US Army Corps of Engineers®

Charleston District

ATLANTIC INTRACOASTAL WATERWAY in SOUTH CAROLINA

APPENDIX F: ESSENTIAL FISH HABITAT

August 2023

PROGRAMMATIC EFH CONSULTATION FOR USACE ACTIVITIES AND PROJECTS REGULARLY UNDERTAKEN IN SOUTH CAROLINA

Programmatic Essential Fish Habitat Consultation for United States Army Corps of Engineers Activities and Projects Regularly Undertaken in South Carolina

Prepared in Collaboration by:

National Marine Fisheries Service, Southeast Regional Office, Habitat Conservation Division
331 Fort Johnson Road, Charleston, South Carolina 29412

With and for:

United States Army Corps of Engineers, South Atlantic Division, Charleston District
69A Hagood Ave, Charleston, South Carolina 29403

Issued by: Date:

_________________________________ March 3, 2023

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division
National Marine Fisheries Service,
Southeast Region

Accepted by: Date:

_________________________________ ______________

ANDREW C. JOHANNES
Lieutenant Colonel, EN
Commander, U.S. Army Engineer District, Charleston

Table of Contents

1. Introduction 4
1.1 Background Statutory and Regulatory Information 4
1.2 Programmatic Consultation Process 4
2. Action Area and Proposed Actions 6
2.1 Description of Action Area 6
2.2 Proposed Actions 6
2.2.1 Navigation Dredging 7
2.2.2 Transportation of Dredged Material 7
2.2.3 Navigation Dredged Material Placement 7
2.2.4 Beneficial Use Placement 7
2.2.5 Emergency Dredging 7
2.2.6 Minor Channel Modifications 8
3. Essential Fish Habitat 8
3.1 Federally Managed Species 8
3.2 Essential Fish Habitat in Project Areas 9
3.2.1 Estuarine Emergent Wetlands (Salt marsh and Brackish Marsh) 10
3.2.2 Intertidal Non-vegetated Flats and Marshes 11
3.2.3 Estuarine Water Column 11
3.2.4 Soft Bottom/ Subtidal (Non-vegetated Flats) 12
3.2.5 Estuarine Scrub/Shrub 13
3.2.6 Tidal Creeks 13
3.2.7 Marine Water Column 13
3.2.8 Offshore Marine Habitats: Spawning Grounds 14
3.2.9 Habitat Areas of Particular Concern (HAPC) 14
4. Adverse Impacts to Essential Fish Habitat Due to Navigation Activities 15
4.1 Purpose and Overview 16
4.2 Adverse Impacts to EFH and Federally Managed Species 16
4.3 Adverse Impacts 16
4.3.1 Suspended Sediments and Turbidity 16
4.3.2 Sedimentation 17
4.3.3 Dissolved Oxygen Reduction 18
4.3.4 Decreased Water Quality/ Contaminants 18
4.3.5 Impingement and Entrainment 19
4.3.6 Channel Blockage 19
4.3.7 Noise Pollution 20
4.3.8 Changes in Salinity 20
4.3.9 Habitat Removal and Degradation 21
4.3.10 Habitat Conversion 21
4.3.11 Discharge of Pollutants 22
4.3.12 Grounding, Sinking, or Prop Scaring 22
4.3.13 Shoreline Erosion 22
5. Programmatic EFH Consultation Conservation Recommendations for Navigation Activities 23

5.1. Time of Year Recommendations 23
5.2. Dredging 26
5.2.1. Potential Adverse Impacts 26
5.2.2. Recommended Best Management Practices 26
5.3. Placement of Dredged Material 27
5.3.1. Potential Adverse Impacts 27
5.3.2. Recommended Best Management Practices 27
5.4. Dredging Vessel Operations and Transportation of Dredged Material 27
5.4.1. Potential Adverse Impacts 27
5.4.2. Recommended Best Management Practices 28
5.5. Beneficial Use - Beach and Nearshore Placement 28
5.5.1. Potential Adverse Impacts 28
5.5.2. Recommended Best Management Practices 29
6. Programmatic Consultation Procedures 30
6.1 Annual Meeting 30
6.2 Project Verification Requirements 30
6.2.1 Initial Screening Process 30
6.2.2 Impact Determination and Consultation Type 31
6.2.3 Projects using Programmatic EFH Consultation process 31
6.3 Annual Report 31
6.4 Revisions and Withdrawal 32
6.5 Supplemental Consultation 32
7. References 32
Appendix A: Project and Activity Descriptions 36
Appendix B. Programmatic Essential Fish Habitat Consultation for United States Army Corps of Engineers Activities and Projects Regularly Undertaken in South Carolina - Verification Form 50

1. Introduction

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal action agencies such as the U.S. Army Corps of Engineers (USACE) to consult with the National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NMFS) for any action they authorize, fund or undertake that may adversely affect Essential Fish Habitat (EFH). A programmatic consultation is often appropriate for funding programs, large-scale planning efforts, and other instances where sufficient information is available to address all reasonably foreseeable adverse effects on EFH of an entire program, parts of a program, or a number of similar individual actions occurring within a given geographic area. The outcome of a programmatic consultation, at minimum, should result in equal or greater protection to EFH than would have been realized through the otherwise required individual project level EFH consultation. The programmatic consultation process consolidates effort and time upfront while realizing the time saving and coordination benefits later.

This Programmatic EFH Consultation, in partnership with the USACE, Charleston District (Charleston District) covers certain Charleston District civil works activities and projects regularly undertaken in South Carolina. This document provides an assessment of the potential effects of dredging, dredged material transportation and dredged material placement activities, including beneficial uses, of federal operations and maintenance dredging projects in the action area, and issues conservation recommendations for those effects. This Programmatic EFH Consultation will reduce the number of individual EFH consultations while satisfying EFH consultation requirements of the MSA.

1.1 Background Statutory and Regulatory Information

The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104- 267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal Fisheries Management Plan (FMP). Section 305(b)(2) of the MSA requires federal agencies to consult with NMFS on any actions they authorize, fund or undertake that may adversely affect EFH. An adverse effect to EFH is any direct or indirect effect that reduces the quality and/or quantity of the designated habitat. NMFS provides advice and recommendations to the federal agency to avoid, minimize, or mitigate for these adverse effects. Conservation Recommendations, such as Best Management Practices, address all reasonably foreseeable adverse impacts on EFH by the proposed action(s).

1.2 Programmatic Consultation Process

The EFH Coordination, Consultation, and Recommendations (50 CFR §§ 600.5– 600.930) outline the process for federal agencies, the NMFS, and the Fishery Management Councils (Councils) to satisfy the EFH consultation requirement under MSA Section 305(b)(2)-(4)). Based on the EFH regulations at 50 CFR § 600.920(j), the programmatic consultation is an effective and efficient method to consult on a large number of minimal impact projects the Charleston District routinely authorizes, and to develop programmatic conservation recommendations that will address reasonably foreseeable adverse impacts to EFH. The scope of the programmatic consultation remains limited to those activity types that will not have a substantial adverse effect both individually and cumulatively on EFH. Activities not specifically covered by the programmatic consultation will have to be addressed through individual consultation.

The *Programmatic Essential Fish Habitat Consultation for United States Army Corps of Engineers Activities and Projects Regularly Undertaken in South Carolina* between the NMFS and the Charleston District, hereinafter referred to as the Programmatic EFH Consultation, addresses numerous in-water and near-shore activities conducted by the Charleston District.

Through this Programmatic EFH Consultation, NMFS has determined certain Charleston District civil works projects and activities, both individually and cumulatively, will not have a substantial adverse effect on EFH; these projects and activities are described herein. Activities and projects not explicitly included in this Programmatic EFH Consultation will be considered separately as an individual consultation. Through the implementation of this programmatic consultation, if NMFS or the USACE determines that other projects and activities may be considered for inclusion in future revisions of the Programmatic EFH Consultation, these projects and activities will be considered jointly, but with NMFS making the final determination on whether programmatic consultation is appropriate. Through the implementation of this programmatic consultation, there will be increased and more productive engagement between staff from both agencies and increased efficiencies in allowing projects to move forward in a timely manner.

2. Action Area and Proposed Actions

2.1 Description of Action Area

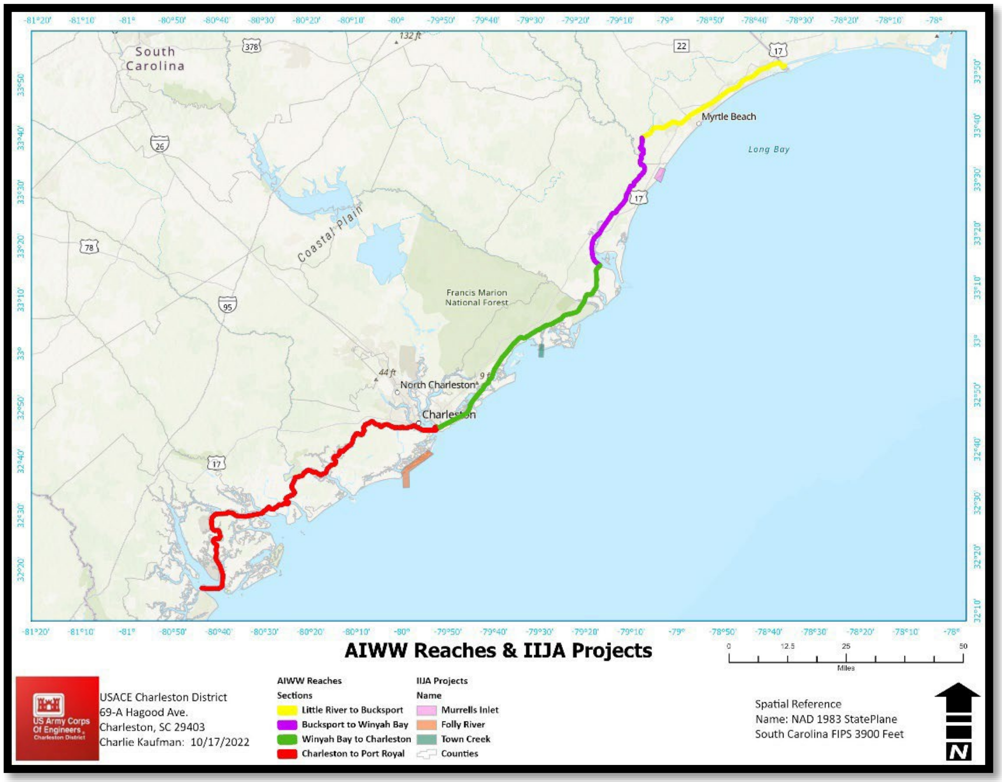

Figure 1. Overview of Navigation Projects under the Programmatic EFH Consultation

Charleston District dredging activities under this programmatic consultation would occur in areas designated EFH for various life stages of fish species managed by the Councils and NMFS and in areas that support prey species and anadromous fish. USACE conducts several kinds of routine and repetitive activities and projects that typically result in predictable effects. The geographic scope of this programmatic consultation includes tidally influenced areas designated EFH in South Carolina as provided below. Specifically, the geographic scope encompasses estuarine/inshore and wetland areas, as well as marine/coastal ocean areas such as nearshore waters adjacent to coastal beaches and the Atlantic Intracoastal Waterway (Figure 1).

2.2 Proposed Actions

USACE has been responsible for the development and maintenance of navigable waterways in the U.S. since the 1800s. The USACE provides safe, reliable, efficient, and environmentally sustainable waterborne transportation systems (channels, harbors, and waterways) for the movement of commerce, national security needs, and recreation. For more details on the USACE navigation dredging program and dredged equipment and dredged material management including placement and habitat development, please refer to USACE Engineering Manual (EM) 1110-2-5025 (Dredging and Dredged Material Management).

2.2.1 Navigation Dredging

This action includes Congressionally authorized and federally-sponsored (i.e., federally-funded or partially federally-funded) dredging for maintenance of Charleston District coastal navigation channels (including Murrells Inlet, Town Creek (McClellanville), Folly River, and the Atlantic Intracoastal Waterway (from the North Carolina state line to Port Royal Sound, South Carolina).

See Appendix A for detailed descriptions of authorized dredging projects covered under this Programmatic EFH Consultation.

2.2.2 Transportation of Dredged Material

This action includes transportation of dredged material via modified hopper dredge, or pump out pipeline. Specifically, the transportation of material from the dredging of navigation channels covered under this Programmatic EFH Consultation includes transportation for: (a) placement alongside or downdrift of the channel being dredged; (b) open water placement in an approved nearshore disposal site; (c) a confined (diked) placement; and/or (d) beneficial uses of dredged material including beach or nearshore placement and habitat restoration.

2.2.3 Navigation Dredged Material Placement

After both dredging and transportation of dredged material, the material is typically placed into a predetermined area for disposal or to serve a beneficial use. This action includes the placement of material from the dredging of navigation channels: (a) alongside or downdrift of the channel being dredged; (b) open water placement area; (c) in a confined (diked) placement area; and/or (d) in beneficial use locations as provided under Section 2.2.4.

2.2.4 Beneficial Use Placement

This action includes the placement of sand in the nearshore or beach area to nourish the littoral zone and/or habitat restoration projects. Sand sources for these placement actions may include dredged navigation channels, and/or nearshore deposition basin areas (see Appendix A for approved areas). Current federal beach, nearshore, and habitat restoration projects covered under this Programmatic EFH Consultation include:

- Charleston District Beach Placement Projects
  Folly Beach, Garden City Beach, Huntington Beach State Park, Bird Key

- Charleston District Nearshore Placement Projects
  Folly Beach, Lighthouse Island (Cape Romain),

- Ecosystem Restoration Placement Projects
  Bird Key

See Appendix A for additional details regarding these beneficial use projects.

2.2.5 Emergency Dredging

This action includes emergency dredging activities following an unforeseen event for the purpose of maintaining existing navigation channels, or to address a national security concern. The emergency may result from a natural disaster such as a flood event, storm or hurricane or from a navigation related catastrophe (e.g., a vessel collision with a bridge). USACE is authorized to conduct emergency response actions under the Flood Control and Coastal Emergency Act (Public Law 84-99) or the Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288).

2.2.6 Minor Channel Modifications

This action includes dredging and disposal activities for minor modifications to existing navigation channels that are within the discretionary authority of USACE (i.e., additional Congressional authorization is not required). Consistent with USACE Engineering Regulations and the budget process, certain navigation channel modifications are funded as maintenance activities. These modifications include channel realignments, turn or bend modifications, advanced maintenance opportunities, and overdepth dredging.

This action does NOT include navigation channel improvements beyond the scope of maintenance dredging or maintenance modifications of channels and turning basins to depths or widths not previously authorized throughout the project area. Maintenance dredging is defined as maintaining channels at specified depths and widths, including overdepth and advanced maintenance dredging. Channel improvements involve dredging to increase channel dimensions (length, depth or width) beyond dimensions previously authorized or permitted. Channel improvements are not within the scope of this Programmatic EFH Consultation and will be consulted on individually, as appropriate.

3. Essential Fish Habitat

The MSA requires fishery management councils and NMFS to identify, describe, map, and conserve EFH for each fish species managed under its jurisdiction. EFH is defined in the MSA as "those waters and substrate necessary to fish [and shellfish] for spawning, breeding, feeding or growth to maturity." This broad definition of EFH has led the South Atlantic Fishery Management Council (SAFMC) and the NMFS to identify EFH in most, if not all areas in the South Atlantic Bight, ranging from offshore pelagic areas (Gulf Stream) to all tidally influenced wetlands. This Programmatic EFH Consultation will focus on federally managed species and designated EFH germane to dredging and dredging related projects in South Carolina. Specific plans, amendments, descriptions of EFH and other information can be found at http://safmc.net/, http://www.mafmc.org/, and https://www.fisheries.noaa.gov. Spatial representations of EFH are available at http://safmc.net/ within the SAFMC Atlas and https://www.habitat.noaa.gov/apps/efhmapper/.

3.1 Federally Managed Species

Federally managed species that have a potential to be adversely affected by one or more USACE dredging and dredging related projects in South Carolina are listed in Table 1. Please refer to the relevant FMP available online for detailed descriptions of the federally managed species and their distribution.

Table 1. Federally managed species occurring in South Carolina tidally influenced waters that may be adversely affected by federal navigation activities.

Common Name	Scientific Name	Management Plan Agency	Fishery Management Plan (FMP)
White Shrimp	*Lytopenaeus setiferus*	SAFMC	Shrimp
Brown Shrimp	*Farfantepenaeus aztecus*	SAFMC	Shrimp
Gag Grouper	*Mycteroperca microlepis*	SAFMC	Snapper Grouper
Gray Snapper	*Lutjanus griseus*	SAFMC	Snapper Grouper
Lane Snapper	*Lutjanus synagris*	SAFMC	Snapper Grouper
Black Sea Bass	*Centropristis striata*	SAFMC	Snapper Grouper
Spanish Mackerel	*Scomberomorus maculatus*	SAFMC	Coastal Migratory Pelagic
King Mackerel	*Scomberomorus cavalla*	SAFMC	Coastal Migratory Pelagic
Summer Flounder	*Paralichthys dentatus*	MAFMC	Summer Flounder
Bluefish	*Pomatomus saltatrix*	MAFMC	Bluefish
Scalloped Hammerhead Shark	*Sphyrna lewini*	NMFS	Highly Migratory Species
Bonnethead Shark	*Sphyma tiburo*	NMFS	Highly Migratory Species
Bull Shark	*Carcharhinus leucas*	NMFS	Highly Migratory Species
Sandbar Shark	*Carcharhinus plumbeus*	NMFS	Highly Migratory Species
Finetooth Shark	*Carcharhinus isodon*	NMFS	Highly Migratory Species
Dusky Shark	*Carcharhinus obscures*	NMFS	Highly Migratory Species
Blacktip Shark	*Carcharhinus limbatus*	NMFS	Highly Migratory Species
Atlantic Sharpnose	*Rhyzoprionodon terranovae*	NMFS	Highly Migratory Species
Lemon Shark	*Negaprion brevirostris*	NMFS	Highly Migratory Species

3.2 Essential Fish Habitat in Project Areas

As noted earlier, complete EFH descriptions are available on Councils and NMFS websites. The following section provides only a brief discussion of EFH with specific and direct relevance to Charleston District dredging and dredging related projects in South Carolina. *Users Guide to Essential Fish Habitat Designations by the South Atlantic Fishery Management Council* provides a useful summary and clarifications to designations and is available at https://safmc.net/documents/2022/05/efh-user-guide.pdf/. Additional information on EFH descriptions for species identified by NMFS or the MAFMC can be found at the EFH Mapper (https://www.habitat.noaa.gov/apps/efhmapper/). This section is not an exhaustive or complete description of EFH and should not be treated as such.

Essential fish habitats identified by the SAFMC, MAFMC, and NMFS and likely to be within the project areas covered by this Programmatic EFH Consultation are listed below.

Estuarine Areas

- Estuarine Emergent Wetlands (Salt Marsh and Brackish Marsh)
- Intertidal Non-vegetated Flats
- Estuarine Water Column
- Soft Bottom/Subtidal
- Estuarine Scrub/Shrub

Tidally Influenced Areas

- Tidal Creeks

Marine Areas

- Marine Water Column
- Offshore Marine Habitats: Spawning Grounds

HAPCs

- Coastal Inlets
- Oyster Reefs/Shell Banks

3.2.1 Estuarine Emergent Wetlands (Salt Marsh and Brackish Marsh)

Salt marshes are transitional areas between land and water, occurring along the intertidal estuarine shorelines where salinity ranges from near ocean strength to near fresh in upriver marshes. The estuarine wetland is described as tidal wetlands in low-wave-energy environments, where the salinity is greater than 0.5 parts per thousand and is variable owing to evaporation and the mixing of seawater and freshwater (SAFMC Habitat Plan 1998). Estuarine emergent marshes protect shorelines from erosion, produce detritus, filter overland runoff, and function as a vital nursery area for various fish and many other species. Estuarine emergent wetlands are characterized by the presence of erect, rooted, herbaceous hydrophytes dominated by salt-tolerant perennial plants.

