U.S. Army Corps of Engineers
Charleston District

APPENDIX F1

CHARLESTON HARBOR POST 45
CHARLESTON, SOUTH CAROLINA

Biological Assessment of Threatened and Endangered Species

May 2015

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1.0 Background

Charleston Harbor, South Carolina is located in a natural tidal estuary formed by the confluence of the Cooper, Ashley, and Wando Rivers that serves the Port of Charleston. The total area of the Harbor is approximately 14 square miles. The study area encompasses the offshore entrance channel and disposal site and the area of Federal channels and any extension of these water bodies and shorelines that are potentially impacted by channel enlargement alternatives as well as landside confined dredged material disposal sites.

The Federal objective of water and related land resources project planning is to contribute to national economic development consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Specific problems warranting Federal consideration include navigation concerns, engineering challenges, and concerns of those that live and work along or around the Federal navigation project. Navigation concerns include three main problems: insufficient Federal channel depths, difficult currents, and restrictive channel widths and turning basins. Larger ships currently experience transportation delays due to insufficient Federal channel depths. To reach port terminals, these larger ships must either be light loaded, anchor offshore to await favorable tide conditions, or both. These approaches require the vessel operator to forego potential transportation cost savings available from the economies of scale associated with larger ships. Other navigation concerns associated with Charleston Harbor include strong and unpredictable ebb tide crosscurrents at the confluence of the Wando and Cooper Rivers, which make turns for large ships difficult in the channel reaches immediately north of the Ravenel Bridge. Restrictive channel widths limit ship passage to one-way traffic in many reaches and larger container ships require expanded turning basins.

2.0 Proposed Project

2.1 Alternatives Considered

A lengthy array of alternatives was considered during plan formulation. The alternatives were developed from ideas provided by the public, resource agencies, USACE, and the non-Federal sponsor. Alternatives considered were the "no-action" plan (retaining the existing 45 feet deep channel and 47 feet deep entrance channel), non-structural plans (improving traffic scheduling, modifying traffic rules, utilizing another port, utilizing existing deep water for channel wideners), and numerous structural alternatives which consisted of variations of channel depths (ranging from 48 to 52 feet deep), channel wideners, and enlarged turning basins. The array of alternatives were screened to identify the proposed project. All of the alternatives were evaluated in terms of whether they met the planning objective and produced a positive preliminary benefit to cost ratio. The planning objectives are to: 1. reduce the transportation cost of import and export trade through Charleston Harbor and contribute to increases in national economic development, and 2. reduce navigation constraints facing harbor pilots and their operating practices including limited one-way traffic in certain reaches.

Differences among alternatives are primarily due to varying project depths. The alternatives, named according to the depths of the (1) Wando/Cooper River to Navy base reach and (2) Navy based to Ordnance Reach, analyzed include the following:

- Alternative 48-47: Channel widths are maximum widenings, transitions, bend easings and turning basin enlargements. Design depth is 50 feet MLLW in the entrance channel, 48 feet MLLW from Mt Pleasant range to Wando River up to Wando terminal (includes turning basin) and to Cooper River at proposed Navy Base terminal (includes turning basin). This includes the widener area in Customs House Reach, but the remainder of Customs House Reach, as well as Tidewater Reach, Town Creek Turning Basin and Lower Town Creek Reach remain at the Existing Condition design depths. Design depth is 47 feet MLLW from Daniel Island bend to Ordnance reach (includes turning basin). Assume SLR is 0.57 feet above existing level.
- Alternative 48-48: Channel widths are maximum widenings, transitions, bend easings and turning basin enlargements. Design depth is 50 feet MLLW in the entrance channel, 48 feet MLLW from Mt Pleasant range to Wando River up to Wando terminal (includes turning basin) and to Cooper River at proposed Navy Base terminal (includes turning basin). Design depth is 48 feet MLLW from Daniel Island bend to Ordnance reach (includes turning basin). Assume SLR is 0.57 feet above existing level.
- Alternative 50-47: Channel widths are maximum widenings, transitions, bend easings and turning basin enlargements. Design depth is 52 feet MLLW in the entrance channel, 50 feet MLLW from Mt Pleasant range to Wando River up to Wando terminal (includes turning basin) and to Cooper River at proposed Navy Base terminal (includes turning basin). Design depth is 47 feet MLLW from Daniel Island bend to Ordnance reach (includes turning basin). Assume SLR is 0.57 feet above existing level.
- Alternative 50-48: Channel widths are maximum widenings, transitions, bend easings and turning basin enlargements. Design depth is 52 feet MLLW in the entrance channel, 50 feet MLLW from Mt Pleasant range to Wando River up to Wando terminal (includes turning basin) and to Cooper River at proposed Navy Base terminal (includes turning basin). Design depth is 48 feet MLLW from Daniel Island bend to Ordnance reach (includes turning basin). Assume SLR is 0.57 feet above existing level.
- Alternative 52-47: Channel widths are maximum widenings, transitions, bend easings and turning basin enlargements. Design depth is 54 feet MLLW in the entrance channel, 52 feet MLLW from Mt Pleasant range to Wando River up to Wando terminal (includes turning basin) and to Cooper River at proposed Navy Base terminal (includes turning basin). Design depth is 47 feet MLLW from Daniel Island bend to Ordnance reach (includes turning basin). Assume SLR is 0.57 feet above existing level.
- Alternative 52-48: Channel widths are maximum widenings, transitions, bend easings and turning basin enlargements. Design depth is 54 feet MLLW in the entrance channel, 52 feet MLLW from Mt Pleasant range to Wando River up to Wando terminal (includes turning basin) and to Cooper River at proposed Navy Base terminal (includes turning basin). Design depth is 48 feet MLLW from Daniel Island bend to Ordnance reach (includes turning basin). Assume SLR is 0.57 feet above existing level. [***This is the Proposed Action***]

For each of the above alternatives, two or three contraction dikes may be constructed near the Wando Welch Terminal and the Wando Reach of the Navigation Channel in order to minimize shoaling and reduce maintenance costs. The dikes would be extended shore perpendicular from the west bank of the river and would range from 350 ft to 840 ft in length. Prior to implementing this measure, ship simulation will be performed to examine possibilities to reduce certain widening measures. Reducing wideners will reduce the amount of shoaling and therefore could eliminate the need for contraction dikes. If contraction dikes become part of the proposed action, reinitiation of coordination with resource agencies will occur and all environmental impacts will be disclosed in a supplemental NEPA document.

2.2 Description of the Proposed Project

After an extensive alternatives analysis, the recommended plan was selected to be Alternative 52-48, which is also the locally preferred plan (LPP). Details on this process can be found within Section 3 of the final Integrated Feasibility Report / Environmental Impact Statement (IFR/EIS). The proposed project contains the following navigation improvements and is referenced as the 52'/48' plan (Figures 2 and 3): Deepen the existing entrance channel from a 47-foot project depth to a 54-foot depth over the existing 800-foot bottom width while maintaining the existing stepped 1000-foot width at a depth of 49 feet; extend the entrance channel approximately three miles seaward from the existing location to the 54-foot project depth contour; deepen the inner harbor from an existing depth of 45 feet to 52 feet to the container facility on the Wando River and the new container facility on the Cooper River and to 48 feet for the reaches above that terminal to the container facility in North Charleston over varying expanded bottom widths ranging from 400 to 1800 feet; enlarge the existing turning basins at the Wando Welch and new South Carolina State Ports Authority (SCSPA) terminals to accommodate post Panamax generation 2 and 3 container ships; enlarge the North Charleston Terminal turning basin to accommodate post Panamax generation 2 container ships; place dredged material at the existing upland confined disposal facilities at Clouter Creek and/or Daniel Island for the upper harbor reaches and at the Ocean Dredged Material Disposal Site (ODMDS) for material from the lower harbor; raise dikes within the footprint of the existing upland confined disposal facilities at Clouter Creek, Yellow House Creek, and/or Daniel Island to accommodate new work and increased maintenance material; expand the existing ODMDS to provide increased capacity for new work and maintenance material (*Action being addressed jointly by EPA and USACE in a Section 102 site modification EA*).

Figures 2 and 3 depict the locations of the proposed construction activities and channel features. New work material from channel deepening and widening would be distributed among the ODMDS, mitigation site, additional reef sites, and upland confined disposal areas. The amount of material from each reach and the location of the disposal is documented in Table 1.

A mitigation reef will be created in between the Entrance Channel and the ODMDS. The objective of the mitigation is to create a marine patch reef feature in mound formations that will replace the functions of the hardbottom dredged from the entrance channel. The designated mitigation area would be surveyed and reviewed prior to construction and must not contain existing hardbottom habitat or support other traditional uses of the marine environment such as trawling or sand mining areas. The sites will be coordinated with the resource agencies prior to construction. The selected alternative involves using dredged limestone rock from the entrance channel and depositing it in a designated mitigation area adjacent to the Charleston Post 45 entrance channel, between the Charleston ODMDS and the entrance channel. The material would be placed or discharged, likely by scow or barge to reach the designed configuration. An excavator or clamshell dredge would permit the largest diameter material to comprise the reef; however, a cutterhead suction dredge could also be used. USACE anticipates mitigating for 28.6 acres of hardbottom habitat within the entrance channel. This habitat represents areas that have not been previously dredged either from new work or maintenance dredging. Water depths in the mitigation area are between 35 and 50 feet. The new reef feature will consist of individual low relief mounds separated by existing bottom service area. The reef feature is designed to provide bathymetric anomalies, hard bottom surfaces material, habitat diversity, and stability. A simple patch reef design and a simple operational plan compatible with dredge plant and transportation capabilities is required. Accordingly, a grid placement plan will be used. The grid will consist of 300-foot by 300-foot cells. The cells will be two (2) across by eight (8) long. This would create approximately 33 acres of patch reef habitat (project footprint). The patch reef area would be 600 feet by 2,400 feet long. At a minimum two scow loads of material dredged from rock areas would be discharged at about the center of each cell. Accordingly, the 16 cells would require 32 - 4,000 to 6,000 cy scow loads, or approximately 128,000 to 192,000 cy. Filling the scows to maximum capacity with each load is not a likely occurrence. The desired peak vertical relief is 3.5 – 4.5 feet and the desired aerial coverage within each cell is 75% coverage. However, placing the load directly on top of each other will be a challenge. Placing more than two loads in each cell can be done in order to make a higher mound or to cover more area. Filling the scows to maximum scow capacity with each load is not a likely occurrence. Additional loads could be placed on specific cells if the two loads do not achieve desired areal coverage. This will be monitored during construction and if necessary, will be adapted.

It is anticipated that the material will be dredged mechanically by a rock bucket clamshell dredge, in which case the rock may be removed in softball and larger basketball size pieces. The scows would be 4,000 to 6,000 cyd vessels. Dredged materials for the patch reef will be new work (not previously dredged) rock to the extent practicable, although some overlying and intermixed sediments will be dredged along with the rock. The scow will transport the dredged material to the placement location. A placement grid will be developed to provide the patch reef design. Grids will be divided into sequentially numbered cells. Each cell would be a placement target. One or more scow placements would occur in a manner that will produce discrete mounds. A second reef would be constructed in this same manner.

In addition to the mitigation reefs, USACE will construct 6 other similar reefs for a total of 8 new 33-acre reefs for a total of 264 acres of new hardbottom habitat. Four will be located along the north side of the channel and 4 will be located along the south side of the channel. The exact location of these reefs is unknown at this time because surveys haven't been completed for existing hardbottom and cultural resources. For a theoretical depiction of the location of these reefs see Figure 4. As stated earlier, prior to construction the locations of these reefs will be refined and coordinated with the resource agencies. At the request of the SCDNR Artificial Reef Program, approximately 240,000 cy of rock material will also be deposited at the 25 acre Charleston Nearshore Reef site. Details on the monitoring and adaptive management pursuant to this action can be found in Appendix P of the Charleston Harbor Post 45 Environmental Impact Statement.

Construction Methodology

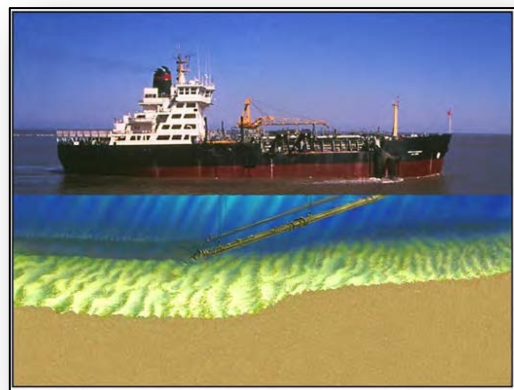
Construction methodology of the project would be determined by the contractor selected by the USACE during the RFP bid process. However, certain assumptions for planning and estimating purposes were made regarding various proposed construction techniques that may be used. Dredged material from widening and deepening of the channel would most likely be excavated using a hydraulic cutterhead dredge, hopper dredge, or mechanical excavator. Since the dredged rock material will not require blasting, removal could be accomplished using a hydraulic excavator dredge that loads scow barges. The rock-hardened cutterhead dredge could pump the rock material to the upland confined disposal facility (CDF) on Daniel Island, Clouter Creek, Yellow House Creek, but most likely the material will be transported by spider barge for offshore placement at the ODMDS.

Mechanical – Clamshell Dredging

Mechanical dredges are classified by how the bucket is connected to the dredge. The three standard classifications are structurally connected (backhoe), wire rope connected (clamshell), and chain and structurally connected (bucket ladder). The advantage of mechanical dredging systems is that very little water is added to the dredged material by the dredging process and the dredging unit is not used to transport the dredged material. This is important when the disposal location is remote from the dredging site. The disadvantage is that mechanical dredges require sufficient dredge cut thickness to fill the bucket to be efficient and greater re-suspended sediment is possible when the bucket impacts the bottom and as fine-grained sediment washes from the bucket as it travels through the water column to the surface. Clamshell excavators are likely to be employed on portions of the Charleston Harbor project. These dredges are able to work in confined areas, can pick up large particles, and are less sensitive to sea conditions than other dredges.

It is anticipated that a clamshell dredge will be used in two separate manners for the construction of this project. The first will be within the lower harbor (Figure 2). Material from these reaches will be placed in a scow or on a barge for transport to the ODMDS. The second area of clamshell dredging will be in the entrance channel (Figure 2). Rock material from this reach will be excavated and placed in a scow to be transported to either the mitigation (hardbottom reef) site, or the ODMDS for use in construction of a sediment containment berm along the south and west perimeters of the disposal area.

Hydraulic – Hopper Dredging



Hopper dredges include self-propelled ocean-going vessels that hydraulically lift dredged material from the bottom surface and deposit it into an open hopper within the ship. The draghead(s) operates like a vacuum cleaner being dragged along the bottom. When the hopper is full, the dredge transits to a disposal location and releases the dredged material into an underwater disposal site by opening doors on the hopper bottom or in some cases the vessel is designed to split open longitudinally. Hopper dredges can also be designed to hydraulically pump the material from the hopper to an upland location. This is often used for beach nourishment projects. Since hopper dredges are self-propelled, they are more maneuverable than dredges that rely upon tug boats to move. However, they require numerous passes over the same area to remove the required material; they are inefficient in small confined dredging areas and are most effective in removing sand and other unconsolidated materials.

A hopper dredge is anticipated to be used to remove unconsolidated overburden material from the entrance channel. Material will be transported to the ODMDS and disposed of according to the Site Management and Monitoring Plan (SMMP).

Hydraulic – Cutter-Suction Dredge

Large cutter-suction dredges (Figures 15, 16, and 17), or cutterhead dredges, are mounted on barges. The cutter suction head resembles an eggbeater with teeth (Figure 18). It mobilizes the dredged material as it rotates. The mobilized material is hydraulically moved into the suction pipe for transport. The cutter suction head is located at the end of a ladder structure that raises and lowers it to and from the bottom surface. The cutter suction dredge moves by means of a series of anchors, wires, and spuds. The cutter suction dredges as it moves across the dredge area in an arc as the dredge barge swings on the anchor wires. The discharge pipeline connects the cutter suction dredge to the disposal area. The dredged material is hydraulically pumped from the bottom, through the dredge, and through the discharge pipeline to the disposal location. Booster pumps can also be added along the discharge pipeline to move the material greater distances. Cutter-suction dredges are limited to dredging depths within reach of the ladder.

It is anticipated that a cutter-suction dredge will be used in two distinct areas for this project. The first area is the upper harbor reaches in the Cooper River (Figure 2). In this area of the Channel, material will be disposed of in upland confined disposal facilities (either Yellow House Creek or Clouter Creek Disposal Areas). The second distinct dredging area for a cutter-suction dredge will be in the Entrance Channel, where a rock cutterhead will be used to excavate consolidated limestone rock from the channel. Material will be placed in a spider barge and transported to the ODMDS for disposal. Material may also be placed at the mitigation site if rock size restrictions can be met.

Post-Dredging Operations

Since dredging equipment does not typically result in a perfectly smooth and even channel bottom (see discussion above); a drag bar, chain, or other item may be pulled along the channel bottom to smooth down high spots and fill in low spots. This finishing technique also reduces the need for additional dredging to remove any high spots that may have been missed by the dredging equipment. It may be more cost-effective to use a drag bar or other leveling device (and possibly less hazardous to sea turtles) than to conduct additional hopper dredging

Table 1. Proposed Action Dredge Quantities, Placement Area, and Dredge Type

52'/48' Project with Max Wideners					
Channel Reach	Dredge Plant Type	# of Dredges	Placement Area	Deepening Dredge Quantity in Cubic Yards (CY)	Duration (Months)
Fort Sumter Reach EC1	Large Hopper	2	ODMDS	4,085,505	3.98
Fort Sumter Reach EC1	Medium Hopper	2	ODMDS	2,199,888	4.11
Fort Sumter Reach EC1	Rock cutter	1	ODMDS Berm	2,503,169	11.57
Fort Sumter Reach EC1	Rock cutter	1	DNR Site	60,000	0.28
Fort Sumter Reach EC1	Rock cutter	1	Reef Placement	420,000	1.81
Ft. Sumter - Reach EC1	Clamshell with bucket	1	ODMDS Berm	660,000	4.34
Ft. Sumter - Reach EC1	Clamshell w/ rock bucket	1	Mitigation Site	360,000	2.52
Ft. Sumter - Reach EC1	Clamshell w/ rock bucket	1	DNR Site	180,000	1.26
Fort Sumter Reach EC2	Large Hopper	2	ODMDS	3,644,084	3.85
Fort Sumter Reach EC2	Medium Hopper	2	ODMDS	1,214,695	2.46
Fort Sumter Reach EC2	Rock cutter	1	ODMDS Berm	3,371,033	13.73
Fort Sumter Reach EC2	Rock cutter	1	Reef Placement	420,000	1.81
Fort Sumter Reach EC2	Clamshell w/ rock bucket	1	Reef Placement	1,080,000	7.69
Mount Pleasant Reach	Clamshell	1	ODMDS	840,083	0.76
Rebellion Reach	Clamshell	1	ODMDS	1,081,341	0.98
Bennis Reach	Clamshell	2	ODMDS	1,942,858	1.12
Horse Reach	Clamshell	2	ODMDS	364,070	0.27
Hog Island Reach	Clamshell	2	ODMDS	2,096,920	1.46
Wando River Lower Reach	Clamshell	2	ODMDS	1,769,070	1.02
Wando River Upper Reach	Clamshell	2	ODMDS	636,251	0.52
Wando River Turning Basin	Clamshell	2	ODMDS	3,284,633	1.81
Segment 1 Total				**32,213,600**	**67.33**
Drum Island Reach	Clamshell	2	ODMDS	917,473	0.72
Myers Bend	Clamshell	2	ODMDS	853,689	0.60
Daniel Island Reach	Pipeline	2	Daniel Island	2,211,957	1.65
Segment 2 Total				**3,983,119**	**2.97**
Daniel Island Bend	Pipeline	2	Daniel Island	74,551	0.21
Clouter Creek Reach	Pipeline	2	Daniel Island	583,150	0.98
Navy Yard Reach	Pipeline	2	Clouter Creek	358,816	0.60
North Charleston Reach	Pipeline	2	Clouter Creek	532,693	0.50
Filbin Creek Reach	Pipeline	2	Yellowhouse	405,420	0.61
Port Terminal Reach	Pipeline	2	Yellowhouse	192,068	0.43
Ordnance Reach	Pipeline	2	Yellowhouse	118,091	0.26
Ordnance Reach Turning Basin	Pipeline	2	Yellowhouse	1,549,313	1.21
Segment 3 Total				**3,814,102**	**4.80**
North Charleston Terminal Berthing Area Dredging	Pipeline	1	Yellowhouse	41,001	0.16
Navy Base Terminal Berthing Area Dredging	Pipeline	1	Daniel Island	474,551	0.73
Wando Terminal Berthing Area Dredging	Pipeline	1	Daniel Island	157,633	0.24
Berthing Areas Total				**673,185**	**1.13**
Total Construction				**40,684,006**	**76.23**

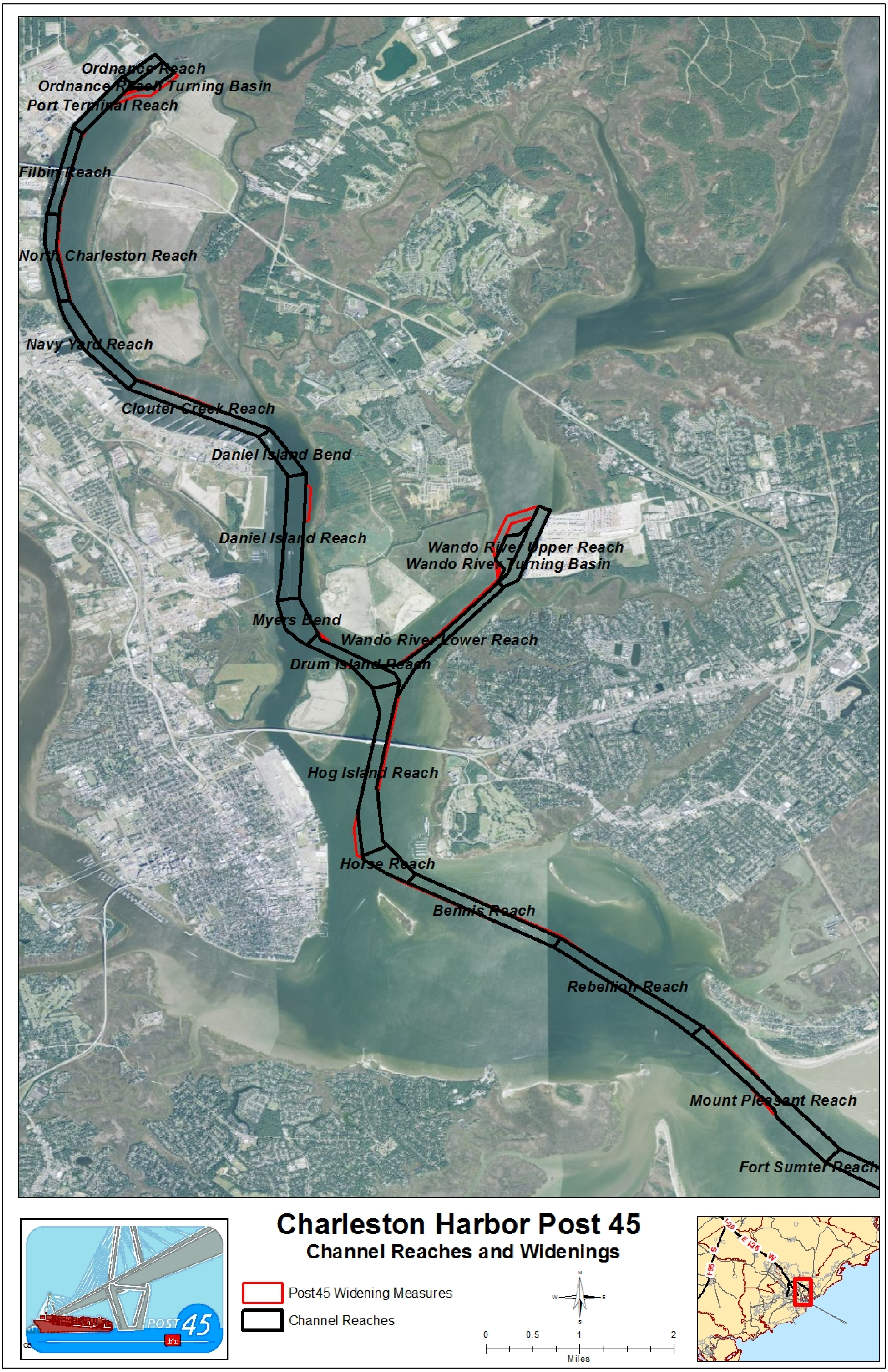


Figure 1. Post 45 channel reaches and widening measures

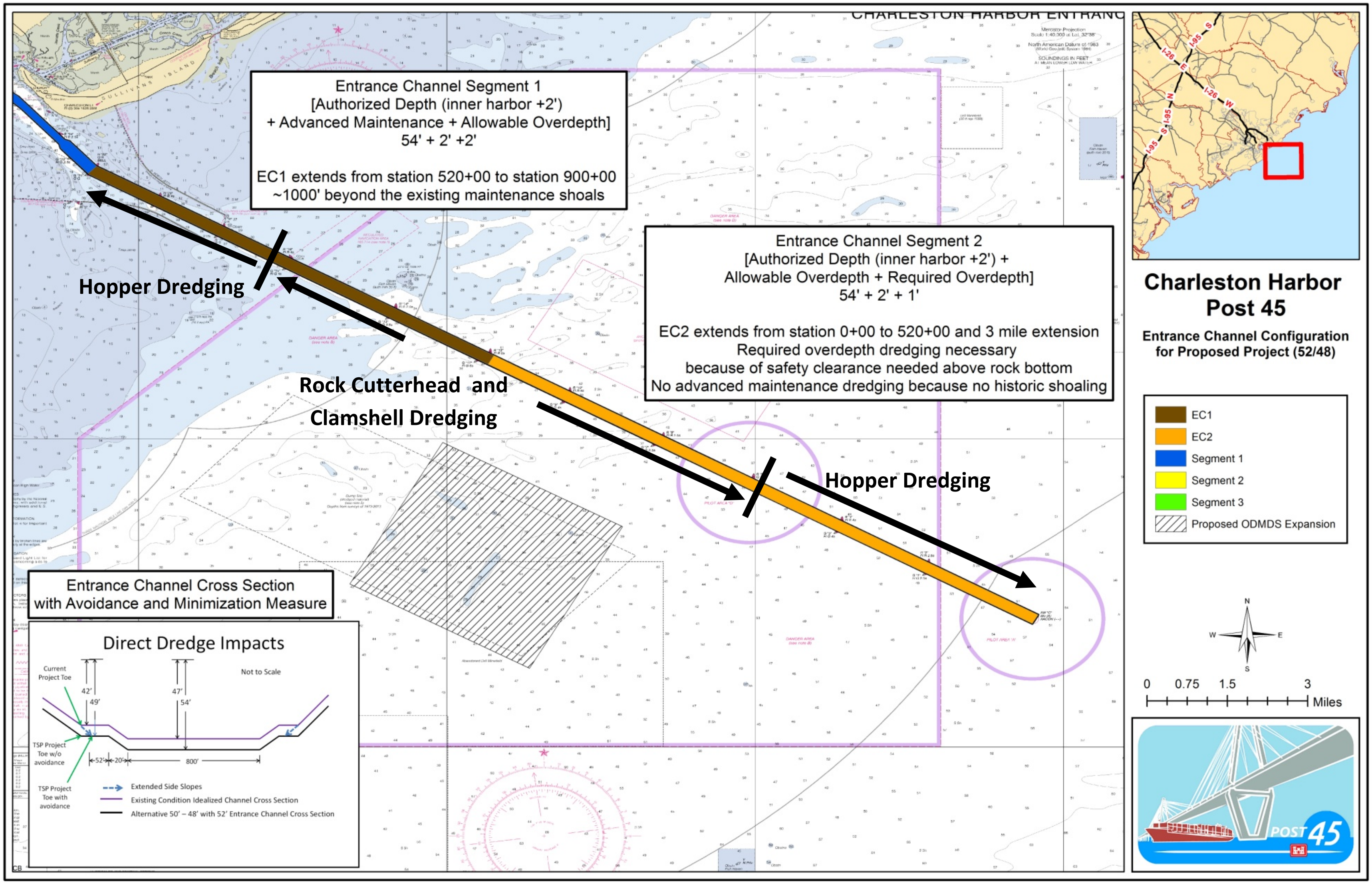


Figure 2. Post 45 entrance channel segments, approximate location of hopper, cutterhead and clamshell dredging, and proposed ODMDS

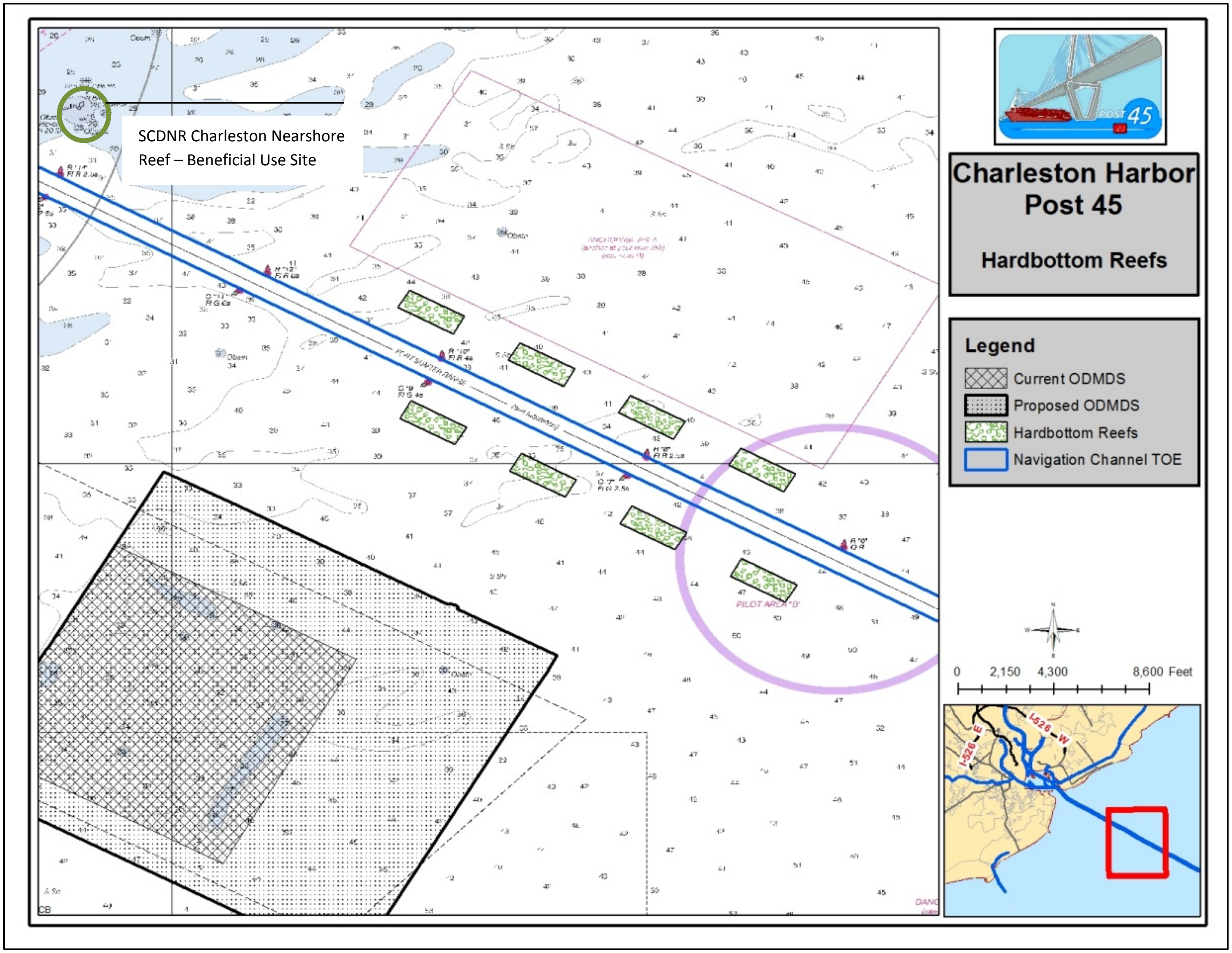


Figure 3. Theoretical depiction of locations for hardbottom reefs

Maintenance dredging would generally be conducted by hopper, clamshell and cutterhead dredges and would operate essentially the same as current practices documented in the Charleston Harbor DMMP Preliminary Assessment. Maintenance dredging would utilize the same placement areas as those utilized for existing conditions, and the duration and frequency of dredging events would be within the range occurring under current conditions. Dredging of the Entrance Channel would generally be performed by a hopper dredge, and material would be placed in the ODMDS located south of the navigation channel. Maintenance material from the lower reaches in the Harbor would be dredged with a clamshell and transported via scow to the ODMDS. Maintenance material from the upper reaches would be dredged with a pipeline cutterhead dredge and transported to upland confined disposal facilities, including Clouter Creek, Yellow House, Daniel Island, and Morris Island. The 50 year placement plan is summarized within Table 2 below. Maintenance dredging will continue to operate under the most current South Atlantic Regional Biological Opinion.

Table 2. O&M Quantities and Placement Areas for 50 years

Channel Reach	Shoaling Rate in CY/year	Placement Area (PA)	Dredge Type	Dredge Cycle (months)	Estimated Number of Cycles in 50 years	Quantity per Cycle (CY)	Total O&M Quantity in 50 years (CY)
Fort Sumter Reach/Entrance Channel	712,000	ODMDS	Hopper	24	25	1,424,000	35,600,000
Mount Pleasant Reach	0	ODMDS	Clamshell	15	40	0	0
Rebellion Reach	923	ODMDS	Clamshell	15	40	1,154	46,150
Bennis Reach	37,264	ODMDS	Clamshell	15	40	46,580	1,863,200
Horse Reach	16,035	ODMDS	Clamshell	15	40	20,044	801,750
Hog Island Reach	179,838	ODMDS	Clamshell	15	40	224,798	8,991,900
Wando River Lower Reach	69,984	ODMDS	Clamshell	15	40	87,480	3,499,200
Wando River Upper Reach	101,985	ODMDS	Clamshell	15	40	127,481	5,099,250
Wando River Turning Basin	263,097	ODMDS	Clamshell	15	40	328,871	13,154,850
Drum Island Reach	131,287	ODMDS	Clamshell	15	40	164,109	6,564,350
Myers Bend	55,119	ODMDS	Clamshell	15	40	68,899	2,755,950
ODMDS Total	**1,567,532**						**78,376,600**
Daniel Island Reach	231,652	Clouter Creek	Cutterhead	19	32	366,782	11,582,600
Daniel Island Bend	10,497	Clouter Creek	Cutterhead	19	32	16,620	524,850
Clouter Creek Reach	33,501	Clouter Creek	Cutterhead	19	32	53,043	1,675,050
Navy Yard Reach	21,520	Clouter Creek	Cutterhead	19	32	34,073	1,076,000
North Charleston Reach	5,104	Clouter Creek	Cutterhead	19	32	8,081	255,200
Filbin Creek Reach	10,742	Clouter Creek	Cutterhead	19	32	17,008	537,100
Filbin/Port Terminal Intersect		Clouter Creek	Cutterhead	19	32	0	0
Port Terminal Reach	14,581	Clouter Creek	Cutterhead	19	32	23,087	729,050
Ordnance Reach	166,433	Clouter Creek	Cutterhead	19	32	263,519	8,321,650
Ordnance Reach Turning Basin	532,713	Clouter Creek	Cutterhead	19	32	843,462	26,635,650
Upland Disposal Areas	**1,026,743**						**51,337,150**

2.3. Potential Additional Beneficial Uses

The Federal Government has placed considerable emphasis on the desirability of using dredged material in a beneficial manner. Statutes such as the Water Resources Development Acts of 1992, 1996, 2000, and 2007 demonstrate that beneficial use has been a Congressional priority. USACE has emphasized the use of dredged material for beneficial use through such regulations as 33 CFR Part 335, ER 1105-2-100, and ER 1130-2-520 and by Policy Guidance Letter No. 56. " (ER 1105-2-100 at E-69) states that "all dredged material management studies include an assessment of potential beneficial uses for environmental purposes including fish and wildlife habitat creation, ecosystem restoration and enhancement and/or hurricane and storm damage reduction". In addition to the hardbottom habitat reefs discussed above, additional opportunities for beneficial use of dredged material exist in the project vicinity. In accordance with ER 1105-2-100, USACE is considering beneficial use of dredged material as a part of the Charleston Harbor Post 45 Project. During the PED phase of the project, there may be an option to further pursue beneficial uses if cost-effective and regulatory and environmental protection requirements are met. Many beneficial use options were considered and during the NEPA scoping process, agencies and the general public expressed interest in the following options:

- Crab Bank enhancement
- Sandbar complex b/w east end of southern jetty and Cummings Point
- Nearshore placement off Morris Island Lighthouse
- Protecting shoreline of Castle Pinckney/Shutes Folly
- Feeder berms for barrier islands
- Offshore fish habitat berms
- Augmenting ODMDS berms
- Protecting shoreline of Fort Sumter

After a meeting with the ICT and after external and internal prioritization the following options were identified and incorporated into the project or carried forward for additional consideration during the Pre-Construction Engineering and Design (PED) phase:

- ODMDS berm creation
- Hardbottom habitat creation
- Crab Bank enhancement
- Castle Pinckney/Shutes Folly protection
- Fort Sumter protection
- Nearshore placement off Morris Island

2.3.1 ODMDS Berm Creation

To protect hardbottom habitat, from being buried by sediment migrating from the ODMDS, limestone rock from the entrance channel would also be used to construct an "L" shaped berm along the south and west perimeters of the ODMDS (Figure 5). The dimensions would be roughly 15,000 ft x 16,000 ft x 603 ft. This area represents approximately 437 acres of the ODMDS. The dimensions would be roughly

15,000 ft x 16,000 ft x 400 ft. The berm would be built on roughly a 3:1 slope, and would rise to about 10 feet above the natural bottom elevation but no higher than -25 ft MLLW. The reef would serve multiple purposes, including hardbottom habitat, fish habitat, and sediment containment. An excavator or clamshell dredge would allow the largest material to be used to construct the berm; however, use of a cutterhead suction dredge could minimize costs and produce smaller size material. This beneficial use project would use smaller material to create the base of the berm and the outer portion of the berm would be created with larger rock dredged with a clamshell dredge. This would serve to increase the surface area of the reef, thereby enhancing habitat value. The reef would serve multiple purposes, including hardbottom habitat, fish habitat, and sediment containment.

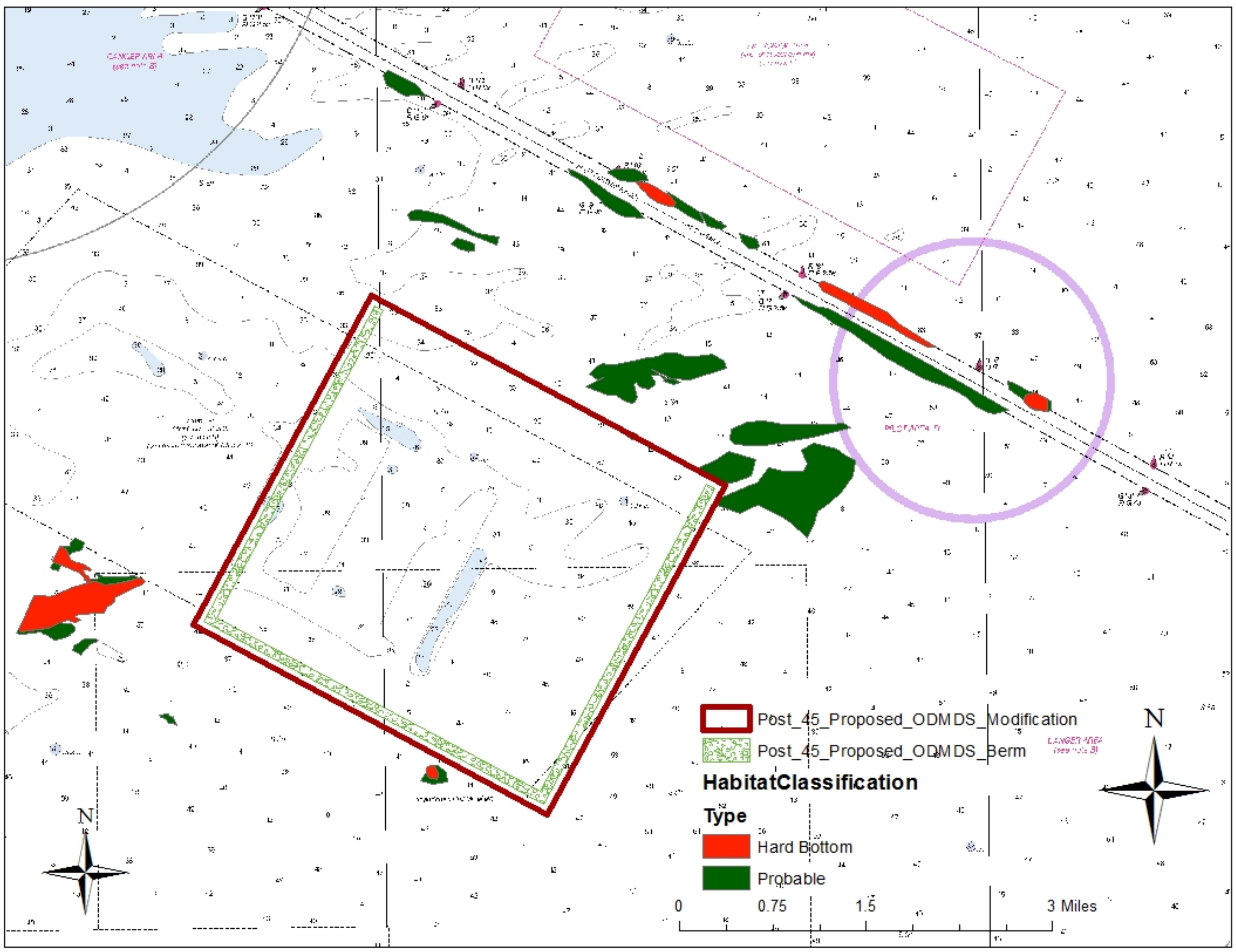


Figure 4. Proposed ODMDS and location of hardbottom habitat and the habitat berm

2.3.2 Crab Bank Enhancement

A beneficial use of dredged material project to enlarge Crab Bank by placing material on the channel side of the island running from north to south would help to support the avian species that utilize the island for nesting, roosting, and foraging (Figure 4-4). Crab Bank has been designated as an "Important Bird Area" in South Carolina and is established as "Crab Bank Seabird Sanctuary". SCDNR indicates that, "Crab Bank supports colonies of nesting waterbirds because of its isolated nature and lack of mammalian predators. Although all species may not nest on the island each year, examples of species that have used the island include: brown pelican, least tern, royal tern, black skimmer, gull-billed tern, sandwich tern, common tern, laughing gull, Wilson's plover, American oystercatcher, willet, great egret, snowy egret, tricolored heron and ibis. Besides providing nesting habitat, the sanctuary provides winter loafing and feeding areas for numerous species. (https://www.dnr.sc.gov/mlands/managedland?p_id=215). While the island fluctuates in size constantly, it has largely been migrating towards the north over the last 15 years. Further demonstrating a need for beneficial use of dredged material at Crab Bank, USACE performed a shoreline change assessment for this study and determined that the island has decreased in size from 17.94 acres of dry beach habitat in 1994 to 5.01 acres in 2011. (Appendix A). While not specifically studied during this project, this beneficial use concept could involve enlarging Crab Bank to roughly 58 acres at approximately +8 feet MLLW based on the southern shoreline of Crab Bank in the early 1990's (shown by the green line in Figure 5). The size and scope of the project will be determined during the PED phase, dependent upon quantity of suitable material.

