



**Wilmington Harbor, North Carolina
Navigation Improvement Project**

**Integrated
Section 203 Study
&
Environmental Report**

**APPENDIX K
BIOLOGICAL ASSESSMENT OF
THREATENED AND ENDANGERED SPECIES**

June 2019

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List of Acronyms

~	Approximately
°C	Degrees Centigrade
°F	Degrees Fahrenheit
μPa	Micropascal
%	Percent
ASSRT	Atlantic Sturgeon Status Review Team
BA	Biological Assessment
CAHA	Cape Hatteras National Seashore
CALO	Cape Lookout National Seashore
CFR	Code of Federal Register
CY	Cubic Yards
CU	Confined Underwater
dB	Decibel
DPS	Distinct Population Segment
ER	Engineer Regulations
ESA	Endangered Species Act
FR	Federal Register
ft	Feet
FWC	Florida Fish and Wildlife Conservation Commission
FWI	Fish and Wildlife Research Institute
FWOP	Future without Project
km	Kilometer
m	Meter
MCY	Million Cubic Yards
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
NC	North Carolina
NCSPA	North Carolina State Ports Authority
NCWRC	North Carolina Wildlife Resources Commission
NM	Nautical Miles
NMFS	National Marine Fisheries Service
NPS	National Park Service
ODMDS	Ocean Dredged Material Disposal Site
PL	Public Law
PPT	Parts per Thousand
PSI	Pounds per Square Inch
PSO	Protected Species Observer
PTS	Permanent Threshold Shift
rkm	River Kilometer
RMS	Root Mean Square
SEL _{cum}	Cumulative Sound Exposure Level
SMA	Seasonal Management Area
SPL	Sound Pressure Level
SSSRT	Shortnose Sturgeon Status Review Team

TEWG	Turtle Expert Working Group
TSP	Tentatively Selected Plan
TTS	Temporary Threshold Shift
US	United States
USC	United States Code
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WRDA	Water Resources Development Act

1 INTRODUCTION

The North Carolina State Ports Authority (NCSPA) has prepared this Biological Assessment (BA) in accordance with Section 7 of the Endangered Species Act, as amended (ESA) [16 United States Code (USC) 1531 *et seq.*] to address the effects of the proposed Wilmington Harbor Modification Project on threatened and endangered species and critical habitats under the jurisdiction of the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). The proposed Wilmington Harbor Modification Project would deepen an approximately 34-mile reach of the existing federally authorized navigation channel from the lower end of the Anchorage Basin at the Port of Wilmington to the seaward limit of the outer harbor ocean bar channel and create a new 9-mile seaward extension of the outer bar channel for purposes of accommodating a larger class of container vessels. This BA has been prepared as a component of the Section 203 Wilmington Harbor Modification Integrated Feasibility and Environmental Study under the authority of Section 203 of the Water Resources Development Act (WRDA) of 1986 [Public Law (PL) 99-662] as amended.

Wilmington Harbor has experienced significant growth in cargo volume, and in the size of vessels calling at the port since the last major channel improvements were completed by the United States Army Corps of Engineers (USACE) in 2013. The NCSPA has made major investments in landside infrastructure to accommodate growth at the Port of Wilmington and the region that it serves. At the present time, the Port of Wilmington is the largest port in North Carolina (NC) and is a major component of the state's economy. Inadequate channel capacity currently impacts trade at Wilmington Harbor and is projected to have a greater detrimental impact on trade in the future as shipping companies transition from the existing fleet of 8,000 TEU vessels to a new fleet of larger 12,400 TEU vessels, providing the impetus for the proposed harbor deepening project.

2 PROPOSED ACTION

Wilmington Harbor is located in southeastern North Carolina, approximately 28 miles from the mouth of the Cape Fear River. The Wilmington Harbor navigational channel begins at the outer ocean bar and extends approximately 38 miles to the City of Wilmington in New Hanover County, NC, where it services the Port of Wilmington. The authorized depth of the channel is 44 feet (ft) mean lower low water (MLLW) at the ocean bar and entrance channel, then 42 ft for the channel up to the Cape Fear Memorial Bridge. Upstream of the Cape Fear Memorial Bridge, the authorized depth decreases to 32 ft up to the Hilton Bridge and decreases further to 25 ft upstream of the Hilton Bridge.

The existing federal project at Wilmington Harbor consists of the Eagle Island Dredged Material Disposal Site, the Wilmington Ocean Dredged Material Disposal Site (ODMDS), the Upper and Lower Anchorage basins, and the system of federal channels from the ocean up to the channel's terminus upstream of the Hilton Bridge.

2.1 Alternatives Considered

Channel deepening, berth deepening, and use of tidal advantage were the three measures used to develop alternative plans. The preliminary evaluation of alternative plans resulted in the identification of a single viable action alternative: the -47-foot plan. Preliminary deepening alternatives with depths less than -47 ft did not reduce waterborne transportation costs enough for the Port of Wilmington to be included as a port-of-call on the United States East Coast-Asia services (Objective #3). Deepening plans with depths greater than -47 feet did not provide enough waterborne transportation cost savings to offset the cost of dredging and therefore are not advanced for more detailed analysis.

2.2 Description of Proposed Project

The selected plan is the -47-foot alternative, which was the only action alternative plan advanced through Preliminary Screening for more detailed analysis. The proposed -47-foot Plan would encompass the following elements:

- Dredging the federal navigation channel from its currently authorized and maintained depth of -42 ft MLLW in the river and -44 ft MLLW beginning at the Battery Island Reach and extending offshore to new depths of -47 ft MLLW in the river and -49 ft MLLW beginning at the Battery Island Reach and extending offshore.
- The 47-foot MLLW depth evaluated for this study applies to the federal navigation channel to the Battery Island range and all ranges up to and including the Lower Anchorage. From Southport the Range to the pilot station, the depth will be increased to -49 ft MLLW to allow for adequate under keel clearance in areas affected by ocean waves. The improved

- channel will extend 48,000 ft out to sea from the junction with Baldhead Reach 3 to reach water that is consistently deeper than the maintained channel depth of -49 ft MLLW. The purpose of this heading change is to reach deeper water in the most direct path and reduce dredging costs.
- Widening of channel reaches (Table 1) is based on Ship Simulation modeling for design vessel maneuvering during vessel transits. The federal navigation channel is not being widened for the purpose of creating meeting areas, which were evaluated during Preliminary Screening and not advanced for more detailed analysis.
- Dredge the existing Lower Anchorage Basin, a portion of which is used to turn vessels, from the existing authorized depth of -42 ft MLLW to -47 ft MLLW.
- The total volume of material to be dredged under the -47-foot plan is projected to be 26.9 million cubic yards (mcy) *in situ*, of which 22.7 mcy is sand and silt and 4.2 mcy is rock.
- Construction dredging material will be placed within the New Wilmington ODMDS. Dredged sediment is expected to primarily include fine- to medium-grained sand with fines from the upper channel reaches and the anchorage basin. Dredged rock is expected to be siltstone and sandstone (sedimentary rock).
- Beneficial use of dredged material has identified a number of options for further consideration during Pre-Construction Engineering and Design, including disposal on adjacent beaches, as well as uses which provide ecosystem level benefits to estuarine and terrestrial resources in the lower Cape Fear basin.
- New work and incremental maintenance dredging volumes resulting from the proposed improvements to the Federal Navigation channel fit within the limitations of the Wilmington District's existing Dredge Material Management Plan and there are no substantial modifications to existing placement sites required.
- All construction material will be either disposed at the New Wilmington ODMDS or placed at one or multiple beneficial use sites being evaluated for this project. All post-construction maintenance material will be placed at the existing sites currently in use.
- Dredging quantities were calculated based on the proposed channel configurations. Dredging *in-situ* volumes are based on the required dredge depth, which consists of the proposed channel dimensions and a one-foot rock buffer in areas where rock is encountered. Two feet of allowable overdepth has been included in the project volume estimates. The total construction volume for rock is 4,168,000 cubic yards (cy) and 22,685,000 cy for sand and silt.

Table 1. Summary of dredge equipment and material type for project areas.

ID	Range Name	Dredge Type	Material Type
0	Entrance	Hopper	Sand / Silt
1	Bald Head Shoal Reach 3	Hopper and Cutterhead	Sand / Silt / Soft Rock
2	Bald Head Shoal Reach 2	Hopper	Sand / Silt
3	Bald Head Shoal Reach 1	Cutterhead with Beach Disposal	Sand
4	Smith Island	Cutterhead with Beach Disposal	Sand
5	Bald Head - Caswell	Cutterhead with Beach Disposal	Sand
6	Southport	Cutterhead with Beach Disposal	Sand
7	Battery Island	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
8	Lower Swash	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
9	Snows Marsh	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
10	Horseshoe Shoal	Cutterhead with Spider Barge	Sand
11	Reaves Point	Cutterhead with Spider Barge	Sand
12	Lower Midnight	Cutterhead with Spider Barge	Sand
13	Upper Midnight	Cutterhead with Spider Barge	Sand
14	Lower Lilliput	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
15	Upper Lilliput	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
16	Keg Island	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
17	Lower Big Island	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
18	Upper Big Island	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
19	Lower Brunswick	Blasting Rig with Mechanical Dredge for Rock, Cutterhead with Spider Barge	Sand / Silt / Hard Rock
20	Upper Brunswick	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
21	Fourth East Jetty	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
22	Between Channel	Cutterhead with Spider Barge	Sand / Silt / Soft Rock
22	Anchorage Basin	Cutterhead with Spider Barge	Sand / Silt / Soft Rock

2.2.1 Dredging and Disposal Methods

The proposed harbor deepening project would employ: 1) hopper dredging in the outer harbor Baldhead Shoal 2 and 3 entrance channel reaches and the Baldhead Shoal 3 extension reach with ocean disposal at the ODMDS; 2) cutterhead dredging in the outer harbor Baldhead Shoal 1 channel reach and inner harbor channel reaches with a combination of direct pipeline beach disposal on Bald Head and Oak Island, direct pipeline disposal to the Eagle Island Confined Disposal Facility, and ocean disposal at the ODMDS via scows; and 3) bucket dredges as needed for the removal of pretreated rock from the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick inner harbor channel reaches with ocean disposal at the ODMDS via barges or scows.

2.2.2 Pre-Treatment Methods

Areas of hard rock would be pretreated with underwater explosives for subsequent removal by cutterhead and bucket dredges. Areas potentially requiring confined blasting encompass approximately (~) 188 acres of rock surface area within the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel reaches (Figure 1). These four reaches comprise a continuous ~4.4-mile section of the navigation channel from a point ~18 miles above the estuary mouth to a point approximately two miles below Eagle Island. Blasting operations under the proposed action would employ stemmed charges and charge delays to reduce the magnitude of blast shock waves. Drill holes containing the individual charges would be stemmed (capped) with angular rock or other suitable material for the purpose of containing blast pressure within the rock. Studies indicate that the use of stemmed charges with confined blasting can reduce shock wave peak pressure by 60 to 90 percent (%) in relation to unconfined open water blasts (Nedwell and Thandavamoorthy 1992, Hempen et. al. 2005). Blasts would employ delays between individual charge detonations to limit the development of cumulative blast pressure.

2.2.3 Beach Placement on Bald Head Island and Oak Island

Beach compatible dredged material from the Southport, Baldhead-Caswell, Smith Island, and Baldhead Shoal 1 channel reaches would be placed on the beaches on Bald Head Island and Caswell Beach/Oak Island (Figure 2). The specific fill volumes and templates would be determined during the Pre-Construction Engineering and Design phase. Beach disposal of navigation dredged material on the beaches of Bald Head Island and Caswell Beach/Oak Island is an ongoing practice that was initiated by the Wilmington Harbor Sand Management Plan (USACE 2000). Pursuant to the Sand Management Plan, Bald Head Island receives material on a two, four, and eight-year cycle, while Oak Island receives material on a six-year cycle (USACE 2000).

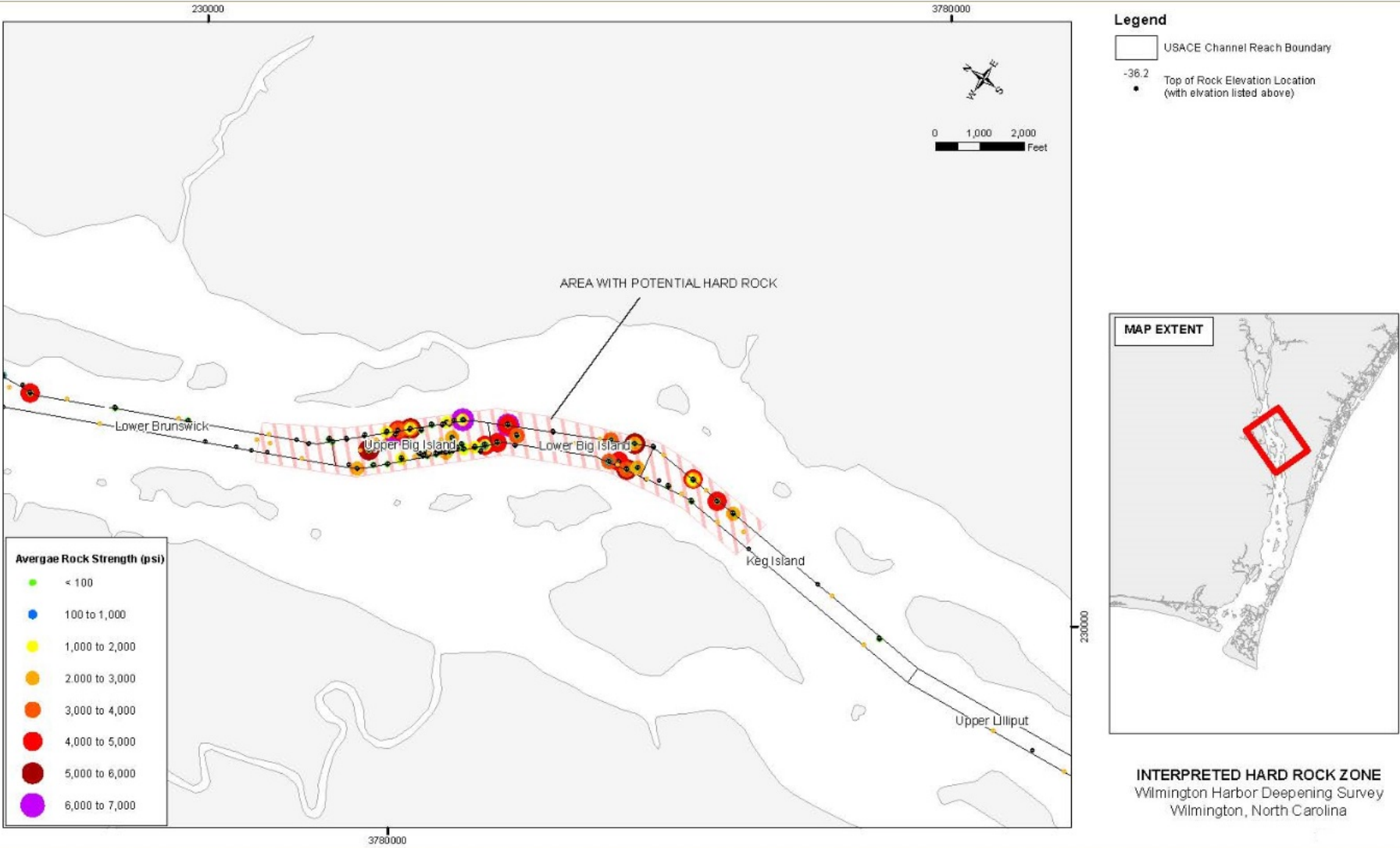


Figure 1. Pre-treatment Area for Wilmington Harbor Navigation Improvement Project



Figure 2. Proposed Beach Placement Areas on Bald Head Island and Caswell Beach/Oak Island

2.2.4 Construction Schedule

Construction schedules for the tentatively selected plan (TSP) have been developed based on equipment types, production rates, and dredging windows. The construction schedules provide one means of accomplishing the project within three years, where dredging is only permitted from 15 June - 15 February, and confined underwater (CU) blasting is only permitted from 1 October - 15 February. This schedule is representative of a typical plan in that it uses the most likely equipment and maximizes dredge efficiency. It should be noted that this schedule will not be a requirement of the contract (i.e., it represents one possible plan, but is not necessarily *the* plan).

This schedule assumes that one hopper and one mechanical dredge will be working in the channel for the entirety of the three years (Table 2); the cutter suction dredge is anticipated to work within the channel (from RM 2 – 3.2 and from RM 3.75 – 5) only during the first year of the project, and two drill barges are anticipated throughout the project duration. Generally, the contractor will have the drill barges working in differently locations. During Year-3, however, both drill barges are working from RM 2 to 3.2; this is a long portion and will provide adequate spacing between the two CU blasting operations.

Table 2. -47-foot Plan construction schedule.

Equipment Type	Year 1	Year 2	Year 3
Hopper Dredges	Entrance	---	---
	Baldhead Shoal 2		
	Baldhead Shoal 3		
Cutterhead Suction Dredge 1	Baldhead Shoal 3	Beach Placement	Lower Lilliput
	Battery Island	Baldhead Shoal 1	Upper Lilliput
	Lower Swash	Smith Island	
	Snows marsh	Baldhead-Caswell	
Cutterhead Suction Dredge 2	Horseshoe	Keg Island	Upper Brunswick
	Reaves	Lower Big Island	Fourth East Jetty
	Lower Midnight	Upper Big Island	Between Reach
	Upper Midnight	Lower Brunswick	Anchorage Basin
Drill Barges	---	Keg Island	---
		Lower Big Island	
		Upper Big Island	
		Lower Brunswick	

2.3 Potential Beneficial Uses of Dredged Material

The Federal Government has placed considerable emphasis on using dredged material in a beneficial manner. Statutes such as the WRDAs of 1992, 1996, 2000, and 2007 demonstrate that beneficial use has been a Congressional priority. The USACE has emphasized the use of dredged material for beneficial use through such regulations as 33 Code of Federal Register (CFR) Part 335, Engineering Regulations (ER) 1105-2-100, and ER 1130-2-520 and by Policy Guidance Letter No. 56. (ER 1105-2-100 at E-69) states that “all dredged material management studies include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or hurricane and storm damage reduction.”

Opportunities exist for beneficial use of dredged material associated with the dredging of new work material during the construction of the Wilmington Harbor Navigation Improvement Project. In accordance with ER 1105-2-100, the USACE is considering beneficial use of dredged material as a part of the project. The USACE regulations (ER 1105-2-100) state that, “where environmentally beneficial use of dredged material is the least cost, environmentally acceptable method of disposal, it is cost shared as a navigation cost.” The incremental costs of a beneficial use that is above the least cost disposal option would need to be funded by a non-federal sponsor or cost-shared according to the applicable authority. The beneficial use concepts and alternatives discussed below may or may not be constructed, particularly if the costs are greater than the least cost disposal option and a non-federal sponsor is not identified to pay for the incremental increase in cost.

During the feasibility phase, the local sponsor hosted an interagency technical working group meeting on 19 February 2019 to discuss the various opportunities for beneficial uses of dredged material and provide preliminary information about the types of analyses that would be needed: monitoring requirements, ecological and shore protection benefits, construction methods, construction windows, physical characteristics of material, etc. Based on a review of the information gained from this meeting, the following options were identified.

- Beach placement on Bald Head Island and Oak Island
- Battery Island shore placement
- South Pelican and Ferry Slip Island restoration
- Creation of new bird islands
- Wetland restoration on Battery, Shellbed, and Striking Islands using thin-layer placement

A map of the beneficial use project area can be seen in Figure 3. During the Pre-Construction Engineering and Design phase, options for beneficial uses that are cost-effective and meet regulatory and environmental protection requirements would be pursued. The additional cost (above the least cost option described above) of most potential beneficial use options would need to be paid by a willing partner. Only the beach placement option is addressed in this document, due to the lack of detail in design of other options at this point in time.



Figure 3. Proposed Beneficial Use Project Area

3 DESCRIPTION OF THE ACTION AREA

The action area encompasses areas potentially affected by proposed harbor channel modifications and associated dredged material disposal activities; including the Cape Fear River estuary and surrounding areas, the barrier island beaches of Bald Head Island and Oak Island, and offshore areas encompassing the ocean entrance channel and Wilmington ODMDS (Figure 4). As defined for purposes of this study, the Cape Fear River estuary encompasses the tidally affected river systems and wetlands of the lower Cape Fear River basin; including the mainstem Cape Fear River from the Atlantic Ocean up to Lock and Dam #1 at Kelly, NC (~60 river miles), the Northeast Cape Fear River from its confluence with the Cape Fear River up to NC HWY 53 (~48 river miles), and the Black River from its confluence with the Cape Fear River up to NC HWY 53 (~24 river miles).

