shore to 1,050 ft and in temperatures between 4 and 22°C. Adults are typically collected from shore to 1,250 ft and in temperatures between 4 and 16°C.

Project Area: Atlantic mackerel is a migratory species and can be expected to occur in the oceanic side of the Project Area, from nearshore to the open ocean.

Atlantic Sea Herring (*Clupea harengus*): Juveniles and Adults

Primary Source: Reid *et al.* (1999)

Adult Atlantic sea herring migrate south into southern New England and mid-Atlantic shelf waters in the winter after spawning in the Gulf of Maine, on Georges Bank, and Nantucket Shoals. Juvenile and adult herring are abundant in coastal and mid-shelf waters from southern New England to Cape Hatteras in the winter and spring. In the spring, adults return north, but juveniles do not undertake coastal migrations.

Project Area: Atlantic herring are pelagic species and can be expected to occupy the water column in the open ocean portion of the Project Area.

Black Sea Bass (*Centropristis striata*): Larvae, Juveniles and Adults

Primary Source: Steimle *et al.* (1999a)

Black sea bass are usually strongly associated with structured, sheltering habitats such as reefs and wrecks. When larvae reach 10 to 16 mm total length (TL), they tend to settle and become demersal on structured inshore habitat such as sponge beds. In the Mid-Atlantic Bight, recently settled juveniles move into coastal estuarine nursery areas between July and September. The estuarine nursery habitat of young-of-year (YOY) black sea bass is relatively shallow, hard bottom with some kind of natural or man-made structure including amphipod tubes, eelgrass, sponges, and shellfish beds with salinities above 8 ppt. Black sea bass do not tolerate cold inshore winter conditions. Following an overwintering period presumably spent on the continental shelf, older juveniles return to inshore estuaries in late spring and early summer. They are uncommon in open, unvegetated, sandy intertidal flats or beaches. Like juveniles, adult sea bass are very structure oriented, especially during their summer coastal residency. Unlike juveniles, adults only enter larger estuaries and are most abundant along the outer Atlantic coast. Larger fish tend to be found in deeper water than smaller fish.

Project Area: Black sea bass are expected to occupy the Project Area. However, due to the strong association of this species with three-dimensional structures, the likelihood of this species being present within vessel traffic lanes will be very low.

Bluefin Tuna (*Thunnus thynnus*): Juveniles and Adults

Primary Source: Colette and Nauen (1983)

This is a very large, highly migratory species. In the western North Atlantic, bluefin tuna migrate seasonally from spring spawning grounds in the Gulf of Mexico to summer feeding grounds off the northeast U.S. coast (USDOC 1999b). Distributions are probably constrained by the 12°C isotherm. Although essentially an oceanic species, bluefin tuna often occur over the continental shelf and in embayments, particularly during the summer months when they feed actively on herring, mackerel, and squids. They are often found in mixed schools with skipjack tuna of the same size (Tiews 1963). Larvae are generally retained in the Gulf of Mexico until they grow into juveniles. In June, YOY move to juvenile habitats thought to be located over the shelf around 34° and 41° N in the summer and further offshore in the winter (USDOC 1999b). Juveniles migrate to nursery areas located between Cape Hatteras, North Carolina and Cape Cod, Massachusetts (Mather *et al.* 1995).

Project Area: Due to the strong migratory and epipelagic nature of this species, juvenile and adult bluefin tuna may pass through the Project Area to feed during the migration.

Bluefish (*Pomatomus saltatrix*): All Stages

Primary Source: Shepherd and Packer (2006)

Bluefish spawn offshore in open ocean waters. Spawning generally occurs offshore near the edge of the continental shelf. Eggs are not known to occur in estuarine waters, and larvae are only rarely collected in estuaries. Generally, bluefish eggs and larvae are collected in spring and summer in temperatures greater than 18^{o}C and in water with salinities above 31 ppt.

Juvenile bluefish move inshore in early- to mid-June, arriving when temperatures reach approximately 20°C. Juveniles are typically found near shorelines, including the surf zone, during the day and in open waters at night. However, it is presently unknown if bluefish are estuarine dependent since the distribution of juveniles over the continental shelf has not been described. Like adults, they are active swimmers and feed on small forage fishes, which are commonly found in nearshore habitats. They remain inshore in water temperatures up to 30°C and return to the continental shelf in the fall when water temperatures reach approximately 15°C. Juvenile bluefish are associated mostly with sand, but are also found over silt and clay bottom substrates. They usually occur in waters with salinities of 23–33 ppt, but can tolerate salinities as low as 3 ppt. Adults are generally oceanic but are found nearshore as well as offshore. Adults usually prefer warm water (at least 14 to 16°C) and full salinity.

Project Area: Based on their range of habitat utilization, YOY juvenile bluefish prefer coastal embayments and estuaries in the summer and can be expected to occupy the water column throughout the Project Area. Adults are typically pelagic and would occupy the open ocean portion of the Project Area.

Cero (*Scomberomorus regalis*): Juveniles and Adults

Primary Source: Collette and Nauen (1983) and NMFS (1999)

Spawning of cero or king mackerel takes place May through September with peaks in July and August. Batch spawning takes place in tropical and subtropical waters, frequently inshore. The eggs are pelagic and hatch into planktonic larvae. The cero is involved in migrations along the western Atlantic coast. With increasing water temperatures, Cero move northward from Florida to Rhode Island between late February and July, and migrate back in the fall. Cero have been reported to migrate along the western Atlantic coast in large schools; however, there appears to be a resident population in the southern Atlantic states (Georgia and Florida) as this species is available to sport fishers year round. The diet of these fish primarily consists of fishes and to a lesser extent penaeid shrimp and cephalopods. The fishes that make up the bulk of their diet are small schooling clupeids (e.g., menhaden, alewives, thread herring, and anchovies).

Cero mackerel are important both commercially and recreationally and are a valued sport fish year round in mid to south-Atlantic states.

Project Area: Cero is a pelagic species and can be expected to occupy the water column in the open ocean portion of the Project Area.

Cobia (*Rachycentron canadum*): All Stages

Primary Sources: Richards (1967), National Audubon Society (1983), and Chesapeake Bay Program (2006)

Cobia is a southern species that overwinters near the Florida Keys and migrates in the spring and summer to the mid-Atlantic to spawn. Juveniles and adults rarely are found as far north as Massachusetts and occasionally are present in the deeper waters of Chesapeake Bay in the summer. Cobia are caught by sports fishermen as far north in the Chesapeake as the mouth of the Potomac River. This warm-water species prefers temperatures from 20-30°C. Cobia spawn in estuarine and offshore areas, including near the mouth of the Chesapeake and offshore from mid-June to mid-August. Eggs and larvae generally are not found in lower salinity portions of estuaries.

Project Area: Cobia are pelagic, warm water species. An occasional adult or juvenile cobia may occur in the water column of the Project Area during the summer. Juveniles and adults can also be expected to occupy the nearshore portion of the Project Area.

Dolphinfish (*Coryphaena hippurus*): All Stages

Primary Sources: Gibbs and Collette (1959) and Oceanic Institute (1993)

The common dolphinfish (*Coryphaena hippurus*) is an oceanic pelagic fish found worldwide in tropical and subtropical waters. Males and females are sexually mature in their first year, usually by 4-5 months old. Spawning can occur at body lengths of 20 cm and occurs offshore, some near the continetal shelf or in areas above 24ºC. Females may spawn two to three times per year, and produce between 80,000 and 1,000,000 eggs per event. Larvae are found all year, with greater numbers detected in spring and fall. Larvae are most abundant at depths greater than 50 m at water temperatures of above 24ºC and a salinity of 33 ppt and above. This species prefer a DO of 6 mg/L and is very sensitive to low DO. Juveniles have been observed inshore but majority are seen offshore in temperatures of 26-34ºC. Early juveniles often show signs of distress at DO levels less than 5.5 mg/L.

Adult populations of the mid-Atlantic are generally highest in the summer due to their seasonal north-south migrations. The northern distributional limit is the 20ºC isotherm and can be found in oceanic salinities.

Project Area: Dolphinfish are a pelagic species and can be expected to occupy the water column in the open ocean portion of the Project Area. Larger aggregations of dolphinfish are likely to be found of the coasts of North and South Carolina where HAPC has been identified for this species in the following areas: The Point, 10 Fathom Ledge, Big Rock, Georgetown Hole, and the Charlestown Bump Complex.

King and Spanish Mackerel (*Scomberomorus cavalla and S. maculatus*): All Stages

Primary Sources: Godcharles and Murphy (1986), Collette and Nauen (1983)

King and Spanish mackerels are highly migratory epipelagic, neritic fish that migrate north from Florida as far as the Gulf of Maine in the summer and fall. King mackerel spawn in coastal waters of the Gulf of Mexico and off the south Atlantic coast. In the south Atlantic, king mackerel larvae have been taken at surface salinities ranging from 30 to 37 ppt and temperatures ranging from 22 to 28°C. King mackerel larvae are typically found near or off the continental shelf and near the Gulf Stream.

Spanish mackerel spawn in mid-June in the lower part of Chesapeake Bay. Spawning typically occurs at night when water temperature drops below 26°C. Spanish mackerel larvae have been collected in waters as shallow as 30 ft and as deep as 300 ft. Some juvenile Spanish mackerel use estuaries as nursery grounds, but most stay nearshore in open-beach waters.

In general, temperature and salinity are believed to be the most important factors governing the distribution of the king and Spanish mackerels. Their northern range limit is in the vicinity of Block Island, Rhode Island. Water temperatures ranging from 21 to 27°C are preferred by Spanish mackerel and this species is rarely observed in waters cooler than 18°C. All life stages of king and Spanish mackerel usually inhabit waters with salinities of 32 to 36 ppt. Spanish mackerel usually avoid freshwater or low salinities near the mouth of rivers.

Project Area: Due to the migratory, epipelagic nature, and habitat preferences of the king and Spanish mackerels, a few adult king and Spanish mackerels may pass through the Project Area to feed during their annual northward migration and when they return south in the fall. The occurrence of early life stages of these species would be rare in the Project Area.

Little Tunny (*Euthynnus alletteratus*): Juveniles and Adults

Primary Source: NMFS 2006c

Spawning occurs in April through November in the eastern and western Atlantic Ocean and, while in the Mediterranean Sea, spawning takes place from late spring through summer. Little tunny spawn outside the continental shelf region in water of at least 25°C, where females release as many as 1,750,000 eggs in multiple batches when they reach a length of 31 inches or 14 pounds. The males release sperm, fertilizing the eggs in the water column. These fertilized eggs are pelagic, spherical, and transparent.

Found in tropical and subtropical waters on both sides of the Atlantic, including the Mediterranean, Caribbean, and Gulf of Mexico, the little tunny often forms large, elliptical schools, which cover up to two miles on the long axis. Individuals of the species rarely live over 5 years. Little tunny feed mostly on small crustaceans, squid and small fishes.

Project Area: Due to the migratory and epipelagic nature of this species, little tunny can be expected to occupy the water column in the open ocean portion of the Project Area.

Monkfish (*Lophius americanus*): Eggs, Larvae, and Juveniles

Primary Source: Steimle *et al.* (1999b)

Spawning locations are not well known but are thought to be on inshore shoals (depths generally greater than 50 ft) to offshore Southern New England, Mid-Atlantic Bight, and Gulf of Maine shelf waters. Monkfish eggs are shed within buoyant, ribbon-like, non-adhesive mucoid veils or rafts. Larvae have been collected in offshore waters in the Mid-Atlantic Bight during March to April. Some larvae have been collected on the continental shelf at depths of 60 to 90 ft in May to July; after July, none have been observed in depths less than 90 ft. Larvae have been found off southern New Jersey, south of Long Island, in the New York Bight at depths of 30 to 300 ft, and off South New England.