Figure 5. Crab Bank beneficial use concept

2.3.3 Shutes Folly Enhancement

Placement of dredged material around Shutes Folly and Castle Pinckney to prevent erosion could provide another beneficial use of dredged material option. Shutes Folly provides nesting habitat for colonial seabirds due to its isolated nature, small size, and lack of predators. It is one of only nine active nesting sites in the entire state. Skimmers and oyster catchers like the shell hash that effaces the eastern side of Shutes Folly. The island has been noted by the group, Charleston Harbor Wildlife, as being “often considered for restoration.” They state that, “in 1997, wildlife biologists pressed for the island as a sight for dredge spoil to boost the small seabird colony there…” (http://charlestonharborwildlife.com/iwa/cp-sf/). Additionally, Castle Pinckney, an historic site, sits atop the island. It is one of the oldest fortifications of its kind still extant and was built to provide defense of the coast. The site is experiencing erosion on the eastern end. The size and scope of the project will be determined during the PED phase, dependent upon quantity of suitable material (Figure 6).

Figure 6. Shutes Folly beneficial use concept

2.3.4 Bird Nesting Island Creation

There are a few locations near the mouth of the harbor that could support the creation of a bird nesting island, similar to Tompkins Island created by the Savannah District. However, this alternative would be more expensive and more complicated from an environmental permitting perspective. The size, scope, and environmental benefits associated with this option would be determined during the PED phase and would depend on a source of suitable material.

2.3.5 Nearshore Placement off Morris Island

Dredged material could be placed offshore of Morris Island where natural processes could sort and transport it. However, this alternative would require extensive modeling and coordination with multiple resource agencies to resolve major and complex concerns. It would also be expensive and complicated from an environmental permitting perspective. The size, scope, and benefits associated with this option would be determined during the PED phase and would depend on a source of suitable material.

2.3.6 Fort Sumter Shoreline Protection

Fort Sumter National Monument has a long history in Charleston Harbor. A description of the history and importance of Fort Sumter can be found in Section 2.4.21 and in Gayes et al., 2013. Placement of dredged material around Fort Sumter to prevent erosion could provide a beneficial use of dredged material option. Long term data indicate that the island has been increasing in size due to accretion on the west side of the island (see Appendix A). Due to the position of the island in the harbor, the eastern and southern sides are exposed to wind waves and wakes from recreational, commercial, and tour boats. While not specifically studied during this project, soft limestone rock from the entrance channel could be placed offshore and parallel to the shoreline of the Fort in an effort to break up wave action prior to those waves/wakes reaching the Fort. This beneficial use concept could involve more engineering to ensure the stability of the breakwater structure. The size and scope of the project would be determined during the PED phase, dependent on a source of suitable material and meeting all applicable laws and regulations.

2.3.7 Beneficial Use Analyses

Typically agencies require a grain size/compatibility analysis and potentially modeling of sediment transport and fate to be completed for these types of projects. Due to the accelerated schedule and limited budget for this study, this work could not be performed during the study phase. As a result, the measures are discussed in the feasibility study / EIS without detailed analysis, but with a commitment to study and design any of these projects during the PED phase. Final designs, decisions to implement or not and permit acquisition will take place during the PED phase. Results of these analyses will be submitted to the resource agencies and, if necessary, the decision to reinitiate consultation will be coordinated with NMFS and USFWS.

3.0 Species Considered Under This Assessment

Through consultation with National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service Southeast Regional Office, St. Petersburg, FL (NMFS) and the U.S. Fish and Wildlife Service Field Office, Charleston, SC and Athens, GA (USFWS) the following species were combined to develop a composite list, which includes Federally-listed Threatened and Endangered species that could be present in the area based upon their geographic range (see Table 3). The list was narrowed down to the species most likely to be present in the action area. NMFS and USFWS staff agreed to this list in informal consultation in January 2012. However, the actual occurrence of a species in the area would depend upon the availability of suitable habitat, the season of the year relative to a species' temperature tolerance, migratory habits, and other factors.

3.1 Sea Turtles

3.1.1 Loggerhead (*Caretta caretta*)

The loggerhead sea turtle was listed as an endangered species throughout its global range on March 10, 2010. It was listed because of direct take, incidental capture in various fisheries, and the alteration and destruction of its habitat. Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. In the Atlantic, developmental habitat for small juveniles is the pelagic waters of the North Atlantic and the

Mediterranean Sea (NMFS and USFWS, 1991a). Within the continental United States, loggerhead sea turtles nest from Texas to New Jersey. Major nesting areas include coastal islands of Georgia, South Carolina, and North Carolina, and the Atlantic and Gulf of Mexico coasts of Florida, with the bulk of the nesting occurring on the Atlantic coast of Florida.

Table 3. Federally Threatened and Endangered Species Potentially Present in the Vicinity of Charleston, South Carolina

Common Name	Scientific Name	Status	Date Listed
Marine Mammals			
Humpback whale	*Megaptera novaeangliae*	E	12/2/1970
North Atlantic right whale	*Eubalaena glacialis*	E	12/2/1970
West Indian Manatee	*Trichechus manatus*	E	10/21/1972
Marine Turtles			
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	12/2/1970
Leatherback sea turtle	*Dermochelys coriacea*	E	6/2/1970
Loggerhead sea turtle	*Caretta caretta*	T	7/28/1978
Green sea turtle	*Chelonia mydas*	T	7/28/1978
Fish			
Shortnose sturgeon	*Acipenser brevirostrum*	E	3/11/1967
Atlantic sturgeon	*Acipenser oxyrhynchus*	E	4/6/2012
Birds			
American Wood stork	*Mycteria americana*	E (proposed for downlisting to "T")	2/28/1984
Piping Plover	*Charadrius meloduc*	T	12/11/1985
Red Knot	*Calidris canutus rufa*	T	1/12/2015
Plants			
Seabeach Amaranth	*Amaranthus pumilus*	T	4/7/1993

E - Federally endangered
T - Federally threatened
Endangered: A taxon "in danger of extinction throughout all or a significant portion of its range."
Threatened: A taxon "likely to become endangered within the foreseeable future throughout all or a significant portion of its range."

The National Oceanic and Atmospheric Administration and the U.S. Fish and Wildlife Service issued a final rule in 2011 changing the listing of loggerhead sea turtles under the Endangered Species Act from a single threatened species to nine distinct population segments (DPSs) listed as either threatened or endangered (NMFS, 2011). Scientists believe this will help focus their sea turtle conservation efforts to the specific needs of the distinct populations. In the final rule, five were listed as endangered ([1]Northeast Atlantic Ocean, [2]Mediterranean Sea, [3]North Indian Ocean,[4] North Pacific Ocean and [5]South Pacific Ocean) and four ([1]South Atlantic Ocean, [2]Southwest Indian Ocean, [3]Southeast Indo-Pacific Ocean and [4]Northwest Atlantic Ocean) as threatened. Scientists found that the Northwest Atlantic Ocean DPS (the DPS that South Carolina loggerheads belong to) is threatened based on review of nesting data available after the proposed rule was published, information provided in public comments to the proposed rule, and further analysis completed by the resource agencies. Even so, substantial conservation efforts are underway to address the threats to these DPSs (Federal Register/Vol. 76, No. 184/Thursday, September 22, 2011/Rules and Regulations).

Additionally, there is evidence of at least several other genetically distinct stocks, including a Cay Sal Bank, Western Bahamas stock; a Quintana Roo, Mexico stock, including all loggerhead rookeries on Mexico's Yucatan Peninsula; a Brazilian stock; and a Cape Verde stock (SWOT Report, Volume II, The State of the World's Sea Turtles, 2007). The fidelity of nesting females to their nesting beach is the reason these subpopulations can be differentiated from one another. Fidelity for nesting beaches makes recolonization of nesting beaches with sea turtles from other subpopulations unlikely.

3.1.1.1 Life History and Distribution

Past literature gave an estimated age at maturity of 21-35 years (Frazer and Ehrhart, 1985; Frazer et al., 1994), with the benthic immature stage lasting at least 10-25 years. However, based on data from tag returns, strandings, and nesting surveys (NMFS 2001a), the NMFS estimates ages of maturity ranging from 20-38 years with the immature stage lasting from 14-32 years.

Mating takes place in late March through early June in the southeastern United States, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests/individual (Murphy and Hopkins, 1984). Nesting of an individual female loggerhead is usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd, 1988). Generally, loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for 7-12 years or more. Stranding records indicate that when pelagic immature loggerheads reach 40-60 cm straight-line carapace length they begin to live in coastal inshore and nearshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico, although some loggerheads may move back and forth between the pelagic and benthic (i.e., nearshore) environment (Witzell, 2002). Benthic immature loggerheads (sea turtles that have come back to inshore and nearshore waters), the life stage following the pelagic immature stage, have been found from Cape Cod, Massachusetts, to southern Texas, and occasionally strand on beaches in Northeastern Mexico. The long life-span, complex migration patterns, and ability to inhabit a variety of habitats during various life stages make a clear understanding of the loggerheads primary constitutional elements (PCEs) difficult to ascertain.

Tagging studies have shown loggerheads that have entered the benthic environment undertake routine migrations along the coast that are limited by seasonal water temperatures. Loggerhead sea turtles occur year round in offshore waters off North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to immigrate to North Carolina inshore waters (e.g., Pamlico and Core Sounds) and also move up the coast (Epperly et al., 1995a; Epperly et al., 1995b; Epperly et al., 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in mid-Atlantic and Northeast areas until late fall. By December loggerheads have emigrated from inshore North Carolina waters and coastal waters to the north to waters offshore North Carolina, particularly off Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (≥ 11ºC) (Epperly et al., 1995a; Epperly et al., 1995b;

Epperly et al., 1995c). Loggerhead sea turtles are year-round residents of central and south Florida. Loggerheads move into South Carolina inshore waters nesting on beaches from May through August.

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd, 1988). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats. A trawling study was conducted within the Charleston Harbor shipping channel between 2004-2007 to evaluate loggerhead usage in the channel and document catch and recapture rates relative to prior trawling studies conducted in the early 1990's (Arendt et. al, 2011). Two hundred and twenty loggerheads were captured, an increase in numbers and in size of the turtles from the 1991 study. Temporal and spatial variables appeared to exert the most influence on loggerhead catch rates and accounted for nearly half of model deviance in the present study. Within-channel spatial influences on catch in the present study were consistent with those from historic data and, as such, represent important sampling design considerations for future studies at this location. Satellite telemetry data collected for a subset of loggerheads tagged and released during this study revealed greatest affinity for adjacent shoals and fidelity to the channel itself during spring (Arendt et al.,in press), an affinity consistent with in situ tracking at this location during spring (Keinath et al., 1987) and summer (Maier et al., 2005). Arendt et al., (2011) suggest that these trends are encouraging for future species recovery, especially if they are indicative of a larger pattern of recovery.

3.1.1.2 Population Dynamics and Status

A number of stock assessments (TEWG, 1998; TEWG, 2000; NMFS 2001a; Heppell et al. 2003) have examined the stock status of loggerheads in the waters of the United States, but have been unable to develop any reliable estimates of absolute population size. Based on nesting data of the five western Atlantic subpopulations, the south Florida-nesting and the northern-nesting subpopulations are the most abundant (TEWG 2000; NMFS 2001a). Nesting data for the Florida, Northern U.S. and Northern Gulf of Mexico are listed below in Table 4 taken from TEWG 2009 Annual Report.

Table 4. Nesting trends for Loggerhead Subpopulations

Nesting Subpopulation	Total number of nests	Trend in annual # of nests
Peninsular Florida	65,460 (1989-2006 mean)	Decreasing
Northern U.S.	5,151 (1989-2005 mean)	Decreasing
Northerner Gulf of Mexico	1,000 (1989-2005 estimated mean)	Decreasing (from data in the Florida Panhandle)

The 2009 TEWG Report shows the number of loggerhead nests from 11 beaches in the Northern U.S. Subpopulation from 1983-2006 has decreased by 1.6% annually with these beaches making up 30% of the nesting population along this coast.

Peninsular Florida has the largest nesting aggregation in the Atlantic and one of the two largest in the world. Originally this aggregation included as part of the subpopulation nesting from Georgia through North Carolina. However the most recent recovery plan (NMFS & USFWS 2008) delineates the Peninsular Florida subpopulation as using beaches from the Florida/Georgia border to the central west coast of Florida. Trend analysis show the Florida subpopulation is declining at a rate of 1.4 to 2.6% per year (TEWG 2009 Report).

The Northern U.S. subpopulation nests on beaches from Georgia through North Carolina and represents the third largest aggregation in the Atlantic. The TEWG 2009 report shows a decline of 1.4 to 1.7% per year. It is unclear at this time whether the nesting decline reflects a decline in population, or is indicative of a failure to nest by the reproductively mature females as a result of other factors (resource depletion, nesting beach problems, oceanographic conditions, etc.).

The 2009 TEWG report points to the following factors as potentially responsible for decreasing number of nests: Incidental capture by fishery operations, adult female survival rates, proportion of putative first-time nesters, directed harvest, and increase in mortality due to disease. Research funding to collect data on population parameters, spatial and temporal distribution, genetic analysis to determine population structures, effects of incidental capture and trophic changes/carrying capacity are identified as priority needs to better understand population declines and dynamics.

Since 1980, aerial surveys have been flown to establish an index of loggerhead nesting on South Carolina's beaches. Twelve aerial surveys were flown yearly for three years followed by two non-survey years. Standardized aerial surveys flown from 1980-2007 indicated a 1.9 percent annual decline in nesting (NMFS and USFWS, 2008).

In South Carolina, the primary nesting beaches are between North Inlet and Prices Inlet (north of Capers Island), but other beaches between Kiawah Island and Hilton Head have moderate nesting densities. Table 5 shows the number of loggerhead sea turtle nests in South Carolina for 2011- 2013. Within the Charleston Harbor project area, primarily only loggerheads nest regularly on the adjacent beaches (Table 6). Since 2009, the number of loggerhead nests on Folly Beach has increased significantly.

Table 5. Number of Sea Turtle Nests in South Carolina for 2011 – 2013

Nesting totals by Species by year	Loggerhead	Green	Leatherback	Kemp's ridley	Unknown
2011	4027	3	4	0	
2012	4615	7	1	0	
2013	5140	5	0	0	5

Data provided by Seaturtle.org

Table 6. Loggerhead Sea Turtle Nest Totals for Morris Island, Sullivan's Island, and Folly Beach

Island Length (kilometers)	2008	2009	2010	2011	2012	2013
Morris	No data available*					
Sullivan (7.7)	3	4	2	4	6	3
Folly (11)	73	35	54	82	74	108

Data provided by Seaturtle.org

The loggerhead is the most common sea turtle to strand in South Carolina. The number of loggerhead and other sea turtle strandings since 2000 for Charleston County, South Carolina is listed in Table 7.

Table 7. Reported Strandings in Charleston County, South Carolina Since 2000

Year	Loggerhead Sea Turtle	Green Sea Turtle	Leatherback Sea Turtle	Kemp's Ridley Sea Turtle
2000	71	3	3	5
2001	55	5	1	11
2002	50	5	4	5
2003	65	2	7	10
2004	57	4	6	12
2005	35	7	1	10
2006	40	1	0	8
2007	32	5	0	5
2008	37	3	2	11
2009	34	14	1	9
2010	30	13	2	22
2011	52	5	1	20
2012	31	9	1	10
2013	31	7	3	8

Data provided by Seaturtle.org

3.1.1.3 Threats

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand erosion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton et al. 1994). Also, many nests were destroyed during the 2004 hurricane season. Other sources of natural mortality include cold stunning and biotoxin exposure. The largest cause of mortality to hatchlings is predation by feral hogs, ghost crabs, raccoons, and occasionally fire ants and humans.

Anthropogenic factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, beach armoring, beach nourishment, artificial lighting, beach cleaning, increased human presence, recreational beach equipment, beach driving, coastal construction and fishing piers, exotic dune and beach vegetation, and poaching. An increase in human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs and an increased presence of native species (e.g., raccoons, and opossums) which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the South Carolina coast (e.g., Cape Island, Cape Romain National Wildlife Refuge, Botany Ball, South Island), other areas along these coasts have limited or no formal protection. Sea turtle nesting and hatching success on unprotected beaches along the coast of South Carolina are affected by all of the above threats.

Loggerhead sea turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, transportation, marine pollution, underwater explosions, hopper dredging, offshore artificial lighting, power plant entrainment and/or impingement, entanglement in debris, ingestion of marine debris, marina and dock construction and operation, boat collisions, poaching, and fishery interactions. Loggerheads in the pelagic environment are exposed to a series of longline fisheries, which include the Atlantic highly migratory species (HMS) pelagic longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various longline fleets in the Mediterranean Sea (Aguilar et al. 1995; Bolten et al. 1996). Loggerheads in the benthic environment in waters off the coastal United States are exposed to a suite of fisheries in federal and state waters including trawl, purse seine, hook and line, gill net, pound net, longline, and trap fisheries. Specific threats as a potential outcome of this study include dredging, dredged material disposal, and habitat displacement.

3.1.1.4 Summary of Status

In the Atlantic Ocean, absolute population size is not known, but based on extrapolation of nesting information, loggerheads are likely much more numerous than in the Pacific Ocean. Total estimated nesting in the U.S. is approximately 68,000 to 90,000 nests per year. The Northern subpopulation is the DPS that would be most affected by the proposed action. Long-term nesting data show loggerhead nesting declining in North Carolina, South Carolina, Georgia, and Florida.

All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects that negatively influence the status of the species. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (i.e., fisheries in international waters).

3.1.1.5 Critical Habitat

NMFS designated critical habitat for the loggerhead sea turtle in a final ruling on July 10, 2014 (FR Vol. 79, No. 132). This ruling established critical habitat for 5 habitat types based on their Physical or Biological Features (PBFs) and the Primary Constituent Elements (PCEs) that support the PBFs: nearshore reproductive, overwintering, breeding, migratory, and sargassum (Figure 7). Nearshore reproductive habitat shown in this map (from MHW to 1.6 km offshore) is the closest designated critical habitat to the project area and is denoted as LOGG-N-07. LOGG-N-7 includes Folly, Kiawah, Seabrook, Botany Bay Islands, Botany Bay Plantation, Interlude Beach, and Edingsville Beach, Charleston County, SC; Edisto Beach State Park, Edisto Beach, and Pine and Otter Islands, Colleton County, SC. The unit contains nearshore reproductive habitat only. The unit consists of nearshore from Lighthouse Intlet to Saint Helena Sound from the MHW line seaward to 1.6 km.

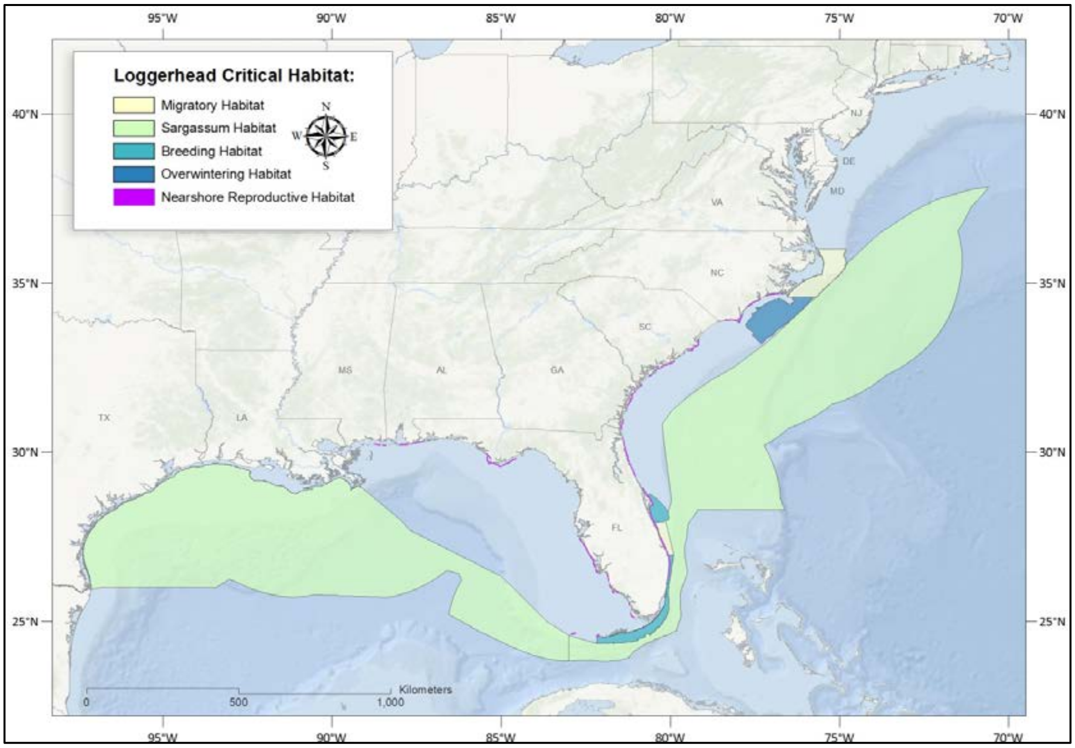


Figure 7. Critical habitat for loggerhead sea turtles

The USFWS has designated critical habitat for nesting loggerheads in South Carolina (Federal Register/ Vol. 79, No. 132. July 10, 2014). Folly Island includes the only beach in the proposed project area included in the listing. All 11.2 miles of Folly Beach is designated from the mean high water (MHW) line to the toe of the secondary dune or developed structure. According to the Federal Register Notice, special management measures may be needed to protect physical biological features (PBFs) and primary constituent elements (PCEs) present. A total of 22 units have been designated in South Carolina.

3.1.2 Leatherback (*Dermochelys coriacea*)

The leatherback sea turtle was listed as endangered throughout its global range on June 2, 1970. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour, 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtle species. The large size of adult leatherbacks and their tolerance to relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS, 1995). Adult leatherbacks forage in temperate and sub Polar Regions from 71°N to 47°S latitude in all oceans and undergo extensive migrations to and from their tropical nesting beaches. The most recent population estimate for leatherback sea turtles from just the North Atlantic breeding groups is a range of 34,000-90,000 adult individuals (20,000-56,000 adult females) (TEWG, 2007).

In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS SEFSC, 2001a). Female leatherbacks nest from the southeastern United States to southern Brazil in the western Atlantic and from Mauritania to Angola in the eastern Atlantic. The most significant nesting beaches in the Atlantic, and perhaps in the world, are in French Guiana and Suriname (NMFS SEFSC, 2001a). Genetic analyses using microsatellite markers in nuclear DNA along with the mtDNA data and tagging data has resulted in Atlantic Ocean leatherbacks being divided into seven groups or breeding populations: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG, 2007). When the hatchlings leave the nesting beaches, they move offshore but eventually utilize both coastal and pelagic waters. Very little is known about the pelagic habits of the hatchlings and juveniles, and they have not been documented to be associated with the *Sargassum* areas as are other species like the Loggerhead. Leatherbacks are deep divers, with recorded dives to depths in excess of 1,000 m (Eckert *et al*. 1999, Hays *et al*. 2004).

3.1.2.1 Life History and Distribution

Leatherbacks are a long-lived species, living for well over 30 years. It has been thought that they reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin, 1985) to 13-14 years (Zug and Parham, 1996). However, some recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the western North Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe, 2007). Continued research in this area is important to understanding the life history of leatherbacks and has important implications in management of the species.

Leatherbacks nest frequently (up to 10 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and, thus, can produce 700 eggs or more per nesting season (Schultz, 1975). Some of these eggs can be infertile which reduces this yearly clutch estimate. The eggs incubate for 55-75 days before hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm curved carapace length (ccl), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 cm ccl.

Although leatherbacks are the most pelagic of the sea turtles, they enter coastal waters on a seasonal basis to feed in areas where jellyfish are concentrated. Leatherback sea turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates.

Atlantic leatherback rookeries were divided into seven stocks- [1]Florida, [2]Northern Caribbean,[3] Western Caribbean, [4]Southern Caribbean/Guianas, [5]Brazil, [6]West Africa, and [7]South Africa. Nesting female Florida stock leatherbacks were tagged with satellite transmitters from Juno Beach and within the Archie Carr National Wildlife Refuge at Melbourne Beach, Florida. Most turtles remained on the North American continental shelf for 3 of 4 seasons during the duration of tracking. One turtle did move across the Atlantic to the region between Mauritania and the Cape Verde Islands in Western Africa and another to the low latitude mid-Atlantic. Although no Florida turtles were followed into the Gulf of Mexico, Hildebrand (1987) reported that a turtle flipper tagged while nesting at Jupiter Beach was later recaptured in the Gulf of Campeche near Cayo Arcas (http://www.sefsc.noaa.gov/turtles/TM_555_DcTEWG.pdf).

Sightings of leatherback turtles in South Carolina began increasing in the late 1980s. From 1980 to 2003, 141 leatherback carcasses stranded (stranding data from 2000-2013 can be found in Table 5). The strandings were seasonal with a major peak in the spring. From 1994 to 2003, during April-June, 1,131 live leatherbacks were observed during 50 nearshore aerial surveys flown parallel to the South Carolina coast. The distribution was neither random nor uniform but contagious (clumped). Numbers varied significantly between transect lines, among years and flights within a year. This evidence demonstrates the recent occurrence, spatial distribution, and temporal variability of leatherbacks in South Carolina nearshore waters (Murphy et al., 2006).

3.1.2.2 Population Dynamics and Status

The status of the Atlantic leatherback population has been less clear than the Pacific population. However, recent coordinated efforts at data collection and analyses by the Leatherback Turtle Expert Working Group have helped to clarify the understanding of the Atlantic population status (TEWG, 2007). The Western Caribbean stock includes nesting beaches from Honduras to Columbia. The most intense nesting in that area occurs in Costa Rica, Panama, and the Gulf of Uraba in Columbia. The area from the Caribbean coast of Costa Rica through Chiriqui Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troëng *et al*., 2004).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, the U.S. Virgin Islands (St. Croix), and the British Virgin Islands (Tortola). In Puerto Rico the primary nesting beaches are at Fajardo, and on the island of Culebra. Nesting between 1978-2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 (TEWG, 2007). At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has fluctuated from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1 from 1986-2004 (TEWG, 2007). Nesting in Tortola is limited, but has been increasing from 0-6 nests/year in the late 1980's to 35-65/year in the 2000's, with an annual growth rate of approximately 1.2 between 1994-2004 (TEWG, 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance; with total nests between 800-900 per year in the 2000's following nesting totals fewer than 100 nests per year in the 1980's (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the Index Nesting Beach Surveys, the TEWG (2007) has estimated a significant annual nesting growth rate of 1.17 between 1989 and 2005.

In 1981, two confirmed leatherback nests were documented in Georgia on Cumberland and Blackbeard Islands. Leatherback nesting has also been confirmed in South Carolina and North Carolina. Since 1980, 21 leatherback nests have been documented in South Carolina (SCDNR unpublished data), with five nests documented from 2011-2013 (Table 4).

Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1996, the entire western Atlantic population was characterized as stable at best (Spotila *et al.* 1996), with numbers of nesting females reported to be on the order of 18,800. Spotila *et al*. (1996) estimated that the leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. This is similar to the estimated figures of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) determined by the TEWG (2007).

3.1.2.3 Threats

Zug and Parham (1996) pointed out that the main threat to leatherback populations in the Atlantic is the combination of fishery-related mortality (especially entanglement in gear and drowning in trawls) and the intense egg harvesting on the main nesting beaches. Other important ongoing threats to the population include pollution, loss of nesting habitat, and boat strikes.

Of sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, possibly their method of locomotion, and perhaps their attraction to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets and pot/trap lines (used in various fisheries) and capture in trawl gear (e.g., shrimp trawls).

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. Unlike loggerhead turtle interactions with longline gear, leatherback turtles do not usually ingest longline bait. Instead, leatherbacks are typically foul hooked by longline gear (e.g., on the flipper or shoulder area) rather than getting mouth hooked or swallowing the hook (NMFS SEFSC, 2001).

Additional leatherbacks are stranded as a result of being wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al*. 2002). Fixed gear fisheries in the mid-Atlantic have also contributed to leatherback entanglements. In the Southeast, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries. In the U.S. Virgin Islands, one of five leatherback strandings from 1982 to 1997 was due to entanglement (Boulon, 2000), but because many entanglements of this typically pelagic species likely go unnoticed, the number of entanglements in fishing gear may be much higher.

Leatherback interactions with the southeast Atlantic shrimp trawl fishery, which operates predominately from North Carolina through southeast Florida (NMFS, 2002b), have also been a common occurrence. Leatherbacks, which migrate north annually, are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast from Cape Canaveral, Florida, to the Virginia/North Carolina border. Leatherbacks also interact with the Gulf of Mexico shrimp fishery. For many years, Turtle Excluder Devices (TEDs) required for use in these fisheries were less effective at excluding leatherbacks than the smaller, hard-shelled turtle species. To address this problem, on February 21, 2003, the NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks and large and sexually mature loggerhead and green turtles.

Other trawl fisheries are also known to interact with leatherback sea turtles. In October 2001, a Northeast Fisheries Science Center observer documented the take of a leatherback in a bottom otter trawl fishing for *Loligo* squid off of Delaware; TEDs are not required in this fishery. The winter trawl flounder fishery, which did not come under the revised TED regulations, may also interact with leatherback sea turtles.

Gillnet fisheries operating in the nearshore waters of the mid-Atlantic states are also suspected of capturing, injuring, and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54 to 92 percent.

Poaching is not known to be a problem for nesting populations in the continental U.S. However, in 2001 the NMFS Southeast Fishery Science Center (SEFSC) noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands and the Guianas. In all, four of the five strandings in St. Croix were the result of poaching (Boulon, 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is on eggs.

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to their pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding areas and migratory routes (Lutcavage *et al*. 1997, Shoop and Kenney 1992). Investigations of the stomach contents of leatherback sea turtles revealed that a substantial percentage (44 percent of the 16 cases examined) contained plastic (Mrosovsky, 1981). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and plastic debris (Mrosovsky, 1981). Balazs (1985) speculated that the object might resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks. It is important to note that, like marine debris, fishing gear interactions and poaching are problems for leatherbacks throughout their range.

3.1.2.4 Summary of Leatherback Status

In the Atlantic Ocean, the scientific understanding of the status and trends of leatherback turtles is somewhat more confounded, although the overall trend appears to be stable to increasing, compared to the bleak situation in the Pacific (TEWG, 2007). Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic: leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in state, federal, and international waters. Poaching is a problem and affects leatherbacks that occur in U.S. waters. Leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species.

3.1.2.5 Critical Habitat

No critical habitat has been designated by the USFWS or NMFS for leatherback sea turtles in the project area.

3.1.3 Kemp's Ridley (*Lepidochelys kempii*)

The Kemp's ridley was listed as endangered on December 2, 1970. Internationally, the Kemp's ridley has been considered the most endangered sea turtle (Zwinenberg, 1977; Groombridge, 1982; TEWG 2000). Kemp's ridleys nest primarily at Rancho Nuevo, a stretch of beach in Mexico, Tamaulipas State. This species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Occasional individuals reach European waters (Brongersma, 1972). Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the United States.

3.1.3.1 Life History and Distribution

The TEWG (1998) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998). Nesting occurs from April into July and is essentially limited to the beaches of the western Gulf of Mexico, near Rancho Nuevo in southern Tamaulipas, Mexico. Nesting also occurs in Veracruz, Mexico, and Texas, U.S., but on a much smaller scale. The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season.

Little is known of the movements of the post-hatchling stage (pelagic stage) within the Gulf of Mexico. Studies have shown the post-hatchling pelagic stage varies from 1-4 or more years, and the benthic immature stage lasts 7-9 years (Schmid and Witzell, 1997). Benthic immature Kemp's ridleys have been found along the eastern seaboard of the United States and in the Gulf of Mexico. Atlantic benthic immature sea turtles travel northward as the water warms to feed in the productive, coastal waters off Georgia through New England, returning southward with the onset of winter (Lutcavage and Musick, 1985; Henwood and Ogren, 1987; Ogren, 1989). Studies suggest that benthic immature Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, 1995).

Stomach contents of Kemp's ridleys along the lower Texas coast consisted of nearshore crabs and mollusks, as well as fish, shrimp, and other foods considered to be shrimp fishery discards (Shaver, 1991). Pelagic stage Kemp's ridleys presumably feed on the available *Sargassum* and associated infauna or other epipelagic species found in the Gulf of Mexico.

3.1.3.2 Population Dynamics and Status

Of the seven species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the Rancho Nuevo beaches of Mexico (Pritchard, 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand, 1963). By the mid-1980s nest numbers were below 1,000 (with a low of 702 nests in 1985). However, observations of increased nesting with 6,277 nests recorded in 2000, 10,000 nests in 2005, and 12,143 nests recorded during the 2006 nesting season (Gladys Porter Zoo nesting database) show the decline in the ridley population has stopped and the population is now increasing overall. A decline was reported in the Recovery Plan from over 20,000 nests in 2009 at Rancho Nuevo to only 13,302 nests in 2010. But in Texas, from 2002-2010, a total of 911 nests were documented, which is more than eleven times greater than nests recorded over the previous 54 years (Shaver and Caillouet 1998, Shaver 2005a).

A period of steady increase in benthic immature ridleys has been occurring since 1990 and appears to be due to increased hatchling production and an apparent increase in survival rates of immature sea turtles beginning in 1990. The increased survivorship of immature sea turtles is attributable, in part, to the introduction of TEDs in the United States and Mexican shrimping fleets and Mexican beach protection efforts. As demonstrated by nesting increases at the main nesting sites in Mexico, adult ridley numbers have increased over the last decade. The population model used by TEWG (2000) projected that Kemp's ridleys could reach the Recovery Plan's intermediate recovery goal of 10,000 nesters by the year 2015.

Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, with ~ 200-300 visiting Chesapeake Bay each summer. The juveniles frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus, 1997). Kemp's ridleys consume a variety of crab species, including *Callinectes* sp., *Ovalipes* sp., *Libinia* sp., and *Cancer* spp. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal, 1997). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus, 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds, as well as smaller juveniles from New York and New England, to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus, 1997; Epperly et al., 1995a; Epperly et al., 1995b).

Small juveniles of this species occur along the South Carolina coast during the summer. Even though it is not a common occurrence, in 1992 and 2008, two Kemp's ridley nests were laid in South Carolina. This species represents the second most common turtle to strand on South Carolina's coast (Table 7). Figures 8-10 show historical stranding data in SC.

3.1.3.3 Threats

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold stunning. Although cold stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. NMFS (http://www.nero.noaa.gov/prot_res/stranding/cold.html) notes that cold stunning is common in New England, with between 50-200 turtles each year stunned, and that Kemp's ridleys are the most commonly cold stunned sea turtle. Annual cold-stunning events do not always occur at this magnitude; the extent of episodic major cold-stunning events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Many cold-stunned turtles can survive if found early enough, but cold-stunning events can still represent a significant cause of natural mortality.

Although changes in the use of shrimp trawls and other trawl gear have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gill net fishery operating offshore in the preceding weeks.

In addition to gill net fisheries, other causes of mortality include predation, parasitism, disease, environmental changes, effects of beach manipulations on eggs and hatchlings, collisions with boats, power plant entrainments, ingestion of plastics and toxic substances, illegal poaching of nests and degradation of foraging habitat by physical damage caused by trawlers over live bottoms.

Dredging of harbors and beach renourishment projects are inherent dangers to all sea turtles in the project area. Of all the sea turtles taken by four U.S. Army Corps of Engineers' Divisions (Mississippi Valley, North Atlantic, South Atlantic, and Southwestern), less than 13 percent were Kemp's ridleys. Charleston District has not historically taken any (http://el.erdc.usace.army.mil/seaturtles/index.cfm).

3.1.3.4 Summary of Status

The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr, 1963). The majority of Kemp's ridley nesting in the United States occurs in Texas, specifically at the Padre Island National Seashore (http://www.nps.gov/pais/naturescience/kridley.htm). From the late 1940s to the mid 1980s, the number of nests fell from approximately 40,000 to fewer than 400. Due to an extensive international conservation partnership, the number of nests has increased more than 10 percent per year. Approximately 21,000 Kemp's ridley nests were recorded in Mexico during the 2009 nesting season (USFWS, 2009). Kemp's ridleys mature at an earlier age (7-15 years) than other chelonids, thus "lag effects" as a result of unknown impacts to the non-breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (NMFS and USFWS, 1992).

The largest contributors to the decline of Kemp's ridleys in the past were commercial and local exploitation, especially poaching of nests at the Rancho Nuevo site, as well as the Gulf of Mexico trawl fisheries. The advent of TED regulations for trawlers and protections for the nesting beaches has allowed the species to begin to rebound.