The structure and function of a salt marsh are influenced by tide, salinity, nutrients, and temperature. Estuarine intertidal marshes, as well as the network of tidal creeks that salt marshes drain into, provide refuge, forage, and nursery habitat for Council- and NMFS-managed species, other non- managed fishes, shellfish, invertebrates, as well as endangered and threatened species. Estuaries provide major sources of nutrients, nekton, prey fish, and detritus to other ecosystems, which is primarily facilitated by water movement. The cross-habitat transfer of energy and carbon from donor to recipient habitats plays a vital role in shaping food webs and productivity in recipient systems, particularly those supporting additional managed species, such as coastal migratory pelagics (i.e., mackerels), highly migratory pelagics (i.e., sharks), and species in the snapper grouper complex (Polis et al. 1997). Additionally, salt marsh estuaries provide commercial and economic value to people; it is estimated that 95 percent of finfish and shellfish species harvested commercially in the U.S. are wetland-dependent, thus could be considered estuarine- dependent (SAFMC Habitat Plan 1998)

3.2.2 Intertidal Non-vegetated Flats

Intertidal flats are the unvegetated bottoms of estuaries and sounds that lie between the high and low tide lines. Intertidal flats occur along shorelines, and can emerge in areas unconnected to dry land. Intertidal flats are most extensive where tidal range is greatest, such as near inlets. Sediment composition on intertidal shorelines tends to shift from coarser, sandy sediment on higher portions of the shoreline, with greater wave energy, to finer, muddier sediments in the lower portion of the shoreline, with relatively less wave energy (Peterson and Peterson 1979).

Intertidal flats play an important role in the ecological function of South Atlantic estuarine ecosystems, particularly in primary production, secondary production, and water quality. Although intertidal flats are usually classified as unvegetated, there is actually an extremely productive microalgae community occupying the surface sediments (SAFMC Habitat Plan 1998). Non-vegetative flats serve various functions for many species' life stages such as: feeding grounds, refuge, and nursery areas for many mobile species, as well as the microalgal community that can function as a nutrient (nitrogen and phosphorus) stabilizer between the substrate and water column. The benthic community of an intertidal flat can include polychaetes, decapods, bivalves, and gastropods. This resident benthos is preyed upon by mobile predators that move onto the flats with the flood tide. Primary production of this community can equal or exceed phytoplankton primary production in the water column, and can represent a significant portion of overall estuarine primary productivity (SAFMC Habitat Plan 1998).

Intertidal flats provide the following ecological functions: (1) nursery grounds for early stages of development of many benthically-oriented estuarine dependent species; (2) refuges and feeding grounds for a variety of forage species and juvenile fishes; (3) significant trophic support to fish and shellfish, including oysters and clams (Page and Lastra 2003); (4) stabilization of sediments via the production of exopolymers (Yallop et al. 2000) and (5) modulation of sedimentary nutrient fluxes (Cerco and Seitzinger 1997). Intertidal flats also provide habitat for a large and diverse community of infauna and epifauna, which in turn may become prey for transient fish species utilizing the intertidal flat. A wide variety of important fishes and invertebrates utilize these unvegetated flats as nurseries including the commercially important paralichthid flounders, many members of the drum family including red drum, spotted seatrout, the mullets, gray snapper, the blue crab, and penaeid shrimps (Peterson and Peterson 1979).

3.2.3 Estuarine Water Column

This habitat traditionally comprises four salinity categories: oligohaline (less than eight parts per thousand); mesohaline (eight to 18 parts per thousand); polyhaline waters (18 to 30 parts per thousand), and euhaline water (>30 parts per thousand) around inlets. Saline environments have moving boundaries, but are generally maintained by sea water transported through inlets by tide and wind mixing with fresh water supplied by land runoff. Particulate materials settle from these mixing waters and accumulate as bottom sediments. Coarser-grained sediments, saline waters, and migrating organisms are introduced from the ocean, while finer grained sediments, nutrients, organic matter, and fresh water are input from rivers and tidal creeks. The sea water component stabilizes the system, with its abundant supply of inorganic chemicals and its relatively conservative temperatures.

The aquatic organisms that flourish in estuaries rely on flow and water movement to: (1) deliver the nutrients and physical water conditions for appropriate food and nursery area development at the opportune time; (2) keep eggs and larvae of pelagic spawners in suspension to enhance survival; (3) transport and distribute eggs, larvae, and juveniles to the appropriate nursery area for optimum food availability and protection from predators; and (4) distribute sediment and affect structures that serve as habitats (i.e., shell bottom, soft bottom) for many fish species. Many fish and shellfish species occupy the estuarine water column at some point in their life cycle. Meroplankton (organisms that spend only part of their life cycle in the plankton), in particular, rely on the corridor function of the water column to transport them to favorable nursery areas.

3.2.4 Soft Bottom/Subtidal

Soft bottom habitat is unconsolidated, unvegetated sediment that occurs in freshwater, estuarine, and marine systems. Soft bottom habitat can be characterized by its geomorphology (the shape and size of the system), sediment type, water depth, hydrography (riverine, intertidal, or subtidal), and/or salinity regime (SAFMC Habitat Plan 1998). The physical and chemical composition of all soft bottom is determined by the underlying geology, basin morphology, and associated physical processes (Riggs et al. 1996). It is important to understand the physical and chemical properties of soft bottom habitat since these affect the benthic organisms that inhabit these areas and, in turn, their value as fish habitat.

Soft bottom habitats are used to some extent by most coastal fishes, especially for planktivores, like the anchovy and menhaden, who feed on benthic microalgae and organisms suspended in the water column by wave action. Many rays, drums, sturgeon, flounder, and crabs forage in soft bottom sediments for invertebrates. Smaller sharks, drums, and sea trout prey on the smaller fish and larger invertebrates in estuarine soft bottom habitat. Additionally, these environments along with intertidal mudflats, provide essential refuge from predators for young and juvenile fishes at low tide when these areas are still submerged, but too shallow for larger predators. The species associated with soft bottom subtidal habitats provide a spectrum of ecosystem services, most widespread are the nutrient cyclers. Polychaete worms, for example, are the most abundant invertebrate in subtidal environments in terms of species and overall abundance, and are constantly exposed to the nutrients and/or other materials present in the sediments. These epibenthic filter feeders maximize their exposure to these materials within the water column as they not only process a large amount of water during feeding, but being an interstitial species, they are in intimate contact with these sediments for their entire lives. These worms are a crucial part of many predators' diets, and act as a nutrient cycler or transfer to other trophic levels. For these reasons, polychaetes have long been an obvious choice to act as representative species in the analysis of the health of benthic communities (Dean 2008).

3.2.5 Estuarine Scrub/Shrub

The class of scrub/shrub wetland includes areas dominated by woody vegetation less than 6 meters (20 feet) tall, and include true shrubs, young trees, and trees and shrubs that are small or stunted because of environmental conditions. Scrub and shrub wetland fall under all water regimes except those subtidal. These wetlands may represent a successional stage leading to a palustrine forested wetland, or they may be relatively stable communities as standalone scrub/shrub habitat.

The physical environment of the habitat affects the types and distribution of plants occurring in each community type. Salinity and tidal regime are the two most important environmental factors influencing plant compositions and distribution in these estuarine communities (SCDNR 2015). At the less saline end of the estuarine zone (salinity around 0.5 parts per thousand), a mixture of freshwater and brackish plant species is common in the low and high marsh zones. As salinity rises to 10 parts per thousand in the lower marsh zone, species diversity decreases and is typically dominated by smooth cordgrass, which becomes an important component of the salt marsh. This middle area near the marsh-upland border typically is characterized by a canopy of herbaceous shrubs and a mixture of brackish and salt flat species such as: groundsel tree, sea myrtle, marsh elder, sea oxeye, salt grass, glasswort, and sea lavender (SCDNR 2015).

3.2.6 Tidal Creeks

Small tidal creeks begin in upland areas and drain into progressively larger creeks, forming an interconnecting network. These tidal creeks increase in size until they join a tidal river, sound, bay, or harbor, eventually reaching the ocean. Tidal creeks provide critical nursery areas for many species of fish and invertebrates with ample amounts of food and protection, making them ideal nursery grounds (SCDNR 2012). Many Council- and NMFS-managed species including shrimp and snapper-grouper species have cyclic life cycles, where they enter the tidal creeks during their post-larval or young juvenile stage, mature for several months during a maturation season, and then move to progressively deeper water. When the high tide floods the beds of the marsh and tidal creeks, these animals have access to nutrient-rich marsh mud, while the dense growth of cord grass restricts entry of large predators (SCDNR 2012). On the outgoing tide, larger predators such as drums or seatrout wait at the mouths of the creeks feeding on the smaller organisms flushed out of the tidal creeks, providing a valuable food source to Council- and NMFS-managed species.

3.2.7 Marine Water Column

Specific habitats in the water column can best be defined in terms of gradients and discontinuities in temperature, salinity, density, nutrients, etc. These structural components of the water column environment are not static, but change both in time and space. Therefore, there are numerous potentially distinct water column habitats for a broad array of species and life-stages. The water column serves as habitat for many marine fish and shellfish. Most marine fish and shellfish broadcast spawn pelagic eggs and thus, most species utilize the water column during some portion of their early life history (e.g., egg, larvae, and juvenile stages). White and brown shrimp, for example, spawn offshore, and shrimp larvae remain in coastal waters until they immigrate into low salinity tidal creeks using tidal currents. The marine water column is also home to a variety of adult fishes, specifically from the snapper-grouper complex, highly migratory species, and coastal migratory pelagics. These fishes utilize the marine water column for a majority of their adult lives. Many snapper and grouper species form spawning aggregations (i.e., gag grouper) along live/hard bottom areas and within the marine water column. The larvae of many snapper-grouper species remain in the water column for up to 60 days before they are transported into inshore nursery areas via tidal and wind driven currents.

3.2.8 Offshore Marine Habitats: Spawning Grounds

Essential fish habitat is identified as necessary to fish for spawning, feeding, or growth to maturity, hence their importance in ensuring viability of fish populations. These habitats can be characterized by the physical, chemical, and biological properties of their waters and substrata. Penaeid shrimp and snapper-grouper fishes produce large numbers of small-sized pelagic eggs, which also become pelagic planktonic larvae. The distribution of spawning adults, i.e., mature adults with ripe gonads, provides a direct indication of spawning grounds. The distribution of fish/shrimp eggs and larvae in the water column can be a powerful indicator of offshore spawning grounds. Penaeid shrimp, specifically brown and white shrimp, spawn in offshore coastal waters over muddy bottom; eggs typically hatch within 24 to 48 hours, and larvae go through their initial larvae stages at these spawning grounds. Once they reach their post-larvae stage, approximately 15 to 20 days after hatching, the young shrimp will immigrate inshore to estuarine nursery habitats. The value of offshore marine spawning grounds is measured by the high density of eggs and post-larvae produced in these habitats, which will contribute to the recruitment of the adult population. Similarly, adult snapper-grouper species also spawn offshore along the outer continental shelf, typically along reefs and hard-bottom. Some snapper-grouper species, such as gag grouper, form spawning aggregations in deep water over rocky bottom, wrecks, and structured habitats; the fertilized eggs typically hatch at or around these spawning locations in less than 72 hours. The larvae stages of most Council- and NMFS-managed snapper-grouper fishes remain pelagic over these offshore reefs or offshore spawning grounds, and are eventually transported by the Gulf Stream as well as tidal and wind driven currents to salt marsh nursery locations where they will grow to maturity and eventually emigrate back offshore to mature and spawn.

3.2.9 Habitat Areas of Particular Concern (HAPC)

Habitat Areas of Particular Concern (HAPC) are a subset of EFH considered rare (rarity), particularly ecologically important, susceptible to anthropogenic degradation, or located in environmentally challenged or stressed areas. HAPCs may include areas used for migration, reproduction, and development, which can include intertidal, estuarine, and marine habitats. The MSA does not provide any additional regulatory protection to HAPCs; however, if HAPCs are potentially adversely affected, additional inquiries and conservation guidance may be provided (NMFS 2008).

a. Coastal Inlets

Coastal inlets include the throat of the inlet as well as shoal complexes associated with the inlets. Shoals formed by waters moving landward through the inlet are referred to as flood tidal shoals, and shoals formed by waters moving water ward through the inlet are referred to as ebb tidal shoals. Coastal inlets meet the criteria for HAPC for penaeid shrimp, species in the snapper-grouper management unit, coastal migratory pelagics, as well as highly migratory species.

b. Oyster Reefs/Shell Bars

Oyster reefs and shell banks provide extremely unique benthic habitats with both intertidal and subtidal populations in the tidal creeks and estuaries of the South Atlantic (SAFMC Habitat Plan 1998). Not only does the larger reef or bank structure provide habitat for fish and invertebrates, but the interstitial spaces among the shell also provide microhabitats for smaller species. Oyster reefs and shell bars provide refuge, benthic-pelagic coupling, and erosion reduction. This ecosystem service largely results from the increase in structural complexity in shellfish habitat compared to surrounding areas (particularly soft sediments); areas typically associated with high structural complexity are characterized as "nursery areas", which refer to places where both juvenile invertebrate and fishes are protected from predators. These areas are critically important for juvenile Penaeid shrimp and juvenile snapper-grouper fishes in the South Atlantic region. Shell bottom protects oyster spat and other juvenile bivalves, finfish and crustaceans from predators, as well as wave action, tide swings, and storm surges.

The three major types of shellfish habitat (reefs, aggregations, and accumulations) differ in their combinations of habitat characteristics. However, all shellfish habitats have three major features in common that are the basis for their ecological value for managed species and as a critical fisheries habitat: hard substrate (for settlement/refuge/prey), complex vertical structure (for settlement/refuge/prey), and food (feeding sites for larger predators). While oyster reefs are the most recognized shell bottom habitat, shell hash concentrations on tidal creek bottoms provide important nursery habitat for young fish. For example, the preferred habitat of juvenile drum species in South Carolina is high marsh areas with shell hash and mud bottoms. Perhaps the most fundamental characteristic of shellfish habitat is hard substrate. The shells provide attachment surfaces for algae and sessile invertebrates, such as polychaetes (e.g., sabellids, serpulids), hydroids, bryozoans, and sponges, which in turn provide substrate for other organisms. All three types of shellfish habitats (i.e., reefs, aggregations, and accumulations) provide suitable substrate for other shellfish and many other species that require hard substrate on which to grow.

4. Adverse Impacts to Essential Fish Habitat Due to Navigation Activities

This section addresses potential adverse impacts to EFH and federally managed species occurring in the project area resulting from Charleston District navigation project activities, focusing on hydraulic cutter head suction and hopper dredges, which are the main dredge operations associated with the proposed actions covered by this Programmatic EFH Consultation (see Section 2). The physical impact of dredging is partly dependent on the method of dredging, the amount and grade of deposits, and overspill from the hopper. The dominant impacts of dredging are habitat loss and alteration, along with the physical removal of substratum and the organisms that utilize that substrate. This section will also focus on the environmental implications, stressors, and responses exhibited by fishes due to navigation actions.

4.1 Purpose and Overview

Navigation projects rely heavily on dredging, typically aimed at maintaining or increasing the depth of navigation channels, anchorages, or berthing areas to ensure smooth and safe passage of vessels. Descriptions of dredging and fill related activities and proposed actions covered under this Programmatic EFH Consultation are provided in Section 2.

4.2 Adverse Impacts to EFH and Federally Managed Species

Charleston District navigation activities that may adversely impact EFH include the excavation and maintenance of channels, the transportation of dredged material to disposal facilities, and the placement of dredged material. Potentially harmful activities associated with dredging vessel operations include, but are not limited to: discharge or spillage of fuel, oil, grease, paints, solvents, trash, and dredged material; grounding/sinking/prop scaring in ecologically and environmentally sensitive locations; exacerbation of shoreline erosion due to wakes.

Stressors caused by dredging and material placement include:	**The stressors associated with dredging vessel operations include:**
1. Suspended Sediments and Turbidity	1. Discharge of pollutants
2. Sedimentation	2. Grounding, Sinking, or Prop Scaring
3. Dissolved Oxygen Reduction	3. Shoreline Erosion
4. Decreased Water Quality / Contaminants	
5. Impingement and Entrainment	
6. Channel Blockage	
7. Noise Pollution	
8. Changes in Salinity	
9. Habitat Removal and Degradation	
10. Habitat Conversion	

4.3 Adverse Impacts

The following sections describe environmental impacts commonly associated with dredge activities, as well as general impacts to federally managed species, their prey, and EFH.

4.3.1 Suspended Sediments and Turbidity

Suspended sediments occur when settled bottom sediments become suspended and mixed into the water column after a disturbance or motion of the water. Suspended matter can include sediments (clay and silt) and organic matter (plankton and other microscopic organisms). Suspended matter consequently interferes with the passage of light through the water and increases turbidity, the degree to which water loses its transparency. Suspended sediments occur naturally in muddy-bottom areas by storms, freshets, or tidal flows (Wilber and Clarke 2001); however, dredging-related activities usually result in prolonged exposure to suspended sediments over a large area.

Typically, elevated particles and turbid water tend to be localized in the immediate vicinity of the cutter head and decrease with increasing distance from the dredge site. The cutter head dredge produces the least amount of suspended sediments, which usually occur along the bottom portion of the water column, while hopper dredges (without overflow) produce more suspended particles near surface waters. Studies have indicated elevated sediment levels up to 1,100 feet from a dredge excavation site (Blair et al. 1990), but concentrations immediately decreased to 10 parts per million within one hour (Neff 1985). Suspended sediments have also been associated with decreased dissolved oxygen levels and impacts to water quality which also put fish at greater risk for being adversely impacted (see Sections 4.3.3 and 4.3.4).

Many coastal and estuarine-dependent species produce pelagic, free-floating eggs, while some anadromous fishes produce demersal eggs. Demersal eggs are more likely to come into contact with suspended sediments within the water column, where they can become subject to burial by accumulated deposited sediments and/or entrainment by suction dredges. Cairns (1968) documented direct effects to fish larvae and eggs by suspended sediments, which include: the abrasion of egg and larval surficial membranes (gills or the epidermis); reduced light availability; resuspension and absorption of contaminants reintroduced into the water column; interference with feeding; and delayed larvae development. As South Carolina estuaries serve as nursery grounds for larval and juvenile stages of fishes, dredging activities occurring during documented spawning times and during periods of ingress or egress would be more likely to cause adverse impacts. Suspended sediments have been documented to affect the hatch successfulness of eggs, percent survival of larvae post-exposure, and increase the time between fertilization and hatching. The eggs and larvae of non-salmonid estuarine fishes exhibit some of the most sensitive responses to suspended sediment exposures of all the taxa and life history stages (Wilber and Clarke 2001). Suspended sediments, especially when fine-grained, decrease the quality and quantity of incident light levels, resulting in a decline in photosynthetic productivity. The increased turbidity reduces visual acuity in fishes, which leads to an array of behavioral, physiological, reproductive, and feeding changes (Wenger et al. 2016). Foraging patterns and success are commonly studied behavioral responses of estuarine fishes to suspended sediments and turbidity; if persistent, decreased feeding success in juveniles may hinder survival, recruitment, year-class strength, and overall physical condition. For adult fishes, the most commonly observed behaviors to elevated levels of suspended sediments are avoidance, changes in foraging patterns, and success rate (Wenger et al. 2016).

4.3.2 Sedimentation

The physical removal of substratum and associated biota, resuspension into the water column, and animal burial due to the subsequent deposition (i.e., sedimentation) of material are the most direct effects of dredging projects. Recent studies suggest the initial sedimentation of material released during the outwash stage of dredging does not actually disperse; rather, it behaves more like a density current where the sediment particles are held together during the initial phase of sedimentation. This in turn effects the immediate area a few hundred meters around the dredge operation rather than dispersing and settling further distances from the dredge site (Newell et al. 1998). Sedimentation can pose major impacts to areas with sedentary species, such as oysters, where small amounts of silt may be enough to cause high rates of mortality. Heavy sedimentation on oyster reefs can cause direct oyster mortality, loss of foraging habitat, loss of shelter functions for other reef fishes and crustaceans when sediments fill the interstitial spaces between oyster shells (Wilber and Clarke 2001). Some documented examples of lethal and sublethal effects of sedimentation on fishes and associated EFH include: decreased feeding ability; decreased growth rates; avoidance and displacement; prolonged egg development and survival;, as well as decreased primary and secondary productivity (Kjelland et al. 2015).

Sedimentation has also been shown to inhibit foraging ability in benthic-feeding fishes (Bellwood and Fulton 2008). Lowe et al. (2015) investigated the impacts of increased sedimentation and subsequent turbidity on juvenile snapper in a shallow estuary, and demonstrated that foraging success had a significant decline following short-term turbidity pulses. Chronic exposure (30 days) to levels resembling that of storm conditions can cause acute effects on fish growth and health, including significant weight loss, increased mortality, presence of gill lesions, and hypoxic behaviors (gulping at surface, lethargy, and increased ventilation). Lowe et al. (2015) found a higher occurrence of gill lesions and fish mortality in estuaries characterized by increasing sedimentation, lower water clarities, frequent levels of disturbance, and increasing urbanization. The most visible turbidity plumes observed by Goodwin and Michaelis (1984) were produced by the discharge of material with high sand content into unconfined placement areas during times of strong tidal currents. The least visible turbidity plumes were produced by the discharge of material with high silt and clay content into areas enclosed by floating turbidity barriers during times of weak tidal currents. Beach nourishment from hopper dredge unloading operations also produced plumes of low visibility (Goodwin and Michaelis 1984). Primary plumes were observed to be directly produced by dredging and placement operations, while secondary plumes were produced indirectly by resuspension of previously deposited material; but if the fill material is compatible with native material, nearshore communities should not be adversely affected by raised turbidity levels. Because the ecological impacts of sedimentation and turbidity on oyster reefs and benthic-feeding fishes and snappers can be severe in South Carolina estuaries, dredging-induced sedimentation and turbidity should be minimized, as practicable.

