passes through the fish. Other impacts may include the rupture of capillaries in internal organs as indicated by observed blood in the abdominal cavity, and maceration of the kidney tissues (Caltrans 2015).

When a pile driving hammer strikes a pile, a pulse is generated that moves through the pile and radiates sound into the water, the ground, and the air. Sound pressure pulse as a function of time is classified as the waveform. These sounds are described by the peak pressure, the root-mean-square pressure (RMS), and the sound exposure level (SEL). The Fisheries Hydroacoustic Working Group (FHWG), a multi-agency work group, developed criteria for the acoustic levels at which various physiological effects to fish could be expected (FHWG 2008). The criteria were developed primarily for species on the west coast of the United States; however, the NMFS and USFWS have relied on these criteria for assessing projects on the east coast and the Gulf of Mexico for sound effects analysis (USFWS 2015b). The FHWG determined that peak sound pressure waves should be within a single strike threshold of 206 decibel (dB), and the cumulative sound exposure level (cSEL) associated with a series of pile strike events should be less than 187 dB cSEL for protected fish species that are larger than 2 grams, and less than 183 dB cSEL for protected fish species that are smaller than 2 grams (FHWG 2008).

3.7 ESSENTIAL FISH HABITAT

Congress enacted amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA [PL 94-265]) in 1996 that established procedures for identifying EFH and required interagency coordination to further the conservation of federally managed fisheries. Rules published by NMFS (50 C.F.R. Sections 600.805–600.930) specify that any federal agency that authorizes, funds, or undertakes, or proposes to authorize, fund, or undertake, an activity that could adversely affect EFH is subject to the consultation provisions of the MSFCMA and identifies consultation requirements. The NMFS provided initial comments to the Corps in a letter dated April 23, 2014, which identified the study area for the Proposed Project as EFH for brown and white shrimp. This EIS serves to further consultation with NMFS.

EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The definition for EFH may include habitat for an individual species or a group of species, whichever is appropriate within each Fisheries Management Plan (FMP). EFH is separated into estuarine and marine components. The estuarine component is defined as "all estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities); sub-tidal vegetation (seagrasses and algae); and adjacent intertidal vegetation (marshes and mangroves)." The marine component is defined as "all marine waters and substrates (mud, sand, shell, rock, and associated biological communities) from the shoreline to the seaward limit of the Exclusive Economic Zone" (GMFMC 2004).

The affected environment for EFH is comprised of four estuarine EFH categories (estuarine emergent marsh, oyster reefs/shell banks, intertidal flats or mudflats, and estuarine water column) within the study area. EFH was identified within the study area based on the review of aerial photography, GIS, literature review, National Wetlands Inventory (NWI) data, and field surveys. The EFH study area includes the aquatic environments of Shipyard Creek and Noisette Creek as depicted in Figure 3.7-1.

Upland habitats, as well as freshwater habitats, that are not connected to tidal waters or are not tidally influenced were not considered as EFH. Federally managed species and their possible life history stages that may use the EFH within the study area are also discussed in this section. A separate EFH Assessment was also prepared and is presented in Appendix E.