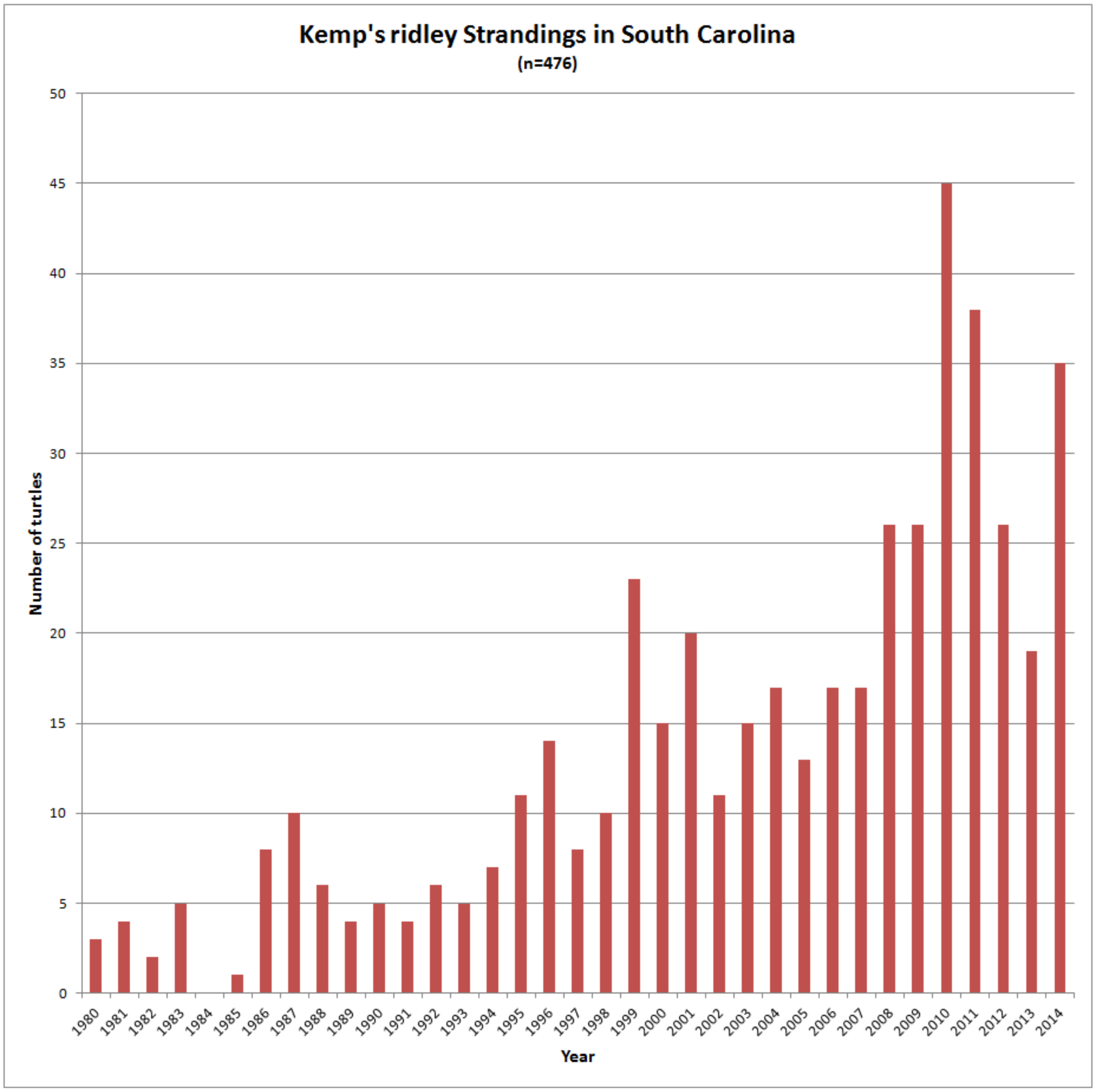


Figure 8. Kemps Ridley strandings in SC from 1980-2014

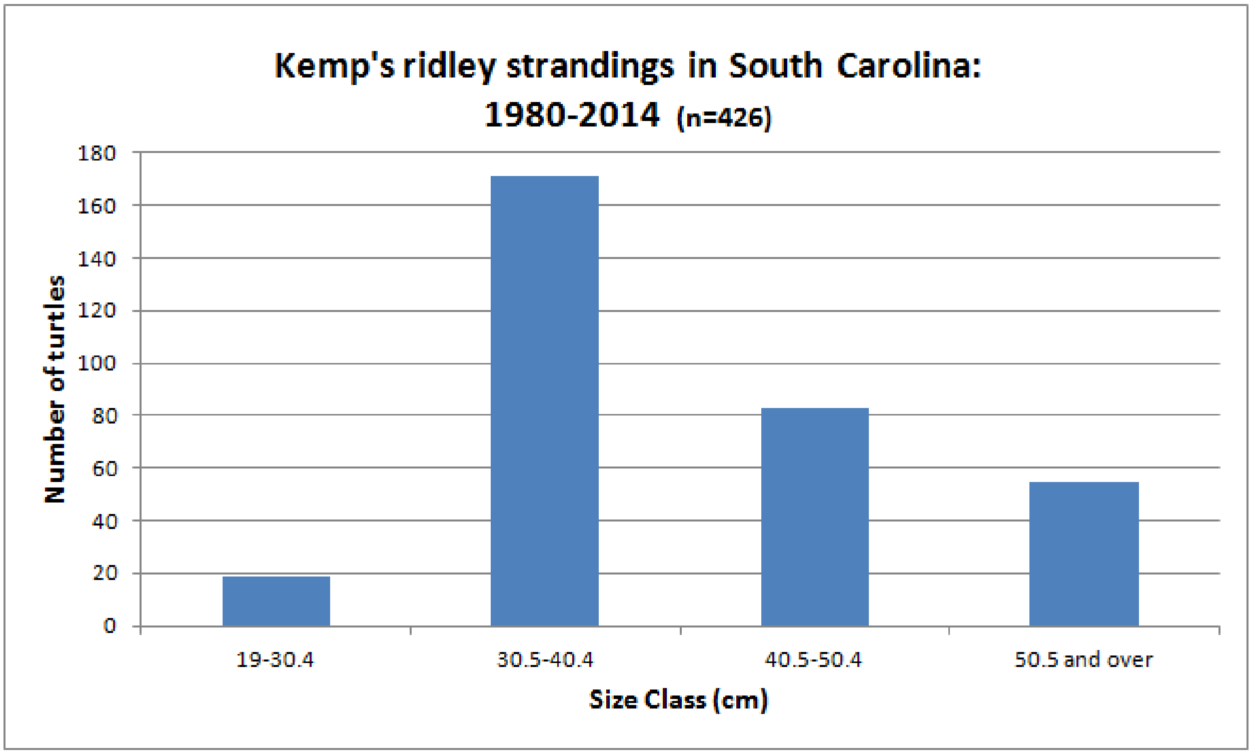


Figure 9. Kemps Ridley stranding based on size class

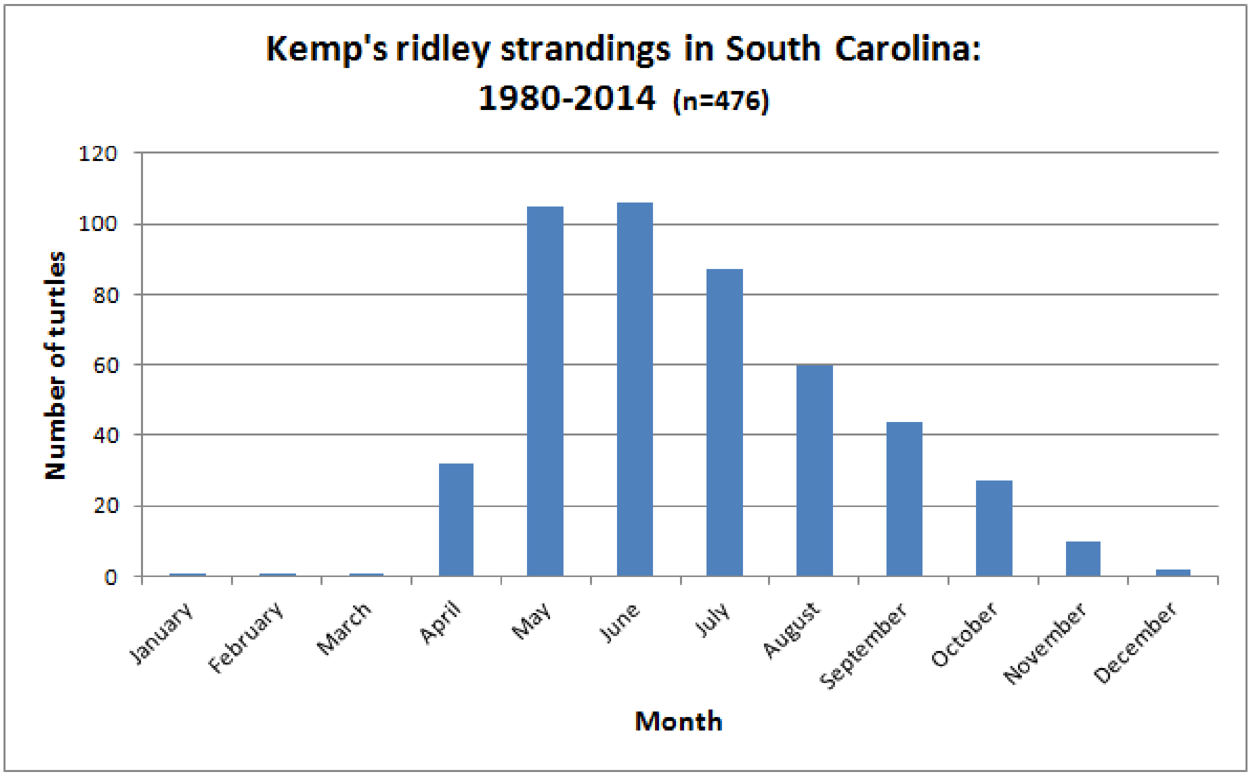


Figure 10. Kemps Ridley stranding based on month

3.1.3.5 Critical Habitat

At this time, no critical habitat has been designated for Kemp's ridley sea turtles in the project area.

3.1.4 Green (*Chelonia mydas*)

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered. The nesting range of green sea turtles in the southeastern United States includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina, the U.S. Virgin Islands (USVI) and Puerto Rico (NMFS and USFWS, 1991b). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties (Ehrhart and Witherington, 1992). Green sea turtle nesting also occurs regularly on St. Croix, USVI, and on Vieques, Culebra, Mona, and the main island of Puerto Rico (Mackay and Rebholz, 1996).

3.1.4.1 Life History and Distribution

The estimated age at sexual maturity for green sea turtles is between 20-50 years (Balazs, 1982; Frazer and Ehrhart, 1985). Green sea turtle mating occurs in the waters off the nesting beaches. Each female deposits 1-7 clutches (usually 2-3) during the breeding season at 12-14 day intervals. Mean clutch size is highly variable among populations, but averages 110-115 eggs/nest. Females usually have 2-4 or more years between breeding seasons, whereas males may mate every year (Balazs, 1983). After hatching, green sea turtles undergo a post-hatchling pelagic stage where they are associated with drift lines of algae and other debris. At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas (Bjorndal, 1997).

Green sea turtles are primarily herbivorous, feeding on algae and sea grasses, but also occasionally consume jellyfish and sponges. The post-hatchling, pelagic-stage individuals are assumed to be omnivorous, but little data are available.

Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or sea grasses. This includes areas near mainland coastlines, islands, reefs, or shelves, and any open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth, 1997; NMFS and USFWS, 1991b). Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty, 1984; Hildebrand, 1982; Shaver, 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr, 1957; Carr, 1984), Florida Bay and the Florida Keys (Schroeder and Foley, 1995), the Indian River Lagoon System, Florida (Ehrhart, 1983), and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven, 1992; Guseman and Ehrhart, 1992). While known to inhabit coastal South Carolina waters, there are no principal benthic foraging areas off of South Carolina. Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs.

3.1.4.2 Population Dynamics and Status

The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Meylan *et al.* 1995; Johnson and Ehrhart 1994). Green sea turtle nesting in Florida has been increasing since 1989 (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute Index

Nesting Beach Survey Database). Nest numbers in Florida have ranged from 435 laid in 1993 to 13,225 in 2010, which likely represents over 5,000 females nesting (USFWS). Nesting by green sea turtles in South Carolina is infrequent and rare (SCDNR).

Although nesting activity is obviously important in determining population distributions, the remaining portion of the green turtle's life is spent on the foraging and developmental grounds. Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth, 1997). The summer developmental habitat for green turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus, 1997).

There are no reliable estimates of the number of immature green sea turtles that inhabit coastal areas (where they come to forage) of the southeastern United States. However, information on incidental captures of immature green sea turtles at the St. Lucie Power Plant (they averaged 215 green sea turtle captures per year from 1977 to 2002) in St. Lucie County, Florida (on the Atlantic coast of Florida) show that the annual number of immature green sea turtles captured increased significantly during that time period (FPL, 2002).

It is likely that immature green sea turtles foraging in the southeastern United States come from multiple genetic stocks; therefore, the status of immature green sea turtles in the southeastern United States might also be assessed from trends at all of the main regional nesting beaches, principally Florida, Yucatán, and Tortuguero. Trends at Florida beaches were previously discussed. Trends in nesting at Yucatán beaches cannot be assessed because of a lack of consistent beach surveys over time. Trends at Tortuguero (ca. 20,000-50,000 nests/year) showed a significant increase in nesting during the period 1971-1996 (Bjorndal *et al.* 1999), and more recent information continues to show increasing nest counts (Troëng and Rankin, 2004). Therefore, it seems reasonable that there is an increase in immature green sea turtles inhabiting coastal areas of the southeastern United States; however, the magnitude of this increase is unknown.

Globally, in a 2004 green turtle assessment by the Marine Turtle Specialist Group (MTSG) of the International Union for Conservation of Nature (ICUN), analyses of historic and recent abundance information found a 48-65% decline in mature female nesting over the past 100-150 years (NOAA Fisheries, Office of Protected Resources).

3.1.4.3 Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the over-exploitation of green sea turtles for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. However, there are still significant and ongoing threats to green sea turtles from human-related causes in the United States. These threats include beach armoring, erosion control, artificial lighting, beach disturbance (e.g., driving on the beach), pollution, foraging habitat loss as a result of direct destruction by dredging, siltation, boat damage, other human activities, and interactions with fishing gear. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles. There is also the increasing threat from green sea turtle fibropapillomatosis disease. Presently, this disease is cosmopolitan and has been found to affect large numbers of animals in some areas, including Hawaii and Florida (Herbst, 1994; Jacobson, 1990; Jacobson et al., 1991).

3.1.4.4 Summary of Status

Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare in benthic areas north of Cape Hatteras (Wynne and Schwartz, 1999). Green turtles face many of the same natural and anthropogenic threats as for loggerhead sea turtles described above. In addition, green turtles are also susceptible to fibropapillomatosis, which can result in death. In the continental United States, green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart, 1979). Recent population estimates for the western Atlantic area are not available. Between 1989 and 2011, the annual number of green turtle nests at core index beaches ranged from 267 to 10,701 (Florida Marine Research Institute Statewide Nesting Database). While the pattern of green turtle nesting shows biennial peaks in abundance, there is a generally positive trend since establishment of index beaches in Florida in 1989. This is also evident in South Carolina. Documented nests have slowly increased overall since 2001. In 2011, 3 nests were documented (Table 5), and 6 were recorded in 2010; the highest number of nests since 1980 (SCDNR, unpublished data).

3.1.4.5 Critical Habitat

No critical habitat has been designated for this species in the project area.

3.2 Whales

3.2.1 Humpback (*Megaptera novaeangliae*)

The International Convention for the Regulation of Whaling regulated commercial whaling of humpback whales in 1946. In 1966, the International Whaling Commission prohibited commercial whaling of humpback whales. The species was listed as endangered in June 1970 by the Endangered Species Conservation Act (ESCA). This act was replaced with the Endangered Species Act in 1973 which continued to list humpback whales as endangered. Additional protection was provided under the Marine Mammal Protection Act (MMPA) in 1972. Under the MMPA, threats to humpbacks are mitigated by regulations under the Pacific Offshore Cetacean Take Reduction Plan and the Atlantic Large Whale Take Reduction Plan.

3.2.1.1 Life History and Distribution

Humpback whales live in all major oceans from the equator to sub-polar latitudes. They typically migrate between tropical/sub-tropical and temperate/polar latitudes. Humpback whales feed on krill and small schooling fish on their summer grounds. The whales occupy tropical areas during winter months when they are breeding and calving and polar areas during the spring, summer, and fall, when they are feeding, primarily on small schooling fish and krill.

In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Six separate feeding areas are utilized in northern waters after their return. These areas are within the biologically important area defined by the 200-m (656-ft) isobath on the North American east coast. These areas are outside of the project's potential impact area. Humpback whales also use the mid-Atlantic as a migratory pathway and apparently as a feeding area, at least for juveniles. Since 1989, observations of juvenile humpbacks in that area have been increasing during the winter months, peaking January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the Mid-Atlantic since they are not participating in reproductive behavior in the Caribbean.

Humpback whales exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes (particularly sand lance and Atlantic herring), euphausiids, and other large zooplankton. Fish prey in the North Pacific include herring, anchovy, capelin, pollack, Atka mackerel, eulachon, sand lance, Pacific cod, saffron cod, arctic cod, juvenile salmon, and rockfish. In the waters west of the Attu Islands and south of Amchitka Island, Atka mackerel were the preferred prey of humpback whales (Nemoto 1957). Invertebrate prey includes euphausiids, mysids, amphipods, shrimps, and copepods. They target fish schools and filter large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill.

Humpback whale reproductive activities occur primarily in winter. They become sexually mature at age four to six. Annual pregnancy rates have been estimated at about 0.40-0.42 (NMFS unpublished and Nishiwaki, 1959). Gestation lasts for about 11 months. Cows will nurse their calves for up to 12 months. The age distribution of the humpback whale population is unknown, but the portion of calves in various populations has been estimated at about 12% (Chittleborough 1965, Whitehead 1982, Bauer 1986, Herman et al., 1980, and Clapham and Mayo 1987).

3.2.1.2 Population Dynamics and Status

The best available estimate for the number of individuals in the North Atlantic is 11,750 whales. The NMFS March 2007 Stock Assessment report on the North Atlantic population (including the Gulf of Maine stock) of humpback whales, noted that the stock is currently estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463) (Waring *et al*, 2011). The minimum population estimate for the Gulf of Maine stock is 647. According to the stock assessment, current data suggests that the Gulf of Maine stock is steadily increasing in size. Potential Biological Removal (PBR) for the Gulf of Maine humpback whale is calculated to be 1.3 whales. A review of the "Whale Strike Database" (http://www.whatlestrikes.com) found no recorded ship strikes of humpback whales in South Carolina (database updated through 2011).

More detailed information on humpback whales can be located in the NMFS Stock Assessment reports under the MMPA (http://www.nmfs.noaa.gov/pr/sars/species.htm) and the Recovery Plan for Humpback Whale (http://www.nmfs.noaa.gov/pr/pdfs/recovery/whale_humpback.pdf).

3.2.1.3 Threats

Humpback whales face many threats due to human activity. They may become entangled in fishing gear, either swimming away with the gear after entanglement or by becoming anchored by it. Inadvertent ship strikes can injure or kill humpbacks. Whale watching vessels may harass/stress or strike whales. Traffic through shipping channels, fisheries and aquaculture may displace whales that normally aggregate in that area.

Humpback whales seem to respond to moving sound sources, such as whale-watching vessels, fishing vessels, recreational vessels, and low-flying aircraft (Beach and Weinrich 1989, Clapham et al. 1993, Atkins and Swartz 1989). Several investigators have suggested that noise may cause humpback whales to avoid or leave feeding or nursery areas (Jurasz and Jurasz 1979b, Dean et al. 1985), while others have suggested that humpback whales may become habituated to vessel traffic and its associated noise making them more vulnerable to vessel strikes (Swingle et al. 1993; Wiley et al. 1995).

There is no legal commercial harvest of humpback whales, but some countries have shown interest in resuming whale harvest. Japan has proposed killing 50 humpback whales as part of its program of scientific research under special permit (JARPA II in the IWS management areas IV and V in the Antarctic). Denmark recently proposed a hunt of 10 humpbacks a year off the coast of Greenland.

3.2.1.4 Summary of Status

Recent estimates of abundance in the North Atlantic stock indicate continued population growth; however, the size of the humpback whale stock may be below the optimum sustainable population (OSP) in the U.S. Atlantic Exclusive Economic Zone (EEZ) (NOAA Fisheries, Office of Protected Resources, (Waring, 2011)).

NMFS is currently conducting a global humpback whale status review. Relevant results will be included in the stock assessment reports when available.

3.2.1.5 Critical Habitat

No critical habitat has been designated for humpback whales under the ESA**.**

3.2.2 North Atlantic Right Whale (*Eubalaena glacialis*)

Right whales are one of the most critically endangered whale species in the world and are protected under the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). The North Atlantic right whale was listed as endangered under the Endangered Species Conservation Act in June 1970, the precursor to the ESA. The species was subsequently listed as endangered under the ESA in 1973, and designated as depleted under the MMPA.

Effective April 7, 2008, the NMFS listed the endangered northern right whale (*Eubalaena* spp.) as two separate, endangered species, North Pacific right whale (*E. japonica*) and North Atlantic right whale (*E. glacialis*). Therefore, for the purposes of this assessment, the right whale will be discussed as the North Atlantic right whale and all references to critical habitat designations will be for the North Atlantic right whale as set forth on June 3, 1994 (Critical habitat for the North Pacific Right Whale (*Eubalaena japonica*), last updated 2008).

3.2.2.1 Life History and Distribution

North Atlantic right whales (NARW) are highly migratory, summering in feeding and nursery grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf (Waring et al, 2014). They migrate southward in winter to the northeastern coast of Florida. Calving grounds for NARW primarily occur off of the coast of southern Georgia south to northern Florida however calving occasionally occurs as far north as Cape Fear, North Carolina. Calving grounds, extending from off of the coast of southern Georgia south to northern Florida, were designated as critical habitat under the ESA in 1994. Currently critical habitat does not extend to the Charleston Harbor area however, NMFS has proposed a rule to expand critical habitat for NARW (80 FR 9313 / NOAA-NMFS-2014-0085). When finalized the proposed rule would extend NARW critical habit to include marine waters from Cape Fear, NC southward to 29°N latitude (approximately 43 miles north of Cape Canaveral, Florida). The new critical habitat designation would include the Charleston Harbor area. During the winter months, right whales are routinely seen close to shore in the critical habitat area.

Kraus et al. (1993) found the area around the Florida/Georgia border and Jacksonville, Florida, in the widest area of the shallow-water shelf in the Georgia Bight, to be the primary and probably only calving ground for western North Atlantic right whales. More recent date demonstrates that the calving ground extends as far north as Cape Fear NC (Cole et al 2013 and Waring et al, 2014). They found cow/calf pairs to be primarily limited to the coastal waters between latitudes 27°30'N and 32°N. They also report right whales to be concentrated between Daytona Beach, Florida and Brunswick, Georgia. Highest densities are around Jacksonville, Florida, and the Florida/Georgia border. Most NARW sightings occur between December and February within 15 miles of shore (but can be seen between November and late March). A few sightings have been reported as early as September and as late as June.

3.2.2.2 Population Dynamics and Status

The current western North Atlantic right whale minimum stock size is based on a census of individual whales identified using photo-ID techniques. A review of this database as it existed in 29 October 2012 showed that a minimum of 455 whales were known to be alive in 2010 (Waring, 2014). This number does not include animals that were alive prior to 2008 but not recorded into the database as seen during 1 December 2008 to 29 October 2012. Subsequently, this number could increase as further analysis of the unmatched photographs proceeds (Waring, 2014).

Despite a decline in the population growth rate in the 1990s and an increase in mortality in 2004 and 2005, the minimum number alive population index calculated from the individual sightings database suggests a positive trend in population size from 1990 through 2007. Even so, due to the low population density, concerns over growth rate, percentage of reproductive females, and calving intervals, no mortality or serious injury for this stock can be considered insignificant.

3.2.2.3 Threats

From 2007 to 2011, the minimum rate per year of human-caused mortality or serious injury to right whales averaged 4.0 in U.S. waters (Waring, 2014). However, this number is a factor of both incidental fishery entanglement and ship strikes. While ship strikes are known to be a major anthropogenic cause of mortality for North Atlantic right whales within several major shipping corridors on the eastern U.S. and southeastern Canadian coasts (NMFS, 1991c), they make up a smaller portion of the annual rate of human-caused mortality. The 2013 NOAA stock assessment states that from 2007 to 2011, the average mortality and serious injury to right whales due to ship strikes was 0.8 whales per year. Historically, most North Atlantic right whales spotted in the southeast are found from 1 to 15 nautical miles from shore (Kraus et al., 1993; Ellis et al., 1993). However, Keller et al (2012) found that NARW occur in areas greater than 15nm from shore and that right whales distribution is strongly correlated with water temperature and water depth. Kraus found that swimming speeds of cow-calf pairs averaged 0.41 km/hr and whales not accompanied by calves averaged 0.51 km/hr. Movements of individual cow-calf pairs ranged from less than 1 km/day to 38.8 km/day. One statistical test found that non-cow North Atlantic right whales travel significantly farther and faster than North Atlantic right whales accompanied by a calf. They also found that cows with calves are more active at the surface than other classes of North Atlantic right whales in the region. It appears that the behavior of this species, including its swimming speed, makes it particularly susceptible to impact from collisions with ships. Between 1970 and October 2006, 48 percent of the 73 documented mortalities of North Atlantic right whales were caused by humans. A 2001 forecast showed a declining population trend in the late 1990s with predictions that if the then-existing anthropogenic mortality rate did not decrease, the species would go extinct within 200 years.

Additional threats to North Atlantic right whales include fishery entanglement, habitat degradation, contaminants, climate and ecosystem change, and predators such as large sharks and killer whales. Disturbance from such activities as whale watching and noise from industrial activities may affect the population as well.

A complete assessment of NARW recovery efforts and activities is reviewed in the Recovery Plan for the North Atlantic Right Whale (NMFS, 2005).

Speed Restrictions

Final Rule - Speed Restrictions: Federal Register / Vol. 73, No. 198/ Friday, October 10, 2008; RIN 0648-AS36.

On October 10, 2008, the NMFS implemented regulations for mandatory vessel speed restrictions of 10 knots (about 11 mph) or less on vessels 65 feet or greater in overall length in certain locations and at certain times of the year along the east coast of the US Atlantic seaboard. The purpose of this rule is to reduce the likelihood of deaths and serious injuries to endangered North Atlantic right whales that result from collisions with ships. Under an agreement between NMFS, U.S. Coast Guard, U.S. Navy, and the U.S. Army Corps of Engineers, vessels operated by Federal agencies, or are under contract to Federal agencies are exempt from the proposed regulations (Volume 73, No. 198, Oct 10, 2008, Part 224.105); however, operation of these vessels will be subject to guidance provided through consultations under the ESA. The rule had a sunset provision of December 31, 2013. On Dec 9, 2013, NOAA published an action to remove the sunset provision for the speed restriction (Vol. 78, No. 236). The rule states that "all other aspects of the rule remain in place until circumstances warrant further changes to the rule." Therefore, the federal exemption still stands.

The rule divides the United States east coast into three large sub-areas: Southeast US, Mid-Atlantic US, and Northeast US. Within each, NMFS seasonal rules restrict vessels speed to 10 knots or less. The areas, and the times in which they would be in effect, are as concisely and specifically defined as possible to reflect the known occurrences or right whales.

Mandatory Speed Restriction Areas

(1) Southeast U.S.: Vessels 65 feet and greater in length shall travel at a speed of 10 knots or less during the period of November 15 to April 15 each year in the area bounded by: the shoreline, 31° 27'N lat, 29° 45'N lat., and 80°51.6'W long. (Figure 11)

(2) Mid-Atlantic U.S.: Vessels shall travel 10 knots or less in the period November 1 to April 30 each year (Figure 11).

(i) Within a 30 nautical mile radius at the:

(A) Ports of New York and New Jersey;

(B) Delaware Bay (Ports of Philadelphia and Wilmington);

(C) Entrance to the Chesapeake Bay (Ports of Hampton Roads and Baltimore);

(D) Ports of Morehead City and Beaufort, NC;

(E) Port of Wilmington, NC;

(F) Port of Georgetown, SC;

(G) Port of Charleston, SC;

(H) Port of Savannah, GA; and

(ii) In Block Island Sound, in the area with a 30 nm width extending south and east of the mouth of the sound.

3.2.2.4 Summary of Status

While there is some evidence through sightings data that there has been a small increase in the number of North Atlantic right whales, the species is still critically endangered and any future mortality or serious injury to this stock is significant. Collision with ships is currently the most serious source of mortality threatening the right whale, followed closely by the threat of entanglement in commercial fishing gear. It should be noted that a review of Jensen and Silber (2003), as well as the Corps' own records, has not documented any ship strike attributed to a Corps-owned or Corps-contracted vessel.

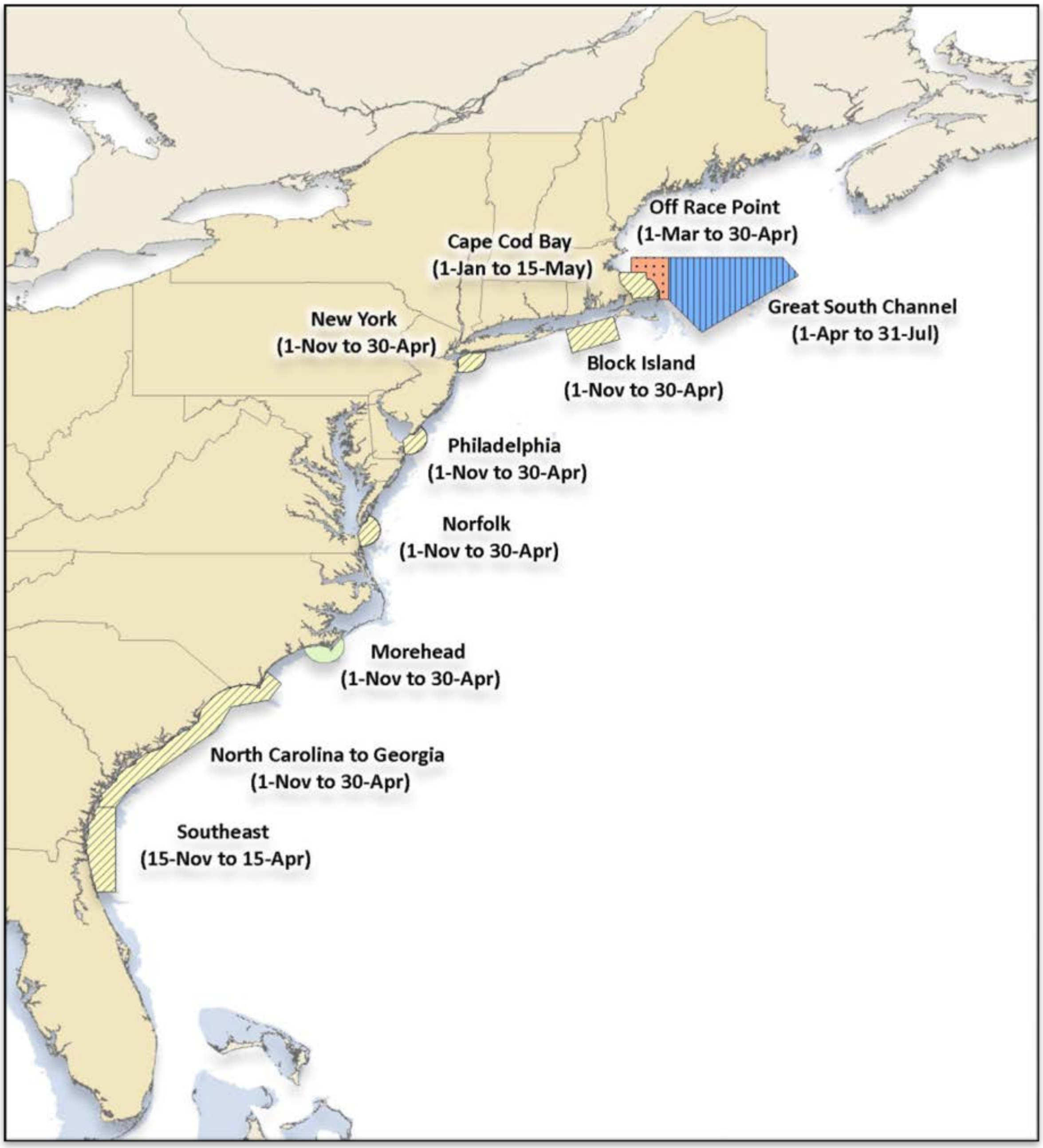


Figure 11. Locations of vessel speed restriction Seasonal Management Areas.

3.2.2.5 Critical Habitat

In the United States, NMFS designated critical habit for the North Atlantic right whale in 1994 for the Northeast and Southeast U.S. (Figure 12); however, there is no designated critical habitat within the project area. As discussed above, NMFS has proposed a rule to expand critical habitat for NARW (80 FR 9313 / NOAA-NMFS-2014-0085). When finalized the proposed rule would extend NARW critical habit to include marine waters from Cape Fear, NC southward to 29°N latitude (approximately 43 miles north of Cape Canaveral, Florida). The new critical habitat designation would include the Charleston Harbor area.

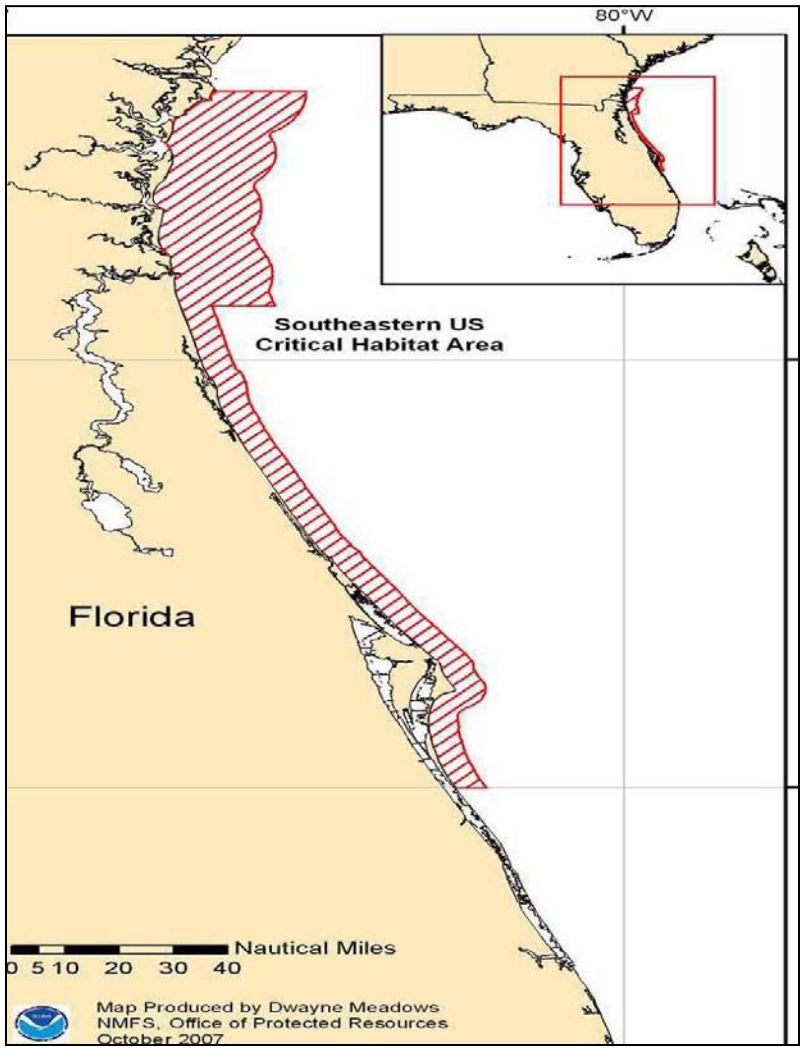


Figure 12. Critical habitat designation for the Southeast Atlantic.

3.3 West Indian Manatee (*Trichechus manatus*)

The West Indian manatee, also known as the Florida manatee, is a Federally-listed endangered aquatic mammal protected under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.), the Marine Mammal Protection Act of 1972, as amended (16 U.S.C 1461 et seq.), and the Florida Manatee

Sanctuary Act of 1978, as amended. The West Indian manatee includes two distinct subspecies, the Florida manatee (Trichechus manatus latirostris) and the Antillean manatee (Trichechus manatus manatus). While morphologically distinctive, both subspecies have many common features. The species of concern to this project is the Florida manatee.

Manatees have large, seal-shaped bodies with paired flippers and a round, paddle-shaped tail. They are typically grey in color (color can range from black to light brown) and occasionally spotted with barnacles or colored by patches of green or red algae. The muzzle is heavily whiskered and coarse, single hairs are sparsely distributed throughout the body. Adult manatees, on average, are about nine feet long (3 meters) and weigh about 1,000 pounds (200 kilograms). At birth, calves are between three and four feet long (1 meter) and weigh between 40 and 60 pounds (30 kilograms) (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A007). Female manatees are capable of reproduction at as early as 4 years of age; however, most breed between the ages of 7 and 9. Gestation lasts from 12 to 14 months. Normally an adult female would have only one calf every 2 to 5 years, but there are rare occurrences of twins. The mother and calf remain together for up to 2 years. Male manatees aggregate in mating herds around a female when she is ready to conceive, but contribute no parental care to the calf (Federal Register/Vol.75, No. 7/January 12, 2010).

Manatees inhabit both salt and fresh water and can be found in shallow (5 to 20 feet), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas (USFWS, 2001) throughout their range.

Manatees are herbivores that feed opportunistically on a wide variety of marine, estuarine, and freshwater plants, including submerged, floating, and emergent vegetation. Common forage plants include and are not limited to: cordgrass, alga, turtle grass, shoal grass, manatee grass, eel grass, and other plant types. Calves initially suckle and may start feeding on plants when a few months of age. Weaning generally takes place within a year of birth. Manatees also require freshwater, obtained from both natural and anthropogenic sources. Manatees need to drink freshwater every 1 to 2 weeks. They intake their freshwater from both drinking and eating aquatic plants (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A007).
Manatees use springs and freshwater runoff sites for drinking water; secluded canals, creeks, embayments, and lagoons for resting, mating, calving, and nurturing their young; and open waterways and channels as travel corridors (Federal Register/Vol.75, No. 7/January 12, 2010).
SCDNR (http://www.dnr.sc.gov/cwcs/pdf/FloridaManatee.pdf) states that, "In South Carolina, manatees occupy fresh, brackish and marine habitats and move freely between salinity extremes. Because of the high tidal amplitude, manatees feed on abundant *Spartina alternaflora* grasses at high tide and frequently move to submerged *Ulva* sp. beds at low tide. Manatees will move up rivers until the water is too shallow for passage or is blocked by a dam. There is no evidence that manatees concentrate on the upper Cooper River…"

3.3.1.1 Life History and Distribution

During the cooler months between October and April, Florida manatees concentrate in areas of warmer water. Manatees are thermally stressed at water temperatures below 18°C (64.4°F) (Garrott et al., 1995); therefore, during winter months, when ambient water temperatures approach 20°C (68°F), the U.S. manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water industrial outfalls. For this reason, manatees are only seen in South Carolina in the summer months. Historically, manatees relied on the warm, temperate waters of south Florida and on natural warm-water springs scattered throughout the State as buffers to the lethal effects of cold winter temperatures. In part, as a result of human disturbance at natural sites (Laist and Reynolds 2005), they have expanded their winter range to include industrial sites and associated warm-water discharges as refuges from the cold.

Counties in South Carolina in which the manatee is known or believed to occur include: Beaufort, Berkeley, Charleston, Colleton, Dorchester, Georgetown, Horry, and Jasper. Manatees are found in Georgia and South Carolina mainly during the warmer months of the year. From 1850 to 2004, 1,117 manatee sightings were reported in South Carolina (http://www.dnr.sc.gov/manatee/dist.htm); however, the website has not been updated since 2004. The Florida manatee has not experienced any curtailment in the extent of its range throughout the southeastern United States. To the contrary, Florida manatees have expanded their summer range to other states along the Atlantic and Gulf coasts. It is now not uncommon to find manatees in coastal waters of Georgia, North and South Carolina, Alabama, and Louisiana (Federal Register/Vol.75, No. 7/January 12, 2010).

3.3.1.2 Population Dynamics and Status

Manatee population trends are poorly understood, but deaths have increased steadily. A large percent of mortality is due to collisions with watercrafts, especially calves. Another closely related factor in their decline has been the loss of suitable habitat through incompatible coastal development, particularly destruction of sea grass beds by boating facilities (USFWS, 2001).

Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges. During summer months, they may migrate as far north as coastal Virginia on the east coast and the Louisiana coast on the Gulf of Mexico and appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water (USFWS, 1983). Annual migratory circuits of some individuals through the intracoastal waterway of the Atlantic Coast are 1,700 km round trips at seasonal travel rates as high as 50 km/day (Reid et al., 1991).

Craig and Reynolds (2004) additionally suggested that populations of wintering manatees in the Atlantic Coast Region have been increasing at rates of between 4 and 6 percent per year since 1994. The most current and best available count of the Florida manatee population is 3,807 animals, based on a single synoptic survey of warm-water refuges and adjacent areas in January 2009 (FWC FWRI 2009 Manatee Synoptic Aerial Survey Data). (Federal Register/Vol.75, No. 7/January 12, 2010).

3.3.1.3 Threats

The major threats to the Florida manatee population are human related, and include watercraft strikes (direct impacts and propeller cuts), which can cause injury and death (Rommel et al. 2007; Lightsey et al. 2006); entrapment and crushing in water control structures (gates, locks, etc.); and entanglement in fishing gear. Natural threats include red tide and exposure to cold. A comprehensive threats analysis, recently conducted as part of the USFWS 5–year status review, indicated that the single largest threat to the persistence of manatees in Florida is collisions with watercraft. The second most significant threat to the species' survival is the loss of warm water habitat. The other threats (water control structures, entanglement, and red tide) are of substantially less impact to the overall status of the species (USFWS 2007; Runge et al. 2007a).

The greatest known human-related cause of manatee mortality in the southeastern United States is collisions with ship/boat hulls and/or propellers. There is limited documented collision mortality in

South Carolina and few of the many manatees sighted are reported to have fresh wounds. However, the lack of extensive collision mortality may be a result of the low number of animals present. It is likely that manatees are prone to being struck by fast moving boats when foraging in shallow areas; however, most boat operators avoid shallow water hazards in South Carolina. The high tidal amplitude and abundant oyster beds present in this state reduce the frequency of collisions.

Cold stunning may have a significant effect on manatees in South Carolina because the state is in the northern range of the species. The threat of cold stunning is complicated by use of heated water discharges at a variety of industrial sites in the fall. Unlike power plants and paper mills, many of these smaller discharge sites are not in continuous operation and do not provide a predictable source of warm water. Many are being eliminated as alternative treatments of heated effluent are being adopted. Although based on a limited sample, several manatee mortalities in South Carolina were related to low water temperature exposure. In Florida, manatee mortality by trauma or drowning can be associated with the operation of locks and water control gates. The only such site in South Carolina is the lock on the upper Cooper River that transports boats between the river and Lake Moultrie. Manatee mortality has occurred in two ways at this site. Several manatees have died from exposure to cold-water temperatures after they failed to navigate back down the lock in the fall during its limited operation. The second source of mortality was from drowning in the lock during operation. Although documented in Florida (O'Shea et al. 1991), harmful algal blooms have not been documented as a source of manatee mortality in South Carolina. However, documentation of the state's first large-scale marine algal bloom (*Heterosigma akashiwo*) in the spring of 2003 increases the likelihood of future blooms. Throughout its range, several manatee mortalities have been associated with the shrimp trawl fishery. The interaction between shrimp trawlers and manatees appears to be rare because manatees should be able to out swim the approaching nets or surface to avoid them (http://www.dnr.sc.gov/cwcs/pdf/FloridaManatee.pdf).

To reduce potential construction-related impacts to the manatee to discountable and insignificant levels, the USFWS recommends implementing the *Standard Manatee Construction Conditions* (Fish and Wildlife Commission, 2005) during project construction.