Adults in the MAB migrate inshore in late winter–spring and move back offshore in summer and fall, probably to avoid warmer inshore water. Neither juveniles nor adults are caught in bottom temperatures greater than 15°C or depths less than 50 ft. Juvenile and adult monkfish caught in a bottom trawl survey in Narragansett Bay conducted four times a year during 1990 through 1996 were almost completely restricted to depths of more than 90 ft.

Project Area: Based on their range of habitat utilization, a few monkfish larvae may be found in surface waters in the Project Area in June and July. Eggs may occur in surface waters of the Project Area as well, probably during a more extended period of time.

Red Drum (*Sciaenops ocellatus*): All Stages

Primary Source: Buckley (1984) and Reagan (1985)

The red drum is an estuarine-dependent species found along the Atlantic coast and in the Gulf of Mexico. Adults are euryhaline and eurythermal and have been found to be most abundant at salinities of 30 to 35 ppt and observed in water temperatures ranging from 2 to 33°C. Spawning of red drum in the mid- and south Atlantic typically occurs from mid-August and extends to late September. It is speculated that red drum in the Atlantic coast spawn in nearshore waters adjacent to channels and passes, similar to those on the Gulf coast. Salinity is an important factor in hatching success. Eggs float at salinities greater than 25 ppt and sink at lower salinities, which could lead to clumping, respiratory stress, and mortality. It has been postulated that eggs and larvae are transported by deep subsurface currents of high-density water in Chesapeake Bay. Larvae occupy either vegetated or unvegetated bottoms in estuaries. Temperature is an important factor as larvae develop. At water temperatures below 20°C, larvae may be unable to make the transition to active feeding. Juveniles are also both euryhaline and eurythermal. They have been found at salinities of 0 to 50 ppt and water temperatures ranging from 13 to 28°C. Yearling juveniles live in protected waters with little wave action. At the end of the first year, they move into deeper bays or marine littoral areas during cold weather and then migrate back into the estuary during the spring.

Project Area: Due to the habitat preference of the red drum, larvae and juveniles may be present throughout the Project Area with a concentration in or around coastal inlets. However, eggs and adults would be rare in the Project Area.

Red Hake (*Urophycis chuss*): All Stages

Primary Source: Steimle *et al.* (1999c)

The red hake occurs in continental waters from the Gulf of St. Lawrence to the mid-Atlantic States (Bigelow and Schroeder 1953). Red hake spawn offshore in the mid-Atlantic Bight in the summer, primarily in southern New England. The distribution of eggs is unknown because they cannot be distinguished from other hakes. However, EFH for eggs is defined as surface temperatures less than 10°C and salinity less than 25 ppt. Larvae dominate the summer ichthyoplankton in the mid-Atlantic Bight and are most abundant on the mid- and outer-continental shelf. Red hake larvae prefer temperatures of 8 to 23°C and depths less than 200 m. Larvae typically settle to the bottom in the fall and need shelter. Juveniles seek shelter and commonly associate with scallops, surf clam shells, and seabed depressions. Juveniles prefer depths from less than 395 ft to the low tide line and temperatures between 2 to 22°C. Adults prefer depths from 100 to 425 ft and temperatures between 2 to 22°C. Adults are typically associated with sand-mud bottom in holes and depressions. Both juveniles and adults make seasonal migrations in response to changes in water temperatures.

Project Area: Hake eggs (including eggs of other species besides red hake) are common in the Project Area from May to November, but red hake larvae are less likely to occupy shallow coastal waters. Juvenile and adult red hake are attracted to deeper, cooler water in the shipping channels, and thus can be expected to occupy the Project Area throughout the year.

Scup (*Stenotomus chrysops*): Juveniles and Adults

Primary Source: Steimle *et al*. (1999d)

YOY juveniles are commonly found from the intertidal zone to depths of about 100 ft in portions of bays and estuaries where salinities are above 15 ppt. Juvenile scup appear to use a variety of coastal intertidal and subtidal sedimentary habitats during their seasonal inshore residency, including sand, mud, mussel beds, and eelgrass beds. Adults move inshore during early May and June between Long Island and Delaware Bay. Adults are found inside bays and sounds, but like juveniles, do not penetrate low salinity areas. Adults are often observed or caught over soft, sandy bottoms and in or near structured habitats, such as, rocky ledges, wrecks, artificial reefs, and mussel beds. Adults move offshore once water temperatures fall below 7.5 to 10°C in the fall.

Project Area: Juvenile and adult scup are known to occupy sandy bottom areas, but are more likely to occur on the shallower sandy shoal areas of the Project Area. Based on their range of habitat utilization, juvenile and adult scup are expected to occupy the Project Area during the spring and summer months.

Skipjack Tuna (*Katsuwonus pelamis*): Adults

Primary Source: Colette and Nauen (1983)

Skipjack tuna are highly migratory, circumglobal pelagic fish that inhabit tropical and warm-temperate waters and are generally limited by the 15°C isotherm. Skipjack tuna are often found in mixed schools with bluefin tuna of the same size. Like bluefin tuna, skipjack tuna often occur over the continental shelf and in embayments, particularly during the summer months when they feed actively on herring, mackerel, and squid. In the Mid-Atlantic Bight, adults typically occur in pelagic waters where water temperatures range from 20 to 31°C.

Project Area: Skipjack tuna are highly migratory and pelagic, and may pass through the Project Area to feed during their annual migration.

Snapper-Grouper Complex (73 species) : All Stages

Primary Source: SAFMC (1998)
The snapper-grouper complex consists of 10 families and 73 species and is recognized, managed, and is EFH-HAPC designated by the South Atlantic Fisheries Management Council. For assessment purposes, this complex of species is grouped and treated as one species designation since snapper-

grouper habitat usually contains multiple species that are listed within the complex (Table 2), a majority of which often exhibit similar life strategies.

Snapper-grouper complex individuals use different habitats – both benthic and pelagic – during different life stages. These species share an association with coral or hard bottom structures during part of their life cycle and all contribute to an interrelated reef fishery ecosystem. The planktonic larval stage generally lives in the water column feeding on zooplankton. Juveniles and adults tend to occupy areas near the ocean floor, often near hard structures with moderate to high relief, such as reefs, rocky bottoms, caves and ledges, and outcroppings. However, the juveniles of some species may occupy seagrass beds, mangroves, lagoons, and bays. Furthermore, individuals may migrate to different habitats across the shelf diurnally and seasonally.

Spawning regimens also exhibits temporal, spatial, and behavioral variability, though some patterns have emerged. For example, spawning generally occurs over one or two months in the winter, but spawning can occur year-round with more than two significant peaks during the year. Spatially, different species use shelf edge environments with moderate to high structural relief, while other species appear to use shallow areas. Furthermore, spawning occurs both in large aggregations and in pairs.

Spawning sites are clearly an important component of essential fish habitat. While specific data on spawning sites are limited, some specific sites have been identified for certain species.

Project Area: Habitat Areas of Particular Concern (HAPC) for the snapper-grouper complex are known to occur along the south Atlantic coasts of North and South Carolina. Potential vessel transit routes (although these routes have not been determined as of yet) may traverse these areas on their approach and departure from the mouth of the Chesapeake Bay. The areas that have been specifically identified as snapper-grouper complex EFH-HAPC are The Point, 10 Fathom Ledge, Big Rock, Georgetown Hole, and the Charleston Bump Complex.

Table 2. Snapper-Grouper Species List as Defined by SAFMC and Commercial/Recreational Designations

Common Name	Scientific Name	Commercially Important	Recreationally Important
MARINE			
Almaco jack	*Seriola rivoliana*	x	x
Atlantic spadefish	*Chaetodipterus faber*	x	x
Banded rudderfish	*Seriola zonata*	x	x
Bank sea bass	*Centropristis ocyurus*	x	x
Bar jack	*Caranx ruber*		
Black grouper	*Mycteroperca bonaci*	x	x
Black margate	*Anisotremus surinamensis*	x	
Black sea bass	*Centropristis striata*	x	x
Black snapper	*Apsilus dentatus*	x	
Blackfin snappper	*Lutjanus buccanella*	x	
Blue runner	*Caranx crysos*		
Blueline tilefish	*Caulolatilus microps*	x	

Common Name	Scientific Name	Commercially Important	Recreationally Important
MARINE			
Bluestripe grunt	*Haemulon sciurus*	x	
Coney	*Epinephelus fulvus*	x	
Cottonwick grunt	*Haemulon melanurum*		
Crevalle jack	*Caranx hippos*		
Cubera snapper	*Lutjanus cyanopterus*	x	x
Dog snapper	*Lutjanus jocu*	x	
French grunt	*Haemulon flavolineatum*	x	
Gag grouper	*Mycteroperca microlepis*		x
Golden tilefish	*Lopholatilus chamaeleonticeps*		x
Goliath grouper (jewfish)	*Epinephelus itajara*		
Grass porgy	*Calamus arctifrons*		
Gray snapper	*Lutjanus griseus*	x	x
Gray triggerfish	*Balistes capriscus*	x	x
Graysby	*Epinephelus cruentatus*	x	
Greater amberjack	*Seriola dumerili*	x	x
Hogfish	*Lachnolaimus maximus*	x	x
Jolthead porgy	*Calamus bajonado*	x	
Knobbed porgy	*Calamus nodosus*	x	
Lane snapper	*Lutjanus synagris*	x	x
Lesser amberjack	*Seriola fasciata*	x	
Longspine porgy	*Stenotomus caprinus*		
Mahogany snapper	*Lutjanus mahogoni*	x	
Margate	*Haemulon album*	x	
Misty grouper	*Epinephelus mystacinus*	x	
Mutton snapper	*Lutjanus analis*	x	x
Nassau grouper	*Epinephelus striatus*	x	
Ocean triggerfish	*Canthidermis sufflamen*	x	
Porkfish	0 *nicus*		
Puddingwife	*Halichoeres*	x	
Queen snapper	*Etelis oculatus*	x	
Queen triggerfish	*Balistes vetula*	x	
Red grouper	*Epinephelus morio*	x	
Red hind	*Epinephelus guttatus*	x	
Red porgy	*Pagrus pagrus*	x	x
Red snapper	*Lutjanus campechanus*	x	x
Rock sea bass	*Centropristis philadelphica*	x	
Sailors choice	*Haemulon parra*		
Sand tilefish	*Malacanthus plumieri*		
Saucereye porgy	*Calamus calamus*	x	
Scamp	*Mycteroperca phenax*	x	
Schoolmaster	*Lutjanus apodus*	x	
Scup	*Stenotomus chrysops*	x	x
Sheepshead	*Archosargus probatocephalus*	x	x
Silk snapper	*Lutjanus vivanus*	x	x
Smallmouth grunt	*Haemulon chrysargyreum*		

Common Name	Scientific Name	Commercially Important	Recreationally Important
MARINE			
Snowy grouper	*Epinephelus niveatus*	x	x
Spanish grunt	*Haemulon macrostomum*		
Speckled hind	*Epinephelus drummondhayi*	x	x
Tiger grouper	*Mycteroperca tigris*	x	
Tomtate	*Haemulon aurolineatum*	x	x
Vermilion snapper	*Rhomboplites aurorubens*	x	x
Warsaw grouper	*Epinephelus nigritus*	x	x
White grunt	*Haemulon plumieri*	x	x
Whiteboned porgy	*Calamus leucosteus*	x	x
Wreckfish	*Polyprion americanus*	x	
Yellow jack	*Caranx bartholomaei*	x	x
Yellowedge grouper	*Epinephelus flavolimbatus*		
Yellowfin grouper	*Mycteroperca venenosa*		
Yellowmouth grouper	*Mycteroperca interstilitialis*	x	
Yellowtail snapper	*Ocyrus chrysurus*	x	

Note : SAFMC reports that 73 species compose the snapper-grouper complex although only 72 could be found in their source documents.