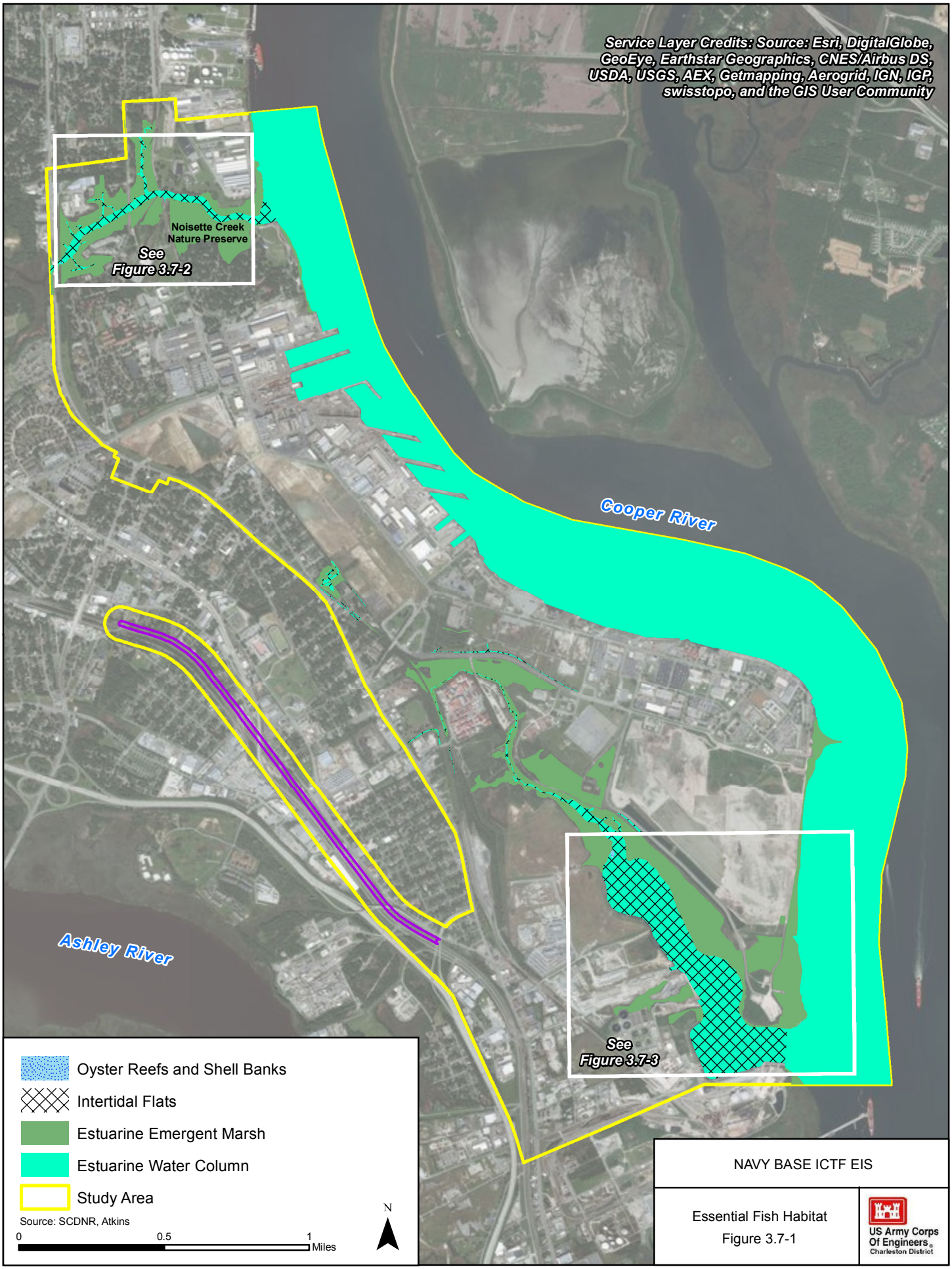
3.7.1 EFH Categories Within the Study Area

3.7.1.1 Estuarine Emergent Marsh

Typical estuarine emergent marshes within the study area were intertidal marshlands commonly found within or near river deltas that experience frequent flooding and drainage events from tidal forces with influences from river discharge, wind, rainfall, and lunar cycles. These marshes are known to occur in areas of higher elevation and are structured as vast expanses, in narrow fringing bands, or "pocket marshes." Marsh development typically leads to sediments with fine particle-size and high organic matter (South Atlantic Fishery Management Council [SAFMC] 1998).

Within the study area, estuarine emergent marshes are typically recognized by a nearly dominant growth of smooth cordgrass. An additional species known to occur within these habitat types is black needle rush (*Juncus roemerianus*). Estuarine emergent marshes provide habitat for important federally managed and commercial fish and invertebrates, as well as export nutrients, detritus, and prey species as ecosystem-supporting species of three SAFMC management plans: the coastal migratory pelagics (mackerel & cobia), shrimp, and snapper-grouper complex. Estuarine emergent marshes prevent erosion to neighboring shorelines (SAFMC 1998). Within the study area, estuarine emergent marshes often are homologous in vegetative composition along edges of estuaries and tidal creeks. There are approximately 205.6 acres of estuarine emergent marsh EFH in the study area (Figure 3.7-1).