3.3.1.4 Summary of Status

Minimum population size has been based on counts of manatees at all known winter refuges in Florida and Georgia. Aerial and ground counts at winter refuges are highly variable depending on weather, water clarity, manatee behavior and other factors (Packard et al. 1985). The number of manatees in SC at any given time appears to be in the tens of manatees during the warmer months. The total number of individual manatees using South Carolina waters in a given year is much higher than the number of resident manatees because several individuals use the state during part of a season or on less than an annual basis.

3.3.1.5 Critical Habitat

There is no Critical Habitat listed in South Carolina for the West Indian Manatee.

3.4 Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon was listed as endangered throughout its range on March 11, 1967, under the Endangered Species Conservation Act, the precursor to the ESA. The species was subsequently listed as endangered under the ESA in 1973. NMFS later assumed jurisdiction for shortnose sturgeon from the USFWS under a 1974 government reorganization plan (38 FR 41370).

3.4.1.1 Life History and Distribution

The shortnose sturgeon is an anadromous species restricted to the east coast of North America. Throughout its range, shortnose sturgeon occur in rivers, estuaries, and the ocean. It is principally a riverine species and is known to use three distinct portions of river systems: (1) non-tidal freshwater areas for spawning and occasional overwintering; (2) tidal areas in the vicinity of the fresh/saltwater mixing zone, year-round as juveniles and during the summer months as adults; and (3) high salinity estuarine areas (15 parts per thousand (ppt.) salinity or greater) as adults during the winter. The majority of populations have their greatest abundance and are found throughout most of the year in the lower portions of the estuary and are considered to be more abundant now than previously thought (NMFS, 1998a). Recent hydroacoustic studies have noted that interbasin movement via the ocean by shortnose sturgeon is more common than previously believed (B. Post SCDNR pers. comm.).

The shortnose sturgeon is a suctorial feeder and its preferred prey is small gastropods. Sturgeon forage by slowly swimming along the bottom, lightly dragging their barbels until they feel something that may resemble food, at which time they suck it up in their protrusible mouths. The non-food items are expelled through their gills. Juveniles may be even more indiscriminate, and just vacuum their way across the bottom. Soft sediments with abundant prey items such as macroinvertebrates are thought to be preferred by shortnose sturgeon for foraging, so established benthic communities are important. They are thought to forage for small epifaunal and infaunal organisms over gravel and mud. A few prey studies have been conducted and prey include small crustaceans, polychaetes, insects, and mollusks (Moser and Ross 1995; NMFS, 1998a), but they have also been observed feeding off plant surfaces and on fish bait (Dadswell et al. 1984).

Spawning Life Stage

As with most fish, southern populations of shortnose sturgeon mature earlier than northern ones: females reach sexual maturity at approximately 6 years, and males reach it at 3 years. In early February to late March, shortnose sturgeon spawn far upstream in freshwater. In most population segments, sturgeon spawn at the uppermost river reaches that are accessible in channels and curves in gravel, sand, and log substrate; however, many spawning grounds are blocked by dams (Hall *et al*. 1991). Other suitable substrates include riffles near limestone bluffs with gravel to boulder-sized substrate (Rogers and Weber 1995). Spawning lasts for about 3 weeks, beginning when water temperatures are at about 8 to 9° C, and ending when it reaches approximately 12 to 15° C. Optimal flows are between 30 and 76 cm/s (Crance, 1986). The spent fish migrate downriver from March to May, and spend the summer from June to December in the lower river (Hall *et al*. 1991). Females likely do not spawn every year, while males may do so. The demersal, adhesive eggs hatch in freshwater, and develop into larvae within 9 to 12 days. Larvae start swimming and initiate their slow downstream migrations at about 20 mm in length (Richmond and Kynard, 1995). In an effort to quantify impacts to shortnose sturgeon habitat, the Post 45 study evaluated impacts using a USFWS habitat suitability index model. The model and its development are fully described within the Fisheries Habitat Impact Assessment Appendix of the EIS (Appendix K). The parameters for this species are velocity, temperature and substrate. At the request of the Post 45 Interagency Coordination Team, a salinity threshold of 0.5ppt was added to the model. Essentially, if salinity was greater than 0.5ppt, habitat was assigned a “0”. Existing habitat for spawning is only suitable in the model above a point approximately 2.7 miles south of the “tee” in the Cooper

River (Figure 13). Substrate appears to drive the relatively low (0.5 or less) HSI results. This is because of the substrate classifications in the model and the relationship to the in situ substrate conditions. Substrates commonly used by spawning shortnose sturgeon include gravel, rubble, large rock, sand, logs, and cobble (Dadswell 1979, Taubert 1980, Kieffer and Kynard 1996, Kynard 1997). Duncan et al. (2004) and Cooke and Leach (2004) state that spawning was successful in the Cooper River despite the "non-traditional" (i.e., barren hard bottom with scattered pockets of clam shell and marl) spawning habitat. Also notable in the existing condition is that HSI numbers go down progressing up the east branch of the Cooper River, which is driven by the lower flows in the east branch than in the west branch. While spawning in the Cooper River has been confirmed by the presence of fertilized eggs (Duncan et ai, 2004), a near total absence of larval and juvenile life stages casts doubt on whether the reproduction is successful (Bill Post, SCDNR, personal communication, Wirgin et al. 2009).

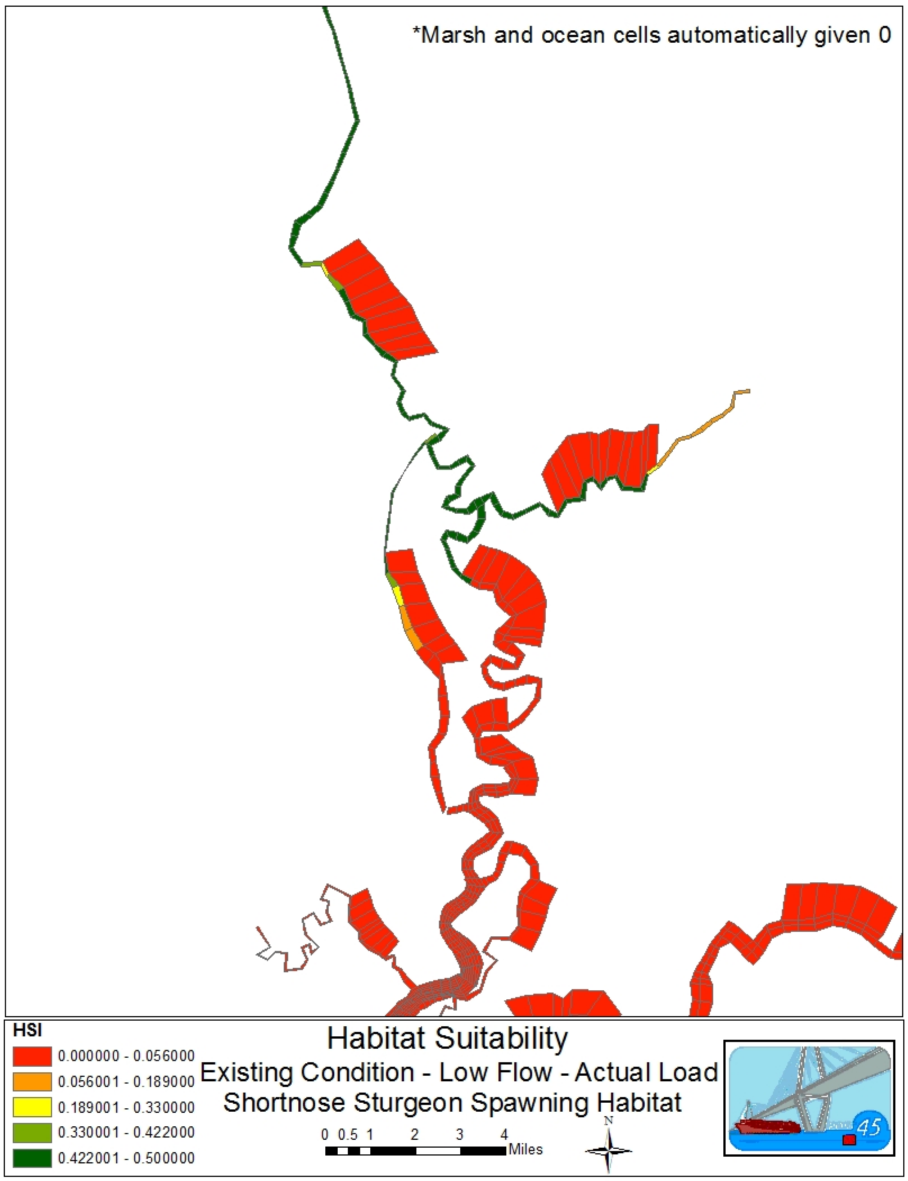


Figure 13. Shortnose Sturgeon Modeled (HSI) Spawning Habitat

Adult Life Stage

Adult shortnose sturgeon migrate extensively throughout an individual river system and may also migrate between different river basins (Wrona *et al*., 2007; Cooke and Leach, 2004), including regional/interstate movement (Bill Post, SCDNR, Unpublished data). In 1999 and 2000, Collins *et al.* (2001) tracked adult and juvenile sturgeon in the Savannah River and identified distinct summer and winter habitats in terms of location and water quality. Observations indicate that they seek relatively deep, cool holes upriver for sanctuary from warm temperatures (and possibly to escape low dissolved oxygen coupled with salinity stress), and in the winter, they migrate downstream to the estuary, perhaps to feed or escape extreme cold. When temperatures are below 22° C, it appears that both adult and juvenile sturgeon stay in the lower river and during warmer periods when temperatures exceed 22° C, telemetry observations and gill net surveys indicate that sturgeon use the upper estuary. While they are known to occur from 4 to 33° C, sturgeon show signs of stress at temperatures above 28°C, and this stress may be exacerbated by low dissolved oxygen conditions during summer critical months. Sturgeon may seek thermal refuges during these periods, deep cool waters where salinity conditions are appropriate and food is available with minimal foraging movements. For example, Flournoy *et al*. (1992) found that sturgeon may use spring-fed areas for summer habitat in the Altamaha River system. The synergistic effects of high temperatures and low dissolved oxygen should be considered in any impact analysis. Based on work done in the Chesapeake Bay, sturgeon may suffer an "oxygen squeeze" in the summer when they seek deep cool areas that also have low dissolved oxygen (Secor and Niklitschek, 2001). Suitable habitat as determined by the USFWS HSI model for foraging habitat is shown in Figure 14. The HSI model is driven by temperature, velocity and substrate.

In order to provide further understanding of modeled habitat based on HSI outputs, USACE compared areas of anticipated change to fishery data collected by SCDNR. In an SCDNR telemetry study of shortnose and Atlantic sturgeons, sonic transmitters are inserted into individuals to monitor migration patterns, seasonal habitats, and spawning locations in several coastal systems including the Santee-Cooper basin (Lakes Moultrie and Marion, the Congaree, the Wateree, the Saluda and the Broad Rivers). An array of fixed receivers is deployed throughout the basin to constantly monitor the transmitter (PIT)-tagged fish. Figure 15 shows the location of the receivers; green means positive for shortnose sturgeon, red means negative. Figure 16 shows the movement of shortnose sturgeon within the Cooper River. The figure indicates high usage of the river between roughly river km 30 and 45, which is approximately where the freshwater/saltwater interface occurs.

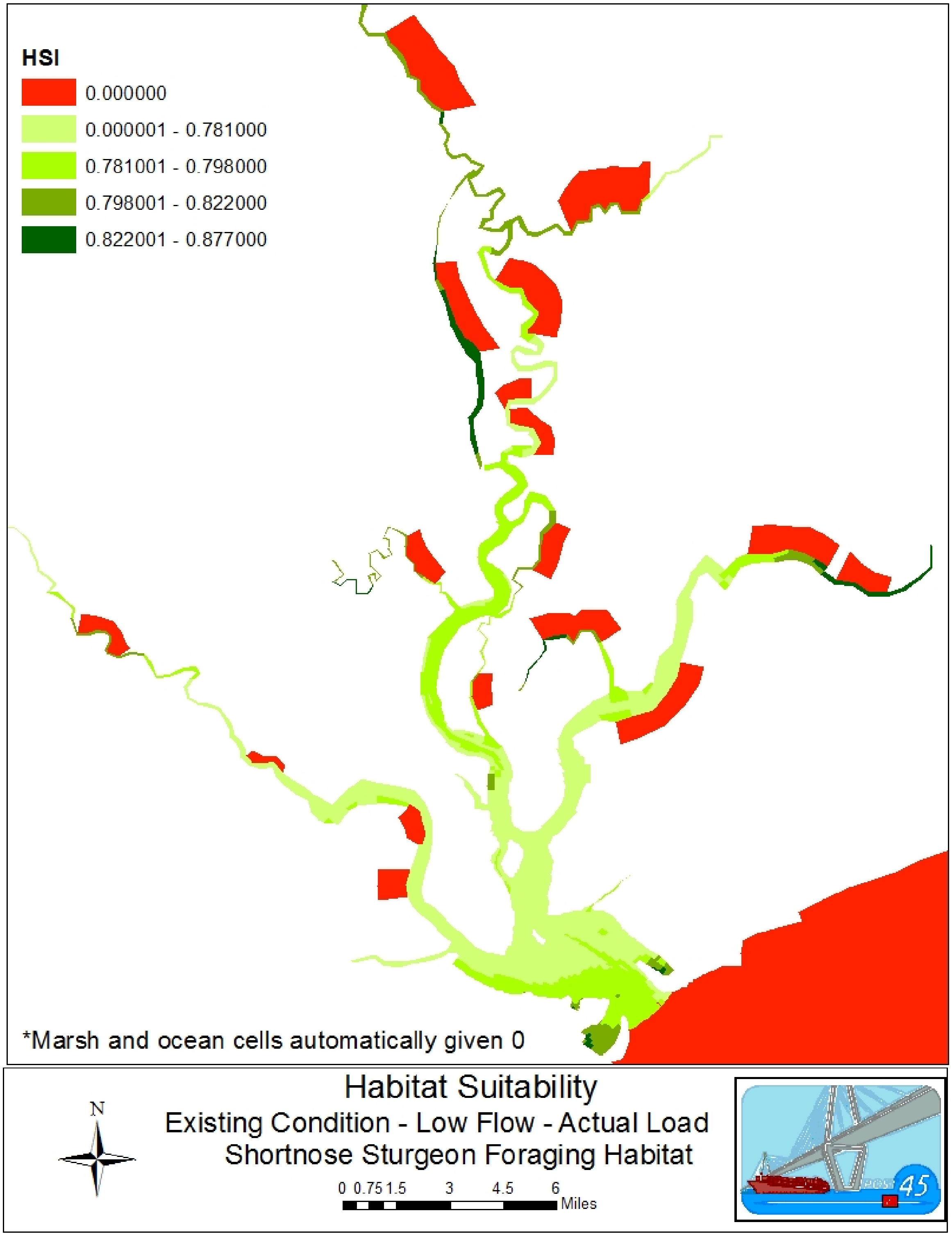


Figure 14. Shortnose Sturgeon Modeled (HSI) Foraging Habitat

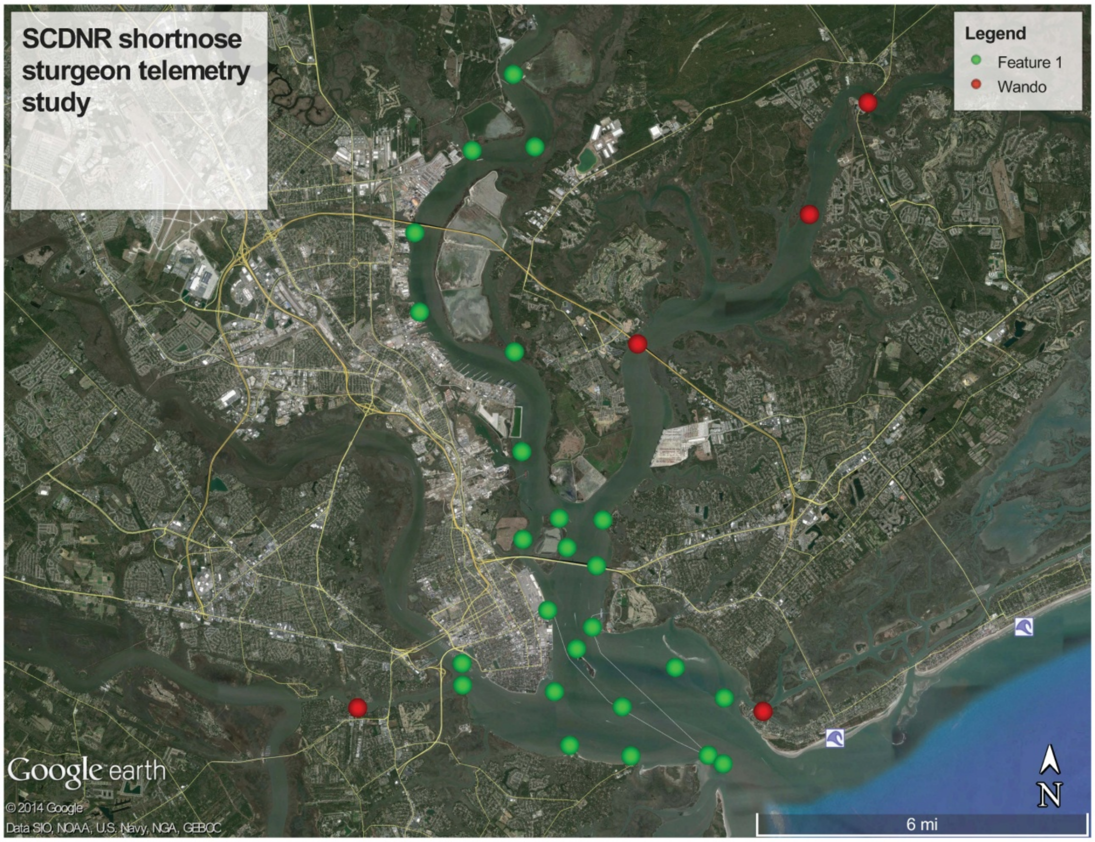


Figure 15. SCDNR telemetry study receiver locations.

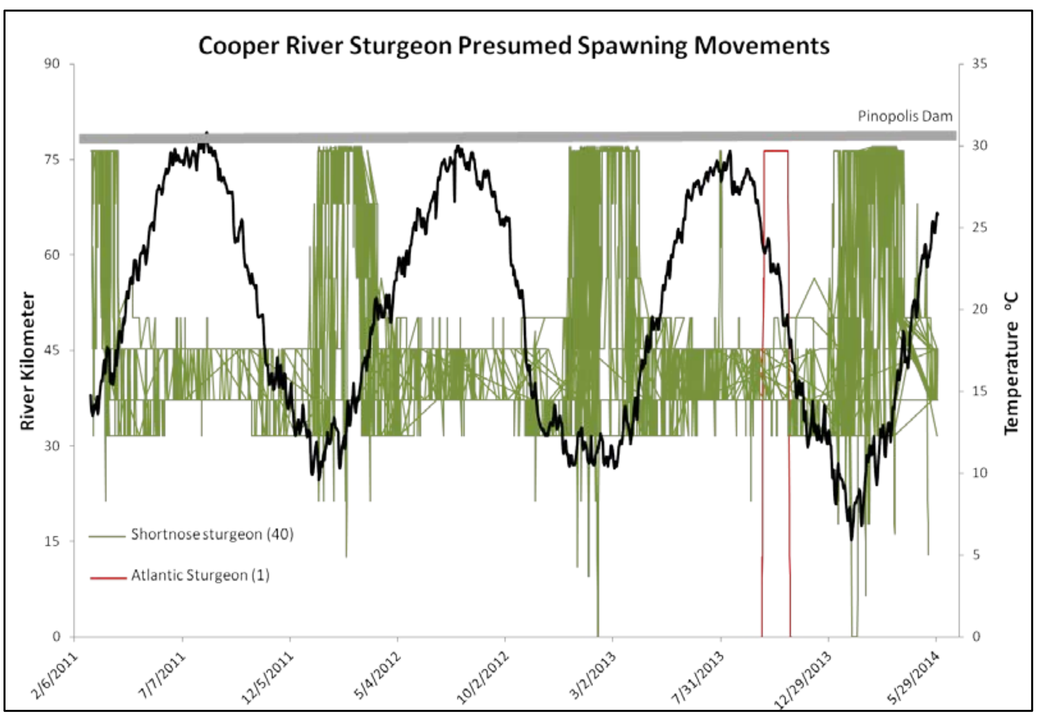


Figure 16. Example of typical shortnose sturgeon movements documented by SCDNR in the Cooper River.

Juvenile Life Stage

Juvenile shortnose sturgeon mature at approximately 3 to 6 years of age, and they live in the salt/fresh interface in most rivers. After spending their first year in the upper freshwater reaches, they adopt the adult migratory lifestyle and go upriver in the summer and down in the winter. Like adults, they need sand or mud substrate for foraging (Hall *et al.* 1991). They are less tolerant of low dissolved oxygen and high salinity than the adults and appear to migrate accordingly within the river system. According to Collins *et al.* (2001), when temperatures exceeded 22° C in the Savannah River, juveniles spent the summer in deep (5 to 7 m) holes with 0 to 1 ppt salinity levels. During the winter, they use the warmer estuarine-influenced lower river. For example, they move into more saline areas (0 to 16 ppt) when temperatures dropped below 16° C in the Ogeechee River. Warm summer temperatures, over 26°C, limit movement of juveniles who may not be able to forage extensively during summers. Tolerance to both dissolved oxygen and salinity is thought to increase with age; very young sturgeon are known to be extremely sensitive to both (Jenkins *et al*., 1993). Jenkins *et al* (1993) reported that in a 6-hour test, fish 64 days old exhibited 86% mortality when exposed to dissolved oxygen concentrations of 2.5 mg/L. However, sturgeon >100 days old were able to tolerate concentrations of 2.5 mg/L with <20% mortality. Jenkins also reported that dissolved oxygen at less than 3 mg/L causes changes in sturgeon behavior: Fish hold still and pump water over their gills, an apparent adaptation to survive low dissolved oxygen conditions. If fish spawn in the spring, it is believed that late age individuals encounter these low dissolved oxygen conditions in the lower estuary. The Environmental Protection Agency (Chesapeake Bay Program Office) recently revised its D.O. criteria for living resources in Chesapeake Bay tributaries from 2.0 mg/L to 3.5 mg/L to be protective of sturgeons (Secor and Gunderson, 1998; Niklitschek and Secor, 2000). It is possible that 3.5 mg/L may be acceptable, but 4.0 mg/L would be safer for the higher temperatures in this southern river. As with adults, temperatures above 28°C reduce tolerance to low dissolved oxygen (Flournoy *et al*. 1992).

Egg and Larval Life Stages

The demersal, adhesive eggs hatch in freshwater, and develop into larvae within 9 to 12 days. Larvae start swimming and initiate their slow downstream migrations when they reach about 20 mm in length (Richmond and Kynard, 1995).

Shortnose sturgeon occur within most major river systems along the Atlantic Coast of North America, from the St. John River in Canada to the St. Johns River in Florida. In the southern portion of the range, they are found in the St. Johns River in Florida; the Altamaha, Ogeechee, and Savannah Rivers in Georgia; and, in South Carolina, the river systems that empty into Winyah Bay and the Santee/Cooper River complex that forms Lake Marion. A 1997 study of sturgeon distribution in South Carolina (Collins and Smith, 1997) found adult shortnose sturgeon at upriver locations in the Savannah, Cooper, Waccamaw, Santee, and Congaree rivers. A later study in 2003 (Collins, et al) documented the presence of shortnose sturgeon in the reservoirs of the Santee-Cooper system as well, one of only two known landlocked populations of the species (Holyoke River, MA).

3.4.1.2 Population Dynamics and Status

Shortnose sturgeon face a high risk of extinction based in part on an estimated range reduction of greater than 30% over the past three generations, irreversible habitat losses, effects of habitat alteration and degradation, degraded water quality, and extreme fluctuations in the number of mature individuals between rivers.

Despite the longevity of adult sturgeon, the viability of sturgeon populations are highly sensitive to juvenile mortality that result in reductions in the number of sub-adults that recruit into the adult, breeding population (Anders *et al.,* 2002; Gross *et al.,* 2002; Secor *et al.,* 2002). Sturgeon populations can be grouped into two demographic categories: populations that have reliable (albeit periodic) natural recruitment and those that do not. The shortnose sturgeon populations without reliable natural recruitment are at the greatest risk (Secor *et al.,* 2002).

Several authors have also demonstrated that sturgeon populations generally, and shortnose sturgeon populations in particular, are much more sensitive to adult mortality than other species of fish (Boreman, 1997; Gross *et al.,* 2002; Secor *et al.,* 2002). These authors concluded that sturgeon populations cannot survive fishing related mortalities that exceed five percent of an adult spawning run and they are vulnerable to declines and local extinction if juveniles die from fishing related mortalities.

3.4.1.3 Threats

Highly prized for their caviar and meat, sturgeon populations were under intense fishing pressure from colonial times until 1990, when the Atlantic States Marine Fisheries Commission issued a moratorium on commercial and recreational fishing for sturgeon in state waters of the Atlantic coast. In 1999, the moratorium was extended to include federal waters under the Atlantic Coastal Fisheries Cooperative Management Act. Historic landings records do not differentiate shortnose from Atlantic, but it is likely that shortnose populations were greatly affected by commercial and recreational fishing, as were Atlantic sturgeon. The construction of dams throughout the shortnose sturgeon's range probably reduced their reproductive success by reducing the volume of suitable spawning habitat. Dredging activities have been known to take individual sturgeon and have the potential to alter the quality of their feeding, rearing, and overwintering habitat (http://www.nmfs.noaa.gov/pr/species/fish/shortnosesturgeon.htm). More recently, larval and juvenile shortnose sturgeon in the different populations along the Atlantic have been killed after being impinged on the intake screens or entrained in the intake structures of power plants on the Delaware, Hudson, Connecticut, Savannah and Santee rivers (Dadswell et al., 1984). Sturgeon populations have also been reduced further by habitat fragmentation and loss, siltation, water pollution, decreased water quality (low D.O., salinity alterations), bridge construction, and incidental capture in coastal fisheries (Dadswell et al., 1984; Collins et al., 1996; NMFS, 1998a; Secor and Gunderson, 1998; Collins et al., 2000; Newcomb and Fuller, 2001).

In addition, habitat alterations from point source discharges, dredging or disposal of material into rivers, or related development activities involving estuarine/riverine mudflats and marshes, remain constant threats. Commercial exploitation of shortnose sturgeon occurred throughout its range starting in colonial times and continued periodically into the 1950's.

3.4.1.4 Summary of Status

NMFS recognizes 19 distinct population segments inhabiting 25 river systems ranging from the Saint John River in New Brunswick, Canada, to the St. Johns River, Florida. Of these, three are in South Carolina: Winyah Bay (Waccamaw, Pee Dee and Black Rivers), Santee (Santee River), and Cooper (Cooper River). Collins and Smith (1997) suggested a landlocked population of shortnose sturgeon resides in Lake Marion and migrates up the Congaree River during the spawning season. Successful reproduction has been documented in this population. Viable eggs were collected in 1999 and a young-of-year individual was collected in 2014. Atlantic sturgeon migrate from the ocean to estuarine and brackish water, while shortnose sturgeon move from estuaries to upper reaches of freshwater tributaries. Therefore, it is assumed that all sturgeon that migrate above the Santee Cooper Project, along with juveniles spawned there, will attempt to migrate out of the project area. Juveniles leaving the Santee Cooper system may grow to almost 18 in and adults to about 50 in. Average predicted survival for fish 15, 36 and 60 inches passing through the Jefferies Development (averaging survival for all turbines at each radius and correlation factor of 0.20) is 83%, 60%, and 46%, respectively. At the two large Kaplan turbines (Units 2 and 4), for which survival predictions are highest, average predicted survival increases slightly to 87%, 69% and 54%, respectively. (Normandeau Associates, Inc. December 2002. (Draft Analysis of Entrainment and Survival of Target Fish Species at the Santee Cooper Hydroelectric Project, South Carolina). Adult spawning populations in the Cooper River in the late 1990s was about 300 fish (DRAFT FERC BO, 2010). Using this estimate NMFS believes the population in the Santee-Cooper to be in the mid-to upper hundreds. SCDNR researchers have estimated that the current adult spawning population consists of approximately 235 fish, with a 95% confidence interval of 208-261 fish. Successful spawning and recruitment within the Cooper River is uncertain at this time (Bill Post, SCDNR, personal communication, 10/29/2013), although SCDNR is working on a study placing egg mats in suspected spawning areas to identify whether spawning actually occurs. The lack of successful spawning below the dams, coupled with the segregation of life stages particularly the paucity of juveniles surveyed, indicates that source and sink population dynamics are affecting the status of the Santee-Cooper population (DRAFT FERC BO, 2010).

There is evidence that some of the population segments are starting to recover. The Recovery Plan for this species states that delisting of all population segments could begin by 2024.

In addition to existing information, an extensive hydroacoustic monitoring study in the Southeast U.S. on Atlantic and shortnose sturgeon, funded by NOAA, began in spring 2011. Scheduled to last for 5 years, funding was reduced in FY 2012 and again in FY 2013. The Charleston District of the U.S. Army Corps of Engineers has provided $200,000 over the past two years to the SCDNR, for augmentation and downloading of receivers in the Cooper River, the Santee River, and in the Cooper River Rediversion Project's tailrace canal.

3.4.1.5 Critical Habitat

No critical habitat has been designated for the shortnose sturgeon within the project area.

3.5 Atlantic Sturgeon (*Acipenser oxyrhynchus*)

In 1998, in response to a petition to list Atlantic sturgeon under the ESA, NMFS and USFWS published a determination that listing the species was not warranted at that time. In order to continue to monitor its status, the NMFS retained the Atlantic sturgeon on its candidate species list and later transferred it to its species of concern list. In 2003, a workshop sponsored by the NOAA Fisheries Service and USFWS was held to review the status of Atlantic sturgeon. The workshop provided an opportunity to gain additional information to determine if a new review of the status of the species was warranted. The 2003 workshop attendees concluded that some populations seemed to be recovering while other populations continued to be depressed.

As a result, NMFS initiated a second status review of Atlantic sturgeon in 2005 to reevaluate whether this species required protection under the Endangered Species Act. Following two separate workshops in 2005 which highlighted ongoing concerns regarding the current status of Atlantic sturgeon, NMFS initiated a third status review. A biological review team (BRT) was formed comprised of representatives from NMFS, USFWS, and the U.S. Geological Survey (USGS) to compile information on the status of Atlantic sturgeon. In 2007 the Status Review Team (SRT) made its status review report available to the public (SRT, 2007). The SRT concluded that Atlantic sturgeon populations should be divided into five distinct population segments (DPS's): (1) Gulf of Maine, (2) New York, (3) Chesapeake Bay, (4) Carolina, and (5) South Atlantic (Figure 17). These Atlantic sturgeon populations are markedly separated based on physical, genetic, and physiological factors; are located in unique ecological settings; have unique genetic characteristics; and would represent a significant gap in the range of the taxon if one of them were to become extinct.

Using an extinction risk analysis (ERA), the SRT concluded that three of the five DPSs (Carolina, Chesapeake, and New York Bight) were likely (> 50% chance) to become endangered in the foreseeable future (20 years). The SRT recommended that these three DPSs should be listed as threatened under the ESA. The remaining DPSs (South Atlantic and Gulf of Maine) were found to have a moderate risk (<50% chance) of becoming endangered in the next 20 years. However, the SRT did not provide a listing recommendation for these remaining DPS's as available science was insufficient to allow a full assessment of these populations.

In the fall of 2010, NMFS proposed that populations of Atlantic sturgeon along the southeast Atlantic coast be listed as endangered under the federal Endangered Species Act. The final rule was published in the Federal Register (77 FR 5914) on February 6, 2012 and lists the Carolina and South Atlantic DPSs of Atlantic sturgeon as endangered. The rule went into effect April 6, 2012.

The following sections were taken from the 2007 NMFS Status Review of Atlantic Sturgeon (SRT, 2007).

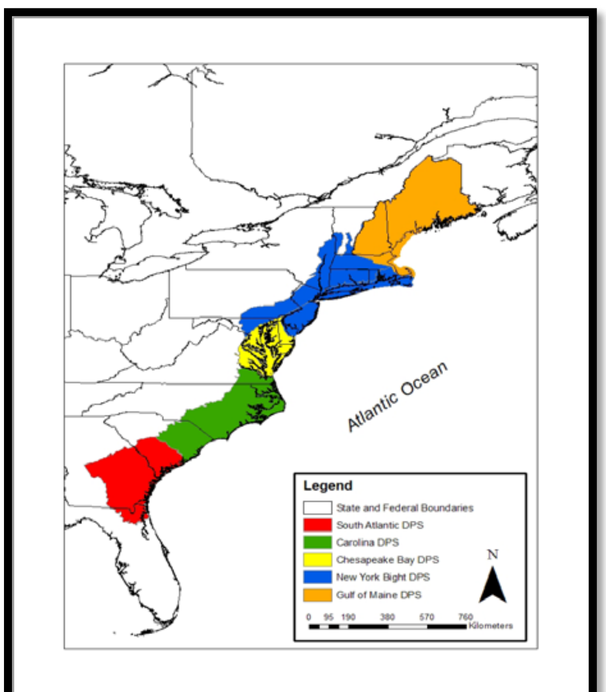


Figure 17. Map depicting the five Distinct Population Segments of Atlantic sturgeon: Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic

3.5.1.1 Life History and Distribution

Although specifics vary latitudinally, the general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, estuarine dependent, anadromous species. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (Murawski and Pacheco, 1977; Smith and Clugston, 1997).

Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco, 1977; Smith, 1985; Bain, 1997; Smith and Clugston, 1997; Caron et al., 2002). In some southern rivers, and southeastern rivers from Virginia to Georgia, a fall spawning migration may also occur (Rogers and Weber, 1995; Weber and Jennings, 1996; Moser et al., 1998).

Atlantic sturgeon spawning is believed to occur in flowing water between the fresh/salt water interface and fall line of large rivers, where optimal flows are 46-76 cm/s and depths of 11-27 meters (Borodin, 1925; Leland, 1968; Scott and Crossman, 1973; Crance, 1987; Bain et al., 2000). Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Gilbert, 1989; Smith and Clugston, 1997).

Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters (Murawski and Pacheco, 1977; Smith, 1985), where populations may undertake long range migrations (Dovel and Berggren 1983, Bain 1997, T. King supplemental data 2006). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult Atlantic sturgeon forage among coastal and estuarine habitats, undergoing rapid growth (Dovel and Berggren, 1983; Stevenson, 1997). These migratory subadults, as well as adult sturgeon, are normally captured in shallow (10-50m) nearshore areas dominated by gravel and sand substrate (Stein et al., 2004). Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities (Dovel and Berggren, 1983; Johnson et al., 1997; Rochard et al., 1997; Kynard et al., 2000; Eyler et al., 2004; Stein et al., 2004; Dadswell, 2006).

The following maps indicate the suitable habitat for various life stages of the Atlantic sturgeon as determined by the HSI modeling noted above in the shortnose sturgeon section (Figures 18-21). The habitat inputs for the modeling effort came from Greene et al., (2009). The figures indicate that the tailrace canal of the Cooper River contains suitable habitat for spawning, but not for egg and larval life stage. This is because the modeled water quality outputs for temperature within the timeframe for egg and larval habitat was just below the thresholds provided in Greene et al., (2009). Details on the modeling effort can be found in Appendix K of the final IFR/EIS.

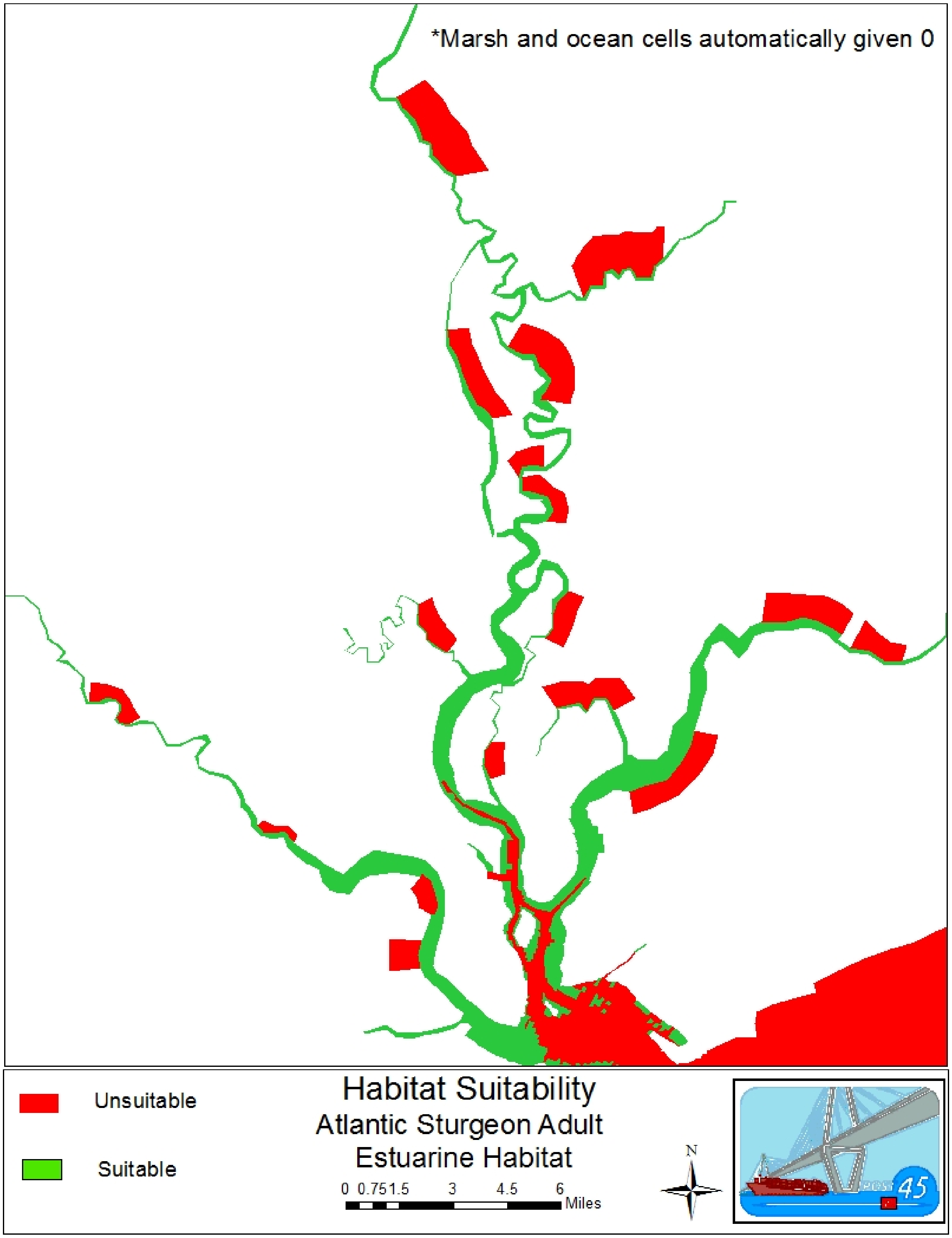


Figure 18. Atlantic sturgeon adult habitat as determined by modeled data

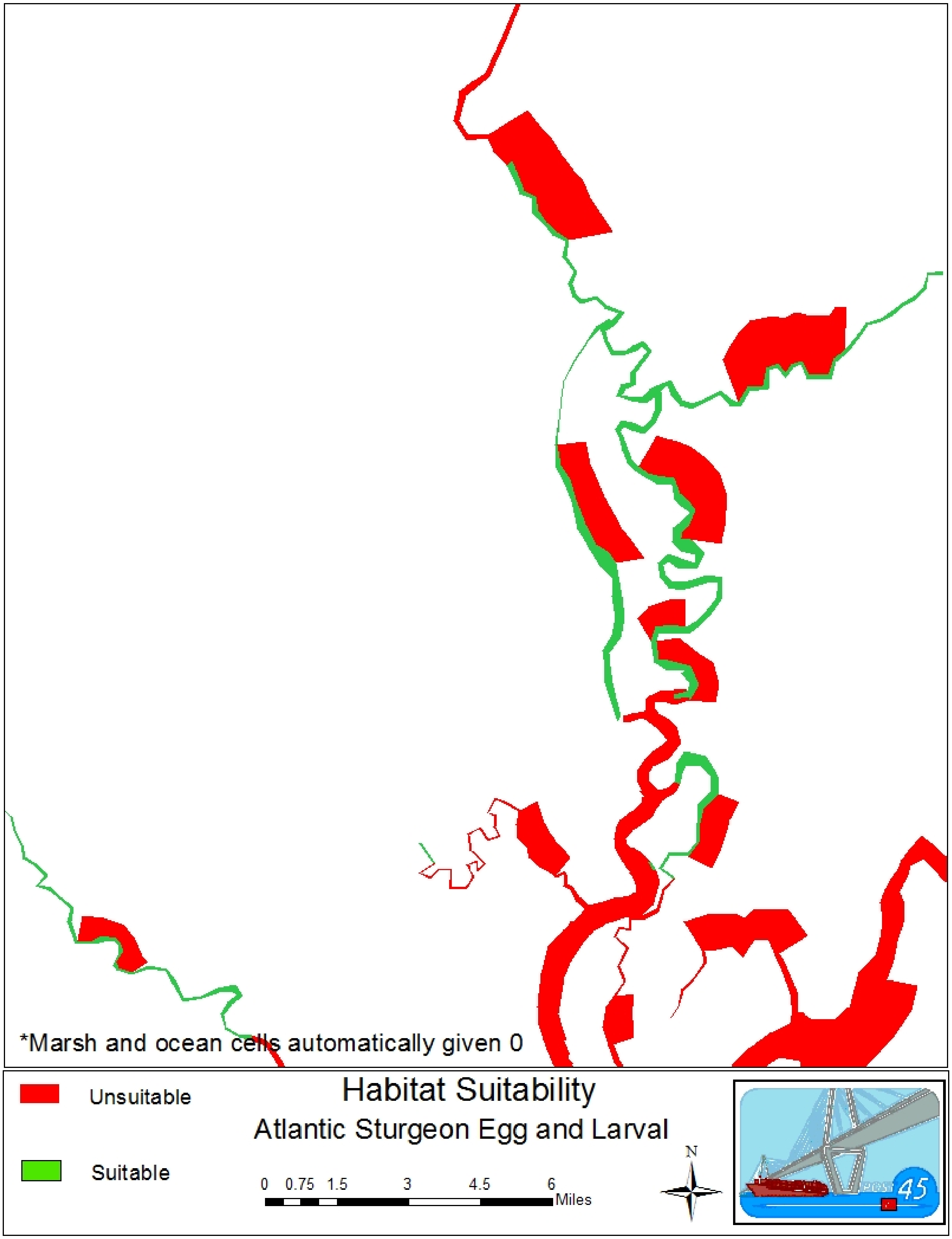


Figure 19. Atlantic sturgeon egg and larval habitat as determined by modeled data