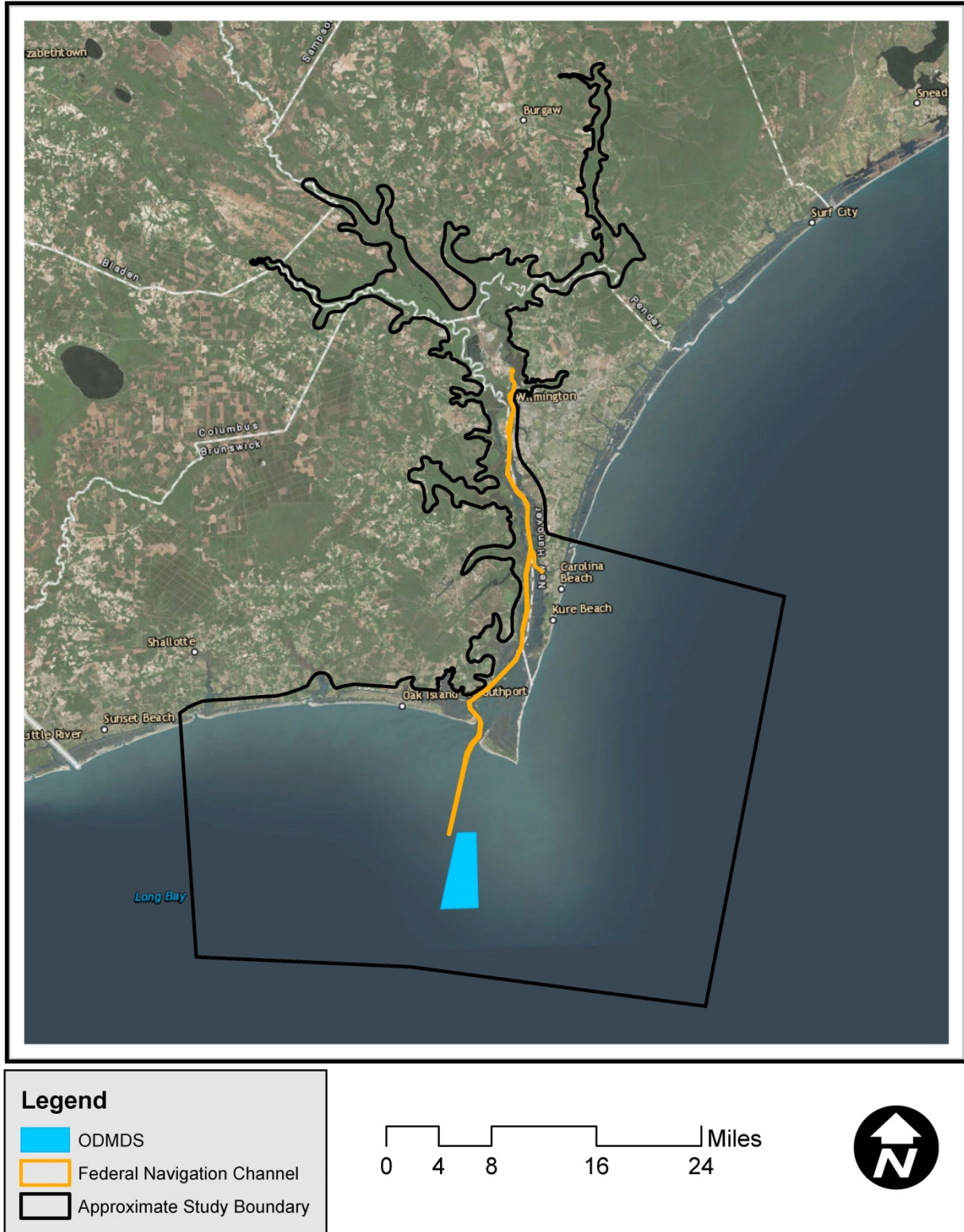


Figure 4. Action Area - Wilmington Harbor Navigation Improvement Project

4 SPECIES CONSIDERED UNDER THIS ASSESSMENT

The species considered in this BA include federally listed species identified by the USFWS as occurring in New Hanover County and Brunswick County, NC, and species identified by the NMFS as occurring in estuarine and/or marine environments along the NC coast (Table 3). Descriptions of the various critical habitats that are utilized by these species are summarized in Table 4. There are a number of species that are associated with terrestrial habitats, including the red-cockaded woodpecker, American chaffseed, Cooley’s meadowrue, golden sedge, rough-leaved loosestrife, and pond berry. These species are located well inland of the project area and not associated with barrier island, estuarine, or marine habitats; and therefore, the proposed action will not affect these species and they are eliminated from further consideration in this assessment. Although blue, finback, and sei whales may occur in offshore waters along the NC coast, these species are strongly pelagic and are unlikely to occur in the nearshore ocean study area. These species are not expected to occur within the nearshore waters of the study area; and therefore, the proposed action will not affect these species and they are eliminated from further consideration in this assessment.

Table 3. Federally listed endangered and threatened species that may occur in or near the project study area.

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS
North Atlantic right whale	<i>Eubalaena glacialis</i>	Endangered
Florida manatee	<i>Trichechus manatus latirostris</i>	Threatened
Piping plover	<i>Charadrius melodus</i>	Threatened
Red knot	<i>Calidris canutus rufa</i>	Threatened
Wood stork	<i>Mycteria americana</i>	Threatened
Hawksbill turtle	<i>Eretmochelys imbricata</i>	Endangered
Kemp's ridley turtle	<i>Lepidochelys kempii</i>	Endangered
Green turtle	<i>Chelonia mydas</i>	Endangered
Leatherback turtle	<i>Dermochelys coriacea</i>	Endangered
Loggerhead turtle	<i>Caretta caretta</i>	Threatened
Atlantic sturgeon	<i>Acipenser oxyrinchus oxyrinchus</i>	Endangered
Shortnose sturgeon	<i>Acipenser brevirostrum</i>	Endangered
Seabeach amaranth	<i>Amaranthus pumilus</i>	Threatened

Table 4. Critical habitats within project study area.

Critical Habitat Type	Unit ID	Description
Piping Plover Wintering Critical Habitat	NC13 Masonboro	North end of Masonboro Island Masonboro Inlet
Piping Plover Wintering Critical Habitat	NC14 Carolina Beach Inlet	South end of Masonboro Island Carolina Beach Inlet emergent shoals North end of Carolina Beach
Piping Plover Wintering Critical Habitat	NC15 Fort Fisher	Fort Fisher Islands and ocean beach south of the ferry terminal
Piping Plover Wintering Critical Habitat	NC16 Lockwoods Folly Inlet	West end of Oak Island Lockwoods Folly Inlet emergent shoals
Piping Plover Wintering Critical Habitat	NC17 Shalotte Inlet	West end of Holden Beach Shalotte Inlet emergent shoals
Piping Plover Wintering Critical Habitat	NC18 Mad Inlet	West end of Sunset Beach Marshes behind west end of Sunset Beach East end of Bird Island
Loggerhead Sea Turtle Terrestrial Critical Habitat	LOGG-T-NC-05	Pleasure Island/Ft Fisher
Loggerhead Sea Turtle Terrestrial Critical Habitat	LOGG-T-NC-06	Bald Head Island
Loggerhead Sea Turtle Terrestrial Critical Habitat	LOGG-T-NC-07	Oak Island
Loggerhead Sea Turtle Terrestrial Critical Habitat	LOGG-T-NC-08	Holden Beach
Loggerhead Sea Turtle Nearshore Reproductive Critical Habitat	LOGG-N-05	Mean High Water to 1.6 kilometers offshore from Carolina Beach Inlet to Shalotte Inlet
Loggerhead Sea Turtle Winter Critical Habitat	LOGG-N-02	Offshore waters between 20-meter and 100-meter depth contours from Cape Fear to Cape Hatteras
Atlantic Sturgeon Carolina DPS Critical Habitat	Carolina Unit 4	Cape Fear River from mouth (river kilometer 0) to Lock and Dam #2 Northeast Cape Fear River from mouth to Roans Chapel Rd Bridge at Mount Olive
North Atlantic Right Whale Southeastern US Calving Critical Habitat	Unit 2	Nearshore waters from Cape Fear, NC, to Cape Canaveral, FL

5 EFFECTS OF THE PROPOSED ACTION

5.1 North Atlantic Right Whale

5.1.1 Status, Distribution, and Habitat

Right whale populations in the North Atlantic and North Pacific were originally listed as a single endangered species in June 1970 (35 FR 8495) under the Endangered Species Conservation Act (a predecessor to the ESA of 1973). In 2008, the two populations were reclassified as separate endangered species; the North Atlantic right whale (*Eubalaena glacialis*) and the North Pacific right whale (*E. japonica*) were listed as two separate endangered species under the ESA (73 FR 12024). The most recent stock status assessment in 2017 estimated the size of the North Atlantic right whale population at 458 individuals (NMFS 2018). North Atlantic right whales calve in warm subtropical waters during winter, and migrate to feeding grounds in highly productive cold temperate and subpolar waters in spring and summer (Greene and Pershing 2004). The majority of the western North Atlantic population ranges from wintering and calving areas in coastal waters off the southeastern United States (US) to summer feeding grounds in coastal waters off New England (Massachusetts Bay, Cape Cod Bay, and the Great South Channel) and Canada (Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence). Waters along the southeastern US coast constitute the only known calving habitat for North Atlantic right whales (Kraus et al. 1986, Knowlton et al. 1994, and Reeves et al. 2001). Reproductive females typically arrive in the calving areas during late November and early December after migrating south from feeding grounds in the northeastern US and Canada (Fujiwara and Caswell 2001, Garrison 2007, and Hamilton et al. 2007). Mothers and newborn calves reside within the southeast through winter and generally depart the calving grounds by the end of March or early April (Reeves et al. 2001). Other members of the population spend the winter on the northern feeding grounds, and a substantial portion of the population may spend the winter in several northern areas such as the Gulf of Maine and Cape Cod Bay (Cole et al. 2013, Clark et al. 2010, and Mussoline et al. 2012). Currently designated critical habitats for the right whale include northeastern feeding grounds in the Gulf of Maine/Georges Bank region, and southeastern nearshore ocean calving habitats from central Florida to Cape Fear, NC (81 FR 4838) (Figure 5).

5.1.2 Occurrence in the Action Area

The coastal waters of the Carolinas are part of the migratory corridor for the North Atlantic right whale (Winn et al. 1986, Knowlton et al. 2002). In an effort to better define the geographic and temporal extent of the right whale migratory corridor, Knowlton et al. (2002) analyzed 489 right whale sightings that occurred along the mid-Atlantic coast between 1974 and 2002. The largest number of sightings (34.4%) occurred within 5 nautical miles (nm) of shore, and well over half of the sightings (63.8%) occurred within ten nm of shore. Nearly all of the sightings (94.1%) were within 30 nm of shore. Despite extensive survey effort, sightings farther offshore were very rare. Sightings near Wilmington, NC, occurred from October through April with a peak during February and March (Knowlton et al. 2002). A total of 18 sightings occurred within a 40 nm radius of the entrance to Wilmington Harbor; including 14 sightings within a 20 nm of the harbor entrance. At Morehead City Harbor, 17 sightings occurred within a 35-nm radius of the

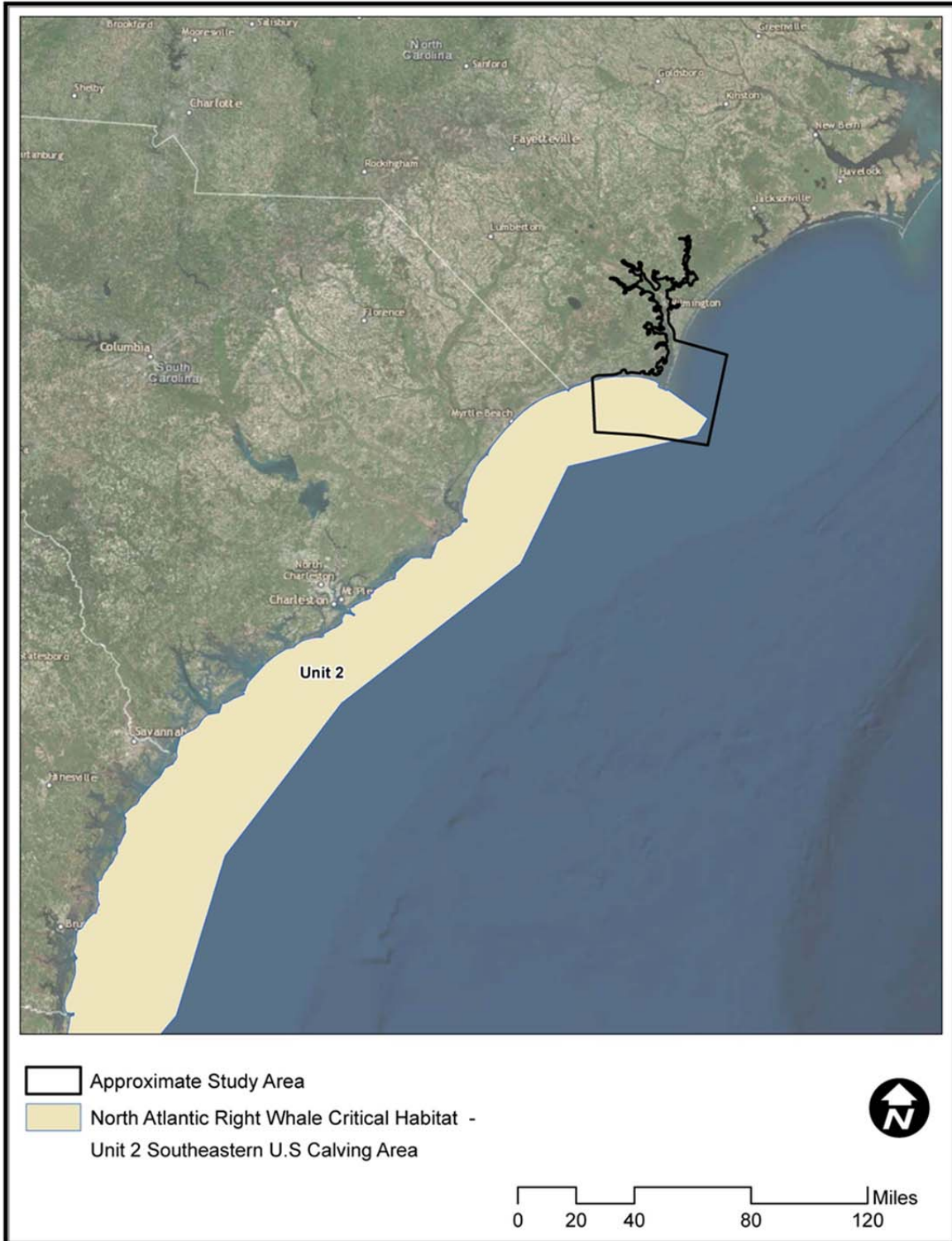


Figure 5. North Atlantic Right Whale Southeastern Calving Critical Habitat

harbor entrance, including 15 sightings within 20 nm of the harbor entrance. Surveys conducted off the southern NC coast during the winters of 2001 and 2002 sighted eight calves, including four calves that were not sighted by surveys conducted farther south (McLellan et al. 2003). The NC calve sightings suggest that the right whale calving grounds may extend north to southern NC waters. In 2016, Southeastern Calving Area Critical Habitat for the right whale was extended north to Cape Fear (Figure 5). The essential features of the southeastern calving critical habitat include physical oceanographic conditions that support calving and nursing; including calm sea surface conditions, sea surface temperatures of 45 degrees Fahrenheit (°F) to 63°F, and water depths of 20 ft to 92 ft.

5.1.3 Threats

Ship collisions and fishing gear entanglements are the principal anthropogenic causes of North Atlantic right whale mortality. A total of 22 mortalities were attributed to ship strikes between 1970 and 2004, and it is estimated that approximately 60% of all right whales have scars associated with fishing gear entanglement (NMFS 2005). For the period of 2011 through 2015, the average minimum rate of annual human-caused right whale mortality and serious injury was 5.36 per year; including incidental fishery entanglements at an average rate of 4.55 per year and vessel strikes at an average rate of 0.81 per year (NMFS 2018). Analyses of whale-vessel interactions indicate that the probability of vessel strikes and the probability of serious injuries from vessel strikes both increase with ship speed (NMFS 2008). In an effort to reduce ship strikes, the NMFS published the Right Whale Ship Strike Reduction Rule (50 CFR 224.105). The Ship Strike Reduction Rule established Seasonal Management Areas (SMAs) with mandatory large vessel (≥ 65 ft) speed restrictions. The southernmost Mid-Atlantic SMA encompasses waters within a 20-nm radius of MCH and a continuous 20 nm zone along the southeastern US coast from Wilmington, NC, to Brunswick, Georgia (Figure 6). Vessels ≥ 65 ft in length are restricted to speeds of ten knots or less in the Mid-Atlantic SMA from 1 November to 30 April (73 FR 60173). Additional federal regulations prohibit the approach of any vessel within 500 yards of a right whale [50 CFR 224.103(c)]. Although instances of lethal whale-dredge interactions (i.e., vessel collisions) have not been documented, a non-lethal interaction was reported in 2005 when a hopper dredge collided with an apparent right whale along the Georgia coast near the Brunswick Harbor entrance channel (NMFS 2012b).

5.1.4 Project Effects

5.1.4.1 Vessel Strikes

Hopper dredging operations in the outer harbor entrance channel and dredged material ocean disposal at the ODMDS would coincide with right whale migration and calving periods along the NC coast. The risk of collisions between hopper dredges and whales during active dredging operations would be minimal, as hopper dredges travel at slow speeds during the active dredging process. The potential for vessel strikes would primarily be associated with hopper dredge transits between the dredging site and the ODMDS and support vessel operations. Hopper dredges and support vessels would employ conservation measures to reduce the risk of vessel collisions; including the continuous presence of Protected Species Observers (PSOs) on hopper dredges during active dredging and transit, and the application of a 10-knot speed restriction to

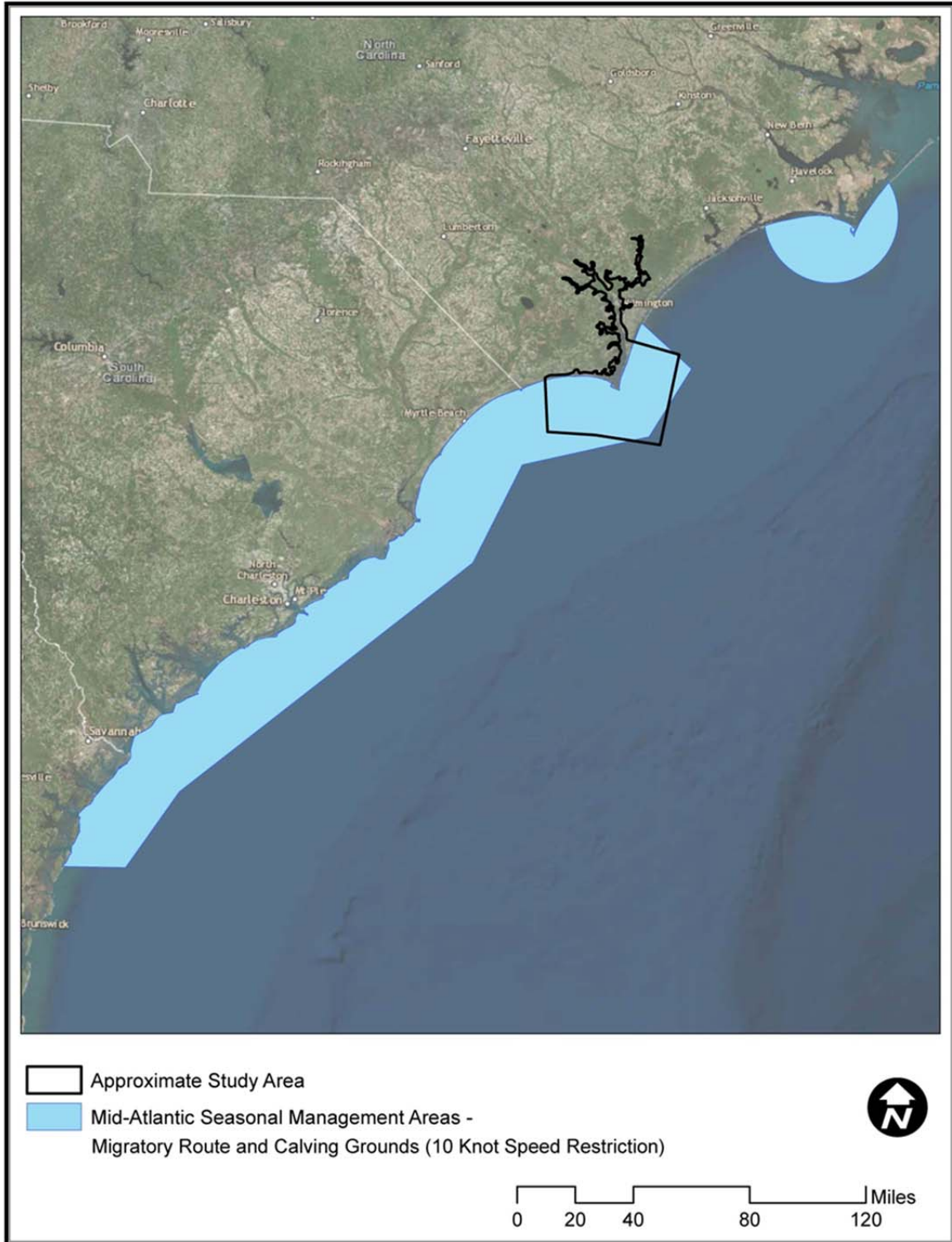


Figure 6. Mid-Atlantic Seasonal Management Areas for the North Atlantic Right Whale

all hopper dredges and support vessels. It is expected that these conservation measures would reduce the risk of collisions to negligible levels.