4.3.3 Dissolved Oxygen Reduction

Dredging induced reductions of the concentration of dissolved oxygen (DO), or hypoxia, is a direct consequence of the suspension of anoxic sediments around a dredge site, resulting in the creation of both chemical and biological oxygen demands. DO is a function of the: (1) sediments suspended into the water column (Lunz and LaSalle 1986); (2) the oxygen demand of the sediment; and (3) the duration of the resuspension (Wilber and Clarke 2001). Sediments found along South Carolina estuaries and the AIWW are dominated by silts and clays, which are anoxic below the upper few centimeters (Stickney and Perlmutter 1975). DO in the AIWW is lowest typically during the summer months. Resuspension of anoxic sediments into the water column should be minimized, especially during the summer months.

4.3.4 Decreased Water Quality/Contaminants

The release of naturally occurring particles such as nutrients, sulfides, and iron, as well as industrial related particles (i.e., metals, organohalogens, and pesticides) by the suspension of sediments during a dredge event does occur. Contaminants entering aquatic systems from agricultural, industrial, and municipal activities typically accumulate in bottom sediments (Winger et al. 2000). Most metals and other compounds are generally not readily available in a soluble form within the water column, but can be associated with organic matter and clays

(Windom 1972, 1976). Contaminants entering aquatic systems bind to the suspended particulate matter and these become incorporated into the sediments (Winger et al. 2000). Contaminated sediments containing harmful metals or other compounds have a greater impact on fish health than suspended sediments alone, since the disturbance of these sediments through dredging has the potential to increase bioavailability. These contaminants also pose a risk to wildlife inhabiting disposal areas upon transferring the sediments, and have the ability to enter multiple levels within the food chain (top-level consumers, primary consumers, producers, and decomposers).

Assessing the level of contamination in sediments is a key step in determining its suitability for beneficial uses. In general, the more contaminated the material, the greater the constraints on reuse. Highly contaminated material is not suitable for reuse unless its potential risk for biomagnification is low. Proper assessment of sediment contamination for dredging activities is critical to minimizing potential adverse impacts. A full characterization of sediment contamination should be conducted to assess any potential exposure and impacts to fishes and habitats.

4.3.5 Impingement and Entrainment

Hydraulic entrainment is the direct uptake/removal of aquatic organisms by the suction field generated at the drag head or cutter head (Reine et al. 1998). Both demersal and pelagic fish eggs, larvae, and small juveniles are highly susceptible to entrainment by suction dredges due to their inability to escape the suction area around the intake pipe (McNair and Banks 1986). They may be picked up directly with the sediment being drawn in or in the vicinity of the surrounding water column near the suction field. Depending on species and time of year, free-floating eggs and young juveniles migrate in and out of inshore waters at various depths within the water column, becoming more or less prone to entrainment. If dredge operations occur during migration periods and/or work is confined to narrow-channel habitats, the potential for entrainment may increase, especially for bottom dwelling fishes, larval oysters, and post-larval white and brown shrimp (Van Dolah et al. 1984). Several studies have indicated that eggs are more vulnerable to entrainment than adults, experiencing damage and mortality more than double that of adults (Wenger et al. 2016). Even though the volume of water entrained by dredges is small in comparison to other sources, if a dredge is in close vicinity to spawning or nursery locations, entrainment rates of eggs and larval fish could be detrimental. The entrainment rates of eggs and larval due to dredging represent a small proportion of the total larval production, but when eggs and larvae are sucked up by hydraulic dredges, they experience a high mortality rate in comparison to other life stages (Harvey and Lisle 1998).

4.3.6 Channel Blockage

This refers to the physical presence of the dredging equipment and sediment disposal pipelines. Channel blockage is suspected to have a minimal effect on the distribution and movement of juvenile and adult organisms. While placement of equipment has little effect on smaller, coastal fishes, it is particularly important to anadromous fishes. The time of year, i.e., environmental windows, should be considered for these animals with regards to channel blockage, as practicable.

4.3.7 Noise Pollution

Dredging projects do not produce intense sounds compared to that of pile-driving or other in-water construction, but rather lower levels of continuous sound at frequencies generally below one kHz. When dredging involves the demolition of rock, the sound generated is louder compared to the soft sediment dredging typically done. Based on the existing literature, underwater noise can affect fish in a number of ways, including behavioral responses, masking, physiological stress, hearing loss or damage, impairment of lateral line functions, and particle motion-based effects on eggs and larvae (Popper et al. 2014; Wenger et al. 2016). Evidence suggests fish possessing a swim bladder may be more affected by dredge noises than fish without a swim bladder (Popper et al. 2014). Fishes that have a swim bladder used for hearing are more likely affected by the continuous noise produced by dredge operations, compared to those without a swim bladder. Fish possessing a swim bladder do show some temporary hearing loss and behavioral effects such as avoidance and site aversion (Popper et al. 2014). Although dredging may not produce sound levels that can be lethal to fish, dredging noises may mask natural sounds used by fish to locate prey or suitable habitat, thus effecting foraging ability, spawning aggregations, or optimal habitat utilization.

4.3.8 Changes in Salinity

When a channel is dredged, the increased depth can result in higher salinity farther upriver, a type of habitat conversion (see section 4.3.10). The intrusion of salt water further into the estuary or in the river system could impact fish assemblages. Higher salinities tend to occur once a channel is dredged, and thus become less desirable or suitable for species that have a lower salinity tolerance or preference. This can lead to shifts in fish communities, abundance in a small area, increased competition, and could result in negative shifts within food-web dynamics (Güt and Curran 2017). However, given the scope of the activities considered herein, change in salinity is not considered a major threat for the activities covered by the Programmatic EFH Consultation.

4.3.9 Habitat Removal and Degradation

In the AIWW, the frequency of maintenance dredging is not expected to be significantly different than what has occurred in past maintenance events. Stickney and Perlmutter (1975) documented rapid community recovery of benthic organisms post dredging, as well as no to very little change in sediment composition between dredging events in the AIWW. The existing navigation channel side-slopes are not expected to change with any maintenance dredging event and, therefore, shellfish harvest areas adjacent to the channel should not be impacted. These shellfish areas are important essential fish habitats and nursery areas, especially for juvenile gray snapper and gag grouper. Maintenance dredging along the AIWW has been shown to completely displace infauna communities, but both species diversity and composition returned to their pre-dredging levels within a month of post-dredge operations (Stickney and Perlmutter 1974). Given the highly variable nature of most estuarine and marine benthic assemblages on the southeastern coast of the U.S., disturbances by maintenance dredging and placement activities usually represent relatively minor and short-lived impacts, consistent with the ecological disturbance theory.

4.3.10 Habitat Conversion

Habitat conversion is a form of habitat destruction, characterized by the conversion of one naturally functioning aquatic system at the expense of creating another. Habitat conversion typically occurs with the conversion of: shallow subtidal to deeper subtidal habitats; intertidal to subtidal or upland habitats; and salt marsh or oyster beds to mud flats. These habitat conversions can cause a ripple of changes to estuarine circulation, salinity, sediments, and can directly influence the distribution of estuarine and nearshore marine biota. New dredging work poses the risk of converting intertidal habitats to subtidal habitats, while maintenance dredging poses the risk of converting shallow subtidal habitats to deeper subtidal habitats (SAFMC Habitat Plan 1998). Additionally, beach placement and similar beneficial reuse projects pose the risk of converting historical subtidal beach into intertidal beach if too much sand is deposited along the beach at once or in a manner that disrupts the beach slope. The ecological characteristics of the beach fauna and flora are very much determined by morphodynamic beach characteristics such as grain size and beach slope; very similar to the construction of hard structures to manage beach erosion (i.e., rock jetties), beach placement puts a severe pressure on the biota living on, in, and around these sandy beaches (Eede 2013). Past the initial disturbance of beach placement, benthic and infaunal communities can be further disrupted and altered if the beach face is converted into intertidal or even subtidal habitats.

Upland placement methods have the potential to convert salt marsh or oyster bottom to mud flats if sediments are not disposed of in a confined manner. Intertidal conversions pose the risk of impacting plant and animal assemblages unique to tidal regimes, substrate, light, and exposure (i.e., air and water exposure). The loss of intertidal habitat, which provides essential refugia and nursery functions for most managed fishes, represents potential reductions in coastal habitat carrying-capacity and connectivity (Peterson et al. 2003). The deepening of shallow sub-tidal habitat can cause multiple losses to habitat integrity including: reduction in photosynthetic ability within the water column; reductions in primary and secondary productivity; increase the likelihood of benthic hypoxia; and alterations to localized benthic-pelagic coupling which effects both federally and state managed species. Particular care should be given to the design and implementation of beneficial reuse projects to ensure that habitat conversions are avoided in order to minimize adverse impacts.

4.3.11 Discharge of Pollutants

Every year, diesel, petrol, oil, and other toxic chemicals are accidentally discharged into marine waters during vessel operations. Major oil spills can occur when vessels collide, run aground, or occur when oil cargoes are transferred. Oils discharged into the marine area can have serious implications on: megafauna; fishes; micro-organisms that break down these oils; estuarine dwelling organisms; as well as the contamination of shellfish beds. The accidental release of oil into seawater introduces PAHs, which are typically sequestered in bottom sediments. Once bottom sediments are disturbed, the petroleum components (usually PAHs) are reintroduced into the water column, becoming available for consumption or come into contact with a variety of organisms. The discharge of these and other pollutants has been linked with dysfunctions in reproductive success, endocrine disruption, post larval growth, and embryonic development of fish (Collier et al. 2013).

4.3.12 Grounding, Sinking, or Prop Scaring

Ship grounding is the impact of a ship on the seabed, usually a result of accidental "running aground," where the depth of the ship passage is not sufficient to completely submerge the ship's hull. Grounding can also result from vision impairment, current and tide swings, waves, wind, and speed of the vessel. Other forms of vessel to seabed interaction including boat sinking and prop scaring. Sinking occurs when the majority of a ship's hull is submerged or the vessel capsizes. Prop scaring is the result of vessels traveling in areas too shallow for the vessel operation, and the propellers leave permanent scars on the seabed floor. In areas where habitats are susceptible to disturbances, ship to substrate interaction can lead to a reduction in habitat productivity, reduction in the number of organisms in that locality, habitat destruction, and direct organism mortality (IMO 2018).

4.3.13 Shoreline Erosion

Vessels moving at fast speeds through coastal passages can create a large wake, which in turn can impact the estuarine environment. Shoreline erosion is particularly associated with large vessels or fast ferries, which are much faster than conventional vessels (e.g., dredging vessels). Faster speeds produce a longer-period wake, which disturbs the seabed at greater depths than conventional shipping. Ship wakes can become the major source of energy in coastal systems where the level of background energy is low and pose a greater risk to shoreline erosion. This is the case for enclosed basins such as estuaries, coastal lagoons, embayments, and intracoastal waterways. This can result in changes to the coastline habitat and the composition of the communities that live there by altering the shape of the shoreline, resulting in accelerated coastal erosion. Coastal erosion can lead to a range of detrimental effects including economic impacts due to property destruction, habitat destruction and degradation, and ecological impacts resulting from loss in biodiversity (associated with habitat removal and degradation 4.3.9 and habitat conversion 4.3.10).

5. Programmatic EFH Consultation Conservation Recommendations for Navigation Activities

This Programmatic EFH Consultation is for the Charleston District's navigation projects and minor new work associated with navigation projects and activities. During the formulation of the programmatic consultation process, the Charleston District coordinated the activity categories with NMFS. In addition, the Charleston District requested NMFS to provide conservation recommendations that would help conserve EFH by avoiding and minimizing adverse effects to EFH. The Charleston District has generally accepted these conservation recommendations described here in Section 5 of this Programmatic EFH Consultation, but will still undertake project-specific review in accordance with Appendix B. To comply with this Programmatic EFH Consultation, the Charleston District will implement all applicable conservation recommendations described within the category that contains that activity, unless otherwise documented in accordance with Appendix B. In addition to these conservation recommendations, the Charleston District may propose additional measures that would result in reduced adverse effects to EFH, but may not substitute new measures for the conservation recommendations linked to each activity as described in this Programmatic EFH Consultation unless otherwise documented in accordance with Appendix B. If NMFS notifies the Charleston District (in accordance with Appendix B) that NMFS' Southeast Regional Office, Habitat Conservation Division (SERO HCD) does not concur with the Charleston District's determination that the project is consistent with the Programmatic EFH Consultation, the Charleston District will conduct additional coordination with SERO HCD and a separate individual EFH consultation may be required.

Conservation recommendations, such as Best Management Practices (BMPs), will address all reasonably foreseeable adverse impacts on EFH by similar individual actions occurring within a given geographic area. Therefore, this section lists BMPs focusing on avoidance and minimization strategies to avoid adverse impacts to EFH most applicable to navigation activities and does not include BMPs that would be applicable only to new dredging projects. The BMPs provided below are commonly recommended for navigation activities and can be traced back to Non-Fishing Impacts to EFH and Recommended Conservation Measures Guide (NOAA Fisheries 2003), the National Park Service Beach Nourishment Guidance (Dalles et. al 2012), and the SAFMC beach dredging and renourishment policy (2015; can be found at http://safmc.net/).

5.1. Time of Year Recommendations

Time of Year (TOY) restrictions are recommendations providing the optimal time periods for federal projects to perform dredge and disposal activities. These TOY recommendations are a type of environmental time window routinely recommended by resource agencies to further protect sensitive biological resources, habitats, and organisms from potentially detrimental effects of dredging and disposal operations. Annually, around 80 percent of all USACE civil works navigation projects implement environmental windows, including the Charleston District (Reine et al. 1998). TOY recommendations can be categorized on the likelihood of effects to fish and other species based on entrainment, turbidity, sedimentation, physical disturbance, dissolved oxygen, and migration patterns, as well as effects to: oysters, shellfish, crab, lobster, shrimp, and submerged aquatic vegetation, Potential detrimental impacts to federally managed species and anadromous fishes are the common reasons for a District to consider TOY recommendations. TOY recommendations for South Carolina are provided in Table 2 using current literature and available fisheries independent data from SCDNR and GADNR, as well as additional information provided by the National Centers for Coastal Ocean Science (NCCOS) (Wickliffe et al. 2019). The TOY recommendations were designed to reflect major ingress and egress times, as well as vulnerable life stages of managed species present in EFH. Seasonal conservation measures for fisheries during coastal development activities in the Carolinas and surrounding areas are available through NCCOS (Wickliffe et al. 2019).

All Charleston District navigation activities should be timed and located in ways that avoid and minimize potential adverse impacts to NOAA-trust resources, as practicable (Table 2). The TOY recommendations for discouraging navigation dredging of coastal inlets and AIWW and sediment transport is from March through October, and encouraging navigation actions to occur during November through February. Due to the large amount of ingressing larval stages in March through May, the NMFS recommends avoiding dredging and related navigation actions in coastal inlets and the AIWW, as practicable, especially in areas with marine emergent wetlands (i.e., intertidal marshes) to avoid larval entrainment. Ideally, but only as practicable, navigation actions would be restricted through the summer to allow for the growth of larvae and juvenile life stages until October 15, when the majority of animals reach maturity and egress out of the estuary to offshore waters. To the maximum extent practicable, activities should be conducted when species are not present in the project area, or are present in low densities. For this reason, the NMFS recommends conducting in-water work from October 15 until March 15 as practicable, if located in areas where managed species persist; however, the time between March 15 and April 15 can be used to conduct navigation activities when the TOY cannot be accommodated. Ideally, and as practicable, navigation work should occur before April 15 to allow recovery of the benthos used by susceptible life stages throughout the spring and summer, ahead of the fall egress.

Table 2. Time of Year recommendations for navigation activities. Using the current literature, the NCCOS Tech Memo, and SCDNR and GADNR Fisheries Independent Data, ingress and egress times, as well as fish presence for each of the following managed species present in inlets and estuarine EFH located with navigation activities were estimated by life stage. Neonatal and juvenile Bull shark presence is pulled from Streich and Peterson (2011). Life stages are designated with the following abbreviations in order: E – egg; L – larvae; P –post larvae; N – neonate; J – juvenile; S – sub-adult; A – adult. Young of year (YOY) indicate young juveniles less than a year old.

Species	Month											
	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
White Shrimp	J	J	L, P	L,P	P	P, J	J	J	J	J	J	J
Brown Shrimp		L,P	L,P	P	P	J	J	J				
Gag Grouper			P	P	P, J	P, J	J	J	J	J		
Gray Snapper									L, P	P, J	P, J	P, J
Black Sea Bass			P	P	P	P, J	P, J	P, J	J	J		
Spanish Mackerel						L, P, A	P, J	P, J	P, J	J, A		
Summer Flounder	L	L, J	J,A	J,A	J,A	J,A	J,A	J,A	J,A	L,J, A	L, J	L, J
Bull shark	A	A	A	A	N,J,S, A	N,J,S, A	N, J, S, A	N,J,S, A	YOY, J,S, A	YOY, J, S	A	A
Sandbar Shark						N, J, A	N, J	N, J	N, J	J		
Scalloped Hammerhead					N, J, A	N, J, A	N, J, A	YOY, J	YOY, J	YOY, J	YO Y, J	
Lemon Shark					N, J, S, A	N, J, S, A	YO Y, J, S, A	YOY, J, S, A	YOY, J, S, A	YOY, J, S, A		
Location												
Coastal Ocean/Inlets*												
AIWW												

*-timed to allow recovery of benthos ahead of fall egress

Legend			
Species Occurrence		Time of Year Recommendations	
Ingress		Preferred Time for In-Water Work	
Present		Consider avoiding In-Water when practicable	
Egress		Avoid In-Water Work when practicable	

5.2. Dredging

5.2.1. Potential Adverse Impacts

The environmental effects of dredging in or adjacent to designated EFH areas can include: (1) direct removal and burial of organisms; (2) turbidity and siltation effects, including light attenuation; (3) contaminant release and uptake including nutrients, metals, and organics; (4) suspended sediments; (5) sedimentation; (6) alteration to hydrodynamic regimes and physical habitat; and (7) habitat degradation and/or conversion.

5.2.2. Recommended Best Management Practices

1. Avoid new dredging to the maximum extent practicable.
2. If minor new work is deemed necessary as part of navigation activities, then dredging area and volume should be reduced to the maximum extent practicable that will still accomplish the stated project purpose; areas that are within the project area, but are deeper than the target dredge depth should be avoided.
3. Incorporate adequate control measures to minimize turbidity plumes. Hydraulic dredging techniques should be the preferred method in areas with fine sediments to reduce turbidity plumes.
4. Equipment to avoid and minimize impacts to species should be used during dredging activities. These include, but are not limited to, sea turtle deflector dragheads and floating pipelines. Inflow screening baskets should be installed to monitor the intake and overflow of the dredge.
5. Avoid placing dredging pipelines and accessory equipment close to oyster aggregations, estuarine/salt marshes, and other high value habitat areas.
6. Implement time-of-year recommendation (i.e., environmental windows), as practicable, to further avoid impacts to habitat during species critical life history stages. Perform dredging during the time frame when impacts due to entrainment of federally managed species or their prey are least likely to be entrained, as practicable. Dredging should be avoided in areas with oyster aggregations.
7. For maintenance dredging, sources of erosion in tidally influenced areas should be identified that may be contributing to excessive siltation and sedimentation and the need for maintenance dredging. Techniques or programs should be implemented that reduce erosion and sedimentation.

For unavoidable adverse impacts to EFH, the Charleston District will consider measures to minimize, mitigate, or offset such effects of the activity on EFH, as appropriate.

5.3. Placement of Dredged Material

5.3.1. Potential Adverse Impacts

The placement of dredged material can adversely affect EFH by: (1) impacting or destroying benthic communities; (2) habitat removal and degradation; (3) creating turbidity plumes; (4) introducing contaminants and/or nutrients; and (5) burial of organisms.