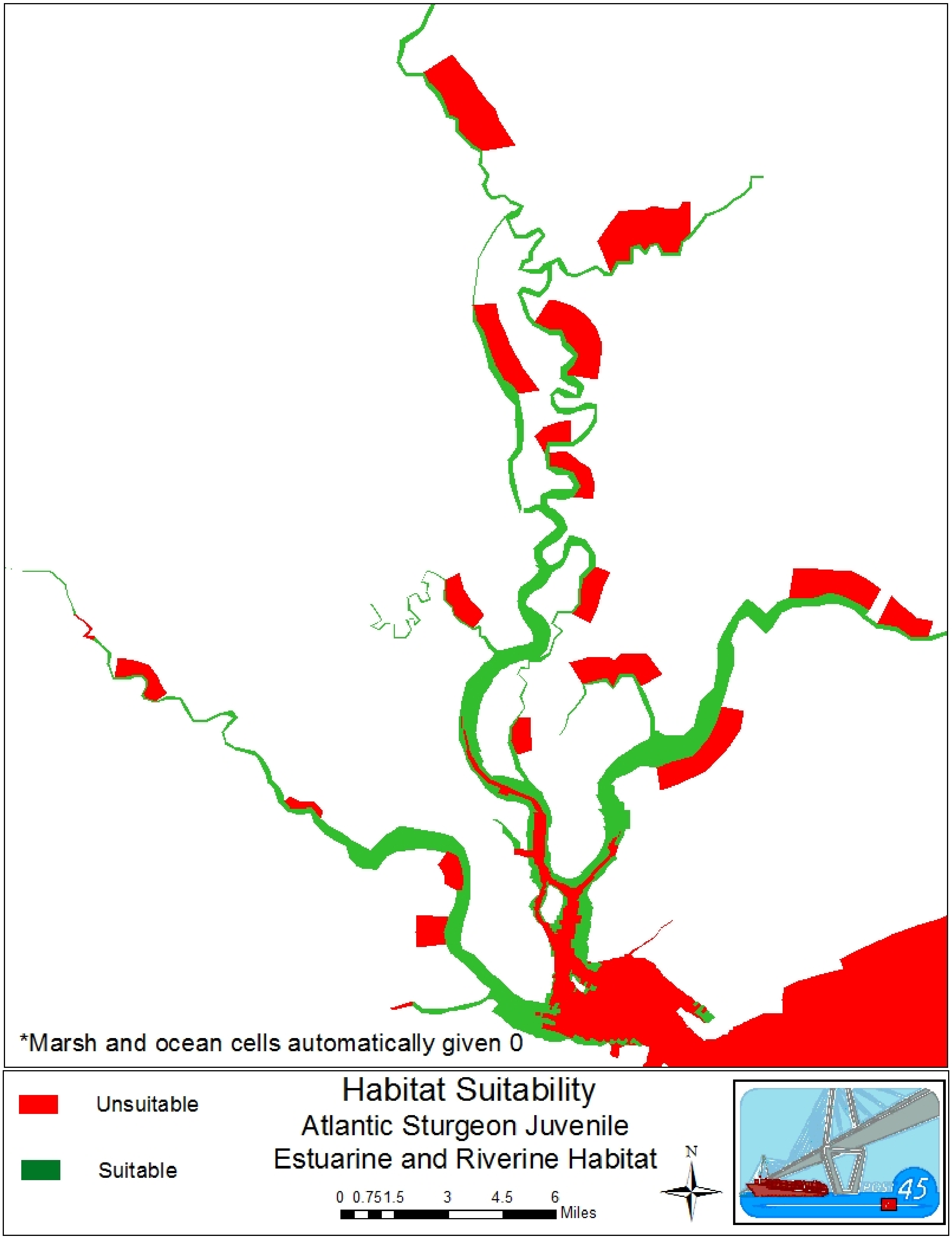


Figure 20. Atlantic sturgeon juvenile habitat as determined by modeled data

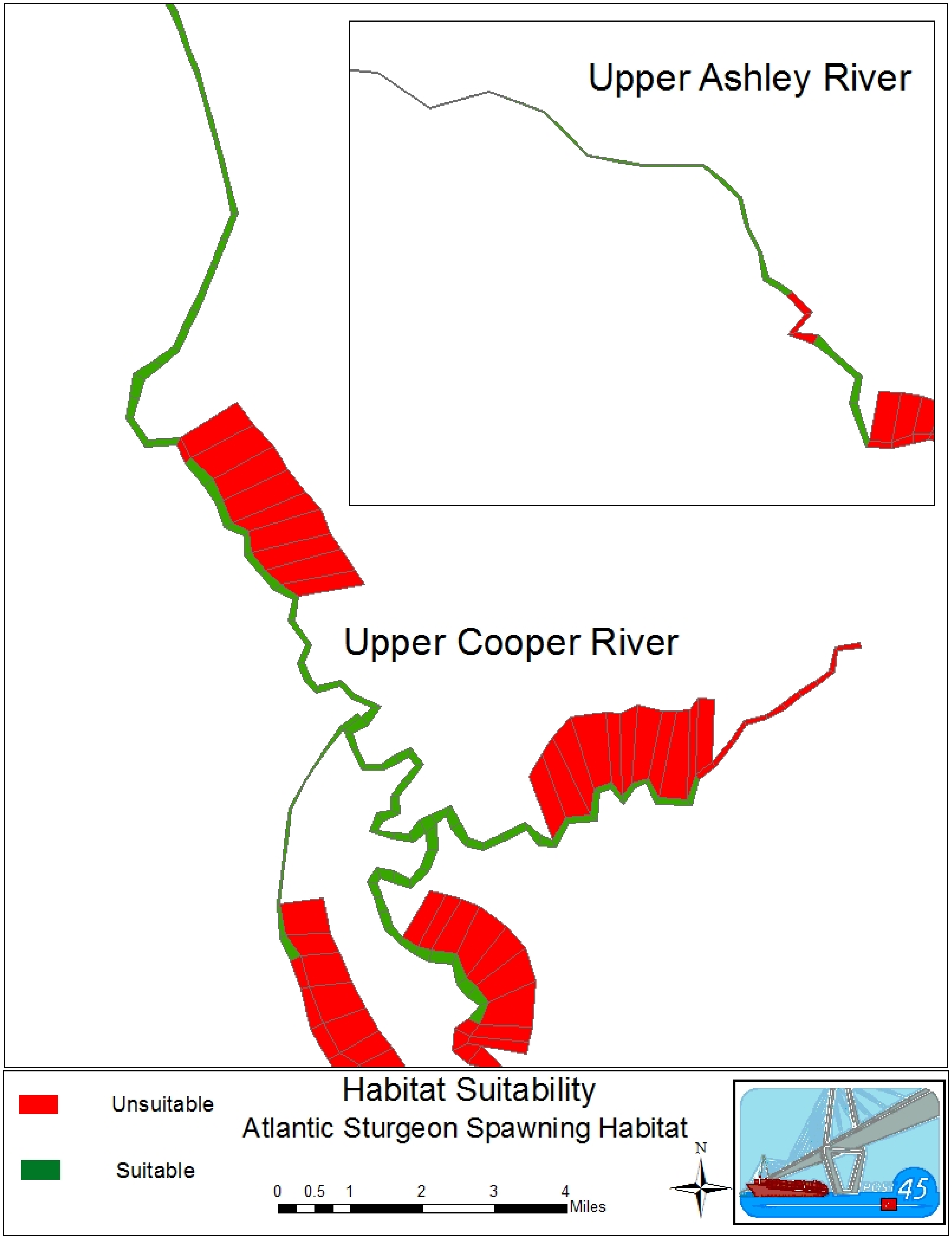


Figure 21. Atlantic sturgeon spawning habitat as determined by modeled data

SCDNR has been tracking Atlantic sturgeon movements in the Charleston Harbor, as described in the shortnose sturgeon discussion. Sites positive for Atlantic sturgeon are shown as green in the figure below; sites negative are shown as red (Figure 19).

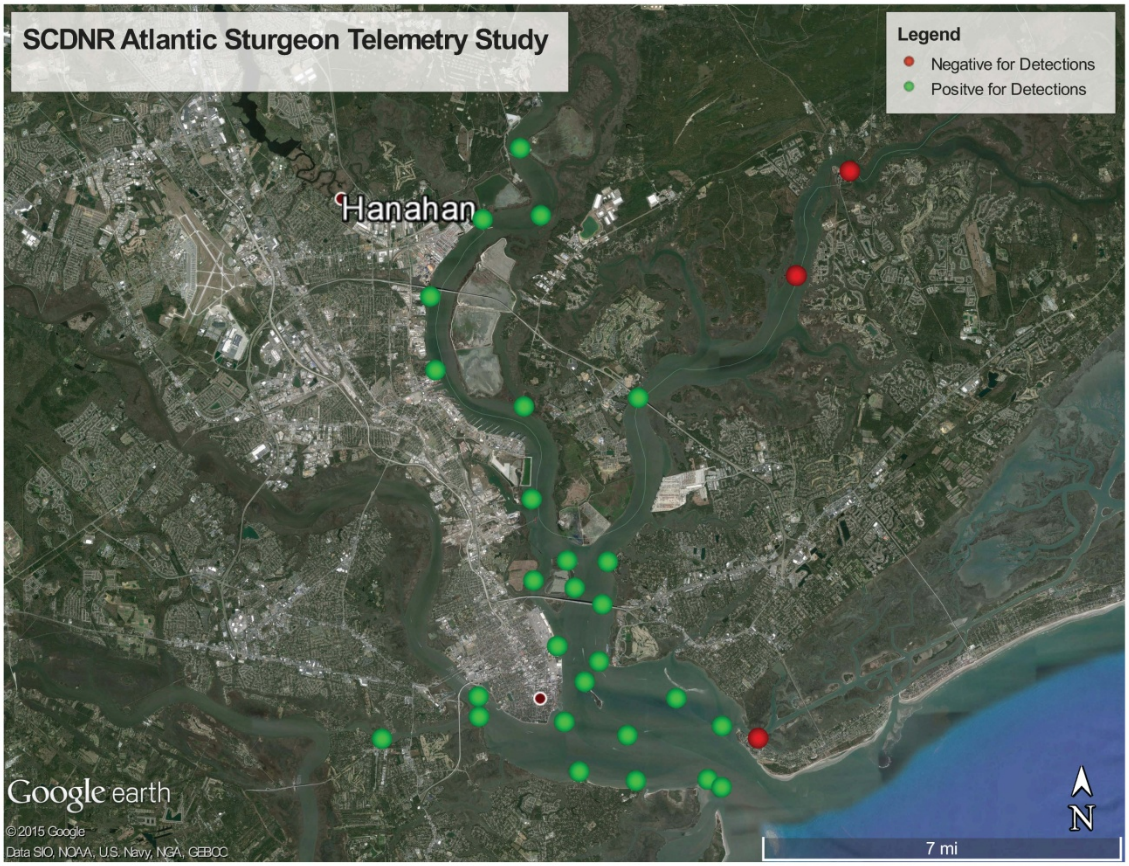


Figure 22. SCDNR telemetry study receiver locations.

3.5.1.2 Population Dynamics and Status

Assessment of the current distribution and abundance of Atlantic sturgeon is based on a comprehensive review of the literature and interviews with provincial, state, and Federal fishery management personnel regarding historic and ongoing sampling programs which targeted or incidentally captured Atlantic sturgeon. Water bodies where no information is available, either historic or current, were assessed as to whether Atlantic sturgeon could use the present habitat based on the geomorphology of the system and expert opinion. Riverine systems where gravid Atlantic sturgeon or young-of-year (YOY)(< age-1; ≤ 50 cm total length (TL) or 42.5 cm fork length (FL)) have been documented within the past 15 years were considered to contain extant spawning populations, as this is the average period of time to achieve sexual maturity. The presence of juveniles greater than age-0 (YOY) does not provide evidence of spawning within a river because subadults are known to undertake extensive migrations into non-natal riverine systems.

Comprehensive information on current or historic abundance of Atlantic sturgeon is lacking for most river systems. Data are largely available from studies directed at other species and provide evidence primarily of presence or absence. Historic and current spawning populations of Atlantic sturgeon in East

Coast estuarine systems of the United States are summarized in Table 8 (Atlantic Sturgeon Status Review Team, 2007). Size and age data were used to indicate how a particular habitat (i.e., spawning, nursery, or migrating habitat) is utilized by sturgeon. The presence of multiple year classes demonstrates successful spawning in multiple years but not necessarily in that system. Available quantitative data on abundance and, where available, data that document changes in abundance of sturgeon populations are included in the 2007 status review.

The Atlantic States Marine Fisheries Commission is conducting a stock assessment of Atlantic sturgeon at present, scheduled for completion by the end of CY2017.

Table 8. Historic and Current Spawning Populations of Atlantic sturgeon in East Coast Estuarine Systems of the United States and Canada

State	River	Historical Spawning Status	Current Spawning Status	Use of River by Atlantic sturgeon
QE	Saint Lawrence	Yes	Yes	Spawning, Nursery
NB	Miramichi	Unknown	Unknown	Nursery
NS	Avon	Yes	No	Unknown
NS	Annapolis	Yes	Yes	Spawning, Nursery
NB	Saint John	Yes	Yes	Spawning, Nursery
NB/ME	Saint Croix	Yes	Possibly	Nursery
ME	Penobscot	Yes	Possibly	Nursery
ME	Kennebec	Yes	Yes	Spawning, Nursery
ME	Androscoggin	Yes	Possibly	Nursery
ME	Sheepscot	Yes	Possibly	Nursery
NH	Piscataqua	Unknown	No	Unknown
NH/MA	Merrimack	Yes	No	Nursery
MA/RI	Taunton	Yes	No	Nursery
RI/CT	Pawcatuck	Unknown	No	Unknown
MA/RI/CT	Thames	No	No	Unknown
CT	Connecticut	Yes	No	Nursery
CT	Housatonic	Unknown	No	Unknown
NY	Hudson	Yes	Yes	Spawning, Nursery
DE/NJ/PA	Delaware	Yes	Yes	Spawning, Nursery
MD/PA	Susquehanna	Yes	No	Nursery
MD/VA	Potomac	Yes	No	Nursery
VA	James	Yes	Yes	Spawning, Nursery
VA	York	Yes	Possibly	Spawning, Nursery
VA	Rappahannock	Yes	No	Nursery
VA	Nottoway	Yes	Unknown	Unknown

NC	Roanoke	Yes	Yes	Spawning, Nursery
NC	Tar-Pamlico	Yes	Yes	Spawning, Nursery
NC	Neuse	Yes	Possibly	Spawning, Nursery
NC	New Brunswick	Yes	Yes	Spawning, Nursery
SC	Waccamaw	Yes	Yes	Spawning, Nursery
SC/NC	Great Pee Dee	Yes	Yes	Spawning, Nursery
SC	Black	Unknown	Unknown	Unknown
SC	Santee	Yes	Yes	Spawning, Nursery
SC	Cooper	Yes	Yes	Spawning, Nursery
SC	Ashley	Yes	Unknown	Nursery
SC	Ashepoo	Unknown	Unknown	Nursery
SC	Combahee	Yes	Yes	Spawning, Nursery
SC	Edisto	Yes	Yes	Spawning, Nursery
SC	Sampit	Yes	No	Nursery
SC	Broad-Coosawatchie	Yes	Unknown	Unknown
SC/GA	Savannah	Yes	Yes	Spawning, Nursery
GA	Ogeechee	Yes	Yes	Spawning, Nursery
GA	Altamaha	Yes	Yes	Spawning, Nursery
GA	Satilla	Yes	Yes	Spawning, Nursery
GA/FL	St. Mary’s	Yes	No	Nursery
FL	St. John’s	Unknown	No	Nursery

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3.5.1.3 Threats

According to the shortnose sturgeon recovery plan (NMFS, 1998) and Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team, 2007), projects that may adversely affect sturgeon include dredging, pollutant or thermal discharges, bridge construction/removal, dam construction, removal and relicensing, and power plant construction and operation. Other stressors on the populations are bycatch mortality, habitat impediments (e.g., Cape Fear and Santee-Cooper rivers) and apparent ship strikes (e.g., Delaware and James rivers).

3.5.1.4 Summary of Status

A review of Atlantic sturgeon stock status in 1998 by NMFS and USFWS concluded that although abundance of sturgeon had declined significantly, adequate spawning stock remained for the persistence of the population and for juvenile production. However, since that review only a few subpopulations show signs of increasing or stabilizing. Most show no signs of recovery and it is evident that stressors such as bycatch, ship strikes/entrainment, dams, and low D.O. levels can have substantial impacts on subpopulations. A stock assessment on Atlantic sturgeon is currently being prepared under the auspices of the Atlantic States Marine Fisheries Commission and is scheduled for completion by the end of CY 2017.

3.5.1.5 Critical Habitat

No critical habitat has been designated for the Atlantic sturgeon in the project area.

3.6 American Wood Stork (*Mycteria americana*)

The American wood stork was listed Endangered on February 28, 1984 for Region 4 (AL, FL, GA, and SC). On September 21, 2010 a petition was filed by the USFWS Jacksonville Ecological Services Field Office to initiate a status review to reclassify the U.S. breeding population of Wood storks from Endangered to Threatened. This petition was a result of a request from the Florida Homebuilders Association (represented by Pacific Legal Foundation) to reclassify (Federal Register/Vol. 75, No. 182/ September 21, 2010). Both a 90 day and 12-month finding were issued. On January 3, 2013, the USFWS revised a proposed rule to reclassify the U.S. breeding population of the wood stork to Threatened (Federal Register/Vol. 78, No. 2). A final action on the proposed reclassification has not yet occurred.

3.6.1.1 Life History and Distribution

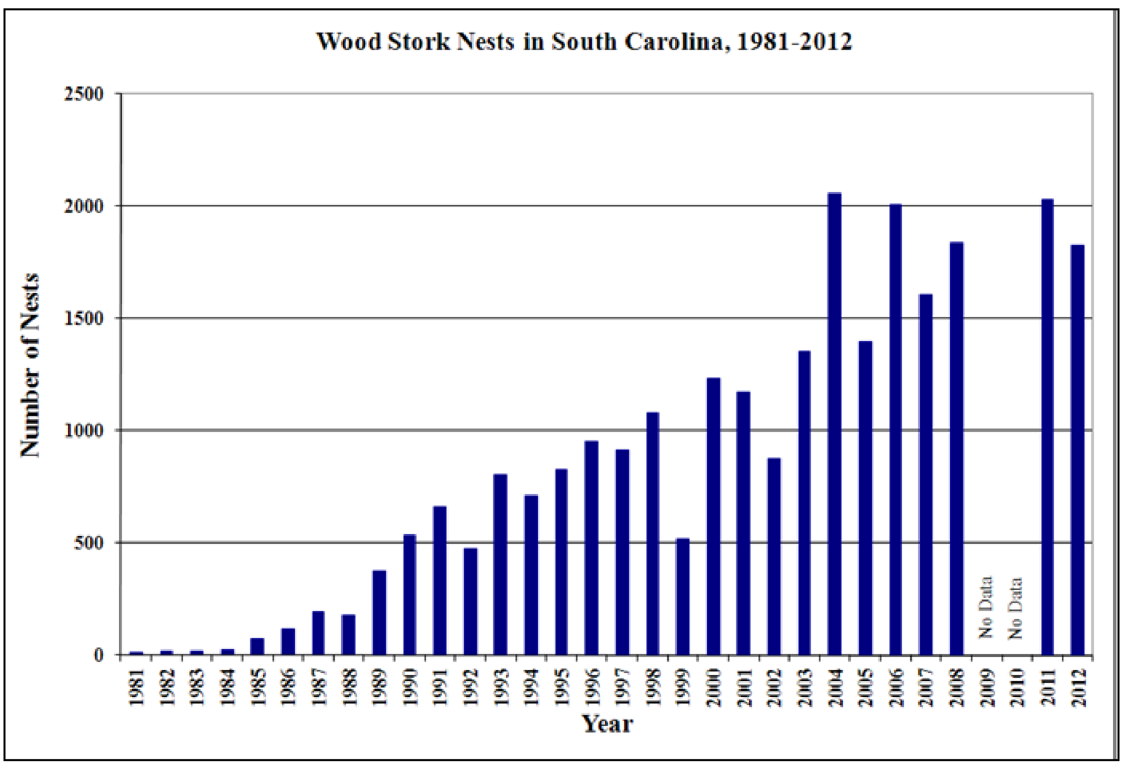
Wood storks are large, long-legged wading birds, about 50 inches tall, with a wingspan of 60 to 65 inches. The plumage is white except for black primaries and secondaries and a short black tail. The head and neck are largely unfeathered and dark gray in color. The bill is black, thick at the base, and slightly decurved. Immature birds are dingy gray and have a yellowish bill (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B06O).

Wood storks have been known to occur in the following counties in South Carolina: Aiken, Allendale, Bamberg, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Clarendon, Colleton, Dorchester, Edgefield, Florence, Georgetown, Greenwood, Hampton, Horry, Jasper, Laurens, Lexington, Marion, McCormick, Newberry, Orangeburg, Richland, Saluda, Sumter, and Williamsburg.

3.6.1.2 Population Dynamics and Status

Wood storks in Georgia and South Carolina initiate nesting on a seasonal basis regardless of environmental conditions. They lay eggs from March to late May, with fledging occurring in July and August (Federal Register/Vol. 75, No. 182/ September 21, 2010). Females lay a single clutch of two to five eggs per breeding season, but the average is three eggs. Females sometimes lay a second clutch if nest failure occurs early in the season. Average clutch size may increase during years of favorable water levels and food resources. Incubation requires about 30 days, and begins after the female lays the first one or two eggs; the eggs therefore hatch at different times and young nestlings in a single nest vary in size. Nestlings require about 9 weeks for fledging, but the young return to the nest for an additional 3 to 4 weeks to be fed. Actual colony production measurements are difficult to determine because of the prolonged fledging period, during which time the young return daily to the colony to be fed. It appears that colonies experience considerable variation in production among years and locations, apparently in response to differences in food availability.

South Carolina Nesting Population: From 1981-2006, wood stork nesting increased from 1 colony with 11 nesting pairs to 13 colonies with 2,010 pairs. Murphy and Coker (2008) indicate that the period from 1985 to 2006 reflects a growth phase in the population and that the growth rate will likely stabilize as the population reaches carrying capacity. Murphy (1995) estimated that the carrying capacity in South Carolina is approximately 2,400 pairs. Since listing, annual nest counts have increased significantly from 22 pairs to 2,010 pairs (Brooks and Dean, 2008). (Wood stork, 5-Year Review: Summary and Evaluation, USFWS, SE Region, Jacksonville Ecological Services Field Office, Jacksonville, FL). Figure 23 shows the number of wood stork nests in South Carolina from 1981-2012.



*http://www.dnr.sc.gov/cwcs/pdf/Woodstork.pdf

Figure 23. Number of Wood Stork Nests in SC, 1981-2012

3.6.1.3 Threats

Habitat loss, pollution and loss of prey base are the major threats to wood stork populations. This reduction is attributed to loss of wetland habitat as well as to changes in water hydroperiods from draining wetlands and changing water regimes by constructing levees, canals, and floodgates to alter water flow in south Florida. Wood storks have a unique feeding technique and require higher prey concentrations than other wading birds. Optimal water regimes for the wood stork involve periods of flooding, during which prey (fish) populations increase, alternating with dryer periods, during which receding water levels concentrate fish at higher densities coinciding with the stork's nesting season. Loss of nesting habitat, primarily wetlands, may be affecting wood storks where nesting in non-native trees and in man-made impoundments has been occurring recently. Less significant factors known to affect nesting success include prolonged drought and flooding, raccoon predation on nests, and human disturbance of rookeries.

3.6.1.4 Summary of Status

Three-year averages calculated from nesting data from 2001 through 2006 indicate that the total nesting population has been consistently above the 6,000 reclassification threshold for nesting pairs, and the averages have ranged from 7,400 to over 8,700. The 2006 nesting totals indicate that the Wood stork population has reached its highest level since it was listed as endangered in 1984 and since the early 1960s with over 11,000 nesting pairs documented in FL, GA, SC and NC during the 2006 breeding season. Since listing, the number of nesting pairs is increasing, the number of nesting colonies is increasing, and the nesting range is growing. Even though threats that affect wood storks appear to be continuing at the same levels, the conclusion is that the overall population status is improving.

3.6.1.5 Critical Habitat

No critical habitat rules have been published for the American Wood stork.

3.7 Piping Plover (*Charadrius melodus*)

There are three recognized populations of piping plovers in North America; Atlantic Coast, Northern Great Plains, and the Great Lakes population. The Atlantic Coast population winters from North Carolina to Florida with some nesting occurring in North Carolina. The Northern Great Plains breeding population extends from Canada to Iowa. The Great Lakes breeding population is now found mainly in Michigan, with one pair nesting in Wisconsin (http://www.fws.gov/plover/q&a.html). The piping plover was listed Threatened on December 11th, 1985 in South Carolina and the Northeast Atlantic Coast population. The Great Lakes watershed population is listed Endangered (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B079#status).

3.7.1.1 Life History and Distribution

The Atlantic Coast piping plover population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast (from North Carolina south), the Gulf Coast, and in the Caribbean where they spend a majority of their time foraging (www.fws.gov/northeast). Piping plovers have been observed in the following counties in South Carolina: Beaufort, Charleston, Colleton, Georgetown, Horry and Jasper (http://ecos.fws.gov). Piping plovers typically nest in sand depressions on un-vegetated portions of the beach above the high tide line on sand flats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. They head to their breeding grounds in late March or early April and nesting usually begins in late April; however, nests have been found as late as July (Potter, et al., 1980). Feeding areas include intertidal portions of ocean beaches, washover areas, mud flats, sand flats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS, 1996). Prey consist of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates (Bent, 1928).

3.7.1.2 Population Dynamics and Status

Population monitoring on the breeding grounds has been an integral part of the recovery program for Atlantic Coast piping plovers since 1986, and annual coastwide censuses have tracked local and regional progress toward recovery. The 2010 Atlantic Coast population estimate was 1,782 pairs, more than double the 1986 estimate of 790 pairs. The uneven pattern of population growth among recovery units has also been accompanied by periodic declines in both overall and regional populations. Most recently, the total Atlantic Coast population estimate attained 1,890 pairs in 2007 before declining 6% to 1,782 pairs in 2010. Decreases during this period occurred in all recovery units except New England, where the population grew 7% between 2007 and 2010. Optimism about progress towards recovery should be tempered by observed geographic and temporal variability in population growth (http://www.fws.gov/northeast/pipingplover/pdf/Abundance&Productivity2010Update.pdf).

3.7.1.3 Threats

Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the decline of piping plovers in southeast. The current commercial, residential, and recreational development has decreased the amount of coastal habitat available for piping plovers to nest, roost, and feed. Furthermore, beach erosion and the abundance of predators, including wild and domestic animals as well as feral cats, have further diminished the potential for successful nesting of this species. Historically the population was almost completely wiped out due to millinery practices.

3.7.1.4 Summary of Status

In South Carolina, Maddock et al. (2009) documented many cross-inlet movements by wintering banded piping plovers as well as occasional movements of up to 18 km by approximately 10% of the banded population; larger movements within South Carolina were seen during fall and spring migration. Similarly, eight banded piping plovers that were observed in two locations during 2006-2007 surveys in Louisiana and Texas were all in close proximity to their original location, such as on the bay and ocean side of the same island or on adjoining islands (Maddock 2008) (Piping Plover 5-Year Review: Summary and Evaluation, U.S. Fish and Wildlife Service NE and Midwest Region, September 2009).

3.7.1.5 Critical Habitat

There are 15 areas in South Carolina with designated Critical Habitat for the Piping plover. These extend along beaches from Little River Inlet to Beaufort County near Hilton Head Island. South Carolina has 187 sandy miles of beach shoreline available, 56 miles of which are nourished within critical habitats, resulting in 30% of affected sandy shoreline in critical habitat units (USFWS, 2009). A total of 5618 acres are designated Critical Habitat in South Carolina. Units 7-11 (see Figures 24 and 25 below) occur in Charleston County, SC. However, there are no critical habitat areas in the proposed project area (http://www.fws.gov/plover/#maps).

Figure 24. General locations of the designated critical habitat for the Wintering Piping Plover, Units 7-8.

Figure 25. General locations of the designated critical habitat for the Wintering Piping Plover, Units 9-11.

3.8 Red Knot (*Calidris canutus rufa*)

The U.S. Fish and Wildlife Service released a proposal to list the *rufa* red knot as threatened on September 28, 2013. A final ruling is expected in 2014 and will include designation of critical habitat (http://www.fws.gov/northeast/redknot).

3.8.1.1 Life History and Distribution

Red knots are migratory shorebirds. Their migration is one of the most impressive, with many individuals annually flying over 9,000 miles from the Arctic breeding grounds to the tip of South America. The red knot is about 9 inches tall, with a wingspan of 20 to 22 inches. During the breeding season, red knots exhibit black, brown and chestnut colored plumage above and a pinkish-cinnamon breast and face. In winter, the plumage changes to pale gray above and white below with a white eyebrow. Its legs are a greenish/blackish in color, with a black, slightly tapered but otherwise straight bill (http://www.dnr.sc.gov/marine/mrri/acechar/specgal/knotred.htm).

Red knots winter in the coastal United States from Cape Cod to Mexico and South America and spend the summer on islands in the High Arctic. They over-winter all along the South Carolina coast, primarily on sandy beaches and mud flats.

3.8.1.2 Population Dynamics and Status

Red knots breed in the Arctic planes and islands above the Arctic Circle in the summer. The female red knot lays four eggs in a depression in the ground. The nest is lined with lichen. Both males and females share incubation duties. Nests have between 3-4 eggs and hatch after 3 weeks. Fledging occurs after 18-20 days. Females raise only one brood per year. The primary diet for young is insects. In the Arctic adults eat insects, plant seeds, grass shoots and invertebrates. Southern migration begins in the fall towards South America. Knots migrate in large numbers and will often fly over 1,500 miles before stopping over at winter feeding grounds. Wintering grounds are coastal beaches and mud flats along both the Pacific and Atlantic coasts from California and Massachusetts south to South America. During the wintering stopovers knots feed on marine worms, small mollusks and most importantly in the southeast United States horseshoe crab eggs. Near Delaware Bay, their spring migration stopover coincides with the horseshoe crab's annual spawning. The abundance of these nutritious eggs also makes them a quick and easily found food, saving the birds' energy. Red knots arrive at staging areas very thin, sometimes emaciated. They eat constantly to increase their fat mass to continue the trip, gaining up to 10 percent of their body weight each day and essentially doubling their body weight during their stopover stay. Historically the abundance of horseshoe crab eggs has provided 90% of the entire migrating population with food in a single day (http://www.allaboutbirds.org/guide/Red_Knot/lifehistory). In recent times, however, habitat alteration and human activities have threatened populations of horseshoe crabs thus indirectly putting migrating birds such as the red knot, at risk.

3.8.1.3 Threats

Habitat loss, pollution, toxins, disease, hunting and loss of prey base are the major threats to red knot populations. One of the most important factors for survival is the continued availability of billions of horseshoe crab eggs at major North Atlantic staging areas, notably the Delaware Bay and Cape May peninsula. The increase in taking of horseshoe crabs for bait in commercial fisheries that occurred in the 1990s may be a major factor in the decline in red knots. Another necessary condition for red knots' survival is the continued existence of middle- and high-arctic habitat for breeding. Red knots could be particularly affected by global climate change, which may be greatest at the latitudes where this species breeds and winters (USFWS Northeast Region August 2005).

3.8.1.4 Summary of Status

Although not currently listed, red knots are likely to be listed as Threatened under the ESA by the beginning of 2015. The best estimation of population numbers for the mid-Atlantic region is 44,680 stopping in Delaware Bay (2012) and 12,611 to 14,688 knots stopping in Virginia (2007-2010). These estimates are determined from models and do not include the birds that bypass the mid-Atlantic going overland from Texas or the Southeast directly to Canada (Federal Register Vol. 78, No. 189. 30 Sep 2013).

3.8.1.5 Critical Habitat

No critical habitat has been published for the red knot but is likely to be by the beginning of 2015. It is not expected that critical habitat would be within the proposed project area.

3.9 Seabeach Amaranth (*Amaranthus pumilusI*)

Seabeach amaranth is an annual plant found on the dunes of Atlantic Ocean beaches. The stems are fleshy and pink-red or reddish, with small rounded leaves that are 1.3 to 2.5 centimeters in diameter. The leaves, with indented veins, are clustered toward the tip of the stem and have a small notch at the rounded tip. Flowers and fruits are relatively inconspicuous, borne in clusters along the stems. Germination occurs over a relatively long period of time, generally from April to July. Upon germination, the species forms a small unbranched sprig, but soon begins to branch profusely into a clump. This clump often reaches 30 cm in diameter and consists of five to 20 branches. Occasionally, a clump may get as large as a meter or more across, with 100 or more branches.

Flowering begins as soon as plants have reached sufficient size, sometimes as early as June, but more typically commencing in July and continuing until the death of the plant in late fall. Seed production begins in July or August and peaks in September during most years, but continues until the death of the plant. Weather events, including rainfall, hurricanes, and temperature extremes, and predation by webworms have strong effects on the length of seabeach amaranth's reproductive season. As a result of one or more of these influences, the flowering and fruiting period can be terminated as early as June or July. Under favorable circumstances, however, the reproductive season may extend until January or sometimes later. The species is an effective sand binder, building dunes where it grows (http://www.fws.gov/nc-es/plant/seabamaranth.html).

Seabeach amaranth was listed as threatened on April 7, 1993 under the provisions of the Endangered Species Act of 1973 (as amended).

3.9.1.1 Life History and Distribution

Seabeach amaranth occurs on barrier island beaches, where its primary habitat consists of overwash flats at accreting ends of islands and lower foredunes and upper strands of non-eroding beaches. It occasionally establishes small temporary populations in other habitats, including sound-side beaches, blowouts in foredunes, and sand and shell material placed as beach replenishment or dredge spoil. Seabeach amaranth appears to be intolerant of competition and does not occur on well-vegetated sites. The species appears to need extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner. These characteristics allow it to move around in the landscape as a fugitive species, occupying suitable habitat as it becomes available.

3.9.1.2 Population Dynamics and Status

Historically, seabeach amaranth occurred in 31 counties in nine states from Massachusetts to South Carolina. The species is currently believed to occur in New York, New Jersey, Delaware, Virginia, North Carolina and South Carolina (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2MZ). Before its listing, seabeach amaranth had undergone a reduction in range, population sizes and populations. At the time of listing only 55 populations were known.

The seabeach amaranth is endemic to beaches on the Atlantic coast from Cape Cod, Massachusetts to Kiawah Island along the central South Carolina coast (58 FR 18035). It occurs on sparsely vegetated overwash flats and foredunes, often around inlets on accreting barrier island ends. Hurricanes and storms reduce and eliminate populations, but also create new habitat by reducing competing ground cover. They may also aid large-scale dispersal. The amaranth traps sand, initiating dune formation and creating suitable habitat for other plants, such as sea oats and beach grass. Numerous shorebirds, including the least tern (*Sterna antillarum*), Wilson's plover (*Charadrius wilsonia*), black skimmer (*Rhynchops niger*), Caspian tern *(Sterna caspia*), and the endangered piping plover (*Charadrius melodus*) and roseate tern (*Sterna dougallii dougallii*), nest in seabeach amaranth stands (Randall, 2002).

3.9.1.3 Threats

The most serious threats to the continued existence of seabeach amaranth include the construction of beach stabilization structures, beach erosion and tidal inundation, beach grooming, herbivory by insects and feral animals, loss of habitat to invasive plant species and, in certain circumstances, by off-road vehicles.

3.9.1.4 Summary of Status

In South Carolina, seabeach amaranth populations declined from 1,334 in 1987 to 0 and 4 plants in 1999 and 2000 (USFWS, 1993), but the population sizes in 2003 (1,381) and 2004 (2,110) were similar to the 1987 count (Strand, 2005). The South Carolina Department of Natural Resources transplanted nearly 4,000 seedlings from greenhouses to barrier-island beaches in 2000-2001 (http://www.esasuccess.org/reports/northeast/ne_species/seabeach-amaranth.html). A survey conducted in 2013 found no Amaranth populations surviving in South Carolina (personal communication, Mark Caldwell, USFWS- Charleston ES office, 24 Oct. 13). This may be a result of erosion, wash over, disease, or eradication by invasive plant species such as beach vitex.

3.9.1.5 Critical Habitat

There is no designated critical habitat for seabeach amaranth within the study area. No critical habitat rules have been published for the seabeach amaranth.

4.0 Effects of Proposed Action on Species and Critical Habitat

The following section will discuss the proposed project effects on federally listed threatened or endangered sea turtles, whales, manatees, sturgeon, birds and plants occurring in the project area. The section is split up to describe construction related impacts followed by long term impacts associated with the proposed project.

4.1 General Impacts of Hydraulic and Mechanical Dredges and Associated Operations

Dredging operations have the potential to adversely affect marine species through actions of the dredging equipment (i.e., cutting, suction, sediment removal, and hydraulic pumping of water and sediment), physical contact with dredging equipment and vessels, and placement of dredged material in nearshore areas or offshore ocean disposal sites. Three types of dredging operations will be used during this project: hopper dredging, hydraulic cutterhead dredging, and mechanical dredging (clam shell).

Of the species considered in this assessment, those most likely to be impacted while dredging the Charleston Harbor Navigation Channel, specifically the Entrance Channel are sea turtles, the Northern Right Whale, and sturgeon species. Impacts to these species are discussed below.

Upper harbor dredging within the Cooper River (Table 1, Figure 1) is typically conducted by cutterhead dredges with sediment disposal into an upland confined disposal facility. Additional cutterhead work will take place in the Entrance Channel with a rock cutterhead dredge (Figure 2). While there is potential for impacts to marine species during dredge activities such as pipe placement on the bottom of inland waters, conservation measures are listed in contract specifications to help protect those species (slow placement of pipe, pipe anchors to prevent movement, etc.).

4.2 Sea Turtles

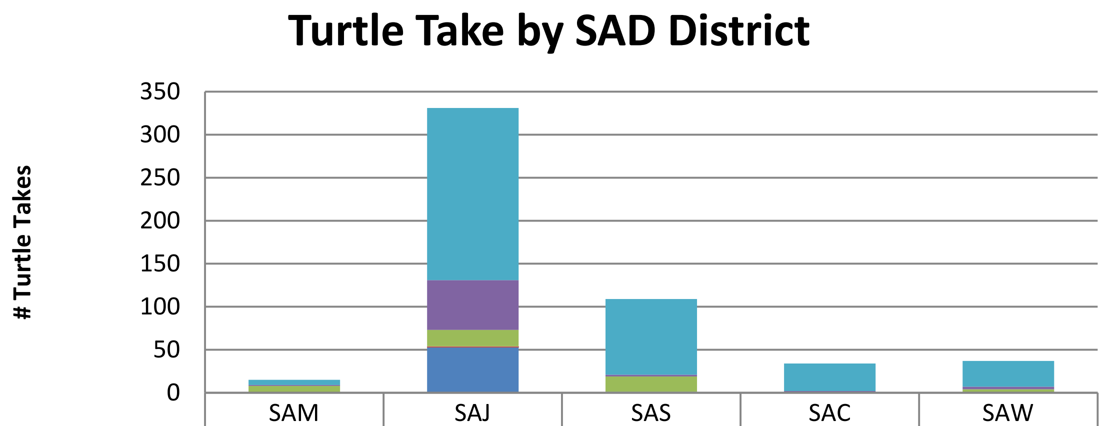
Four species of sea turtles are potentially at risk from the proposed project- loggerhead, leatherback, Kemp's ridley, and green.

4.2.1 Short Term Impacts During Construction

Hopper Dredge

Lethal Turtle Take

The take of sea turtles by hopper dredges was first identified as a problem in the late 1970's and in Charleston District five species of threatened or endangered sea turtles could potentially be impacted – loggerhead, green, Kemp's ridley, leatherback and hawksbill. However, since take observations began in 1980, records indicate that only 32 takes of loggerheads and 2 takes of green sea turtles (Figure 26) have occurred in Charleston District (SAC) (1991-2012). That number is less than 7% of the total number of takes (n=526) for the South Atlantic Division during the period (http://el.erdc.usace.army.mil/seaturtles/index.cfm). South Atlantic Division is comprised of five districts: Mobile (SAM), Jacksonville (SAJ), Savannah (SAS), Charleston (SAC), and Wilmington (SAW).