Summer Flounder (*Paralichthys dentatus*): All Stages

Primary Source: Packer et al. (1999)

Summer flounder are distributed from the eastern portion of Georges Bank to South Carolina and Florida, but are most abundant south of Cape Cod (Bigelow and Schroeder 1953). This species exhibits strong inshore-offshore movements. Summer Flounder eggs are pelagic and buoyant with the highest concentrations being found within nine miles of the shore of New Jersey and New York. Eggs are most abundant in the fall months between depths of 100 to 230 ft. Summer flounder larvae are most abundant 12 to 50 mi from shore at depths of 100 to 230 ft in the northern part of the mid-Atlantic Bight from September to February. Planktonic larvae and post-larvae derived from offshore fall and winter spawning migrate inshore from October to May, entering coastal and estuarine nursery areas to complete transformation.

Summer flounder exhibit strong inshore–offshore movements. Adults and juveniles typically move offshore in the fall and remain there through the winter. Adults and juveniles occupy shallow coastal and estuarine waters during spring and summer. Some juveniles remain inshore for an entire year before migrating offshore, while others move offshore in the fall and return the following spring. Juvenile summer flounder utilize several different estuarine habitats such as marsh creeks, seagrass beds, mud flats, and open bay areas, but are not found in areas with pollution issues that lack food sources or that lack sufficient water circulation. Juveniles are sometimes found in Chesapeake Bay, with YOY found in tidal creeks with salinities greater than 15 ppt but more abundant in higher salinity systems. As long as other conditions are favorable, substrate preferences and prey availability are the most important factors affecting distribution. Some studies indicate that juveniles prefer mixed or sandy substrates; others show that mud and vegetated habitats are used. Adults are reported to prefer sandy habitats, but can be found in a variety of habitats with both mud and sand substrates. Spawning occurs in open ocean areas as fish are moving to their offshore wintering areas. Eggs and larvae are found in offshore waters, particularly in fall (eggs) and winter (larvae) months.

Project Area: Based on the habitat preference of this species, the buoyant eggs are expected to occur in the Project Area. Eggs and larvae may be common within the oceanic portion of the Project Area. Juvenile and adult summer flounder would be common throughout the lower potions of the Chesapeake Bay, but less so in the Project Terminal Area. However, given their association with sandy substrates and the fact that they feed on a variety of bottom-dwelling invertebrates and fish species that occupy the Project Area, transitory individuals can be expected to occupy the Project Area during the summer months.

Swordfish (*Xiphias gladius*): Juveniles

Primary Source: USDOC (1999b)

Swordfish are epipelagic to mesopelagic. This species is circumglobal, ranging through tropical, temperate, and sometimes cold-water regions. Their optimum temperature range is believed to be 18 to 22°C, but they will dive into 5 to 10°C waters at depths of up to 2130 ft. This species also migrate diurnally, coming to the surface at night. Specifically, two different migration patterns have been observed: swordfish in neritic (shallow, near-coastal) waters of the northwest Atlantic were found in bottom waters during the day and moved to offshore surface waters at night. Swordfish in oceanic waters migrated vertically from a daytime depth of 1640 to 295 ft at night. Juveniles are typically found in pelagic waters warmer than 18°C from the surface to a depth of 1640 ft.

Project Area: Swordfish are highly migratory and pelagic, and may pass through the Project Area to feed during their annual migration.

Whiting (*Merluccius bilinearis*): Larvae and Juveniles

Primary Source: Morse *et al.* (1999)

Whiting, or silver hake, spawn on the outer continental shelf. Eggs and larvae are distributed in mid and outer shelf waters, but not in coastal waters. Significant egg production occurs during May to October, with a peak in August. Primary spawning grounds apparently occur between Cape Cod and Montauk Point, New York, on the southeastern slope of Georges Bank, and in Massachusetts Bay. Juveniles are common during spring and summer in relatively shallow waters in Southern New England and south of Long Island. Coastal waters off New Jersey, Long Island, and Rhode Island are centers of abundance in the fall. Adults occupy bottom habitats of all substrate types. In general, adults prefer depths between 100 to 1,000 ft and water temperatures below 21°C.

Juvenile whiting are primarily caught at depths greater than 30 ft and prefer high DO concentrations (10 to 11 mg/l), high salinities (greater than 27 ppt), and a wide range of temperatures (3 to 23°C). Juveniles are present in the New York Bight at all times of year and adults are mostly restricted to the colder months (winter and spring). Juveniles prefer shallower water (80 to 250 ft) during the fall and deeper water (greater than 500 ft) in the spring, while adults prefer depths greater than 150 ft in the fall and greater than 400 ft in the spring. Eggs and larvae are primarily restricted to mid and outer continental shelf waters.

Project Area: Based on their range of habitat utilization, juvenile whiting can be expected to occupy the Project Area throughout the year and adults in the winter and spring. Larvae typically occur in deeper water, and therefore are not likely to be found within the Project Area in significant numbers.

Windowpane (*Scophthalmus aquosus*): All Stages

Primary Source: Chang *et al.* (1999)

Windowpane are a shallow water mid- and inner-shelf species found primarily between Georges Bank and Cape Hatteras on fine sandy sediment. Spawning occurs on inner shelf waters, including many coastal bays and sounds, and on Georges Bank. Juveniles and adults are similarly distributed. They are found in most bays and estuaries south of Cape Cod throughout the year at a wide range of depths (less than 5 to 130 ft), bottom temperatures (3 to 12°C in the spring and 9 to 12°C in the fall), and salinities (5.5 to 36 ppt). Juveniles that settle in shallow inshore waters move to deeper offshore waters as they grow. Adults occur primarily on sand substrates off southern New England and mid-Atlantic Bight. Spawning occurs primarily in offshore areas but may occur in high salinity portions of estuaries as well. Larvae are found primarily in continental shelf waters in the autumn. Although in general larvae may be present in high salinity estuarine areas in the spring, they are considered rare in Chesapeake Bay. Eggs have not been recorded in Chesapeake Bay.

Project Area: Based on the habitat utilization of this species, juvenile and adult windowpane would be rare throughout the Project Area. Similar to the summer flounder, occasional transients can be expected to occupy the Project Area during the summer months. Eggs and larvae would not be anticipated to be present in the Project Area.

Winter Flounder (*Pseudopleuronectes americanus*): Juveniles and Adults

Primary Source: Pereira *et al.* (1999)

Winter flounder spawning occurs from late winter through early spring, peaking south of Cape Cod in February and March. Recently settled YOY juveniles are found close to spawning grounds and in high concentrations in depositional areas with low current speeds. YOY juveniles migrate very little in the first summer, move to deeper water in the fall, and remain in deeper cooler water for much of the following year. Habitat utilization by YOY is not consistent across habitat types and is highly variable among systems and from year to year. Several field and lab studies suggest a "preference" for muddy/fine sediment substrates where they are most likely to have been deposited by currents. Adult winter flounder prefer temperatures of 12 to 15°C, DO concentrations greater than 2.9 mg/l, and salinities above 22 ppt, although they have been shown to survive at salinities as low as 15 ppt. Mature adults are found in very shallow waters during the spawning season.

Project Area: Due to their range of habitat utilization, juveniles and adults can be expected to be common in the Project Area throughout the year.

Witch Flounder (*Glyptocephalus cynoglossus*): Eggs and Larvae

Primary Source: Luca *et al.* (1999)

Witch flounder inhabit continental shelf waters as deep as 4,920 ft. Adults inhabit mud and clay substrates, or mud and clay mixed with sand, but rarely on sand. Spawning occurs from shore to the outer continental shelf, primarily at depths of 330 to 525 ft, from March through October, but peaks in the Mid-Atlantic Bight between May and June. Eggs are laid at or near the bottom, but rise into the water column where subsequent egg and larval development occurs. Larvae remain in the water column for a long time, from four to six months to a year. Offshore larval surveys indicate that larval witch flounder are evenly distributed over the continental shelf from Cape Hatteras to southwest Nova Scotia. Larvae are present in the New York Bight from May to July, primarily in deep water (165 to 300 ft).

Project Area: Based on the habitat requirements of eggs and larval witch flounder, they are expected to occupy the offshore water column portion of the Project Area.

Yellowfin Tuna (*Thunnus albacares*): Juveniles and Adults

Primary Source: USDOC (1999b)

Yellowfin tuna is an epipelagic, oceanic species. This species is circumglobal, typically found in tropical and temperate waters ranging from 18 to 31°C. Similar to all other tuna species, yellowfin tuna is a known schooling species, with juveniles found in schools at the surface, mixing with skipjack and bigeye tuna. Adults have the same habitat preference as the juveniles and can be found in pelagic waters from the surface to 330 ft deep.

Project Area: Yellowfin tuna are highly migratory and pelagic, and may pass through the Project Area to feed during their annual migration.

Yellowtail Flounder (*Limanda ferruginea*): Larvae

Primary Source: Johnson *et al.* (1999)

Yellowtail flounder occupy continental shelf waters on the Atlantic coast between depths of 35 and 1,200 ft, but are more common in depths less than 330 ft. Larvae have been collected at depths of 35 to 100 ft in April and 100 to 300 ft during May to September. Larvae are present in the New York Bight from April to July.

Project Area: Based on their range of habitat utilization, yellowtail flounder larvae are expected to occur in the Project Area during spring and summer.

4.1.2 Invertebrate Species

Long-Finned Squid (*Loligo pealei*): Juveniles and Adults

Primary Source: Cargnelli *et al.* (1999a)

Long-finned inshore squid are a pelagic schooling species that can be found in continental shelf and slope waters from Newfoundland to the Gulf of Venezuela. Juveniles inhabit the upper 10 m of the water column over water 165 to 490 ft deep on continental shelf. Juveniles are typically found in coastal inshore waters in spring/fall while migrating to offshore waters in winter. Juveniles have a temperature preference of 10 to 26°C and salinities of 31.5 to 34.0 ppt. Adult long-finned inshore squid inhabit the continental shelf and upper continental shelf slop to depths of 400 m. Adults are typically found over mud or sandy mud bottoms, and have been found at surface temperatures ranging from 9 to 21°C and bottom temperatures ranging from 8 to 16°C.

Project Area: Based on their range of habitat utilization, juveniles and adults can be expected to occur in the Project Area.

Ocean Quahog (*Arctica islandica*): Juveniles and Adults

Primary Source: Cargnelli *et al.* (1999b)

Ocean quahogs are extremely slow-growing and long-lived, distributed on the continental shelf from Newfoundland to Cape Hatteras, North Carolina. The inshore limit of their distribution appears to be defined by the 16°C bottom isotherm in the summer months. Juveniles are typically found offshore in sandy substrates, but may survive in muddy intertidal environments if protected from predators. Juveniles in the Mid-Atlantic Bight have a temperature preference of 1 to 12°C, depth of 150 to 250 ft, and salinities of 32 to 34 ppt. Adults usually are found in dense beds over level bottoms, just below the surface of the sediment, ranging from medium to fine grain sand. Adults have a temperature preference of 6 to 16°C, depth of 150 to 200 ft, and oceanic salinities. Adults are also capable of surviving low DO levels by burrowing into the sand and respire anaerobically for up to seven days.