In a letter to the Corps dated April 23, 2014, NMFS identified that the agency has recently completed restoration of 12 acres of the former Navy Base golf course, and constructed a living shoreline near the mouth of Noisette Creek and along the Cooper River. This restoration project was constructed within the confines of the 135-acre Noisette Creek Nature Preserve (NOAA 2012, 2018), which is located along Noisette Creek (see Figure 3.7-1). Future restoration projects may be undertaken in the future within this nature preserve.


Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Noisette Creek Nature Preserve
See Figure 3.7-2
Cooper River
Ashley River
See Figure 3.7-3
Oyster Reefs and Shell Banks
Intertidal Flats
Estuarine Emergent Marsh
Estuarine Water Column
Study Area
Source: SCDNR, Atkins
0
0.5
1
Miles
N
NAVY BASE ICTF EIS
Essential Fish Habitat
Figure 3.7-1
US Army Corps Of Engineers
Charleston District

3.7.1.2 Oyster Reefs/Shell Banks

Oyster reefs and shell banks in the South Atlantic typically are observed as natural structures found in the intertidal zone or just below the intertidal zone, and are composed of oyster shell, live oysters, and other organisms. Oyster reefs and shell bank are discrete, contiguous, and clearly distinguishable from scattered oysters in marshes and mudflats. Oysters are predominantly intertidal in South Carolina.

Oyster habitat is designated a Habitat Area of Particular Concern (HAPC) for estuarine-dependent species of the snapper-grouper complex and occurs in the EFH study area. Oyster reefs and shell banks provide important habitat for other fish and invertebrates, as well as microhabitat for smaller species. In addition, oyster reefs provide more areal coverage for attachment of oysters and other sessile organisms than occur on the surrounding intertidal flats or submerged soft bottom habitats. As a result, oyster reefs facilitate more habitat niches for aquatic species, such as sponges, gastropods, polycheate worms, and decapod crustaceans (Livingston 1990). Oyster reefs and shell banks form barriers in areas where vessels, boat traffic, and winds drive waves ashore and facilitate calmer, less-turbid waters shoreward.