5.3.2. Recommended Best Management Practices

1. All available options for placement of dredged materials, including placement sites and methods used should be thoroughly investigated. Placement areas should be properly sited, managed, and monitored to avoid adverse impacts associated with dredge material placement.
2. Placement of dredge material in EFH should meet or exceed applicable state and/or federal water quality standards for such placement.
3. Direct and indirect impacts of open-water disposal of dredged material on EFH should be assessed during navigation project reviews. If necessary (e.g., the project occurs outside TOY recommendation), physical and biological monitoring programs to gauge whether actual results of open-water placement are within the predicted ranges should be conducted.
4. The areal extent of any placement site in EFH should be avoided or, if identified as a beneficial use, minimized.
5. Dredge placement sites should be appropriately considered, using the volumes of proposed dredged material prior to dredging so placement sites will adequately contain dredge material.
6. Beneficial uses of uncontaminated sediments should be considered whenever practicable; materials that contribute to habitat restoration and enhancement should be prioritized.
7. When practicable, placement of dredge material should be avoided outside the TOY recommendations (Section 5.1) when direct burial or sedimentation to EFH, federally managed species or their prey are most likely to be impacted.
8. Placement of material into undiked tracts, regardless if Geotubes or similar structures are used, should include Best Management Practices to minimize the likelihood of impacts occurring outside placement areas from the dredged material and from any dike construction.
9. Pipelines between the dredges and placement sites should pass through the least amount of EFH, as practicable, and avoid oyster beds.

For unavoidable adverse impacts to EFH, the Charleston District will consider measures to minimize, mitigate or offset such effects of the activity on EFH, as appropriate.

5.4. Dredging Vessel Operations and Transportation of Dredged Material

5.4.1. Potential Adverse Impacts

The routine operation and maintenance of navigable waterways introduces dredging vessels more frequently to the surrounding environment. The use of large dredge vessels increases the likelihood of encounters with the surrounding habitat and organisms, including dredging vessel groundings, modification of water circulation (breakwaters, channels, and fill), dredging vessel wake generation, pier lighting, anchor and prop scouring, and the discharge of contaminants and debris. Direct impacts include permanent or temporary loss of productive forage habitat resulting from minor channel realignment and maintenance dredging, turbidity-related impacts due to both dredging and placement of dredged material, and reduced water quality from resuspension of contaminated sediments. Dredging vessel discharges, engine operations, bottom paint sloughing, boat wash-downs, painting and other vessel maintenance activities can deliver debris, nutrients, and contaminants to waterways and may degrade water quality and contaminate sediments if gone unnoticed.

5.4.2. Recommended Best Management Practices

1. For unavoidable adverse impacts to EFH, compensatory mitigation may be required to replace the loss of wetland, stream, and/or other aquatic resource functions and area.
2. Include low-wake vessel technology, appropriate routes, and best management practices for wave attenuation structures as part of the design process. Dredging vessels should be operated at sufficiently low speeds to reduce wake energy, and no-wake zones should be designated near sensitive habitats.
3. The discharge of contaminated bilge water and sewage is illegal and strictly prohibited.
4. Prevent oil contamination of bilge water. Do not drain oil into the bilge. Use containment troughs underneath the engine to capture any drips or spills and oil absorbent pads, socks or pillows to soak up oil and fuel. Keep the bilge area of the dredging vessel as clean and dry as possible fixing all fuel and oil leaks as they occur. Inspect fuel lines and hoses for chaffing, wear, and general deterioration and secure and prevent hoses from chaffing. Clean bilge areas after engine maintenance.

5.5. Beneficial Use - Beach and Nearshore Placement

This section lists BMPs focusing on avoidance and minimization strategies to avoid adverse impacts to EFH most applicable to federal navigation project beach and nearshore placement activities and does not include BMPs that would be applicable only to new beach nourishment projects.

5.5.1. Potential Adverse Impacts

The implementation of restoration/enhancement activities may have localized and temporary adverse impacts on EFH. Possible impacts can include: (1) localized nonpoint source pollution such as influx of sediment or nutrients; (2) interference with spawning and migration periods; (3) temporary or permanent removal of feeding opportunities; and (4) animal burial or smothering.

5.5.2. Recommended Best Management Practices

1. Use material consisting solely of natural sediment and shell material, containing no construction debris, toxic material or other foreign matter.
2. Use material similar in color and grain size distribution (sand grain frequency, mean and median grain size and sorting coefficient) to the native material in the project area. Ideally, sediment used for beach placement should be indistinguishable from native site sediment in terms of color, shape, size, mineralogy, compaction, organic content, and sorting. Sediment for nearshore placement should also be of similar color, shape, size, mineralogy, compaction, organic content, and sorting to any nearby beach sites.
3. Beach placement projects should use fill material with a composite grain size distribution similar to that of the native beach material. Ideally, the median size of the dredged sediment should not be less than the median of the native material and the spread of sizes in the dredge distribution should not exceed that of the native sediment.
4. Avoid beach and nearshore placement in areas containing sensitive marine benthic habitats adjacent to the beach (e.g., spawning and feeding sites, hard bottom, and cobble/gravel substrate).
5. When practicable, conduct beach and nearshore placement following the TOY recommendations (Section 5.1), when productivity for benthic infauna is at a minimum; this may minimize the impacts for some beach sites.
6. Slope of the beach after placement of dredged material should mimic the natural beach profile.
7. The overall volume of fill material to be added to the beach in any fill episode should not exceed 50 percent of the estimated annual net sediment transport for the beach in order to minimize the magnitude of the disturbance to the ecosystem and to prevent large-scale alterations of the local coastal processes.
8. If heavy equipment is used on the beach for placement activities, it should not leave ruts. Storage of heavy equipment and pipe on the beach should be avoided to the extent possible, using staging areas off of the beach wherever available.
9. When practicable, placement episodes should only be conducted after the ecosystem has fully recovered for a duration of at least one year, preferably two or three, in order to avoid permanent perturbations to the system; and disturbances should be episodic and their ecological impacts should not overlap between placement episodes (i.e., a placement episode should not take place before the impacts from the previous fill event have completely abated).
10. A during-construction monitoring plan as deemed necessary for a specific project, designed with appropriate methodology to adequately detect and document both direct and indirect project impacts. Monitoring plans, if deemed necessary, should follow the Before-After-Control-Impact (BACI) sampling framework.
11. A post-construction monitoring plan as deemed necessary for biological, physical and water resources designed with appropriate methodology to adequately detect and document both direct and indirect project impacts. Monitoring plans, if deemed necessary, should follow the BACI sampling framework.

6. Programmatic Consultation Procedures

For a given navigation project, the Charleston District must first determine whether EFH may be present and whether the activity is covered under this programmatic consultation. The Programmatic EFH Consultation will serve as a fundamental tool between NMFS and the Charleston District to review activities that conform to all conditions described. This programmatic consultation will be adaptive, accountable, and credible as a conservation tool. As such, additional categories of activities and/or stressors may be added and/or removed based on best available scientific information. The scope of the Programmatic EFH Consultation remains limited to those activity and project types that will not have a substantial adverse effect both individually and cumulatively on EFH. The review and consultation procedures are further described in the following section.

6.1 Annual Meeting

Following the implementation of this Programmatic EFH Consultation, the Charleston District and SERO HCD will meet annually, in-person or virtually. The Charleston District and SERO HCD may subsequently agree to meet less often if both agencies agree the programmatic consultation is functioning as intended and if less frequent meetings will not undermine the goals of the Programmatic EFH Consultation. At the meeting, the Charleston District and SERO HCD will:

- discuss the annual tracking of covered projects;
- evaluate and discuss the continued effectiveness of the programmatic consultation;
- account for any new information or technology;
- ensure the activities authorized by the programmatic consultation continue to minimize adverse effects to EFH; and/or
- update the procedures, covered actions, or best management practices, if necessary.

6.2 Project Verification Requirements

After implementation of this Programmatic EFH Consultation, the Charleston District will not need to initiate individual EFH consultation for covered navigation projects (Section 2). For each project proposed under this Programmatic EFH Consultation, the Charleston District will provide all of the required project-specific information to SERO HCD. This will serve as a record of the activity to take place and account for cumulative effects of those activities funded or authorized by the Charleston District. The Charleston District will track and analyze the activities on an annual basis, as noted below, and will review the results with SERO HCD.

6.2.1 Initial Screening Process

6.2.1.1. The Charleston District will screen the project for the presence of EFH/EFH-HAPC and/or federally managed species (Section 3).

6.2.1.2. If EFH may be present within the project action area, then the Charleston District will review the Programmatic EFH Consultation to determine whether the project conforms to the activity description and the specified criteria and limitations.

6.2.2 Impact Determination and Consultation Type

Once there is sufficient information on the project design, the Charleston District will make an EFH determination on the project effects using the following standards.

6.2.2.1. If the action does not adversely affect EFH temporally or spatially, the Charleston District will determine that an action covered by this Programmatic EFH Consultation will not adversely affect EFH, and no EFH consultation is required. It is not necessary to notify SERO HCD or seek NMFS' concurrence with the determination if there is no adverse effect to EFH.

6.2.2.2. If the action may adversely affect EFH, then the Charleston District will initiate programmatic consultation with SERO HCD in accordance with Appendix B. An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from an action occurring within or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

6.2.3 Projects using Programmatic EFH Consultation process

6.2.3.1. The Charleston District will send the verification form (Appendix B) to SERO HCD for each project covered under the Programmatic EFH Consultation, with complete project information.

6.2.3.2. Within 15 calendar days of receipt of the verification form (Appendix B), SERO HCD will notify the Charleston District (via execution of Part III of the verification form) whether SERO HCD concurs with the Charleston District's determination that a given project is consistent with the Programmatic EFH Consultation. If the 15th calendar falls on a weekend, the deadline shall be the next business day. The Charleston District will ensure that any project using the Programmatic EFH Consultation incorporates all applicable EFH best management practices, unless otherwise documented in accordance with Appendix B.

6.3 Annual Report

The Charleston District will provide an annual summary of the activities carried out under this Programmatic EFH Consultation for the purpose of determining the effectiveness of the programmatic consultation and calculating aggregate effects. The Charleston District will provide the compiled information to SERO HCD for the previous calendar year of activities, each year that the Programmatic EFH Consultation is in effect. The reporting period ends December 31each year and the Annual Report will be due 90 days later.

The Annual Reporting Spreadsheet and description of results will be sent electronically to:

National Marine Fisheries Service SERO
Habitat Conservation Division
Attn: Cindy Cooksey
331 Fort Johnson Road
Charleston, South Carolina 29412
Cynthia.Cooksey@noaa.gov and nmfs.ser.hcdconsultations@noaa.gov

6.4 Revisions and Withdrawal

The Charleston District and SERO HCD will discuss the need for revisions at the annual meetings, as noted above. Revisions may be needed to account for new information or technology or to better streamline the coordination process. SERO HCD and the Charleston District may revise this document (e.g., restricting or expanding its scope) at any time by agreement of both agencies. At any time, NMFS or the Charleston District may withdraw from this Programmatic EFH Consultation by providing written 15-day notice. NMFS and the Charleston District are encouraged, but not required, to attempt to address any issues via proposed revisions before withdrawing from the Programmatic EFH Consultation.

6.5 Supplemental Consultation

Pursuant to 50 CFR § 600.920(a)(l), the Charleston District must reinitiate EFH consultation with SERO HCD if the proposed action considered under this Programmatic EFH Consultation is substantially revised in a manner that may adversely affect EFH, or if new information becomes available that affects NMFS trust resources. In addition, if SERO HCD receives new or additional information that fall outside the scope of this Programmatic EFH Consultation, SERO HCD may request an additional consultation.

7. References

Bellwood, D.R. and C.J. Fulton. 2008. Sediment-mediated suppression of herbivory on coral reefs: Decreasing resilience to rising sea-levels and climate change? Limnology and Oceanography, 53, 2695–2701.

Blair, S.M., B.S. Flynn, S. Markley. 1990. Characteristics and assessment of dredge related mechanical impact to hard-bottom reef areas off northern Dade County, FL. Diving for Science 90.

Cairns, J. 1968. Suspended solids standards for the protection of aquatic organisms. Purdue University Engineering Bulletin, 129: 16-27.

Cerco, C.F. and S.P. Seitzinger. 1997. Measured and modeled effects of benthic algae on eutrophication in Indian River-Rehoboth Bay, Delaware. Estuaries and Coasts, 20(1): 231-248.

Collier, T.K., B.F. Anulacion, , and M.R. Arkoosh. 2013. Effects on Fish of Polycyclic Aromatic Hydrocarbons (PAHS) and Naphthenic Acid Exposures. Organic Chemical Toxicology of Fishes 33: 195-255.

Dallas, K. L., J. Eshleman, and R. Beavers. 2012. National Park Service beach nourishment guidance. Natural Resource Technical Report NPS/NRSS/GRD/NRTR—2012/581. Fort Collins, CO: National Park Service.

Dean, H.K. 2008. The use of polychaetes (Annelida) as indicator species of marine pollution: a review. Int J Trop Biol 56 (4): 11-38.

Dew, C.B. and J.H. Hecht. 1994. Recruitment, growth, mortality, and biomass production of larval and early juvenile Atlantic tomcod in the Hudson River estuary. Transactions of the American Fisheries Society, Vol. 123, Number 5. Pp.681-702.

Eede, S.V. 2013. Impact of beach nourishment on coastal ecosystems with recommendations for coastal policy in Belgium. Ghent University (UGent), pp. 301. www.vliz.be/imisdocs/publications/251138.pdf

Goodwin, C.R. and D.M. Michaelis. 1984. Appearance and Water Quality of Turbidity Plumes Produced by Dredging in Tampa Bay, Florida. USACE Jacksonville District.

Güt, J.A. and M.C. Curran. 2017. Assessment of fish assemblages before dredging of the shipping channel near the mouth of the Savannah River in Coastal Georgia. Estuaries and Coasts, 40:251-267.

Harvey, B.C., and T.E. Lisle. 1998. Effects of suction dredging on streams: A review and an evaluation strategy. Fisheries, 23, 8–17.

International Maritime Organization (IMO). 2018. Marine Environment and Pollution. http://www.imo.org/en/OurWork/Environment/Pages/Default.aspx

Kjelland, M.E., C.M. Woodley, T.M Swannack, and D.L. Smith. 2015. A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioral, and transgenerational implications. Environ. Syst. Decis 35: 334-350.

Lowe, M. L., M.A. Morrison, and R.B. Taylor.2015. Harmful effects of sediment-induced turbidity on juvenile fish in estuaries. Marine Ecology Progress Series, 539, 241–251.

Lunz, J. D., and M.W. LaSalle. 1986. Physicochemical Alterations of the Environment Associated with Hydraulic Cutterhead Dredging, American Malacological Bulletin, Special Edition No. 3, pp 31-36.

McNair, E.C., Jr., and G.E. Banks. 1986. Prediction of Flow Fields Near the Suction of a Cutterhead Dredge, American Malacological Bulletin, Special Edition No. 3, pp 37-40.

Neff, J.F. 1985. Biological effects of drilling fluids, drill cuttings, and produced waters. In: D.F. Boesch and N.N. Rabalasis (eds). The long-term effects of offshore oil and gas development: An assessment and research strategy.

Newell, R.C., L.J. Seiderer, and D.R. Hitchcock. 1998. The impact of dredging works in coastal waters: a review of the sensitivity to disturbance and subsequent recovery of biological resources on the sea bed. Oceanography and Marine Biology: An Annual Review 36: 127–178.

NMFS. 2008. Essential Fish Habitat: A Marine Fish Habitat Conservation Mandate for Federal Agencies. St. Petersburg, Florida. 21pp.

NOAA. 2003. Non-fishing impacts to essential fish habitat and recommended conservation measures. National Marine Fisheries Service, Alaska Region, Northwest Region, Southwest Region. 79 p.

Page H.M. and M. Lastra. 2003. Diet of intertidal bivalves in the Ria de Arosa (NW Spain): evidence from stable C and N isotope analysis. Mar Biol 143:519–532.

Peterson, C.H., J.H. Grabowski, and S.P. Powers. 2003. Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. Marine Ecology Progress Press 264: 249-264.

Peterson C.H. and N.M. Peterson, 1979. The ecology of intertidal flats of North Carolina: A community profile. U.S. Fish and Wildlife Service, Office of Biological Services. FWS/OBS-79/39. 73 pp.

Polis, G. A., W.B. Anderson, and R.D. Holt. 1997. Toward an integration of landscape and food web ecology: The dynamics of spatially subsidized food webs. Annual Review of Ecology and Systematics 18: 293-3.

Popper, A. N., A.D. Hawkins, and R.R. Fay. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1 and registered with ANSI, ASA S3/SC1.4 TR- 2014 (pp. 1–73). Cham, Switzerland: Springer International Publishing.

Ray, G. L., and D.G. Clarke. 2010. Issues related to entrainment of horseshoe crabs (Limulus polyphemus) by hopper dredges. Proc. Western Dredging Assoc. Conf., San Juan, Puerto Rico:82–94 (available online at: https://www.westerndredging.org/phocadownload/ConferencePresentations/2010_SanJuanPR/Session2A-EnvironmentalAspectsOfDredging/3%20-%20Ray%20-%20Issues%20Related%20to%20Entrainment%20of%20Horseshoe%20Crabs%20by%20Hopper%20Dredges.pdf

Reine, K. J., D.D. Dicerkson,, and D.G. Clarke. 1998. Environmental windows associated with dredging operations." DOER Technical Notes Collection (TN DOER-E2). U.S. Army Engineer Research and Development Center, Vicksburg, MS. www.wes.army.mil/el/dots/doer

Riggs, S.R., S.W. Synder, A.C. Hine, and D.L. Mearns. 1996. Hard bottom morphology and relationship to the geologic framework: Mid-Atlantic continental shelf. Jour. Sedimentary Researh. 66:830-846.

SAFMC. 1998. Habitat Plan for the South Atlantic Region: essential fish habitat requirements for Fishery Management Plans of the South Atlantic Fishery management Council. SAFMC. Charleston, SC. http://safmc.net/habitat-and-ecosystems/safmc-habitat-plan/

SCDNR. 2012. Marine- Tidal Creeks. http://www.dnr.sc.gov/marine/habitat/tidalcreeks.html

SCDNR. 2015. Characterization of the Ashepoo-Combahee-Edisto (ACE) Basin, South Carolina. http://www.dnr.sc.gov/marine/mrri/acechar/biological/plants.html

Stickney, R.R., and D. Perlmutter. 1975. Impact of Intracoastal Waterway maintenance dredging on a mud bottom benthos community. Biological Conservation 7: 211–226.

Van Dolah, R.F.,D.R. Calder, and D.M. Knott. 1984. "Effects of Dredging and Open Water Disposal on Benthic Macroinvertebrates in a South Carolina Estuary," Estuaries, Vo17, pp 28-37.

Wenger, A.S., E. Harvey, S. Wilson, C. Rawson, S.J. Newman, D. Clarke, B.J. Saunders, N. Browne, M.J. Travers, J.L. Mcilwain, P.L.A. Erftemeijer, J.P.A. Hobbs, D. Mclean, M. Depczynski, and R.D. Evans. 2016. A critical analysis of the direct effects of dredging on fish. Fish and Fisheries, 18: 967- 985.

Wickliffe, L.C., F.C. Rohde, K.L. Riley, and J.A. Morris, Jr. (eds.). 2019. Seasonal Conservation Measures for Fisheries during Coastal Development Activities in the Carolinas. NOAA Technical Memorandum NOS NCCOS. 267 pp.

Wilber, D.H., D.G. Clarke. 2001. Biological Effects of Suspended Sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries. N. Jour. Fisheries Management. 21:855-875.

Windom, H.L. 1972. Environmental Aspects of Dredging in Estuaries, Journal of Water, Harbor, and Coastal Engineering, Vol 98, pp 475-487.

Windom, H.L. 1976. Environmental Aspects of Dredging in the Coastal Zone, CRC Critical Review in Environmental Control, No. 6, pp 91-110.

Winger, P.V., P.J. Lasier, D.H. White, and J.T. Seginak. 2000. Effects of Contaminants in Dredge Material from the Lower Savannah River. Arch. Environ. Contam. Toxicol. 38, 128–136.

Yallop, M., P. Wellsbury, and D.M. Paterson. 2000. Exopolymer production, microbial biomass, and sediment stability in biofilms of intertidal sediments. Microbial Ecology, 39(2): 116-127.

Appendix A: Project and Activity Descriptions

Project and Activity Descriptions

1 Atlantic Intracoastal Waterway.

The AIWW project includes 210 miles of federal channel, 12 ft MLLW deep and not less than 90 ft wide, beginning at the North Carolina – South Carolina state line above Little River Inlet and extending to Port Royal Sound near Hilton Head, as well as upland, and in-water placement areas (Table 1). Maintenance Dredging will be performed using a hydraulic cutterhead dredge. Hydraulic dredging utilizes suction to remove sediments from the channel bed. The cutterhead is a rotating tool mounted in front of the suction head that dislodges and excavates the sediments. The material will be transported hydraulically via a pipeline to the placement sites. Figure1 depicts an overview of the AIWW in South Carolina and Figures 2 through 11 depict shoaling and placement areas.