Project Area: Based on their range of habitat utilization, juveniles and adults are expected to occur in the Project Area. However, they would be limited to the bottom of the offshore ocean with little to no impact.

Rock Shrimp (*Sicyonia brevirostris*): All Stages

Primary Source: SAFMC (1998)

Rock shrimp occur in terrigenous and biogenic fine to medium sand substrate habitats with small patches of silt and clay. They also utilize coral and hard bottom habitats, but are found only sporadically in areas with mud substrates. Rock shrimp are distributed along the Atlantic Coast from Virginia to Florida, south to Cuba and the Bahamas, and in the Gulf of Mexico. These bottom feeders inhabit waters ranging from 60 to 600 ft in depth with the highest concentrations occurring between 80 and 215 ft.

Rock shrimp generally spawn from November to January with females spawning three or more times in a season, often coinciding with the full moon. Larvae can be found year round without regard for temperature, salinity, depth, or moon phase. The Florida coast shelf current systems are essential for keeping larvae on the Florida coast and for transporting them onshore, while the Gulf Stream is essential for dispersing the larvae.

Project Area: Based on their range of habitat utilization, all life stages can be expected to occur in deepwaters of the Project Area. However, similar to other substrate-dwelling invertebrates, most individuals would be limited to the bottom of the offshore ocean and suffer little or no impact.

Royal Red Shrimp (*Pleoticus robustus*): All Stages

Primary Source: SAFMC (1998)

Royal red shrimp are usually found in waters over blue/black mud, sand, muddy sand, or white calcareous mud. They are distributed throughout the Gulf of Mexico and South Atlantic from Cape Cod to French Guinea. Royal red shrimp inhabit waters of the upper continental slope from depths of 590 to 2,400 ft, but they are most commonly found between 820 and 1,560 ft.

Essential fish habitat for royal red shrimp also includes the Gulf Stream, because it disperses royal red shrimp larvae.

Project Area: Based on their range of habitat utilization, all life stages can be expected to occur in deepwaters of the Project Area. However, similar to other substrate-dwelling invertebrates, most individuals would be limited to the bottom of the offshore ocean and suffer little or no impact.

Surf Clam (*Spisula solidissima*): Juveniles and Adults

Primary Source: Cargnelli *et al.* (1999c)

The greatest concentration of Atlantic surf clam is usually found in well-sorted, medium sand, but they may also occur in fine sand and silty-fine sand. Atlantic surf clam is distributed in western North Atlantic continental shelf waters from the southern Gulf of St. Lawrence to Cape Hatteras, North Carolina. Atlantic surf clam can inhibit waters from the surf zone to a depth of 420 ft. Along Long Island and New Jersey waters, the highest concentrations occur at less than 60 ft. The preferred temperature range is between 1 to 25^{o}C with spawning occurring in temperatures greater than 15^{o}C. In New Jersey, spawning occurs from late June to early August and may begin as early as late May or early June in inshore waters.

Atlantic surf clams are typically found in salinities higher than 28 ppt, but are capable of surviving salinities as low as 12.5 ppt for a period of two days. Studies have found severe hypoxic events (DO less than 3 parts per million [ppm]) in New Jersey killing Atlantic surf clam. Positive hypoxia effects include the decimation of Atlantic surf clam predators, would allow successful recruitment of recently settled clams. Currently, there is minimal information on the effects of currents on Atlantic surf clam, particularly on feeding and bedload transport of small clams. The dynamic environments in which Atlantic surf clam live may substantially affect flux of food and population distribution where oceanic storms can displace adults a considerable distance from their burrows.

Project Area: Based on their range of habitat utilization, juveniles and adults can be expected to occur in the Project Area. However, similar to the ocean quahog, juveniles and adults would be limited to the bottom of the offshore ocean with little to no impact.

4.1.3 Shark Species

Atlantic Sharpnose Shark (*Rhizoprionodon terraenovae*): Adults

Primary Source: USDOC (1999b)

The Atlantic sharpnose shark is a small coastal species, inhibiting the waters of the northeast coast of North America. This species is a common year-round resident of the South Atlantic Bight and can be found in schools of uniform size and sex. Adults prefer temperature between 20 to 30°C and salinity between 21 to 35 ppt.

Project Area: Based on their range of habitat utilization, adults can be expected to occur in the nearshore portions of the Project Area.

Blue Shark (*Prionace gluaca*): Adults

Primary Source: USDOC (1999b)

Blue shark is an oceanic-epipelagic, fringe-littoral, cosmopolitan species, occurring throughout the tropical, subtropical, and temperate open waters (Bigelow and Schroeder 1953). Atlantic blue sharks are highly migratory with a regular clockwise trans-Atlantic migration route following the warm Gulf Stream waters. The general range of blue shark is from Argentina to Newfoundland in the western Atlantic. The temperature preference of blue shark is between 7 to 18°C.

Project Area: Based on their range of habitat utilization, blue shark may pass through the Project Area to feed during their annual migration.

Dusky Shark (*Carcharinus obscurus*): Juveniles

Primary Source: Compagno (1984) and USDOC (1999b)

The dusky shark is a coastal-pelagic, inshore and offshore warm-temperate and tropical species found in the continental insular shelves and oceanic waters. Lateral range of dusky shark is close inshore in the surf zone to well out to sea, and a depth preference from the surface to 1,310 ft deep. Adults do not prefer areas with reduced salinities and tend to avoid estuaries. (Compagno 1984). In the western Atlantic, dusky sharks are highly migratory with a geographical range from Nova Scotia to Cuba (including the northern Gulf of Mexico).

Male dusky sharks attain sexual maturity at 231 (cm) (fork length) and 19 years of age, while females mature at 235 cm (fork length) and 21 years (Natanson et al. 1995). Dusky sharks are viviparous with a yolk-sac placenta. In the western Atlantic, young per litter ranges from six to 10 per brood

(Knickle 2002a). Females move inshore to drop the young and then depart the nursery area shortly after. Pups measure 85-100 cm TL at birth (Castro 1983).

Project Area: Although migratory and pelagic, dusky sharks spawn in nearshore water, and therefore juveniles are expected to occur in the Project Area.

Sandbar Shark (*Carcharinus plumbeus*): Juveniles and Adults

Primary Source: Compagno (1984) and USDOC (1999b)

The sandbar shark is an abundant, coastal-pelagic shark of temperate and tropical waters that occurs inshore and offshore. It is found on continental and insular shelves and is common at bay mouths, in harbors, inside shallow muddy or sandy bays, and at river mouths, but tends to avoid sandy beaches and the surf zone. Sandbar sharks migrate north and south along the Atlantic coast, reaching as far north as Massachusetts in the summer. Sandbar sharks bear live young in shallow Atlantic coastal waters between Great Bay, New Jersey, and Cape Canaveral, Florida. The young inhabit shallow coastal nursery grounds during the summer and move offshore into deeper, warmer water in winter. Late juveniles and adults occupy coastal waters as far north as southern New England and Long Island.

Sandbar sharks are viviparous where the embryos are nourished via a placenta sac. Mating occurs in the spring or early summer (May-June) and pups are born from June through August. Litter size varies by region and dependent upon the size of the mother. Sandbar sharks bear live young in shallow bays and estuaries of the east-central U.S. from Delaware to North Carolina. The young inhabit shallow coastal nursery grounds until late fall and move southward and further offshore in the winter and return to the nursery ground during the summer months. This movement between shallow coastal waters and warmer, deeper waters may continue for a period of up to five years (Knickle 2002b).

Project Area: Sandbar sharks are migratory and coastal-pelagic species. The Project Area is a potential nursery ground for this species and has HAPC status. Late juvenile and adult sandbar sharks may also occupy the nearshore coastal waters of the Project Area.

Sand Tiger Shark (*Caracharius taurus*): Juvenile and Adults

Primary Source: Compagno 2002

Sand tiger shark is a tropical to warm-temperate, inshore to offshore, and littoral to deepwater species. Sand tiger sharks occur in continental and insular waters from the outer shelves and down the slopes to seamounts, possibly 5,250 ft deep. Occasional species have been observed to come into the tide line along beaches or enter mouths of rivers (Bigelow and Schroeder 1953). They may also be found in shallow bays and around coral reefs. The general range of sand tiger shark is from Brazil to Maine in western Atlantic. Sand tiger sharks have been observed hovering motionless just above the seabed in or near deep sandy bottom gutters or rocky caves, usually in the vicinity of inshore rocky reefs and islands.

Although female sand tiger shark may produce up to 17,000 eggs, only two embryos develop (one in each oviduct). The embryos are hatched within the mother and retained there until the resultant young are ready for independent existence. The embryos are oviphagous (egg-eating) and nourished by feeding on unfertilized eggs. Pregnant females captured near Woods Hole, Massachusetts contained only eggs, thus making it likely that juvenile species in southern New England have come from a more southerly birthplace. Females mature and reproduce at eight years of age while males mature and reproduce at four to five years of age.

Project Area: Based on their range of habitat utilization, juvenile and adult sand tiger sharks can be expected to occupy the water column in the oceanic section of the Project Area.

Scalloped Hammerhead Shark (*Sphryna lewini*): Juveniles

Primary Source: USDOC (1999b)

The scalloped hammerhead shark is a very common, large, schooling species, commonly associated with warm waters. This species has been found in coastal regions, appearing in shallow waters such as estuaries and inlets. Vertical movement of this species is from the surface down to a depth of approximately 900 ft. Specifically, early juveniles are typically associated with shallow coastal waters of the South Atlantic Bight and late juveniles are typically associated with shallow coastal waters of the U.S. Atlantic seaboard from the shoreline to the 660 ft isobath.

Project Area: Based on the habitat requirements of juvenile scalloped hammerhead shark, this species may occur in the nearshore waters of the Project Area.

Shortfin Mako Shark (*Isurus oxyrhincus*): Juveniles and Adults

Primary Source: Compagno (2002) and USDOC (1999b)

The shortfin mako shark is a common, extremely active, highly migratory, offshore littoral and epipelagic species found in tropical and warm temperate seas. Its geographical range in the western Atlantic is from the Gulf of Maine to southern Brazil and possibly northern Argentina. Shortfin mako shark have a depth variance from the surface down to at least 1,640 ft. It occurs well offshore but penetrates the inshore littoral just off the surf zone in places where the continental shelves are very narrow. This species prefers clear water to turbid water and have a temperature range between 17 to 22°C. Juveniles tend to stay near the surface above 65 ft and in waters 20 to 21°C and avoid the thermocline and cold deeper waters. Juveniles tend to use the offshore continental waters as nursery areas. Shortfin mako shark is ovoviviparous, producing litters of young ranging from four to 25 per brood and measuring between 60 and 70 cm at birth. Both sexes reach sexual maturity between ages of four to six years. Birth occurs mostly in late winter to midsummer. This species is an oceanic species at the top of the food chain, feeding on fast-moving fishes such as swordfish, tuna, and other sharks.

Project Area: Based on habitat requirements of this species, they are expected to occur in the offshore portion of the Project Area.