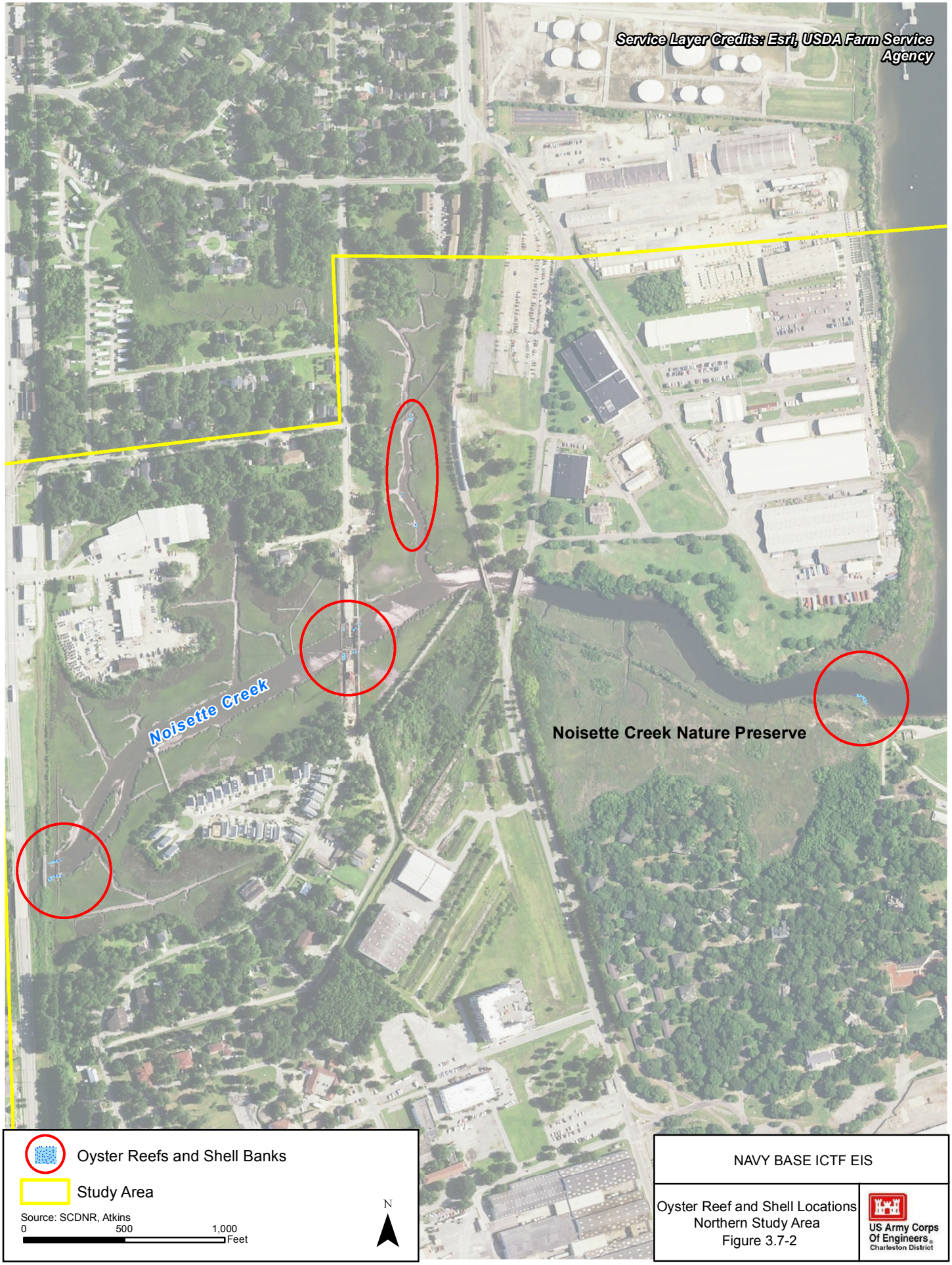
The South Carolina Oyster Restoration and Enhancement Program (SCORE) is a SCDNR community-based program focused on oyster habitat restoration and monitoring. The SCORE program restores and enhances oyster habitat by planting recycled oyster shells in intertidal habitat utilizing volunteer support. The SCORE program provides the South Carolina coastal community with an outlet to understand how oysters improve water quality, control erosion, and provide habitat for other commercially important shellfish and fish species. The SCORE program has planted numerous oyster reef sites and has an interactive website to identify the locations and productivity of the restoration sites[61]. There are no SCORE oyster restoration sites within the study area (Figure 3.7-1).

Within the study area, there is approximately 0.3 acre of oyster reefs and shell banks EFH. Small scattered oyster reefs and/or shell banks were observed within a tidal creek channel flowing into Noisette Creek (approximately 1 acre) and in Shipyard Creek (approximately 0.2 acre), as depicted in Figures 3.7-2 and 3.7-3.

3.7.1.3 Intertidal Flats

Individual characteristics and distribution of intertidal flats are influenced by tidal ranges, coastal geology, freshwater inflow, and weather patterns. Intertidal flats located in areas with little tidal range are primarily influenced by wind and waves. Those located in areas with large tidal ranges are primarily influenced by tidal action. Intertidal flat substrates become finer and more susceptible to

[61]SCORE program website http://score.dnr.sc.gov/index.php



NAVY BASE ICTF EIS

Oyster Reef and Shell Locations
Northern Study Area
Figure 3.7-2

US Army Corps Of Engineers
Charleston District


Service Layer Credits: Esri, USDA Farm Service Agency
Shipyard Creek
Oyster Reefs and Shell Banks
Study Area
Source: SCDNR, Atkins
0
500
1,000
Feet
N
NAVY BASE ICTF EIS
Oyster Reef and Shell Locations
Southern Study Area
Figure 3.7-3
US Army Corps Of Engineers
Charleston District

wind fetch influences with increasing distance from an inlet. Intertidal flats serve as feeding grounds, refuge, and nursery areas for many different species life stages. The benthic community of an intertidal flat may include decapods, polychaetes, gastropods, and bivalves. This tidally influenced habitat provides feeding grounds for predators, juvenile, and forage fish species, as well as nursery grounds for estuarine-dependent benthic species (SAFMC 1998). Typically, nursery areas may include unvegetated soft bottom areas surrounded by saline or brackish emergent marsh (Street et al. 2005).