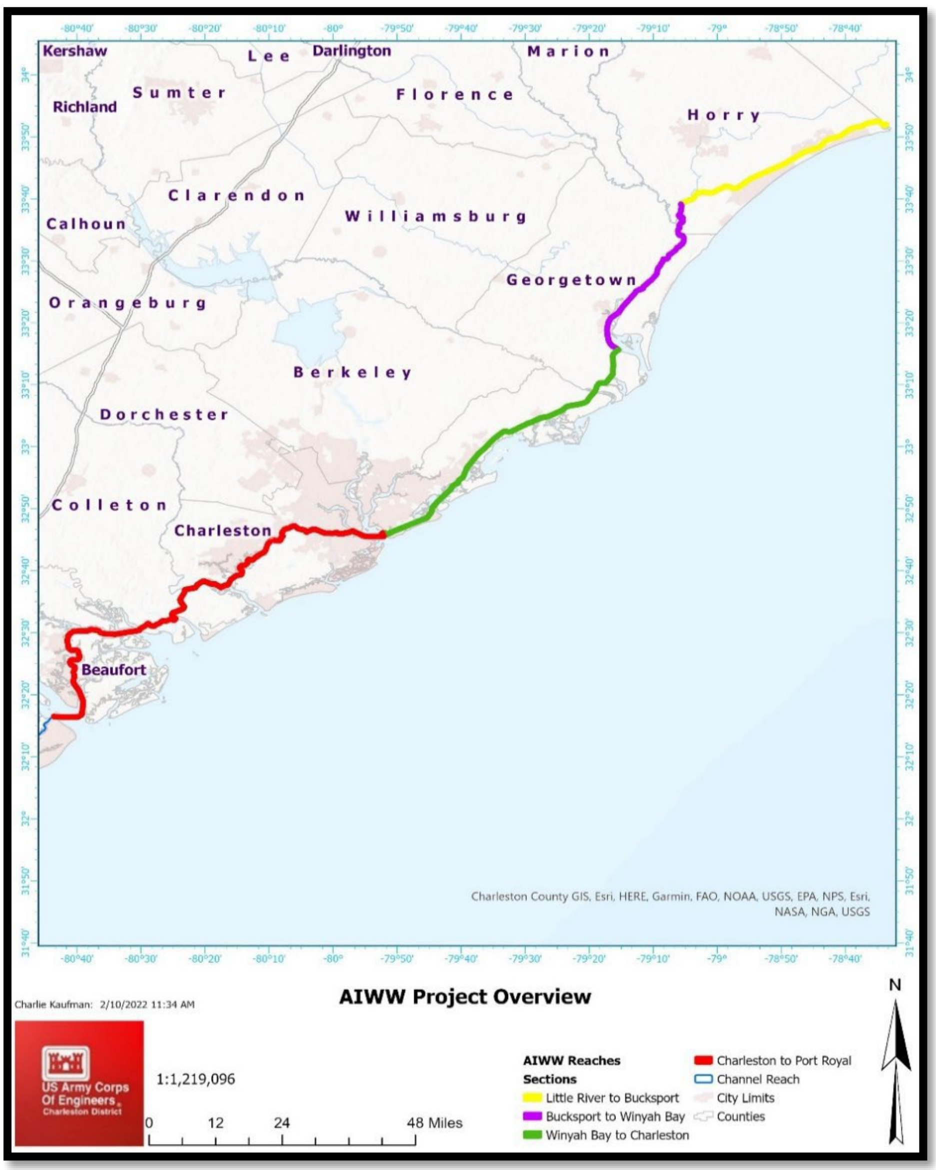

Figure 1. Overview of the Atlantic Intracoastal Waterway in SC

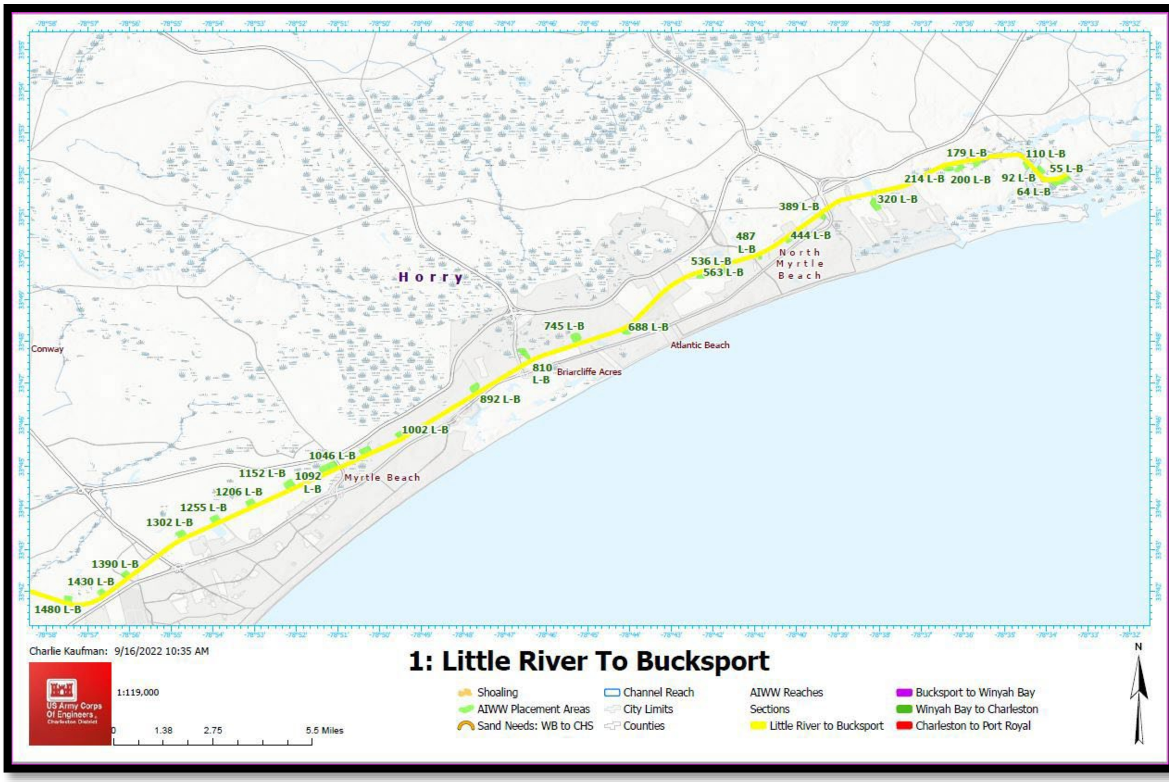

Figure 2. Little River to Bucksport Reach Part 1

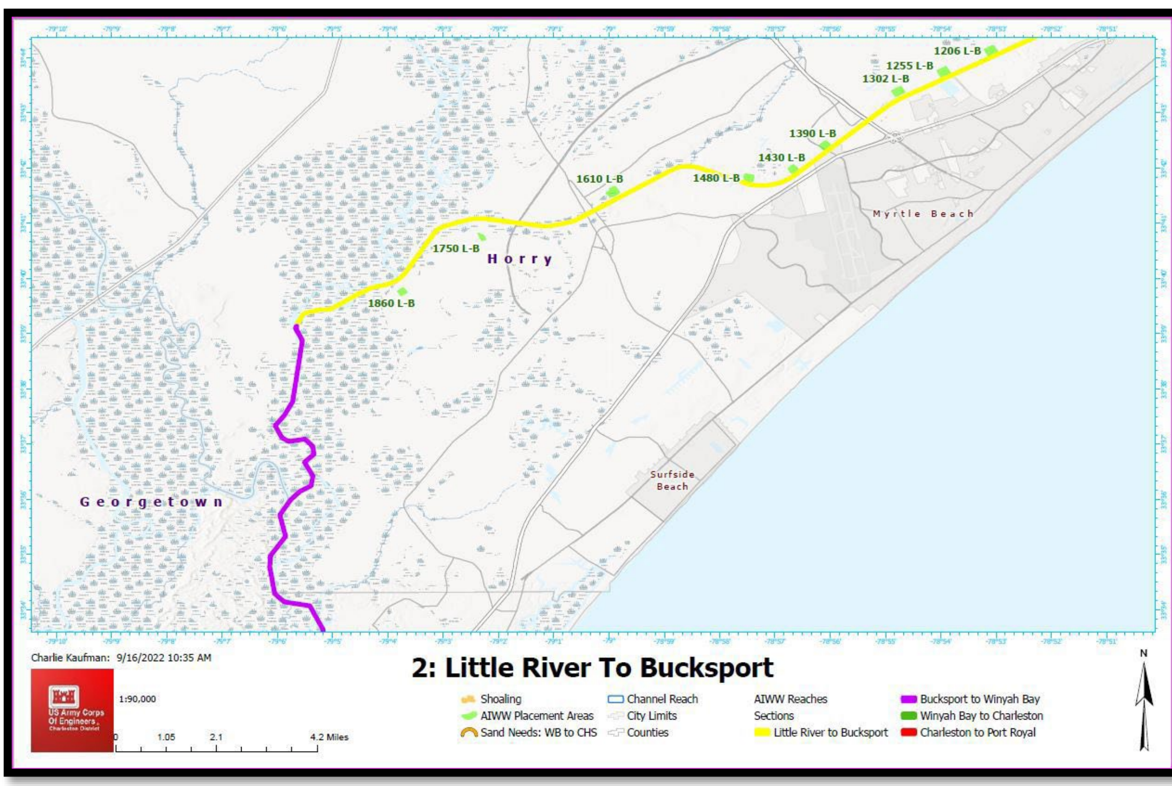

Figure 3. Little River to Bucksport Reach Part 2

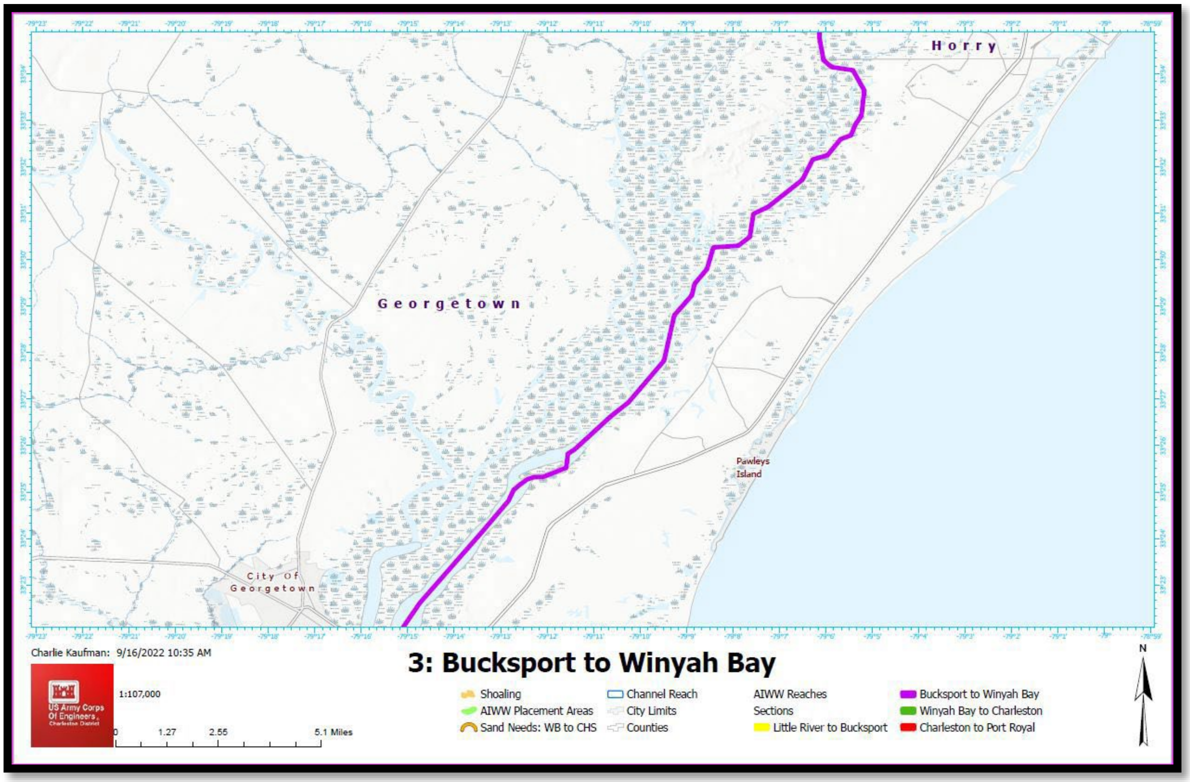

Figure 4. Bucksport to Winyah Bay Part 1

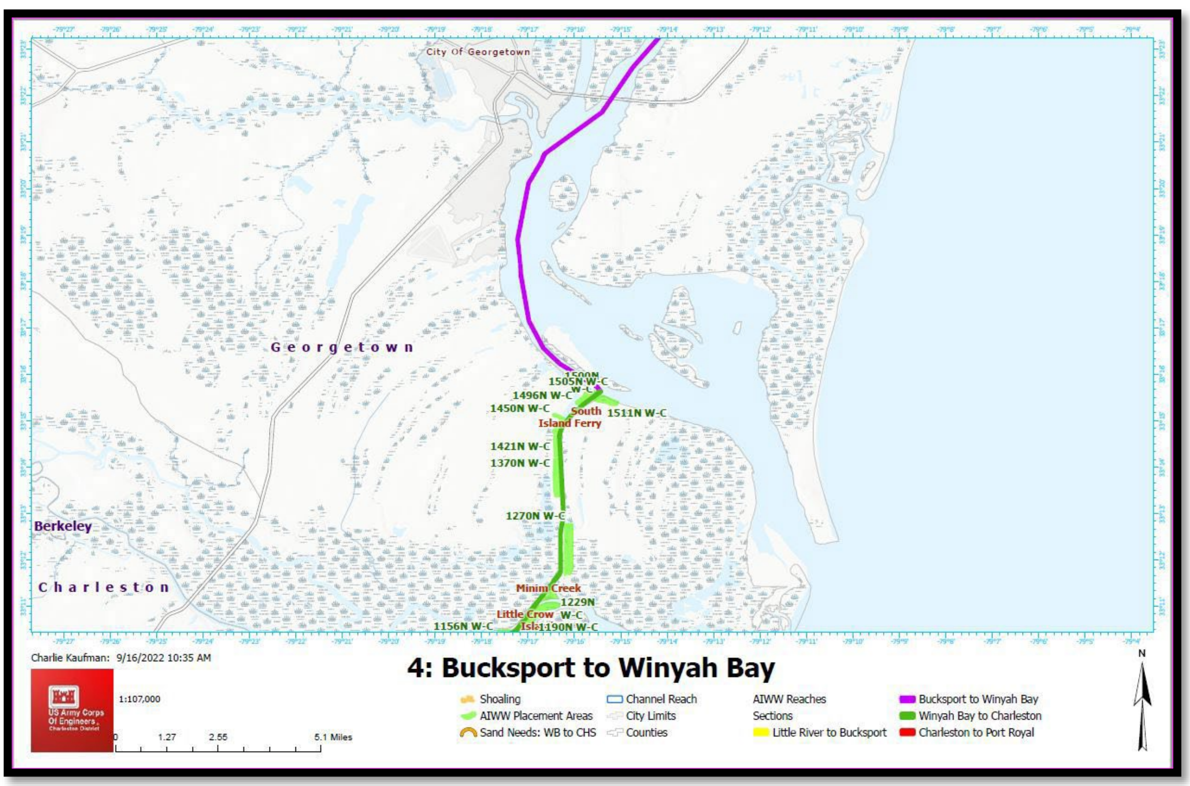

Figure 5. Bucksport to Winyah Bay Part 2

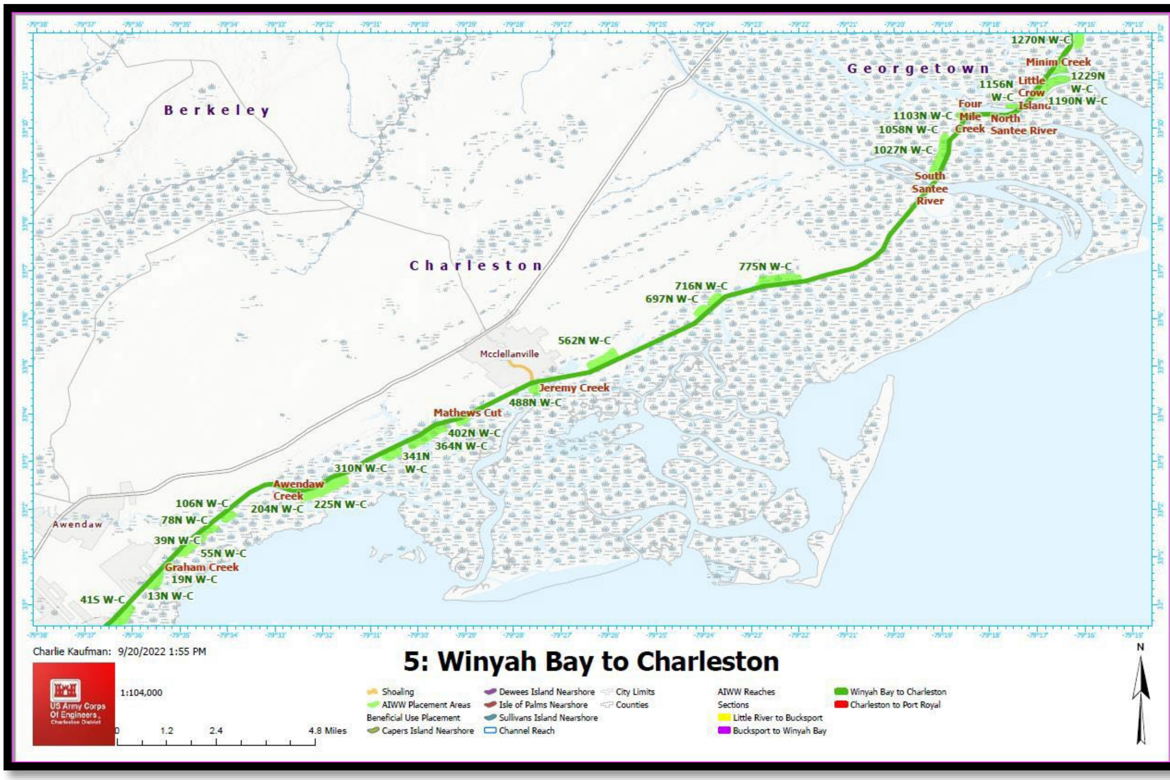

Figure 6. Winyah Bay to Charleston Part 1

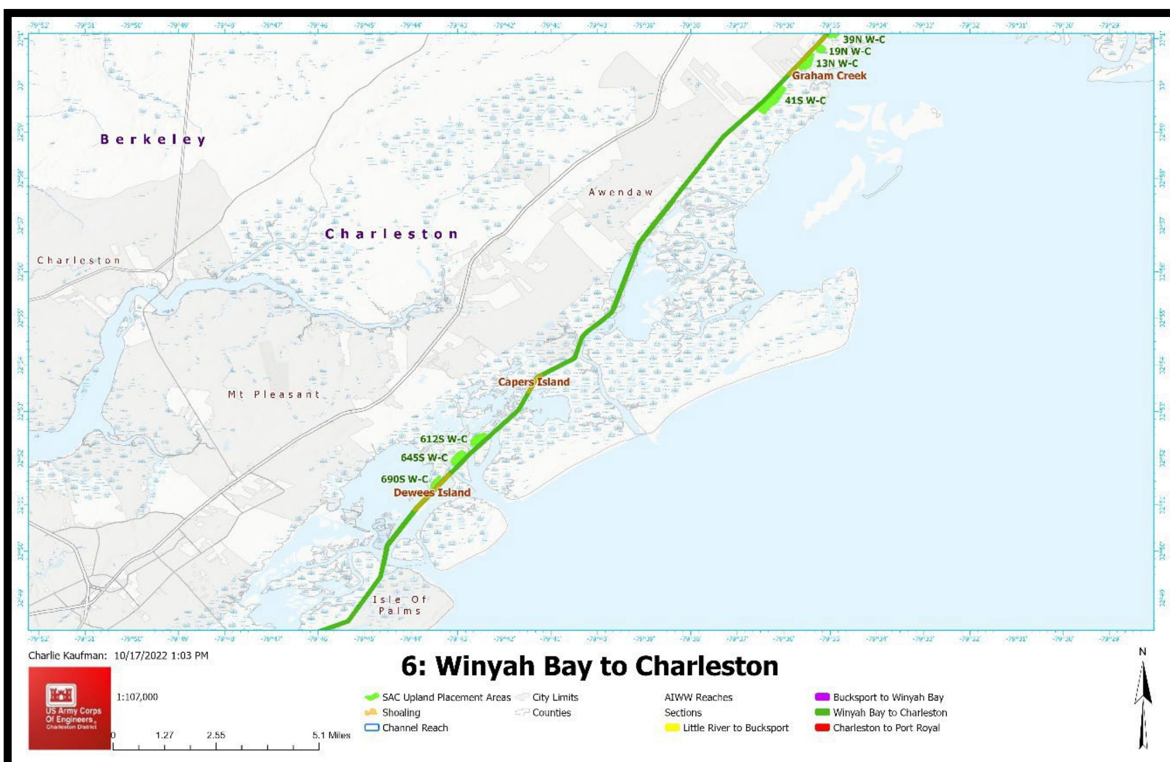

Figure 7. Winyah Bay to Charleston Part 2

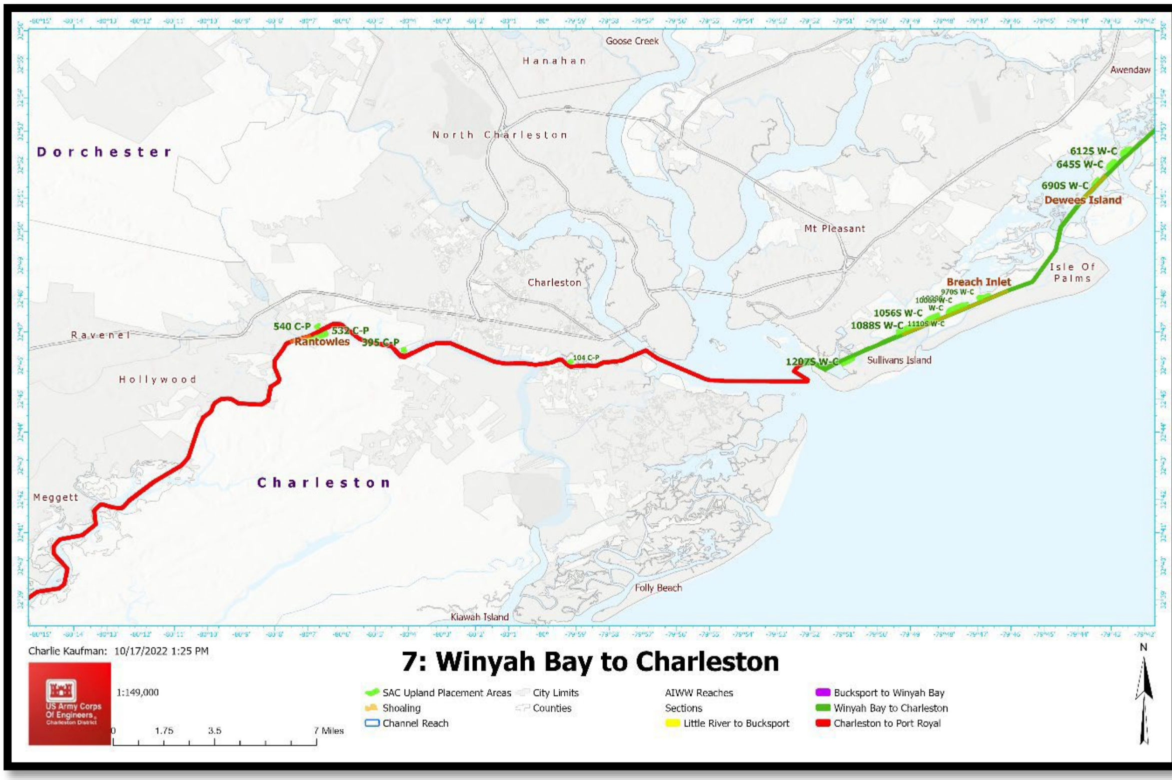

Figure 8. Winyah Bay to Charleston Part 3

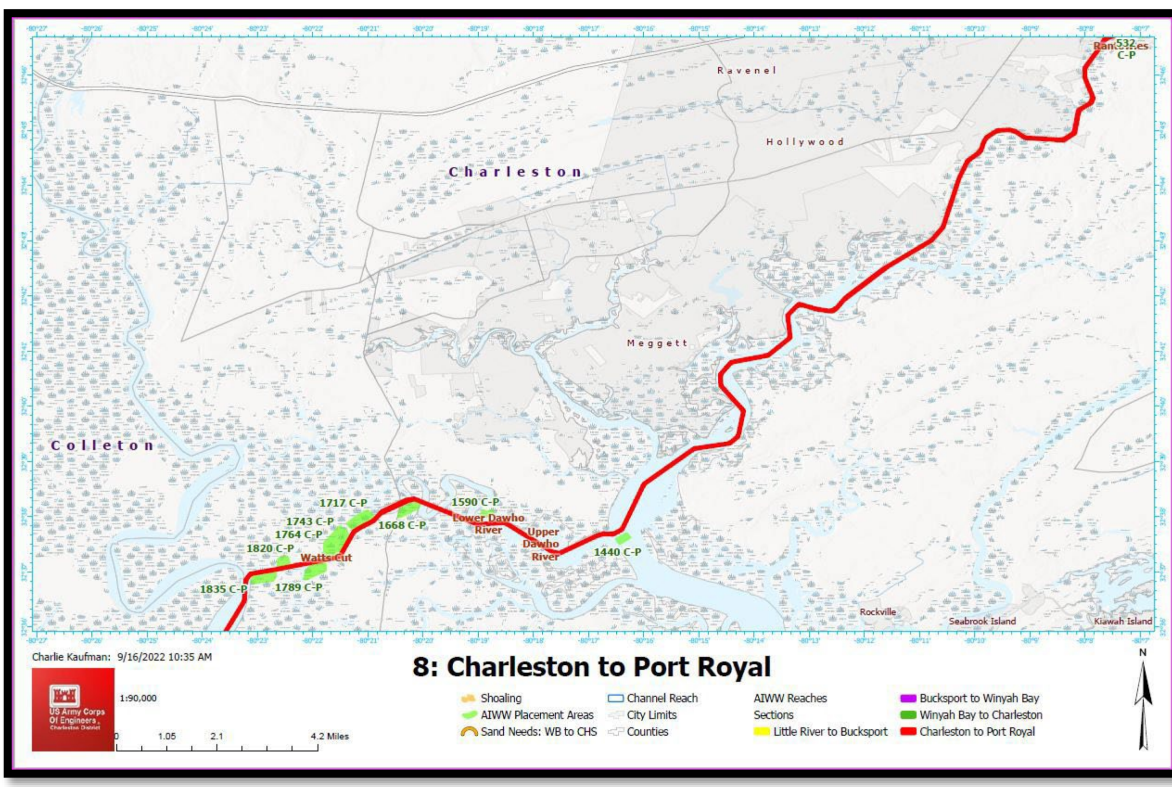

Figure 9. Port Royal to Charleston Part 1

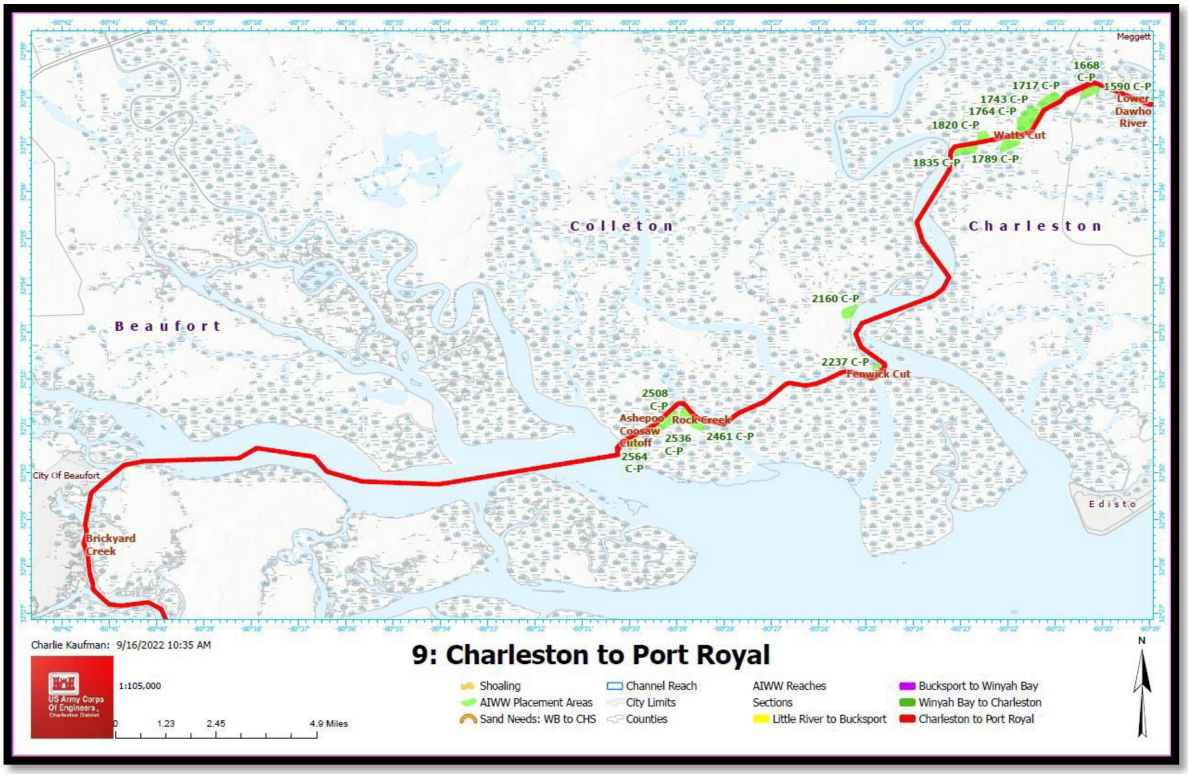

Figure 10. Charleston to Port Royal Part 2

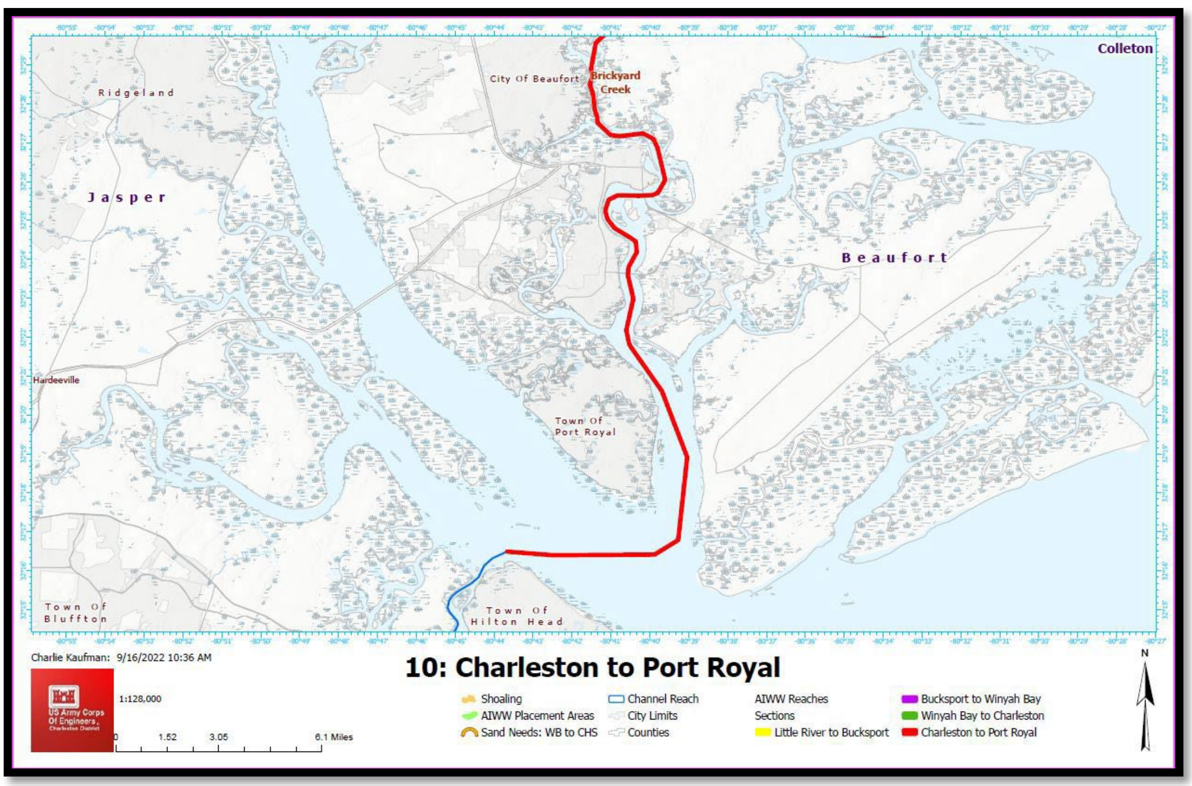

Figure 11. Charleston to Port Royal Part 3

Table 1. AIWW Shoaling and Placement Information

Little River to Bucksport								
Stations	0+00	to	1930+00					
Mileage	36.55	miles						
Shoal Identifier	**Alternate Identifier**	**Start Station**	**End Station**	**Dredge Frequency (months)**	**Estimated Quantity (cy)**	**Upland DMMAs**	**In-water DMMAs**	**Beneficial Use Options**
Day Marker 22A	22A	1085+00	1100+00	48	10000	1152 L-B	None	Haul Out
Unidentified	N/A	N/A	N/A	As Needed, primarily based on extreme events	As Needed	55, 64, 92, 110, 179, 200, 214, 320, 389, 444, 487, 536, 563, 688, 745, 810, 892, 1002, 1046, 1092, 1152, 1255, 1302, 1390, 1430, 1480, 1610, 1750, 1860 L-B	None	Haul Out
Bucksport to Winyah Bay								
Stations	1930+00	to	3691+00					
Mileage	33.35	miles						
Shoal Identifier	**Alternate Identifier**	**Start Station**	**End Station**	**Dredge Frequency (months)**	**Estimated Quantity (cy)**	**Upland DMMAs**	**In-water DMMAs**	**Beneficial Use Options**
Not Applicable	Not Applicable	N/A	N/A	N/A	N/A	None	None	N/A
Winyah Bay to Charleston								
Stations	3691+00	to	6510+00					
Mileage	53.39	miles						
Shoal Identifier	**Alternate Identifier**	**Start Station**	**End Station**	**Dredge Frequency (months)**	**Estimated Quantity (cy)**	**Upland DMMAs**	**In-water DMMAs**	**Beneficial Use Options**
Unidentified	N/A	N/A	N/A	As Needed, primarily based on extreme events	As Needed	775N, 716N, 697N W-C	None	Not pursued at this time
South Island Ferry	N/A	3698+00	3744+00	36	100,000	1511N, 1505N, 1500N, 1496N, 1450N, 1421N, 1370N W-C	None	Not pursued at this time
Minim Creek	Minim Creek to North Santee	3956+00	3997+35	36	100,000	1270N, 1229N, 1190N W-C	None	Not pursued at this time
Little Crow Island	Minim Creek to North Santee	3997+35	4050+00	36	140,000	1270N, 1229N, 1190N W-C	None	Not pursued at this time
North Santee River	Minim Creek to North Santee	4053+00	4066+00	36	25,000	1229N, 1190N, 1156N W-C	None	Not pursued at this time
Four Mile Creek	N/A	4084+00	4109+00	48	50,000	1156N, 1103N, 1058N, 1027N W-C	None	Not pursued at this time
South Santee River	N/A	4195+00	4216+00	48	22,000	1058N, 1027N W-C	None	Not pursued at this time
Jeremy Creek	Jeremy Creek Turning Basin	00+45	42+77.95	24	200,000	562N, 488N W-C	None	Not pursued at this time
Mathews Cut	N/A	4723+18	4926+00	36	730,000	488N, 402N, 364N, 341N, 310N, 225N, 204N W-C	None	Not pursued at this time
Awendaw Creek	N/A	5000+000	5020+00	36	45,000	225N, 204N W-C	None	Not pursued at this time
Graham Creek	N/A	5179+00	5244+00	36	180,000	106N, 78N, 55N, 39N, 19N, 13N, 41S W-C	None	Not pursued at this time
Capers Island	N/A	5730+00	5758+00	48	75,000	612S, 645S W-C	None	Not pursued at this time