<u>Spiny Dogfish (*Squalus acanthias*): Juveniles and Adults</u>

<u>Primary Source</u>: McMillan and Morse (1999) and Bigelow and Schroeder (1953)

The spiny dogfish, *Squalus acanthias* is a highly migratory coastal squaloid shark with a circumboreal distribution. *S. acanthias* has been recorded as the most abundant shark in the western North Atlantic. The range of the spiny dogfish extends from Labrador to Florida, but is most abundant from Nova Scotia to Cape Hatteras, North Carolina. Adults migrate northward in the spring and summer and southward in the fall and winter. Fish that spend the summer north of Cape Cod move south to Long Island in the fall and as far south as North Carolina in the winter. Seasonal inshore-offshore movements and coastal migrations are related to water temperature. Generally, spiny dogfish spend the summers in inshore waters and overwinter in deeper offshore waters. They are usually epibenthic, but occupy pelagic zones as well. They can be found from nearshore shallows to offshore shelf waters up to depths of 2,950 ft and are tolerant of a wide range of water temperatures (1 to 22°C). Dogfish prefer oceanic salinities (30 to 34 ppt).

Adult spiny dogfish fertilization occurs internally and is ovoviviparous. The gestation period averages 18–22 months. Parturition generally takes place offshore in the winter yielding litters averaging six to seven pups but have been recorded as high as 15.

In the spring, juveniles and adults occur in deeper, generally warmer waters on the outer shelf from North Carolina to Georges Bank. In the fall, they occur in the shallower, moderately warm waters from mid to north Atlantic. Dogfish are rare transient visitors to estuaries since they prefer higher salinities.

<u>Project Area</u>: Given the life history and habitat preferences, juvenile and adult spiny dogfish may occur within the Project Area.

<u>Tiger Shark (*Galeocerdo cuvieri*): Juveniles and Adults</u>

<u>Primary Source</u>: Compagno (1984) and USDOC (1999b)

Tiger sharks inhabit warm waters in both deep oceanic and shallow coastal regions (Castro 1983). Tiger sharks have a tolerance for different marine habitats, but prefer turbid waters in coastal areas (Compagno 1984). Tiger sharks commonly are found in river estuaries, harbors, and other inlets where runoff from the land may attract a high number of prey items (Knickle 2002c). Shallow areas around large island chains and oceanic islands including lagoons are also part of tiger sharks' natural environment. Depth preference of this species is from the surface to depths of 350 m (Knickle 2002c). This species undergoes seasonal migrations, moving into temperate waters from the tropics during the warmer months and returning during the winter months. It is a very large species, reaching 550 cm TL and 900 kg. Tiger sharks are ovoviviparous, producing large litters of young ranging from 10 to 80 per brood and measuring between 50 and 85 cm TL at birth. In the northern hemisphere, mating usually takes place between March and May and the young are born between April and June of the following year.

Project Area: Based on habitat requirements of the tiger shark, this species may occur in the offshore portion of the Project Area during migration.

4.1.4 Skate Species

Clearnose Skate (*Raja eglanteria*): Juveniles and Adults

Primary Source: Packer *et al.* (2003a)

The clearnose skate is found on soft bottoms along the continental shelf, but also occurs on rocky or gravelly bottoms. In general, clearnose skate are inshore along the continental shelf during the spring and early summer, moving offshore and south during autumn and early winter as water temperatures cool. In Chesapeake Bay, juvenile and adult clearnose skate have been found in all seasons but are more abundant from spring until December. During surveys of the Chesapeake Bight, clearnose skate was more abundant in shallow water during spring and summer than during autumn and winter and was more abundant in the Bight during the summer and autumn than in the winter and spring. In the 1988 to 1999 Virginia Institute of Marine Science (VIMS) trawl surveys, the most common catches of juvenile and adult clearnose skates occurred in water temperatures between 8 to 24°C near the Bay mouth, but were present throughout the Bay, rarely in tributaries. Result of the VIMS surveys also showed a strong correlation with salinity as 85% of the catch was captured at salinities greater than or equal to 22 ppt. The depth of capture ranged from 3 to 100 ft, with the most common depths ranging between 9 and 50 ft.

North of Cape Hatteras, spawning occurs in the spring and summer. Eggs are deposited in sandy or muddy flats. Young skates may follow large objects (such as adults). Eggs would likely be present in the lower part of the Chesapeake where higher salinities occur.

Project Area: Based on the habitat utilization of this species, occurrences of juvenile and adult clearnose skates would be rare throughout the Project Area, although occasional transient individuals can be expected to occupy the Project Area during the summer months.

Little Skate (*Leucoraja erinacea*): Juveniles and Adults

Primary Source: Packer *et al.* (2003b)

Little skate are generally found on sandy or gravelly bottoms, but also occur on mud. The species generally makes no extensive migrations, though when it occurs in inshore areas they may move between inshore and offshore areas with seasonal temperature changes. This species is known to remain buried in depressions during the day and are more active at night. Overall depth preference of this species is 1 to 450 ft with a water temperature range between 2 to 15°C. Bottom trawls conducted by NMFS from the Gulf of Maine to Cape Hatteras from 1963-2002 resulted in juveniles most commonly found between 8 and 16°C and salinities at 32-33 ppt. Results from these trawls indicated that adults were most commonly found between 4 and 16°C in the spring and 9 and 14°C in the fall, and salinities at 32-33 ppt. Little skate have been found in the lower part of Chesapeake Bay, particularly around the bay mouth in higher salinity waters. This species has been observed to leave some estuaries for deeper water during warmer months.

Eggs are generally deposited in sandy bottoms, usually at depths less than 330 ft. Pregnant little skate occur year-round, but spawning peaks may occur in October and May. Eggs would likely be present in the lower part of the Chesapeake where higher salinities occur.

Project Area: Based on the habitat utilization of this species, juvenile and adult little skates would be rare throughout the Project Area, although an occasional passing individual could occur within the Project Area during the spring and fall months.

Rosette Skate (*Leucoraja garmani virginica*): Juveniles

Primary Source: Packer *et al.* (2003c)

Rosette skate is typically found on soft bottoms, including sand to mud bottoms, mud with echinoid and ophiuroid fragments, and shell and pterpod ooze. It occurs in depths from 100 to 1,740 ft, but is most common between 240 and 900 ft. In the Chesapeake Bight, rosette skate are typically found in depths between 100 and 640 ft, generally at depth greater than 240 ft and appears to have a shoreward movement during the summer. In the Chesapeake Bight, rosette skate has a temperature range between 6 to 17°C, with a preference between 9 to 13°C, and a salinity range between 31 to 36 ppt, with a preference between 35 to 36 ppt.

Project Area: Based on the habitat utilization of this species, juveniles would occur within the deep waters of the offshore Project Area.

Winter Skate (*Leucoraja ocellata*): Juveniles and Adults

Primary Source: Packer *et al.* (2003d)

Similar to the little skate, winter skate are generally found on sandy or gravelly bottoms, but also occur in mud. This species remains buried in depressions during the day and are most active at night. Juvenile and adults winter skates have been caught at depths ranging from shoreline to 1,215 ft, although most abundant at less than 365 ft. This species has been captured over a water temperature range of -1.2 to 19°C. During the winter months, captures off the coast of the mid-Atlantic typically occur when water temperatures range from 10 to 12°C. Winter skate are found in saline waters, with adults in water with salinities greater than 30 ppt and juveniles found in slightly less saline waters, generally around 25 to 30 ppt. Winter skate have been reported from the Chesapeake from December to April in lower parts of the Bay with higher salinities.

Females with developed egg cases are found in summer and fall, though reproduction may possibly occur throughout the year. Eggs are deposited in sandy or muddy flats.

Project Area: Based on the habitat utilization of this species, juvenile and adult little skates would be rare throughout the Project Area, although an occasional passing individual could occur within the Project Area during the winter months.

4.2 NON EFH-DESIGNATED FISH AND CRUSTACEANS

This section provides information on life history and habitat requirements for important recreational and commercial, non EFH-designated species that may occur within the proposed Project Terminal Site since this area is most likely to be directly impacted by the proposed construction and the additional areas (*i.e.,* the vessel transit routes beginning at the demarcation of U.S. Territorial Waters and continuing inland to Chesapeake Bay), are not likely to be significantly affected by the increase in ship traffic as the majority of routes that will be traveled are over deep water. For this reason, the focus of further non EFH-designated-species discussion will be placed on non EFH-designated species that are most likely to occur within the Terminal Site of the propose Project Area and not along prospective vessel transit routes.

Unlike the EFH-designated species, no life stages of importance have been designated for the non EFH-designated species, and therefore each species assessment addresses all life stages of that particular species. Conclusions regarding the likelihood of occurrence of each species and life history stage in the Project Area are presented at the end of each species assessment. These species includes striped bass (*Morone saxatilis*), blue crab (*Callinectes sapidus*), horseshoe crab (*Limulus polyphemus*), Atlantic croaker (*Micropogonias undulates*), spot (*Leiostomus xanthurus*), alewife (*Alosa pseudoharengus*), blueback herring (*Alosa aestivalis*), American eel (*Anguilla rostrata*), yellow perch (*Perca flavescens*), and white perch (*Morone americana*). Similar to the treatment of EFH-designated species in Section 4.1, primary reference sources are cited once, at the beginning of each summary. Available information on feeding habits of EFH-designated species and on benthic resources in the Project Terminal Area is presented in the Section 4.4 of this EFH assessment report.

During the fish sampling survey conducted by AES in June and October of 2006, a total of 13 species were captured in the proposed Project Terminal Area, with white perch being the most dominant in both abundance and biomass. Table 2 provides the results of that survey.

Table 3. Trawl Catch Abundance, June and October 2006 Sampling.

Common Name	Scientific Name	Total (number)	Percent of Total	Total (grams)	Percent of Total
June					
White perch	*Morone americana*	390	84	15,563	88
Atlantic croaker	*Micropogonias undulatus*	42	9	976	6
Spot	*Leiostomus xanthurus*	19	4	368	2
Striped bass	*Morone saxatilis*	6	1	162	1
Atlantic menhaden	*Brevoortia tyrannus*	3	< 1	105	1
Blue crab	*Callinectes sapidus*	2	< 1	450	2
	Total:	**462**	**100**		**100**
October					
White perch	*Morone americana*	158	44	4,705	32
Spot	*Leiostomus xanthurus*	114	32	3,921	27
Bay Anchovy	*Anchoa mitchilli*	32	9	47	< 1
Blue crab	*Callinectes sapidus*	30	8	4,448	30
Weakfish	*Cynoscion regalis*	8	2	110	< 1

Common Name	Scientific Name	Total (number)	Percent of Total	Total (grams)	Percent of Total
Summer Flounder	*Paralichthys dentatus*	5	1	1,048	7
Alewife	*Alosa pseudoharengus*	3	< 1	61	< 1
Florida Pompano	*Trachinotus carolinus*	3	< 1	53	< 1
Striped Bass	*Morone saxatilis*	3	< 1	240	2
Bluefish	*Pomatomus saltatrix*	2	< 1	82	< 1
Gizzard Shad	*Dorosoma cepedianum*	1	< 1	20	< 1
	Total:	**359**	**100**	**14,735**	**100**

Striped Bass (*Morone saxatilis*)

Primary Source: Fay et al. (1983)

Striped bass is a "generalist" species in that it can tolerate a variety of environmental conditions and eat a variety of organisms. The mid-Atlantic distribution ranges from Cape Hatteras to the St. Lawrence River, Canada. However, there are distinct populations associated with the Roanoke River, Chesapeake Bay, Delaware River and the Hudson River. Striped bass are an anadromous species, spawning once a year in fresh or nearly fresh water. Spawning for the mid-Atlantic region takes place primarily in April, May and June. Striped bass eggs tolerate temperatures of 14 to 23°C, and larvae tolerate temperatures of 10 to 24°C. Larvae generally stay in or near the area spawned. Juvenile striped bass tolerate temperatures of 10 to 27°C and tend to remain in the river or estuarine habitat where they were spawned. Adult striped bass tolerate temperatures of 0 to 30°C. Striped bass are opportunistic carnivores with a diet that may consist of a mix of fish and various invertebrates. A study of the mid-Atlantic stocks found that as their size increases, striped bass diet evolves from invertebrates, to a mixture of fish and invertebrates, and then to a diet of primarily fish with various invertebrates also consumed.