	SAM	SAJ	SAS	SAC	SAW
Loggerhead	6	200	88	32	30
Green	1	58	2	2	3
Kemp's Ridley	8	19	18		4
Leatherback		1			
Unknown		53	1		

Figure 26. Comparison of total number of turtle takes in the South Atlantic Division (SAD); SAM (2002-2013); SAJ (1980-2013); SAS (1988-2013); SAC (1991-2012); SAW (1992-2013).

Since 1980, the Corps and the dredging industry have worked to develop protocols, operational methods, and modified dredging equipment to reduce dredging impacts to sea turtles. The success of these protection efforts is seen in the reductions in incidental takes since 1992 with the implementation of turtle deflectors, relocation trawling, and dredging windows. Between 1980 and 1981, 71 sea turtle incidental takes were recorded for Canaveral Harbor, Florida alone, whereas 270 takes were collectively recorded from all coastal hopper dredging along the southeastern United States (SAJ, SAS, SAC and SAW) from 1995 through 2012. The Corps has also established, and continues to update and improve, an internet-based database to centralize and archive historical and future data regarding sea turtle impacts from dredging activities for long-term continuity and evaluation of these data (http://el.erdc.usace.army.mil/seaturtles/index.cfm). Although the overall impacts to sea turtles from dredging activities is relatively small and continues to improve, the Corps and the dredging industry is committed to the continued pursuit of efforts to further reduce dredging impacts on sea turtles. Current conservation measures implemented by the Corps to reduce impacts to sea turtles during hopper dredging operations are discussed in Section 4.2.1.1.

Dredge Lighting

The presence of artificial lighting on or within the vicinity of nesting beaches is detrimental to critical behavioral aspects of the nesting process including nesting female emergence, nest site selection, and the nocturnal sea-finding behavior of both hatchlings and nesting females. Sea turtles rely on vision to find the sea upon completion of the nesting process and use a balance of light intensity within their eyes to orient towards the brightest direction (Ehrenfeld, 1968); thus, misdirection by lighting may occur resulting in more time being spent to find the ocean. Hatchlings rely almost exclusively on vision to orient to the ocean and brightness is a significant cue used during this immediate orientation process after hatch out (Mrosovsky and Kingsmill, 1985; Verheijen and Wilschut, 1973; Mrosovsky and

Shettleworth, 1974; Mrosovsky et al., 1979). Hatchlings that are mis-oriented (oriented away from the most direct path to the ocean) or disoriented (lacking directed orientation or frequently changing direction or circling) from the sea by artificial lighting may die from exhaustion, dehydration, predation, and other causes. Though hatchlings use directional brightness of a natural light field (celestial sources) to orient to the sea, light from artificial sources interferes with the natural light cues resulting in misdirection (Witherington and Martin, 2003).

Female sea turtles approaching nesting beaches and neonates (i.e., hatchlings) emerging from nests and exiting their natal beaches, may be adversely affected by lighting associated with dredges and equipment operating in the nearshore (0-3 nm) environment. Females approaching the beach to nest could be deterred from nesting by bright lights in the nearshore environment. Hatchlings emerging from their nests could be attracted away from the shortest path to the water and instead crawl or swim toward the bright lights of a nearshore dredge or associated anchored equipment (instead of crawling or swimming seaward toward the open horizon), thus increasing their exposure time to predation. Though the risk of disorientation from dredge-associated lighting has been documented, as identified in a survey conducted in 2006 by the Florida Fish and Wildlife Conservation Commission (FWCC) on percentages of light sources contributing to disorientation events in Florida, boats (dredges were not specifically identified) were identified as contributing to 0.07% (N=1) of the total disorientation events recorded in the state (http://myfwc.com/seaturtle/Lighting/Light_Disorient.htm).

For dredging vessels, appropriate lighting is necessary to provide a safe working environment during nighttime activities on deck (i.e. general maintenance work deck, endangered species observers, etc.). In compliance with the US Army Corps of Engineers Safety and Health Requirements Manual (USACE, 2003), a minimum luminance of 30 lm/ft2 is required for outside work performed on board the dredge during nighttime dredge operations. In order to reduce potential disorientation effects on female sea turtles approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches, while still adhering to minimum luminance requirements, light emanating from offshore equipment will be minimized through reduced wattage, shielding, lowering, and/or use of low pressure sodium lights to the extent practicable. Shielded low-pressure sodium vapor lights have been identified by the Florida Fish and Wildlife Conservation Commission (FWCC) as the best available technology for balancing human safety and security, roadway illumination, and endangered species protection.

Hydraulic Cutterhead

The potential impacts of hydraulic cutterhead dredging on sea turtles was considered by NMFS in their 1991, 1995, and 1997 South Atlantic Regional Biological Opinions (SARBO), as well as the 2003 (revised in 2005) Gulf of Mexico Regional Biological Opinion (GRBO), for Corps hopper dredging activities. Under each biological opinion the NMFS determined that cutterhead pipeline dredging may affect but is not likely to adversely affect sea turtles. In contrast to hopper dredges, pipeline dredges are relatively stationary and therefore act on only small areas at any given time. The cutterhead works most efficiently buried within thick sediment deposits and is not frequently exposed to open water when dredging. Therefore, for a turtle to be taken with a pipeline dredge, it would have to approach the cutterhead within the sediment and be caught in the suction. This type of behavior is unlikely but may be possible if the turtle is cold stunned or brumating. On 29 December 2004, while conducting maintenance dredging of the Brownsville Entrance Channel in Texas, a live stranded green sea turtle was discovered outside of the dredge discharge area with a cracked plastron and carapace. This stranding was one of 42 cold stunned green sea turtle strandings in the area relative to an arctic cold front that swept through South Texas on 22 December. Though it is unlikely that this turtle was taken by the pipeline dredge, it is possible that an increased potential for take may occur if dredging is being conducted where cold-stunned turtles are present.

In the 1980s, observer coverage was required by the NMFS at pipeline outflows during several dredging projects deploying pipeline dredges along the Atlantic coast. No turtles or turtle parts were observed in the outflow areas. Additionally, the Corps' SAD office in Atlanta, Georgia, charged with overseeing the work of the individual Corps Districts along the Eastern Seaboard from North Carolina through Florida, provided documentation of hundreds of hours of informal observation by Corps inspectors during which no takes of listed species were observed. Additional monitoring by other agency personnel, conservation organizations or the general public has never resulted in reports of turtle takes by pipeline dredges (NMFS, 1991a).

Mechanical Dredging - Clamshell (Bucket) Dredge

The impacts of mechanical dredging operations on sea turtles were previously assessed by the NMFS (NMFS, 1991a; NMFS, 1995a; NMFS 1997b; NMFS, 2003c) in the various versions of the SARBO and the 2003 (revised in 2005) GRBO. The 1991 SARBO states that “clamshell dredges are the least likely to adversely affect sea turtles because they are stationary and impact very small areas at a given time. Any sea turtle injured or killed by a clamshell dredge would have to be directly beneath the bucket. The chances of such an occurrence are extremely low…” (NMFS, 1991a). NMFS also determined that “Of the three major dredge types, only the hopper dredge has been implicated in the mortality of endangered and threatened sea turtles.” This determination was repeated in the 1995 and 1997 SARBO’s (NMFS, 1995a and 1997). No new information is available that suggests increased risk of sea turtle take by clamshell dredges since the 1991, 1995, and 1997 SARBO’s were received.

Dredge Turbidity Plume

Mechanical dredges could be used throughout the proposed action area, including the lower harbor and portions of the Entrance Channel. Turbidity could be generated when the full bucket travels through the water column to the surface and is emptied into an adjacent barge. However, turbidity within the open water system would be quickly dissipated due to currents, wind and wave action.

Trawling

Although not a common practice within Charleston Harbor, modified shrimp trawling equipment and techniques are used to capture and relocate threatened and endangered sea turtles from hopper dredging sites. This method of sea turtle protection was originally initiated in the early 1980s at Canaveral Harbor, Florida. In 1992, relocation trawling was implemented as a potential mitigation tool for incidental take (injury or mortality) of sea turtles for additional coastal hopper dredging projects in the southeastern United States. Although its effectiveness under various project conditions has been undocumented, this mitigation tool is now used extensively whenever sea turtles and/or Gulf sturgeon (*Acipenser oxyrinchus desotoi*) in the Gulf of Mexico are potentially at risk for incidental take during hopper dredging projects. NMFS now recommends and authorizes take for relocation trawling during many hopper projects throughout the southeastern United States and may recommend suspension of hopper dredging activities if weather or other conditions prevent trawling operations. This requirement impacts dredging schedules and inflates project costs. Relocation trawling is also a potentially hazardous undertaking for trawler crews and the species intended for protection. Other protected and non-protected organisms are also captured as by-catch and may be killed during the relocation trawling efforts. Specifically, sturgeon species, smalltooth sawfish, and bottlenose and Atlantic spotted dolphin have been captured by trawling activities throughout the Atlantic and Gulf coasts.

With respect to trawling and sea turtle interactions, the effects of trawling during capture and handling can result in raised levels of stressor hormones. Based on past observations obtained during similar research-trawling for turtles, these effects are expected to dissipate within a day (Stabenaua and Vietti, 1999). Though turtle recaptures during trawling and relocation activities do occur, recapture rates are not frequent enough to suggest significant cumulative adverse effects. Rarely, even properly conducted relocation trawling can result in accidental sea turtle deaths. Trawl-captured loggerhead sea turtles died on several occasions during handling on deck during winter trawling in Canaveral Channel in the early 1980s, after short (approximately 30-minute) tow times. However, it was noted that a significant number of the loggerheads captured at Canaveral during winter months appeared to be physically stressed and in "bad shape" compared to loggerheads captured in the summer months from the same site, which appeared much healthier and robust (Henwood and Ogren, 1987). Stressed turtles or unhealthy turtles or turtles exposed to repeated forced submergences are more likely to be injured or killed during relocation trawling than healthy turtles.

According to Dickerson et al. (2007), based on the available data collected on relocation trawling since its conception in the 1980’s and updated through 2013 from the USACE Sea Turtle Data Warehouse, a total of 1,896 sea turtles have been relocated within the Gulf of Mexico (Total 1,402; Cc: 933, Lk: 378, Cm: 82, Dc: 7, Ei: 2) and Atlantic (Total 494; Cc: 394, Lk: 51, Cm: 46, Dc: 3, Ei: 0) regions combined. Furthermore, a total of 4 confirmed turtles (Cc: 2 (Navarre Beach, FL), Cm: 1(Canaveral Harbor, FL), and Dc: 1 (Walton County / City of Destin beach nourishment)) have been lethally taken by trawlers while being utilized as a mitigation option to avoid lethal hopper dredge takes.

Routinely, when a sea turtle is captured, and before it is released, the turtle is tagged and a tissue sample is taken for diagnostics. According to NMFS, previous research suggests that, when done correctly, individual turtles will not experience more than short-term stresses during tissue biopsy procedures. Furthermore, the collection of tissue samples is not expected to cause any additional significant stress or discomfort to the sea turtles beyond what is experienced during other research activities. Tagging activities are minimally invasive and all tag types have negatives associated with them, especially concerning tag retention. Plastic tags can become brittle, break and fall off underwater, and titanium tags can bend during implantation and thus not close properly, leading to tag loss. Tag malfunction can result from rusted or clogged applicators or applicators that are worn from heavy use. Turtles that have lost external tags would be re-tagged if captured again at a later date, which subjects them to additional effects of tagging. PIT tags have the advantage of being encased in glass, which makes them inert, and are positioned inside the turtle where loss or damage due to abrasion, breakage, corrosion or age over time is virtually non-existent. Turtles would experience some discomfort during the tagging procedures and these procedures would produce some level of pain. The discomfort would usually be short and highly variable between individuals. Most turtles barely seem to notice, while a few others exhibit a marked response. However, NMFS expects the stresses to be minimal and short-term and that the small wound-site resulting from a tag would heal completely in a short period of time. Similarly, turtles that must be re-tagged would also experience minimal short-term stress and heal completely in a short period of time. Re-tagging would not be expected to appreciably affect these turtles. Internal and external tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs, 1999).

Considering that NMFS approved and permitted observers who would be handling sea turtle species and adherence to the permit conditions to ensure the safety of the turtles, it is expected that tagging activities would have minimal and insignificant effects on the animals. All animals would be handled with care, kept moist, protected from temperature extremes during sampling, and later returned to the sea in accordance with the sea turtle handling permit conditions.

4.2.1.1 Conservation Measures for the Proposed Project

a. Relocation and Abundance Trawling

Currently, the SARBO does not allow relocation or abundance trawling. However, NMFS has recently been allowing such practices in new biological opinions issued for specific projects outside routine Operation and Maintenance (O&M) dredging. Where it is allowed and can feasibly and safely be used, relocation trawling is an effective management option for reducing incidental take of sea turtles during hopper dredging in some locations, provided aggressive trawling effort is initiated either at the onset of dredging or early in the project. Furthermore, prior to the onset of dredging a given site, abundance trawling may be performed to assess the presence or absence of sea turtles and the subsequent risk of sea turtle take for a given project. Though abundance trawling is not necessary for all circumstances and can be costly and logistically difficult, it can be used as a tool to help better understand sea turtle abundance, distribution, and habitat use of a dredge site in order to assess take risk. USACE will coordinate with NMFS staff to determine if relocation and abundance trawling is necessary if and when an excessive level of take has occurred during project construction.

b. Draghead Deflector

The sea turtle deflecting draghead evolved from engineering studies performed in the 1980's to minimize sea turtle takes. Since its conception, turtle deflecting dragheads have been used on almost all hopper dredging projects in the South Atlantic and have significantly minimized the risk of sea turtle take. Contractors are required to equip dragheads with rigid sea turtle deflectors. To assure that the turtle deflecting draghead is engineered and installed correctly, the contractor provides the Corps with drawings and calculations for the project depth to be dredged. These submittals are approved by the Corps prior to project commencement.

Specifically, the leading V-shaped portion of the deflector must have an included angle of less than 90 degrees. Internal reinforcement must be installed in the deflector to prevent structural failure of the device. The leading edge of the deflector must be designed to have a plowing effect of at least 6" in depth when the drag head is being operated so that turtles located in front of the draghead will be pushed away by the resultant sand wave. The dragtender must have the appropriate instrumentation on board the dredge in order to assure that the critical "approach angle" is maintained during dredging operations. The design "approach angle" or the angle of the lower drag head pipe relative to the average sediment plane is very important to the proper operation of a deflector. If the lower drag head pipe angle in actual dredging conditions varies tremendously from the design angle of approach used in the development of the deflector, the 6" plowing effect does not occur and the risk of sea turtle interaction increases. As a component of the contractor's pre-project submittal to the Corps, approach angle calculations (relative to dredge specific draghead configurations and project specific dredging depths) are provided.

Studies from U.S. dredging projects have demonstrated that, due to the mode of operation for the trailing suction draghead, sea turtles most at risk for entrainment are those that are on or actually nestled into the sea floor sediment. If the dragtender allows the draghead to rise up or bounce along the bottom during suction dredging, turtles that are on or in the sea floor can become trapped underneath the draghead and suctioned into the pumps. Turtles swimming in the water column are not at risk for entrainment, primarily due to the extremely small area of suction influence around the draghead (< ½ meter). However, a turtle might be entrained if it happened to swim directly underneath (within ½ meter) a draghead suspended in the water column with the suction pumps still engaged.

In order to minimize risk of impingement or entrainment of sea turtles in the open water column, hopper dredge contract specifications require that dredge pumps not be operated when the dragheads are not firmly on the bottom, to the maximum extent practicable. Furthermore, pumping water through the draghead is not allowed while maneuvering or during travel to/from the disposal area. During turning operations the pumps must either be shut off or reduced in speed to the point where no suction velocity or vacuum exists. If the required dredging section includes compacted fine sands or stiff clays, a properly configured arrangement of teeth is recommended to enhance dredge efficiency, which reduces total dredging hours and "turtle takes." Pipe plugging shall not be corrected by raising the draghead off the bottom to increase suction velocities; therefore, dredge operators are required to configure and operate their equipment to eliminate the potential for low level suction velocities. An example recommendation for providing additional mixing water to the suction line is through the configuration of water port openings on top of the drag head or on raised stand pipes above the drag head. All water port configurations are required to be screened before they are used during a dredging project. To assure that these conditions are understood and implemented by the contractor, the Corps requires that the contractor develop a written operational plan to minimize turtle takes and submit it as part of the Environmental Protection Plan for approval prior to project commencement. Furthermore, in order to assure contractor compliance with all sea turtle protection measures during hopper dredge operations, detailed quality assurance inspections are performed by Corps personnel on each hopper dredge as well as after each sea turtle take.

c. Environmental Windows

Environmental windows were established by NMFS, and further refined by the Corps, which restrict dredging to periods when turtles are least abundant or least likely to be affected by dredging. The environmental windows for turtle-safe dredging have targeted the winter months since sea turtle abundance is dramatically reduced at water temperatures below 13°C and typically absent during temperatures below 11°C (Moon et al., 1997; STAC, 2006; USACE Sea Turtle Data Warehouse (http://el.erdc.usace.army.mil/seaturtles/allowed.cfm)). For the SARBO, the environmental window for Charleston Harbor maintenance hopper dredging activities is November 1 through May 31. It has evolved over time but is now typically performed between December 1 and March 31 in order to minimize risk. During construction of the proposed project, the Charleston District will dredge within the SARBO window and manage risk within the flexibility afforded by this window. Future O&M dredging after the proposed project will follow the most up-to-date SARBO.

No environmental windows are necessary for mechanical or hydraulic cutterhead dredging.

d. Inflow/Overflow Screening and Observers

Inflow/Overflow Screening

In accordance with the Reasonable and Prudent Measures (RPMs) outlined in previous 1995 and 1997 NMFS SARBOs, all SAD hopper dredging contracts require year round 100% inflow screening throughout the duration of each contract. If possible, 100% overflow screening is also recommended; however, the configuration of the overflow for each hopper dredge is different and 100% overflow screening, in some cases, may not be possible. Nonetheless, if 100% inflow screening is not possible, 100% overflow screening is enforced.

The configuration of inflow and overflow screening is hopper dredge specific, resulting in multiple contractor configurations to meet Corps contract screening requirements. Corps hopper dredging contracts require a 4”x4” screen mesh size for both inflow and overflow screening to allow biotic and abiotic debris to be screened and evaluated by endangered species observers before being disposed into the hopper. The efficacy of this inflow and overflow screening mechanism depends on the dredge specific configuration. Some configurations are more prone to clogging with debris resulting in reduced monitoring efficiency and coverage. In some cases, debris accumulation in the inflow boxes is so significant that effective observer coverage is not possible and the Corps must implement the removal of inflow screening with 100% overflow screening. Depending on the type of debris encountered, overflow screening may become clogged with floating debris and compromise the safety of the vessel. The Corps has consulted with the NMFS on a case-by-case basis to address these site specific circumstances.

Observers

During hopper dredging operations, observers approved by the NMFS for sea turtles, sturgeon, and whales are required to be aboard the hopper dredge to monitor for the presence of the species where appropriate. Specific observer requirements throughout the South Atlantic are outlined in Table 3 of the 1997 SARBO; however, the USACE SAD currently encourages a more stringent protocol of one hundred percent (24hr/day) observer coverage conducted year round for hopper dredge operations. During dredging operations, while dragheads are submerged, the observer continuously monitors the inflow and/or overflow screening for turtles and/or turtle parts. Upon completion of each load cycle, dragheads are monitored as the draghead is lifted from the sea surface and is placed in the saddle in order to assure that sea turtles that may be impinged within the draghead are not lost and un-accounted for. Physical inspections of dragheads and inflow and overflow screening/boxes for threatened and endangered species take are performed to the maximum extent practicable.

For the construction of the proposed project, during transit to and from offshore disposal areas, an observer will monitor from the bridge during daylight hours for the presence of endangered species, especially the right whale, during the period December through March 31 (or April 30, if necessary).

e. National Dredging Quality Management Program (DQM)

The National DQM Program is an automated dredge contract monitoring system comprised of both hardware and software developed by the Corps. The mission of the National DQM Program is to provide the USACE dredging manager with a nationally standardized low cost remote monitoring and documentation system. This system provides the Corps with timely data access, multiple reporting formats, full technical support, including dredge certifications, data quality control, database management, and support for the DQM operating system. On board the dredge, sensors continually monitor dredge activities, operations, and efficiency. Information from these sensors is routed to the National DQM Support Center for data processing, storage and publishing. The DQM web-based tools can be utilized to view project operations, produce disposal plots and data export of dredge operations.

Information about the program, Standard Operating Procedures (SOPs) and requirements for annual system inspections and certifications for the hopper dredge or scow, and specifications for sensor and data requirements are listed at http://dqm.usace.army.mil. Currently, DQM systems are required for all Corps-contracted hopper and scow dredging projects. Detailed instrument and reporting requirements are included in every contract.

f. Sea Turtle Community of Practice

The Corps' South Atlantic Division (SAD) established a sea turtle community of practice (CoP) consisting of a representative from Civil Works and Regulatory programs at each SAD district who have a comprehensive background on sea turtle and hopper dredge interactions to represent their District with respect to these issues. The goal of this CoP is to effectively implement the Corps' mission, as it relates to the use of hopper dredges, while adhering to the environmental laws and regulations for the protection of sea turtle species. This collaboration of individuals throughout SAD fosters the sharing of ideas and development of innovative solutions to minimize impacts to protected sea turtle species to the maximum extent practicable. The regular interactions of this CoP allow for strategic planning initiatives for sea turtle and hopper dredging issues with consistent application of solutions throughout SAD.

4.2.1.2 Effect Determination

Hydraulic Hopper Dredge

The myriad of conservation measures discussed above have been pivotal in successfully reducing the level of impact to sea turtle species from hopper dredging operations performed by the Corps. However, while implementation of these measures has reduced the number of incidental takes per project over time, the risk of incidental take is still evident. Therefore, hopper dredging operations may affect, and is likely to adversely affect loggerhead, Kemp's ridley, and green sea turtles and the potential lethal take would result in reduction in numbers and possible loss in future reproduction. However, no Kemp's ridleys and only two green sea turtles have been taken in Charleston Harbor since data collection began in 1991. Furthermore, NMFS states in the biological opinion issued for the Savannah Harbor Expansion Project (SHEP) that the anticipated take for both loggerheads and Kemp's ridleys associated with that project are not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of those species in the wild. Since turtle take in Charleston Harbor is significantly less than historical take records for Savannah District, a similar determination is expected. Dredging operations is also not expected to affect leatherback or hawksbill sea turtles considering their differing habitat range and diet and lack of significant historical incidental take by hopper dredging operations in Charleston District.

Other Hydraulic and Mechanical Dredging Operations

Though the potential exists for impacts to loggerhead, Kemp's ridley, and green sea turtles from other dredging operations such as mechanical dredging and cutterhead (pipeline) dredging, no sea turtle species are known to have been specifically taken by these operations. Therefore, they continue to be considered as dredging alternatives which may affect, but are not likely to adversely affect sea turtle species.

Relocation and Abundance Trawling

Sea turtle relocation and abundance trawling activities, if allowed, may be used as a mitigative tool to assess pre-project risk of potential take as well as to relocate sea turtles away from the area of hopper dredging impact. Though most turtles are moved outside of the dredging area unharmed, some turtles have been lethally taken during the trawling relocation process. However, in the SHEP Biological Opinion, NMFS encourages the use of turtle relocation trawling and the agency states "NMFS believes the use of relocation trawling should be required during all proposed hopper dredging", and "NMFS expects the effect of any turtle relocation trawling would be non-lethal and non-injurious." Therefore, Charleston District believes that relocation/abundance trawling may affect, but will not likely adversely affect sea turtle species.

Relocation trawling frequently consists of both capture trawling and non-capture trawling. Non-capture trawling is a non-traditional method of relocation trawling where a net is dragged with the cod end removed. USACE research has suggested that it is an effective way of reducing sea turtle entrainments in hopper dredges. The stimulation of the net going over the turtle, or the turtle getting initially trapped in and then passing through the net, is presumed to cause the turtle to move away from the area, at least long enough so that it is not entrained by the oncoming dredge. The USACE Biological Assessment submitted to NMFS at the time of the release of the Draft FR/EIS did not specify the difference between capture and non-capture trawling. After the consultation period passed the timeframes identified in the Endangered Species Act, NMFS submitted draft Reasonable and Prudent Measures and Terms and Conditions to USACE for review. Non-capture trawling was not included in these conditions. Subsequently, USACE asked for non-capture trawling to be included in the final Biological Opinion as it is recognized as another tool to minimize incidental take. NMFS indicated that additional schedule delays would occur ensue if non-capture trawling was included in the Biological Opinion.

Tissue Sampling/Tagging/Dredge Lighting

Based on the research history performed by NMFS and other research biologist on the effects of tissue sampling and tagging on sea turtles, the Charleston District believes that these activities, as proposed in this assessment, will not affect sea turtles. However, the presence of artificial lighting on or within the vicinity of nesting beaches as a component of the proposed action may affect behavioral aspects of the nesting process including nesting female emergence, nest site selection, and the nocturnal sea-finding behavior of both hatchlings and nesting females. However, in order to reduce potential disorientation effects on female sea turtles approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches, while still adhering to minimum luminance requirements from a safety perspective, light emanating from offshore equipment will be minimized through reduced wattage, shielding, lowering, and/or use of low pressure sodium lights to the extent practicable. The Charleston District believes that lighting associated with the proposed activities may affect, but is not likely to adversely affect hatchling and nesting female sea turtles due to the distance from the nearest nesting beaches.

Critical Habitat

There is no designated or proposed critical habitat for the leatherback, hawksbill, green sea turtles in or around the project area. Therefore, the Charleston District believes that the proposed activities will not adversely modify designated critical habitat for leatherback, hawksbill, and green sea turtle species.

The USFWS has designated critical habitat for nesting loggerheads in South Carolina (Federal Register/ Vol. 79, No. 132. July 10, 2014). Folly Island includes the only beach in the proposed project area included in the listing. All 11.2 miles of Folly Beach is designated from the mean high water (MHW) line to the toe of the secondary dune or developed structure.

NMFS designated critical habitat for the loggerhead sea turtle in a final ruling on July 10, 2014 (FR Vol. 79, No. 132). This ruling established critical habitat for 5 habitat types based on their Physical or Biological Features (PBFs) and the Primary Constituent Elements (PCEs) that support the PBFs: nearshore reproductive, overwintering, breeding, migratory, and sargassum. Nearshore reproductive habitat shown in Figure 7 (from MHW to 1.6 km offshore) is the closest designated critical habitat to the project area and is denoted as LOGG-N-07. LOGG-N-7 includes Folly, Kiawah, Seabrook, Botany Bay Islands, Botany Bay Plantation, Interlude Beach, and Edingsville Beach, Charleston County, SC; Edisto Beach State Park, Edisto Beach, and Pine and Otter Islands, Colleton County, SC. The unit contains nearshore reproductive habitat only. The unit consists of nearshore from Lighthouse Inlet to Saint Helena Sound from the MHW line seaward to 1.6 km.

Since neither dredging nor disposal will occur within designated critical habitat, the construction of the proposed project, including potential beneficial uses, will not adversely modify loggerhead critical habitat.

4.2.2 Long Term Impacts from Project

Channel modifications will have no effect on sea turtles. This determination is discussed in further detail in the below sections for each species.

4.2.2.1 Loggerhead (*Caretta caretta*)

4.2.2.1.1 Food Supply

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd, 1988). Sub-adult and adults are primarily coastal dwellers and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats. The main food sources are blue crabs (*Callinectes sapidus*), horseshoe crabs (*Limulus polyphemus*), other crabs, cannonball jellyfish (*Stomolophus meleagris*), and miscellaneous jellyfish.

Effects of the proposed project on food supply: The proposed project will displace benthic food supply but these effects are expected to be temporary in nature. Though initial loss of benthic resources are likely, quick recovery, between 6-months (McCauley et al., 1977; Van Dolah et al., 1979; Van Dolah et al., 1984; and Clarke and Miller-Way, 1992) to two years, (Bonsdorff, 1980; Ray, 1997) is expected. A small increase in turbidity and some suction from dredging activities may affect some species of aquatic organisms or vegetation that loggerheads may feed on. These sediment disturbance impacts are expected to be minimal in nature and are not expected to have a measurable effect on water quality beyond the frequent natural increases in sediment load. The proposed project may affect but is not likely to adversely affect other sources of food supply for the loggerhead since those prey species are motile or not likely to be in the project area (SARBA, 2008). Neither the proposed project nor potential beneficial uses will have an effect on the long term distribution of food supply to the loggerhead sea turtle.

4.2.2.1.2 Habitats

In the U.S. Atlantic Ocean, loggerhead populations are pelagic and spend many years in the North Atlantic Gyre. From hatchling until age 10-12 years, sea turtles remain in the pelagic/oceanic zones. Once the turtles reach 10-12 years of age (~50-70cm), the juveniles leave the pelagic zone and return to coastal inshore and nearshore waters, feeding on the bottom and remaining in these waters until they mature and for the remainder of their lives. In South Carolina, nesting season occurs from May through August. The primary nesting beaches are between North Inlet and Prices' Inlet, but other beaches in the southern part of the state also have moderate nesting densities. These are mainly undeveloped nesting beaches between Kiawah Island and Hilton Head (www.dnr.sc.gov/seaturtle/cc.htm). After emerging, hatchlings immediately head into the ocean and swim continuously until reaching the Gyre where they can rest and forage in *Sargassum*, eating small invertebrates and mollusks. Adults can be found in nearshore waters of South Carolina year round except when temperatures drop below 55°F (generally December through mid-March).

Effects of the proposed project on habitats: The Charleston District believes the proposed project will have no long term effect on loggerhead habitat within the navigation channel. A study published by Arendt et al. (2011) documented loggerhead captures by trawling in the shipping channel between May and August during 2004-2007. Two hundred and twenty loggerheads were captured during the study. Eight of the turtles were recaptured during the study, only two tagged turtles were reported as recaptured away from the channel implying loggerheads may have an affinity for the shipping channel even though it is dredged every year for operations and maintenance. The authors contend that loggerheads in the shipping channel have increased since the late 1990's. The shipping channels may be important for transient use by juvenile loggerheads migrating between foraging and overwintering areas. The proposed project and potential beneficial uses will not adversely modify loggerhead critical habitat.

4.2.2.1.3 Life Period:

NMFS estimates ages of maturity for loggerheads ranging from 20-38 years with the immature stage lasting from 14-32 years. It is uncertain how long loggerheads live, but scientists estimate they may live up to 50 years.

Effects of the proposed project on life period: Except for the potential takes that could occur during construction, the proposed project will have no effect on the life period of loggerheads.

4.2.2.2 Leatherback (*Dermochelys coriacea*)

4.2.2.2.1 Food Supply

Leatherback sea turtles feed primarily on cnidarians (medusae, siphonophores) and tunicates near the water surface. Although leatherbacks are the most pelagic of the sea turtles, they enter coastal waters on a seasonal basis to feed in areas where jellyfish are concentrated. As the ocean becomes more acidic, largely due to increased carbon into the atmosphere, jellyfish species are thriving. This increase of prey may lead to increased utilization of nearshore waters by leatherbacks in South Carolina. It is not expected that leatherbacks would utilize the channel as a primary foraging area.

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no long term effect on the food supply for the leatherback. Take of cnidarians species by the dredge(s) is unlikely to be substantial since these species occur in the sub-surface or surficial layer and dredging will be primarily impacting the lower portions of the water column and channel bottoms.

4.2.2.2.2 Habitats

Leatherbacks have the widest global distribution of all reptile species, and possibly of any vertebrate. They are widely distributed throughout the oceans of the world, and are found in the Atlantic, Pacific, and Indian Oceans (Ernst and Barbour, 1972). Adult leatherbacks also traverse as far north as Canada and Norway and as far south as New Zealand and South America (http://www.nmfs.noaa.gov/pr/species/turtles/leatherback.htm). They are predominantly a pelagic species but will enter coastal waters seasonally to feed and nest. Leatherbacks can tolerate colder water temperatures than other sea turtle species. Scientists have observed them in waters at 32°F. Leatherbacks can dive to depths of 4,200 feet (1,280 meters)—deeper than any other turtle—and can stay down for up to 85 minutes (SARBA, 2008).

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no long term effect on leatherback habitats.

4.2.2.2.3 Life Period

Leatherbacks may live for well over 30 years. It has been thought that they reach sexual maturity somewhat faster than other sea turtles (except Kemp's ridley), with an estimated range from 3-6 years (Rhodin, 1985) to 13-14 years (Zug and Parham, 1996). However, some recent research using sophisticated methods of analyzing leatherback ossicles has cast doubt on the previously accepted age to maturity figures, with leatherbacks in the western North Atlantic possibly not reaching sexual maturity until as late as 29 years of age (Avens and Goshe, 2007). Estimates of total population size for Atlantic leatherbacks are difficult to ascertain due to the inconsistent nature of the available nesting data. In 1996, the entire western Atlantic population was characterized as stable at best (Spotila et al. 1996), with numbers of nesting females reported to be on the order of 18,800. Spotila et al. (1996) estimated that the leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa totaled approximately 27,600 nesting females, with an estimated range of 20,082-35,133. This is similar to the estimated figures of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) determined by the TEWG (2007).

Effects of the proposed project on life period: The proposed project and potential beneficial uses will have no effect on leatherback life periods because they are the most pelagic of the sea turtle species.

4.2.2.3 Kemp's Ridley (*Lepidochelys kempii*)

4.2.2.3.1 Food Supply

Kemp's are benthic foragers and will prey on nearshore crabs and mollusks, fish, jellyfish, shrimp, and other infauna, as well as *sargassum.*

Effects of the proposed project on food supply: The proposed project will remove the benthic food supply but these effects are expected to be temporary in nature. The proposed project and potential beneficial uses will result in no long term effect to food supply.

4.2.2.3.2 Habitats

This species occurs mainly in coastal areas of the Gulf of Mexico and the northwestern Atlantic Ocean. Occasional individuals reach European waters (Brongersma, 1972). Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals sometimes are found on the east coast of the United States. Juveniles are pelagic for 1- 4 years or more. Studies suggest that benthic immature Kemp's ridleys stay in shallow, warm, nearshore waters in the northern Gulf of Mexico until cooling waters force them offshore or south along the Florida coast (Renaud, 1995). Large groups of Kemp's ridleys gather off a particular nesting beach near Rancho Nuevo, Mexico, in the state of Tamaulipas to participate in the annual arribada (SARBA, 2008). One adult Kemp's ridley was captured in Charleston Harbor during a 1991 trawling study (Dickerson et al. 1995).

Effects of the proposed proposed on habitats: The proposed project and potential beneficial uses will have no effect on Kemp's ridley habitats.

4.2.2.3.3 Life Period

The TEWG (1998) estimates age at maturity from 7-15 years. It is unknown how long Kemp's can live and very little is known about their movements prior to maturity. In 2010 15,000 nesting females were recorded at Tamaulipas (http://www.nmfs.noaa.gov/pr/species/turtles/kempsridley.htm).

Effects of the proposed project on life period: Except for the potential takes that could occur during construction, the proposed project and potential beneficial uses will have no effect on Kemp's ridley life period.

4.2.2.4 Green (*Chelonia mydas*)

4.2.2.4.1 Food Supply

Green turtles are herbivorous, shallow water grazers, feeding on algae and sea grasses but occasionally jellyfish and sponges. The post-hatchling, pelagic-stage individuals are assumed to be omnivorous, but little data are available. Green sea turtle foraging areas in the southeastern United States include any coastal shallow waters having macroalgae or sea grasses. This includes areas near mainland coastlines, islands, reefs, or shelves, and any open-ocean surface waters, especially where advection from wind and currents concentrates pelagic organisms (Hirth, 1997; NMFS and USFWS, 1991b). Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty, 1984; Hildebrand, 1982; Shaver, 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr, 1957; Carr, 1984), Florida Bay and the Florida Keys (Schroeder and Foley, 1995), the Indian River Lagoon System, Florida (Ehrhart, 1983), and the Atlantic Ocean off Florida from Brevard through Broward counties (Wershoven and Wershoven, 1992; Guseman and Ehrhart, 1992).

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no effect on food supply for the Green turtle since the prey sources are not likely to be in the project area.

4.2.2.4.2 Habitats

The nesting range of the green sea turtles in the southeastern United States includes sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands between Texas and North Carolina, the U.S. Virgin Islands (USVI) and Puerto Rico (NMFS and USFWS, 1991b). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard through Broward counties (Ehrhart and Witherington, 1992).

Adults of both sexes are presumed to migrate between nesting and foraging habitats along corridors adjacent to coastlines and reefs. Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean, but are considered rare in benthic areas north of Cape Hatteras (Wynne and Schwartz, 1999). Nesting by Green sea turtles in South Carolina is infrequent (SARBA, 2008).

Effects of the proposed project on habitats: The proposed and potential beneficial uses will have no effect on Green turtle habitats.

4.2.2.4.3 Life Period

The estimated age at sexual maturity for green sea turtles is between 20-50 years (Balazs, 1982; Frazer and Ehrhart, 1985). Recent population estimates for the western Atlantic area are not available. Between 1989 and 2006, the annual number of green turtle nests at core index beaches ranged from 267 to 7,158 (Florida Marine Research Institute Statewide Nesting Database). While the pattern of green turtle nesting shows biennial peaks in abundance, there is a generally positive trend since establishment of index beaches in Florida in 1989. In the U.S., green turtles nest primarily along the central and southeast coast of Florida where an estimated 200-1,100 females nest annually (http://www.nmfs.noaa.gov/pr/species/turtles/green.htm).

Effects of the proposed project on life period: Except for the potential takes that could occur during construction, the proposed project and potential beneficial uses will have no effect on the life period of Green turtles.

4.3 Whales

4.3.1 Short Term Impacts During Construction

Both of the two species of large whales being considered under this assessment, the North Atlantic right whale and the humpback whale, may be present in the project area. Direct and indirect impacts from dredging operations and dredge plants are similar for mechanical or hydraulic type dredges.

Direct Impacts

Impacts from dredging operations have the potential to occur offshore during a dredge plant's transit to and from an ocean disposal site but such interactions are rare. Since consultations with NMFS were completed in the SARBO (1991, 1995, and 1997), (1) the estimated number of right whales has increased based on the data presented in the NMFS annual stock assessments, (2) the annual support for the Right Whale Early Warning System associated with operations near or within the calving grounds has been ongoing, and (3) the Corps' involvement with and awareness of right whale issues has increased significantly. Based on these factors and the success of the current right whale protection measures, the Corps expects that dredging operations is not likely to adversely affect North Atlantic right or humpback whales. Additionally, a review of the NMFS large whale strike database does not indicate any records of large whale ship strikes associated with any dredging equipment. There is an account of a dredge/whale interaction observed in 1988 when a dredge approached within 100 yards of a right whale and another incident in 2005. These situations are unlikely to occur in the future, since dredges maintain a distance of 500 yards from the known position of right whales, consistent with federal marine mammal approach regulations. Specific observer requirements throughout the South Atlantic are outlined in Table 3 of the 1997 SARBO. For the construction of the proposed project, one hundred percent dedicated daytime whale observer coverage will be required on the bridge between December 1 and March 31 (or April 30, if necessary) when the dredge is transiting to and from the ODMDS. Monitoring by sea turtle observers is allowed between April 1 and November 30. Pursuant to the most current SARBO, by requiring slow down procedures, using dedicated observers, as well as being a partner in aerial surveys of high use whale areas, USACE continues to demonstrate significant successful efforts to greatly diminish the potential interactions between large baleen whales and dredging equipment.

Indirect Impacts

Noise

In order to better assess potential species impacts (i.e. disturbance of communication among marine mammals) associated with dredge specific noise from navigation maintenance or deepening operations, Clarke et al. (2002) performed underwater field investigations to characterize sounds emitted by bucket, hydraulic cutterhead, and hopper dredge operations. A summary of results from this study are presented below and are a first step towards the development of a dredge sounds database which will encompass a range of dredge plant sizes and operational features.

Dredging operations generally produce lower levels of sound energy but last for more extended periods of time than more intense construction activities (e.g., pile driving) (Nightengale and Simenstad 2001). These sounds have been documented to be continuous and low frequencies (< 1000 Hz) and are within the audible range of listed species of both whales (7Hz–22kHz) and sea turtles (100-1000Hz) (Clarke et al., 2002). Noise generated by a cutterhead suction dredge is continuous and muted and results from the cutterhead rotating within the bottom sediment and from the pumps used to transport the effluent to the placement area. The majority of the sound generated was from 70 to 1,000 Hz and peaked at 100 to 110 dB range. Though attenuation calculations were not completed, reported field observations indicate that the cutterhead suction dredge became almost inaudible at about 500 meters (Clarke et al., 2002).

The noise generated from a hopper dredge is similar to a cutterhead suction dredge except there is no rotating cutterhead. The majority of the noise is generated from the dragarm sliding along the bottom, the pumps filling the hopper, and operation of the ship engine/propeller. Similar to the cutterhead suction dredge, most of the produced sound energy fell within the 70 to 1,000 Hz range; however peak pressure levels were at 120 to 140 dB (Clarke et al., 2002).

Mechanical dredges (clam shell or bucket) are relatively stationary and produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The noise generated from a mechanical dredge entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. Based on the data collected for this study, which included dredging of coarse sands and gravel, the maximum noise spike occurs when the bucket hits the bottom (120 dB peak amplitude). A reduction of 30 dB re 1 µPa/m occurred between the 150 m and 5,000 m listening stations with faintly audible sounds at 7-km. All other noises from this operation (i.e., winch motor, spuds, etc.) were relatively insignificant (Clarke et al., 2002).