Intertidal flats can provide relatively low energy, shallow water habitat and feeding grounds (with deeper water areas depending on the tidal phase) to support species such as summer flounder, red drum, and striped mullet. Intertidal flats within the study area were delineated based on GIS desktop analysis and limited field assessments. There are approximately 120.4 acres of intertidal flats EHF in the study area.

3.7.1.4 Estuarine Water Column

Habitats within the estuarine water column can be defined in terms of gradients and fluctuations in temperature, salinity, dissolved oxygen, turbidity, and nutrient supply. These components of the water column are variable in both time and space due to tidal fluctuations, freshwater inflows, and strong wind events. The estuarine water column serves as EFH by providing habitat for spawning, breeding, feeding, and growth for a wide array of species and life stages within species. Furthermore, the estuarine open water column serves as a transport medium for organisms between the ocean, upstream rivers, and freshwater systems where species-specific habitat components are favorable for completing particular life-stages. Zooplankton and phytoplankton are the dominant organisms in this habitat and serve as the foundation of the estuarine and marine food webs. Phytoplankton are major contributors to primary production, which is directly linked to production of biomass (macroinvertebrates and vertebrates). Many zooplankton feed on phytoplankton and are in turn eaten by small ichthyoids. In addition to supplying food for wildlife, phytoplankton plays a central role in nutrient cycling in estuarine and marine ecosystems (SAFMC 1998). There are approximately 1,614.1 acres of estuarine water column EFH in the study area.

3.7.2 Federally Managed Species That May Use EFH Within the Study Area

Numerous federally managed species and their life history stages may use the EFH within the study area (Table 3.7-2). This section identifies and discusses the preferred habitat, life history stages, and relative abundance of each of these species based on information provided by the South Atlantic Fisheries Management Plan (SAFMP 1998). Additional descriptive information on these species and the quality of EFH in the study area is presented in Appendix E – Essential Fish Habitat Assessment.

3.7.2.1 Penaeid Shrimp

Penaeid shrimp associated with EFH in the study area include white, brown, and pink shrimp. These species are managed by the SAFMC via the SAFMP (SAFMC 2004). The most common South Carolina shrimp species is white shrimp, which are regionally referred to as green shrimp, green-tailed shrimp, or southern shrimp. Brown shrimp are commonly referred to as green lake shrimp, red-tail shrimp, or summer shrimp. Pink shrimp are commonly referred to as northern shrimp or deepwater prawn. Each penaeid shrimp species is described in more detail below. Shrimp EFH within the study area would include estuarine emergent marsh, intertidal mudflats, and the estuarine water column.

Brown Shrimp

Brown shrimp occur from Massachusetts to the Florida Keys and west into the Gulf of Mexico. They support an important commercial fishery along the South Atlantic coast, but primarily in North Carolina and South Carolina. Brown shrimp are omnivores, and although they prefer mud and peat bottoms, they can be observed on sand, silt, or clay mixed shell hash bottoms (SAFMC 2004; NCDENR 2006). Adults can reach maturity in offshore waters within the first year of life, growing to 5.5 to 5.7 inches and have a maximum life span of 18 months (NOAA 2014f).

White Shrimp

White shrimp are found along the Atlantic Coast from New York to Florida and spawn along the South Atlantic Coast from March to November, with May and June reported as peak months. Being benthic omnivores, they consume fecal pellets, detritus, chitin, bryozoans, sponges, corals, algae, and annelids; feeding primarily at night. Sexually mature adults emigrate to offshore waters when body size, age, and environmental conditions allow. It has been documented that a decrease in water temperature in estuaries triggers emigration in the South Atlantic (Muncy 1984). The south-migrating white shrimp provide a valuable fishery in southern North Carolina, South Carolina, and Georgia. The life span of white shrimp usually does not extend beyond 1 year (NOAA 2014g).