Project Area: Striped bass eggs and larvae are unlikely to be found in the Project Area since they are spawned in fresh to nearly fresh water and the larvae stay in the area of spawning. Juvenile striped bass also tend to remain in the spawning habitat but may use nearshore areas as a foraging area. Both juvenile and adult stripped bass are likely to occupy the Project Area since the Chesapeake Bay serve as an important nursery and forage area.

Blue Crab (*Callinectes sapidus*)

Primary Source: Hill et al. (1989)

The blue crab is found in coastal waters from Massachusetts to South America. Its primary habitat is in bays and brackish estuaries. Substrate preference varies with life stage. Areas with SAV and soft sediments are important for juvenile crabs, which use the vegetation as refuge from predation. Adult crabs prefer harder substrates such as sand, rock, or mud bottoms. Mating takes place primarily in relatively low salinity waters in upper portions of estuaries and lower portions of rivers. After mating, females migrate to high salinity waters in lower estuaries, sounds and nearshore spawning areas. Juveniles then migrate to shallower, low salinity waters where they grow and mature. Blue crabs are predators of commercially important clams and oysters, and serve as food for commercially important species such as striped bass.

Project Area: Based on their range of habitat utilization and availability of food sources, all life stages of blue crab are expected to occur in the Project Area.

Atlantic Horseshoe Crab (*Limulus polyphemus*)

Primary Source: Atlantic States Marine Fishery Commission (1998)

The horseshoe crab is a benthic arthropod that utilizes both estuarine and continental shelf habitats. They are not a true "crab" and are classified in their own class (Merostomata), which is more closely related to arachnids. Horseshoe crabs range from the Yucatan peninsula to northern Maine but are most abundant between Virginia and New Jersey. The NMFS bottom trawl surveys from 1963-2002 show that 74 percent of the horseshoe crabs caught were in waters shallower than 66 ft. Horseshoe crabs are ecological generalists that can survive in a range of environmental conditions. Studies report that adult horseshoe crabs migrate from deep bay waters and the Atlantic continental shelf to spawn on intertidal sandy beaches. Spawning generally occurs from March to July. Eggs are laid in the sediment and hatch approximately 14 to 30 days after fertilization. Larvae may over-winter in the sediment but when they emerge they generally settle in shallow water areas to molt. Juvenile horseshoe crabs usually spend the first two years on intertidal flats near the breeding beaches. Older individuals move out of intertidal areas to a few miles offshore, but some remain in intertidal areas year round.

Larvae feed on a variety of small polychaetes and nematodes. Juvenile and adults horseshoe crabs feed primarily on mollusks including various clams and blue mussels, but will prey on a wide variety of benthic organisms.

Project Area: Based on their range of habitat utilization and availability of food sources, horseshoe crabs are expected to occur in the Project Area.

Atlantic Croaker (*Micropoqonias undulatus*)

Primary Source: Diaz and Onuf (1985)

The Atlantic croaker spawns in the fall in marine waters. Spawning grounds are not clearly defined and can range from the mouths of estuaries to continental shelf depth of at least 175 ft. Croaker eggs are pelagic, and upon hatching, the larvae and postlarvae move into estuaries. It has been postulated that larvae transport into the estuarine nursery grounds is from a combination of both passive current transport and active swimming. Once recruited from nearshore marine waters in the fall and winter, larvae move up the estuary to areas of brackish water and transition into juveniles. Juveniles take up residence in the estuarine nursery area and are common in tidal riverine habitats. It has been reported that due to the daily fluctuations of water level increase, juveniles in the Chesapeake Bay avoid shallow areas and are concentrated in the deep, main channels of the estuaries.

Croaker can tolerate a wide range of temperatures with juveniles caught in water temperatures ranging from 0 to 36°C. In general, the early life stages of the croaker are most tolerant to cold, and adults are the least cold tolerant. This species also has a wide range of salinity tolerance and has been found in salinities ranging from 0 to 70 ppt, with a salinity preference of 0.5 to 18 ppt. This species prefers bare, soft muddy bottoms with areas that are covered with large quantities of detritus.

Project Area: Based on their range of habitat utilization and availability of food sources, Atlantic croaker are expected to occur in the Project Area.

Spot (*Micropogonias undulatus*)

Primary Source: Phillips et al. (1989)

Most spot spawn offshore over the outer continental shelf, from October to March. However, some spot have been observed to spawn inshore. Spot larvae are most dense in mid-water and at the bottom during the day and appear to migrate to the surface at night. It has been postulated that postlarvae spot are transported inshore by the water currents and from the incoming flood tide. In the Chesapeake Bay, young spot remain in the estuaries until September or October, and then migrate out of the estuary to the open ocean. The temperature preference of spot ranges between 8 to 31°C. This species has been found at salinities ranging from 0 to 60 ppt, with a preference of 16 ppt or greater.

Project Area: Based on their range of habitat utilization and availability of food sources, larval and juvenile spot are expected to occur in the Project Area, while eggs and adults would be rare throughout the Project Area.

Alewife and Blueback Herring (*Alosa pseudoharengus* and *A. aestivalis*)

Primary Source: Mullen et al. (1986) and Pardue (1983)

Alewife and blueback herring (river herring) make spawning runs up all or nearly all streams with access to lakes, ponds, and backwaters. River herring spawn once a year in spring or early summer in fresh or brackish water. Alewife select a wide variety of spawning sites, using standing water and oxbows, as well as mid-river sites, where blueback herring prefer to spawn in fast currents over hard substrate. Eggs of river herring are initially demersal and adhesive in still water, but pelagic in running water. After water-hardening, all eggs become pelagic and lose their adhesive properties. Juveniles may remain in the lower ends of the rivers where spawning occurred, with some seasonal (summer and fall) migration. In most Atlantic coast populations, juvenile river herring emigrate from freshwater-estuarine areas between June and November of their first year. River herring larvae in the Chesapeake Bay apparently remain near or slightly downstream of presumed spawning areas, with a preferred water temperature range of 10.5 to 26.3°C and salinity of less than 12 ppt. Water temperature preference of juvenile river herring ranged between 11.5 to 32°C and a salinity preference of 29 to 32 ppt.

Project Area: Based on their range of habitat utilization, adult river herrings are expected to migrate through the Project Area (to their spawning beds) prior to spawning season. Eggs and larvae tend to remain near the spawning area and therefore would be rare in the Project Area. Juveniles are expected to occur in the Project Area.

American Eel (*Anguilla rostrata*)

Primary Source: Facey and Van Den Avyle (1986)

The American eel is catadromous. It spends most of its life in rivers, freshwater lakes, and estuaries, but returns to the sea to spawn. Spawning occurs in the Sargasso Sea as early as February and may continue at least till April. Larval eels are transported from the spawning grounds to the eastern Atlantic seaboard by the Antilles Current, Florida Current, and the Gulf Stream. Once there, larval eels begin migrating upstream. Most larval eels move into coastal areas, estuaries, and up freshwater rivers in late winter or early spring. Male juvenile and adult eels tend to be more abundant in estuaries than in upriver areas. Due to the broad geographic range and diverse habitats, American eel has a flexible and broad range of temperature and salinity requirements. Larvae have been found in temperatures as low as –0.8°C while the preferred water temperature range of juveniles and adults ranged between 6 to 30°C. Post-larval eels tend to be bottom dwellers and hide in burrows, tubes, snags, plant masses, other types of shelter, or the substrate itself. Flow alteration in estuaries can affect upstream migration of small eels. Similarly, tide and time of day can also play a role in limiting movement up tidal creeks.

Project Area: Based on their range of habitat utilization, adult eels are expected to migrate through the Project Area (to their spawning beds) prior to spawning season. Eggs will not be present in the Project Area. Larval and juveniles are expected to occur in the Project Area during their migration upriver.

Yellow Perch (*Perca flavescens*)

Primary Source: Krieger et al. (1983)

This species is predominantly a freshwater species, although it has been found in brackish water at river mouths (up to 13 ppt) in the Chesapeake Bay. This species is frequently associated with shoreline (littoral) areas in lakes and reservoirs where there are moderate amount of vegetation present. This species require freshwater for spawning and spawning migrations begin from deep water into tributaries, lake shallows, or low velocity areas of rivers from April to June when water temperature reach 7 to 13°C. The preferred water temperature of adults ranges from 17.6 to 25°C. Habitat requirements of juveniles are similar to those of adults, with a preferred water temperature range of 20 to 23°C.

Project Area: Based on their range of habitat utilization, eggs and larvae will not be present in the Project Area. Juveniles and adults may be present, but would be very rare throughout the Project Area.

White Perch (*Morone americana*)

Primary Source: Stanley and Danie (1983)

White perch are ubiquitous in estuaries and freshwater ecosystems, preferring substrates with fairly level bottoms composed of compact silt, mud, clay, or sand. White perch species spawn in estuaries, rivers, lakes, and marshes, typically in freshwater but may occur in brackish water at salinities up to 4.2 ppt. Preferred spawning habitats encompass a range of environmental conditions, including waters that are tidal and nontidal, clear or turbid, fast or slow. Eggs are demersal and usually attach singly to detritus, although thin sheets occasionally occur. The preferred water temperature for white perch eggs ranges between 15 and 20°C. Newly hatched larvae remain in the general spawning area during the first couple of weeks. As larvae grow, they alternatively swim vertically or sink, exhibiting an increase in demersal preference. Larvae have a similar temperature tolerance as eggs, with a salinity tolerance of up to 3 to 5 ppt. The inshore zones of estuaries and creeks are nursery grounds for white perch, where juveniles have been observed to remain there for up to a year. Juveniles also exhibit a preference for demersal habitat, and occasionally migrate to offshore waters during the day, but return to the protected beach and shoal areas at night and during rough waters. Adults show similar seasonal movements, catalyzed by temperature. The preferred water temperature of juveniles and adults ranges from 2.0 to 32.5°C, with a salinity tolerance ranging from fresh to sea water.

Project Area: Eggs and larvae would be rare throughout the Project Area. However, juveniles and adults would be common year-round through the Project Area. During the June 2006 fish survey, white perch were by far the most common species caught in terms of individuals and biomass, accounting for nearly 90% of biomass collected.

4.3 PREY SPECIES

Principal prey items for EFH-designated species, identified as probable occupants of the proposed Project Area, are listed in Table 4. Adults and juveniles with different diets are listed separately.

Of the 27 EFH-designated bony-fish species identified (including the snapper-grouper complex), 13 exhibit both pelagic and benthic feeding preferences during there juvenile and adult stages, 10 exhibit preferences for pelagic prey species, and four prefer feeding on benthos. Of the 13 EFH-designated shark/skate species identified, five exhibit both pelagic and benthic feeding preferences during there juvenile and adult stages, four exhibit preferences for pelagic prey species, and four prefer a benthic feeding strategy.