According to Richardson et al. (1995) the following noise levels may be detrimental to marine mammals:

- Prolonged Exposure of 140 dB re 1 µPa/m (continuous manmade noise), at 1 km may cause Permanent Hearing Loss
- Prolonged Exposure of 195 to 225 dB re 1 µPa/m (intermittent noise), at a few meters or tens of meters, may cause Immediate Hearing Damage

But, he states "Many marine mammals would avoid these noisy locations, although it is not certain that all would do so." In a study evaluating specific reaction of bowhead whales to underwater drilling and dredge noise, Richardson et al. (1990) also noted that bowhead whales often move away when exposed to drillship and dredge sound; however, the reactions are quite variable and may be dependent on habituation and sensitivity of individual animals. Received noise levels diminish by about 60 dB between the noise source and a radius of 1 km (Richardson et al, 1995). For marine mammals to be exposed to a received level of 140 dB at 1 km radius, the source level would have to be about 200 dB re 1 micro Pa-m. Furthermore, few human activities emit continuous sounds at source levels greater than or equal to 200 dB re 1 micro Pa-m; however, supertankers and icebreakers may exceed the 195 dB noise levels.

According to Clarke et al. (2002), hopper dredge operations had the highest sustained pressure levels of 120-140 dB among the three measured dredge types; however, this measurement was taken at 40 m from the operating vessel and would likely attenuate significantly with increased distance from the dredge. Based on: (1) the predicted noise impact thresholds noted by Richardson et al. (1995), (2) the background noise that already exists within the marine environment, and (3) the ability of marine mammals to move away from the immediate noise source, noise generated by mechanical, cutterhead, and hopper dredge activities will not affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral impacts are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present within a given project area is small and any behavioral impacts would be expected to be minor. Furthermore, for hopper dredging activities, endangered species observers (ESOs) will be on board and will record all large whale sightings and note any potential behavioral impacts. Maintaining a safe distance of 500 yards will minimize the likelihood of noise impacts.

4.3.1.1 Conservation Measures for the Proposed Project

To ensure that dredging and sand mining operations do not adversely affect the North Atlantic right whale, the Corps has fully adopted the Terms and Conditions (T&C) set forth in the 1991 (T&C #2) and 1995 (T&C's #'s 6-9) SARBO's, and reiterated in the 1997 SARBO.

The Corps has established precautionary collision avoidance measures to be implemented during dredging and disposal operations that take place during the time North Atlantic right whales are present in waters offshore of Corps projects. For the construction of the proposed project, these precautionary measures include:

a. Before the initiation of each project, at the pre-construction/partnering meeting, the Corps briefs the contractor on the presence of the species, and reviews the requirements for right whale protection,

b. Each contractor will be required to instruct all personnel associated with the dredging/construction project about the possible presence of endangered North Atlantic right whales in the area and the need to avoid collisions. Each contractor will also be required to brief his personnel concerning the civil and criminal penalties for harming, harassing or killing species that are protected under the Endangered Species Act of 1973 and the Marine Mammal Protection Act of 1972. Dredges and all other disposal and attendant vessels are required to stop, alter course, or otherwise maneuver to avoid approaching the known location of a North Atlantic right whale. The contractor will be required to submit an endangered species watch plan that is adequate to protect North Atlantic right whales from the impacts of the proposed work.

c. Monitoring by endangered species observers with at-sea large whale identification experience to conduct daytime observations for whales between December 1 and March 31 (or April 30, if necessary). The dredge operator must take necessary precautions to avoid whales. During evening hours or when there is limited visibility due to fog or sea states of greater than Beaufort 3, the dredge must slow down to safe navigable speed when transiting between areas if whales have been spotted within 15 nm of the vessel's path within the previous 24 hours. (Contractors will be required to use daily available information on the presence of North Atlantic right whales in the project area.) One hundred percent dedicated daytime whale observer coverage is required on the bridge between December 1 and March 31 (or April 30, if necessary) when the dredge is transiting to and from the disposal area. If the Early Warning System (EWS) is operational at the time of the project, it will be deemed to provide adequate information on the presence of whales during dredging operations.

d. The Corps will notify the program manager for the EWS of projects that are likely to take place during calving season and the estimated beginning, ending and duration of the proposed projects.

4.3.1.2 Effect Determination

These protective measures have been protective of large whales, and specifically north Atlantic Right Whales for many years and the Corps believes that continued adherence to these measures will afford the whales the needed protections while not preventing the Corps from completing projects in a timely, cost effective and environmentally protective manner. Based on the implementation of these protective measures, the proposed project may affect but is not likely to adversely affect the North Atlantic right whale or humpback whale. Furthermore, the proposed project and potential beneficial uses of dredged material will not adversely modify North Atlantic right whale critical habitat.

4.3.2 Long Term Impacts from Project

4.3.2.1 Humpback Whale (*Megaptera novaeangliae*)

4.3.2.1.1 Food Supply

Humpback whales exhibit a wide range of foraging behaviors, and feed on a range of prey types including small schooling fishes (particularly sand lance and Atlantic herring), euphausiids, mysids, amphipods, shrimps, and copepods and other large zooplankton and invertebrates. They target fish schools and filter large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill (SARBA, 2008).

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no effect on the food supply for the humpback whale. Humpback whales are not likely to utilize the shipping channel as a primary foraging area.

4.3.2.1.2 Habitats

Humpback whales typically migrate between tropical/sub-tropical and temperate/polar latitudes. In the Atlantic Ocean, humpback whales feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Six separate feeding areas are utilized in northern waters after their return. These areas are within the biologically important area defined by the 200-m (656-ft) isobath on the North American east coast.

Effects of the proposed project on habitats: Due to the relatively minor extension of the Entrance Channel, the proposed project and potential beneficial uses will have no effect on humpback whale habitats.

4.3.2.1.3 Life Period

SCDNR and SAFMC (South Atlantic Fishery Management Council) personnel serve as members of the Atlantic Large Whale Take Reduction Team (ALWTRT). The ALWTRT works with NMFS to develop and amend the Atlantic Large Whale Take Reduction Plan. The goal of the plan is to reduce the incidental take of finback, humpback and right whales in commercial fishing operations so that they can reach or maintain their optimum sustainable population size.

To reduce the incidence of ship strikes, especially in the area of shipping lanes, NMFS, in collaboration with other Federal agencies, state agencies including SCDNR, environmental groups, citizen groups and the shipping industry have developed ship strike reduction measures along the U.S. Atlantic coast. Currently, the focus of this effort is on the north Atlantic right whale given its highly endangered status; however, such measures are also expected to benefit the humpback (http://www.dnr.sc.gov/cwcs/pdf/HumpbackWhale.pdf). The project will adhere to the measures outlined in the most current South Atlantic Regional Biological Opinion.

Effects of the proposed project on life period: The project channel modifications and potential beneficial uses will have no effect on the life period of the humpback whale.

4.3.2.2 North Atlantic Right Whale (*Eubaleana glacialis)*

4.3.2.2.1 Food Supply

North Atlantic right whales (NARW) are highly migratory, summering in feeding and nursery grounds in New England waters and northward to the Bay of Fundy and the Scotian Shelf (Waring et al, 2001). They migrate southward in winter to the northeastern coast of Florida. Their diet consists of zooplankton, copepods, euphausiids, and cyprids (SHEP BATES, 2012).

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no effect on food supply for the right whale. Deepening of the channel will have temporary impacts to zooplankton populations but these effects are expected to be minor and temporary in nature.

4.3.2.2.2 Habitats

The current distribution and migration patterns of the eastern North Atlantic right whale population are unknown. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare. The National Recovery Plan for the North Atlantic right whale, dated May 2005 (NMFS, 2005) , defines the coastal waters of the southeastern United States and, especially, the shallow waters from Savannah, Georgia, south to Cape Canaveral, Florida, as the wintering ground for a small but significant part of the North Atlantic right whale population. According to the recovery plan, most records of sighting involve adult females, many of them accompanied by very young calves, although a few juveniles and males have been sighted in the region. More recent data shows that NARW do regularly use the area between Cape Fear, NC southward to the area currently designated as critical habitat. NMFS has proposed a rule to expand critical habitat for NARW. When finalized the proposed rule would extend NARW critical habit to include marine waters from Cape Fear, NC southward to 29°N latitude (approximately 43 miles north of Cape Canaveral, Florida). This area is regularly used by pregnant females, males and juveniles depending on the time of the season (Waring et al 2014).

Effects of the proposed project on habitats: The proposed project and potential beneficial uses will have no effect on North Atlantic right whale habitat. The data indicates the primary calving area for this species is south of Charleston (SARBA, 2008).

Effect of the proposed project on proposed Critical Habitat: Charleston Harbor and the Federal Navigation Channel fall within the proposed critical calving habitat for the NARWs. NMFS defines in the FR the physical features that are essential to the conservation of the NARW as being: "(1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) Sea surface temperatures from a minimum of 7°C, and never more than 17°C; and (3) Water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 km2 of ocean waters during the months of November through April." NMFS notes that the critical habitat was designated based in part on two models that predict calving habitat, and that the habitat extends from New Smyrna, FL to Cape Fear, NC between 10 and 50 km from shore (Figure in FR). NMFS also notes that the essential features of NARW calving habitat may require special management considerations because of: offshore energy development, large-scale offshore aquaculture operations, and global climate change. The concern with the first two of these is more in fragmenting habitat than any changes to the 3 PCE's. Infrastructure that could limit the availability of essential features such that NARWs are not able to move about could have a negative impact on calving critical habitat. NMFS also identified 5 categories of activities that have the potential to affect essential features. One of these is USACE maintenance dredging or permitting of dredging and disposal activities under the Clean Water Act. NMFS then states that, "in order to avoid underestimating impacts, we assumed that all projected categories of future actions resulting in incremental impacts to essential features will require formal consultations."

The Charleston District has evaluated the proposed rule for NARW critical habitat and has determined that the proposed action is not likely to adversely modify critical calving habitat. The project features, as described in this report, would have no influence on water temperature or sea surface roughness, and would not substantially modify depth to a magnitude that would be detected or rise to significance in either of the two models used to predict the boundary for calving habitat. The spatial scale of those models is coarse enough that channel modifications would not likely affect the models (spatial scale of 4km x 4km) to a meaningful extent. The proposed hardbottom habitat is another project feature that would affect depth. These features are roughly 33 acres in size and therefore not large enough to substantially impact the 4km x 4km model grid. Additionally, as NMFS notes, manmade features become significant when they become a barrier, or impediment to NARW movement. These features are staggered throughout either side of the navigation channel and will not rise above -25ft MLLW; therefore, they allow for uninterrupted passage of fish and in this case NARW. Also, the project is anticipated to reduce vessel traffic when compared to the without project condition. This assertion stems from the projections that container throughput will be unaffected by the action and that larger ships can be more fully loaded and take advantage of the full tidal range to call on/from on Charleston Harbor; thereby allowing fewer vessels to transport the anticipated cargo volumes.

On 20 February, 2015, USACE requested informal conference on the proposed critical habitat.

4.3.2.2.3 Life Period

In 2014 the population size is estimated to be roughly 500 individuals (Barb Zoodsma, NOAA PRD, personal communication, July 1, 2014). No estimate of abundance with an associated coefficient of variability is available. Examination of population data for the western NARW , for the years 1990-2010 reveals an increase in the number of catalogued whales with a geometric mean growth rate for the period of 2.8% (Waring et al, 2014). A review of the "Large Whale Ship Strike Database" (Jensen and Silber, 2003) found five recorded ship strikes of NARW's offshore of Florida, all between Fernandina and Jacksonville from 1975 – 2002. There have been at least two additional ship strikes (one in 2003 and one in 2006) in that same area since 2002.

Effects of the proposed project on life period: The proposed project channel modifications and potential beneficial uses will have no effect on the life period of the right whale. Protective measures will be in place during construction. The project will adhere to the measures outlined here or in the most current South Atlantic Regional Biological Opinion.

4.4 Impacts to Atlantic and Shortnose Sturgeon

4.4.1 Short Term Impacts During Construction

Considering their similarities in habitat use, distribution throughout the proposed project area, foraging behavior and prey base, and subsequent risk of take relative to dredging and trawling operations, this assessment will consider impacts from the proposed activity to shortnose and Atlantic sturgeon together. Potential direct and indirect impacts associated with dredging that may adversely impact sturgeon include entrainment and/or capture of adults, juveniles, larvae, and eggs by dredging and trawling activities, short-term impacts to foraging and refuge habitat, water quality, and sediment quality, and disruption of migratory pathways.

Hopper Dredge

Hopper dredges are used within known sturgeon habitat throughout the proposed project area and have been known to directly impact adult, juvenile, and larval sturgeon species through entrainment in the draghead. Hopper dredging activities throughout the Atlantic and Gulf coasts of the US are known for incidentally taking sturgeon species. Since 1990, documented incidental takes throughout CESAD of Atlantic (n=19) and Gulf (n=3) sturgeon have occurred during hopper dredging activities, five of which occurred in Charleston District. Considering that Atlantic sturgeon primarily lead a marine existence, with the exception of their spawning migration, and hopper dredging operations are often utilized in ocean bar channels or offshore borrow areas, it is likely that the risk of entrainment by hopper dredges is higher for Atlantic sturgeon than shortnose sturgeon. It is often less economical to use a hopper dredge in upstream environments where shortnose sturgeon predominantly spend their time. The unit of effort with respect to hopper dredging in shortnose sturgeon habitat is less than Atlantic sturgeon habitat and; thus, the risk of shortnose sturgeon take with a hopper dredge is less likely than Atlantic sturgeon in the South Atlantic region.

The use of the “turtle deflecting draghead” reduces the potential for take of benthic oriented species (i.e., sea turtles and sturgeon) by creating a sand wave in front of the draghead and pushing animals out of the way that were otherwise at risk of entrainment. Though the use of the “turtle deflecting draghead” likely reduces potential risk of sturgeon entrainment based on the understanding of its operating conditions, it is likely that takes can still occur due to dragtender operator error, uneven bottom contours, difficult dredging conditions (currents, slope, etc…). Few studies exist that evaluate entrainment risk relative to sturgeon behavior, size class, life cycle, etc; though effects of entrainment on adult fish are presumed low (Dickerson et al., 2004).

Atlantic and shortnose sturgeon are both anadromous fish species; however, their habitat ranges, as a component of their migration cycle, are slightly different. Atlantic sturgeon spawn in freshwater but primarily lead a marine existence; whereas, shortnose sturgeon spawn at or above head-of-tide in most rivers and rarely occur in the marine environment aside from seasonal migrations to estuarine waters. However, recent research by SCDNR indicates that interbasin and interstate movements do occur for shortnose sturgeon. Considering that Atlantic sturgeon spend more time in the nearshore marine environment than shortnose sturgeon, the opportunity for hopper dredge interactions with Atlantic sturgeon are more significant. This could explain the predominance of Atlantic sturgeon taken by hopper dredges.

Hydraulic Cutterhead Dredge

Adult and juvenile sturgeons are believed to be very mobile, even when occupying resting areas during the summer months (deep holes and other deep areas). Though five shortnose sturgeon takes by a pipeline (hydraulic cutterhead) have been documented, the potential for significant numbers of adult and juvenile fish being hit by the cutterhead is fairly low. The eggs and larval sturgeons are not as mobile and; therefore, would be more likely to be impacted either by being entrained by the dredge or being smothered/physically damaged by the materials in the dredge plume. However, dredging activities will be limited to areas well downstream of suspected spawning and nursery grounds, so there is little potential for sturgeon eggs or larvae to be impacted by cutterhead dredging.

Mechanical Dredges – Clamshell (bucket) Dredge

Though rare, documented incidental take of shortnose and Atlantic sturgeon by mechanical dredges have been reported. Clamshell dredges operate by dropping an open bucket into the water column which slowly descends to the bottom where the bucket closes, ascends, and discards the dredged material into a scow, barge, etc.

Since 1990, for all mechanical dredging operations throughout the North Atlantic, South Atlantic, and Gulf waters a total of three sturgeon (one shortnose and two Atlantic) have been reported as captured by clamshell dredge operations, but none known within the project area. Of the three documented captures by a clamshell, one occurred in CESAD on 12/03/00 while performing work for the Wilmington Harbor deepening project in the Cape Fear River, NC. Though this sturgeon was cited in various reports as a lethal incidental take, the endangered species incident report prepared by Coastwise Consulting indicated that the "bucket brought up an Atlantic Sturgeon, *Acipenser oxyrhynchus*, entangled in a net. The specimen was decomposing." Assuming that the specimen was killed by entanglement in a net prior to being captured by the bucket, this documented "take" can be discounted. Detailed information is not available for the other two mechanical dredge takes. Given the mobility of sturgeon, the lack of a suction field from mechanical dredging, and the small area of active dredging by a bucket during each load, the likelihood of mechanical dredging practices to incidentally take sturgeon species is relatively small. Furthermore, compared to other hydraulic dredging techniques, mechanical dredging is often recommended by NMFS as the preferred dredging technique for minimizing incidental take of sea turtles and sturgeon. Clamshell dredge operations have reported capture of larger sturgeon (adult/juvenile), but it is unlikely that clamshell dredging operation would impact small juvenile and larval sturgeon since there is no suction field generated by mechanical dredges and project operations will occur well below suspected spawning/nursery areas. As shown in Table 1, USACE intends to use a clamshell dredge for many areas of the entrance channel and lower harbor.

Indirect impacts

Indirect impacts to sturgeon from either mechanical or hydraulic dredging include (1) short-term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from resuspension of sediments and subsequent increase in turbidity/siltation, and (3) disruption of spawning migratory pathways.

Benthic Foraging

At individual dredged channels and ports throughout the South Atlantic, it is not known how extensively the channels and turning basins are used by sturgeon as feeding areas. Furthermore, specific aggregation areas for spawning, feeding, resting, etc… have not been identified for all dredging locations throughout the distribution range for shortnose and Atlantic sturgeon. However, based on the current understanding of the variables required (i.e., salinity regime, depth, substrate, etc...) for various stages of the sturgeon life cycle (i.e., spawning, migrating, foraging, etc...), dredging activities presumably create some level of disruption based on their location relative to the life stage requirements. Channels maintained at frequent dredging intervals are not expected to be used extensively for feeding or other activities. As identified in the 2007 Status Review of Atlantic Sturgeon, it was tested whether dredging operations affected Atlantic sturgeon behavior by comparing Catch Per Unit Effort (CPUE) before and after dredging events in 1999 and 2000. The Review documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating that sturgeon avoid these areas during operations.

Dredging activities can impact benthic assemblages either directly or indirectly and may vary in nature, intensity, and duration depending on the project, site location, and time interval between dredging operations. Direct catastrophic impacts include physical removal or smothering by the settlement of suspended materials (Morton, 1977; Guillory, 1982). Suspended materials may also interfere in the feeding respiration or reproduction of filter feeding benthos and nekton (Sherk and Cronin, 1970). Though initial loss of benthic resources are likely, quick recovery between 6-months (McCauley et al., 1977; Van Dolah et al., 1979; Van Dolah et al., 1984; and Clarke and Miller-Way, 1992) to two years (Bonsdorff, 1980; Ray, 1997) is expected; thus, the impacts to sturgeon foraging habitat are expected to be short-term. Recent benthic studies in Savannah Harbor, just prior to annual maintenance dredging, have shown primarily healthy benthic communities both inside and outside the channel. For most sediment types, average abundance and biomass were found to be higher inside the channel compared to locations outside the channel with the exception of silt-sand substrates (USACE, 2008). Sturgeon foraging sites with soft mud bottoms and oligohaline or mesohaline salinities tend to recover quickly, likely due to the dominance of opportunistic species assemblages (e.g., *Streblospio benedicti, Capitella capitata, Polydora Ligni*) (Ray, 1997). Recovery in dredged sites occurs by four basic mechanisms: remnant (undredged) materials in the sites, slumping of materials with their resident fauna into the site, adult immigration, and larval settlement. Remnant materials, sediments missed during the dredging operation, act as sources of "seed" populations to colonize recently defaunated sediments. Adult immigration can occur as organisms burrow laterally throughout the sediments, drift with currents and tides, or actively seek out recently defaunated sediments (Ray, 1997). Likewise materials slumping or falling into the site from channel slopes provide organisms for colonization (Kaplan et al., 1975). During periods of extreme conditions (i.e. extreme temperature regimes, low dissolved oxygen, etc.), sturgeon may become relatively immobile and forage extensively in one area. Therefore, considering that limited mobility would not allow for sturgeon to move to more productive foraging grounds following dredging activities, it is possible that reduced benthic assemblages during site and time specific conditions could have a more significant impact to foraging behavior.

For benthic assemblages in estuarine and riverine systems, the distribution of individual species is consistent with their known sediment and salinity preferences (polyhaline, mesohaline, and oligohaline). The distribution of each of these assemblages varies depending on the intensity of river flow, often correlated with season (Ray, 1997; Posey et al., 1996). Therefore, in addition to the anthropogenic dredging impacts to benthic assemblages, natural community shifts are correlated with river flow rates.

Considering the ephemeral nature of this environment, the benthic assemblages consist of opportunistic species which are capable of adapting to natural fluctuations in the environment (Ray, 1997). This is especially important due to the SCDNR noted sturgeon movements in the upper Cooper River between river km 30 and 45. In an environmental baseline study of benthic habitat conducted by SCDNR for this project (Sanger et al., 2013), the authors conclude that the macroinvertebrate community in the upper Cooper River was most influenced by the sediment composition and that salinity was not as strong of a factor when assessing the entire community. After comparing species composition at sites studied in the 1980's and in this study, the authors found that the macroinvertebrate community compositions were similar. Furthermore, assuming that natural benthic community shifts are an inherent component of sturgeon foraging behavior, it is possible that post dredging movements to more productive foraging grounds are not far outside of the normal foraging behavior response to natural benthic community shifts. As such, minor salinity shifts resulting from the proposed project are not anticipated to cause habitat or behavioral changes to shortnose sturgeon foraging and/or migrating through the Cooper River.

Water Quality – Turbidity

Extensive studies have been done on the behavioral responses of fish to increased turbidity. These studies measured reactions such as cough reflexes, swimming activity, gill flaring, and territoriality that may lead to physiological stress and mortality; however, specific studies on sturgeon responses are limited. The effects of suspended sediment on fish should be viewed as a function of concentration and exposure duration (Wilber and Clarke, 2001). The behavioral responses of adult salmonids for suspended sediment dosages under dredging-related conditions include altered swimming behavior, with fish either attracted to or avoiding plumes of turbid water (Newcombe and Jensen, 1996)

Water quality impacts to sturgeon as a result of proposed dredging activities are expected to be temporary, with suspended particles settling out within a short time frame or moved out of the area due to tidal influences. These sediment disturbance impacts are expected to be minimal in nature and are not expected to have a measurable effect on water quality beyond the frequent natural increases in sediment load.

Spawning Migration

In the Cape Fear River, NC, Moser and Ross (1995) observed that shortnose sturgeon appeared to be most active in the night and early morning and, when migrating, they stayed mid-channel, in the upper to middle portion of the water column. During periods of daytime holding, shortnose sturgeon preferred deep holes. Since spawning occurs upstream of the proposed project's dredging operations, impacts to eggs and larvae are not expected. However, spawning migration pathways may occur within the vicinity of proposed dredging activity considering that some anadromous fish immigrate to their upstream spawning grounds via dredged or natural channel corridors. Specific migratory pathways of significance within the action area are not known, although ongoing SCDNR studies are indicating heavy usage of Charleston Harbor for both species of sturgeon (Bill Post, Unpublished data). Nonetheless, considering that (1) dredging activities that occur within seasonal or spawning migration areas will be localized at any one time and would not span the length and width of the entire channel and (2) when migrating, sturgeon have been documented to stay in the upper to middle portion of the water column, it is likely that dredging activities will not preclude passage through migratory pathways or significantly reduce adequate areas for migration.

Trawling

Relocation and abundance trawling for sea turtles as a component of hopper dredging operations has been known to non-lethally take shortnose and Atlantic sturgeon throughout SAD. Since 2006, non-lethal trawling takes have occurred in the South Atlantic Regions (n=4, Atlantic sturgeon) and the Gulf Region (n=47, Gulf sturgeon). Based on the: (1) documented non-lethal sturgeon take history by trawlers, (2) short duration of the tow times, and (3) required safe handling procedures by observers, incidental take of sturgeon species are not expected to be injurious or lethal. However, recognizing that trawling operations do present the risk of lethal take and survivability of sturgeon after release is not known, closed-net capture trawling may adversely affect sturgeon.

4.4.1.1 Conservation Measures for the Proposed Project

Endangered species observers (ESOs) on board hopper dredges and trawlers will be responsible for monitoring for incidental take of shortnose and Atlantic sturgeon species. For hopper dredging operations, dragheads and all inflow and overflow screening will be inspected for sturgeon species following the same ESO protocol for sea turtles. All ESOs on-board trawlers will be capable of identifying shortnose and Atlantic sturgeon as well as following safe handling protocol as outlined in Moser et. al. 2000.

4.4.1.2 Effect Determination

Based on the history of incidental take data collected, both hydraulic (cutterhead and hopper) and mechanical dredge techniques have been documented to directly impact shortnose and Atlantic sturgeon species through entrainment by the cutterhead or draghead or capture in the clamshell bucket. Hydraulic and mechanical dredging techniques may also indirectly impact sturgeon species through (1) short-term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from re-suspension of sediments and subsequent increase in turbidity/siltation, (3) possible changes in salinity and other water quality parameters upstream of the project area and (4) disruption of spawning migratory pathways. Furthermore, sea turtle mitigation trawling activities associated with hopper dredging projects are known to incidentally take shortnose and Atlantic sturgeon. Therefore, all proposed hydraulic dredging activities, as well as associated sea turtle relocation trawling techniques, may affect and are likely to adversely affect shortnose and Atlantic sturgeon species either directly or indirectly. Although it is difficult to estimate the actual number of sturgeon that could be affected during the proposed project, Charleston District does not expect it to rise to a population level adverse affect.

4.4.2 Long Term Impacts from Project

4.4.2.1 Food Supply

Both Shortnose and Atlantic sturgeon are bottom suctorial feeders and feed primarily on small macroinvertebrates or other benthic organisms such as crustaceans, worms, and mollusks. Some reports indicate that female adult shortnose sturgeon have been found to feed throughout the year; however, Dadswell (1979) found that females ceased feeding nearly eight months before spawning. Conversely, males continue to feed throughout the fall and winter as long as they are located in saline waters (Dadswell et al. 1984). Dadswell (1979) documented individuals of both sexes actively feeding immediately after spawning. Limited observations indicate that feeding occurs primarily at night

(Dadswell et al. 1984, Gilbert 1989). Juveniles feed indiscriminately, often ingesting large amounts of mud, stone, and plant material along with prey items (DadswellI979, Carlson and Simpson 1987). Because substrate type strongly affects composition of benthic prey, both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which are good producers of benthic invertebrates (Carlson and Simpson 1987, Kynard 1997).

Effects of the proposed project on food supply: The proposed project will temporarily affect benthic food supplies but these organisms have been shown to recolonize quickly. Sturgeon have been documented in the shipping channel each year even after regular O&M dredging (Draft FERC BO, 2010). The project may affect but is not likely to adversely affect sturgeon behavior in the Cooper River.

4.4.2.2 Habitats

Atlantic and shortnose sturgeon are "anadromous"; adults spawn in freshwater in the spring and early summer and migrate into "estuarine" and marine waters where they spend most of their lives. In some southern rivers a fall spawning migration may also occur. They spawn in moderately flowing water (46-76 cm/s) in deep parts of large rivers. Sturgeon eggs are highly adhesive and are deposited on bottom substrate, usually on hard surfaces (e.g., cobble). It is likely that cold, clean water is important for proper larval development. Once larvae begin migrating downstream they use benthic structure (especially gravel matrices) as refuges. Juveniles usually reside in estuarine waters for months to years.

Subadults and adults live in coastal waters and estuaries when not spawning, generally in shallow (10-50 m depth) nearshore areas dominated by gravel and sand substrates. Long distance migrations away from spawning rivers are common. There is conclusive evidence from both tagging data and genetic analysis that shortnose sturgeon make coastal movements to adjacent rivers. Tagged shortnose sturgeon have recently been found to move between the following rivers in the southeast U.S.: I) Santee and Winyah Bay; 2) Winyah Bay and ACE Basin; and 3) Altamaha and Ogeechee. The greatest distance between river mouths of these known movements in the southeast is about 100 miles. Similar distances of movement have been recently realized for the Atlantic sturgeon (ASSRT 2007 & Draft FERC BO, 2010). Shortnose sturgeon had previously been thought to not utilize the lower 35 kilometers (approximate) of the Cooper River (Palmer 2001). This area between the Naval Weapons Station (about river km 35) and Charleston Harbor is dredged about every 18 months (removing - 1 million cy) to allow safe passage of deep-draft vessels and thereby removing substrate and prey. Therefore, Palmer (2001) determined that shortnose sturgeon in the Cooper River exist in an abbreviated ecosystem; available habitat is restricted within the upper 42 kilometers of the Cooper River between Pinopolis Dam at river km 77 and about river mile 35.

In an effort to understand riverine and coastal movements of shortnose and Atlantic sturgeon, the SCDNR began a multistate biotelemetry study in 2010, with funding from the Charleston District Corps of Engineers. During the span of the project, over 200 Atlantic and shortnose sturgeon have been captured and tagged with Vemco acoustic transmitters and over 300 Vemco VR2W acoustic receivers have been deployed in South Carolina’s major river systems and along the coast. Receiver coverage in the Charleston Harbor and the Cooper River began in December 2010. At the time, the Charleston Harbor was not assumed to have a resident sturgeon population and with the limited funding provided for the research only a limited number of receivers were deployed in the area. Vemco VR2W acoustic receivers can detect an acoustic transmitter anywhere from a quarter of a mile to a half mile radius around the unit and have been strategically located throughout the Harbor in an attempt to limit gaps in receiver coverage (Figure 27); however, there still exists a potential for a fish to swim through the harbor without being detected. Many of those in the Harbor and in the Cooper River are located very near the Federal channel, and would record 'hits' of tagged sturgeon that approached or passed by them (data as of December 2013 provided to NMFS). In order to help with the cover gaps SCDNR biologists have also begun manually tracking along the Charleston Harbor shipping channels beginning in October 2013. Manual tracking plot points are spaced 0.5 miles apart (Figure 28). Preliminary results indicate that shortnose sturgeon move between estuaries and even states and both species of sturgeon enter Charleston Harbor but don't specifically utilize the channel for extended periods of time.

Figure 27. SCDNR sturgeon study - Estimated coverage areas around receivers with shaded areas for .25 mile and .5 mile radii around receivers.

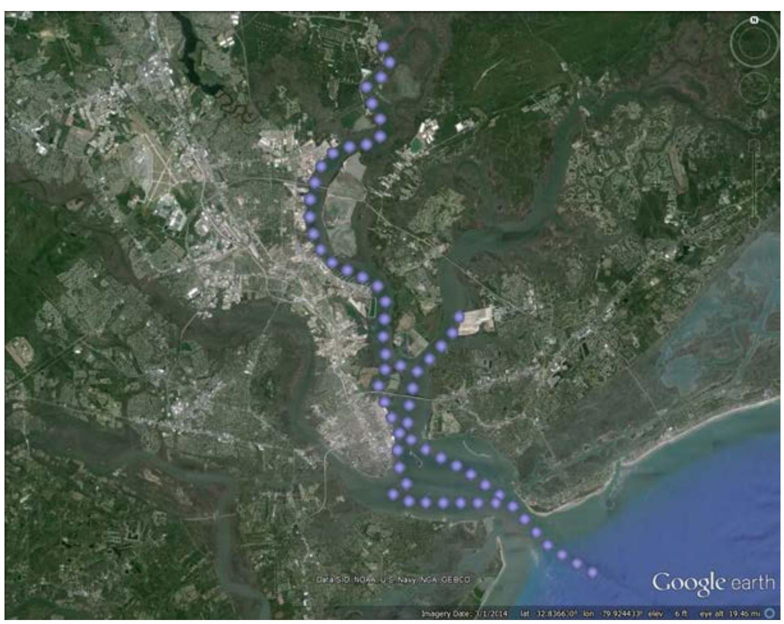


Figure 28. SCDNR Sturgeon study - Manual tracking plot points

Effects of the proposed project on habitats: In the long term, the proposed project may affect but is not likely to adversely affect sturgeon habitats due to the fact they are not frequenting the areas undergoing deepening. At individual dredged channels and ports throughout the South Atlantic, it is not known how extensively the channels and turning basins are used by sturgeon as feeding areas. Specific aggregation areas for spawning, feeding, resting, etc. have not been identified for all dredging locations throughout the distribution range for shortnose and Atlantic sturgeon. However, since channel maintenance activities remove the bottom sediments and any benthos that reside there, these actions likely decrease sturgeon foraging habitat for a period of time. Benthos will recruit to the newly exposed bottom surface from adjacent river bed. Channels maintained at frequent dredging intervals are not expected to be used extensively for feeding or other activities (EA, 2008). This would be essentially the same for existing and maintenance conditions after the harbor is deepened. As identified in the 2007 Status Review of Atlantic Sturgeon, Hatin et al., 2002, tested whether dredging operations affected Atlantic sturgeon behavior by comparing Catch Per Unit Effort (CPUE) before and after dredging events in 1999 and 2000. The authors documented a three to seven-fold reduction in Atlantic sturgeon presence after dredging operations began, indicating that sturgeon avoid these areas during operations (SHEP BATES, 2012).

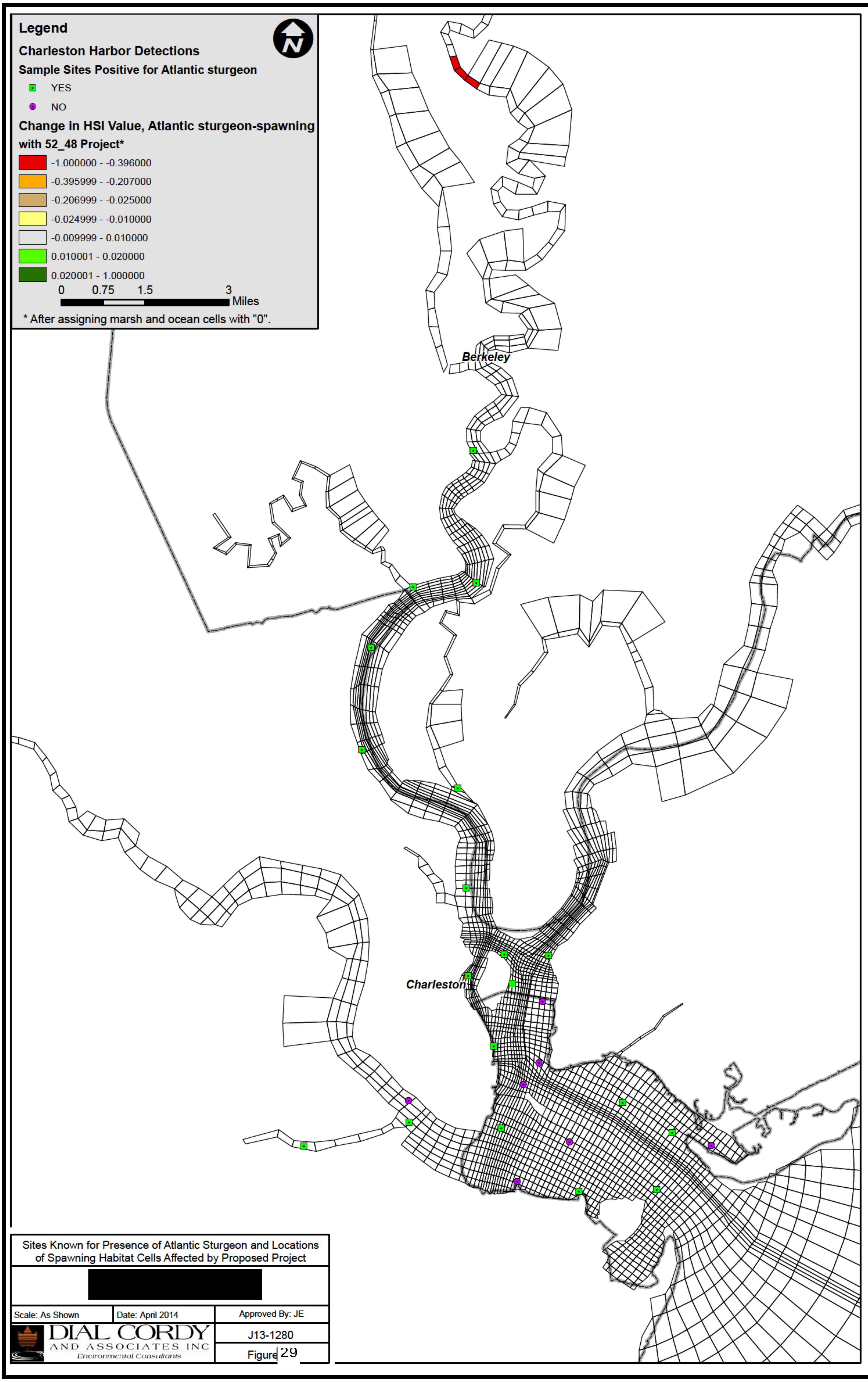
As previously discussed, the Charleston District performed modeling of affected sturgeon habitats. The modeling results are discussed below. Details can be found in Appendix K of the EIS.

Atlantic Sturgeon – Spawning Habitat

The Atlantic sturgeon spawning life stage is most impacted by salinity in the habitat models. The only salinity changes occurred in cells approximately three miles south of "The Tee" (Figure 29). Anticipated impacts for the 52'/48' project alternative are for three cells to change from "suitable" to "non-suitable." These cells represent a loss of 2.70% from the FWOP condition suitable habitat. SCDNR has determined that spawning does occur in the Cooper River in the tailrace canal near the Pinopolis Dam. The success of this spawning is unknown (Bill Post, SCDNR, personal communication, 10/29/13). Because the impact of the project, as described above, occurs over 20 river-miles downstream of where spawning is known to occur, this change is unlikely to impact this species.

Atlantic Sturgeon – Adult Habitat

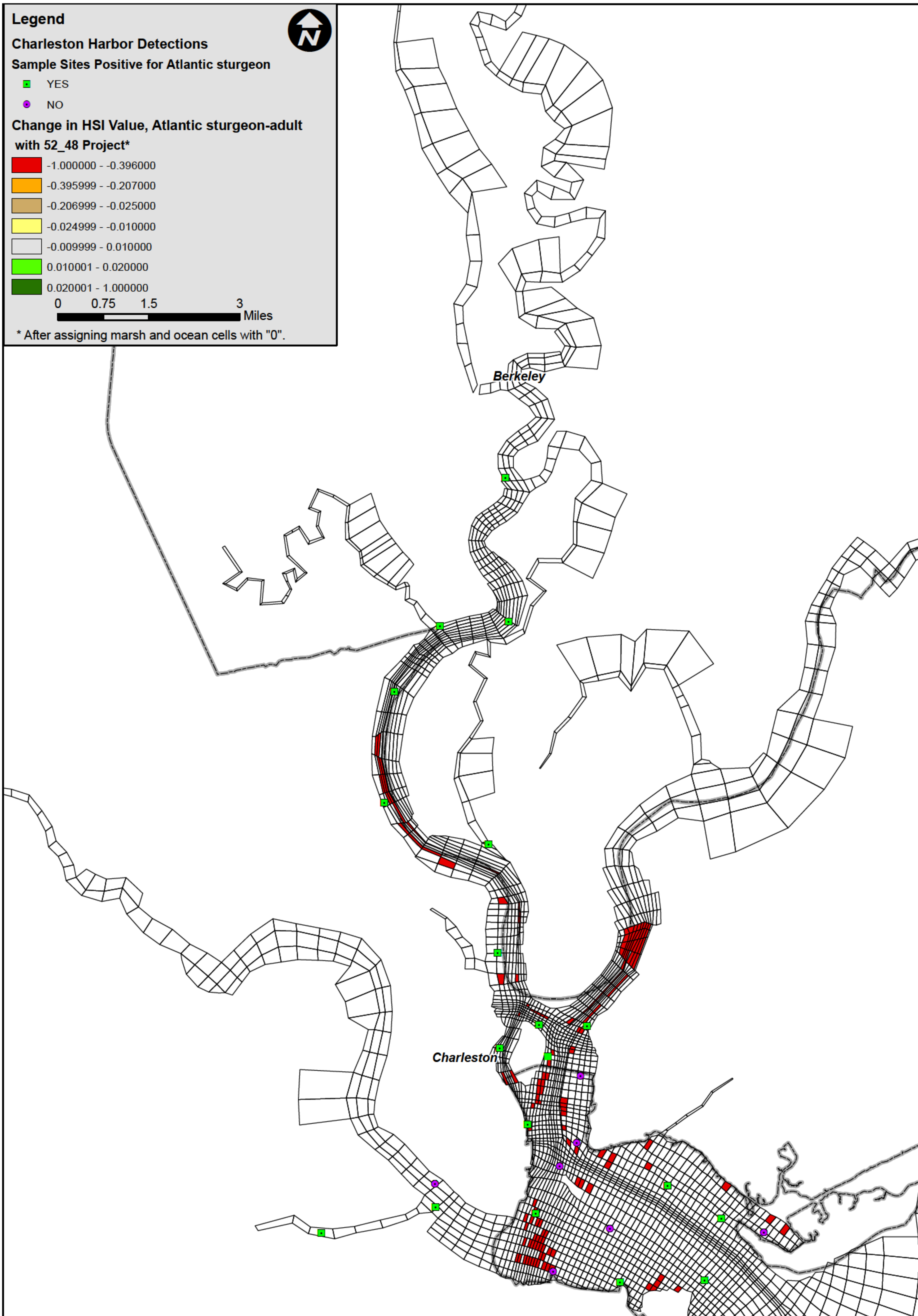
The various dredging alternative resulted in relatively small changes in suitable habitat for adult Atlantic Sturgeon habitat ranging from -1.66% to -3.97%. The model output for this life stage is driven by two parameters, salinity and temperature. None of the project alternatives cause temperature to go above the identified threshold. Salinity appears to be the ultimate driver in the impacts. With only a few exceptions at the mouth of the Ashley River, the north shore of James Island and near Patriots Point heading east past Shem Creek, changes occur in the navigation channel or along the margins. This is because depths of these areas would increase and would result in subsequent increase in salinity. These impacts are very small and essentially only take cells that had a salinity of just under the 28.6 ppt threshold to just over that threshold. SCDNR has documented the occurrence of Atlantic and shortnose sturgeon within the harbor, and it's unlikely that the small changes to temperature that occur in and along the navigation channel will impact this species life stage. Since the analysis is based on the future without project condition which factors in sea level rise, the increase in salinity from the alternatives is on top of the expected salinity increase resulting from sea level rise and therefore will be indistinguishable from the sea level rise affects. Because of this and the modeled results which indicate the majority of changes being within the channel where it is unlikely that sturgeon spend much time foraging it is unlikely that this life stage will be impacted by a change of less than 4% modeled suitable habitat. Figure 30 shows where Atlantic sturgeon have been detected in the Charleston Harbor area; these could have been adult or juveniles. The figure also shows that several dozen HSI cells will exhibit (0.4 to 1.0) decreases (on a scale from 0.0 to 1.0) in quality of habitats associated with adult sturgeon. At or within a few hundred meters of approximately three sites where sturgeon were observed, decreases in adult HSI are predicted if the proposed project is constructed (Figure 30).