Dewees Island	N/A	5896+00	5957+00	48	245,000	612S, 645S, 690S W-C	810S W-C (Dewees Inlet)	Not pursued at this time
Breach Inlet	N/A	6163+00	6341+00	24	500,000	970S, 1006S, 1028S, 1056S, 1088S, 1110S, 1207S W-C	810S W-C (Dewees Inlet)	Not pursued at this time
Charleston to Port Royal								
Stations	6510+00	to	11282+08					
Mileage	90.38	miles						
Shoal Identifier	**Alternate Identifier**	**Start Station**	**End Station**	**Dredge Frequency (months)**	**Estimated Quantity (cy)**	**Upland DMMAs**	**In-water DMMAs**	**Beneficial Use Options**
Unidentified	N/A	N/A	N/A	As Needed, primarily based on extreme events	As Needed	104, 395, 540, 580 C-P	None	Not pursued at this time
Rantowles	Grimball Gates	7390+00	7424+00	48	50,000	532 C-P	None	Haul Out
Upper Dawho River	Dawho River 1	8274+00	8381+00	Recently realigned	Recently realigned	1590 C-P	1440 C-P (North Edisto River)	Not pursued at this time
Lower Dawho River	Dawho River 2	8391+00	8431+00	24	45,000	1590 C-P	1440 C-P (North Edisto River)	Not pursued at this time
Watts Cut	N/A	8511+00	8670+00	24	490,000	1668, 1717, 1743, 1764, 1789, 1820, 1835 C-P	None	Not pursued at this time
Fenwick Cut	N/A	9042+00	9064+00	36	21,000	2160, 2237 C-P	None	Not pursued at this time
Rock Creek	N/A	9270+00	9294+00	48	Recently realigned	2461 C-P	None	Not pursued at this time
Ashepoo Coosaw Cutoff	Ashepoo Coosaw Cut	9306+00	9392+00	24	360,000	2461, 2508, 2536, 2564 C-P	None	Not pursued at this time
Brickyard Creek	N/A	10065+00	10083+00	48	Recently realigned	None	None	Not pursued at this time

2 Murrell's Inlet

Murrell's Inlet project (Figure 12) is located on the Atlantic Coast between the south end of Garden City Beach and the north end of Huntington Beach State Park in Georgetown County. The action area includes the federal entrance channel at the inlet located between the south end of Garden City Beach and the north end of Huntington Beach State Park and extending approximately 3000 ft landward from the -12 ft ocean contour, Main Creek extending approximately 3 miles north/northeast from the entrance channel, a 14.9-acre deposition basin located north and adjacent to the entrance channel, an auxiliary channel extending approximately 1000 ft northwest from the entrance channel, and dredge material placement along the shorelines of Huntington Beach State Park and Garden City Beach and along the beach area at the landward terminus of the south jetty. The authorized project dimensions include a 12 ft MLLW deep by 300 ft wide entrance channel and a 10 ft MLLW deep by 90 ft wide inner channel. Maintenance dredging will be performed using a hydraulic cutterhead dredge. The material will be transported hydraulically via a pipeline to the placement sites.

Table 2. Murrells Inlet Project Shoaling and Placement Information

Reaches	Channel Reaches	Shoaling (Cubic yards per event)	Frequency of Dredging (years)	Placement Location	Dredge Type	Sediment Type
Entrance Channel	25+00 to 40+00	300,000	5-7 (or as funding permits)	Front Beach, Jetty	Pipeline Dredge	Beach Compatible Sand
Auxiliary Channel	00+00 to 10+00	15,000	5-7 (or as funding permits)	Front Beach, Jetty	Pipeline Dredge	Beach Compatible Sand
Deposition Basin	Entire (14.9 acres)	600,000	5-7 (or as funding permits)	Front Beach, Jetty	Pipeline Dredge	Beach Compatible Sand
Inner Shoal A	42+00 to 68+00	50,000	5-7 (or as funding permits)	Front Beach, Jetty	Pipeline Dredge	Beach Compatible Sand
Inner Shoal B	145+00 to 155+00	50,000	5-7 (or as funding permits)	Front Beach, Jetty	Pipeline Dredge	Beach Compatible Sand
Inner Shoal C	186+00 to 197+00	50,000	5-7 (or as funding permits)	Front Beach, Jetty	Pipeline Dredge	Beach Compatible Sand

Figure 12. Shoaling and Placement Locations for Murrells Inlet.