5.1.4.2 Dredging Acoustic Effects

The NMFS defines two levels of acoustic “take” under the Marine Mammal Protection Act (MMPA). Actions that may expose marine mammals to noise in excess of the values shown in Table 5 constitute Level A harassment with the potential to cause injury, and actions that may expose marine mammals to impulse (e.g., pile driving, blasting) noise levels ≥ 140 decibels (dB) re 1 micropascal (μPa) root mean square (rms) or continuous (e.g., dredging) noise levels ≥ 120 dB re $1\mu\text{Pa}$ constitute Level B harassment with the potential to cause behavioral disruption. A study of the sounds produced by hopper dredges during sand mining at offshore borrow sites in Virginia reported noise levels ranging from 161 to 179 dB re $1\mu\text{Pa}$ rms (Reine et al. 2014). Peak source levels did not exceed the former generic Level A harassment threshold (≥ 180 dB re $1\mu\text{Pa}$ rms) for injurious effects on marine mammals; however, noise levels generally exceeded the NMFS Level B harassment threshold (≥ 120 dB re $1\mu\text{Pa}$ rms) within 1.2 kilometers (km) of the source and generally remained at or near 120 dB re $1\mu\text{Pa}$ rms out to 2.1 km. According to a study by Clarke et al. (2002), cutterhead dredges produce peak sound levels in the range of 100 to 110 dB re $1\mu\text{Pa}$ rms with rapid attenuation occurring at short distances from the dredge and sound levels becoming essentially inaudible at a distance of approximately 500 meters (m). Mechanical dredges produce non-continuous but repetitive sound, with maximum sound level spikes of ~ 120 dB peak pressure occurring when the bucket or clamshell contacts the bottom (Clarke et al. 2002).

Based on the noise studies described above, the sound levels produced by cutterhead and mechanical dredges would not be expected to exceed the NMFS thresholds for behavioral or injurious effects on marine mammals. In the case of hopper dredging, these studies indicate that sound levels would not be expected to exceed the NMFS thresholds for injurious effects on marine mammals (Level A harassment), but may exceed the threshold for behavioral effects on marine mammals (Level B harassment) within 2.1 km of the dredge. Most observations of baleen whale responses to anthropogenic noise have been limited to short-term responses; including avoidance of the source area, cessation of feeding, rapid swimming away from the source, altered dive patterns, vocalization changes, and changes in respiration (Fisheries and Oceans Canada 2010). Therefore, it is expected that any behavioral effects on right whales would be limited to minor short-term avoidance responses.

Table 5. Level A permanent threshold shift onset harassment values for marine mammal hearing groups.

Hearing Group	PTS Onset (Received Level)	
	Impulsive	Non-Impulsive
Low-Frequency (LF) Cetaceans	PK: 219 dB SEL _{cum} : 183 dB	SEL _{cum} : 199 dB
Mid-Frequency (MF) Cetaceans	PK: 230 dB SEL _{cum} : 185 dB	SEL _{cum} : 198 dB
High-Frequency (HF) Cetaceans	PK: 202 dB SEL _{cum} : 155 dB	SEL _{cum} : 173 dB
Phocid Pinnipeds (PW)	PK: 218 dB SEL _{cum} : 185 dB	SEL _{cum} : 201 dB
Otariid Pinnipeds (OW)	PK: 232 dB SEL _{cum} : 203 dB	SEL _{cum} : 219 dB

PTS = Permanent Threshold Shift; PK = Peak sound level; SEL_{cum} = Cumulative sound exposure level

Source: NMFS 2016

5.1.4.3 Confined Blasting

The proposed confined blasting areas are located in the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel reaches in the mid-estuary at a distance of 18 miles or more from the ocean. Based on sound pressure and dB levels produced by test blasting in the Cape Fear River for the Wilmington Harbor 96 Act project, the Wilmington District USACE determined that the sound pressure levels meeting or exceeding the NMFS thresholds for injurious and behavioral marine mammal effects would occur within ~560 ft and ~3,500 ft of the blast locations, respectively (USACE 2000). Therefore, blasting would not be expected to have any adverse effects on North Atlantic right whales.

The proposed confined blasting areas encompass ~188 acres of rock surface area within the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel reaches. The proposed confined blasting areas are located in the mid-estuary at a distance of 18 miles or more from the ocean. Based on sound pressure and dB levels produced by test blasting conducted in the Cape Fear River for the Wilmington Harbor 96 Act project, the Wilmington District determined that the NMFS thresholds for injurious and behavioral marine mammal effects would be met or exceeded within ~560 ft and 3,500 ft of the blast locations, respectively (USACE 2000). Therefore, blasting would not be expected to have any adverse effects on North Atlantic right whales.

5.1.4.4 Effects on North Atlantic Right Whale Critical Habitat

The essential features of right whale southeastern US critical calving habitat are those associated with optimal calving habitat; including calm sea surface conditions, sea surface temperatures of

45°F to 63°F, and water depths of 20 ft to 92 ft. The proposed action would not be expected to affect any of these essential features.

5.1.5 Conservation Measures

5.1.5.1 Vessel Speed Restrictions and Contractor Briefings

During transit between the dredge area and disposal sites, dredges, material transport vessels, and other associated support vessels would adhere to a set speed limit (e.g. <10 knots) that would minimize the risk of vessel strikes to important species. Contractors will also be briefed on the presence of species within the project area along with the requirements for protection of these species. All contractor personnel should be informed of the civil and criminal penalties for harming, harassing, or killing protected species under the ESA and MMPA. Dredges and associated vessels will be required to stop or alter course when North Atlantic right whales are encountered. Additional caution will be taken during periods of limited visibility.

5.1.5.2 Endangered Species Observers

During daylight hours (dawn to dusk), one PSO would be onboard all hopper dredges during active dredging operations and transit to conduct observations for large whales. If a right whale is sighted within 500 yards during dredging operations, operations will cease until the PSO is confident that the whale has left the area. If a whale is sighted during transit, the crew would reduce speed and alter course as necessary to maintain a distance of 500 yards between the vessel and the whale. All whale sightings would be documented and reported to the NMFS.

5.1.6 Determination of Effects

5.1.6.1 Vessel Strikes

The conservation measures addressed above would be effective in reducing the risk of right whale vessel collisions. It is expected that adherence to speed restrictions and the use of qualified endangered species observers would reduce the risk of collisions to negligible levels. Therefore, it is determined that the proposed action may affect, but is not likely to adversely affect the North Atlantic right whale.

5.1.6.2 Dredging Acoustic Disturbance

The previously described noise studies indicate that the sound levels produced by dredging would not be expected to exceed the NMFS thresholds for injurious effects on marine mammals (Level A harassment). Hopper dredges may produce sound levels that exceed the thresholds for behavioral effects on marine mammals (Level B harassment) within 2.1 km of the dredge. Behavioral effects may include short-term avoidance of the area, cessation of feeding, resting, or social interactions. However, since North Atlantic right whales are transient within the action area, any behavioral effects are anticipated to be short-term and minor. Therefore, it is determined that the proposed action may affect, but is not likely to adversely affect the North Atlantic right whale.

5.1.6.3 Confined Blasting

The proposed confined blasting areas are located in the mid-estuary at a distance of 18 miles or more from the ocean. Therefore, it is determined that blasting would have no effect on the North Atlantic right whale.

5.1.6.4 North Atlantic Right Whale Southeastern U.S. Calving Critical Habitat

It is determined that the proposed action may affect, but is not likely to adversely affect southeastern U.S. calving critical habitat for the North Atlantic right whale.

5.2 Florida Manatee

5.2.1 Status, Distribution, and Habitat

The Florida manatee (*Trichechus manatus latirostris*), a subspecies of the West Indian manatee, was originally listed as endangered in 1967 (32 FR 4001) under the Endangered Species Preservation Act of 1966 (a predecessor to the ESA of 1973). In 1969, the endangered listing was expanded to encompass the species throughout its range, including the Antillean manatee (*Trichechus manatus manatus*), a subspecies occurring in the Caribbean and South America. In May 2017, both subspecies were reclassified from endangered to threatened throughout their ranges (82 FR 16668). Manatees are intolerant of cold water temperatures; and consequently, are generally restricted to warm water sites of peninsular Florida during the winter. In the spring, as water temperatures reach 68°F, manatees disperse from winter sites and can undertake extensive movements along the coast and up rivers and canals (USFWS 2001). Manatees inhabit marine, brackish, and freshwater environments where they are found in seagrass beds, salt marshes, freshwater bottom areas, and many other habitat types. Manatees feed on a wide variety of submerged, floating, and emergent vegetation. Seagrasses are a staple in coastal habitats, and preferred foraging habitats consist of shallow seagrass beds with access to deep water. Manatees are also known to feed on salt marsh vegetation (i.e., smooth cordgrass), which they access at high tide. Although manatees tolerate a wide range of salinities, they prefer areas where osmotic stress is minimal or areas that have a natural or artificial source of fresh water (USFWS 2001). The most recent abundance estimate for the Florida subspecies within the southeastern US was 6,350 individuals (Martin et al. 2015). Numerous coastal water bodies in Florida have been designated as critical habitat for the manatee; including waters as far north as Nassau County on the east coast of Florida and as far north as Citrus County on the west coast of Florida (42 FR 47840-47845).

5.2.2 Occurrence in the Action Area

Cummings et al. (2014) described the temporal and spatial distribution of manatees in NC based on sighting and stranding records for the period of 1991-2012. Although sightings were reported along the entire NC coast, most were concentrated around the densely populated areas of Wilmington and Beaufort, NC. Sightings were most common in the Atlantic Intracoastal Waterway; however, manatees were also observed in sounds, bays, rivers, creeks, marinas, and the open ocean. Manatee occurrences in NC are primarily restricted to the months of June through October. Nearly all (93%) of the NC sighting (n=99) and stranding (n=9) records that were analyzed by Cummings et al. (2014) occurred between June and October when water

temperatures were above 68°F [20 degrees Centigrade (°C)]. Reported sightings in the mainstem Cape Fear River estuary were confined to the lowermost estuary below Snows Cut; however, two sightings were reported in the northeast Cape Fear River approximately 20 to 30 river miles above Wilmington. A number of additional sightings were reported from the Atlantic Intracoastal Waterway channels behind Oak Island and Carolina Beach.

5.2.3 Threats

The principal anthropogenic causes of manatee mortality are watercraft strikes, entrapment and/or crushing in water control structures, ingestion of marine debris, and entanglement in fishing gear. Natural causes of mortality include cold stress syndrome and exposure to red tide (brevetoxicosis). Of 2,372 human-caused manatee deaths that occurred from 1978-2012; 84% (n=1,980) were attributed to watercraft strikes, 9% (n=204) to water control structures, and the remaining 8% (n=188) to ingestion of marine debris, entanglement in fishing gear, and other human causes. Based on 493 deaths that were attributed to human causes during the most recent 5-year period of 2008-2012, the average annual rate of human-caused mortality is estimated at 99 manatees per year (USFWS 2014). Although no manatee strandings have been reported from the action area, nine strandings were reported along the NC coast from 1991-2012. Rapid declines in water temperature during the early fall can cause cold stress syndrome in manatees that have not departed NC waters for Florida (Cummings et al. 2014). Of the nine strandings that were reported in NC from 1991-2012; seven occurred during the months of November, December, and January; with four showing signs of cold stress at necropsy.

5.2.4 Project Effects

5.2.4.1 Dredging

Hopper dredging operations in the outer harbor entrance channel would adhere to a dredging window of 1 December to 30 April; thus limiting operations to periods of relatively cold water temperatures when manatees are unlikely to be present in NC waters. The use of hopper dredges would be limited to the outermost Baldhead Shoal 2 and 3 ocean entrance channel reaches where manatees would be unlikely to occur even during the warmer months. Cutterhead and bucket dredging in the inner harbor channels would occur from 1 October to 31 March in the reaches south of Snow's Cut and 1 July to 31 January in the reaches north of Snow's Cut; thus coinciding with the months of July-October when manatees could potentially be present in the Cape Fear River estuary. Cutterhead and bucket dredges operate from anchored barges, and would present only a minimal collision risk during brief periods of barge repositioning. The principal collision risk associated with inner harbor dredging would occur from support vessel operations and the use of scows to transport dredged material to disposal sites. As a measure to reduce the risk of vessel strikes, all dredging and disposal operations and supporting vessel activities would implement: Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters (USFWS 2003) (Appendix A). Based on the implementation of these measures, the stationary operational mode of cutterhead and bucket dredges, and the rarity of manatees in NC waters; it is expected that the vessel strike risk would be negligible.

5.2.4.2 Blasting

Manatees may be present in the Cape Fear River estuary during the proposed 1 July-31 January blasting window; although the analyses conducted by Cummings et al. (2014) indicate that the likelihood of occurrences would be greatly reduced after the end of October. Underwater explosions produce shock waves that can have physiological effects on marine mammals ranging from mortality and non-auditory physical injuries to auditory injuries involving Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) hearing loss. In-water blast waves travel through the bodies of marine animals and can cause internal injury to gas-filled organs. Injuries most commonly reported in marine mammals that have been exposed to underwater explosions include hemorrhaging in the fine structure of the lungs and injuries to the gastrointestinal tract (Richmond et al. 1973, Yelverton et al. 1975, and Finneran and Jenkins 2012). Blasting can also have behavioral effects on marine mammals ranging from startle reactions to single detonations to negative effects on feeding, sheltering, reproduction, or other important biological functions when exposed to multiple detonations in the same area over an extended period of time (NMFS 2008a).

Areas potentially requiring confined blasting encompass ~188 acres of rock surface area within the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel reaches. These four reaches comprise a continuous ~4.4-mile section of the navigation channel from a point ~18 miles above the estuary mouth to a point approximately two miles below Eagle Island. Blasting operations under the proposed action would employ stemmed charges and charge delays to reduce the magnitude of potentially injurious blast shock waves. Drill holes containing the individual charges would be stemmed (capped) with angular rock or other suitable material for the purpose of containing blast energy within the rock. Studies indicate that the use of stemmed charges with confined blasting can reduce shock wave peak pressure by 60 to 90% in relation to unconfined open water blasts (Nedwell and Thandavamoorthy 1992, Hempen et. al. 2005). The use of delays between individual charge detonations limits the development of cumulative blast pressure.

Blasting operations would implement protective measures for marine mammals and sea turtles similar to those previously approved by the NMFS in 2000 and 2012 for blasting operations under the Wilmington Harbor 96 Act Project (NMFS 2000, 2012). Protective measures would include the establishment of blast zones of influence and the development of a Watch Program in accordance with NMFS Southeast Region guidance for mitigating the effects of marine blasting on protected species; including marine mammals and sea turtles (Baker 2008). The NMFS guidance provides specific procedures and equations for calculating zones of influence based on the blasting method used and project-specific details. In the case of confined blasting, the required zones of influence include Danger, Harassment, and Watch zones (Table 6). The innermost Danger Zone encompasses the area nearest to the blast location where mortality and injury may occur. The intermediate Harassment Zone encompasses the area where TTS and behavioral effects may occur, and the outermost Watch Zone is an additional area that is monitored to detect animals that are moving towards the inner blast impact zones.

Table 6. Recommended zones of influence for confined blasting with stemmed charges.

Influence Zone	Definition	Equation
Danger Zone	Mortality and Injury (Onset of PTS)	$260 \sqrt[3]{lb/delay}$
Harassment (Safety) Zone	Onset of TTS and Behavioral Effects	$520 \sqrt[3]{lb/delay}$
Watch Zone	Monitoring to detect approaching animals	3 x distance of danger zone

Source: Baker 2008

5.2.5 Conservation Measures

5.2.5.1 USFWS Manatee Impact Avoidance Guidelines

The contractor will implement: Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters (USFWS 2003) (Appendix A).

5.2.5.2 Blast Mitigation Watch Program

Blast zones of influence (Danger Zone, Harassment Zone, and Watch Zone) will be calculated for each blast event in accordance with NMFS guidelines (Table 6). The zones of influence cannot be calculated until the weights of all charges that will comprise each blast are known. The contractor will calculate the zones of influence and include the information in the blasting plans and monitoring reports for each blast event. Information regarding the influence zones will be provided to the PSOs prior to each blast for incorporation into the event-specific watch plans.

The watch program for each blast event will adhere to the following procedures:

- The watch program will begin at least one hour prior to the scheduled start of blasting to identify the possible presence of protected species and will continue until at least one half-hour after detonations are complete.
- A combination of sonar and other imaging techniques will be used to monitor a 500-ft zone surrounding the blast area for schools of fish. Monitoring will begin 20 minutes prior to the detonation and no blasting will occur until any observed fish have left the area.
- The watch program for each blast shall consist of a minimum of five PSOs.
- PSOs will be equipped with two-way radios, polarized sunglasses, binoculars, a red flag for backup visual communication, and a sighting log with a map to record sightings.
- All blasting events will be weather dependent. Climatic conditions must be suitable for optimal viewing conditions, as determined by the observers.

- The event shall be halted if any animals are spotted within the Safety Zone.
- The blasting event shall be halted immediately upon request by any of the PSOs.
- If marine mammals or sea turtles are sighted, the blast event shall not take place until the animal(s) moves out of the area under its own volition. Animals shall not be herded away, and will not be intentionally approached by project watercraft. If the animal(s) is not sighted a second time, the event may resume 30 minutes after the last sighting.
- Blasting will not occur within the 2-hour period after sunrise or the 1-hour period before sunset.
- Blasting will be limited to the period of 1 July to 31 January in accordance with the NC Division of Marine Fisheries Anadromous Fish Moratorium (1 February -30 June).
- A delay of at least 25 milliseconds shall be applied to the charge in each drill hole to prevent cumulative blasting impacts.
- Maximum peak pressure shall not exceed 120 pounds per square inch (psi) at a distance of 140 ft.
- Average peak pressure shall not exceed 70 pounds psi at a distance of 140 ft. This average will be based on each series of five consecutive charge detonations.
- Blast pressures will be monitored and upper limits will be imposed on each series of 5 consecutive detonations. Pressure will be monitored for each blast only at a distance of 140 ft.
- The PSOs and contractors shall evaluate any problems encountered during blasting events and logistical solutions shall be presented to the Contracting Officer. Corrections to the watch program shall be made prior to the next blasting event. If any one of the aforementioned conditions is not met prior to or during blasting, the watch observers shall have the authority to terminate the blasting event until resolution can be reached with the Contracting Officer. The Contracting Officer will contact the NMFS.
- If an injured or dead protected species is sighted after the blast event, the PSOs shall contact the USACE, and the USACE shall contact the following resource agencies:
 - UNC Wilmington, Marine Mammal Stranding Program: 910-254-5713
 - NC Wildlife Resources Commission, Sea Turtle Stranding Hotline: 252-241-7367
 - NMFS SERO-PRD: 727-824-5312 (Sea Turtles)
 - NMFS Southeast Marine Mammal Stranding Hotline: 1-877-433-8299

- The PSOs shall maintain contact with the injured or dead mammal or sea turtle until authorities arrive. Blasting shall be postponed until consultations are completed and determinations can be made as to the cause of injury or mortality. If blasting injuries are documented, all blasting activities shall cease, and the USACE will submit a revised plan to the NMFS for review.
- A watch plan will be formulated based on the required monitoring zones of influence and optimal observation locations. The watch plan will consist of at least two (2) boat-based PSOs, and two (2) PSOs stationed on the drill barge. A fifth PSO will be placed in the most optimal observation location (boat or barge) on a day-by-day basis, depending on the location of the blast and the placement of dredging equipment. This process will ensure complete coverage of the three zones as well as any critical areas. The watch will begin at least 1-hour prior to each blast and continue for one-half hour after each blast (Jordan et al. 2007).
- Within 30 days of the completion of each blasting event, the primary PSO shall submit a report to the USACE, which will provide the report to the NMFS. The report for each blast will describe the event, number and location of animals seen, actions that were taken when animals were observed, any problems encountered during the event, and suggestions for improvements.

5.2.6 Determination of Effect

5.2.6.1 Dredging

Based on adherence to the USFWS manatee impact avoidance guidelines, and considering that relatively stationary cutterhead and bucket dredges would be used in the inner harbor, it is determined that the proposed action may affect, but is not likely to adversely affect the Florida manatee.

5.2.6.2 Confined Blasting

Cummings et al. (2014) identified just two reported manatee sightings in the Cape Fear River estuary above Snow's Cut (river mile 13); thus, indicating that manatee occurrences are rare in the vicinity of the proposed blasting areas (river mile 18 to river mile 22). Based on the use of stemmed charge confined blasting methods, the proposed watch program and other blast mitigation measures, and the apparent rarity of manatee occurrences in the vicinity of the blasting areas; it is determined that blasting under the proposed action may affect, but is not likely to adversely affect the Florida manatee.