The non EFH-designated fish and shellfish assessed in this report (those that are most likely to occur in the Project Terminal Site Area) all feed on benthic and infaunal organisms. Juvenile striped bass, as noted above, have diets that include various benthic and infaunal organisms, but adults of these species primarily feed on fish. Blue crabs forage on the benthos and have diets that consist mainly of benthic invertebrates.

Table 4. Prey Species for EFH-Designated Fish Species and Life History Stages Likely To Occupy the Project Area.

Species	Zone*	Principal Prey
FISH		
Albacore tuna	BP	Fish, crustaceans, and squid
Atlantic butterfish	P	Adults feed mainly on jellyfish; juveniles feed primarily on plankton
Atlantic mackerel	BP	Zooplankton, small fish, benthic and planktonic crustaceans, and mollusks
Atlantic sea herring	BP	Juveniles eat small planktonic copepods; adults consume planktonic and benthic crustaceans, some fish, and planktonic invertebrates
Black sea bass	BP	Finfish and benthic crustaceans
Bluefin tuna	P	Small schooling fishes and benthic crustaceans; juveniles also eat octopi
Bluefish	BP	Fish, benthic and planktonic crustaceans, and cephalopods
Cero	P	Both juveniles and adults eat fish; adults also eat cephalopods and shrimp
Cobia	BP	Both juveniles and adults eat fish; while adults also eat crabs and squid
Dolphinfish	BP	Fish, cephalopods, zooplankton, crustaceans, and squid
King mackerel	P	Fish, penaeid shrimp, and squid
Little tunny	BP	Crustaceans, fish, squids, heteropods and tunicates; while juveniles mostly eat fish, and planktonic and benthic crustaceans
Monkfish	P	Fish
Red drum	BP	Fish, benthic crustaceans, shrimp, and mollusks
Red hake	BP	Shrimp, amphipods and other crustaceans, squid, herring, flatfish, mackerel, etc.
Scup	BP	Amphipods, worms, sand dollars, and squid
Skipjack	P	Benthic and planktonic crustaceans, fish, cephalopods, and mollusks
Snapper-grouper complex (73 species)	P	Fish and large invertebrates
Spanish mackerel	P	Small fish (clupeoids and anchovies), crustaceans, penaeoid shrimp, and cephalopods
Summer flounder	BP	Benthic and planktonic crustaceans, bivalves, mollusks, marine worms, and finfish
Swordfish	P	Fish, crustaceans, and squid
Whiting	BP	Both juveniles and adults eat fish and squid; juveniles also eat shrimp and euphausiids
Windowpane	B	Fish, small crustaceans, zooplankton, and zoobenthos
Winter flounder	B	Shrimp, amphipods, crabs, sea urchins, and snails
Witch flounder	B	Both juveniles and adults eat bivalves and planktonic crustaceans; while adults also consume benthic crustaceans, polychaetes, and brittle stars
Yellowfin tuna	P	Fish, crabs and shrimp, squid, mollusks, and planktonic crustaceans
Yellowtail flounder	B	Polychaete worms and amphipods, echinoderms, shrimp, isopods and other crustaceans and occasionally fish
SHARKS/SKATES		
Atlantic sharpnose shark	BP	Fish, shrimp, crabs, worms, and mollusks segmented worms and mollusks
Blue shark	BP	Fish, sharks, squid, pelagic red crabs, shrimp, cetacean carrion, sea birds, and garbage
Clearnose skate	B	Decapod crustaceans, bivalves, polychaetes, squid and fish

Species	Zone*	Principal Prey
Dusky shark	BP	Fish, sharks, skates, rays, cephalopods, gastropods, crustaceans, carrion, and inorganic objects; NOTE: is it spelled Carcharinus
Little skate	B	Primarily scallops
Rosette skate	B	Decapod crustaceans, amphipods, polychaetes, squid, and fish
Sand tiger shark	BP	Fish, sharks, rays, squid, crabs, and lobsters
Sandbar shark	P	Fish, sharks, cephalopods, shrimp, rays, and gastropods
Scalloped hammerhead shark	P	Fish, cephalopods, lobsters, shrimp, crabs, sharks, and rays
Shortfin mako shark	P	Fish, sharks, cephalopods, billfish, and cetaceans
Spiny dogfish	BP	Fish, mollusks, crustaceans, and other invertebrates; NOTE they call it piked dogfish
Tiger shark	P	Sharks, rays, fish, marine mammals, tortoises, seabirds, sea snakes, squid, gastropods, crustaceans, detritus porpoises, whales, sea turtles, cephalopods, domestic animals and humans
Winter skate	B	Fish, crabs, shrimp, bivalves, and marine worms

*B=Benthic, BP=Benthic & Pelagic, P=Pelagic
Source: Froese and Pauly (2006).

5.0 IMPACTS

This section identifies the potential direct, indirect and cumulative impacts of the proposed Project on the relevant life history stages of EFH-designated species, their habitats, and their prey species. It also addresses potential impacts to non EFH-designated species that have important commercial and/or recreational value (as explained previously, this discussion is limited to species that may occur within the Project Terminal Site Area) and endangered and/or rare species, their habitat, and their potential prey species that may occur in the Project Area. Significant impacts are not anticipated for the majority of species and life history stages. Table 5 identifies potential direct and indirect impacts for each EFH-designated species. Table 6 identifies potential direct and indirect impacts for each non EFH-designated species with important commercial and/or recreational value in the Project Terminal Area.

In regard to the Terminal Site, there will be temporary impacts to the habitat and associated prey species for the duration of the Project. However, since the Project Terminal Site Area is a small portion of this type of habitat in the region, the overall impact on the affected species will be minimal. In regard to prospective vessel transit routes, no direct or indirect impacts to habitat are expected (although some mortality to individuals may occur) given the overall depth of the water that will most likely be traversed by LNG carriers, provided they adhere to United States Coast Guard navigation rules and obey the Traffic Separation Scheme that has been implemented for Chesapeake Bay (Pearson et al. 1989).

5.1 HABITAT IMPACTS

As discussed previously, no HAPC's are known to occur within the proposed Project Terminal Area but several may occur along potential vessel transit routes (although these routes have not been determined as of yet and will most likely depend on fluctuating factors such as weather and market trends). All but one of these areas can be found on the south Atlantic coasts of North and South

Carolina; specifically within the areas of The Point, 10 Fathom Ledge, Big Rock, Georgetown Hole, the Charleston Bump Complex, and in areas adjacent to the Outer Banks, Cape Hatteras, and the Ocracoke Islands (NMFS 2006b; SAMFC 1998). The remaining HAPC has been identified in the lower region of Chesapeake Bay and is thought to be used as nursery and pupping grounds by sandbar sharks (NMFS 2006b). No direct or indirect impacts to habitat are expected given the overall depth of the water that will most likely be traversed by LNG carriers and that no ballast will be released or drawn while in transit. Furthermore, a survey for SAV resulted in no locations where SAV was present in the Project Terminal Area, or in potential locations within approximately two miles of the Project Area. The results of this survey are supported by additional surveys that have been completed recently (Orth et al. 2005).

The proposed Project also involves the extraction of sediment from an area that has been dredged in the past; no new areas will be dredged. Existing habitat in this area is likely already impaired due to the presence of contaminants and relatively low dissolved oxygen levels in the water column. Material will be removed from the Project Area using a mechanical clamshell dredge, unless sediment testing and/or permitting indicates that a different extraction method—such as the use of an environmental bucket—is warranted. Material will be placed onto barges and transferred to an upland location for processing. The final dredged material disposal site will be an appropriate upland location, so no fish species or habitat impacts are anticipated as a result of disposal activities.

Dredging production is expected to be up to 12,000 cubic yards per day and last approximately 24 months. It is anticipated that ten (10) to fourteen (14) 1,500 to 3,500-cubic yard work scows will be assigned to the project for dredged material transport. All scows and containers will be of solid hull construction and will be completely sealed and watertight in order to avoid any release of dredge material.

Note that the area to be used for LNG vessel approach and maneuvering has been dredged in the past and maintains a permit issued by the USACE and Water Quality Certification from the State of Maryland to perform dredging using hydraulic or mechanical techniques. Dredging is allowed under existing permit for maintenance and waterfront operations to a depth of less than 39 ft across approximately the same area as would be developed for the Sparrows Point LNG terminal project.

5.1.1 Hydrodynamic Changes

Changes to the circulation of the Patapsco River are not anticipated as a result of this project. Changes to the bottom topography are anticipated in the areas to be dredged, but are insignificant relative to the remaining portions of the estuary which would be untouched.

5.1.2 Water Quality

Water quality data recorded by AES in 2006 are similar to data collected during previous studies of the relatively well-studied harbor (e.g., Dail et al. 1998; Hall et al. 2002; MDDNR 2005). Previous records suggest that the quality of water found within and around the proposed Project Area is severely degraded and it is unlikely that the proposed construction will cause any additional long term impacts, although short term impacts such as elevations in turbulence, turbidity, nutrients, and wave action are likely to occur in the water column as a result of dredging and vessel transit.

Physical bottom disturbances attributed to dredge operation or propeller turbulence may decrease oxygen availability and increase internal nutrient loading and phytoplankton productivity, ultimately impacting water quality (Riemann and Hoffmann 1991). Additionally, any contaminants residing in the sediment may be disrupted during the course of these events and become resuspended and contribute further to a decrease in overall water quality (Savino et al. 1994). Federal and state permitting will likely include conditions intended to address these issues, and therefore no significant water quality impacts are anticipated as a result of the proposed Project.

5.2 DIRECT IMPACTS

There are potential direct impacts that could affect EFH-designated species, non EFH-designated commercially and/or recreational important fish and shellfish species that are in the Project Area. For those species expected to occur along the proposed vessel transit route, mortality associated with ship movements and operations (such as propeller wash) may be expected for coastal pelagic and highly migratory species whose egg and larval stages are planktonic (Holland 1986; Nielsen et al. 1986; Pearson et al. 1989); although little or no direct impact is expected for the juvenile and adult stages of these species given their mobility. Additionally, no direct or indirect impacts to benthic habitat or bottom-dwelling finfish are expected as the potential LNG carrier routes will likely traverse very deep waters. The potential direct impact of the dredging operation to invertebrates and fishes near or associated with the benthic environment is mortality resulting from capture or displacement by the dredging apparatus. However, rates of capture or displacement of EFH-designated fish are likely to be quite limited, and overall species impact should be minimal (Table 5; Newell et al. 1998).

Dredging in the Project Terminal Site Area would also cause the mortality of any juvenile EFH-designated bottom fish and shellfish that are removed from the bottom along with sediment. This type of direct impact is expected to be primarily limited to small, juvenile windowpane and summer flounder. The overall mortalities of an individual finfish species would likely be quite limited, since these fish species are likely rare, transient visitors to the Terminal Site and most fish are capable of avoiding the dredge as it approaches (Table 5). Additionally, these two species are more commonly associated with sandy substrate, whereas the majority of the substrate that would be dredged is made mostly of silty material (Nielsen et al. 1986; Newell et al. 1998).

None of the other EFH-designated fish species or life history stages that are likely to occupy the Project Terminal Site Area are at risk because they are either pelagic species or adult demersal species (of which, only juveniles are at risk).