Table 3.7-2
Federally Managed Species That May Use EFH within the Study Area

Common Name[1]	Scientific Name	Management Plan Agency[2]	Fishery Management Plan (FMP)[4]	Life History Stage in Study Area[3]	Type of EFH[6]
Penaeid Shrimp					
Brown shrimp[5]	*Farfantepenaeus aztecus*	SAFMC	Shrimp	P, J, A	EEM, IF, EWC
White shrimp[5]	*Litopenaeus setiferus*	SAFMC	Shrimp	P, J, S	EEM, IF, EWC
Pink shrimp[5]	*Farfantepenaeus duorarum*	SAFMC	Shrimp	P, J, S	EEM, IF, EWC
Coastal Migratory Pelagics					
Cobia	*Rachycentron canadum*	SAFMC	CMP	L, P, J, A	EEM, EWC
Spanish mackerel	*Scomberomorus maculatus*	SAFMC	CMP	J	EEM, EWC
King mackerel	*Scomberomorus cavalla*	SAFMC	CMP	J	EWC
Highly Migratory Species					
Atlantic sharpnose shark	*Rhizoprionodon terraenovae*	NMFS	HMS	J	EEM, IF, EWC
Blacknose shark	*Carcharhinus acronotus*	NMFS	HMS	J	EEM, IF, EWC
Bonnethead shark	*Sphyrnaa tiburo*	NMFS	HMS	J	EEM, IF, EWC
Bull shark	*Carcharhinus leucas*	NMFS	HMS	J	EEM, IF, EWC
Dusky shark	*Carcharhinus obscurus*	NMFS	HMS	J	EEM, IF, EWC
Finetooth shark	*Carcharhinus isodon*	NMFS	HMS	J, A	EEM, IF, EWC
Lemon shark	*Negaprion brevirostris*	NMFS	HMS	J, A	EEM, IF, EWC
Sandbar shark	*Carcharhinus plumbeus*	NMFS	HMS	J	EEM, IF, EWC
Sand tiger shark	*Odontaspis taurus*	NMFS	HMS	N	EEM, IF, EWC
Scalloped hammerhead	*Sphyrna lewini*	NMFS	HMS	J	EEM, IF, EWC
Spinner shark	*Carcharhinus brevipinna*	NMFS	HMS	J, A	EEM, IF, EWC

Common Name[1]	Scientific Name	Management Plan Agency[2]	Fishery Management Plan (FMP)[4]	Life History Stage in Study Area[3]	Type of EFH[6]
Snapper-Grouper Complex					
Jack crevalle	*Caranx hippos*	SAFMC	SGC	J	OR/SB
Gag grouper	*Mycteroperca microlepis*	SAFMC	SGC	PL, J	OR/SB
Black sea bass	*Centropristis striata*	SAFMC	SGC	PL, J	OR/SB
Mutton snapper	*Lutjanus analis*	SAFMC	SGC	PL, J	OR/SB
Red snapper	*Lutjanus campechanus*	SAFMC	SGC	PL, J	OR/SB
Lane snapper	*Lutjanus synagris*	SAFMC	SGC	PL, J	OR/SB
Gray snapper	*Lutjanus griseus*	SAFMC	SGC	PL, J	OR/SB
Yellowtail snapper	*Ocyurus chrysurus*	SAFMC	SGC	PL, J	OR/SB
Atlantic spadefish	*Chaetodipterus faber*	SAFMC	SGC	J	OR/SB
White grunt	*Haemulon plumieri*	SAFMC	SGC	J	OR/SB
Hogfish	*Lachnolaimus maximus*	SAFMC	SGC	J	OR/SB
Other Managed Fish Species					
Bluefish	*Pomatomus saltatrix*	MAFMC	Bluefish	J, A	EEM, EWC
Summer flounder	*Paralichthys dentatus*	MAFMC	Summer Flounder	L, J, A	EEM, OR, IF, EWC

[1] Based on species lists from SAFMC 1998 and 2017.