5.3 Piping Plover and Red Knot

5.3.1 Status, Distribution, and Habitat

5.3.1.1 Piping Plover

The piping plover (*Charadrius melodus*) was listed as endangered and threatened under the ESA on 10 January 1986 (50 FR 50726 – 50734). The final listing rule recognized three

demographically independent populations that breed in three separate regions: the Atlantic Coast from NC to Canada, the Great Lakes watershed, and the Northern Great Plains region. Birds that breed along the Atlantic Coast are recognized as the subspecies *C. m. melodus*, while birds belonging to the interior Great Lakes and Northern Great Plains breeding populations are recognized as the subspecies *C. m. circumcinctus* (Miller et al. 2010). The piping plover is classified as endangered within the Great Lakes watershed and as threatened throughout the remainder of its breeding, migratory, and wintering range. The shared migratory and wintering range of the three breeding populations encompasses the Atlantic and Gulf Coasts from NC to northern Mexico, as well as the Bahamas and West Indies. Outside of their breeding range, birds belonging to the endangered Great Lakes breeding population are indistinguishable from those belonging to the threatened Great Plains and Atlantic coast populations; and consequently, all piping plovers are classified as threatened within their shared migratory and wintering range (USFWS 2009b). Critical habitat has been designated for the Great Lakes (66 FR 22938 22969) and Northern Great Plains (67 FR 57638 57717) breeding populations. Critical habitat has not been designated for the Atlantic Coast breeding population; however, critical habitat units for US wintering population have been designated along the Atlantic and Gulf coasts from NC to Texas (66 FR 36038 - 36143).

The 1996 revised Recovery Plan for the Atlantic Coast breeding population established a recovery goal of 2,000 breeding pairs maintained for five years and distributed among four recovery units (Eastern Canada, New England, New York-New Jersey, and Southern) (USFWS 1996a). The Southern Recovery Unit, encompassing NC, Virginia, Delaware, and Maryland; was assigned a subpopulation goal of 400 breeding pairs. Additional recovery criteria include a five-year average annual productivity rate of 1.5 fledged chicks per pair in each of the four recovery units, and the long-term maintenance of wintering habitat sufficient to maintain a breeding population of 2,000 breeding pairs. Annual Atlantic Coast population abundance estimates are reported as numbers of breeding pairs [i.e. adult pairs that exhibit sustained (>2 weeks) territorial or courtship behavior or are observed with nests or unfledged chicks] (USFWS 1996a). Since its listing, the overall Atlantic Coast population has increased by 137% from approximately 790 pairs in 1986 to an estimated 1,870 pairs in 2015 (Table 7). The estimated number of breeding pairs in the New York-New Jersey Unit, which includes the study area, experienced an increase of 98%.

Table 7. Net change in estimated Atlantic Coast breeding pairs 1986 to 2015.

Recovery Unit	Net Change Number Breeding Pairs	Percent Increase/Decrease
Eastern Canada	-61	-25%
New England	+734	+399%
New York – New Jersey	+203	+98%
Southern	+204	+129%
Overall Atlantic Coast Net Change	+1,080	+137%

Source: USFWS 2016

Although there is no exclusive partitioning of the wintering range based on breeding origin, band sightings indicate that Atlantic Coast breeding birds from Eastern Canada and the majority of the Great Lakes population winter along the southeast coast from NC to Southwest Florida (Gratto-Trevor et al. 2012). Banded Eastern Canada plovers are more heavily concentrated in NC, whereas a larger proportion of banded birds from the Great Lakes are found in South Carolina, Georgia, and Florida. Banded piping plovers from the Northern Great Plains population are concentrated farther west and south along the Gulf Coast, although a few banded individuals from Prairie Canada occur along the Atlantic Coast from NC to Florida. Of 57 piping plovers banded in the Bahamas in 2010, 79% have been reported breeding on the Atlantic Coast (USFWS 2012). Banding efforts on the Atlantic Coast breeding grounds have been less extensive; and consequently, the distribution of these birds during winter remains poorly understood.

5.3.1.2 Red Knot

The rufa red knot (*Calidris canutus rufa*) (hereinafter referred to as “red knot”) was listed as threatened under the ESA on 12 January 2015 (79 FR 73705 73748). The USFWS has not approved a recovery plan for the red knot, and no critical habitat has been designated for the species. Red knots migrate between breeding grounds in the central Canadian High Arctic and wintering areas that are widely distributed from the southeastern US coast to the southern tip of South America. Migration occurs primarily along the Atlantic coast, where red knots use key stopover and staging areas for feeding and resting. Departure from the Arctic breeding grounds occurs from mid-July through August, and the first southbound birds arrive at stopover sites along the US Atlantic coast in July. Numbers of southbound birds peak along the US Atlantic coast in mid-August; and by late September, most birds have departed for their wintering grounds. Major fall stopover sites along the US Atlantic coast include the coasts of Massachusetts and New Jersey and the mouth of the Altamaha River in Georgia. Principal wintering areas include the southeastern US Atlantic Coast from NC to Florida, the Gulf Coast from Florida to northern Mexico, the northern Atlantic coast of Brazil, and the island of Tierra del Fuego along the southern tip of South America. Smaller numbers of red knots also winter along the central and northeastern US Atlantic coast and in the Caribbean. The core southeastern US Atlantic wintering area is thought to shift from year to year between Florida, Georgia, and South Carolina (USFWS 2014). Although long term monitoring efforts in key migratory and wintering areas since the 1980s have shown sustained declines in red knot numbers on the order of 75%, population estimates for the southeastern US Atlantic Coast wintering population were approximately the same during the 1980s and 2000s (USFWS 2014). Recent evidence suggests that the southeast wintering population may number as high as 20,000 birds (USFWS 2014). Consistent aerial surveys of the Virginia coast since 1995 have produced stable counts during peak migration periods, and more recent ground surveys in Virginia suggest an upward trend since 2007.

Red knots typically arrive at southeastern US and Caribbean wintering sites in November, but may arrive as early as September. Birds wintering along the US Atlantic coast and in the Caribbean typically remain on their wintering grounds through March, and in some cases as late as May. Northbound birds from both North and South American wintering areas use stopover sites along the US mid-Atlantic coast from late April through late May/early June (USFWS 2014). Important spring stopover sites in the US include Delaware Bay and the Atlantic Coast

from Georgia to Virginia; however, small to large groups of northbound red knots may occur in suitable habitats along all of the Atlantic and Gulf Coast states. Unknown numbers of non-breeding red knots, many consisting of one-year-old subadult birds, remain south of the breeding grounds throughout the year (USFWS 2014). Migrating and wintering red knots use similar habitats, generally expansive intertidal sand and mud flats for foraging and sparsely vegetated supratidal sand flats and beaches for roosting. The red knot is a specialized molluscivore, feeding on hard-shelled mollusks that are swallowed whole and crushed in the gizzard. The diet is sometimes supplemented with softer invertebrate prey such as shrimp- and crab-like organisms, marine worms, and horseshoe crab eggs. Both high-energy oceanfront intertidal beaches and sheltered estuarine intertidal flats are used for foraging. Preferred habitats include sand spits and emergent shoals associated with tidal inlets, and habitats associated with the mouths of bays and estuarine rivers. Access to quality high-tide roosting habitat in close proximity to foraging areas is an important constituent of high quality stopover and wintering sites (USFWS 2014).


5.3.2 Occurrence in the Action Area

5.3.2.1 Piping Plover

The breeding, migratory, and wintering ranges of the piping plover overlap in NC; and consequently, piping plovers can be found in the state during every month of the year (Cameron et al. 2006). Breeding and nesting sites in NC are principally confined to undeveloped and unstabilized barrier islands along the northern section of the coast, mostly within the Cape Lookout National Seashore, Cape Hatteras National Seashore, Pea Island National Wildlife Refuge, and on Lea and Hutaff Islands (USFWS 2009b, Dinsmore et al. 1998). The accreting south end of Topsail Island along New Topsail Inlet is the only site associated with a developed island that supports any notable breeding activity in NC. Since 2000, all other developed islands in NC combined have accounted for just four breeding pair observations. Breeding pair observations in the Cape Fear region from 2000-2017 include just two pairs at Fort Fisher; one each during 2002 and 2005.

The largest numbers of non-breeding plovers have been observed in NC during the fall migration period, with peak numbers occurring during August and September. Observations decline sharply during the months of October and November; and by December, the relatively small numbers of plovers that remain in NC are presumed to be winter residents (Cohen 2005). Spring migrants begin to arrive along the NC coast in late February, with numbers peaking in late March. Migrating and wintering plovers are highly concentrated on inlet shoals and the adjoining inlet-influenced ends of the barrier islands. Habitat use patterns are characterized by movements between different inlet complex habitats, with some sites being used exclusively for foraging while others are used for roosting (Cameron et al. 2006). Migrating piping plovers use stopover sites at essentially all of the inlets along the NC coast (Cameron et al. 2006). Data from the International Piping Plover Winter Census indicate that wintering plovers along the southern NC coast are highly concentrated at the Lea-Hutaff/New Topsail Inlet/South Topsail complex and the Bear Island/Bogue Inlet complex (Table 8). International Piping Plover Winter Census wintering plover observations in the vicinity of the action area have been relatively sparse. Piping plovers in NC are very rarely seen on developed ocean facing beaches, and these areas are not considered to be suitable habitat (Cameron 2009). Designated critical habitat units in the

Table 8. International piping plover winter census data.

Site Name	1991	1996	2001	2006	2011	2016	Total
Cape Hatteras National Seashore			18	15	10	16	59
Cape Lookout National Seashore			46	17	15	35	113
Rachael Carson Estuarine Reserve			0	18	3	7	28
Regional Subtotal			64	50	28	58	1200
Bogue Inlet/Bear Island			9	9	2	10	30
Onslow Beach			0	0	0	-	0
New River Inlet/North Topsail			0	0	1	0	1
New Topsail Inlet/South Topsail/Lea-Hutaff			0	13	11	11	35
Rich Inlet/Lea-Hutaff			11	2	0	8	21
Masonboro Inlet/Masonboro Island			2	3	0	8	13
Bald Head to Fort Fisher			1	3	0	0	4
Ocean Isle			0	4	1	0	5
Regional Subtotal			23	34	15	43	7109
STATEWIDE TOTAL	20	50	87	84	43	101	214
 Site-specific data not available							

Source: [North Carolina Wildlife Resources Commission (NCWRC) 2016 Winter Census]

vicinity of the action area are located along Carolina Beach (NC-14), at Fort Fisher (NC-15), and at Lockwoods Folly Inlet on the west end of Oak Island (NC-16) (Figure 7).

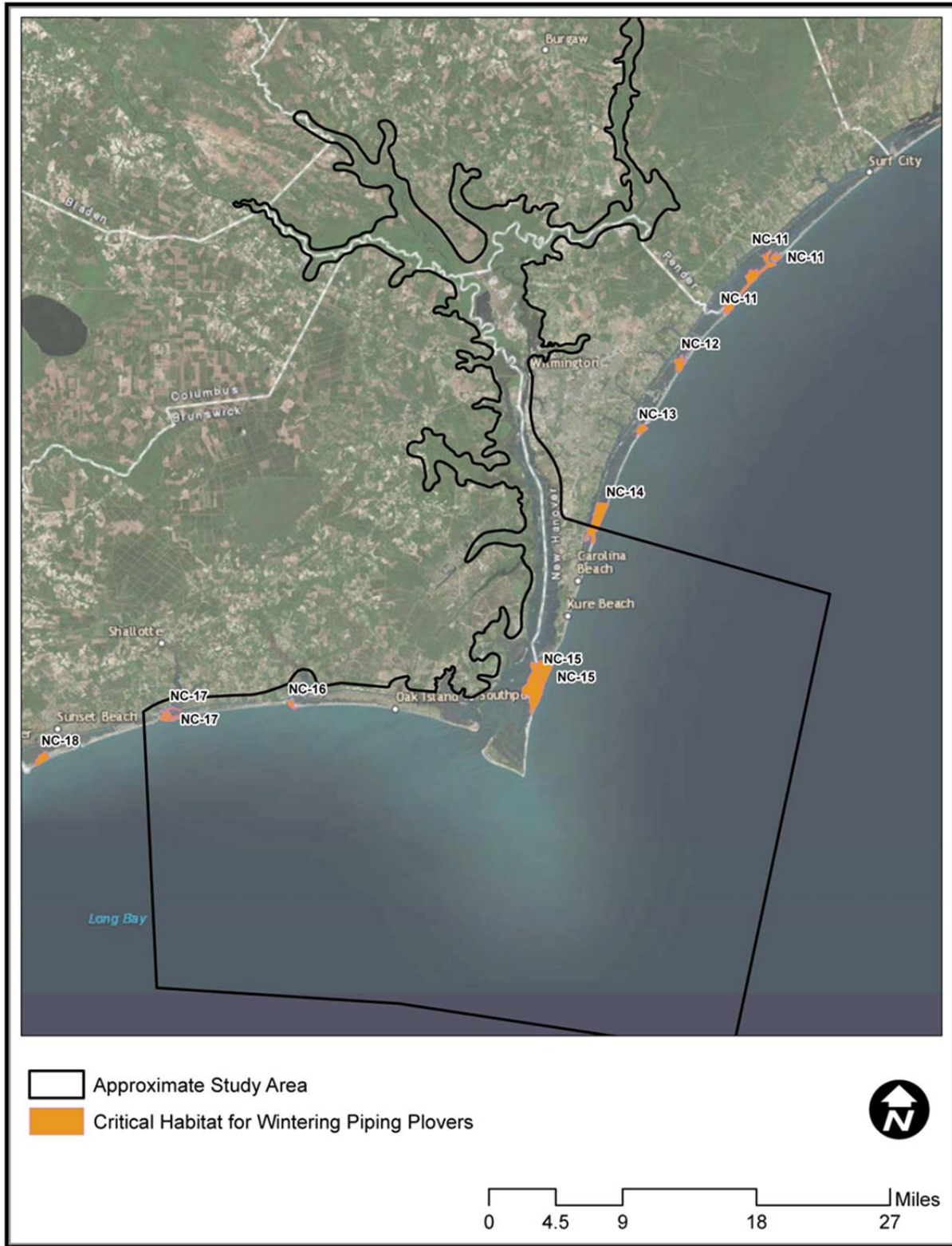


Figure 7. Critical Habitat for Wintering Piper Plovers in the Action Area

5.3.2.2 Red Knot

Red knots have been observed in NC during all seasons (Dinsmore et al. 1998); however, they are most common in NC during spring and fall migration periods (mid-April through May and July to mid-October) (Personal communication, K. Matthews, USFWS 28 August 2014). Red knots appear to be most abundant in May during the spring migration (Personal communication, S. Schweitzer, NCWRC 17 October 2014). The largest numbers of red knots are observed along the NC coast during spring migration from mid-April to early June. Numbers of northbound birds generally peak during the first two weeks of May, and most spring migrants depart NC by mid-June. A small number of red knots consisting primarily of non-breeding subadults remain in NC throughout the summer [National Park Society (NPS) 2014a, Dinsmore et al. 1998]. A smaller secondary peak occurs during late July and August as southbound migrants move along the NC coast. Numbers decline rapidly after the end of August; and by the end of September, most red knots have departed NC for their wintering grounds. Small numbers red knots winter along the NC coast, and these birds are present throughout the late fall and winter months. Systematic survey efforts have been relatively limited along the southern NC coast; and consequently, patterns of red knot distribution and abundance along some portions of the southern coast remain poorly understood. Systematic surveys along the southern NC coast have primarily been limited to annual coordinated aerial surveys, which are conducted from 20-24 May during the peak spring migration period. The aerial survey data suggest that the west end of Bogue Banks (Emerald Isle), Lea-Hutaff Island, Figure Eight Island, Masonboro Island, and Bald Head Island are important stopover sites for northbound red knots during the spring; however, the data also indicate that red knots make wide use of habitats along many of the southern region barrier islands, including habitats associated with both developed and undeveloped islands (Table 9) (NCWRC 2015). The aerial surveys have recorded red knots along all of the action area ocean beaches from Carolina Beach Inlet to Lockwoods Folly Inlet.

Table 9. Red knot aerial survey data for the southern NC coast 2006-2012.

Location	Number of Red Knot Observations						
	2006	2007	2008	2009	2010	2011	2012
Bogue Banks			24	345	0	37	33
Bear Island		0		34		0	25
Onslow Beach				336			
North Topsail Overwash					42	8	16
New Topsail Inlet					0	0	0
Lea-Hutaff Island	38	0	34	68	26	7	34
Rich Inlet				40	0		
Figure Eight Island	2	85		64	9	0	54
Mason Inlet			57		0		
Wrightsville Beach	6	0	1	72	5	0	0
Masonboro Island	111	30	1	27	15	22	58
Carolina Beach Inlet			36	11			
Carolina Beach		0	14		0		
Fort Fisher				81	4	20	8
Bald Head Island	78	67		21	5	26	40
Battery Island South			0		0		
Oak Island			0		0	22	0
Lockwoods Folly Inlet		0	25	18			
Holden Beach					0	15	56
Ocean Isle Beach					0	23	112
Tubbs Inlet		0		11			
Sunset Beach				0	0	35	75
Bird Shoal (Rachael Carson)		40		0			
Total	235	222	192	1128	106	215	511

Source: NCWRC 2015

5.3.3 Threats

The primary threat to piping plovers and red knots is the loss and degradation of habitat; primarily due to anthropogenic activities such as inlet relocation and stabilization, beach nourishment, sand mining, and the construction of groins, seawalls, and revetments (USFWS 2009b). Sand placement and grading may eliminate important microhabitat elements such as wrack lines, tidal pools, and isolated clumps of vegetation; thereby temporarily reducing the quality of piping plover and red knot foraging and roosting habitats. Direct losses of intertidal benthic invertebrates within sand placement areas via direct burial may temporarily reduce benthic invertebrate prey resources for piping plovers and red knots. Inlet relocation and stabilization projects may alter natural hydrodynamic and sediment transport processes that maintain optimal habitat conditions for piping plovers and red knots. Additional threats include human disturbance and introductions of predators and non-native invasive plants (USFWS 2009b). Human disturbance associated with vehicular and pedestrian recreational activities is a

severe threat to the Atlantic Coast breeding population of piping plovers. Predation or harassment by free-roaming domestic and feral cats, domestic dogs, foxes, raccoons, and skunks may result in the loss of adults, eggs, and chicks. Invasive species such as beach vitex (*Vitex rotundifolia*) may out-compete native plant species and form dense colonies that reduce the availability of sparsely vegetated supratidal habitat.

5.3.4 Project Effects

5.3.4.1 Beach Placement

Piping plover breeding activity has not been documented in the vicinity of the proposed beach placement areas; therefore, no effects on nesting or breeding activity would be expected. Beach placement of dredged material on Bald Head Island and Oak Island would occur within and/or adjacent to potential foraging and roosting habitats for piping plovers and red knots. Beach placement operations may disrupt the foraging and/or roosting activities of migratory and wintering piping plovers and red knots; however, disturbance would be temporary and confined to a relatively short section of the beach at any given point during the beach construction process. Beach placement would result in the temporary loss of intertidal benthic invertebrate infauna within the beach fill templates, thereby reducing the availability of potential benthic prey for piping plovers and red knots. However, most benthic recovery studies have reported rapid recovery within one year of the initial impact when highly compatible beach fill sediments were used and larval recruitment periods were avoided (Jutte et al. 1999a, Burlas et al. 2001, Van Dolah et al. 1994, Van Dolah et al. 1992, Gorzelany and Nelson 1987, Salomon and Naughton 1984, Parr et al. 1978, and Hayden and Dolan 1974). Peak benthic invertebrate recruitment periods in NC [May to September (Hackney et al. 1996, Diaz 1980, and Reilly and Bellis 1978)] would be avoided through adherence to a 16 November to 30 April beach placement window. Additionally, only compatible beach fill material that is similar in grain size composition and color to the native beach sediments would be placed on the beach. It is expected that these measures would minimize the extent and duration of effects on habitat and benthic prey resources. Therefore, it is expected that the effects of beach placement on piping plovers and red knots would be short-term and localized.

5.3.4.2 Dredging

Dredging would not have any direct impacts on piping plover or red knot habitats, as there are no intertidal or supratidal habitats within that proposed channel deepening footprint. The potential indirect effects of channel deepening on hydrodynamics and shoreline change were evaluated through numerical modeling. The GenCade shoreline change and sand transport model was used to simulate deepening effects on sediment transport and shoreline erosion rates along Bald Head Island and Oak Island. GenCade was used to simulate shoreline changes over a 14-year period using input wave conditions derived from DELFT 3D wave transformation modeling results. On Bald Head Island, the GenCade model results indicate that channel deepening would have minor adverse effects on the central South Beach shoreline and minor beneficial effects on the western South Beach shoreline in relation to future without project conditions (FWOP). The model results indicate that erosion rates would increase slightly along the central South Beach shoreline from Stations 92+15 to 170+02, with the largest relative increase of ~0.6 ft/year occurring between Stations 118+2 and 129+98. The model results indicate that erosion rates would decrease by an average of ~1.3 ft/year along the westernmost ~1,200-ft shoreline reach adjacent

to Cape Fear River Inlet. Westerly longshore sediment transport rates along the western half of the South Beach shoreline are projected to increase by 3,800 cy/year or less in relation to FWOP. In the case of Oak Island, the model results indicate that deepening would have negligible effects on the shoreline in relation to FWOP, with projected erosion rate increases of <0.1 ft/year along most of the island and ~0.2 ft/year along the east end of Caswell Beach. Model-projected changes in sediment transport along Oak Island are negligible. The model results indicate that deepening would have minimal effects on potential piping plover and red knot habitats in the vicinity of Cape Fear River Inlet.