Non EFH-designated species such as striped bass have important recreational and commercial value in this region. Adult striped bass are unlikely to be directly affected by the dredging, as they would likely avoid the disturbance (Table 6; Peddicord and McFarland 1978). Juvenile striped bass likely forage in this area and may also be displaced by the dredge if they are in the immediate area of the dredging. Similarly, juvenile spot, adult or juvenile white perch, adult or juvenile yellow perch, or Atlantic croaker could be displaced by the dredge if they are in the immediate area during dredge operations. The Project Terminal Site Area is, however, a very small portion of the habitat used as a nursery and foraging area for these species, so the overall impacts on these populations as a result of the dredging will be minimal (Table 6). American eel, alewives, and blueback herring are predominantly found in the Project Area only as transitory species, and therefore are not likely to be significantly impacted by dredging operations.

Table 5. Potential Impacts for EFH-Designated Species and Life History Stages in the Proposed Project Area.

Species	Stage	Potential Impacts
Fish		**TS = Terminal Site / VR = Vessel Transit Route**
Albacore tuna	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Atlantic butterfish	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Atlantic mackerel	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Atlantic sea herring	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Black sea bass	Larvae	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Bluefin tuna	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Bluefish	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** No impact; eggs are not found in estuarine waters.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** No significant impact; larvae are rare in estuarine waters.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Temporary displacement of fish and their prey (forage fish). No significant impact.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.
Cero	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.

Species	Stage	Potential Impacts
Fish		**TS = Terminal Site / VR = Vessel Transit Route**
Cobia	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Transient, rare pelagic species. No significant impact.
Dolphinfish	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
King mackerel	Eggs	**VR:** Surface distribution – likely to be impacted by vessel traffic. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Surface distribution – likely to be impacted by vessel traffic. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Transient, rare pelagic species. No significant impact.
Little tunny	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Monkfish	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Red drum	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** May be impacted by vessel traffic around coastal inlets. **TS:** No significant impact.
	Juveniles	**VR:** May be impacted by vessel traffic around coastal inlets. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area because of low salinities.
Red hake	Eggs	**VR:** Pelagic – may be impacted by vessel passage to/from the north. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.

Species	Stage	Potential Impacts
Fish		**TS = Terminal Site / VR = Vessel Transit Route**
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Scup	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Skipjack tuna	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Snapper-grouper complex	Eggs	**VR:** HAPC; Demersal – no impact likely from vessel traffic. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** HAPC; Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** HAPC; no significant impact likely due to habitat depth. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** HAPC; no significant impact likely due to habitat depth. **TS:** Unlikely to occur in Project Area.
Spanish mackerel	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Transient, rare pelagic species. No significant impact.
Summer flounder	Eggs	**VR:** Pelagic – may be impacted by vessel passage during Dec-Jan. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Loss of benthic infaunal prey organisms would have minimal impact because fish also feed on pelagic prey organisms.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Loss of benthic infaunal prey organisms would have minimal impact because fish also feed on pelagic prey organisms and larger, more mobile benthic epifauna (e.g., crabs).
Swordfish	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Whiting	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Windowpane	Eggs	**VR:** Pelagic – may be impacted by vessel passage during May-Aug. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.

Species	Stage	Potential Impacts
Fish		**TS = Terminal Site / VR = Vessel Transit Route**
	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Smaller YOY juveniles vulnerable to mortality/displacement from dredge. No significant impact from loss of benthic infaunal species because primary prey are more mobile epifaunal species.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact from loss of benthic infaunal species because primary prey are more mobile epifaunal species.
Winter flounder	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact from loss of benthic infaunal species because primary prey are more mobile epifaunal species.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact from loss of benthic infaunal species because primary prey are more mobile epifaunal species.
Witch flounder	Eggs	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
Yellowfin tuna	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Yellowtail flounder	Larvae	**VR:** Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
SHARKS/SKATES		
Atlantic sharpnose shark	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Blue shark	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Clearnose skate	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.
Dusky shark	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Little skate	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.
Rosette skate	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Sand tiger shark	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Sandbar shark	Juveniles	**VR:** HAPC; Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** HAPC; Pelagic – may be impacted by vessel passage. **TS:** Unlikely to occur in Project Area.

Species	Stage	Potential Impacts
Fish		**TS = Terminal Site / VR = Vessel Transit Route**
Scalloped hammerhead shark	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Shortfin mako shark	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Spiny dogfish	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Tiger shark	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** Unlikely to occur in Project Area.
Winter skate	Juveniles	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.
	Adults	**VR:** No significant impact from vessel traffic likely to occur. **TS:** No significant impact.

Table 6. Potential Impacts for Non-EFH Designated Species with Commercial and/or Recreational Value in the Proposed Project Terminal Area.

Species	Stage	Potential Impacts
Striped Bass	Eggs	No significant impact.
	Larvae	No significant impact.
	Juveniles	Smaller juveniles vulnerable to displacement from dredge. Loss of benthic prey species.
	Adults	Loss of benthic prey would have minimal impact; fish also feed on pelagic prey organisms and larger, mobile benthic epifauna.
Blue Crab	Eggs	Eggs attached to females would be lost if crab is removed by dredge.
	Larvae	No significant impacts.
	Juveniles	Juveniles are susceptible to mortality from dredge.
	Adults	Loss of infaunal prey species. Dredge could cause mortality but crabs are likely to avoid it.
Atlantic croaker	Eggs	No significant impact.
	Larvae	No significant impact.
	Juveniles	Vulnerable to displacement from dredge activities.
	Adults	Displacement from dredge activities.
Spot	Eggs	Unlikely to occur in Project Area.
	Larvae	No significant impact.
	Juveniles	Vulnerable to displacement from dredge activities.
	Adults	Unlikely to occur in Project Area.
Atlantic Horseshoe Crab	Eggs	No significant impact.
	Larvae	No significant impact.
	Juveniles	Older Juveniles could be removed by dredge. Loss of infaunal prey species.
	Adults	Dredge could cause mortality. Loss of infaunal prey species.

Species	Stage	Potential Impacts
Alewife/Blueback herring	Eggs	Unlikely to occur in Project Area.
	Larvae	Unlikely to occur in Project Area.
	Juveniles	No significant impact, as transitory in Project Area.
	Adults	No significant impact, as transitory in Project Area.
American Eel	Eggs	Unlikely to occur in Project Area.
	Larvae	Unlikely to occur in Project Area.
	Juveniles	No significant impact, as transitory in Project Area.
	Adults	No significant impact, as transitory in Project Area.
Yellow Perch	Eggs	Unlikely to occur in Project Area.
	Larvae	Unlikely to occur in Project Area.
	Juveniles	No significant impact, as only rarely occurs in Project Area.
	Adults	No significant impact, as only rarely occurs in Project Area.
White Perch	Eggs	Unlikely to occur in Project Area.
	Larvae	Unlikely to occur in Project Area.
	Juveniles	Vulnerable to displacement by dredging activities.
	Adults	Vulnerable to displacement by dredging activities.

The blue crab is a non EFH-designated but commercially important crustacean species found in the Project Area. Both blue crab juveniles and adults forage along the bottom, so some degree of mortality within these two life stages is expected to occur as a result of dredging. An investigation for the NY & NJ Harbor Navigation Study (USACE 1999) suggested that blue crabs prefer shoals and shallower areas and may not be that common in the deeper channel of the Project Area. Adult blue crabs are extremely mobile and are likely able to avoid a slow moving dredge. Juvenile blue crabs are more likely to be removed by the dredge. The overall direct impact to the blue crab population as a result of the proposed dredging is expected to be small (Table 6). Following similar reasoning, the overall direct impact to horseshoe crabs is also anticipated to be insignificant.

Significant increases in sedimentation and turbidity could potentially lead to gill abrasion and cause suffocation to fish species in the Project Area as well as hinder predation efficiency by visually limiting feeding fish at or adjacent to the Project Area.

5.3 INDIRECT IMPACTS

No significant indirect impacts would likely result from the increase in vessel traffic along the potential transit routes. The most significant impact of dredging on EFH in the Patapsco River would be the indirect effects caused by the removal of benthic infaunal prey organisms, and some epifaunal prey organisms, for bottom-feeding EFH-designated species and non EFH-designated species that have important commercial and or recreational value. Any benthic organism that lives within the sediment (infauna) and the smaller, less motile organisms that live on top of the bottom substrate (epifauna) and are not capable of avoiding the dredge, would be pumped aboard the dredge vessel with the sand.

The negative effects of prey removal are temporary, lasting only as long as it takes for benthic invertebrates to re-colonize the bottom. Larvae of re-colonizing invertebrate species would be readily available from adult populations that inhabit the areas on either side of the channel. Therefore, while there would be an immediate loss of some prey resources to some bottom feeding

EFH-designated species and some non EFH-designated species with commercial and/or recreational value, the overall indirect impact of the dredging on the prey organisms of these species will be small as re-colonization would take place shortly after, perhaps within months as reported in other studies of dredged areas (Reish 1979 and Pagliai et al. 1985)

The temporary loss of benthic prey resources caused by dredging would not have any serious adverse effects on EFH for any species that feeds primarily on more motile epifaunal organisms or fish, since these organisms would re-occupy the dredged area almost immediately after material was removed. For this reason, most of the EFH species and non EFH-designated but commercially and/or recreationally important species in the Project Area would probably continue to feed there even after the dredge passed through (Tables 4 and 5).

Any bottom-feeding finfish that had trouble finding sufficient prey in the Channel following dredging would simply re-locate to the adjacent shoal water areas or to an unaffected portion of the Channel to feed. Any pelagic piscivorous (fish-feeding) species might leave the immediate area where the dredge was operating because of the noise it produces, but would resume feeding as soon as the dredge leaves and forage fish re-occupy the area.

5.4 CUMULATIVE AND SYNERGISTIC IMPACTS

A cumulative impact is defined in 40 C.F.R. § 1508.7 as:

> The impact on the environment which results from incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

A possible cumulative and/or synergistic impact associated with the proposed increase in vessel traffic (and associated transit routes) could result inasmuch that an overall increase in ocean/bay/harbor traffic may increase the mortality rate of planktonic eggs and larvae (Holland 1986; Nielsen et al. 1986; Pearson et al. 1989). It is not yet (and may never be) known if the relationship between traffic and mortality would be linear or exponential with the latter of which being the least desirable. With respect to the Terminal Site construction component, a cumulative and/or synergistic impact could result if effects arising from dredging are combined with impacts of other nearby dredging projects, if any, to cause a greater impact than the additive effect of each individual impact. If a dredging event occurs adjacent to the Project site, the re-colonization rate of the newly dredged site might be slower due to the disturbed state of the Project site. Also, dredging near the Project site may diminish the rate at which re-colonization of the Project site occurs. However, other dredging projects in the Project vicinity are periodic and would likely enable re-colonization to occur. Synergistic effects associated with water quality changes due to resuspension of sediment are not expected to occur. Resuspended sediment is expected to rapidly settle, and currents in this area would rapidly disperse suspended sediments that remain in the water column. Therefore, the cumulative and synergistic impacts associated with this project are expected to be minimal.

6.0 CONCLUSION

This assessment concludes that, overall, potential adverse impacts to EFH-designated species and EFH in the Project Area will be minimal. Most EFH-designated species are highly mobile and will not be impacted by ship movements along potential transit routes. In regard to the dredging component of the proposed Project, most EFH-designated species feed on more motile epifaunal organisms or on small forage fish and would not be seriously affected by temporary construction impacts. For any bottom-feeding EFH species, the impact of dredging on local forage habitat area would be temporary, lasting only until the dredged area is re-colonized by new benthic organisms, a process that is expected to take less than a year. For these reasons, we conclude that the proposed increase in vessel traffic and proposed dredging of Baltimore Harbor in the Project Area will not cause adverse effects to EFH-designated species and EFH, thereby alleviating the need for mitigation measures.

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