[2] Fishery Management Plan (FMP) Agencies: SAFMC = South Atlantic Fishery Management Council; MAFMC = Mid-Atlantic Fishery Management Council; NMFS = National Marine Fisheries Service.

[3] Life stages include: E = Eggs; L = Larvae; N = Neonate; P = Post-Larvae; J = Juveniles; S = Sub-Adults; A = Adults.

[4] Fishery Management Plans: CMP = Coastal Migratory Pelagics; HMS = Highly Migratory Species; SGC = Snapper-Grouper Complex.

[5] Habitat areas of particular concern for shrimps includes tidal inlets, state-designated nursery, and overwintering habitats.

[6] Shrimp EFH: EEM = estuarine emergent marsh; OR/SB = oyster reefs/shell banks; IF = intertidal flats; EWC = estuarine water column.

Pink Shrimp

Pink shrimp have a less common occurrence in South Carolina, but do occur along the Atlantic Coast from the Chesapeake Bay south to the Florida Keys. They are most abundant in water depths of 33 to 111 feet. Pink shrimp reach sexual maturity at about 3.35 inches total length. They spawn during the early part of the summer months at depths of approximately 12 to 52 feet.

3.7.2.2 Coastal Migratory Pelagics

Cobia

Cobia inhabit tropical and subtropical coastal waters in the estuarine and continental shelf waters, depending on their life stage (University of Florida 2014). Cobia are typically fished by recreational boaters through charter boats and recreational harvest from piers and jetties. Cobia are managed by the SAFMC (SAFMC 1998; NMFS 2008).

Cobia larvae, post-larvae, juvenile, and adult life stages use the estuarine water column and estuarine emergent vegetation within the study area for transport, refuge, and feeding grounds, as well as developmental areas.

Spanish Mackerel

The Spanish mackerel is a commercially and recreationally important species, and is managed by the Atlantic States Marine Fisheries Commission (ASFMC) and the SAFMC. Spanish mackerel are found along the coastal waters of the eastern United States and the Gulf of Mexico. Spanish mackerel seasonally migrate northward along the western Atlantic Coast initiated from Florida to Rhode Island between late February and July (Collette and Nauen 1983). Adult Spanish mackerel spend most of their life in the open ocean, whereas juveniles depend on estuarine EFH for foraging and refuge similar to what is found within the study area, including the estuarine water column and emergent marsh habitat.

King Mackerel

The king mackerel is found in the western Atlantic Ocean in tropical and subtropical waters from Maine in the United States to Rio de Janeiro, Brazil, including the Gulf of Mexico, and is common around south Florida in the winter months. King mackerel prefer warm, clear waters; all phases of development occur over the continental shelf, including both nearshore and offshore habitats and live bottom. Adults tend to inhabit high salinity, ocean waters, near the surface or at moderate depths but may move inshore on higher tides and during summer months. Congregations often occur around wrecks, buoys, coral reefs, and other such areas where food is abundant (SCDNR 2017c).

Juveniles typically occur from mid-shelf to inshore waters and from the surface to moderate depths in the water column. Juveniles may use the estuarine water column EFH within the study area.

3.7.2.3 Highly Migratory Species

Highly migratory species include billfishes, tunas, and sharks. Of these species, sharks are the most likely to use the EFH in the study area, specifically the Atlantic sharpnose, blacknose, bonnethead, bull, dusky, finetooth, lemon, sandbar, sand tiger, scalloped hammerhead, and spinner shark species. The Florida Museum of Natural History (FLMNH), a leading data source for Atlantic shark species,

maintains an interactive website with information on the biological profiles for these highly migratory/managed shark species (FLMNH 2014). Sharks will use the inshore and estuarine habitats for foraging when inlet water temperatures are warmer than those offshore, and some may use the estuaries as nursery grounds. Juvenile life history stage is mostly found within the study area. Sharks will forage in the benthic areas and mid and upper water column. These species are highly migratory, moving north in the spring and south in the fall along the Atlantic Coast.

These shark species may use the estuarine water column, intertidal flats, and emergent marsh EFHs within the study area; however, their occurrence in the study area is likely limited based on individual size and tidally influenced water depths.