5.3.4.3 Effects on Wintering Critical Habitat for Piping Plovers

There are no designated piping plover wintering critical habitat units within or adjacent to the proposed placement areas on eastern Oak Island and the South Beach of Bald Head Island. The nearest critical habitat areas are located at Lockwoods Folly Inlet, approximately nine miles west of the Oak Island placement area and along the east-facing ocean beach of the Fort Fisher State Recreation Area, approximately four miles north of Cape Fear. Intertidal flats along the eastern Cape Fear River shoreline that comprise part of the Fort Fisher wintering critical habitat unit are located approximately one mile east of the proposed channel deepening footprint. The DELFT 3D hydrodynamic model results indicate that the effects of deepening on current velocities and sediment transport are negligible outside of the proposed navigation channel footprint. Therefore, channel deepening and beach placement would not be expected to have any effects on wintering critical habitat for the piping plover.

5.3.5 Conservation Measures

5.3.5.1 Environmental Windows

The proposed action would adhere to a 16 November to 30 April beach placement window. Adherence to this placement window would avoid the majority of the piping plover breeding season, the peak red knot migration period in NC (May), and peak benthic invertebrate recruitment periods in NC.

5.3.5.2 Sediment Compatibility

Only compatible beach fill material that is similar in grain size composition and color to the native beach sediments would be placed on the beach. The use of compatible material would provide for rapid recovery of intertidal benthic infauna, thereby minimizing the extent and duration of beach placement effects on the infaunal prey base for piping plovers and red knots.

5.3.6 Determination of Effect

5.3.6.1 Piping Plover and Red Knot

Based on the proposed measures to minimize disturbance and effects on benthic infaunal prey resources, including the proposed 16 November to 30 April beach placement window and the use of compatible beach fill, it is determined that the proposed action may affect, but is not likely to adversely affect the piping plover and red knot.

5.3.6.2 Piping Plover Critical Habitat

Based on the absence of critical habitat in the vicinity of the Cape Fear River Inlet and the proposed beach placement areas and the distance between the Fort Fisher critical habitat unit and the proposed channel (~1 mile), it is determined that the proposed action would have no effect on wintering critical habitat for the piping plover.

5.4 Wood Stork

5.4.1 Status, Distribution, and Habitat

The wood stork (*Mycteria americana*) US breeding population was initially listed under the ESA as threatened in 1984 (49 FR 7332). In 2014, the ESA status of the US wood stork breeding population was revised from endangered to threatened (79 FR 37078). The 2014 listing rule also designated the US breeding population as a Distinct Population Segment (DPS). Wood storks comprise a mosaic of breeding populations in North, Central, and South America, and the Caribbean. The current US breeding range encompasses peninsular Florida and the coastal regions of Georgia, South Carolina, and southeastern NC. The US breeding population has been increasing and expanding northward. The three-year annual nesting averages for Florida, Georgia, South Carolina, and NC have exceeded 6,000 nests since 2003, and the average annual nest total for 2011-2013 was 9,692 nests (79 FR 37078). Wood storks from northern Florida to southeastern NC lay eggs between March and late May, with fledging occurring in July and August (79 FR 37078). Post-breeding wood storks depart the colony sites and disperse widely throughout the Coastal Plain of the southeastern US, but many remain in NC through the early fall before migrating to Florida to spend the winter. Twin Lakes at Sunset Beach in Brunswick County is an important post-breeding site where numerous wood storks congregate each year. Wood storks use a wide variety of freshwater and estuarine wetlands for nesting, foraging, and roosting. Nesting colonies are primarily established in cypress swamps, but other freshwater to estuarine forested habitats are also used; including mangroves, black gum, willow, and buttonbush (Coulter et al. 1999). Wood storks tend to use the same colony site over many years as long as the site remains undisturbed and there is sufficient feeding habitat in the surrounding area (USFWS 1997). Foraging habitat consists of natural and artificial wetlands with suitable prey and appropriate water depths (<50 centimeters) (Coulter et al. 1999). Wood storks also forage in man-made wetlands such as storm water treatment areas, golf course ponds, borrow pits, reservoirs, agricultural ditches, and dredge spoil sites (USFWS 2007). Roosting sites are generally in trees over water, but storks may also rest on the ground near feeding sites (Coulter et al. 1999).

5.4.2 Occurrence in the Action Area

The first NC nesting colony, consisting of 32 pairs, was discovered at Lays Lake in Columbus County in 2005 (USFWS 2007). Three additional breeding colonies have since been discovered at Mill Branch Swamp in Columbus County, Steep Run along the Cape Fear River in Bladen County, and Warwick Mill Bay in Robeson County. There are no known breeding colonies within the action area. The Steep Run colony is located along the southwest side of the Cape Fear River approximately four miles upriver of Lock and Dam #1. Annual nesting pair totals in NC increased from 32 pairs in 2005 to nearly 600 pairs in 2016 (Schweitzer 2016). Wood storks may use various wetland habitats in the action area for foraging, especially during the post-breeding season when they disperse widely throughout the Coastal Plain.

5.4.3 Threats

Wood storks are primarily threatened by the loss and degradation of wetland habitats. Habitat losses affecting the wood stork are primarily attributed to anthropogenic causes, including coastal development and water management activities that have eliminated optimal foraging habitats (USFWS 2007).

5.4.4 Project Effects

No nesting colonies are known from the action area, and no potential nesting or foraging habitat would be directly affected under the proposed action. Indirect salinity effects on potential wetland habitats are anticipated to be minor. As described in Appendix F (Main Report, Wetlands Impact Analysis), the model-projected effects of the proposed action on surface salinities are limited to increases of 0.3 parts per thousand (ppt) or less at the upper ends of existing salinity gradients where any effects on wetlands would be expected to occur. Although the projected salinity increases could have minor effects on the composition of tidal freshwater marsh and swamp forest communities, conversions of tidal swamp forest to tidal marsh would not be expected. Therefore, the proposed action would not be expected to have any adverse effects on the wood stork.

5.4.5 Determination of Effect

Based on the absence of breeding colonies in the action area, and considering that the proposed action would not be expected to have any direct or indirect impacts on potential nesting or foraging habitats, it is determined that the proposed action would have no effect on the wood stork.

5.5 Sea Turtles

5.5.1 Status, Distribution, and Habitat

5.5.1.1 Loggerhead Sea Turtle

The loggerhead sea turtle (*Caretta caretta*) was initially listed under the ESA as threatened throughout its range on 28 July 1978 (43 FR 32800). In 2011, the loggerhead's ESA status was revised to threatened and endangered based on the recognition of nine DPSs. Distinct population segments encompassing populations in the Northwest Atlantic Ocean, South Atlantic Ocean, Southwest Indian Ocean, and Southeast Indo-Pacific Ocean were reclassified as threatened; while the remaining five populations in the Northeast Atlantic Ocean, Mediterranean Sea, North Pacific Ocean, South Pacific Ocean, and North Indian Ocean were reclassified as endangered. Nesting in the US occurs along the Atlantic and Gulf coasts from southern Virginia to Texas, but is concentrated from NC through Alabama (NMFS and USFWS 2008). Nesting populations along the southeastern US coast from southern Virginia to the Florida-Georgia border comprise the Northern Recovery Unit, one of five designated recovery units within the Northwest Atlantic DPS (USFWS 2009). Nesting in the Northern Recovery Unit had been declining at an annual rate of 1.3% through 2007; however, nesting has increased substantially since 2008, with the three highest annual nest totals on record occurring in 2012, 2013, and 2015. Similar nesting increases throughout the Northwest Atlantic DPS since 2007 indicate that the population may be stabilizing (USFWS 2015b). A total of 38 terrestrial critical habitat units encompassing ~245

miles of nesting beaches have been designated within the Northern Recovery Unit; including eight units (~96 miles) in NC, 22 units (~79 miles) in South Carolina, and eight units (~69 miles) in Georgia (79 FR 39756). Nesting in these 38 units comprises approximately 86% of all loggerhead nesting within the Northern Recovery Unit.

Adult female loggerheads return to their natal region to nest, and show a high degree of site fidelity to the nesting beach selected during their initial reproductive season, typically nesting during subsequent years within zero to three miles of the initial nesting site (Miller et al. 2003). A variety of different substrates and beach slopes are used for nesting, but loggerheads appear to prefer relatively narrow, steeply sloped, coarse-grained beaches (Provancha and Ehrhart 1987). Slope has been found to have more influence on nest-site selection than temperature, moisture, and salinity; and nest sites along a given beach are typically located on the steepest slopes, which generally correspond to the highest elevations on the beach (Wood and Bjorndal 2000). Loggerheads require deep, clean, relatively loose sand above the high-tide line for successful nest construction (Hendrickson 1982). Embryonic development requires a high-humidity substrate with sufficient gas exchange (Mortimer 1990, Miller 1997, and Miller et al. 2003). The gender of hatchlings is determined by prevailing sand temperatures during the middle of the incubation period (Mrosovsky and Yntema 1980, Yntema and Mrosovsky 1982). The pivotal incubation temperature that produces equal numbers of males and females is approximately 29.0°C (84.2°F) (Limpus et al. 1983, Mrosovsky 1988, and Marcovaldi et al. 1997). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings, while temperatures near the lower end of the range produce only males. Loggerhead hatchlings pip (break through the egg shell) and escape from their eggs over a period of one to three days, and move upward and out of the nest over a period of two to four days (Christens 1990). The time from pipping to emergence averages 4.1 days, but can be as long as seven days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and initial emergences are sometimes followed by secondary emergence events on subsequent nights (Carr and Ogren 1960, Witherington 1986, Ernest and Martin 1993, and Houghton and Hays 2001). Hatchlings use light cues to guide their movement from the nest to the surf zone, relying on the contrast between the relatively bright ocean horizon and the relatively dark dune line (Daniel and Smith 1947, Limpus 1971, Salmon et al. 1992, Witherington and Martin 2003, and Witherington 1997).

5.5.1.2 Green Sea Turtle

The green sea turtle (*Chelonia mydas*) was initially listed as endangered and threatened under the ESA on 28 July 1978 (43 FR 32800). Breeding populations in Florida and along the Mexican Pacific Coast were listed as endangered, while all other populations throughout the species' range were listed as threatened. In 2011, the green sea turtle's ESA status was revised to threatened and endangered based on the recognition of eight DPSs (81 FR 20057). All green sea turtles in the North Atlantic were listed as threatened under the North Atlantic Ocean DPS. Nesting in the US is primarily limited to Florida, although nesting occurs in small numbers along the southeast coast from Georgia to NC and the Gulf Coast of Texas. Nesting turtles appear to prefer high wave energy barrier island beaches with coarse sands, steep slopes, and prominent foredunes; with the highest nesting densities occurring on sparsely developed beaches that have minimal levels of artificial lighting (Witherington et al. 2006). Nesting in Florida has increased exponentially over the last 20 years, with record highs of 36,195 and 37,341 nests recorded in

2013 and 2015, respectively [Florida Fish and Wildlife Conservation Commission (FWC)/Fish and Wildlife Research Institute (FWRI) 2016]. No critical habitat has been designated in the continental US. In US waters, green sea turtles are distributed along the Atlantic and Gulf Coasts from Massachusetts to Texas (NMFS and USFWS 2007a). Post-hatchlings migrate to oceanic waters and begin an oceanic juvenile phase of development. Oceanic phase juveniles appear to move with the predominant ocean gyres for several years before returning to neritic waters where juvenile development continues to adulthood. Neritic phase juveniles inhabit shallow estuarine waters and nearshore continental shelf waters that are rich in seagrasses and/or marine macroalgae. Adults generally remain in relatively shallow foraging habitats with abundant seagrasses and macroalgae, but may enter the oceanic zone when migrating between foraging grounds and nesting beaches. No critical habitat has been designated in the continental US.

5.5.1.3 Leatherback Sea Turtle

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on 2 June 1970 (35 FR 8491). The leatherback has a circumglobal oceanic distribution that extends north and south into sub-polar regions. Leatherbacks undertake extensive migrations between northern foraging grounds and tropical and subtropical nesting beaches (NMFS and USFWS 2007e). During the summer and fall, the highest densities of adult and subadult leatherbacks in the North Atlantic are found in Canadian waters (James et al. 2005). Little is known of the distribution and developmental habitat requirements of leatherbacks from hatchling to adulthood (NMFS and USFWS 2013). Nesting in the US is primarily restricted to Florida, Puerto Rico, and the US Virgin Islands; but nesting occurs in small numbers along the Gulf Coast of Texas and the southeastern US Atlantic Coast from Georgia to NC. The 1992 Recovery Plan for the US Caribbean, Atlantic, and Gulf of Mexico populations established recovery criteria for the assemblage of nesting populations in Florida, Puerto Rico, and the US Virgin Islands; including an increasing adult female population over 25 years and the protection of nesting beaches encompassing at least 75% of all nesting activity (NMFS and USFWS 1992). Nesting in Florida has increased substantially over the last 20 years, with record and near-record highs of 1,747 and 1,712 nests recorded in 2009 and 2012, respectively.

5.5.1.4 Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle (*Lepidochelys kempii*) was listed as endangered throughout its range on 2 December 1970 (35 FR 18320). Kemp's ridley sea turtles occur primarily in coastal waters of the Gulf of Mexico and the western North Atlantic Ocean. Data indicate that adults utilize coastal habitats of the Gulf of Mexico and the southeastern US. Adults inhabit nearshore waters and are commonly found over crab-rich sandy or muddy bottoms (NMFS and USFWS 2007c). Nesting is primarily restricted to coastal beaches along the Mexican states of Tamaulipas and Veracruz, although a small number of turtles nest consistently along the Texas coast (Turtle Expert Working Group (TEWG) 1998). Rare nesting events have also occurred along the coasts of NC, South Carolina, Georgia, Florida, and Alabama. A total of 80 Kemp's ridley nests were documented in Florida from 1979 to 2013 (FWC/FWRI 2016). Hatchlings migrate to the oceanic zone where they are carried by currents into various areas of the Gulf of Mexico and the North Atlantic Ocean. At approximately two years of age, juveniles leave the oceanic zone and move to coastal benthic habitats in the Gulf of Mexico and the Atlantic Ocean along the eastern US. During this stage, juveniles occupy protected coastal waters such as bays,

estuaries, and nearshore waters that are less than 165 ft deep. Juveniles utilize a wide range of bottom substrates but apparently depend on an abundance of crabs and other invertebrates (NMFS and USFWS 2007c). No critical habitat has been designated for the Kemp's ridley sea turtle.

5.5.1.5 Hawksbill Sea Turtle

The hawksbill sea turtle (*Eretmochelys imbricate*) was listed as endangered throughout its range on 2 June 1970 (35 FR 8491). Hawksbill sea turtles are globally distributed in tropical and to a lesser extent subtropical waters of the Atlantic, Indian, and Pacific Oceans. Nesting occurs on sandy beaches throughout the tropical and subtropical regions of the Atlantic, Pacific, and Indian Oceans. Nesting in the US is primarily limited to Florida and the US Caribbean (NMFS and USFWS 1993). Rare nesting events in the continental US are essentially restricted to the southeastern coast of Florida and the Florida Keys (Meylan 1992, Meylan et al. 1995), although two hawksbill nests were recently confirmed in NC (NPS 2015). A total of 46 hawksbill nests were documented in Florida from 1979-2013 (FWC/FWRI 2016). Although documented nesting in the continental US is extremely rare, hawksbill tracks are difficult to differentiate from those of the loggerhead and may not be recognized by surveyors. Therefore, surveys in Florida likely underestimate actual hawksbill nesting numbers (Meylan et al. 1995). In US waters, hawksbills have been reported along the Atlantic and Gulf Coasts from Massachusetts through Texas; however, sightings north of Florida are rare. Hawksbills are commonly observed in the Florida Keys and on reefs off the coast of Palm Beach County, Florida. Texas is the only other state where sightings occur with any regularity. Hatchlings are carried by currents to the oceanic zone where they reside in major ocean gyres. Juveniles eventually depart the oceanic zone and move to nearshore habitats. Juveniles and adults are primarily associated with coral reef habitats; but may use other habitats such as hardbottoms, seagrass beds, algal beds, mangrove bays and creeks, and mud flats. Adults undertake extensive migrations between foraging grounds and nesting beaches (NMFS and USFWS 2007d).

5.5.2 Occurrence in the Action Area

5.5.2.1 Nesting

Loggerhead nesting occurs along the entire NC coast, but is concentrated along three sections of the coast; including the Cape Fear region from Holden Beach to Fort Fisher, Topsail Island, and Onslow Beach, and the barriers that comprise Cape Lookout National Seashore (CALO) and Cape Hatteras National Seashore (CAHA). Collectively, these three sections of the coast accounted for 83% of all loggerhead nesting in NC from 2000-2016. Nesting in NC is typically restricted to the period of 1 May to 15 September. Relatively few nests are recorded during the first three weeks of May, but nesting increases rapidly from late May onward, peaking from mid-June through the end of July. Nesting declines abruptly after July, and few nests are recorded after the third week of August. The Cape Fear region from Holden Beach to Fort Fisher supports the highest concentration of loggerhead nesting in NC, accounting for 30% of all loggerhead nests recorded in the state from 2000-2016. The average annual nest density for the region was 7.5 nests per mile from 2000-2016. A total of 1,196 loggerhead nests were recorded on Bald Head Island from 2000-2016, while 1,958 nests were recorded on Caswell Beach/Oak Island (Table 10). Annual nesting from 2000-2016 averaged 70 nests per year on Bald Head and 115 nests per year on Caswell Beach/Oak Island.

Table 10. Cape Fear region sea turtle nests 2000-2016.

Shoreline Reach	Loggerhead	Green	Leatherback	Kemp's Ridley
Fort Fisher	516	4	0	1
Bald Head Island	1196	25	1	0
Caswell Beach	850	0	0	0
Oak Island	1108	3	0	0
Holden Beach	608	2	1	0
Total	4278	34	2	1

Source: NCWRC 2015, Seaturtle.org 2017

Green sea turtles nest in relatively small numbers along the NC coast, with reported nesting from 2000-2016 averaging 18 nests per year. Annual NC nest totals from 2000-2012 ranged from four to 26 nests. Nesting has increased since 2012, with the two highest nest totals on record occurring during 2013 (n=39) and 2015 (n=38). An average of 27 nests per year were recorded in NC from 2013-2018. Green sea turtle nesting is concentrated along the barrier islands of CALO and CAHA. Along the southern NC coast, areas supporting consistent nesting in small numbers include Bald Head Island, Topsail Island, and Onslow Beach. Nesting along the remainder of the NC coast has generally occurred sporadically in very small numbers. NC nesting data show a peak in nesting activity from the last week of June through the third week of August, with 79% of all nesting occurring during this period. A total of 25 green sea turtle nests were recorded on Bald Head Island from 2000-2016. Additional nests that were recorded in the action area from 2000-2016 include four nests at Fort Fisher, three nests on Oak Island, and two nests on Holden Beach (Table 10).

Leatherback nesting is rare in NC, with just 33 nests reported from 2000 through 2016. Nesting records span the entire NC coast, but are heavily concentrated along the northern barrier islands of CALO and CAHA. Leatherback nesting in the southern region from 2000-2016 was limited to two nests along Bogue Banks and one nest each along Carolina Beach, Bald Head Island, and Holden Beach. Reported leatherback nest establishment dates in NC range from 16 April to 30 July. Kemp's ridley nesting is extremely rare in NC, with just 12 nests reported during the period of 2000-2016. Of the 12 nests, eight were reported from the northern Outer Banks. Reported Kemp's ridley nesting in the action area is limited to one nest at Fort Fisher in 2015. Reported nest establishment dates for the Kemp's ridley in NC range from 25 May to 23 June. Hawksbill nesting records for NC are limited to two nests that were identified at CAHA in 2015 through DNA testing (NPS 2015). However, the similarity of hawksbill tracks to those of the loggerhead suggests that some hawksbill nesting may go undetected along the southeastern US coast (USFWS 2015b, Meylan et al. 1995).