3 Town Creek

The Town Creek project (Figure 13) is located on the Atlantic Coast between Bulls Bay and Sandy Point near McClellanville, South Carolina. The action area includes an entrance channel approximately 12 ft MLLW deep and 100 ft wide across the ocean bar and approximately 4 miles long from the Atlantic Ocean to the mouth of Five Fathom Creek, and a channel 10 ft MLLW deep and 80 ft wide through Five Fathom Creek and Town Creek to the AIWW, a distance of approximately 6.2 miles. Dredging would be accomplished through sidecast dredge with placement adjacent to the channel or modified hopper dredge for transport and placement along the Lighthouse Island nearshore. Sidecast dredging involves removal of sediments from the channel using drag arms with discharge by pumping the dredged material directly overboard through an elevated discharge boom. A modified (small) hopper dredge is a ship equipped with trailing suction pipes, dredge pumps, and a hopper. The trailing suction pipes are equipped with a drag head that moves over the ocean floor or channel bed to suction sediments and create a slurry. The dredge pumps are used to hydraulically transport the slurry to the hopper for storage and excess water is then allowed to drain from the hopper. Once the hopper is full, the material can be discharged from the bow of the ship using a nozzle, pumped via floating or underwater pipes to a placement area, or deposited through doors located in the bottom of the dredging vessel. Unlike traditional hopper dredge equipment, the modified hopper dredge equipment has small dragheads (2-feet by 2-feet to 2-feet by 3-feet), small openings (5-inch by 5-inch to 5-inch by 8-inch, small suction intake pipe diameters (10-14 inches), and limited draghead suction. Additional activities could include realignment of the entrance channel for the purpose of following deep water and reducing dredging amounts.

Table 3. Town Creek Project Shoaling and Placement Information

Reaches	Channel Reaches	Shoaling (Cubic yards per event)	Frequency of Dredging (years)	Placement Location	Dredge Type	Sediment Type
Entrance Channel (Outer Shoal)	36+00 to 46+00	21,000	5 (or as funding permits)	Nearshore (Lighthouse Island)	Sidecast or modified hopper dredge	Beach Compatible Sand
Entrance Channel (Inner Shoal)	75+94 to 97+14	25,000	5 (or as funding permits)	Nearshore (Lighthouse Island)	Sidecast or modified hopper dredge	Beach Compatible Sand
Entrance Channel Advanced Maintenance	78+00 to 88+00	50,000	5 (or as funding permits)	Nearshore (Lighthouse Island)	Sidecast or modified hopper dredge	Beach Compatible Sand

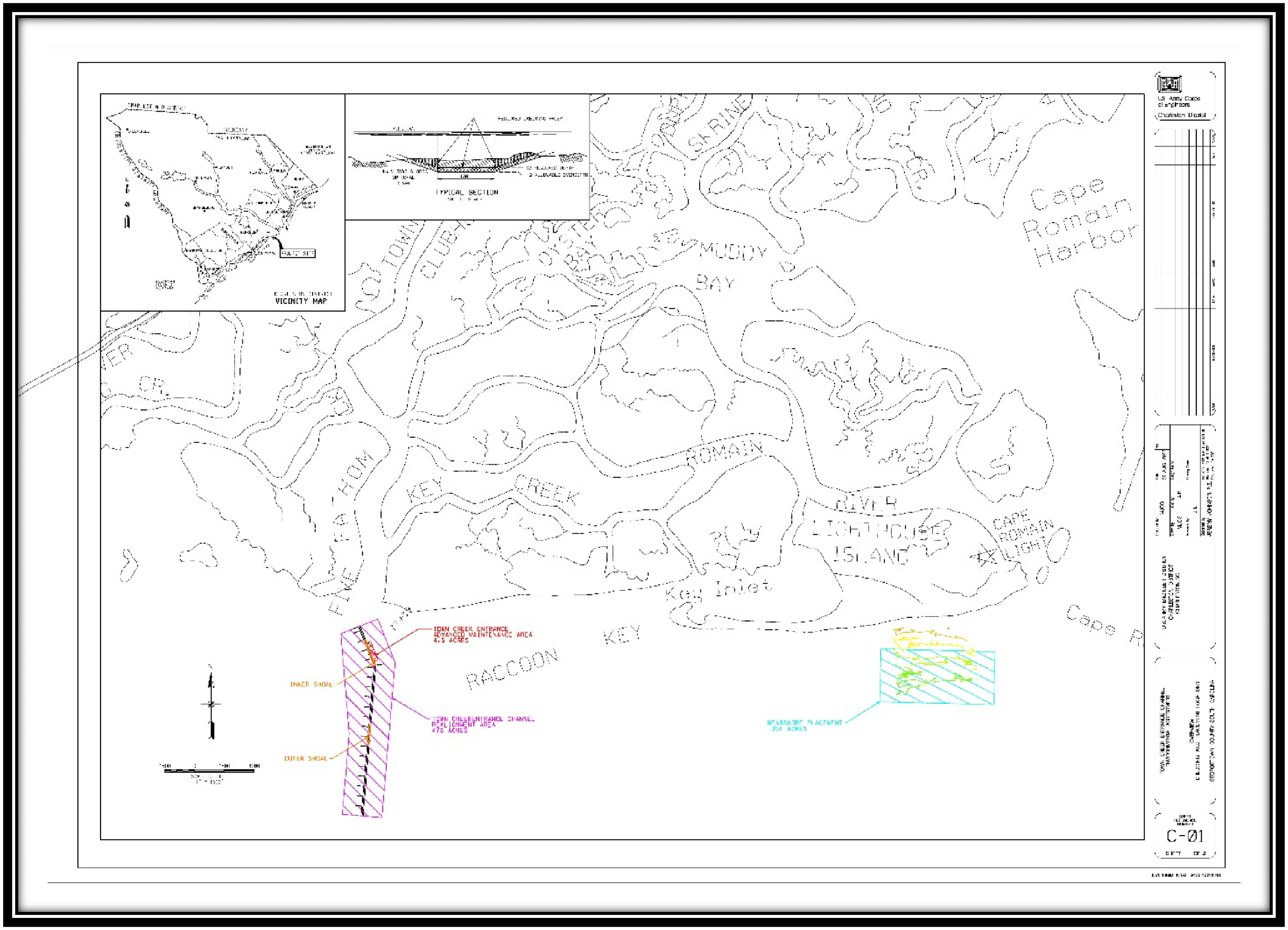

Figure 13. Shoaling and Placement Locations for Town Creek.

4 Folly River

The Folly River project (Figure 14) is located between Kiawah Island and Folly Beach. The action area includes the Stono Inlet entrance channel extending waterward approximately 3 miles from the 11 ft contour, the Folly River channel extending downstream approximately 3 miles from Highway 171 to its confluence with the Stono River, the Folly Creek channel extending downstream approximately 3 miles from Highway 171 to its confluence with the Folly River, as well as placement along the beach and nearshore of Folly Beach, and on Bird Key. The authorized dimensions include the 11 ft MLLW deep by 100 ft wide Stono River entrance channel, and a 9 ft MLLW deep by 80 ft wide Folly River channel and Folly Creek channel.

Dredging equipment used would be dependent on the placement location and equipment availability, and may include hydraulic cutterhead pipeline dredge, sidecaster dredge and/or the modified hopper dredge. The suitability of dredge materials will determine the potential placement locations which include Bird Key Island, Folly Beach, sidecast placement in the Stono channel, or nearshore placement for Folly Beach. Additional activities could include realignment of the entrance channel for the purpose of following deep water and reducing dredging amounts.

Table 4. Folly River Project Shoaling and Placement Information

Reaches	Channel Reaches	Shoaling (Cubic yards per event)	Frequency of Dredging (years)	Placement Location	Dredge Type	Sediment Type
Folly River	103+00 to 303+68	400,000	3	Front Beach, Nearshore, Bird Key	Pipeline Dredge	Beach Compatible Sand
Stono River Entrance South Approach	0+00 to 105+00	300,000	2	Front Beach, Nearshore, Bird Key	Modified Hopper Dredge, Pipeline Dredge, Sidecast	Beach Compatible Sand
Stono River Entrance (East Approach)	0+00 to 58+00	300,000	2	Front Beach, Nearshore, Bird Key	Modified Hopper Dredge, Pipeline Dredge, Sidecast	Beach Compatible Sand

Figure 14. Shoaling and Placement Locations for Folly River.

Appendix B. Programmatic Essential Fish Habitat Consultation for United States Army Corps of Engineers Activities and Projects Regularly Undertaken in South Carolina - Verification Form

Programmatic Essential Fish Habitat Consultation for United States Army Corps of Engineers Activities and Projects Regularly Undertaken in South Carolina - Verification Form

This form will be filled out by the United States Army Corps of Engineers, Charleston District (Charleston District) for activities and projects regularly undertaken in the tidally-influenced waters of South Carolina using the Programmatic Essential Fish Habitat (EFH) Consultation with NOAA's National Marine Fisheries Service, Southeast Regional Office, Habitat Conservation Division (SERO HCD). Upon obtaining sufficient information, the Charleston District will submit the form to SERO HCD for their review and response. After receiving a response from SERO HCD, the Charleston District will keep the completed form(s) for reporting purposes.

In addition to the information required below, the Charleston District must also provide a list of all recommended management practices that will not be adhered to (with justification provided). This list may use the same numbers as the recommended management practices listed in Section 5.

PART I.

Project Activity Type

☐ 1. Dredging
☐ 2. Placement of Dredged Material
☐ 3. Transportation of Dredged Material
☐ 4. Beneficial Use - Beach and Nearshore Placement

USACE Charleston District Project Information

Waterway Name:	
Latitude (e.g., 42.6258):	
Longitude (e.g., -70.6461):	
Work Description:	
Total area of impact to EFH (in acres), broken down by individual types of EFH:	
Programmatic EFH Consultation Appendix A Project Reference Number:	

Part II.

USACE's Determination of Effects to Essential Fish Habitat

The Charleston District will select the appropriate determination:

☐ The activity complies with all elements of the Programmatic EFH Consultation, including all Programmatic EFH Consultation recommended best management practices, and adverse effects to EFH will not be substantial.

☐ The activity does not comply with all of the elements of the Programmatic EFH Consultation, including some Programmatic EFH Consultation recommended best management practices. However, the justification below demonstrates that the adverse effects to EFH are not substantial. This does not apply to Programmatic EFH Consultation recommended best management practices that are not applicable to the project.

Justification for Not Incorporating All EFH conservation measures

If the project does not comply with all of the applicable Programmatic EFH Conservation measures and the Charleston District has still determined that the effects of a project on EFH are not substantial and the project is otherwise consistent with the Programmatic EFH Consultation, provide justification below and identify which conservation measures, provided in the Programmatic EFH Consultation as BMPs, are not included:

____

____

____

____

____

____

____

USACE, Charleston District preparer:

______________________________ ______________________________

Name Signature

____

Date

<u>Part III.</u>

SERO HCD Determination (To be filled out by NMFS SERO HCD)

After receiving the Verification Form, SERO HCD will contact the Charleston District with any concerns.

☐ SERO HCD concurs with the Charleston District's determination that the proposed project is consistent with the Programmatic EFH Consultation (without the need for justification).

☐ SERO HCD concurs with the Charleston District's determination that the proposed project is consistent with the Programmatic EFH Consultation, with justification described above.

☐ SERO HCD does not concur with the Charleston District's determination that the project is consistent with the Programmatic EFH Consultation. The Charleston District must conduct additional coordination with SERO HCD and a separate individual EFH consultation may be required.

SERO HCD reviewer:

____________________________________ ____________________________________

Name Signature

____

Date

EFH CONSULTATION FOR BENEFICIAL USE ACTIVITIES

Beneficial Use Placement
Atlantic Intracoastal Waterway Federal Navigation Project
in South Carolina

Essential Fish Habitat Assessment

U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
69-A HAGOOD AVENUE
CHARLESTON, SOUTH CAROLINA

April 2023

Table of Contents

1.0 INTRODUCTION
2.0 BACKGROUND
3.0 PROJECT DESCRIPTION
4.0 ESSENTIAL FISH HABITAT
  4.1 Unconsolidated Sand/Mud Bottoms
  4.2 Intertidal Flats
  4.3 Water Column
5.0 HABITAT AREAS OF PARTICULAR CONCERN
  5.1 Penaeid Shrimp
  5.2 Snapper Grouper Complex
6.0 Managed Fish Species
  6.1 White Shrimp
  6.2 Brown Shrimp
  6.3 Snapper Grouper Complex
  6.4 Coastal Migratory Pelagics
  6.5 Mid-Atlantic Species Which Occur in the South Atlantic
  6.6 Highly Migratory Species
7.0 ASSESSMENT OF IMPACTS
8.0 BEST MANAGEMENT PRACTICES
9.0 CONCLUSION
10.0 REFERENCES

1.0 INTRODUCTION

The objective of this Essential Fish Habitat (EFH) Assessment is to describe how the proposed federal action for the Atlantic Intracoastal Waterway (AIWW) beneficial use placement could potentially affect EFH resources. EFH is designated by the National Marine Fisheries Service (NMFS) and the South Atlantic Fisheries Management Council (SAFMC), as required by the Magnuson-Stevens Fishery Conservation and Management Act of 1976 (Magnuson-Stevens Act), reauthorized in 2006. The Magnuson-Stevens Act defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity".

2.0 BACKGROUND

Construction of the AIWW in South Carolina was completed in 1940 and authorized by the following Rivers and Harbors Acts: September 19, 1890; June 13, 1902-H. Doc. 63rd Congress, 1st Session; March 3, 1925-S. Doc. 178, 68th Congress, 2nd Session; July 3, 1930-H. Doc. 41, 71st Congress, 1st Session; August 31, 1935-Rivers and Harbors Committee Doc. 11, 72nd Congress, 1st Session; August 26, 1937- Rivers and Harbors Committee Doc. 6, 75th Congress, 1st Session; March 2, 1945-H. Doc. 327, 76th Congress, 1st Session.

Prior to 1937, federal authorization provided for a channel 8 feet deep and 75 feet wide from Southport, N.C. to Georgetown, S.C., a distance of 95.2 miles; 10 feet deep and 90 feet wide from Georgetown to Charleston Harbor, a distance of 62.8 miles; and 7 feet deep and 75 feet wide to Savannah, Georgia, a distance of 120 miles. In 1937, based on the justification presented in the August 26, 1937 Rivers and Harbors Committee document number 6, 75th Congress, 1st Session, authorization was granted for deepening and maintenance of a channel 12 feet wide and 90 feet deep. Operation and maintenance of the waterway has been ongoing since construction was completed in 1940.

USACE finalized a 1976 Environmental Impact Statement (EIS) titled *Maintenance Dredging of the Atlantic Intracoastal Waterway, South Carolina*, that evaluated environmental impacts resulting from the project, and alternatives to reduce some of the environmental impacts. A Supplemental Information Report (SIR) for maintenance dredging of eight AIWW reaches located in Charleston, Colleton, and Beaufort Counties, South Carolina, was finalized in August 2017. The Federal Action was coordinated with Federal and State agencies and NMFS provided recommendations in a letter dated 14 October 2016. USACE is currently updating National Environmental Policy Act (NEPA) compliance for future AIWW dredging and placement activities. A 2023 programmatic EFH consultation agreement between NMFS and USACE, *Programmatic Essential Fish Habitat Consultation for USACE Activities and Projects Regularly Undertaken in South Carolina,* addresses potential effects of routine dredging, dredged material transportation and dredged material placement activities for the AIWW; however, because the borrow sources for the proposed beneficial use placement along Sullivan's Island and Isle of Palms include five existing upland disposal areas, these activities are not considered routine activities and are not covered under the existing programmatic agreement.

3.0 PROJECT DESCRIPTION

Beneficial use of dredged sediment is proposed throughout beach profiles (nearshore, foreshore and backshore) at Isle of Palms and Sullivans Island (Figures 1 and 2). Under the proposed action, beach quality-sand (i.e., sediment containing ≥ 80% sand) provided for backshore and some foreshore placement would either come from (1) the approximately 500,000 yd3 of shoaling identified for dredging in the Breach Inlet reach of the AIWW; or (2) 200,000-400,000 yd3 beach-quality sand derived from dredged sediment previously placed at Breach Inlet upland placement sites (a.k.a. dredged material management area or DMMA) (Figure 3). Sediment dredged from Breach Inlet that is not considered beach-quality sand but composed of 60-79% of sand may be used for nearshore placement. The needed frequency of dredging cycles is anticipated to be every 2-3 years for Breach Inlet and would be placed similarly in future cycles depending on dredged sediment composition, placement area (i.e., nearshore to backshore), DMMA capacity, equipment and contractor availability, and availability of funding. Any dredged sediment consisting of <60% sand would be disposed of at nearby DMMAs. Sediment testing is currently underway which will identify and delineate the upland areas with high sand content. This testing is physical testing for grain size only. SCDHEC-OCRM has confirmed that chemical testing from in-situ testing is sufficient, and no further testing of the upland sites is required.

Materials dredged directly from the waterway would utilize hydraulic cutterhead dredge with pipelines to transport the dredged materials to the beach and nearshore areas (dredging activities are covered under the 2023 programmatic EFH consultation). Beach placement would include earthmoving equipment on the beach. Placement in the surf zone may require minimal land-based equipment while relying heavily on nature to organize the sediment. Placement in the nearshore would not involve land-based equipment and would entirely rely on nature to move and organize the sediments. Nearshore placement typically occurs from about the 8' MLLW contour landward. USACE is coordinating with the local governments and their consultants to determine the most appropriate locations based on need and the required quantities.

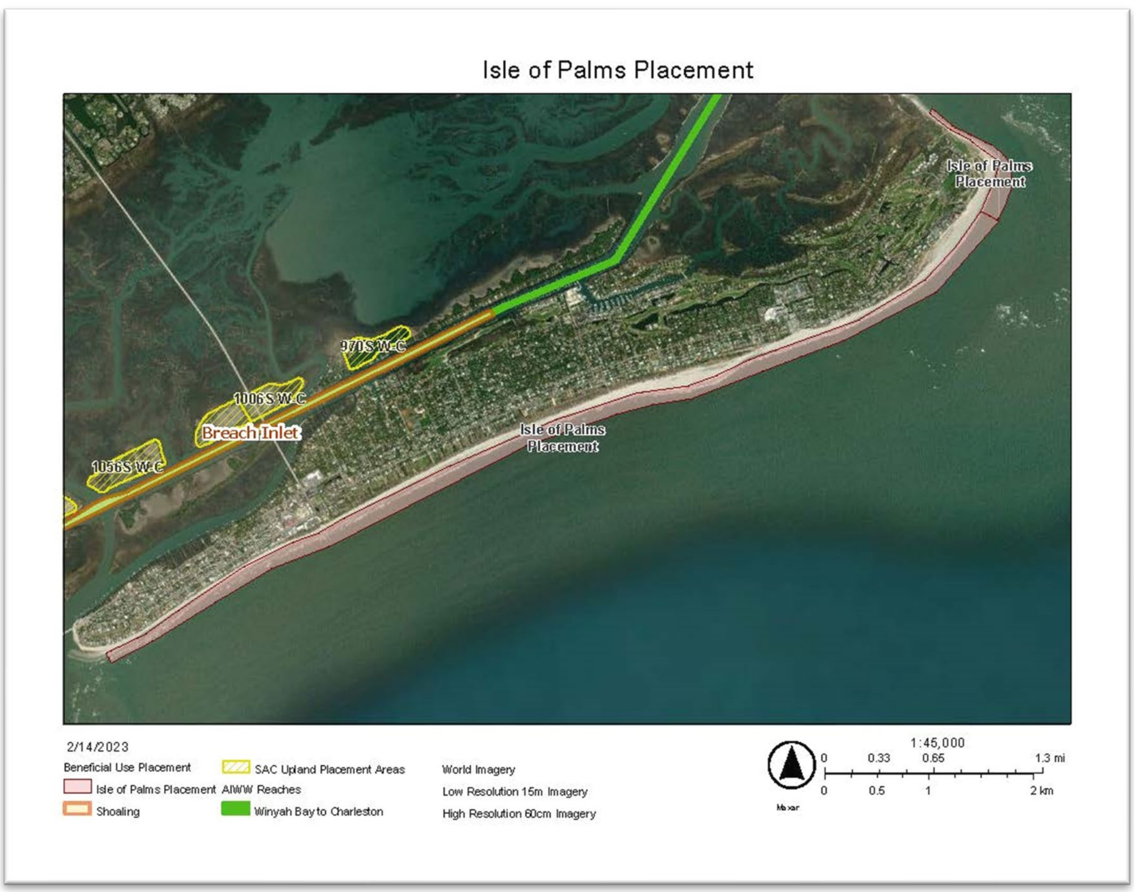

Figure 1. Isle of Palms Potential Beneficial Use Placement Locations.