Sites Known for Presence of Atlantic Sturgeon and Locations of Spawning Habitat Cells Affected by Proposed Project

[redacted]

Figure 29



Sites Known for Presence of Atlantic Sturgeon and Locations of Adult Habitat Cells Affected by Proposed Project

[redacted]

Scale: As Shown	Date: April 2014	Approved By: JE
DIAL CORDY AND ASSOCIATES INC Environmental Consultants		J13-1280
		Figure 30

Atlantic Sturgeon – Egg and Larval Habitat

Ten model-grid cells exhibited decreases in habitat suitability for Atlantic sturgeon egg and larvae habitat (Figure 31). The locations of these are not in proximity to potential spawning locations. Therefore it is not likely that these potential changes would adversely affect these life-history stages.

Atlantic Sturgeon – Juvenile Habitat

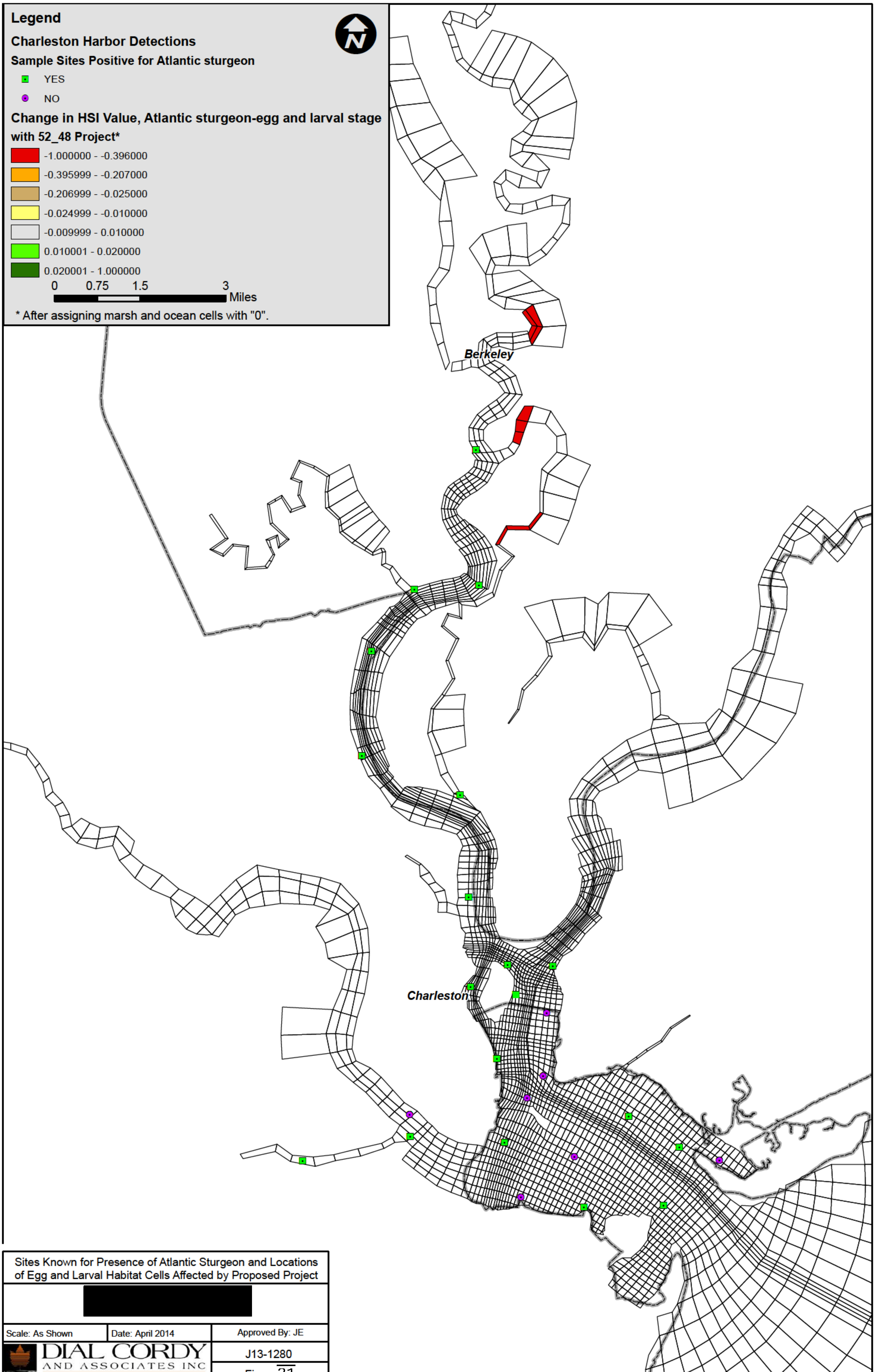
Several dozen model-grid cells exhibited substantial decreases in future-with-project habitat suitability for juvenile Atlantic sturgeon habitat (Figure 32). Large areas in the Wando River are anticipated to decrease in juvenile habitat quality. Other areas of decreased quality are scattered throughout the project area.

Shortnose Sturgeon – Spawning Habitat

For the 52'/48' dredging alternative, the spawning SNS HSIs of four cells below The Tee decrease to "0" when compared to the FWOP (Figure 33). These cells switch automatically to 0's because salinity goes above 0.5 ppt. This results in a decrease in the HSI for these cells from 0.5 to 0. Other than these four cells the only other changes are very small (thousandths of a change in HSI), and sometimes positive, sometimes negative. The negative deltas are located in the upper portions of the Cooper River. These small changes are a result of variable V5 (velocity) and represented only minor changes on the suitability curve. SCDNR has determined that spawning does occur in the Cooper River in the tailrace canal near the Pinopolis Dam. The success of this spawning is unknown (Bill Post, SCDNR, pers com, 10/29/13). Because the impact of the project is over 20 river-miles downstream of where spawning is known to occur, this change is unlikely to impact this species. Figure 30 also shows that tagged individuals were not detected in or near cells that decrease in spawning habitat suitability.

Shortnose Sturgeon – Foraging Habitat

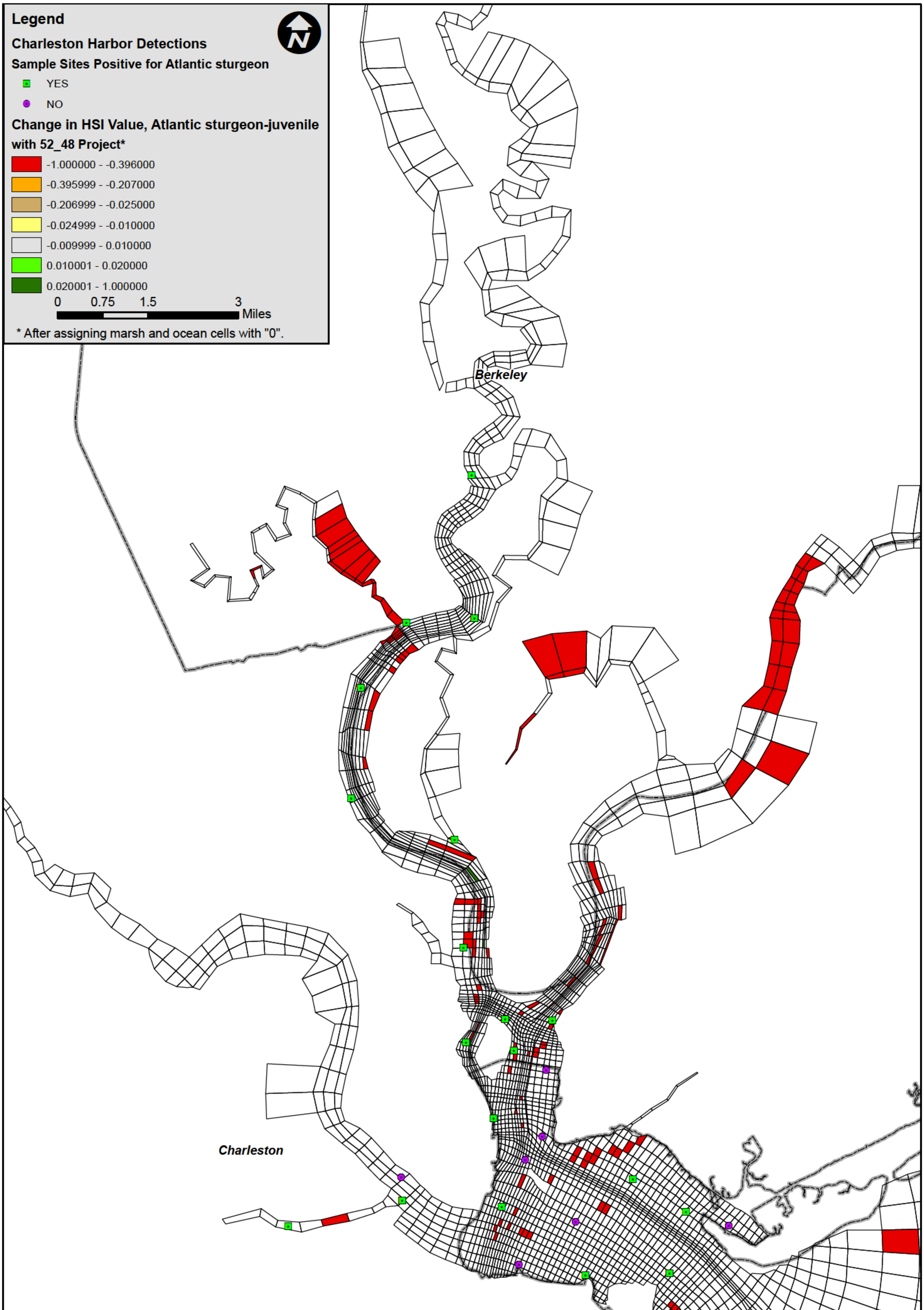
Project-area SNS foraging habitat experiences a net 0.19% increase in habitat units from the 52'/48' dredging alternative when compared to the FWOP condition. HSI numbers for all cells range from 0.715 to 0.85, and the deltas are very small, ranging from -0.004 to 0.007. Figure 31 shows that these changes do not result in substantial changes in modeled cells. Foraging habitat is affected by substrate, velocity, and temperature in the HSI. Since substrate stays constant, velocity, and temperature become the influencing variables. Since the bottom temperatures are slightly lower in the alternative conditions compared to the FWOP, temperature positively benefits shortnose sturgeon foraging in the HSI within many cells, and negatively in fewer cells. Results of HSI modeling indicate that SNS foraging will not be adversely affected by the proposed project. Figure 34 also shows where shortnose sturgeon (adult or juvenile) have been detected in the Charleston Harbor area.



Sites Known for Presence of Atlantic Sturgeon and Locations of Egg and Larval Habitat Cells Affected by Proposed Project

[redacted]

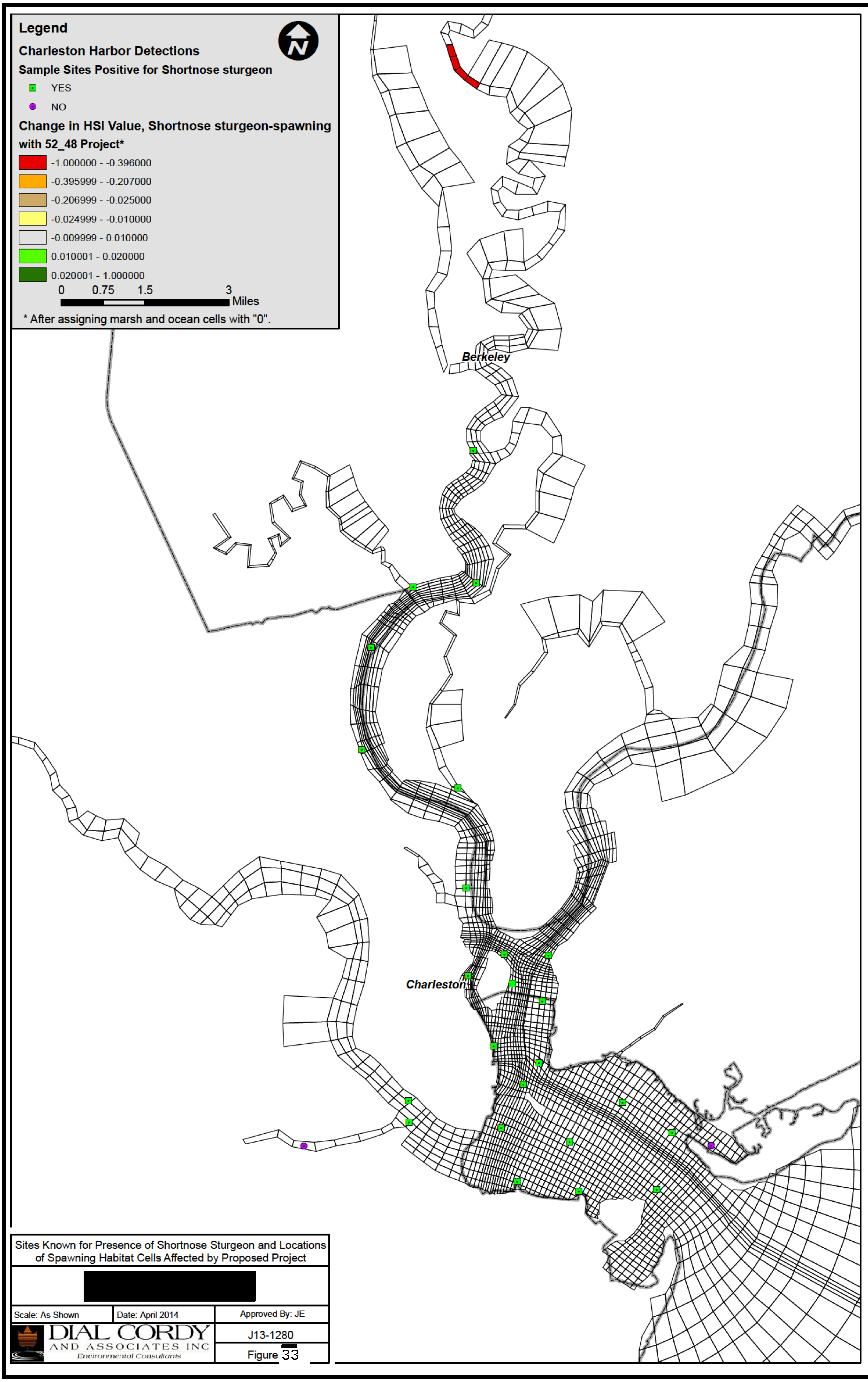
Scale: As Shown	Date: April 2014	Approved By: JE
DIAL CORDY AND ASSOCIATES INC Environmental Consultants		J13-1280
		Figure 31



Sites Known for Presence of Atlantic Sturgeon and Locations of Juvenile Habitat Cells Affected by Proposed Project

[redacted]

Scale: As Shown	Date: April 2014	Approved By: JE
DIAL CORDY AND ASSOCIATES INC Environmental Consultants		J13-1280
		Figure 32



Sites Known for Presence of Shortnose Sturgeon and Locations of Spawning Habitat Cells Affected by Proposed Project

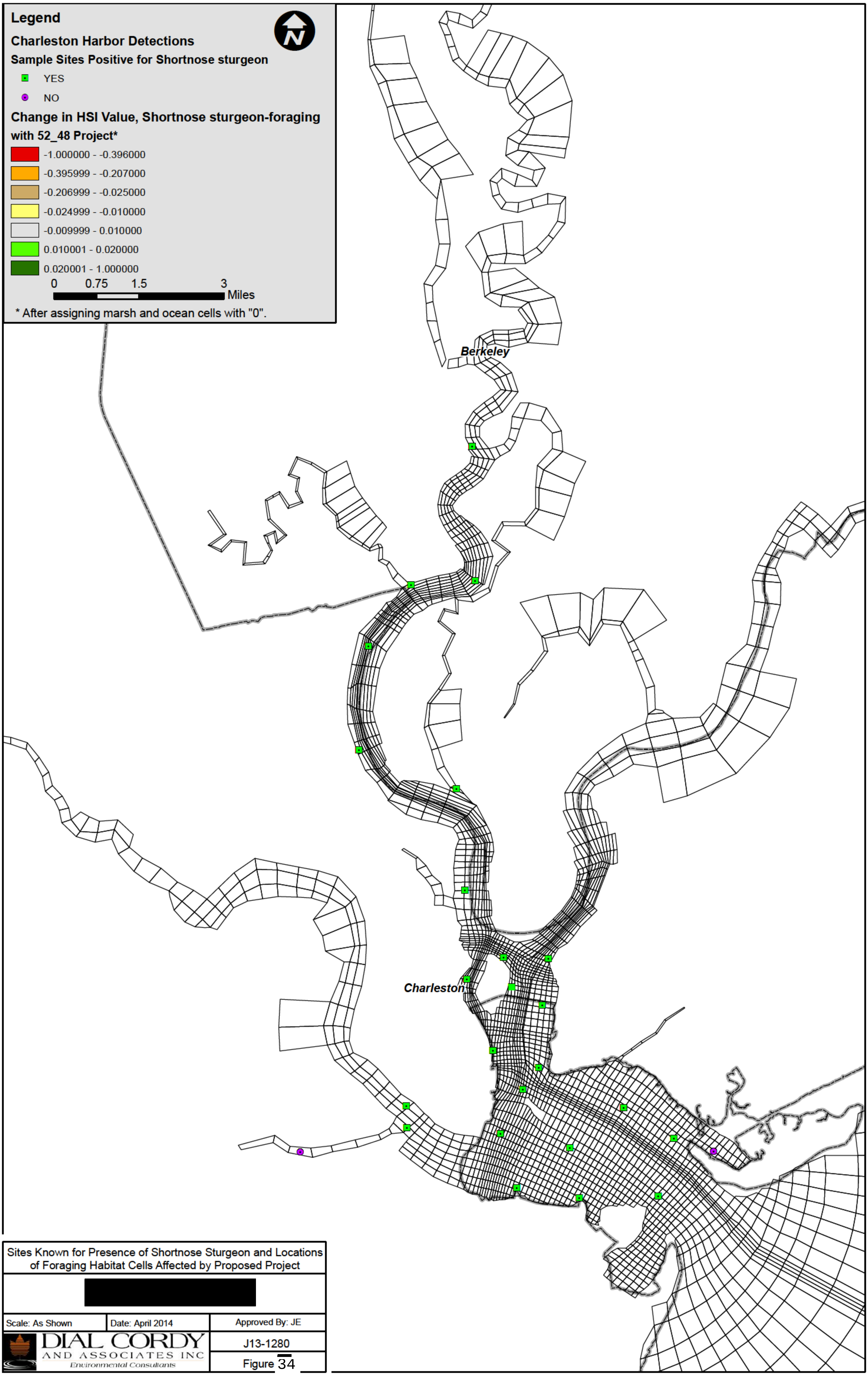
[redacted]

Scale: As Shown | Date: April 2014 | Approved By: JE

DIAL CORDY AND ASSOCIATES INC Environmental Consultants

J13-1280

Figure 33



Sites Known for Presence of Shortnose Sturgeon and Locations of Foraging Habitat Cells Affected by Proposed Project

[redacted]

Scale: As Shown	Date: April 2014	Approved By: JE
DIAL CORDY AND ASSOCIATES INC Environmental Consultants		J13-1280
		Figure 34

4.4.2.3 Life Period

Atlantic sturgeon have been aged to 60 years. There is generally faster growth and earlier age at maturation in more southern populations. For example, Atlantic sturgeon mature in South Carolina rivers at 5 to 19 years of age, in the Hudson River at 11 to 21 years, and in the Saint Lawrence River at 22 to 34 years (http://www.nmfs.noaa.gov/pr/species/fish/atlanticsturgeon.htm).

Genetic analysis has confirmed that the shortnose sturgeon in the Cooper River, Santee River and Lake Marion are not significantly different from one another; however, these fish (the "Santee-Cooper" population) are genetically distinct even from the adjacent population of shortnose sturgeon in Winyah Bay- separated by only 11 km of coastal waters (Wirgin et al. 2009). While spawning in the Cooper River has been confirmed by the presence of fertilized eggs (Duncan et al, 2004), a near total absence of larval and juvenile life stages casts doubt on whether the reproduction is successful (Wirgin et al. 2009). NMFS believes that persistent recruitment failure is occurring as indicated by a lack of juveniles captured in the Cooper and Santee Rivers (Draft FERC BO, 2010). The subpopulations downstream of the Santee, St. Stephen, and Pinopolis Dams likely rely on import of offspring from shortnose sturgeon residing in Lakes Marion and Moultrie above the dams. It is not known at what life stage recruits are moving downstream through the facility dams and into the Santee and Cooper Rivers. SCDNR is currently conducting studies to determine the presence or absence of juvenile shortnose sturgeon in the Cooper River. At this time no juvenile shortnose sturgeon have been found in the Cooper River It is logical that YOY or yearlings are the primary migrants downstream into the Santee and Cooper Rivers as this stage has been found to be the primary migratory stage (Kynard 1997), occur at the saltwater/freshwater interface in most rivers (Dads well 1979, Pottle and Dadswell 1979, Dovel et al. 1992, Hall et al. 1991, Flournoy et al. 1992, Weber 1996), and given their smaller size have a better chance of surviving movement through the turbines.

Effects of the proposed project on life period: The proposed project may affect but is not likely to adversely affect life period of Atlantic or shortnose sturgeon. Successful spawning of these species has not been documented in the project area.

4.5 West Indian Manatee

4.5.1 Short Term Impacts during Project Construction

Due to protective measures that will be in place during construction, the proposed project may affect, but is not likely to adversely affect the manatee.

4.5.1 Long Term Impacts from Project

4.5.1.1 Food Supply

Manatees are herbivores and feed primarily on sea grasses, algae, and other aquatic plants. In coastal South Carolina manatees may feed on salt marsh vegetation.

Effects of the proposed action on food supply: The proposed project and potential beneficial uses will have no long term effect on site-specific food supplies for manatees.

4.5.1.2 Habitats

Manatees are regularly sighted in South Carolina during summer months. They prefer water temperatures of 18°C or warmer and spend winters in Florida. West Indian manatees have been observed gravitating towards warm water discharges from industrial plants.

Effects of the proposed project on habitats: The proposed project and potential beneficial uses will have no long term effect on manatee habitats.

4.5.1.3 Life Period

Manatees mature at three to five years of age. Mature females go into heat for anywhere from two to four weeks. Mating activity can occur throughout the year. When in heat, females will attract numerous males and mate repeatedly; aggregations that include an estrus or focal female and numerous males are described as mating herds. Gestation lasts for about 13 months and cows usually give birth to a single calf; twinning is known to occur. While calving primarily peaks in the spring, calves may be born at any time of the year. Reproductive senescence is poorly described; a known female has given birth to seven individual calves over a period of about 30 years. A calf may remain with its mother for about two years. Calving intervals range from two and three years. The oldest known manatee is 65 years of age (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A007#crithab).

Effects of the proposed project on life period: The proposed project and potential beneficial uses will have no effect on the life period of the West Indian manatee.

4.6 American Wood stork

4.6.1 Short Term Impacts during Project Construction

Most aspects of the proposed project construction and O&M dredging will have no effect on the American wood stork. If beneficial use of dredged material occurs at Crab Bank or Shutes Folly, the project may affect but is not likely to adversely affect this species food supply, life stage, nor habitats. Little or no nesting or foraging data for these species has been found at the project's upland confined disposal areas.

4.6.2 Long Term Impacts from Project

4.6.2.1 Food Supply

Wood storks forage for small fish in estuarine rivers or impoundments in South Carolina. They use tactile feeding techniques, foraging in shallow water and snapping their bills closed as soon as contact with prey is made. Within the project area wood storks have been observed foraging but not nesting (Personal Communication, Morgan Wolf, USFWS- Charleston ES office, 28 Oct 2013).

Effects of the proposed project on food supply: Since dredging will not occur in shallow water habitat, the proposed project and potential beneficial uses will have no long term effect on food supplies for wood storks. Wood storks forage in the area but no nesting sites are within the proposed project area.

4.6.2.2 Habitats

Wood storks form large colonies in shallow waterbodies containing inundated vegetation or man-made platforms.

Effects of the proposed project on habitats: Navigation channel modifications and potential beneficial use projects will have no long term effect on woodstork habitat. No critical habitat for the species is within the project area.

4.6.2.3 Life period

Wood storks typically reproduce at age 4 and fledge 2 to 3 chicks per nest. The storks are monogamous and raise offspring together. Their lifespan is between 11 and 15 years old (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B06O).

Effects of the proposed project on life period: Navigation channel modifications and potential beneficial use projects will have no long term effect on the life period of wood storks. Nesting is not known to occur in the project area.

4.7 Piping Plover

4.7.1 Short Term Impacts during Project Construction

Most aspects of the proposed project construction and O&M dredging will have no effect on the piping plover. If beneficial use of dredged material occurs at Crab Bank or Shutes Folly, the project may affect, but is not likely to adversely affect this species food supply, life stage, or habitats. Little or no nesting or foraging data for these species has been found at the project's upland confined disposal areas.

4.7.2 Long Term Impacts from Project

4.7.2.1 Food Supply

Piping plovers feed along sandy shorelines digging for small macroinvertebrates. They display a characteristic "foot trembling" scratch and dance to bring their prey to the surface. There are no survey records of piping plovers utilizing the Charleston Harbor upland confined disposal facilities (CDFs) (Clouter Creek and Daniel Island) but it is possible the species occasionally forages in the area. This would likely be a rare occurrence.

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no effect on food supply for piping plovers.

4.7.2.2 Habitats

Atlantic Coast piping plovers utilize the open, sandy beaches close to the primary dune of the barrier islands and coastlines of the Atlantic for breeding. They prefer sparsely vegetated open sand, gravel, or cobble for a nest site. They forage along the rack line where the tide washes up onto the beach (http://ecos.fws.gov/docs/life_histories/B079.html). While there is critical habitat nearby there is none within the project area.

Effects of the proposed project on habitats: The proposed project and potential beneficial uses will have no effect on habitat for piping plovers. No critical habitat for the species is within the project area.

4.7.2.3 Life Period

While the lifespan of the piping plover is unknown, mating in the Atlantic Coast populations is known to occur in the spring from Canada to North Carolina with occasional nesting recorded in South Carolina.

Effects of the proposed project on life period: The proposed project and potential beneficial uses will have no effect on the life period of piping plovers.

4.8 Red Knot

4.8.1 Short Term Impacts during Project Construction

Most aspects of the proposed project construction and O&M dredging will have no effect on the red knot. If beneficial use of dredged material occurs at Crab Bank or Shutes Folly, etc, the project may affect, but is not likely to adversely affect this species food supply, life stage, or habitats. Little or no nesting or foraging data for these species has been found at the project's upland confined disposal areas.

4.8.2 Long Term Impacts from Project

4.8.2.1 Food Supply

Red knots are migratory shorebirds stopping along the Carolina coast to feed along sandy shorelines and mud flats. One important food source along the eastern Atlantic is horseshoe crab eggs. This easy to digest and readily abundant food source enables emaciated migrants to return to health and continue their journey.

Effects of the proposed project on food supply: The proposed project and potential beneficial uses will have no effect on the food supply for red knots. No surveys for red knots have been conducted at the CDF's but it is possible the species may forage or rest there during their spring/fall migrations.

4.8.2.2 Habitats

Proposed critical habitat is scheduled to be released by USFWS in 2013 and a final determination made in 2014. The red knot is one of the longest-distance migrants, flying approximately 9,300 miles from southern Argentina north to the Arctic Plains every spring and then reversing the trip in the autumn. The red knot makes stopovers along flyways including in South Carolina and other areas along the Atlantic Coast to rest and forage on sandy beaches/mudflats and bays.

Effects of the proposed project on habitats: The proposed project and potential beneficial uses will have no effect on habitats for red knots. No critical habitat for the species is expected to be designated within the project area.

4.8.2.3 Life Period

Red knots are a long lived species but exact lifespan remains unknown. One bird was documented to be 20 years old or more (http://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf). Red knots breed in northern Canada and Alaska in the summer and typically have 4 eggs to a nest. Red knots are territorial during breeding and gather in huge numbers to nest and then migrate in the winter. Migration routes take birds through South Carolina in the spring/fall on their way to their final wintering grounds in southern Argentina.

Effects of the proposed project on life period: The proposed project and potential beneficial uses will have no effect on the life period of red knots.

4.9 Seabeach Amaranth

4.9.1 Short Term Impacts during Project Construction

Project construction will have no effect on seabeach amaranth because, as noted above, it is not found in the project area.

4.9.2 Long Term Impacts from Project

No anticipated impacts, either direct or indirect, are expected to seabeach amaranth as a result of to the proposed project and potential beneficial uses. Areas where the plant is known to occur are outside the construction or construction related activities. No amaranth was found during the 2013 beach surveys in South Carolina (personal communication, Mark Caldwell, USFWS- Charleston ES office, 24 Oct 2013).

5.0 Summary of Effect Determination

The proposed project may affect and is likely to adversely affect the loggerhead, green and Kemp's ridley sea turtles when hopper dredges are operating during the new work construction. The project may affect but is not likely to adversely affect the loggerhead, green and Kemp's ridley sea turtles when a cutterhead, mechanical dredged and any bed leveling is performed. All other activities will have no effect on these species. The project construction methods will have no effect on the leatherback sea turtle. Protective dredging measures will be incorporated consistent with this document. In addition to these short term construction impacts, the project will have no effect on marine sea turtle food supplies, habitats, or life periods as a result of channel modifications.

No whales are likely to be adversely affected by the proposed project. Transportation to and from dredging sites and the disposal areas may affect but is not likely to adversely affect the North Atlantic right whale and the humpback whale. All other construction aspects and the changed channel dimensions will have no effect on these species food supply, life stage, nor habitats. North Atlantic right whales have been observed in the project area and dredging conditions outlined in this report will be followed in order to avoid/minimize impacts to North Atlantic right whales. Humpback whales are not likely to be in the project area but the same protective conditions will be followed in order to avoid potential impacts.

The USFWS has standard manatee protection conditions involving water-borne construction projects including dredging. With implementation of these conditions the proposed project construction may affect but is not likely to adversely affect the West Indian manatee. The channel modifications will have no effect on food supplies, habitats, or life period.

Both the shortnose and Atlantic sturgeon will have protective conservation measures in place as outlined in this document. The NMFS may also include additional protective terms and conditions in a Biological Opinion that will be adhered to. With the implementation of the protection measures in place the proposed project construction methods (i.e., hopper, cutterhead and mechanical dredging) may affect, and is likely to adversely affect shortnose and Atlantic sturgeon. If trawling is used during construction both species are likely to be adversely affected. In the long term, channel modifications that will result in minor changes to salinity, dissolved oxygen, temperature, and velocities, may affect but are not likely to adversely affect sturgeon species food supplies, habitats, or life periods. Potential beneficial use projects will have no effect on shortnose and Atlantic sturgeon.

Most aspects of the proposed project construction and O&M dredging will have no effect on the American wood stork, piping plover, or red knot. If beneficial use of dredged material occurs at Crab Bank, the project may affect but is not likely to adversely affect these species food supply, life stage, or habitats. Little or no nesting or foraging data for these species has been found at the project's upland confined disposal areas. These species are protected under the migratory bird treaty act as well as the endangered species act. Therefore, regardless of status changes in the case of any bird species, protective measures will be in place.

There will be no effect on seabeach amaranth as no records of the species occurrence in the project area have been found. If seabeach amaranth is in the project area it would be expected to be outside of the construction areas as it is a beach dwelling plant.

	*Effect Determination											
	Sea Turtle				Large Whales		Birds					
Proposed Activity	***Leatherback***	***Loggerhead***	***Green***	***Kemp's Ridley***	***NARW***	***Humpback***	***American Wood Stork***	***Piping Plover***	***Red Knot***	***West Indian Manatee***	***Sturgeon sp.***	***Seabeach Amaranth***
Hydraulic Hopper	NE	MALAA	MALAA	MALAA	NE	NE	NE	NE	NE	MANLAA	MALAA	NE
Hydraulic Cutterhead	NE	MANLAA	MANLAA	MANLAA	NE	NE	NE	NE	NE	MANLAA	MALAA	NE
Mechanical Dredge	NE	MANLAA	MANLAA	MANLAA	NE	NE	NE	NE	NE	MANLAA	MALAA	NE
Bed Leveling	NE	MANLAA	MANLAA	MANLAA	NE	NE	NE	NE	NE	MANLAA	NE	NE
Transportation - Hopper, Tug/Scow, Barge	NE	NE	NE	NE	MANLAA	MANLAA	NE	NE	NE	MANLAA	NE	NE
Ocean Disposal	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Confined Disposal	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Beneficial Uses	NE	NE	NE	NE	NE	NE	MANLAA	MANLAA	MANLAA	NE	NE	NE
Trawling	MANLAA	MANLAA	MANLAA	MANLAA							MALAA	
Tissue Sampling	MANLAA	MANLAA	MANLAA	MANLAA								
Tagging	MANLAA	MANLAA	MANLAA	MANLAA								
Dredge Lighting	MANLAA	MANLAA	MANLAA	MANLAA								
Channel Modification Impacts	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	MANLAA	NE
Critical Habitat		NLAM			NLAM							

**** Not Applicable (grey); No Effect (NE – green); May Affect Not Likely to Adversely Affect (MANLAA – orange); May Affect Likely to Adversely Affect (MALAA – red); and Not Likely to Adversely Modify***

6.0 Consultation History

- Email from Mark Messersmith (SAC) to Eric Hawk (NOAA) on 26 Jan 2012 to discuss NMFS jurisdictional T&E species list and concurrence response from Eric Hawk on 26 Jan 2012.
- April 2012: USACE and NMFS staff discuss ways to ensure timely completion of future BiOP
  - Provide species information section early
  - Provide draft BA early (prior to initiating formal consultation)
  - Allow NMFS opportunity to request information prior to formal consultation
  - Engage NMFS in all ICT meetings
- April 2012 – June 2014: NMFS and USACE engage during multiple ICT meetings
- Email from Mark Messersmith (SAC) to Karla Reece (NMFS) and Mark Caldwell (USFWS) on 28 Aug 2012 regarding jurisdictional T&E species to be included in the BATES. Concurrence and recommendations received 29 Aug 2012.
- 28 August 2012: USACE sends NMFS a draft of the species information portion of the BA.
- 29 August 2012: NMFS sends email to USACE stating, "This looks like a good overview of each species." Email requests some edits
- Phone call from Ellie Covington (SAS) to Mark Caldwell (USFWS) on 24 Oct 2013 to confirm no Seabeach Amaranth has been documented in the project area.
- Phone call from Ellie Covington (SAS) to Morgan Wolf (USFWS) on 28 Oct 2013 to confirm the American Wood Stork does utilize SAC CDFs for foraging but not nesting.
- Phone call from Ellie Covington (SAS) to Michelle Pate (SC DNR) on 3 Oct 2013 to confirm sea turtle nesting numbers for 2013.
- Email from Ellie Covington (SAS) to Melissa Bimbi (USFWS) on 29 Oct 2013 to confirm no known occurrences of Piping Plovers or Red Knots at SAC CDFs exist.
- 20 February 2014: NMFS sends USACE an example BA
- 22 April 2014: USACE sends pertinent tables on dredging and dredge quantities to NMFS for early review.
- 8 May 2014: NMFS responds that the information is good and requests a corresponding map be presented in the BA.
- Distribution of Draft Biological Assessment to Karla Reece (NMFS) for an early pre-consultation review on 08 June 2014
- Karla Reece (NMFS) submittal of draft comments on pre-consultation review on 8 July 2014.
- NMFS received Draft FR/EIS and BATES on Thursday, October 9.
- NMFS logged in the BATES on Wednesday, October 15
- October 14 Email to Karla Reese from Mark Messersmith asking if all documentation was received and if NMFS had any initial questions. Karla had not seen the document yet as NMFS staff had not yet relayed the disc to her.
- 15 October 2014: Auto email from NMFS acknowledging receipt of BA (If NMFS acknowledges this date as start of initiation, the completion date would have been 26 February, 2015)

- Phone call from Mark Messersmith (SAC) to Karla Reese (NMFS) on Monday, October 27 to discuss initial questions/concerns on the BATES. NMFS indicated that they have not yet had a chance to open the document.
- 16 December 2014 (~60 days into review): Email from NMFS stating that a project description would be submitted to USACE in early January for review.
- 5 January 2015: NMFS requested a word document of the BA (USACE replied on same day)
- 6 January – 21 January 2015: NMFS sent approximately 15 emails requesting information (USACE replies typically in one day)
- 22 January 2015: NMFS sent USACE project description
- 22 January 2015: email from USACE to NMFS expressing concern meeting the 135 days. Requested a minimum review time of 2 weeks to review the draft BiOP prior to 21 February. Asked for notification if the completion of BiOP by 21 February would be a problem.
- 23 January 2015: email from NMFS to USACE agreeing to send draft BiOP only when "ready for signature". Stated that after we review it, we can "finalize without delay unless you (USACE) have issues that need to be addressed."
- 23 January 2015: email from SAC to SAD expressing concern over completion of BiOP in timely manner
- 30 January 2015: USACE responded with edits to the project description
- 23 January 2015 – 18 February 2015: NMFS still requesting information and maps through emails. USACE responses typically within one day
- 3 February 2015: email from USACE to NMFS expressing concern with meeting 21 February. Email states that, "I'm (USACE) is assuming that there are no significant concerns since we didn't hear about any issue with our effect determinations during the 90-day consultation period." Email lays out a proposed schedule for NMFS and USACE to meet the 21 February completion of consultation. Email asks for an alternative schedule if NMFS doesn't agree.
- 3 February 2015: email from NMFS stating that, "we (NMFS) will do our best to conclude consultation as quickly as possible."
- 4 February 2015: email from USACE to NMFS requesting NMFS to provide a projected date for completing the draft BO (no response)
- Late February – early March: phone calls between NMFS consulting biologist and SAC biologist discussing the project and deadlines. No dates were ever agreed to by NMFS staff.
- 16 March 2015: Recognizing that NMFS was late on the delivery of a draft BiOP to USACE, and owing to coordination between USACE SAD and NMFS SERO, an email from Messersmith (USACE) to Karla Reece (NMFS) requested that NMFS submit draft RPMs and T&C's to USACE as quickly as possible.
- 19 March 2015: email from Karla Reece to Messersmith (USACE) asking for information on hardbottom mitigation
- 19 March 2015: USACE answers request for information
- 20 March 2015: NMFS submits the draft RPMs and T&Cs to USACE via email. NMFS requests feedback no later than 25 March in order to meet "USACE deadlines".
- 20 March 2015: USACE acknowledges receipt

- 20 March 2015: NMFS retracts initial RPMs and T&Cs and submits new ones that include a ~$6 million speed restriction for North Atlantic Right Whales (not included in first delivery)
- 23 March 2015: Messersmith (USACE) sends email to Reece (NMFS) requesting information on how NMFS derived 33 ft vessel length for the T&C on speed restrictions for NARW.
- 23 March 2015: NMFS supplies requested information via email
- 25 March 2015: email from Walters (USACE) to Reece (NMFS) with comments on T&C's.
- 26 March 2015: telecom with NMFS and USACE – SAC, SAD, HQ, OWPR to discuss T&Cs.
- 26 March 2015: email from Bernhardt (NMFS) to USACE with requested edits from meeting.
- 30 March 2015: Reece (NMFS) requesting more information from USACE via email.
- 30 March 2015: Messersmith (USACE) responds that the requested information was previously provided to NMFS.
- 30 March 2015: Walters (USACE) email to NMFS with information related to USACE position on 10 knot speed restriction for NARW and removal of trawling trigger points as a T&C.
- 30 March 2015: Sweeney (NMFS) acknowledges receipt
- 6 – 9 April 2015: Multiples requests for information by NMFS to Messersmith (USACE)
- 6 – 9 April 2015: Messersmith responds to all information requests.
- 13 April 2015: email from Messersmith (USACE) to Sweeney (NMFS) asking for confirmation that there are no remaining questions from NMFS
- 13 April 2015: email from Sweeney (NMFS) to Messersmith (USACE) confirming that there are no additional information needs at the moment.
- 22 April 2015: NMFS submits BO to USACE

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