5.5.2.2 Spatial and Temporal Distribution of Non-Breeding Sea Turtles

North Carolina's sounds and estuaries provide important developmental and foraging habitats for post-pelagic juvenile loggerhead, green, and Kemp's ridley sea turtles. Most of the information regarding the inshore distribution of sea turtles in NC has been generated by studies in the Pamlico-Albemarle estuarine complex, where large numbers of loggerhead, green, and Kemp's ridley sea turtles are incidentally captured annually by commercial fishing operations. All three species are represented primarily by juveniles, with few reported captures of older juveniles and adults (Epperly et al. 2007). All three species move inshore during the spring and disperse throughout the sounds during the summer. All three species leave the sounds and move offshore during the late fall and early winter. Epperly et al. (1995a) reported the presence of sea turtles in back-barrier estuaries along the NC coast from April through December. Goodman et al. (2007) reported the presence of sea turtles in Core and Pamlico Sounds and the nearshore (≤ 1 mile) ocean waters of Raleigh Bay from April through November. Juvenile loggerhead, green, and Kemp's ridley sea turtles utilize the lower Cape Fear River estuary during the warmer months. Sea turtles have been observed in the Cape Fear River estuary as far upstream as river mile 15 (NMFS 1996). Although there are no published data on the distribution and movements of juvenile sea turtles in the Cape Fear River estuary, during a tracking study of 18 gill netted green and Kemp's ridley juveniles in the lower estuary, only one individual (a presumed mortality) moved north of Snows Cut (Snoddy and Williard 2010).

Several studies have reported a strong relationship between sea turtle distribution and sea surface temperature. Goodman et al. (2007) conducted aerial sea turtle surveys and sea surface temperature monitoring in Core Sound, Pamlico Sound, and adjacent nearshore ocean waters within 1 mile of shore from July 2004 to April 2006. All but one of the 92 sea turtle observations occurred in waters where sea surface temperatures were above 11°C. All sightings in the sounds occurred between 16 April and 20 November, and all sightings in the nearshore ocean occurred between 23 April and 27 November. The winter distribution of sea turtles offshore of Cape Hatteras was also correlated with sea surface temperatures above 11°C (Epperly et al. 1995c). In a similar study by Coles and Musick (2000), sea turtle distribution offshore of Cape Hatteras (from shore to edge of Gulf Stream) was restricted to sea surface temperatures $\geq 13.3^\circ\text{C}$.

The leatherback sea turtle is primarily a pelagic species preferring deep, offshore waters. Leatherbacks may be present in nearshore ocean waters during certain times of the year; however, they rarely enter estuarine waters. Epperly (1995b) reported the appearance of significant numbers of leatherback turtles in nearshore ocean waters during May, coincident with the appearance of jellyfish prey. Sightings declined sharply after four weeks and only a few sightings were reported after late June. Leatherbacks were infrequently observed in estuarine waters during this period. The surveys conducted by Goodman et al. (2007) recorded only one leatherback observation, during the summer in the nearshore ocean south of Cape Hatteras. Epperly et al. (1995a) reported the occurrence of three leatherbacks in Core and Pamlico Sounds during December 1989. Hawksbill sea turtles are rare in NC waters, and they rarely enter estuarine waters (Epperly et al. 1995a). A total of nine hawksbill stranding incidents were reported along NC beaches between 1998 and 2009 (Seaturtle.org 2011). Strandings were reported during the months of January, March, April, and November. Epperly et al. (1995b) reported the incidental capture of one hawksbill in Pamlico Sound.

5.5.2.3 Loggerhead Critical Habitat

In the action area, all of the ocean-facing barrier island beaches from Carolina Beach Inlet to Shallotte Inlet are encompassed by four loggerhead terrestrial critical habitat units; including Pleasure Island/Fort Fisher (LOGG-T-NC-05), Bald Head Island (LOGG-T-NC-05), Oak Island (LOGG-T-NC-05), and Holden Beach (LOGG-T-NC-05) (Figure 8). Terrestrial critical habitat units encompass the dry ocean beach from the Mean High Water line landward to the toe of the secondary dune or the first developed structure. The units represent beaches that are capable of supporting a high density of nests or those that are potential expansion areas for beaches with high nest densities. Critical nesting habitat primary constituent elements include unimpeded ocean-to-beach access for adult females and unimpeded nest-to-ocean access for hatchlings, substrates that are suitable for nest construction and embryonic development, a sufficiently dark nighttime environment to ensure that adult females are not deterred from nesting and that hatchlings are not disoriented and delayed or prevented from reaching the ocean, and natural coastal processes that maintain suitable nesting habitat or artificially maintained habitats that mimic those associated with natural processes (79 FR 39756).

All nearshore ocean waters from the Mean High Water line out to 1.6 km along the designated terrestrial units are encompassed by a single nearshore reproductive critical habitat unit (LOGG-N-05) that extends continuously from Carolina Beach Inlet to Shallotte Inlet (Figure 8). Nearshore reproductive marine critical habitat units encompass reproductive habitat along nesting beaches that is used by hatchlings for egress to the open ocean and by nesting females for movements between beaches and the open ocean during the nesting season. Critical nearshore reproductive habitat primary constituent elements include nearshore waters directly off the highest density nesting beaches and their adjacent beaches, waters sufficiently free of obstructions and artificial lighting to allow transit through the surf zone to open water, and waters with minimal manmade structures that could promote predators, disrupt wave patterns necessary for orientation, and/or create excessive longshore currents (79 FR 39855). An additional winter critical habitat unit (LOGG-N-02) encompasses offshore waters between the 20-m and 100-m bathymetric contours from Cape Fear to Cape Hatteras. The inner boundary (20-m contour) of LOGG-N-02 is located ~11 nm (13 m) seaward of the east-facing beaches to the north of Cape Fear (Figure 8). Winter critical habitat encompasses warm waters near the western edge of the Gulf Stream that are used by a high concentration of juveniles and adults during the winter. Primary constituent elements include water temperatures above 10°C from November through April, continental shelf waters in proximity to the boundary of the Gulf Stream, and water depths between 20 and 100 m.

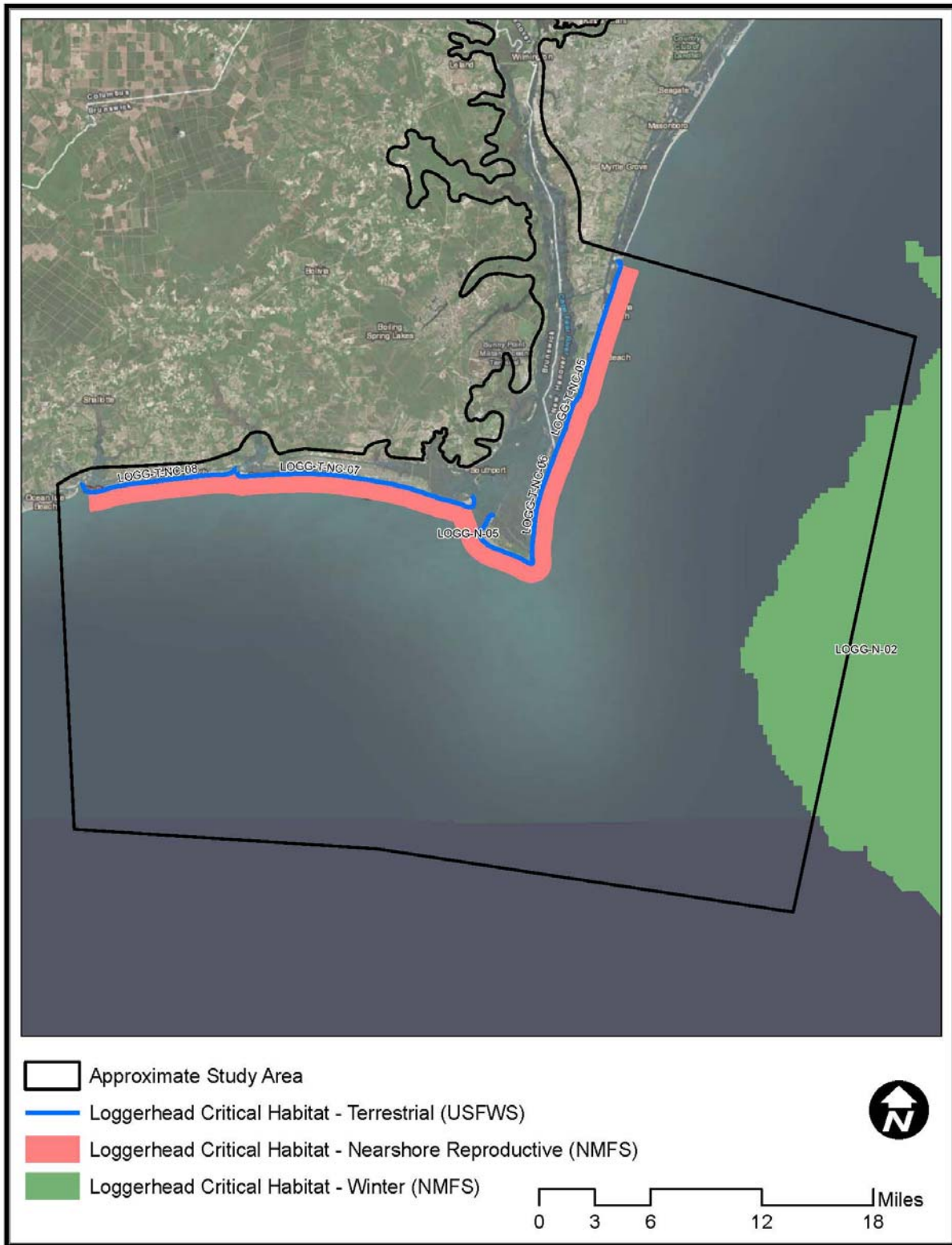


Figure 8. Loggerhead Nearshore Reproductive Critical Habitat

5.5.3 Threats

Threats that are common to all sea turtle species in the terrestrial nesting environment include loss or degradation of nesting habitat due to beach armoring, beach nourishment, coastal development, artificial lighting, and the proliferation of non-native invasive plant species (NMFS and USFWS 2007a-e). Threats that are common to all sea turtle species in estuarine and marine environments include fisheries by-catch, vessel strikes, marine debris ingestion or entanglement, intake into the cooling systems of power plants, environmental contamination, and disease. Threats associated with fisheries by-catch include entrapment in trawls and entanglement in a wide variety of other fishing gear. Shrimp trawling is the most detrimental fishing practice and the greatest overall anthropogenic cause of loggerhead mortality. In 1990, loggerhead mortality attributable to offshore shrimp trawling in the southeastern US and Gulf of Mexico was estimated to be 5,000 to 50,000 turtles per year (NMFS and USFWS 2007a). Mortality attributable to shrimp trawling was estimated to be ten times that of all other anthropogenic activities combined. Vessel strikes are also a common cause of sea turtle mortality. Approximately 15% of all loggerhead strandings that were reported from 1997 through 2005 exhibited signs of vessel strikes. Loggerhead, green, and Kemp's ridley sea turtles are vulnerable to direct injury by hopper dredges as a result of being entrained in the dredge intake pipe.

Sand placement projects can affect sea turtles through direct impacts on nesting females, nests, and hatchlings and indirectly through nesting habitat modifications such as changes in beach morphology and/or substrate properties. Observed declines in nesting on nourished beaches have been attributed to substrate compaction, escarpment formation, and/or modification of the natural beach profile (Crain et al. 1995, Steinitz et al. 1998, Ernest and Martin 1999, Herren 1999, Rumbold et al. 2001, Byrd 2004, and Brock et al. 2009). By design, sand placement projects typically construct a flat dry beach or "berm" that gradually steepens to the natural equilibrium profile as the placed material is redistributed by natural wave and wind driven transport processes. This equilibration process often results in the formation of escarpments that can prevent sea turtles from accessing upper dry beach nesting habitats. The use of heavy machinery to redistribute and establish the design beach profile can result in compaction of the newly deposited beach sediments, which in turn can impede sea turtle nest excavation. Sediment compaction and changes in sediment composition may also affect the suitability of the nest incubation environment and the ability of hatchlings to emerge from the nest (Nelson and Dickerson 1988, Crain et al. 1995). Embryonic development and hatching success are influenced by temperature, gas exchange, and moisture content within the nest environment (Carthy et al. 2003). Changes in substrate characteristics such as grain size, density, compaction, organic content, and color may alter the nest environment; potentially affecting embryonic development and hatching success (Nelson and Dickerson 1988, Nelson 1991, Ackerman et al. 1991, Crain et al. 1995, Ehrhart 1995, and Ackerman 1996). Artificial lighting on the ocean beach may deter nesting sea turtles from emerging onto the nesting beach (Witherington 1992, Witherington and Martin 2003). Artificial lighting may also impair the ability of sea turtle hatchlings to properly orient to the ocean. Disoriented hatchlings that are delayed in reaching the ocean may experience high mortality from dehydration and predation; and those that are attracted to lighted parking lots or streetlights are often crushed by passing vehicles (Witherington and Martin 2003).

5.5.4 Project Effects

5.5.4.1 Dredging

The NMFS has previously determined that hydraulic cutterhead and mechanical (clamshell and bucket) dredging activities are not likely to adversely affect sea turtles (NMFS 2012). Sea turtle takes by cutterhead dredges have not been reported along the southeastern US coast, and only one take by a mechanical dredge has been reported along the southeastern coast over the past several decades. Therefore, proposed cutterhead and bucket dredging activities would not be expected to have any adverse effects on sea turtles. Takes of hawksbill and leatherback sea turtles by hopper dredges have not been reported along the southeastern US coast. Hawksbill sea turtles are rare in NC waters (Epperly et al. 1995a) and are primarily associated with coral reef habitats (NMFS and USFWS 2007c). Coral reef habitats along the NC coast are restricted to deep offshore waters >20 miles from shore (MacIntyre and Pilkey 1969, MacIntyre 2003). Leatherback sea turtles have been observed in nearshore waters along the NC coast during the warmer months; however, the leatherback is primarily a species of deep oceanic waters with a pelagic feeding habit that reduces its vulnerability to entrainment. Therefore, hopper dredging under the proposed action would not be expected to have any adverse effects on hawksbill or leatherback sea turtles.

The Wilmington District USACE reported takes of 30 loggerhead, four Kemp's ridley, and three green sea turtles by hopper dredges in the vicinity of Wilmington Harbor from 1992-2013. All but one of the takes occurred outside of the 1 December to 30 April hopper dredging window that is proposed for the harbor deepening project. The one exception was a Kemp's ridley that was taken during mid-December. The use of hopper dredges under the proposed action would be limited to deepening of the outer harbor Baldhead Shoal 2 and 3 entrance channel reaches and construction of the new Baldhead Shoal 3 seaward extension reach. Adherence to the proposed 1 December to 30 April hopper dredging window would limit operations to the colder months when most loggerhead, green, and Kemp's ridley sea turtles have moved to warmer offshore waters beyond the proposed dredging areas. The risk of entrainment would be further minimized through the use of rigid draghead deflectors, which dramatically reduce sea turtle entrainment rates when they are used and deployed correctly (Dickerson et al. 2004). Given that only one sea turtle take has been reported at Wilmington Harbor during the proposed hopper dredging window; it is expected that the risk of loggerhead, green, and Kemp's ridley entrainment by hopper dredges would be negligible.

5.5.4.2 Confined Blasting

Sea turtles have been observed in the Cape Fear River estuary up to river mile 15, but apparently prefer higher salinity waters of the lower estuary (NMFS 2000, 2012). During a tracking study of 18 gill-netted green and Kemp's ridley juveniles in the lower Cape Fear River estuary, only one individual (a presumed mortality) moved north of Snows Cut (river mile 13) (Snoddy and Williard 2010). Based on the location of the proposed blasting areas between river mile 18 and river mile 22, it is unlikely that sea turtles would be affected by blasting activities. However, as previously described, blasting operations would implement protective measures for sea turtles and marine mammals similar to those previously approved by the NMFS in 2000 and 2012 for proposed blasting operations under the Wilmington Harbor 96 Act Project (NMFS 2000, 2012). Protective measures would include the establishment of blast zones of influence and the

development of a Watch Program in accordance with NMFS Southeast Region guidance for mitigating the effects of marine blasting on sea turtles and marine mammals (Baker 2008). The NMFS guidance provides specific procedures and equations for calculating zones of influence based on the blasting method used and project-specific details. In the case of confined blasting, the required zones of influence include Danger, Harassment, and Watch zones. The innermost Danger Zone encompasses the area nearest to the blast location where mortality and injury may occur. The intermediate Harassment Zone encompasses the area where TTS and behavioral effects may occur, and the outermost Watch Zone is an additional area that is monitored to detect animals that are moving towards the inner blast impact zones. The zones of influence determine how and where specific protective measures are implemented to mitigate the potential effects of blasting protected species. Specific watch program measures and procedures would be implemented as previously outlined in Section 5.2.5.

5.5.4.3 Beach Placement of Dredged Material

The construction window for each beach placement event (16 November - 30 April) would avoid the NC sea turtle nesting and hatching season as defined by the NCWRC (1 May - 15 November); thereby, minimizing the likelihood of direct impacts on nesting adult females, nests, and hatchlings. Beach placement may have temporary indirect effects on sea turtle nesting through changes in beach morphology and/or nesting substrate characteristics; however, the potential for these effects would be minimized by the use of only compatible fill material that is suitable for nesting and implementation of escarpment and compaction monitoring. Therefore, it is expected that any effects on sea turtle nesting would be minor and short-term.

5.5.4.4 Beneficial Effects

In the case of severely eroded beaches, the restoration of wider and higher dry beaches through proposed beneficial use projects may enhance the quality of sea turtle nesting habitat. Studies have reported immediate increases in nesting success following sand placement on chronically eroded beaches (Davis et al. 1999, Byrd 2004). It is expected that the placement of compatible material on the erosional shorelines of Bald Head Island and Oak Island would maintain a wider beach, thereby increasing area of availability of dry beach nesting habitat for sea turtles.

5.5.4.5 Effects on Loggerhead Critical Habitat

Beach placement of dredged material would occur within loggerhead terrestrial critical habitat units LOGG-T-NC-06 (Bald Head Island) and LOGG-T-NC-07 (Oak Island). The potential for construction-related impacts on sea turtle nesting would be minimized through adherence to a 16 November to 30 April beach placement window. The use of only compatible beach fill would minimize potential effects on the suitability of the substrate for nesting, embryonic development, and hatching. Post-construction compaction and escarpment monitoring would minimize the potential for substrate effects that would reduce nesting success or prevent females from accessing suitable nesting sites. Beach placement activities may include the placement of delivery pipelines within nearshore reproductive critical habitat unit LOGG-N-05; however, based on avoidance of the sea turtle nesting and hatching season in NC, it is unlikely that pipelines would affect any of the critical habitat primary constituent elements.

5.5.5 Conservation Measures

5.5.5.1 Hopper Dredging Window

Hopper dredging operations would adhere to a 1 December to 30 April dredging window. The proposed window would limit hopper dredging to periods when sea turtles are unlikely to present in the dredging areas due to low water temperatures.

5.5.5.2 Rigid Draghead Deflectors

The use of rigid draghead deflectors would be required on all hopper dredges to reduce the risk of sea turtle entrainment.

5.5.5.3 Inflow/Overflow Screening

Hopper dredges would employ 100% inflow screening and monitoring.

5.5.5.4 Endangered Species Observers

Protected Species Observers would monitor inflow screens, dragheads, and hoppers during active dredging. When dragheads are submerged, during active dredging, PSOs would continuously monitor the inflow screening for turtles and/or turtle parts. At the completion of each load cycle, dragheads would be physically inspected as they are lifted from the sea surface and placed on the saddle to account for sea turtles that may be impinged within the draghead. During daylight hours PSOs would survey for the presence of endangered species during transits between the dredging sites and disposal areas.

5.5.5.5 Blast Mitigation Watch Program

Specific watch program measures and procedures for sea turtles and marine mammals would be implemented as previously outlined in Section 5.2.5.2.

5.5.5.6 Beach Placement Window

Sand placement operations would be limited to 16 November to 30 April construction window. Adherence to the placement window would avoid direct impacts on nesting females, nests, eggs, and hatchlings.

5.5.5.7 Sediment Compatibility

All material placed on the beach and in associated dune systems would consist of beach compatible sediment that is suitable for sea turtle nesting.

5.5.5.8 Escarpment Monitoring

Immediately after construction and to the maximum extent practicable prior to 1 May, surveys for escarpments will be conducted within the limits of construction areas. Identified escarpments that may interfere with sea turtle nesting (>18 inches in height and \geq 100 ft in length) will be leveled to the natural beach profile. If it is determined that escarpment leveling is required during the nesting season, leveling activities would be coordinated with the USFWS and NCWRC.

5.5.5.9 Compaction Monitoring

Immediately after construction and to the maximum extent practicable prior to 1 May, the limits of construction areas will be evaluated for compaction in coordination with the USFWS and NCWRC. If it is determined that tilling is required for sea turtle nesting habitat suitability, the construction areas will be tilled to a depth of 36 inches. All tilling activity shall be completed prior to 1 May to the maximum extent practicable. In the case of projects that run until the 30 April nesting window cutoff, any tilling activities required after 1 May would be coordinated with the USACE, USFWS, and NCWRC.