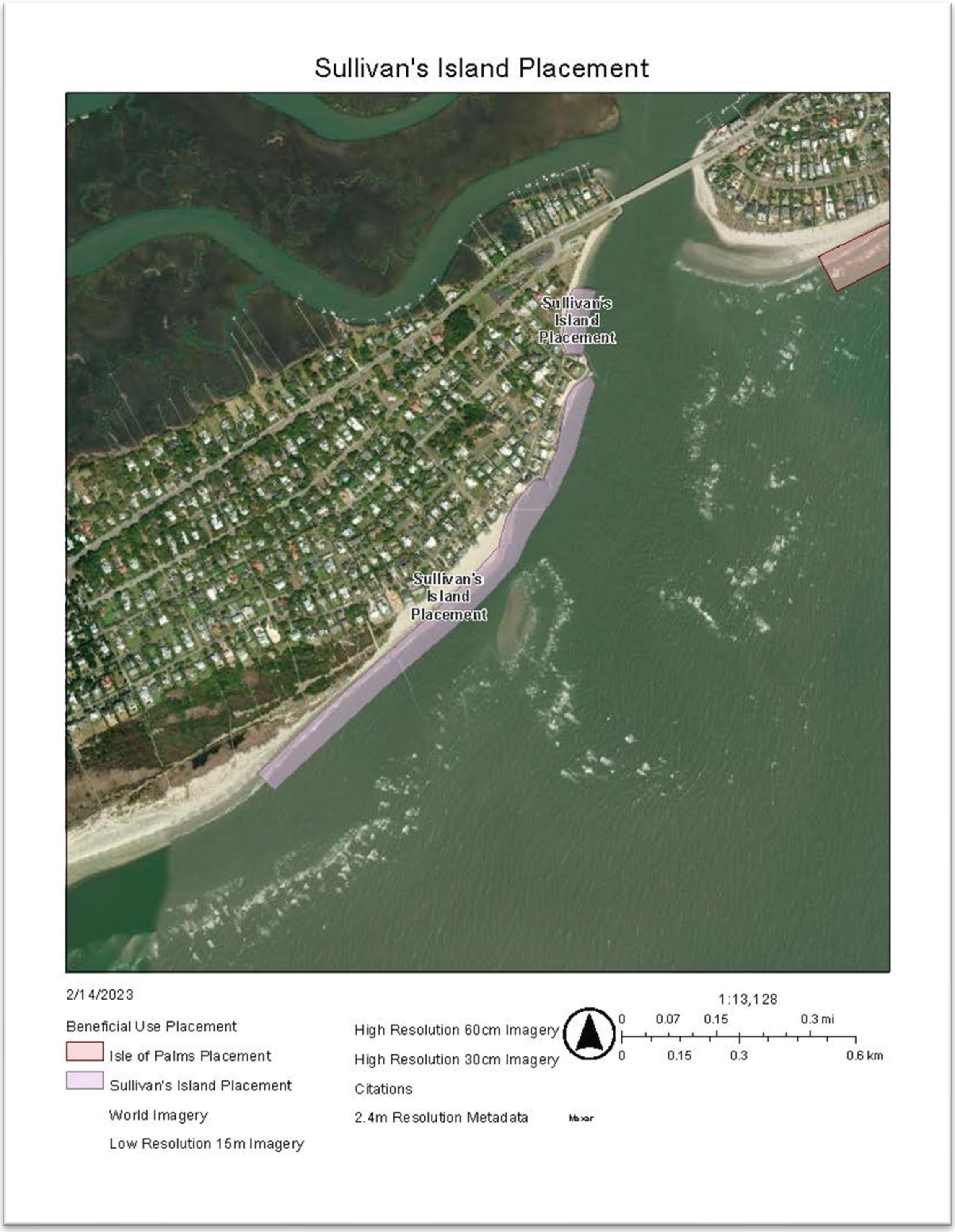

Figure 2. Sullivan's Island Beneficial Use Placement Locations.

Rehandling (use of material from existing upland DMMAs) may be accomplished by methods the bidders deem appropriate. Potential options include but are not limited to 1) excavation of material using traditional land-based equipment, loading material onto barges, and hydraulic pump out to the nearshore; 2) excavation of material via small hydraulic cutterhead dredge inside of placement areas with pipeline transportation to the nearshore. Water from the AIWW would need to be pumped into the barge for option 1 to turn the material back into a slurry to be discharged into the nearshore. Likewise, for option 2, water would need to be pumped from the AIWW into the placement area for the sand to be hydraulically pumped by the dredge.

Figure 3. Upland Placement Locations For Sand Excavation

4.0 ESSENTIAL FISH HABITAT

Sullivan's Island and Isle of Palms are coastal barrier islands, characteristic of the sea island coastal region of South Carolina and Georgia, and are surrounded by sensitive coastal marine and estuarine habitats. Coastal barrier beaches, near-shore waters, inlets, and associated estuarine tidal wetlands provide high quality feeding cover, spawning, and maturation sites for a variety of living marine resources. EFH that may be found in the project area includes estuarine marsh, unconsolidated bottoms, intertidal flats, and marine and estuarine water column. No impacts to estuarine marsh are anticipated because of dredge placement material along the beaches and nearshore of Sullivan's Island and Isle of Palms; therefore, this habitat is not discussed below.

4.1 Unconsolidated Sand/Mud Bottoms

Unconsolidated bottoms include all wetland and deep-water habitats with less than 30% vegetative cover and at least 25% cover of particles smaller in size than stones. Marine and estuarine unconsolidated bottoms are typically characterized by the lack of large stable surfaces for animal and plant attachment, but the communities vary depending on temperature, salinity, and light penetration. Unconsolidated bottoms are inhabited by a diverse assemblage of macroinvertebrates that serve as prey to demersal fish species. Marine and estuarine sand systems may be dominated by the tellin shell *Tellina*, the lugworm *Arenicola*, the wedge shell *Donax*, the sand dollar *Dendraster*, the heart urchin *Echinocardium*, the sea pansy *Renilla*, and the scallop *Pecten*. Marine and estuarine mud systems may be dominated by the deep-sea scallop *Placopecten*, the quahog *Mercenaria*, the echiurid worm *Urechis,* the terebellid worm *Amphitrite*, the boring clam *Platyodon*, the sea cucumber *Thyone*, the mud snail *Nassarius,* and the macoma *Macoma* (FGDC 2013).

4.2 Intertidal Flats

Intertidal flats are the non-vegetated areas located where the ocean meets the land between high and low tides. Intertidal flats are characterized by a range of sediment types from coarse sandy sediments on the higher elevations of the shorelines to finer sediments in the lower elevations. This habitat type serves as a foraging ground, refuge, and nursery area for many mobile species as well as the microalgal community. The benthic community of intertidal flats can include worms, crustaceans, bivalves, and gastropods that provide food for juvenile and small pelagic fish which in turn are preyed upon by larger fish, seabirds, and marine mammals. Some species use this habitat type as a nursery including summer flounder (*Paralichthys dentatus*), striped mullet (*Mugil cephalus*), red drum (*Sciaenops ocellatus*), blue crab (*Callinectes sapidus*) and Penaid shrimp (SAFMC 1998).

4.3 Water Column

The water column includes estuarine and marine waters. Estuarine waters are considered polyhaline (salinity of 18 to 30 ppt) while marine waters are euhaline (>30 ppt). The water column has vertical and horizontal components that result in changes to salinity, oxygen content, phytoplankton, and nutrients. The water column serves as EFH for all managed species and their prey at various life stages by providing habitat for spawning, breeding, feeding, and growth.

5.0 HABITAT AREAS OF PARTICULAR CONCERN

EFH-Habitat Areas of Particular Concern (HAPCs) are subsets of EFH that are rare habitats, have ecological importance, are susceptible to human-induced environmental degradation, or are susceptible to stress from development. Fishery Management Councils (FMC) and NMFS designate HAPCs in order to highlight these areas for management and conservation.

5.1 Penaeid Shrimp

Areas meeting the HAPC for penaeid shrimp include all coastal inlets, all state-designated nursery habitats of particular importance to shrimp, and state-identified overwintering areas. In South Carolina, estuarine outstanding resource waters within coastal counties have been designated as nursery habitat for shrimp. Since seagrass beds are not found in South Carolina, nursery habitat includes high marsh areas with shell hash and mud bottoms. During the winter months, shrimp move out of the marsh areas and into creek channels and deepwater habitats. Breach Inlet between Sullivan’s Island and Isle of Palms, and DeWees Inlet adjacent to Isle of Palms are considered HAPC for penaeid shrimp.

5.2 Snapper Grouper Complex

Areas meeting the criteria snapper grouper complex for the AIWW include oyster/shell habitat and all coastal inlets. Breach Inlet between Sullivan's Island and Isle of Palms, and DeWees Inlet adjacent to Isle of Palms are considered HAPC for the snapper grouper complex. Inlets are critical locations for spawning activities, feeding and daily movement.

6.0 Managed Fish Species

This section is intended to give a brief description of the fish species and groups of species that may be found in the project area and are managed under the Magnuson-Stevens Act. See Table 1 below.

Table 1. Fishery Management Plans and Managed Species for the Project Area

Common Name	Scientific Name	Management Plan Agency	Fishery Management Plan (FMP)
White Shrimp	*Lytopenaeus setiferus*	SAFMC	Shrimp
Brown Shrimp	*Farfantepenaeus aztecus*	SAFMC	Shrimp
Gag Grouper	*Mycteroperca microlepis*	SAFMC	Snapper Grouper
Gray Snapper	*Lutjanus griseus*	SAFMC	Snapper Grouper
Lane Snapper	*Lutjanus synagris*	SAFMC	Snapper Grouper
Black Sea Bass	*Centropristis striata*	SAFMC	Snapper Grouper
Spanish Mackerel	*Scomberomorus maculatus*	SAFMC	Coastal Migratory Pelagic
King Mackerel	*Scomberomorus cavalla*	SAFMC	Coastal Migratory Pelagic
Summer Flounder	*Paralichthys dentatus*	MAFMC	Summer Flounder
Bluefish	*Pomatomus saltatrix*	MAFMC	Bluefish
Scalloped Hammerhead Shark	*Sphyrna lewini*	NMFS	Highly Migratory Species
Bonnethead Shark	*Sphyma tiburo*	NMFS	Highly Migratory Species
Bull Shark	*Carcharhinus leucas*	NMFS	Highly Migratory Species
Sandbar Shark	*Carcharhinus plumbeus*	NMFS	Highly Migratory Species
Finetooth Shark	*Carcharhinus isodon*	NMFS	Highly Migratory Species
Dusky Shark	*Carcharhinus obscures*	NMFS	Highly Migratory Species
Blacktip Shark	*Carcharhinus limbatus*	NMFS	Highly Migratory Species
Atlantic Sharpnose	*Rhyzoprionodon terranovae*	NMFS	Highly Migratory Species
Lemon Shark	*Negaprion brevirostris*	NMFS	Highly Migratory Species

6.1 White Shrimp

White shrimp are offshore and estuarine dwellers. They can be either pelagic or demersal depending on their life stage. When occupying inshore waters, white shrimp prefer muddy or peaty bottoms rich in organic matter and decaying vegetation. When offshore, they are most abundant on soft, muddy bottom sediments. Post larval white shrimp are benthic dwellers when reaching their nursery areas in estuaries. The juveniles move from estuarine areas to coastal waters as they mature, and adults generally inhabit waters of 27 m or less. White shrimp have centers of abundance in South Carolina, Georgia, and northeast Florida. Spawning typically occurs between April and October within 4 miles of the South Carolina coast.

6.2 Brown Shrimp

Brown shrimp prefer soft, muddy bottom sediments when residing offshore. Adult brown shrimp may be found in areas of mud, sand, and shell. They are more active at night and bury into the sediment during the day. In South Carolina, most spawning occurs within 4 miles of the coast.

6.3 Snapper Grouper Complex

The fish community referred to as the snapper-grouper complex consists of demersal tropical and subtropical species generally occupying the same habitat type. The snapper grouper complex includes the families of snappers (*Lutjanidae*), sea basses and groupers (*Serranidae*), porgies (*Sparidae*), tilefishes (*Malacanthidae*), grunts (*Pomadasyidae*), triggerfishes (*Balistidae*), wrasses (*Labridae*), and jacks (*Carangidae*).

Among the snapper grouper species complex, there is variation in specific life history patterns and habitat use. Snapper grouper species typically utilize both pelagic and benthic habitats throughout their life cycles. Larvae are free swimming within the water column and commonly feed on zooplankton. Juveniles and adults are bottom dwellers that prefer hard structures with moderate to high relief. Spawning characteristics for this complex include: (1) for many grouper species, spawning occurs over one or two winter months, (2) for others, spawning occurs at low levels year-round with peaks during the warmer months, and (3) some species tend to form sizable spawning aggregations, but this might not be the case with all species.

6.4 Coastal Migratory Pelagics

King and Spanish mackerel are coastal migratory pelagic species managed jointly by the South Atlantic and Gulf of Mexico Fishery Management Councils. These species mostly live in open waters near the coast, but Spanish mackerel can also be found in shallow estuaries and over deep grass beds. They typically travel from one area to another to harvest resources. On the Atlantic coast, Spanish mackerel typically spawn from April to September and release their eggs in batches throughout the spawning season. King mackerel spawn on the outer continental shelf from May through October and the females release eggs in the open water where they are fertilized. Spanish mackerel primarily feed on schools of small fish and less commonly, shrimp, crabs, and squid. King mackerel primarily feed on fish, squid, and shrimp.

6.5 Mid-Atlantic Species Which Occur in the South Atlantic

Bluefish (*Pomatomus saltarix*) and summer flounder (*Paralichthys dentatus*) are two species listed in the Mid-Atlantic Fisheries Management Plan that occur in the South Atlantic. Bluefish juveniles and adults frequent estuaries and surf zones from North Carolina to Florida.

6.6 Highly Migratory Species

This category consists of tunas, swordfish, billfish, and sharks. These species travel long distances and tend to occupy deep water. There are 9 shark species that could occur in the project area.

Shark habitat can be described in four broad categories: (1) coastal, (2) pelagic, (3) coastal - pelagic, and (4) deep-dwelling. Coastal species inhabit estuaries, the nearshore, and waters of the continental shelves. Pelagic species range widely in the upper zones of the oceans, often traveling over entire ocean basins. Coastal-pelagic species are intermediate in that they occur both inshore and beyond the continental shelves, but have not demonstrated mid-ocean or transoceanic movements. Deep-dwelling species inhabit the dark, cold waters of the continental slopes and deeper waters of the ocean basins.

7.0 ASSESSMENT OF IMPACTS

In this section, potential impacts to EFH for managed species are examined. Impacts could occur from dredged material placement along the nearshore and beaches of Sullivan's Island and Isle of Palms.

In addition to materials dredged from the waterway, the borrow areas for the proposed work include 5 upland placement areas (see Figure 4). Removal of sand from the upland placement areas should not result in direct impacts to EFH; however, if water is needed to extract sand from the upland areas, pumps may be required. Fish or larvae could be adversely impacted by use of pumps. If pumps are necessary, low flows would be required or screens would be installed to avoid or minimize adverse impacts.

Beneficial use placement along the nearshore, foreshore, and backshore of Sullivan's Island and Isle of Palms has the potential to result in impacts to benthic and fish communities through direct burial, increased turbidity, loss of habitat, or changes in sand grain size or beach profile. Upon completion of the work, the inter-tidal and sub-tidal zones along the beach and nearshore would be covered with sand which could result in the temporary loss of benthic organisms and interference with fish spawning and migration. Materials placed for the project may also be transported by natural processes onto other areas that support benthic communities; however, no hard bottoms or vegetated wetlands would be affected. For the beneficial use placement at Sullivan's Island and Isle of Palms, construction would occur during the fall and winter months, as practicable, before the onshore recruitment of most surf zone fish and invertebrate species. To ensure compatibility of nourishment material with native sediment characteristics and to minimize impacts to benthic invertebrates from the placement of incompatible sediment, physical testing is currently being conducted on the upland borrow sites. Only beach quality sand would be placed on the foreshore and backshore of Sullivan's Island and Isle of Palms. Dredged sediments composed of 60-79% of sand may be used for nearshore placement.

Other short-term potential impacts include turbidity elevation and suspended solids in the immediate area of sand deposition when compared to the existing non-storm conditions. Significant increases in turbidity are not expected to occur outside the immediate construction area. Elevated turbidity can reduce photosynthesis activity of pelagic and benthic algae and suspended sediments can cause physical damage to respiratory structures of early life history stages of fish and invertebrates. Turbidity levels and suspended sediments would be expected to return to background levels once construction ceases.

8.0 BEST MANAGEMENT PRACTICES

The following best management practices would be implemented to minimize effects to EFH and managed species:

1. Materials used for placement along the beach and nearshore would consist of natural sediment and shell material with no construction debris, toxic material, or other foreign matter.
2. Materials used would be similar in color and grain size distribution to the native material in the project area.
3. No material would be placed in hard bottom areas.
4. Beach and nearshore placement would occur in the fall and winter months, as practicable, to avoid periods of high productivity for benthic infauna.
5. After placement of materials, the slope of the beach should mimic the natural beach profile.
6. The overall volume of fill material to be added to the beach/nearshore should not exceed 50% of the cumulative net sediment transport (annual net transport times the years since last nourishment).
7. Use of heavy equipment for placement activities would avoid causing ruts and equipment staging would occur outside beach areas as available.
8. If pumps are required, low flows or screens would be implemented as necessary.
9. A post construction monitoring plan will be implemented, as appropriate, to adequately detect and document both direct and indirect impacts related to use of upland placement areas as borrow sites.

9.0 CONCLUSION

The proposed project activities would result in unavoidable impacts to unconsolidated sand/mud bottoms, intertidal flats, and the water column. The overall magnitude of these impacts is expected to be short term and minor under the dredging and placement operations to be employed. While the beneficial placement of dredged material will result in the temporary loss of benthic habitat, recolonization of the beach and nearshore are expected to occur within 1 to 2 years, or less. Additionally, implementation of best management practices should limit the extent and duration of turbidity impacts, which can temporarily alter fish dynamics in the vicinity of the construction activities. Overall, the impacts to EFH and HAPC related to the beneficial use placement of dredged materials along the beaches and nearshore of Sullivan's Island and Isle of Palms are expected to be short-term and should not result in significant impacts to the managed species that depend on them.

10.0 REFERENCES

Bergquist, D. C., S. E. Crowe, and M. Levisen. 2009. Change and recovery of physical and biological characteristics of the borrow area impacted by the 2007 Folly Beach emergency renourishment project. Final Report submitted to USACE, Charleston District. SC Department of Natural Resources, Marine Resources Division. Technical Report Number 104.

Bergquist, D. C., S. E. Crowe, M. Levisen and R.F. Van Dolah. 2008. Change and recovery of physical and biological characteristics at beach and borrow areas impacted by the 2005 Folly Beach renourishment project. Final Report , Marine Resources Research Institute, South Carolina Department of Natural Resources, Charleston, SC for the U.S. Army Corps of Engineers, Charleston District. 112 pp plus appendices.

Cowardin, LM, Carter, V, Golet, F.C.and LaRoe, E.T. 1979. Classification of wetlands and deepwater habitats of the United States. US Fish and Wildlife Service FWS/OBS 79/31. 103pp.

Federal Geographic Data Committee. 2013. Classification of wetlands and deepwater habitats of the United States. FGDC-STD-004-2013. Second Edition. Wetlands Subcommittee, Federal Geographic Data Committee and U.S. Fish and Wildlife Service, Washington, DC.

Leewis, L., P.M. van Bodegom, J. Rozema, and G.M. Janssen, 2012. Does beach nourishment have long-term effects on intertidal macroinvertebrate species abundance? *Estuarine, Coastal and Shelf Science*. 113, 172-181.

Peterson, C.H., and M.J. Bishop, 2005. Assessing the environmental impacts of beach nourishment. *BioScience*. 55 (10) 887-896.

South Atlantic Fishery Management Council. 1998. Final habitat plan for the South Atlantic Region: Essential Fish Habitat requirements for fishery management plans of the South Atlantic Fishery Management Council. 457 pp plus appendices.

U.S. Army Corps of Engineers. 1976. Final Environmental Statement: Maintenance Dredging of Atlantic Intracoastal Waterway, South Carolina. Charleston District, Charleston, SC.

Wilber, D., D. Clarke, G. Ray, and R. Van Dolah, 2009. Lessons learned from biological monitoring of beach renourishment projects. *Proceedings of the Western Dredging Association's Twenty-Ninth Technical Conference* (Tempe, Arizona), pp. 262-274.

Wooldridge, T., H.J. Henter, and J.R. Kohn. 2016. Effects of beach replenishment on intertidal invertebrates: A 15-month, eight beach study. *Estuarine, Coastal and Shelf Science*. 175, 24-33.