3.7.2.4 Snapper-Grouper Complex

The snapper-grouper complex involves ten families of fish containing 73 species that are managed by the SAFMC. Specific life history patterns and habitat use vary among the snapper-grouper species complex. Snapper-grouper species utilize both benthic and pelagic habitats during their life cycle. They live in the water column and feed on zooplankton during their planktonic larval stage, while juveniles and adults are demersal and usually associate with hard structures with high relief. EFH for these species in South Carolina includes estuarine emergent wetlands, estuarine scrub/shrub wetlands, and shellfish beds (SAFMC 2017). As stated above, oyster habitat is designated a HAPC for estuarine-dependent species of the snapper-grouper complex which occurs in the study area.

3.7.2.5 Other Managed Species

Bluefish

Bluefish are an important recreational species along the Atlantic Coast. The Bluefish Fishery Management Plan was the first management plan developed jointly by an interstate commission and a regional fishery management council (ASMFC 2014a). Bluefish are a migratory pelagic species found along the coast from Maine to Cape Hatteras in the summer and from Cape Hatteras to Florida in winter months (ASMFC 2014a). Bluefish have a summer and winter spawning event that results in two distinct size groups that mix during the year making a single genetic stock (Mid-Atlantic Fishery Management Council [MAFMC] 2009; Northeast Fisheries Science Center [NEFSC] 2014; ASMFC 2014a]. Temperature and photoperiod are limiting factors affecting the migration and distribution of adult bluefish. Tides, weather, seasons, and prey may dictate local migrations into inlets and sounds (MAFMC 2009).

Migratory pelagic species such as bluefish depend on the estuarine systems during juvenile and adult stages. The estuarine water column and emergent marsh EFH within the study area provide transport, refuge, and feeding/developmental areas for the bluefish.

Summer Flounder

The recreational and commercially important summer flounder are managed under the Summer Flounder, Scup, and Black Sea Bass Fishery Management Plan directed by the MAFMC (NMFS 2008). The summer flounder ranges from the shallow estuarine and outer continental shelf waters from Nova Scotia to Florida to the northern Gulf of Mexico (NEFSC 1999). Summer flounder exhibit seasonal inshore/offshore migration patterns from late spring through early fall in estuaries and sounds, and migrate offshore on the outer continental shelf during the winter (NEFSC 1999; ASMFC 2014b).

The adults primarily inhabit sandy substrates but can also be found in seagrass beds, marsh creeks, and sand flats. They are quick predators, ambushing their prey and making full use of their camouflage and bottom positioning for efficient predation on small fish and squid. Crustaceans make up a large percentage of their diet (ASMFC 2014b; NEFSC 1999). The EFH habitats within the study area support the larval, juvenile, and adult developmental life stages of the summer flounder (NMFS 2008; ASMFC 2014b).

3.8 TRAFFIC AND TRANSPORTATION

This section describes the infrastructure of the existing transportation system within the Transportation Study Area (TSA). The section is broken down into the following sections: Roadways, Railroad, Port of Charleston, Pedestrian and Bicycle, and Transit.

The TSA, as shown in Figure 3.8-1, covers a greater area than the general study area due to the need to analyze the impacts to the surrounding transportation network as a result of the Navy Base ICTF, two existing rail-truck intermodal facilities (CSX's Bennet Yard and NS's 7-Mile Yard), and three Port facilities that handle containerized cargo (Future HLT, Wando Welch, and North Charleston port facilities). As shown in Figure 3.8-1, the TSA includes the entire I-526 corridor from US 17 in West Ashley to US 17 in Mount Pleasant and the portion of the I-26 corridor from Aviation Avenue (Exit 211A) to US 17 (Exit 220B). The TSA also includes 48 analyzed existing roadway intersections and 11 analyzed existing roadway at-grade rail crossing locations generally bounded by I-526 to the north, the Cooper River to the east, Stromboli Avenue to the south, and I-26 to the West in North Charleston. Impacts to pedestrian, bicycle, and transit facilities and from historical roadway crash data are limited to the study area.