5.5.6 Determination of Effect

5.5.6.1 Dredging

Based on the pelagic feeding habit of the leatherback, its association with deep oceanic waters, and the absence of reported takes by dredges; it is determined that dredging under the proposed action may affect, but is not likely to adversely affect the leatherback sea turtle. Based on the rarity of the hawksbill in NC waters, its association primarily with coral reef habitats, and the absence of reported takes by dredges; it is determined that dredging under the proposed action may affect, but is not likely to adversely affect the hawksbill sea turtle. Adherence to a 16 November - 30 April hopper dredging window and the use of rigid draghead deflectors on hopper dredges would minimize the risk of loggerhead, green, and Kemp's ridley entrainment. Given that only one sea turtle take has been reported at Wilmington Harbor during the proposed hopper dredging window; it is determined that dredging under the proposed action may affect, but is not likely to adversely affect loggerhead, green, and Kemp's ridley sea turtles.

5.5.6.2 Confined Blasting

Based on the low probability of sea turtle occurrences in the vicinity of the blasting areas, and considering the proposed blast protection measures that would be implemented; it is determined that blasting under the proposed action may affect, but is not likely to adversely affect loggerhead, green, Kemp's ridley, leatherback, and hawksbill sea turtles.

5.5.6.3 Beach Placement of Dredged Material

Based on the proposed beach placement window and the proposed measures to minimize effects on sea turtle nesting habitat; it is determined that beach placement under the proposed action may affect, but is not likely to adversely affect loggerhead, green, Kemp's ridley, leatherback, and hawksbill sea turtles.

5.5.6.4 Loggerhead Critical Habitat

Based on the proposed measures to minimize effects on sea turtle nesting habitat; including the use of compatible beach fill and escarpment and compaction monitoring; and it is determined that the proposed action may affect, but is not likely to adversely affect loggerhead terrestrial critical habitat.

Based on avoidance of the sea turtle nesting and hatching season in NC, it is unlikely that beach placement and associated pipeline placement activities would affect any of the critical habitat primary constituent elements of nearshore reproductive habitat. Therefore, it is determined that

the proposed action may affect, but is not likely to adversely affect loggerhead nearshore reproductive critical habitat.

5.6 Atlantic and Shortnose Sturgeon

5.6.1 Status, Distribution, and Habitat

5.6.1.1 Atlantic sturgeon

The Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) was listed under the ESA in 2012 as DPS segments; including the endangered New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs and the threatened Gulf of Maine DPS (77 FR 5914, 77 FR 5880). The Carolina DPS encompasses subpopulations from the Roanoke, Tar/Pamlico, Cape Fear, Waccamaw, Pee Dee, and Santee-Cooper Rivers in NC and South Carolina. The historical US distribution of the Atlantic Sturgeon included approximately 38 rivers from the Saint Croix River in Maine to the Saint Johns River in Florida, including spawning populations in at least 35 rivers. The current US distribution includes 35 rivers with spawning known to occur in at least 20 rivers. Atlantic sturgeon spawn in freshwater, but spend most of their adult life in a marine environment. Spawning adults generally migrate upriver in the spring/early summer, although a fall spawning migration may also occur in some southern rivers. Spawning is believed to occur in flowing water between the salt front and fall line of large rivers. Post-larval juveniles move downstream into brackish waters and eventually move to estuarine waters where they reside for a period of months or years. Subadult and adult Atlantic sturgeons emigrate from rivers into coastal waters, where they may undertake long range migrations. Migratory adult and subadult sturgeon are typically found in shallow (40-70 ft) nearshore waters with gravel and sand substrates. Although extensive mixing occurs in coastal waters, Atlantic sturgeons return to their natal river to spawn [Atlantic Sturgeon Status Review Team (ASSRT) 2007]. In 2017, the NMFS designated critical habitats for the Atlantic sturgeon in large spawning river systems throughout the five DPSs (82 FR 39160). Critical habitat for the Carolina DPS was designated in the Roanoke, Tar-Pamlico, Neuse, Cape Fear, and Pee Dee Rivers of NC and South Carolina.

5.6.1.2 Shortnose Sturgeon

The shortnose sturgeon (*A. brevirostrum*) was listed as endangered throughout its range on 11 March 1967 (32 FR 4001). The species inhabits large Atlantic coast rivers from the St. Johns River in northeastern Florida to the Saint Johns River in New Brunswick, Canada. Adults in southern rivers are estuarine anadromous, foraging at the saltwater-freshwater interface and moving upstream to spawn in the early spring. Shortnose sturgeon spend most of their lives in their natal river systems and rarely migrate to marine environments. Spawning habitats include river channels with gravel, gravel/boulder, rubble/boulder, and gravel/sand/log substrates. Spawning in southern rivers begins in later winter or early spring and lasts from a few days to several weeks. Juveniles occupy the saltwater-freshwater interface, moving back and forth with the low salinity portion of the salt wedge during summer. Juveniles typically move upstream during the spring and summer and move downstream during the winter, with movements occurring above the saltwater-freshwater interface. In southern rivers, both adults and juveniles are known to congregate in cool, deep thermal refugia during the summer. The shortnose sturgeon is a benthic omnivore that feeds on crustaceans, insect larvae, worms, and mollusks. Juveniles randomly vacuum the bottom and consume mostly insect larvae and small crustaceans.

Adults are more selective feeders, feeding primarily on small mollusks (NMFS 1998). No critical habitat has been designated for the shortnose sturgeon.

5.6.2 Occurrence in the Action Area

5.6.2.1 Atlantic Sturgeon

The Atlantic sturgeon was historically abundant in most NC coastal rivers and estuaries; however, at the time of its listing under the ESA, the Carolina DPS spawning population was estimated at less than 300 individuals (NMFS 2012a). Extant spawning populations in NC are currently known from the Roanoke, Tar-Pamlico, Cape Fear, and potentially the Neuse River systems (ASSRT 2007). Gill net surveys in the Cape Fear River system have captured substantial numbers of Atlantic sturgeon in the Cape Fear River mainstem, Brunswick River, and Northeast Cape Fear River (Moser and Ross 1995, ASSRT 2007). Subadult Atlantic sturgeon in the Cape Fear River system exhibit seasonal movements and distribution patterns; moving upriver during the summer and migrating out of the river to estuarine or ocean waters during the coldest time of the year (Post et al. 2014). High inter-annual return rates of tagged fish demonstrate fidelity to the Cape Fear River system; indicating that the Cape Fear River system may be the natal river system for these individuals (Post et al. 2014). Reports of Atlantic sturgeon above Lock and Dam #1 indicate that some fish are successful at passing Lock and Dam #1 via the recently constructed rock arch ramp. Although eggs have not been detected, the collective body of evidence suggests that both the Cape Fear River and the Northeast Cape Fear River may be important spawning areas.

Portions of the mainstem Cape Fear River and Northeast Cape Fear River were designated as critical habitat (Carolina Unit 4) for the Carolina DPS in 2017. Carolina Unit 4 encompasses the mainstem Cape Fear River from the estuary mouth (river mile 0) up to Lock and Dam #2 and the Northeast Cape Fear River from its confluence with the Cape Fear River up to Rones Chapel Road Bridge at Mount Olive, NC (Figure 9). The physical or biological features of Atlantic sturgeon critical habitat that are essential to the conservation of the species include hardbottom substrate in low salinity waters for egg settlement and early life stage development; aquatic habitat encompassing a gradual salinity gradient (0.5-30 ppt) and soft bottom (sand/mud) substrate for juvenile foraging and development; waters of sufficient depth and absent physical barriers to passage to support unimpeded movements of adults, subadults, and juveniles; and water quality conditions (temperature and oxygen) that support spawning, survival, development, and/or recruitment of the various life stages (82 FR 39160).

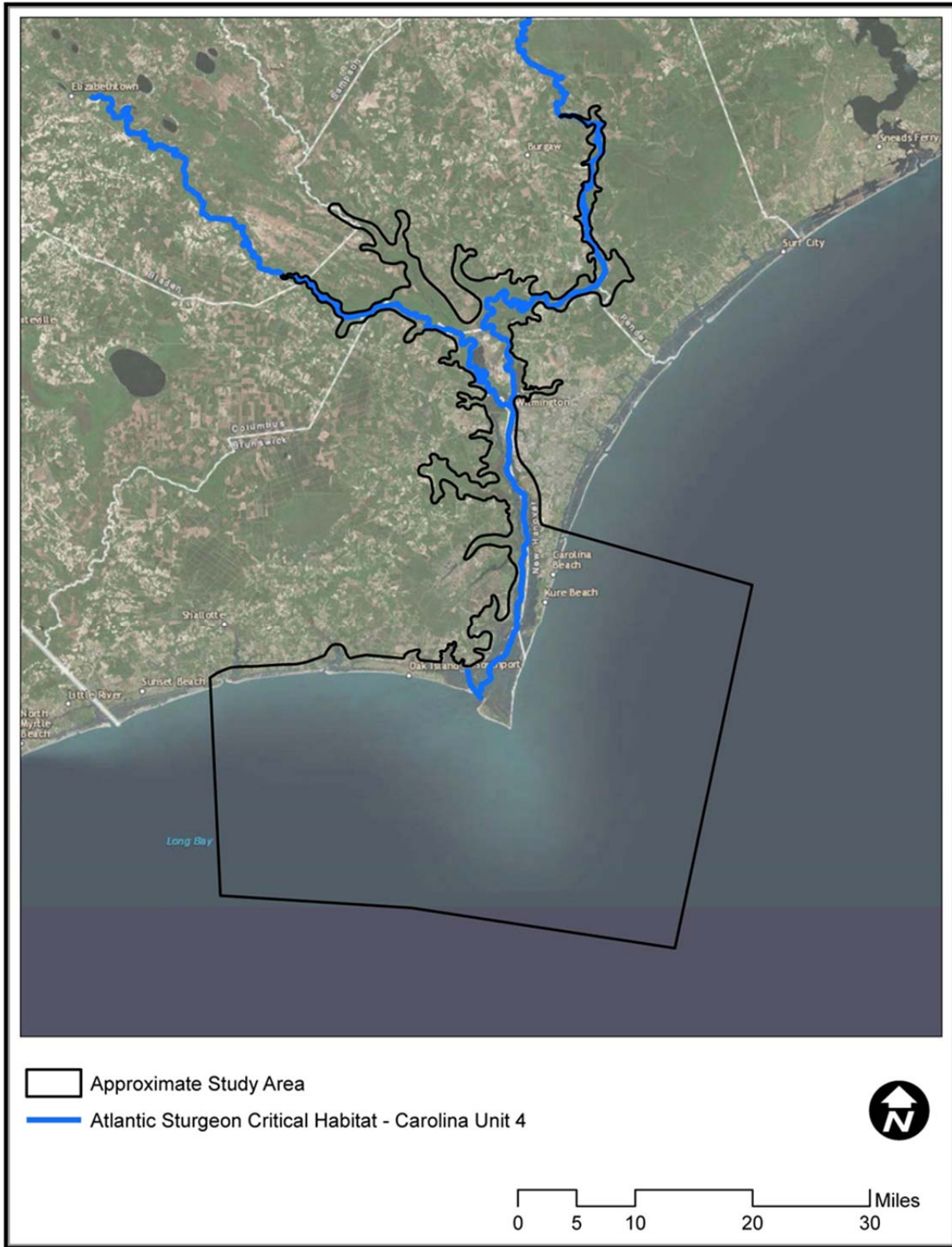


Figure 9. Critical Habitat (Carolina Unit 4) for Atlantic Sturgeon within the Project Area

5.6.2.2 Shortnose Sturgeon

The current distribution of the shortnose sturgeon in NC is thought to include only the Cape Fear and Pee Dee Rivers, and no spawning populations have been confirmed in the state [Shortnose Sturgeon Status Review Team (SSSRT) 2010]. Shortnose sturgeons were thought to be extirpated from NC waters until 1978 when an individual was captured in the Brunswick River (Ross et al. 1988). Subsequent gill net studies (1989-1993) resulted in the capture of five shortnose sturgeons, thus confirming the presence of a small population in the lower Cape Fear River below Lock and Dam #1 (Moser and Ross 1995). Movements of tagged shortnose sturgeons were detected from rkm 16 up to Lock and Dam #1. Moser and Ross (1995) observed directed upstream migrations by gravid females that suggested the possible existence of a reproducing population above Lock and Dam #1. However, the current distribution, abundance, and reproductive status of the shortnose sturgeon in the Cape Fear River is unknown (SSSRT 2010).

5.6.3 Threats

Historical overharvesting contributed to drastic declines in shortnose and Atlantic sturgeon populations. Commercial exploitation of shortnose sturgeons continued into the 1950s, and Atlantic sturgeons were commercially exploited throughout most of the 20th century (NMFS 1998, ASSRT 2007). Although directed commercial harvest is no longer permitted, by-catch mortality associated with other fisheries remains a major threat. By-catch mortality associated with the shad and shrimp fisheries and water quality degradation in nursery habitats are the primary threats currently facing southeastern sturgeon populations (Collins et al. 2000). Dams that block access to spawning grounds are a major stressor in some southern river systems, including the Cape Fear River. Additional stressors include ship strikes and dredging (ASSRT 2007). A total of 18 Atlantic sturgeons were taken by hopper dredges during federal navigation dredging along the South Atlantic Coast from October 1990 to March 2012 (USACE 2014). Incidental takes occurred at Wilmington Harbor, NC (n=2), Winyah Bay, South Carolina (n=1), Charleston Harbor, South Carolina (n=4), Savannah Harbor, Georgia (n=5) and Brunswick Harbor, Georgia (n=6).

5.6.4 Project Effects

5.6.4.1 Dredging

Entrainment

The proposed harbor deepening project would employ: 1) hopper dredging in the outer entrance channel reaches (Baldhead Shoal Reaches 2 and 3) with ocean disposal at the ODMDS; 2) cutterhead dredging in Baldhead Shoal Reach 1 channel and inner harbor channel reaches with a combination of direct pipeline beach disposal, direct pipeline disposal to the Eagle Island Confined Disposal Facility, and ocean disposal at the ODMDS via scows; and 3) bucket dredges as needed for the removal of pretreated rock from the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel inner harbor reaches with ocean disposal at the ODMDS via barges.

Dredging operations can potentially impact Atlantic and shortnose sturgeons directly through entrainment in the dredge intake pipe and/or indirectly through sediment suspension and soft bottom habitat modification. Although shortnose sturgeons have been taken by both hopper and cutterhead dredges in rivers along the North Atlantic Coast, no takes have occurred along the South Atlantic Coast. The shortnose sturgeon is typically found in the upper portions of rivers above the freshwater-saltwater interface, which reduces the potential for dredge interactions. Based on the absence of reported dredge interactions along the South Atlantic Coast and its restriction primarily to the upper portions of rivers, it is expected that the risk of shortnose sturgeon entrainment would be negligible.

Cutterhead dredges have not been implicated in Atlantic sturgeon takes along the southeastern US coast. However, a total of 18 Atlantic sturgeons were taken by hopper dredges during federal navigation dredging operations along the southeastern US coast from October 1990 to March 2012 (USACE 2014b). Takes occurred at Wilmington Harbor, NC (n=2), Winyah Bay, South Carolina (n=1), Charleston Harbor, South Carolina (n=4), Savannah Harbor, Georgia (n=5) and Brunswick Harbor, Georgia (n=6). The two takes at Wilmington Harbor included one in the upper Cape Fear River near the state port in 1998, and one in the lower river near Horse Shoe Shoals in 2010. The small number of takes at Wilmington Harbor indicates that the potential hopper dredge entrainment risk to Atlantic sturgeon is very low. Under the proposed action, the use of only cutterhead dredges in the inner harbor channels would greatly reduce the potential entrainment risk to Atlantic sturgeon. Analysis of historical take along the south Atlantic Coast indicates that the risk of dredge entrainment is primarily limited to hopper dredging within riverine channels (USACE 2014b). The use of hopper dredges would be limited to the outer harbor Baldhead Shoal 2 and 3 entrance channel reaches and the Baldhead Shoal 3 seaward extension reach. It is anticipated that any occurrences of Atlantic sturgeon in the vicinity of ocean entrance channel reaches would likely consist of adults and subadults that would be able to avoid the dredge. The use of rigid draghead deflectors on hopper dredges would further reduce the risk of entrainment. The potential risk of entrainment to adult sturgeon is presumed to be low, and the use of rigid deflecting dragheads and associated operating requirements likely reduces the risk of entrainment (Dickerson et al. 2004). Therefore, it is anticipated that the risk of Atlantic sturgeon entrainment by hopper dredges would be negligible under the proposed action.

Impacts on Soft Bottom Habitat

Temporary losses of benthic invertebrates in the new dredging areas may negatively affect the foraging activities of Atlantic and shortnose sturgeon, potentially inducing individuals to seek out alternative soft bottom foraging habitats. It is expected that rapid recolonization of disturbed soft bottom habitats in the new dredging areas would provide substantial prey resources within a relatively short period of time. However, increases in depth and subsequent periodic disturbance from maintenance dredging may permanently shift community composition towards an earlier successional benthic assemblage. At greater depths, lower DO concentrations and reduced sunlight penetration may limit the productivity of benthic communities as a prey resource for sturgeon. However, the vast majority of the proposed new dredging areas in the estuary are located in relatively deep waters (99% >6 ft and 97% >12 ft) along the margins of the existing navigation channel, and thus, are presently subject to frequent disturbance and depth limitations on productivity. Based on existing conditions within the new dredging areas, it is anticipated

that the recovering benthic communities would provide prey resources similar to those of the existing communities. The proposed new dredging areas encompass just 5.9 acres of shallow (<6 ft) soft bottom habitat. In contrast, the Cape Fear River estuary contains an estimated 37,800 acres of shallow soft bottom habitat in waters <6 ft and an estimated 188,549 acres of soft bottom habitat in waters >6 ft (Deaton et. al 2016). New dredging impacts would be confined to the Anchorage Basin and the estuary below, which do not encompass known concentration areas for sturgeon. Therefore, based on the abundance of alternative foraging habitat in relation to the area of habitat that would be newly affected, any reduction in foraging habitat suitability would not be expected to have significant adverse effects on Atlantic and shortnose sturgeons.

5.6.4.2 Salinity and Water Quality Effects

The DELFT 3D hydrodynamic model results indicate that the proposed action would have negligible effects on temperature and DO concentrations. In relation to the FWOP, DO concentrations in the estuary are projected to decrease by 0.3 milligrams per liter or less; and the maximum decreases are projected to occur during the winter months when DO concentrations are typically the highest of the year (8-10 milligrams per liter). Therefore, changes in DO under the TSP would not be expected to have any significant adverse effects on Atlantic or shortnose sturgeons. The model results indicate that channel deepening would increase surface, mid-depth, and bottom salinities in relation to the FWOP. Under typical flow conditions, the maximum relative increases in average annual salinity occur in the mid-depth (3.9 ppt) and bottom (4.1 ppt) layers in the vicinity of the Anchorage Basin and Battleship channel reaches. Projected salinity increases at all depths are rapidly reduced in the reaches above and below Wilmington under typical flow conditions.

The juveniles of Atlantic and shortnose sturgeon, and to lesser extent the adults, are known to follow the salt front during certain times of the year. The largest increases in salinity are projected in the vicinity of downtown Wilmington where there are known concentration areas for sturgeon in the estuary such as the Brunswick River below the US 74/76 Bridge. Although the location of the salt front in the Cape Fear River estuary varies widely throughout the year, the projected increases in salinity would shift the average position of the salt front upstream, potentially affecting habitat suitability in the vicinity of Wilmington during certain times of the year. Reductions in habitat suitability would be most likely to occur during the late summer/fall period when the salt front typically reaches its uppermost limit in the estuary. The presence of known sturgeon concentration areas in the vicinity of the maximum projected salinity increases suggests that Atlantic and shortnose sturgeons could experience a loss of habitat or a reduction in habitat suitability.

5.6.4.3 Confined Blasting

The effects of confined blasting on shortnose sturgeon were investigated through a series of test blasts conducted in the Cape Fear River estuary during the fall and winter of 1998/1999 (USACE 1999; Moser 1998, 1999). Test blasts consisting of 32 or 33 stemmed 52 to 62 pound charges on a 25 millisecond delay were conducted in a portion of the Big Island channel reach where pre-treatment rock blasting was proposed as part of the Wilmington Harbor 96 Act Project. Hatchery reared shortnose sturgeons were held in cages at distances of 35, 70, 140, 280, and 560 ft from the blast locations. Fish were evaluated and assigned an index of injury score immediately after

the blasts and again after a holding period of 24 hours. Subsamples of the surviving sturgeons that appeared to be uninjured based on external examination were subsequently necropsied to document internal injuries and assess the likelihood that fish would have recovered from any injuries that were identified. Additional subsamples of surviving sturgeons were held in tanks for a period of two months to evaluate long-term survival. Blasts were also conducted with and without the use of air bubble curtains that were designed to reduce blast pressure impacts; however, bubble curtains were determined to have had little or no effect on fish survival, and were ultimately abandoned as a mitigative measure (Moser 1999, USACE 2000).

Sturgeon survival rates at distances of 140 ft and beyond were similar to survival rates at control stations located 0.5 mile from the blast locations, thus indicating that effects were confined to the area within a 140-foot radius of the blast location (Moser 1999). At the 35-foot and 70-foot locations, shortnose sturgeon mortality and injury rates were much lower than those for other species that were included in the study (striped bass, white mullet, and killifish). Immediate post-blast survival rates for sturgeon at distances of 35 ft and 70 ft ranged from 82.2% to 99.8%. Sturgeon survival rates did not change over the 24-hour post-blasting holding period, and the long-term (2-month) survival rates of sturgeons from the 35 ft and 70 ft locations were similar to those from the control station. Necropsies indicated that 88% and 100% of the surviving sturgeon from the 35-foot and 70-foot locations would have recovered and survived long-term. Sturgeon injuries consisted primarily of distended intestines and hemorrhaging of the interior body wall. In contrast to the other species that were exposed to blasting, sturgeon suffered very few swim bladder injuries. Moser (1999) attributed the low incidence of swim bladder injuries and relatively high survival rates of sturgeon to a direct connection between the swim bladder and the esophagus that allows gas to escape rapidly.

Areas potentially requiring confined blasting under the proposed action encompass ~188 acres of rock surface area within the Keg Island, Lower Big Island, Upper Big Island, and Lower Brunswick channel reaches. These four reaches comprise a continuous ~4.4-mile section of the navigation channel from a point ~18 miles above the estuary mouth to a point approximately two miles below Eagle Island. All blasting would occur between August and January when fish density is expected to be lowest. As previously described, blasting operations would employ stemmed charges and charge delays to reduce the magnitude of potentially injurious blast shock waves. Drill holes containing the individual charges would be stemmed (capped) with angular rock or other suitable material for the purpose of containing blast energy within the rock. Studies indicate that the use of stemmed charges with confined blasting can reduce shock wave peak pressure by 60 to 90% in relation to unconfined open water blasts (Nedwell and Thandavamoorthy 1992, Hempen et. al. 2005). The use of delays between individual charge detonations limits the development of cumulative blast pressure.

Blasting operations would implement additional protective measures for Atlantic and shortnose sturgeon similar to those previously approved by the NMFS in 2000 and 2012 for blasting operations under the Wilmington Harbor 96 Act Project (NMFS 2000, 2012). Protective measures would include the use of sinking gill nets, sonar surveys, and scare charges prior to each blast event.

5.6.5 Conservation Measures

5.6.5.1 Rigid Draghead Deflector

The use of rigid draghead deflectors would be required on all hopper dredges to reduce the risk of sturgeon entrainment.

5.6.5.2 Blast Protection Measures

Blasting would be limited to the period of August through January.

The following protection measures would be implemented for each blast event:

- Sinking gill nets will be set for a duration of two hours prior to each blast. The nets will surround the blast area to the extent feasible, and will not be removed sooner than one hour before the blast. Any sturgeon captured will be released in the Brunswick River within 300 ft of the US 74/76 Bridge. The nets will be manned continuously and will be retrieved if any marine mammal or sea turtle is observed in the area. The nets will have floats with reflective tape that extend to the surface. If the floats indicate that a large animal has become entangled, the nets will be immediately retrieved and the animal released. If nets are set in the dark (0.5 hour or more before sunrise) prior to any early morning blast, night vision equipment will be used to monitor the net floats and water surface. No overnight sets will be used.
- Surveillance for fish will be conducted by vessels equipped with side-scan sonar fish finders for a period of 20 minutes before each blast. If fish are detected, blasting will be delayed until they leave. The surveillance zone will encompass a radius of 500 ft extending outward from each blast set.
- Scare charges will be detonated prior to each blast for the purpose of excluding aquatic organisms from the area of an impending blast. Two scare charges similar to those described by Collins et al. (2000) and Yelverton et al. (2000) will be used for each blast. One scare charge will be detonated 45 seconds prior to the blast and one 30 seconds prior to the blast.

5.6.6 Determination of Effect

5.6.6.1 Dredging

Based on the location of proposed hopper dredging in the outer ocean entrance channel reaches, it is determined that the dredging under the proposed action may affect but is not likely to adversely affect the Atlantic and shortnose sturgeons.

5.6.6.2 Salinity and Water Quality Effects

Based on the projected salinity increases in the vicinity of known sturgeon concentration areas, it is determined that the proposed action may affect and is likely to adversely affect the Atlantic sturgeon and shortnose sturgeon.

5.6.6.3 Blasting

Based on the potential for injury and mortality, it is determined that the proposed action may affect and is likely to adversely affect the Atlantic sturgeon and shortnose sturgeon.

Atlantic Sturgeon Critical Habitat

Based on the projected salinity increases in the vicinity of known Atlantic sturgeon concentration areas, it is determined that the proposed action may affect and is likely to adversely affect critical habitat for the Atlantic sturgeon.

5.7 Seabeach Amaranth

5.7.1 Status, Distribution, and Habitat

Seabeach amaranth (*Amaranthus pumilus*) is an annual flowering plant that overwinters entirely in the form of small seeds. The annual nature of this plant means that the presence of plants in any given year is dependent on seed production and dispersal during previous years. Seed germination begins in April or May and continues through July. Flowering begins as early as June, and seed production is initiated in July or August. Flowering and seed production continue until the death of plant in late fall or early winter. Under favorable climatic conditions, some plants may survive and continue to produce seed into January (USFWS 1996b).

Seabeach amaranth was listed as threatened throughout its range on 7 April 1993 (58 FR 18035 18042). No critical habitat has been designated for this species. The current distribution includes coastal beaches from New York to South Carolina. Historically, this species was also found as far north as Rhode Island and Massachusetts, but has not been observed in these states in over a century. Range-wide populations increased substantially during the 1990s and reached a population estimate of 244,608 plants in 2000. During this period, seabeach amaranth was rediscovered in New York after an absence of 40 years. Between 1998 and 2000, additional populations were rediscovered in Virginia, Maryland, Delaware, and New Jersey after periods of absence ranging from 30 to 125 years (USFWS 2005). All of the state-specific populations have experienced similar declines, with record or near record lows recorded in all states by 2013.

Seabeach amaranth is a pioneering colonizer of newly formed and recently disturbed barrier island habitats; including supratidal overwash flats on the accreting ends of barrier islands, the upper dry ocean beach, and the lower exposed faces of foredunes. The species is intolerant of competition, and relies on regular disturbances to create areas devoid of other competitive plant species. Suitable habitats are eventually lost to dynamic erosional processes or succession to more stable dune grass communities. Consequently, seabeach amaranth is dependent on continual new habitat formation through dynamic barrier island and inlet processes. The species is well-adapted to this ephemeral habitat niche, producing vast numbers of tiny seeds that are widely dispersed throughout the coastal barrier system, thereby providing for the rapid colonization of new suitable habitats as they are formed

5.7.2 Occurrence in the Action Area

Although variable from year to year, the distribution of seabeach amaranth encompasses the entire barrier island coast of NC. Annual state-wide surveys from 1995 to 2014 recorded an average of 6,726 plants per year. Long-term population trends in NC have been similar to those of the overall range-wide population. After a record high annual count of 39,933 plants in 1995, annual survey totals from 1996 through 2002 fluctuated between approximately 200 and 14,000 plants. Beginning in 2003, the NC population increased substantially over three consecutive years, reaching 25,885 plants in 2005. The NC population has since been in rapid decline, reaching a record low annual total of 154 plants in 2012. Numbers remained low in 2013 and 2014, with surveys recording just 166 and 526 plants, respectively. The largest numbers of plants have been found along the southern NC coast, with concentrations occurring along Topsail Island and Bogue Banks. Since 2000, occurrences of seabeach amaranth in the action area have been heavily concentrated on the Brunswick County beaches to the west of Cape Fear, primarily on the beaches of Oak Island and Holden Beach (Table 11). Annual numbers in the action area have varied considerably from a low of just 22 plants in 2000 to a high of 2,420 in 2006. Since 2010, the population trend within the action area has mirrored the statewide and range-wide trend of steadily declining plant numbers, with annual totals from 2011 to 2014 ranging from just 51 to 350 plants (Table 11).

Table 11. Seabeach amaranth counts for the Cape Fear region between 2000-2014.

Survey Reach	Year															Total
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Fort Fisher	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Bald Head Island	3	1	0	0	0	45	4	0	2	2	0	0			0	226
Oak Island East	9	63	413	302	4	92	291	105	51	40	1372	1	5	1	1	15,341
Oak Island West	0	3	129	965	7	82	171	11	14	24	204	15	0	0	0	1,626
Holden Beach East	1	12	0	18	4	8	9	0	0	0	0	0	0	0	26	272
Holden Beach West	9	211	702	825	75	792	1945	281	574	123	434	116	46	108	323	6,829
Total	22	290	1244	2110	90	1020	2420	397	641	189	2010	132	51	109	350	24,295

5.7.3 Threats

The principal factors affecting seabeach amaranth include habitat loss and degradation. These are usually attributable to anthropogenic activities such as inlet dredging, beach nourishment, and the construction of groins and revetments for shoreline and inlet stabilization (USFWS 2005). Sand placement and other shoreline stabilization projects may affect seabeach amaranth by altering the dynamic coastal processes that create and maintain suitable habitat. Sand placement projects typically include the construction of berms and continuous artificial dunes that may impede natural ocean-to-sound overwash events that are responsible for the creation of new sparsely vegetated seabeach amaranth habitat. Sand placement during the growing season may affect seabeach amaranth directly through the burial and mortality of plants. Placement and grading operations may redistribute seeds, depositing them in unsuitable habitats where they are unable to germinate. Groins and jetties may impede seed dispersal, thereby limiting the species' ability to colonize new habitats. Pedestrian foot traffic, off-road vehicle use, and beach raking can damage or uproot plants. Seabeach amaranth is also threatened by the proliferation of non-native invasive plant species. Beach vitex has been widely planted in NC, and has the potential to displace seabeach amaranth from suitable habitat.

5.7.4 Project Effects

5.7.4.1 Sand Placement

Adherence to a 16 November - 30 April beach placement window and the use of compatible beach fill would minimize the potential effects by avoiding the seabeach amaranth growing season and minimizing the potential for adverse substrate changes. Some seeds that are redistributed by sand placement and grading operations may be redeposited in unsuitable habitats, thereby preventing successful germination or growth. Conversely, some seeds that are banked in unsuitable habitats may be redistributed to suitable dry beach habitats. Beach disposal would contribute to the maintenance of wider vegetation-free dry beach habitats, thereby enhancing habitat conditions for seabeach amaranth along the erosional shorelines that adjoin the inlet. It is expected that any adverse effects on seed germination would be minor and localized.

5.7.5 Conservation Measures

5.7.5.1 Beach Placement Window

Beach placement operations would be limited to 16 November to 30 April construction window. Adherence to the placement window would avoid the seabeach amaranth growing season.

5.7.5.2 Sediment Compatibility

All material placed on the beach and in associated dune systems would consist of beach compatible sediment that is similar in grain size composition to that of the native beach sediments.

5.7.6 Determination of Effect

Based on the proposed conservation measures, it is determined that the proposed action may affect, but is not likely to adversely affect seabeach amaranth.

6 SUMMARY OF EFFECTS DETERMINATION

A summary of the effects determination for all federal species discussed in the document is provided in Table 12. This determination may be revised through coordination with NMFS and the USFWS.

Table 12. Summary of effect determinations.

Species/Critical Habitat	ESA Listing Status	Effect Determination ¹			
		Dredging	Blasting	Salinity Change	Beach Disposal
North Atlantic right whale (<i>Eubalaena glacialis</i>)	Endangered	MANLAA	NE	NE	NE
Florida manatee (<i>Trichechus manatus</i>)	Endangered	MANLAA	MANLAA	NE	MANLAA
Leatherback sea turtle (<i>Dermochelys coriacea</i>)	Endangered	MANLAA	MANLAA	NE	MANLAA
Loggerhead sea turtle (<i>Caretta caretta</i>)	Threatened	MANLAA	MANLAA	NE	MANLAA
Green sea turtle (<i>Chelonia mydas</i>)	Endangered	MANLAA	MANLAA	NE	MANLAA
Hawksbill sea turtle (<i>Eretmochelys imbricata</i>)	Endangered	MANLAA	MANLAA	NE	MANLAA
Kemp's ridley sea turtle (<i>Lepidochelys kempii</i>)	Endangered	MANLAA	MANLAA	NE	MANLAA
Shortnose sturgeon (<i>Acipenser brevirostrum</i>)	Endangered	MANLAA	MANLAA	MALAA	NE
Atlantic sturgeon (<i>Acipenser oxyrinchus</i>)	Endangered	MANLAA	MANLAA	MALAA	NE
Piping plover (<i>Charadrius melodus</i>)	Threatened	NE	NE	NE	MANLAA
Red knot (<i>Calidris canutus rufa</i>)	Threatened	NE	NE	NE	MANLAA
Wood Stork (<i>Mycteria Americana</i>)	Threatened	NE	NE	NE	NE
Seabeach amaranth (<i>Amaranthus pumilus</i>)	Threatened	NE	NE	NE	MANLAA
North Atlantic Right Whale Southeastern US Calving Critical Habitat	Critical Habitat	NE	NE	NE	NE
Atlantic Sturgeon Critical Habitat	Critical Habitat	MANLAA	MANLAA	MALAA	NE
Loggerhead Nearshore Reproductive Critical Habitat	Critical Habitat	MANLAA	NE	NE	MANLAA
Loggerhead Terrestrial Critical Habitat	Critical Habitat	NE	NE	NE	MANLAA
Piping Plover Wintering Critical Habitat	Critical Habitat	NE	NE	NE	NE

¹ NE = No Effect; MANLAA = May affect, not likely to adversely affect; MALAA = May affect, likely to adversely affect

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APPENDIX A

GUIDELINES FOR AVOIDING IMPACTS TO THE WEST INDIAN MANATEE



United States Department of the Interior

FISH AND WILDLIFE SERVICE

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GUIDELINES FOR AVOIDING IMPACTS TO THE WEST INDIAN MANATEE Precautionary Measures for Construction Activities in North Carolina Waters

The West Indian manatee (*Trichechus manatus*), also known as the Florida manatee, is a Federally-listed endangered aquatic mammal protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) and the Marine Mammal Protection Act of 1972, as amended (16 U.S.C 1461 *et seq.*). The manatee is also listed as endangered under the North Carolina Endangered Species Act of 1987 (Article 25 of Chapter 113 of the General Statutes). The U.S. Fish and Wildlife Service (Service) is the lead Federal agency responsible for the protection and recovery of the West Indian manatee under the provisions of the Endangered Species Act.

Adult manatees average 10 feet long and weigh about 2,200 pounds, although some individuals have been recorded at lengths greater than 13 feet and weighing as much as 3,500 pounds. Manatees are commonly found in fresh, brackish, or marine water habitats, including shallow coastal bays, lagoons, estuaries, and inland rivers of varying salinity extremes. Manatees spend much of their time underwater or partly submerged, making them difficult to detect even in shallow water. While the manatee's principal stronghold in the United States is Florida, the species is considered a seasonal inhabitant of North Carolina with most occurrences reported from June through October.

To protect manatees in North Carolina, the Service's Raleigh Field Office has prepared precautionary measures for general construction activities in waters used by the species. Implementation of these measure will allow in-water projects which do not require blasting to proceed without adverse impacts to manatees. In addition, inclusion of these guidelines as conservation measures in a Biological Assessment or Biological Evaluation, or as part of the determination of impacts on the manatee in an environmental document prepared pursuant to the National Environmental Policy Act, will expedite the Service's review of the document for the fulfillment of requirements under Section 7 of the Endangered Species Act. These measures include:

1. The project manager and/or contractor will inform all personnel associated with the project that manatees may be present in the project area, and the need to avoid any harm to these endangered mammals. The project manager will ensure that all construction personnel know the general appearance of the species and their habit of moving about completely or partially submerged in shallow water. All construction personnel will be informed that they are responsible for observing water-related activities for the presence of manatees.
2. The project manager and/or the contractor will advise all construction personnel that

there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammal Protection Act and the Endangered Species Act.

3. If a manatee is seen within 100 yards of the active construction and/or dredging operation or vessel movement, all appropriate precautions will be implemented to ensure protection of the manatee. These precautions will include the immediate shutdown of moving equipment if a manatee comes within 50 feet of the operational area of the equipment. Activities will not resume until the manatee has departed the project area on its own volition (i.e., it may not be herded or harassed from the area).

4. Any collision with and/or injury to a manatee will be reported immediately. The report must be made to the U.S. Fish and Wildlife Service (ph. 919.856.4520 ext. 16), the National Marine Fisheries Service (ph. 252.728.8762), and the North Carolina Wildlife Resources Commission (ph. 252.448.1546).

5. A sign will be posted in all vessels associated with the project where it is clearly visible to the vessel operator. The sign should state:

CAUTION: The endangered manatee may occur in these waters during the warmer months, primarily from June through October. Idle speed is required if operating this vessel in shallow water during these months. All equipment must be shut down if a manatee comes within 50 feet of the vessel or operating equipment. A collision with and/or injury to the manatee must be reported immediately to the U.S. Fish and Wildlife Service (919-856-4520 ext. 16), the National Marine Fisheries Service (252.728.8762), and the North Carolina Wildlife Resources Commission (252.448.1546).

6. The contractor will maintain a log detailing sightings, collisions, and/or injuries to manatees during project activities. Upon completion of the action, the project manager will prepare a report which summarizes all information on manatees encountered and submit the report to the Service's Raleigh Field Office.

7. All vessels associated with the construction project will operate at "no wake/idle" speeds at all times while in water where the draft of the vessel provides less than a four foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

8. If siltation barriers must be placed in shallow water, these barriers will be: (a) made of material in which manatees cannot become entangled; (b) secured in a manner that they cannot break free and entangle manatees; and, (c) regularly monitored to ensure that manatees have not become entangled. Barriers will be placed in a manner to allow manatees entry to or exit from essential habitat.

Prepared by (rev. 06/2003):
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Figure 1. The whole body of the West Indian manatee may be visible in clear water; but in the dark and muddy waters of coastal North Carolina, one normally sees only a small part of the head when the manatee raises its nose to breathe.

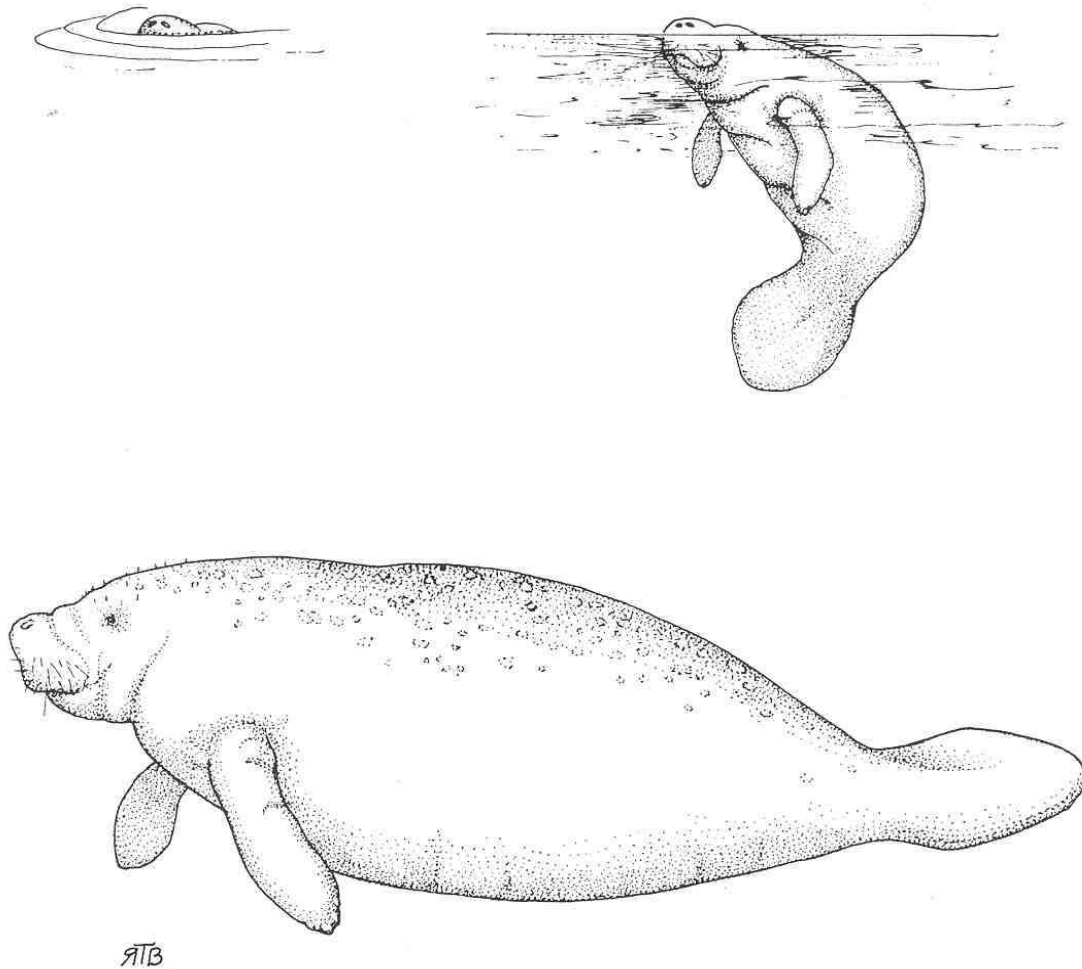


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